



**Energy Audit
Oriental University
Indore (M.P.)
Year 2022-23**



ENERGY AUDIT REPORT



ORIENTAL UNIVERSITY

Gate No.1, Sanwer Road, opposite Revati Range, Jakhya,
Indore, Madhya Pradesh-453555, India

(Academic Year: 2022-23)



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ACKNOWLEDGEMENT

Empirical Exergy Private Limited (EEPL), Indore (M.P) takes this opportunity to appreciate & thank the management of **Oriental University, Indore (M.P.)** for allowing us to conduct an energy audit for the university.

We are indeed touched by the helpful attitude and co-operation of all faculties and technical staff, who rendered their valuable assistance and co-operation during the study.



Rajesh Kumar Singadiya

(Director)


M.Tech (Energy Management), Ph.D. (Research Scholar)
Accredited Energy Auditor [AEA-0284]
Certified Energy Auditor [CEA-7271]
(BEE Empanelled "URJA MITRA")
(BEE, Ministry of Power, Govt. of India)
Empanelled Energy Auditor with MPUVN, Bhopal M.P.
Lead Auditor ISO 50001:2011 [EnMS] from FICCI, Delhi
Certified Water Auditor (NPC, Govt of India)
Chartered Engineer [M-1699118], The Institution of Engineers (India)
Member of ISHRAE [58150]



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Certificate of Accreditation

 **BUREAU OF ENERGY EFFICIENCY**

Examination Registration No.: **EA-7271**

Accreditation Registration No.: **AEA-284**



Certificate of Accreditation

This is to certify that Mr./Ms. **Shri. Rajesh Kumar Singadiya** having its trade/registered office at has been given accreditation as accredited energy auditor. The certificate shall be effective from **9th** day of **May, 2018**


The certificate is subject to the provisions of the Bureau of Energy Efficiency (Qualifications for Accredited Energy Auditors and Maintenance of their List) Regulations, 2010.

This certificate shall be valid until it is cancelled under regulation 9 of the Bureau of Energy Efficiency (Qualifications for Accredited Energy Auditors and Maintenance of their List) Regulations, 2010.

On cancellation, the certificate of accreditation shall be surrendered to the Bureau within fifteen days from the date of receipt of order of cancellation.

Your name has been entered at AEA No. **284** in the register of list of accredited energy auditors. Your name shall be liable to be struck out on the grounds specified in regulation 8 of the Bureau of Energy Efficiency (Qualifications for Accredited Energy Auditors and Maintenance of their List) Regulations, 2010.

Given under the seal of the Bureau of Energy Efficiency, Ministry of Power, this **5th** day of **October, 2018**


Secretary,
Bureau of Energy Efficiency
New Delhi



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The Audit Team

The study team constituted of the following senior technical executives from **Empirical Exergy Private Limited,**

- ✚ **Mr. Rakesh Pathak**, [Director & Electrical Expert]
- ✚ **Mr. Rajesh Kumar Singadiya** [Accredited Energy Auditor (AEA-0284)]
- ✚ **Ms. Laxmi Raikwar** [Energy Expert & Report Reviewer]
- ✚ **Mr. Charchit Pathak** [Project Engineer]
- ✚ **Mr. Mohan Choudhary** [Sr. Electrician]



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EXECUTIVE SUMMARY

The executive summary of the energy audit report furnished in this section briefly gives the identified energy conservation measures and other recommendations during the project that can be implemented in a phased manner to conserve energy and increase productivity inside the university campus.

ENERGY MANAGEMENT INITIATIVES BY THE UNIVERSITY

- ✚ The university added a 50KWp Solar rooftop system, to enhance utilization of renewable energy in the university campus in the month of December 2023. Now the capacity solar plant capacity is 100 KWp and Solar units generation from the above system from June to May 2023 is 1,11,681 units. it's 20.32% of the total energy consumption of the university. **It's appreciable.**
- ✚ The university management has installed 2no's of sensor based timer control on the main Street lights, which is operated at sunrise and sunset time. **It's appreciable.**
- ✚ The university has planned and implemented maintenance schedules for air conditioners, to improve the performance of ACs. **It's appreciable.**
- ✚ The University has updated the LT side (Cable Junction box) of the transformer and replaced the MCCB at the powerhouse to reduce energy losses of the system. **It's appreciable.**
- ✚ The university has carried out a total overhauling of one Lift in library block to optimize energy losses of the system. **It's appreciable.**
- ✚ The university has installed sub-meters to monitor the energy consumption of each building block. It will help to analyze the line losses of the system. **It's appreciable.**

ENERGY AUDIT RECOMMENDATIONS


- ✚ Update the power factor from 0.95 to Unity.
- ✚ Conduct thermography on the electrical panel once a year. It will improve the maintenance schedule of powerhouses and solar panel.



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Monitoring Committee

 **ORIENTAL UNIVERSITY, INDORE**
"A Professional University"
First self-financed university established at Indore by M.P. Legislative Assembly, Approved u/s 21 of UGC 1956 act

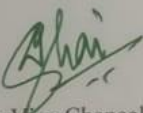
July 01, 2022

Energy, Green & Environment Audit Committee

Energy, Green and Environment Audit committee will consist of the following faculty and staff.

S.No.	Designation	Department
01.	HOD	Mechanical Engineering
02.	HOD	Electrical Engineering
03.	HOD	Chemistry
04.	OSD (Officer on special Duty)	Projects

Time duration for this committee is 3 years up to June-2025 after which the committee will be reconstituted.


Pro Vice-Chancellor
Oriental University, Indore



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**CHAPTER-1
INTRODUCTION**

1.1 ABOUT UNIVERSITY

Oriental University, Indore (OUI) was established by Devi Shakuntala Thakral Charitable Foundation in the year 2011. The Oriental Group is one of the most recognizable names in the field of education since 1995, it has many renowned institutions in Bhopal, Indore and Jabalpur.

Oriental University, the first private university of Indore, has proudly acquired the university status under section 2f of UGC, 1956 Act with effect from May 2011. Oriental University is committed to offer unparalleled quality of education in different streams viz.- Agriculture, Commerce, Computer Applications, Education, Engineering, Law, Library & Information Sciences, Management, Media Studies, Pharmacy, Science etc.

The university has won many awards to its credit, for research, best practices, education excellence, intellectual development, etc.

A Thoughtfully Designed University Campus

Majestically located at Indore – Ujjain state highway near Devi Ahilya International Airport, the lush green campus is one of the most beautiful and serene educational institutes spread over 77 acres of land.

Apart from the academic blocks, the university has one of the best hostel facilities for boys and girls; residential accommodation for faculty members, bank and other facilities in the campus.

Crossing Traditional Education Boundaries

We are committed to go well beyond traditional education. Currently, the University's exquisite infrastructure houses spacious classrooms with the latest teaching aids, well-equipped and high tech laboratories and workshops.

The State-of-Art laboratories using the latest technologies are a prominent feature of OUI which makes it an outstanding organization. Apart from this, we have various workshops including the Hyundai Tech center, ICT-based spacious classrooms, and a central library with



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separate reading areas for students and faculty members and RFID based book issue/return complain and inventory control. OUI combines innovative teaching and pioneering research in a highly collaborative environment that helps students to achieve quality education and excellence.

Developing Responsible Professionals

Our intent at OUI is to march forward to develop personally, professionally and socially responsible human beings who could be easily deployed in the industry and also leave their “mark” in any business domain they work in. Our Alumni are spread all over the world in they hold responsible positions in government, judiciary and almost all kinds of companies. The environment is committed to students’ growth and success, career readiness, community engagement, health and well-being ultimately leading to becoming a “Responsible Human being”.

We believe in Academic Emancipation

For OUI, education is more than simply teaching, we believe in creating an atmosphere of academic freedom where individuals can discover, collaborate, learn, and achieve excellence in their specific domains and beyond. Oriental Group has successfully established many reputed university’s of Engineering, Management, Computer Application, Pharmacy etc. OUI imparts studies at different levels leading to Certificate, Diploma, Undergraduate, Post-Graduate and Ph.D. Today, Oriental Group is a prime educational group that retains National rankings. Highly qualified and experienced faculty members along with knowledgeable industrial experts impart education to the students. The curriculum adopted is industry friendly and OUI plays a vital role in bridging the gap between the extremely demanding corporate and the mediocre curriculum running in many universities.

Home to Exceptional Opportunities

Students and faculties have exceptional opportunities for intellectual, professional as well as personal growth. Educational offerings at OUI are well beyond traditional teaching, we create a fun learning environment that helps individuals to become creative minds, allowing them to deliver exceptional performance in their respective fields. At the same time, we are dedicated



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to a creative and rewarding work environment for all our knowledgeable and vastly experienced faculty members who work relentlessly to educate students.

We promote the value of learning with teamwork and growth, making our students highly productive and responsible members of society.

Explore our educational offerings and give wings to your career!

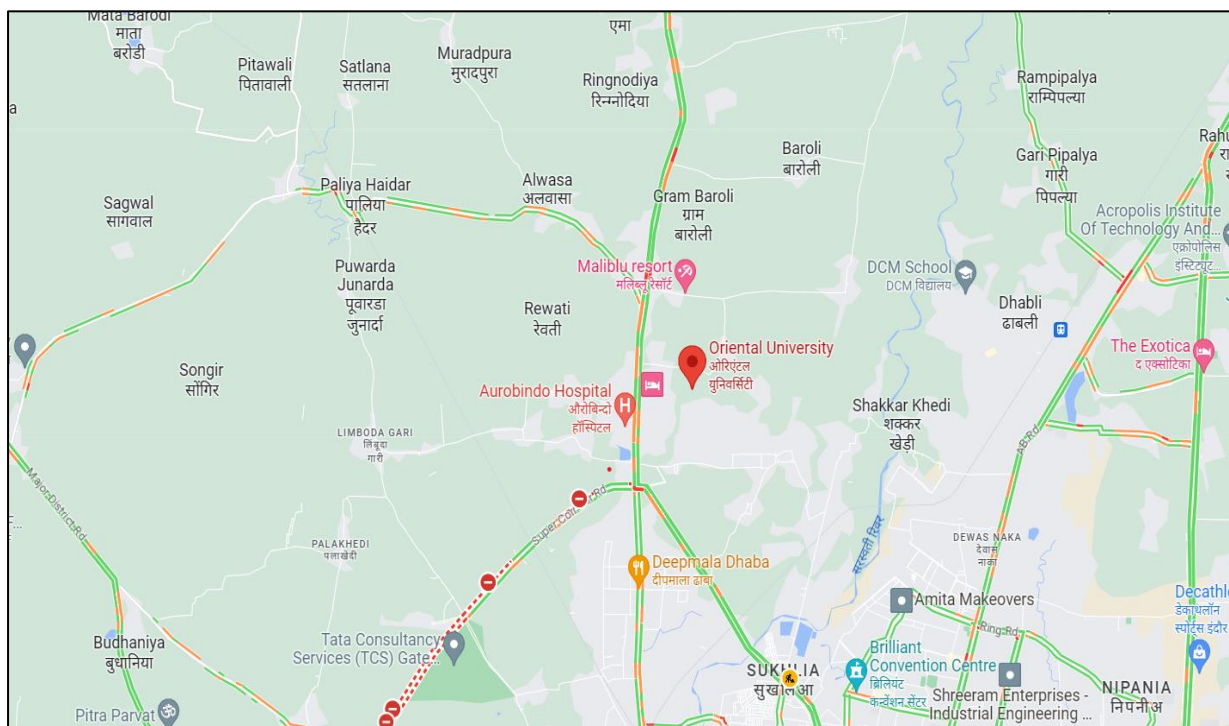


Figure 1.1 Source : Google Image of Oriental University Indore (M.P.)



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Vision

“To provide a distinctively – Indian environment of educational excellence while challenging the academically accelerated individual and accelerating the academically challenged individual.”

Mission

- To promote the value of learning, self-growth among students and staff, quality performance among students and staff, and transition for students to productive and responsible participation in society.
- To promote a safe and stimulating environment for bright and curious students to interact with and learn from each other.
- To entertain students with educational offerings that provides fun learning opportunities.
- To provide a creative and rewarding work environment for all employees.



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About Infrastructure

The university is spread over 77-acre with plenty of open space and sports area interspersed within academic buildings. The Academic Blocks (Block-B & Block-C) & Admin Block (Block-G) are under construction at present time. The details of various department and building's are given below:

Table1.1 Name of the various Building in oriental university

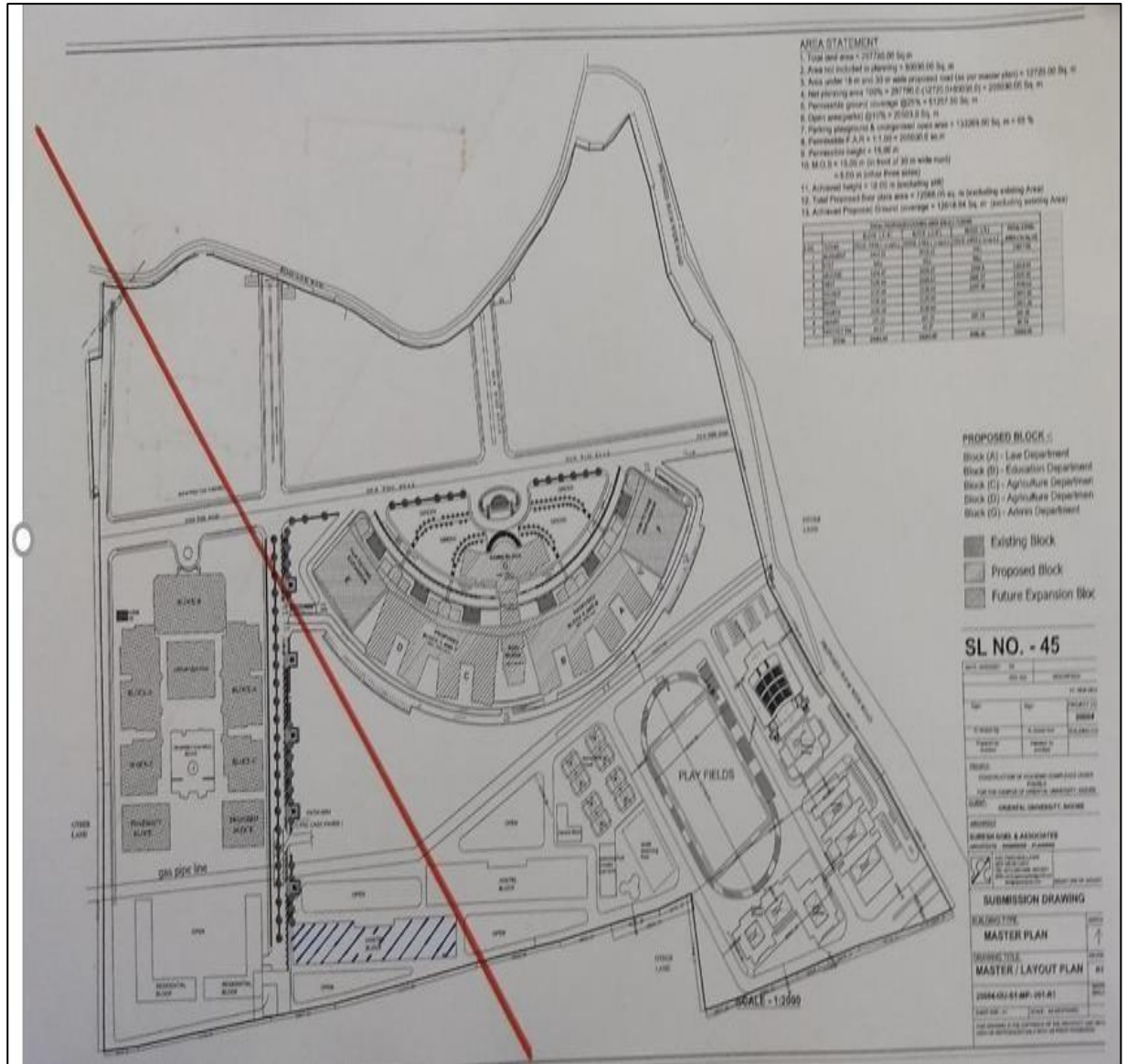
Oriental University, Indore		
Built-up area of buildings		
Sr. No.	Name of Building	Built-up area (Approx.- Sq.mt.)
1	Administrative Building	76223
2	Eastern Wing	154212
3	Western Wing	152835
4	Library Building	80538
5	O.C.P.R.	57243
6	Residential block	36282
7	Boy's Hostel	77709
	Corridor between boy's wings & mess G.F. to fifth Floor	6032
8	Girl's Hostel	77709
	Corridor between girl's wings & mess G.F. to fifthFloor	6032
9	Mess	13250
10	1 BHK Flats in Hostel	8328
	Total Build-up area of Campus	746393



Energy Audit Oriental University Indore (M.P.) Year 2022-23



Oriental University Layout of Various Buildings





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1.2 ABOUT ENERGY AUDIT

An energy audit helps to understand more about the ways energy is used in any organization and helps in identifying areas where waste may occur and scope for improvement exists. The overall energy efficiency from generation to the final consumer becomes 50%. Hence one unit saved by the end user is equivalent to two units generated in the power plant.

An energy audit is the most efficient way to identify the strength and weaknesses of energy management practices and to find a way to solve problems. An energy audit is a professional approach to utilizing economic, financial, social, and natural resources responsibly. Energy audits “adds value” to management control and are a way of evaluating the system.

Empirical Exergy Private Limited (EEPL), Indore M.P. carried out the “Energy Audit” at the site to find gaps in the energy consumption pattern for **Oriental University**. A technical report is prepared as per the need and the requirement of the project.

1.3 OBJECTIVES OF ENERGY AUDITING

An energy audit provides a vital information base for an overall energy conservation program covering essentially energy utilization analysis and evaluation of energy conservation measures. It aims at:

- Identifying the quality and cost of various energy inputs.
- Assessing the present pattern of energy consumption in different cost centers of operations.
- Relating energy inputs and production output.
- Identifying potential areas of the thermal and electrical energy economy.
- Highlighting wastage in major areas.
- Fixing energy-saving potential targets for individual cost centers.
- Implementation of measures for energy conservation & realization of savings.



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1.4 PRESENT ENERGY SCENARIO

The university uses energy in the form of electricity purchased from the MPPKVCL grid and 100 KWp solar grid connected system. The electricity bill is based on the MPPKVCL 33 KV, and Tariff Category HV-3.2 B Non-Industrial on 33 kV. The university has contract demand of 150 kVA. Total billing amount of electricity bill of **Oriental University, Indore** has been found to be about **INR 43,37,700** /- for 12 months analysis period from June-22 to May- 23. Oriental university has 100 KWp grid connected roof top solar plant .Total unit generation of the solar plant from June-22 to May- 23 is 1,11,681 units. It is 20.32% of total unit consumption of the year 2022-23.

Solar Unit Generation (June - 2022 to Jul-2023)	Grid Unit Consumption (June - 2022 to Jul-2023)	Total Unit Consumption (Solar+ Grid)	RE Share (%)Year 2022-23
1,11,681	4,37,694	5,49,375	20.32



CHAPTER- 2 POWER SUPPLY SYSTEM

2.1 POWER SUPPLY SYSTEM

The power supply for the university is from MPPKVV CO. Limited with the help of 33 KV feeders under Tariff HV3.2. B 33 KV Non-Industrial with contract demand 150 kVA. There is one Step down transformer with capacity 200 kVA. The details are given in following table

Table: 2.1 Name plate detailed of transformer

Sr. No.	Items	Technical Specification of Transformer
1	Make	Awadh Enterprises
2	Rating (kVA)	200
3	Voltage (HV/ LV)	33000/200
4	Current Rating (HV/ LV)	3.5/266.6
5	Frequency (Hz)	50
6	Impedance at 75°C (%)	4.5
7	Vector group	Dyn-11
8	Type of cooling	ONAN
9	Total no of Tap	5
10	Ideal Tap Potion	3



33KV Grid Before work



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33KV Grid After work 300 mm. cable termination



33KV Grid After work 400 AMP MCCB with Box & Bus Bar



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33KV Grid After work 07 Electrical GI earthing



33KV Grid After work oil filtration



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33KV Grid After work oil level and new Breather installed

Figure 2.1 33 kV Feeder and 200 kVA TX



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Table 2.2: Transformer Loading % Year (2022-23)

Sr.No.	Month & Year	Maximum Demand(kVA)	TR loading (%)
1	Jul-22	121	60.50
2	Aug-22	127	63.50
3	Sep-22	125	62.50
4	Oct-22	134	67.00
5	Nov-22	106	53.00
6	Dec-22	115	57.50
7	Jan-23	81	40.50
8	Feb-23	120	60.00
9	Mar-23	118	59.00
10	Apr-23	138	69.00
11	May-23	157	78.50
12	Jun-23	172	86.00
		Average Transformer loading %	63.08
		Maximum Loading %	86.00

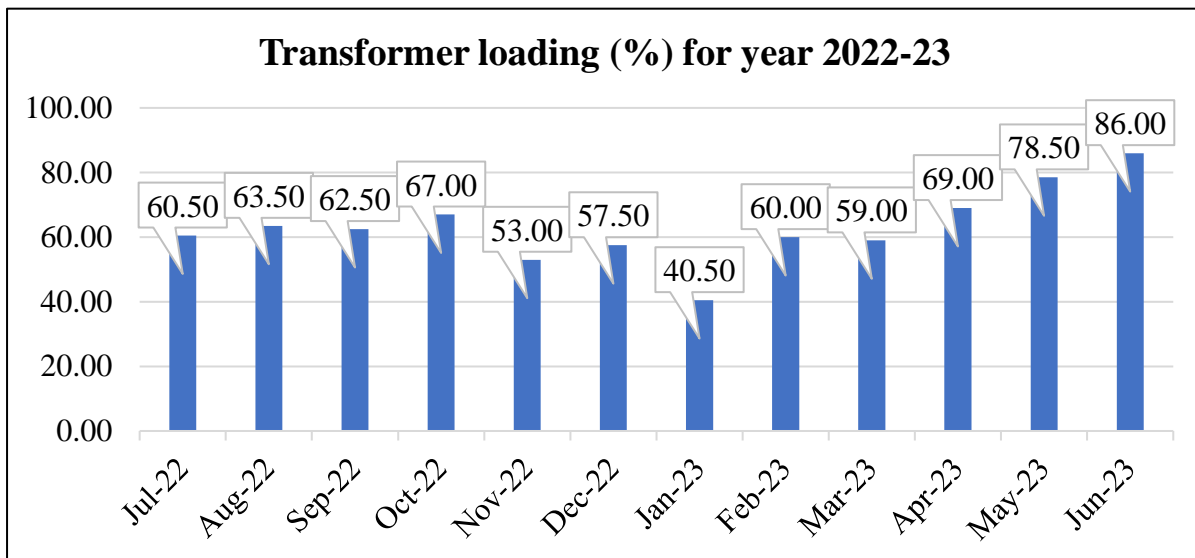


Figure 2.2 Graphical presentation of TR loading percentage Year 2022-23

Observation:

It was observed that average transformer loading percentage is 63%.

2.2 DG SET

There is 1 DG set in power house. Detailed of the DG Sets are given Table

2.3 Technical Specifications for DG sets

Sr. No.	Parameter	Technical Specification
1	Make	KOEL GREEN
2	M/C No	ES3S116FP090504
3	Capacity	125 KVA
4	Rated Voltage	415 V
5	Full load current	173.9 A
6	Frequency	50 Hz
7	Power factor	0.80
8	RPM	1500
9	Phase	3



Figure 2.3 DG set in Power House

Observation

- DG set use only in case of grid power failure.
- There is no system to monitor fuel consumptions w.r.t. unit generation.



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2.3 CAPACITOR BANK HEALTH CHECK-UP

The energy audit team carried out a health check-up of the existing capacitor bank in the powerhouse. The average power factor of the current year (2022-23) is 0.92. Details of the bank are given in table 2.4.

Table: 2.4 Health check-up of Capacitor bank

Sr. No.	Location No	Capacity KVAR	Phase	Measured Current	Rated Current	Output KVAR	% Derating
1	Capacitor-1	5	R	6.3	6.6	4.8	4.5
			y	6.3			
			B	6.3			
			Avg.	6.3			
2	Capacitor-2	5	R	3.5	6.6	1.8	64.6
			y	0			
			B	3.5			
			Avg.	2.3			
3	Capacitor-3	15	R	18.8	19.8	14.4	3.9
			y	19.4			
			B	18.9			
			Avg.	19.0			
4	Capacitor-4	10	R	0	12.2	0.0	100.0
			y	0			
			B	0			
			Avg.	0.0			
5	Capacitor-5.1	5	R	3.7	6.6	3.5	30.8
			y	6.5			
			B	3.5			
			Avg.	4.6			
6	Capacitor-5.2	3	R	3.5	3.96	2.6	12.5
			y	3.5			
			B	3.4			
			Avg.	3.5			
7	Capacitor-6	3	R	3.6	3.96	2.7	10.8
			y	3.5			
			B	3.5			
			Avg.	3.5			
8	Capacitor-7.1	5	R	6.1	6.6	4.8	3.5
			y	6.6			
			B	6.4			
			Avg.	6.4			
9	Capacitor-7.2	3	R	0	6.6	0.0	100.0
			y	0			
			B	0			
			Avg.	0.0			



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Sr. No.	Location No	Capacity KVAR	Phase	Measured Current	Rated Current	Output KVAR	% Derating
10	Capacitor-8	20	R	24.5	26.2	19.0	5.2
			y	25			
			B	25			
			Avg.	24.8			



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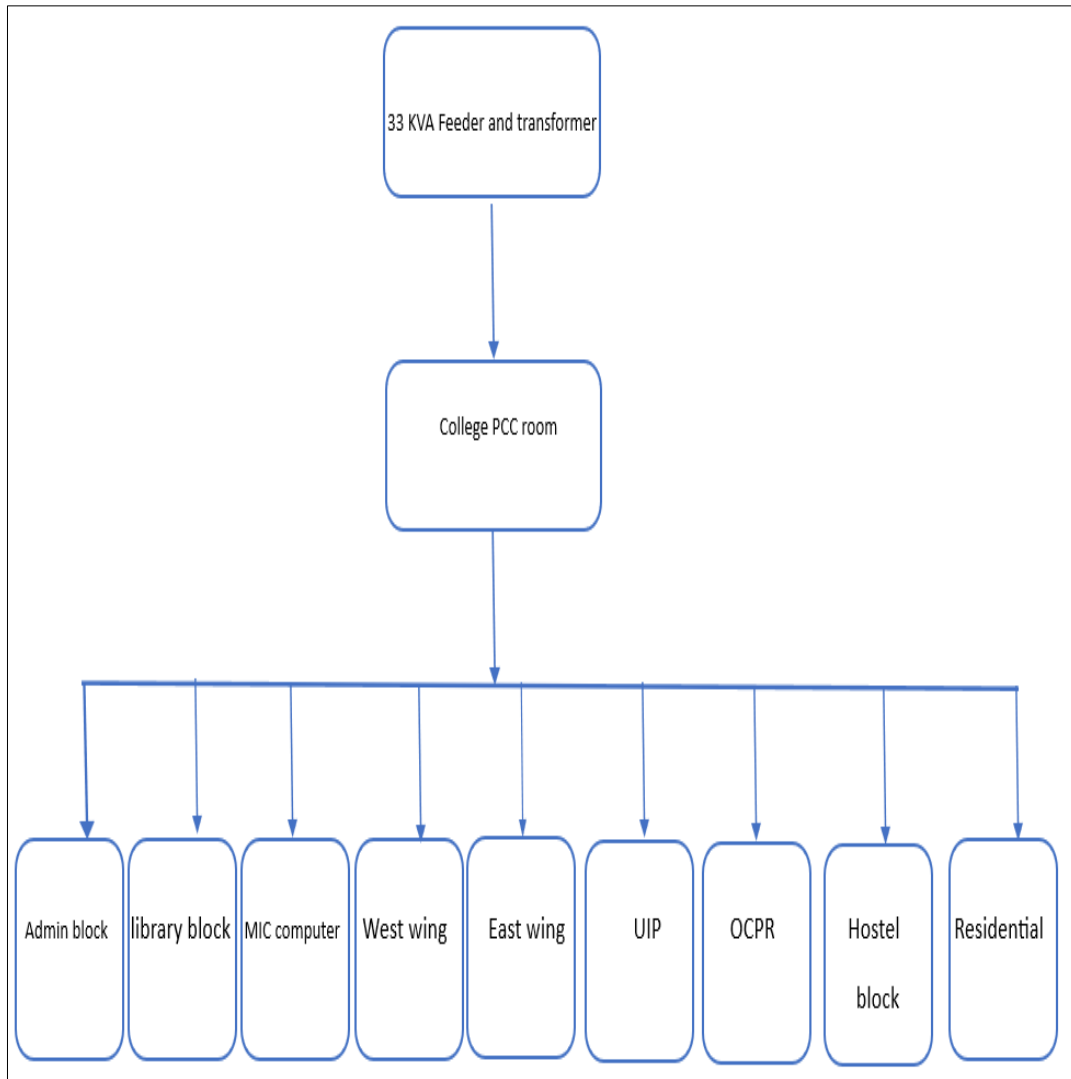


Figure 2.4 Single line diagram of oriental university Indore



**CHAPTER- 3
ELECTRICITY BILL ANALYSIS**

3.1 ELECTRICITY BILL ANALYSIS 2018-23

Electricity bills for the last five years were analyzed. Details of unit consumption, annual average power factor, and annual per unit charges are determined as follows

Table 3.1 Annual energy consumption (From 2018 to 2023)

Sr. No.	Year	Annual Unit Consumption (kWh)	Annual Average Power Factor	Annual Energy Bill (Rs. / year)	Annual per-unit Charges (Rs./kWh)
1	2018-19	2,53,150	0.91	26,16,362	10.72
2	2019-20	2,70,736	0.92	25,71,477	9.6
3	2020-21	2,11,366	0.83	20,25,240	9.58
4	2022-23	3,16,351	0.94	32,40,569	10.7
5	2022-23	4,28,363	0.92	43,37,700	10.20

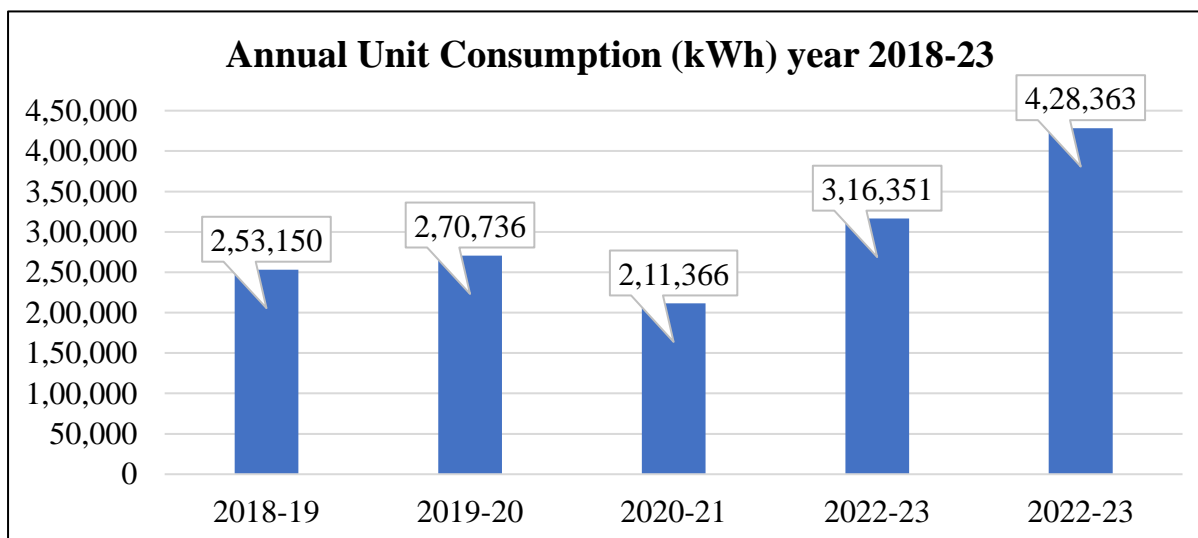


Figure 3.1 Annual energy consumption (from year 2018 - 23)



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Annual Average Power Factor: From Year 2018 to Year 2023

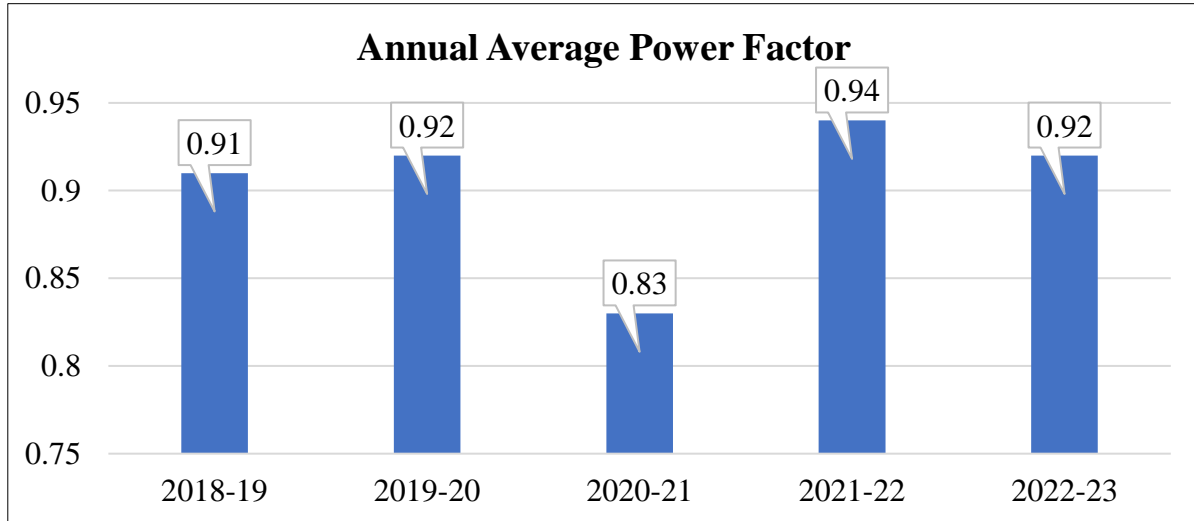


Figure 3.2 Annual average power factor (From Year 2018 to Year 2023)

Annual Overall Energy Charges per unit: Year 2018 to Year 2023

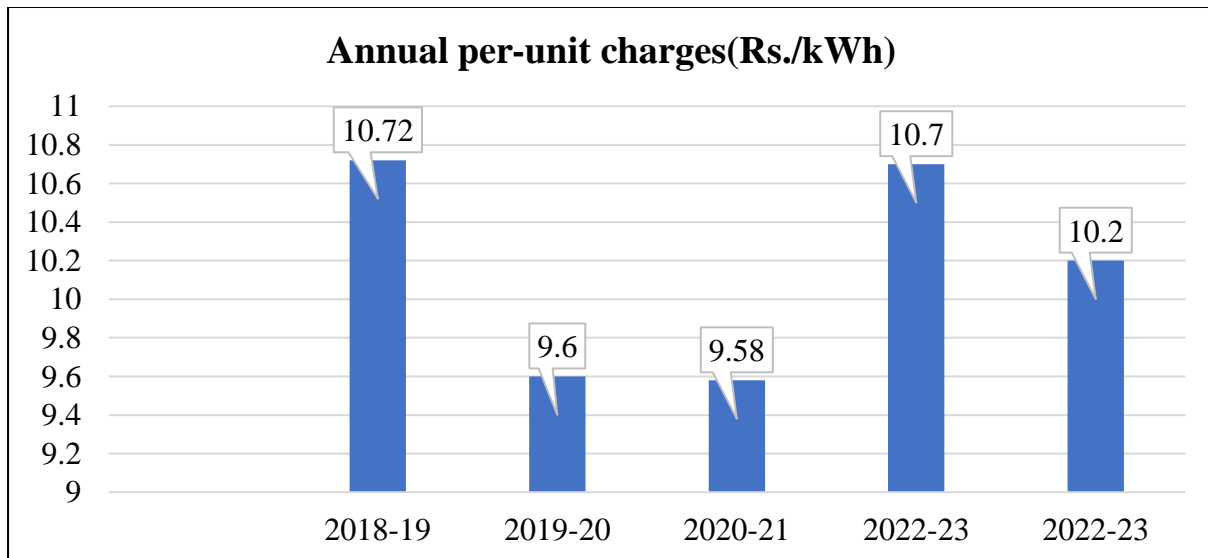


Figure 3.3 Overall per unit charges (From Year 2018 to Year 2023)



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3.2 MONTHLY ELECTRICAL ENERGY CONSUMPTION (2022-23)

The monthly electrical consumption for the university is given in table 3.2

Table 3.2 Energy consumption and billing amount (the year 2022-23)

Sr. No.	Month & Year	Total Consumption (kWh)	Amount (Rs.)	Overall Unit charges (Rs./kWh)
1	Jul-22	34,942	3,81,373/-	10.91
2	Aug-22	27,352	3,30,212/-	12.07
3	Sep-22	37,528	4,01,911/-	10.71
4	Oct-22	38,773	3,63,586/-	9.38
5	Nov-22	31,362	3,03,569/-	9.68
6	Dec-22	31,141	3,02,901/-	9.73
7	Jan-23	25,019	2,65,779/-	10.62
8	Feb-23	29,481	3,04,337/-	10.32
9	Mar-23	32,164	3,22,911/-	10.04
10	Apr-23	44,669	3,91,173/-	8.76
11	May-23	47,769	4,77,019/-	9.99
12	Jun-23	48,163	4,92,929/-	10.23
Total		4,28,363	43,37,700/-	10.20

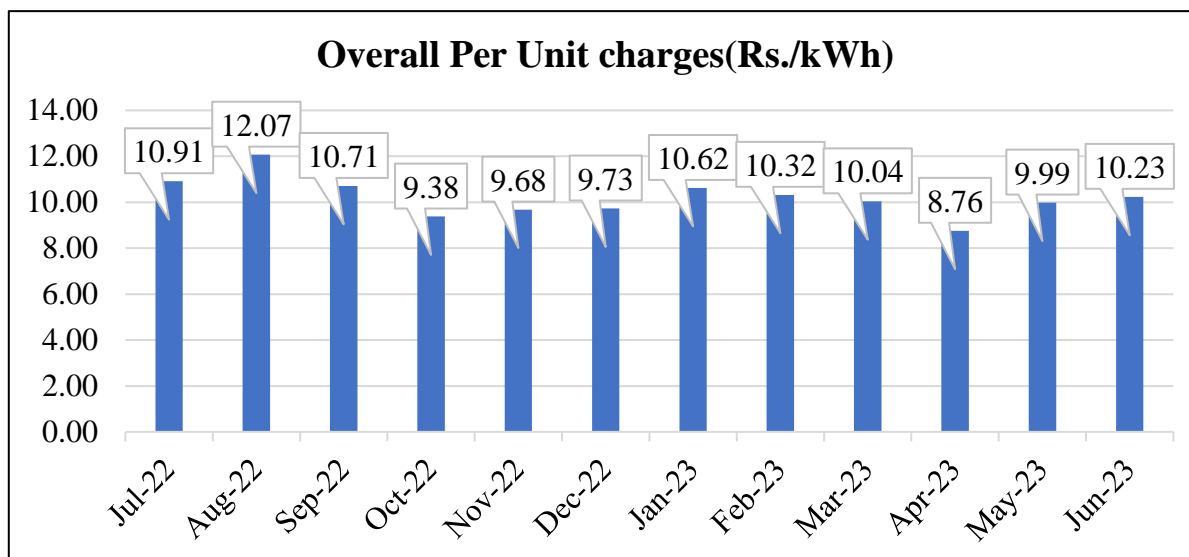


Figure 3.4 Graphical presentation of overall per unit charges year 2022-23

Observation

It was found out that total energy consumption in last 12 month was 4,28,363 unit. Overall, per unit charges are Rs 10.20 /kWh.



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**CHAPTER- 4
CONNECTED LOAD DETAIL**

4.1 CONNECTED LOAD OF UNIVERSITY

Sr.no.	Location	Total load (KW)
1	STP	25
2	Hostel	85
3	Residency	120
4	OCPR	35
5	West side block	132
6	East side block	98
7	MIC lab	22
8	Admin block	50
9	Library block	113
Total load		680



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4.2 SOME PHOTOGRAPH OF ELECTRICAL EQUIPMENT'S



LED tube light



Ceiling Fan



Air Conditioner



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4.3 LUX READING

Table 4.2 Lux reading

Sr. No.	Location / Room No.	Lux reading
1	Dean Academic	269
2	Advisor R&D	356
3	Office Research	306
4	V C Cabin	156
5	V C Meeting room	334
6	Pro. V C cabin	732
7	Chancellor office	880
8	I.Q.A.C Dept.	243
9	Doctor room	194
10	Hostel advisor	315
11	Counselling room	269
12	Ghai Sir cabin	189
13	Account section	334
14	Registrar room	188
15	Deputy registrar	185
16	Administration office	442
17	Account office	316
18	Account section	400
19	Placement office	211
20	Training & Placement	184
21	Digital operation	487
22	T P O Dept.	349
23	E R P head	401
24	Research Dean	374
25	Calling room	399
26	Law director	271
27	Admission head	290
28	Admission cell	467
29	Conference room	434

Observation

The range of lux reading range is 150/200/250. The lowest lux reading in VCC room , Training & Placement cell lux readings are low.



CHAPTER-5 SOLAR PERFORMANCE REPORT

5.1 SOLAR PHOTOVOLTAIC ROOF TOP GRID CONNECTED SYSTEMS (100 KWP)

There is 100 KWP Solar Photovoltaic Roof Top Grid Connected Systems installed on university building.

Table 5.1: Solar plant detailed

Sr. No	Description	Technical Specification
1	Plant Information	
1.1	Plant capacity	100 KWP
1.2	Location	West wing, Oriental University
2	PV Panel Details	
2.1	Make	JAKSON ENGINEERING
2.2	Panel Type	Multi-Crystalline
2.3	Panel Wattage	325 Watt
2.4	No of PV Panels	164
2.5	Panel Tilt Angle	23°





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Figure 5.1: Solar Plant 100 KWp and Inverter System



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5.2 ANNUAL SOLAR UNIT AND GRID UNIT ANALYSIS

Table 5.2 Annual solar, grid unit analysis in years from 2020 to 2023

Year	Grid unit	Solar Unit	Total Unit	Grid %	Solar %
2020-21	2,11,366	76,200	2,87,566	73.50	26.50
2021-22	3,16,351	78,426	3,94,777	80.13	19.87
2022-23	4,28,363	1,11,681	5,40,044	79.32	20.68

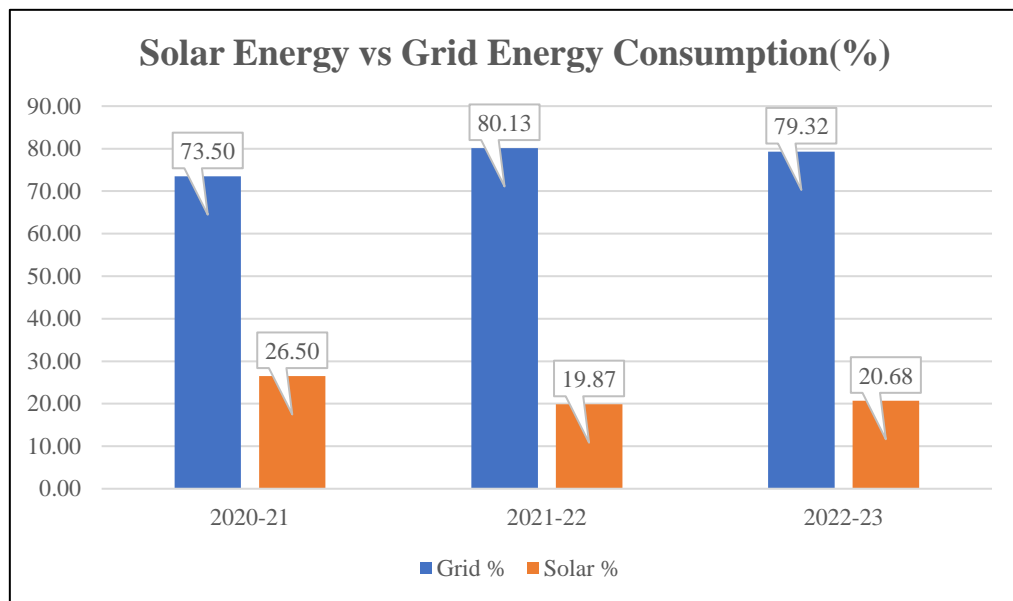


Figure 5.2 Solar vs Grid Unit consumption Year 2020-23



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5.3 MONTHLY SOLAR UNIT GENERATION JUN-2022 TO JUL-2023

Table 5.3 Solar unit generation from June 2022 to May 2023

Sr. No.	Month & Year	Installation Capacity (KWp)	Solar Unit Consumption	CUF %
1	Jun-22	53.00	6,720	17.61
2	Jul-22	53.00	3,960	10.04
3	Aug-22	53.00	4,120	10.45
4	Sep-22	53.00	6,360	16.67
5	Oct-22	53.00	5,960	15.11
6	Nov-22	53.00	6,560	17.19
7	Dec-22	100.00	9,080	10.80
8	Jan-23	100.00	10,871	12.93
9	Feb-23	100.00	13,250	17.45
10	Mar-23	100.00	14920	17.75
11	Apr-23	100.00	12,840	15.78
12	May-23	100.00	17040	20.27
Total			1,11,681	15.17

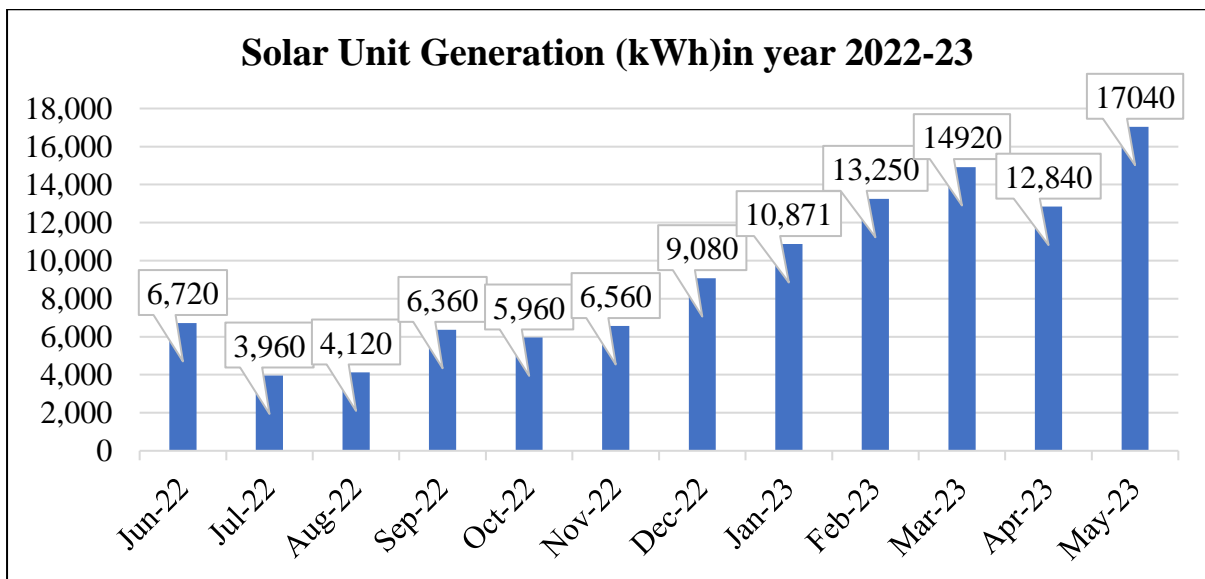


Figure 5.3 Solar Unit Generation Year 2022-23

Observation

During the energy audit, it was observed that the plant is working, Total unit generation from June 2022 to May 2023 is 1,11,681 units, with a 15.17% average annual Utilization Capacity Factor.



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ENVIRONMENT AUDIT REPORT



ORIENTAL UNIVERSITY

Gate No.1, Sanwer Road, opposite Revati Range, Jakhya,
Indore, Madhya Pradesh-453555, India

(Academic Year: 2022-23)





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ACKNOWLEDGEMENT

Empirical Exergy Private Limited (EEPL), Indore takes this opportunity to appreciate & thank the management of **Oriental University, Indore (M.P.)** for giving us an opportunity to conduct environment audit for the university.

We are indeed touched by the helpful attitude and co-operation of all faculties and technical staff, who rendered their valuable assistance and co-operation the course of study.



Rajesh Kumar Singadiya

(Director)

M.Tech (Energy Management), Ph.D. (Research Scholar)
Accredited Energy Auditor [AEA-0284]
Certified Energy Auditor [CEA-7271]
(BEE Empanelled "URJA MITRA")
(BEE, Ministry of Power, Govt. of India)
Empanelled Energy Auditor with MPUVN, Bhopal M.P.
Lead Auditor ISO 50001:2011 [EnMS] from FICCI, Delhi
Certified Water Auditor (NPC, Govt of India)
Chartered Engineer [M-1699118], The Institution of Engineers (India)
Member of ISHRAE [58150]



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EXECUTIVE SUMMARY

The executive summary of the environment audit report furnished in this section briefly gives the identified water conservation measures that can be implemented in a phased manner to water conservation and increase the productivity of the university.

Initiative for Environment Management Taken by University

- ✚ The university has Collected 500 Lit. per hour RO rejected water in the collection take and reused in the cleaning of utensils in mess. If any additional water is generated from the RO system is collected and sent to the Rainwater harvesting system for recharging the pit. **It's appreciable.**
- ✚ The university has maintained the logbook for STP outlet Water parameters TDS and PH on a regular basis. ETP-treated water is used for grading purposes only. **It's appreciable.**
- ✚ The university has provided a guide On the 2nd floor for students to eliminate any accident hazards. **It's appreciable.**
- ✚ 2no's new lifts are installed in East wing & West wing to provide a more comfortable zone for students and university employees. **It's appreciable.**
- ✚ The university has replaced ordinary washroom cleaners with more eco-friendly products. **It's appreciable.**

Audit Recommendation

FRESHWATER MONITORING SYSTEM

- ✚ Installation of a “**Cloud-based (IoT based) groundwater extraction monitoring system**” for bore-well to quantify freshwater consumption per day in the university.
- ✚ Install water flow meters (Mechanical or Electronics) on the Bore well distribution network, like fresh water consumption per day of individual buildings.



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The Audit Team

The study team constituted of the following senior technical executives from **Empirical Exergy Private Limited,**


- ✚ **Mr. Rakesh Pathak**, [Director & Electrical Expert]
- ✚ **Mr. Rajesh Kumar Singadiya** [Accredited Energy Auditor (AEA-0284)]
- ✚ **Ms. Laxmi Raikwar** [Energy Expert & Report Reviewer]
- ✚ **Mr. Charchit Pathak** [Project Engineer]
- ✚ **Mr. Mohan Choudhary** [Sr. Electrician]



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Monitoring Committee

 **ORIENTAL UNIVERSITY, INDORE**
"A Professional University"
First self-financed university established at Indore by M.P. Legislative Assembly, Approved u/s 21 of UGC 1956 act


July 01, 2022

Energy, Green & Environment Audit Committee

Energy, Green and Environment Audit committee will consist of the following faculty and staff.

S.No.	Designation	Department
01.	HOD	Mechanical Engineering
02.	HOD	Electrical Engineering
03.	HOD	Chemistry
04.	OSD (Officer on special Duty)	Projects

Time duration for this committee is 3 years up to June-2025 after which the committee will be reconstituted.


Pro Vice-Chancellor
Oriental University, Indore



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**CHAPTER-1
INTRODUCTION**

1.1 ABOUT UNIVERSITY

Oriental University, Indore (OUI) was established by Devi Shakuntala Thakral Charitable Foundation in the year 2011. The Oriental Group is one of the most recognizable names in the field of education since 1995, it has many renowned institutions in Bhopal, Indore and Jabalpur.

Oriental University, the first private university of Indore, has proudly acquired the university status under section 2f of UGC, 1956 Act with effect from May 2011. Oriental University is committed to offer unparalleled quality of education in different streams viz.- Agriculture, Commerce, Computer Applications, Education, Engineering, Law, Library & Information Sciences, Management, Media Studies, Pharmacy, Science etc.

The university has won many awards to its credit, for research, best practices, education excellence, intellectual development, etc.

A Thoughtfully Designed University Campus

Majestically located at Indore – Ujjain state highway near Devi Ahilya International Airport, the lush green campus is one of the most beautiful and serene educational institutes spread over 77 acres of land.

Apart from the academic blocks, the university has one of the best hostel facilities for boys and girls; residential accommodation for faculty members, bank and other facilities in the campus.

Crossing Traditional Education Boundaries

We are committed to go well beyond traditional education. Currently, the University's exquisite infrastructure houses spacious classrooms with the latest teaching aids, well-equipped and high tech laboratories and workshops.

The State-of-Art laboratories using the latest technologies are a prominent feature of OUI which makes it an outstanding organization. Apart from this, we have various workshops including the Hyundai Tech center, ICT-based spacious classrooms, and a central library with



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separate reading areas for students and faculty members and RFID based book issue/return complain and inventory control. OUI combines innovative teaching and pioneering research in a highly collaborative environment that helps students to achieve quality education and excellence.

Developing Responsible Professionals

Our intent at OUI is to march forward to develop personally, professionally and socially responsible human beings who could be easily deployed in the industry and also leave their “mark” in any business domain they work in. Our Alumni are spread all over the world in they hold responsible positions in government, judiciary and almost all kinds of companies. The environment is committed to students’ growth and success, career readiness, community engagement, health and well-being ultimately leading to becoming a “Responsible Human being”.

We believe in Academic Emancipation

For OUI, education is more than simply teaching, we believe in creating an atmosphere of academic freedom where individuals can discover, collaborate, learn, and achieve excellence in their specific domains and beyond. Oriental Group has successfully established many reputed university’s of Engineering, Management, Computer Application, Pharmacy etc. OUI imparts studies at different levels leading to Certificate, Diploma, Undergraduate, Post-Graduate and Ph.D. Today, Oriental Group is a prime educational group that retains National rankings. Highly qualified and experienced faculty members along with knowledgeable industrial experts impart education to the students. The curriculum adopted is industry friendly and OUI plays a vital role in bridging the gap between the extremely demanding corporate and the mediocre curriculum running in many universities.

Home to Exceptional Opportunities

Students and faculties have exceptional opportunities for intellectual, professional as well as personal growth. Educational offerings at OUI are well beyond traditional teaching, we create a fun learning environment that helps individuals to become creative minds, allowing them to deliver exceptional performance in their respective fields. At the same time, we are dedicated



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to a creative and rewarding work environment for all our knowledgeable and vastly experienced faculty members who work relentlessly to educate students.

We promote the value of learning with teamwork and growth, making our students highly productive and responsible members of society.

Explore our educational offerings and give wings to your career!

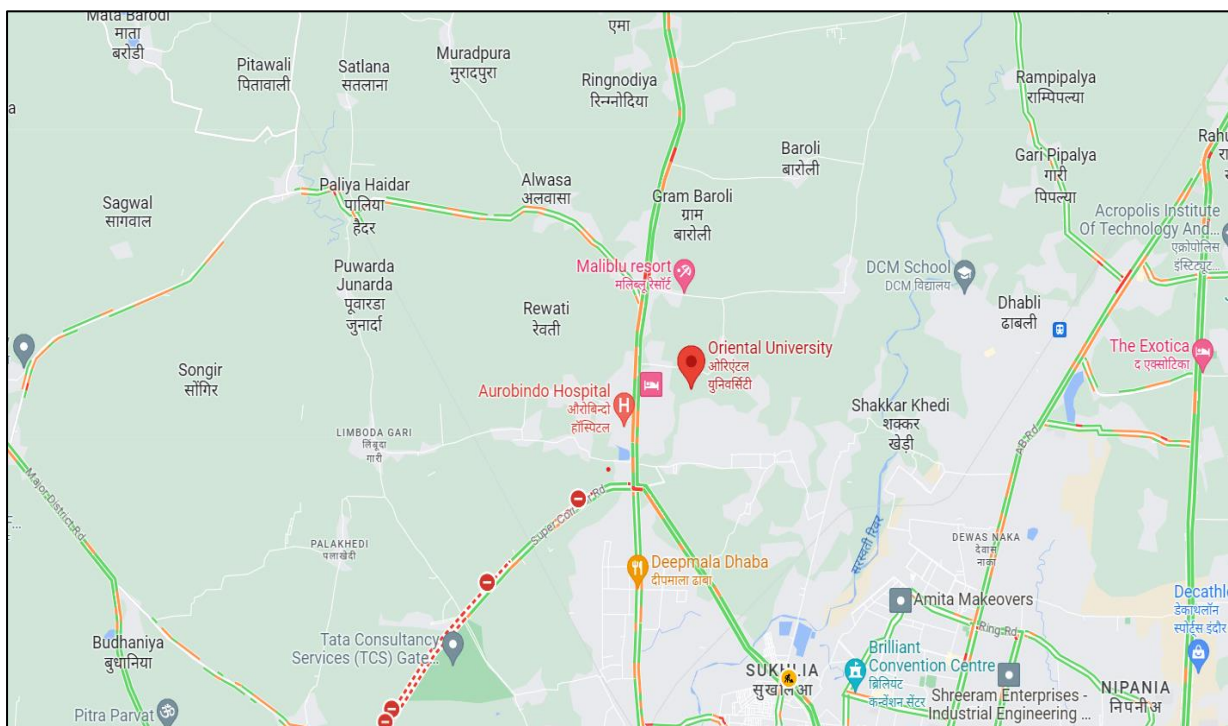


Figure:- 1.1 Source : Google Image of Oriental University Indore (M.P.)



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Vision

“To provide a distinctively – Indian environment of educational excellence while challenging the academically accelerated individual and accelerating the academically challenged individual.”

Mission

- To promote the value of learning, self-growth among students and staff, quality performance among students and staff, and transition for students to productive and responsible participation in society.
- To promote a safe and stimulating environment for bright and curious students to interact with and learn from each other.
- To entertain students with educational offerings that provides fun learning opportunities.
- To provide a creative and rewarding work environment for all employees.



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About Infrastructure

The university is spread over 77-acre with plenty of open space and sports area interspersed within academic buildings. The Academic Blocks (Block-B & Block-C) & Admin Block (Block-G) are under construction at present time. The details of various department and building's are given below:

Table1.1 Name of the various Building in oriental university

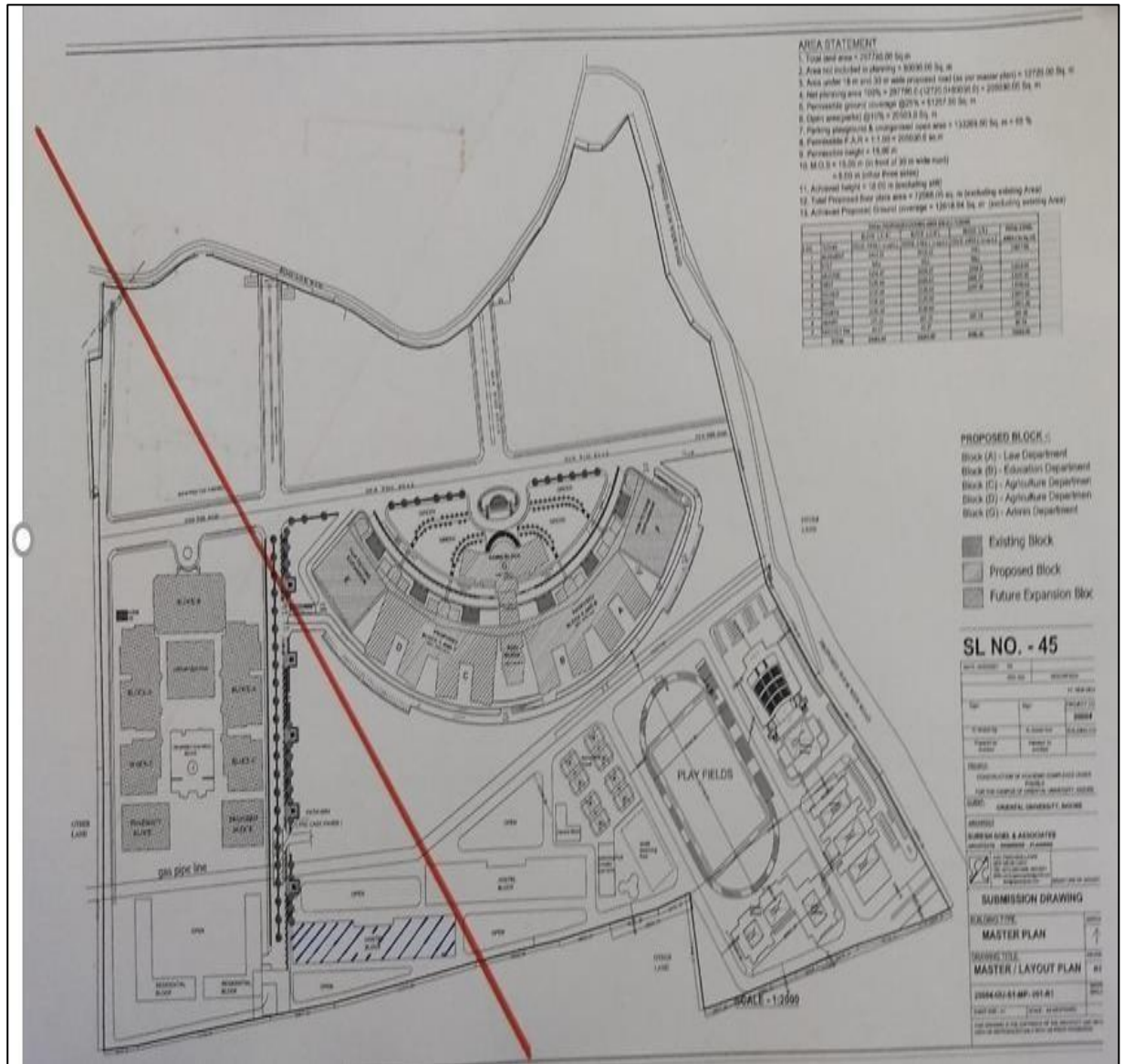
Oriental University, Indore		
Built-up area of buildings		
Sr. No.	Name of Building	Built-up area (Approx.- Sq.mt.)
1	Administrative Building	76223
2	Eastern Wing	154212
3	Western Wing	152835
4	Library Building	80538
5	O.C.P.R.	57243
6	Residential block	36282
7	Boy's Hostel	77709
	Corridor between boy's wings & mess G.F. to fifth Floor	6032
8	Girl's Hostel	77709
	Corridor between girl's wings & mess G.F. to fifthFloor	6032
9	Mess	13250
10	1 BHK Flats in Hostel	8328
	Total Build-up area of Campus	746393



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Oriental University Layout of Various Buildings





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1.2 ABOUT ENVIRONMENT AUDITING

Environment audit can be a highly valuable tool for university in a wide range of ways to improve their energy, environment, and economic performance. While reducing wastage and operating costs. Environment audits provide a basis for calculating the economic benefits of water conservation projects by establishing the current rates of water use and their associated cost.

1.3 OBJECTIVES OF ENVIRONMENT AUDIT

The general objective of an environment audit is to prepare a baseline report on water conservation measures to mitigate consumption, and improve quality and sustainable practices.

The specific objectives are

- ✚ To monitor the water consumption and water conservation practices.
- ✚ To assess the quantity of water, usage, the quantity of wastewater generation, and their reduction within the university.

1.4 TARGET AREAS OF ENVIRONMENT AUDIT

This indicator addresses water sources, water consumption, irrigation, stormwater, appliances and fixtures aquifer depletion and water contamination are taking place at unprecedented rates. It is therefore essential that any environmentally responsible institution should examine its water use practices.



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1.5 METHODOLOGY FOLLOWED FOR CONDUCTING ENVIRONMENT AUDIT

Step 1: Walk through the survey

- ✚ Understanding of existing water sourcing, storage, and distribution facility.
- ✚ Assessing the water demand and water consumption areas.
- ✚ Preparation of a detailed water circuit diagram.

Step 2: Secondary Data Collection

- ✚ Analyse historic water use and wastewater generation
- ✚ Field measurements for estimating current water use
- ✚ Metered & unmetered supplies.
- ✚ Understanding of “base” flow and usage trend at site
- ✚ Past water bills
- ✚ Wastewater treatment scheme & costs etc.

Step 3: Site Environment Audit Planning (based on-site operations and practices)

- ✚ Preparation of a water flow diagram to quantify water use at various locations
- ✚ Wastewater flow measurement and sampling plan

Step 4: Conduction of Detailed Environment Audit and measurements

- ✚ Conduction of field measurements to quantify water/wastewater streams
- ✚ Power measurement of pumps/motors
- ✚ Preparation of water balance diagram
- ✚ Establishing water consumption pattern
- ✚ Detection of potential leaks & water losses in the system
- ✚ Assessment of productive and unproductive usage of water
- ✚ Determine key opportunities for water consumption reduction, reuse & recycle.

Step 5: Preparation of Environment Audit Report

- ✚ Documentation of collected & analysed water balancing and measurement details
- ✚ Projects and procedures to maximize water savings and minimize water losses.
- ✚ Opportunities for water conservation based on reduce/recycle/reuse and recharge option



CHAPTER-2 WATER CONSUMPTION AND WASTEWATER SOURCES

2.1 DETAILS OF SOURCE OF FRESH WATER AND USE AREAS

The main sources of freshwater for the university are 2 no. of borewells; one is an open well, located in different areas inside the university campus. Freshwater is used for drinking, housekeeping, gardening, domestic consumption, and new construction projects. Details of bore- wells are given in table 2.1

Table: 2.1 Fresh water sources on university campus

Source of Water	Location	Type of Pumps	Rated (HP)	Rated Flow (M ³ /hr)
Bore well No-1	Near Main gate	Submersible	7.5	3.5
Bore well No-2	Near hostel building	Submersible	7.5	NA

2.2 Water Accounting & Metering system

It was observed that there is requirement of water flow meters on borewells and open well to quantify per day ground water extraction from different sources.



Figure:- 2.1 Borewell in university



2.3 WATER DISTRIBUTION LAYOUT

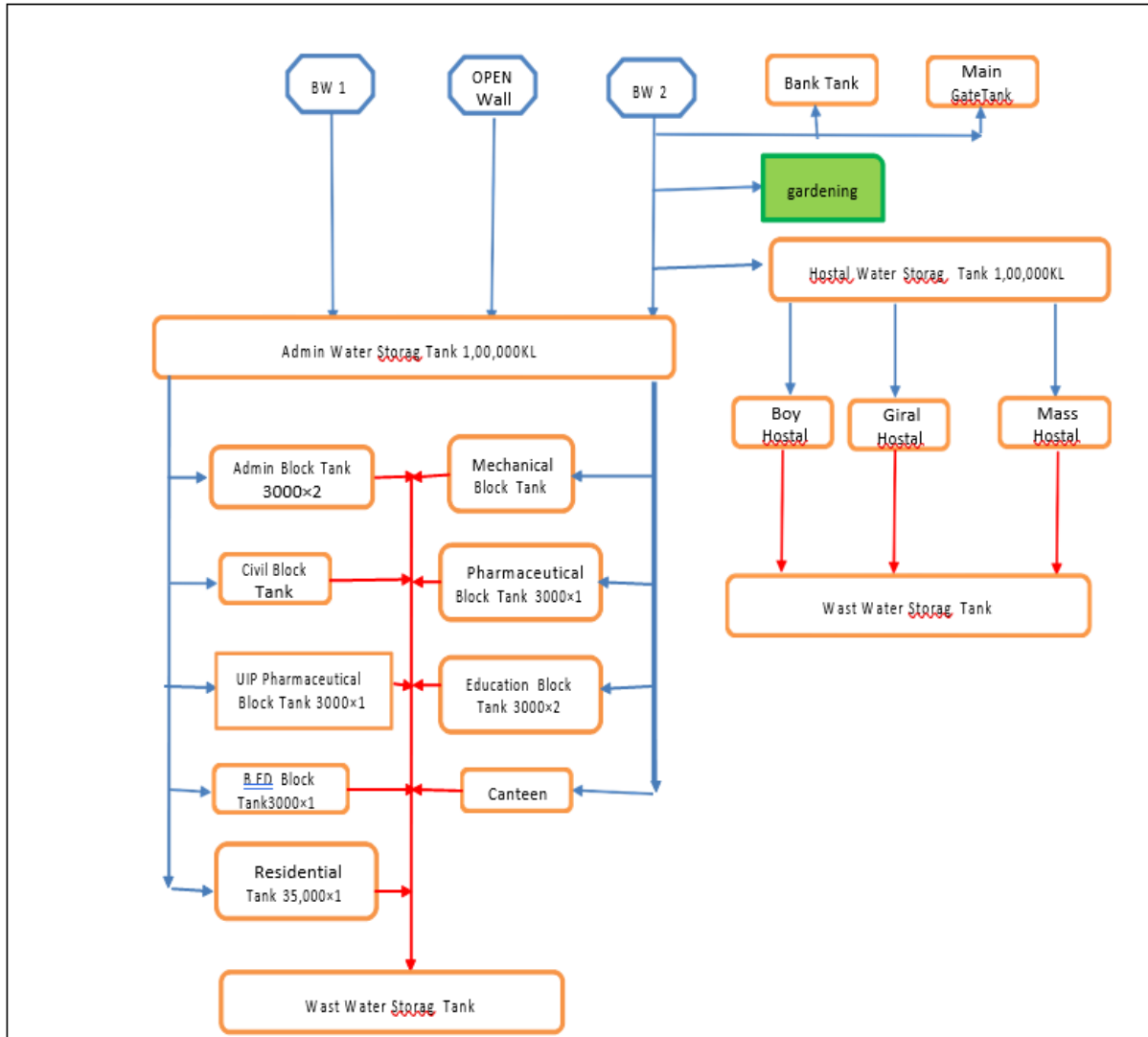


Figure:- 2.2 Fresh Water distribution layout



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2.4 WATER STORAGE CAPACITY IN THE UNIVERSITY

In university RCC and PVC, tanks are available for water storage like underground tanks, and overhead tanks. Details of the tanks are given in the table 2.3.

Sr. No	Type of Storage System (Over Head Tank, Underground Tanks, Reservoir etc.)	Location	No. of Quantity (RO)	No. of Quantity (For Uses like Washroom, Toilet)	Storage Capacity (ltr.)
1	PVC	Dept. of Agriculture	1	2	1000,3000
2	PVC	Dept. of Law	1	2	1000,3000
3	PVC	Dept. of Electrical	2	3	1000,3000
4	Overhead tank RCC	Hostel (Boys & Girls)	2	4	1000,5000
5	PVC	Admin Block	1	3	1000,3000
6	PVC	Dept. of Pharmacy	1	1	1000,3000
7	PVC	Residential Block	2	1	1000,5000
8	Overhead tank RCC	Main Gate (Bank/Account Sec.)	1	1	1000,1500



Figure: - 2.3 Water storage tank in the university



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2.5 WATER USE AREAS IN THE UNIVERSITY

Water is preliminary used for drinking, domestic, and gardening. The environment audit team visited various departments and buildings to determine appliances. The details of the washroom, toilet, and taps are given on table

Table: 2.4 Washrooms in various areas

Building Name	No. of floors	Total no. of washrooms in the building	No. of taps in the building
Administration Building	3	17 (2 Male, 1 Female Washrooms in each floor) and 8 for staff	43
Mechanical Department	4	20 (2 Male and 2 Female, 1 staff Washroom in each floor)	77
Civil Department	3	20 (2 Male and 2 Female, 1 staff Washroom in each floor)	77
Pharmaceutical block	3	9 Washrooms and	26
UIP-Pharmaceutical	4	(2 Males and 2 Females 1 staff Washroom in each floor)	48
B.ED	4	(2 Male and 1 Female, 1 staff Washroom in each floor)	36
Education Department	3	(2 Male and 2 female staff Washrooms on each floor)	27



Figure: - 2.4 Efficient water fixtures for water saving in campus



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2.6 WATER USES FOR GARDENING

The one of major contributions of freshwater and treated water consumption is watering for other plants in the university. There is good potential for water saving by adopting the “Automatic Watering 360 adjustable misting nozzle irrigation dripper’s system” for plants. Adjustable drip irrigation tools to provide different amounts of water depending on the water requirements of different plants. The drip speed can be set for indoor and outdoor plants.



Figure: - 2.5 Proposed Adjustable Misting Nozzle Irrigation Drippers Proposed water timer



2.7 RO PLANT AND REJECTED WATER STORAGE FACILITIES

The university has an RO and water cooler system for drinking water in departments. It is observed that all Ro rejected water is lined and connected a separate tank after the collection water is used for rainwater harvesting pit for recharging the system.



Figure: - 2.6 Central RO System



Figure: - 2.7 Rejected Water Collection tank



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2.8 WASTE WATER TREATMENT PROCESS

Wastewater generated from departments, canteen, washroom, showers (bath) in hostels, and mess shall be collected in separate tanks and sent to the proposed STP plant. Treated wastewater from the STP plant will be reused for gardening purposes. It will reduce the freshwater consumption of the university.



Figure: - 2.8 Sewage Treatment Plant in University



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CHAPTER- 3

Air Quality Measurement

3.1 AIR QUALITY MEASUREMENT

The audit team conducted air monitoring survey on university campus. Details are given in table 3.1

Sr. No.	Location / Room No.	PM _{2.5} µg/m ³	PM ₁₀ µg/m ³	Particle	CO ₂ ppm	C	%
1	Dean office	26.6	38.6	4045	419	30	62
2	Advisor P&D	21.7	35.8	3998	469	30	62
3	Office Research	21.7	35.8	4180	411	30	61
4	VC cabin	19.7	34.9	3364	430	29	55
5	VC meeting room	21.5	34.9	3575	504	29	61
6	IQAC Dept.	24.8	29.5	2837	587	29	63
7	Dr. room	18.7	31.2	3669	525	29	64
8	Advisor Hostel	21.5	31.6	3619	525	29	64
9	Counselling room	19.4	30.5	3703	481	29	62
10	Ghai sir cabin	19.2	30.2	3677	429	29	62
11	Account section	20.1	33.0	3477	428	29.6	63
12	Registrar room	20.2	32.6	3676	433	30	62
13	Deputy registrar	21.2	27.2	3393	511	30	63
14	Administration office	20.4	34.1	5284	474	30	63
15	Account office	25.7	41.2	4290	439	30	62
16	Placement office	23.5	36.9	1644	495	30	64
17	TPO dept.	25.5	46.7	4692	498	30	63
18	ERP new	25.7	40.9	4844	485	30	66
19	Research dean office	18.5	30.1	3485	819	30	64
20	Calling room	22	35.7	4846	710	30	62
21	Law director	23.5	39.7	5090	566	30	65
22	Administrator room	25.9	42.6	4322	512	30	54
23	Admission cell	21.2	34.1	5460	490	30	61
24	Conference room	25.1	44.2	4733	505	30	62

Observation:-

- ✚ PM_{2.5} value is higher side. The 24-hour concentration of PM_{2.5} is considered unhealthy when it rises above **35.4 µg/m³**
- ✚ PM₁₀ value is acceptable range. It should be below **155 µg/m³**
- ✚ CO₂ value is acceptable range. It should be below 1000 ppm



CHAPTER - 4 RAINWATER HARVESTING SYSTEM

4.1. RAIN WATER HARVESTING SYSTEMS

Rainwater harvesting is a technique to capture the rainwater when it precipitates, store that water for direct use, or charge the groundwater and use it later.

There are typically four components in a rainwater harvesting system:

- ✚ Roof Catchment
- ✚ Collection
- ✚ Transport
- ✚ Infiltration or storage tank and use.

If rainwater is not harvested and channelized it runoff quickly and flows out through storm-water drains. For storm-water management, the recharge pits, percolation pits, and porous trenches are constructed to allow stormwater to infiltrate inside the soil.

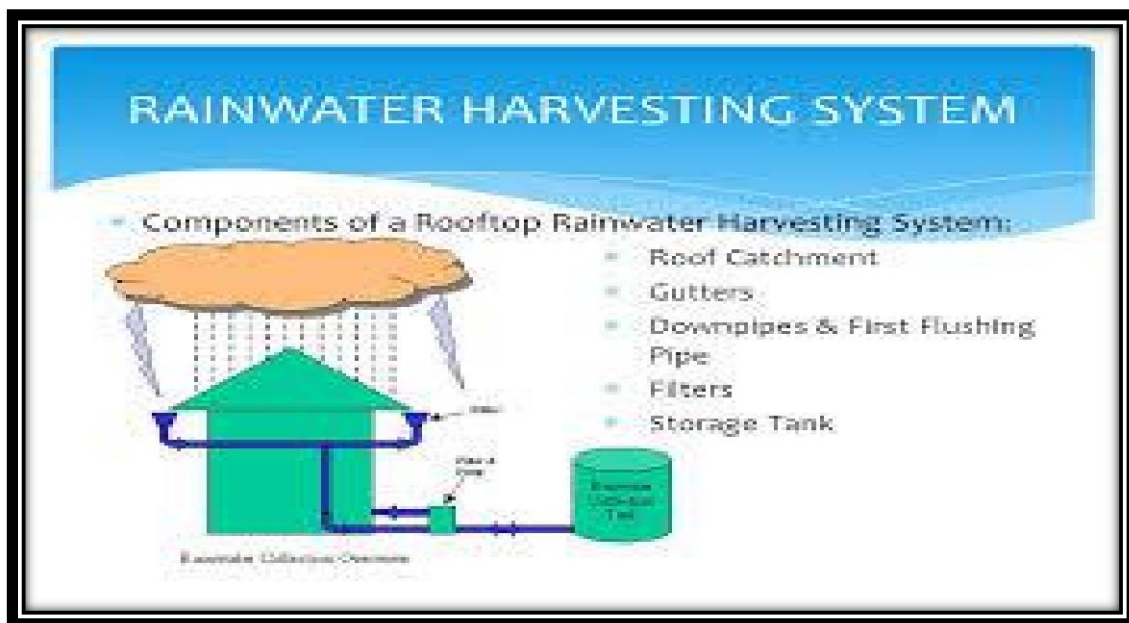


Figure: - 4.1 Components of a rooftop rainwater harvesting system



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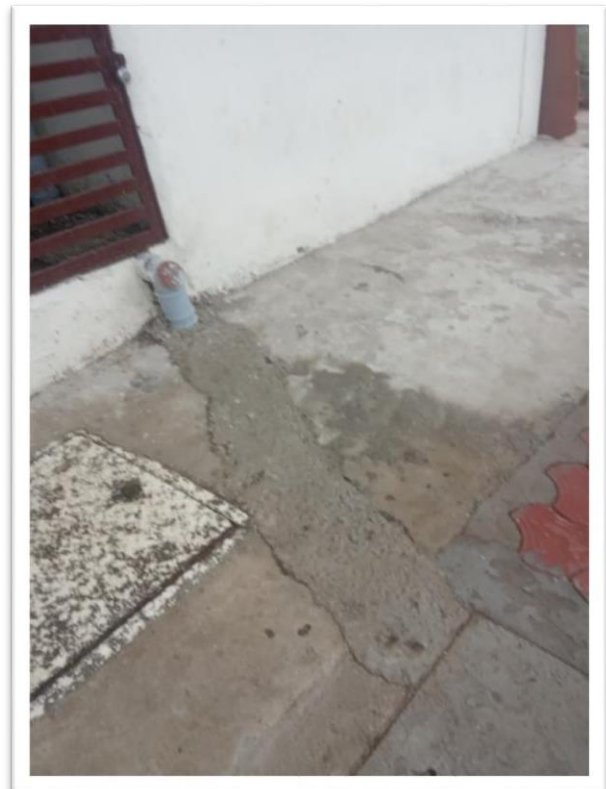


4.2 RAIN WATER HARVESTING SYSTEM IN UNIVERSITY

The rainwater harvesting is a technique to capture the rainwater when it precipitates, store that water for direct use or charge the groundwater and use it later. Rainwater harvesting systems collect and capture rainwater which runs off large surfaces such as roofs and stores it in tanks which can be underground, such as Raintraps and Aquabanks, or above ground harvesting tanks like water butts in gardens or larger tanks around farm buildings. If rainwater is not harvested and channelized its runoffs quickly and flow out through storm-water drains. For storm-water management the recharge pits, percolation pits and porous trenches are constructed to allow storm water to infiltrate inside the soil. Hostel roof top area is about 2800m². The average annual rainfall is 1 m in Indore city and runoff coefficient is 0.95 considered for commercial building. Therefore, estimated rainwater harvesting potential is 2,660m³/year. it is used to recharge a dry bore well.

The following mathematical equation is used for above calculation:

RWH Potential = Rainfall (m) x Area of catchment (m²) x Runoff coefficient





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Rainwater harvesting on Hostel roof top area

Sr.No.	Rain Water Harvesting on Hostel Roof Top	Technical details
1	Roof top area (m²)	
	Boys Hostel (m ²)	1203
	Girls Hostel(m ²)	1203
	Mess(m ²)	313
	Total Roof top area of hostel (m²)	2719
2	Average rain fall in indore (meter/year)	1
	Rain water endowment (m ³)	2719
	Rooftop Finish coefficient	0.85
	Run off, spillage ,evaporation coefficient	0.95
	Rain water Harwesting potential(m ³)	2196
3	Assuming indore has rains for 45 days/year ,and has 80% rain in 25 days@15 hours per day ,20 % rain in 20 days i.e. Maximum rain water collection /hours on way day (m³) Hence , 2196*0.8/25/15	4.685
4	Rain water collection (3m*3m*2m)-m ³	18
5	Volume of rain water on hostel roof top/year (m ³)	=28 lac litre
6	Amount of rain water per year that is expected to feed ground water reserve	28,00,000 litre



Rainwater Harvesting installed in university campus



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✚ Uses of RWH (Rainwater harvesting)

- Rain water is used to recharge a dry bore well.

•	Rain Water Harvesting on Hostel Roof Top
1	Roof top area (m ²)
•	Boys Hostel (m ²)
•	Girls Hostel(m ²)
•	Mess(m ²)
•	Rain Water Harvesting on Hostel Roof Top
•	Average rain fall in indore (meter/year)
•	Rain water endowment (m ³)
•	Rooftop Finish coefficient
•	Run off, spillage, evaporation coefficient
•	Rain water Harvesting potential(m ³)
•	Average rain fall in indore (meter/year)
•	Rain water endowment (m ³)
•	Rooftop Finish coefficient
•	Rain water Harvesting potential(m ³)
•	Run off, spillage , evaporation coefficient
•	Rain water Harvesting potential(m ³)
2	Assuming indore has rains for 45 days/year, and has 80% rain in 25 day
•	Maximum rain water collection /hours on way day (m ³)
•	$2196 * 0.8 / 25 / 15$
3	Rain water collection (3m*3m*2m)-m ³
4	Rain water is used to recharge a dry bore well