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/E-1/649 Dated 07.07.2014

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

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

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

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

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

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

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

The Registrar,
Punjab Technical University,
Jalandhar.

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

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

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

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

Sub : Construction of new campuses of Punjab Technical University – 42nd meeting of the Standing Building Construction Committee.

Dear Sir/Madam,

42nd meeting of the Standing Building Construction Committee shall be held under the Chairmanship of Dr. R. S. Khandpur, Director General, PGSC (Retd) at 1100 hours on 16.07.2014 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,
07/07/14
(H. P. Singh)
Executive Engineer

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

PUNJAB TECHNICAL UNIVERSITY, JALANDHAR

Sub : Agenda for the 42nd meeting of the Standing Building Construction Committee.

Item No. 42.1 : To confirm the Minutes of 41st meeting of Standing Building Construction Committee held on 03.04.2014.

Item No. 42.2 : Action taken on various items discussed during previous meeting of Standing Building Construction Committee.

Item No. 42.3: To discuss and approve the rough cost estimate for construction of proposed auditorium at main campus, Kapurthala.

Item No. 42.4 : 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. 42.5 : 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, Sikhwala, Mukatsar Sahib.

Item No. 42.6 : To discuss and approve the design basis reports submitted by the Architect for Structure, Electrical and Public Health works of Hostels and auditorium proposed to be constructed at main campus, Kapurthala.

Item No. 42.7 : To discuss and approve the finishing schedules (internal and external) for Punjab Institute of Technology buildings at Arniwala, Sikhwala and auditorium & hostels for main campus, Kapurthala.

Item No. 42.8: To discuss and approve the revised estimate for raising, repairing and painting of existing boundary wall of main campus, Kapurthala.

Item No. 42.9 : To discuss and approve the revised estimate for construction of boundary wall of Punjab Institute of Technology, Mansa.

Item No. 42.10 : To discuss and approve the requirement and scheme for construction of buildings for Bank, Post office and shopping centre at main campus, Kapurthala.

Item No. 42.11 : To discuss and approve the requirement and scheme for construction of major roads at main campus, Kapurthala.

Item No. 42.12 : Any other point with the permission of the Chair.

PUNJAB TECHNICAL UNIVERSITY, JALANDHAR

Agenda Note for the 42nd meeting of the Standing Building Construction Committee.

Item No. 42.1 : To confirm the Minutes of 41st meeting of Standing Building Construction Committee held on 03.04.2014.

The minutes of 41st meeting of Standing Building Construction Committee held on 03.04.2014 were circulated on 07.04.2014. The minutes circulated are to be confirmed.

Item No. 42.2 : Action taken on various items discussed during previous meeting of Standing Building Construction Committee.

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

- The concept plans of convention centre (auditorium) has been revised by the Architect based upon the discussions held in the previous meeting and rough cost estimate for the same is to be discussed in the present meeting. Building plans have been submitted to Chief Town Planner, Punjab for approval.

- The detailed designing and estimation for the works to be executed at Punjab Institute of Technology, Sikhwala and Punjab Institute of Technology, Arniwala based upon approved master plan and building plans has been started. Building plans for both the institutes have been submitted to Chief Town Planner, Punjab for approval.

- The detailed designing and estimation for the hostels to be constructed at main campus has been started by the Architect. Building plans have been submitted to Chief Town Planner, Punjab for approval.

- The detailed estimate for proposed Director's office at Punjab Institute of Technology, Kapurthala has been prepared and sent to PWD for vetting.

- Punjab State Council for Science and Technology has completed 'Energy Audit' for PTU's administrative building at main campus, Kapurthala and their report is awaited.

Item No. 42.3: To discuss and approve the rough cost estimate for construction of proposed auditorium at main campus, Kapurthala.

Based upon the approved concept plans of the auditorium proposed to be constructed at main campus, Kapurthala, the Architect has submitted rough cost estimate based upon plinth area rates of CPWD for an amount of Rs. 2175.97 lacs (Annexure-A).

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

Item No. 42.4 : **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. 42.5 : **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, Sikhwala, Mukatsar Sahib.**

The Architect has submitted design basis reports of Structure, Electrical and Public Health works in respect of Punjab Institute of Technology, Sikhwala, Mukatsar Sahib (Annexure-C). 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. 42.6 : **To discuss and approve the design basis reports submitted by the Architect for Structure, Electrical and Public Health works of Hostels and auditorium proposed to be constructed at main campus, Kapurthala.**

The Architect has submitted design basis reports of Structure, Electrical and Public Health works for hostels and auditorium proposed to be constructed at main campus, Kapurthala (Annexure-D). 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. 42.7 : **To discuss and approve the finishing schedules (internal and external) for Punjab Institute of Technology buildings at Arniwala, Sikhwala and auditorium & hostels for main campus, Kapurthala.**

The Architect will be presenting the finishing schedules (internal and external) for Punjab Institute of Technology buildings at Arniwala, Sikhwala and auditorium & hostels for main campus, Kapurthala.

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

Item No. 42.8 : **To discuss and approve the revised estimate for raising, repairing and painting of existing boundary wall of main campus, Kapurthala.**

In 41st meeting (Agenda item No. 41.10) of the Standing Building Construction Committee, scheme and estimate for raising, repairing and painting of existing boundary wall of main campus, Kapurthala for an amount of Rs. 43.14 lacs was approved. However, during the discussions held with PWD officers, it has been suggested by them that instead of painting the boundary wall with snowcem (as taken in the estimate), painting with silicon based paint should be done for longer durability. It is also suggested that APST's boundary wall should also be raised and painted. Accordingly, the estimate has been revised by the Architect to Rs.62.49 lacs (Annexure-E).

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

Item No. 42.9 : **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. At the time of approval of this estimate, the length of the boundary wall was considered as 4200 metre. However, as per site conditions, the actual length of the boundary wall is 4680 metre. Additionally, it is also proposed that painting of the pre-cast panel boundary wall portion, which is on the three sides of the campus, is also got done. This was not considered at the time of approval of earlier estimate. By considering all these factors, Architect has submitted a revised estimate for boundary wall for an amount of Rs. 350.87 lacs (Annexure-F). 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.

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

Item No. 42.10 : **To discuss and approve the requirement and scheme for construction of buildings for Bank, Post office and shopping centre at main campus, Kapurthala.**

Based upon the approvals accorded in previous building committee meetings, construction of three college buildings, two hostels, one library and one seminar hall for Punjab Institute of Technology, main campus, Kapurthala is in progress. Further, construction of hostels for 400 students and auditorium is being taken up. It is likely that strength of students will be more than one thousand in coming years. To take care of their needs, it has been suggested by senior officers of the University that building for housing Post office, Bank and a small shopping centre may be constructed. Architect has prepared concept plans for the same and will be presenting in the meeting.

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

Item No. 42.11 : To discuss and approve the requirement and scheme for construction of major roads at main campus, Kapurthala.

Presently, construction of three college buildings, two hostels, one library and one seminar hall for Punjab Institute of Technology, main campus, Kapurthala is in progress. Further, construction of hostels for 400 students and auditorium is being taken up. Thus, all round development of the campus is taking place. Under the circumstances, it is suggested that tree plantation for the complete campus is done at this stage. For proper development of the campus and green belts, it is proposed that all major roads of the campus are got constructed. The roads proposed to be constructed are being presented by the Architect.

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

Item No. 42.12 : Any other point with the permission of the Chair.

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, Kaputhala 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, ninty six thousand, six hundred & forty six only			

Auditorium

Type of Building -	Assembly	Refer Drg No. PTU-IV/PRE/AC/01-01 to 09
Total Plinth Area -	3,746.70 sq.m	
Plinth area on ground floor	3,178.00 sq.m	
Total covered area-	3,821.50 sq.m	
No. of storeys-	G+1	
Floor height	13.50 m	

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 5.0m	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	343,980.00	
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 & lounges
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) =					**97,124,065.65**	
	Total B (1.2.3 to 1.2.8) =					**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					**150,760,218.60**	

OTHER BUILDING EXPENSES

Annexure-1

S. No.	Description	Unit	Quantity	Rate	Amount (INR)	Explanation
1	2	3	4	5	6	7
	Richer 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	5,316.99	5,625,375.42	
5	PA system				1,250,000.00	Rates considered from acoustic report of auditorium submitted in 2007
6	Stage lighting				3,000,000.00	
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	21,299,421.08

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 sq.m		

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 6% 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 celling: - 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:

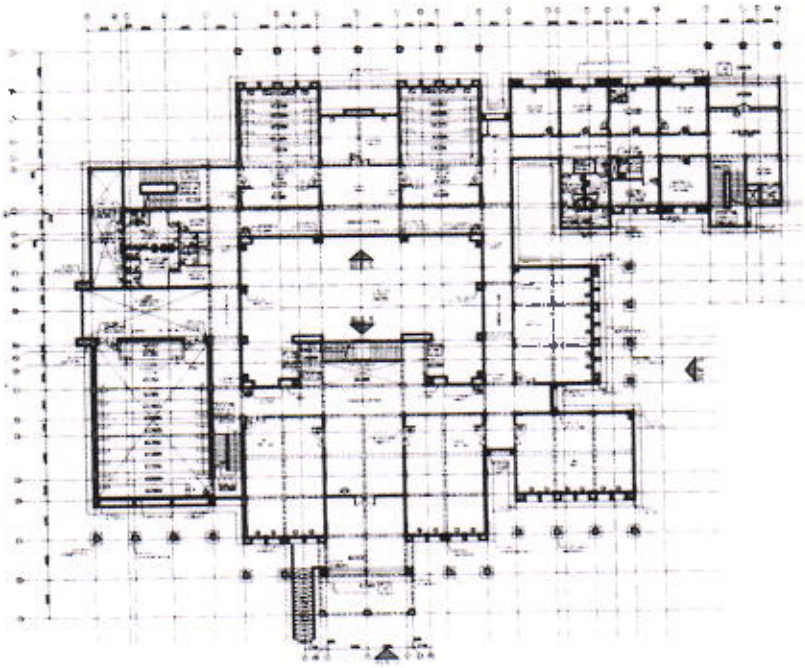
Arnlwala- Exposed concrete finish in architectural features, Weather proof paint, grooves in plaster. Red sandstone cill in windows.

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 (Ah) = $\frac{ZI\,Sa}{2Rg}$

Zone factor Z = 0.24 corresponding to zone IV.

Importance factor I = 1.5

Response reduction factor R = 5

(Sa/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: -

(Fy 250/ Fy 345)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 deign 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	Warner, Rangan, Hall & Faulkes (Longman, 1998)
5	Reinforced Concrete Designers Handbook	Fourth Edition, Reynolds & Steedman
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. Dayaratanam
10	Prestress Concrete Structure	P. Dayaratanam
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 & Caull
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 tonns	40.00	0.50	20.00	20.00
ii	Office area for 15 tonns	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 K.W				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 K.W			=	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 FRZHLS 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 currants 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 compuler
- 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

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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)	Water Requirement For Flushing (LPD)
					@40%	@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-1)	**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.

5. 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

5.1 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 chorine contact tank where chorine 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 superannuate 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.

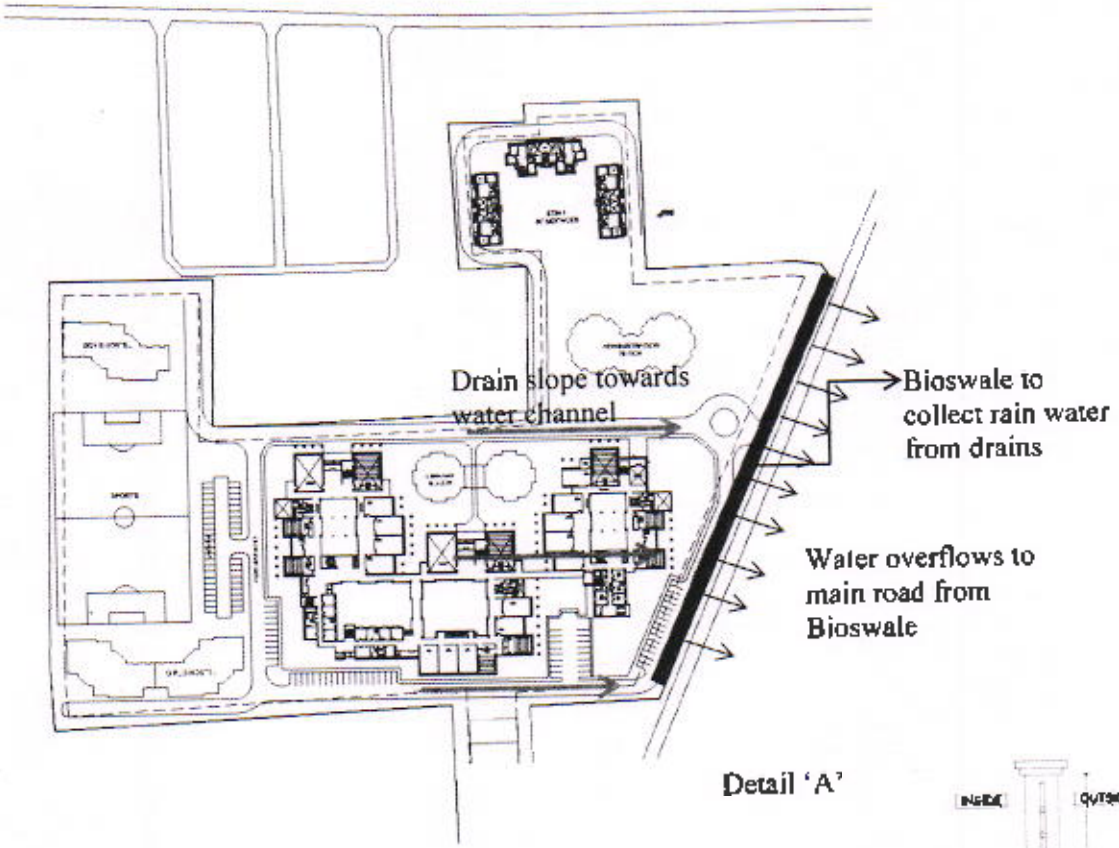
Bioswale are landscape elements designed to remove silt & surface runoff water. They consist of a swaled drainage course with gently sloped sides and filled with vegetation.

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.

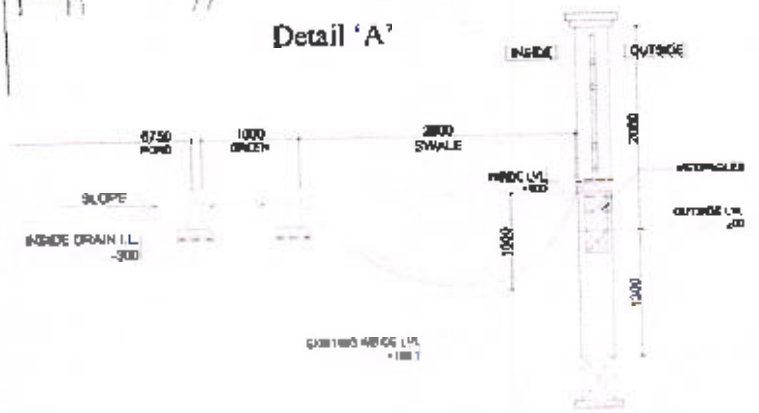
Rain water from buildings, roads & open areas will be channelized by a drainage system sloping towards the bioswales along the main road inside the

site. The overflow from the swale will be spilled onto the main road. (Refer plan & section below).

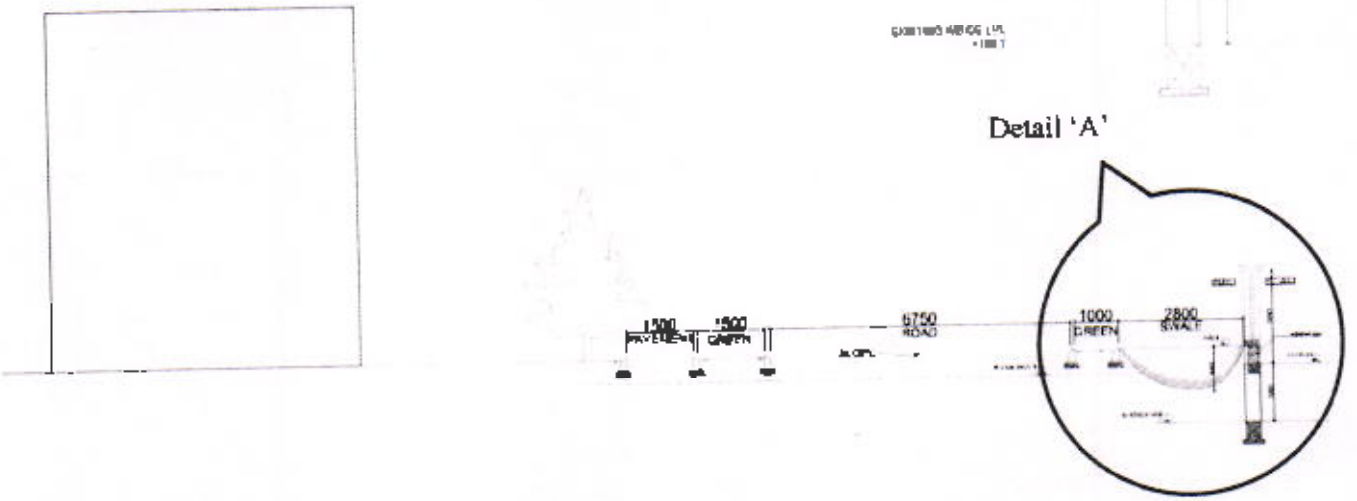
The size of swale has been derived considering maximum rainfall of 30mm/hr.



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 gradiant 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 651-1965	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 1536-1 976	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 then 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:

i) **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 lt. 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 1536-1 976	Horizontally cast iron pressure pipes for water, gas & sewage (first revision) (with Amendments No. 1 to 4)
IS 1554-1988 Part I	PVC insulated (heavy duty) electric cables (working voltage upto and including 1100 volts (third revision)
IS 1554-1988 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:

Amlwala- 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 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 | **DESIGN DATA SUMMARY**

CONDITIONED SPACE	ACTUAL AIR CONDITIONED AREA	HEIGHT	INSIDE DESIGN CONDITION				OCCUPANCY	LIGHT LOAD	EQPT LOAD	SUMMER LOAD	MONSOON LOAD	SUMMER DEHUMIDIFIED CFM	MONSOON DEHUMIDIFIED CFM	REQUIRED OUTDOOR AIR QTY(Normal)
(A)	(B)	(C)	(D)	(E)	(F)	(G)	(H)	(I)	(J)	(K)	(L)	(M)	(N)	(O)
	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														
Seminer Hall	1904.5	17.0	17.0	-	26+1	55	150	1.0	5.0	21.4	28.2	5,194	5,635	2,550
Pro. Room	258	11.6	5.0	0.06	24+1	55	6	1.5	2.0	1.56	1.79	512	414	126
Board Room	258	11.6	5.0	0.06	24+1	55	8	1.5	2.0	1.72	2.13	489	416	168
HOD Room	226	11.6	5.0	0.06	24+1	55	4	1.5	2.0	1.10	1.28	373	325	84
P.A Room	258	11.6	5.0	0.06	24+1	55	5	1.5	2.0	1.45	1.62	508	417	105
First Floor														
Ast. Prof.	1044	11.6	5.0	0.06	24+1	55	15	1.5	2.0	5.34	5.57	2,069	1,640	315
ASSO. PROF1	102	11.6	5.0	0.06	24+1	55	2	1.5	2.0	0.60	0.70	215	193	42
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	0.60	0.69	216	188	16
ASSO. PROF-4	124	11.6	5.0	0.06	24+1	55	2	1.5	2.0	0.49	0.50	209	183	16
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.

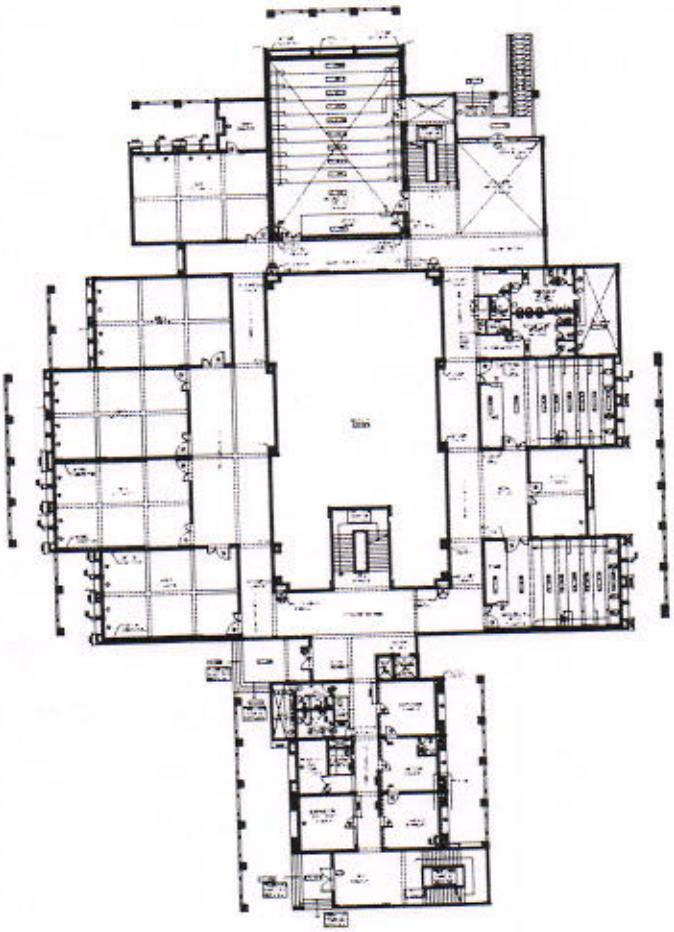
6. MECHANICAL VENTILATION

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.

ANNEXURE-C

DESIGN BASIS REPORT FOR STRUCTURE FOR PIT- SIKHWALA

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:-

Soil is very poor in upper strata, hence pile foundation is proposed.

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 (Ah) = $\frac{Z I Sa}{2Rg}$

Zone factor Z = 0.24 corresponding to zone IV.

Importance factor I = 1.5

Response reduction factor R = 5

(Sa/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: -
(Fy 250/ Fy 345)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 deign 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	Warner, Rangan, Hall & Faulkes (Longman, 1998)
5	Reinforced Concrete Designers Handbook	Fourth Edition, Reynolds & Steedman
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. Dayaratanam
10	Prestress Concrete Structure	P. Dayaratanam
11	Handbook of concrete, Engineering	Mark Finfel
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 & Caull
15	Structural Analysis	C.S.Reddy

ANNEXURE-D

DESIGN BASIS REPORT FOR PHASE-IV ELECTRICAL INSTALLATION WORKS FOR PTU

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

1. ELECTRICAL LOAD ANALYSIS

The electrical load requirement for lighting and small power (e.g. computers, servers,),HVAC load have been estimated empirically based on the areas proposed and considering the approximate load for External Lighting & Plumbing for phase-IV. The conclusions have been tabulated below, while the details for individual buildings are listed later in annexure 1.

S.NO.	BUILDING	MAXIMUM DEMAND LOAD (KW)	EMERGENCY LOAD (KW)
1	MARRIED HOSTEL	139.4	42
2	BOY'S HOSTEL	148	52
3	GIRL'S HOSTEL	119.4	45
4	AUDITORIUM	317.5	318
5	FUTURE BUILDINGS i.e. Guest house, Sports complex, Indoor sports stadium, health & shopping	345	290
6	External development, fire & water pump load	57.5	60
	TOTAL	**1128.6**	**807**
Adopting over all diversity factor 0.9, Maximum Demand in K.W		1015.8	726.3
Adopting P.F, 0.9 in case of Mains & 0.8 in case of emergency, Demand KVA capacity comes out to be		1128.68	908
Adopting loading, 0.8 in case of Transformers & 0.8 in case of DG set backup, Demand KVA capacity comes out to be		1410.86	1135

Selection of transformers comes out to be= 3x500KVA

Selection of DG Set= 1 x 380 KVA + 1 x 250 KVA

Further options for DG selections have been elaborated in subhead no. 3

2. DESIGN CONSIDERATIONS

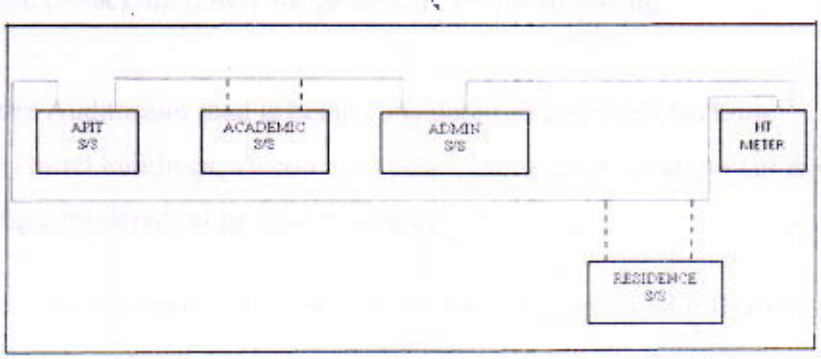
The electrical load of the whole site is proposed to be,fed from 5 number substations. The details are given below:

S.NO	Substation number	Phase	Buildings fed	Configuration (KVA)	Load of building s (KVA)
1	1 (Existing)	Phase I	Administration building	3x1000	1625
2	2 (Existing)	Phase III	APIT (CB3, Boy's & girl's hostel, staff quarters, Director's office)	1x315 existing 1x315 planned	321
3	3	Phase III	CB1, CB2, Library & seminar	2x1250	1834
A	SUBTOTAL				3780
4	4	Phase IV	Hostels, Auditorium, sports area & guest house	3x500	1420
B	SUBTOTAL				1420
C	TOTAL				5200
5	5	Future for residences		as/ future demand	
6	6	Future for college buildings			

VARIOUS PHASES ADDING UP TO 4MVA NECESSITATING 33KVA CONNECTION

The electrical load for phase I and phase III is within the range of 4MVA, therefore existing 11KVA connection suffices for the present demand.

A ring main of 11KVA line exists on site. Substation no. 1, 2 & 3 are commissioned from this ring.



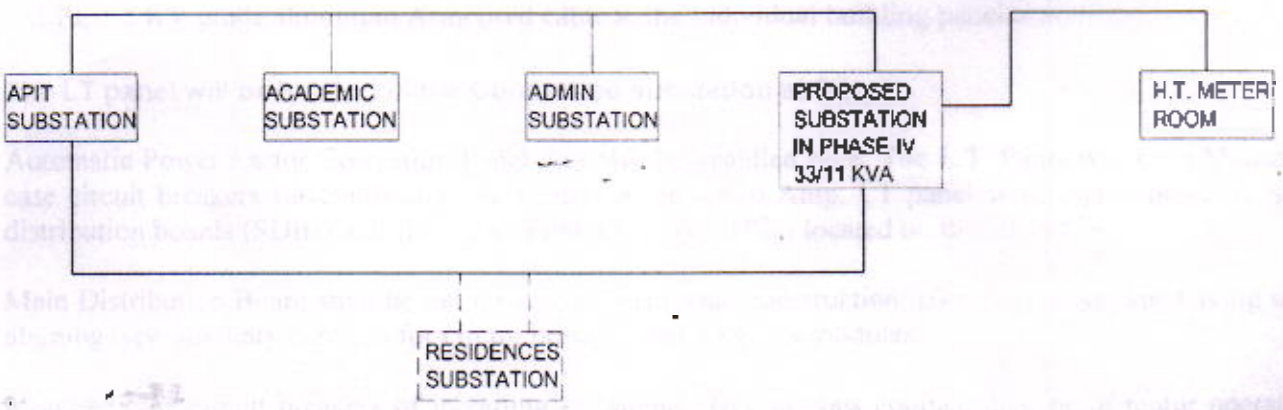
RING MAIN SYSTEM

NEED FOR 33 KVA CONNECTION

With the electrical demand of phase IV, the load exceeds present demand of 4MVA. To meet the demand, a 33KVA HT Metering supply from SEB is required.

For this we need to install 33/11 KV connection in the proposed phase IV substation, which will feed existing of administration, academic & APIT 11KVA substations.

This proposed substation in phase IV will also cater to the future residential requirements.



In Phase IV, the LT connection from 11KV substation to the following individual buildings will be provided with respect to their maximum demand loads:

1. Boy's hostel
2. Girl's hostel
3. Married hostel
4. Auditorium

Keeping in mind space provisioning, the 11 KV substation has been located generally in the load-center.

3. D.G Sets and Power Back-up Facilities

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

- Entire Auditorium load is being considered on generator back-up
- For Hostel buildings, all common area lighting, fans, small power & other utility services is being considered on generator back up.

To cater all those emergency loads any of the following options for DG sets configuration can be installed:

Options 1: Provide two DG sets – one each for hostel and auditorium. In this case 1 no. 380 KVA (audi)+ 1 no.250 KVA (hostel) DG is required.

Option 2: Provide only one DG set for hostels and in case of the eventuality of outage during a performance in auditorium which is a rare possibility, the DG set provided for hostels could be diverted to feed the lights in the auditorium. In this case the air conditioning in the auditorium would not run. In this case 1 no. 350 KVA DG is required.

4. Power Distribution

LT supply from the Main LT Panel located in substation and the DG Sets would be carried by LT XLPE 1.1 KV grade aluminum Armoured cable to the Individual building panels.

The LT panel will be located in the Centralized substation at Site.

Automatic Power Factor Correction Panel will also be installed here. The L.T. Panel will have Moulded case circuit breakers for controlling the feeders of upto 630 Amp. LT panel shall supply power to sub distribution boards (SDBs) and floor distribution boards (FDBs) located on the area basis.

Main Distribution Board shall be indoor type of metal clad construction, partly draw out type having self aligning type auxiliary contacts for circuit breakers and draw out modules.

Moulded case circuit breakers of incoming LT supply, DG and bus coupler shall be of motor operated type with microprocessor based release with the necessary protections & contactors for interlocking if required.

For all incomers and the main outgoing feeders like AC Equipment, light, power, water supply and treatment, KWH meter in the outgoing will be provided.

The main distribution board shall have double bus bar, one for grid supply and other for D.G. supply. ATS will be provided for changeover.

DOL starters will be provided for motors rated up to 5.5 KW and Star Delta starters for all motors rated from 7.5 KW will be provided.

Cables

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

5. Earthing

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 currants 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 pieees
- Steel Structures

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

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

6. Point Wiring

For Hostels:

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 Hostel rooms), for "Emergency" power (which will feed 100% of fans and lights of common area).

For Auditorium:

Point wiring shall be carried out using Fire Resistant (FR) grade PVC insulated wire with multi-stranded copper conductors carried in MS conduit. Switches proposed to be used are contemporary modular type switches or as per consultation with architect.

There will be separate DBs for light power & equipments.

7. Illumination System

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, and ease of maintenance and energy conservation.

S. No.	Description of Space	Type of Lighting	Illumination (LUX Level)
i)	Corridors and circulation spaces	CFL/T5/LED	100-150
ii)	Toilets	CFL/LED	100-150
iii)	Staircases	CFL/LED	100-150
iv)	Office Areas	T5/LED	300-500
v)	Service Areas	T5	150-300
vi)	Hostel Rooms	CFL/T5/LED	100-150
vii)	Auditorium	CFL/LED/MH	200-700
vi)	Terrace & External Lighting	LED/MH/CFL	20

Comparison of CFL & T5 has been attached as annexure II.

CFL/LED 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.

8. TELEPHONE SYSTEM, CABLE TV AND INTERNET NET WORK

Provision for telephone wiring connections are proposed to be provided in the offices, Kitchen, married hostels. Telephone, Data/Internet points will also be provided in the Auditorium. 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.

9. SECURITY / PA 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.

Fire Alarm & PA system provisions will be made as per NBC for Auditorium.

10. EXTERNAL DEVELOPMENT (ELECTRICAL)

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 and LEDs would be used for steps, corridors and effect lighting.

ANNEXURE 1

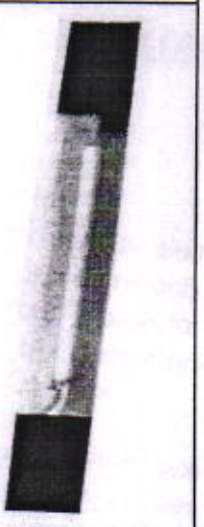
SUMMARY OF ELECTRICAL LOADS FOR PTU-IV					
S. No	Description	Connected Load (KW)	Diversity	Maximum Demand Load (KW)	Emergency Load (KW)
A	Married Hostel (as instructed by BC, split air conditioners have been considered in the rooms)				
1	Common Area				
i	Light load	10	0.8	8	8
ii	Power load	16	0.4	6.4	
2	Hostel Rooms				
i	Light load	20	0.7	14	
ii	Power load	220	0.35	77	
3	Lifts (2 Nos.,10 K.W Each)	20	1	20	20
4	Ventilation & pressurization	15	0.4	6	6
5	Fire Fighting	10	0.8	8	8
a	**TOTAL**	**311**		**139.4**	**42**
B	Boys Hostel				
1	Common Area				
i	Light load	21	0.8	16.8	16.8
ii	Power load	30	0.4	12	
2	Hostel Rooms				
i	Light load	40	0.6	24	
ii	Power load	150	0.4	60	
3	Lifts (2 Nos.,10 K.W Each)	20	1	20	20

4	Ventilation & pressurization	18	0.4	7.2	7.2
5	Fire Fighting	10	0.8	8	8
b	**TOTAL**	**289**		**148**	**62**
C	Girls Hostel				
1	Common Area				
i	Light load	13	0.8	10.4	10.4
ii	Power load	25	0.4	10	
2	Hostel Rooms				
i	Light load	35	0.6	21	
ii	Power load	110	0.4	44	
3	Lifts (2 Nos., 10 K.W Each)	20	1	20	20
4	Ventilation & pressurization	15	0.4	6	6
5	Fire Fighting	10	0.8	8	8
c	**TOTAL**	**228**		**119.4**	**44.4**
D	Auditorium				
i	Light load (building related)	40	0.7	28	28
ii	Power load	35	0.5	17.5	17.5
iii	Equipment load (Assumed for stage lighting, projection etc.)	80	0.6	48	48
2	Air conditioning	280	0.8	224	224
d	**TOTAL**	**435**		**317.5**	**317.5**
	Future upcoming buildings				
E	Guest house				

i	Total Area 2450 sq.mtr.				
ii	Light & Power Load @ 6w/sq.ft of the carpet area & 1.5w/sq.ft of common area				
iii	Light & Power (carpet area/guest rooms for 1000 sq.mtr.)	64.56	0.6	38.74	38.74
iv	Light & Power (common area for 1450 sq.mtr)	23.4	0.7	16.38	16.38
2	Air conditioning	95	0.7	66.5	66.5
3	Fire Fighting O.H.T	10	0.8	8	8
4	Lifts (1 Nos.,10 K.W Each)	10	1	10	10
e	TOTAL	**202.96**		**139.62**	**139.62**
F	Sports Complex				
i	Total Area 700 sq.mtr.				
ii	Light & Power Load @ 4w/sq.ft of the total area				
iii	Light & Power (total area of sports for 700 sq.mtr.)	30.13	0.6	18.08	18.08
f	TOTAL	**30.13**		**18.08**	**18.08**
G	Indoor sports stadium				
i	Total Area 2500 sq.mtr.				
ii	Light & Power Load @5w/sq.ft of the total area				
iii	Light & Power (total area of indoor sports for 2500 sq.mtr.)	134.5	0.6	80.7	80.7
iv	Ventilation & smoke extraction	120	0.3	36	36
2	Fire Fighting O.H.T	10	0.8	8	8
g	TOTAL	**264.5**		**124.7**	**124.7**
H	Health & Shopping				

i	Total Area 500 sq.mtr.				
ii	Light , Power & AC Load @ 15Kw/1000sq.ft				
iii	Light & Power (total areaof health & shopping for 500 sq.mtr.)	80.7	0.7	56.49	
2	Fire Fighting O.H.T	10	0.8	8	8
h	**TOTAL**	**90.7**		**64.49**	**8**
I	Fire Fighting (for fire hydrant)	125	Only Jockey Pumps	15	15
J	Pumps & Water Treatment	50	0.6	30	30
K	External Development including borewell	25	0.5	12.5	12.5
J	**TOTAL**	200		**57.5**	**67.5**
	GRAND TOTAL	2051.29		1128.68	803.8
Adopting over all diversity factor 0.9, Maximum Demand In K.W				1015.81	723.42
Adopting P.F, 0.9 In case of Mains & 0.8 in case of emergency, Demand KVA capacity comes out to be=				1128.68	904.275
Adopting loading, 0.8 in case of Transformers & 0.8 in case of DG set backup, Demand KVA capacity comes out to be=				1410.86	1130.34
Selection of transformers comes out to be =				3 x 500 KVA	
Selection of DG Set =		1 x 380 KVA + 1 x 250 KVA for now & 1 x 500 KVA for future			

ANNEXURE II

Typical Worksheet for Anticipated return on Investment (ROI) After implementation of energy efficiency using LED Bay light fixtures .			Typical Photograph of Proposed Virex Energy make Energy saving 220 volts 18 watts (max)LED Fixture.
	Data of lighting fixtures/Lamps Presently in Use	Data on light fixtures after LED Replacements	
Type/Make	Not Known	LED/Virex Energy	
Description	Flourescent Tube Lights	Bay Lights	
Size/Model	36 watts 4 ft Flourescent Tubelight Fixtures. (approx 40 watts with choke)	2 ft 18 watts	
No of Fixtures(Assumed figure)	108	108	
No of lights in each fixture	1	1	
Total No of Light units	108	108	
Wattage	40	18	
pf	0.8	0.95	
efficiency	0.8	0.92	
Cost Per Unit(Fixture)	Rs. 2,800.00	Rs. 3,250.00	
Cost per Unit(Light)	0	0	
Initial cost(per fixture)	Rs. 2,800.00	Rs. 2,900.00	
Energy Cost/ unit	Rs. 5.70	Rs. 5.70	
Hours of operation	10	10	
Replacements Per Year	1	0	
Cost per replacement	Rs. 150.00	Rs. 0.00	
No. of years of operation	5	5	
No of Working Days(Annual)	280	280	
Energy Cost(Per day)	Rs. 384.75	Rs. 126.78	
Energy Cost(Monthly)	Rs. 11,542.50	Rs. 3,803.48	
Energy Cost(Annual)	Rs. 107,730.00	Rs. 35,499.13	
Cost of Replacement(Per Year)	Rs. 16,200.00	Rs. 0.00	
Total Cost of Ownership(5 years)	Rs. 554,850.00	Rs. 177,495.65	
Monthly Electricity Bill	Rs. 11,542.50	Rs. 3,803.48	
Initial Cost of LED Street light Fixtures	Rs. 302,400.00	Rs. 351,000.00	5% VAT & Transportation charges extra
Anticipated Payback Period(Years)	0.55		
Warranty by manufacturer for Virex make LED Lights - 3 Yrs			
Note:- Above work sheet has been prepared based on data made available by the user. Suggestions for any corrections are welcome.			

PRELIMINARY DESIGN REPORT FOR HVAC SYSTEM FOR AUDITORIUM & MARRIED STUDENT'S HOSTEL AT PUNJAB TECHNICAL UNIVERSITY, JALANDHAR, PUNJAB

1. 800 CAPACITY AUDITORIUM

GENERAL

The project consists of an Auditorium block which consists of following areas: Entrance lobby, VIP lounge, Auditorium, Change rooms, Corridors, Control room, Office, Drawing room, Bed room, toilets blocks & pantry etc.

It is proposed to air-conditioning of all these areas except toilets & pantry with the help of economical and efficient central air conditioning system. The VIP suits shall be separately treated by split air-conditioning system. Mechanical Ventilation is proposed for services area.

The following figures are assumed for various seasons for designing the HVAC system of the Buildings:-

Design Philosophy

The HVAC has been designed keeping in view the following:

i) Continuity and reliability.
ii) Flexibility of operation.
iii) Concentration/distribution of loads.
iv) Safety of personnel and equipment.
v) Investment and operational costs.
vi) Ease of maintenance.
vii) Maximum interchangeability of equipment resulting in minimum inventories and spare parts.
viii) Minimum fire risk.
ix) Simplicity of operation.

In order to develop HVAC design concept and determine the energy loads necessary for the design concept, we have taken into account the following design criteria:

City: Jalandhar (Punjab)
Latitud. : 31° 16' North

1. Outdoor Design Conditions :	
Summer	
Dry Bulb Temp.	43.3 deg. C (110 deg F)
Wet Bulb Temp.	23.9 deg. C (75 deg F)
Monsoon	
Dry Bulb Temp.	35.0 deg. C (95 deg F)
Wet Bulb Temp.	28.3 deg. C (83 deg F)

Inside Design Condition :	22.2 ± 1 deg C (72 ± 2 deg F)
Dry Bulb Temp.	22.2 ± 1 deg C (72 ± 2 deg F)
Relative Humidity (RH)	55% (Design Value – No Control)

3. Outdoor Air Requirement

Area Description	Outdoor Air Requirement
All area	17 CFM / Person

4. Lighting & Equipment Load

Area Description	Lighting Load (Watt/Sqft)
Stage Area	5.5
Auditorium (Seating Area), Control Room	1.0
Change Rooms, Lobby, Lounge, Office, Drawing, Bed room etc.	1.5

5. Equipment Load/ Occupancy:

As per summary sheet attached below.

6. Factors Considered:

i) Glass (Single glass):

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

ii) Roof (Insulated)

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

LOAD ESTIMATION

Based on the above conditions, the Air conditioning loads is as follows :

HEAT LOAD SUMMARY

		BASIS OF DESIGN								DESIGN DATA SUMMARY				
S. NO.	CONDITIONED SPACE	ACTUAL AIR CONDITIONED AREA	HEIGHT	INSIDE DESIGN CONDITION		FRESH AIR	OCCUPANCY	LIGHT LOAD	EQPT LOAD	SUMMER LOAD	MONSOON LOAD	SUMMER DEHUMIDIFIED CFM	MONSOON DEHUMIDIFIED CFM	OUTDOOR AIR REQUIRED
	(A)	(B)	(C)	(D)	(E)	(G)	(H)	(I)	(J)	(K)	(L)	(M)	(N)	(O)
		S.FT	FT.	TEMP (°C)	RH % (Design Value-No Control)	CFM /PERSON	NOS.	W/S.FT	KW	TR	TR	CFM	CFM	CFM
1	**GROUND FLOOR**													
1.1	Auditorium (Stage Area)	2738	36.0	22.2±1	55	17.0	30	5.5	1.00	18.60	17.14	9791	7775	510
1.2	Auditorium (Sitting Area)	8500	25.0	22.2±1	55	17.0	900	1.0	5.00	108.01	152.20	28199	23516	15300
1.3	Change Room (Male)	540	10.5	22.2±1	55	17.0	10	1.5	0.50	3.73	3.71	1870	1495	170
1.4	Change Room (Female)	540	10.5	22.2±1	55	17.0	10	1.5	0.50	3.42	3.28	1674	1224	170
1.5	Entrance Lobby	4156	18.0	22.2±1	55	17.0	80	1.5	0.50	19.31	20.61	8298	6212	1360
1.6	VIP Lounge	1970	10.5	22.2±1	55	17.0	20	1.5	2.00	13.07	11.33	7302	5476	340
1.7	Corridor Area (L)-1	1240	18.0	22.2±1	55	17.0	12	1.5	0.00	10.12	9.70	5571	4507	372
1.8	Corridor Area (R)-2	1240	18.0	22.2±1	55	17.0	12	1.5	0.00	6.55	5.56	3561	2497	204
1.9	Office	350	11.0	22.2±1	55	17.0	6	1.5	1.00	2.10	2.05	1035	785	102
1.10	Control Room	570	10.5	22.2±1	55	17.0	3	1.0	2.00	2.87	3.11	1334	1057	200
	Sub Total	**22150**								**188**	**229**	**68634**	**54543**	**18728**

Since the main Auditorium sitting & stage area has high density occupancy, which requires high amount of fresh air, hence increase in the air-conditioning load. To reduce the fresh air load & reducing the operating cost & plant size as well, we have the following options:

a. **Heat recovery System:** In this system the exhaust air shall be utilized to pre- cool the warm outdoor air which reduces the fresh air load up to 75 %. This reduces the plant capacity.

b. **Ozonizer System:** In this system, Ozone is injected to remove the volatile organic compounds which reduce the outdoor air requirement by 50 to 60 % hence reduce the fresh air load.

Since the estimated air-conditioning load of the building is 229 TR with normal fresh air. With the help of these energy economizer systems the load can be reduced by 50 TR. approx. Hence the total air-conditioning load shall be 180 TR.

After taking diversity of 90 %, the Total load shall be 162 TR.

To meet the above referred load, we have following options:

1. **Air-cooled water chilling machines with Reciprocating Compressors**

   This is a very convenient system and is taking over the conventional water-cooled, water chilling machines in a big way. The basic advantages of the system include non-requirement of valuable space at lower floor for the plant room, practically nil requirement of condenser water and no problem of scaling of pipe lines. This system has one major reservation that while designing the building the structural engineer has to make necessary provisions for additional load and vibrations at the terrace level because the machines are normally placed at the terrace of the building. In this case the building has been designed for the required loads.

2. **Water-cooled water chilling machines with Reciprocating Compressors**

   This system use Reciprocating Compressors which are becoming obsolete due to their large power requirement. In this system the main plant is located in the plant room & the cooling towers are located in open space like-terrace etc. The AHU.s are housed in the AHU Rooms or are ceiling suspended. This system can sustain the high ambient temperature.

3. **Water-cooled water chilling machines with Screw Compressors**

   This system of air-conditioning is very popular because of its low power consumption. In this system the main plant is located in the plant room at the ground floor or basement. The cooling towers are located on the terrace and the AHU.s are housed in the AHU Rooms or are ceiling suspended. This system can sustain the high ambient temperature. Suitable for any configuration using machines from 50Tr to 600Tr.

4. **Air-cooled water chilling machines with Screw Compressors**

   This system of air-conditioning is also becoming very popular because of its low space requirement and No water requirement. In this system the main plant is located on the terrace of the building. There are No cooling towers in the system and in fact the whole plant can be located in the same area where cooling towers are normally located. This system can sustain the high ambient temperature. Suitable for any configuration using machines from 50Tr to 400Tr. This system is rejected due to its high energy consumption.

5. **Water-cooled water chilling machines with Centrifugal Compressors**

This system of air-conditioning is the most suitable system for the building having very large loads. In this system the main plant is located in the plant room at ground floor or basement. The cooling towers are located at open space either ground floor or Terrace. The AHU.s is housed in the AHU Rooms or are ceiling suspended. This system can sustain the high ambient temperature. Suitable for any configuration using machines above 250 Tr, but is economical only above 450 Tr.

Keeping all the above factors in mind it is recommended that as a first preference, Air Cooled Chilling Machines with screw compressors to be used for providing Air-Conditioning system to the buildings.

Chillers can be located either on the ground as shown in the attached drawing or on the roof top as/ the detail design considerations.

SELECTION OF EQUIPMENT

HIGH SIDE:

(i) **Chilling Machine:** 2 Nos. Energy efficient Air cooled Screw Chiller of 160 Tr. actual capacity each (1 Working + 1stand by) will be installed.

(ii) **Chilled Water Primary Pumps:** 2 Nos. Primary chilled water pumps of required capacity (1 Nos. Working & 1 No. Stand by) are proposed to install.

(iii) **Chilled Water Secondary Pumps:** 2 Nos. Primary chilled water pumps of required capacity (1 Nos. Working & 1 No. Stand by) are proposed to install.

These pumps shall operate through VFDs, which will take care of part load requirement and hence saving in energy.

LOW SIDE:

To cater the above referred loads, following equipment's are proposed to install-

(i) **Air Handling Units**

Floor mounted air handling units with energy economizer are proposed to install to cater the main auditorium sitting & stage area.

Since the capacity of the AHUs shall be designed to meet the peak load during the day time of summer hence to minimize the load as per the requirement during night or during mild season, Variable frequency drives will be provided for the main auditorium AHUs to control the air quantity as per the actual requirement. The use of the Variable frequency drives would results in substantial power saving.

The rest area shall have individual ceiling suspended Air handling units/ fan coil units of required capacities.

Conditioned air from the AHUs will be taken through the G.S.S. ducting and will be supplied to conditioned areas through diffusers/ grills. Return air will be collected through similar diffusers/ grills mounted on false ceiling and will be taken to AHUs.

Ducted return air system is proposed for main auditorium area. It is proposed to provide return air masonry plenums adjacent to stage area, in which the return air duct shall run &

the return air shall be collected through return air grille and taken back to AHUs for reconditioning.

(ii) **Piping:** All chilled/condenser water pipes shall be of MS 'C' Class. The Pipes size 150mm & below shall be M.S. heavy class as per IS: 1239 and pipes size above 150mm shall be welded black steel pipe heavy class as per IS: 3589.

(iv) **GSS Ducting:** All ducting shall be machine made of G.I. sheets as per IS: 655 (amended upto date), for certain areas wherever required it will be made at site.

(v) **Insulation:** The supply air duct will be insulated up to the tail-end with closed cell electrometric insulation of 15 mm thickness. The material shall be fixed to the ducts using synthetic adhesive.

The initial section of all the supply air ducts upto first grill/diffuser will be provided with acoustic lining with resin bonded fiber glass wool & covered with reinforced Plastic tissue paper and 0.5 mm thick perforated aluminum sheet at the inside surface of ducts to prevent transmission of noise to air-conditioned area.

The chilled water pipes shall be insulated with polyurethane foam pipe section. The insulation in the plant & exposed area shall be covered with aluminum cladding to avoid damage to the insulation.

The wall and ceiling of AHU rooms shall be acoustically treated by providing resin bonded fiber glass wool covered with reinforced fiber glass tissue & perforated aluminum sheet to prevent transmission of noise to adjoining air-conditioned areas.

(v) **Main Electrical Panel:** Main HVAC panel shall be installed in the Plant Room.

SPECIAL REQUIREMENT

It is suggested that the entire exposed roof of the building should be insulated with a minimum of 50 mm thick expanded polystyrene board (or equivalent polyurethane).

MECHANICAL VENTILATION & SMOKE EXTRACTION SYSTEM

Toilet exhaust will also be planned for 10-12 air changes per hour. Inline/propeller fans are proposed to be provided.

Exhaust system for pantry & other storage area will also be provided via Inline/propeller fans.

As per the requirement of National Building Code of India (NBC) the assembly areas would be provided with smoke extraction system in case of fire. The smoke extraction fans shall be provided at two side of the auditorium. These fans would be connected to the fire detection system of the building and would start automatically in case of fire.

2. MARRIED STUDENT'S HOSTEL

Provision for Window air conditioners is considered for all the rooms in the hostel. AC Units will be installed by the occupants only.

PTU, PHASE-IV

Plumbing & Fire Fighting Design Basic Report

JUNE 30, 2014

Client:
PUNJAB TECHNICAL UNIVERSITY
JALANDHAR

Architect:
ARCHIGROUP ARCHITECTS (REGD.)
A-14, First Floor, Sector 15, Noida
Tel: 0120- 4312431

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[This report covers the Plumbing & firefighting design basis for construction of three hostels, one auditorium, in phase IV of Punjab Technical University, Jalandhar]

SANITARY ENGINEERING AND FIRE FIGHTING SERVICES

GENERAL

The project consists of developing various buildings in the existing Punjab Technical University Campus.

The Buildings to be developed are 200 capacity Boy's hostel, 150 capacity girl's hostel, 50 capacity married student's hostel & 800 capacity auditorium.

S. No.	Type of Building	Covered Area (Sq. mt.)
1	Boy's hostel	10,173.7
2	Girl's hostel	6,503.12
3	Married student's hostel	4,246.86
4	Auditorium	3,663.29
	TOTAL	24,586.98

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 well being 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 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
- Fire fighting 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 shall be as below:

Punjab Technical University, Kapurthala -Calculation for Daily Water Requirement						
S. No.	Type of Building	Occupancy	Water Requirement (LPCD)	Total Water Requirement (LPD)	Water Requirement For Domestic LPD	Water Requirement For Flushing LPD
Boy's hostel						
1	Students	200	135	27,000	16200	10800
2	Warden & other staff	5	135	675	405	270
3	IV Class Staff	5	45	225	90	135
4	Kitchen	L.S.		5,000	5,000	
A	**Total**	**210**		**32,900**	**21695**	**11205**
Girl's hostel						
1	Students	150	135	20,250	12150	8100
2	Warden & other staff	5	135	675	405	270
3	IV Class Staff	5	45	225	90	135
4	Kitchen	L.S.		5,000	5,000	
B	**Total**	**160**		**26150**	**17645**	**8505**
Married student's hostel						
1	Students	100	135	13,500	8100	5400
2	Warden & other staff	5	45	225	135	90
3	IV Class Staff	5	45	225	90	135
C	Total	110		13,950	8325	5625
Auditorium						
1	Visitors	900	15	13,500	5400	8100
2	Staff	10	45	450	180	270
3	IV Staff	10	45	450	180	270
D	**Total**	**920**		**14,400.00**	**5760**	**8640**
E	**TOTAL WATER DEMAND**			**87400**	**53425**	**33975**

TOTAL WATER REQUIREMENT FOR PHASE IV = 87,400 LITERS PER DAY

Water demand for Sports area & guest house is proposed to be considered in the same U.G. tank

Water demand for Sports & guest house- 30,000 liters per day

TOTAL WATER REQUIREMENT FOR PHASE IV+GUEST HOUSE+SPORTS = 117,400 LITERS PER DAY

Horticulture water requirement to be calculated at the rate of 5 liters per sqm per day.

Green area coverage = 13,400 sq.m @ 5 l/sq.m = 13400 x 5 l/sqm

= 67,000 Liters per day

Or Say Total = 70 KL

Quantity of Water Available after Sewage Treatment:

Waste water available	=	80% of 117,400 lpd
	=	**93,920 lpd**
Treated water available after Treatment	=	90% of 93,920 lpd
	=	**84,528 lpd**

2.2 Source of Water

2.2.1 Since municipal water supply 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. Although there are two tube wells existing on site, one near Academic area and another near residential area. Both tube wells are inter - connected by water supply line for domestic as well horticulture purposes. Minimum one no. bore well having a discharge of 15000 lph to be operated for 8-10 hours will be provided to fulfill the requirement. Approval of boring from the competent authority will be required.

2.2.2 Part of the water requirement will also be met by recycling the treated effluent from sewage treatment plant for horticulture purposes.

2.3 Storage

Considering minimum requirement of storage for one day (excluding for horticulture purpose), the capacity in underground tanks and overhead tanks shall be as follows:

Water Tanks

Under Ground Tank		
1	Fire Water Tank	100KL
2	Raw water tank (compartment 1)	100KL
3	Treated water tank (compartment 2)	100KL
Overhead Tank at Terrace Level for half day storage		
	Boy's hostel	
1	Fire Tank	25KL
2	For Domestic Water tank	20KL
	Girl's hostel	
1	Fire Tank	25KL
2	For Domestic Water tank	15KL
	Married hostel	
1	Fire Tank	25KL
2	For Domestic Water tank	7.5KL
	Auditorium	
1	Fire Tank	5KL
2	For Domestic Water tank	7.5KL

Location of U.G. tank marked on site plan enclosed at the end of report.

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.

However, as a standard, the water shall be passed through a chlorination prior to the supply to the buildings.

It is proposed to locate all the pumps and equipments in the underground pump room which shall accommodate all major pumps and equipments and electrical panels etc.

2.5 Water Supply System

2.5.1 Water from the sources will be brought into compartment No. 1, which will serve as a fire water storage tank. From fire tank water will overflow into compart no. 2 which will serve as raw water tank. Water from raw water tank shall be pumped by centrifugal pump of respective discharge and head for treatment, chlorination and then stored in Treated water tank compartment No. 3.

2.5.2 The compartment No. 3 termed as treated/domestic water tank shall supply water to overhead tanks. Pumps will be manually operated to fill in the tanks.

2.5.3 An under ground ring main shall be provided along the building periphery / boundary of the hostel & auditorium zone which will be connected directly to the bore well and Sewage Treatment Plant. Water will be pump by centrifugal pumping system arrangement for horticulture. Garden hydrants will be provided on the ring main.

2.5.4 Pump room of approximately size = 17 x 6 m shall be proposed nearby Underground Water tank. All pump and equipment for water treatment and supply system will be placed inside the pump room.

3. HOT WATER SYSTEM

It is suggested that a 9533 litres per day solar water heating system with an electrical backup may be provided on top of hostels to supply hot water to the toilets. Geysers to be provided for main kitchens.

4. MATERIALS FOR WATER SUPPLY

4.1. 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.

4.2. 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.

4.3 Valves on branches, main line and pumps shall have ball valve / butterfly valve of good approved quality, as per requirement.

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

5.1 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).

5.2 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

5.3 All soil, waste, vent & rain water pipes running vertically, shall be exposed and approachable, in vertical shafts as per architectural design.

5.4 No clean out plugs to be provided

5.5 All traps shall be with a minimum water seal of 50mm.

5.6 Materials

(a) All soil, waste, vent and anti-syphonage pipes and fittings 50mm and above shall be CI centrifugally cast.

6. SEWERAGE SYSTEM

6.1 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 be 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.

6.2 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 (For surface run off, subsoil water conditions etc.)	Add 8.33% of average discharge

(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. 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.

7.1 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/lit.

Available treated effluents from STP is 84,528 lpd

2 Nos. 45 kld STPs are proposed

The STP for phase-IV will be based on FAB technology.

7.2 PROCESS DESCRIPTION: FAB System

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 waslewater out of the plate/tube settler.

From the plate/tube settler, treated wastewater will flow by gravity into chorine contact tank where chorine 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 superannuate 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

8. RAIN WATER DISPOSAL

8.1 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 be overflow into the surface drain.

8.2 Surface Drainage:

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 have been incorporated to remove the silt, heavier particles and other objectionable material which can cause the 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 pond near boy's hostel.

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 gradiant 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**

9. RAIN WATER HARVESTING

- The main emphasis given in the planning of the storm water drainage system is on recharging the underground aquifer of the area while having the safe disposal of storm water without flooding the campus.
- A network of storm water disposal drains will be planned which will finally dispose off into a percolation well for direct injection of collected storm water into the ground water. Bar screens and silt traps have been incorporated before the percolation wells to remove the silt, heavier particles and other objectionable material which can cause the choking of the percolation well. Type of percolation wells etc. will be decided

after detailed hydrological and geological survey analysis results are obtained.

- The drainage system shall be led to various percolation wells catering to different parts of the catchments area. Silt traps will be provided at inlet to each percolation well. The overflow from percolation wells will be inter -connected and the overflow will be in the river flowing along the plot.

IMPORTANT INDIAN STANDARDS PLUMBING & SANITARY WORK TITLE

IS 651-1965	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 1536-1 976	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. Where-ever this specification calls for a higher standard of materials and/or workmanship then 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.

FIRE FIGHTING SERVICES

1.0 PREAMBLE

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.

1.1 AIM

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:

Building: Boys Hostel, Girls Hostel & Married students Hostel
Group-A: Residential (above 15m but not exceeding 35m in height)

Building: Auditorium
Group-D: Assembly buildings (Above 10 m but not exceeding 15m in height)

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

2.3 The proposed fire fighting shall be consisting of static U.G water storage tank of capacity 100 KL, with a provision of fire brigade inlet and suction connections with pump capacity 2280 l/m electrical as well diesel driven pump. Location of tank marked on site plan enclosed at the end of report.

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

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	Required	Provided
5	Down Comer	Not Required	Not Provided
6	Yard Hydrant	Required	Provided

7	Automatic Sprinkler System	Not Required	Provided only in Auditorium.
8	Manually Operated Electric Fire Alarm System	Required	Provided
9	Automatic Detection Alarm System	Required only in Auditorium	Provided only in Auditorium
10	Underground Static Water Storage Tank	Required (75 KL)	Provided 100 KL
11	Terrace Tank	Required	Provided
12	Pump Near UG Tank	Required	Provided
13	Pump at Terrace	Required	Provided

2.4 Vertical wet riser cum 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 over head tank and pump. Along with wet riser system, portable fire extinguishers are to be provided at all accessible positions.

2.5 An over head tank of 25000 l capacity and pump of 900 lpm @ 45 m head will also be provided for the building which come under Dormitories/apartment houses while the building coming under assembly will be provided with over head tank of 5000 l capacity and pump of 450 lpm @ 40 m head for firefighting system will be connected to the risers through a non-return valve and also connected to the suction of the pumps in the underground pump room.

2.6 A fire hose cabinet with complete fire fighting accessories shall be provided with following specifications:

- 2 nos., 63mm dia. and 15m long rubberized fabric lined hose pipe as per I.S:636 type-II.
- Gunmetal male and female instantaneous type coupling as per I.S:903 with I.S. specifications.
- Gunmetal branch pipe with nozzle as per I.S:903
- First-aid fire hose reels with 20mm dia. 30m long with 5mm bore gunmetal nozzle as per I.S:884 - 1969.
- Fireman's axe.

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

- 9 lit. water expelling type.
- 4.5 lt. CO2 Type.
- 5 kg ABC type.

- Dry chemical powder type of 1 0kg/5kg capacity.

2.8 Sprinkler system although not specified by NBC, we recommend sprinkler should be provided in Auditorium building for the safety purposes and casualty.

2.9 Sprinklers shall be provided in auditorium, each sprinkler covering an area of upto 100-120 sqft, & connected to the same pressurized system with provision for an automatic alarm system in case of activation. The sprinkler shall be automatically activated at a temperature of 57°C-68° C.

2.10 Also, upright sprinkler pendant shall be provided in the areas where the depth between the soffit of the main slab and the false ceiling is more than 750mm.

2.11 The delivery pipes for the sprinkler pumps and main fire pumps shall be interconnected.

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 1536-1 976	Horizontally cast iron pressure pipes for water, gas & sewage (first revision) (with Amendments No. 1 to 4)
IS 1554-1988 Part I	PVC insulated (heavy duty) electric cables (working voltage upto and including 1100 volts (third revision)
IS 1554-1988 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.

1.0 Introduction

1.1 General Project Information

Project Title: Punjab Institute of Technology, PHASE-IV.
Location of the Project: JALANDHAR, PUNJAB.
Description of the Project:
Type of Buildings: - RCC framed structure.

The buildings on site are primarily divided into four type of building having G+6 to G+8 floors. The description of each type of building along with no. of floor is given below.

S. No.	Name of Building	No. of floor
1	Boys hostel	G+8
2	Girls hostel	G+8
3	Married students hostel	G+6
4	Auditorium	G+1

1.2 Structural Design:-

The main considerations followed for the design of structure are:

(a) Structure safely 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 foolings are proposed for the Phase-IV. The safe gross allowable soil bearing capacity for isolated/combined foundation Size 4.0X4.0m is considered 26.34t/sqm at a depth of 3 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 Hostel building:

(a)	living rooms & Bed rooms	0.2 T / m^2
(b)	billiards room & public lounges	0.3 T / m^2
(c)	Store rooms	0.5T / m^2
(d)	Toilets and bathrooms	0.2 T / m^2
(e)	Kitchen, Laundries	0.3T / m^2
(f)	Corridors, passages, staircases including Fire escapes, lobbies, balconies	0.3T / m^2
(g)	Dining rooms, cafeterias and restaurants	0.4T / m^2
(h)	Office rooms	0.25T / m^2
(i)	Rooms for Indoor games	0.3T / m^2
(j)	Boiler room & Plant room	0.3T / m^2
(k)	Terrace	0.15 T / m^2 0.50 T/m^2 usable Terrace for services 0.5T / m^2

5.2 Auditorium Block

6.0 Seismic Load:

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

Design horizontal seismic coefficient (Ah) = $\frac{ZI\,Sa}{2Rg}$

Zone factor Z = 0.24 corresponding to zone IV.

Importance factor I = 1.5

Response reduction factor R = 5

(Sa/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: -
(Fy 250/ Fy 345)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 lable 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 deign 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	Warner, Rangan, Hall & Faulkes (Longman, 1998)
5	Reinforced Concrete Designers Handbook	Fourth Edition, Reynolds & Steedman
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. Dayaratanam
10	Prestress Concrete Structure	P. Dayaratanam
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 & Caull
15	Structural Analysis	C.S.Reddy

ANNEXURE-E

ABSTRACT OF ESTIMATED COST (CIVIL WORKS)			
SUBHEAD	**DESCRIPTION**		**AMOUNT (Rs.) CSR**
Sub-Head -No-I	Concrete Work	Rs	1,32,097
Sub-Head -No-II	Steel Work	Rs	47,37,038
Sub-Head -No-III	Plaster Work	Rs	1,93,921
Sub-Head -No-IV	Painting Work	Rs	7,38,479
Sub-Head -No-V	Dismantling Work	Rs	61,519
	TOTAL A		**58,63,053**
	ADD PROVISION FOR ESCALATION & VARIATION @7.5%		**2,93,153**
	TOTAL B		**61,56,206**
	Add 1.5% Contigency Charges as per MOU		**92,343**
	GRAND TOTAL A		**62,48,549**
	SAY		**62,48,549**
Rs. Sixty two lacs, Forty eight thousand, Five hundred & Forty nine only			

ESTIMATES

SL. NO.	Ref. No.	DESCRIPTION	UNIT	QUANTITY		Through Rate /MR /DSR-2012 Rate	Premium on CSR (%)	CSR with Premium /MR /DSR-2012 Rate	Amount (INR)		
				PITK	APST				PITK	APST	TOTAL
I		CONCRETE WORKS									
1	CSR 10.11	Cement Concrete 1:2:4 with stone ballast or shingle. (20mm gauge)	cum	25.65	6.55			4,102.39	1,05,226	26,871	1,32,097
		TOTAL OF CONCRETE WORKS							1,05,226	26,871	1,32,097
II		STEEL WORK									
1	CSR 18.4	Wrought iron and mild steel ladders, framed grills, grating etc. with ends of bars, riveted or welded or forged, framed window guards, barred iron doors, stair case, iron railing including cost of bolts and nuts or screws or welding rod, complete fixed in position.	qtl	439.36	119.21	6,894.90	23%	8,480.73	37,26,050	10,10,987	47,37,038
		TOTAL OF STEEL WORKS							37,26,050	10,10,987	47,37,038
III		PLASTER WORKS									
1	CSR 15.10	12.5 mm thick cement plaster 1:5	sqm	563.42	107.90			109.89	61,915	11,857	73,773
2	CSR 15.21	20mm thick cement plaster 1:5 in two coat work	sqm	563.42	107.90			148.22	83,509	15,993	99,502
3	CSR 15.75	Forming groove of uniform size from 12x12mm and upto 25x15mm in plastered surface as per approved pattern using wooden battens, nailed to the under layer including removal of wooden battens, repairs to the edges of plaster panel and finishing the groove complete as per specifications and direction of the Engineer-in-Charge.	m	874.08	167.40	14.16	40%	19.82	17,328	3,319	20,646
		TOTAL OF PLASTER WORKS							1,62,752	31,169	1,93,921
IV		PAINTING WORKS									
1	CSR 16.18	Painting two coats excluding priming coat with synthetic enamel paint in all shades on wood work, metallic or plastered, concrete surface to give an even shade.									
1.1	(a)	With special quality paint	sqm	1717.08	438.46	46.48	25%	58.10	99,762	25,475	1,25,237
2	CSR 16.21	Applying priming coat with metal primer on new steel or iron work including preparation of surface.									
2.1	(a)	With special quality paint	sqm	1717.08	438.46	13.79	25%	17.24	29,598	7,558	37,156
3	CSR 16.61	Finishing walls with premium Acrylic smooth exterior paint with silicon additives of required shade with two coats applied @1.43 litre/10 sqm over and including base coat of water proofing cement paint applied @ 2.20 Kg/10.	sqm	5634.17	1438.71	65.16	25%	81.45	4,58,903	1,17,183	5,76,086
		TOTAL OF PAINTING WORKS							5,88,264	1,50,215	7,38,479

SL. NO.	Ref. No.	DESCRIPTION	UNIT	QUANTITY		Through Rate /MR /DSR-2012 Rate	Premium on CSR (%)	CSR with Premium /MR /DSR-2012 Rate	Amount (INR)		
				PITK	APST				PITK	APST	TOTAL
V		DISMANTLING									
1	CSR 8.39	Dismantling of brick work in cement sand mortar / lime mortar including T&P scaffolding wherever necessary, sorting the dismantled material, disposal of unserviceable material. & staking the serviceable material with all lifts & lead of 100 metre (By Mechanical Means)	cum	25.65	6.55	207.34	75%	362.85	9,307	2,377	11,684
2	8.31	SCRAPING									
	(a)	White wash and colour wash	sqm	4507.33	-	2.52	75%	4.41	19,877	-	19,877
2.2	(c)	Cement Plaster.	sqm	1126.84	215.80	12.75	75%	22.31	25,143	4,815	29,958
		TOTAL OF DISMANTLING							54,327	7,192	61,519

S.NO	ESTIMATE BOUNDARY WALL - PITK Takeoff Sheets									
		NOS.	HEIGHT	WIDTH.	LENGTH	RMT/SQM	kg/ mtr/SQM	WEIGHT.IN (KG)		
1	BALUSTER (M.S BOX SEC.50X50X3)	3	2			6.00	4.39	26.34		
2	M.S FLAT (50X5)MM	4			1.20	4.80	1.96	9.408		
3	M.S PLATE (100X100X3)MM	6	0.1	0.1		0.06	23.6	1.416		
4	M.S BAR(16X16)MM	14			1.10	14.30	2.01	28.743		
5	SPIKE	14					0.5	7		
				2.5MTR RAILING WEIGHT (IN KG)				**72.907**		
				RAILING WEIGHT 1 METER				**29.16**		
				TOTA LENGTH OF RAILING				**1506.56**		
				TOTAL WEIGHT OF TOTAL RAILING				**439.36**		
		PANEL	HEIGHT	WIDTH	LENGTH	Nos	AREA			
6	**CEMENT CONCRETE**	607	0.23	0.35	0.175	3	25.65	CUM		
7	**PAINT**	607	1.7		2.500	1	2579.75			
		607	1.7		0.115	2	237.34			
							2817.087	SQMT	For One Side	
							5634.174	SQMT	For both side	
8	**PLASTER 20% OF PAINT**						0.000	SQMT		
	12.5 MM CEMENT PLASTER						563.417	SQMT		
	20MM CEMENT PLASTER						563.417	SQMT		
9	**GROVE**	607	1.2			4	2913.600			
		607	2.4			2	5827.200			
							8740.800	MTR.		
							874.080			
10	**PAINT WORK ON RAILING**									
	BALUSTER 50X50MM	607	0.2		1.8	3	655.56	SQMT		
	M.S FLAT 50X5MM	607	0.11		2.4	2	320.496	SQMT		
	M.S BAR 16X16 MM	607	0.064		1.1	14	598.2592	SQMT		
	SPIKES	8498	0.175		0.048	2	142.7664			
				TOTAL PAINT			1717.0816	SQMT		

S.NO	ESTIMATE BOUNDARY WALL - APST Takeoff Sheets									
		NOS.	HEIGHT	WIDTH.	LENGTH	RMT/SQM	kg/ mtr/SQM	WEIGHT.IN (KG)		
1	BALUSTER (M.S BOX SEC.50X50X3)	3	2			6.00	4.39	26.34		
2	M.S FLAT (50X5)MM	4			1.20	4.80	1.96	9.408		
3	M.S PLATE (100X100X3)MM	6	0.1	0.1		0.06	23.6	1.416		
4	M.S BAR(16X16)MM	14			1.10	14.30	2.01	28.743		
5	SPIKE	14					0.5	7		
				2.5MTR RAILING WEIGHT (IN KG)				72.907		
				RAILING WEIGHT 1 METER				29.16		
				TOTA LENGTH OF RAILING				408.76		
				TOTAL WEIGHT OF TOTAL RAILING				119.21		
		PANEL	HEIGHT	WIDTH	LENGTH	Nos	AREA			
6	CEMENT CONCRETE	155	0.23	0.35	0.175	3	6.55	CUM		
7	PAINT	155	1.7		2.500	1	658.75			
		155	1.7		0.115	2	60.61			
							719.355	SQMT	For One Side	
							1438.710	SQMT	For both side	
8	PLASTER 15% OF PAINT						107.903			
	12.5 MM CEMENT PLASTER						107.903			
	20MM CEMENT PLASTER									
9	GROVE	155	1.2			4	744.000			
		155	2.4			2	1488.000			
							2232.000	MTR.		
							1116.000			
							167.400			
10	PAINT WORK ON RAILING									
	BALUSTER 50X50MM	155	0.2		1.8	3	167.4	SQMT		
	M.S FLAT 50X5MM	155	0.11		2.4	2	81.84	SQMT		
	M.S BAR 16X16 MM	155	0.064		1.1	14	152.768	SQMT		
	SPIKES	2170	0.175		0.048	2	36.456			
				TOTAL PAINT			438.464	SQMT		

DETAIL OF RATES OF ITEMS OF BOUNDARY WALL FOR PTU KAPURTHALA

Decription of item	CSR RATE					Consumption of material							Extra carriage beyond 5 Kms						Difference in Rates as per Premium List				Total
	CSR refrence	Unit	Basic Rate	Premium	Total Rate	Cement	Local Sand	Coarse Sand	Bajri	Brick Ballast	Bricks	Tiles	Local Sand	Coarse Sand	Bajri/ Stone Ballast	Brick Ballast	Bricks	Tiles	Coarse Sand	Bajri	Bricks	Tiles	
													154.69	346.84	386.77	0.00	0.0000	0.0000	-17.38	-66.72	0.3131	0.3535	
													Cum	Cum	Cum	Cum	Nos:	Nos:	Cum	Cum	Nos:	Nos:	
													Amount		Amount		Amount	Amount	Amount	Amount	Amount	Amount	
						Bags	Cum	Cum	Cum	Cum	Nos	Nos	0.00	174.04	312.61	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4013.890
Cement concrete 1:2:4 with stone ballast 20mm	10.11	Cum	2799.75	26%	3527.69	6.5	0	0.45	0.9														88.50
Extra for using Conc Mixer volumetric type where not including in the rate	10.46	Cum	75.00	18%	88.50								0.00										4102.39
Total		Cum	2874.75	0.44	3616.19	6.50	0.00	0.45	0.90				0.00	174.04	312.61	0.00	0.00	0.00	0.00	0.00	0.00	0.00	109.89
12.5 mm thick cement plaster 1:5 on walls	15.10	Sqm	76.18	40%	106.65	0.094	0.016						3.24	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	148.22
20mm thick cement plaster 1:5 on walls in two coat work	15.21	Sqm	103.22	40%	144.51	0.14	0.024						3.71	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	

ANNEXURE-F

ABSTRACT OF COST (Civil Works)

Name of Project :Proposed Construction of Boundary wall at Punjab Institute of Technology, Mansa, Punjab

SUBHEAD	DESCRIPTION		AMOUNT (Rs.) DSR	AMOUNT (Rs.) NDSR
Sub-Head -No-I	Earth Work	Rs	254,351.95	-
Sub-Head -No-II	Concrete Work	Rs	515,531.95	1,327,681.16
Sub-Head -No-III	Reinforced Concrete Work	Rs	3,584,074.81	-
Sub-Head -No-IV	Stone Work	Rs	479,219.26	-
Sub-Head -No-V	Steel Work	Rs	1,558,410.95	-
Sub-Head -No-VII	Finishing Work	Rs	1,958,737.67	18,858,555.52
	TOTAL		8,350,326.59	20,186,236.68
	Add cost index for Jalandhar on DSR 2007 @ 49%		4,091,660.03	-
	TOTAL		12,441,986.62	20,186,236.68
A	TOTAL (Updated DSR+NS)		32,628,223.30	
B	Add 4% WCT on A		1,305,128.93	
C	TOTAL with WCT (A+B)		33,933,352.23	
D	Add Service Tax 10.3% of 33% of C		1,153,394.64	
E	TOTAL with Service Tax (C+D)		35,086,746.88	
F	**GRAND TOTAL**		**35,086,746.88**	

BILL OF QUANTITIES

Name of Project :Proposed Construction of Boundary wall at Punjab Institute of Technology, Mansa, Punjab

SL. NO.	DSR NO.	DESCRIPTION	UNIT	RATE (RS)	QUANTITY	AMOUNT (RS) DSR	AMOUNT (RS) NS
I		EARTH WORK					
1	2.6	Earth work in excavation by mechanical means (Hydraulic excavator)/ manual means over areas including disposal of excavated earth, lead upto 50m and lift upto 1.5m, disposed earth to be levelled and neatly dressed (Plan area to be measured)					
1.1	2.6.1	All kinds of soil	cum	101.85	2062.00	210,014.70	
2	2.25	Filling available excavated earth (excluding rock) in trenches, plinth, sides of foundations etc. in layers not exceeding 20cm in depth, consolidating each deposited layer by ramming and watering, lead up to 50 m and lift upto 1.5 m.	cum	45.70	922.00	42,135.40	
3	1.1	Carriage of materials by mechanical transport including loading, unloading and stacking for lead of :					
3.1	1.1.2	Earth	cum	6.99	315.00	2,201.85	
3.1.1		1 Km					
		TOTAL OF EARTH WORKS				254,351.95	-
II		CONCRETE WORKS					
1	4.1	Providing and laying in position cement concrete of specified grade excluding the cost of centring and shuttering - All work upto plinth level :					
1.1	4.1.3	1:2:4 (1 cement : 2 coarse sand : 4 graded stone aggregate 20 mm nominal size)	cum	3257.45	6.26	20,407.75	
1.2	4.1.8	1:4:8 (1 Cement : 4 coarse sand : 8 graded stone aggregate 40 mm nominal size).	cum	2449.00	182.52	446,980.71	
2	4.5	Providing and fixing upto floor five level precast cement concrete string or lacing courses, copings, bed plates, anchor blocks, plain window sills, shelves, louvers, steps, stair cases, etc. including hoisting and setting in position with cement mortar 1:3 (1 Cement : 3 coarse sand), cost of required centring, shuttering and finishing smooth with 6mm thick cement plaster 1:3 (1 Cement : 3 fine sand) on exposed surfaces complete.					

Architects.
Archigroup Architects (Regd.)

SL. NO.	DSR NO.	DESCRIPTION	UNIT	RATE (RS)	QUANTITY	AMOUNT (RS) DSR	AMOUNT (RS) NS
2.1	4.5.1	1:2:4 (1 cement : 2 coarse sand : 4 graded stone aggregate 20mm nominal size).	cum	4814.35	10.00	48,143.50	
3	4.7	Providing and fixing upto floor five level precast cement concrete solid block including hoisting and setting in position with cement mortar 1:3 (1 cement : 3 coarse sand), cost of required centring, shuttering and finishing smooth with 6mm thick cement plaster 1:3 (1 cement : 3 fine sand) on exposed surfaces complete :					
3.1	4.7.1	1:2:4 (1 cement : 2 coarse sand : 4 graded stone aggregate 20mm nominal size).	cum	5300.00	250.51		1,327,681.16
		TOTAL OF CONCRETE WORKS				515,531.95	1,327,681.16
III		REINFORCED CEMENT CONCRETE					
1	5.1	Providing and laying in position specified grade of reinforced cement concrete excluding the cost of centring, shuttering, finishing and reinforcement - All work upto plinth level :					
1.1	5.1.2	1:1½:3 (1 cement : 1½ coarse sand : 3 graded stone aggregate 20 mm nominal size)	cum	3732.00	136.00	507,552.00	
1.2	5.1.3	1:2:4 (1 cement : 2 coarse sand : 4 graded stone aggregate 20 mm nominal size)	cum	3359.60	288.51	969,630.64	
2	5.3	Reinforced cement concrete work in beams, columns, suspended floors, roofs having slope upto 15° landings, balconies, shelves, chajjas, lintels, bands, plain window sills, staircases and spiral stair cases upto floor five level excluding the cost of centring, shuttering, finishing and reinforcement with 1:2:4 (1 cement : 2 coarse sand : 4 graded stone aggregate 20 mm nominal size).	cum	3673.85	82.00	301,255.70	
3	5.9	Centring and shuttering including strutting, propping etc. and removal of form for :					
3.1	5.9.1	Foundations, footings, bases of columns, etc. for mass concrete.	sqm	119.25	492.93	58,781.43	
3.2	5.9.5	Lintels, beams, plinth beams, girders, bressumers and cantilevers.	sqm	162.65	308.69	50,209.16	
3.3	5.9.6	Columns, Pillars, Piers, Abutments, Posts and Struts.	sqm	238.40	1035.99	246,980.87	

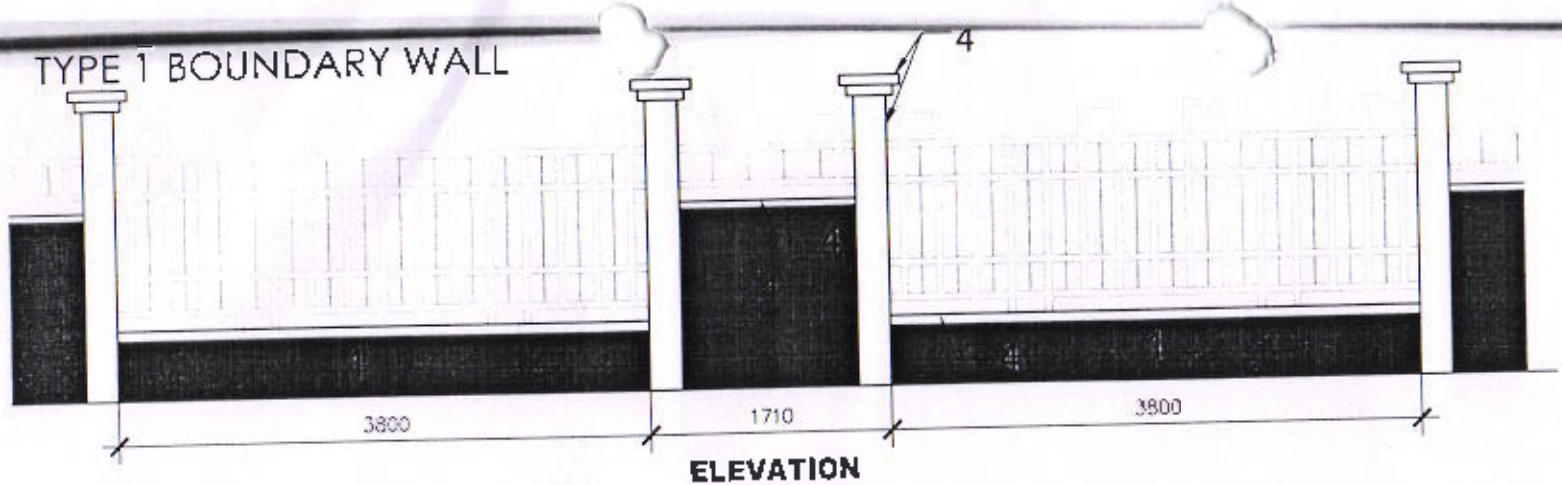
SL. NO.	DSR NO.	DESCRIPTION	UNIT	RATE (RS)	QUANTITY	AMOUNT (RS) DSR	AMOUNT (RS) NS
4	5.22	Reinforcement for R.C.C. work including straightening, cutting, bending, placing in position and binding all complete.					
4.1	5.22.6	Thermo-Mechanically Treated bars.	kg	42.70	33950.00	1,449,665.00	
		TOTAL OF REINFORCED CEMENT CONCRETE WORKS				**3,564,074.61**	-
IV		**STONE WORKS**					
1	7.23	Stone work (machine cut edges) for wall lining etc. (veneer work) including V groove, backing filled with a grout of 12mm thick cement mortar 1:3 (1 cement : 3 coarse sand) including pointing in white cement mortar 1:2 (1 white cement : 2 stone dust) with an admixture of pigment matching the stone shade :					
1.1	7.23.1.5	30mm thick	sqm	966.20	495.98	479,219.26	
		TOTAL OF STONE WORKS				**479,219.26**	-
V		**STEEL WORK**					
1	10.2	Structural steel work riveted, bolted or welded in built up sections, trusses and framed work, including cutting, hoisting, fixing in position and applying a priming coat of approved steel primer all complete:	kg	46.35	1223.00	56,686.05	
2	10.25	Steel work welded in built up sections/ framed work including cutting, hoisting, fixing in position and applying a priming coat of approved steel primer using structural steel etc. as required.					
2.1	10.25.2	In gratings, frames, guard bar, ladder, railings, brackets, gates and similar works.	kg	51.20	6887.00	352,614.40	
3	10.26	Providing and fixing hand rail of approved size by welding etc. to steel ladder railing, balcony railing and staircase railing including applying a priming coat of approved steel primer.					
3.1	10.26.1	M.S. tube	kg	62.35	18430.00	1,149,110.50	
		TOTAL OF STEEL WORKS				**1,558,410.95**	-

Construction of Boundary wall at
Punjab Institute of Technology, Mansa

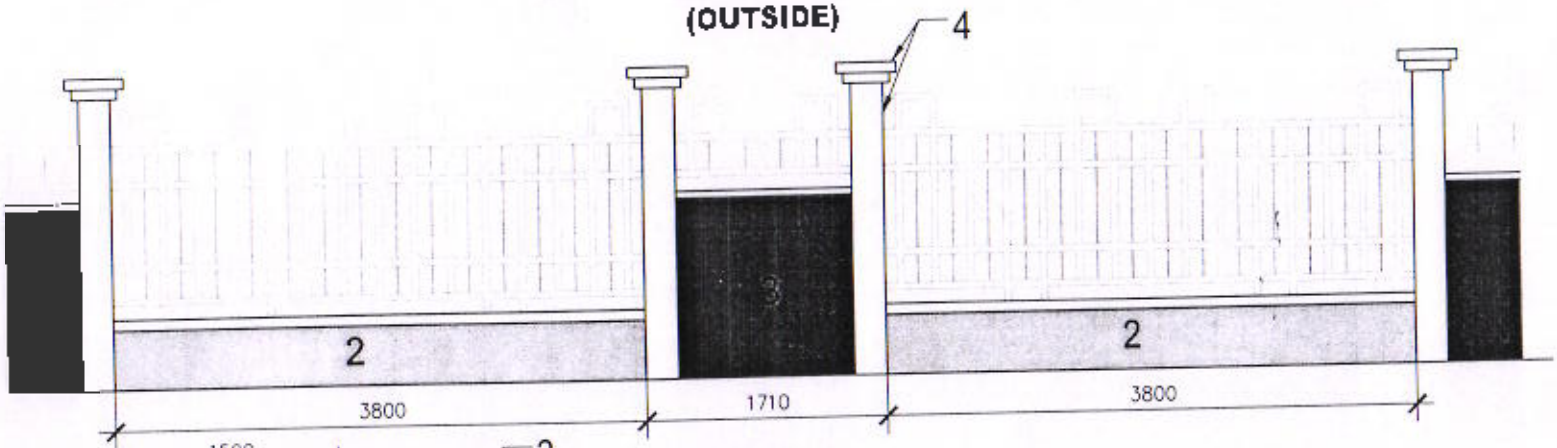
SL. NO.	DSR NO.	DESCRIPTION	UNIT	RATE (RS)	QUANTITY	AMOUNT (RS) DSR	AMOUNT (RS) NS
VI		FINISHING WORKS					
1	13.16	6 mm cement plaster of mix :					
1.1	13.16.1	1:3 (1 cement : 3 fine sand)	sqm	62.15	1591.88	98,935.24	
2	13.62	Painting with synthetic enamel paint of approved brand and manufacture of required colour to give an even shade:					
2.1	13.62.1	Two or more coats on new work over an under coat of suitable shade with ordinary paint of approved brand and manufacture.	sqm	51.30	1730.07	88,752.69	
3	13.45	Finishing walls with textured exterior paint of required shade :					
3.1	13.45.1	New work (Two or more coats applied @ 3.28 ltr/10 sum) over and including base coat of water proofing cement paint applied @ 2.20kg/10 sum.	sqm	96.25	18400.52	1,771,049.74	
4	NS	Finishing walls with Rustic textured exterior paint of required shade :					
4.1		New work (Two or more coats applied @ 3.28 ltr/10 sum) over and including base coat of water proofing cement paint applied @ 2.20kg/10 sum.	sqm	287.45	856.37		246,161.34
5	NS	Providing and fixing 2500 mm high boundary wall - 100 mm thick in brick finish texture panel consists of RCC Precast Concrete Post of size 300mm X 300mm X 3500 mm Height, having two grooves of size 115 X 50mm, so as to receive 2 Nos. Precast Concrete RCC Panels of size 2500mm X 1250mm X 100 mm thickness The post is reinforced with 4 Nos. 12 mm dia Tor Bars and 2 Nos. 8mm dia Tor Bars with 6mm dia stir-ups @ 150mm c/c, Panels are reinforced with 13 Nos. longitudinal bars of 8mm. dia Tor Steel & 25 Nos. 8 mm dia Tor Bars along the height manufactured by using M-30 grade of concrete. The post shall be fixed as per architectural drawing complete.	rmt	5407.44	3442.00		18,612,394.17
		TOTAL OF FINISHING WORKS				1,958,737.67	18,858,555.52

Architects:
Archigroup Architects (Regd.)

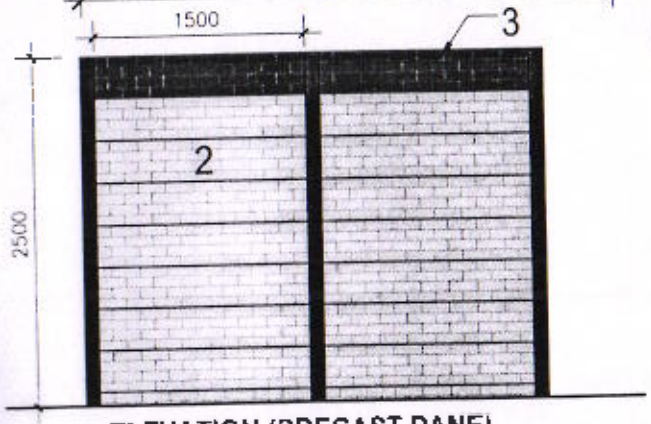
TYPE 1 BOUNDARY WALL



ELEVATION (OUTSIDE)



ELEVATION (INSIDE)



ELEVATION (PRECAST PANEL BOUNDARY WALL (OUTSIDE)

TYPE 2 BOUNDARY WALL

LEGEND

NO.	FINISH
1	REDSANDSTONE
2	RUSTIK TEXTURE FINISH WITH DULUX EXTERIORS ORANGE PEKOE 00YY 67/212 SHADE
3	TEXTURE PLAIN FINISH WITH DULUX EXTERIORS CHARRED CLAY 30YR 17/341 SHADE
4	TEXTURE PLAIN FINISH WITH DULUX EXTERIORS TUSK TUSK 30YY 79/070 SHADE

UNIVERSITY

KEY PLAN

CONSTRUCTION NOTES:

NO.	REFERENCES	
1	KEY PLAN	REMAINS/SHEET NO
2	KEY PLANS & TYPE 2 DETAILS	REMAINS/SHEET NO
3	TYPE 1 DETAILS	REMAINS/SHEET NO
4	TYPE 1 & GATE DETAILS	REMAINS/SHEET NO

GENERAL NOTES:

REVISIONS			
	R-3		
	R-4		
	R-5	27.06.14	REVISED AS PER TYPE 1 & 2
	R-2	13.06.14	ENTRANCE GATE REVISED
	R-1	30.05.14	
	No.	DATE	DESCRIPTION
SUBMISSIONS	5		5
	4	19.06.14	SE PTU (IVth SUB)
	3	13.06.14	SE PTU (3rd SUB)
	2	10.06.14	SE PTU (2nd SUB)
	1	03.04.14	SE PTU (1st SUB)
	No.	DATE	DESCRIPTION

WORKING DRAWING

PROJECT: PUNJAB INSTITUTE OF TECHNOLOGY, MANSA

OWNER: PUNJAB TECHNICAL UNIVERSITY

ARCHITECT: Archigroup Architects (regd.)

BOUNDARY WALL SITE -1,2 & 3

WALL FINISHES

DRG No: PIT/MANS/ WD/BW/01A

SCALE	DATE	DRAWN
1:35	27.06.14	PRERNA

OWNER | ARCHITECT