Reports of the Audits

1. **Environmental and Green Audit**
2. **Energy Audit**

Environmental and Green Audit Report of All India Shri Shivaji Memorial Society (AISSMS) Campus Kennedy Road, Near R. T. O., Pune

By

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ENVIRONMENTAL SCIENCES
SAVITRIBAI PHULE PUNE UNIVERSITY

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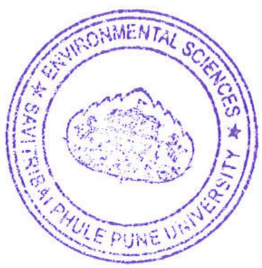
ENVIRONMENTAL SCIENCES ★ SAVITRIBAI PHULE PUNE UNIVERSITY ★

Abbreviations

AISSMS	All India Shri Shivaji Memorial Society
COE	College of Engineering
COP	College of Pharmacy
IOM	Institute of Management
IOIT	Institute of Information Technology
DoES	The department of Environmental Science
SDGs	Sustainable Development Goals
NBC	National Building Code
PMC	Pune Municipal Corporation
RWH	Rain Water Harvesting
dB	Decibels
RTO	Regional Transport Office
WHO	World Health Organization
MSWM	Municipal Solid Waste Management
PV	Photovoltaic
KW	Kilo Watt
ETP	Effluent Treatment Plant
MPCB	Maharashtra Pollution Control Board
PUC	Pollution Under Control
NSS	National Service Scheme



1. Background

All India Shri Shivaji Memorial Society (AISSMS) was established in 1917 by late Shri Shrimant Chattrapati Shahu Maharaj of Kolhapur and H.H. Late Alija Bahadur Madhavrao Scindia Maharaj of Gwalior. It was established with well defined objective to bring about all round development of students and to create technically skilled manpower in the various fields.

The Society started a day school and junior college in 1972. To keep up with the changing times, in 1992, All India Shri Shivaji Memorial Society made a foray into higher and technical education. Today besides running residential and Day schools and Junior Colleges ranging from vocational to other disciplines, AISSMS runs world class ITI which has collaborated with Germany to impart vocational training, Polytechnic in two shifts, Hotel Management and Catering Technology, Pharmacy, Engineering Colleges with a wide spectrum of disciplines, and Management College in two shifts as well.

All the colleges except Polytechnic run under-graduate as well as Masters Programmes in various disciplines all affiliated to the Prestigious Savitribai Phule Pune University (previously University of Pune). AISSMS colleges have obtained accreditation from the National Board of Assessment and Accreditation Council (NAAC), National Board of Accreditation (NBA) and also have signed MOU's with Universities from the UK, the USA and Germany to run joint programmes of global standards. The Corporates, academicians, industrialists and the student community have lauded the efforts made by the All India Shri Shivaji Memorial Society to take the society to un-scaled heights.

Campus institutes

1. College of Engineering (COE)
2. College of Pharmacy (COP)
3. Institute of Management (IOM)
4. Institute of Information Technology (IOIT)
5. Polytechnic College
6. Day School
7. Primary school

2. Scope of Work

The department of Environmental Science (DoES), S. P. Pune University has strong network of experts in the field of Environment. With the previous experience of DoES in the field of environmental assessment, the management of AISSMS initiated the discussion and process of environmental audit with DoES. The management approached DoES with this initiative, where the AISSMS and DoES agreed to undertake environmental assessment of the following environmental issues for the above-mentioned campus areas.

1. Water Supply and Sewerage
2. Plant diversity of the Campus
3. Noise Monitoring of the Selected locations within the campus
4. Solid Waste Management Practices within the campus.
5. Air Quality Monitoring

Based on the available data, sampling and information provided by the AISSMS officials this report has been prepared and recommendations for betterment of campus environment are provided.

3. Baseline Data

It was observed that some of the campus part was handed over to the local government for the purposes of construction of Metro-line (adjoining existing DP road to the South of the campus) and Road (adjoining Sudarshan chemicals to the West of the campus). Due to this infrastructure development many of the trees adjoining to these fence areas have been lost and noise levels may rise during construction.

The most of the baseline data relating population, water supply, solid waste generation has been collected partially from the AISSMS management, where the samples for drinking water, noise, plant diversity where collected by visiting the campus area by the expert teams.

Table No. 1: Total Population of the campus

Sr. No.	Department	Total population of institute (incl. Students, Permanent, Temporary staff and visitors
1	College of Pharmacy	532
2	College of Engineering	3186
3	Day school	1577
4	Polytechnic College	1465
5	Institute of Information Technology	2608
6	Institute of Management	390
7	Primary school	895
	Total	**10,653**

4. Environmental Issues

4.1 Water Supply and Sewerage

Water is a key driver and is vital to development of Biodiversity, Agriculture, Humans as well as the economy. With recent experiences across the world and in India, the water scarcity and security are emerging as a global risk. The state of Maharashtra has also faced severe impact of the water scarcity in the recent past. Therefore, water management is a crucial step of sustainable development and it also has been made an integral part of the Sustainable Development Goals (SDGs).

Unplanned urban growth and economic development has placed unprecedented pressures natural resources especially on water. The world-bank estimates '" that with the business as usual, global water crises may rise multiple folds due to a shortfall of about 40% between the demand and available supply of water by 2030. This brief background highlights the necessity of the overall water management.

4.1.1 Water supply on the campus

There are about 25 water storage tanks within the campus. The capacities are shown in Table No. 2.

Table No. 02: Water Storage Capacity at the campus

Sr. No.	Type of water storage	No. of units	Total Capacity (m^3/day)
1	Underground Tanks	7	252.82
2	Overhead Tanks	18	311.41
	Total	**25**	**564.23**

Table No. 03: Water supply requirements as per National Building Code, 2016 (Water Supply for Buildings Other than Residences)

Sr. No.	Department	Total population of institute (incl. Students, Permanent, Temporary staff and visitors	Water requirement (m^3/day)
1	College of Pharmacy	532	23.94
2	College of Engineering	3186	143.37
3	Day school	1577	70.97
4	Polytechnic College	1465	65.93
5	Institute of Information Technology	2608	117.36
6	Institute of Management (MBA)	390	17.55
7	Primary school	895	40.28
	Total	**10,653**	**479.39**

Note: This requirement is inclusive of drinking water.

Based on the available data and benchmarking for water supply as per National Building Code (NBC), it can be seen that the campus has about 84.84 m^3 of excess fresh water storage. Considering that about 80% of the water supplied is converted in to the waste water, the campus generated about 384 m^3 of waste water every day.

4.1.2 Water quality on the campus

4.1.2.1 Laboratory procedures

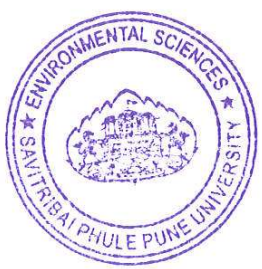
After sampling, collected samples were immediately brought to analytical laboratory and kept in refrigerator at temperature below 40^0C and further analysis started without delay based on the priority to analyze parameters as prescribed by APHA (1995) methods. Various physico-chemical parameters analysed for water sample include pH (Digital pH meter DPH504), Electrical conductivity (EC) (Digital EC meter DEM900). Total Hardness (TH), Residual Chlorine, was estimated by standard titrimetry.

A) **Physico - Chemical analysis of Ground water and Surface water:**
All parameters were determined in the laboratory by following the Standard protocols (APHA, 1995). The samples were analyzed in order to evaluate 10 parameters as follows:

- pH
- EC
- Total Alkalinity (TA) As HCO_3^-
- TSS
- TDS
- Residual Chlorine
- BOD
- COD
- Residual Chlorine

Table No. 04: Drinking water quality in the campus

Sr. No.	Parameters	Method of Analysis	Day School First floor	IOIT Overhead	Polytechnique Overhead	Engineering College (2nd Floor)	Pharmacy (Ground Floor)	Primary School	Drinking water standards as per IS 10500:2012- acceptable limits
1	pH	pH meter	7.4	7.9	7.4	7.5	7.6	7.5	6.5-8.5
2	Electrical Conductivity (Mho/cm)	EC meter	1.45	2.33	2.36	1.96	2.14	1.64	---
3	TSS (mg/l)	Filtration Method	0.65	2.68	2.16	0.89	0.73	0.75	---
4	TDS (mg/l)	Evaporation Method	2.1	3.45	3.56	2.73	0.76	4.5	500
5	BOD (mg/l)	Winkler's Iodometric method	Nil	Nil	Nil	Nil	Nil	Nil	---
6	COD (mg/l)	Reflux Digestion Method	Nil	Nil	Nil	Nil	Nil	Nil	---
7	Residual Chlorine (mg/l)	Sodium Thiosulphate Titration Method	Nil	Nil	Nil	Nil	Nil	NII	0.2



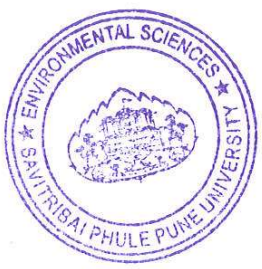
8	Chlorides (mg/l)	Silver Sulphate Method	20.45	30.78	36.25	17.36	14.63	35.64	250
9	Total Hardness (mg/l)	EDTA Titration Method	85	91	75	56	78	69	200
10	Total Alkalinity (mg/l)	Titration Method	36	45	49	46	37	55	200

Note:

1. All result values are in mg/l, except pH and EC.
2. These results are not reproducible; the results are subject to water storage and supply conditions on the site.

Conclusion

On the basis of analysis carried out in our laboratory, it is interpreted that all samples are within acceptable limit of WHO standards. As all water is supplied by PMC to campus, quality of water is suitable for drinking purpose. The parameters like BOD, COD and Residual Chlorine is Nil, indicates very good quality of water.



4.1.3 Sewerage Management

Most of the waste water generates from the toilet facility.

Table No. 5 - number of toilets and urinals available

Sr. No.	Department	No. of Toilet Blocks - Staff	No. of Toilet Blocks - Students	Total no. of Toilet Blocks	No. of Toilet Seats - conventional	Total no. of urinals - Boys	Total no. of urinals - Girls (western)
1	College of Pharmacy	3	8	11	23	17	22
2	College of Engineering	7	8	15	57	23	30
3	AISSMS - Day school	5	10	15	35	23	30
4	Polytechnic college	4	10	14	45	21	28
5	Institute of Information Technology	17	13	30	79	45	60
6	Institute of Management (MBA)	9	8	17	49	26	34
7	Primary school	1	2	3	9	5	6
	Total	46	59	105	297	160	210

Note:

1. It is assumed that at least 2 toilet seats area are available per toilet block; and urinals for females are of western type
2. It is assumed that 50 % of the toilet blocks are for females (student and staff) and 50% of the toilet blocks are for males (student and staff)
3. It is assumed that each of the Boy's toilet block has at least 3 urinals whereas Girl's toilet block has a provision of at least 2 western urinals i.e. commode.

- The quantum of waste water is high and can be converted in to a resource by treating this waste water.
- No separate facility to treat the liquid chemical waste generated within the campus.

4.1.4 Rain Water Harvesting

Water scarcity is a grave problem for mankind. More and more water is needed for domestic, construction, and industrial use – and the rate of extraction is far more than the rate of recharging our water tables.

Overexploitation of groundwater has been a result of urbanization, a decrease in open soil surface and water infiltration rate, and a resultant worsening in water quality. Industrial

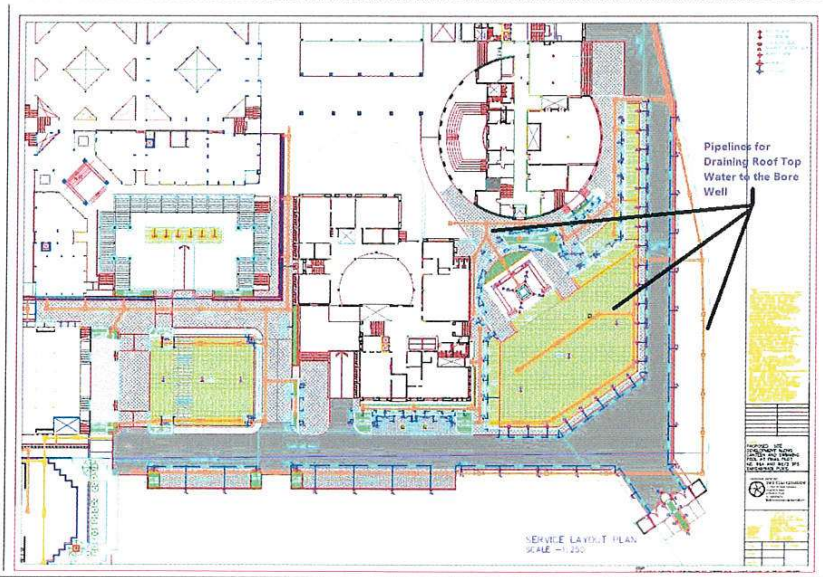
units and residential apartments face acute water shortages, consequence of this shortage comes in the form of elevated amounts of money spent on purchasing water from government and private water suppliers and the rural scenario is no good. An increasing population increases the burden of food production which in turn demands more land, more fertilizers and more water.

Rainwater harvesting (RWH) is a simple method by which rainfall is collected for future usage. The collected rainwater may be stored, utilised in different ways or directly used for recharge purposes. With depleting groundwater levels and fluctuating climate conditions, RWH can go a long way to help mitigate these effects. Capturing the rainwater can help recharge local aquifers, reduce urban flooding and most importantly ensure water availability in water-scarce zones.

As suggested during previous Environmental Audit, AISSMS has partly implemented Rain Water Harvesting (RWH) (Table no. 6) by recharging about 54 m^3 of rain water. It is further suggested that, as the campus includes large paved and unpaved areas along with large terrace areas; this RWH can further be expanded.

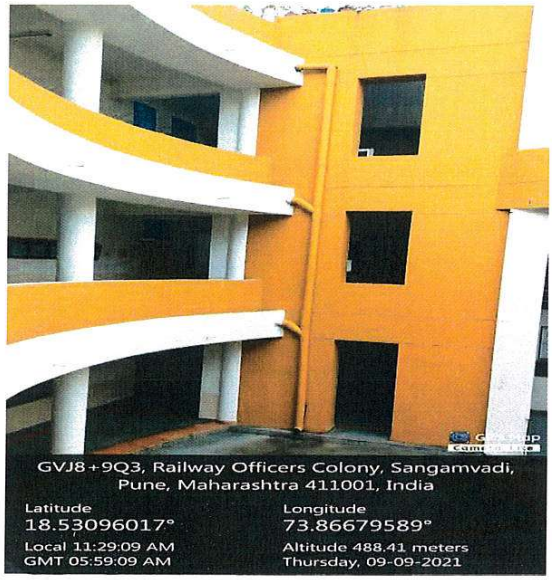
Table No.6 – Rain Water Harvesting

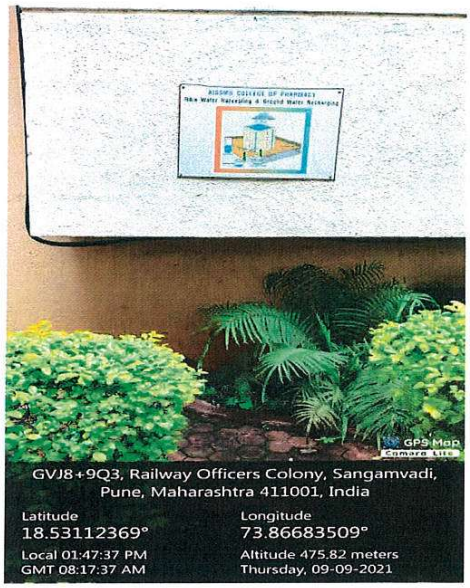
No. of recharge wells	Capacity (m^3)	Total Capacity (m^3)
2	27 m^3 capacity each with 300 feet depth	54

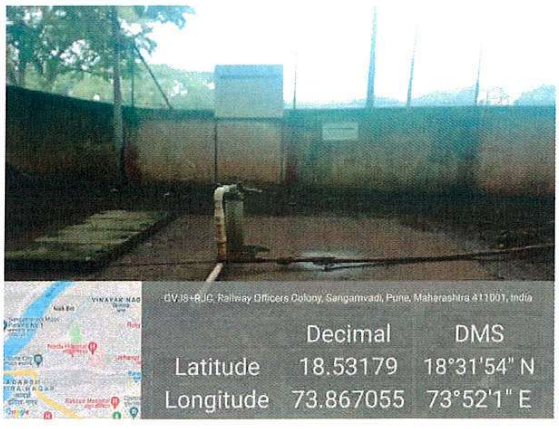


AISSMS CAMPUS LAYOUT

Rain water harvesting system was incorporated in the architecture plan and has been installed in the college building right from its inception. The water from rooftops and floors is collected through down pipes and discharged in the ground as well as in recharge pits near bore-well through pipe lines in the campus.







Well Recharge

4.2 Noise Environment

Noise pollution is one of the major environmental issues in India today and most of us are unaware of the hazards it can cause. In India, we all are subjected to some form of loud noises for a considerable amount of time on daily basis as well across the year based on the festive season such as Ganesh Festival, Diwali and others.

Unwarranted sounds such as honking, other vehicular noise, the loudspeakers and not to forget about household noise such as television and music system sounds on daily basis are inevitable. In our country it's a major perception that happiness can only be expressed by creating loud noises.

Exposure to high levels of noise may cause permanent hearing loss. The repeated exposures to loud noise can lead to permanent tinnitus and/or hearing loss. Furthermore, it may create physical and psychological stress, reduce productivity, and interfere with communication and concentration. The effects of noise induced hearing loss can be profound, limiting your ability to hear high frequency sounds, understand speech, and seriously impairing your ability to communicate.

Table No. 7: Health Hazards of Noise on the Human Body

Sr. No.	Noise Levels in dB	Health Hazards
1	80	Annoying
2	90	Hearing Damage
3	95	Very Annoying
4	110	Stimulation of Skin
5	120	Pain Threshold
6	130 – 135	Dizziness, Vomiting
7	140	Pain in Ear
8	150	Significant change in Heart Pulse

Site Location

AISSMS society, Kennedy Road Campus comprises schools and private college affiliated to Savitribai Phule Pune University is located in Pune, Maharashtra. Entire campus is spread over the 11 acres of land and it is situated adjacent to the Pune Railway Station

and Shivajinagar RTO office which is influenced by the constant traffic inflow. Recent, Pune Metro Development works is underway parallel to the college boundary.

Image No.01: Noise Monitoring Locations

Table No. 8: Noise Monitoring Locations

Sr. No.	Location	Distance from the Kennedy Road boundary walls in meters
1	**Main Gate**	10
2	**Parking Facing Kennedy Road**	10
3	**Back Gate Near Canteen**	10
4	**Near Primary School**	10
5	**Near Sudarshan Chemicals Compound**	100
6	**Compound Corner Near Biomedical Waste Plant Entrance**	150
7	**Horse Stable**	100
8	**Animal House Gate**	150
9	**CoE Podium**	100

10	**IOIT Classroom 213**	150
11	**IOIT Right Side Entrance**	150
12	**IOIT Admin Office**	150

Noise monitoring methodology adopted for present study

1. The station was located at the ambient level i.e. away from the direct source, away from any vibration and any obstruction.

2. The area with land use pattern is in commercial zone of Development Plan of Pune city.

Monitoring time

Daytime monitoring method was adopted for this location as the it comes under Silent zone and is located in development and commercial zone where daytime working hours are being observed.

Monitoring Methodology:

The following criteria will be observed when undertaking the noise monitoring directed by Central Pollution Control Board, Delhi.

a) During ambient noise monitoring sound comes from more than one direction, it is important to choose a microphone and mounting which gives the best possible Omni directional characteristics.

b) The noise measurement equipment was supervised continuously during the monitoring period and notes will be made of the date, time and prevailing weather conditions.

c) Immediately prior to and following each noise measurement session the accuracy of the noise level meter was checked using an acoustic calibrator generating a known sound pressure level at a known frequency.

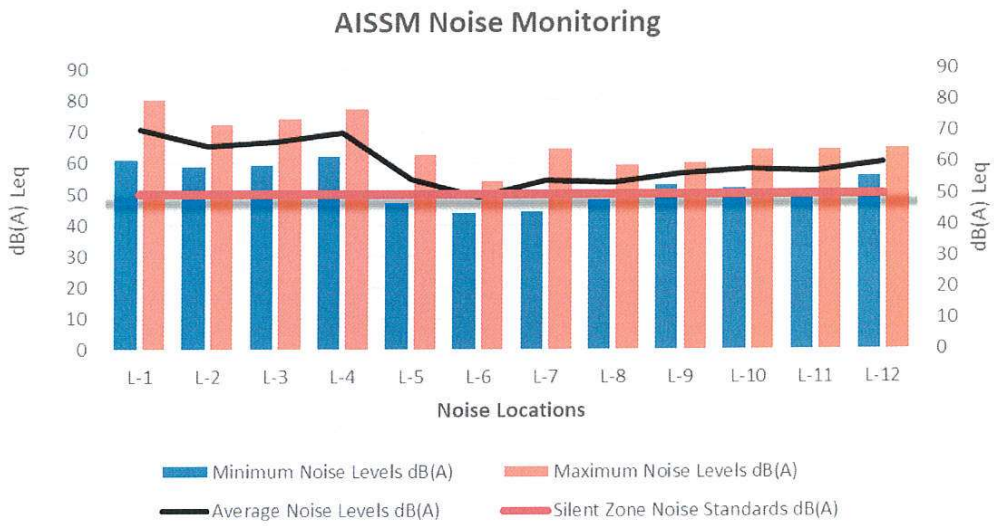
d) Noise measurements should not have been done during fog and rains.

Table No. 9: Ambient Air Quality Standards in respect of Noise

Area Code	**Category of Area / Zone**	**Limits in dB (A) Leq**	
		Day Time	**Night Time**
A	Industrial	75	70
B	Commercial	65	55
C	Residential	55	45
D	Silent	50	40

Table No. 10: Noise Monitoring Results

Sr. No.	Location	Minimum Noise Levels dB (A)	Maximum Noise Levels dB (A)	Average Noise Levels dB(A)	Ambient Air Quality Standards in respect of Noise dB (A), in accordance with Noise Pollution (Regulation and Control) amendment rules, 2000 Silent Zone
1	Main Gate	60.9	80.3	**70.6**	**50**
2	Parking Facing Kennedy Road	58.7	72.3	**65.5**	**50**
3	Back Gate Near Canteen	59.4	74.2	**66.8**	**50**
4	Near Primary School	62.0	77.3	**69.65**	**50**
5	Near Sudarshan Chemicals Compound	47.0	62.7	**54.85**	**50**
6	Compound Corner Near Biomedical Waste Plant Entrance	44.0	54.1	**49.05**	**50**
7	Horse Stable	44.4	64.6	**54.5**	**50**
8	Animal House Gate	48.3	59.4	**53.85**	**50**
9	CoE Podium	52.7	60.1	**56.4**	**50**
10	IOIT Classroom 213	51.6	64.1	**57.85**	**50**
11	IOIT Right Side Entrance	50.3	64.3	**57.3**	**50**
12	IOIT Admin Office	55.6	64.7	**60.15**	**50**



All the locations of the premises are exceeding noise levels from the prescribed permissible limits for Silent zone. As the study location is situated near the main road, the continuous flow of traffic and ongoing Pune Metro Development project activities has contributed significantly towards higher noise levels in these locations.

However, the average noise levels at the location 6 (Compound Corner near Biomedical Waste Plant Entrance) are marginally within the limits as this location is away from the noise sources viz. road traffic and metro construction site. As well as this location is at the rear side of campus.

From the above results, it is clear that the equivalent day noise level at the AISSMS Society Kennedy Road Campus are above the prescribed limit of noise pollution rules 2000 except location 6.

4.3 Plant diversity:

Various man-made activities have wide range of impacts on the surrounding ecosphere, both negative and positive. AISSMS campus (Kennedy rd.) expresses its commitment to sustainability in many ways. The college undertakes various activities like plantation and beautification of campus through National Service Scheme (NSS). The campus has good plantations along with well-maintained medicinal plants' garden; and landscaping. It's a

positive step to reduce its environmental impact. This section provides a detailed list of plant species observed within the campus.

The college attempts to maintain ecofriendly atmosphere on the campus; and number and variety of plant species helps to maintain eco-friendly ambience. Further, to create eco-friendly awareness among the students, college arranges special programs through which the students get clear idea and importance of trees in life. In all 99 perennial plant species have been listed (Table 11); whereas total numbers of small trees were 176; medium sized – 114; and large 160 trees. This shows a significant increase than that of previous plant diversity assessment in 2015 (57 perennial plant species with a total number of 75 small trees were; 37 medium sized and 89 large trees). The biodegradable waste was utilized for composting.

The trees like *Polyalthea longifolia, Peltophorum pterocarpum, Pithecelobium dulce, Azadirachta indica,* and *Delonix regia* were most abundant; whereas few species like *Adenanthera pavonia, Butea monosperma, Cassia fistula,* and *Semecarpus anacardium* are very few. Though, the college campus represents good plant diversity, there is large scope to plant more trees. We have reported major threat to plants along the main road. This was due the road expansion for Metro in Pune city. Along the vicinity of main road high to very high traffic was noticed.

Table No. 11: List of Plant species planted in the campus

Botanical Name	Local Name	Habit	Family	Size and Number		
				L	M	S
Acacia auriculiformis	Australian acacia	Tree	Mimosaceae	1	0	0
Acacia nilotica	Babhul	Tree	Mimosacae	3	0	0
Adenanthera pavonina	Red Bead Tree	Tree	Mimosaceae	1	0	0
Aegle marmelos	Bel	Tree	Rutaceae	0	0	1
Albizia saman	Rain tree	Tree	Mimosaceae	3	1	2
Alpinia galangal	Alpinia	Herb	Zingiberaceae	0	0	1
Alstonia scholaris	Saptaparni	Tree	Apocynaceae	0	0	8

Annona squamosa	Sitaphal	Shrub	Annonaceae	0	0	9
Araucaria columnaris	Christmas tree	Tree	Araucariaceae	1	0	0
Areca catechu	Areca nut	Palm	Arecaceae	0	2	0
Asparagus racemosus	Shatawari	Climber	Asparagaceae	0	0	4
Azadirachta indica	Neem	Tree	Meliaceae	15	2	4
Bauhinia racemosa	Aapata	Tree	Caesalpiniaceae	0	1	0
Bauhinia variegate	Kanchan	Tree	Caesalpiniaceae	0	0	2
Bixa Orellana	Shendri	Tree	Bixaceae	0	1	1
Broussonetia papyrifera	Paper mulberry	Tree	Moraceae	1	3	1
Butea monosperma	Palas	Tree	Fabaceae	1	0	0
Callistemon lanceolatus	Bottle brush	Tree	Myrtaceae	0	1	0
Canna indica	Canna	Herb	Cannaceae	0	0	2
Cardamomum sp	Veldode	Herb	Zingiberaceae	0	0	1
Carica papaya	Papai	Shrub	Caricaceae	2	0	1
Cassia fistula	Amaltash	Tree	Caesalpiniaceae	0	2	3
Cassia grandis	Coral Shower Tree	Tree	Caesalpiniaceae	4	1	0
Cassia siamea	Kasod	Tree	Caesalpiniaceae	3	2	1
Ceiba pentandra	Kapok	Tree	Malvaceae	3	0	1
Citrus lemon	Limbu	Shrub	Rutaceae	0	1	0
Clematis gauriana	Morvel	Climber	Ranunculaceae	0	0	1
Cocos nucifera	Coconut	Palm	Arecaceae	10	2	1
Codiaeum variegatum	Croton	Shrub	Euphorbiaceae	0	0	15
Combretum indicum	Rangoon Creeper	Climber	Combretaceae	0	1	0
Costus igneus	Insuline plant	Herb	Costaceae	0	0	1
Couroupita guianensis	Cannon ball tree	Tree	Lecythidaceae	2	0	0
Crataeva nurvala	Varun	Tree	Capparaceae	0	1	0

Crinum asiaticum	Bhuishirid	Herb	Liliaceae	0	0	5
Cymbopogon citratus	Gavati-chaha	Herb	Poaceae	0	0	4
Delonix regia	Gulmohor	Tree	Caesalpiniaceae	12	5	2
Dracena compacta	Dracena	Shrub	Agavaceae	0	0	5
Duranta erecta	Duranta	Shrub	Verbanaceae	0	0	10
Dypsis leutescens	Cane palm	Palm	Arecaceae	0	8	0
Emblica officinalis	Awla	Tree	Euphorbiaceae	2	2	0
Erythrina indica	Pangara	Tree	Fabaceae	1	0	0
Ficus benghalensis	Wad	Tree	Moraceae	4	1	1
Ficus benjamina	Ficus	Tree	Moraceae	0	1	6
Ficus elastic	Rubber tree	Tree	Moraceae	2	0	1
Ficus racemosa	Umbar	Tree	Moraceae	3	1	1
Ficus religiosa	Pimpal	Tree	Moraceae	0	1	1
Filicium decipiens	Filicium	Tree	Sapindaceae	0	1	0
Gliricidia sepium	Giripushpa	Tree	Fabaceae	2	1	0
Grevillea robusta	Silver Oak	Tree	Proteaceae	0	0	3
Helicteris isora	Murudsheng	Shrub	Sterculiaceae	0	1	0
Hibiscus rosa-sinensis	Jaswand	Shrub	Malvaceae	0	0	1
Ixora coccinea	Ixora	Shrub	Rubiaceae	0	0	4
Jacaranda mimosifolia	Nilmohor	Tree	Bignoniaceae	2	0	0
Jasminum auriculatum	Jui	Climber	Oleaceae	0	0	2
Jasminum grandiflorum	Jai	Climber	Oleaceae	0	0	2
Jatropha integerrima	Jatropha	Shrub	Euphorbiaceae	0	0	10
Justicia adatoda	Adulsa	Shrub	Acanthaceae	0	0	3
Lagerstroemia speciosa	Taman	Tree	Lythraceae	0	4	3
Leucaena latisiliqua	Subabhul	Tree	Mimosaceae	6	4	4
Mangifera indica	Mango	Tree	Anacardiaceae	3	4	4
Michelia champaka	Sonchapha	Tree	Magnoliaceae	0	0	1
Millingtonia hortensis	Buch	Tree	Bignoniaceae	1	1	0
Neolamarkia	Kadamb	Tree	Rubiaceae	1	0	0

cadamba						
Nyctanthes arbor-tristis	Prajakt	Tree	Oleacaeae	0	1	0
Pandanus odorifer	Kewada	Shrub	Pandanaceae	0	0	1
Passiflora caerulea	Krishnakamal	Climber	Passifloraceae	0	0	2
Peltophorum pterocarpum	Sonmohor	Tree	Caesalpiniaceae	8	5	2
Pimenta dioica	All spice	Tree	Myrtaceae	1	0	0
Pithecellobium dulce	Madras Thorn	Tree	Mimosaceae	8	13	1
Pithecelobium saman	Rain tree	Tree	Mimosaceae	9	1	1
Plumeria alba	Pandhra Chapha	Tree	Apocynaceae	0	3	0
Plumeria filifolia	White chapha	Shrub	Apocynaceae	1	1	3
Plumeria obtuse	White chapha	Tree	Apocynaceae	0	2	5
Plumeria pudica	Wild plumeria	Shrub	Apocynaceae	0	0	4
Plumeria rubra	Red chapha	Tree	Apocynaceae	0	4	3
Polyalthia longifolia	Ashok-Khota	Tree	Annonaceae	21	6	0
Pongamea pinnata	Karanj	Tree	Fabaceae	0	3	1
Pseudocalymma alliaceum	Lasunvel	Climber	Bignoniaceae	0	0	1
Psidium guajava	Guava	Shrub	Myrtaceae	0	2	1
Punica granatum	Pomegranate	Shrub	Punicaceae	0	0	1
Ricinus communis	Erand	Shrub	Euphorbiaceae	0	0	1
Rosa indica	Rose	Shrub	Rosaceae	0	0	1
Roystonia regia	Bottle palm	Tree	Arecaceae	13	1	0
Santalum albam	Sandalwood	Tree	Santalaceae	0	4	2
Sapindus laurifolius	Ritha	Tree	Sapindaceae	0	1	0
Saraca asoca	Sitecha Ashok	Tree	Caesalpiniaceae	1	1	1
Semecarpus anacardium	Bibba	Tree	Anacardiaceae	1	0	0
Sesbania grandiflora	Hadga	Shrub	Fabaceae	0	3	2
Syzygium aromaticum	Lavang	Tree	Myrtaceae	0	1	0

Syzygium cumini	Jambhul	Tree	Myrtaceae	1	4	2
Tabebuia rosea	Tabebuia	Tree	Bignoniaceae	1	0	0
Tamarindus indica	Chinch	Tree	Caesalpiniaceae	1	0	5
Terminalia arjuna	Arjun	Tree	Combretaceae	1	0	0
Terminalia bellirica	Beheda	Tree	Combretaceae	1	0	0
Terminalia catappa	Jangli Badam	Tree	Combretaceae	1	1	0
Terminalia muelleri	Australian Almond	Tree	Combretaceae	1	0	0
Thespecia populnea	Bhend	Tree	Malvaceae	0	1	1
Vetiveria zizanioides	Wala	Herb	Poaceae	0	0	2
Ziziphus mauritiana	Bor	Tree	Rhamnaceae	1	0	0
			TOTAL=	**160**	**114**	**176**

Legend: L: Large; M: Medium; S: Small

4.4 Waste Management

The committee constituted by the Union Ministry of Urban Development (1998 -2000) had reported that "Solid Waste Management has been one of the neglected areas of urban management activities in India. By and large, in cities and towns; hardly 50% of the solid waste generated is collected, transported and disposed off, giving rise to insanitary conditions and diseases, especially amongst the urban poor who constitute about 35% of the urban population." Even after 20 years of this report, the solid waste management systems in India are still the same with minor improvisations.

World Health Organization (WHO) has observed that 22 types of diseases can be prevented/ controlled in India by improving Municipal Solid Waste Management (MSWM) system. The Planning Commission Task Force (2014) identifies that "principal reasons for the prevailing unhygienic conditions in our cities is the casual attitude of the citizens as well as the municipal authorities towards managing solid waste, lack of priority to this essential service, inadequate and inappropriate institutional structure, lack of technical knowhow and paucity of financial resources".

Due to Covid 19 outbreak most of the campus activities were closed and therefore waste quantity data is on lower side. All the waste quantity data was taken from the campus institutes and the observations are made based on the information made available.

Domestic Waste data

- Common Canteen = 0 kg/day total (mixed)
- Extended Canteen – IoIT = 0 kg/day total (mixed)
- Primary school = 10 kg wet, 15 kg dry
- Common Garbage (entire campus) = 45 kg (mixed)

Observations:

- Separate bins are provided for the common garbage on the campus.
- The waste is handed over to the PMC workers.
- E-Waste and Battery waste is segregated and handed over to MPCB authorised dealer or recycler.
- There is no separate mechanism of treatment and disposal of chemical waste (liquid and solid)
- Metallic waste is handed over to the vendor.
- Paper waste is in large quantities and is measured once in three years. Part of the paper waste is reused for day-to-day printing and other activities.

Table No. 12: E Waste Generation

		Institute Name							
Sr. No.	Type of Waste	IOIT	Pharmacy	Engineering	Polytechnic	Institute of Management	Day school	Primary school	Total
1	CPUs	26	13	20	24	10	2	0	95
2	Monitors	11	13	21	26	10	2	0	83
3	Printers	21	0	3	1	1	0	0	26
4	Stabilisers	0	0	0	0	0	0	0	0
5	Photocopy Machines	0	0	0	0	0	0	0	0
6	Keyboards	9	7	22	18	10	2	0	68
7	Mouse	9	7	19	13	20	2	0	70
8	LCD	4	2	0	0	1	0	0	7
9	Water Purifier	0	3	0	0	0	0	0	3
10	CRO	3	0	0	0	0	0	0	3
11	Digital Multimeter	2	0	0	0	0	0	0	2
12	Other	1	0	0	0	0	4	0	5
13	Duel Power Supply	1	0	0	0	0	0	0	1
14	Trainer Kit	1	0	0	0	0	0	0	1
15	Differentiators	1	0	0	0	0	0	0	1
16	Precision Rectifier	1	0	0	0	0	0	0	1

	SWR								
17	8085 Cable and Connector	2	0	0	0	0	0	0	2
18	Variac Single Phase	1	0	0	0	0	0	0	1
19	Interphase Card	1	0	0	0	0	0	0	1
20	SERVER	2	0	0	0	0	0	0	2

Legend: DNA: Data not available

Table No. 13: Battery and other related Waste Generation

		Institute Name							
Sr. No.	**Type of Waste / (nos.)**	**IOIT**	**Pharmacy**	**Engineering**	**Polytechnic**	**Institute of Management**	**Day school**	**Primary school**	**Total**
1	Batteries	126	1	0	36	0	32	0	195
2	Inverters	0	0	0	0	0	0	0	0
3	UPS	3	7	0	0	0	0	0	10
4	Transformers	0	0	0	0	0	0	0	0

Table No. 14: Paper and other related waste generation

Sr. No.	Type of Waste (in kg)/ annum	Institute Name							
		IOIT	Pharmacy	Engineering	Polytechnic	Institute of Management	Day school	Primary school	Total
1	Paper	10	0	500	DNA	15	20	50	595
2	Journals	460	0	500	DNA	0	10	0	970
3	Files	5	0	200	DNA	0	2	10	217
4	Notebooks	5	0	0	DNA	0	4	0	9
5	Books	0	0	0	DNA	0	4	10	14
6	Answer sheets	0	0	0	DNA	5	40	100	145
7	Forms	0	0	0	DNA	0	6	0	6
8	Magazines	0	0	0	DNA	0	4	20	24
9	News papers	0	0	1000	DNA	200	20	0	1220

Legend: DNA: Data not available

4.5 Air Environment

Air pollution has also become a critical issues India. Most of the urban conglomerations in India are highly polluted with recent case of Delhi air pollution. A survey in 2020, suggests that 22 of the 30 cities India have high air pollution with high doses of $PM_{2.5}$.

The air pollution is mainly caused by vehicle emissions, fuel, Industrial activities and coal fired power plants. The WHO further suggests that the vast majority of Indians breathe unsafe air. Air pollution causes asthma which is now soaring, even amongst the children. $PM_{2.5}$ contributes to cancer and it kills by triggering heart attacks and strokes.

The locations for air quality sampling were chosen based on their proximity to various man made activities such as waste management plant, traffic, etc. The sampling was undertaken for 8 hours.

Image No.02: Ambient Air Quality Monitoring Locations

Observations

- The campus adjoins one of the busy road networks in Pune as well as has close proximity to the Rail station, Biomedical waste treatment plant, a cremation centre, Waste Water treatment plant and a chemical industrial unit e.g. Sudarshan Chemicals.
- The campus population (student, staff and others) is very high, which would bring in large number of vehicles (including two wheelers and four wheelers) which also contribute to air pollution.
- Table no. 15 shows air pollution levels are at different locations within the campus. This sampling was carried out on different dates through two weeks' time.
- The observations show low levels of PM_{10} within the campus during day time.

Table No. 15: Ambient Air Quality Observations

Sr. No.	Description	Unit	Near IOIT (1)	Near College of Pharmacy (2)	Near Day School (3)	NAAQ Standards	Standard Method
01	Sulphur Dioxide (SO_2)	$\mu g/M^3$	19.1	21.3	22.7	≤ 80	IS 5182 (Part 2): 2001
02	Oxides of Nitrogen (NO_2)	$\mu g/M^3$	28.5	30.6	31.8	≤ 80	IS 5182 (Part 6): 2006
03	Particulate Matter PM_{10}	$\mu g/M^3$	55.4	57.2	61.7	≤ 100	IS 5182 (Part 23): 2006

Legend: NAAQ standard - National Ambient Air Quality standard.

4.6 Solar Energy

Solar power is energy from the sun that is converted into thermal or electrical energy. Solar energy is the cleanest and most abundant renewable energy source available, and the U.S. has some of the richest solar resources in the world. Solar technologies can harness this energy for a variety of uses, including generating electricity, providing light or a comfortable interior environment, and heating water for domestic, commercial, or industrial use.

4.6.1 Solar Technologies

There are three main ways to harness solar energy: photovoltaic, solar heating and cooling, and concentrating solar power. Photovoltaic generates electricity directly from sunlight via an electronic process and can be used to power anything from small electronics such as calculators and road signs up to homes and large commercial businesses.

4.6.2 Solar power at AISSMS

Currently, due to Covid 19 outbreak the campus doesn't host students and the faculty in full strength. It is reported that about 50,000 units used in month, about 60% of the units are generated via Photovoltaics which is substantial. It is suggested to continue to use photovoltaics and add to the capacity once the student and faculty strength returns to full as the energy consumption will sharply rise.

Table No. 16: Photovoltaic capacity

Institute	No of Panels	Total Capacity	Total Solar Power Generated (units/month)	Total Electricity Used (units/month)
COE	472	150 KW	30000	50000
COP	50	50 KW		
IOIT	320	100 KW		

5. Recommendations

5.1 Water Environment

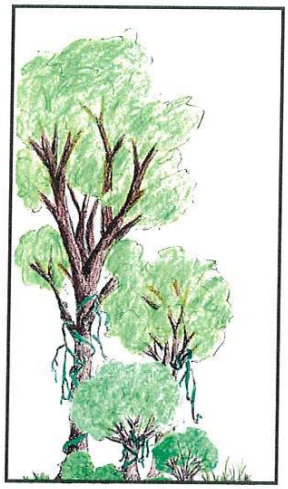
1. The campus buildings have high potential for the Rain Water Harvesting (RWH) due to large terrace areas as well as the open surfaces (paved and unpaved areas).
2. The campus already has started RWH in terms of the ground water recharge scheme which can further be boosted by storing rain water (only from roof top areas). This would satisfy part requirement of the campus in the monsoon season (i.e. about 80 – 90 days in a year) and thus reducing fresh water intake during rainy days.
3. It is recommended to install water efficient faucets and flushing systems across the campus which would reduce the fresh water requirement of the campus.

4. Even though all the drain lines of the campus are connected to the common sewer line, it is suggested that if the management is looking forward to overall environmental sustainability then an Effluent Treatment Plant (ETP) may be installed. This would treat and recycle the waste water within the campus and this treated waste water can further be used either for flushing or landscaping, thus further reducing fresh water requirement of the campus by 50 – 60 % of the total.
5. In order to use the treated waste water for flushing a separate plumbing system is required.
6. It is recommended that liquid chemical waste from the laboratories should not be disposed without treatment.

5.2 Noise Environment

1. In order to make campus friendly for educational purposes, the noise levels need to be reduced as directed by Noise Pollution (Regulation and Control) amendment rules, 2000 and certain disciplinary measures need to be taken.
2. It is observed that due to the close proximity of the campus to the main road, rail station and other industrial, commercial activities, the noise levels are high. It ranges from 47 dB(A) – 80.3 dB(A) which at time is 30.3 dB(A) over the stipulated standard. This would mean students are getting exposed to high noise pollution levels within the campus due to either internal activities or external activities. This would create hurdle in learning and their overall health.
3. It is recommended that the campus to have noise barriers along the fence line either in terms of natural barriers such as trees or artificial barriers such as acoustic fence. A combination of both can also be used at appropriate locations.

Image No. 03: Types of noise barriers



Biological noise barrier - trees

Acoustic Fence

4. It is recommended that parking lots within the campus to be made strictly as no honking zones and vehicles with unwarranted vehicle silencers (mufflers) not be allowed.

5.3 Plant diversity

For maintaining the college campus green and eco-friendly, more trees need to be planted. A thick green belt (of *Ficus benjamina*) development along the fence is strongly recommended. The plant diversity shall be maintained by avoiding the plantation of exotic plant species. A tree monitoring committee shall be established, if not at present. The college authorities should ensure frequent meetings with the tree monitoring committee.

Carbon dioxide neutrality can be maintained on the campus by developing more greenery. The plant species that are found suitable are suggested for plantation and greenbelt development. In addition to above some flowering plants, shrubs, herbs, and climber plants species will also be planted for beautification in the campus.

Criteria for selection of tree species:

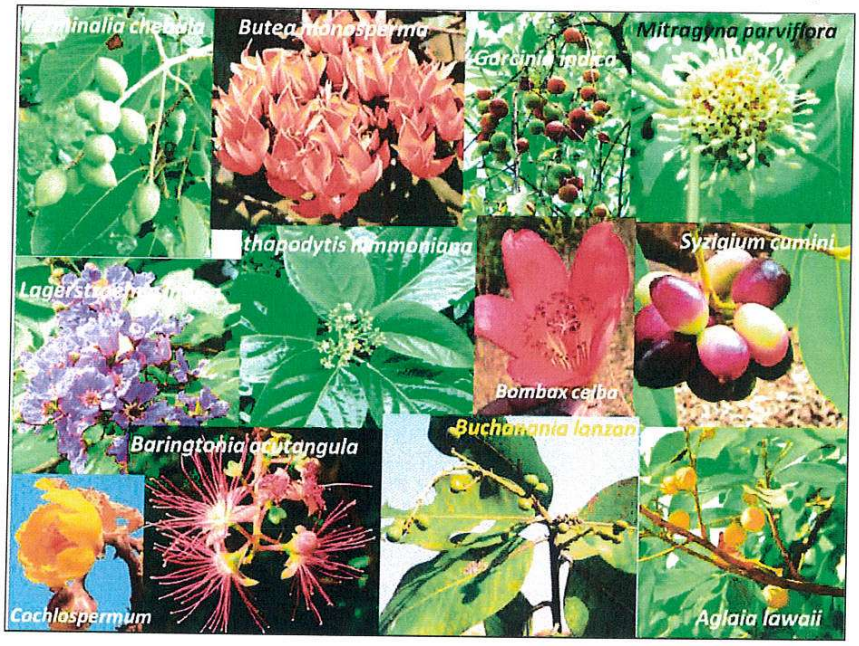
The choice of species is based on the adaptability to the site, early returns, multiple uses, complimentary role to the system and its possible role during the lean/critical periods. The key factor contributing to the success of tree planting is selection of suitable tree species. Some of the considerations for selection of tree species are:

- Adaptation to local soil and agro-climate condition.
- Drought resistant species that can survive long dry periods.
- Multipurpose use species.
- Species that can serve for soil and water conservation.
- Species that help in building up soil fertility.
- Species that have good coppicing ability.

For the purpose of landscaping, following eight categories are being considered.

1. Avenues – Trees to shade roads or create avenues within property.
2. Parking - Shade giving trees for open parking lots.
3. Ornamentals – the purpose indicates:
    a. Thicket – To be grown in groups to form a thick vegetated corner, centre or pocket.
    b. Isolation - To be planted singly either in corners or as central attraction.
    c. Scattered - To be planted at random to be able to appreciate its ornamental nature.
    d. Groups – To be grown in groups of 3 to 4.
4. Hedges/Edges/Screens. –
    a. Hedges for property hedges, for demarcating areas etc.
    b. Edges for edging of small flower patches, for setting boundaries, for layering etc.
    c. Screens - Provide privacy, as screens from pollution from adjoining road or to provide shadow from south sun.
5. Ground covers – These include native lawn varieties and plant species that spread laterally and can be used to cover soil below trees etc.
6. Temple plants – Trees normally associated with religious areas.
7. Climbers – Plants that can be used for forming trellis, etc.
8. Aquatic plants – For ponds or water bodies. Some of these plants need to be maintained by regular pruning to prevent excessive growth.

Image No. 04: The native plant species suggested for plantation in the college campus.



The plant species suggested for green belt development in addition to the present one-layer vegetation boundary will also helpful for mitigating gases and particulate matter as also to act as reducing noise from the heavy traffic road close to the campus will serve for long time.

Table No. 17 – List of suggested plants

Botanical Name	Local Name	Family	Habit	Flower Color
First Row-trees (outermost)				
Ficus benjamina		Moraceae	Tree	Yellow pale
Drypetes roxburghii	Putranjiva	Euphorbiaceae	Tree	Greenish Yellow
Holoptelea integrifolia	Wavli	Ulmaceae	Tree	Greenish
Tamarindus indica	Chinch	Caesalpiniaceae	Tree	Yellowish pink
Terminalia bellirica	Beheda	Combrataceae	Tree	White
Terminalia chebula	Hirda	Combrataceae	Tree	White
Terminalia cuneata	Arjun	Combrataceae	Tree	Yellow
Terminalia paniculata	Kinjal	Combrataceae	Tree	Greenish-white
Terminalia tomentosa	Ain	Combrataceae	Tree	White

Botanical Name	Local Name	Family	Habit	Flower Color
Alstonia scholaris	Satvin	Apocynaceae	Tree	White greenish
Bambusa arundinacea	Bamboo	Poaceae	Bamboo	White, greenish
Dendrocalamus strictus	Velu	Poaceae	Bamboo	Blackish
Cordia dichotoma	Bhokar	Boraginaceae	Tree	White
Dalbergia latifolia	Shisam	Fabaceae	Tree	White
Diospyros peregrine	Tembhurni	Ebenaceae	Tree	White creamy
Garcinia indica	Kokam	Clusiaceae	Tree	Yellowish
Haldina cordifolia	Hedu	Rubiaceae	Tree	Red yellowish
Shrub Layer				
Gardenia gummifera	Dikemali	Rubiaceae	Shrub	White
Ixora coccinea	Bakara	Rubiaceae	Shrub	Orange / Red
Ixora nigricans	Kat-kuda	Rubiaceae	Shrub	White
Justicia adhatoda	Adulsa	Acanthaceae	Shrub	White
Helicteres isora	Murudseng	Sterculiaceae	Shrub	Red bright
Murraya koenigii	Kadhipatta	Rutaceae	Shrub	Greenish White
Murraya paniculata	Kunti	Rutaceae	Shrub	White
Hiptage benghalensis	Madhvilata	Malpighianceae	Climber	White
Ehretia laevis	Ajan	Ehratiaceae	Tree	White
Vitex negundo	Nirgudi	Verbenaceae	Shrub	Bluish - Purple
Woodfordia fruticosa	Dhyati	Lythraceae	Shrub	Red
Gardenia resinifera	Dikemali	Rubiaceae	Shrub	White
Cassia auriculata	Tarwad	Caesalpiniaceae	Shrub	Yellow
Second Row (from outside)				
Artocarpus heterophyllus	Phanas	Moraceae	Tree	Green
Azadirachta indica	Neem	Meliaceae	Tree	White
Bauhinia recemosa	Apta	Caesalpiniaceae	Tree	White
Butea monosperma	Palas	Fabaceae	Tree	Orange-red
Lagerstroemia microcarpa	Nana-bondara	Lythraceae	Tree	White
Lagerstroemia reginae	Taman	Lythraceae	Tree	Pink
Kydia calycina	Warung	Malvaceae	Tree	White
Mangifera india	Amba	Anacardiaceae	Tree	Green

Botanical Name	Local Name	Family	Habit	Flower Color
Along the paths				
Caryota urens	Bherali mad	Arecaceae	Tree	Red and green
Casssia fistula	Bava	Caesalpiniaceae	Tree	Yellow
Mammea surgia	Surungi	Clusiaceae	Tree	White
Phoenix sylvestris	Shindi	Arecaceae	Tree	White
Nyctanthes arbor- tristis	Parijatak	Oleaceae	Tree	White
Other Suggested Plants				
Madhuca latifolia	Moha	Sapotaceae	Tree	White
Mallotus philippensis	Kumkum	Euphorbiaceae	Tree	Yellow
Manilkara hexandra	Khirni	Sapotaceae	Tree	White
Memecylon umbellatum	Anjani	Melastamaceae	Tree	Bluish - Purple
Michelia champaca	Sonchafa	Magnoliaceae	Tree	Yellow
Mimusops elengi	Bakul	Sapotaceae	Tree	White
Mitragyna parvifolia	Kadam	Rubiaceae	Tree	Red yellow
Morinda pubescens	Bartondi	Rubiaceae	Tree	White
Neolamarckia cadamba	Kadamb	Rubiaceae	Tree	White creamy
Pandanus odoratissimus	Kewada	Pandanceae	Tree	Yellow golden
Pongamia pinnata	Karanj	Fabaceae	Tree	Pinkish white
Santalum album	Chandan	Santalaceae	Tree	Brownish red
Sapindus laurifolius	Ritha	Sapindaceae	Tree	White
Semecarpus anacardium	Bibba	Anacardiaceae	Tree	Greenish white
Syzygium cumini	Jambhul	Myrtaceae	Tree	White
Thespesia populnea	ParasBhendi	Malvaceae	Tree	Yellow
Trema orientalis	Gol	Ulmaceae	Tree	White cremy

5.4 Waste Management

1. It is found that in the buildings the wet garbage is not segregated from the dry garbage and it is collectively handed over to the corporation, it is recommended that the wet garbage to be segregated appropriately which further can be processed and treated within the campus either by using vermicomposting or biomethanation process. The fertilizer from either of the methods can further be used as manure for the landscaping within the campus. If the biomethanation is to be used to treat the

wet garbage, the biogas generated from the process can be used for the canteen either for common canteen / IOM / IOIT extended canteen.

2. Chemical waste (solid/semisolid) from the laboratories not to be disposed in municipal solid waste. Based on the physico-chemical properties of the waste, it should be handed over to the MPCB authorised chemical/ hazardous waste management facility only.
3. High quantity of the paper waste is observed in the campus. Hence recycled paper to be used for day to day printing and other activities.

5.5 Air Environment

1. It is recommended that only Pollution Under Control (PUC) Certificate holding vehicles to be allowed in the campus.
2. Trees tolerant to air pollution to be planted along the fence line.
3. Possible air pollution (mainly of PM_{10} and $PM_{2.5}$) may be occurring due to the biomedical waste treatment plant and / cremation centre to the north of the campus. It is suggested that a detailed air pollution study with respect to the biomedical waste treatment plant and / cremation centre and the institute campus to be carried out to identify the exact source of the air pollution and appropriate measures to be taken.

5.6 Safety Aspects

1. Teaching and non-teaching staff to be trained for emergency situations.
2. Emergency exits to be established for the spaces including laboratories.
3. Fire extinguishers, sprinklers to be placed as per fire safety rules at appropriate locations.
4. Periodic mock drills to be conducted.
5. Personal Protective Equipment (PPE) to be used at locations including chemistry laboratories to avoid any accident.
6. Parking safety to be followed.
7. Special safety features to be followed at Day School and Primary School.

6. Audit and Reporting Team

Sr. No.	Name	Education
1	Dr. Venkat Gunale	M.Sc., Ph. D. (Ecology)
2	Dr. D. M. Mahajan	M.Sc., Ph. D. (Plant Diversity and Ecology)
3	Dr. Rohit Bhagwat	M.Sc., MESPOM, Ph. D. (Solid Waste Management, Water Management)
4	Dr. Sanjay Kale	M. Sc., Ph. D. (Waste Water Management)
5	Mr. Pawan Soyam	M. Sc. (Ph. D. student) (Ambient Air Quality Monitoring, Noise Monitoring)
6	Mr. Sandip Nivdange (Project coordinator and Audit Reporting)	M. Sc. (Ph. D. student) (Ambient Air Quality Monitoring)

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AISSMS GROUP OF COLLEGES – KENNEDY ROAD CAMPUS, PUNE

ENERGY AUDIT REPORT

AUDITED BY

Mr. UPENDRA DEUSKAR

BEE CERTIFIED ENERGY AUDITOR

513/E, RUIKAR TRUST BUILDING , NEAR ST STAND,

DABHOLKAR CORNER, KOLHAPUR.

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Date- 22nd Decemer,2022

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i. Acknowledgement

We, Upendra Deuskar & Associates are grateful to Mr. Malojiraje Chhatrapati Hon. Secretary of AISSMS Group, Shivajinagar Pune for giving us an opportunity to contribute in their efforts towards efficient energy management by undertaking this Energy Audit exercise.

We acknowledge with thanks for the co-operation and support extended by management and operating personnel from client side during the audit exercise. Detailed discussions and interaction were held with plant personnel throughout the course of the audit and awareness of energy conservation was noted as exemplary. We would also like to place on record our sincere thanks and appreciation for all plant executives.

We are also thankful to the other staff members who were actively involved while collecting the data and conducting the field studies. We take this opportunity to also thank all the team members at various departments associated with this study of energy audit for extending co-operation during collection of on-site data.

We trust that the findings of this study will help plant management in improving the equipment performance thereby giving optimum energy consumption at the premise.

ii. Energy Audit Team

Upendra Deuskar &	Mr. Upendra G. Deuskar (BEE Certified Energy Auditor)
Associates	Mr. Sunny Pangire
AISSMS Group	Mr. Sachin S. Kulkarni-Chief Executive Officer
	Mr. Shivaji Patil-Project Manager

Date of Measurement 15th Nov, 2022

iii. Instruments

1. Power Quality Analyzer
2. Ultrasonic Flow meter
3. Thermal Imager
4. Temperature – RH logger
5. Lux Meter
6. Power Clamp Meter
7. Measuring Tape

iv. Executive Summary

AISSMS group of colleges (Client) has decided to do detailed energy audit of their premise at Kennedy Road (Near RTO), Pune, Maharashtra. Client has already implemented most of energy efficiency measure into their premises. Client is focusing on energy savings and successful in reducing their energy demand.

Following are some energy saving and sustainability approach driven measures that are taken by college management.

1. Replacement of fluorescent lights with energy efficient LED lights.
2. Selection of Energy Efficient Equipment's (BEE 5 Star Labeled) whenever replacement of any equipment is to be done.
3. College is also maintaining energy consumption records of each section to track energy consumption of the premise.
4. Use of Solar energy for water heating purpose instead of electric geysers.
5. Use of Solar Photovoltaic system to generate own electricity using rooftop area available at the premise.

The action taken for energy conservation measures and use of renewable energy by the college management shows the sustainable approach towards energy use and environment friendly behaviour which is appreciable.

Other energy saving measures & cost saving measures

Although the college management is doing well in energy efficiency area further improvements can be done by the management for additional savings-

1. Use of aerators for water taps.
2. Use of heat pumps wherever possible in college premises for cooling and heating.
3. Fine tuning of Automatic Power Factor Correction system to improve PF to unity & reduce billing units in kVAh billing system.

1 Introduction

1.1 General Description of Facility

AISSMS Group of Colleges (Client) is located at Kennedy Road in Pune city area, Pune District of Maharashtra, India. The institutes are committed towards creating a community which is vibrant and which provides a lifelong learning experience and professional development, corporates, academicians, industrialists and the student community have lauded the efforts made by the All India Shri Shivaji Memorial Society to take the Society to unscaled heights.

At present the campus has multiple colleges in one premise and description of area is provided below.

- College of Engineering having built-up area of about 23888 sq.m.
- College of Polytechnic having buit-up area of about 11340 sq.m.
- College of Pharmacy having built-up area 7178 sq.m
- College of Business Management having built-up area 3626 sq.m.

1.2 Objectives

- To undertake an energy audit so as to identify areas for energy saving, both without and with investment.
- To prioritize distinct areas identified for energy savings depending upon saving potential, skills, and time frame for execution, investment cost, paybacks etc.

1.3 Scope of Work

- To correlate monthly data of production with electricity, fuels & water consumption, for a period of 12 months of normal operation to establish bench mark values for energy consumption.
- To study electrical energy metering, monitoring and control system existing at the plant and to recommend a suitable system for future monitoring.
- To study monthly power factor, maximum demand, working hours, load factor etc. for the reference period along with monthly electricity consumption and establish scope for MD control through possible optimization of load factor and through detailed load management study.
- Based on above, to evaluate the possibility of replacing major motors with energy efficient motors. To provide cost benefit analysis for the replacement policy.
- To study existing requirements of energy provisions at present locations and to identify distinct possibilities of rationalization / savings.
- To study existing maintenance practices for utility systems and recommend areas for improvement in energy efficiency / savings.
- To identify, evaluate and priorities energy saving opportunities into short, mid and long-term time spans depending upon investments, quantum of savings, skills and time required for implementation, etc.
- To prepare draft energy audit report, present to management, undertake necessary modifications based on presentation meeting and submit the final report.

1.4 Energy Source and Breakup

College campus is having diesel generator for emergency power supply and the share of diesel consumption is about 5 % of total energy consumption. Energy consumption breakup & energy breakup on the basis of source of energy are provided below.

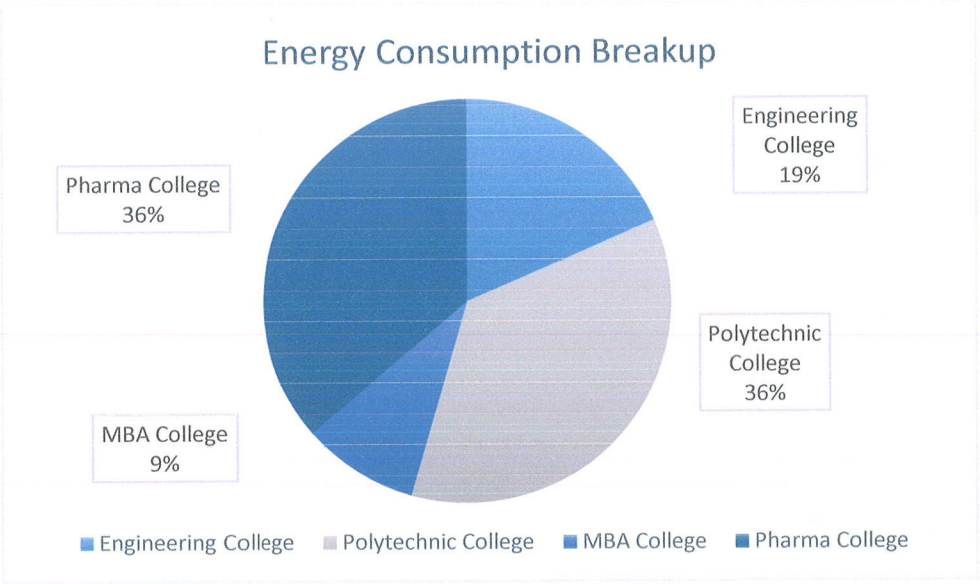

Figure 1 Energy Consumption Breakup

College is having rooftop solar system of 300 kWp and energy generation by the solar PV plant is having major share in the energy supply to the premise. Breakup of the same is represented below.

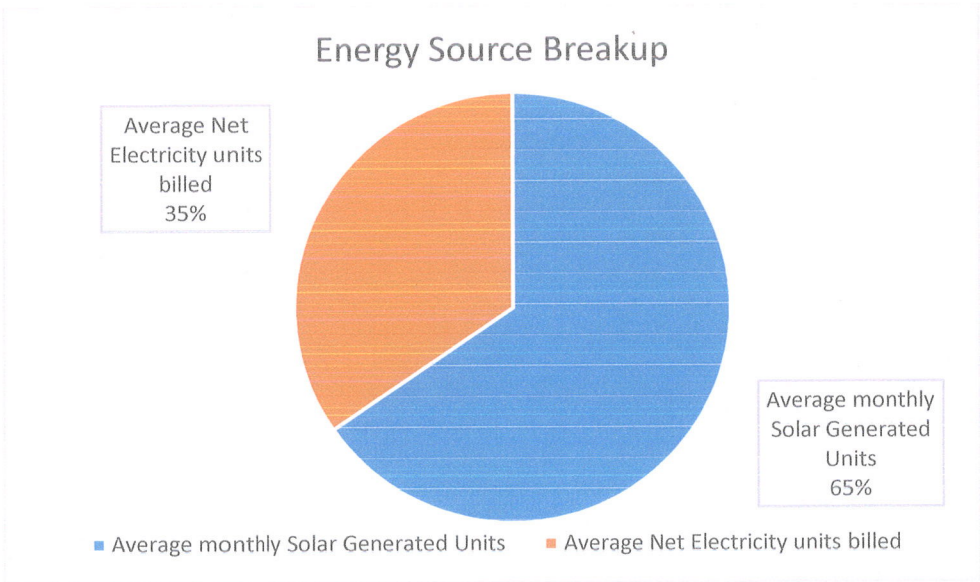

Figure 2 Energy Source Breakup

1.5 Electricity Consumption

Client is receiving electricity supply from Maharashtra State Electricity Distribution Company Limited (MSEDCL) with contract demand of 400 KVA & 11kV/433 V, 630 KVA Transformer .

Following table represents bill analysis for last 12 months energy use of the facility.

Table 1-Bill Analysis – Last 12 months

Month	Billed Demand	Highest Recorded MD	Energy Consumption		Power Factor	Demand Charges	Energy Charges	Total Current Bill	Excess Payment due to higher contract Demand
	kVA	kVA	kWh	kVAh		Rs.	Rs.	Rs.	Rs.
May-21	240	39	11310	11538	0.98	103680	106265	261546	86832
Jun-21	240	49	13458	13678	0.98	103680	125974	288491	82512
Jul-21	NA	NA	NA	16328	NA	NA	NA	NA	NA
Aug-21	NA	NA	NA	13828	NA	NA	NA	NA	NA
Sep-21	240	83	16025	17495	0.91	103680	161129	333788	67824
Oct-21	NA	NA	NA	20260	NA	NA	NA	NA	NA
Nov-21	NA	NA	NA	16420	NA	NA	NA	NA	NA
Dec-21	NA	NA	NA	16898	NA	NA	NA	NA	NA
Jan-22	NA	NA	NA	14470	NA	NA	NA	NA	NA
Feb-22	240	81	18683	18860	0.99	103680	173700	350979	68688
Mar-22	NA	NA	NA	30550	NA	NA	NA	NA	NA
Apr-22	NA	NA	NA	28565	NA	NA	NA	NA	NA
Total	-	-	**59,476**	**218,890**	-	**414,720**	**567,068**	**1,234,804**	**3,05,856**
Average	**240**	**63**	**14,869**	**18,241**	**0.96**	**103,680**	**141,767**	**308,701**	**76,464**

Average monthly MSEDCL unit's consumption is 18,241 units and avg. monthly bill is Rs. 3.08 Lakh.

Average of last 12 months unit cost is Rs. 16.92 / kVAh.

Average PF is at 0.96 & shall be improved to 0.995 for reduced kVAh billed.

No leakage currents were observed in the facility in the various feeders.

Energy consumption trend represented in graphical format as below-

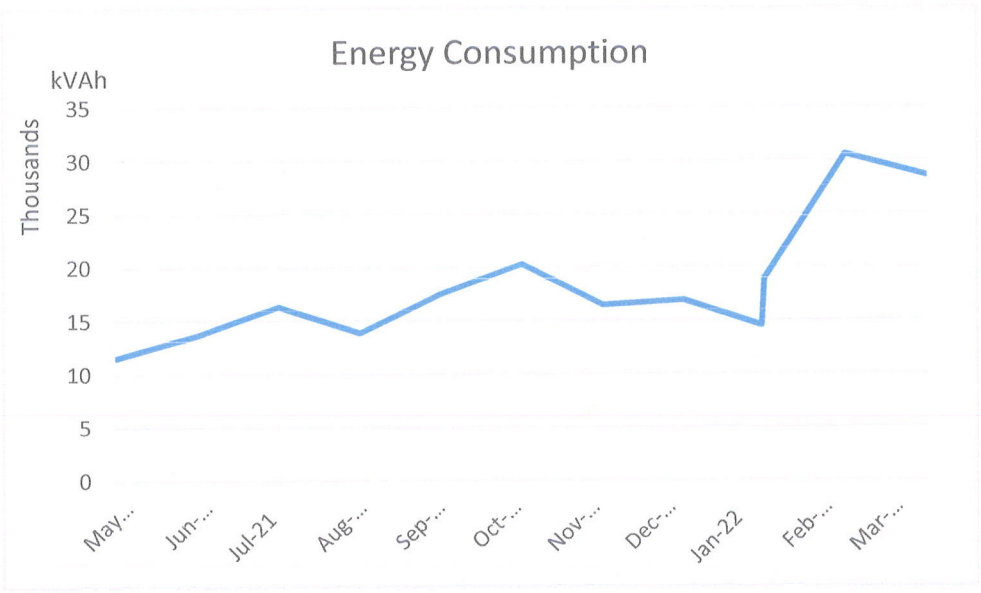

Figure 3- Energy Consumption Trend

- **The Electricity bill consist of following parts:-**

Demand charges – Maximum Peak Demand (in terms of KVA) is recorded in the bill for the complete month and a fixed charge of Rs. 432/- per KVA

Unit charges – As per the units consumed Industrial tariff are applicable.

Time of Day Charges – Depending on the time of day of usage, the Time of Day charges adjustment is made.

Other charges, which cannot be controlled

- **The following are the conclusions of Electrical Bill Analysis:**

1. Considering data available, average cost of electricity is Rs. 16.92 / kVAh.

2. Average billed Power factor is 0.96 (Based on available data). The power factor is maintained but can be improved to near unity value.

3. As contract demand is 400 kVA, minimum billed Demand is 240 kVA (60% of contract demand). Even though the actual maximum demand is lower (due to higher contract demand) extra Maximum Demand charges are being paid. It is recommended to reduce the contract demand so as to reduce the Maximum Demand charges. Average monthly loss of Rs. 76,464*/- is being incurred due to higher contract demand.

*Value based on available data

1.6 Water Consumption

College campus is having 5 water connections and average water consumption per billing cycle for the premise is represented below.

Table 2- Average Water consumption

Month	connection no.				
	ST005483	SE025101	SE025102	ST005483	SE025620
	kL	kL	kL	kL	kL
Average Water Consumption	882	91	241	244	237

1.7 Harmonics Study

Harmonic of a wave is the wave which has frequency as the positive integer multiple of the frequency of the original wave, known as the fundamental frequency.

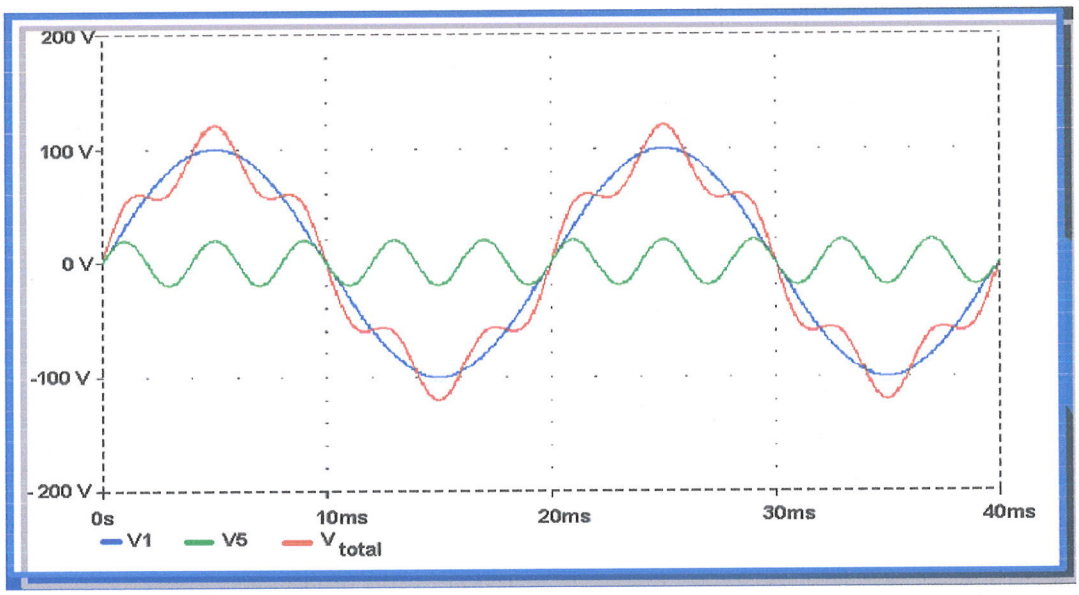

Figure 4- Harmonics

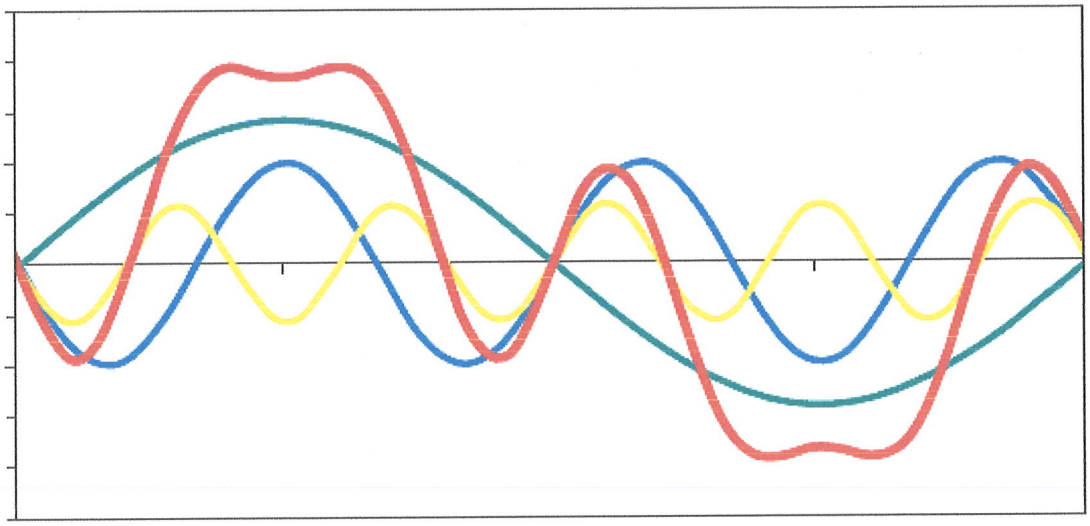

Figure 5-. Harmonics Generation

Electrical loads can be classified as linear and non-linear loads. A linear load is one, which draws a sinusoidal current when subjected to sinusoidal voltage. The current wave may or may not have a phase difference with respect to the voltage. A pure resistance, inductance or capacitance or any combination of these forms a linear load. On the contrary, a non-linear load is one, which draws non-sinusoidal or pulsating current when subjected to sinusoidal voltage.

Any non-sinusoidal current can be mathematically resolved into a series of sinusoidal components (Fourier series). The first component is called as fundamental and the remaining components whose frequencies are integral multiples of the fundamental frequency are known as harmonics. If the fundamental frequency is 50 Hz, then 2nd harmonic will have a frequency of 100Hz and the 3rd will have 150Hz and so on.

Non-linear loads that draw current in abrupt pulses rather than a smooth sinusoidal manner create harmonics. The pulses of current cause distorted current wave shape, which in turn cause harmonic currents to flow back into other parts of the power system.

1.7.1 Voltage Harmonics

Main reason for voltage harmonics is current harmonics. The voltage wave form from voltage source is distorted by the current harmonics due to source impedance. Larger the source impedance, higher will be the voltage harmonics caused by current harmonics. It is typically the case that voltage harmonics are indeed small compared to current harmonics. Thus, harmonic voltage can be defined as the product of harmonic current and source impedance at the harmonic frequency.
The source impedance includes the Impedance of the power source (Transformer, Generator, and Grid etc.), Impedance of the Bus bars, Cables, Switchgears and other loads in the network.
Following are some of the non-linear loads, which generate harmonics:

- Static power converters and rectification circuits, which are used in ups, battery chargers, etc.
- Arc furnaces
- Power electronics drivers for motor controls (AC/DC) drives.

- Computers
- Television receivers
- Saturated transformers
- Fluorescent lighting
- Telecommunication equipment's

Table 3- Voltage Harmonics level at Engineering College

Voltage Harmonics	R	Y	B
THD	1.60	1.88	1.64
3rd Level Harmonics	0.15	0.32	0.13
5th Level Harmonics	0.46	0.59	0.38
7th Level harmonics	1.25	1.60	1.30
9th Level harmonics	0.50	0.19	0.48
11th Level harmonics	0.62	0.61	0.70
13th Level harmonics	0.21	0.22	0.26

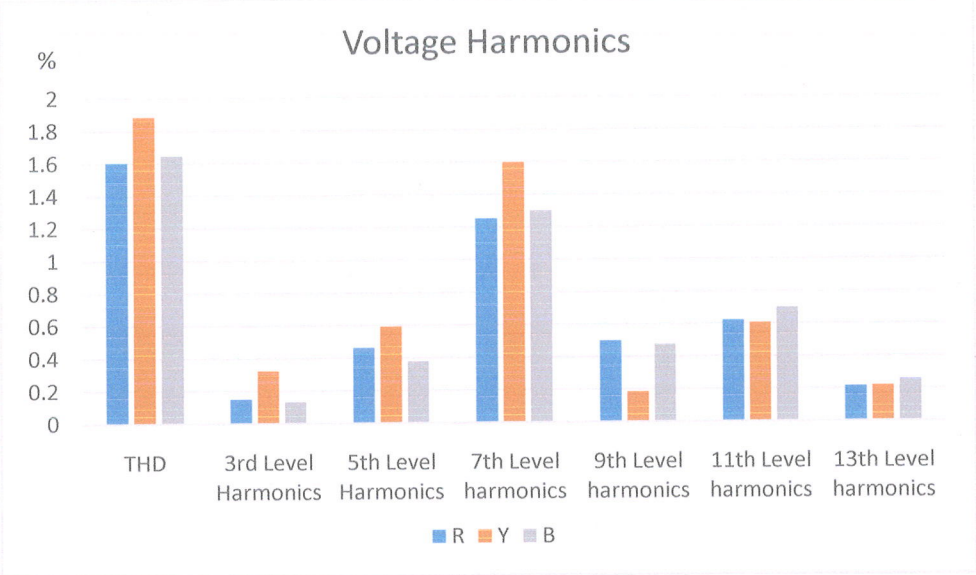

Figure -6. Voltage Harmonics Profile – Engineering College

Observations:

- It is observed that the voltage harmonics for engineering college is within limit which 1.88 % which is acceptable as standard value of 5% (voltage harmonics (V_{THD} %) limit as per IEEE 519:2014 standards).

Table 4-. Voltage Harmonics level at Management College

Voltage Harmonics	R	Y	B
THD	1.68	1.77	1.60
3rd Level Harmonics	0.18	0.29	0.16
5th Level Harmonics	0.33	0.34	0.29
7th Level harmonics	1.43	1.58	1.23
9th Level harmonics	0.36	0.11	0.62
11th Level harmonics	0.67	0.56	0.69
13th Level harmonics	0.19	0.22	0.19

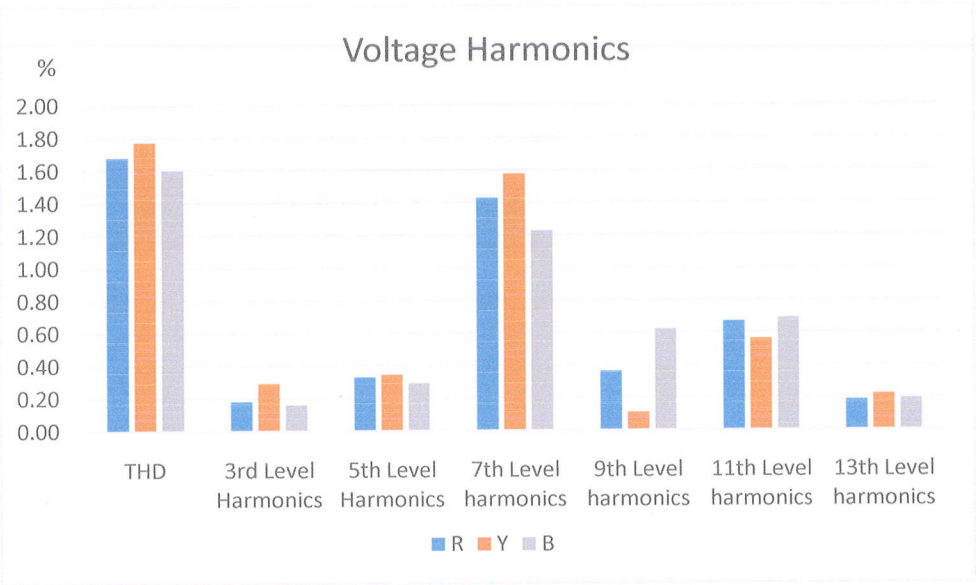

Figure7. Voltage Harmonics Profile – Management College

Observations:

- It is observed that the voltage harmonics for engineering college is within limit which 1.77 % which is acceptable as standard value of 5% (voltage harmonics (V_{THD} %) limit as per IEEE 519:2014 standards).

Table 5. Voltage Harmonics level at College of Pharmacy

Voltage Harmonics	R	Y	B
THD	1.63	1.78	1.62
3rd Level Harmonics	0.18	0.31	0.15
5th Level Harmonics	0.28	0.27	0.23
7th Level harmonics	1.37	1.58	1.30
9th Level harmonics	0.36	0.17	0.50
11th Level harmonics	0.66	0.58	0.71
13th Level harmonics	0.18	0.26	0.23

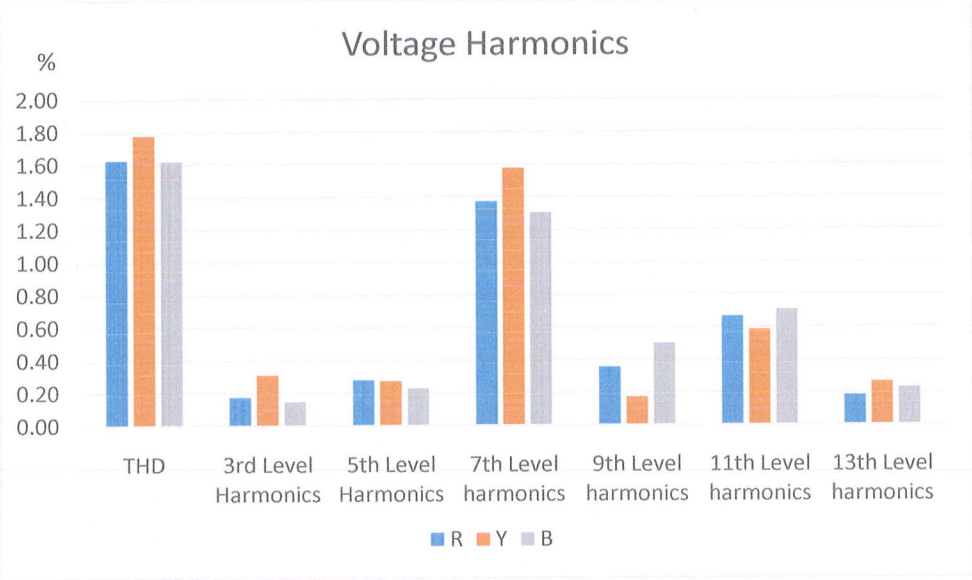

Figure 8-. Voltage Harmonics Profile – College of Pharmacy

Observations:

- It is observed that the voltage harmonics for engineering college is within limit which 1.78 % which is acceptable as standard value of 5% (voltage harmonics (V_{THD} %) limit as per IEEE 519:2014 standards).

Table 6. Voltage Harmonics level at Polytechnic College

Voltage Harmonics	R	Y	B
THD	1.49	1.61	1.49
3rd Level Harmonics	0.24	0.22	0.06
5th Level Harmonics	0.52	0.43	0.44
7th Level harmonics	1.31	1.28	1.04
9th Level harmonics	0.31	0.35	0.27
11th Level harmonics	0.44	0.62	0.67
13th Level harmonics	0.21	0.20	0.14

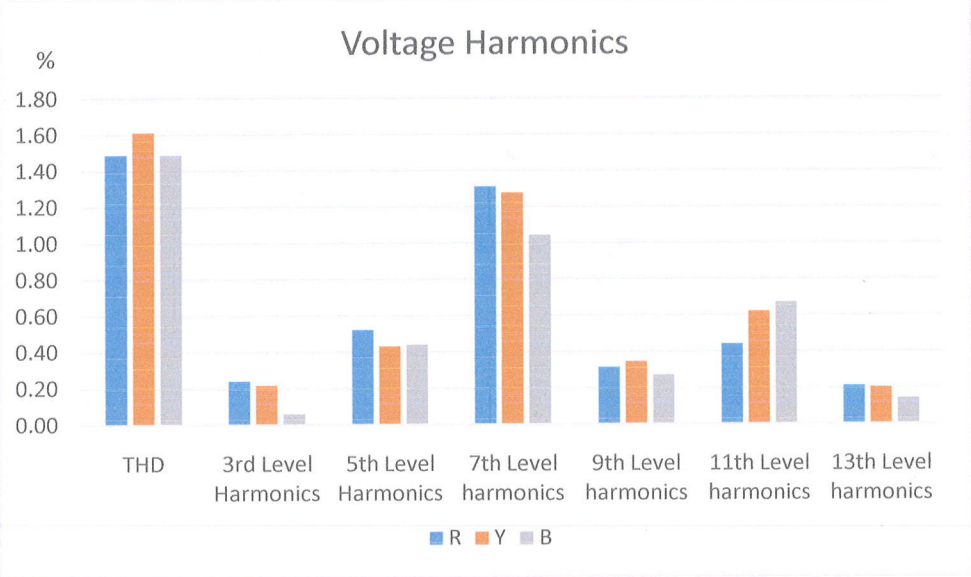

Figure 9- Voltage Harmonics Profile – Polytechnic College

Observations:

- It is observed that the voltage harmonics for engineering college is within limit which 1.49 % which is acceptable as standard value of 5% (voltage harmonics (V_{THD} %) limit as per IEEE 519:2014 standards).

1.7.2 Current Harmonics

In a normal alternating current power system, the current drawn by a linear load will be sinusoidal at the specified frequency. The current wave may or may not have a phase difference with respect to the voltage. Current harmonics are caused by non-linear loads which draw current that is not necessarily sinusoidal. The current wave form can be distorted and complex depending on the load and the interaction between other components of the system. Using Fourier series, the complex wave form can be resolved into simple sinusoidal waves of multiple frequency for analysis purpose.

Any non-sinusoidal current can be mathematically resolved into a series of sinusoidal components (Fourier series). The first component is called as fundamental and the remaining components whose frequencies are integral multiples of the fundamental frequency are known as harmonics. If the fundamental frequency is 50 Hz, then 2nd harmonic will have a frequency of 100Hz and the 3rdwill have 150Hz and so on.

Table 7- Current Harmonics Level – Engineering College

Current Harmonics	R	Y	B
THD	80.36	119.70	142.25
3rd Level Harmonics	30.97	17.53	23.12
5th Level Harmonics	50.91	76.89	81.06
7th Level harmonics	39.24	74.16	80.22
9th Level harmonics	30.01	33.44	63.80
11th Level harmonics	15.36	29.58	39.06
13th Level harmonics	10.30	19.33	22.74

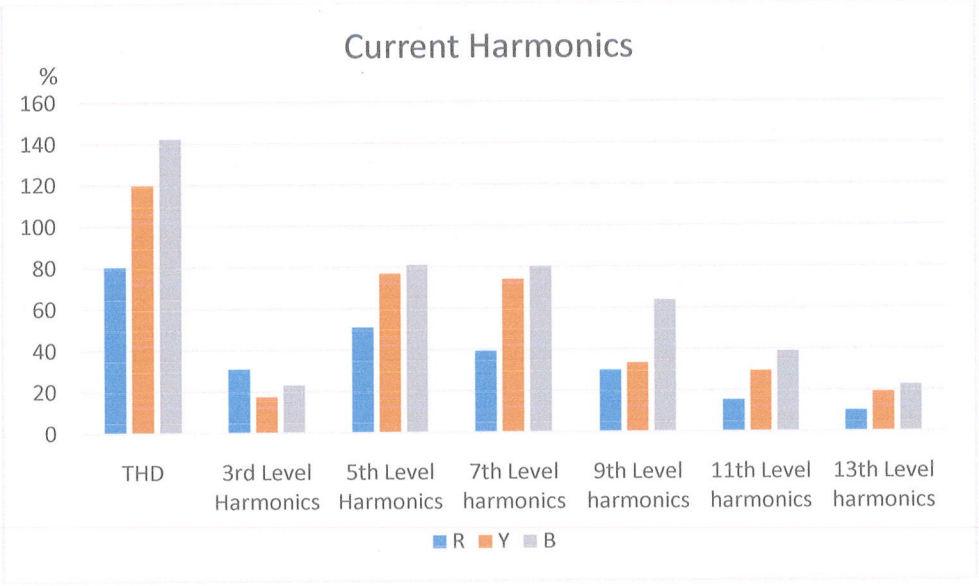

Figure 10- Current Harmonics– Engineering College

Observations:

- It is observed that THD is 142 % which is on higher side than standard value of 8% (Current harmonics (I_{THD} %) limit as per IEEE 519:2014 standards).

Table 8- Current Harmonics Level – Management College

Current Harmonics	R	Y	B
THD	12.91	21.55	14.61
3rd Level Harmonics	10.73	4.29	13.16
5th Level Harmonics	3.49	9.60	3.05
7th Level harmonics	3.37	13.69	3.00
9th Level harmonics	3.19	9.98	3.42
11th Level harmonics	1.89	4.77	1.09
13th Level harmonics	1.39	1.82	1.47

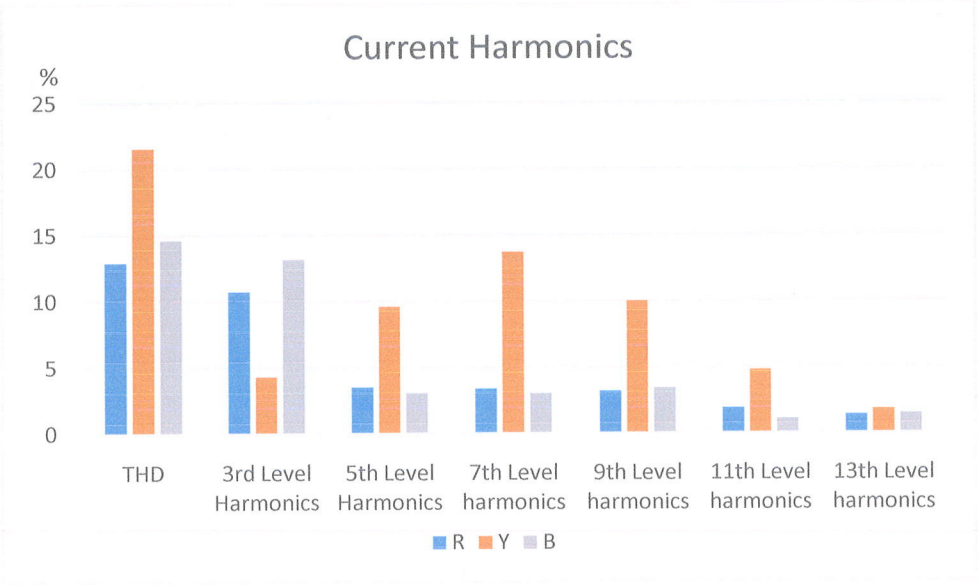

Figure 11- Current Harmonics – Management College

Observations:

It is observed that THD is 21 % which is on higher side than standard value of 8% (Current harmonics (I_{THD} %) limit as per IEEE 519:2014 standards).

Table 9- Current Harmonics Level – College of Pharmacy

Current Harmonics	R	Y	B
THD	13.65	11.80	12.71
3rd Level Harmonics	7.50	2.65	4.47
5th Level Harmonics	8.43	5.81	8.38
7th Level harmonics	4.40	7.04	4.11
9th Level harmonics	4.24	3.92	5.41
11th Level harmonics	2.92	4.18	3.76
13th Level harmonics	1.81	2.86	1.42

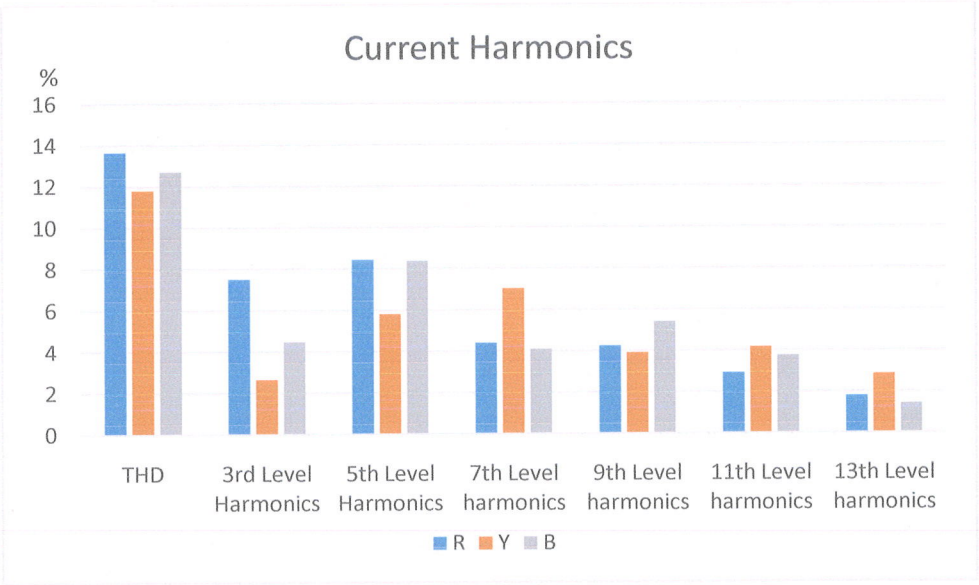

Figure 12- Current Harmonics – College of Pharmacy

Observations:

It is observed that THD is 13 % which is on higher side than standard value of 8% (Current harmonics (I_{THD} %) limit as per IEEE 519:2014 standards).

Table 10- Current Harmonics Level – Polytechnic College

Current Harmonics	R	Y	B
THD	13.65	12.97	22.79
3rd Level Harmonics	5.78	3.05	9.30
5th Level Harmonics	9.12	9.71	14.16
7th Level harmonics	6.99	5.71	9.56
9th Level harmonics	3.91	4.96	9.96
11th Level harmonics	0.81	0.49	3.47
13th Level harmonics	1.12	1.22	1.64

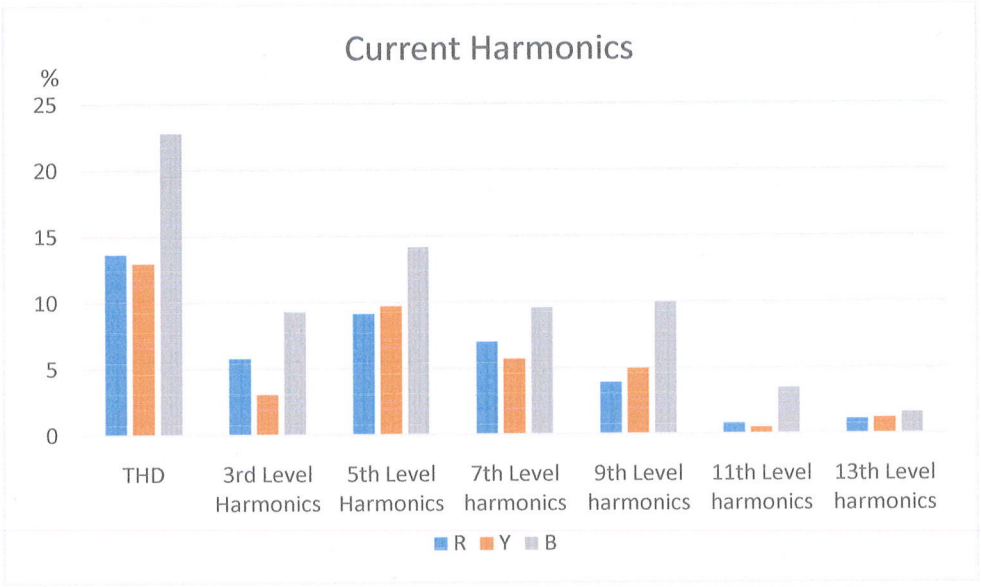

Figure 13- Current Harmonics – Polytechnic College

Observations:

It is observed that THD is 13.6 % which is on higher side than standard value of 8% (Current harmonics (I_{THD} %) limit as per IEEE 519:2014 standards).

1.7.3 Limits of Harmonics

IEEE recommended practices and requirements for harmonic control in electrical power system: It represents a standard level of acceptable harmonic distortion in a power system.

Table 11-Harmonics Distortion Limits: – IEEE – 519C:2014

I_{sc}	Short Circuit current at the point of common coupling (PCC), under normal operating conditions
I_L	Fundamental full load current in Amps
H	Harmonic number
11<h<17	Limits of individual current at PCC
THD	Total harmonic distortions

Table 12- Current distortion limits for systems rated 120 V to 69 kV – User's responsibility

Maximum harmonic current distortion in percent of I_L						
	Individual harmonic order (odd harmonics)					
I_{sc}/I_L	**3≤h<11**	**11≤h<17**	**17≤h<23**	**23≤h<35**	**35≤h<50**	**TDD**

Maximum harmonic current distortion in percent of I_L						
	Individual harmonic order (odd harmonics)					
I_{sc}/I_L	3≤h<11	11≤h<17	17≤h<23	23≤h<35	35≤h<50	TDD
<20*	4.0	2.0	1.5	0.6	0.3	5.0
20<50	7.0	3.5	2.5	1.0	0.5	8.0
50<100	10.0	4.5	4.0	1.5	0.7	12
100<1000	12.0	5.5	5.0	2.0	1.0	15
>1000	15.0	7.0	6.0	2.5	1.4	20

*All power generation equipment is limited those values regardless their I_{sc}/I_L.

- Odd harmonics are represented as % of fundamental at PCC
- Even harmonics are limited to 25% of odd harmonic's limits.

2 Power Parameter Profiles

2.1 Power Parameter Profiles

All electrical parameters for individual feeders were logged using 3 phase electrical data logger. The logging was conducted at all feeders from main panel for evaluation of load in each section.Voltage, Current, Power and power factor profile with other electrical measurements were carried out at the main incomer coming of installed Transformer using a Power Quality Analyser. The profiles for the each section/feeders are given below.

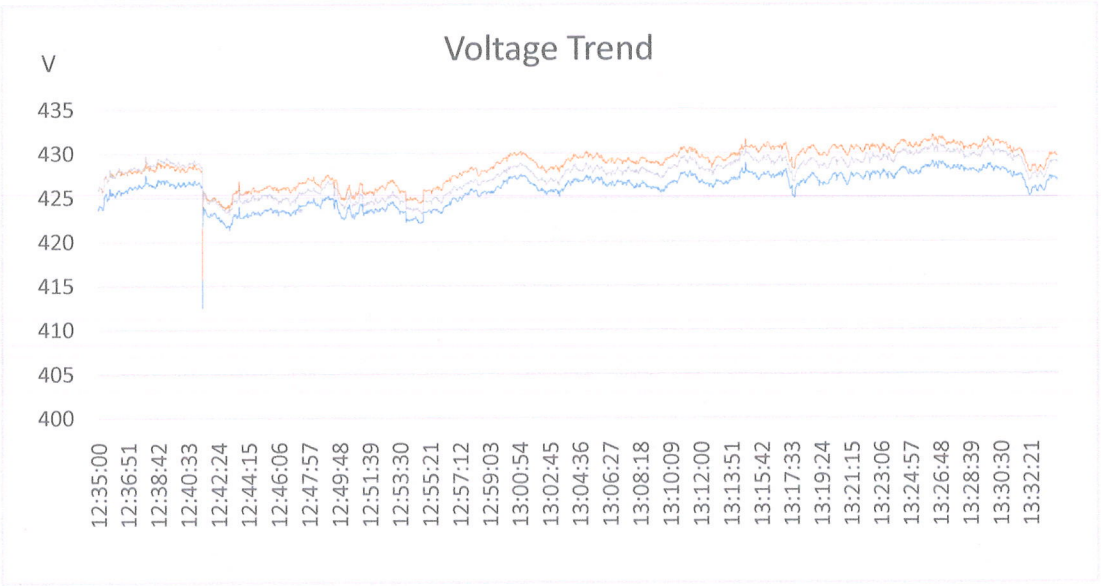

Figure 14- Engineering College Voltage Profile

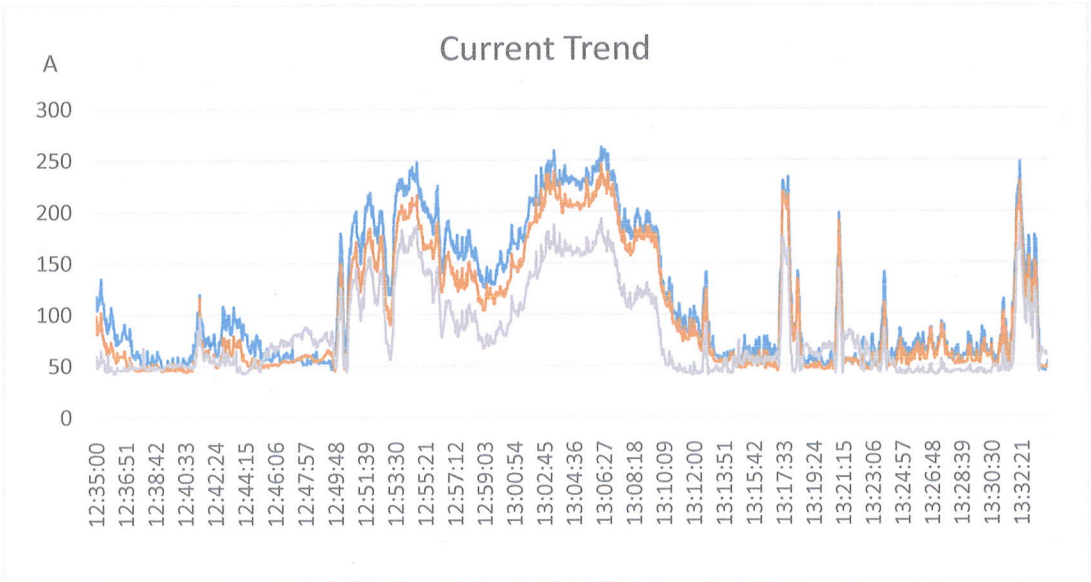

Figure 15- Engineering College Current Profile

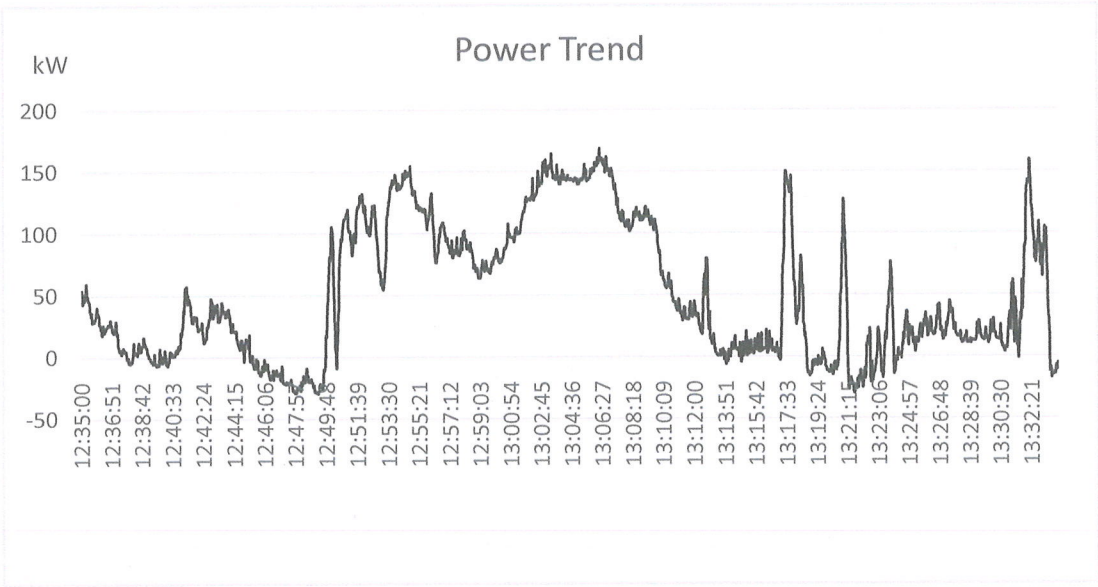

Figure 16- Engineering College Power Consumption Profile – kW

Whenever there was net export of electricity due to solar power generation exceeding the actual consumption negative power consumption was observed in graph.

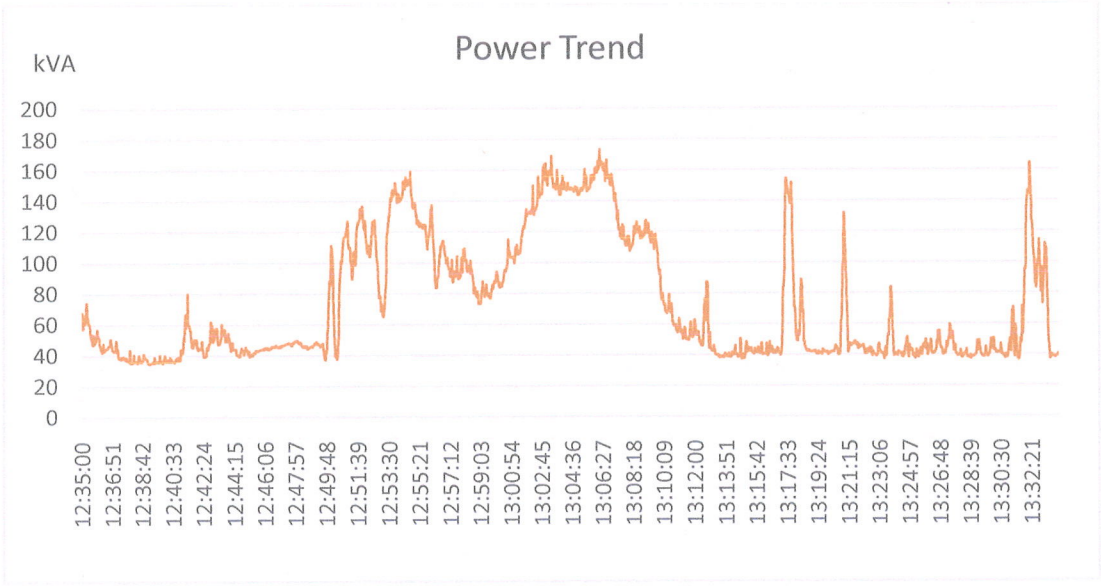

Figure 17- Engineering College Power Consumption Profile – kVA

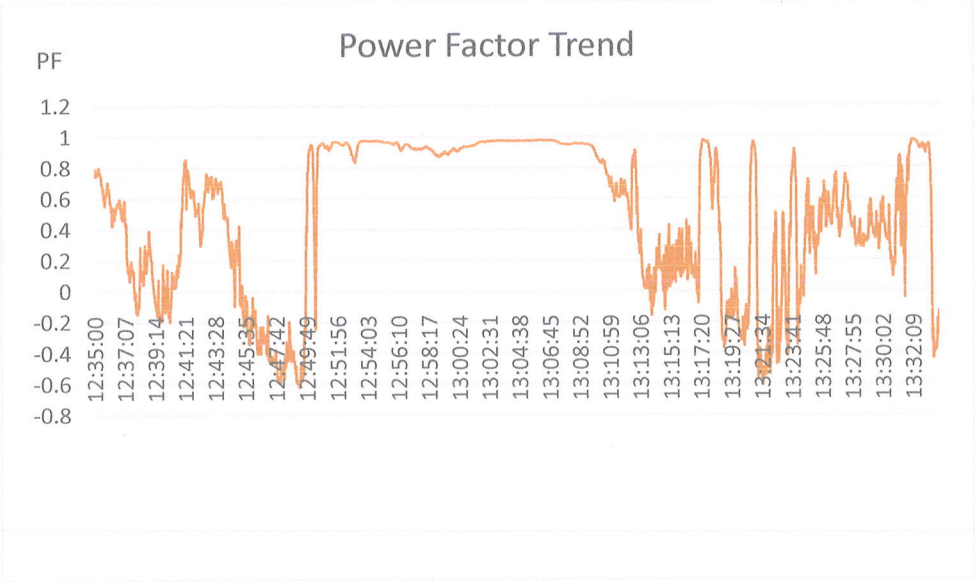

Figure 18- Engineering College Power Factor Profile

As it can be clearly seen in above graph that Power factor variation is due to additional capacitance being generated in the electrical system causing leading PF. However when these loads are less the power factor is varying both on inductive and capacitive side due to switching of capacitors. Fine tuning of the capacitor banks is recommended in this case.

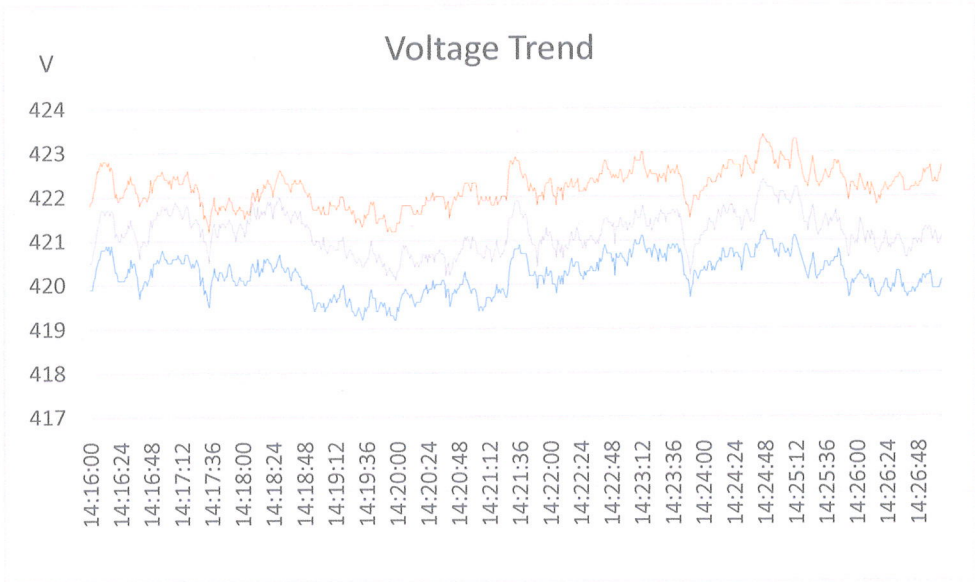

Figure 19-College of Management Voltage Profile

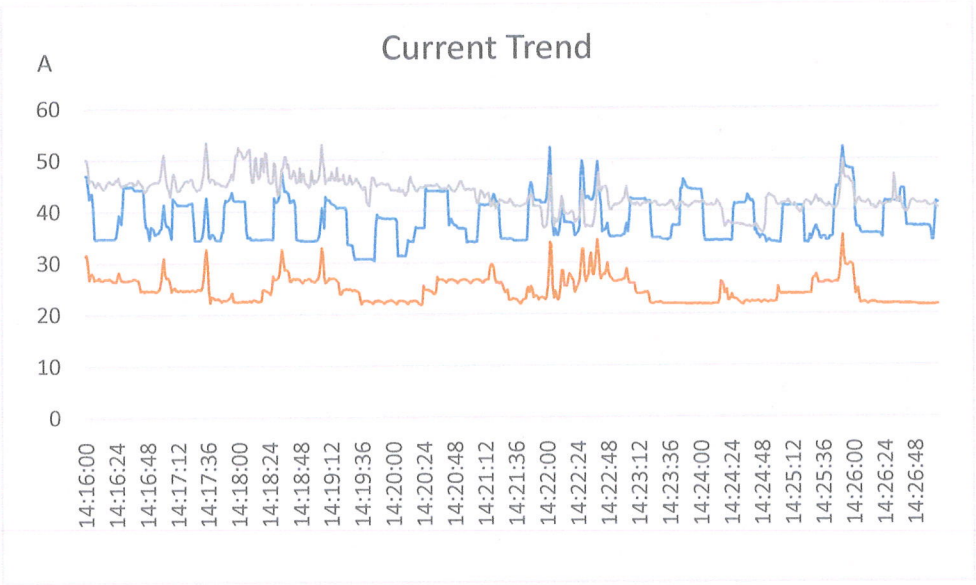

Figure 20- College of Management Current Profile

Current Unbalance of value ~ 31% was observed in the feeder & need to be resolved immediately.

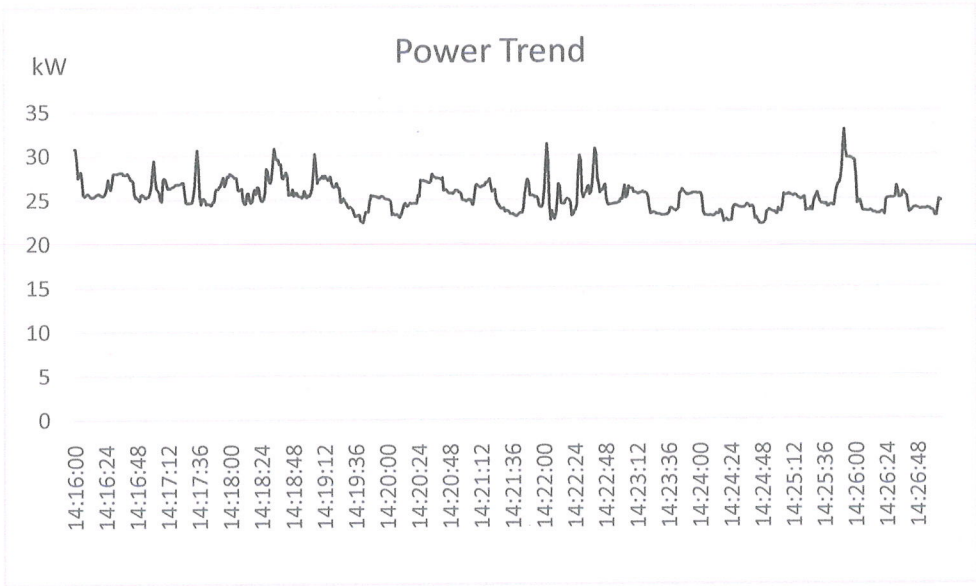

Figure 21- College of Management Power Consumption Profile – kW

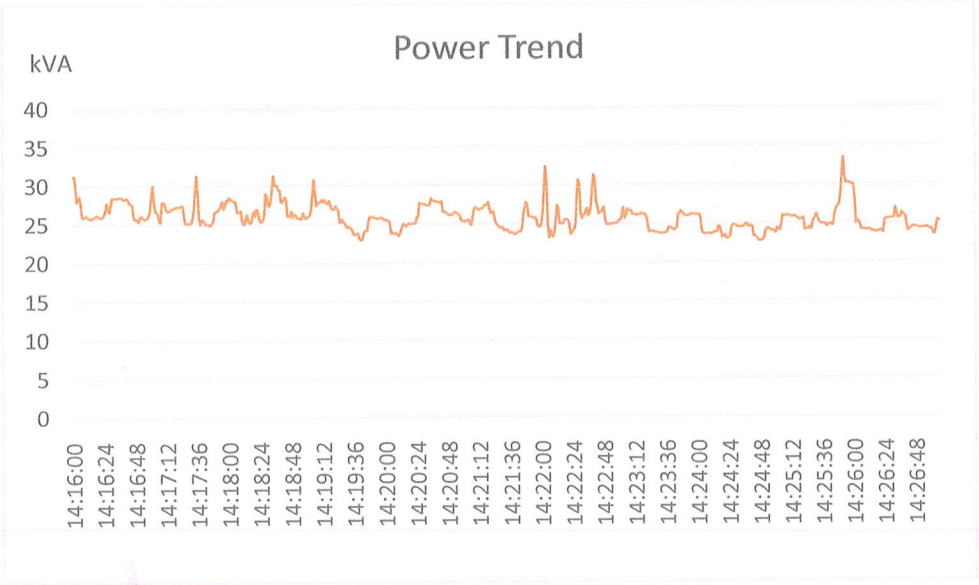

Figure 22-College of Management Power Consumption Profile – KVA

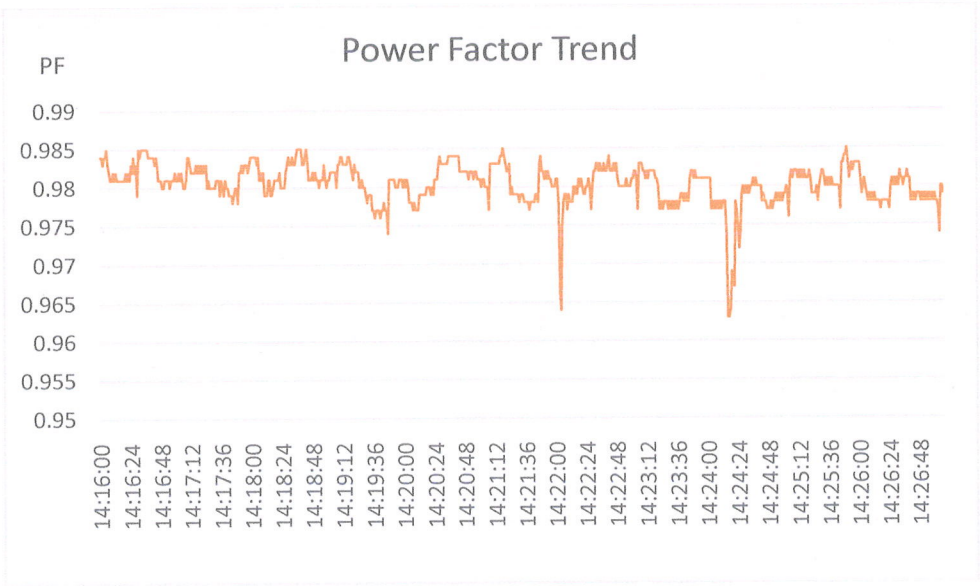

Figure 23-College of Management Power Factor Profile

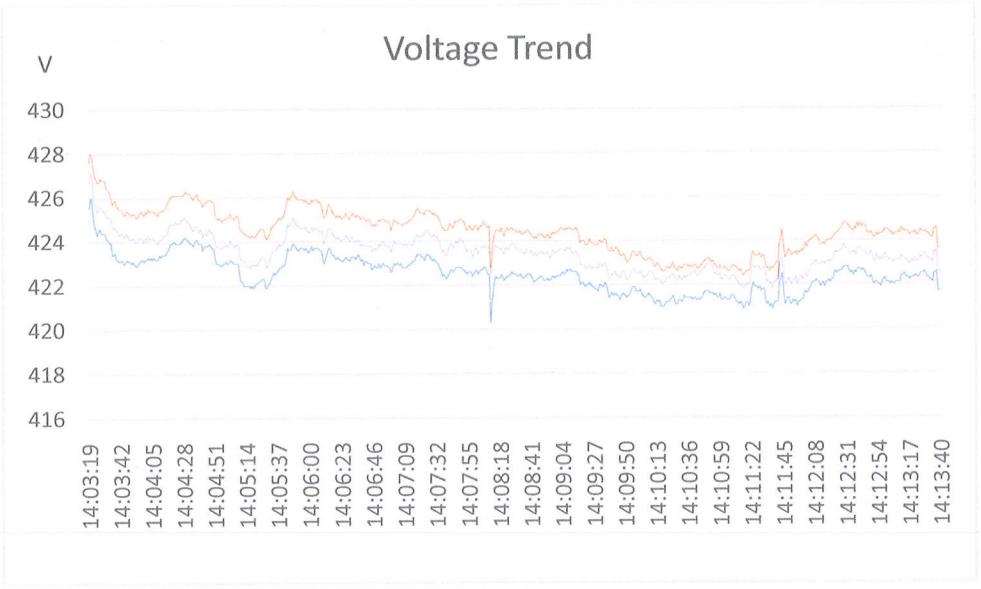

Figure 24- College of Pharmacy Voltage Profile

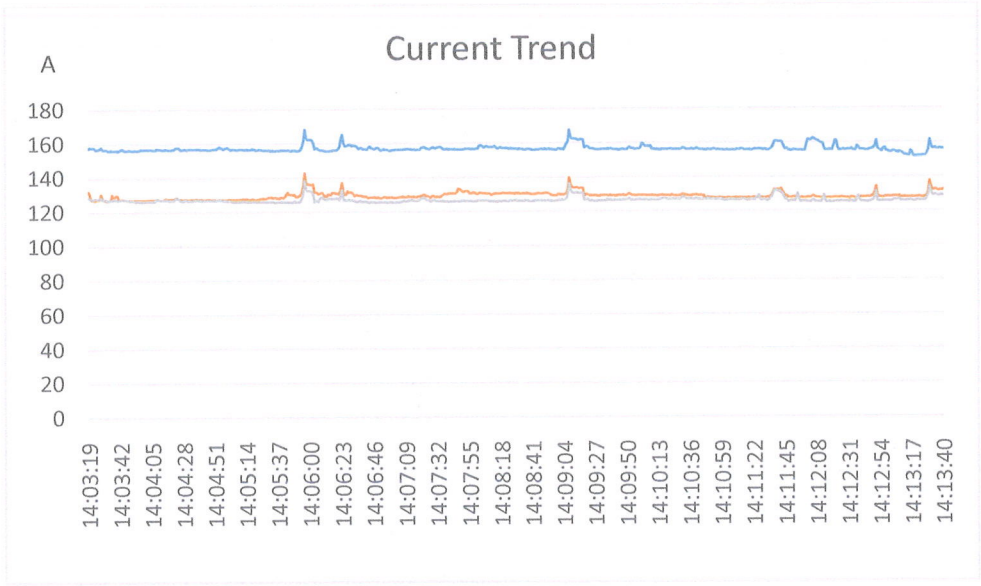

Figure 25- College of Pharmacy Current Profile

Current unbalance observed is 13% and need immediate attention.

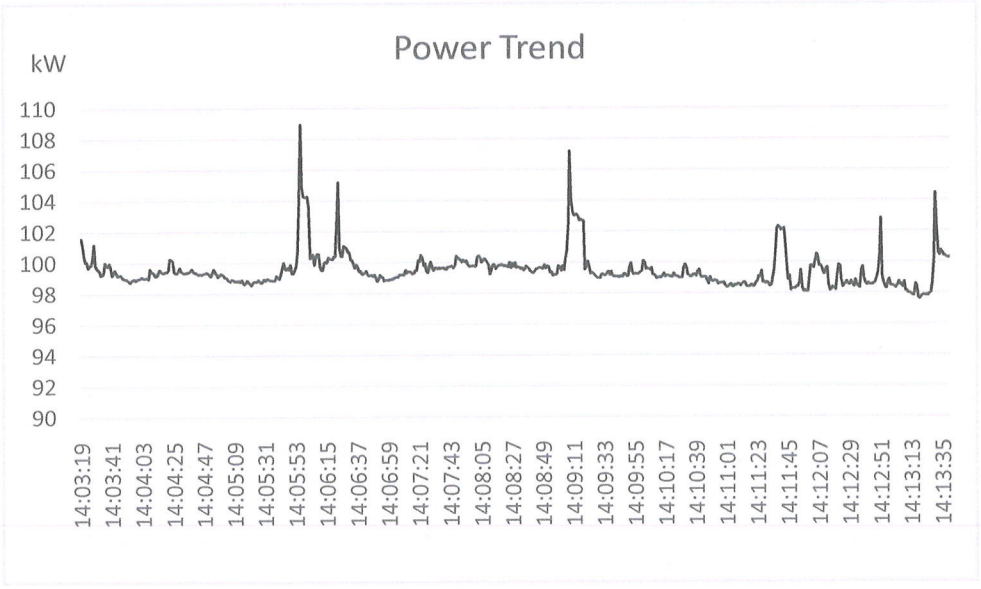

Figure 26- College of Pharmacy Power Consumption Profile – kW

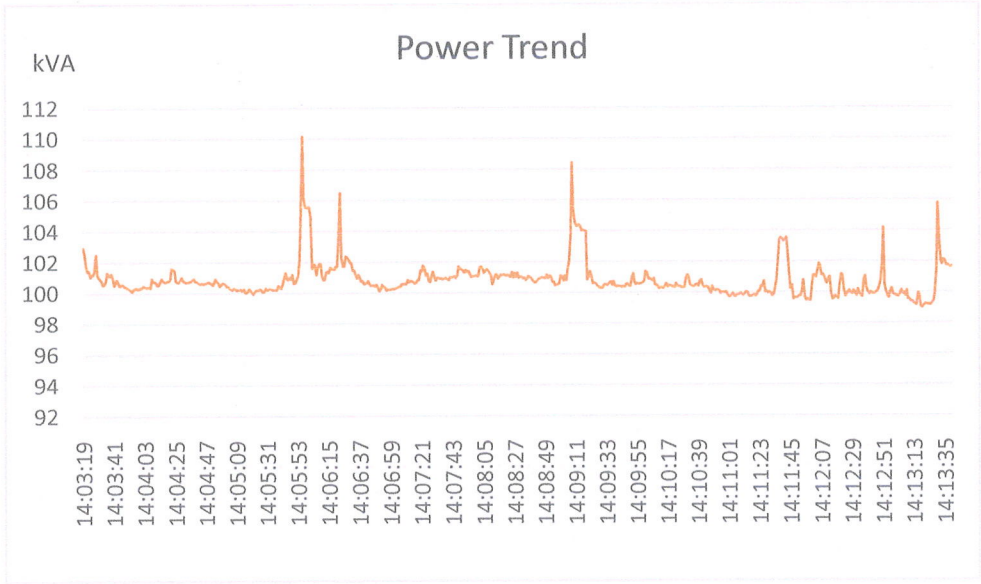

Figure 27-College of Pharmacy Power Consumption Profile – kVA

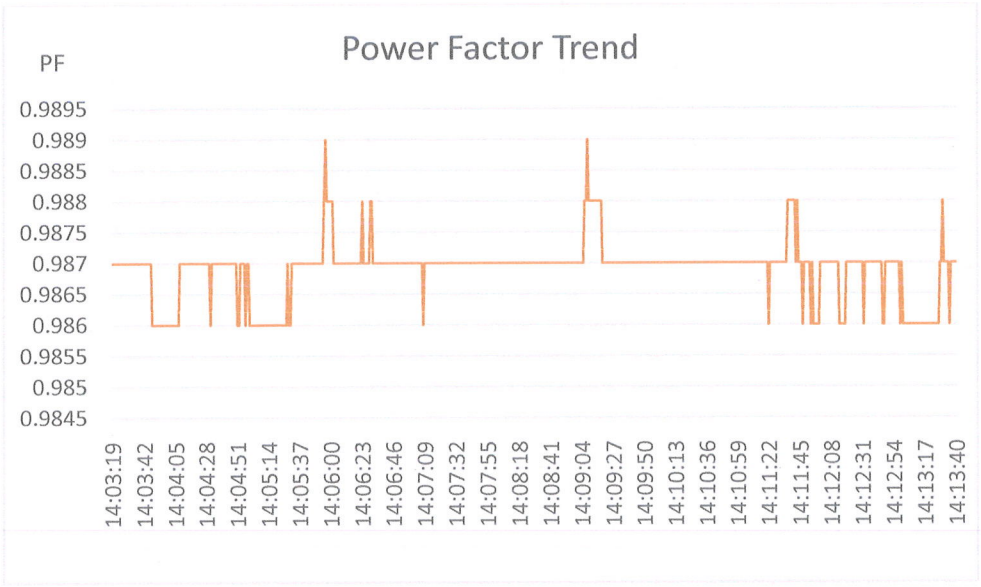

Figure 28- College of Pharmacy Power Factor Profile

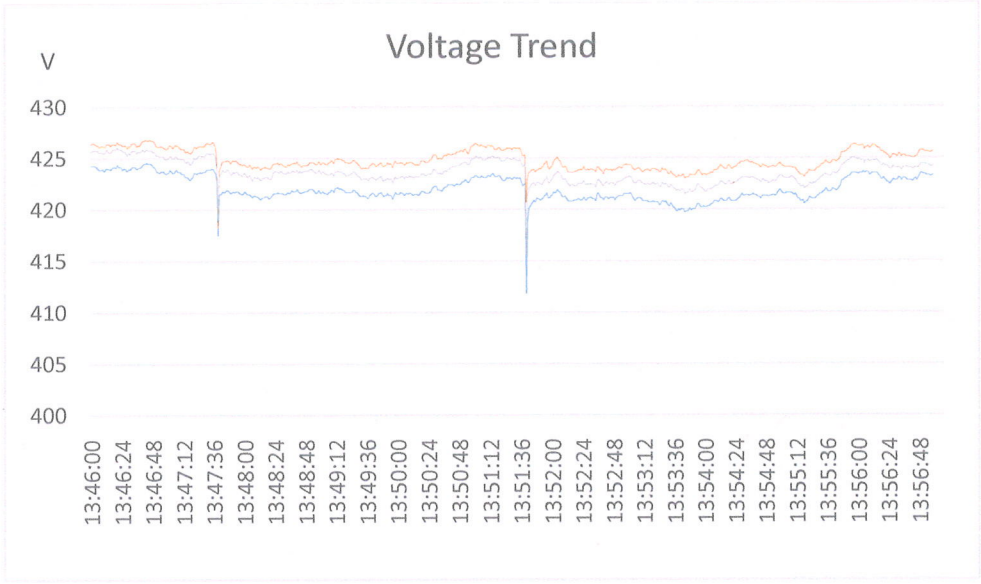

Figure 29- College of Polytechnic Voltage Profile

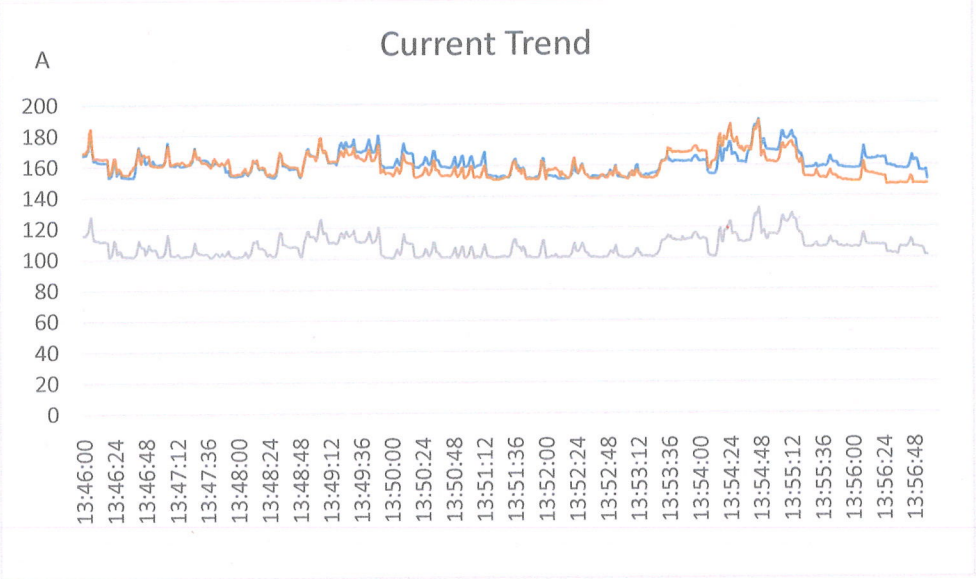

Figure 30- College of Polytechnic Current Profile

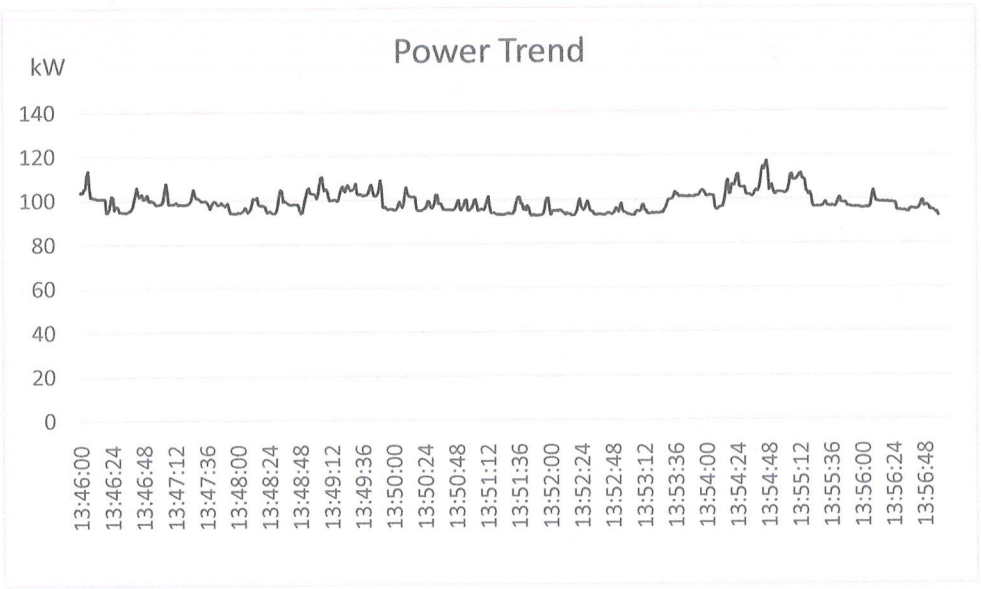

Figure 31-. College of Polytechnic Power Consumption Profile – kW

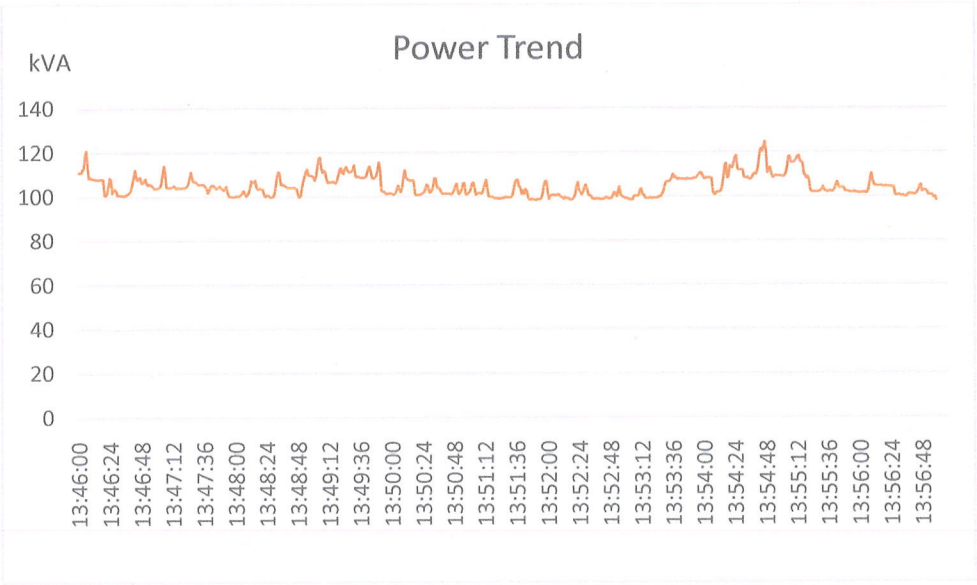

Figure 31-College of Polytechnic Power Consumption Profile – KVA

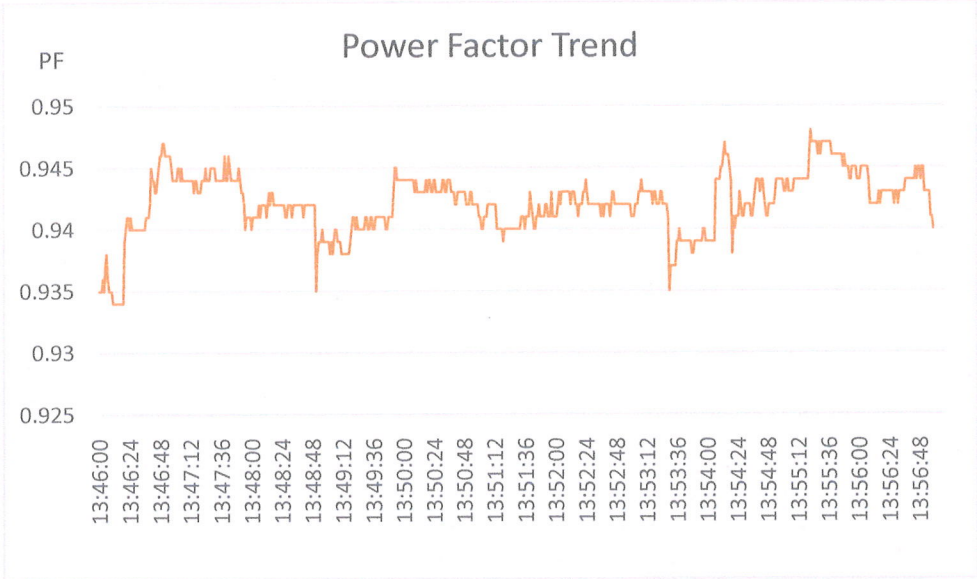

Figure 32- College of Polytechnic Power Factor Profile

Power Factor is in the range of 0.935 to 0.949 & can be improved.

3 Energy Conservation Measures

3.1 Energy conservation measures already undertaken by college

College management is very keen on implementation of energy saving initiatives and have already implemented some energy conservation measures in the premise.

College management is also doing cleaning and maintenance best practices for improved performance of renewable energy systems installed in the premises.

Energy conservation measure which are under implementation stage are as follows.

1. Replacement of fluorescent lights with energy efficient LED lights.
2. Selection of Energy Efficient Equipment's (BEE 5 Star Labeled) whenever replacement of any equipment is to be done.
3. College is also maintaining energy consumption records of each section to track energy consumption of the premise.
4. Use of Solar energy for water heating purpose instead of electric geysers.
5. Use of Solar Photovoltaic system to generate own electricity using rooftop area available at the premise.

The action taken for energy conservation measures and use of renewable energy by the college management shows the sustainable approach towards energy use and environment friendly behaviour which is appreciable.

Other energy saving measures & cost saving measures

Although the college management is doing well in energy efficiency area further improvements can be done by the management for additional savings.

1. Use of heat pumps wherever possible in college premises for cooling and heating.
2. Use of aerators for water taps.
3. Cost saving measure - Fine tuning of Automatic Power Factor Correction system to improve PF to unity & reduce billing units in kVAh billing system.
4. Cost Saving measure - Reduce contract demand to last recorded highest demand to reduce the excess demand charges being paid each moth.

****

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Date-22-12-2022

TO WHOSOEVER IT MAY CONCERN

This is to certify that we had carried out the Energy & Water Audit in the Kennedy Road Campus of All India Shri Shivaji Memoral Society (AISSMS) , Pune.

It was observed that client already have installed energy efficient equipment in their premise. Most of energy efficiency improvement work has been already done by client; which shows their positive approach to energy efficiency and sustainability.

Our Observations & Recommendations are summarized as below-

Energy saving and sustainability improvement measures undertaken by college management are as follows.

1. Replacement of fluorescent lights with energy efficient LED lights.
2. Selection of Energy Efficient Equipment's (BEE 5 Star Labeled) whenever replacement of any equipment is to be done.
3. Active Harmonic Filter is also installed to control Harmonics.
4. Maintaining energy consumption records of each section to track energy consumption of the premise.
5. Use of Solar energy for water heating purpose instead of electric geysers.
6. Use of Solar Photovoltaic system to generate own electricity using rooftop area available at the premise.

Recommendations for further energy savings are as follows-

1. **Use of heat pumps wherever possible in college premises for cooling and heating.**
2. **Use of aerators for water taps.**
3. **Cost saving measure - Fine tuning of Automatic Power Factor Correction system to improve PF to unity & reduce billing units in kVAh billing system.**
4. **Cost Saving measure - Reduce contract demand to last recorded highest demand to reduce the excess demand charges being paid each month.**

Yours truly,

UPENDRA G. DEUSKAR
BEE Certified Energy Auditor.
Regn. No.- EA -1674

AISSMS
COLLEGE OF ENGINEERING
ज्ञानम् सकलजनहिताय
Accredited by NAAC with "A+" Grade

Report on Case study of

ENERGY AUDIT OF AISSMS COE

By

Varun Marathe	22ME 082
Akhilesh Kulkarni	22ME072
Atharva Kendre	22ME 066
Atharva Kulkarni	22ME074
Manas Kulkarni	22ME075

AY 2022-2023

Guide

Mr. V. R. Patil

AISSMS
COLLEGE OF ENGINEERING

ज्ञानम् सकलजनहिताय

Accredited by NAAC with "A+" Grade

Department of First Year Engineering

CERTIFICATE

This is to certify that Mr. Varun Marathe, Mr. Akhilesh Kulkarni, Mr. Atharva Kendre,Mr. Atharva Kulkarni,Mr. Manas Kulkarni of FE (Mechanical)Division B has successfully completed the activity under Project Based Learning (110013) -Case Study entitled *"**Energy Audit of AISSMS COE**"* under my supervision, in the partial fulfillment of First Year Bachelor of Engineering (Choice Based Credit System) (2019 Course) of Savitribai Phule University of Pune

Date:

Place: Pune

Mr. V. R Patil
Guide

AISSMS COLLEGE OF ENGINEERING PUNE

Mr. S.S. Patil
PBL Coordinator

Dr. D. V. Nighot
Head Department of First Year Engg
AISSMS COE, Pune

PRINCIPAL
AISSMS, COE, PUNE-1

ACKNOWLEDGEMENT

The satisfaction that accompanies the successful completion of this review would be incomplete without the mention of the people who made it possible, without their constant guidance and encouragement would have made the efforts go in vain. We consider ourselves privileged to express gratitude and respect towards all those who guided us through the completion of this Project.

We convey thanks to our project g u i d e **Mr.V. R. Patil** of First Year Engineering Department for providing encouragement, constant support and guidance which was of great help to complete this first stage successfully.

Student Name 1 – Varun Marathe

Student Name 2 – Akhilesh Kulkarni

Student Name 3- Atharva Kulkarni

Student Name 4- Atharva Kendre

Student Name 5- Manas Kulkarni

Dr.D. S. Bormane
Principal

INDEX

Dr.D. S. Bormane
Principal

1. INTRODUCTION

An energy audit is a survey in which the study of energy flows for the purpose of conservation is examined at an organization. It refers to a technique or system that seeks to reduce the amount of energy used in the Organization without impacting the output. The audit includes suggestions of alternative means and methods for achieving energy savings to agreater extend. Conventionally, electrical energy is generated by means of fossil fuels, hydraulic and wind. The availability of fossil fuels and their depletion rate, insist the need for alternate energy systems and conservation of electric energy. Energy audit programme provide aid in maintaining a focus on energy price variations, energy supply availability and efficiency, determining an appropriate energy mix, identifying energy-saving technology, retrofitting for energy-saving equipment and so on. In general, an energy audit process dealt with the driving conservation concepts into reality by giving technically possible solutions within a specified time limit while also considering the economic and other organizational issues. It also dealt with the uncover ways to cut operating expenses or reduce energy use per unit of productionin terms of savings. It serves as a "benchmark" (reference point) for managing energy in the organization for planning more energy efficient use across the board.

2. NEED OF ENERGY AUDIT

Energy has the highest potential for cost reduction, and thus the energy audit becomes a crucial exercise. Energy Audit will help to understand more about the ways energy and fuel are used in any industry, and help in identifying the areas where waste can occur and where scope for improvement exists.

The Energy Audit would give a positive orientation to the energy cost reduction, preventive maintenance and quality control programmes which are vital for production and utility and activities. Such an audit programme will help to keep focus on variations which occur in the energy costs, availability and reliability of supply of energy, decide on appropriate energy mix, identify energy conservation technologies, retrofit for energy conservation equipment etc.

In general, Energy Audit is the translation of conservation ideas into realities, by lending technically feasible solutions with economic and other organizational considerations within a specified time frame. The primary objective of Energy Audit is to determine ways to reduce energy consumption per unit of product output or to lower operating costs.

3. M AND OBJECTIVE OF AN ENERGY AUDIT

An energy audit is a useful tool for developing and implementing comprehensive energy management plans of an organization. The aim of an energy audit is to identify the energy efficiency, conservation and savings opportunities at the premises of the audit sites in a systematic manner.

The audit process is carried out as per the following.

1) Review of energy saving opportunities and measures implemented in the audit sites.
2) Identification of additional various energy conservation measures and saving opportunities.
3) Implementation of alternative energy resources for energy saving opportunities and decision making in the field of energy management.
4) Providing a technical information on how to build an energy balance as well as guidance to be sought for particular applications.

Dr.D. S. Bormane
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5) Detailed analysis on the calculation of energy consumption, analysis of latest electricity bill of the campus, understanding the tariff plan provided by the central and State Electricity Board
6) Use of bulb and tube lights, fans, air conditioners, equipment and instruments installed in the organization
   (for example- 60-watt bulb x 4hours x number of bulbs = kwh).

4. PROBLEM STATEMENT – INCREASING GLOBAL CARBON FOOTPRINT

#What is a carbon footprint? : A carbon footprint is the total amount of greenhouse gases (including carbon dioxide and methane) that are generated by our actions.

The average carbon footprint for a person in the United States is 16 tons, one of the highest rates in the world. Globally, the average carbon footprint is closer to 4 tons. To have the best chance of avoiding a 2℃ rise in global temperatures, the average global carbon footprint per year needs to drop to under 2 tons by 2050.

Lowering individual carbon footprints from 16 tons to 2 tons doesn't happen overnight! By making small changes to our actions, like eating less meat, taking fewer connecting flights and line drying our clothes, we can start making a big difference.

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5. METHODOLOGY

In order to conduct an energy audit, several methods are adopted in the audit sites in which walk-through audit is conducted. The balance of total energy inputs with total energy outputs and identification of all energy streams in a facility are taken into account. The amount of energy used by each of its energy streams are calculated.

The top three operating expenses of the Organization are typically observed to be energy (Both electrical and thermal), labour and materials. During the audit, physical verification of Lighting, Ceiling, Table and Exhaust Fans, A/C machines, verification of installed energy efficient system's capacities are carried out. Inspection of when the cost or prospective cost savings in each of the above components are considered, energy always wins, and the energy management task becomes a key cost reduction area. The energy audit assisted in better understanding how energy and fuel are used in the Organization as well as identifying waste factors and development. potential towards energy savings opportunities. Finally, after the audit process, the energy audit included suggestions for energy cost reduction, preventive maintenance and quality control activities, all of which are critical for the utility operations in the auditee (Organization). The audit involved visiting the campus and physical verification of the loads and sources installed. The entire campus is divided into different sections and those sections are audited in which electrical fittings and energy supply are monitored.

The production process flow is studied and electricity consumption are measured. Location of electrical machines, conditions of them and their accessories are inspected through physical verification. The energy bill from the supply is audited and assessed for the load demand requirement and efficient consumption of energy. Stakeholders are interacted with the scope for improvement and energy management during the audit. Potential areas in which the scope of energy conservation and saving opportunities available in the current context have been identified and suggested for implementation to the Organization. The level of carbon dioxide might be measured in different places across the Organization using a portable CO_2 Analyzerto calculate the carbon footprint. It may be useful to check where carbon emission is prominent which could be taken into account to reduce.

6. PROCESS

Steps Involved

Step 1: Opening meeting among the audit team.

Step 2: Planning and organizing the energy audit.

Step 3: Conduct a walk-through audit at different sites

Step 4: Macro data collection and listing observations.

Step 5: Analysis of data collected from the Organization.

Step 6: Best practices followed in the Organization towards energy savings

Step 7: Recommendations for further improvement.

7. PLANNING AND ORGANISING THE ENERGY AUDIT

1. Walk-through Audit Process,

   Simple audit, screening audit or visual audit are the other names, by which walkthrough audits are addressed. The main purpose of the walk-through audit is to obtain general information about the sites in which electrical energy is being used at the maximum. More specific information has been obtained from the maintenance and operational people during the time walk-through audit. It also included a walk-through of the facility to become familiar with the building's operation and a brief evaluation offacility utility bills (amount paid for electricity) and other operating data. During the audit the primary problem areas are discovered.

2. Macro Data collection and observation

   Current level operation and practices within the campus are assessed and then the data regarding the number of electrical loads connected in each section are collected. The power ratings of each component and their respective hours of operation are alsoobserved and documented for preparing the recommendations to the Organization.

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3. Measurements in the Energy Audit process

An energy audit required measurements, such as the energy identification and quantification, and these quantities necessitate the instruments used in a consistent way. Some of the basic electrical parameters are monitored during the energy audit such as Voltage (V), Current (I), Kilowatt (KW) and other parameters that are analysed during the audit depending upon the requirements.

8. SAMPLE CALCULATION

(Here 1 Tube light consumes 40 watts and 1 fan consumes 60 watts electricity.)

SR. NO.	FLOOR	POWER CONSUMPTION OF DEVICES PER FLOOR In KW	ENERGY UNITS CONSUMED PER DAY In KWH	PROPOSED POWER CONSUMPTION PER DAY In KWH	WATT CONSUMPTION AFTER REPLACING In KW *8
1.	1st	7.780	62.240	9.648	6.574
2.	2nd	13.780	110.240	17.856	11.548
3.	3rd	22.360	178.880	36.432	17.806
4.	4th	16.400	131.200	23.608	13.448
TOTAL		60.320	482.560	87.554	395.008

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Cost analysis:

(Assuming daily 8 hours of operations and electricity at prevailing rate given below)

SR.NO.	ELECTRICITY BILL TILL NOW PER MONTH In INR	PROPOSED SAVINGS PER MONTH In INR	ELECTRICITY BILL AFTER SAVING PER MONTH In INR
1	65,145	11,820	53,326

(Rate of Electricity considered

0 to 100 units at Rs.3.50 per unit. 101 to 300 units at Rs 7.34 per unit and 301 to 500 at Rs. 10.37 per unit and above 500 units its Rs 11.86 per unit. Other charges extra)

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9. CONCLUSION

Considering the fact that the organization is a well-established, long time run establishment with good reputation, there is significant scope for conserving energy and make the campus as self-sustained in it. The energy conservation initiatives taken up by the institution are substantial.

Energy efficient lighting schemes, awareness created among stakeholders and necessary power backups are being practiced by the institution. There are some best Practices followed on Energy Audit in the Organization like Transformers, Generators and UPS are protected properly with fencing and kept awareness boards on 'Dangers' and 'Warnings'.

It is observed that the most of places, sign board of 'Switch ON' and 'Switch OFF' are kept towards saving energy measures to the stakeholders. Electrical wires, switch boxes and stabilizers are properly covered without any damage which will cause any problems to the staff and student members.

Adaptation of sprinkler irrigation in the campus to minimize the energy potential are well appreciated.

Few recommendations, in addition, can further improve the energy savings of the Organization. This may lead to the prosperous future in context of Energy Efficiency Campus and thus sustainable environment and community development to the stakeholders in coming years to come.

Reference

1. Energy Literacy training program