

ENERGY AUDIT REPORT



AGGARWAL COLLEGE

Ballabgarh

February - 2023

ENERGY AUDIT SERVICES

1116, SECTOR # 17

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ACKNOWLEDGEMENT

The management is very much dedicated to the cause of Energy Efficiency. **Several effective steps have already been undertaken for the objectives of Energy Efficiency.**

The management is keen for furthermore Energy Saving and with this objective, we have been awarded this assignment for Energy Audit.

We **express our sincere thanks** to the management for awarding this prestigious assignment to us.

We are **very much thankful to Shri KRISHNA KANT Ji and his team** for providing to us all the support and the best possible co-operation to carryout elaborate measurements and critical studies, **related to Energy Efficiency**

We express our sincere thanks **to Mr. Manmohan Singla**, for taking very keen interest in the Assignment and providing us, day –today coordination for conducting the Assignment.



(R. B. SINHA)

ENERGY AUDIT SERVICES



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CHAPTER # A

INTRODUCTION

Aggarwal College is located at Ballabgarh and was established in the year 1971, with the sole mission to make accessible & affordable quality higher education to the students of rural areas. The college is affiliated to M.D. University, Rohtak and aided by Government of Haryana, is included under section 2(f) and 12(B) of UGC.

The College is being run in three campuses, simultaneously. There are 3 Wings: Wing # 2 (Co-ed. in Arts, Commerce and Science faculty), Milk Plant Road, Sector-2, Ballabgarh and Wing # 3 (Co-ed. for Vocational Courses), Tigaon Road, Ballabgarh. Since 2009, the college has been running a number of Job Oriented short term Courses which can be pursued along with regular courses.

These **Add- On Courses** are accounting on Computers, Functional English, Web Designing & Office Automation, Retail Marketing, Accountancy & Tax Procedure and Computer Hardware & Maintenance which are run with an assistance provided by University Grants Commission.

CHAPTER # B

EXECUTIVE SUMMARY

We have carried out the assignment for **Energy Audit** during the month of January-February, 2023. We have carried out **very elaborate measurements** for various Operating- Parameters, covering each area. We have **critically examined** the effectiveness of Energy being consumed in the entire college consisting of three Areas i.e. B.Ed. Building, Wing-II and Wing-III.

- **MAIN OBSERVATIONS**

Various effective steps have already been undertaken for Energy Efficiency. Some of the achievements are being illustrated here with.

1. **LED Lamp:** - Some of the old conventional Lights are being replaced by Energy Efficient LED Lamps, in phases.
2. Some of the '**non star rating**' **AC Units** are being replaced by Energy Efficient AC Units, in phases.
3. Old Sewage Pump has been already replaced with Energy Efficient Pump.
4. **Solar Energy** # In line with the latest trend for Solar Power Generation, Solar Power generation system has already been commissioned for Wing # II, Wing # III & B.Ed. Building.

Actual Power generation, under **normal situation measured to be about.**

- a) Wing # II – 25 KVA Rated - **18.1 KW** Generating Instantly
- b) B.Ed. Building - 36 KVA Rated - **23.0 KW** Generating Instantly.
- c) Wing # III - 90 KVA Rated – **Under Maintenance**

This is **very encouraging step for Energy Conservation.**

- **OUR OBJECTIVE**

To determine what further Energy Saving can be achieved, on the **most practical lines.** Our thrust has been towards **hidden losses & Technical up- gradation.**

- **PROPOSALS for further ENERGY SAVING**

We have identified several areas, having significant potential for further more Energy Saving.

- **ENERGY AUDIT REPORT**

Each area has been covered with elaborate details, in the respective Chapters. We have provided elaborate Technical details as well as Cost - benefit calculations for each Proposal for Energy Saving.

Various Options for Energy Saving: - Various Proposals for Energy Saving has been illustrated in **Chapter # C**, for the quick reference of the senior Management.

For the details, the respective Chapters may please be referred.

❖ Summary of Various Proposals for Energy Saving

SUMMARY OF Various Proposals

1. Expected saving has been worked out on the **annual basis**.

Sl. No.	PARTICULARS	Unit Rate	Expected annual Saving		Estimated Cost of Implementation (Rs. Lac)
			Qty.	Amount (Rs. Lac)	
1	Electricity	Rs. 7.39 per Unit	5747 Units	0.425	0.40
2	Power Factor Improvement Wing-II	6.65 Per KVAH	2124 Units	0.14	Routine Maintenance
3	Power Factor Improvement Wing-III	7.00 Per KVAH	16,119 Units	1.13	Routine Maintenance
4	TOTAL	-	-	1.70	0.40

Energy Audit Report – Aggarwal College, Ballabhgarh

- Amount of Expected Annual Saving = **Rs. 1.70 Lac**
- **Estimated Cost** = **Rs. 0.40 Lac**
- Simple payback Period **≈ 3 Months**
- **Expected Energy Saving works out to be @ 11 % of the total Energy cost.**
- It may please be appreciated that each Proposals for Energy Saving are on the **most practical lines.**

- We **sincerely thank** the Management for **extending the best possible co-operation** to us to carry out the Assignment.


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ENERGY AUDIT SERVICES

CHAPTER # C

OPTIONS for ENERGY SAVING

C.1 INTRODUCTION

All the options for Energy Saving have been worked out in the respective Chapters, with elaborate details and are being summarized herewith.

Objectives: Main objective would be to monitor the necessary implementation, **Very effectively**. This will also be **very helpful for the successful implementation as well as** the status of Implementation, at any stage.

SUMMARY OF Various Proposals

1. Expected saving has been worked out on the **annual basis**.
2. Cost of Implementation, for Routine Maintenance has been excluded.

Sl. No.	PARTICULARS	Unit Rate	Expected annual Saving		Estimated Cost of Implementation (Rs. Lac)
			Qty.	Amount (Rs. Lac)	
1	Electricity	Rs. 7.39 per Unit	5747 Units	0.43	0.40
2	Power Factor Improvement Wing-II	6.65 Per KVAH	2124 Units	0.14	Routine Maintenance
3	Power Factor Improvement Wing-III	7.00 Per KVAH	16,119 Units	1.13	Routine Maintenance
4	TOTAL	-	-	1.70	

					0.40
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- Amount of Expected Annual Saving = **Rs. 1.70 Lac**
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- It may please be appreciated that each Proposals for Energy Saving are on the **most practical lines.**
- We **sincerely thank** the Management for **extending the best possible co-operation** to us to carry out the Assignment.


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OPTIONS FOR ENERGY SAVING

Sl. No.	Area	Option for Energy Saving	Expected Saving – Qty.	Estd. Cost (Rs. Lac)	Ref.	Remarks
1	Power Factor Improvement (Wing-II)	<p>Annual Average P.F. = 0.96 level</p> <p>It is necessary to improve Power Factor to 0.99 level, as Energy charges is based upon KVAH consumption.</p> <p>Please refer TABLE # 11, Table # 12 and GRAPH # P for the details.</p> <ul style="list-style-type: none"> PROPOSAL <p>Auto P. F. Panel has already been provided. To make Auto P.F. Panel – Operational.</p> <p>Please refer F.4 for the details.</p>	<p>2,124 Units (KVAH)</p> <p>Rs. 0.14 Lac</p>	Routine Maint.	<p>Table # 11</p> <p># 12</p> <p>Graph # P</p> <p>F.3</p>	

OPTIONS for ENERGY SAVING

Sl. No.	Area	Option for Energy Saving	Expected Saving – Qty.	Estd. Cost (Rs. Lac)	Ref.	Remarks
2	Power Factor Improvement (Wing-III)	<p>Annual Average P.F. = 0.90, based upon Electricity Billing</p> <p>Please refer TABLE # 13 & # 14 and GRAPH # Q for the details. However, on actual measurement (during Audit) Power Factor observed to be Unity – Excellent.</p> <p>It is necessary to improve Power Factor, as Energy charges is based upon KVAH consumption.</p> <ul style="list-style-type: none"> PROPOSAL To make Auto P.F. Panel work effectively. 	<p>16,119 Units</p> <p>Rs 1.13 Lac</p>	Routine Maint.	<p>Table # 13 # 14 Graph # Q F.4</p>	

OPTIONS for ENERGY SAVING

Sl. No.	Area	Option for Energy Saving	Expected Saving – Qty.	Estd. Cost (Rs. Lac)	Ref.	Remarks
3	36 Watt, Tube Light	<p>There are 139 nos. 36 Watt, Tube Lights with Electronics Chokes. Please refer Tables # 15 for the details.</p> <ul style="list-style-type: none"> ❖ PROPOSAL: - To replace all these Tubes by 20 Watt, LED. ❖ Please refer Table # 15 and G.7 for all the details 	<p>4375 Units Rs. 32,331/-</p>	<p>Rs. 34,750/-</p>	<p>Table # 15 G.7</p>	<p>SPP = 1 Year</p>
4	40 Watt, Tube Light	<p>There are 28 nos. 40 Watt, Tube Lights with Electronics Chokes .Please refer Tables # 15 for the details.</p> <ul style="list-style-type: none"> ❖ PROPOSAL: - To replace all these Tubes by 20 Watt, LED. Please refer Table # 15 and G.8 for all the details 	<p>1372 Units Rs. 10,139/-</p>	<p>Rs. 4500/-</p>	<p>Table # 15 G.8</p>	<p>SPP = 6 M</p>

CHAPTER # D

ANNUAL ENERGY COST

D.1 Brief Description

There are three sources for Energy at this college:-

1. Electricity from DHBVNL
2. Diesel Consumption in D.G. Sets
3. Electricity generated from **Rooftop Solar Panels** (Installed on Wing # II, B.Ed. Building & Wing # III recently). For Wing # III, Solar Power System is under Maintenance.

D.2 Electricity Billing Cost (Annual)

There are 3 nos. Incomers from **DHBVNL**.

Monthly Electricity Billing has been studied with elaborate details in **CHAPTER- F**

TABLE # 1

Annual Electricity Cost – 2022

Sl. No.	Particulars	B.Ed.	Wing # II	Wing # III
1	Reference	Table # 10	Table # 11	Table # 13
2	Annual Electricity Consumption (Purchased from Electricity Board)	16,334 Units	79,267 Units	49,121 Units
3	Annual Cost (Rs.)	Rs 1.13 Lac	Rs 5.86 Lac	Rs 6.31 Lac
4	Remarks			

Total Electricity Purchased = 1,44,722 Units

Total Annual Electricity Cost = Rs 13.30 Lac

Table # 2

Annual Solar Units, Year - 2022

Sl. No.	Particulars	B.Ed.	Wing # II	Wing # III
1	Reference	Table # 10	Table # 11	Table # 13
2	Annual Solar Unit Generation	30,860	27,662	64,690
3	Annual Solar Consumption Unit	13857	22028	43096
4	Annual Solar Unit Export to DHBVNL	17,003	5,633	21,594
5	Remarks	Export of Power – Outstanding Achievement		

D.3 HSD Consumption

It has been observed that the operating data for D.G. Sets is not being maintained properly. There are no record for units generation.

Table # 3

Annual HSD Consumption

in Wing- II & B.Ed. - 2022

125 KVA DG Set, HSD Consumption- Wing-II & B. Ed					
Sl. No.	Date	Lit	Rs./Lit	Amount Rs.	R. Hrs
1	21.12.2021	400	87.41	34964	35
2	27.05.2022	300	97.39	29217	36
3	07.07.2022	400	90.33	36132	27
4	14.11.2022	400	90.33	36132	0
5	Total	1500	91.37	1,36,445	98 Hours

Table # 4
Annual HSD Consumption in Wing-III – 2022

125 KVA DG Set, HSD Consumption Wing-III				
Sl. No.	Date	Lit	Rs/Lit	Amount
1	07.02.2022	200	87.41	17482
2	07.05.2022	200	97.39	19478
3	15.07.2022	200	90.33	18066
4	19.09.2022	200	90.33	18066
5	Total	800	91.37	73,092

- Total annual HSD Consumption = 1500 + 800
= 2,300 Lit

D.4 Annual Energy cost - 2022

From Table # 1, # 3 & # 4

- Electricity Cost = Rs. 13.30 Lac
- HSD Cost = Rs. 2.095 Lac

➤ Total Annual Energy Cost = Rs. 15.40 Lac

CHAPTER # E

POWER SYSTEM

E.1 Brief Description

LT Power Supply, for B.Ed. and Wing # 2 # LT Power Supply is received directly from Pole.

- ◆ **Wing -III** :- One Step Down Transformers for LT Power Supply
Rated capacity of Wing # 3 Transformer = **200 KVA**
- ◆ **Wing -II** :- One LT Transformer 66 KVA Pole Mounted.
- ◆ **B.Ed.-** One LT Transformer 66 KVA Pole Mounted.

E.2 Power Measurement Data

Elaborate Measurement for all power parameters carried out for all the 3 nos. Incomers.

Summary of all the measurement data is tabulated as Following **Table # 5**

◆ Solar Power

All the measurement data is tabulated in **TABLE # 6, # 7 & # 8**



B.Ed. Building, Main Incomer

Table # 5

Main Incomer Power Measurement Data

Date: 31.01.2023

Sl. No.	Parameters	Main I/C	Main I/C	Main I/C
1	Location	Wing-II (Milk Plant Side)	B.Ed. (Milk Plant Side)	Wing-III (S/F Side)
2	Rated Capacity, KVA	66	66	60
3	Voltage	435	442	420
4	Current	37.3	24.6	19.2
5	Power – KW	27.6	17.5	13.7
6	Power Factor	0.98	0.93	0.98
7	Power - KVA	28	18.8	14
8	Loading -%	43%	29%	23%
9	V - THD %	1.8	1.5	1.5
10	A - THD %	16.4	3.9	11.0
11	Remarks			

E.4 Power Measurement Data

On the identical Line, power parameters measured for Wing # II, Wing # III & B.Ed. Building.

Summary of all the measurement data is tabulated as Following.

B.Ed. - Table # 6

Wing # 2 - Table # 7

Wing # 3 - Table # 8

Wing # 3 ,TR Details

Sr. No.	Rated Specifications	TR Wing # 3
1	Make	Trecser Industries
2	KVA	60
3	Input Voltage	300-460
4	Output Voltage	415+- 20%
5	Type of Cooling	ON
6	Frequency	50
7	Ambient	45
8	Year	2003

- TR Outer condition as per visual is not OK. Need to clean the TR outer area.



- Wing-III Main Transformer, Dust on the Transformer,
- please improve Cleaning.

Table # 6

B.Ed. Main Incomer (Grid + Solar + Capacitors)

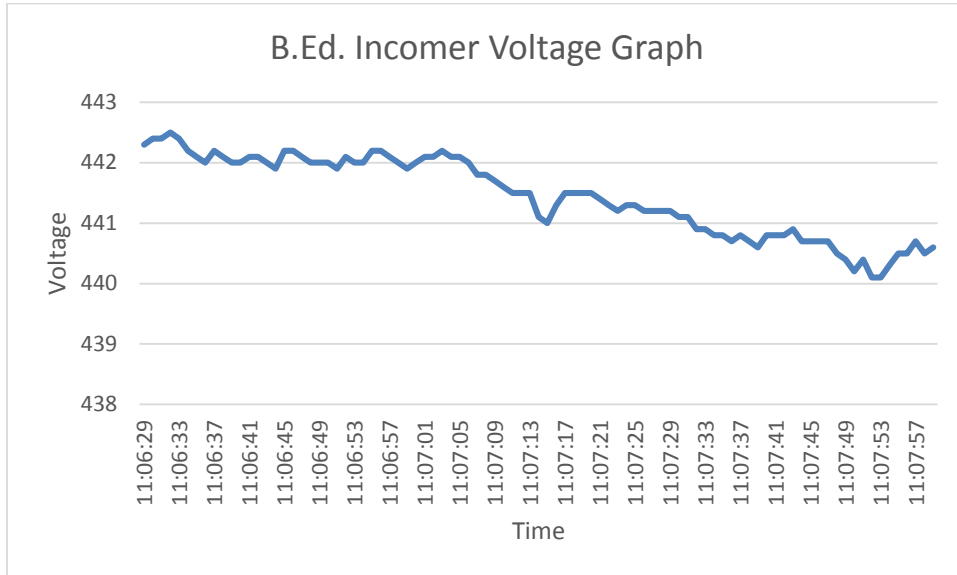
Power Measurement Data

Sl. No.	Name Of Drive	Plant Ref.	Motor	Load Data				Remarks
				Voltage	Current	KW	PF	
1	Incomer	B.Ed. (Milk Plant Side)	66 KVA	442	24.6	17.5	0.93	Sanctioned Load- 40 KW
2	Solar Generation	B.Ed.	36 KVA	447	23	17.7	0.996	12:22 PM
3	Capacitors Panel	B.Ed.	46 KVAR	439	5.60	4.2 KVAR		Make – EPCOS Auto Working
				435	7.50	5.6 KVAR		
				438	7.70	5.8 KVAR		
4	Submersible Pump	B.Ed.	3.7 KW	431	8.4	3.8	0.60	6 Hrs/Day

◆ **Solar Power Generated = 17.7 KW**

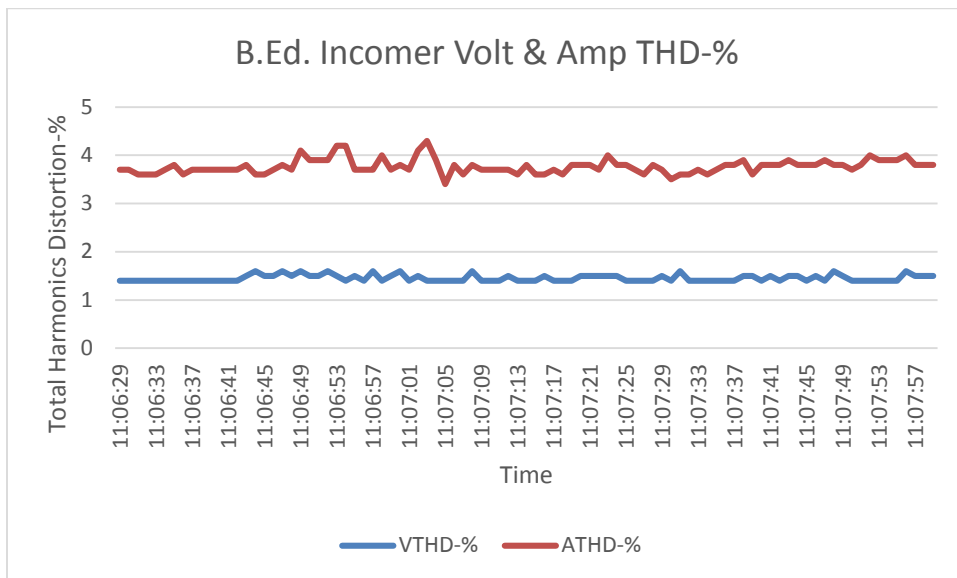
Graph # A

B.Ed. Incomer Voltage Graph



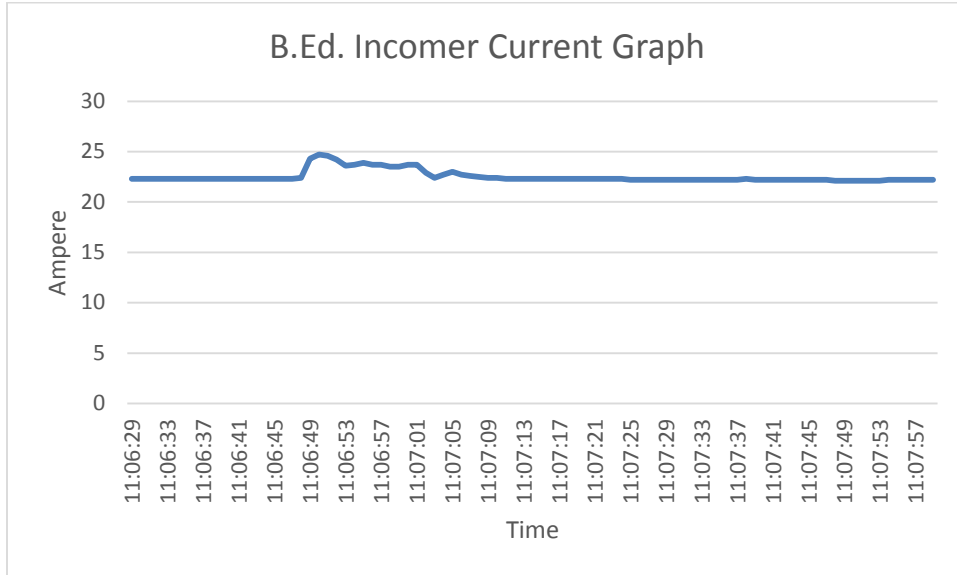
Graph # B

B.Ed. Incomer 3 Total harmonis Distortions Voltage & Current



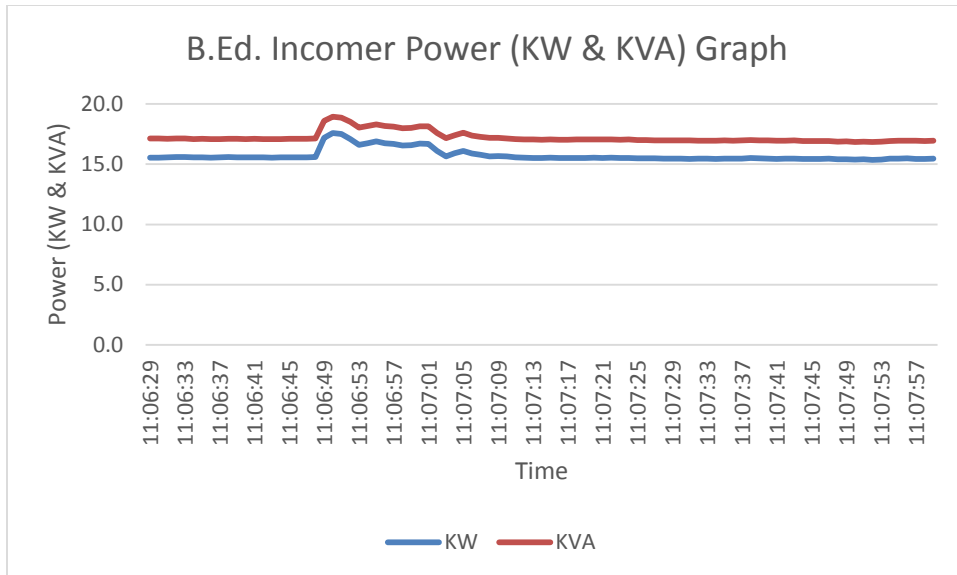
Graph # C

B.Ed. Incomer load current



Graph # D

B.Ed. Incomer Power (KW & KVA) Graph



Graph # E

B.Ed. Incomer Power Factor Graph

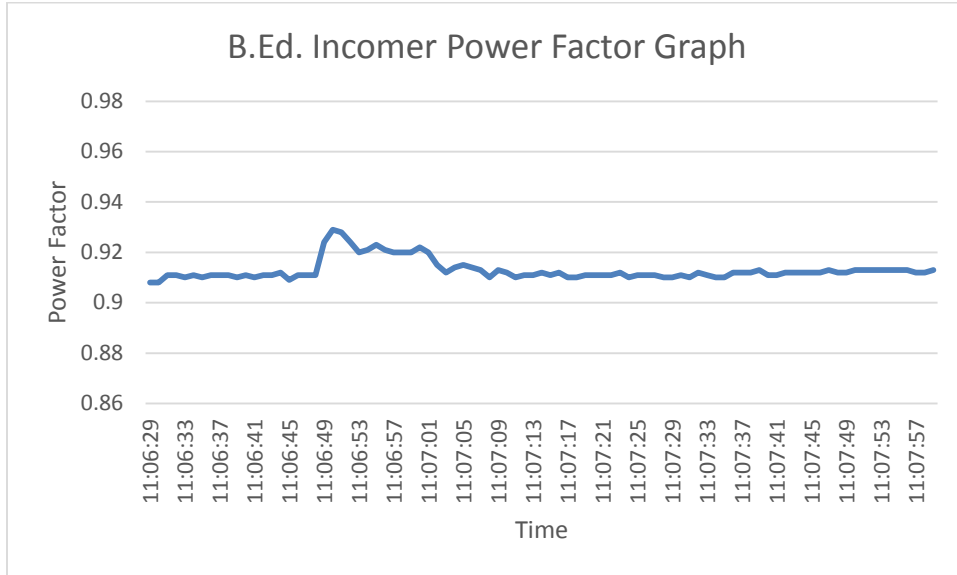
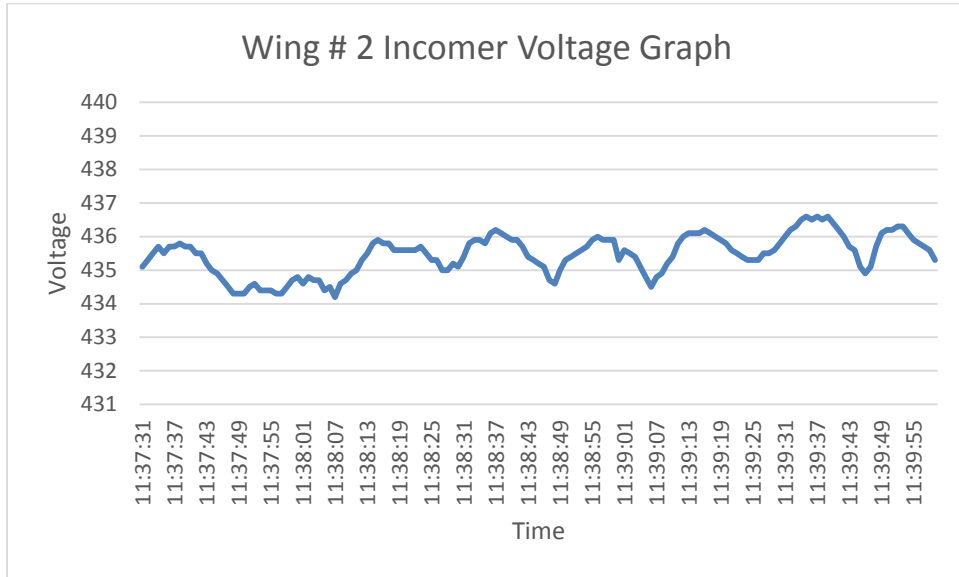


Table # 7
Wing-II, Main Incomer (Grid + Solar + Capacitors)
Power Measurement Data

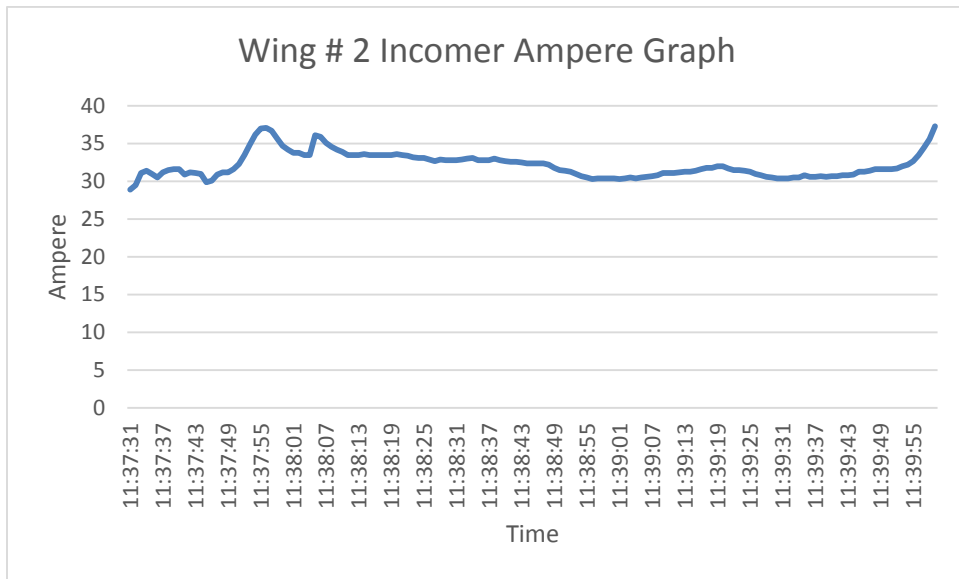
Sl. No.	Name Of Drive	Plant Ref.	Load	Load Data				Remarks
				Voltage	Current	KW	PF	
1	Incomer	Wing-2 (Milk Plant Side)	66 KVA	435	37.3	27.6	0.98	Aggarwal Sabha, Sanctioned Load-40 KW
2	Solar Generation	Wing-II	25 KVA	443	24	18.3	0.994	12:19 PM
3	Capacitors Panel	Wing-II	29 KVAR	Not working properly, Panel Mismanaged				Make – EPCOS Auto Working
4	Submersible Pump		2 HP	237	7.1	1.5	0.91	Single Phase - 13 Hrs
5	Sewage Pump		5 HP	237	16.7	3.5	0.89	Single Phase- 2 Hrs
6	R.O. 200 Ltr. Cap	Total Load, 2 Small Motor		237	7.6	1.6	0.88	12 Hrs

◆ **Solar Power Generated = 18.3 KW**

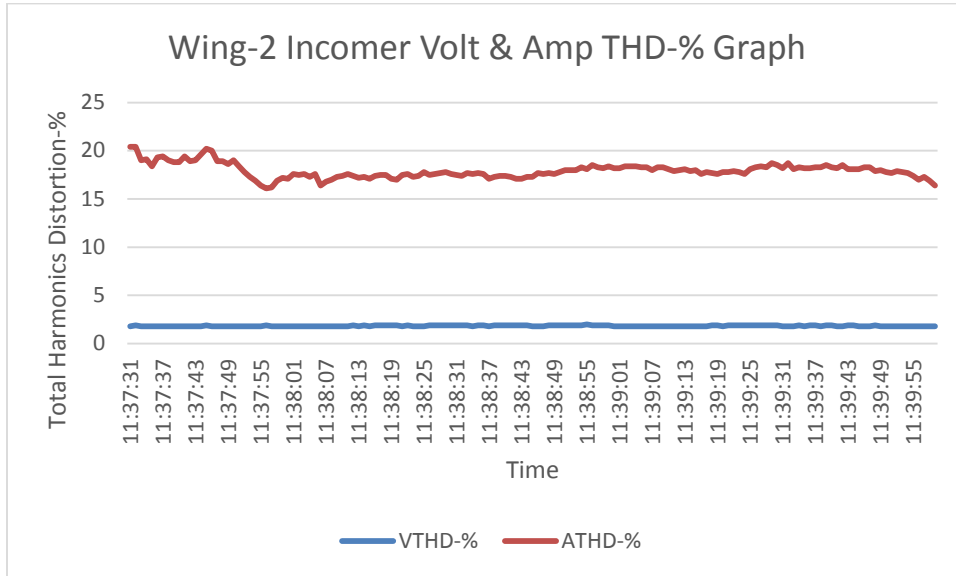
Graph # F
Wing # 2, Incomer Voltage



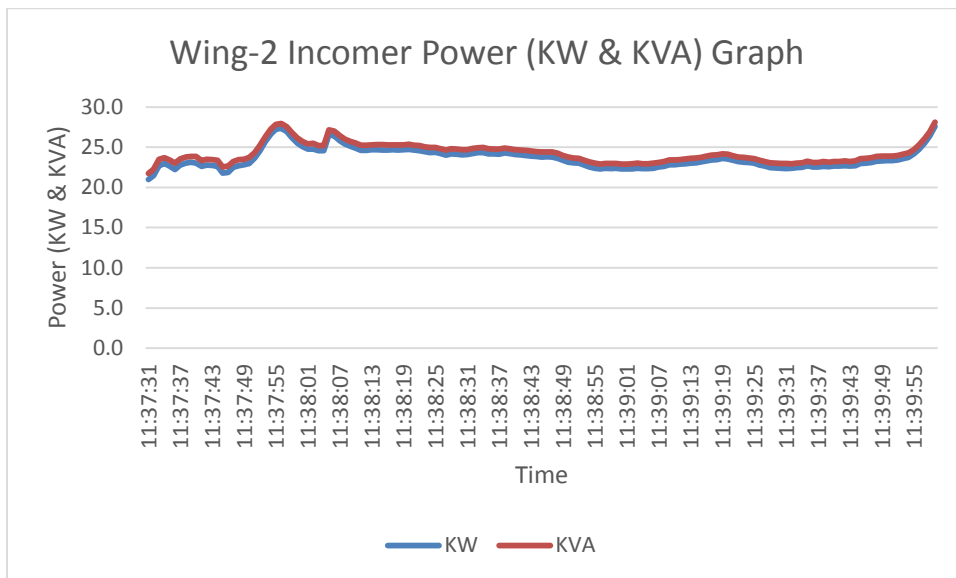
Graph # G
Wing # 2 Incomer Load Current



Graph # H
Wing # 2 , Total Harmonics Distortion
Incomer Voltage & Current :- THD %



Graph # I
Wing # 2 Incomer Power (KW & KVA)



Graph # J
Wing # 2 Incomer Power Factor

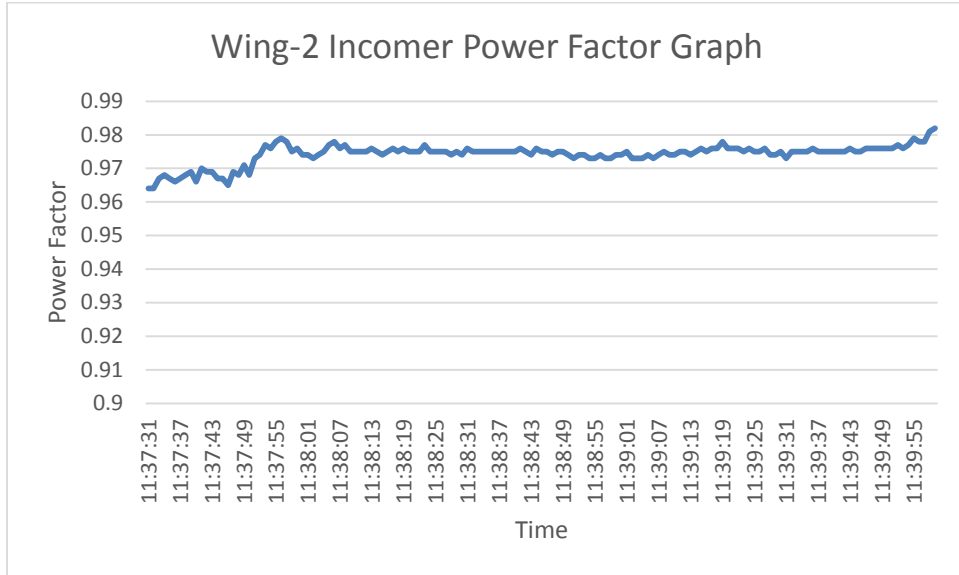


Table # 8

Wing-III, Main Incomer (Grid + Solar + Capacitors)

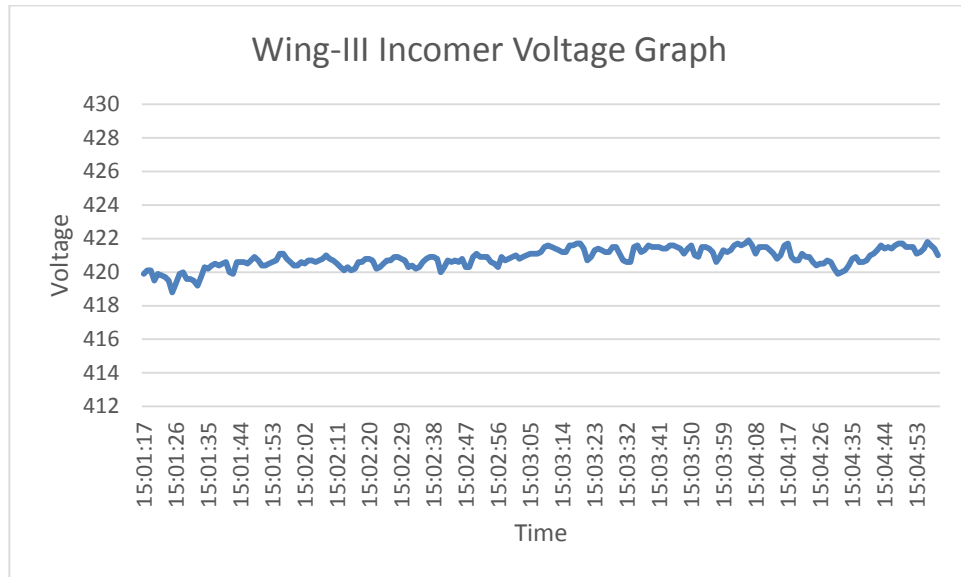
Power Measurement Data

Sl. No.	Name Of Drive	Plant Ref.	Motor	Load Data				Remarks
				Voltage	Current	KW	PF	
1	Incomer	Wing-3 (Self Finance Side)	60 KVA	420	19.2	13.7	0.98	President S/F
2	Solar Generation	Wing-III	90 KVA	Under Maintenance				
3	Capacitors Panel	Wing-III	70 KVAR	Not Approachable				Make – EPCOS Auto not Working
4	Submersible Pump		3 HP	225	11.8	2.64	0.994	
5	Sewage Pump		1 HP	225	3	0.49	0.73	

◆ **Solar Power Generation** – Under maintenance

Graph # K

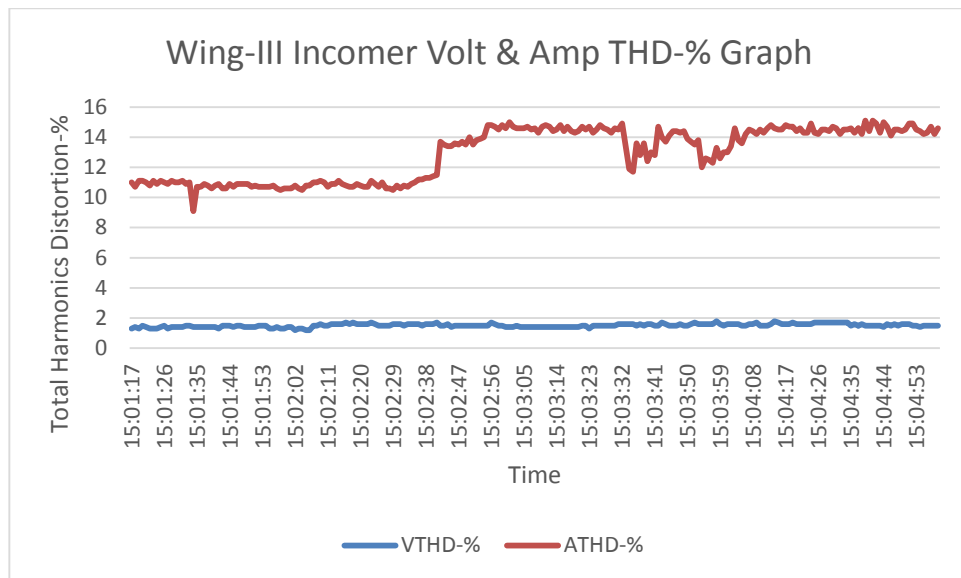
Wing-III, Incomer Supply Voltage



Graph # L

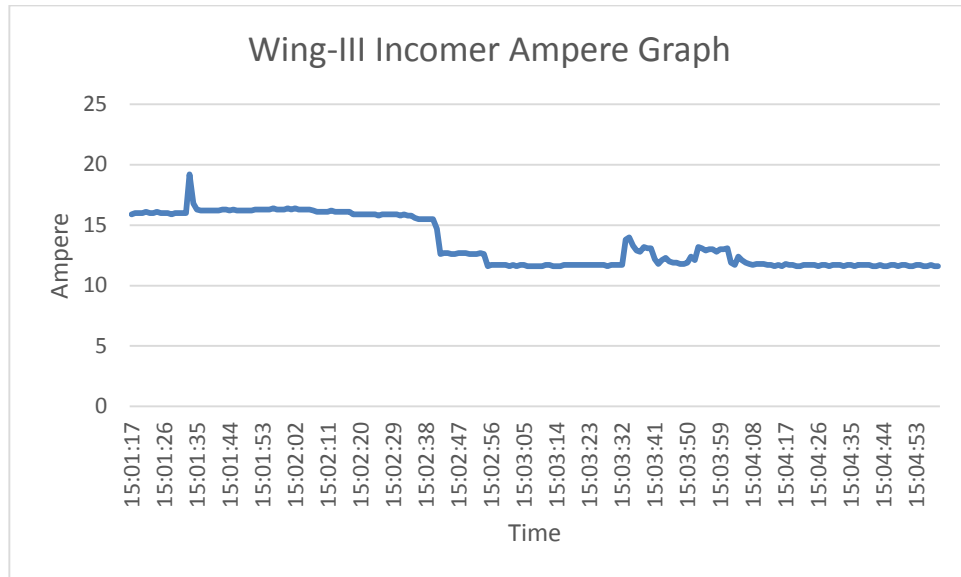
Wing-III Incomer; Total Harmonics Distortions

Voltage & Current # THD-% Graph



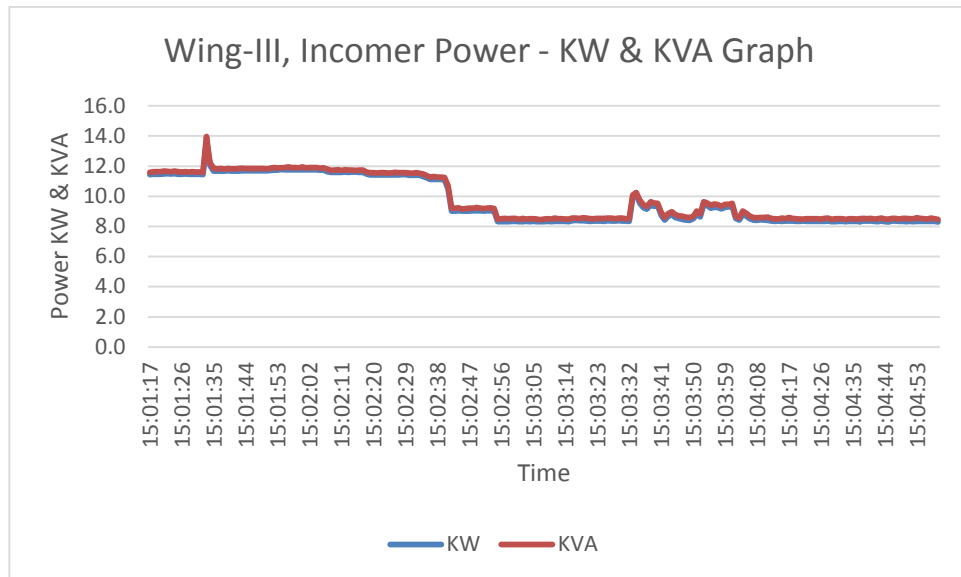
Graph # M

Wing-III, Incomer Load current Graph

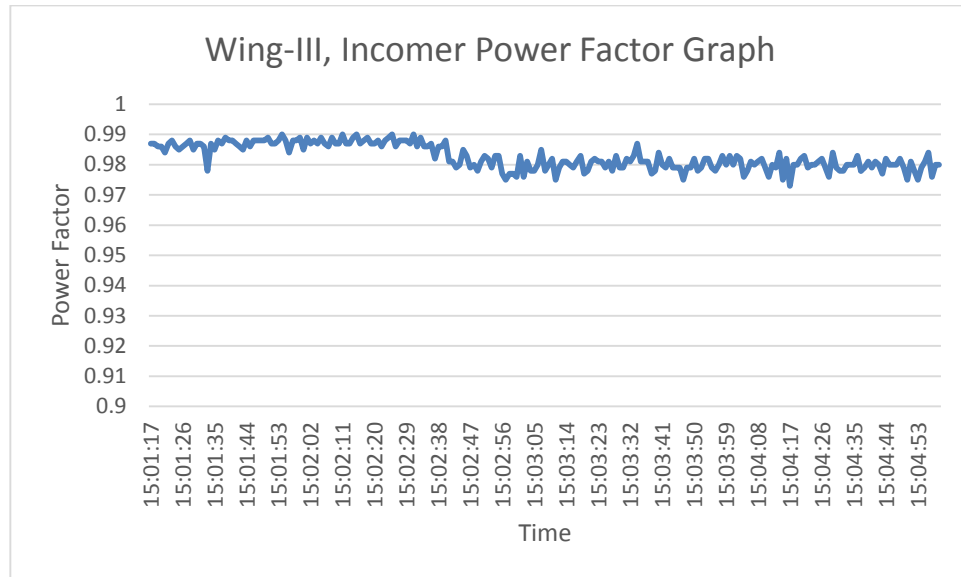


Graph # N

Wing-III Incomer Power – KW & KVA Graph



Graph # O
Wing-III; Incomer Power Factor



E4.1 Data Analysis

B.Ed. Incomer - 17.50 KW

Wing # II - 27.60 KW

Wing # III – 13.50 KW

- ❖ Total Power consumption = 58.60 KW
- ❖ Solar Power Generation = 36.0 KW
- ❖ Solar Power Generation amounts to be @ 38 % of the Total requirement
- ◆ **Power Factor** – By the measurement data

B.Ed. – Power factor – 0.93 level

Wing # II – Power factor – 0.98 level – Excellent

Wing # III – Power factor – 0.98 level – Excellent

Conclusion:-

During measurement, we found that Power Factor is Excellent, But Annual Electricity Billing Power Factor is lower in Wing-II & Wing-III

E.5 Auto P.F. Panels

All the three connection's i:e B.Ed., Wings-II and Wing-III have been provided with Auto P.F. Panels.

At the time of Load, Auto P.F. Panels for Wing-II and Wing-III and B.Ed. Building Auto P.F. Working Properly but at the time of No Load **Auto P.F. Panel was not working properly.**

E5.1 Capacitor Banks

We checked all the Capacitor Banks by measuring current in each phase of all the capacitor banks.

Summary of all the measurement data has been tabulated as following: -

Wing	Table #	Remarks
B.Ed.	Table # 9	O.K
Wing # 2	Table # 9	Needs Maintenance
Wing # 3	Table # 9	Needs Maintenance

Table # 9

Capacitor Panel (APFC)

Sl. No.	Name Of Drive	Location	Motor	Load Data				Remarks
				Voltage	Current	KVAR	Rated	
1	Capacitors Panel	B.Ed.	46 KVAR	439	5.60	4.2		
				435	7.50	5.6		
				438	7.70	5.8		
2	Capacitors Panel	Wing-II	29 KVAR	Not working properly, There are no provision to take reading separately.				
3	Capacitors Panel	Wing-III	70 KVAR	Not Approachable				

Wing # 3 ; Capacitors

Wing-3 APFC							
Sr. No.	Location	KVAR Installed	Rated Voltage (Volt)	Measured Parameters			KVAR Delivered
				Voltage	Ampere		
					R	Y	
1	Capacitor-1	20	440	Not Able to take load as panel was not approachable.			
2	Capacitor-2	10	440				
3	Capacitor-3	10	440				
4	Capacitor-4	10	440				
5	Capacitor-5	10	440				
6	Capacitor-6	5	440				
7	Capacitor-7	5	440				

- APFC of Wing # 3 is at height, so we were not able to take measurement of capacitors. At panel it is showing 0.99 PF. The panel must be installed at approachable height.



Wing # 2 Capacitors

Wing -1 APFC								
Sr. No.	Location	Make	kVAr Installed	Rated Voltage (Volt)	Measured Parameters			kVAR Delivered
					Voltage	Ampere		
						R	Y	
1	Capacitor Bank-1	EPCOS	10	440	Measurement was not possible, due to bad condition of the panel lots of cable connected in one bus bar there are no space to take measurement.			
2	Capacitor Bank-2	EPCOS	10	440				
3	Capacitor Bank-3	EPCOS	5	440				
			3	440				
			2	440				
			1	440				

CHAPTER # F

Monthly Electricity Billing

F.1 Monthly Electricity Billing

Power Supply is received from DHBVNL.

Monthly Electricity Billing has been studied for a period of one year duration, following parameters have been studied.

1. KWH Consumption during the month
2. Average Power Factor
3. KVAH Consumption during the month
4. Total Billing Amount
5. Average Billing Rate = $\frac{\text{Total Billing Amount}}{\text{Total KWH Consumption}}$

All the data for each Wing has been tabulated as following:-

B.Ed. Building	-	Table # 10
Wing # II	-	Table # 11
Wing # III	-	Table # 13

F.2 Energy Charges

Energy Charges is based upon KVAH Consumption.

$\text{KVAH} = (\text{KWH}) \div (\text{Power Factor})$

As such, Power Factor is of vital importance for cost reduction in Energy charges.

F.3 Power Factor

Monthly Power Factor has been analyzed for all the three nos. Feeders for Power supply for the 3 nos. Wings. Monthly Power Factor has been studied.

Table # 10
Monthly Electricity Billing
(B.Ed. Building)

B.Ed. College (3262469667)											
Sl. No.	Billing Month	Total Solar Gen. (KVHS)	Solar Export (KVHE)	Solar Unit Cons. (KVAH)	DHBVN Units (KVHI)	Total Consume Unit	Contract Demand (KVA)	Fixed Charge	Total Billing Amount	Avg. Billing Rate (Rs/Unit)	Remarks
1	Jan-22	1427	1080	347	1008	1355	49.9	6523	6654	6.60	
2	Mar-22	2900	2433	467	753	1220	49.9	5892	6009	7.98	
3	Apr-22	4306	3381	925	816	1741	49.9	6523	6653	8.15	
4	May-22	4200	1790	2409	1386	3795	49.9	6312	6439	4.65	
5	Jun-22	3505	1467	2038	1560	3598	49.9	6523	6693	4.29	
6	Jul-22	3311	1332	1979	2050	4029	49.9	6312	10764	5.25	
7	Aug-22	2310	916	1394	1586	2979	49.9	6523	11112	7.01	
8	Sep-22	2264	993	1271	1548	2819	49.9	6523	11877	7.67	
9	Oct-22	2095	756	1339	2305	3644	49.9	6312	18078	7.84	
10	Nov-22	1488	704	784	1378	2162	49.9	6523	12877	9.34	
11	Dec-22	1628	1070	558	937	1495	49.9	6312	8747	9.34	
12	Jan-23	1427	1080	347	1008	1355	49.9	6523	6654	6.60	
Total		30860	17,003	13857	16334	30191		76800	1,12,557	6.89	

F-4 Average Billing Rate

F4.1 B. Ed. Building

For calculating average billing rate of B.Ed. Building, for the month of Jan-22 to Jan-23 (Excluding February-22) has been considered.

Period – Jan-22 to Jan-23 (Excluding February)

Total KVAH Consumption = **16,334 Units**

Total Billing Amount = **Rs. 1, 12,557/-**

Average Billing Rate = $\frac{\text{Total Billing Amount}}{\text{Total KVAH Consumption}}$

$$= \frac{\text{Rs. 112557}}{16,334 \text{ Units}}$$

= **Rs. 6.89 per Unit**

Table # 11

Monthly Electricity Billing (Wing-II)

Aggarwal Sabha (8392490000) Wing-II

Sl. No.	Billing Month	Total Solar Gen. (KVAS)	Solar Export (KVHE)	Solar Unit Cons. (KVAH)	Units Consumed (KWHI)	Units (KVHI)	Total Consume Unit	Net Billed Unit (I-E)	Average Monthly P.F.	Contract Demand (KVA)	Fixed Charge	Total Billing Amount	Avg. Billing Rate (Rs/Unit)	Remarks
1	Jan-22	1387	1240	147	3787	3949	4096	2708	0.96	49	6523	26061	7.21	
2	Feb-22	1404	284	1120	4422	4630	5750	4346	0.96	49	6523	35463	6.66	
3	Mar-22	2470	745	1725	2583	2727	4452	1982	0.95	49	5892	19206	6.72	
4	Apr-22	3364	912	2453	3926	4113	6566	3201	0.95	49	6523	27866	6.67	
5	May-22	3174	377	2797	9155	9355	12152	8978	0.98	49	6312	64353	6.47	
6	Jun-22	2896	431	2465	10262	10467	12931	10035	0.98	49	6523	73149	6.64	
7	Jul-22	3402	252	3149	10085	10258	13407	10006	0.98	49	6312	72740	6.64	
8	Aug-22	1357	148	1209	9242	9582	10791	9434	0.96	49	6523	69149	6.64	
9	Sep-22	2133	237	1896	7171	7581	9477	7345	0.95	49	6523	55502	6.67	
10	Oct-22	2220	184	2036	9646	9944	11980	9760	0.97	49	6312	71203	6.65	
11	Nov-22	1999	427	1572	5383	5692	7264	5265	0.95	49	6523	41463	6.64	
12	Dec-22	1854	395	1459	3605	3894	5353	3499	0.93	49	6312	29562	6.64	
Total		27662	5,633	22028	79267	82192		76558	0.96		76800	5,85,717	6.65	

F4.2 WING # II

For calculating average billing rate of Wing-II, for the month of Jan-22 to Dec-22 has been considered.

Period – Jan-22 to Dec-22

Total KWH Consumption = **79267 Units**

Total Billing Amount = **Rs. 585717 /-**

Average Billing Rate = $\frac{\text{Total Billing Amount}}{\text{Total KWH Consumption}}$

$$= \frac{\text{Rs. 585717}}{79267 \text{ Units}}$$

= **Rs. 7.39 per Unit**

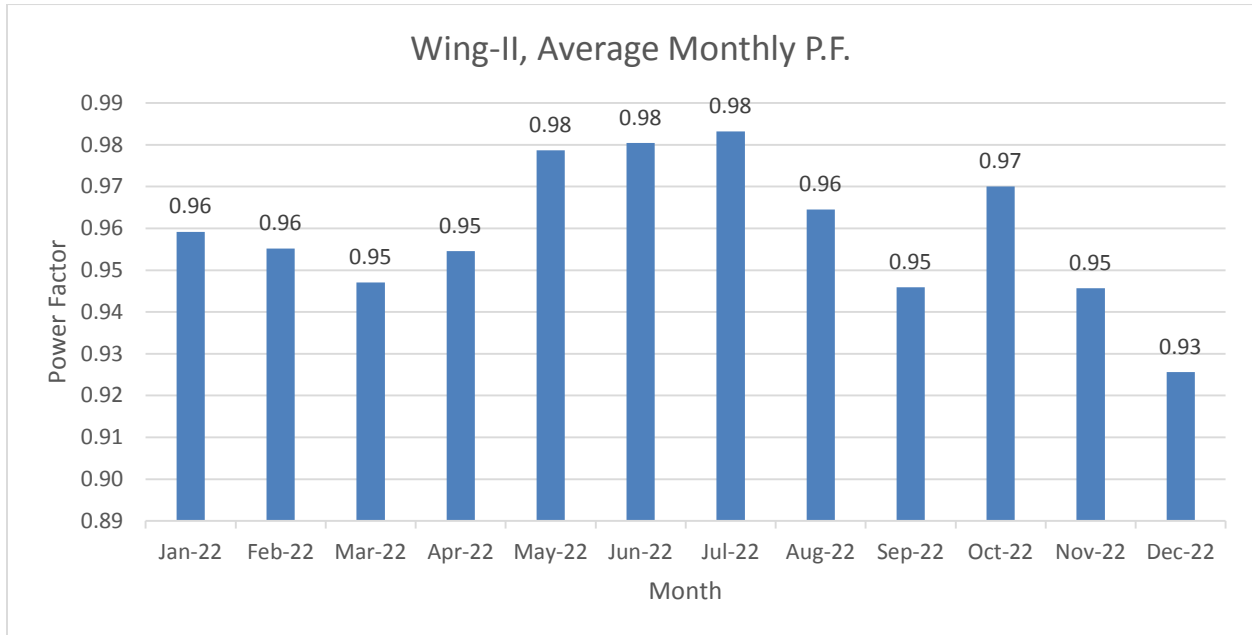
F.4.3 Wing # II Power Factor

Monthly Power Factor has been plotted on **GRAPH # P**

◆ **Conclusion** – There is some margin for the improvement.

Graph # P

Monthly Power Factor (Wing # II)



Monthly Power Factor (Wing # II)

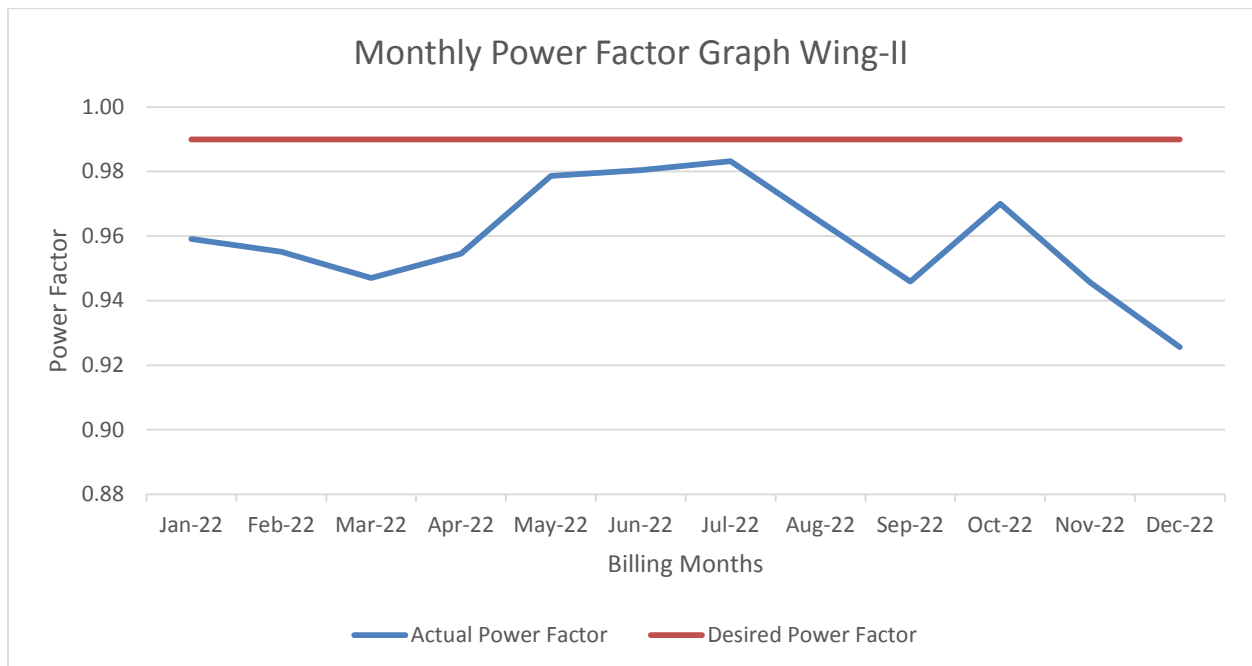


TABLE # 12
Expected Saving in KVAH Consumption WING # II
(At P.F. = 0.99)

Billing Month	Units (KVHI)	Units Consumed (KWHI)	Actual Power Factor	Desired Power Factor	Expected Unit Consumption in KVAH	KVAH Saving by improving P.F.
Jan-22	3949	3787	0.96	0.99	3826	123
Feb-22	4630	4422	0.96	0.99	4467	163
Mar-22	2727	2583	0.95	0.99	2609	118
Apr-22	4113	3926	0.95	0.99	3966	147
May-22	9355	9155	0.98	0.99	9247	107
Jun-22	10467	10262	0.98	0.99	10365	101
Jul-22	10258	10085	0.98	0.99	10187	71
Aug-22	9582	9242	0.96	0.99	9336	247
Sep-22	7581	7171	0.95	0.99	7244	337
Oct-22	9944	9646	0.97	0.99	9743	201
Nov-22	5692	5383	0.95	0.99	5437	255
Dec-22	3894	3605	0.93	0.99	3641	253
Total	82192	79267	0.96	0.99	80068	2124

F. 4.5 POWER FACTOR # WING-II

Power Factor for Wing # 2 has been plotted on **GRAPH # P**

It can be concluded that there is Marginal potential for PF improvement.

All the calculation has been carried out in **TABLE # 12**.

Expected Savings in KVAH consumption at P.F.	= 0.99
	= 2124 KVAH Units
@ Rs. 6.65 per KVAH	= Rs. 14121/-
Expected annual saving	= <u>Rs. 0.14 Lac</u>

F.4.6 Wing-II

Monthly Power Factor has been plotted on **GRAPH # P**

From **GRAPH # P**,

It can be concluded that Power Factor is mostly at the Level

= 0.90 generally

Desired Value = 0.99

Monthly Power Factor vs. Desired Power factor has been plotted, on Graph # A. It can be concluded that there is need for Improvement in Power Factor.

Expected Power Savings

KWH Consumption remaining the same, KVAH consumption will decrease as P.F. is improved in TABLE # 11, Following Data has been worked out for Wing-II

- a) Monthly KWH Consumption
- b) Monthly KVAH Consumption
- c) Av. Power Factor
- d) Total Billing Amount
- e) Av. Cost Rs KVAH
- f) KVAH Consumption.
- g) Expected Savings in KVAH consumption at P.F. = 0.99

Table # 13

Monthly Electricity Billing (Wing-III)

M/S President Aggarwal (7572601000) Wing-III														
Sl. No.	Billing Month	Total Solar Gen. (KVS)	Solar Export (KVHE)	Solar Unit Cons. (KVAH)	Units Consumed (KWHI)	Units (KVHI)	Net Billed Unit (I-E)	Average Monthly P.F.	Actual Max. Demand (KVA)	Contract Demand (KVA)	Fixed Charge	Total Billing Amount	Avg. Billing Rate (Rs/Unit)	Remarks
1	Jan-22	4619	2116	2504	2021	3671	1556	0.55	15.4	150	25225	37635	7.98	
2	Feb-22	4222	2383	1839	2113	3952	1569	0.53	16.2	150	25225	37740	7.98	
3	Mar-22	6613	4608	2005	1549	2976	0	0.52	16.2	150	25225	24468		
4	Apr-22	8265	4476	3789	1951	3318	0	0.59	17.4	150	25225	27141		
5	May-22	7456	1369	6087	4519	5551	4183	0.81	56.08	150	25225	50455	6.03	
6	Jun-22	7666	1422	6245	6592	7853	6431	0.84	56.08	150	25225	71332	7.17	
7	Jul-22	7444	1401	6044	5445	6560	5159	0.83	64.2	150	25225	61711	7.07	
8	Aug-22	4566	1005	3561	5770	7022	6017	0.82	48.28	150	25225	68357	7.17	
9	Sep-22	7805	1605	6200	3829	4766	3161	0.80	47.64	150	25225	45411	6.39	
10	Oct-22	4376	846	3530	6450	7272	6425	0.89	59.44	150	25225	69598	6.91	
11	Nov-22				6559	8702	8702	0.75	69.56	150	25225	86892	7.09	
12	Dec-22	1658	365	1292	2324	4094	3728	0.57	14.88	150	25225	50636	6.82	
Total		64690	21,594	43096	49121	65737	46932	0.75			302696	631376	7.00	

F4.7 WING # III

For calculating average billing rate of Wing-III, for the month of Jan-22 to Dec-22 has been considered.

Period – Jan-22 to Dec-22

Total KWH Consumption = **49121 Units**

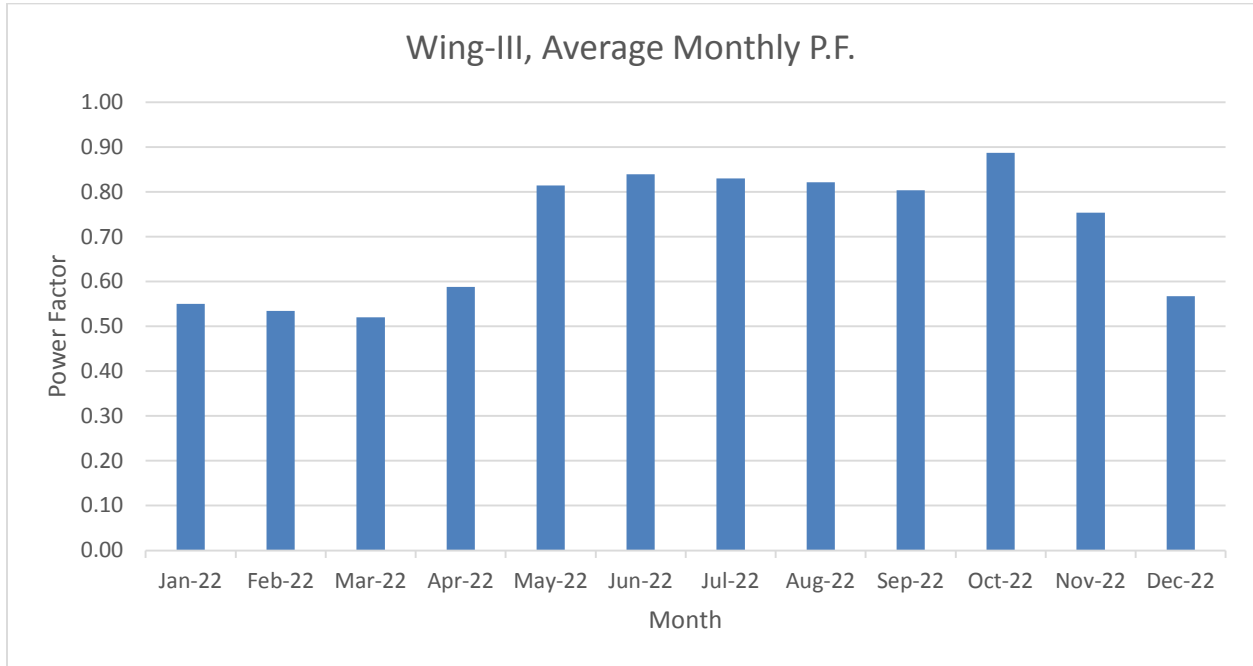
Total Billing Amount = **Rs. 631376/-**

Average Billing Rate = $\frac{\text{Total Billing Amount}}{\text{Total KWH Consumption}}$

$$= \frac{\text{Rs. 631376}}{49121 \text{ Units}}$$

= **Rs. 12.85 per Unit**

GRAPH # Q
Wing-III, Average Monthly P.F



Wing-III, Average Monthly P.F

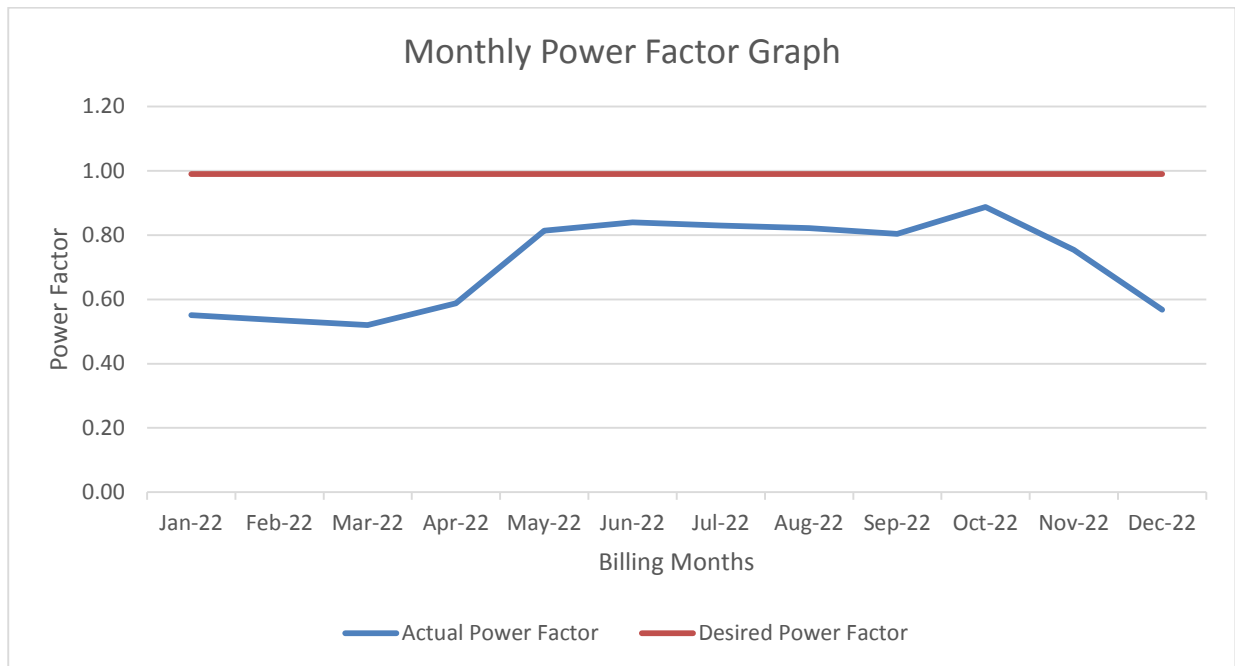


TABLE # 14

Expected Saving in KVAH Consumption WING # III

Billing Month	Units (KVHI)	Units Consumed (KWHI)	Actual Power Factor	Desired Power Factor	Expected Unit Consumption in KVAH	KVAH Saving by improving P.F.
Jan-22	3671	2021	0.55	0.99	2041	1630
Feb-22	3952	2113	0.53	0.99	2134	1817
Mar-22	2976	1549	0.52	0.99	1564	1412
Apr-22	3318	1951	0.59	0.99	1971	1347
May-22	5551	4519	0.81	0.99	4565	986
Jun-22	7853	6592	0.84	0.99	6659	1194
Jul-22	6560	5445	0.83	0.99	5500	1060
Aug-22	7022	5770	0.82	0.99	5828	1194
Sep-22	4766	3829	0.80	0.99	3867	899
Oct-22	7272	6450	0.89	0.99	6515	756
Nov-22	8702	6559	0.75	0.99	6626	2077
Dec-22	4094	2324	0.57	0.99	2347	1746
Total	65737	49121	0.75	0.99	49617	16119

F. 4.8 POWER FACTOR # WING-III

Power Factor for Wing # III has been plotted on **GRAPH # Q**

It can be concluded that there is Marginal potential for PF improvement.

All the calculation has been carried out in **TABLE # 14**.

Expected Savings in KVAH consumption at P.F. = 0.99
 = **16119 KVAH Units**
 @ **Rs. 7.00 per KVAH** = **Rs. 112836/-**
 Expected annual saving = **Rs. 1.13 Lac**

F.4.9 Wing-III

Monthly Power Factor has been plotted on **GRAPH # Q**

From **GRAPH # Q**

It can be concluded that Power Factor is mostly at the Level

= 0.90 generally

Desired Value = 0.99

Monthly Power Factor vs. Desired Power factor has been plotted, on Graph # B. It can be concluded that there is need for Improvement in Power Factor.

Expected Power Savings

KWH Consumption remaining the same, KVAH consumption will decrease as P.F. is improved in TABLE # 13, Following Data has been worked out for Wing-III

- h) Monthly KWH Consumption
- i) Monthly KVAH Consumption
- j) Av. Power Factor
- k) Total Billing Amount
- l) Av. Cost Rs KVAH
- m) KVAH Consumption.
- n) Expected Savings in KVAH consumption at P.F. = 0.99

SECTION # G

LIGHTING

G.1 Introduction:

This report outlines the benefits and considerations of replacing old lighting systems with new, energy-efficient lighting technologies. In recent years, energy efficiency has become a top priority for many organizations, with lighting accounting for a significant portion of energy usage in commercial and residential buildings. Replacing old lighting systems with more efficient alternatives can offer numerous benefits, including cost savings, improved lighting quality, and reduced environmental impact.

G.2 Benefits of energy-efficient lighting:

Energy-efficient lighting technologies, such as LED (Light Emitting Diode) lighting, offer numerous benefits over traditional lighting systems. LED lighting uses significantly less energy than traditional incandescent bulbs, reducing energy consumption and associated costs. Additionally, LED lighting can last up to 25 times longer than traditional bulbs, reducing maintenance costs and the need for frequent bulb replacements.

Another significant benefit of energy-efficient lighting is improved lighting quality. LED lighting offers more consistent and uniform lighting, with a higher color rendering index (CRI) than traditional lighting systems. This can enhance visibility and comfort, improving the overall quality of the space.

G.3 Considerations:

When considering a transition to energy-efficient lighting, there are several factors to consider. The initial cost of new lighting technologies can be higher than traditional systems, although this cost can often be offset by long-term energy savings and reduced maintenance costs. Additionally, the installation process may require specialized equipment or expertise, and may require temporary disruption to the space.

Another consideration is the compatibility of new lighting technologies with existing electrical systems. Older electrical systems may not be able to support the power requirements of energy-efficient lighting technologies, requiring upgrades or modifications to the electrical system.

G.4 Conclusion:

Replacing old lighting systems with new, energy-efficient lighting technologies can offer numerous benefits, including cost savings, improved lighting quality, and reduced environmental impact. However, it is important to carefully consider the initial costs and installation requirements, as well as compatibility with existing electrical systems. With careful planning and implementation, transitioning to energy-efficient lighting can be a smart investment for organizations looking to improve energy efficiency and reduce costs

G.5 Major Observations

- ◆ Several Effective Steps have already been undertaken
- ◆ Necessary Steps are being undertaken to avoid operations of any unwanted lighting.

G.6 Summary of Light Fittings

All the lighting has been surveyed and the details are being summarized Wing-Wise.

Wing #	Table #	Remarks
B.Ed.	Table # 15	
Wing # II	Table # 15	
Wing # III	Table # 15	

We have provided our comments against each item Several Old Lamps/ Lighting have been very successfully replaced by LED Lamps.

Table # 15
Old - Lighting Assessment Table

Sl. No.	Area	36 Watt Old Light	40 Watt Old Light
1	B.Ed. First Floor	17	
2	B.Ed. G/F	16	
3	Library Basement Wing-II	30	0
4	1st Floor Wing-II	1	12
5	2nd Floor Wing-II	2	16
6	G/F Floor Wing-II	11	0
7	1st Floor Wing-III	23	
8	2nd Floor Wing-III	16	
9	G/F Floor Wing-III	23	
10	Total	139	28

G.7. Replacement of 36 Watt Tube Light (With Electronics Chokes) by 20W LED.

Covering All three Wings, All the Detailed Calculations are illustrated vide **Table # 15**, From Table # 15,

Operating Hours

Classrooms & Lab Area	= 7 Hours x 250 Days
(38 Watt – 20 Watt) = 18 Watt	= 18 Watt x 139 Nos. Of Light
	= 2.50 Units x 1750 Hrs
Total Expected Annual Power saving	= 4375 units
Monetary Saving	= Rs 7.39 per unit x 4375 Units
	= Rs 32331/-

Estimated Cost

For 139 nos. 20 Watt LED Tubular Lamps	= Rs 34,750 /-
Simple Payback Period	= 1 Year

G.8. To Replace 40 Watt Tube Light (Electronic Choke) by 20 Watt LED Lamps

40 Watt Tube Light with Copper Choke = $40W + 8W = 48W$.

Expected Power saving = $48W - 20W = 28W$

All the details have been provided in **Table # 15**

From Table # 15,

Total nos. of 40 Watt Tube Lights to be replaced by 20 Watt LED

= 28 Nos.

Expected Annual savings = $28W \times 28 \text{ Nos.} \times 7 \text{ Hrs} \times 250 \text{ Days}$

= **1372 Units**

@ Rs. 7.39 per Unit,

= Rs. 10,139/-

Estimated Cost for 28 nos, 20 Watt LED Lamps

= $Rs\ 250 \times 28 \text{ Nos.}$

= **Rs 4500 /- (approx.)**

Simple Payback Period

= **6 months**

Table # 16

Wing # II Lux Measurement Data

Sr. No	Location	Measured Lux level	Remarks
1	Admin Block Room No-1	110, 98, 112, 89	
2	Principle Room	132, 138, 128, 127,	
3	Class Room No-1	206, 211, 198, 186	
4	Class Room No-2	142, 155, 165, 185, 177, 169	
5	Computer Lab No-3	240, 192, 186, 212	
6	Computer Lab No-4	212, 198, 195, 185, 195	
7	Physics Deptt -08	147, 152, 178, 165, 145	
8	Physics Lab -09	212, 208, 195, 196, 189	
9	Instrument Store	45, 37, 38, 35,	
10	Dark Room	25, 22, 23, 24,	
11	Dept. Of math	Closed	Room Locked
12	Staff room	103, 98, 89, 85	
13	Girls common Room-19	90, 112, 115, 98,	Day Lights Available, All Lights off
14	Computer Lab-2 (18)	110, 105, 114, 109	
15	Computer Lab-1 (17)	98, 102, 105,107	
16	Chemistry Lab-(12)	43, 42, 47, 46, 40	
17	Chemistry Lab-3	88, 89, 85, 80	
18	Chemistry Lab-2	127, 125, 122, 118	
19	Dept of Chemistry	107, 112, 107, 103	
20	Deptt of NCC Office	112,103,114, 107	
21	Library Wing-II(11)	87, 85, 84, 79, 75, 78, 81	
22	Conference Hall Basement	75, 63, 65, 58, 59	

Table # 16A

Wing # II Lux Measurement Data

Sl. No	Location	Measured Lux level	Remarks
23	Audio Visual Room	Closed	
24	Room No-102	120, 118, 108, 124,	
25	Room No-103	110, 102, 108, 115	
26	Room No-104	Closed	
27	Room No-105 Sports Room	252, 285, 266, 278	Day Lights Available, All Lights off
28	Room No-106	135, 145, 139, 141	Day Lights Available, All Lights off
29	Room No-107	169, 185, 199,205	Day Lights Available, All Lights off
30	Room No-108	136, 138, 142, 149, 159	Day Lights Available, All Lights off
31	Room No-109	140, 145, 151, 162	Day Lights Available, All Lights off
32	Room No-110	130, 124, 115, 98	
33	Room No-111	135, 124, 126, 128,	
34	B.Ed Building (New) Canteen	Closed	
35	Room No-2 Boys common room	96, 89, 112, 115, 95	
36	Room No-3	112, 106, 104, 106	Day Lights available
37	Room No-4	110, 102, 112, 108	
38	Room No-5	124, 98, 130, 128	
39	Staff room	35, 45, 42, 46	

Table # 16B

Wing # II Lux Measurement Data

Sr. No	Location	Measured Lux level	Remarks
40	Principal Office	45, 47, 48, 46,	
41	Admin Office	66, 69, 72, 75,	
42	Admin Office	79, 75, 85, 81,	
43	Computer lab	35, 41, 46, 42,48	
44	Class Room No-1	45, 49, 46, 47	
45	Class Room No-2	44, 48, 46, 41	
46	Psychology Lab	Closed	
47	Art & Craft Centre	38, 42, 43, 46, 47	
48	Ist Floor Physics Lab-1 (PG)	115, 1114, 110	
49	Physics Store-2 (PG)	Closed	
50	Physics Store-1 (UG)	Closed	
51	Physics Store-3 (PG)	40, 36, 44, 46	
52	Science Lab	Closed	
53	Room No-112	130, 135, 140, 145	
54	Room no-116	Closed	
55	Room No-115	150, 144, 145, 164	
56	Room No-113	85, 89, 114	

Table # 17

Wing # III Lux Measurement Data

Sr. No	Location	Measured Lux level	Remarks
1	Room No-120 Computer Lab No-8	92, 112, 110, 118, 104,	
2	Room No-119	55, 67, 71, 89	
3	Room No-118 Computer Lab No-6	104, 112, 118, 119, 121	
4	Room No-117	275, 220, 235, 240, 255,	
5	Room No-116	320, 311, 290, 280	
6	Rang Manch		All lights off, day lights available
7	Room No-114 Computer Lab No-5	Closed	
8	Store Room No-115	Closed	
9	Dept Of Commerce	162, 170, 169, 142, 152, 142	
10	Room No-112	99, 112, 105, 114, 118	
11	Dept Of Computer Science	111, 125, 121, 128	
12	Room No-110	201, 195, 182, 196, 210	
13	Canteen	158, 152, 148, 152, 149, 165	
14	Computer Maint Room	144, 152, 163, 152, 164, 154	
15	Office Room No-107	85, 89, 95, 96, 112, 105	
17	Room No-106 Language Lab	126, 128, 142, 114, 132,	
19	1st Floor Room No-214	215, 210, 199, 203, 220, 217	
20	1st Floor Room No-214	136, 138, 142, 129, 128	
21	Library Wing-III, R.No-212	185, 179, 166, 169, 172	

Table # 17A

Wing # 3 Lux Measurement Data

Sr. No	Location	Measured Lux level	Remarks
22	Library Store 1st floor	35, 40, 41, 45, 46	
23	Library 2nd floor	135, 145, 155, 152, 148	
24	Store Library - 2nd floor	89, 87, 79, 92, 85, 91	
25	Room No-211	148, 145, 137, 145	
26	Dept Of Hindi, Sanskrit, Math,	97, 112, 108, 95, 89	
27	Room No-209	Closed	
28	Room No-208	220, 221, 218, 200	
29	Room No-207	248, 219, 237, 232, 211	
30	Room No-205	240, 260, 244, 256, 245	
31	Room No-204	205, 211, 210, 207	
32	Room No-204 A	Closed	
33	Room No-202	Closed	
34	Room No-201	231, 212, 235, 219, 239	
35	Room No-206 Lab	175, 188, 185, 169 149	
36	SLT Room (203)	260, 256, 245, 266, 2.41	
37	2nd floor	260, 255, 245, 258, 238	
38	Room No-315	280, 282, 265, 211, 264	All lights off, day lights available
39	Room No-314	255, 247, 238, 237	All lights off, day lights available
40	Room No-312	Closed	
41	Room No-311 Dept Of Management	225, 231, 229, 233, 234,	
42	Room No-310	211,199,195, 205	

Table # 17B

Wing # 3 Lux Measurement Data

Sr. No	Location	Measured Lux level	Remarks
43	Room No-309	290, 285, 265, 275, 274	
44	Room No-308	Closed	
45	Room No-307	140, 152, 147, 145, 156	
46	Room No-306	420, 411, 455, 485, 464	All lights off, day lights available
47	Room No-305	498, 418, 432, 399, 423	All lights off, day lights available
48	Room No-304	410, 380, , 399, 368, 386	All lights off, day lights available
49	Room No-303	414, 425, 424, 450, 436,	All lights off, day lights available
50	Room No-302	510, 504, 500, 498, 485	All lights off, day lights available
51	Room No-301	410, 401, 399, 412	

SECTION # H

D.G.SETS

H.1 Brief Description

There are separate D.G. sets for all three Wings.

D.G. Set	Make	Rated Capacity (KVA)
DG # 2 (Wing-2)	Sudhir	125
DG # 3 (Wing-3)	Sudhir	125



H.1 Annual Operating Data

It has been observed that the D.G. Sets data is not being maintained by the college authorities. Hence, we would recommend to maintain the Diesel consumption, Running Hours and KWH consumption for individual D.G. Sets. This would help to evaluate the performance of DG Set on periodic basis.

Table # 18
Annual HSD Consumption – 2022

125 KVA DG Set, HSD Consumption- 2022, Wing-II & B.Ed					
Sl. No.	Date	Li	Rs/Lit	Amount Rs.	R. Hrs
1	21.12.2021	400	87.41	34964	35
2	27.05.2022	300	97.39	29217	36
3	07.07.2022	400	90.33	36132	27
4	14.11.2022	400	90.33	36132	0
5	Total	1500	91.37	1,36,445	98

125 KVA DG Set, HSD Consumption-2022 Wing-III				
Sl. No.	Date	Lit	Rs/Lit	Amount(Rs.)
1	07.02.2022	200	87.41	17482
2	07.05.2022	200	97.39	19478
3	15.07.2022	200	90.33	18066
4	19.09.2022	200	90.33	18066
5	Total	800	91.37	73,092