

ENERGY AUDIT REPORT

OF

**Guru Gobind Singh College of Engineering and Research Centre
Khalsa Educational Complex , Guru Gobind Singh Marg , Wadala , Pathrdi Road ,
Indira Nagar Annexe , Nashik -9**

PROF. DR. B. E. KUSHARE

**POWER QUALITY & ELECTRICAL CONSULTANT,
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MAY 2023

ACKNOWLEDGEMENT

Power quality, Energy audit and Electrical consultancy cell of Dr B. E. Kushare and Associates places sincere gratitude to Management and principal of Guru Gobind singh college of Engineering and Research centre for entrusting to conduct energy audit of campus .We are thankful to plant head , all section heads , maintenance team , for providing required support during site measurement and providing required data to complete energy audit Report .



Prof. (DR.) B. E. KUSHARE

Certified Energy Auditor

Power quality consultant

Energy auditor certification number :EA-0288

“A Mission made programme can be created for energy conservation. We have to set yearly target of saving twenty-five billion units per year from the present 3.2 billion units, so that we can wipe out the existing shortage within the next four years”

Dr APJ Abdul Kalam

Ex. Hon. President of India

Address at National Energy Awards Function,

Dec.15, 2005

EXECUTIVE SUMMARY

Energy audit of college campus was carried out during 16th to 19th may 2023 .Energy conservation identified opportunities and suggested cost effective Energy conservation measures are summarized in following Section

Implemented Energy conservation measures and good practices by institute are:

- Light fixtures installed to provide indoor illumination are LED type .
- Day light is used during day to meet indoor illumination requirement.
- Solar roof top 200 Kwp SPV system is installed to harness renewable Energy which meets major Energy requirement of campus

Energy and demand cost saving potential by adequate reactive power compensation:

Reactive power variation is between 17.8KVAR to -14.4KVAR. Reactive power compensation is not adequate. There is under compensation by 17.8 KVAR and over compensation by -14.4KVAR.Recommended to add one 5KVAR and 10KVAR step for better resolution and reactive power compensation.

Total Energy and demand cost saving potential per year by adequate reactive power compensation = Rs240056.95

Investment: Rs 5000.00

Payback period: 0.0208 year or 0.249 months

% ROI = 4801.139

Energy saving potential by replacement of conventional ceiling fans by 28W BLDC ceiling fans

Total number of ceiling fans = 356

Energy saving potential per year = $(356 \times 60 - 356 \times 28) \times 6 \times 320 / 1000 = 21872.64 \text{KWH}$

Energy cost saving potential per year considering Energy cost of Rs 17.34 = Rs $17.34 \times 21872.64 = \text{Rs } 379271.577$

Investment : $356 \times \text{Rs}2750 = \text{Rs } 979000.00$

Pay back period = 2.581 year or 30.975 months

% ROI = 38.74

Summary of Energy potential

S.No.	Suggested Energy conservation measures	Energy saving potential per year in KVAh	Energy cost saving potential per year in Rs	Investment Rs	Payback period	% ROI
1	Adequate reactive power compensation	-	240056.95	Rs 5000.00	0.0208 year	4801.139
2	Replacement of conventional ceiling fans by BLDC ceiling fans	21872.64	379271.577	979000.00	2.581 Year	38.74
3	Total	21872.64	619328.527	984000.00	1.588 year	62.939

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Chapter 1
ENERGY CONSERVATION OPPORTUNITIES IN LIGHTING AREA
(OBSERVATIONS, FIELD TRIALS, ANALYSIS AND KEY RESULT AREAS)

Energy saving Opportunities in Lighting Area

Collage General lighting is provided by use LED light fixtures at Major places.

Lights are controlled by switched and there is no timer based as well as occupancy sensor-based control. Energy audit of lighting was carried out by measurement of illumination level with lux meter and Lighting load assessment was carried out to identify the areas for Energy saving in lighting area.

Area Wise Light Fixture Details and Measured Illumination Level

Illumination Level

Table 0-1: Area Wise Light Fixture Details and Measured Illumination Level

Location	Illumination Level	Avg.	Lux Level	Light Fixture	Wor king	Other Load
Main LT Room	571, 546, 554, 562 (Day Light)	558.25	OK	21W LED Batten Tube light	1	Ceiling Fan-1 Exhaust Fan-1
Meter Room	325, 365, 340, 392, 348 (Day Light)	354.00	OK	21W LED Batten Tube light	1	Ceiling Fan-1 Exhaust Fan-1
Ground Floor						
Conference Room	448, 465, 495, 496, 422, 476, 452, 455, 448	461.89	Ok	16W LED 36W LED Oval shape 8W LED 8W LED Dual LED STRIP 96 W	10 15 7 20 7	AC-2 Nos.
Management Board Room	345, 348, 320, 343, 352, 354, 360	346.00	Ok	16W LED 36W LED 4W LED LED STRIP 96 WATT	7 6 8 1	AC-1 Nos.
Auditorium	150, 135, 170, 162, 187, 155, 190, 165	164.25	OK	24W LED 22W LED 8W LED LED STRIP 96 WATT 36W LED Halogen 12W LED Spot Light	3 24 92 1 5 20	Central AC
Canteen & Kitchen	Day Light	Day Light	OK	28W Tube light Down Light 36W Tube light	26 4 4	Ceiling Fan-7 Nos.
008 Boys Toilet	Day Light	Day Light	OK	28W Tube light	1	Exhaust Fan-1 Nos.

Location	Illumination Level	Avg.	Lux Level	Light Fixture	Working	Other Load
007 Girls Toilet	Day Light	Day Light	OK	28W Tube light	2	Exhaust Fan-1 Nos.
Account & Admin Office	219, 215, 218, 238, 246	227.20	OK	28W LED Tube light 10W LED Down Light	28 3	-
Reception	Day Light	Day Light	OK	72W LED HB LED strip 96 watt 15-watt CFL watt	4 1 6	-
Principal Office	450, 433, 456, 452, 456, 478, 488, 452	458.13	OK	CFL Fitting (15-wattfitting) 72 WATT LED (2*2) LED STRIP 96 WATT	6 3 1	Cassette AC-1 Nos.
Bard room	430, 452, 415, 419, 435, 475, 448, 452, 465	443.44	OK	28W LED 16W LED 36W LED(2X2) LED STRIP 96 WATT	36 18 10 1	Split AC-2 Nos.
Electrical Panel Room	170, 190, 185, 165, 185, 142, 165	171.71	OK	21W LED Tube light	1	-
Gents Washroom	Day Light	Day Light	OK	28W Tube light	1	-
Ladies Washroom	Day Light	Day Light	OK	28W Tube light	2	-
Workshop	115, 127, 125, 134, 145, 152, 161, 152, 171, 122, 145	140.82	OK	40W Tube Light 16 W LED hanging fitting 28-WATT tube	96 7 6	-
Ladies Toilet	Day Light	Day Light	OK	28W Tube light	1	Exhaust Fan-1 Nos.
Gents Toilet	Day Light	Day Light	OK	28W Tube light	2	Exhaust Fan-1 Nos.
Passage	Day Light	Day Light	OK	16-WATT LED surface 8 WATT LED 4 LED spot light Halogen (400Watt)	16 4 8 4	-
First Floor						
109 Handicap Toilet	Day Light	Day Light	OK	28W LED Tube light	1	-
108 Girls Toilet	Day Light	Day Light	OK	28W LED Tube light	2	-

Location	Illumination Level	Avg.	Lux Level	Light Fixture	Working	Other Load
110 Department Office	Day Light	Day Light	OK	28W LED Tube light	4	Ceiling Fan-4
111 Classroom	251, 217, 222, 275 (Day Light)	241.25	OK	28W LED Tube light	4	Ceiling Fan-4
113 Classroom	251, 217, 222, 275 (Day Light)	241.25	OK	28W LED Tube light	4	Ceiling Fan-4
112 Classroom	251, 217, 222, 275 (Day Light)	241.25	OK	28W LED Tube light	4	Ceiling Fan-4
126 Classroom	251, 217, 222, 275 (Day Light)	241.25	OK	28W LED Tube light	3	Ceiling Fan-4
125 Classroom	251, 217, 222, 275 (Day Light)	241.25	OK	28W LED Tube light	4	Ceiling Fan-4
127 Classroom	251, 217, 222, 275 (Day Light)	241.25	OK	28W LED Tube light	3	Ceiling Fan-4
112 Computer Center	228, 235, 232, 245, 221	232.20	OK	28W LED Tube light	4	Ceiling Fan-4
113 Computer Center	228, 235, 232, 245, 221	232.20	OK	28W LED Tube light	4	Ceiling Fan-4
104 Environmenta I Lab	131, 129, 141, 145, 147, 178, 189, 165	153.13	OK	28W LED Tube light	4	Ceiling Fan-2
105 Trans Engineering. Lab	132, 131, 145, 147, 148, 152, 154, 187, 188, 183	156.70	OK	28W LED Tube light	6	Ceiling Fan-3
106 Drawing Hall	127, 415, 190, 492, 170, 175	261.50	OK	28W LED Tube light	4	Ceiling Fan-4
103 Store Room	420, 434, 438, 445, 449	437.20	OK	28W LED Tube light	4	Ceiling Fan-1
102 Fluid Mech. lab	100, 105, 109, 107, 115, 127, 130, 135	116.00	Low Lux Level	28W LED Tube light	4	Ceiling Fan-2
101 Seminar Hall	131, 129, 141, 145, 147	138.60	Low Lux Level	28W LED Tube light	10	Ceiling Fan-8

Location	Illumination Level	Avg.	Lux Level	Light Fixture	Working	Other Load
128 Surveying Lab	132, 131, 145, 147, 148, 152, 154, 187, 189, 175	156.00	OK	28W LED Tube light	4	Ceiling Fan-2
129 Exam Control Office	127, 415, 190, 492, 170, 175	261.50	OK	28W LED Tube light	6	Ceiling Fan-4
116 Geotech Engineering Lab	420, 434, 438, 445, 449	437.20	OK	28W LED Tube light	4	Ceiling Fan-2
117 Model Lab	100, 105, 109, 107, 115, 127, 130, 135	116.00	Low Lux Level	28W LED Tube light	4	Ceiling Fan-2
118 Engineering geology lab	131, 129, 141, 145, 147, 187, 185, 189	156.75	OK	28W LED Tube light	5	Ceiling Fan-2
124 Departmental Office	132, 131, 145, 147, 148, 152, 154	144.14	OK	28W LED Tube light	4	-
119 Civil CAD Lab	127, 415, 190, 492, 170, 175	261.50	OK	28W LED Tube light	6	Ceiling Fan-2
120 Civil Design Lab	420, 434, 438, 445, 449	437.20	OK	28W LED Tube light	6	Ceiling Fan-1
121 Faculty Room	200, 205, 209, 207, 115, 127, 130, 135	166.00	OK	28W LED Tube light	2	Ceiling Fan-2
122 Handicap Toilet	Day Light	Day Light	OK	28W LED Tube light	1	Exhaust Fan-1 Nos.
123 Boy's Toilet	Day Light	Day Light	OK	28W LED Tube light	2	Exhaust Fan-1 Nos.
passage + Porch	Day Light	Day Light	OK	16-WATT LED surface 8 WATT LED 4 LED spot light	16 4 8	-
Panel Room	124, 141, 157, 142, 156, 135, 187	148.86	OK	28W LED Tube light	1	-
Second Floor						
218 Girls Toilet	Day Light	Day Light	Ok	28W LED Tube light	1	Exhaust Fan-1 Nos.
217 Handicap Toilet	Day Light	Day Light	Ok	28W LED Tube light	2	Exhaust Fan-1 Nos.

Location	Illumination Level	Avg.	Lux Level	Light Fixture	Working	Other Load
214 SW / NSS / ANT Ragging Cell	131, 129, 141, 145, 147, 194, 178, 165, 188	157.56	Ok	28W LED Tube light	4	Ceiling Fan-2
215 Engineering. Physical Lab	132, 131, 145, 147, 148, 152, 154, 185, 187, 189	157.00	OK	28W LED Tube light	6	Ceiling Fan-2
216 Engineering. Chemistry Lab	127, 415, 190, 492, 170, 175	261.50	OK	-	-	-
219 SC / ST/ NT/ Minority OBC Cell	420, 434, 438, 445, 449	437.20	OK	28W LED Tube light	2	Ceiling Fan-4
220 Engineering. Mechanics Lab	200, 205, 209, 207, 115, 127, 130, 135	166.00	OK	28W LED Tube light	6	Ceiling Fan-2
207 Classroom	251, 217, 222, 275 (Day Light)	241.25	OK	28W LED Tube light	2	Ceiling Fan-4
208 Classroom	251, 217, 222, 275 (Day Light)	241.25	OK	28W LED Tube light	2	Ceiling Fan-4
209 Classroom	251, 217, 222, 275 (Day Light)	241.25	OK	28W LED Tube light	2	Ceiling Fan-4
210 Classroom	251, 217, 222, 275 (Day Light)	241.25	OK	28W LED Tube light	2	Ceiling Fan-4
221 Classroom	251, 217, 222, 275 (Day Light)	241.25	OK	28W LED Tube light	2	Ceiling Fan-4
222 Classroom	251, 217, 222, 275 (Day Light)	241.25	OK	28W LED Tube light	2	Ceiling Fan-4
223 Classroom	251, 217, 222, 275 (Day Light)	241.25	OK	28W LED Tube light	2	Ceiling Fan-4
212 Seminar Hall	271, 285, 248, 256, 217, 248, 249, 251	253.13	OK	Spot LED	15	Ceiling Fan-8
213 Reading Room	131, 129, 141, 145, 147 (Day Light)	Day Light	OK	Spot LED	16	Ceiling Fan-8

Location	Illumination Level	Avg.	Lux Level	Light Fixture	Working	Other Load
202 Computer Center	132, 131, 145, 147, 148, 152, 154	144.14	OK	28W LED Tube light	6	Ceiling Fan-4
211 Tutorial Room	127, 415, 190, 492, 170, 175	261.50	OK	28W LED Tube light	6	Ceiling Fan-4
204 Department Office	420, 434, 438, 445, 449	437.20	OK	28W LED Tube light	1	Ceiling Fan-1
203A Language Lab	100, 105, 109, 107, 115, 127, 130, 135 (Day Light)	Day Light	OK	28W LED Tube light	8	Ceiling Fan-4
203 Language Lab	175, 178, 185, 190, 125	170.60	OK	28W LED Tube light	8	Ceiling Fan-4
205 Handicap Toilet	Day Light	Day Light	OK	28W LED Tube light	1	-
206 Boys Toilet	Day Light	Day Light	OK	28W LED Tube light	2	-
207 Faculty Room	215, 227, 251, 225, 231, 242, 235, 237	232.88	OK	28W LED Tube light	4	Ceiling Fan-2
passage + Porch	Day Light	Day Light	OK	16-WATT LED surface 8 WATT LED 4 LED spot light	16 4 50	-
Third Floor						
308 Girls Toilet	Day Light	Day Light	OK	28W LED Tube light	2	Exhaust Fan-1 Nos.
307 Handicap Toilet	Day Light	Day Light	OK	28W LED Tube light	1	Exhaust Fan-1 Nos.
309 Classroom	251, 217, 222, 275	241.25	OK	28W LED Tube light	4	Ceiling Fan-4
310 Classroom	251, 217, 222, 275	241.25	OK	28W LED Tube light	4	Ceiling Fan-4
311 Classroom	251, 217, 222, 275	241.25	OK	28W LED Tube light	4	Ceiling Fan-4
306 Department Office	100, 105, 109, 107, 115, 127, 130, 135	116.00	OK	28W LED Tube light	6	Ceiling Fan-4
305 Digital Electronics Lab	127, 415, 190, 492, 170, 175	261.50	OK	Spot LED	4	Ceiling Fan-2

Location	Illumination Level	Avg.	Lux Level	Light Fixture	Working	Other Load
304 Software Lab	227, 219, 215, 238, 242	228.20	OK	36W LED Panel LED	4	Ceiling Fan-2
302 Network Lab	227, 235, 242, 219, 215, 231, 237	229.43	OK	36W LED Panel LED	4	Ceiling Fan-2
303 Programming Lab	288, 298, 278, 248, 258, 259, 279	272.57	OK	36W LED Panel LED	6	Ceiling Fan-4
323 Reprographic Center	227, 219, 215, 238, 242	228.20	OK	36W LED Panel LED	6	Ceiling Fan-4
301 A TOI Lab	227, 235, 242, 219, 215, 231, 237	229.43	OK	36W LED Panel LED	6	Ceiling Fan-4
Panel Room	165, 141, 45, 175, 187	164.40	OK	28W LED Tube light	1	-
301B System Programming Lab	288, 298, 278, 248, 258, 259, 279	272.57	OK	36W LED Panel LED	6	Ceiling Fan-4
312 LCS Seminar Hall	131, 129, 141, 145, 147, 185, 189, 158	153.13	OK	28W LED Tube light	4	Ceiling Fan-1
Siemens LV Switchgear Lab	132, 131, 145, 147, 148, 152, 154	144.14	OK	28W LED Tube light	4	Ceiling Fan-1
Siemens Drive Lab	127, 415, 190, 492, 170, 175	261.50	OK	28W LED Tube light	6	Ceiling Fan-2
Siemens Automation Lab	420, 434, 438, 445, 449	437.20	OK	28W LED Tube light	6	Ceiling Fan-2
BOSCH Auto Electrical Lab	200, 205, 209, 107, 115, 127, 130, 135	153.50	OK	28W LED Tube light	6	Ceiling Fan-2
Siemens Mechatronics Lab	175, 178, 185, 190, 125	170.60	OK	28W LED Tube light	6	Ceiling Fan-2
322 Training Room	157, 218, 214, 251, 264, 271	229.17	OK	36W LED Panel LED	2	Ceiling Fan-1
321 Training Cell	227, 219, 215, 238, 242	228.20	OK	36W LED Panel LED	4	Ceiling Fan-1
321 Placement Cell	227, 235, 242, 219, 215, 231, 237	229.43	OK	36W LED Panel LED	2	Ceiling Fan-1
320 Conference Hall	288, 298, 278, 248, 258, 259, 279	272.57	Ok	36W LED Panel LED	4	Ceiling Fan-1

Location	Illumination Level	Avg.	Lux Level	Light Fixture	Working	Other Load
318 Handicap Toilet	Day Light	Day Light	Ok	28W LED Tube light	1	Exhaust Fan-1 Nos.
319 Boys Toilet	Day Light	Day Light	Ok	28W LED Tube light	2	Exhaust Fan-1 Nos.
passage + Porch	Day Light	Day Light	OK	16-WATT LED surface 8 WATT LED	49 12	-
Fourth Floor						
422 Girls Toilet	Day Light	Day Light	OK	28W LED Tube light	2	Exhaust Fan-1 Nos.
421 Handicap toilet	Day Light	Day Light	OK	28W LED Tube light	1	Exhaust Fan-1 Nos.
420 Departmental office	100, 105, 109, 107, 115, 127, 130, 135	116.00	Low Lux Level	28W LED Tube light	3	Ceiling Fan-3
419 Machine Learning Lab	157, 218, 214, 251, 264, 271	229.17	OK	36W LED Panel LED	4	Ceiling Fan-4
423 Data structure Lab	227, 219, 215, 238, 242	228.20	OK	36W LED Panel LED	4	Ceiling Fan-4
424 Artificial Intelligence Lab	227, 235, 242, 219, 215, 231, 237	229.43	OK	36W LED Panel LED	6	Ceiling Fan-4
425 Data Science Lab	288, 298, 278, 248, 258, 259, 279	272.57	OK	36W LED Panel LED	6	Ceiling Fan-4
418 PECD Lab	157, 218, 214, 251, 264, 271	229.17	OK	36W LED Panel LED	6	Ceiling Fan-4
417 Tutorial Lab	227, 219, 215, 238, 242	228.20	OK	36W LED Panel LED	6	Ceiling Fan-4
416 PS & SGP Lab	227, 235, 242, 219, 215, 231, 237	229.43	OK	36W LED Panel LED	6	Ceiling Fan-4
415 Project Lab	288, 298, 278, 248, 258, 259, 279	272.57	OK	36W LED Panel LED	6	Ceiling Fan-4
401B MS & HVE Lab	157, 218, 214, 251, 264, 271	229.17	OK	36W LED Panel LED	6	Ceiling Fan-4
401A Ele Machine Lab I & II	227, 219, 215, 238, 242	228.20	OK	36W LED Panel LED	6	Ceiling Fan-4

Location	Illumination Level	Avg.	Lux Level	Light Fixture	Working	Other Load
414 Seminar Hall	227, 235, 242, 219, 215, 231, 237	229.43	OK	28W LED Tube light	6	Ceiling Fan-4
403 BEE Lab	288, 298, 278, 248, 258, 259, 279	272.57	OK	28W LED Tube light	3	Ceiling Fan-2
402 CP & PLC Lab	227, 219, 215, 238, 242	228.20	OK	28W LED Tube light	3	Ceiling Fan-2
405 Project Lab	227, 235, 242, 219, 215, 231, 237	229.43	OK	28W LED Tube light	3	Ceiling Fan-2
402 CS & SGP Lab	180, 105, 209, 207, 115, 127, 230, 135	163.50	OK	28W LED Tube light	3	Ceiling Fan-2
411 Classroom	251, 217, 222, 275 (Day Light)	Day Light	OK	28W LED Tube light	4	Ceiling Fan-4
412 Classroom	251, 217, 222, 275 (Day Light)	Day Light	OK	28W LED Tube light	4	Ceiling Fan-4
413 Classroom	251, 217, 222, 275 (Day Light)	Day Light	OK	28W LED Tube light	4	Ceiling Fan-4
402 FMA & EMI Lab	217, 222, 231, 235, 224, 256, 284, 211	235.00	OK	28W LED Tube light	4	Ceiling Fan-2
407 ADR & EMI Lab	218, 227, 225, 226, 224, 213	222.17	OK	28W LED Tube light	4	Ceiling Fan-2
408 Department Office	217, 235, 242, 241, 247, 256, 281, 234,	244.13	OK	28W LED Tube light	3	Ceiling Fan-3
409 Handicap Toilet	Day Light	Day Light	OK	28W LED Tube light	1	Exhaust Fan-1 Nos.
410 Boys Toilet	Day Light	Day Light	OK	28W LED Tube light	2	Exhaust Fan-1 Nos.
passage + Porch	Day Light	Day Light	OK	16-WATT LED surface 8 WATT LED	49 12	-
Fifth Floor						
Departmental Office	147, 148, 128, 129, 145	139.40	OK	28W LED Tube light	9	Ceiling Fan-6
522 Fluid Mech Lab-1	131, 129, 141, 145, 147	138.60	OK	28W LED Tube light	4	Ceiling Fan-2

Location	Illumination Level	Avg.	Lux Level	Light Fixture	Working	Other Load
521 Turbo M/C R & C Lab	132, 131, 145, 147, 148, 152, 154	144.14	OK			-
519 HT Lab	127, 415, 190, 492, 170, 175	261.50	OK	28W LED Tube light	4	Ceiling Fan-1
504 Mech CAD Lab	420, 434, 438, 445, 449	437.20	OK	28W LED Tube light	4	Ceiling Fan-2
501 Design & TOM Lab	200, 205, 209, 207, 215, 127, 130, 135	178.50	OK	28W LED Tube light	3	Ceiling Fan-2
503 DOM Lab	175, 178, 185, 190, 125	170.60	OK	28W LED Tube light	2	Ceiling Fan-2
505 H & P mechatronics Lab	178, 178, 103, 107, 209	155.00	OK	28W LED Tube light	3	Ceiling Fan-2
506 MQC Metallurgy lab	227, 219, 215, 238, 242	228.20	OK	28W LED Tube light	4	Ceiling Fan-3
507 IQAC Office	227, 235, 242, 219, 215, 231, 237	229.43	OK	28W LED Tube light	5	Ceiling Fan-3
508 Handicap Toilet	Day Light	Day Light	OK	28W LED Tube light	1	Exhaust Fan-1 Nos.
509 Girls Toilet	Day Light	Day Light	OK	28W LED Tube light	3	Exhaust Fan-1 Nos.
510 Faculty room	222, 227, 134, 145, 147, 152, 154, 157	167.25	OK	28W LED Tube light	4	Ceiling Fan-5
511 Class room	251, 217, 222, 275 (Day Light)	Day Light	OK	Tube light	4	Ceiling Fan-4
512 Class room	251, 217, 222, 275 (Day Light)	Day Light	OK	Tube light	4	Ceiling Fan-4
513 Class room	251, 217, 222, 275 (Day Light)	Day Light	OK	Tube light	4	Ceiling Fan-4
514 Class room	251, 217, 222, 275 (Day Light)	Day Light	OK	Tube light	4	Ceiling Fan-4
528 Class room	251, 217, 222, 275 (Day Light)	Day Light	OK	Tube light	4	Ceiling Fan-4

Location	Illumination Level	Avg.	Lux Level	Light Fixture	Working	Other Load
529 Class room	251, 217, 222, 275 (Day Light)	Day Light	OK	Tube light	4	Ceiling Fan-4
527 stacking Room	147, 154, 172, 185, 165	164.60	OK	Tube light	4	Ceiling Fan-4
Project Lab	111, 119, 117, 112	114.75	OK	Tube light	4	Ceiling Fan-4
Seminar Hall	115, 127, 135, 145, 142	132.80	OK	Tube light	7	Ceiling Fan-8
526 Boys Common Room	235, 187, 175, 172	192.25	OK	Tube light	2	Ceiling Fan-2
524 Handicap Toilet	Day Light	Day Light	OK	28W LED Tube light	1	Exhaust Fan-1 Nos.
525 Boys Toilet	Day Light	Day Light	OK	28W LED Tube light	2	Exhaust Fan-1 Nos.
Passage + Porch	Day Light	Day Light	OK	16-WATT LED surface 8 WATT LED	49 12	-

Energy saving implemented initiatives:

LED light fixtures are used.

Natural day light is used for indoor illumination during day

Energy saving potential by replacement of conventional ceiling fans by 28W BLDC ceiling fans

Total number of ceiling fans = 356

Energy saving potential per year = $(356 \times 60 - 356 \times 28) \times 6 \times 320 / 1000 = 21872.64 \text{ KWH}$

Energy cost saving potential per year considering Energy cost of Rs 17.34 = Rs $17.34 \times 21872.64 = \text{Rs } 379271.577$

Investment : $356 \times \text{Rs } 2750 = \text{Rs } 979000.00$

Pay back period = 258.00

Chapter 2
POWER QUALITY AUDIT FINDINGS
AND RECONNENDATIONS

2.1 Need of Power Quality Audit:

There are several important reasons to conduct power quality audit. The various reasons are: To avoid financial loss due to process disruption: - The various cost of disruption is

a) Lost work: The product or service is not generated for a period of time until the recovery is complete. The various cost related to lost work are idled labour, lost production hence lost profits, overtime labour and premium charges, overtime operating cost, late delivery fees.

b) Cost of repair of the damaged equipment: - The various costs involved in repairing of damaged equipment due to power quality problem are repair, cost of labour, cost of replaced spare parts, cost of replacement part availability.

c) Cost of recovery: - Cost involved in recovery of secondary equipment failures, recovery of labour inefficiency.

d) Cost of scrap and product quality: - The various cost involved are replacement value of scrap (BOM value + labour value, product lost profit margin and rework costs.

e) Miscellaneous cost: - The various miscellaneous costs are customer's dissatisfaction, lost business, avoided customers due to longer lead time, fines and penalties etc.

Considering the huge financial losses related to a power quality event causing process disruption to industry, it is necessary to monitor power quality to provide cost effective solution to avoid financial losses. The various effects of power quality event on equipment and process operation include miss-operation, damage, process disruption, and other anomalies.

2.2 Impact of Power Quality Problems on The Operations of Various Equipment's:

The growing percentage of sensitive equipment's and process downtime due to power quality problems has pointed out an incompatibility between the tolerances of electronics appliances to power disturbances and the expected electric environment. Power quality audit helps to study various power quality problems present in electric supply distribution system and to take appropriate remedial actions. With a better understanding of the electrical environment, end users can request improvements in the tolerance of electrical appliances to power quality disturbances to ensure electrical power system compatibility. In order to mitigate these power quality anomalies a statistical knowledge base of frequency, voltage profiles as a function of time of the day is required. The harmonics present in the electrical distribution are undesirable for the operation of various equipment's. They cause frequent failure of equipment's due to excessive heating, over loading of transformers and cables, malfunctioning of electronic equipment and increase in line loss etc.

Some symptoms caused by power quality include:

- Malfunction of equipment.
- Frequent system reboots becoming necessary.
- High failure rate of electronic systems.
- Overheating of transformers, cables, motors and capacitor banks.
- A.C coil contactor disengagement and tripping of ASD's.

- Inaccuracy of testing and measuring equipment.
- Light dimming or blinking.

The level of power quality required is that level which will result in proper operation of equipment at a particular facility. It is the susceptibility of end use equipment that defines the necessary level of power quality. The various power quality problems with their characteristics are tabulated in tables below.

2.3 Results of Power Quality Analysis:

Power quality analysis was conducted at various feeders. The result of power quality analysis conducted for various positions of tap of the distribution transformer is presented below

2.4 :Power quality analysis at main LT panel

Table 2.0:Power quality analysis at main LT panel.

Parameter	CH1			CH2			CH3		
	Max.	Avg.	Min.	Max.	Avg.	Min.	Max.	Avg.	Min.
RMS VOLTAGE (V)	435.5	422.5	308.8	435	421.5	308	440	426.9	311
RMS CURRENT (A)	185	131.8	62.4	176	117.4	43.3	207	148.7	58.5
RMS VOLTAGE AVG.(V)	436.8	423.6	309.2	---	---	---	---	---	---
RMS CURRENT AVG.(A)	189.3	132.6	54.73	---	---	---	---	---	---
ACTIVE POWER (KW)	136	96.98	39	---	---	---	---	---	---
REACTIVE POWER (KVAR)	17.8	5.99	14.4 Cap.	---	---	---	---	---	---
APPARENT POWER (KVA)	136	98.01	40.4	---	---	---	---	---	---
POWER FACTOR	1.00	0.989	0.965 Lead	---	---	---	---	---	---
%Vthd	2.80	2.64	2.78	---	---	---	---	---	---
%Ithd	10.22	9.63	9.40	---	---	---	---	---	---

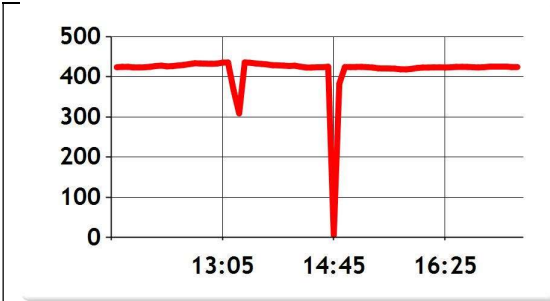
Table 2.1: Individual Voltage & Current Harmonic Distortion in volts at Main LT Panel

Order	Voltage Harmonic			Current Harmonic		
	CH1	CH2	Ch3	CH1	CH2	CH3
	[%]	[%]	[%]	[%]	[%]	[%]
2	0.07	0.08	0.07	2.11	1.97	1.57
3	0.34	0.34	0.08	4.63	1.53	1.34
4	0.06	0.08	0.07	0.44	0.22	0.36
5	2.15	2.10	2.06	6.30	7.87	6.96
6	0.02	0.02	0.02	1.01	0.80	0.38
7	1.59	1.44	1.58	5.05	3.89	3.75
8	0.09	0.07	0.04	0.57	0.56	0.23
9	0.19	0.16	0.48	0.73	0.82	3.30
10	0.10	0.08	0.05	0.34	0.23	0.16
11	0.56	0.35	0.67	1.54	0.94	1.82
12	0.02	0.03	0.03	0.17	0.15	0.12
13	0.32	0.28	0.41	2.08	1.81	1.84
14	0.04	0.03	0.03	0.10	0.11	0.14
15	0.05	0.13	0.17	0.30	0.42	0.79
16	0.03	0.03	0.03	0.17	0.13	0.10
17	0.20	0.19	0.19	0.69	0.43	0.70
18	0.02	0.02	0.01	0.11	0.11	0.10
19	0.18	0.22	0.20	1.65	1.35	1.27
20	0.03	0.02	0.02	0.27	0.15	0.08
21	0.02	0.02	0.04	0.38	0.44	0.34
22	0.03	0.02	0.02	0.12	0.14	0.07
23	0.08	0.06	0.09	0.60	0.52	0.56
24	0.01	0.02	0.01	0.10	0.09	0.08
25	0.03	0.05	0.03	0.22	0.39	0.40
26	0.01	0.02	0.01	0.17	0.16	0.11
27	0.01	0.05	0.02	0.21	0.13	0.18
28	0.01	0.02	0.01	0.08	0.11	0.09
29	0.04	0.05	0.03	0.36	0.16	0.32
30	0.01	0.01	0.01	0.06	0.10	0.06
31	0.02	0.02	0.04	0.41	0.61	0.17
32	0.01	0.01	0.01	0.09	0.08	0.06
33	0.03	0.02	0.02	0.12	0.09	0.12
34	0.01	0.01	0.01	0.06	0.08	0.06
35	0.02	0.01	0.03	0.19	0.13	0.12
36	0.01	0.01	0.01	0.05	0.06	0.03
37	0.02	0.03	0.02	0.14	0.23	0.13
38	0.01	0.01	0.01	0.07	0.06	0.05
39	0.02	0.02	0.01	0.05	0.10	0.06
40	0.01	0.01	0.01	0.04	0.05	0.03
THD	2.80	2.64	2.78	10.22	9.63	9.40

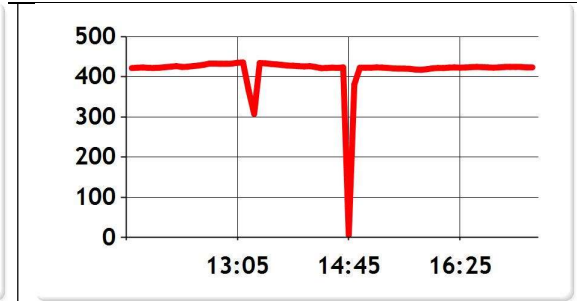
2.5 : Conclusion of Power Quality Analysis at Main LT PANEL

- RMS voltage is between 308V to 440V RMS voltage variation is recommended limit of 380-420V
 - % Voltage unbalance factor is within 1% recommended limit as per NEMA -MG standard
 - Reactive power variation is between 17.8KVAR to -14.4KVAR. Reactive power compensation is not adequate. There is under compensation by 17.8 KVAR. And over compensation by -14.4KVAR
 - % Current unbalance factor is within than recommended limit.
 - % Total voltage harmonic distortion is 2.80 % less than 8% recommended limit as per IEEE standard 519-2022 for system voltage below 1KV.
 - % Individual voltage harmonic distortion of 2nd orders up to 50th is within recommended 5% limit as per IEEE standard 519-2022
 - % Total current harmonic distortion is 10.22% and is higher than 5% recommended limit as per IEEE 519-2022 standard for system voltage between 120V up to 69 KV for ISC/IL ratio is below 20
 - % Individual current harmonic distortion of 5th and 7th orders are exceeding the recommended 5% limit as per IEEE standard 519-2022
-

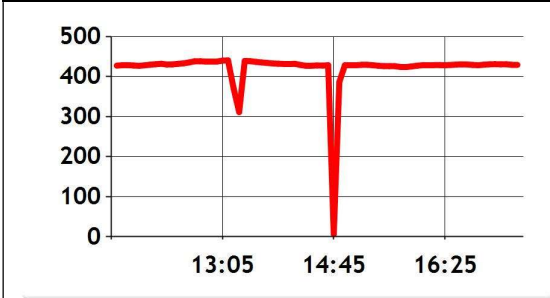
Time plot at Main LT Panel



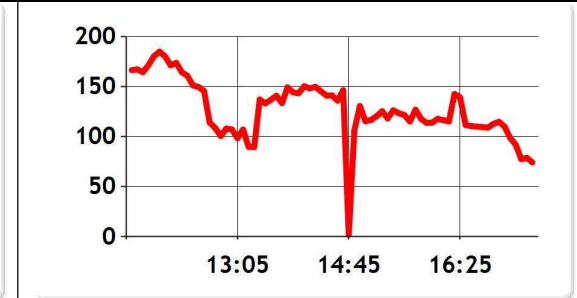
RMS VOLTAGE VARIATION TIME
 PLOT OF CH1
 Max Val. : 435.57 V
 Avg. Val. : 417.6 V
 Min Val. : 6.43 V



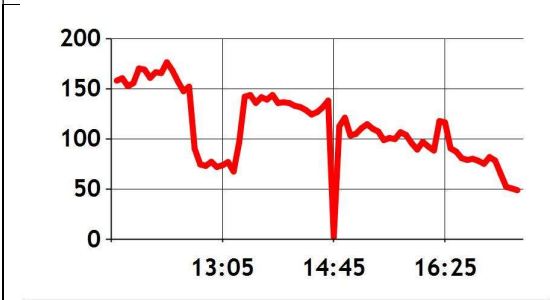
RMS VOLTAGE VARIATION TIME
 PLOT OF CH2
 Max Val. : 435.38 V
 Avg. Val. : 416.57 V
 Min Val. : 6.41 V



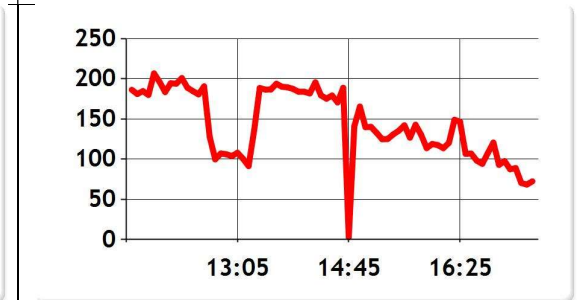
RMS VOLTAGE VARIATION TIME
 PLOT OF CH3
 Max Val. : 440.32 V
 Avg. Val. : 421.92 V
 Min Val. : 6.39 V



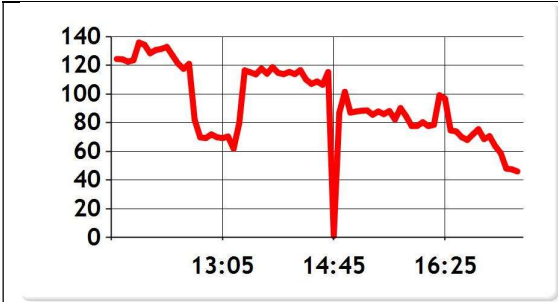
RMS CURRENT VARIATION TIME
 PLOT OF CH1
 Max Val. : 184.76 A
 Avg. Val. : 130.26 A
 Min Val. : 2.07 A



RMS CURRENT VARIATION TIME
 PLOT OF CH2
 Max Val. : 176.33 A
 Avg. Val. : 116.1 A
 Min Val. : 2.54 A

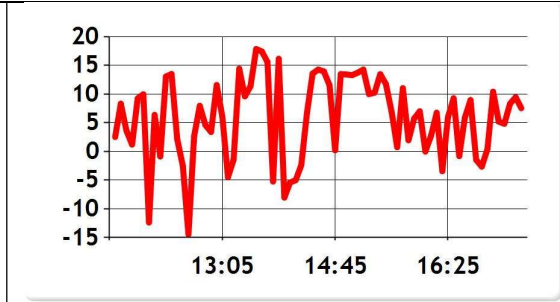


RMS CURRENT VARIATION TIME
 PLOT OF CH3
 Max Val. : 206.63 A
 Avg. Val. : 146.97 A
 Min Val. : 2.9 A



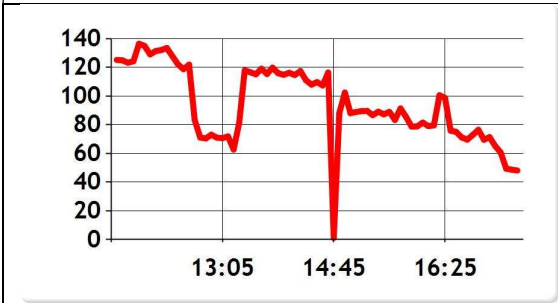
TOTAL ACTIVE POWER VARIATION TIME PLOT

Max Val. : 135.79 KW
 Avg. Val. : 95.83 KW
 Min Val. : 1.09 KW



TOTAL REACTIVE POWER VARIATION TIME PLOT

Max Val. : 17.82 KVAR
 Avg. Val. : 5.92 KVAR
 Min Val. : -14.44 KVAR



TOTAL APPARENT POWER VARIATION TIME PLOT

Max Val. : 136.38 KVA
 Avg. Val. : 96.84 KVA
 Min Val. : 1.12 KVA



POWER FACTOR VARIATION TIME PLOT

Max Val. : 1
 Avg. Val. : 0.87
 Min Val. : -1

Transformer name plate

Make	Fairdeal electrical & Engineering P.LTD
KVA	315
Volts at no load	HV: 11000V
	LV: 415V
Amperes	HV: 16.563A
	LV: 238.24A
Phase HV/LV	3 Phase
Type of cooling	ONAN
Frequency	50 HZ
Impedance volts	4.27%
Vector Symbols	Dy11
Oil	290 litters
Mass of oil	240 Kg.
Core & WDGS	700 Kg.
Total mass	1300 Kg.

OLTC specifications :

High Volts	Low Volts	Connect	Tap switch position
115.50	Rated	6.5	1
112.75	Rated	5.7	2
110.00	Rated	7.4	3
107.25	Rated	4.8	4
104.50	Rated	8.3	5

DG Name plate

Alternator Name Plate:

Make	Stamford
KVA	160 KVA
Speed (N)	1500 RPM
Volts	415V
AMPS	222.6A
Rating	CONT.
Ambient temperature	40°C
INS Class	H
STR Con	S.Star
STR WDG	311
Frequency	50 HZ

DG Name Plate:

Make	Powerica
Rating	160 KVA/125 KW
Model family No	XPTS/B-160-52/F35

ELECTRICITY BILL ANALYSIS

Sanctioned contract demand – 201.00KVA, 70% OF sanctioned contract demand:140.70 KVA

Month	Recorded MD in KVA	Recorded Avg. P.F.	Billed MD in KVA	Calculated actual Demand in KVA considering P.F. As One	Difference in billed MD and actual MD at unity Power factor	KVA @Rs XXX X From Bill Data	Reduction in MD charges in Rs	Monthly KWH consumption	Monthly KVAH consumption	KVAH-KWH	RKVAH (LAG)	RKVAH (LEAD)	Electricity Board Bill Amount	
Apr-23	143	0.984	143	140.71	2.29	147	336.34	28574	29039	465.00	5155	35	550612.	
May-23	127	0.968	127	122.94	4.06	127	516.13	26138	27002	864.00	6706	42	499336.	
Jun-23	137	0.957	137	131.11	5.89	137	807.07	27242	28466	1224.00	7026	1198	534430.	
Jul-23	109	0.953	109	103.88	5.12	109	558.41	29111	30547	1436.00	9253	0	518517.	
Aug-23	145	0.955	145	138.48	6.53	145	946.13	32106	33619	1513.00	9946	0	612413.	
Sep-23	148	0.959	148	141.93	6.07	148	898.06	28480	29698	1218.00	8351	35	497189.	
Oct-23	151	0.962	151	145.26	5.74	151	866.44	32970	34272	1302.00	8320	50	549205.	
Nov-23	128	0.96	141	122.88	18.12	141	2554.92	23120	24083	963.00	5995	0	415210.	
Dec-23	112	0.94	141	105.28	35.72	141	5036.52	25920	27574	1654.00	8835	15	461093.	
Jan-24	121	0.939	141	113.62	27.38	141	3860.72	25895	27577	1682.00	8765	10	465390.	
Feb-24	153	0.968	153	148.10	4.90	153	749.09	28725	29675	950.00	6620	40	521305.	
Mar-24	123	0.964	141	118.57	22.43	141	3162.35	20830	21608	778.00	58900	48	405074.	
Total								19,439.7	2,74,399.	2,87,119.	12,720	1,24,985	198.	49,79,827.
Electricity Average per unit Charge Rs/KVAH =					17.34									
Reduction in MD charges per year Rs =					19439.70									

Energy cost saving potential by adequate reactive power compensation per year =	220617.25							
Total demand & Energy cost reduction by adequate reactive power compensation per year =	240056.95							
Energy cost saving % =	5%							

Energy and demand cost saving potential by adequate reactive power compensation:

Reactive power variation is between 17.8KVAR to -14.4KVAR. Reactive power compensation is not adequate. There is under compensation by 17.8 KVAR and over compensation by -14.4KVAR. Recommended to add one 5KVAR and 10KVAR step for better resolution and reactive power compensation.

Total Energy and demand cost saving potential per year by adequate reactive power compensation = Rs240056.95

Investment: Rs 5000.00

Payback period: 0.0208 year or 0.249 months

% ROI = 4801.139