

*Estd. Under Punjab Technical University Act, 1996
(Punjab Act No. 1 of 1997)*

Ref. No. : IKGPTU/CC/859

Dated : 09/10/2015

Dean (P&D),
IKG Punjab Technical University, Jalandhar.

Finance Officer,
IKG Punjab Technical University, Jalandhar.

Registrar,
IKG Punjab Technical University, Jalandhar.

Director,
IKG Punjab Institute of Technology, Khunimajra.

Chief Engineer, PWD (Central)
SCF 61-62, Phase-II, Mohali.

Chief Architect, Punjab
SCO 98-100, Near DPI Office,
Sector 17-D, Chandigarh.

Chief Executive,
Punjab Energy Development Agency,
Plot No. 1 & 2, Sector 33-D, Chandigarh.

**Sub : 47th meeting of the Standing Building Construction Committee of I K Gujral
Punjab Technical University.**

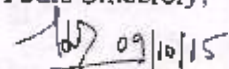
Dear Sir/Madam,

47th meeting of the Standing Building Construction Committee of I K Gujral Punjab Technical University (IKG PTU) shall be held under the Chairmanship of Sh. Rakesh Verma, IAS, Secretary, Department of Technical Education, Punjab and Vice Chancellor, IKG PTU at 1100 hours on 20.10.2015 at IKG PTU Mohali campus at C-102B, Phase-7, Industrial area, Mohali. Agenda for the meeting is enclosed.

You are requested to make it convenient to attend the meeting.

Thanking you

Yours Sincerely,


(H. P. Singh)
Executive Engineer

Copy to : PS to Vice Chancellor, IKG PTU for kind information of Hon'ble VC.

Encl. As above.

IK GUJRAL PUNJAB TECHNICAL UNIVERSITY

**AGENDA FOR
47th MEETING OF
STANDING BUILDING
CONSTRUCTION COMMITTEE**

**SCHEDULED TO BE HELD ON
20.10.2015**



**AGENDA FOR 47TH MEETING OF
STANDING BUILDING CONSTRUCTION COMMITTEE**

- Item No. 47.1 : To confirm the Minutes of 46th meeting of Standing Building Construction Committee held on 09.04.2015.
- Item No. 47.2 : Action taken on various items discussed during 46th meeting of Standing Building Construction Committee.
- Item No. 47.3 : To review the minutes of 43rd, 44th, 45th and 46th meetings of Standing Building Construction Committee.
- Item No. 47.4 : To discuss and approve the concept plans and estimates for setting up sports hostel at main campus, Kapurthala.
- Item No. 47.5 : To discuss and approve the scheme of construction of 220 KV electric line of PSTCL to pass through PTU main campus, Kapurthala.
- Item No. 47.6 : To discuss and finalize the fee payable to the Architect for preparation of building plans of auditorium and hostels proposed at main campus, Kapurthala.
- Item No. 47.7 : Any other item with the permission of chair.

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Item No. 47.1 : To confirm the Minutes of 46th meeting of Standing Building Construction Committee held on 09.04.2015.

The minutes of 46th meeting of Standing Building Construction Committee held on 09.04.2015 were circulated on 16.04.2015 (Placed at Annexure-A). No comments have been received from any member. The minutes circulated are to be confirmed.

Item No. 47.2 : Action taken on various items discussed during 46th meeting of Standing Building Construction Committee.

Actions taken report on various items discussed during 46th meeting of Standing Building Construction Committee are as under:

Agenda Item No.	Agenda Item and Decision	Action taken
46.1	<i>To confirm the Minutes of 45th meeting of Standing Building Construction Committee held on 22.01.2015.</i> As no comments have been received, the minutes of 45 th meeting of Standing Building Construction Committee held on 22.01.2015 were confirmed.	No action required
46.2	<i>Action taken on various items discussed during previous meeting of Standing Building Construction Committee:-</i> Based upon the concept plans approved by the Building Committee in respect of the proposed auditorium and hostels at main campus, Kapurthala, the municipal drawings have been approved by Chief Town Planner, Punjab.	No action required.
	The Architect will be making a presentation in the present meeting on cost comparison of projector and LED screen to be provided for the proposed auditorium at main campus, Kapurthala. The presentation was made by the Architect and decision taken is described under agenda item No. 46.3.	No action required.
	The detailed estimate for provision of speakers, amplifiers and microphones to be provided for the proposed auditorium at main campus, Kapurthala will be presented by the Architect in the present meeting for discussions and approval. The detailed estimates were presented by the Architect and decision taken is described under agenda item No. 46.4.	No action required.

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	<p>The issue pertaining to payment to the Architect against preparation of building plans for the proposed auditorium and hostels at main campus, Kapurthala is to be discussed in the present meeting.</p> <p>Committee noted that the documents presented are not sufficient to take the decision. Executive Engineer, PTU was advised to present additional documents like the original recommendations of the committee set up by the Hon'ble Vice Chancellor, Agendas of 20th and 27th meetings of the building committee etc.</p>	The case is being put up in the present meeting as an agenda item.
46.3	<p><i>To discuss and finalize the provision of projector or LED screen for the proposed auditorium at main campus, Kapurthala.</i></p> <p>Committee agreed for provision of LED screen for proposed auditorium at main campus, Kapurthala. However, specifications, estimates etc. will be discussed and approved at the time of procurement depending upon the technology available at that time. It was also agreed to provide conduits etc. for the conventional projector to take care of the situation in case the provision of LED screen is ruled out at a later stage.</p>	No action is required at this stage.
46.4	<p><i>To discuss and approve the estimate for speakers, amplifiers and microphones for the proposed auditorium at main campus, Kapurthala.</i></p> <p>Committee approved the estimate for speakers, amplifiers and microphones for the proposed auditorium at main campus, Kapurthala for an amount of Rs. 81.26 lacs. It was decided by the committee that tenders for execution of these works shall be invited on performance basis only.</p> <p>Additionally, it was also agreed that the complete tendering process/scheme for execution of various works of the auditorium shall be discussed and approved by the Building committee.</p>	No action is required at this stage.
46.5	<p><i>To discuss and finalize the provision of LED lights in place of CFL lights in college buildings and library building (under construction) of Punjab Institute of Technology, main campus, Kapurthala.</i></p> <p>Committee decided for provision of CFL lights, as originally approved in the estimates.</p>	No action is required.
46.6	<p><i>To discuss and approve the revised layout plan of proposed buildings for Punjab Institute of Technical Teachers Training and Research (PITTTR) at Ladowali Road, Jalandhar.</i></p> <p>Committee approved the revised site plan/scheme presented by the Architect.</p>	No action is required.

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46.7	<p><i>To discuss and finalize the fee payable to the Architect for preparation of building plans of auditorium and hostels proposed at main campus, Kapurthala.</i></p> <p>Committee noted that the documents presented are not sufficient to take the decision. Executive Engineer, PTU was advised to present additional documents like the original recommendations of the committee set up by the H'nble Vice Chancellor, Agendas of 20th and 27th meetings of the building committee etc.</p>	The case is being presented in this meeting as an agenda item.
46.8	<p><i>To discuss and approve the start of construction works of proposed college buildings at Punjab Institute of Technology at Arniwala and Sikhwala.</i></p> <p>Committee noted that University has decided to go ahead with construction of proposed buildings (Phase-I) and external development works of Punjab Institute of Technology at Arniwala and Sikhwala.</p>	No action is required.
46.9	<p><i>To discuss and approve the estimate for painting of boundary walls Punjab Institute of Technology, Mansa.</i></p> <p>Committee decided that the work of painting of boundary wall may be taken up at the time of making the campus operational.</p>	No action is required.
46.10	<p><i>To discuss and approve authorization to PWD for taking Environmental Clearance for construction of proposed auditorium and hostels buildings at main campus, Kapurthala.</i></p> <p>In view of the notification dated 22.12.2014 issued by 'Ministry of Environment, Forest and Climate Change' presented in the meeting, committee noted that Environmental Clearance for building construction projects for educational institutes is not required. However, committee advised PWD/PTU to confirm the same before start of any new construction activity.</p>	No action is required.

Item No. 47.3 : To review the minutes of 43rd, 44th, 45th and 46th meetings of Standing Building Construction Committee.

The term of previous Standing Building Construction Committee has expired on 28.09.2014 and the new committee has been constituted/notified on 18.09.2015. During the intervening period, to discuss some important issues related to construction, 44th, 45th and 46th meetings of the earlier nominated building committee have been conducted on 20.10.2014, 22.01.2015 & 09.04.2015 respectively. The minutes of these committee meetings and 43rd meeting of the building committee were put up in 55th meeting of BOG, wherein, it was decided that new constituted Building Committee should review the minutes of 43rd, 44th, 45th and 46th meetings of Standing Building Construction Committee and the same are put up in the next meeting of BOG.

Accordingly, agendas and minutes of 43rd, 44th, 45th and 46th meetings of Standing Building Construction Committee are placed at Annexure B to J below (Agenda and Minutes of 43rd meeting – Annexure B & C, Agenda and Minutes of 44th meeting – Annexure D & E, Agenda and Minutes of 45th meeting – Annexure F & G, Agenda and Minutes of 46th meeting – Annexure H & I) for review of the building committee. The abstract of Agendas and Minutes for all these meetings is also enclosed at Annexure-J.

Item No. 47.4 : To discuss and approve the concept plans and estimates for setting up sports hostel at main campus, Kapurthala.

In 55th meeting of BOG of the University, it was decided that sports hostel should be set up at University's main campus and suitable proposal for the same is put up in the next meeting of BOG. Accordingly, the Master plan of campus showing location of sports hostel, concept plans of the proposed hostel and rough cost estimate for an amount of Rs. 733.45 lacs for setting up the sports hostel having capacity of 52 students (33 boys and 19 girls) are placed below at Annexure-K and the same will also be presented by the Architect.

The concept plans have been prepared on the following considerations:

Capacity	:	52 Students Boys - 33 Girls - 19 (Separate block/entry for boys and girls)
Facilities	:	All rooms with attached toilets. Separate recreation rooms for boys and girls Separate open air theaters for boys and girls
No. of floors	:	Ground plus three floors for boys portion Ground plus two floors for girls portion.
Total plinth area	:	3015.58 Sqm (32448 Sft)
Estimated cost for civil, Electrical & Public Health Works (on the basis of CPWD Plinth area rates).	:	Rs. 733.45 Lacs

The matter is placed before the committee for discussions and approval please.

Item No. 47.5 : To discuss and approve the scheme of construction of 220 KV electric line of PSTCL to pass through PTU main campus, Kapurthala.

This is brought to the notice of the committee that one 66 KV electric overhead line of PSTCL is already passing through IKG PTU main campus (Science City end). Further, PSTCL has informed IKG PTU that one more electric overhead line of 220 KV is to be passed through IKG PTU campus and this line will run parallel to the existing 66 KV line. For passing the new line through IKG PTU, two new towers will also be constructed on university's land. After discussing the matter with PSTCL and university's Architect, the scheme has been revised by PSTCL and as per this revised scheme, part of area already occupied by 66 KV line will also be used for the new line. The sketch showing the location of the existing and proposed electric lines is placed at Annexure-I. The scheme will also be presented by the Architect in the meeting.

The matter is placed before the committee for deliberation and decision please.

Item No. 47.6 : To discuss and finalize the fee payable to the Architect for preparation of building plans of auditorium and hostels proposed at main campus, Kapurthala.

This is to bring to the notice of the committee that a payment of Rs.8.93 lacs plus service tax claimed by the Architect for preparation of building plans of auditorium and hostels proposed at main campus, Kapurthala was put up in 45th meeting of the committee (agenda item No. 45.8) wherein it was decided that Executive Engineer, PTU to put up the case in the next meeting with details and basis of payments made earlier for similar cases. Agenda and Minutes of 45th meeting are placed at Annexure F & G.

The case was put up in 46th meeting (agenda item No. 46.7), wherein details of the payments already made were submitted, as detailed below:

S. No.	Description	Covered Area of buildings approved	Amount Paid	Reference approval of Building committee
1	Housing Project (Phase-II)	17428.0 Sqm.	Rs. 6.0 lacs + S. Tax	20.7
2	College buildings-3Nos, Library, seminar hall and hostels.	31928.0 Sqm.	Rs. 10.99 lacs + S. Tax	27.7

In this meeting, committee noted that the documents presented are not sufficient to take the decision. Agenda and Minutes of 46th meeting – Annexure H & I. Executive Engineer, PTU was advised to present additional documents like the original recommendations of the committee set up by the Hon'ble Vice Chancellor, Agendas of 20th and 27th meetings of the building committee etc.



In this regard, following documents are placed before the committee:

Agenda of 20 th Meeting	-	Annexure M
Minutes of 20 th Meeting	-	Annexure N
Agenda of 27 th Meeting	-	Annexure P
Minutes of 27 th Meeting	-	Annexure Q
Recommendations of the committee set up by Vice Chancellor	-	Annexure R

The matter is placed before the Committee for discussions and decision please.

Item No. 47.7 : Any other item with the permission of chair.

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Er. H.P. Singh
Executive Engineer

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PTU PUNJAB
TECHNICAL
UNIVERSITY

Estd. Under Punjab Technical University Act, 1996
(Punjab Act No. 1 of 1997)

Ref. No. Pou/CC/318

Dated 16.04.2015

Sh. D.L. Sharma, President,
Vardhman Spg. & Gen. Mills Ltd.,
Chandigarh Road, Ludhiana.

The Director,
Department of Technical Education, Pb,
Plot No. 1, Sector-36A, Chandigarh.

Er. A. K. Prabhakar,
OSD to Vice Chancellor,
Punjab Technical University, Jalandhar.

Dr. A. P. Singh,
Dean (P&D),
Punjab Technical University, Jalandhar.

Dr. Prahljot Kaur (Special Invitee),
Officiating Director Mohali Campus,
C102B, Phase-7 Industrial Area, Mohali.

Er. Kamaljit Chopra (Sp. Invitee),
(Electrical Expert)
13, Jyoti Nagar, Jalandhar.

Er. P. S. Saini,
Superintending Engineer,
PGI, Chandigarh.

Sh. Rajiv Aggarwal, Architect
M/s Archigroup Architects,
A-14, Sector-15, Noida -201301.

Sh. Amrit Sagar Mittal
CMD, Sonalika Tractors Ltd,
Hoshiarpur.

Sh. S.L. Kaushal,
Chief Architect, Punjab (Retd),
2865, Sector 42-C, Chandigarh.

Er. A. N. Chowdhry (Special Invitee),
3-B, Jyoti Nagar,
Jalandhar.

Dr. Buta Singh,
Dean (Academics),
Punjab Technical University, Jalandhar.

The Registrar,
Punjab Technical University,
Jalandhar.

Er. Ashok Goyal,
CE/N-II, PWD, SCO 61-62, Phase-II,
SAS Nagar, Mohali.

Sh. Inderjit Kumar (Special Invitee),
(PH Experts) House No. 116, Phase 3B/I,
S.A.S. Nagar, Mohali.

Er. Varinder Kumar,
Executive Engineer, Const. Div-II,
PWD, Kapurthala.

Sub : Construction of new campuses of Punjab Technical University – 46th meeting of the Standing Building Construction Committee.

Dear Sir/Madam,

Please find enclosed herewith minutes of the above said meeting for kind information and further necessary action please. Comments, if any, may please be forwarded within 10 days of issue of this letter.

Thanking you

Yours Sincerely,

16/04/15

(H. P. Singh)

Executive Engineer

Copy to : Dr. R. S. Khandpur, DG, PGSC (Retd), Science House, H. No. 2901, Phase 7,
(Sector 61), Mohali.

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Punjab Technical University Jalandhar

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Mobile : 9478098017 www.ptu.ac.in E-Mail : xen@ptu.ac.in

PUNJAB TECHNICAL UNIVERSITY, JALANDHAR

Minutes of the 46th Meeting of the Standing Building Construction Committee held on 09.04.2015 under the Chairmanship of Dr. R. S. Khandpur, Director General, PGSC (Retd) at PTU's Mohali campus.

Following were present in the meeting:

1. Sh. S. L. Kaushal, Chief Architect, Punjab (Retd),
2. Sh. Kamaljit Chopra, Chief Electrical Engineer, PSEB (Retd),
3. Sh. Mohanbir Singh, Additional Director, DTE
4. Sh. P.S. Saini, Superintending Engineer, PGI

5. Dr. Buta Singh, Dean/Academics, PTU,
6. Dr. Prabhjot Kaur, Officiating Director PTU's Mohali campus.
7. Sh. H. P. Singh, Executive Engineer, PTU.

8. Sh. Ashok Goyal, Chief Engineer, North-II, PWD,
9. Sh. Vijay Kumar Chopra, Chief Electrical Engineer, PWD,
10. Sh. Varinder Kumar, XEN, PWD, Div. 2, Kapurthala,
11. Sh. Roop Chand, XEN, PWD, Electrical Division, Jalandhar.

From Archigroup Architects, Noida:

12. Sh. Rajiv Aggarwal, Architect
13. Sh. Satyendra Sharma, Architect
14. Sh. Nirutpal, Architect
15. Sh. Raman Gupta, Acoustic consultant.

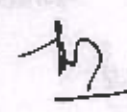
Item No. 46.1 : To confirm the Minutes of 45th meeting of Standing Building Construction Committee held on 22.01.2015.

As no comments has been received, the minutes of 45th meeting of Standing Building Construction Committee held on 22.01.2015 were confirmed.

Item No. 46.2 : Action taken on various items discussed during previous meeting of Standing Building Construction Committee.

It was informed by the Executive Engineer/PTU that following actions have been taken on various items discussed during previous meeting of Standing Building Construction Committee:

- Based upon the concept plans approved by the Building Committee in respect of the proposed auditorium and hostels at main campus, Kapurthala, the municipal drawings have been approved by Chief Town Planner, Punjab.



- The Architect will be making a presentation in the present meeting on cost comparison of projector and LED screen to be provided for the proposed auditorium at main campus, Kapurthala.
- The detailed estimate for provision of speakers, amplifiers and microphones to be provided for the proposed auditorium at main campus, Kapurthala will be presented by the Architect in the present meeting for discussions and approval.
- The issue pertaining to payment to the Architect against preparation of building plans for the proposed auditorium and hostels at main campus, Kapurthala is to be discussed in the present meeting.

Item No. 46.3: To discuss and finalize the provision of projector or LED screen for the proposed auditorium at main campus, Kapurthala.

After detailed discussions and deliberations, committee agreed for provision of LED screen for proposed auditorium at main campus, Kapurthala. However, specifications, estimates etc. will be discussed and approved at the time of procurement depending upon the technology available at that time. It was also agreed to provide conduits etc. for the conventional projector to take care of the situation in case the provision of LED screen is ruled out at a later stage.

Item No. 46.4: To discuss and approve the estimate for speakers, amplifiers and microphones for the proposed auditorium at main campus, Kapurthala.

After discussions, committee approved the estimate for speakers, amplifiers and microphones for the proposed auditorium at main campus, Kapurthala for an amount of Rs. 81.26 lacs. It was decided by the committee that tenders for execution of these works shall be invited on performance basis only.

Additionally, it was also agreed that the complete tendering process/scheme for execution of various works of the auditorium shall be discussed and approved by the Building committee.

Item No. 46.5: To discuss and finalize the provision of LED lights in place of CFL lights in college buildings and library building (under construction) of Punjab Institute of Technology, main campus, Kapurthala.

After detailed discussions and deliberations, committee decided for provision of CFL lights, as originally approved in the estimates.

Item No. 46.6: To discuss and approve the revised layout plan of proposed buildings for Punjab Institute of Technical Teachers Training and Research (PITTTR) at Ladowali Road, Jalandhar.

Committee approved the revised site plan/scheme presented by the Architect.

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- Item No. 46.7 :** To discuss and finalize the fee payable to the Architect for preparation of building plans of auditorium and hostels proposed at main campus, Kapurthala.

Committee noted that the documents presented are not sufficient to take the decision. Executive Engineer, PTU was advised to present additional documents like the original recommendations of the committee set up by the H'nble Vice Chancellor, Agendas of 20th and 27th meetings of the building committee etc.

- Item No. 46.8 :** To discuss and approve the start of construction works of proposed college buildings at Punjab Institute of Technology at Arniwala and Sikhwala.

Committee noted that University has decided to go ahead with construction of proposed buildings (Phase-I) and external development works of Punjab Institute of Technology at Arniwala and Sikhwala.

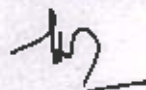
- Item No. 46.9 :** To discuss and approve the estimate for painting of boundary walls Punjab Institute of Technology, Mansa.

Committee noted that buildings and other development works of the campus are yet to be started and it may take 2-3 years time to make the campus operational. If painting of the boundary wall is done at this stage, repainting may be required at the time of start of the campus and expenditure done at this stage will become redundant. After detailed discussions and deliberations, committee decided that the work of painting of boundary wall may be taken up at the time of making the campus operational.

- Item No. 46.10 :** To discuss and approve authorization to PWD for taking Environmental Clearance for construction of proposed auditorium and hostels buildings at main campus, Kapurthala.

In view of the notification dated 22.12.2014 issued by 'Ministry of Environment, Forest and Climate Change' presented in the meeting, committee noted that Environmental Clearance for building construction projects for educational institutes is not required. However, committee advised PWD/PTU to confirm the same before start of any new construction activity.

The meeting ended with a vote of thanks to the chair.





Er. H.P. Singh
Executive Engineer

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Estd. Under Punjab Technical University Act, 1996
(Punjab Act No. 1 of 1997)

Ref. No.

Pu/ce/719

Dated

23-07-2014

Sh. D.L. Sharma, President,
Vardhman Spg. & Gen. Mills Ltd.,
Chandigarh Road, Ludhiana.

Sh. S.L. Kaushal,
Chief Architect, Punjab (Retd),
2865, Sector 42-C, Chandigarh.

Dr. A. P. Singh,
Dean (P&D),
Punjab Technical University, Jalandhar.

Sh. A. N. Chowdhry (Special Invitee),
3-B, Jyoti Nagar,
Jalandhar.

Er. Jaswant Singh Pabla (Sp. Invltee),
(Electrical Expert)
House No. 2631, Sector-79,
Mohali.

Sh. Inderjit Kumar (Special Invitee),
(PH Experts)
House No. 116, Phase 3B/I,
S.A.S. Nagar, Mohali.

Sh. Amrit Sagar Mittal
CMD, Sonalika Tractors Ltd,
Hoshiarpur.

Er. A. K. Prabhakar,
OSD to Vice Chancellor,
Punjab Technical University, Jalandhar.

The Director,
Department of Technical Education, Punjab,
Plot No: 1, Sector-36A, Chandigarh.

The Registrar,
Punjab Technical University,
Jalandhar.

Dr. Prabhjot Kaur (Special Invitee),
Officiating Director Mohali Campus,
C102B, Phase-7 Industrial Area, Mohali.

Sh. Rajiv Aggarwal, Architect
M/s Archigroup Architects,
A-14, Sector-15,
Noida -201301.

Sub : Construction of new campuses of Punjab Technical University – 43rd meeting of the Standing Building Construction Committee.

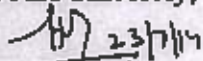
Dear Sir/Madam,

43rd meeting of the Standing Building Construction Committee shall be held under the Chairmanship of Dr. R. S. Khandpur, Director General, PGSC (Retd) at 1130 hours on 01.08.2014 at PTU's Mohali campus at C-102/B, Industrial Area, Phase VII, (Sector-119), Mohali – 160 059 (Punjab). Agenda and Agenda note for the meeting are enclosed.

You are requested to make it convenient to attend the meeting.

Thanking you

Yours Sincerely,


(H. P. Singh)

Executive Engineer

Copy to : Dr. R. S. Khandpur, DG, PGSC (Retd), Science House, H. No. 2901, Phase 7,
(Sector 61), Mohali.

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PUNJAB TECHNICAL UNIVERSITY, JALANDHAR

Sub : Agenda for the 43rd meeting of the Standing Building Construction Committee.

- Item No. 43.1 : To confirm the Minutes of 42nd meeting of Standing Building Construction Committee held on 16.07.2014.
- Item No. 43.2 : Action taken on various items discussed during previous meeting of Standing Building Construction Committee.
- Item No. 43.3 : To discuss, analyze and approve the provisions/specifications for video presentation system, sound reinforcement system, stage lighting, fire fighting, wall paneling and acoustic treatment for proposed auditorium at main campus, Kapurthala.
- Item No. 43.4 : To discuss and approve the patterns for exterior finishes of hostels and auditorium proposed to be constructed at main campus, Kapurthala.
- Item No. 43.5 : To discuss and approve the flooring patterns for circulation area and VIP Banquet area of auditorium proposed to be constructed at main campus, Kapurthala.
- Item No. 43.6 : Any other point with the permission of the Chair.



PUNJAB TECHNICAL UNIVERSITY, JALANDHAR

Agenda Note for the 43rd meeting of the Standing Building Construction Committee.

Item No. 43.1 : To confirm the Minutes of 42nd meeting of Standing Building Construction Committee held on 16.07.2014.

The minutes of 42nd meeting of Standing Building Construction Committee held on 16.07.2014 were circulated on 21.07.2014. The minutes circulated are to be confirmed.

Item No. 43.2 : Action taken on various items discussed during previous meeting of Standing Building Construction Committee.

Actions taken on various items discussed during previous meeting of Standing Building Construction Committee are as under:

- The provisions/specifications for video presentation system, sound reinforcement system, stage lighting, fire fighting, wall panelling and acoustic treatment for proposed auditorium at main campus, Kapurthala are to be presented in the present meeting for analysis, discussions and approval.
- The patterns for exterior finishes of hostels and auditorium proposed to be constructed at main campus, Kapurthala are to be discussed in the present meeting
- The flooring patterns for circulation area and VIP Banquet hall of auditorium proposed to be constructed at main campus, Kapurthala are to be presented by the Architect in the present meeting for discussions and approval.
- The estimate for raising, repairing and painting of existing boundary wall of main campus, Kapurthala has been forwarded to PWD for further action at their end.
- The detailed designing and estimation for Bank & Post office buildings and roads for main campus, Kapurthala has been started by the Architect.

Item No. 43.3: To discuss, analyze and approve the provisions/specifications for video presentation system, sound reinforcement system, stage lighting, fire fighting, wall paneling and acoustic treatment for proposed auditorium at main campus, Kapurthala.

In 42nd meeting of Standing Building Construction Committee (Agenda item No. 42.3), it was decided that detailed study, analysis and specifications of various provisions (as listed below) are finalized before finalization of the estimate of proposed auditorium at main campus, Kapurthala and experts engaged by the

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Architect for these works shall make the presentations on the provisions, specifications, manufacturers etc. considered while preparing the estimate:-

- i. Video presentation system
- ii. Sound reinforcement system
- iii. Stage lighting
- iv. Fire Fighting
- v. Wall paneling
- vi. Acoustic Treatment.

Accordingly, the experts engaged by the Architect will be making the presentations on the above.

The matter is placed before the Committee for discussions and approval please.

Item No. 43.4 : To discuss and approve the patterns for exterior finishes of hostels and auditorium proposed to be constructed at main campus, Kapurthala.

In 42nd meeting of Standing Building Construction Committee (Agenda item No. 42.7), committee agreed for provision of stones for exterior finishes of the auditorium and grit wash on entrance and painting for rest of the area for the external finishes of the proposed hostels. It was also decided that type of stone, pattern/scheme for these finishes shall be got approved by the Architect from the committee. Accordingly, the Architect will be making the presentations on the same.

The matter is placed before the Committee for discussions and approval please.

Item No. 43.5 : To discuss and approve the flooring patterns for circulation area and VIP Banquet area of auditorium proposed to be constructed at main campus, Kapurthala.

In 42nd meeting of Standing Building Construction Committee (Agenda item No. 42.7), committee agreed for granite and marble stone pattern for flooring of circulation area and VIP Banquet area of auditorium proposed to be constructed at main campus, Kapurthala and the flooring pattern same shall be got approved from the committee. Accordingly, the Architect will be making the presentations on the same.

The matter is placed before the Committee for discussions and approval please.

Item No. 43.6 : Any other point with the permission of the Chair.





Er. H.P. Singh
Executive Engineer

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PTU PUNJAB
TECHNICAL
UNIVERSITY

Estd. Under Punjab Technical University Act, 1996
(Punjab Act No. 1 of 1997)

Ref. No. Pw/EC/753

Dated 06/08/2014

Sh. D.L. Sharma, President,
Vardhman Spg. & Gen. Mills Ltd.,
Chandigarh Road, Ludhiana.

Sh. S.L. Kaushal,
Chief Architect, Punjab (Retd),
2865, Sector 42-C, Chandigarh.

Dr. A. P. Singh,
Dean (P&D),
Punjab Technical University, Jalandhar.

Sh. A. N. Chowdhry (Special Invitee),
3-B, Jyoti Nagar,
Jalandhar.

Er. Jaswant Singh Pabla (Sp. Invitee),
(Electrical Expert)
House No. 2631, Sector-79, Mohali.

Sh. Inderjit Kumar (Special Invitee),
(PH Experts)
House No. 116, Phase 3B/I, Mohali.

Sh. Rajiv Aggarwal, Architect
M/s Archigroup Architects,
A-14, First Floor, Sector-15, Noida -201301.

Sh. Amrit Sagar Mittal
CMD, Sonalika Tractors Ltd,
Hoshiarpur.

Er. A. K. Prabhakar,
OSD to Vice Chancellor,
Punjab Technical University, Jalandhar.

The Director,
Department of Technical Education, Punjab,
Plot No. 1, Sector-36A, Chandigarh.

The Registrar,
Punjab Technical University,
Jalandhar.

Dr. Prabhjot Kaur (Special Invitee),
Officiating Director Mohali Campus,
C102B, Phase-7 Industrial Area, Mohali.

Sh. P. S. Saini,
Superintending Engineer,
PGL, Chandigarh.

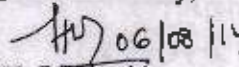
Sub : Construction of new campuses of Punjab Technical University – 43rd meeting of the Standing Building Construction Committee.

Dear Sir/Madam,

Please find enclosed herewith minutes of the above said meeting for kind information and further necessary action please. Comments, if any, may please be forwarded within 10 days of issue of this letter.

Thanking you

Yours Sincerely,


(H. P. Singh)
Executive Engineer

Copy to : Dr. R. S. Khandpur, DG, PGSC (Retd), Science House, H. No. 2901, Phase 7,
(Sector 61), Mohali.

PUNJAB TECHNICAL UNIVERSITY, JALANDHAR

Minutes of the 43rd Meeting of the Standing Building Construction Committee held on 01.08.2014 under the Chairmanship of Dr. R. S. Khandpur, Director General, PGSC (Retd) at PTU's Mohali campus.

Following were present in the meeting:

1. Sh. S. L. Kaushal, Chief Architect, Punjab (Retd),
2. Sh. A. N. Chowdhry, Chief Engineer, PWD (Retd),
3. Sh. Jaswant Singh Pabla, Chief Engineer, PSPCL (Retd)
4. Sh. P.S. Saini, Superintending Engineer, PGI, Chandigarh
5. Sh. Inderjit Kumar, Executive Engineer (Retd), Public Health Expert
6. Sh. H. P. Singh, Executive Engineer, PTU.

From Archigroup Architects, Noida:

7. Sh. Rajiv Aggarwal, Architect
8. Ms. Prema Sharma, Architect
9. Sh. Satinder, Architect
10. Sh. Nitin Gupta, Consultant, Video Projection and Sound Reinforcement system
11. Sh. Ajay Wats, Consultant, Acoustic and Street Lighting.

Item No. 43.1 : To confirm the Minutes of 42nd meeting of Standing Building Construction Committee held on 16.07.2014.

As no comments had been received, the minutes of 42nd meeting of Standing Building Construction Committee held on 16.07.2014 were confirmed.

Item No. 43.2 : Action taken on various items discussed during previous meetings of Standing Building Construction Committee.

It was informed by the Executive Engineer/PTU that following actions have been taken on various items discussed during previous meeting of Standing Building Construction Committee:

- The provisions/specifications for video presentation system, sound reinforcement system, stage lighting, fire fighting, wall paneling and acoustic treatment for proposed auditorium at main campus, Kapurthala are to be presented in the present meeting.
- The patterns for exterior finishes of hostels and auditorium proposed to be constructed at main campus, Kapurthala are to be discussed in the present meeting.
- The flooring patterns for circulation area and VIP Banquet hall of auditorium proposed to be constructed at main campus, Kapurthala are to be presented by the Architect in the present meeting.
- The estimate for raising, repairing and painting of existing boundary wall of main campus, Kapurthala has been forwarded to PWD for further action at their end.
- The detailed designing and estimation for Bank & Post office buildings and roads for main campus, Kapurthala has been started by the Architect.

[Handwritten signature]

- Item No. 43.3:** To discuss, analyze and approve the provisions/specifications for video presentation system, sound reinforcement system, stage lighting, fire fighting, wall paneling and acoustic treatment for proposed auditorium at main campus, Kapurthala.

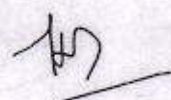
After detailed discussions and deliberations on the presentations made by the Consultants engaged by the Architect and by Sh. Rajiv Aggarwal, Architect, following decisions have been taken by the committee:

a) Acoustic Treatment :-

- i. All the materials proposed to be used for this work should preferably be manufactured in India. The technical specifications of such materials, their comparative cost to be put up in the next meeting. The costing of this work will also be revised accordingly.
- ii. Committee agreed for provision of push back chairs with wooden arm rest and without cup holder.
- iii. All the wood to be used should be pre-treated against termite.
- iv. Provision for three motorized curtains shall be made on the stage. The front curtain will be uplifting and rear curtains will be side moving.
- v. Fixed cyclorama will be provided and the same will also act as a rear wall of the stage.
- vi. Carpet will be provided in the aisles only and remaining area will be covered with PVC or linoleum sheets.
- vii. The design/scheme of the treatment proposed for the walls of the auditorium shall be presented to the committee for approval.

b) Stage Lighting System :-

- i. Provision of three lighting bars over the stage and one in front of the stage is approved.
- ii. All lights will be LED lights and a combination of normal and intelligent light fittings to be provided.
- iii. Provision of suitable cat-ladders for maintenance of lights is to be provided.
- iv. Lighting control is to be provided in the projector room.



c) Sound Reinforcement System :-

- i. Provision of stereo sound system with hanging/flying line-array FOH speakers and subwoofer is approved. However, no provision is to be made for 5.1 sound system.
- ii. Front fill speakers on vertical wall of stage and stage fill speakers along with stage monitor are to be provided.
- iii. Sufficient microphone connection socket would be provided in the stage for easy access.
- iv. The SPL, STI and other performance related specifications for audio systems to be submitted along with design so that the same can be verified after implementation.

d) Audio Video System :-

- i. Provision of two side screens in the auditorium hall is not to be kept. However, provision for TVs is to be kept in VIP suite, VIP banquet and student's verandah.
1. Video projector of 20000 ANSI lumens at control room is to be provided.
2. Minimum 2 presentation point at stage for connecting booth of analogue- VGA and digital inputs - HDMI from laptop/computer to be provided.
3. All the controls should be provided in the control room to be set up on one side of the stage.
4. No provision for inter-active touch screen at podium and video conferencing system is to be kept.
5. Stage Monitor Screen of 55" or suitable higher size to be provided for people at Dias /Podium.

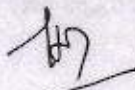
Item No. 43.4 : To discuss and approve the patterns for exterior finishes of hostels and auditorium proposed to be constructed at main campus, Kapurthala.

The patterns presented by the Architect for exterior finishes of hostels and auditorium were approved by the committee.

Item No. 43.5 : To discuss and approve the flooring patterns for circulation area and VIP Banquet area of auditorium proposed to be constructed at main campus, Kapurthala.

It was decided that some more patterns may be presented by the Architect so that appropriate decision is taken in this regard.

The meeting ended with a vote of thanks to the chair.





Er. H.P. Singh
Executive Engineer

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PTU PUNJAB
TECHNICAL
UNIVERSITY

Estd. Under Punjab Technical University Act, 1996
(Punjab Act No. 1 of 1997)

Ref. No. PTU/EE/1932

Dated 14.10.2014

Sh. D.L. Sharma, President,
Vardhman Spg. & Gen. Mills Ltd.,
Chandigarh Road, Ludhiana.

Sh. S.L. Kaushal,
Chief Architect, Punjab (Retd),
2865, Sector 42-C, Chandigarh.

Dr. A. P. Singh,
Dean (P&D),
Punjab Technical University, Jalandhar.

Sh. A. N. Chowdhry (Special Invitee),
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(Electrical Expert)
House No. 2631, Sector-79,
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Sh. Inderjit Kumar (Special Invitee),
(PH Experts)
House No. 116, Phase 3B/L,
S.A.S. Nagar, Mohali.

Sh. Amrit Sagar Mittal
CMD, Sonalika Tractors Ltd,
Hoshiarpur.

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OSD to Vice Chancellor,
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The Director,
Department of Technical Education, Punjab,
Plot No. 1, Sector-36A, Chandigarh.

The Registrar,
Punjab Technical University,
Jalandhar.

Dr. Prabhjot Kaur (Special Invitee),
Officiating Director Mohali Campus,
C102B, Phase-7 Industrial Area, Mohali.

Sh. Rajiv Aggarwal, Architect
M/s Archigroup Architects,
A-14, Sector-15,
Noida -201301.

Sub : Construction of new campuses of Punjab Technical University – 44th meeting of the Standing Building Construction Committee.

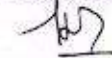
Dear Sir/Madam,

44th meeting of the Standing Building Construction Committee shall be held under the Chairmanship of Dr. R. S. Khandpur, Director General, PGSC (Retd) at 1130 hours on 20.10.2014 at PTU's Mohali campus at C-102/B, Industrial Area, Phase VII, (Sector-119), Mohali – 160 059 (Punjab). Agenda and Agenda note for the meeting are enclosed.

You are requested to make it convenient to attend the meeting.

Thanking you

Yours Sincerely,


(H. P. Singh)

Executive Engineer

Copy to : Dr. R. S. Khandpur, DG, PGSC (Retd), Science House, H. No. 2901, Phase 7,
(Sector 61), Mohali.

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Kapurthala Campus : Jalandhar-Kapurthala Highway, Kapurthala-144601

Mobile : 9478098017 www.ptu.ac.in E-Mail : xen@ptu.ac.in

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PUNJAB TECHNICAL UNIVERSITY, JALANDHAR

Sub : Agenda for the 44th meeting of the Standing Building Construction Committee.

- Item No. 44.1 : To confirm the Minutes of 43rd meeting of Standing Building Construction Committee held on 01.08.2014.
- Item No. 44.2 : Action taken on various items discussed during previous meeting of Standing Building Construction Committee.
- Item No. 44.3 : To discuss and approve the manufacturers/specifications for acoustic treatment for proposed auditorium at main campus, Kapurthala.
- Item No. 44.4 : To discuss and approve rough cost estimate for proposed auditorium at main campus, Kapurthala.
- Item No. 44.5 : To discuss and approve the flooring patterns for circulation area and VIP Banquet area of auditorium proposed to be constructed at main campus, Kapurthala.
- Item No. 44.6 : To discuss and approve the revised estimate for construction of boundary wall of Punjab Institute of Technology, Mansa.
- Item No. 44.7 : To discuss and approve the design basis reports submitted by the Architect for Structure, Electrical and Public Health works in respect of Punjab Institute of Technology, Arniwala, Fazilka.
- Item No. 44.8 : Any other point with the permission of the Chair.
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PUNJAB TECHNICAL UNIVERSITY, JALANDHAR

Agenda Note for the 44th meeting of the Standing Building Construction Committee.

Item No. 44.1 : To confirm the Minutes of 43rd meeting of Standing Building Construction Committee held on 01.08.2014.

The minutes of 43rd meeting of Standing Building Construction Committee held on 01.08.2014 were circulated on 06.08.2014. The minutes circulated are to be confirmed.

Item No. 44.2 : Action taken on various items discussed during previous meeting of Standing Building Construction Committee.

Actions taken on various items discussed during previous meeting of Standing Building Construction Committee are as under:

- The manufacturers/specifications for acoustic treatment for proposed auditorium at main campus, Kapurthala are to be presented in the present meeting for discussions and approval.
- The flooring patterns for circulation area and VIP Banquet hall of auditorium proposed to be constructed at main campus, Kapurthala are to be presented by the Architect in the present meeting for discussions and approval.
- The comments offered by the committee for Stage lighting system, Sound reinforcement system and audio video system have been incorporated in the design/scheme and the detailed estimate is being presented in this meeting.

Item No. 44.3: To discuss and approve the manufacturers/specifications for acoustic treatment for the proposed auditorium at main campus, Kapurthala.

In 43rd meeting of the committee, it was decided that all the materials proposed to be used for acoustic treatment should be preferably manufactured in India. Accordingly, the Architect will be making the presentation on type of the materials proposed to be used and their cost comparison.

The matter is placed before the Committee for discussions and approval please.



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Item No. 44.4: To discuss and approve rough cost estimate for proposed auditorium at main campus, Kapurthala.

In 42nd meeting of the committee, the rough cost estimate for the proposed auditorium was discussed under agenda item No. 42.3 (copy of the estimate discussed in 42nd meeting is placed at Annexure-A). After detailed discussions, the committee agreed for the cost except for specialized items such as Acoustic treatment, Stage lighting system, Sound reinforcement system and audio video system. The Architect will be making presentations on detailed estimate for these items.

The matter is placed before the Committee for discussions and approval please.

Item No. 44.5 : To discuss and approve the flooring patterns for circulation area and VIP Banquet area of auditorium proposed to be constructed at main campus, Kapurthala.

In 43rd meeting of the committee, it was decided that some more flooring patterns for circulation area and VIP Banquet area of the proposed auditorium may be presented by Architect so that appropriate decision is taken in this regard. Accordingly, the Architect will be presenting some more flooring patterns.

The matter is placed before the Committee for discussions and approval please.

Item No. 44.6 : To discuss and approve the revised estimate for construction of boundary wall of Punjab Institute of Technology, Mansa.

In 30th meeting (Agenda item No. 30.7) of the Standing Building Construction Committee, estimate for construction of boundary wall of Punjab Institute of Technology, Mansa for an amount of Rs. 300.0 lacs was approved. This estimate was based upon a tentative design prepared by the Architect. Additionally, at the time of approval of this estimate, the length of the boundary wall was considered as 4224 metre. However, as per site conditions, the actual length of the boundary wall is about 4870 metre. It has been confirmed by the Architect that by mistake length of boundary wall for one site was not included in the approved estimate. There has been substantial increase in size of the foundations from that considered at the time of preparation of original estimate. Moreover, there are some increase in the quantities as per site conditions also. By considering all these factors, the revised estimated cost for the boundary wall works out to be Rs. 409.27 lacs i.e. increase in cost by 36.42%. In addition to this, price escalation as per clause 10cc of CPWD already approved in building committee and BOG meetings, shall be payable to the contractor.

This matter was also discussed in 42nd meeting of the committee and it was decided that works upto award value of the works is got executed from the contractor to avoid any litigation with the contractor and contract is foreclosed by considering the facts that Punjab Cabinet has approved constitution of new technical university at Bathinda and district Mansa will fall under the jurisdiction of new university and it was opinioned by the committee that new university may have different requirements for this campus.

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The matter has again discussed at University level and by considering the facts that final decision is still to be taken by Punjab Govt. on new University and to avoid trespasses, theft and misuse/encroachment of the campus area, boundary wall works are got completed from the existing contractor.

The matter is placed before the Committee for discussions and approval please.

Item No. 44.7 : **To discuss and approve the design basis reports submitted by the Architect for Structure, Electrical and Public Health works in respect of Punjab Institute of Technology, Arniwala, Fazilka.**

The Architect has submitted design basis reports of Structure, Electrical and Public Health works in respect of Punjab Institute of Technology, Arniwala, Fazilka (Annexure-B). The same will be presented by the Architect in the meeting.

The matter is placed before the Committee for discussions and approval of the reports.

Item No. 44.8 : **Any other point with the permission of the Chair.**

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ANNEXURE-A

PREAMBLE TO PRELIMINARY ESTIMATE

1. **State:** PUNJAB

2. **Name of Work**

2.1. Construction of Punjab Technical University, Kapurthala.

2.2. This preliminary estimate of probable cost of Rs. 217,596,646/- (Rs. Twenty one crore, seventy five lacs, ninty six thousand, six hundred & forty six only only) excluding contingencies, cost of external development and departmental charges has been framed by Archigroup Architects (Regd.)

3. **History**

3.1. This preliminary estimate covers the probable cost of construction of Convention Centre. This scope of work was finalized in the meeting held on 7th May 2014 at Chandigarh. This estimate is submitted for accord of Administrative approval and expenditure sanction by the competent authority.

4. **Design & Scope:**

4.1. The proposed buildings shall be constructed as RCC structure. The present estimate consists of:

4.1.1. Convention center: - The block is G+1 consisting of 800 capacity auditorium, 2 green rooms, 1 control room, 1 no. VIP lounge with kitchen, 1 no. VIP suites, Student's verandah with kitchen, 2 offices, toilets etc.

5. **Civil works:** Most of the items to be executed in these buildings are already included in the provisions in the PAR – CPWD for year 2012.

6. The salient features of various provisions are as under:

6.1. **Building:** - The building shall be of R.C.C. framed structure with raft and combined footing.

6.2. **Foundation:** - As per structural design based on soil investigation.

6.3. **Flooring :-**

Auditorium	Carpet
Stage	Wooden flooring
VIP lounge, suites, lobby, corridor	Granite
Staircase	Granite
Student's verandah	Kota stone
Toilets	Vitrified tiles

6.4. **Doors and windows: -**

6.4.1. Door frames shall be of Aluminium with pre-laminated shutter. Doors of auditorium shall be acoustic doors. Windows shall be of Aluminium sections & shutter as per architectural drawings. Structural glazing has been provided at places in the elevation. Fitting shall be steel or aluminum as per architect's requirements.

6.5. **Staircase Railing:** Stainless steel railing has been provided.

6.6. Toilets: Floor vitrified tiles and dado up to door level height with glazed ceramic tiles, vitreous china WC, washbasin and urinals.

6.7. Roofing: - Terrace shall have brick bat coba treatment and acoustical false ceiling shall be provided in auditorium as per architectural drawing & gypsum false ceiling in VIP lounge & suites.

6.8. Internal Finishing: cement plaster, oil bound distemper and acrylic emulsion paint and plastic emulsion with putty, doors shall be enamel/ spirit polish finish. Walls of auditorium will have acoustic paneling.

6.9. External Finishing: Weather proof paint, structural glazing, Stone cladding as per architectural drawings.

6.10. Furniture: Chairs of auditorium has been included in this estimate.

7. Services:

7.1. Following provisions have been made in this preliminary estimate.

7.1.1. Fire prevention system as/ NBC have been provided. Sprinklers system has been considered

7.1.2. Internal Electrical Installation, telephone data, networking, power plugs etc.

7.1.3. Video presentation & sound reinforcement system has been considered in this estimate.

8. Exclusions:

8.1. No provisions have been made in the preliminary estimate for interior decorations, façade lighting, for external development works like roads, rain water harvesting bulk services such as tube wells, pumps, extension of lines, HT- substation equipments, LT distribution system. DG sets, external lighting, IBMS and CCTV access control system etc.

9. Rates

9.1. Rates are based on CPWD PAR of 1.10.2012. For the items not covered under PAR 2007, rates have been derived from market rate analysis, PTU-III, Kapurthala approved estimates and CSR of Punjab.

10. T & P : No special T&P is required all other shall be arranged by the contractor.

11. Land : Available.

12. Method : By contract after call of tenders.

SUMMARY- PRELIMINARY ESTIMATE				
S. No.	Building / Component	Plinth Area (Sqm)	Total Cost of building in Rs	Reference
1	2	3	4	5
1	Convention centre	3,746.70	150,760,218.60	Ref. Detailed calculation
2	Other Building Expenses(Richer Specifications)		45,537,006.40	Ref. Annexure 1
3	AC cost		21,299,421.08	Ref. Annexure 2
4	Total (1+2+3)		217,596,646.08	
5	SAY		217,596,646	
Twenty one crore, seventy five lacs, ninety six thousand, six hundred & forty six only				

Auditorium Type of Building - Assembly Total Plinth Area - 3,746.70 sq.m Plinth area on ground floor 3,178.00 sq.m Total covered area- 3,621.50 sq.m No. of storeys- G+1 Floor height 13.50 m Refer Org No. PTU-IV/PRE/AC/01-01 to 09							
Sr.No.	Description	Unit	Qty	Nos	Rate	Amt	Explanation
1	2	3	4	5	6	7 = (4*5*6)	8
1	R.C.C. FRAMED STRUCTURE						
1.1	RCC framed structure upto 2 storeys						
1.1.1	Floor height 3.35m						
a.	Floors	sqm	3,746.70	1.0	23,500.00	88,047,450.00	
1.2	Extra for						
1.2.1	Every 0.3m additional height of floor above normal floor height of 3.35m.						
a.	Ceiling at 12.9m	sqm	430.69	31.83	270.00	3,701,780.55	Ceiling height at different levels. Refer dwg no. PTU-IV/PRE/AC/01-07 & 08
b.	Ceiling at 11.4m	sqm	264.23	26.83	270.00	1,914,346.35	
c.	Ceiling at 6.3m	sqm	300.29	9.83	270.00	797,269.95	
d.	Ceiling at 6m	sqm	638.30	8.83	270.00	1,522,345.50	
e.	Ceiling at 5.3m	sqm	327.95	6.50	270.00	575,552.25	
f.	Ceiling at 4.2m	sqm	274.53	2.83	270.00	210,015.45	
g.	Ceiling at 4m	sqm	607.36	2.17	270.00	355,305.60	
1.2.3	Every 0.3m deeper foundation over normal depth of 1.20m (on G.F. area only)	sqm	3,178.00	4.33	270.00	3,718,260.00	
1.2.4	Every 0.3m higher plinth over normal plinth height of 0.6 mt. (on G.F. area only)						
a.	Plinth at 0.9m	sqm	1,274.00	1.00	270.00	342,980.00	
b.	Plinth at 1.6m	sqm	567.70	3.33	270.00	510,930.00	
1.2.5	Resisting Earthquake forces	sqm	3,746.70	1.00	1,140.00	4,271,238.00	
1.2.6	Large modules over 35 sq m	sqm	1,169.60	1.00	1,500.00	1,754,400.00	Auditorium & lounge
1.2.7	Fire fighting						
1.2.7.1	With wet riser system	sqm	3,746.70		500.00	1,873,350.00	
1.2.7.2	With sprinkler system	sqm	3,178.00		750.00	2,383,500.00	
1.2.8	Fire Alarm						
1.2.8.1	Automatic Fire alarm system	sqm	3,746.70		500.00	1,873,350.00	
	Total A (1.1.1.a + 1.2.1) =					97,124,085.85	
	Total B (1.2.3 to 1.2.6) =					16,729,008.00	
2	SERVICES						
2.1	Internal water supply & sanitary installations	% of A			@ 15%	14,568,609.85	
2.2	External service connections	% of A			@ 5%	4,856,203.28	
2.3	Internal Electrical Installation	% of A			@ 12.5%	12,140,508.21	
2.4	Extras for						
2.4.1	Data network conduits	% of A			@ 0.5%	485,620.33	
2.4.2	Power wiring & plugs	% of A			@ 4%	3,884,962.63	
2.4.3	Telephone conduits	% of A			@ 0.5%	485,620.33	
2.5	Lightning conductors						
2.5.1	Upto 4 storeyed building	% of A			@ 0.5%	485,620.33	
	Total C (2.1 to 2.5.1) =					36,907,144.95	
	Grand Total E = A+B+C					150,760,218.80	

OTHER BUILDING EXPENSES

Annexure-1

S. No.	Description	Unit	Quantity	Rate	Amount (INR)	Explanation
1	2	3	4	5	6	7
Richet Specifications						
1	Wooden Flooring	sqm	273.72	11,860.00	3,246,319.20	On stage
2	Carpet -	sqm	935.00	2,058.61	1,924,800.35	Rates derived from preliminary estimate of auditorium submitted in 2007
3	Chairs	No.	800.00	5,800.00	4,640,000.00	
4	False ceiling & panelling					
4.1	Acoustic tiles for lobby (600x600) 0.9 NRC	sqm	306.60	2,282.24	699,734.78	Market rate analysis of Anutone ceiling for 0.9 & 0.7 NRC
4.2	Acoustic ceiling for hall	sqm	1,208.72	3,847.44	4,650,477.68	
4.3	Wall panelling	sqm	1,058.00	5,318.98	5,625,375.42	
5	PA system				1,250,000.00	
6	Stage lighting				3,000,000.00	Rates considered from acoustic report of auditorium submitted in 2007
7	Sound reinforcement system				10,000,000.00	
8	Video presentation system				10,500,000.00	
	Total				45,537,006.40	

Cost of Airconditioning					Annexure-2
S.No.	Building	Unit	Area	Refrigeration Provided @ 1 TR/100sq.ft	Cost @ 95,000/ TR
1	2	3	4	5	6
	AC areas	Sqm.	2,082.91	224.20	21,299,421.00

AREA CALCULATION		Annexure-3		
		Building block/ Function		
		Convention centre		
		Covered Area (sqm)	Additional Area (sqm)	Plinth Area 1(a)+1(b) (sqm)
S.NO.		1 (a)	1(b)	1(c)
1	Ground Floor	3,052.80	125.20	3,178.00
2	First floor	568.70	-	568.70
3	Total Area	3,621.50	125.20	3,746.70
4	Total Ground Coverage	3,191.78 sqm		

ANNEXURE-B

Introduction

Punjab Technical University is a growth oriented University established by the Government of Punjab as an affiliating and teaching University to facilitate and promote studies, research and extension work with a focus on professional education in emerging areas of higher education in the fields of Engineering, Technology, Management, Medicine, Pharmacy, Nursing, Education and Law etc. In a brief span of existence, the University has made a significant progress and has multiplied its activities, manifold. In its endeavor to impart education from high school level upto engineering degree level it has been decided to construct campuses in different parts of Punjab under PTU. The campuses at Arniwala & Sikhwala are among such campuses.

The campus at Arniwala & Sikhwala are to become cohesive and an integrated unit, construction of the required infra-structural facilities like academic functions, students and staff accommodation, playing fields etc. on plots measuring about 12.27 acres at Arniwala and 13.3 acres at Sikhwala.

Phase I for PIT Arniwala & Sikhwala

Phase I of the project consists of a college building of G+1 floors with an approximate area of 3,700 sq. mts.. These proposed college buildings will house classrooms, labs, tutorial, and seminar hall & faculty rooms.

Since the area constructed in current phase is only 8% of the total F.A.R available, hence designing of services on modular basis is not a feasible & viable solution which is evident from the reports attached.

Finishing works:

The salient features of various provisions are as under:

Flooring:-

Main entrance	Kota stone flooring with marble pattern
Circulation	Kota stone
Rooms	Kota Stone
Toilets	Vitrified Tiles
Staircases	Kota stones

Doors and windows: - Door frames shall be in Pressed Steel sections with flush door shutters. Windows shall be of Aluminum frames and shutters as per architectural drawings. Structural glazing has been provided at places in the elevation. Fittings shall be of aluminum as per architectural drawings/specifications.

Staircase Railing: Mild Steel railing finished with approved synthetic enamel has been proposed.

Toilets: Matt finish ceramic tiles dado up to door level height, vitreous china WC, wash basin and urinals as/ requirement.

Roofing: - Terrace shall have brick coba treatment with polyurethane insulation.

False ceiling: - Proposed in the Seminar Hall and partially in classrooms for acoustical treatment.

Internal Finishing: Cement plaster, oil bound distempers, Plastic emulsion and acrylic emulsion paint with POP, doors shall be enamel painted. Corridors will have 4 ft. high ceramic tile cladding.

External Finishing:

Arniwala- Exposed concrete finish in architectural features, Weather proof paint, grooves in plaster. Red sandstone cill in windows.

Sikhwala- Texture paint in architectural features, Weather proof paint, grooves in plaster. Red sandstone cill in windows.

This report is submitted for accord of Administrative approval of the design basis for Electrical, plumbing, Firefighting & HVAC services in the building.

DESIGN BASIS REPORT FOR STRUCTURE FOR PIT- ARNIWALA

Type of Buildings: - RCC framed structure.
The proposed building is Ground+1 storey.

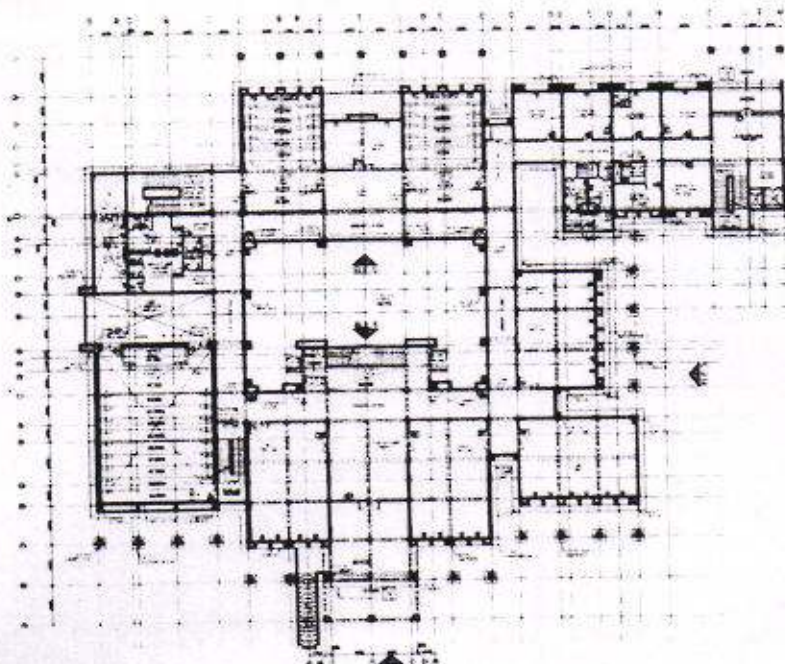
1.0 Structural Design:-

The main considerations followed for the design of structure are:

- (a) Structure safety and stability.
- (b) To meet the demands of aesthetics conceived by the architect.
- (c) Availability of material, equipment and expertise.
- (d) Constructability and ease of maintenance.
- (e) Durability.
- (f) Economy.

2.0 Structural System:

All the Buildings have been designed as RCC framed structure with RCC slab, beams and columns. The buildings has been designed as slab beam arrangement in accordance with the relevant Indian



Code of Practice for civil works i.e. IS: 456, IS: 875, IS: 1893-2002, IS: 4326-1976 and IS -13920-1993.

2.1 Design Approach:

Structural Modeling: Three dimensional model of building will be generated using STAAD- Pro software. All the beams and columns have been idealized as beam elements. The structure is analyzed and designed for all possible combinations of gravity loads (dead & live loads), and lateral loads (earthquake loads). Fatigue effects of persistent cyclic loads are not anticipated therefore ignored, if any.

2.2 Foundation System:-

Isolated/combined footings are proposed for the Phase-1. The net soil bearing capacity for isolated/combined foundation is considered 15.0 t/sqm at a depth of 2 m below NGL. The settlement of 50 mm has been considered in the design of isolated/combined footings.

3.0 Computer Programs Used:

Name	Purpose	Producer
STAAD Pro	Structural and Design Analysis	BENTLEY
AUTOCAD	Drafting Works	Autodesk

4.0 Material Dead Loads:

All the permanent loads on the structure are applied as dead load. The dead load in a building shall comprise of self weight of beams, columns, walls, partitions, floors, roofs and also include the weight of all other permanent constructions in the building and shall conform to IS: 1911-Schedule of unit weights of buildings materials. Unit weight of various materials considered on the structural members is as follows:

S.No.	Item	Density
1	Concrete	2.50 T/m ³
2	115mm Brick Work with 25mm Plaster	0.275 T/m ²
3	230mm Brick Work with 25mm Plaster	0.50 T/ m ²

Following loads has been considered in structure for analysis:-

- I. Self wt of structure
- II. Slab thickness and floor finish – as per actual
- III. Wall loads – as per actual

5.0 LIVE LOAD:

Live loads on the entire floor shall comprise all loads other than dead loads. The minimum live loads on different occupancies have been considered as per IS: 875 (Part 2).

Live load shall be considered in design as per Table 1 of IS: 875
(Part 2)-1987 as follows:

5.1 Educational Building:

(a) Class rooms & Lecture rooms	0.4 T / m ²
(b) Cafeteria	0.3 T / m ²
(c) Office and Staffrooms	0.25T / m ²
(d) Toilets and bathrooms	0.2 T / m ²
(e) Kitchen, Laboratories	0.3T / m ²
(f) Corridors, passages, staircases including Fire escapes, lobbies, balconies	0.5T / m ²
(g) Libraries	
i) Reading rooms (without separate Storage)	0.4T / m ²
ii) Reading rooms (with separate Storage)	0.3T / m ²
(g) Terrace	0.15 T / m ² 0.50 T/m ² usable Terrace for services

6.0 Seismic Load:

Response spectrum method was used as code with the
following data:

Design horizontal seismic coefficient $(A_h) = \frac{Z I S_a}{2R_g}$

Zone factor $Z = 0.24$ corresponding to zone IV.

Importance factor $I = 1.5$

Response reduction factor $R = 5$

(S_a/g) = Curve given for medium soil

T = Time period = $0.075 (h)^{0.75}$

h = Height of building from foundation Level

7.0 Materials

Concrete: -

Concrete mix of M25 conforming with IS: 456 and CPWD specifications are used.

Steel Reinforcement: -

Fe 500 Grade (TMT - bars) conforming with IS: 1786.

Structural steel: -

$(F_y 250/ F_y 345) \text{ N/mm}^2$

8.0 Design Limit States

The Limit state design method is used for the structural design of concrete member. For design of the individual members loads are combined in accordance with the loading combinations specified in IS 875 to achieve the respective limit state. These are listed below:

S. No.	Dead Load	Live Load	Earthquake/ Wind load
--------	-----------	-----------	--------------------------

1	1.5	1.5	-
2	1.2	1.2	1.2
3	1.5	-	1.5
4	0.9		1.5

9.0 LOAD COMBINATIONS:

1. $1.5^* (DL + LL)$
2. $1.5^* (DL +/- EQX)$
3. $1.5^* (DL +/- EQZ)$
4. $0.9^* DL +/- 1.5EQ$
5. $0.9^* DL +/- 1.5EQZ$
6. $1.2^* (DL + LL +/- EQX)$
7. $1.2^* (DL + LL +/- EQZ)$

For non orthogonal Columns following additional load combination has been used in the design.

14. $1.2(DL + LL +/- EQX +/- 0.30EQZ)$
15. $1.2(DL + LL +/- EQZ +/- 0.30EQX)$
16. $1.5(DL +/- EQX +/- 0.30EQZ)$
17. $1.5(DL +/- EQZ +/- 0.30EQX)$
18. $(0.9DL) + 1.5(+/-EQX +/- 0.30EQZ)$
19. $(0.9DL) + 1.5(+/-EQZ +/- 0.30EQX)$

Notations

DL = Dead Load

LL = Live Load

RLL = Reduced Live Load

EQX = Earthquake Load in X-direction

EQZ = Earthquake Load in Z-direction

Whereas X & Z are two principal axes.

10.0 Requirements for Durability and Fire

Concrete cover requirements is governed by Indian Code. The values in the following table are appropriate for a fire rating of 2 hours.

The following classification also applies in the design of structural elements:

Exposure	Classification
Members in contact with the ground	Very Severe
Members in interior environments	Mild
Members in above-ground exterior environments	Moderate

In general, adopting the minimum concrete strengths and reinforcement covers will ensure the durability and fire resistance of concrete elements. Values shown on the drawings shall not be less than the following:

Element/Location	Minimum Cover (mm)	Minimum Thickness (mm)	Minimum Concrete Design (used in the design)
Cast In Place Concrete			
1. Concrete cast against and permanently exposed to earth	75	200	M25
2. Concrete exposed to weather and not in contact with ground (moderate)			
a.) RC slabs	25	125	M25
b.) RC walls	25	200	M25
c.) RC beams	30	230	M25
d.) RC columns	40	230	M25

11.0 Design Codes, Standards and Reference Documents

11.1 Codes, Standards and Commentaries

S. No.	CODE	NAME
1	IS: 1893 – 2002	Criteria for Earthquake resistant design of Structures
2	IS: 13920	Ductile detailing of Reinforced Concrete Structures subjected to Seismic forces.
3	IS: 4326 – 1993	Earthquake resistant Design and construction of Buildings
4	IS: 875 – 1987 (Part I to III & Part V)	Code and Practice for Design Loads (Other than earthquake) for Building and Structures like Dead, Imposed, Wind and other Loads
5	IS: 456 – 2000	Plain and Reinforced Concrete (Code of practice)
6	SP: 16	Design aids for Reinforced concrete Structure.
7	SP: 34	Handbook on Concrete Reinforcement and Detailing
8	IS: 3370 Part I, Part II and Part IV	Code of practice for Concrete structures for the storage of liquids.
9	IS: 1786	Specification for High Strength Deformed Steel bars and wires for concrete reinforcement
10	IS: 1904	Code and Practice for design and Construction of Foundations in Soils
11	IS: 2950	Code and Practice for Design and Construction of Raft Foundations
12	IS: 800-1984	Code of Practice for general Construction in Steel.
13	IS: 1343-1980	Code of Practice for Prestressed Concrete.

12.0 Design References and Hand Books:

S.No.	Name of Book	Author
1	Reinforced Concrete Design	W.H.Mosley
2	Foundation Analysis & Design (4th Edition)	Bowles
3	Foundation Design and Construction	Tomlinson
4	Concrete Structures	Wamer, Rangan, Hall & Faulkes (Longman, 1998)
5	Reinforced Concrete Designers Handbook	Fourth Edition, Reynolds & Sledman
6	Reinforced Concrete Design (Second Edition)	S Unnikrishna Pillai, Devdas Menon
7	Reinforced Concrete	S. N. Sinha
8	Reinforced Concrete	O. P. Jain
9	Design of steel structure	P. Dayaratnam
10	Prestress Concrete Structure	P. Dayaratnam
11	Handbook of concrete, Engineering	Mark Fintel
12	Properties of concrete	A.M.Neville
13	Dynamic of Structures: Theory and Application to Earthquake Engineering	Anil K. Chopra
14	Tall building structures: Analysis and design	B.S.Smith & Cault
15	Structural Analysis	C.S.Reddy

DESIGN BASIS REPORT FOR PHASE-I ELECTRICAL INSTALLATION
WORKS FOR PIT, ARNIWALA & SIKHWALA

OBJECTIVES

The objective of this report is to present the design considerations for various elements of the electrical systems and low voltage systems like Electronic Fire Detection, provisions only for Voice & Data Networks, Public Address and Electronic Security systems. This will form a basis for the process of development and approval of the final design for electrical systems to suit the client's brief, purpose and budget before final preparation of design, tenders and Schedules of Quantities.

The intent will be to provide a robust, reliable and safe electrical power distribution system based on principles of ready-to-use energy efficient practices and clean energy technologies wherever feasible, and to ensure an easy-to-maintain, cost effective and flexible system in line with the best available in local and international markets.

STANDARDS + CODES

All aspects of design shall conform to relevant portions of the following:

- National Building Code of India 2005
- Energy Conservation Building Code 2007
- Bureau of Indian Standards
- International Electro technical Commission
- CPWD General Specifications for Electrical Works (Internal) 2005

The electrical load requirement for lighting and small power (e.g. computers, servers, photocopiers, scanners, faxes and other lab equipment's), HVAC load have been estimated empirically based on the areas proposed and considering the approximate load for External Lighting & Plumbing for phase-I. The conclusions have been tabulated below, while the details for individual buildings are listed later.

SUMMARY OF ELECTRICAL LOADS AT PIT ARNIWALA & SIKHWALA					
S. No.	Description	Connected Load (KW)	Diversity	Maximum Demand Load (KW)	Emergency Load (KW)
1	College building				
i	Light load	34.76	0.70	24.33	6.61
ii	Power load	40.40	0.50	20.20	7.50
2)	Air conditioning				
i	Seminar Hall for 28.7 tonnes	40.00	0.50	20.00	20.00
ii	Office area for 15 tonnes	25.00	0.70	17.50	
3	External Development including borewell	25.00	0.50	12.50	3.13
4	Sewerage Treatment Plant	5.00	0.50	2.50	
	Total	170.16		97.03	37.24
Transformer Capacity:					
Adopting over all diversity factor 0.9, Maximum Demand in KW				87.33	33.51
As the maximum demand load comes out to be less than 100 KW, LT connection of 90 KW will be demanded from the SEB/authority					
DG Set Capacity					
Adopting over all diversity factor 0.9, Maximum Demand in KW			=	33.51	
Adopting DG Set loading 0.8 and Power factor 0.8					
DG Set Capacity works out to be			=	52.36	
Selection of DG SET for college building			1x 50 KVA		

DESIGN CONSIDERATIONS

This is covered under the following subheads:

Subhead A	Substation & Power Distribution Plan.
Subhead B	Point Wiring
Subhead C	Illumination system
Subhead D	LV Services: Voice, Data, & Security System
Subhead E	External Development (Electrical) Substation & Power Distribution Plan, Lighting & Fan

SUBHEAD A- Substation & Power Distribution Plan

In Phase I, the LT connection of 90 KW meter for 0.433kV LT supply will be installed and commissioned at the entry of the site. LT connection will feed phase-I i.e college building-1 & external development for phase-I

As the load increases than 100 KW connection for HT metering will be applied to PSEB/authority & based on the load 11 KV substation will be installed, keeping in mind space provisioning for the 11 KV substation has been done with the consultation of the architect.

A.1. D.G Sets and Power Back-up Facilities

It is proposed to back-up power for generators for the following:

- 50% of AC load in Seminar hall load is being considered on generator back-up
- For other buildings, 25% of lighting, fans and small power is being considered on generator back up

It is therefore proposed to have a final configuration of 1 no. 50kVA D.G. Set. For Phase - I now we would suggest 1nos 50kVA D.G. Sets be installed and the remaining set will be installed later as the load increases in next phase. The DG set will be provided with individual AMF panel for automatic starting in case of power failure. It is not intended to either synchronize the sets or share the loads in future for smaller DG sets. There will be a manual selection of sets to run for various load conditions. The AMF panels will also be supplied with manual override facilities.

It is proposed to locate the set on ground floor level so that servicing, operation and maintenance is consolidated for more efficiency. The sets would be located in open

Cables

All wires shall be PVC insulated FRZHS with copper conductor. All conduits will be PVC and MS conduits will be provided in the basement and on places subject to mechanical damage.

A.3. Earthing Systems

Earthing system including earthing strips/cables and earth pits will be provided.

It is proposed to provide electrolytic, chemical earthing system. This type of earthing system has:

- Low electrical resistance to earth
- Good Corrosion resistance
- Ability to carry high currents repeatedly
- Reliable long life system
- Low Maintenance

Main earth electrode will be suitable to achieve a maximum resistance to earth of 1 Ohm.

Proper Grounding will be provided for

- Normal AC supply
- All apparatus and metal pieces
- Each laboratory

Separate systems of earthing shall be provided in the building for.

- UPS/Inverter
- Telephone / EPABX
- Servers and computer
- AV Systems

SUBHEAD B- Point Wiring

Point wiring shall be carried out using Fire Resistant (FR) grade PVC insulated wire with multi-stranded copper conductors carried in Medium/heavy duty PVC conduit. Switches proposed to be used are contemporary modular type switches

Cables

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- Telephone / EPABX
- Servers and computer
- AV Systems

SUBHEAD B- Point Wiring

Point wiring shall be carried out using Fire Resistant (FR) grade PVC insulated wire with multi-stranded copper conductors carried in Medium/heavy duty PVC conduit. Switches proposed to be used are contemporary modular type switches

There shall be separate DBs for "Normal" power (which will feed the power outlets and some lights) and for "Emergency" power (which will feed 25% of fans and lights)

SUBHEAD C- Point Wiring

The provision of luminaries in various areas of the building to be designed to achieve the illumination levels as per relevant standards and site requirement. The luminaries will be selected keeping in mind Aesthetics, location requirement, ease of maintenance and energy conservation.

S. No.	Description of Space	Type of Lighting	Illumination (LUX Level)
i)	Corridors and circulation spaces	CFL/T5	100-150
ii)	Toilets	CFL	100-150
iii)	Staircases	CFL	100-150
iv)	Office Areas	T5	300-500
v)	Service Areas	T5 Lamps	150-300
vi)	Terrace & External Lighting	MH/CFL Lamps	20

CFL will be the preferred source of light for maximum lumen/ watt package. Fittings with conversion efficiencies of 65% and above are selected for areas requiring 300 lux and above. Suitable mirror optic louvers have considered minimizing the cut-off angle of direct light incident on the screens. Compact fluorescent light has been selected for corridors and lobbies as they are the highest usage areas.

Fans will be provided for all rooms - including rooms with AC.

C.1. Telephone System, Cable TV and Internet Net Work

Telephone wiring connections are proposed to be provided in the offices, labs, seminar halls. Telephone, Data/Internet points will also be provided in the office areas. All the voice points will be connected through telephone cable from the MDF. All the tag blocks in turn shall be connected to the main tag block located in the LV room. Only conduits for 2 Pairs telephone wires, internet. Provision for signal boosters will also be made as per the requirement of the various service providers.

C.2. Security System

Provision for installing a CCTV system would be made to monitor the Main Entries & Exits of the building. The system itself – the cameras, monitors and cabling - will not be included in the scope of design and execution as it would be best to be integrated at

the time of commissioning and handing over.

SUBHEAD D- External Development

External lighting would be designed for in a manner to ensure the security of people at various hours on all roads, pedestrian paths. In addition lighting for the landscaped areas would be integrated so that the luminaries blend and contribute to the aesthetic nature of the landscape design. Particular care would be taken to minimize upward spill of light to ensure compliance with "Night Sky" criterion.

Lamp sources with maximum efficiency and high colour rendering index would be selected. For larger lumen packages Metal Halide (MH) lamps would be used, for medium level requirements CFLs would be used.

DESIGN BASIS REPORT FOR PHASE-I SANITARY ENGINEERING AND FIRE FIGHTING SERVICES FOR PIT, ARNIWALA & SIKHWALA

1.0 INTRODUCTION

- 1.1 Water supply and wastewater disposal constitute a very important part of the services in a building. Maintenance of hygiene and cleanliness are indispensable to the wellbeing of the occupants as a whole.
- 1.2 This report intends to highlight the details of the following proposed services, which are to be provided from the point of view of Sanitary Engineering, Fire Fighting and other allied services.
- Water Supply System
 - Wastewater Disposal System
 - Sewerage and drainage system including disposal
 - Sewage Treatment Plant and Recycling of Waste Water
 - Rain Water Harvesting
 - Firefighting system
- 1.3 It is proposed to design the services, storage capacities and piping network of the buildings in totality.

2.0 WATER SUPPLY SYSTEM

2.1 **Total Water Requirement Calculation:** The consolidated and distributed water requirement as per I.S. specifications and Govt. manuals for phase I shall be as below:

Punjab Institute of Technology ,Arniwala & Sikhwala-Calculation for Daily Water Requirement						
S. No.	Type of Building	Occupancy	Water Requirement (LPCD)	Total Water Requirement (LPD)	Water Requirement For Domestic (LPD) @40%	Water Requirement For Flushing (LPD) @60%
PHASE-I						
A	COLLEGE BUILDING - 1					
1	Students	240	45	10,800	4,320	6,480
2	Teachers	25	45	1,125	450	675
3	Technical Staff	5	45	225	90	135
4	Support Staff	5	45	225	90	135
5	IV Class Staff	5	45	225	90	135
6	Laboratory Requirement	L.S		4,000	4,000	
	Total (Phase-I)	280		16,600	9,040	7,560

2.2 Source of Water

2.2.1 Since municipal water supply does not exist in the vicinity of project site it will be necessary to develop own infrastructure to fulfill the entire requirement. It is proposed to meet the total water requirement for the campus by other source / external supply such as bore wells etc. Two nos. bore wells (1 working+1standby) having a discharge of 18000 lph for operating 2-3 hours operated manually should be provided to fulfill the requirement.

2.2.2 However, it is also proposed to design a sewage treatment plant in such a way that effluent will be recycled for horticulture purpose only.

2.3 Storage

Since the water requirement is only 17KL, therefore underground tank has not been considered for phase I building.

Overhead tank capacity for 1 day storage has been considered.

2.4 Quality of Water Supply

Since, the water will be required for different purposes i.e. for drinking, cooking, in laboratories in the toilets etc., it has to be of a required standard quality. The exact treatment of water will be suggested after getting the bore well water test report for potability which will be provided by PTU.

3. MATERIALS FOR WATER SUPPLY

- All the external pipes to be used for water supply shall be Ductile Iron (DI) / Galvanized steel tubes confirming to I.S.1239 medium class of superior quality. Fittings shall be malleable iron/brass as applicable. For pipes above 80mm dia, Ductile Iron pipes will be used.
- For internal works, the pipes running on the terrace, shaft are proposed to be G.I pipe and in the wall chases to the various fixtures of CPVC pipes.
- Valves on branches, main line and pumps shall have ball valve / butterfly valve of good approved quality, as per requirement.

4. Soil, Waste, Vent & Rain Water Disposal Pipe System

- The system will be designed based on two pipes (stack) system as recommended in code of practice for soil and waste pipes above ground (I.S. 5329 - 1964).
- Minimum diameter of pipes shall be adopted as:

▪ All main soil pipes	--	100mm
▪ All branch soil pipes	--	100mm
▪ All main waste pipes	--	100mm
▪ All branch waste pipes	--	50mm
▪ All main soil and waste pipes stack	--	150mm
▪ Wash basin/Sink waste connection to floor trap	--	32/40/50mm

- Rain water pipes - - min 150mm
- All soil, waste, vent & rain water pipes running vertically, shall be exposed and approachable, in vertical shafts as per architectural design.
- Each connection from the fixtures shall be provided with access doors for cleaning (door junctions).
- All traps shall be with a minimum water seal of 50mm.

Materials

- (a) All soil, waste, vent and anti-syphonage pipes and fittings 50mm and above shall be CI centrifugally cast.
- No clean out plugs provided as/ the decision of PTU on previous PIT projects.

6. SEWERAGE SYSTEM

- Soil waste from water closets and urinals etc. will be collected by horizontal and vertical soil pipes and discharged directly to the manholes. Waste water from wash basins, sinks, and from other waste fixtures shall be collected separately by waste pipes and discharged through gully traps into the manhole of the external sewerage system.
The external sewerage system shall be running around the building periphery having manholes in front of each shaft. The main sewer line will carry the whole sewage by gravity up to the Sewage Treatment Plant.

Capacity of S.T.P:

Phase-1 - 15 KLD

6.1 Sewage Treatment Plant

It is proposed to treat the domestic sewage in a scientific manner through a properly planned sewage treatment plant. The objective is to stabilize the decomposable organic matters present in sewage so as to get an effluent and sludge having characteristics which are within safe limits, and which can be recycled and re-utilized for various purposes to help in maintaining the ecology of nature and save energy resources. The treatment process for sewage/effluent and the location of the final waste water disposal shall be based on the following considerations:

- Use of Treated Sewage.
- Aesthetics of the area and nearby inhabitation.
- Wind direction
- Availability of suitable land.
- Initial Cost of the system
- Recurring Cost of the system.

5.1.1 Salient Features of STP

(A) Characteristics of Influent

• B.O.D (5 days at 20°C) (mg/lit)	--	250 - 300
• Suspended solids (mg/lit)	--	400 - 600
• PH	--	6.5 - 8.5

(B) Characteristic of Effluent (after treatment)

- B.O.D (5 days 20°C) (mg/lit) less than 20mg/lit.
- Suspended solids mg/lit less than 30mg/li

The technology suggested to be used for Sewage treatment will be M.S fabricated FAB type. The equalization tank, treated water tank will be underground constructed in R.C.C and the other parts of the equipments will be fabricated in M.S.

5.1.2 PROCESS DESCRIPTION: FAB Process

Sewage generated from the building will reach the last manhole of trunk sewer line from where it shall be passed through a bar screen of suitable size before entering the equalization cum collection tank. There shall be suitable arrangement for cleaning and lifting the coarse material from the platform near the screen chamber.

From equalization tank the sewage shall be lifted through submersible automatic control pumps into FAB aeration tanks. The equalization tank shall also have provision of the aeration system to keep the sewage in the homogeneous condition.

In the FAB aeration tank of required capacity wastewater will be mixed with microorganisms in presence of dissolved oxygen. Microorganisms will assimilate organic impurities. The FAB aeration tank will be supplied through two positive displacements (roots type) air blowers (1 working + 1 standby) located outside

the tank. Submerged air diffusers will provide mixing and oxygen for the needs of microorganisms. The blowers will be sized to maintain dissolved oxygen level in the aeration tank of approximately 2 mg/lit.

From the FAB aeration tank mixed liquor will flow by gravity into adjoining Tube/Plate Settler of required capacity. The solids will settle in the tube/plate settler tank. A sludge return pump will be provided for pumping the settled sludge from the tube/plate settler tank back to the aeration tank. Tube/Plate settler tank will also be provided with skimmer system to pump floating scum back to the aeration tank to keep the plate settler surface clean.

An overflow weir with scum baffle will be provided in plate settler to take treated wastewater out of the plate/tube settler.

From the plate/tube settler, treated wastewater will flow by gravity into chlorine contact tank where chlorine will be added to the water for disinfection. From this tank the water will be lifted with a submersible pump and passed through a pressure sand filter and an activated carbon filter and stored in the flushing water tank. The water will also be softened and stored in the soft water tank. Water from these tanks will be further used for Flushing and Horticulture purpose. In case of extra effluent the arrangement shall be made to dispose off into municipal sewer.

Excess sludge from the tube/plate settler tank will be taken periodically into sludge holding tank. In this tank sludge will be aerated for self-stabilization. Air will be shut off periodically and supernatant water will be transferred to the aeration tank creating stabilized sludge. This stabilized sludge shall be dried in filter presses and carted off for disposal or for further use for horticulture purposes. The stabilized sludge shall be lifted from tank into the tanker for outside transportation

6. DESIGN PARAMETERS

The following parameters shall be considered for design of sewerage system:

- | | | |
|-------|--|----------------------|
| (i) | Flow of sewage | 0.8 of water Supply) |
| (ii) | Peak Flow | 3 x average flow |
| (iii) | Min. velocity of flow in pipes flowing half full | 0.75 m/sec |

- (iv) Max Velocity of flow 2.0 m/sec.
- (v) Min. depth for sewers 0.9m
- (vi) Infiltration Factor Add 8.33% of average discharge
- (For surface run off, subsoil water conditions etc.)
- (vii) Formula for calculation for design of sewer lines shall be by Manning's formula:
- (viii)
- $$V = S^{1/2} R^{2/3} \frac{1}{n}$$
- Where,
- V = Velocity in m/sec.
- R = Hydraulic radius in m
- S = Slope or hydraulic gradient in m/m
- n = Manning's co-efficient
- (viii) Manning's co-efficient $n = 0.015$

6.3 Appurtenances & Materials' Specifications

6.3.1 Pipes

(a) S.W. Pipes

For dia 150mm to 250mm Grade 'A' as per IS: 651 depending on site conditions with laying and jointing and bedding as per IS: 4127-1983

(b) R.C.C. Pipes Class NP2

For dia 250mm and above as per IS: 458, for normal slopes and general site conditions.

(c) R.C.C. Pipes Class NP3

For road crossings, for heavy loading conditions as per IS:458.

All R.C.C. pipes shall be laid as per IS: 873 - 1985 and as per "Manual on Sewerage and Sewage Treatment" by Ministry of Urban Development, New Delhi.

(d) C.I. Pipes Class LA

For steep slopes and exposed pipe as per IS: 1536.

6.3.2 Manholes

- (a) The manholes shall be constructed of brick masonry as per standard specifications of National Building Code.
- (b) Minimum Depths of Manhole - 0.9m
- (c) Spacing
 - (i) Manholes shall be provided at all junctions, change of directions, and change in diameters, as per connection requirement.
 - (ii) A distance of 30 metres on the main trunk sewer lines, depending on dia. of pipe and local conditions.
- (d) Manhole Covers
 - (i) Medium/heavy duty for manholes.

7. RAIN WATER DISPOSAL

7.1 Roof Drainage:

Vertical rain water pipes provided as per requirement and will collect the rainwater pipe through khurrahs and this will discharge into masonry storm water drains with SFRC Covers or Piping cum manhole storm water drainage system.

Drainage system shall be designed on the parameters setup by the metrology department and various statutory codes. Rooftop rainwater is generally clean does not require any pretreatment before discharging into Rain water Harvesting wells. Rain water from roof shall first be discharged into the harvesting wells and excess water from the wells shall overflow into the surface drain.

8.2 Surface Drainage:

Arniwala

Surface drainage consisting of surface drains and underground storm water disposal pipes will be provided so that there is no accumulation of rain water.

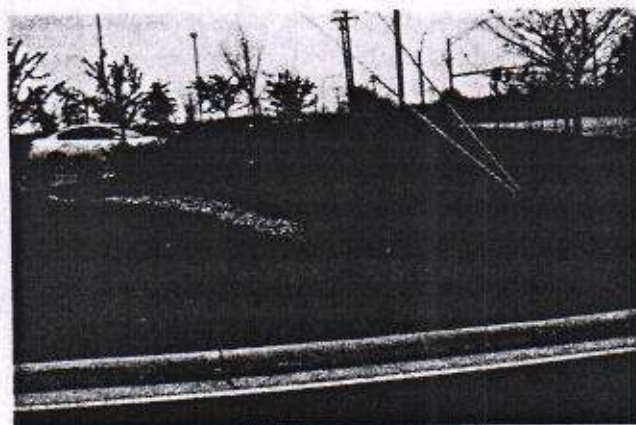
Before discharging into rain water harvesting wells bar screens and silt traps will be incorporated to remove the silt, heavier particles and other objectionable material which can cause choking of the percolation well. Surface rain water separately collected in the external masonry storm water drains with SFRC Covers or Piping cum manhole storm water drainage system and discharge into the rain water harvesting chamber.

The final disposal of the rain water collected from the overflow of the rain water harvesting system will be in the proposed retention basin. In case of over flooding of storm water in the basin, one of the following systems can be adopted:

1. Bio swale (as elaborated in 8.2.1)
2. Pumping the water to the reservoir at water works site
3. Pumping the water to the drain along the main road

Sikhwala

The level of site is 1.5m down from the main road level of that area. Also, as per soil test report, sub-soil water was at a depth of 1.2 m below natural ground level so rain water harvesting system cannot be provided.



8.2.1 Bio swale-

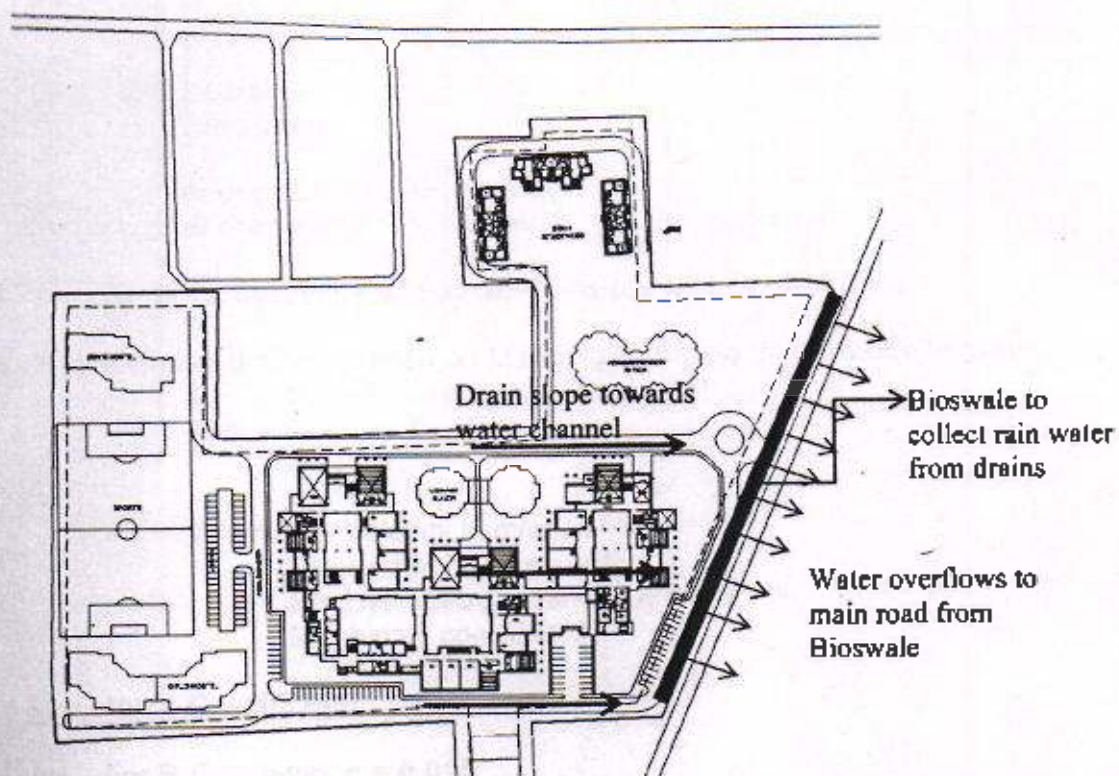
Storm water drainage through Bioswale is proposed.

Bioswale are landscape elements designed to remove silt & surface runoff water. They consist of a swaled drainage course with gently sloped sides and filled with vegetation.

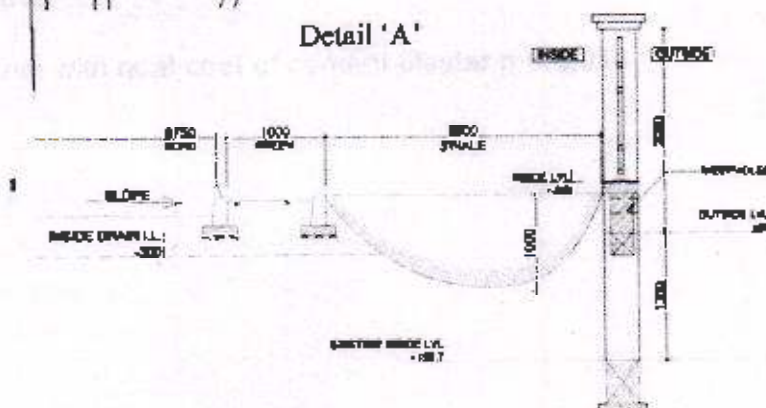
Bioswales have four functions for storm water management: collection, conveyance, filtration and infiltration. These four traits reduce and delay peak run off volumes as well as treat storm water quality.

Rain water from buildings, roads & open areas will be channelized by a drainage system sloping towards the bioswales along the main road inside the

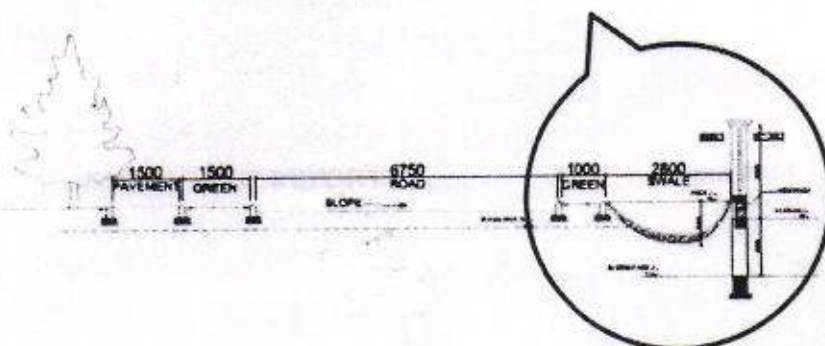
The size of swale has been derived considering maximum rainfall of 30mm/hr.



Detail 'A'



Detail 'A'



8.3 Design/Technical Parameters**8.3 Design/Technical Parameters**

8.3.1	Min. velocity of flow in pipes	=	0.6 m/sec or as per site
	Max Velocity of flow	=	2.0 m/sec.
	Min. Free board		
	a. For drains upto 300 mm width	=	75 mm
	b. For drains upto 900 mm width	=	150 mm

8.3.2 The run off for designing of drainage = As per Metrological Data

8.3.3 The design of drains is based on Manning's formula, for flow due to gravity

$$V = \frac{1}{n} R^{2/3} S^{1/2}$$

Where V = Velocity in m/sec.

R = Hydraulic mean radius in m

S = Hydraulic gradient in m/metre n =

Manning's co-efficient

8.3.4 Manning's Co-efficient

(a) For R.C.C. pipes n = 0.015

(b) For brick masonry channel with neat coat of cement plaster n = 0.013

IMPORTANT INDIAN STANDARDS PLUMBING & SANITARY WORK TITLE

IS 851-1965	Specification for salt Glazed stoneware pipes and fittings (First revision).
IS 782-1978	Specification for caulking lead.
IS 1172-1971	Code of basic requirements for water supply, drainage and sanitation (revised).
IS 1239-1 968 (Part-I)	Specifications for mild steel tube, tubular and other steel pipe fittings.
IS 1239-1 968 (Part-II)	Specifications for mild steel tube, tubular and other steel pipe fittings.
IS 1537-1 976	Specification for vertically cast iron pressure pipes for water, gas and sewage.
IS 1538-1 976	Specification for centrifugally Cast (Spun) Iron pressure pipes for water, gas and sewage.
IS 1538 (Part 1 to 23)	Specification for Cast Iron fittings for pressure pipes for water, gas and sewage.
IS 1626-1960	AC building pipes, gutters and fittings (Spigot and socket type).
IS 1726-1960	Code for cast iron manhole frame and cover.
IS 1729-1979	Specification for Sand cast iron Spigot and Ventilating pipes, fittings and accessories.
IS 1742-1960	Code of practice for building drainage
IS 2064-1962	Code of practice for selection, installation and maintenance of sanitary appliances.
IS 2065-1963	Code of practice for water supply to buildings.
IS 3114-1965	Code of practice for laying of C.I. Pipes.
IS 3589-1981	Specification for electrically welded steel pipes for water, gas and sewage

IS 3989-1970	Centrifugally cast spun iron and socket soil and ventilating pipe, fittings and accessories.
IS 4111-1967	Code of practice for Ancillary structure in sewerage system.
IS 4127-1 967	Code of Practice for laying glazed stone ware pipe.
IS 4515	Specification for unplasticised PVC pipe fittings.
IS 4985-1 981	Specification for unplasticised PVC pipes for portable water supplies.
IS 1703-1 984	Ball Valves
IS 2548-1 970	Toilet Seat Cover
National building code for water supply, drainage and sanitation Part IX Plumbing services section 1 & 2.	

The installation shall also be in conformity with the bye-laws and a requirement of the local authority is so far as these become applicable to the installation. Wherever this specification calls for a higher standard of materials and/or workmanship than those required by any of the above regulations and standards, hence these specifications shall take precedence over the said regulations and standards. Wherever drawings and specifications require something that may violate the regulations, the regulation shall govern.

DESIGN BASIS REPORT FOR PHASE-I FIRE FIGHTING SERVICES **FOR PIT, ARNIWALA & SIKHWALA**

1.0 INTRODUCTION

Most accidental fires have a small, insignificant beginning, but a terrible ending. They advance rapidly from the incipient stage to a devastating stage and soon go out of control. And fire is no sojourner and travels rapidly to engulf large areas with least delay. The end result is always horrible and needs no further description.

The present objective is to put forth a Fire Protection and Safety Scheme for the campus in conformity with existing standards and practices.

2.0 Details of the building

2.1 The fire fighting will be designed as per the recommendations of the National Building Code of India-Part IV, 2005. The Occupancy wise classification will be as under:

1) Building-Colleges & Workshop

Group-B: Educational Buildings (Less than 15 m in height, 15 m and above but not exceeding 30 m in height)

2.2 Considering that the purpose of the buildings, as well as the height of the structure, it will be necessary to provide a proper and adequate fire fighting system based on the requirements of the National Building Code 2005.

Minimum Requirement for Fire Fighting System as per NBC - 2005 (Table No.-23)

Building-College

Group-B: Educational Buildings (Less than 15 m in height)

S. No.	Description	As Per (NBC)	
1	Fire Extinguisher	Required	Provided
2	Hose Reel	Required	Provided
3	Dry Riser	Not Required	Not Provided

4	Wet Riser	Not Required	Not Provided
5	Down Comer	Not Required	Provided
6	Yard Hydrant	Not Required	Not Provided
7	Automatic Sprinkler System	Not Required	Not Provided
8	Manually Operated Electric Fire Alarm System	Not Required	Not Provided
9	Automatic Detection Alarm System	Not Required	Not Provided
10	Underground Static Water Storage Tank	Not Required	Not Provided
11	Terrace Tank	Required-5 KL	Provided-5KL
12	Pump Near UG Tank	Not Required	Not Provided
13	Pump at Terrace	Required-450 LPM	Provided 450 LPM

2.3 Vertical down comer of 100mm dia M.S. pipes will be taken to provide pressurized water to the single outlet hydrant landing valve on each floor as per requirement and then connected commonly to an overhead tank and pump. Along with down comer system, portable fire extinguishers are to be provided at all accessible positions.

2.4 Also it has been proposed to provide following portable type fire extinguishers.

- 9 lit. Water expelling type.
- 4.5 lit. CO₂ Type.
- 6 kg ABC type.
- Dry chemical powder type of 10kg/5kg capacity.

IMPORTANT INDIAN STANDARDS FOR FIRE FIGHTING WORK TITLE

IS 1239-1 968 (Part-I)	Specifications for mild steel tube, tubular and other steel pipe fittings.
IS 1239-1 968 (Part-II)	Specifications for mild steel tube, tubular and other steel pipe fittings.
IS 1536-1 976	Specification for centrifugally Cast (Spun) Iron pressure pipes with flanges for water, gas and sewage.
IS 1538 (Part 1 to 23)	Specification for Cast Iron fittings for pressure pipes for water, gas and sewage.
IS 1726-1960	Code for cast iron manhole frame and cover.
IS 3589-1981	Specification for electrically welded steel pipes for water, gas and sewage.
IS 4736-1986	Galvanizing G.I. Pipes
IS 636-1988	Non percolating flexible fire fighting delivery hose (third revision)
IS 694-1990	PVC insulated cables for working voltages upto and including 1.100 volts (third revision)
IS 778-1984	Copper alloy gate, globe and check valves for water works purposes (fourth revision) (Amendment 2)
IS 780-1984	Sluice valves for water works purposes (50 to 300 mm) size (sixth revision) (amendment 3)
IS 884-1985	Specification for first-aid hose-reel for fire fighting (for fixed installations) (first revision) (with amendment No.1)
IS 900-1992	Code of practice for installation and maintenance of induction motors (second revision)
IS 901-1988	Specification for couplings, double male and double female, instantaneous pattern for fire fighting (third revision)
IS 902-1992	Suction hose coupling for fire fighting of purposes (third revision)
IS 903-1984	Specification of fire hose delivery couplings branch pipe, nozzles and nozzle spanner (third revision) (Amendment 5)

IS 937-1981	Specification for washers for water fittings for fire fighting purposes (revised) (with amendment No. 1)
IS 1520-1 980	Horizontal centrifugal pumps for clear cold, fresh water (second revision)
IS 1538-1 976	Horizontally cast iron pressure pipes for water, gas & sewage (first revision) (with Amendments No. 1 to 4)
IS 1654-1988 Part I	PVC insulated (heavy duty) electric cables (working voltage upto and including 1100 volts (third revision)
IS 1654-1988 Part II	PVC insulated (heavy duty) electric cables (working voltage from 3.3 KV upto and including 11 KV (second revision)
IS 1648-1 961	Code of practice for fire safety of buildings (General) Fire fighting equipment and its maintenance (with amendment No.1)
IS 3624-1 987	Pressure and vacuum gauges (Second revision)
IS 4736-1 968	Hot-dip zinc coatings on steel tubes (with Amendment No.1)
IS 5290-1983	Specification for landing valves (second revision) (with Amendments No.6)
IS 5312- 1984 Part I	Swing check type reflux (non return) valves Part I-single door pattern (with amendments nos. 1 & 2)
IS 5312- 1986 Part II	Swing check type reflux (non return) valves Part II-Multi door pattern (with amendments nos. 1 & 2)
IS 7285	Seamless cylinders for storage of gas at high pressure.
IS 2189-1962	Code of practice for Automatic Fire alarm system
IS 2195-1962	Specification for heat sensitive fire detectors
IS 732-1973	Code of practice for electrical wiring installation
	UL 168 Underwriters Laboratory specification for smoke detector.

Introduction

Punjab Technical University is a growth oriented University established by the Government of Punjab as an affiliating and teaching University to facilitate and promote studies, research and extension work with a focus on professional education in emerging areas of higher education in the fields of Engineering, Technology, Management, Medicine, Pharmacy, Nursing, Education and Law etc. In a brief span of existence, the University has made a significant progress and has multiplied its activities, manifold. In its endeavor to impart education from high school level upto engineering degree level it has been decided to construct campuses in different parts of Punjab under PTU. The campuses at Arniwala & Sikhwala are among such campuses.

The campus at Arniwala & Sikhwala are to become cohesive and an integrated unit, construction of the required infra-structural facilities like academic functions, students and staff accommodation, playing fields etc. on plots measuring about 12.27 acres at Arniwala and 13.3 acres at Sikhwala.

Phase I for PIT Arniwala & Sikhwala

Phase I of the project consists of a college building of G+1 floors with an approximate area of 3,700 sq. mts.. These proposed college buildings will house classrooms, labs, tutorial, and seminar hall & faculty rooms.

Since the area constructed in current phase is only 8% of the total F.A.R available, hence designing of services on modular basis is not a feasible & viable solution which is evident from the reports attached.

Finishing works:

The salient features of various provisions are as under:

Flooring:-

Main entrance	Kota stone flooring with marble pattern
Circulation	Kota stone
Rooms	Kota Stone
Toilets	Vitrified Tiles
Staircases	Kota stones

Doors and windows: - Door frames shall be in Pressed Steel sections with flush door shutters. Windows shall be of Aluminum frames and shutters as per architectural drawings. Structural glazing has been provided at places in the elevation. Fittings shall be of aluminum as per architectural drawings/specifications.

Staircase Railing: Mild Steel railing finished with approved synthetic enamel has been proposed.

Toilets: Matt finish ceramic tiles dado up to door level height, vitreous china WC, wash basin and urinals as/ requirement.

Roofing: - Terrace shall have brick coba treatment with polyurethane insulation.

False ceiling: - Proposed in the Seminar Hall and partially in classrooms for acoustical treatment.

Internal Finishing: Cement plaster, oil bound distempers, Plastic emulsion and acrylic emulsion paint with POP, doors shall be enamel painted. Corridors will have 4 ft. high ceramic tile cladding.

External Finishing:

Arniwala- Exposed concrete finish in architectural features, Weather proof paint, grooves in plaster. Red sandstone cill in windows.

Sikhwala- Texture paint in architectural features, Weather proof paint, grooves in plaster. Red sandstone cill in windows.

This report is submitted for accord of Administrative approval of the design basis for Electrical, plumbing, Firefighting & HVAC services in the building.

Outside Design Conditions

Summer	
Day Air Temp	45.3 deg C (113.5 deg F)
Night Air Temp	32.2 deg C (90 deg F)
Humidity	60%
Day Air Temp	35.2 deg C (95.4 deg F)
Night Air Temp	30.0 deg C (86 deg F)
Humidity	60%

DESIGN BASIS REPORT FOR PHASE-I HVAC WORKS FOR PIT, ARNIWALA & SIKHWALA

GENERAL

It is proposed to provide comfort cooling conditions with the help of economical and efficient air conditioning system for only seminar hall & faculty offices.

1. Design Philosophy

The air-conditioning system has been designed keeping in view the following:

- (i) Continuity and reliability.
- (ii) Flexibility of operation.
- (iii) Safety of personnel and equipments.
- (iv) Ease of maintenance.

2. Applicable Codes and Guides

- (i) National Building Code of India 2005
- (ii) Indian Society of Heating, Refrigeration and Air Conditioning Engineers, Inc. (ISHRAE).

3. DESIGN CRITERIA

3.1 Outside Design Condition

Design outside air conditions are extracted from the NBC Part-8 design weather database for Hissar.

Outdoor Design Conditions :	
Summer	
Dry Bulb Temp.	43.3 deg. C (110 deg F)
Wet Bulb Temp.	25.8 deg. C (78.4 deg F)
Monsoon	
Dry Bulb Temp.	38.9 deg. C (102 deg F)
Wet Bulb Temp.	30.0 deg. C (86 deg F)
Winter	
Dry Bulb Temp.	6.1 deg. C (43.0 deg F)
Wet Bulb Temp.	5.2 deg. C (41.4 deg F)

Inside Design Conditions :		
Summer & Monsoon		
Dry Bulb Temp.	Seminar Hall	26±1 deg C (79 ±2 deg F)
	Faculty Offices	24±1 deg C (79 ±2 deg F)
Relative Humidity (RH)	Seminar Hall	55% (Design Value – No Control)
	Faculty Offices	

3.2 Outdoor Air Requirements

Outdoor Air Requirements	As per NBC 2005
Seminar hall	17 cfm/person
Offices	21 cfm/person

3.3 Lighting & Equipment

Area Description	Lighting (Watt/Sqft)	Equipment Load
Seminar hall	1.0	5.0 (Watt / Sqft)
Office	1.5	1.0 (Watt / Sqft)

3.4 Factor Considered (Building Envelope)

i) Glass

SHGF = 0.56 & 'U' Value = 1.13 BTU / Hr - Sft - °F

ii) Walls

'U' Value = 0.36 BTU / Hr.-Sft - °F.

iii) Walls(Seminar Hall)

'U' Value = 0.21 BTU / Hr.-Sft - °F.

iv) Roof (Insulated)

'U' Value = 0.12 BTU / Hr. - Sft - °F.

4. LOAD ESTIMATION

The Air Conditioning loads are as follows:

Heat Load Summary Of PIT Arniwala

Outdoor Condition		DBT (°F)	WBT (°F)	Grains/ lb		Latitude (°N)		Revision							
Summer		110.0	78.4	76.0		30.2		0							
Monsoon		102.0	86.0	164.0	0.0										
BASIS OF DESIGN															
CONDITIONED SPACE	ACTUAL AIR CONDITIONED AREA	HEIGHT	INSIDE DESIGN CONDITION					OCCUPANCY	LIGHT LOAD	EQUIP LOAD	SUMMER LOAD	MONSOON LOAD	SUMMER DEHUMIDIFIED CFM	MONSOON DEHUMIDIFIED CFM	REQUIRED OUTDOOR AIR QTY(Normal)
			(B)	(C)	(D)	(E)	(F)								
(A)	S.FT	FT.	CFM/ Person	CFM/ Sq. Ft	TEMP (°C)	RH % (Design Value-No Control)	NOS.	W/S.FT	W/S.FT	TR	TR	CFM	CFM	CFM	
DX Split system															
Ground Floor	1904.5	17.0	17.0	-	26+1	55	150	1.0	5.0	21.4	28.2	5,194	5,635	2,550	
Seminar Hall	258	11.6	5.0	0.06	24+1	55	6	1.5	2.0	1.56	1.79	512	414	126	
Pro. Room	258	11.6	5.0	0.06	24+1	55	8	1.5	2.0	1.72	2.13	489	416	168	
Board Room	226	11.6	5.0	0.06	24+1	55	4	1.5	2.0	1.10	1.28	373	325	84	
HOD Room	258	11.6	5.0	0.06	24+1	55	5	1.5	2.0	1.45	1.62	508	417	105	
P.A Room															
First Floor	1044	11.6	5.0	0.06	24+1	55	15	1.5	2.0	5.34	5.57	2,069	1,640	315	
Asst. Prof.	102	11.6	5.0	0.06	24+1	55	2	1.5	2.0	0.60	0.70	215	193	42	
ASSO. PROF-1	124	11.6	5.0	0.06	24+1	55	2	1.5	2.0	0.60	0.69	216	188	16	
ASSO. PROF-2	124	11.6	5.0	0.06	24+1	55	2	1.5	2.0	0.60	0.69	216	188	16	
ASSO. PROF-3	124	11.6	5.0	0.06	24+1	55	2	1.5	2.0	0.49	0.50	209	183	16	
ASSO. PROF-4	124	11.6	5.0	0.06	24+1	55	2	1.5	2.0						
Total Of DX Split system	4422									34.8	43.2	10001	9597	3438	

Based on the above design calculations, air Cooled non-ductable Dx Split units are proposed for air conditioning the building. The system is proposed due to following reasons.

- Only specified areas needs to be air conditioned.

Some of the advantages of using Dx split system Machine for this project are:

- The Dx split system comes with completely Air-cooled System with two basic parts- Outdoor & indoor
- DX system comes with single point responsibility.
- DX system comes with inbuilt starter panel & also has a less noise level.
- No Trained Manpower is required for operation.

5. AIR CONDITIONING SCHEME

Hi-wall type DX split system shall be provided for seminar hall & faculty offices & there individual outdoor units shall be located in the specified area. The drain for each office units shall be terminated to the nearest drain point & for the seminar hall the drain shall be combined & will be terminated to the nearest drain point.

6. MECHANICAL VENTILATION

Toilet exhaust will also be planned for 50 cfm per WC/Urinal or 15 Air Changes per Hour whichever is more. A dedicated propeller fans are on each level.



Er. H.P. Singh
Executive Engineer

ਪੰਜਾਬ ਟੈਕਨੀਕਲ ਯੂਨੀਵਰਸਿਟੀ ਜਲੰਧਰ

PTU PUNJAB
TECHNICAL
UNIVERSITY

Estd. Under Punjab Technical University Act, 1996
(Punjab Act No. 1 of 1997)

Ref. No PTU/CC/961

Dated 27.10.2014

Sh. D.L. Sharma, President,
Vardhman Spg. & Gen. Mills Ltd.,
Chandigarh Road, Ludhiana.

Sh. S.L. Kaushal,
Chief Architect, Punjab (Retd),
2865, Sector 42-C, Chandigarh.

Dr. A. P. Singh,
Dean (P&D),
Punjab Technical University, Jalandhar.

Sh. A. N. Chowdhry (Special Invitee),
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Jalandhar.

Er. Jaswant Singh Pabla (Sp. Invitee),
(Electrical Expert)
House No. 2631, Sector-79, Mohali.

Sh. Inderjit Kumar (Special Invitee),
(PH Experts)
House No. 116, Phase 3B/I, Mohali.

Sh. Amrit Sagar Mittal
CMD, Sonalika Tractors Ltd,
Hoshiarpur.

Er. A. K. Prabhakar,
OSD to Vice Chancellor,
Punjab Technical University, Jalandhar.

The Director,
Department of Technical Education, Punjab,
Plot No. 1, Sector-36A, Chandigarh.

The Registrar,
Punjab Technical University,
Jalandhar.

Dr. Prabhjot Kaur (Special Invitee),
Officiating Director Mohali Campus,
C102B, Phase-7 Industrial Area, Mohali.

Sh. Rajiv Aggarwal, Architect
M/s Archigroup Architects,
A-14, First Floor, Sector-15, Noida -201301.

Sub : Construction of new campuses of Punjab Technical University – 44th meeting of the Standing Building Construction Committee.

Dear Sir/Madam,

Please find enclosed herewith minutes of the above said meeting for kind information and further necessary action please. Comments, if any, may please be forwarded within 10 days of issue of this letter.

Thanking you

Yours Sincerely,

[Signature] 27/10/14

(H. P. Singh)

Executive Engineer

Copy to :

Dr. R. S. Khandpur, DG, PGSC (Retd), Science House, H. No. 2901, Phase 7,
(Sector 61), Mohali.

The Secretary to VC - for kind information of H.H. & C.

*By
The office
Send*

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1/4

PUNJAB TECHNICAL UNIVERSITY, JALANDHAR

Minutes of the 44th Meeting of the Standing Building Construction Committee held on 20.10.2014 under the Chairmanship of Dr. R. S. Khandpur, Director General, PGSC (Retd) at PTU's Mohali campus.

Following were present in the meeting:

1. Sh. S. L. Kaushal, Chief Architect, Punjab (Retd),
2. Sh. A. N. Chowdhry, Chief Engineer, PWD (Retd),
3. Sh. H. P. Singh, Executive Engineer, PTU.

From Archigroup Architects, Noida:

4. Sh. Rajiv Aggarwal, Architect
5. Sh. Jeewan Kapur, Architect
6. Ms. Perna Sharma, Architect
7. Sh. Nitin Gupta, Consultant, Video Projection and Sound Reinforcement system
8. Sh. Ajay Wats, Consultant, Acoustic and Street Lighting.

Item No. 44.1 : To confirm the Minutes of 43rd meeting of Standing Building Construction Committee held on 01.08.2014.

As no comments had been received, the minutes of 43rd meeting of Standing Building Construction Committee held on 01.08.2014 were confirmed.

Item No. 44.2 : Action taken on various items discussed during previous meetings of Standing Building Construction Committee.

It was informed by the Executive Engineer/PTU that following actions have been taken on various items discussed during previous meeting of Standing Building Construction Committee:

- The manufacturers/specifications for acoustic treatment for proposed auditorium at main campus, Kapurthala are to be presented in the present meeting for discussions and approval.
- The flooring patterns for circulation area and VIP Banquet hall of auditorium proposed to be constructed at main campus, Kapurthala are to be presented by the Architect in the present meeting for discussions and approval.
- The comments offered by the committee for Stage lighting system, Sound reinforcement system and audio video system have been incorporated in the design/scheme and the detailed estimate is being presented in this meeting.

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- 2/4
- Item No. 44.3:** To discuss and approve the manufacturers/specifications for acoustic treatment and audio video system for the proposed auditorium at main campus, Kapurthala.

The Architect presented the various options available in respect of the materials, specifications, their finishes, costs etc. for acoustic treatment and audio video system. After detailed discussions and deliberation, the committee was of the opinion that before taking any decision in this regard, University must finalize its requirements for acoustic treatment finishes and audio video system. Accordingly, the committee decided to appoint following sub-committee to finalize the University's requirements in respect of acoustic treatment finishes and Audio Video System:-

1. Dr. Buta Singh, Dean/Academics, PTU
2. Sh. P.S. Saini, Superintending Engineer, PGI, Chandigarh
3. Executive Engineer, PTU
4. Executive Engineer, PWD, Construction Division 2, Kapurthala
5. Sh. Rajiv Aggarawal, Architect.

- Item No. 44.4:** To discuss and approve rough cost estimate for proposed auditorium at main campus, Kapurthala.

After detailed discussions and deliberations, the committee approved the rough cost estimate based upon plinth area rates of CPWD for Civil, Electrical, Public Health, Fire fighting and air-conditioning works amounting to Rs. 1720.59 lacs. As regards, the estimates for other specialized items such as Acoustic treatment, Stage lighting, Sound reinforcement system, Audio video presentation etc. the same shall be finalized after receipt of requirements from University (Agenda item No. 44.3 above).

However, for the time being, payment to the Architect may be released by considering 70% of this cost (Rs. 1720.59 lacs) as detailed estimates being prepared on the basis of Punjab PWD CSR are always lower than the estimates prepared on the basis of plinth area rates of CPWD.

- Item No. 44.5 :** To discuss and approve the flooring patterns for circulation area and VIP Banquet area of auditorium proposed to be constructed at main campus, Kapurthala.

The Architect presented various flooring patterns by using kota stone, marble, granite and their combinations alongwith their cost implications. The committee is of the view that some hard stone should be used for these areas. However, there is a huge difference in the cost of kota/marble stone and granite stone. After detailed discussions and deliberation, the committee is of the opinion that before taking any decisions in this regard, it will be appropriate that University finalizes its requirements for the type of the stone to be used for these areas. Accordingly, the committee decided to appoint following sub-committee to finalize the University's requirements for the type of the stone to be used for these areas:-

1. Dr. A. P. Singh, Dean/P&D, PTU
 2. Dr. Rajneesh Sachdev, Registrar, PTU
 3. Executive Engineer, PTU
 4. Executive Engineer, PWD, Construction Division 2, Kapurthala
 5. Sh. Rajiv Aggarawal, Architect.
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Item No. 44.6 : To discuss and approve the revised estimate for construction of boundary wall of Punjab Institute of Technology, Mansa.

The Architect informed committee that there has been increase in the cost of work of boundary wall of PIT, Mansa on account of the followings:

1. The estimate approved in 30th meeting (Agenda item No. 30.7) of the Standing Building Construction Committee for this work for an amount of Rs. 300.0 lacs was based upon a tentative design prepared by the Architect and there has been a substantial change in the design as per actual site conditions/geo-technical investigations. There has been substantial increase in size of the foundations from that considered at the time of preparation of original estimate.
2. The length of boundary wall has increased from 4224 metre to 4870 metre on account of a mistake by the Architect at the time of preparation of original estimate as length of boundary wall for one site was not included in the estimate. Moreover, there has been increase in length of boundary wall as per site conditions. Additional boundary wall is being constructed all-around one acre of land, which has not been acquired by Punjab Govt. and this land is falling in between PTU's land.

After reviewing the earlier decisions taken by the committee in this regard and considering the reasons for increase in the cost, committee approved the revised estimated cost for the boundary wall works of PIT Mansa for an amount of Rs. 409.27 lacs. plus price variations payable to the contractor as decided earlier. It was also agreed by the committee that works may be got executed from the existing contractor at already accepted rates to avoid trespasses, encroachments and misuse of the area as without completing the boundary wall works, the whole area will remain open.

Item No. 44.7 : To discuss and approve the design basis reports submitted by the Architect for Structure, Electrical and Public Health works in respect of Punjab Institute of Technology, Arniwala, Fazilka.

After detailed discussions and deliberations, committee decided as under:

1. Structure:

The report presented by the Architect has been approved.

2. Electrical Works:

- i. As the maximum demand load is only 40 KW for the proposed construction, LT connection will be taken.

- ii. Provision of DG set of 25KVA capacity.

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3. Public Health Works:

a) Water supply system:

- i. Provision of Underground reservoir (UGR)
- ii. Treatment of raw water near UGR.
- iii. Pumping of water after treatment directly to overhead PVC tanks to be installed at terrace of the building.

b) Sewerage system:

- i. Provision of 15 KLD overhead STP with FAB technology.

In addition to the above, committee reviewed its earlier decisions taken for PIT Arniwala and decided as under:

- i. Plinth level of the buildings should be kept minimum 300mm above the main highway running in front of the institute.
- ii. The buildings proposed to be constructed now should be constructed in front area of the campus.
- iii. No filling of earth is to be done for open areas around the buildings.

Following table item was discussed with the permission of Chair:

Item No. 44.8 To discuss and approve the Electric load of Hostels and auditorium proposed to be constructed at main campus, Kapurthala.

In 42nd meeting of the committee, it was decided that calculation of electric loads for proposed hostels and auditorium may be re-examined. Accordingly, the same has reviewed and presented by the Architect in the meeting. After detailed discussions and deliberations, committee approved the following:-

- i. Total demand load of 1123 KVA.
- ii. Provision of 3 transformers of capacity 400 KVA each.

As the total demand load of the University has increased to more than 4 MVA, the committee directed that planning for 66 KVA sub-station is done on priority. Location proposed by the Architect for housing 66 KVA sub-station in about 1000 Sqm. area near the existing metering house was also approved by the committee.

The meeting ended with a vote of thanks to the chair.

4/4



Er. H. P. Singh

PTU PUNJAB
TECHNICAL
UNIVERSITY

Dated 02.01.2015

Ref. No.

Sh. D.L. Sharma, President,
Vardhman Spg. & Gen. Mills Ltd.,
Chandigarh Road, Ludhiana.

The Director,
Department of Technical Education, Pb,
Plot No. 1, Sector-36A, Chandigarh.

Er. A. K. Prabhakar,
OSD to Vice Chancellor,
Punjab Technical University, Jalandhar.

Dr. A. P. Singh,
Dean (P&D),
Punjab Technical University, Jalandhar.

Dr. Prabhjot Kaur (Special Invitee),
Officiating Director Mohali Campus,
C102B, Phase-7 Industrial Area, Mohali.

Er. Kamaljit Chopra (Sp. Invitee),
(Electrical Expert)
13, Jyoti Nagar, Jalandhar.

Sh. Inderjit Kumar (Special Invitee),
(PH Experts)
House No. 116, Phase 3B/I,
S.A.S. Nagar, Mohali.

Sub : Construction of new campuses of Punjab Technical University - 45th meeting of the Standing Building Construction Committee.

Dear Sir/Madam,

45th meeting of the Standing Building Construction Committee shall be held under the Chairmanship of Dr. R. S. Khandpur, Director General, PGSC (Retd) at 1130 hours on 22.01.2015 at PTU's Mohali campus at C-102/B, Industrial Area, Phase VII, (Sector-119), Mohali - 160 059 (Punjab). Agenda and Agenda note for the meeting are enclosed.

You are requested to make it convenient to attend the meeting.

Thanking you

Yours Sincerely,

H. P. Singh
(H. P. Singh)

Executive Engineer

Dr. R. S. Khandpur, DG, PGSC (Retd), Science House, H. No. 2901, Phase 7,
(Sector 61), Mohali.

Punjab Technical University Jalandhar

PUNJAB TECHNICAL UNIVERSITY, JALANDHAR

Sub : Agenda for the 45th meeting of the Standing Building Construction Committee.

- Item No. 45.1 :** To confirm the Minutes of 44th meeting of Standing Building Construction Committee held on 20.10.2014.
- Item No. 45.2 :** Action taken on various items discussed during previous meeting of Standing Building Construction Committee.
- Item No. 45.3 :** To discuss and approve the requirements, manufacturers/specifications for acoustic treatment and audio video system for the proposed auditorium at main campus, Kapurthala.
- Item No. 45.4 :** To discuss and approve the flooring patterns for circulation area and VIP banquet area of the proposed auditorium at main campus, Kapurthala.
- Item No. 45.5 :** To discuss and finalize the Energy audit report of PTU's main administrative building, main campus, Kapurthala submitted by Punjab State Council for Science and Technology.
- Item No. 45.6 :** To discuss and approve the master plan of main campus, Kapurthala after including International Resource Center-Universal Human Values & Ethics (IRC-UHVE) established at existing Lal Kothi.
- Item No. 45.7 :** To discuss and approve the layout and estimate for construction of internal road connecting existing road near main gate to International Resource Center-Universal Human Values & Ethics (IRC-UHVE).
- Item No. 45.8 :** Any other point with the permission of the Chair.

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PUNJAB TECHNICAL UNIVERSITY, JALANDHAR

Agenda Note for the 45th meeting of the Standing Building Construction Committee.

Item No. 45.1 : To confirm the Minutes of 44th meeting of Standing Building Construction Committee held on 20.10.2014.

The minutes of 44th meeting of Standing Building Construction Committee held on 20.10.2014 were circulated on 27.10.2014. The minutes circulated are to be confirmed.

Item No. 45.2 : Action taken on various items discussed during previous meeting of Standing Building Construction Committee.

Actions taken on various items discussed during previous meeting of Standing Building Construction Committee are as under:

- The sub-committee constituted for finalization of University's requirements for acoustic treatment finishes and audio video system for the proposed auditorium at main campus, Kapurthala has submitted their report and the same is to be discussed in the present meeting for approval.
- The sub-committee constituted for finalization of University's requirements for type of stone to be used for flooring of circulation area and VIP Banquet area of the proposed auditorium at main campus, Kapurthala has submitted their report and the same is to be discussed in the present meeting for approval.
- Based upon the concept plans approved by the building committee in respect of the proposed auditorium and hostels at main campus, Kapurthala, municipal drawings have been submitted to Chief Town Planner, Punjab for approval.
- The detailed designing of 66 KVA sub-station for main campus, Kapurthala has been taken up by the Architect.

Item No. 45.3 : To discuss and approve the requirements, manufacturers/ specifications for acoustic treatment and audio video system for the proposed auditorium at main campus, Kapurthala.

In 44th meeting of the committee, a sub-committee was constituted to finalize University's requirements for acoustic treatment finishes and audio video system for the proposed auditorium at main campus, Kapurthala. The committee has submitted their report (placed at Annexure-A). Based upon this report, the Architect will be making the presentation.

The matter is placed before the Committee for discussions and approval please.

Handwritten signature

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Item No. 45.4: To discuss and approve the flooring patterns for circulation area and VIP banquet area of the proposed auditorium at main campus, Kapurthala.

In 44th meeting of the committee, a sub-committee was constituted to finalize University's requirements for type of stone to be used for flooring of circulation area and VIP Banquet area of the proposed auditorium at main campus, Kapurthala. The committee has submitted their report (placed at Annexure-B). Based upon this report, the Architect will be making the presentation.

The matter is placed before the Committee for discussions and approval please.

Item No. 45.5 : To discuss and finalize the Energy audit report of PTU's main administrative building, main campus, Kapurthala submitted by Punjab State Council for Science and Technology.

In 39th meeting of the committee, it was decided that Energy audit of PTU's main administrative building, main campus, Kapurthala will be got done from Punjab State Council for Science and Technology. Accordingly, the energy audit has been done by Punjab State Council for Science and Technology and submitted draft audit report (placed at Annexure-C). The observations/recommendations made by Punjab State Council for Science and Technology in their audit report will be presented by the Architect.

The matter is placed before the Committee for discussions and approval of the report please.

Item No. 45.6 : To discuss and approve the master plan of main campus, Kapurthala after including International Resource Center-Universal Human Values & Ethics (IRC-UHVE) centre established at existing Lal Kothi.

Punjab Technical University has established International Resource Center-Universal Human Values & Ethics (IRC-UHVE) centre after renovation of existing building of Lal Kothi at main campus, Kapurthala. The Architect will be making a presentation on the master plan of main campus, Kapurthala after including this centre in the plan.

The matter is placed before the Committee for discussions and approval of the revised master plan please.

Item No. 45.7 : To discuss and approve the layout and estimate for construction of internal road connecting existing road near main gate to International Resource Center-Universal Human Values & Ethics (IRC-UHVE).

Punjab Technical University has established International Resource Center-Universal Human Values & Ethics (IRC-UHVE) centre after modifying the existing building of

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Lal Kothi at main campus, Kapurthala. Presently, there is no access road to this centre from the main campus. Architect will be making a presentation of the layout and estimate for an approach road to this centre from the main administrative building.

The matter is placed before the Committee for discussions and approval of layout and estimate of the proposed approach road please.

Item No. 45.8 : **Any other point with the permission of the Chair.**

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ANNEXURE-A

ANNEXURE-A

PUNJAB TECHNICAL UNIVERSITY, JALANDHAR

Minutes of the meeting held on 12.11.2014 in the office of Superintending Engineer, PGI, Chandigarh to finalize the University's requirements in respect of acoustic treatment finishes and Audio Video System for the proposed auditorium at PTU's main campus, Kapurthala.

1.0 In terms of OSD to VC/PTU's order dated 04.11.2014, a committee consisting of following members was constituted to finalize University (PTU)'s requirements in respect of acoustic treatment finishes and Audio Video System for the proposed auditorium at PTU's main campus, Kapurthala:

1. Dr. Buta Singh, Dean/Academics, PTU
2. Sh. P.S. Saini, Superintending Engineer, PGI, Chandigarh
3. Executive Engineer, PTU
4. Executive Engineer, PWD, Construction Division 2, Kapurthala
5. Sh. Rajiv Aggarawal, Architect.

2.0 Following members were present in the meeting held in this regard on 12.11.2014 :

1. Dr. Buta Singh, Dean/Academics, PTU (On telephone)
2. Sh. P.S. Saini, Superintending Engineer, PGI, Chandigarh
3. Er. H. P. Singh, Executive Engineer, PTU
4. Sh. Mahabir Singh, SDO/PWD on behalf of Executive Engineer, PWD, Construction Division 2, Kapurthala
5. Sh. Rajiv Aggarawal, Architect.
6. Sh. Jeewan Kapur, Architect
7. Sh. Satyendra Sharma, Architect
8. Sh. Nitin Gupta, Sound Reinforcement expert

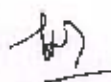
Archigroup Architects, Noida.

3.0 After detailed discussions and deliberations, committee recommends the following:-

1. Acoustics:

Internal finishes including the materials to be used were discussed and the following were agreed considering the least maintenance and the economics:

- i. Wall paneling up to Dado: Wood based panels with linear perforations. It was agreed that panels with grooves at 32/64mm c/c would be used.
- ii. Wall paneling above Dado: Fibral Stoff Panels
- iii. False-ceiling – glass wool based acoustical ceiling tiles.
- iv. Chairs: Godrej chairs may be preferred.



2. Audio Video systems:

- i. Video: Option 2 would be adopted (copy placed below).
- ii. Microphones and fittings: the numbers would be changed as follows:

a. Gooseneck	4
b. Wireless hand held	5
c. Lapel microphone	2
d. Headset microphone	Not required
e. Wide band antenna	2
f. Omni directional antenna UHF2	
g. Dynamic vocal microphone	4
h. Dynamic instrument microphone	2
i. DI Box	2

Other time shall remain the same

- iii. Projector: to be brought in the middle of the auditorium using a projector lift the lumen requirement and cost estimate shall be revised by the Architect accordingly.

- iv. Sound: Option 1 of line array system to be adopted (copy placed below).

ANNEXURE 

ANNEXURE-B

PUNJAB TECHNICAL UNIVERSITY, JALANDHAR

Minutes of the meeting held on 21.11.2014 under the Chairmanship of Dr. A. P. Singh, Dean/RIC, PTU in his to finalize the University's requirements *for type of stone to be used for flooring in circulation area* for the proposed auditorium at PTU's main campus, Kapurthala.

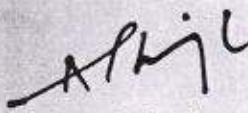
1.0 In terms of OSD to VC/PTU's order dated 04.11.2014, a committee consisting of following members was constituted to finalize University (PTU)'s requirements for type of stone to be used for flooring in circulation area and VIP banquet area for the proposed auditorium at PTU's main campus, Kapurthala:

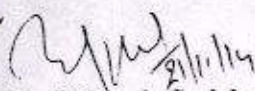
1. Dr. A. P. Singh, Dean/RIC, PTU
2. Dr. Rajneesh Sachdev, Registrar, PTU,
3. Executive Engineer, PTU
4. Executive Engineer, PWD, Construction Division 2, Kapurthala
5. Sh. Rajiv Aggarawal, Architect.

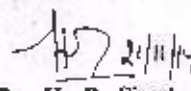
2.0 Following members were present in the meeting held in this regard on 21.11.2014 :


1. Dr. A. P. Singh, Dean/RIC, PTU
2. Dr. Rajneesh Sachdev, Registrar, PTU,
3. Er. H. P. Singh, Executive Engineer, PTU
4. Sh. Mahabir Singh, SDO/PWD on behalf of Executive Engineer, PWD, Construction Division 2, Kapurthala
5. Sh. Rajiv Aggarawal, Architect.] Archigroup Architects, Noida.
6. Sh. Nitin, Architect

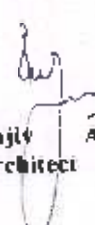
3.0 After detailed discussions and deliberations, committee recommends use of complete granite stone for flooring in circulation area and VIP banquet area for the proposed auditorium at PTU's main campus, Kapurthala.


Dr. A. P. Singh
Dean/RIC/PTU


Dr. Rajneesh Sachdev,
Registrar, PTU.


Er. H. P. Singh,
E.E./PTU


Mahabir Singh
SDO/PWD/Kpt.


Rajiv Aggarawal,
Architect

ANNEXURE-C



Consist. No. 902, 05/11/14
Receipt
From To End

Phone : 91-172-2792325, 2795001
Fax : 91-172-2793143
Website : www.pscst.gov.in

Punjab State Council for Science & Technology

A Scientific & Industrial Research Organization approved by DSIR & Central Govt.
under Clause (ii) of Sub-Section (i) of Section 35 of Income Tax Act, 1961

(A State Govt. Undertaking)

MGSIPA Complex, Institutional Area, Sector 26, Post Box No. 727, Chandigarh-160 019 (India)

Ref. No. : PSCST/0/369

Dated 30/10/2014

**Registrar,
Punjab Technical University,
Jalandhar-Kapurthala Highway,
Kapurthala**

Subject: Energy Audit of PTU's Administrative Building at Kapurthala.

I am grateful to Punjab Technical University (PTU) for awarding the work of carrying out detailed energy audit of its complex at Kapurthala. PSCST has completed the field audit and has recommended 8 energy saving options based on the energy conservation measures (ECM) identified during audit. A summary of annual savings identified is as below:

Short term energy saving proposals (5 nos.)

- Annual Savings with zero investment (2 nos.) : Rs. 8.60 lacs
- Annual Savings with investment of Rs. 2.0 lacs (3 nos.) : Rs. 2.64 lacs

Long term energy saving proposals

- Annual Savings with investment of Rs. 47.55 lacs (3 nos.) : Rs. 20.52 lacs

I am enclosing copy of draft detailed energy audit report for perusal and comments. Further, before finalizing the report, findings & comments can be discussed with implementation team at mutual convenient date & venue, preferably in mid November, 2014.

With regards,

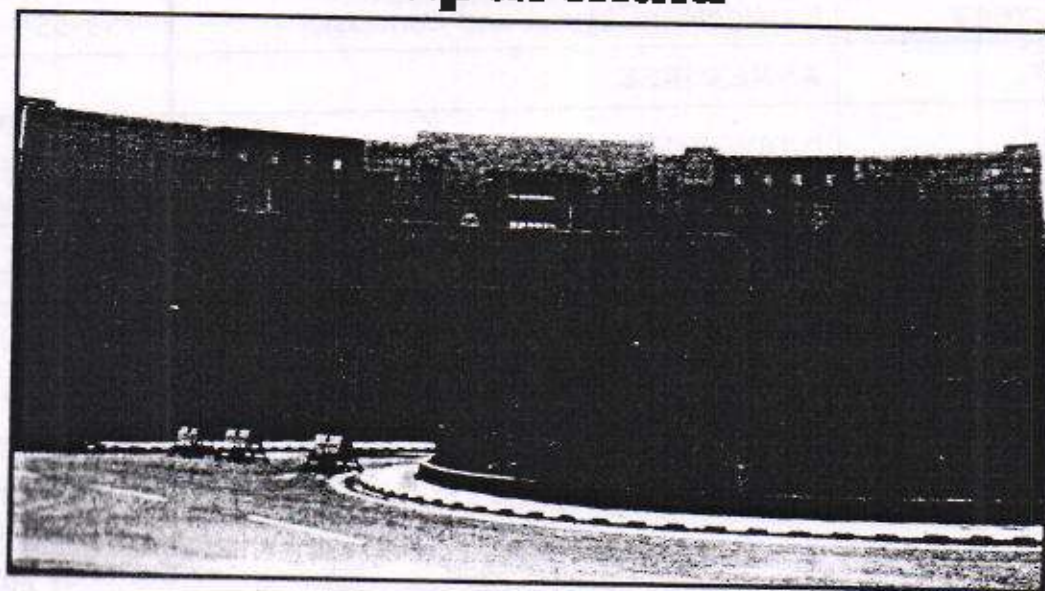
DA: Draft Report


23/10/14
Additional Director

Detailed Energy Audit Report

for

**Punjab Technical University
Kapurthala**



**Draft report
October 2014**



Punjab State Council for Science & Technology

MGSIPA Complex, Sector 26, Chandigarh-160 019

☎ +91 172 2792325, 2795001, Fax: +91 172-2793143

www.pscst.gov.in

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ACKNOWLEDGEMENT

We express our gratitude to Punjab Technical University (PTU), Kapurthala for giving us an opportunity to undertake the energy audit of their complex. The energy audit is indeed a very important assignment as the electricity tariffs are increasing day by day and the reduction in energy bill has become very important.

During field studies, the management was found to be progressive as it has done very well on energy conservation front by implementing several energy conservation initiatives, such as:

- Maintaining power factor above 0.95
- Good electrical transmission & distribution system
- Separate feeders for inside & outside lights
- Separate floor wise control panel for indoor lights
- Utilization of T8 & CFL light fixtures in indoor lighting
- Energy Conservation by switching ON alternate street lights
- Good insulation practices in HVAC system

We are also thankful to Shri H.P. Singh, Executive Engineer and Shri. Vishal Beri, Estate Officer for coordinating the field visits and providing all possible help during energy audit in the campus. We also express our profound thanks to the officers and staff of Punjab Technical University, especially Sh. P.C. Thakur, AAE; Sh. Pankaj Sharma, Sh. Ram Singh and Sh. Jasbir Singh, technicians for their assistance to the energy audit team.

The PSCST team worked in close collaboration with the team of CII-AVANTHA Centre for carrying out the detail energy audit of the complex. We are especially grateful to Sh. R. Narayanan, Head, CII-AVANTHA Centre for readily agreeing to take up this assignment with us, Sh. Sanjay Namdeo, Senior Counselor for his comments from time to time, and the CII team comprising Sh. Manpreet Singh & Sh. Mohd. Khalid for their active participation.

Additional Director

ENERGY AUDIT TEAM

- | S. No. | Name & Designation |
|--------|--|
| 1. | Sh. S.K. Jain,
<i>Additional Director, PSCST</i> |
| 2. | Sh. Pritpal Singh,
<i>Senior Engineer, PSCST</i> |
| 3. | Sh. Krishan Kant Singla,
<i>Certified Energy Auditor,
Process Engineer, PSCST</i> |
| 4. | Sh. Manpreet Singh,
<i>Certified Energy Auditor,
Counsellor, CII</i> |
| 5. | Sh. Mohd. Khalid
<i>Engineer, CII</i> |
| 6. | Ms. Rajeena
<i>Steno Typist, PSCST</i> |

CHAPTER 1.0

EXECUTIVE SUMMARY

Punjab Technical University (PTU) was established in the Year 1997 under the Punjab Technical University Act, 1996 (Punjab Act No. 1 of 1997) to provide for the establishment and incorporation of a University for the advancement of technical education and development thereof in the State of Punjab and for matters connected therewith. In pursuance of this Act, the University has 494 affiliated colleges. At present, after 15 year of its existence, PTU is providing education to approximately 5 lac students from Punjab and other States in the fields of Engineering, Management, Architecture and Pharmacy.

Punjab Technical University is propelled by the vision and wisdom & is continuously strived to discharge its duties for the overall improvement of quality of education and to make sure that the courses it offers remain relevant to society and useful to students in the globalized work environment.

Punjab Technical University has evinced interest in availing the services of the Punjab State Council for Science and Technology, Chandigarh for conducting a detailed energy audit of their Complex, Kapurthala. The annual power consumption of the PTU Complex during the year 2013 (January to December 2013) was 13.21 lacs kWh and energy bill for this period was Rs. 1.01 crores.

PSCST team carried out the preliminary energy audit on 26.05.2014 & detailed energy audit of their energy intensive equipments from 30.06.2014 to 02.07.2014 jointly with CII-AVANTHA Centre for Competitiveness for SMEs.

1.1 Methodology

1.1.1 Pre-audit Visit

A preliminary visit of Punjab Technical University Complex was made for finalizing the audit schedule and discussions were held with senior management. A walk-through audit was also conducted so as to familiarize with institution activities and to get first hand information like building layout, energy consumption data, electrical distribution system, specifications of the energy intensive equipments & existing instrumentation. The requisite information for all energy intensive equipments installed in their campus was supplied by Punjab Technical University Complex management on the questionnaire provided by PSCST. The data was analyzed & it was observed

that the total connected load of the equipments installed is 3300kW, with its distribution as under:

Table-1.1: Total Load of equipments installed at PTU

Area	Load (kW)	Load (% age)
HVAC (Chillers 4nos, Primary Pumps 4 nos., Secondary pumps 3 nos. & fresh air fans 18 nos., AHUs 41 nos., CDS pumps)	1240	52%
Split/Window AC (30 nos of ACs)	94.50	4%
Hot water generator	400	17%
Lighting	178	7.5%
Pumping, Plumbing And Fire Fighting pumps (Submersible pump 1 no, Sump pumps 3 nos., fire pump 1 no., terrace pump 1 no., fountain pumps 2nos., jocky pumps 1 no & STP pumps)	160	6.7%
Fans / Water coolers	75	3.0%
General Load (Dispenser, Oven, Heater, Computer, projector)	210	9%
Lifts (4 nos.)	23.12	0.8%
Total	2380	100%

1.1.2 Detailed Energy Audit

Detailed energy audit of various equipments installed in the PTU Complex was carried out by using various digital energy audit instruments such as Three Phase power analyzer, ultrasonic flow meter, pressure gauge, lux meter, distance meter, multimeter, power clamp meter, hygrometer. During the detailed study, the following observations were made:

Power Distribution System

- Two 1000kVA transformers are being operated throughout the year, as working load during day time in summers is 670-740 kW. However, the average running load during night time throughout the year is only 30-50kW.
- The average annual Power Factor (PF) during the period January 2013 to December 2013 was 0.96. Average Power Factor at substation during day time & night time was observed to be 0.98-0.99.
- Automatic Power Factor Control (APFC) panel of 350 kVAR each has been installed on the two 1000kVA transformers to maintain the power factor. The capacitor banks were working efficiently.

Heating, Ventilation & Air-conditioning (HVAC) System

- No control system to regulate the flow of chilled water to HVACs in the isolated/unoccupied areas.
- The specific power consumption of air cooled screw chiller plant was 1.46 kW/TR. Whereas, water cooled screw chillers have specific power consumption of 0.7 to 0.8 kW/TR.
- The available head of return water from AHUs, at inlet of chiller plant is 2.9 kg/cm² which is sufficient for the operation in chilling plant & at times may not require primary water pumps.
- Low temperature (20-24°C) maintained in the centrally air conditioned areas. No automated sensor based system to maintain the inside temperature.

Lighting

- Operation of the indoor lights during night time even when there is no occupancy.
- Use of T8 fixtures for indoor lighting

1.1.3 Analysis & Report Preparation

The data collected during these field studies was analyzed for identifying the scope of energy conservation. The Cost Benefit Analysis with regards to recommended Energy Conservation Measures (ECM) was prepared for calculating the payback period.

The report has been prepared considering the minimum number of hours of operation of following equipments in consultation with the concerned staff/ officers.

Table-1.2: No. of Operating Hours of Various Equipments

Equipment/ Location	No of hours/day/ equipment	Total no. of hours/ year / equipment
• Transformers	24 hrs/d	8760
• HVAC		
o Chillers	10 hrs/d	1250
o Chilled water pump	10 hrs/d	1250
o Condenser water pumps	10 hrs/d	1250
• Indoor lights	10-20 hrs/d	3000-6000
• Street light	10hrs/d	3650
• Submersible pumps	6-12 hrs/d	1800-3600

1.1.4 Recommendations

Based on the energy conservation measures identified, the cost benefit analysis like simple payback period of all the ECMs has been calculated. It has been observed that there is a annual energy saving potential of

4,02,604 kWh amounting to Rs.30.92 lacs besides power factor incentive Rs.0.84 Lacs. Thus, there is total annual saving potential of Rs.31.76 Lac with an investment of Rs.49.55 lacs. The simple pay-back period of the investment is only 1.6 years. The investment cost has been prepared while taking into account the prevailing market rates.

The recommendations which have early payback period are termed as short term measures and recommendations which have long payback period are termed as long term measures. It is proposed that the energy conservation measures requiring no investment should be implemented immediately and the remaining ECMs are proposed to be implemented in two phases as short term measures and long term measures.

Short Term Measures:

The following ECMs can lead to saving of Rs. 8.60 lacs with zero investment.

- Optimize operation of transformers.
- Optimize the contract demand power supply from PSPCL.

Further, the following ECMs are recommended to be implemented in the first phase which has a saving potential of Rs. 2.64 lacs per annum with an investment of Rs. 2.0 lacs having simple payback period as 9 months.

- Improve overall power factor of complex to unity.
- Modify chilled water circulation system & eliminate the use of primary pumps.
- Optimize power consumption of lighting by automation.

Long Term Measures:

The following ECMs are recommended to be implemented in the second phase which has a saving potential of Rs. 20.52 lacs per annum with an investment of Rs. 47.55 lacs having simple payback period as 28 months.

- Replace existing air cooled screw chiller with water cooled screw chiller.
- Replace 36 W fluorescent tube lights with 18 W LED tube lights.
- Replace 18 W fluorescent tube lights with 9 W LED tube lights.
- Replace 150 W HPSV Street Lights With 60 W LED Street Light.
- Replace 70 W HPSV Street Lights With 30 W LED Street Light

1.1.5 Summary of annual savings identified

Short Term Energy Saving Proposals

Annual Savings with zero Investment (2 Proposals) : Rs. 8.60 Lacs

Annual Savings with Investment of Rs.2.00 Lacs (3 Proposals) : Rs. 2.64 Lacs

Long Term Energy Saving Proposals

Annual Savings with Investment of Rs.47.55 Lacs (3 proposals) : Rs. 20.52 Lacs

**Total annual savings with investment of : Rs.31.76 Lacs
Rs.49.55 Lacs. (8 Proposals)**

Average payback period for capital proposals : 1.6 years

Each Energy Conservation Idea should be seen as an opportunity for improvement. The management of PTU Complex should have a firm commitment so that the complex:

- Achieves energy conservation on a time bound basis.
- Make energy conservation a permanent activity.
- Achieve lowest auxiliary energy consumption.
- Implement the recommended proposals and reap the benefit.
- Achieve the status of best energy efficient complex in India.

List of Energy Saving Proposals at Punjab Technlcal University, Kapurthala

Sr. No.	Energy saving proposals	Annual Savings	Invest. Required	
		(Rs. in Lacs)	(Rs. in Lacs)	
1	Optimize operation of transformers	0.56	-	
2	Optimize the contract demand power supply from PSPCL	8.04	-	
3	Improve overall power factor of complex to unity	0.84	0.50	7
4	Replace existing air cooled screw chillers with water cooled screw chiller.	11.52	25	25
5	Modify chilled water circulation system and eliminate use of primary pumps.	0.80	0.50	
6	Replace 36 watts & 18 watts fluorescent tube lights with 18 watts & 9 watts LED tube lights	5.32	12.55	28
7	Replace 150W HPSV street lights with 60 watts LED & 70W HPSV with 30W LED street lights.	3.68	10.0	12
8	Optimize power consumption of lighting by automation	1.0	1.0	12
Observations				
1	Optimize power consumption of lighting by switching off indoor lights in night.			
2	Install Roof top Solar Photovoltaic system			
Total		31.76	49.55	11

CHAPTER 2.0

INTRODUCTION

Punjab Technical University (PTU) was established in the Year 1997 under the Punjab Technical University Act, 1996 (Punjab Act No. 1 of 1997) to provide for the establishment and incorporation of a University for the advancement of technical education and development thereof in the State of Punjab and for matters connected therewith. In pursuance of this Act, the University has 494 affiliated colleges. At present, after 15 year of its existence, PTU is providing education to approximately 5 lac students from Punjab & other States in the fields of Engineering, Management, Architecture and Pharmacy.

Punjab Technical University is propelled by the vision and wisdom & is continuously strived to discharge its duties for the overall improvement of quality of education and to make sure that the courses it offers remain relevant to society and useful to students in the globalized work environment.

Punjab Technical University has evinced interest in availing the services of the Punjab State Council for Science and Technology, Chandigarh for conducting a detailed energy audit of their Complex, Kapurthala.

Preliminary visit of PTU Complex was carried out on 26.05.2014 and discussions were held with the senior management. A walk through audit of the campus was also conducted so as to familiarize with the institution activity, obtain first hand information like building layout, energy consumption data, electrical distribution system, identification of energy intensive equipments and existing instrumentation. The information w.r.t. all energy intensive equipments installed in the campus was supplied by PTU on the questionnaire provided by PSCST. The detailed energy audit of PTU Complex was carried out from 30.06.2014 to 02.07.2014 to study the existing energy consumption pattern and identify energy conservation measures.

The contents of this report are based on the actual data provided by the PTU officials and measurements carried out by PSCST and CII energy audit team.

The management was found to be progressive as it has done very well on energy conservation front by implementing several energy conservation initiatives such as:

- Maintaining power factor above 0.95
- Good electrical transmission & distribution system

- Separate feeders for inside & outside lights
- Separate floor wise control panel for indoor lights
- Utilization of T8 & CFL light fixtures in indoor lighting
- Switching ON alternate lights in street lighting
- Good insulation practices in HVAC system

• Maintaining power factor above 0.95

• Good electrical transmission & distribution

CHAPTER 3.0

GENERAL & TECHNICAL ASPECTS

3.1 General/ Administrative

Table-3.1: General Aspects

Parameter	Description
Name of the Institution	Punjab Technical University, Kapurthala
Land area and year of construction	74 acres, 2008
Total Built up area (Sq. m) approx.	24,749
Total number of employees in the office	610
Occupancy information (5 days a week, daily 9.00 AM to 5 PM)	60,000 visitor/ Annum
Power Tariff :	
• Energy Charges	Rs.7.68 per kWh <i>However, basic tariff rate excluding PF incentive, ED and rentals works out to Rs. 6.39 per kWh</i>
• Minimum charges (monthly)	Rs.5.98 Lacs
• P.F Penalty/Rebate	Yes, applicable
Status of Bill Payments on time/Delay in Bill Payments, percentage paid	On Time

3.2 Detail of Visitors

Punjab Technical University remains open for 5 days (except Saturday, Sunday and Public Holidays) in a week. As such it remains open for around 270-280 days in a year. As per the data provided by the management, approximately, 60,000 persons visit the University Complex during the period January, 2013-December 2013.

The technical data is provided in table-3.2 below:

Table-3.2: Technical Aspect

S.No.	Item	Description																																	
1.	Source of Supply	Punjab State Power Corporation Ltd.																																	
2.	Voltage Level of Incoming Supply	11 kV-HT line																																	
3.	a) Main Transformer	1000 kVA – 02 No.																																	
4.	Break up of all major loads	Details at Table 4.3																																	
5.	Power Requirement of the plant: (Based on Monthly Energy bill period Jan 2013- Dec2013)																																		
	a) Connected Load	2380 kW																																	
	b) Contract Demand	2000 kVA																																	
	c) Maximum Demand	998 kVA																																	
	d) Average power factor	0.95 to unity																																	
	e) Annual electricity bill	Rs 1.01 Crore (Approx.)																																	
	f) Annual electricity consumption- table-4.2	13.19 Lacs kWh																																	
6.	Other Sources of Power Supply.																																		
	• Installed DG capacity	2 No. - 380 kVA each 1 No. – 62.5 kVA																																	
	• Total electricity generated from DG	Only during power break-down																																	
7.	LT Capacitor Bank Details (Installed in substations or load centre with APFC)	350 kVAR Capacitor Bank (25 kVAR- 6 nos. & 50 kVAR- 4 nos. for each transformer)																																	
9.	Major Equipments/Main motors	<ul style="list-style-type: none"> • Transformers • HVAC Plant • AHU's • Hot Water Generator • Pumps • DG Sets • Lighting • Lifts 																																	
9.	Load distribution pattern	<table> <tr> <th>Equipment</th><th>No.</th><th>Load(kW)</th></tr> <tr> <td>HVAC Plant</td><td>4</td><td>1240</td></tr> <tr> <td>Split & Window AC</td><td>30</td><td>94.5</td></tr> <tr> <td>Hot Water Generator</td><td>1</td><td>400</td></tr> <tr> <td>Lighling</td><td>3262</td><td>178</td></tr> <tr> <td>Pumps/motors</td><td></td><td>160</td></tr> <tr> <td>Fans</td><td>825</td><td>75</td></tr> <tr> <td>Water Coolers</td><td>22</td><td></td></tr> <tr> <td>General Load</td><td>-</td><td>210</td></tr> <tr> <td>Lifts</td><td>4</td><td>23.126</td></tr> <tr> <td>Total</td><td></td><td>2380</td></tr> </table>	Equipment	No.	Load(kW)	HVAC Plant	4	1240	Split & Window AC	30	94.5	Hot Water Generator	1	400	Lighling	3262	178	Pumps/motors		160	Fans	825	75	Water Coolers	22		General Load	-	210	Lifts	4	23.126	Total		2380
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General Load	-	210																																	
Lifts	4	23.126																																	
Total		2380																																	

CHAPTER 4.0

ENERGY CONSUMPTION PATTERN

4.1 Energy Use Pattern

Punjab Technical University complex receives power from Punjab State Power Corporation Limited (PSPCL) at 11 kV voltage level. D.G. sets are used only during power failure/ break-down. The energy consumption is recorded from the main meter installed on the HT side of 11 kV grid and through the monthly bills. The parameters like energy consumption during day and night, monitoring the energy consumption in different areas, power factor and maximum demand etc. were studied.

The Specific Energy Consumption based on covered area (kWh/sq.ft.) and average occupancy (kWh/person) has been calculated on the basis of data supplied by the organization for the period January 2013- December 2013.

Table-4.1: Specific Energy Consumption (SEC) at PTU Complex

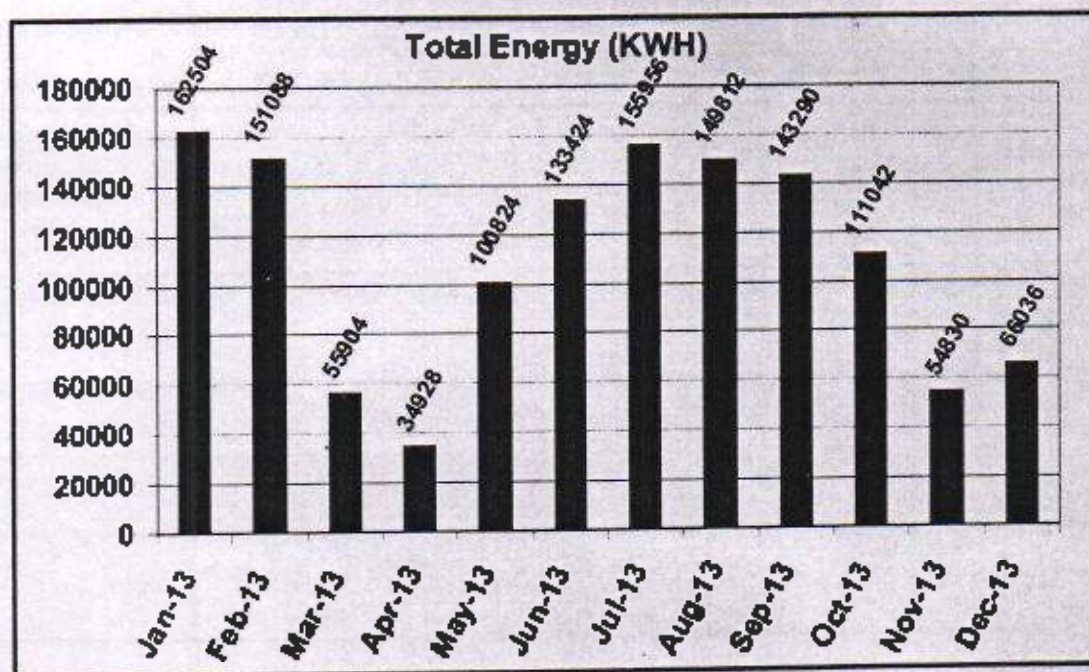
Yearly Data (Jan 2013- Dec 2013)	Quantity	Unit	Energy Consumption (in Lac kcal)	Av. worked out Unit Cost (Rs.)	Total Cost (Rs in Lacs)	SEC based on covered area (kWh/ Sq.ft./Year)	SEC based on occupancy (kWh/ Person)
Annual Electricity Consumption	1,319,638	kWh	1,134	7.68	101	4.98	6.2
Annual Diesel Consumption	5,000	Litres	45	60	3.0		
Covered area of Building	264,638	Sq.ft.					
Average Occupancy /annum	60,000	Persons					

4.2 Electrical Energy Consumption Pattern

Total electrical energy consumption pattern and energy charges based on the monthly bills of last 12 months is given in the **Table-4.2**. The variation in the Energy Consumption is attributed mainly due to the seasonal variation. The Power consumption goes up in the peak summer & peak winter seasons due to the additional load of HVACs system in summers and utilization of hot water generator in winters.

Table-4.2: Monthly Energy Consumption Pattern

Month & Year (As per bill cycle)	MDI (kVA)	Total Energy (kWh)	Total Energy Bill (Rs.)	Actual Power Factor
Jan-13	633.34	162504	10,31,126	Unity
Feb-13	626.80	151088	9,66,350	0.99
Mar-13	597.32	55904	5,69,879	Unity
Apr-13	461.62	34928	5,92,710	Unity
May-13	998.24	100824	7,06,796	0.96
June-13	973.42	133424	9,85,030	0.96
July-13	952.90	155956	11,78,309	0.95
Aug-13	931.82	149812	10,55,090	0.94
Sep-13	931.7	143290	10,11,740	0.93
Oct-13	828.18	111042	7,88,680	0.94
Nov-13	509.94	54830	6,12,624	0.97
Dec-13	613.98	66036	6,41,960	Unity
		1319638	1,01,40,294	0.96 (Average)

**Figure-4.1: Energy Consumption Pattern (May 2013- April 2014)**

From the above, maximum energy consumption has been observed during the winter months of January & February (1.5 lac to 1.62 lac kWh) whereas, Maximum Demand Index (MDI) during this period was only 626 to 633 kVA. The MDI during summer months (May to September) ranged between 930-1000 kVA with energy consumption ranging between 1.0 lac to 1.43 lac kWh. Minimum monthly charges has been levied during the months March - April & November - April due to low MDI & energy consumption.

While auditing, power consumption during working hours ranged between 670-740 kW whereas, power consumption during non-working hours was only 30-50 kW. The connected load of outdoor lighting during non-working hours was only 18 kW.

4.3 Connected Load Details

Table-4.3: Connected load Details at Punjab Technical University Complex

Area	Load (kW)	Load (% age)
HVAC (Chillers 4nos, Primary Pumps 4 nos., Secondary pumps 3 nos. & fresh air fans 18 nos., AHUs 41 nos., CDS pumps)	1240	52%
Split/Window AC (30 nos of ACs)	94.50	4%
Hot water generator	400	17%
Lighting	178	7.5%
Pumping, Plumbing And Fire Fighting pumps (Submersible pump 1 nos, Sump pumps 3 nos., fire pump 1 nos., terrace pump 1 nos., fountain pumps 2nos., jockey pumps 1 nos, STP pumps)	160	6.7%
Fans / Water coolers	75	3.0%
General Load (Dispenser, Oven, Heater, Computer, projector)	210	9%
Lifts (4 nos.)	23.12	0.8%
Total	2380	100%

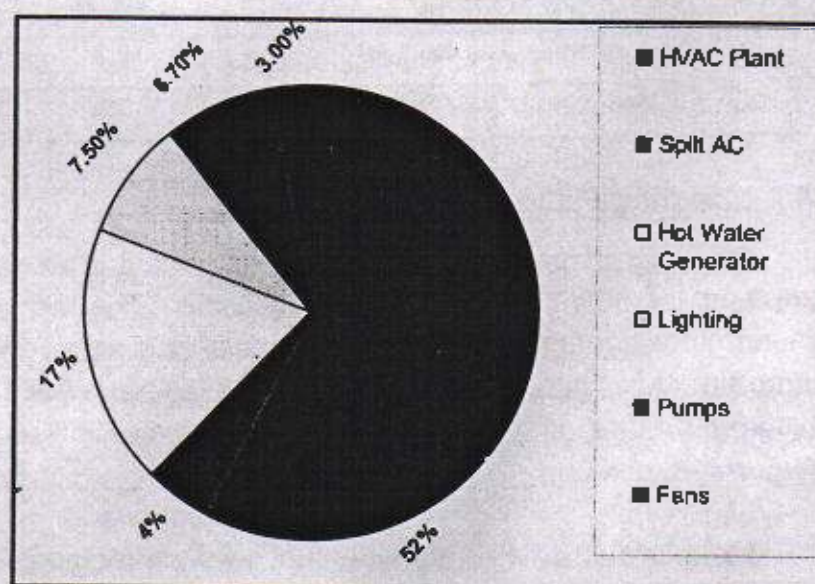


Figure-4.2: Connected load Break-up

It is evident from the above that 73% of the total connected load is for HVAC & heating ventilation system only and HVAC/heating plant is used, depending on the season (summer or winter). Whereas, remaining 27%

connected load is for pumps, lighting system and other auxiliary load. It was also noticed that the actual electricity load is less than the total connected load as the MDI varied between 509 to 1000 kVA against the sanctioned contract demand of 2000 kVA. Therefore, the sanctioned load can be optimised/reduced so as to avoid monthly minimum charges.

4.4 Electrical power Distribution System:

Punjab Technical University Complex receives power from PSPCL at 11 kV and steps down to 400 V through 1000 kVA Transformer, which is supplied to the main complex.

The design specifications of transformers are given in Table-4.4 below:

Table-4.4: Design Data for 11/0.4 kV Transformers

Sr. No.	Description	Transformer 1	Transformer 2
1	Make	VOLTAMP	VOLTAMP
2	Type	ONAN	ONAN
3	Rating (kVA)	1000	1000
4	Primary Voltage (kV)	11	11
5	Primary Current (Amps)	52.49	52.49
6	Secondary Voltage (kV)	0.400	0.400
7	Secondary Current (A)	1443.38	1443.38
8	OLTC (With/Without)	WITH	WITH
9	Rated No Load Loss (kW)	1.2	1.2
10	Rated copper loss (kW)	12	12

4.4.1 Loading Pattern of Transformers

The log of power data for 2 transformers was noted using portable instrument on HT/LT side of the transformer. The logging for each of the transformer was made to ascertain the actual load variation on the transformer. During the study period, the maximum load, average load and minimum load registered on each of the transformer are presented in Table-4.5 & Figures-4.3 to Figure-4.5 below.

As informed by the management, two transformers of 1000 kVA each operate throughout the year. During audit, the average loading on the transformers was found to be low. During day time, operating load on transformer no.1 & transformer no.2 varied between 240-290 kW and 430-450 kW respectively. Energy consumption during the night hours was in the range

of 30-50 kW, which is 3-5% of the total connected load. The voltage range during the night was 380-420 volts.

Table-4.5: Load Distribution on all Transformers

Sl No	Transformer no.	Maximum load (kVA)	Minimum load (kVA)	Average load (kVA)	Percentage loading (%)
During working hrs					
1	Transformer 1	290	240	265	24- 29 %
2	Transformer 2	450	430	440	43-45%
During non working hrs.					
3.	Transformer 1	50	30	40	3-5%

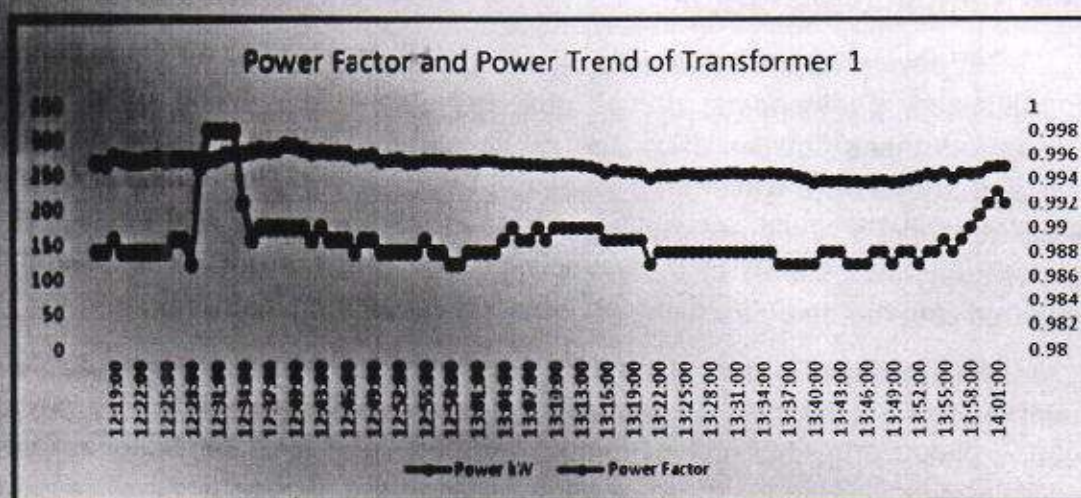


Figure-4.3: Loading Trend of 11/0.4 kV, 1000 kVA Transformer

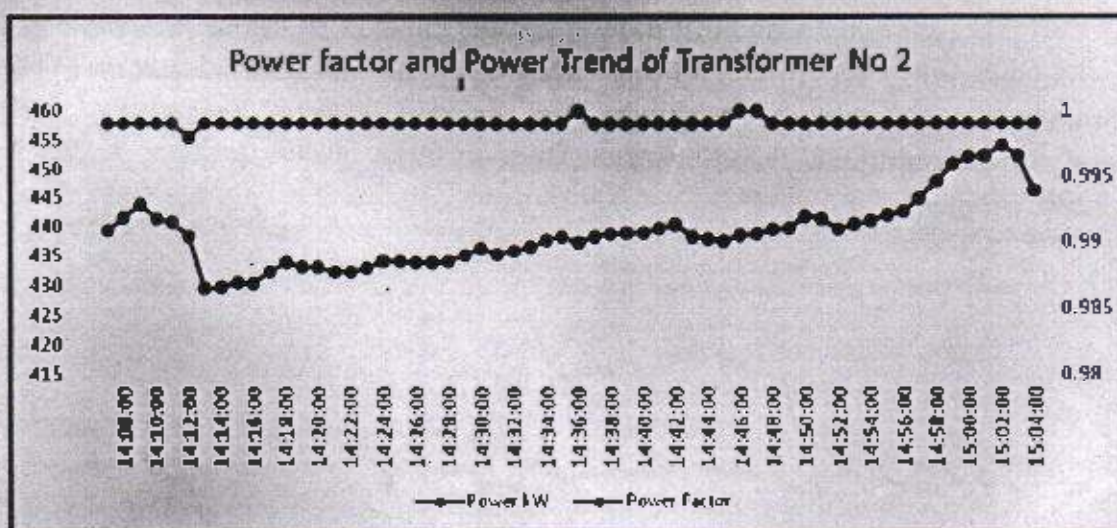


Figure-4.4: Loading Trend of 11/0.4 kV, 1000 kVA Transformer

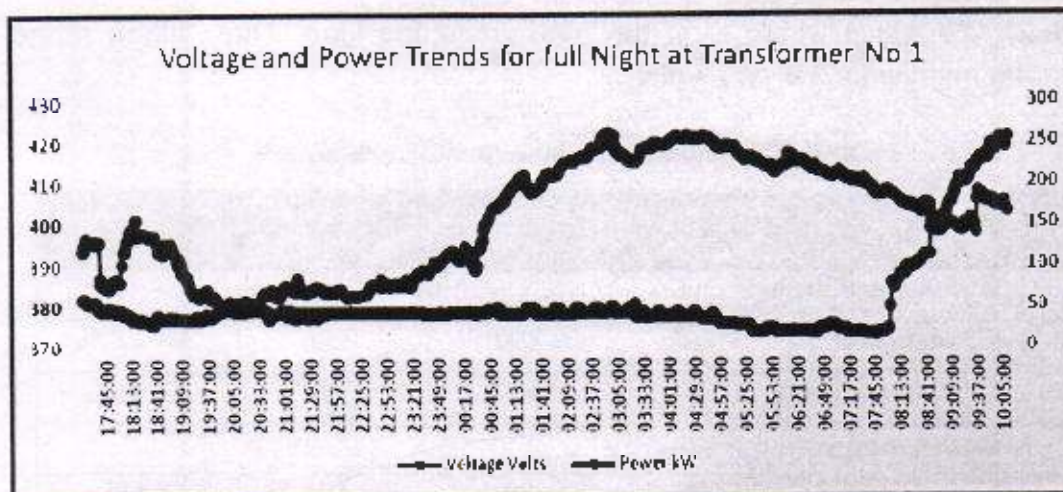


Figure-4.5: Loading Trend of 11/0.4 kV, 1000 kVA Transformer (Night time)

4.4.2 Harmonic Distortion:

The devices like motors with drives, computers, UPS, Air Conditioners, fax machines, photocopies, printer etc. are extensively being used in the complex. All these devices draw non sinusoidal currents and cause distortion in voltage and current waveforms leading to harmonics. Harmonics occurs as spikes at intervals which are multiples of the main frequency and these distort the pure sine wave form of the supply voltage and current. These can be measured with the help of advanced electrical measuring instruments.

Many problems can arise from harmonic current in a power system. These include overheating of neutral conductors, motors, transformers, switch gears, voltage drop, low power factor, reduced capacities, capacitor failures, circuit breaker, tripping with no apparent reason etc. These problem leads to increased electricity bills besides being operational and maintenance concerns.

The harmonic trends at main incomer, LT side of transformer no.1 & 2 was checked by using digital power analyzer. Total harmonic distortion (THD) in voltage at HT side of transformer was observed to be in the range of 1-2% and current harmonic distortion was observed to be in the range of 3-10% as shown in figure-4.6 below:

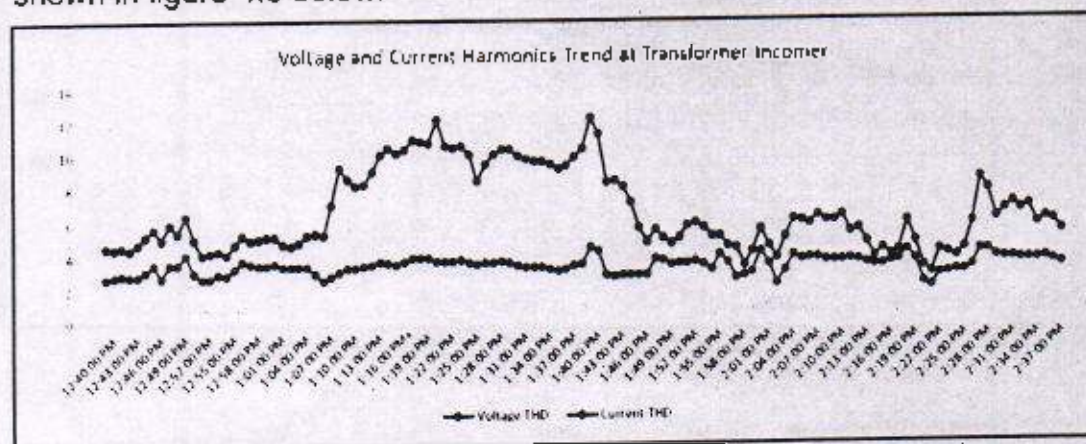


Figure-4.6: Voltage and Current Harmonics Trend at Transformer Incomer

The total voltage harmonics at LT site of 11 KVA transformer no. 1 was observed to be in the range of 1.5 to 2.0% and current harmonics were in the range of 5.5 to 7.0%. Similarly, the voltage harmonics on LT side of transformer no. 2 was 0.6-0.8% and the current harmonics was observed to be in the range of 1.2-1.8% as shown in figure-4.7 & figure-4.8 below. These observations are well within the permissible range of 3-5% for voltage and upto 10% for current harmonics.

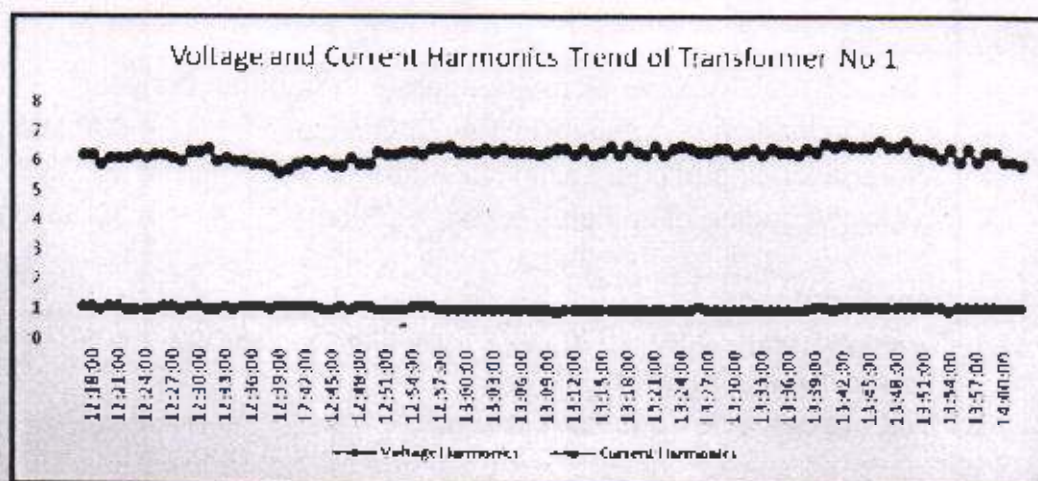


Figure-4.7: Voltage and Current Harmonics Trend of Transformer No. 1

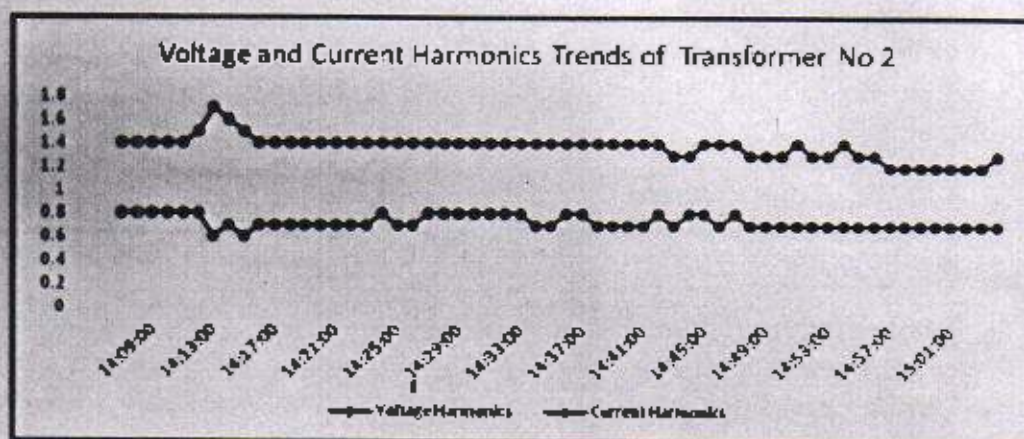


Figure-4.8: Voltage and Current Harmonics Trend of Transformer No. 2

4.5 Recommendations

1. Operate only one 1000 kVA transformer during night time (6 PM to 7AM) throughout the year.
2. Operate only one 1000 KVA transformer during the holidays.

4.6 Benefits

The annual saving potential is **Rs. 0.56 Lacs**, which requires no investment. Details are given in Energy Saving Proposal-1.

ENERGY SAVING PROPOSAL No. 1

Optimise operation of transformers

As observed during the audit, the average loading on transformers is very less. During day time, it varies between 25-45% whereas, during night time, it is less than 10%.

Existing Scenario

- 2 Nos of 1000 kVA transformers operate throughout the year
- Average loading of complex in May to October = 900 kW
- Average loading of complex in November to April = 550 kW
- Average Loading of complex during night time = 30-50 kW

A. Recommendations

1. Operate only one 1000 kVA transformer during Night Hours (6 PM to 7 AM) throughout the year
2. Operate only one 1000 KVA transformer during the holidays

Existing Scenario:

- Two Transformers (1000 kVA) are operated
- Actual total effective load is 50 kW
- % load to the individual transformers is 2% & 3%
- Losses
 - Iron loss = 1.2* kW
 - FL. Copper losses = 12* kW

*Standard losses of transformer

Losses calculation:

- When both transformers are in operation : 2.41 kW
 $[(1.2) + 12 \times (0.02)^2] + [(1.2) + 12 \times (0.03)^2]$
- When one transformer in operation : 1.24 kW
 $(1.2) + 12 \times (0.05)^2$
- Saving potential in kW : 1.17 kW
 $(2.41 \text{ kW} - 1.24 \text{ kW})$
- Annual Savings on working days : 0.30 Lacs
 $1.17 \times 13 \text{ hrs/day} \times 20 \text{ days/month} \times 12 \text{ months} \times \text{Rs. } 7.68/\text{unit}$
- Annual Savings during non working days : 0.26 Lacs
 $1.17 \times 24 \text{ hrs/day} \times 120 \text{ days/annum} \times \text{Rs. } 7.68/\text{unit}$

B. Savings:

- Annual Savings (0.30+0.26) : 0.56 Lacs
- Investment : Nil

ENERGY SAVING PROPOSAL No. 2

Optimize the contract demand power supply from PSPCL

As analyzed from the electricity bills of the complex, the Maximum Demand Index (MDI) is very less compared to contract demand.

Existing Scenario

- Contract Demand of the Complex = 2000 kVA
- MDI of Jan,2013 - Dec,2014 = 998 kVA
- Minimum monthly charges based on contract demand = Rs. 5,98,000
- PTU paid the energy bills of March, April, November & December 2013 on minimum monthly charges (MMC) bases.

Table-4.6: Monthly Energy Consumption Pattern

Month & Year (As per bill cycle)	MDI	kVAh	Total Energy (kWh)	Total Energy Bill (Rs.)	Actual Power (Rs./ kWh) factor	
Jan-13	633.34	163198	162504	10,31,126	Unity	6.34
Feb-13	626.80	151904	151088	9,66,350	0.99	6.39
Mar-13	597.32	56082	55904	5,69,879	Unity	10.19
Apr-13	461.62	34992	34928	5,92,710	Unity	16.96
May-13	998.24	104564	100824	7,06,796	0.96	7.0
June-13	973.42	138320	133424	9,85,030	0.96	7.38
July-13	952.90	163650	155956	11,78,309	0.95	7.55
Aug-13	931.82	149134	149812	10,55,090	0.94	7.04
Sep-14	931.7	153990	143290	10,11,740	0.93	7.06
Oct-14	828.18	118034	111042	7,88,680	0.94	7.10
Nov-14	509.94	56418	54830	6,12,624	0.97	11.17
Dec-14	613.98	66298	66036	6,41,960	Unity	9.72
		1356584	1319638	1,01,40,294	0.96 (Average)	

PTU management has got approval of contract demand of 2000 kVA based on the connected load is around 1950 kW, which includes, the load of stand by motors/equipments installed in the campus. Whereas, the MDI during the last one year has never exceeded 1000 kVA as shown in the table above. Therefore, the levy of monthly minimum charges (MMC) during the four months can be avoided by re-scheduling/optimizing the contract demand by declaring the connected load of standby equipment/motors & subsequently take approval

obtaining approval of PSPCL for the same. The annual MDI trend of PTU is as shown in figure-4.9.

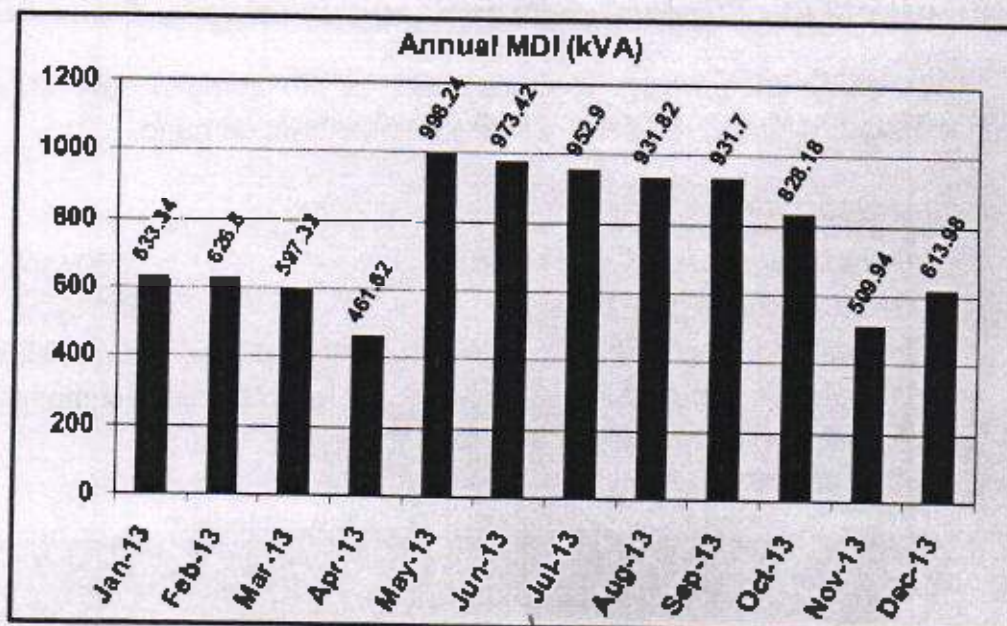


Figure-4.9: Annual MDI Trend

Recommendations:

- Reduce the contract demand of 2000 kVA to 1300 kVA from PSPCL

A. Savings Due to Recommendation

Month	Basic unit rate	Existing MMC (for 2000 kVA Contract Demand)	Energy Consumption	Energy Cost	Proposed MMC (for 1300 kVA Contract Demand)	Energy Cost After Reducing contract demand to 1300 kVA	Saving Potential
	Rs./kWh	Rs.	kWh	Rs.	Rs.	Rs.	
Jan-13	6.39	598000	162504	1038401	388700	1038401	0
Feb-13	6.39	598000	151088	965452	388700	965452	0
Mar-13	6.39	598000	55904	357227	388700	388700	209,300
Apr-13	6.39	598000	34928	223190	388700	388700	209,300
May-13	6.39	598000	100824	644265	388700	644265	0
Jun-13	6.39	598000	133424	852579	388700	852579	0
Jul-13	6.39	598000	155956	996559	388700	996559	0
Aug-13	6.39	598000	149812	957299	388700	957299	0
Sep-13	6.39	598000	143290	915623	388700	915623	0
Oct-13	6.39	598000	111042	709558	388700	709558	0
Nov-13	6.39	598000	54830	350364	388700	388700	209,300
Dec-13	6.39	598000	66036	421970	388700	421970	176,030
B. Savings due to Recommendation							803,930
C. Investment							Nil

Power Factor Analysis

The management has installed Automatic Power Factor Correction Panel (APFC panel) at transformer end and is maintaining power factor above 0.95. During the study, it was observed that Power Factor (PF) at 11 kV grid varied between 0.982 to 0.99 (figure-4.9). The Power Factor at 11kV transformer no. 1 was in the range of 0.988 to 0.998 during day time and 0.998 to unity at night time. The trend of power factor recorded during the study period (during the day time) at 11 kV main incomer & both the transformers is shown in figure-4.10, figure-4.11 & figure-4.12. However, the average Power factor analysed from the energy bills provided by the management for the period January 2013 to December 2013 is 0.968, which can be further improved to nearly unity. Improving the power factor at the mains would result in rebate from State Electricity Board (SEB).

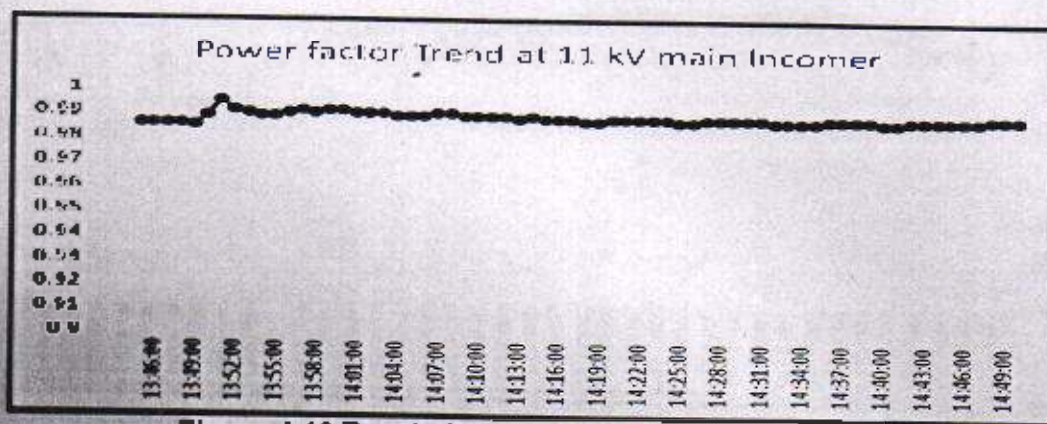


Figure-4.10: Trend of power factor at 11 kV sub station

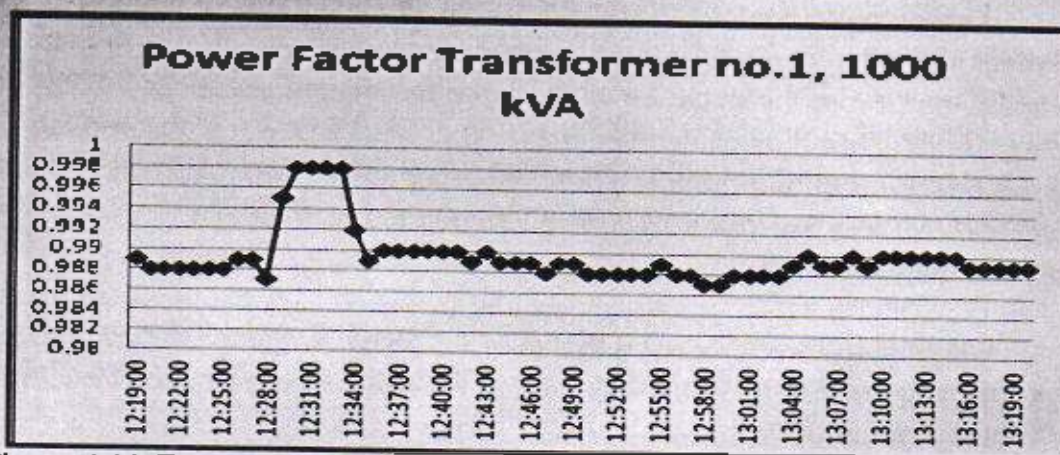


Figure-4.11: Trend of power factor at Transformer 1000 kVA Transformer1 (day time)

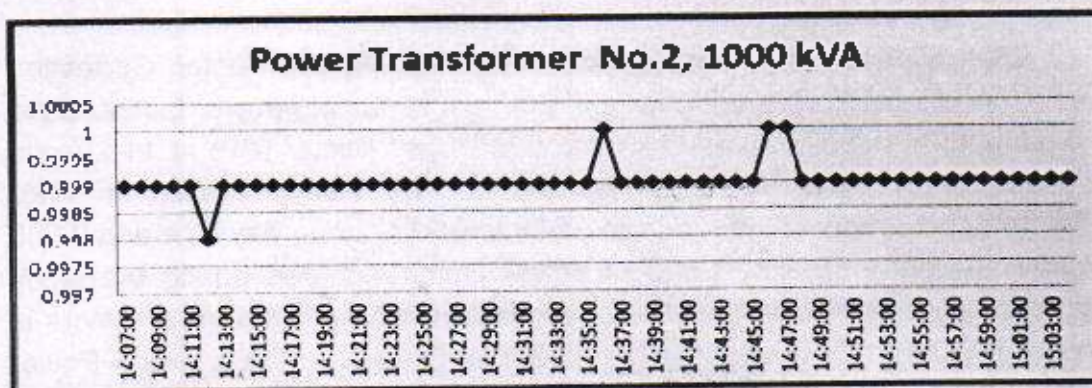


Figure-4.12: Trend of power factor at Transformer 1000 KVA Transformer 2 (day time)

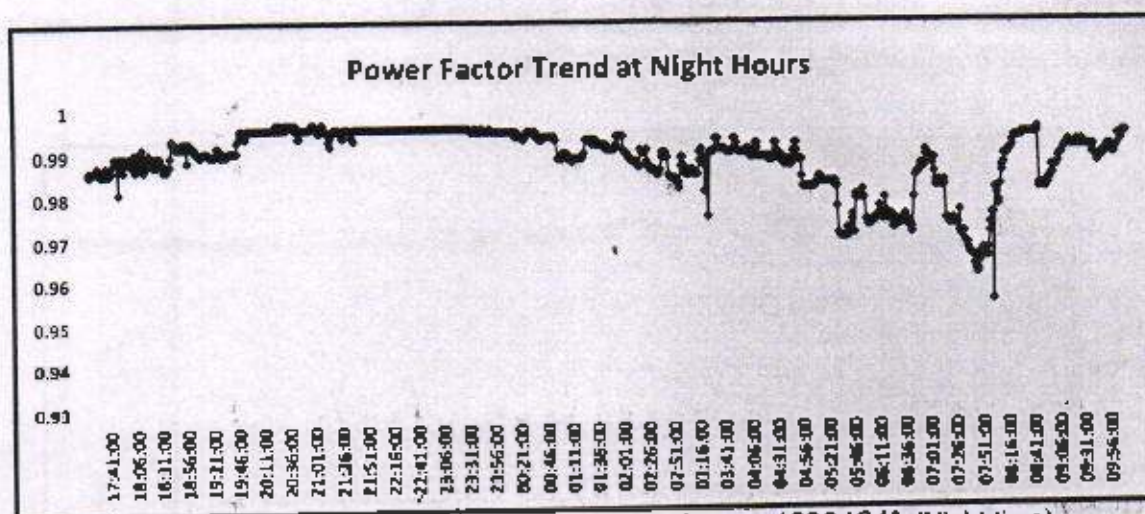


Figure-4.13: Trend of power factor at Transformer 1000 KVA (Night time)

It was noted that, each transformer has APFC panel of 350 kVAR with 6 capacitor banks of 25kVAR and 4 capacitor banks of 50 kVAR on each transformer. From the above, it is clear that the minimum capacity of capacitor bank is 25kVAR. Lot of fluctuations in the hourly power consumption have been observed during the study for which capacitor bank of small steps such as 2kVAR, 5kVAR & 10kVAR are recommended to maintain the power factor to near unity.

It is, therefore, proposed that 2 APFC Panels of small capacitor bank of 25 kVAR of small steps (10 kVAR x 1 nos, 5 kVAR x 3 nos) for both transformers of 1000 kVA be provided.

Capacitor Health Checkup

The output of all the capacitor banks installed in both the transformers at 11 kVA substations was checked with details as below:

Table-4.7: Capacitor Health Checkup 1000 KVA Transformer 1

Rated Parameters			Measured Parameters				
Capacitor No	kVAR @ 440V	kVAR @ 400V	Current	Current			Actual kVAR
				R	Y	B	
C1	25	20.7	29.8	28.2	28.2	29.1	19.6
C2	25	20.7	29.8	27.9	28.6	28.3	19.1
C3	25	20.7	29.8	28.6	28.6	28.9	19.7
C4	25	20.7	29.8	27.2	28.3	28.8	19.4
C5	25	20.7	29.8	28.6	28.6	28.9	19.7
C6	25	20.7	29.8	27.5	27.7	28.5	19.2
C7	50	41.3	59.6	56.5	56	57.1	38.4
C8	50	41.3	59.6	28.8	57	56.7	33
C9	50	41.3	59.6	56.6	56.3	55.1	37.5
C10	50	41.3	59.6	55.8	56.7	56.8	38

Table-4.8: Capacitor Health Checkup 1000 KVA Transformer 2

Rated Parameters			Measured Parameters				
Capacitor No	kVAR @ 440V	kVAR @ 400V	Current	Current			Actual kVAR
				R	Y	B	
C1	25	20.7	29.8	28.4	29.3	30.1	19.4
C2	25	20.7	29.8	28	27.7	28.2	18.88
C3	25	20.7	29.8	29	28.2	28.8	19.4
C4	25	20.7	29.8	28.1	28.6	29.3	19.8
C5	25	20.7	29.8	27.6	28.8	29	19.6
C6	25	20.7	29.8	28.5	28	28.4	19.4
C7	50	41.3	59.6	57.1	58.5	57.2	38.9
C8	50	41.3	59.6	55.4	57.8	57.2	38.5
C9	50	41.3	59.6	55.8	56.7	57.3	38.9
C10	50	41.3	59.6	56.8	57.8	57.6	39.2

The performance of all the capacitors at transformer no. 1 and transformer no. 2 was found to be satisfactory.

Recommendations

- Maintenance of existing APFC relay system
- Installation of small capacitors in the system to maintain the power factor as during the night, load is less and system required small sized capacitance to maintain the PF near unity.
- Therefore, add 10/5 kVAR capacitor banks in the system to maintain the PF near unity in night time also.

- Regularly, check the health of capacitor banks after every 15 days. If the output current of capacitors reduces less than 70%, the capacitor should be replaced with new capacitor.

Benefits

The annual savings potential is **Rs. 0.84 Lacs**. The investment required is **Rs. 0.50 Lacs**, which will be paid back in **7 Months**.

ENERGY SAVING PROPOSAL No. 3**Improve overall power factor to unity**

It is possible to achieve power factor of unity at 0.4 KV sub-station by adding small capacitor banks in all the existing APFC panels. The energy saving potential has been worked out as under:

Table-4.9 : Saving Potential by Improving the Power Factor to Unity

Month & Year (As per bill cycle)	Energy Bill (Rs.)	Actual Power factor	Saving opportunity @ Unity PF
Jan-13	10,31,126	Unity	0
Feb-13	9,66,350	0.99	2,415
Mar-13	5,69,879	Unity	0
Apr-13	5,92,710	Unity	0
May-13	7,06,796	0.96	7,067
June-13	9,85,030	0.96	9,850
July-13	11,78,309	0.95	14,728
Aug-13	10,55,090	0.94	15,826
Sep-14	10,11,740	0.93	17,705
Oct-14	7,88,680	0.94	11,830
Nov-14	6,12,624	0.97	4,594
Dec-14	6,41,960	Unity	0
	1,01,40,294	0.96 (Average)	84,015

The %age saving in energy bill is feasible by improving the power factor to unity is worked out as under:

Table-4.10 : Saving Potential by Improving the Power Factor

Avg. Power Factor	Total Bill amount during the Last 1 Year	Saving Opportunity	
		PF = Unity	% age
0.968	1.01 Crores	0.84 Lacs	0.82 %

Annual Savings = 0.84 Lacs

Investment = Rs 0.50 Lacs

(Investment estimated for 2 APFC Panels of small capacitor bank of 25 kVAR of small steps of (10 kVAR x 1 no, 5 kVAR x 3 Nos) for both 1000 kVA transformers @ Rs. 1000/kVAR; necessary electrical modification, if required, @ Rs. 25000/transformer).

Payback = 7 Months

CHAPTER 5.0

HEATING, VENTILATION & AIRCONDITIONING SYSTEM

5.1 Chiller System

Heating, Ventilation Air Conditioning (HVAC) system is provided in Punjab Technical University Complex, Jalandhar mainly for Offices, Examination Room, meeting room and library for human comfort application. A detailed energy audit for the HVAC system of PTU was conducted. This plant consists of 4 air-cooled screw chillers with specifications given in the table-5.1 below:

Table-5.1: Details of Chilling Unit

System Details	Unit	Air cooled screw
Manufacturer	Climaventta, Italy	
Model No.	FOCS-3602/B-S	
Rated capacity at full load	TR	200
Installed capacity	TR	3 x 200 & 1x 50
Refrigerants		R134A
Drive motor name plate rating	kW	289.9
Voltage	V	400
Frequency	Hz	50

5.1.1 Vapour Compression Refrigeration system

The vapor compression refrigeration cycle for the chiller is given in the figure-5.1.

As shown, heat flows naturally from a hot to a colder body. In refrigeration system, the opposite must occur i.e. heat flow from a cold to a hotter body. This is achieved by using refrigerant, which absorbs heat and hence boils or evaporates at a low pressure to form a gas. The gas is then compressed to a higher pressure, such that it transfers the heat it has gained to ambient air or water and turns back (condenses) into a liquid. In this way heat is absorbed, or removed, from a low temperature source and transferred to a higher temperature source.

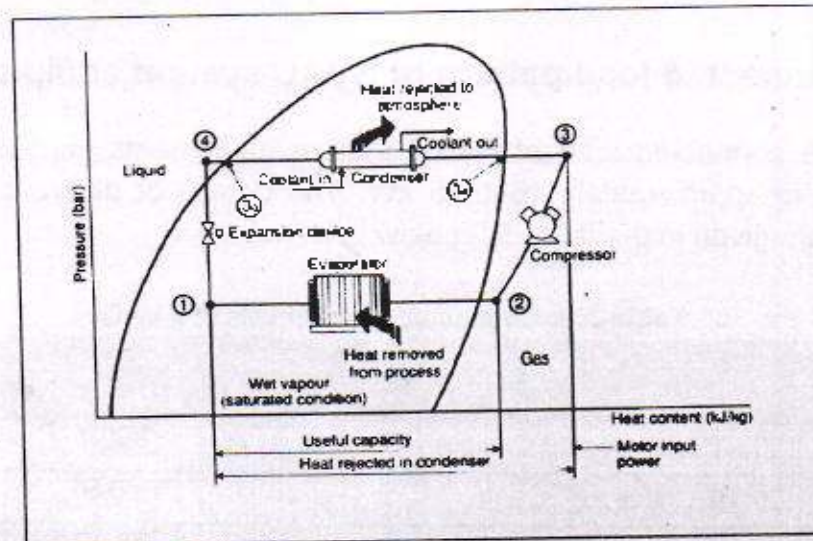


Figure-5.1: Schematic of a Basic Vapor Compression Refrigeration System

The refrigeration cycle can be broken down into the following stages (refer fig.-5.1)

- 1-2: Low pressure liquid refrigerant in the evaporator absorbs heat from its surroundings, usually air, water or some other process liquid. During this process it changes its state from a liquid to a gas, and at the evaporator exit is slightly superheated.
- 2-3: The superheated vapour enters the compressor where its pressure is raised. There will also be a big increase in temperature, because a proportion of the energy input into the compression process is transferred to the refrigerant.
- 3-4: The high pressure superheated gas passes from the compressor into the condenser. The initial part of the cooling process (3 - 3a) de-superheats the gas before it is then turned back into liquid (3a - 3b). The cooling for this process is usually achieved by using air or water. A further reduction in temperature happens in the pipe work and liquid receiver (3b - 4), so that the refrigerant liquid is sub-cooled as it enters the expansion device.
- 4-1: The high-pressure sub-cooled liquid passes through the expansion device, which both reduces its pressure and controls the flow into the evaporator.

It can be seen that the condenser has to be capable of rejecting the combined heat inputs of the evaporator and the compressor, i.e. $(1 - 2) + (2 - 3)$ has to be the same as $(3 - 4)$. There is no heat loss or gain through the expansion device.

5.2 Connected load pattern of HVAC system equipment

The connected load of HVAC system equipments (including hot water generator) is approximately 1640.55 kW. The details of different equipments installed are given in the table-5.2 below:

Table-5.2: Connected Load Details of HVACs

S. No	Description	Qty	Connected Load (kW)	Load (% age)
1	200 TR Air Cooled Chillers	3	869.7	53.02
2	50 TR Chiller	1	85.9	5.24
3	Fan Condenser for 200 TR Plant	12	52.20	3.18
4	Fan Condenser for 60 TR Plant	6	7.2	0.44
5	Secondary Pumps	3	45	2.74
6	Primary Pumps	4	22	1.34
7	Air Handling Units	41	143.45	8.74
8	CDS Pumps	2	11	0.67
9	Hot Water Generator	1	400	24.38
10	Load of Service lamps in AHU rooms	41	4.1	0.25
	Total		1640.55	

The chiller unit and hot water generator operates during the summer and winter months respectively. Therefore, connected load of the HVACs during the summer is 1240.6 kW whereas in winters the connected load of heating system is 592 kW.

3 no. of capacity 200 TR each & 1 no. chiller of 50TR capacity have been installed to meet the cooling load of the facility. The HVAC plant is operated from May to September of every summer season. One chiller plant is operated from may to mid of June & two chiller plants are operated from mid june to end of September. Again only one plant is operated in the month of October. At the time of study also, two chillers were in operation which were connected to a centralized network as illustrated in figure-5.2 below.

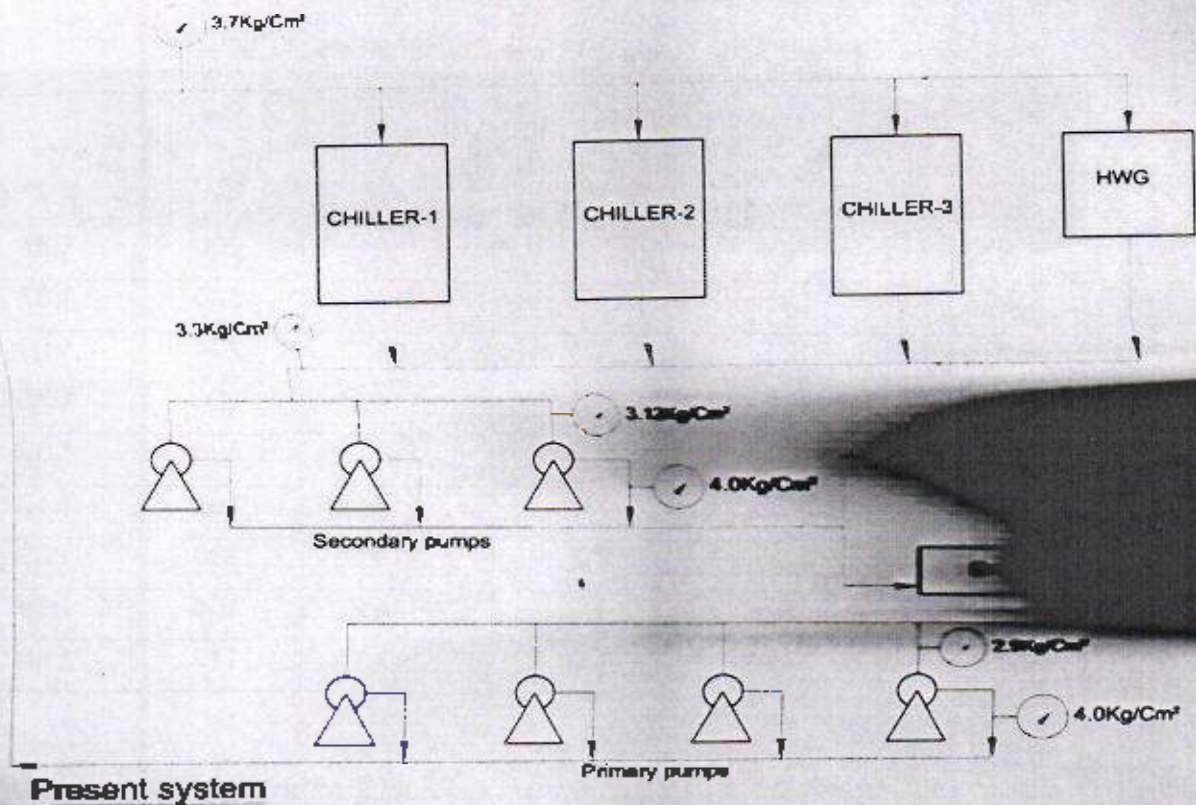


Figure-5.2: Centralized Chiller system for facility

5.2.1 Observations

During the study, chiller 1 & chiller 2 were in operation. The operating parameters of both the 200TR air-cooled screw chiller were monitored at **normal load condition**. The chilled water temperature in supply line (input) and return line (output) were monitored and also noted from the control panel of chiller. Similarly operating electrical parameters of compressors mainly **voltage, current, power factor** and kW were measured by using portable power analyser. Chilled water flow rate was monitored by using ultrasonic flow meter. The electrical parameters measured are given in table-5.3 below:

Table-5.3: Electrical Parameters Measurement

	Voltage (V)	Current (Amps)	PF (%)	Power (kW)
Chiller No.1	386	470	0.87	273
Chiller No.2	386	330	0.86	183

The average specific power consumption (kW/TR) of chiller1 & chiller 2 was calculated in table-5.3(a) & 5.3 (b) given below:

Table-5.3 (a): Specific Power Consumption of Chiller-1

Power Consumption (kW)	Inlet Chilled Water Temperature (°C)	Outlet Chilled Water Temperature (°C)	Chilled Water Flow (m ³ /hr)	TR Generated	SEC (kW/TR)
273	12.4	7.1	114	200	1.37
273	12.5	7.2	114	200	1.37
275	12.8	7.4	114	204	1.35
276	12.7	7.3	114	204	1.36
273	12.2	7.0	114	196	1.39
270	12.9	7.8	114	192	1.40
278	12.6	7.3	114	200	1.39
273	12.6	7.4	114	196	1.39
174	11.4	6.9	80	119	1.46

Table-5.3 (b): Specific Power Consumption of Chiller-2

Power Consumption (kW)	Inlet Chilled Water Temperature (°C)	Outlet Chilled Water Temperature (°C)	Chilled Water Flow (m ³ /Hr)	TR Generated	SEC (kW/TR)
183	12.2	8.8	123	138	1.32
190	12.5	9	123	142	1.33
195	12.2	8.6	123	146	1.33
173	12	8.9	123	126	1.37
170	11.9	9	123	118	1.44
180	12.9	9.4	123	142	1.26

The SEC of chiller-1 & chiller-2 was observed in the range of 1.35 to 1.45 kW/TR and 1.26 to 1.44 kW/TR. Designed parameters were not available for the comparison. Whereas, the specific energy consumption (SEC) of water cooled screw chillers of same capacity is reported to be less than 0.7 kW/TR.

5.3 Air Handling Unit (AHU) System

Air handling units are installed to maintain a clean environment with controlled temperature and relative humidity in the process areas. 41 AHUs have been installed to maintain a room condition of $22 \pm 2^{\circ}\text{C}$ and $55\% \pm 5\%$

relative humidity for G+3 & G+7 buildings. During the energy audit, 6 nos. of AHUs were covered to evaluate the performance.

Table-5.4: Details of AHUs installed in the complex

Sr. No	AHU No.	Area Name	Capacity (CFM)	Motor Input. (kW)
1	AHU-1	Ground Floor(G+7)	6,000	2.2
2	AHU-2	Ground Floor(G+7)	5,000	2.2
3	AHU-3	First Floor(G+7)	5,000	2.2
4	AHU-4	First Floor(G+7)	8,000	3.7
5	AHU-5	First Floor(G+7)	8,000	3.7
6	AHU-6	First Floor(G+7)	8,000	3.7
7	AHU-7	Second Floor(G+7)	7,000	3.7
8	AHU-8	Second Floor(G+7)	7,000	3.7
9	AHU-9	Second Floor(G+7)	7,000	3.7
10	AHU-10	Second Floor(G+7)	8,000	3.7
11	AHU-11	Third Floor(G+7)	8,000	3.7
12	AHU-12	Third Floor(G+7)	7,000	3.7
13	AHU-13	Third Floor(G+7)	7,000	3.7
14	AHU-14	Third Floor(G+7)	8,000	3.7
15	AHU-15	Fourth Floor(G+7)	8,000	3.7
16	AHU-16	Fourth Floor(G+7)	7,000	3.7
17	AHU-17	Fourth Floor(G+7)	7,000	3.7
18	AHU-18	Fourth Floor(G+7)	8,000	3.7
19	AHU-19	Fifth Floor(G+7)	10,000	5.5
20	AHU-20	Fifth Floor(G+7)	8,000	3.7
21	AHU-21	Fifth Floor(G+7)	7,000	3.7
22	AHU-22	Fifth Floor(G+7)	6,000	2.2
23	AHU-23	Sixth Floor(G+7)	8,000	5.5
24	AHU-24	Sixth Floor(G+7)	7,000	3.7
25	AHU-25	Sixth Floor(G+7)	7,000	3.7
26	AHU-26	Sixth Floor(G+7)	6,000	2.2
27	AHU-27	Seventh Floor(G+7)	10,000	2.2
28	AHU-28	Seventh Floor(G+7)	7,000	3.7
29	AHU-29	Seventh Floor(G+7)	4,000	5.5
30	AHU-30	Ground Floor(G+3)	2,000	2.2
31	AHU-31	Ground Floor(G+3)	1,600	1.1
32	AHU-32	Ground Floor(G+3)	5,000	0.75

33	AHU-33	First Floor(G+3)	5,000	2.2
34	AHU-34	First Floor(G+3)	8,000	3.7
35	AHU-35	First Floor(G+3)	10,000	5.5
36	AHU-36	Second Floor(G+3)	8,000	2.2
37	AHU-37	Second Floor(G+3)	5,000	3.7
38	AHU-38	Second Floor(G+3)	10,000	5.5
39	AHU-39	Third Floor(G+3)	5,000	3.7
40	AHU-40	Third Floor(G+3)	8,000	2.2
41	AHU-41	Third Floor(G+3)	10,000	5.5

The air handling systems are located on respective floor or zone in order to facilitate maintenance without disturbance to the process area. A fresh air window is provided in each of the AHU room for mixing it with return air. The AHUs are installed to cater the human comfort-cooling requirement in complex.

The temperature & relative humidity of both delivery air & return air from AHU were measured using hygrometer. The average air velocity across the coil was also checked using anemometer. The measured parameters are given in the table-5.5 below:

Table-5.5: Measured Values of AHU

S.No	Description	Units	AHU 28	AHU 19	AHU 14	AHU 41
1	Filter area	m ²	0.475	0.645	0.57	0.684
2	Supply air dry bulb temperature	°C	20.6	22.8	19.3	18
3	Supply air Relative humidity	%	52	48	48	48
4	Return air dry bulb temperature	°C	27.8	25.8	25.5	26.2
5	Return air Relative humidity	%	61.4	58	58	55.6
6	Air velocity	m/s	4.2	6.5	3.6	8.25

The overall kW/TR of HVAC System was calculated as 1.46

$$\begin{aligned}
 \text{Overall kW/TR (chiller1 + chiller2)} &= (\text{Total kW})/\text{Total tonnage} \\
 &= [(\text{kW chiller1} + (\text{kW chiller2} + (\text{kW Primary Pumps} \\
 &\quad + (\text{kW Secondary Pumps})/\text{Total Tonnage generated} \\
 &= (273+176+8.4+12.36)/316 \\
 &= 1.50 \text{ kW/TR}
 \end{aligned}$$

5.4 Recommendations

- It is proposed to replace one existing air cooled screw chiller 1 with water cooled screw chillers which can be operated from May to October.
- One existing air cooled screw chiller can be used during the months of June to September in addition to the proposed water cooled plant.

5.5 Benefits

The implementation of above recommendations has a saving potential of Rs. 11.52 Lacs. The investment for one new water cooled screw chiller, condenser pumps & cooling tower would be Rs. 35.0 lacs. However, the salvage value of existing air cooled screw chiller would be Rs. 10.0 lacs and the net investment required would be Rs. 25 lacs only. This gets paid back within **2.1 Years**.

ENERGY SAVING PROPOSAL NO 4

Replace existing Chiller1 with water cooled screw chiller.

During the detailed energy audit two of the 200 TR chillers were studied to evaluate the saving potential by replacing existing chillers with water cooled screw chillers.

The energy consumption pattern of chiller no. 1 at normal running load was recorded and is given in the figure-5.3 below:

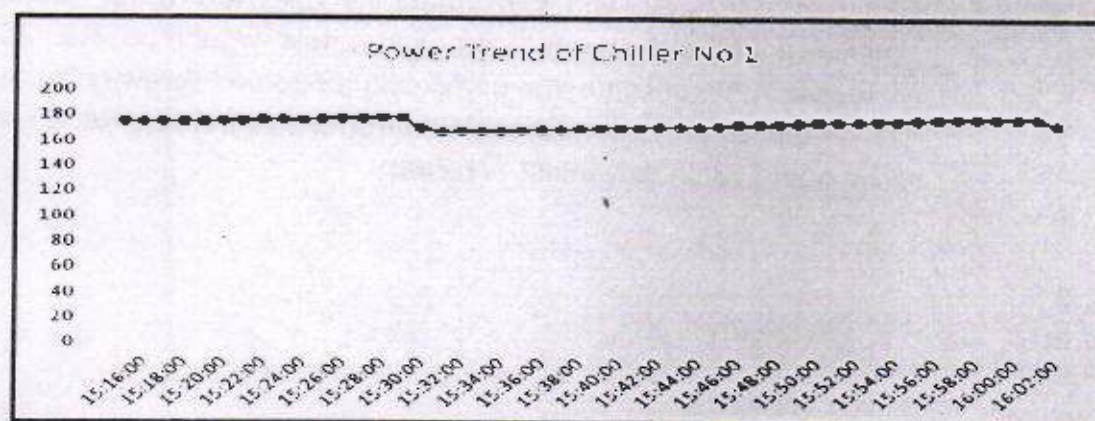


Figure-5.3: Average loading pattern of chiller1

The average power consumption and the TR generated by chiller-1 during the monitoring period was recorded as 273 kW and 200 TR, respectively. Therefore, the average energy consumption worked out to be 1.36 kW/TR. However, the energy consumption of 2 no. chilled primary water pumps was 8.4 kW & power consumption of secondary water pump was 12.36kW respectively. Thus average energy consumption for chiller plant-I works out to be 1.46 kW/TR.

PSCST had recently conducted energy audit of water cooled chillers of capacity 350 TR wherein specific energy consumption of chiller was found to be as low as 0.495 kW /TR. The same can be corroborated with technical literature wherein recommended SEC of similar water cooled chillers at full load is 0.64 kW /TR or less. Further, as per efficiency recommendations Air Conditioning & Refrigeration Institute (ARI) standard 550/590, the recommended full load SEC of air cooled chillers with screw compressor of capacity upto 200 tones is 1.23 kW /TR or less.

The existing air cooled screw chillers are operating at the SEC of 1.46 kW /TR. Replacement of existing system with water cooled screw chiller will reduce the SEC by 0.6 kW/TR.

Recommendation

It is therefore recommended to replace one existing air cooled chiller used from May to September with water cooled screw chillers.

Benefits

Energy Consumption of existing Air Cooled Screw Chiller Plant	=	1.46 kW/TR
Energy Consumption of proposed Water Cooled Screw Chiller Plant	=	0.86 kW/TR
Energy consumption reduction	=	{1.46-0.86} kW/TR = 0.6 kW/TR
Operating hours	=	1250 hrs/year
Annual savings	=	0.6 kW/TR x 200 TR x 1250 hrs/ year x Rs 7.68 /unit = Rs. 11.52 Lacs
Investment (investment estimated for 1 new water cooled Screw chillers 200 TR each, condenser water pumps and cooling towers)	=	Rs. 35.0 Lacs
Salvage value of existing chillers	=	Rs. 10.0 Lacs
Payback	=	2.1 Years

The annual saving potential is Rs. 11.52 Lacs, which requires investment of Rs. 0.25 Lacs. This gets paid back within 2.1 Years.

ENERGY SAVING PROPOSAL NO 5

Modify chilled water circulation system and eliminate use of primary pumps.

The performance of the existing operation of the primary chilled water pumps and secondary chilled water pumps was analysed. Four primary chilled water pumps are installed before the chillers and three secondary pumps are installed after the chillers as illustrated in figure-5.4 below. Out of these, 2 primary pumps and 1 secondary pumps were in operation during the audit. The rated/design and measured values of chilled water pumping system is given in the Table-5.6.

Table-5.6: Parameters for Chilled Water Circulation Pumping Network

S.No	Unit	Rated Values				Measured Values				
		Q (m ³ /hr)	H (m)	kW	Efficiency (%)	Q (m ³ /hr)	H suction (kg/cm ²)	H discharge (kg/cm ²)	kW	Efficiency (%)
1	Primary Pump 1	109.39	12	5.5	65	79.66	2.9	4.0	4.2	57.06
2	Primary Pump 2	109.39	12	5.5	65	79.66	2.9	4.0	4.1	58.45
3	Primary Pump 3	109.39	12	5.5	65	79.66	2.9	4.0	4.1	56.06
4	Secondary Pump	NA	NA	NA	NA	240	3.1	3.7	12.36	26.35

Analysis:

The chilled water circulation pump transfers the chilled water in the circulation circuit of the network. The chilled water from chillers is pumped by the secondary pumps to AHUs for G+7 & G+3. The water is returned by gravity flow at the inlet of primary pumps. Primary pumps are used to pump the water to the condensers of the chillers as illustrated in figure below. As seen from the above table, the measured head at the inlet of primary pumps is already high (more than 2.9 kg/cm²). Therefore, return chilled water of AHUs can be directly sent to the chillers, bypassing the primary chilled water pumps. However, the primary pumps can be used during exigencies by providing pressure switch with transmitter, when available head at the outlet of secondary pumps is less than the required head.

Present System

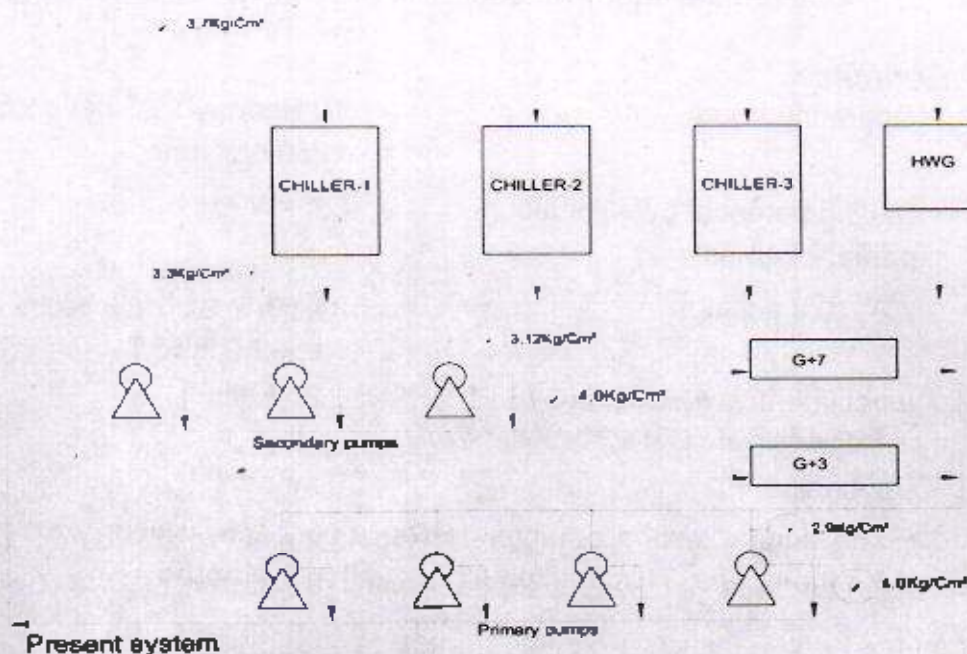


Figure-5.4: Present Chilled Water Circulation System of HVAC Plant

Proposed System

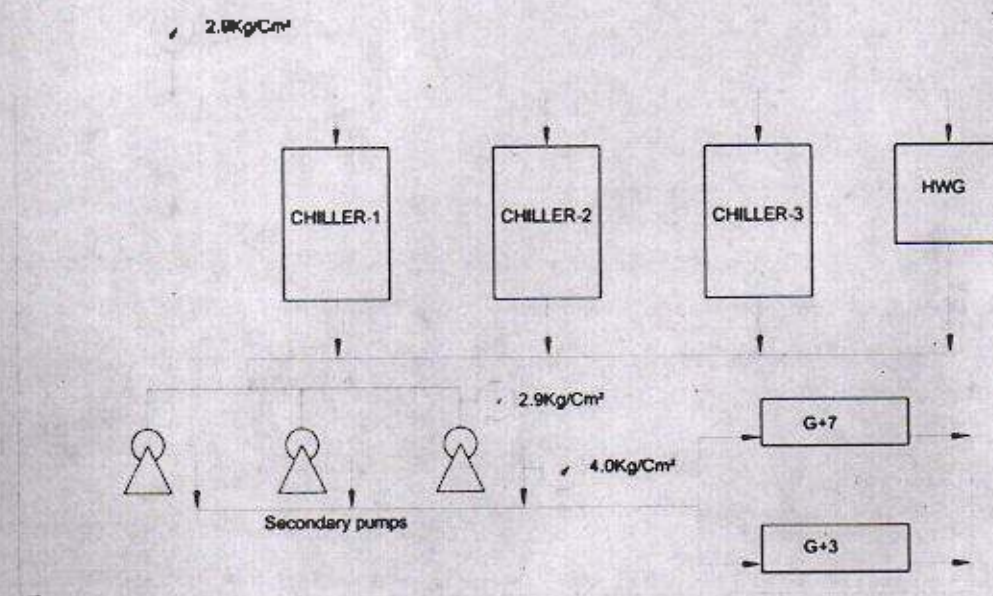


Figure-5.5: Proposed Chilled Water Circulation System of HVAC Plant

Recommendations

- Eliminate the use of primary chilled water pumps.
- Feed the return water of AHUs directly to the inlet of chillers

Benefits

Operating hours = 10 Hrs/day x 25 days x 5 months
= 1250 hrs/year

Saving potential by eliminating
primary pumps = 8.4 kW

Annual savings = 8.4 kW x 1250 hrs/ year x Rs. 7.68/ unit
= **Rs. 0.80 lacs**

Investment (Estimated investment for
modification of existing chilled water line) = 0.50 Lacs

Payback = 8 months

The annual saving potential is **Rs. 0.80 Lacs**, which requires investment of **Rs.0.50 Lacs**. This gets paid back within **8 Months**.

CHAPTER 6.0

DIESEL GENERATOR

Three Diesel Generator sets have been installed to take care backup electrical power in case of power failure. Rating of 2 DG sets is 350 kVA each and 1 DG set is 62.5 kVA. Performance analysis was carried out on DG sets of 350 kVA to check the specific power generation of DGs.

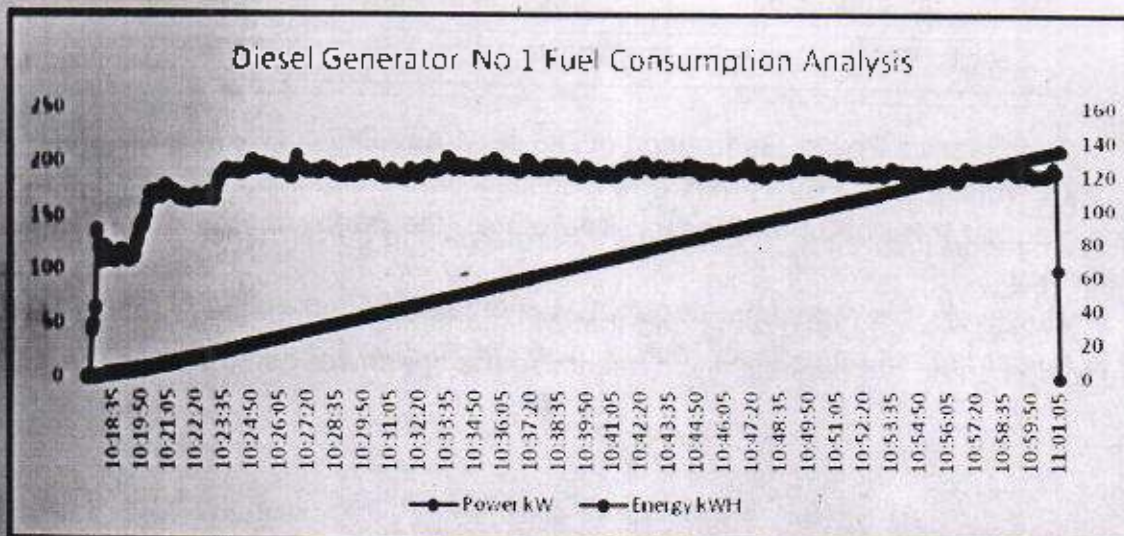


Figure-6.1: Performance curve of DG set-1

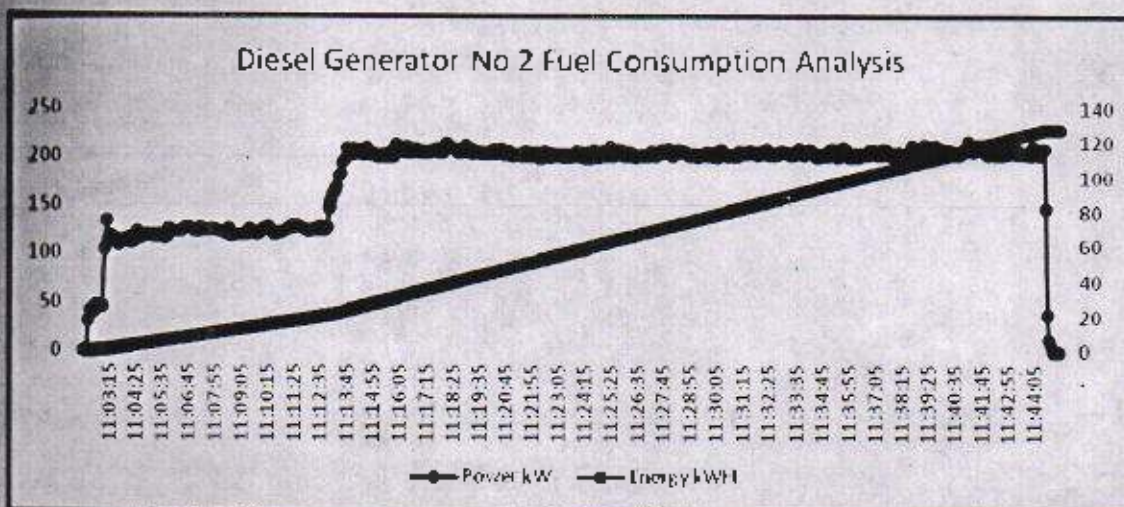


Figure-6.2: Performance curve of DG set-2

In the figures above, blue (upper) line is showing average loading in kW on the DG and red (below) line is showing units generated in kWh by DG set. The Specific Power Generation was worked out as given in the table-6.1 below. The average loading of DG set 1 was 190-200 KVA & the loading of DG set 2 was 200-210 KVA. The average loading of the DG sets was found to be in the range 55-60%.

Table-6.1: Calculation of Specific Power Generation of DG set

Description	Units	DG-1	DG-2
Energy Meter			
Start Reading	kWh	33317	58319
Stop Reading	kWh	33459	58456
Total Units Generated	kWh	142	137
Total Fuel Consumed	Litres	40.3	37.5
Specific Power Generation	kWh/Liter	3.52	3.65

The Specific Power Generation of DG set-1 and DG set-2 was observed as 3.52 kWh/litre and 3.65 kWh/litre respectively, which is above the minimum recommended level of 3.50 kWh/litre. Therefore, the performance of DG sets is satisfactory.

However, it is recommended that Maintenance/ overhauling of DG sets are to be carried out periodically to maximize the sp. power generation.

Chapter 7.0

LIGHTING

The Lighting system and illumination in different areas of Complex was studied in detail. The total connected lighting load of the complex was 178.65 kW with its distribution as under:

- Indoor light load - 160 kW
- Outdoor light load - 18.65 kW

The Indoor lights installed in the complex are 18 Watt & 36 Watt tubes and 18 Watt CFL. The various type of light fixtures installed in the indoor and outdoor lights are given in Table-7.1 below:

Table-7.1: Details of Indoor & Outdoor Light Fixtures

S No.	Type of Fixture	Quantity
A	Indoor Lights	
1.	4x18 E. Tube set (PH)	238
2.	1x36 E. Tube set (PH)	699
3.	2x36 E. Tube set (PH)	652
4.	2x36 box type. Tube set (PH)	28
5.	1x36 box Tube set (PH)	334
6.	2x18 CFL	1007
7.	1x18 CFL	111
8.	70 W Halide lamp	16
B.	Outdoor Lights	
1.	HPSV lamps at 6 meter pole	56
2.	CFL lamps at 4 meter pole	7
3.	Mercury vapour lamps at hump pipes	3
4.	HPSV lamps at 3 meter pole	63
5.	CFL lamps at 1 meter environment lighting	36
6.	HPSV face light	12

As detailed above, the indoor lighting is mostly based on fluorescent tube lights/CFLs. Whereas, sodium vapour lamps/ CFLs have been used for outdoor lighting. As per Bureau of Energy Efficiency (BEE) recommendations, LED tube light fittings provide more lumens and are energy efficient. The LED

fixtures can be replaced within the existing fittings directly. Further, the use of LEDs will also improve power factor in the supply grid.

During the audit, the operation of lights during the day and night time was studied for identifying feasibility of energy conservation in lighting system. The lux levels of lighting in indoor and outdoor area, both during day time and night time were also monitored using lux meter. The average lux levels in various areas are given in table-7.2. It was also observed that the occupancy level is negligible in washrooms and lights are kept ON.

Table-7.2: Measured Lux Levels at Various Locations in the Complex

Area	Lux Level	Fixtures
Banquet Hall	300	FTLs(4x18 W) : 58 nos. , FTLs (2x36 W) : 10 nos.
Washroom	50	FTLs (2x36 W) : 60 nos.
VIP Canteen	120	FTLs (4x18W) : 28 nos. FTLs (28 W) : 2 nos.
Canteen	100	FTLs (1x36W) : 20 nos.
7 th Floor, Distance Education Store	120	FTLs (2x36W,1x36) : 78 nos.
6 th Floor	Not in operation	FTLs (2x36W,1x36) : 78 nos.
5 th Floor	150	FTLs (2x36 W) : 25 nos
4 th Floor	120	FTLs (2x36W,1x36) : 78 nos.
3 rd Floor	120	FTLs (2x36W,1x36) : 78 nos.
2 nd Floor	120	FTLs (2x36W,1x36) : 78 nos.
1 st Floor	120	FTLs (2x36W,1x36) : 78 nos.
Ground Floor	120	FTLs (2x36W,1x36) : 78 nos.
VC Office	120	FTLs (2x36W,1x36) : 78 nos.

7.1 Observations

- Around 3400 nos. of 36 watts (T8) & 18 watts Fluorescent Tube Light (FTL) fixtures with electronic chokes are being used for illumination at different areas. Out of these, 2400 are T8 fixtures and 1000 are 18 watts FTL fixtures. Majority of light fixtures are installed in storage rooms/non occupied area which are in use for short duration. Out of the total lights, approximately 35% of the T8 FTL fixtures and 50% of the 18 W FTLs fixtures are commonly used during the day time which can be replaced with the 18W LED fixtures and 9W LED fixtures respectively. The power consumption of remaining fixtures in the stores/un occupied areas can be further reduced by controlling additional light operation/optimising its operation by installing the sensors.

- 56 nos. of 150 watts High Pressure Sodium Vapour (HPSV) and 63 nos of 70 watts fixtures are being used for street light illumination at different areas. These fixtures are reported to be with Copper Chokes. The 150W HPSV fixtures can be replaced with the 60W LED lamps and 70W HPSV fixtures can be replaced with the 30W LED lamps.

7.2 Recommendations

- **Proposal No. 6:** Replace 800 nos. of 36W FTL's & 500 nos. of 18W FTL's with 18W LED tube light fittings & 9W LED tube lights, respectively, which remain operational most of the time in indoor lighting, in a phased manner under the fault replacement policy.
- **Proposal No. 7:** Replace 56 nos. of 150W High Pressure Sodium Vapour (HPSV) fixtures & 63 nos. 70W fixtures with 60W & 30W LED fittings respectively in outdoor lighting.
- **Proposal No. 8:** Installation of occupancy sensor in washrooms and stores.

7.3 Benefits

The implementation of above recommendations has a saving potential of **Rs. 7.26 Lacs** with an investment of **Rs. 23.55 Lacs**. The recommendations wise details are as under:

Recommendation	Saving Potential	Investment	Payback Period
Recommendation 6	Rs. 5.32 Lacs	Rs. 12.55 Lacs	28 months
Recommendation 7	Rs. 3.68 Lacs	Rs. 10.0 Lacs	33 months
Recommendation 8	Rs. 1.0 lac	Rs. 1.0 lac	12 months

Energy Saving Proposal no. 6

Replace 800 nos 36 watts with 18 watts LED fluorescent tube lights and 500 nos. of 18 watts fixtures with 9 watts LED tube lights

Approximately 800 nos. of 36W & 500 nos. of 18W Fluorescent Tube Light fixtures are commonly used for illumination of different indoor areas. These fixtures are with electronic chokes. These fittings can be replaced with 18 watts & 9 watts LED Tube light fittings directly.

The advantages of LED tube light fittings are:

- It gives equivalent/more lumens output while consuming less power.
- It has better colour rendering index and gives more bright light
- It Improves Power factor (approx. 0.95 lag.) across the supply grid.

Recommendation

There is a potential of savings by replacing existing fittings with new energy efficient LED fittings. Moreover, the LED based fittings have average life of more than 50,000 hrs.

Benefits

Replacement of 800 nos 36 watts fluorescent tube lights with 18 watts LED

Power Consumption Data of 1 fixture

Existing Fixture	=	40 W
Proposed (LED based)	=	18 W
Power saving per fitting	=	40-18 W = 22 W
Total No. of fittings	=	800 nos.
Total Savings Potential	=	22W x 800 nos. = 17.6 kW
Annual savings	=	17.6 kWx3000hrs.x Rs7.68/Unit = Rs 4.05 Lacs
Investment (Investment estimated for 800 new LED fixtures and necessary electrical modification if required in the system @ Rs. 1100 /fixture)	=	Rs 8.8 Lacs
Payback	=	2.17 years

Replace 500 nos 18 watts fluorescent tube lights with 9 watts LED

Benefits

Power Consumption Data of 1 fixture

Existing Fixture	=	20 W
Proposed Fixture (LED)	=	9 W
Power saving per fitting	=	20-9 W
	=	11 W
Total No. of fittings	=	500 nos.
Total Savings Potential	=	11W x 500 nos.
	=	5.5 kW
Annual savings	=	5.5 kWx 3000hrs.x Rs 7.68/Unit
	=	Rs 1.27 Lacs
Investment (Investment estimated for 500 new 9 watts LED fixtures and necessary electrical modification if required in the system @ Rs. 750 /fixture)	=	Rs 3.75 Lacs
Payback period	=	2.95 years

The annual savings potential is Rs 1.27 Lacs. The investment required is Rs. 3.75 Lacs, which will be paid back in 2.95 Years.

ENERGY SAVING PROPOSAL NO 7

Replace 150W HPSV street lights with 60 watts LED & 70W HPSV with 30W LED street lights.

56 nos. of 150 watts High Pressure Sodium Vapour (HPSV) fixtures & 63 nos. of 70 watts fixtures are being used for street light illumination at different areas. These fixtures are with traditional Copper Chokes. We can replace 150W HPSV fixtures with 60W LED lamps & 70W HPSV fixtures with 30W LED lamps.

LED fixtures have the following advantages –

- Gives equivalent/more lumens output while consuming very less power.
- Better Colour rendering index.
- Gives more bright light
- Improved Power factor (approx. 0.95 lag.)
- Life of the LED lamps is 50,000 hours (10 years) whereas, the life of HPSV lamp is 15,000 hours (4 years).

Benefits

Replacement 56 nos 150 watts High Pressure Sodium Vapor fixtures with 30 watts LED

Power Consumption Data of 1 fixture

Existing Fixture	=	165 W
Proposed (LED based)	=	60 W
Power saving per fitting	=	165-60 W
	=	105 W
Total No. Of fittings	=	56 nos.
Total Savings Possible	=	105 W x 56 nos.
	=	5.9 kW
Annual savings	=	5.9 kW x 3650 hrs. X Rs 7.68 /Unit
	=	Rs 1.65 Lacs
Saving on account of reduction in the repair/ maintenance/replacement @ Rs. 1000/- per HPSV lamp per annum	=	Rs. 0.56 lacs
Total Annual Saving	=	Rs. 2.21 lacs
Investment	=	Rs 5.6 Lacs
<i>(Investment estimated for 56 new LED street lights and necessary electrical modification if required in the system at the rate of Rs. 10,000 / street light)</i>		
Payback	=	2.5 years

Replace 63 nos 70 watts lighting fixtures with 30 watts LED**Power Consumption Data of 1 fixture**

Existing Fixture	=	77 W
Proposed (LED based)	=	30 W
Power saving per fitting	=	77-30 W
	=	47 W
Total No. Of fittings	=	63 nos.
Total Savings Possible	=	47 W x 63 nos.
	=	3.0 kW
Annual savings	=	3.0 kW x 3650 hrs. X Rs 7.68/Unit
	=	Rs 0.84 Lacs
Saving on account of reduction in the repair/ maintenance/replacement @ Rs. 1000/- per HPSV lamp per annum	=	Rs. 0.63 lacs
Total Annual Saving	=	Rs. 1.47 lacs
Investment	=	Rs 4.41 Lacs
<i>(Investment estimated for 63 new LED street lights and necessary electrical modification if required in the system at the rate of Rs. 7,000 / street light)</i>		
Payback period	=	3.0 years

ENERGY SAVING PROPOSAL NO 8

Optimize power consumption of lighting by automation

During audit, it was observed that the occupancy in washrooms is very low. Therefore the lights remain ON continuously. Each Washroom has 3 nos. of 2x36 watt lighting fixtures. The total connected load of washrooms is about 12 kW.

Recommendation

It is recommended to optimize power consumption of washroom lighting system by identifying and removal of unwanted/extra lights and by installing occupancy sensors. It is estimated that there would be around 30% reduction in the energy in the washrooms by installation of occupancy sensors.

Benefits

Annual Savings = $12 \text{ kW} \times 30\% \times 12 \text{ hrs.} \times 300 \text{ days/annum} \times \text{Rs.7.68/Unit}$
= **Rs.1.0 Lacs**

Investment = **Rs. 1.0 Lacs**
(For Occupancy Sensors)

Simple Payback = **1 year**

The total annual saving potential is **Rs. 1.0 lacs**. The investment required is **Rs. 1.0 Lacs**, which will be paid back in **1.0 year**.

Chapter 8.0

OTHER OBSERVATIONS

Optimize power consumption of lighting by switching off indoor lights in night.

As per the data provided by Punjab Technical University in the questionnaire, the indoor lights are kept ON from 8:30 AM to 5:30 PM during day time & outdoor lights are kept ON from 7:00 PM to 5:30 AM. The total connected load of the outdoor lighting is 18 kW. However, during the energy audit, it was observed that in most of the areas, the indoor lights during night time were also kept ON & the total working load during the night (i.e. 7:00 PM to 5:00 AM) was in the range of 34-44 kW and the load from 5:00 AM to 8:00 AM reduced to 17-22 kW due to switching off the outdoor lights.

As per the total connected load of outdoor lighting, the total working load during night should not exceed 20 kW/hr. The unwanted indoor lights can be switched off during the night/non working hours which will result in saving of at least 5 kW/hr.

Recommendations

Switch off the indoor lights during night/non-working period.

Benefits

Total working load measured during night
(7:00 PM to 5:00 AM) = 34-44 kW

Total connected/working load of outdoor
lights = 18 kW

Power Consumption of indoor lighting during
night time = 10-15 kW

Saving Potential by Switching off the indoor
lights = 5 kW

Annual Savings = 5 kW/hr x 3000 hrs.x Rs.
= 7.68/unit
= Rs. 1.15 lacs

Investment = Nil

Payback = Nil

CHAPTER 9.0

MANAGEMENT ASPECTS & CONCLUSIONS

9.1 *Objectives of Punjab Technical University, Kapurthala should be*

- To have a firm top management commitment so that the complex achieves energy conservation on a time bound basis.
- To make Energy conservation a permanent activity
- To achieve lowest auxiliary energy consumption.
- To achieve the status of best energy efficient complex in India.
- To implement the recommended proposals and reap the benefits.

9.2 *Approaches to an Energy Conservation Idea*

- Each energy conservation idea should be seen as an opportunity for improvement. The approach must be on how to implement each proposal and overcome the problems, if any.
- It is easier to say a proposal is not possible or not implementable, but the benefit comes from the actual implementation, which needs lot of courage, conviction and will power to implement.

9.3 *Specific Recommendation*

- Punjab Technical University should form an energy conservation committee. The committee should consist of senior operating and maintenance personnel.
- The committee should meet once in a month with a specific agenda to review the progress of implementation of proposals and to guide the implementation team.
- The management should also select a senior person, as Energy Manager and he should co-ordinate all implementation activities.
- The main responsibility of implementing the proposals and achievement of savings should be with the concerned operating and maintenance personnel and not with the Energy Manager.
- The immediate task of Team should be to implement the identified proposals and get the savings.
- It is recommended to introduce a suggestion scheme for energy conservation. The energy conservation committee should review all suggestions and good proposals should be implemented.

9.4 Assign specific responsibility

- While, the overall responsibility for energy conservation rests with the top management, the concerned operating / maintenance personnel should implement and periodically report progress on energy saving proposals.
- Therefore, each energy saving proposal should be assigned to a specific operating / maintenance personnel for implementation and monitoring.
- Specific time bound action plan is required for implementation and monitoring of energy saving proposals.

9.5 Monitoring of proposals

- All the implemented proposals are to be monitored on a proposal-by-proposal basis for actual achievement of savings on a monthly basis.

9.6 Motivational aspects

- The successful management of energy depends on motivation of technical personnel and their commitment. It is recommended that operating / Maintenance staff be deputed for training programs in specific areas like
 - Pumps
 - HVAC
 - Cooling towers
 - DG sets
 - Motors
 - Electrical distribution
 - Lighting

9.7 Conclusions

The detailed energy audits conducted jointly by the plant and energy teams have identified an annual energy saving potential of **Rs. 31.76 Lacs**, based on the present energy cost.

The summary of annual savings identified

Total annual saving (8 Proposals)	= Rs.31.76 Lacs
Annual Savings without investment (2 Proposals)	= Rs. 8.60 Lacs
Investment required (6 proposals)	= Rs.49.55 Lacs
Average payback period for capital proposals	= 19 Months

It is proposed that the management should

- Assign specific responsibility for implementation of proposals.
- Monitor savings achieved on a proposal by proposal basis.
- Punjab Technical University team, should have the goal of achieving the best energy efficient complex status in the country.

ANNEXURE – I

PROPOSED FORMAT FOR MONITORING THE IMPLEMENTATION OF ENERGY SAVING PROPOSALS

**FORMAT FOR MONITORING THE IMPLEMENTATION OF
ENERGY SAVING PROPOSALS**

S No	Energy saving proposals	Annual Savings (Rs Lacs)	Investment (Rs Lacs)	Simple Payback (Months)	Dept / Person Responsible	Target Dates	Remarks
1							
2							
3							
4							
5							
	Total						

ANNEXURE - II

LIST OF INSTRUMENTS

List of Instruments used during Energy Audit

1. Three Phase Electrical Power Analyzer
2. Digital Ultra Sonic Water Flow Meter
3. Digital Pressure Gauge
4. Digital Lux meter
5. Digital Distance Meter
6. Digital Multi-meter
7. Digital power clamp meter
8. Power factor meter
9. Digital Hygro Thermo Meter
10. Digital Anemometer

ANNEXURE-III

LIST OF ENERGY EFFICIENT EQUIPMENTS SUPPLIERS

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ADDRESS OF ENERGY SAVING EQUIPMENT SUPPLIERS

SUPPLIER OF TRANSFORMER

<p>1. Crompton Greaves Limited. (Transformer Division) Kanjur Marg (East), Mumbai-400042, India. Tel: +91-022-25782974, 67558000,67558202, 67558211,67558390, FAX: +91-022-67558305. 25798214 <u>Contact Person:</u> Mr. B Ukil Email: cg.power@cgl.co.in</p>	<p>2. EMCO Limited Plot # F-5, Road No. 28, Wagle Industrial Estate, Thane-400 604. (India Tel : (91-22) 40404802 Fax :(91-22) 2582 0571 <u>Contact Person:</u> Mr M.K. Pradhan Mobile:996 757 8113 Email:pradhan@emcoindia.com</p>
<p>3. Bharat Heavy Electricals Ltd. Integrated Office Complex Lodhi Road, New Delhi - 110 003 Tel : (011) 26001010 Fax : (011) 26493021 (011) 26492534</p>	<p>4. ABB Ltd. 14 Mathura Road , Faridabad, 121003 Tel : (0129) 227 5592 Fax : (0129) 227 9692 <u>Contact Person</u> Mr. Sanjib Chaudhuri Email: sanjib.chaudhuri@in.abb.com</p>

SUPPLIER FOR SOFT START-CUM-ENERGY SAVER

<p>1. BHEL BHEL House, Siri Fort, New Delhi- 110049, Tel : 011 26001010 Fax : 011 26493021 <u>Contact Person :</u> Mr. N Ramakrishna Contact No. - 9945530146</p>	<p>2.Danfoss Industry Pvt Ltd VI floor, JMD Pacific Square,Sector - 15,N.H.-8, Hoshiarpur -122001 Tel : 0124 4036677 Fax : 0124 4039321 <u>Contact Person:</u> Mr. Mahendra Chalke Contact No.-09967971799</p>
<p>3. Siemens Ltd. Thane Belapur Road Thane - 400601, Tel : (022)27623502 Fax :(022)27623727 <u>Contact Person</u> Mr. Rajesh Jain Contact No. 9987089336</p>	<p>4. ABB Ltd. 14 Mathura Road , Faridabad, 121003 Tel : (0129) 227 5592 Fax : (0129) 227 9692 <u>Contact Person</u> Mr. BV Ravishankar / Mr. R Narayanan Contact No. (080) 222318231</p>

AUTOMATIC STAR-DELTA-STAR CONVERTOR

<p>1. BHEL BHEL House, Siri Fort, New Delhi- 110049, Tel : +91 11 26001010 Fax : +91 11 26493021 +91 11 26492534</p>	<p>2.Danfoss Industry Pvt Ltd VI floor, JMD Pacific Square,Sector - 15,N.H.-8, Hoshiarpur -122001 Tel : +911244036677 Fax : +911244039321</p>
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<u>Contact Person :</u> Mr. N Ramakrishna Contact No. - 9945530146	<u>Contact Person:</u> Mr. Mahendra Chalke Contact No.-09967971799
3. Siemens Ltd. Thane Belapur Road Thane - 400601, Tel : (022)27623502 Fax : (022)27623727 <u>Contact Person</u> Mr. Rajesh Jain Contact No. 9987089336	4. ABB Ltd. 14 Mathura Road , Faridabad, 121003 Tel : (0129) 227 5592 Fax : (0129) 227 9692 <u>Contact Person</u> Mr. BV Ravishankar Contact No. (080) 222318231
5. Phoenix Contact A - 58/2, Okhla Indl. Area, Phase - II, New Delhi -110 020 Tel (011) 30262 800 Fax (011) 26383 285 Email:works@phoenixcontact.co.in <u>Contact Person</u> Mr. Ashish Manchanda Contact No. - 9350043430	6. PMI ASSOCIATES 114, GH-3 DDA Flats, Paschim Vihar, New Delhi -110063(India) Tel : 011-25253104 Fax : 011-25280319 <u>Contact Person:</u> Mr. Sandeep Sharma Contact No. 0910037099

SUPPLIER FOR APFC

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3. Siemens Ltd. Thane Belapur Road Thane - 400601, Tel : (022)27623502 Fax : (022)27623727 <u>Contact Person</u> , Mr. Rajesh Jain Contact No. 9987089336	4. CONZERV SYSTEMS PVT LTD 87, 1st Floor Industrial Development Colony (IDC) Mehrauli Road Hoshiarpur - 122 001, Tel:- 0124 4268899 Fax:- 0124 4268957 Email: del.sales@conzerv.com
5. NAAC Energy Controls (P) Ltd C-135 Hosiery Complex, Phase II (Extn.), Noida - 201305 Tel.: 0120-4221631, 32, 33, 34 <u>Contact Person:</u> Mr. Chander M. Kapoor Cell: 09811199085	6. EPCOS India Pvt Limited 11'th Floor, 28 Dr. Gopal Das Towers Barakhamba Road, New Delhi- 110 001 Tel: 011 23704143, 23704144 Fax: 011 23704146

SUPPLIER FOR CAPACITORS BANK

1. BHEL BHEL House, Siri Fort, New Delhi- 110049, Tel : +91 11 26001010 Fax : +91 11 26493021 <u>Contact Person :</u> Mr. N Ramakrishna Contact No. - 9945530146	2. ABB Ltd. Plot Nos 5 & 6 2nd Phase 560058 Bangalore Phone: 08022949328 Fax : 080 22949339 <u>Contact Person:</u> Mr. Uday Sampat
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3. Siemens Ltd. Thane Belapur Road Thane - 400601, Tel : (022)27623502 Fax : (022)27623727 <u>Contact Person</u> Mr. Rajesh Jain Contact No. 9987089336	4. MAGNEWIN MAGNETICS L - 49, M.I.D.C., Kupwad - 416436. Dist. Sangli, Tel.: 0233 - 2645041 / 2645456 Fax : 0233 - 2645856
5. NAAC Energy Controls (P) Ltd C-135 Hosiery Complex, Phase II (Extn.), Noida - 201305 Tel.: 0120-4221631, 32, 33, 34 Fax: (91)-(120)-4221635 <u>Contact Person:</u> Mr. Chander M. Kapoor Cell: 09811199085	6. EPCOS India Pvt Limited 11'th Floor, 28 Dr. Gopal Das Towers Barakhamba Road, New Delhi- 110 001 Tel: 011 23704143, 23704144 Fax: 011 23704146
7. Madhav Capacitors Pvt. Ltd. B-5-2, M.I.D.C. Indl. Estate, Bhosari, Pune - 411 016. Tel: 020 - 27122360/27122762 Fax : 020 - 2712 27 62	8. HOC AGE Engineering Ltd. 165, HSIDC KUNDLI, Indl. Area, Distt. Sonapat - 130128 Tel: 0130 - 6452667
SUPPLIER FOR ENERGY EFFICIENT MOTORS	
1. BHEL BHEL House, Siri Fort, New Delhi- 110049, Tel : +91 11 26001010 Fax : +91 11 26493021 <u>Contact Person :</u> Mr. N Ramakrishna Contact No. - 9945530146	2. Crompton Greaves Limited (LT Motors Division): A/6-2, MIDC Industrial Area, Ahmednagar- 414111 Tel: 0241- 2777500, 2777372 FAX: 0241-2777508, 2776103 <u>Contact Person:</u> Mr. Ramesh Kumar Email:ramesh.kumar@cgl.co.in
3. Siemens Ltd. Thane Belapur Road Thane - 400601, Tel : (022)27623502 Fax : (022)27623727 <u>Contact Person</u> Mr. Rajesh Jain Contact No. 9987089336	4. Kirloskar Brothers Ltd Jeevan Tara Building, 5, Parliament Street, New Delhi 110 001 Tel : +91-011-41501055 to 62 Fax : +91-011-23342002 Email delhi@kbl.co.in
5. Bharat Bijlee Ltd. Milap Niketan, 4th Floor, 8A, Bahadur Shah Zafar Marg, New Delhi, 110 002. Tel: 011-23356033, 23319694 Fax: 011-23319413 Email: bbl Delhi@del.bharatbijlee.com <u>Contact Person:</u> Ms. Pratibha Chopra Cell : 09810096684	6. Navyug Electric Motors & Pumps Ltd. Plot-4, Phase-II, GIDC, Vatva, Ahmedabad - 382 445 Tel : 079 25831432, 25831433 Fax : 079 25831434

SUPPLIER FOR ENERGY EFFICIENT PUMPS

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3. BHARAT BIJLEE LTD. Milap Niketan, 4th Floor, 8A, Bahadur Shah Zafar Marg, New Delhi, 110 002. Tel: 011-23356033, 23319694 Fax: 011-23319413 <u>Contact Person:</u> Ms. Pratibha Chopra Cell : 09810096684 Email: bbl Delhi@del.bharatbijlee.com	4. Kirloskar Brothers Ltd Jeevan Tara Building, 5, Parliament Street, New Delhi 110 001 Tel : +91-011-41501055 to 62 Fax : +91-011-23342002 Email delhi@kbl.co.in <u>Contact Person:</u> Mr. P K Tayal Cell: 09425048723
5. Shakti Pumps (India) Limited, Plot no. 401,402 & 413, Sector 3, Pithampur-454775 Tel: 07292- 410500, 410700 Fax: 07292 407044	6. Grundfos Pumps India Pvt. Ltd. B - 1/ D-5, 1st Floor Mohan Co-operative Indl Estate Mathura Road, New Delhi - 110044 Tel: (011) 4222 6090 Fax: (011) 4222 6020 E-mail: salesindia@grundfos.com

SUPPLIER FOR VARIABLE SPEED/FREQUENCY DRIVES/PROCESS AUTOMATION

1. Amtech Electronic (I) Ltd, E-6, GIDC, Electronics Zone, Gandhinagar - 382028, Tel : (079)-23289101, 23289102, Fax : (079)-23289111 Email: info@amtechelectronics.com <u>Contact Person</u> Mr. S B Mahajani Contact No. - 9913143673	2. Crompton Greaves Ltd (LT Motors Division) A/6-2, MIDC Industrial Area, Ahmednagar- 414111 Tel: (0241)- 2777500, 2777372 FAX: (0241) 2777508, 2776103 <u>Contact Person:</u> Mr. Ramesh Kumar Email: ramesh.kumar@cgl.co.in
3. Rockwell Automation India Ltd A-66, Sector-64, Noida-201301(U.P) India Tel : (0120) 4671477 Fax : (0120) 4217928 <u>Contact Person</u> Mr. Meenu Singhal Contact No. - 9811150530	4. Phoenix Contact A - 58/2, Okhla Indl. Area, Phase - II, New Delhi -110 020, Tel (011) 30262 800 Email: works@phoenixcontact.co.in <u>Contact Person</u> Mr. Ashish Manchanda Contact No. - 9350043430
5. Honeywell Automation India Ltd 86, 1st Floor, Okhla Phase III New Delhi - 110020 Tel.: 011-66116300 Fax: 011-66116327 <u>Contact Person</u> Mr. Prabhat Verma Contact No. - 9818230888	6. ABB Ltd. Plot Nos 5 & 6 2nd Phase Bangalore 560058 Tel: 080- 22949355 Fax: 080-22949389 <u>Contact Person</u> Mr. K Sreevatsa Cell: 099014 90980

SUPPLIER OF ELECTRONIC BALLAST

1. OSRAM India Private Limited Signature Towers, 11th Floor Tower B, South City - 1 122001 Hoshlarpur, Tel.: 0124 238 31 80 Fax: 0124 238 31 82	2. Bajaj Electricals 1/10, Asaf Ali Road New Delhi 110002 Tel +91-11-23236055 Fax +91-11-23230214 E-mail: del_cic@bajajelectricals.com
3. Philips Electronics India Ltd Ashoka Estate, 9th Floor, 24, Barakhamba Road, Connaught Place New Delhi - 110001 Tel: 011-43529800, 23353280 Fax: 011 23314332 <u>Contact Person:</u> Mr. S K. Dangl Email: s.k.dangl@philips.com	4. G.K. Energy Marketers Pvt. Ltd. F. No 601, B No 11 B, Opp Data Mandir, Lokmanya Nagar, LBS Road, Navl Peth, PUNE - 411030 Ph. no - (020) 2432 1115 Fax No - (020) 2432 1115 Contact Person : Mr. Gopal Kabra Cell - 09970450000

SUPPLIER OF CFL & METAL HALIDE LAMPS

1. OSRAM India Private Limited Signature Towers, 11th Floor Tower B, South City - 1 122001 Hoshlarpur, Tel.: 0124 238 31 80 Fax: 0124 238 31 82	2. Bajaj Electricals 1/10, Asaf Ali Road New Delhi 110002 Tel +91-11-23236055 Fax +91-11-23230214 E-mail: del_cic@bajajelectricals.com
3. Philips Electronics India Ltd Ashoka Estate, 9th Floor, 24, Barakhamba Road, Connaught Place New Delhi - 110001 Tel: 011-43529800, 23353280 Fax: 011 23314332 <u>Contact Person:</u> Mr. S K. Dangl Email: s.k.dangl@philips.com	4. Crompton Greaves Limited (Lighting Division) Kanjur Marg (East), Mumbai -400 042. India. Tel: 022-67558000, 67558425/26 FAX: 022- 25787283 <u>Contact Person:</u> Mr. B Chakrabarti Email: biswa.chakrabarti@cgl.co.in

SUPPLIER OF LED & T- 5 LAMPS

1. OSRAM India Private Limited Signature Towers, 11th Floor Tower B, South City - 1 122001 Hoshlarpur, Tel.: 0124 238 31 80 Fax: 0124 238 31 82	2. Bajaj Electricals Ltd 1/10, Asaf Ali Road New Delhi 110002 Tel +91-11-23236055 Fax +91-11-23230214 E-mail: del_cic@bajajelectricals.com
3. Philips Electronics India Ltd Ashoka Estate, 9th Floor, 24, Barakhamba Road, Connaught Place New Delhi - 110001 Tel: 011-43529800, 23353280 Fax: 011 23314332 <u>Contact Person:</u> Mr. S K. Dangl Email: s.k.dangl@philips.com	4. Crompton Greaves Limited (Lighting Division) Kanjur Marg (East), Mumbai -400 042. Tel: 022-67558000, 67558425/26 FAX: 022- 25787283 <u>Contact Person:</u> Mr. B Chakrabarti Email: biswa.chakrabarti@cgl.co.in