

QUARTERLY PROGRESS REPORT (QPR-2)

(Please go through the detailed SOP before filing this Form)

1.	PARTICULARS OF THE REAL ESTATE PROJECT		
Sr. No.	Particulars	Details	
1.1	Name of the Real Estate Project	AURAMAH VALLEY	
1.2	Phase of the Real Estate Project	PHASE – II	
1.3	Name of the Promoter	MANAVINDER SINGH	
	Name of the Co- Promoter(s) *Add more rows to disclose all co- promoters **The land owner, (if not a promoter), will mandatory be a co-promoter / one of the co-promoters, if there are more than one co-promoters in the phase / project and so on	N/A	
1.4	Total area of the Real Estate Project / Phase	18214.0 Sq.m	
1.5	Location of the Real Estate Project	Village Tikkar, P.O. Durga Pur Naldehra, Shimla (H.P.) – 171007	
1.6	Type of the Real Estate Project or Phase of the Real Estate Project	Residential Plotted Colony (NA)	
		Residential Development Project (Yes)	Residential Development Project (Yes)
		Commercial Development Project (NA)	
		Mix Land Use Development Project (NA)	
1.7	Registration No. of the Real Estate Project b. Registration number of TCP	RERAHP SHP08170003 HIM/TP/LIC - 17/2014 Dated 09/06/2014 &	
1.8	Validity of Registration Certificate (RERA)	Valid from 19/08/2017	Valid up to 17/08/2022

	(TCP)	09/06/2014	08/06/2017
1.9	Date of Start of the Real Estate Project / Phase	31/01/2015	
1.10	SPECIFICATIONS (As finalized by Promoter for the Real Estate Project)		
-	Particulars	Details (Attach Sheets & Documents)	
a.	Individual Plots	NA	
b.	Apartments/ Flats	Detailed specifications of all items ,copy to be attached as Annexure 1B	
c.	Cottage/ Villa	Not Provisioned	
d.	Commercial Units (Not Started)	Detailed specifications of all items ,copy to be attached as Annexure 1D	
e.	Garages / Parking Slots (Covered) (Not Started)	Detailed specifications of all items, copy to be attached as Annexure 1 E	
f.	Community Buildings	Detailed specifications of all items ,copy to be attached as Annexure 1F	
g.	Common facilities and services like swimming pool, gym, club, recreational areas indoor and outdoor, (separately for all facilities and services), complete specifications of external development works like boundary wall and gates in a gated community project, flooring, ceiling, wall surfaces etc. of public areas. (Club House with the facilities is under construction)	Detailed specifications of all items ,copy to be attached as Annexure 1G	
1.11	AGREEMENT(S) TO SELL		
-	Particulars	Attach sheets/ Documents	
a.	Performa of ‘Agreement for sale’ for Plots / Flats or Apartments / Villas or Cottages / Garage or Covered Parking / Commercial Units “ Form L ” as provided in HP RERA Rules, 2017	Copy to be attached (Annexure 2)	
b.	An undertaking stating that all the	The undertaking to be provided	

	<p>Agreements to sell are absolutely in accordance with the format provided in HP Real Estate (Regulation and Development) Rules, 2017 and carpet area of the unit for sale is in accordance with the definition of Carpet Area as specified in the Real Estate (Regulation and Development) Act, 2016 and HP Real Estate (Regulation and Development) Rules, 2017. It should also include that the payment terms with the Allottee are also in accordance with the terms as specified in the HP Real Estate (Regulation and Development) Rules, 2017 read with Explanation at Sr. No.2 of Form 'L', particularly with regards to the clause of taxes and making it clear that there are no hidden clauses.</p> <p><u>The format of the undertaking, Annexure 3 is provided in the detailed SOP provided along with this form.</u></p>	<p>duly signed by the promoter on the letter head of the firm and should be named (Annexure 3)</p>	
1.12	Quarter for which information is provided	Quarter ending (tick mark)	
		31 st MAR, 2022	<input type="checkbox"/>
		30 th JUNE 2022	Yes
		30 th SEPT, 2021	<input type="checkbox"/>
		31 st DEC, 2021	<input type="checkbox"/>
2.	BANK DETAILS (Account separately opened for 70% / 100% of amount realized from Allottees)		
2.1	Account No.	0160002100026312	
2.2	Account Name	CLUB ONE ESTATES	
2.3	Bank Name	Punjab National Bank	
2.4	Branch Name	Nizamuddin West, NEW DELHI-110013	
2.5	IFSC Code	PUNB0016000	
2.6	Branch Address	Nizamuddin West, NEW DELHI-110013	
3	DETAILS OF THE INVENTORY OF THE PROJECT		

3.1	Total Plot Booking Details								
No									
Providean indicative schematic sketch on A-4 size of paper- SCHEME SKETCH-1									
3.2	Details of Individual Plots								
*Increase no. of rows to submit details of all plots for Sr.No. 3.2. Note- 1 sqm. =10.76 sft. **Providean indicative schematic sketch on A-4 size of paper SCHEME SKETCH-2									
3.3	Total Flats/ Apartments Booking Details								
	From Date	To Date	Total Flats/ Apartments (Nos)	Total Flats/ Apartments Booked/Sold previously till the end of previous Quarter (Nos)	Total Flats/ Apartments Booked/Sold in this Quarter (Nos)	Total remaining Flats/ Apartments (Nos)			
	Beginning	June 22	208	19	5	184			
* Providean indicative schematic sketch on A-4 size of paper SCHEME SKETCH-3									
3.4	Details of Individual Flats/ Apartments								
	From	To Date	Detail of Total Flats/ Apartments Booked / Sold till the end of this Quarter				Poss ession Status	Mortgage If any, Flat/ Apartm ent wise	
			Block /Tower / No. as per sanctioned plan	Flat / Apartment Name / No.	Carpet Area (Sqm)	Area of exclusive balcony, if any (Sqm)	Area of exclusive terrace, if any (Sqm)		
	Begin ning	June 22	IRIS 2 BHK	G-A	125			NA	NA
				G-B	125				
				1-A	125				
				1-B	125				
*Increase / decrease no. of rows according to the number of Flats in the block / building. Note- 1 sqm. =10.76 sft.									
			IRIS 2 BHK	2-A	161.83 sq. mtr				
				2-B	161.83 sq. mtr				
				3-A	161.83 sq. mtr				
				3-B	161.83 sq. mtr				
				4-A	327.78 sq. mtr				
				4-B	327.78 sq. mtr				
			Hydrangea	GF-A	139.41 Sq.Mtr				
				4 A	197.49 Sq.Mtr.				

				GF -B	139.41 Sq.Mtr					
				I A	139.41 Sq.Mtr					
				2 A	139.41 Sq.Mtr					
				2 B	139.41 Sq.Mtr					
				3 A	139.41 Sq.Mtr					
				1B	139.41 Sq.Mtr					
				3 B	139.41 Sq Mtr.					
			Magnolia	2 A	139.41 Sq.Mtr					
				1A	139.41 Sq.Mtr					
				1B	139.41 Sq.Mtr					
				3A	139.41 Sq.Mtr					
				3B	139.41 Sq.Mtr					
		<div>*Add more no. of blocks/ towers in accordance with the approved number of blocks/ towers as in the latest sanctioned plans to mark the details of all approved flats/Apartments</div> <div>** Providean indicative schematic sketch on A-4 size of paper SCHEME SKETCH-4</div>								
3.5	Brief Details of All Villas / Cottages									
	From	To Date	Total Villas/ Cottages (Nos)	Villas/ cottages booked / sold previously (Nos)	Villas/ Cottages booked / sold in this Qtr (Nos)	Rema ining Villas/ Cottage (Nos)	Carpet Area of Villa / Cottage (Sqm)	Area of exclusi ve lawn / terrace if any, (Sqm)	Pos sess ion Status	Mort gage If any, Villa/ Cotta ge wise
	Begin ning	June 22	Not Provisi oned							
<div>*Providean indicative schematic sketch on A-4 size of paper SCHEME SKETCH-5</div> <div>Note- 1 sqm. =10.76 sft.</div>										

3.6	Details of Garages / Parkings (Covered)									
	From Date	To Date	Total Garages/ Parking (Nos)	Garages booked /sold previously (Nos)	Garages booked /sold In this Qtr (Nos)	Remaining Garages (Nos)				
	Beginning	June 22		0	0					
*Providean indicative schematic sketch on A-4 size of paper SCHEME SKETCH-6										
3.7	Details of Individual Garages/ Parkings									
	From Date	To Date	Detail of total Garages / Parkings sold / booked till the end of this Quarter					Posse ssion Status	Mortgage If any, Garage/ Covered Parking Wise	
	Beginni ng	June 22	(e.g Block-1)							
			*Increase / decrease no. of rows according to the number of flats in the block/ building. Note- 1 sqm. =10.76 sft.							
			(e.g Block-2)							
			* Keep adding more no. of blocks/ towers in accordance with thesanctioned number of blocks/ towers as in the latest sanctioned plans							
**Providean indicative schematic sketch on A-4 size of paper SCHEME SKETCH-7										
3.8	Details of Commercial Buildings									
	From Date	To Date	Total Commercial. Units/Shops (Nos)	Commercial Units /Shops booked / sold previously (Nos)	Commercial Units / Shops booked / sold in this Qtr (Nos)	Remaining Commercial Units/Shops (Nos)				
	Beginning	June 22	NIL	NIL	NIL	NIL				
*Providean indicative schematic sketch on A-4 size of paper SCHEME SKETCH-8										
3.9	Details of Individual Commercial Units (Shops/ Offices/Others)									
	From Date	To Date	Detail of Total Commercial Units booked / sold till the end of this Quarter					Posse ssion Status	Mortgage If any , Commerci al Unit wise	
			Block/ Tower / No. as per sanctioned plan	Commer cial Unit / Shop No.	Type Shop/ Office/ Other	Carpet Area (Sqm)	Addition al detail, if any			
	Beginning	June 22	(e.g Block-1)					NIL		

			*Increase / Decrease no. of rows according to the number of flats in the block/ building. Note- 1 sqm. =10.76 sft.						
			(e.g Block-2)						NIL
			*Keep adding more no. of blocks/ towers in accordance with the sanctioned number of blocks/ towers as in the latest sanctioned plans						
	**Provide an indicative schematic sketch on A-4 size of paper SCHEME SKETCH-9								
4.	STATUS OF PHYSICAL COMPLETION OF WORKS								
4.1	Details of status of Plotted Development (Nomenclature as per Sanctioned Plan)								
	Plot No.	Residential / Commercial / other Use	% of completion	Likely completion date			Remarks		
							NA		
	* Increase no. of rows to submit details of all plots for Sr.No 4.1 To be marked on layout plan schematic Sketch on A-4 size of Paper SCHEME SKETCH-10								
4.2	Details of status of Completion of Work in Case of Flats/ Apartments (Nomenclature as per Sanctioned Plan)								
	Block/Tower wise details		% of completion	Likely completion date			Remarks		
	Block 1		100						
	Block 2		10%	December 2023					
	Remaining Blocks			December 2023					
	*Add more rows to mark the details of all blocks/ towers accommodating all Flats/Apartments ** To be marked on layout plan schematic Sketch on A-4 size of Paper SCHEME SKETCH-11								
4.3	Details of status of Completion of Work in Case of Villas /Cottages (Nomenclature as per Sanctioned Plan)								
	Villa / Cottage wise details		% of completion	Likely completion date			Remarks		
							Not Provisioned		
	*Add more rows to mark the details of all Villas / Cottages ** To be marked on layout plan schematic Sketch on A-4 size of Paper SCHEME SKETCH-12								
4.4	Details of status of Completion of Work in Case of Garages/ Covered Parking (Nomenclature as per Sanctioned Plan)								
	Garage/ Covered Parking wise details		% of completion	Likely completion date			Remarks		
	Garage/Covered parking-1		0						
	*Add more rows to mark the details of all Garage/ Parking ** To be marked on layout plan schematic Sketch on A-4 size of Paper SCHEME SKETCH-13								

4.5	Details of status of completion work in case of Blocks/ Shops/ Commercial Units (Nomenclature as per Sanctioned Plan)			
	Tower / Block / Shop wise details	% of completion	Likely completion date	Remarks
	Commercial Unit / shop - 1	0	Dec 2023	
	*Add more rows to mark the details of all Commercial Units ** To be marked on layout plan schematic Sketch on A-4 size of Paper SCHEME SKETCH-14			
5.	STATUS OF COMPLETION OF INFRASTRUCTURE DEVELOPMENT			
	Components	% of completion	Likely completion date	Remarks
5.1	A-Services			
i.	Roads and Pavements	75	2022	
ii.	Parking	0	2022	
iii.	Water Supply	100	Completed	
iv.	Sewerage	90	2022	Done for existing units, new units will be connected as and when they are built
v.	Electrification	75	2022	PAC received electricity will be provided as new blocks are made.
vi.	Storm Water Drainage	91	2022	Done for existing units new units drainage will be connected as and when they are built
vii.	Parks and Play Grounds	50	2022	Made for unites delivered
viii.	Street Light	100	Completed	
ix.	Renewable Energy System	0	2022	
x.	Security and Fire Fighting Services	85	2022	
xi.	Sewerage Treatment	0	2022	Inadequate

	Plant (STP)			quantum for STP. Thus, using septic tanks.
xii.	Underground Tank	100	Completed	
xiii.	Rain Water Harvesting	100	Completed	Common Filter plants equipped.
xiv.	Electrical Sub-Station	55	2022	Applied for
5.2	*B1–Community building to be transferred to Resident Welfare Association (RWA)			
i.	Community Centre	0	NA	
ii.	Others	NA	NA	
5.3	*B2–Community building to be sold to third party or to be retained by Promoter			
i.	Schools	NA	NA	
ii.	Club House	0	2023	Retained by Promoter
iii.	Hospital and Dispensary	NA	NA	
iv.	Shopping Areas	NA	NA	
v.	Others	NA	NA	
	<p>* Buildings under B1 and B2 are interchangeable and buildings shall be as per sanctioned plan of the Real Estate Project**</p> <p>To be marked on layout plan schematic Sketch on A-4 size of Paper SCHEME SKETCH-15</p>			
6.	FINANCIAL PROGRESS (COST AND EXPENDITURE ON THE PROJECT)			
Sr. No.	Particulars	Amount (in Rs.)		
6.1	Total estimated cost of the Project Copy should be attached (Annexure 5)	6176.50 Lacs		
6.2	Components of expenditure	Estimated expenditure incurred up to the start of Quarter	Estimated expenditure incurred up to the end of Quarter	Estimated balance Cost

I	Cost of the land (if not included in the estimated cost)					
li	Estimated Cost of construction of apartments / commercial area / Mixed use development	405.72	427.74	4204.63		
iii	Estimated Cost of infrastructure and other structures/community facilities	117.64	124.98	1419.15		
Iv	Other costs including External Development Charges (EDC), Internal Development Charges (IDC), Taxes, Levies, Cess etc.					
-	TOTAL	523.36	552.72	5623.78		
6.3	(i) Total estimated expenditure incurred till the end of Quarter under reference	552.72				
	(ii) Expenditure of total estimated cost in %	8.95 %				
6.4	Whether the project is on schedule as per the actual expenditure.	YES				
	(i) Specify the reasons, if not as per schedule	NA				
	(ii) Mention details on how to overcome the backlog	NA				
7.	DETAILS OF FINANCIAL TRANSACTIONS IN SEPARATE BANK ACCOUNT					
	Amount in Lakhs (Rs.) Status in Separate Bank Account of this Quarter					
	From Date	To Date	Balance amount before this Quarter (Rs.)	Amount deposited in this Quarter (Rs.)	Amount withdrawal in this Quarter (Rs.)	Total remaining amount (Rs.)
	1.4.22	30.6.22	0.53	285.08	264.77	20.84
8.	GOVERNMENT DUES AND PAYMENT DETAILS					
	Description of Head			Amount (in Rs.)	Image of Receipt (jpeg)	
8.1	Development fee / Planning Permission Fee / Change of Land Use fee etc.					

8.2	Infrastructure charges/ fees paid to any other authority e.g. NH/PWD/HPSEB/PCB/ULB for NOC		
8.3	Compounding Charges/ Regularization charges		
8.4	Total		-
9.	DETAILS OF SANCTION AND REVISED / COMPLETION SANCTION		
	Type of Sanction (Proposal / Revised/ Completion)	Order No	Date
			No. of pages of Sanction Letter
			Total no. of Sanctioned Plans
			Image / Pdf of all pages of Sanction Letter and Plans (jpeg/Pdf)
9.1	Revised	HIM/TCP(S)case no. 208-09	03.06.2019
9.2			
Note. Copy of Original/ first Sanction to be submitted along with first quarterly progress report of the project in the manner as described above, at serial no. 9 and all subsequent sanctions,if any, in the descending order. Add more rows if needed.			
10.	MISCELLANEOUS		
10.1	List of Channel Partners(HP RERA Registered Agents)		
	Channel Partner's Name		HP RERA Registration No.
	i.	NA	
*Add more rows to enter details of all channel partners/ Agents associated with the Real Estate Project			
10.2	List of Legal Cases (if any)		
	Project	Name of Parties and Case No.	Issue involved (in brief)
	Next date of hearing and its status		
	i.	NA	
	ii	NA	
	iii	NA	
* Add more rows to enter details of all legal cases before all Forums			
10.3	Summary of Allottees and Sale Report during the Quarter		
	Sr. No.	Unit No. and parking No. if any	Name of the Allottee
			Date of booking
			Rate (per Sft.) of main unit and of parking, if allotted
			Carpet Area of the Unit and of parking, if allotted
			Sale value of Unit including parking, if
			Amount collected
			Total amount Collected (in Lac)

							allotted	(in %)	
	1	3 B-Hydrangea	Kamal Rampuria	20.6.22	6375	1500 Sqr Feet	95.62	9.58 %	9.16
	2	1A-Magnolia	Praveer Kumar	16.6.22	8800	1500 Sqr Feet	132.04	9.69 %	12.80
	3	1B- Magnolia	Neha Harneja	27.6.22	8627	1500 Sqr Feet	129.40	3.68%	4.76
	4	3A- Magnolia	Kartikay Saini	30.5.22	9857	1500 Sqr Feet	139.70	9.86%	13.77
	5	3 B-Magnolia	Kartikay Saini	30.5.22	9857	1500 Sqr Feet	139.70	9.86%	13.77
	* Add more rows to enter details of all bookings in the Quarter. Note- 1 sqm. =10.76 sft.								
10.4	Latest marketing collateral, if any						https://fb.me/qOZ1lpjSjxlQRcC		
10.5	Copy of latest advertisement details, if any						https://fb.me/1UAeinJ3WzWCrEg		

Note. — (*) Extend as required

11.	LATEST SITE UPDATE THROUGH MEDIA GALLERY							
11.1	Plots							
Sr. No.	From Date	To Date	Image 1 Jpeg	Image 2 Jpeg	Image 3 Jpeg	Image 4 Jpeg	Image 5 Jpeg	Video (only on website)
	April22	June 22	NA					
11.2	Flats / Apartments							
	April22	June 22	www.auramahvalley.com					
11.3	Villas / Cottages							
	April22	June 22	NA					
11.4	Commercial Units (Shops, Offices, Others etc)							
	April22	June 22	NA					
11.5	Facilities like Swimming Pool, Club House, Gym , Central Greens, Parking etc.							

	April 22	June 22						
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*Extend, if Required

12.	VARIOUS ANNEXURES AND CERTIFICATES BY PROFESSIONALS TO BE SUBMITTED	
12.1	Detailed Specifications for each prototype of plot, flat, cottage, shop/ commercial units etc.	Annexure- 1A to 1G and so on
12.2	Typical performa of Agreement of Sale for each prototype of plot, flat, cottage, shop/ commercial units, "Form L" of HP RERA Rules, 2017	Annexure 2
12.3	Undertaking with Agreement for Sale	Annexure -3
12.4	Inventory detail Schematic Sketches 1 to 9,	Annexure -4A
12.5	Development, construction and financial progress Schematic sketches 10 to 15	Annexure -4B
12.6	Detailed Cost of Estimate	Annexure -5
12.7	Certificate by an Architect in practice to certify progress of construction work of the project at the end of the quarter, to be submitted to HP RERA	Annexure -6
12.8	Certificate by an Engineer in practice to certify cumulative cost incurred upon construction work of the project at the end of the quarter, to be submitted to HP RERA	Annexure -7
12.9	Certificate by a Chartered Accountant in practice to certify withdrawal of money from separate Bank Account at the end of the quarter, to be submitted to HP RERA	Annexure – 8
12.10	Certificate by an Architect in practice to certify progress of construction work at the time of withdrawal of money from Separate Bank Account, to be submitted to the Bank	Annexure – 9
12.11	Certificate by an Engineer in practice to certify cumulative cost incurred upon construction work of the project at time of withdrawal of money from Separate Bank Account, to be submitted to the Bank	Annexure -10
12.12	Certificate by a Chartered Accountant in practice to certify withdrawal of money from Separate Bank Account at the end of the quarter, to be submitted to the Bank	Annexure -11

12.13	Certificate by an Architect in practice to certify the completion of works, to be issued to the Authority after the completion plan of the project has been sanctioned by the competent authority, to be submitted to HP RERA	Annexure -12
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Place: SHIMLA

Date: 08.08.2022

(Name of the authorized Signatory of the Project)

Manavinder Singh

S/o. Sh. Mukhinder Singh

R/o. Vilette Kothi, Khalini, Shimla 171002



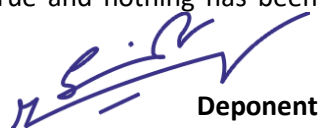
Club One Estates

Annexure 3 of QPR(Apr' 22 – June'22)

UNDERTAKING

I Sh. Manvinder Singh (Owner) S/o Sh.Mukhinder Singh, R/o Villette Kothi, Khalini, Shimla (H.P.) do hereby solemnly affirm & declare as under:-

1. That I, as a Promoter, have been developing a Real Estate Project by the name "AURAMAH VALLEY" coming up on Khasra Nos No150,220, 221, 224, 226, 227, 228, 229, 230, 231, 236, 237, 238, 239, 240, 241, 242, 243, 244, 245, 247 & 248 at Mauza / Mohal- Village Tikker P.O. Durgapur, Tehsil and District- Shimla, Pin Code- 171203 Himachal Pradesh.
2. That an "Agreement for sale" is to be entered into with every Allottee in accordance with the provisions of the Himachal Pradesh Real Estate (Regulation and Development) Rules, 2017 and Regulation No R-2 of the Himachal Pradesh Real Estate Regulatory Authority, for every plot and built up units like Flat / Apartment/ Villa / Cottage / Garage/ Commercial Unit as provided for in **Annexure 2**.
3. That the said "Agreement for sale" has been entered into with the Allottees in " **Auramah Valley** " Real Estate Project coming up have come up on Khasra No150,220, 221, 224, 226, 227, 228, 229, 230, 231, 236, 237, 238, 239, 240, 241, 242, 243, 244, 245, 247 & 248 at Mauza / Mohal- Village Tikker P.O. Durgapur, Tehsil and District- Shimla, Pin Code- 171203 Himachal Pradesh, being developed by Sh. Manvinder Singh (Owner).
4. That the signed/ entered into "Agreement for sale" for plots and built-up units are absolutely in accordance with the **FORM "L"** as appended with in the Himachal Pradesh Real Estate (Regulation and Development) Rules 2017 (**Annexure 3 of current QPR**) as provided under Regulation No R-2 of the Himachal Pradesh Real Estate Regulatory Authority. The carpet area of the unit for sale has been specified in accordance with the definition of Carpet Area as defined under clause 2(k) of section 2 of the Himachal Pradesh Real Estate (Regulation and Development) Act, 2016.The area of the plot as well as of built-up unit is as per the sanctioned plans.
5. That the payment terms with the Allottee is also in accordance with the terms as provided clearly in "Explanations" provided under "Terms" in Form L, covenants of Agreement for Sale, appended with the Himachal Pradesh Real Estate (Regulation and Development) Rules, 2017 particularly with regards to the clause of taxes and there are no hidden clauses .
6. That the contents of my above undertaking from para 1 to 5 are true and nothing has been concealed.


Deponent



BAAS PROJECTS SERVICES

L-11, 2ND FLOOR, DDA Flat, Sarita Vihar
New Delhi-110076

Mob: 9868466256, 9868028568

Email: baasprojects@gmail.com

Ref:RERA/AURA/BS/Q2/06

Dated:06.08.2022

ANNEXURE-6

ARCHITECT'S CERTIFICATE

(To be submitted at the time of Quarter update of the Project)

(Quarter: April'22 to June'22)

To,

Sh. Manavinder Singh, Vilette Kothi, Khalini, Shimla (H.P.) (OWNER)

Subject:- Certificate of progress of work, Percentage of Completion of Development / Construction work in "AURAMAH VALLEY" (Phase-II) bearing Registration No. RERAHPSP08170003, HIM/TP/LIC - 17/2014 Dated 09/06/2014

Sir,

I, NITIN GAUTAM have undertaken assignment as Architect for the professional architectural services for the above cited Project , coming up on Khasra No150, 220, 221, 224, 226, 227, 228, 229, 230, 231, 236, 237, 238, 239, 240, 241, 242, 243, 244, 245, 247 & 248, kita 22 at Mauza / Mohal- Village Tikker P.O. Durgapur, Tehsil and District- Shimla, Pin Code- 171203 Himachal Pradesh, being developed by Sh. Manvinder Singh (Owner).

Based on Site Inspection, with respect to the aforesaid Real Estate Project, I certify that as on the date of this Certificate, the Percentage of Work done, for the Real Estate Project **AURAMAH VALLEY**, is as per **Table-A** herein below. The percentage of the work executed with respect to each of the activity of the entire phase is detailed in **Table-B** herein below-



BAAS PROJECTS SERVICES

L-11, 2ND FLOOR, DDA Flat, Sarita Vihar

New Delhi-110076

Mob: 9868466256,9868028568

Email: baasprojects@gmail.com

***TABLE A**

License No.HIM/TP-Lic.17/2014-1588-1626 dated 09.06.2014

Sr. No.	Tasks / Activity	Total Units / Blocks	Work done for Units / Blocks	Percentage of Work done
1	Foundation and Plinth	208 Units+ 20Hotel Units	26Units+ 20 Hotel Units	100% 100%
2	Basement			
3	Super Structure (Column and lintel up to Slab bottom Level)		26 Units + 20 Hotel Units	100% 40%
4	Slabs		26 Units+ 20 Hotel Units	100%
5*	Internal task/activities to each of the Flat/ Premises - (i) Bricks wall (ii) Joinery (doors and windows) (iii) Plaster (iv) Flouing (v) Painting		26 Units	100%
6	Sanitary fitting within the Flat/Premises, Electrical Fittings within the Flat/Premises		10 Units 16 Units under progress	100%
7	Stair cases, Lifts Wells and Lobbies at each Floor level connecting Staircases and Lifts, Overhead and Underground Water Tanks		10 Units 16 Units under progress	100%
8	The external plumbing, external plaster, external painting, elevation and completion of terraces with		10 Units 16 Units under progress	100%



BAAS PROJECTS SERVICES

L-11, 2ND FLOOR, DDA Flat, Sarita Vihar

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Email: baasprojects@gmail.com

	water proofing of the Building / Wing			
9	Installation of Lifts, Water Pumps, Fire Fighting Fittings and Equipment, Electrical fittings to Common Areas, Electro – Mechanical equipments, Compliance to conditions of environmental NOCs (if any), Finishing to entrance lobby, plinth protection, paving of areas appurtenant to Building, Compound Wall and all other requirements as may be required to obtain Occupation /Completion Certificate		10 Units+ 16 Units under progress	100%

***Note** – The above percentages of all items should be mentioned which is only to assess the physical progress of the project only.



BAAS PROJECTS SERVICES

L-11, 2ND FLOOR, DDA Flat, Sarita Vihar
New Delhi-110076

Mob: 9868466256, 9868028568

Email: baasprojects@gmail.com

TABLE-B

Internal & External Development Works in respect of the entire Project

Sr. No	Common Areas Facilities and Amenities	Proposed (Yes/No)	Percentage of Work Done	Details
1.	Internal Roads & Foot paths	Yes	90%	As per Drawing
2.	Water Supply Line	Yes	90%	As per Drawing
3.	Sewerage (chamber, lines, Septic Tank)	Yes	92%	As per Drawing
4.	Sewage Treatment Plant (STP)	Yes		As per Drawing
5.	Storm Water Drains	Yes	92%	As per Drawing
6.	Landscaping & Tree Planting	Yes	90%	As per Drawing
7.	Street Lighting	Yes	100%	As per Drawing
8.	Community Buildings/ Club House	Yes	90%	As per Drawing
9.	Solid Waste Management & Disposal	Yes		As per Drawing
10.	Water conservation, Rain Water Harvesting	Yes	93%	As per Drawing
11.	Energy Management / Sub-station	Yes	85%	As per Drawing
12.	Fire protection and fire safety requirements	Yes		As per Drawing
13.	Open area (Park)	Yes	90%	As per Drawing
14.	Boundary Wall & Main Gate	Yes	85%	As per Drawing
15.	Security Service	Yes	90%	As per Drawing

16.	Others (As per Brochure) (Option to add more)	NA	NA	NA
-----	--	----	----	----

***Note** – The above percentages of all items should be mentioned to assess the physical progress of the project only.

TABLE C
Overall percentage of the work completed

Sr. No.	Particular	Total No. of Unit / Amenities	Work Done No. of Unit / Amenities	Percentage of Work Done
1.	Overall percentage of construction (Building) completed as per Table-A.	208 Units	10 Units +16 Units under progress	9.23 %
2	Overall percentage of development completed as per Table-B.			8.09%
3*	Overall percentage of completion of the project			8.95 %

***Note** – The above percentages should be mentioned to assess the physical progress of the project only.

Place: New Delhi

Ar.NITIN GAUTAM

(Council of Arch. Regn.
No.....

NITIN GAUTAM
 Architect Town Planner
 B. Arch. MCP, MCOA, ..
 CA No. 2002/29475



BAAS PROJECTS SERVICES

L-11, 2ND FLOOR, DDA Flat, Sarita Vihar
New Delhi-110076
Mob: 9868466256, 9868028568
Email: baasprojects@gmail.com

Ref:RERA/AURA/BS/Q2/08

Dated:06.08.2022

ANNEXURE-9

ARCHITECT'S CERTIFICATE

(To be submitted at the time of Quarter update of the Project)
(Quarter April 2022 to June 2022)

To,

Sh. Manavinder Singh, Villette, Khalini, Shimla (H.P.) (OWNER)

Subject:- Certificate of progress of work, Percentage of Completion of Development / Construction work in "AURAMAH VALLEY" (Phase-II) bearing Registration No. RERAHPSP08170003, HIM/TP/LIC - 17/2014 Dated 09/06/2014

Sir,

I, NITIN GAUTAM have undertaken assignment as Architect for the professional architectural services for the above cited Project, coming up on Khasra No150,220, 221, 224, 226, 227, 228, 229, 230, 231, 236, 237, 238, 239, 240, 241, 242, 243, 244, 245, 247 & 248, kitta 22 at Mauza / Mohal- Village Tikker P.O. Durgapur, Tehsil and District- Shimla, Pin Code- 171203 Himachal Pradesh, being developed by Sh. Manvinder Singh (Owner).

With respect to the aforesaid Real Estate Project, I certify that the percentage of work done, for the Development / Construction work of Real Estate Project "AURAMAH VALLEY", is 8.95 % as worked out in the quarterly Progress Report submitted vide Certificate (copy enclosed).

Place: Delhi

Ar.NITIN GAUTAM

(Council of Arch. Regn.

No.....

NITIN GAUTAM
Architect Town Planner
B. Arch. MCP, MCOA, ..
CA No. 2002/29475



BAAS PROJECTS SERVICES

L-11, 2ND FLOOR, DDA Flat, Sarita Vihar
New Delhi-110076
Mob: 9868466256, 9868028568
Email: baasprojects@gmail.com

Ref:RERA/AURA/BS/Q2/10

Dated: 06.08.2022

ANNEXURE- 12

ARCHITECT'S CERTIFICATE

(To be submitted at the time of Quarter update of the Project)

(Quarter: April'22 to June'22)

To,

Sh. Manavinder Singh, Vilette, Khalini, Shimla (H.P.) (OWNER)

**Subject:-Certificate for Partial Completion of Construction /Development work in
"AURAMAH VALLEY" (Phase-II) bearing Registration No RERAHPSP08170003,
HIM/TP/LIC - 17/2014 Dated 09/06/2014**

Sir,

I, NITIN GAUTAM have undertaken assignment as Architect for the professional architectural services for the above cited Project , coming up on Khasra No150,220, 221, 224, 226, 227, 228, 229, 230, 231, 236, 237, 238, 239, 240, 241, 242, 243, 244, 245, 247 & 248, kita 22 at Mauza / Mohal- Village Tikker P.O. Durgapur, Tehsil and District- Shimla, Pin Code- 171203 Himachal Pradesh, being developed by Sh. Manavinder Singh (Owner).

- 1 Based on Site Inspection, with respect to the aforesaid Real Estate Project, I certify that as on the date of this Certificate, and based on applied for Completion Certificate from Engineer and Site Supervisor and to the best of my /our knowledge, I / We hereby certify that the Real Estate Project,

AURAMAH VALLEY has been completed partially in all aspects and is fit for occupancy for which it has been erected/re-erected / constructed and enlarged.

2. The Real Estate Project **AURAMAH VALLEY** is applied for partial completion Certificate (Copy attached) to TCP, Shimla

Place: Delhi


NITIN GAUTAM
Architect Town Planner



BAAS PROJECTS SERVICES

L-11, 2ND FLOOR, DDA Flat, Sarita Vihar
New Delhi-110076
Mob: 9868466256, 9868028568
Email: baasprojects@gmail.com

Ref:RERA/AURA/PH-II/Q2/07

Dated:06.08.2022

ANNEXURE-7

ENGINEER'S CERTIFICATE

(To be submitted at the time of Quarter update of the Project)
(Quarter: April 2022 to June 2022)

To,

Sh. Manavinder Singh, Vilette Kothi, Khalini, Shimla (H.P.) (OWNER)

Subject:- Certificate of estimated expenditure for Development/ Construction work in "AURAMAH VALLEY" (Phase -II) bearing RERA Registration No. RERAHPSP08170003, HIM/TP/LIC - 17/2014 Dated 09/06/2014

Sir,

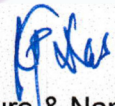
I, Kalyan Prasun Das have undertaken assignment as Engineer for the professional engineering services for the above cited Project, coming up on Khasra No.150,220, 221, 224, 226, 227, 228, 229, 230, 231, 236, 237, 238, 239, 240, 241, 242, 243, 244, 245, 247 & 248, kita 22 at Mauza / Mohal- Village Tikker P.O. Durgapur, Tehsil and District- Shimla, Pin Code- 171203 Himachal Pradesh, being developed by Sh. Manvinder Singh (Owner).

1. I have prepared the Detailed Cost of Estimate of the above cited project considering all items of works that are required to be executed up to completion of the project. My estimated cost calculations are based on the sanctioned plans made available to me for the project by the Promoter and based on the Schedule of Items and quantity for the entire work as calculated by me and the site inspection carried out by me.

2. I certify that the Cost of the Civil, Mechanical, Electrical, Plumbing and allied works for the aforesaid Project, as completed on the date of this Certificate is as given in **Table-A** and **Table-B** herein below:

Place: New Delhi


KALYAN PRASUN DAS
B. TECH (CIVIL ENGS.), MBA (FIN.)
CHARTERED ENGINEER (INDIA)
Regd. : M 1699290


Signature & Name of the Engineer
Chartered Engineer(India)
(Membership No. M- 1699290)
Certificate No. 019044



BAAS PROJECTS SERVICES

L-11, 2ND FLOOR, DDA Flat, Sarita Vihar
New Delhi-110076

Mob: 9868466256, 9868028568

Email: baasprojects@gmail.com

TABLE-A

Apartments/Buildings Construction (Excluding Cost of land)

Sr. No	Particulars	Amounts (In Rs)
(i)	(ii)	(iii)
1	Total Estimated Cost	4632.375 LAKH
2	Cost incurred as on dated 30 th June'2022 (based on the Estimated items)	427.74 LAKH
3	If Cost incurred for items other than estimated items	
4	Balance Cost to be incurred (Based on Estimated items) $[A(1)(iii)-(A(2)(iii)+A(3)(iii))]$	4204.635 LAKH
5	Work done in percentage $[A(2)(iii)+A(3)(iii)/A(1)(iii)] \times 100$ (as percentage of the estimated cost)	9.23%



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L-11, 2ND FLOOR, DDA Flat, Sarita Vihar
New Delhi-110076

Mob: 9868466256, 9868028568

Email: baasprojects@gmail.com

TABLE-B

Internal and External Development (Excluding Cost of land)

Sr. No	Particulars	Amounts (In Rs)
(i)	(ii)	(iii)
1	Total Estimated Cost of the internal and external development works including amenities and facilities in the layout as on date 30th June 2022	1544.125 LAKH
2	Cost incurred as on date 30 th June 2022 (based on the Estimated items)	124.98 LAKH
3	If cost incurred for items other than Estimated items	
4	Balance cost to be incurred (based on estimated items) $[B(1)(iii) - (B(2)(iii) + B(3)(iii))]$	1419.265 LAKH
5	Work done in percentage $[B(2)(iii) + B(3)(iii) / B(1)(iii)] \times 100$ (as percentage of the estimated cost)	8.09 %



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New Delhi-110076

Mob: 9868466256, 9868028568


Email: baasprojects@gmail.com

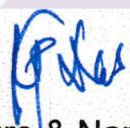
TABLE-C

(Overall Estimated Cost / Incurred)

Sr. no.	Particular	Amount (In Rs)
(i)	(ii)	(iii)
1	Total Estimated Cost [Table A(1)(iii)+Table B(1) (iii)]	6176.50 LAKH
2	Total Cost incurred [TableA(2)(iii)+A(3)(iii)+Table B (2)(iii) +Table B (3) (iii)]	552.72 LAKH
3	Total work done in percentage	8.95%
4	The balance cost to complete the project	5623.90 LAKH

Place: New Delhi


KALYAN PRASUN DAS
B. TECH (CIVIL ENGG.), MBA (FIN.)
Partner
CHARTERED ENGINEER (INDIA)
Regd. : M 1699290


Signature & Name of the Engineer
Chartered Engineer(India)
(Membership No. M- 1699290)
Certificate No. 019044



BAAS PROJECTS SERVICES

L-11, 2ND FLOOR, DDA Flat, Sarita Vihar
New Delhi-110076
Mob: 9868466256, 9868028568
Email: baasprojects@gmail.com

Ref:RERA/AURA/BS/PH-II/Q2/09

Dated:06.08.2022

ANNEXURE-10

ENGINEER'S CERTIFICATE

(To be submitted at the time of Quarter update of the Project)
(Quarter: April 2022 to June 2022)

Sh. Manavinder Singh, Vilette Kothi, Khalini, Shimla (H.P.) (OWNER)

Subject:- Certificate of estimated expenditure for Development/ Construction work in
"AURAMAH VALLEY" (Phase -II) bearing RERA Registration **RERAHPSP08170003**,
HIM/TP/LIC - 17/2014 Dated 09/06/2014

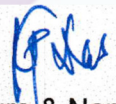
Sir,

I, Kalyan Prasun Das have undertaken assignment as Engineer for the professional engineering services for the above cited Project, coming up on Khasra No.150,220, 221, 224, 226, 227, 228, 229, 230, 231, 236, 237, 238, 239, 240, 241, 242, 243, 244, 245, 247 & 248, kita 22 at Mauza / Mohal- Village Tikker P.O. Durgapur, Tehsil and District- Shimla, Pin Code- 171203 Himachal Pradesh, being developed by Sh. Manvinder Singh (Owner).

With respect to the aforesaid Real Estate Project, I certify that the total estimated expenditure/ cost incurred for the Development/ Construction work of Real Estate Project "**AURAMAH VALLEY**" is Rs 29.36 LAKH as worked out in the same as Quarterly Progress Report submitted vide Certificate (copy enclosed).

Place: New Delhi


KALYAN PRASUN DAS
B. TECH (CIVIL ENGG.), MBA (FIN.)
CHARTERED ENGINEER (INDIA)
Regd. : M 1699290


Signature & Name of the Engineer
Chartered Engineer(India)
(Membership No. M- 1699290)
Certificate No. 019044

Finishing Schedule for Phase- II block

(FOR IRIS(2 BHK Unit) & CLUB Building)

SL.NO	LOCATION	FLOORING	WALL FINISHES	CEILING	SKIRTING/ DADO
-------	----------	----------	---------------	---------	----------------

The building is designed as per the "state-of-the-art" Intelligent building, energy smart, green, efficient building technology. Smart building solutions, energy efficiency, building performance, user-centric buildings. Increasing performance. Power of Data. Optimal use of resources in Sustainable development.

- A. **Civil Structural work**
RCC in Foundation
- B. **Superstructure in Pre- Engineered Steel Building(PEB)**
- C. **Partition in Light Gauge Framing System(LGFS)**
- D. **Galvalume steel corrugated roofing including drain board,insulation and heat protected system**

	GROUND FLOOR				
1	STAIR CASE	GRANITE STONE IN TREAD	OIL BOND DISTEMPER	WOOD POLYMER COMPOSIT(WPC) PANEL CEILNG	150MM HIGH GRANITE STONE
2	STAIR CASE	WOODEN PLANK IN RISER	OIL BOND DISTEMPER	WOOD POLYMER COMPOSIT(WPC) PANEL CEILNG	150MM HIGH GRANITE STONE

Finishing Schedule for Phase- II block

(FOR IRIS(2 BHK Unit) & CLUB Building)

SL.NO	LOCATION	FLOORING	WALL FINISHES	CEILING	SKIRTING/ DADO
3	LIVING/ DINING HALL	WOODEN FLOORING	WASHABLE ACRYLIC EMULSION PAINT WITH ANTIBACTERIAL PAINT	DESIGNER PLASTER OF PARIS (POP) FALSE CEILING/PLYWOOD CEILING WITH LAMINATE FINISH	150MM HIGH WOODEN PROFILE MATCH WITH FLOORING
4	MASTER BED ROOM	WOODEN FLOORING	WASHABLE ACRYLIC EMULSION PAINT WITH ANTIBACTERIAL PAINT	DESIGNER PLASTER OF PARIS (POP) FALSE CEILING/PLYWOOD CEILING WITH LAMINATE FINISH	150MM HIGH WOODEN PROFILE MATCH WITH FLOORING
5	BED ROOM	WOODEN FLOORING	WASHABLE ACRYLIC EMULSION PAINT WITH ANTIBACTERIAL PAINT	DESIGNER PLASTER OF PARIS (POP) FALSE CEILING/PLYWOOD CEILING WITH LAMINATE FINISH	150MM HIGH WOODEN PROFILE MATCH WITH FLOORING
6	KITCHEN(Modular finishes)	WOODEN FINISH VITRIFIED TILE	WASHABLE ACRYLIC EMULSION PAINT WITH ANTIBACTERIAL PAINT	DESIGNER PLASTER OF PARIS (POP) FALSE CEILING/PLYWOOD CEILING WITH LAMINATE FINISH	150MM HIGH WOODEN COLOUR MATT FINISH VITRIFIED TILE
7	TOILET-1	VITRIFIED TILE NON-SKIDING TYPE	VITRIFIED TILE CLADDING TILL BOTTOM OF FALSE CEILING	WOOD POLYMER COMPOSIT(WPC) PANEL CEILNG	VITRIFIED TILE CLADDING TILL BOTTOM OF FALSE CEILING
8	TOILET-2	VITRIFIED TILE NON-SKIDING TYPE	VITRIFIED TILE CLADDING TILL BOTTOM OF FALSE CEILING	WOOD POLYMER COMPOSIT(WPC) PANEL CEILNG	VITRIFIED TILE CLADDING TILL BOTTOM OF FALSE CEILING
9	TOILET-1 & 2	GRANITE TOP VANITY COUNTER WITH MIRROR AND ALL SS FINISH BATH ASSESSORIES			

Finishing Schedule for Phase- II block

(FOR IRIS(2 BHK Unit) & CLUB Building)

SL.NO	LOCATION	FLOORING	WALL FINISHES	CEILING	SKIRTING/ DADO
10	TOILET-1 & 2	10MM THICK TOUGHENED GLASS SHOWER PARTITION			
11	SHAFT FOR TOILET-1 & 2	CONCRETE FLOORING	CEMENT PAINT	POLYMER SHEET TRANPARANT ROOF	CONCRETE SKIRTING 150MM HIGH
12	BALCONY-1 FOR LIVING ROOM	VITRIFIED TILE WOODEN COLOUR MATT FINISH TYPE	WASHABLE ACRYLIC EMULSION PAINT WITH ANTIBACTERIAL PAINT	WOOD POLYMER COMPOSIT(WPC) PANEL CEILNG	150MM HIGH WOODEN COLOUR MATT FINISH VITRIFIED TILE
13	BALCONY-1 & 2	1 M HIGH STAIN LESS STEEL TOUGHENED GLASS RAILING			
14	BALCONY-2 FOR BED ROOM	VITRIFIED TILE WOODEN COLOUR MATT FINISH TYPE	WASHABLE ACRYLIC EMULSION PAINT WITH ANTIBACTERIAL PAINT	WOOD POLYMER COMPOSIT(WPC) PANEL CEILNG	150MM HIGH WOODEN COLOUR MATT FINISH VITRIFIED TILE
15	COMMON PASSAGE	WOODEN FLOORING	WASHABLE ACRYLIC EMULSION PAINT WITH ANTIBACTERIAL PAINT	DESIGNER PLASTER OF PARIS (POP) FALSE CEILING/PLYWOOD CEILING WITH LAMINATE FINISH	150MM HIGH WOODEN PROFILE MATCH WITH FLOORING
16	LIFT LOBBY	GRANITE FLOORING	OIL BOND DISTEMPER	WOOD POLYMER COMPOSIT(WPC) PANEL CEILNG	150MM HIGH GRANITE STONE
17	LIFT LOBBY- ARCHITRAVE		WOODEN PANELLING	WOOD POLYMER COMPOSIT(WPC) PANEL CEILNG	150MM HIGH GRANITE STONE

Finishing Schedule for Phase- II block

(FOR IRIS(2 BHK Unit) & CLUB Building)

SL.NO	LOCATION	FLOORING	WALL FINISHES	CEILING	SKIRTING/ DADO
18	ALL WOODEN DOORS	WOODEN DOOR: HARD WOOD FRAME WITH 40MM THICK LAMINATED WOODEN FLUSH DOOR INCLUDING BRASS HARDWARE ASSESSORIES			
19	ALL WOODEN WINDOWS	WOODEN WINDOWS: HARD WOOD WINDOW FRAME WITH GLAZED WOODEN STYLED WINDOW WITH BRASS HARDWARE ASSESSORIES			
20	ALL WARDROBE	WOODEN WARDROBE: HARD WOOD FRAME WOODEN WARDROBE WITH BRASS HARDWARE ASSESSORIES			
	1ST FLOOR				
1	STAIR CASE	GRANITE STONE IN TREAD	OIL BOND DISTEMPER	WOOD POLYMER COMPOSIT(WPC) PANEL CEILNG	150MM HIGH GRANITE STONE
2	STAIR CASE	WOODEN PLANK IN RISER	OIL BOND DISTEMPER	WOOD POLYMER COMPOSIT(WPC) PANEL CEILNG	150MM HIGH GRANITE STONE
3	LIVING/ DINING HALL	WOODEN FLOORING	WASHABLE ACRYLIC EMULSION PAINT WITH ANTIBACTERIAL PAINT	DESIGNER PLASTER OF PARIS (POP) FALSE CEILING/PLYWOOD CEILING WITH LAMINATE FINISH	150MM HIGH WOODEN PROFILE MATCH WITH FLOORING
4	MASTER BED ROOM	WOODEN FLOORING	WASHABLE ACRYLIC EMULSION PAINT WITH ANTIBACTERIAL PAINT	DESIGNER PLASTER OF PARIS (POP) FALSE CEILING/PLYWOOD CEILING WITH LAMINATE FINISH	150MM HIGH WOODEN PROFILE MATCH WITH FLOORING

Finishing Schedule for Phase- II block

(FOR IRIS(2 BHK Unit) & CLUB Building)

SL.NO	LOCATION	FLOORING	WALL FINISHES	CEILING	SKIRTING/ DADO
5	BED ROOM	WOODEN FLOORING	WASHABLE ACRYLIC EMULSION PAINT WITH ANTIBACTERIAL PAINT	DESIGNER PLASTER OF PARIS (POP) FALSE CEILING/PLYWOOD CEILING WITH LAMINATE FINISH	150MM HIGH WOODEN PROFILE MATCH WITH FLOORING
6	KITCHEN(Modular finishes)	WOODEN FINISH VITRIFIED TILE	WASHABLE ACRYLIC EMULSION PAINT WITH ANTIBACTERIAL PAINT	DESIGNER PLASTER OF PARIS (POP) FALSE CEILING/PLYWOOD CEILING WITH LAMINATE FINISH	150MM HIGH WOODEN COLOUR MATT FINISH VITRIFIED TILE
7	TOILET-1	VITRIFIED TILE NON-SKIDING TYPE	VITRIFIED TILE CLADDING TILL BOTTOM OF FALSE CEILING	WOOD POLYMER COMPOSIT(WPC) PANEL CEILNG	VITRIFIED TILE CLADDING TILL BOTTOM OF FALSE CEILING
8	TOILET-2	VITRIFIED TILE NON-SKIDING TYPE	VITRIFIED TILE CLADDING TILL BOTTOM OF FALSE CEILING	WOOD POLYMER COMPOSIT(WPC) PANEL CEILNG	VITRIFIED TILE CLADDING TILL BOTTOM OF FALSE CEILING
9	TOILET-1 & 2	GRANITE TOP VANITY COUNTER WITH MIRROR AND ALL SS FINISH BATH ASSESSORIES			
10	TOILET-1 & 2	10MM THICK TOUGHENED GLASS SHOWER PARTITION			
11	SHAFT FOR TOILET-1 & 2	CONCRETE FLOORING	CEMENT PAINT	POLYMER SHEET TRANPARANT ROOF	CONCRETE SKIRTING 150MM HIGH
12	BALCONY-1 FOR LIVING ROOM	VITRIFIED TILE WOODEN COLOUR MATT FINISH TYPE	WASHABLE ACRYLIC EMULSION PAINT WITH ANTIBACTERIAL PAINT	WOOD POLYMER COMPOSIT(WPC) PANEL CEILNG	150MM HIGH WOODEN COLOUR MATT FINISH VITRIFIED TILE

Finishing Schedule for Phase- II block

(FOR IRIS(2 BHK Unit) & CLUB Building)

SL.NO	LOCATION	FLOORING	WALL FINISHES	CEILING	SKIRTING/ DADO
13	BALCONY-1 & 2	1 M HIGH STAIN LESS STEEL TOUGHENED GLASS RAILING			
14	BALCONY-2 FOR BED ROOM	VITRIFIED TILE WOODEN COLOUR MATT FINISH TYPE	WASHABLE ACRYLIC EMULSION PAINT WITH ANTIBACTERIAL PAINT	WOOD POLYMER COMPOSIT(WPC) PANEL CEILNG	150MM HIGH WOODEN COLOUR MATT FINISH VITRIFIED TILE
15	COMMON PASSAGE	WOODEN FLOORING	WASHABLE ACRYLIC EMULSION PAINT WITH ANTIBACTERIAL PAINT	DESIGNER PLASTER OF PARIS (POP) FALSE CEILING/PLYWOOD CEILING WITH LAMINATE FINISH	150MM HIGH WOODEN PROFILE MATCH WITH FLOORING
16	LIFT LOBBY	GRANITE FLOORING	OIL BOND DISTEMPER	WOOD POLYMER COMPOSIT(WPC) PANEL CEILNG	150MM HIGH GRANITE STONE
17	LIFT LOBBY- ARCHITRAVE		WOODEN PANELLING	WOOD POLYMER COMPOSIT(WPC) PANEL CEILNG	150MM HIGH GRANITE STONE
18	ALL WOODEN DOORS	WOODEN DOOR: HARD WOOD FRAME WITH 40MM THICK LAMINATED WOODEN FLUSH DOOR INCLUDING BRASS HARDWARE ASSESSORIES			
19	ALL WOODEN WINDOWS	WOODEN WINDOWS: HARD WOOD WINDOW FRAME WITH GLAZED WOODEN STYLED WINDOW WITH BRASS HARDWARE ASSESSORIES			
20	ALL WARDROBE	WOODEN WARDROBE: HARD WOOD FRAME WOODEN WARDROBE WITH BRASS HARDWARE ASSESSORIES			

Finishing Schedule for Phase- II block

(FOR IRIS(2 BHK Unit) & CLUB Building)

SL.NO	LOCATION	FLOORING	WALL FINISHES	CEILING	SKIRTING/ DADO
	2ND FLOOR				
1	STAIR CASE	GRANITE STONE IN TREAD	OIL BOND DISTEMPER	WOOD POLYMER COMPOSIT(WPC) PANEL CEILNG	150MM HIGH GRANITE STONE
2	STAIR CASE	WOODEN PLANK IN RISER	OIL BOND DISTEMPER	WOOD POLYMER COMPOSIT(WPC) PANEL CEILNG	150MM HIGH GRANITE STONE
3	LIVING/ DINING HALL	WOODEN FLOORING	WASHABLE ACRYLIC EMULSION PAINT WITH ANTIBACTERIAL PAINT	DESIGNER PLASTER OF PARIS (POP) FALSE CEILING/PLYWOOD CEILING WITH LAMINATE FINISH	150MM HIGH WOODEN PROFILE MATCH WITH FLOORING
4	MASTER BED ROOM	WOODEN FLOORING	WASHABLE ACRYLIC EMULSION PAINT WITH ANTIBACTERIAL PAINT	DESIGNER PLASTER OF PARIS (POP) FALSE CEILING/PLYWOOD CEILING WITH LAMINATE FINISH	150MM HIGH WOODEN PROFILE MATCH WITH FLOORING
5	BED ROOM	WOODEN FLOORING	WASHABLE ACRYLIC EMULSION PAINT WITH ANTIBACTERIAL PAINT	DESIGNER PLASTER OF PARIS (POP) FALSE CEILING/PLYWOOD CEILING WITH LAMINATE FINISH	150MM HIGH WOODEN PROFILE MATCH WITH FLOORING
6	KITCHEN(Modular finishes)	WOODEN FINISH VITRIFIED TILE	WASHABLE ACRYLIC EMULSION PAINT WITH ANTIBACTERIAL PAINT	DESIGNER PLASTER OF PARIS (POP) FALSE CEILING/PLYWOOD CEILING WITH LAMINATE FINISH	150MM HIGH WOODEN COLOUR MATT FINISH VITRIFIED TILE
7	TOILET-1	VITRIFIED TILE NON-SKIDING TYPE	VITRIFIED TILE CLADDING TILL BOTTOM OF FALSE CEILING	WOOD POLYMER COMPOSIT(WPC) PANEL CEILNG	VITRIFIED TILE CLADDING TILL BOTTOM OF FALSE CEILING

Finishing Schedule for Phase- II block

(FOR IRIS(2 BHK Unit) & CLUB Building)

SL.NO	LOCATION	FLOORING	WALL FINISHES	CEILING	SKIRTING/ DADO
8	TOILET-2	VITRIFIED TILE NON-SKIDING TYPE	VITRIFIED TILE CLADDING TILL BOTTOM OF FALSE CEILING	WOOD POLYMER COMPOSIT(WPC) PANEL CEILNG	VITRIFIED TILE CLADDING TILL BOTTOM OF FALSE CEILING
9	TOILET-1 & 2	GRANITE TOP VANITY COUNTER WITH MIRROR AND ALL SS FINISH BATH ASSESSORIES			
10	TOILET-1 & 2	10MM THICK TOUGHENED GLASS SHOWER PARTITION			
11	SHAFT FOR TOILET-1 & 2	CONCRETE FLOORING	CEMENT PAINT	POLYMER SHEET TRANPARANT ROOF	CONCRETE SKIRTING 150MM HIGH
12	BALCONY-1 FOR LIVING ROOM	VITRIFIED TILE WOODEN COLOUR MATT FINISH TYPE	WASHABLE ACRYLIC EMULSION PAINT WITH ANTIBACTERIAL PAINT	WOOD POLYMER COMPOSIT(WPC) PANEL CEILNG	150MM HIGH WOODEN COLOUR MATT FINISH VITRIFIED TILE
13	BALCONY-1 & 2	1 M HIGH STAIN LESS STEEL TOUGHENED GLASS RAILING			
14	BALCONY-2 FOR BED ROOM	VITRIFIED TILE WOODEN COLOUR MATT FINISH TYPE	WASHABLE ACRYLIC EMULSION PAINT WITH ANTIBACTERIAL PAINT	WOOD POLYMER COMPOSIT(WPC) PANEL CEILNG	150MM HIGH WOODEN COLOUR MATT FINISH VITRIFIED TILE
15	COMMON PASSAGE	WOODEN FLOORING	WASHABLE ACRYLIC EMULSION PAINT WITH ANTIBACTERIAL PAINT	DESIGNER PLASTER OF PARIS (POP) FALSE CEILING/PLYWOOD CEILING WITH LAMINATE FINISH	150MM HIGH WOODEN PROFILE MATCH WITH FLOORING

Finishing Schedule for Phase- II block

(FOR IRIS(2 BHK Unit) & CLUB Building)

SL.NO	LOCATION	FLOORING	WALL FINISHES	CEILING	SKIRTING/ DADO
16	LIFT LOBBY	GRANITE FLOORING	OIL BOND DISTEMPER	WOOD POLYMER COMPOSIT(WPC) PANEL CEILNG	150MM HIGH GRANITE STONE
17	LIFT LOBBY- ARCHITRAVE		WOODEN PANELLING	WOOD POLYMER COMPOSIT(WPC) PANEL CEILNG	150MM HIGH GRANITE STONE
18	ALL WOODEN DOORS	WOODEN DOOR: HARD WOOD FRAME WITH 40MM THICK LAMINATED WOODEN FLUSH DOOR INCLUDING BRASS HARDWARE ASSESSORIES			
19	ALL WOODEN WINDOWS	WOODEN WINDOWS: HARD WOOD WINDOW FRAME WITH GLAZED WOODEN STYLED WINDOW WITH BRASS HARDWARE ASSESSORIES			
20	ALL WARDROBE	WOODEN WARDROBE: HARD WOOD FRAME WOODEN WARDROBE WITH BRASS HARDWARE ASSESSORIES			
	3RD FLOOR				
1	STAIR CASE	GRANITE STONE IN TREAD	OIL BOND DISTEMPER	WOOD POLYMER COMPOSIT(WPC) PANEL CEILNG	150MM HIGH GRANITE STONE
2	STAIR CASE	WOODEN PLANK IN RISER	OIL BOND DISTEMPER	WOOD POLYMER COMPOSIT(WPC) PANEL CEILNG	150MM HIGH GRANITE STONE
3	LIVING/ DINING HALL	WOODEN FLOORING	WASHABLE ACRYLIC EMULSION PAINT WITH ANTIBACTERIAL PAINT	DESIGNER PLASTER OF PARIS (POP) FALSE CEILING/PLYWOOD CEILING WITH LAMINATE FINISH	150MM HIGH WOODEN PROFILE MATCH WITH FLOORING

Finishing Schedule for Phase- II block

(FOR IRIS(2 BHK Unit) & CLUB Building)

SL.NO	LOCATION	FLOORING	WALL FINISHES	CEILING	SKIRTING/ DADO
4	MASTER BED ROOM	WOODEN FLOORING	WASHABLE ACRYLIC EMULSION PAINT WITH ANTIBACTERIAL PAINT	DESIGNER PLASTER OF PARIS (POP) FALSE CEILING/PLYWOOD CEILING WITH LAMINATE FINISH	150MM HIGH WOODEN PROFILE MATCH WITH FLOORING
5	BED ROOM	WOODEN FLOORING	WASHABLE ACRYLIC EMULSION PAINT WITH ANTIBACTERIAL PAINT	DESIGNER PLASTER OF PARIS (POP) FALSE CEILING/PLYWOOD CEILING WITH LAMINATE FINISH	150MM HIGH WOODEN PROFILE MATCH WITH FLOORING
6	KITCHEN(Modular finishes)	WOODEN FINISH VITRIFIED TILE	WASHABLE ACRYLIC EMULSION PAINT WITH ANTIBACTERIAL PAINT	DESIGNER PLASTER OF PARIS (POP) FALSE CEILING/PLYWOOD CEILING WITH LAMINATE FINISH	150MM HIGH WOODEN COLOUR MATT FINISH VITRIFIED TILE
7	TOILET-1	VITRIFIED TILE NON-SKIDING TYPE	VITRIFIED TILE CLADDING TILL BOTTOM OF FALSE CEILING	WOOD POLYMER COMPOSIT(WPC) PANEL CEILNG	VITRIFIED TILE CLADDING TILL BOTTOM OF FALSE CEILING
8	TOILET-2	VITRIFIED TILE NON-SKIDING TYPE	VITRIFIED TILE CLADDING TILL BOTTOM OF FALSE CEILING	WOOD POLYMER COMPOSIT(WPC) PANEL CEILNG	VITRIFIED TILE CLADDING TILL BOTTOM OF FALSE CEILING
9	TOILET-1 & 2	GRANITE TOP VANITY COUNTER WITH MIRROR AND ALL SS FINISH BATH ASSESSORIES			
10	TOILET-1 & 2	10MM THICK TOUGHENED GLASS SHOWER PARTITION			

Finishing Schedule for Phase- II block

(FOR IRIS(2 BHK Unit) & CLUB Building)

SL.NO	LOCATION	FLOORING	WALL FINISHES	CEILING	SKIRTING/ DADO
11	SHAFT FOR TOILET-1 & 2	CONCRETE FLOORING	CEMENT PAINT	POLYMER SHEET TRANPARANT ROOF	CONCRETE SKIRTING 150MM HIGH
12	BALCONY-1 FOR LIVING ROOM	VITRIFIED TILE WOODEN COLOUR MATT FINISH TYPE	WASHABLE ACRYLIC EMULSION PAINT WITH ANTIBACTERIAL PAINT	WOOD POLYMER COMPOSIT(WPC) PANEL CEILNG	150MM HIGH WOODEN COLOUR MATT FINISH VITRIFIED TILE
13	BALCONY-1 & 2	1 M HIGH STAIN LESS STEEL TOUGHENED GLASS RAILING			
14	BALCONY-2 FOR BED ROOM	VITRIFIED TILE WOODEN COLOUR MATT FINISH TYPE	WASHABLE ACRYLIC EMULSION PAINT WITH ANTIBACTERIAL PAINT	WOOD POLYMER COMPOSIT(WPC) PANEL CEILNG	150MM HIGH WOODEN COLOUR MATT FINISH VITRIFIED TILE
15	COMMON PASSAGE	WOODEN FLOORING	WASHABLE ACRYLIC EMULSION PAINT WITH ANTIBACTERIAL PAINT	DESIGNER PLASTER OF PARIS (POP) FALSE CEILING/PLYWOOD CEILING WITH LAMINATE FINISH	150MM HIGH WOODEN PROFILE MATCH WITH FLOORING
16	LIFT LOBBY	GRANITE FLOORING	OIL BOND DISTEMPER	WOOD POLYMER COMPOSIT(WPC) PANEL CEILNG	150MM HIGH GRANITE STONE
17	LIFT LOBBY- ARCHITRAVE		WOODEN PANELLING	WOOD POLYMER COMPOSIT(WPC) PANEL CEILNG	150MM HIGH GRANITE STONE
18	ALL WOODEN DOORS	WOODEN DOOR: HARD WOOD FRAME WITH 40MM THICK LAMINATED WOODEN FLUSH DOOR INCLUDING BRASS HARDWARE ASSESSORIES			

Finishing Schedule for Phase- II block

(FOR IRIS(2 BHK Unit) & CLUB Building)

SL.NO	LOCATION	FLOORING	WALL FINISHES	CEILING	SKIRTING/ DADO
19	ALL WOODEN WINDOWS	WOODEN WINDOWS: HARD WOOD WINDOW FRAME WITH GLAZED WOODEN STYLED WINDOW WITH BRASS HARDWARE ASSESSORIES			
20	ALL WARDROBE	WOODEN WARDROBE: HARD WOOD FRAME WOODEN WARDROBE WITH BRASS HARDWARE ASSESSORIES			
	4TH FLOOR				
1	STAIR CASE	GRANITE STONE IN TREAD	OIL BOND DISTEMPER	WOOD POLYMER COMPOSIT(WPC) PANEL CEILNG	150MM HIGH GRANITE STONE
2	STAIR CASE	WOODEN PLANK IN RISER	OIL BOND DISTEMPER	WOOD POLYMER COMPOSIT(WPC) PANEL CEILNG	150MM HIGH GRANITE STONE
3	LIVING/ DINING HALL	WOODEN FLOORING	WASHABLE ACRYLIC EMULSION PAINT WITH ANTIBACTERIAL PAINT	DESIGNER PLASTER OF PARIS (POP) FALSE CEILING/PLYWOOD CEILING WITH LAMINATE FINISH	150MM HIGH WOODEN PROFILE MATCH WITH FLOORING
4	MASTER BED ROOM	WOODEN FLOORING	WASHABLE ACRYLIC EMULSION PAINT WITH ANTIBACTERIAL PAINT	DESIGNER PLASTER OF PARIS (POP) FALSE CEILING/PLYWOOD CEILING WITH LAMINATE FINISH	150MM HIGH WOODEN PROFILE MATCH WITH FLOORING
5	BED ROOM	WOODEN FLOORING	WASHABLE ACRYLIC EMULSION PAINT WITH ANTIBACTERIAL PAINT	DESIGNER PLASTER OF PARIS (POP) FALSE CEILING/PLYWOOD CEILING WITH LAMINATE FINISH	150MM HIGH WOODEN PROFILE MATCH WITH FLOORING

Finishing Schedule for Phase- II block

(FOR IRIS(2 BHK Unit) & CLUB Building)

SL.NO	LOCATION	FLOORING	WALL FINISHES	CEILING	SKIRTING/ DADO
6	KITCHEN(Modular finishes)	WOODEN FINISH VITRIFIED TILE	WASHABLE ACRYLIC EMULSION PAINT WITH ANTIBACTERIAL PAINT	DESIGNER PLASTER OF PARIS (POP) FALSE CEILING/PLYWOOD CEILING WITH LAMINATE FINISH	150MM HIGH WOODEN COLOUR MATT FINISH VITRIFIED TILE
7	TOILET-1	VITRIFIED TILE NON-SKIDING TYPE	VITRIFIED TILE CLADDING TILL BOTTOM OF FALSE CEILING	WOOD POLYMER COMPOSIT(WPC) PANEL CEILNG	VITRIFIED TILE CLADDING TILL BOTTOM OF FALSE CEILING
8	TOILET-2	VITRIFIED TILE NON-SKIDING TYPE	VITRIFIED TILE CLADDING TILL BOTTOM OF FALSE CEILING	WOOD POLYMER COMPOSIT(WPC) PANEL CEILNG	VITRIFIED TILE CLADDING TILL BOTTOM OF FALSE CEILING
9	TOILET-1 & 2	GRANITE TOP VANITY COUNTER WITH MIRROR AND ALL SS FINISH BATH ASSESSORIES			
10	TOILET-1 & 2	10MM THICK TOUGHENED GLASS SHOWER PARTITION			
11	SHAFT FOR TOILET-1 & 2	CONCRETE FLOORING	CEMENT PAINT	POLYMER SHEET TRANPARANT ROOF	CONCRETE SKIRTING 150MM HIGH
12	BALCONY-1 FOR LIVING ROOM	VITRIFIED TILE WOODEN COLOUR MATT FINISH TYPE	WASHABLE ACRYLIC EMULSION PAINT WITH ANTIBACTERIAL PAINT	WOOD POLYMER COMPOSIT(WPC) PANEL CEILNG	150MM HIGH WOODEN COLOUR MATT FINISH VITRIFIED TILE
13	BALCONY-1 & 2	1 M HIGH STAIN LESS STEEL TOUGHENED GLASS RAILING			
14	BALCONY-2 FOR BED ROOM	VITRIFIED TILE WOODEN COLOUR MATT FINISH TYPE	WASHABLE ACRYLIC EMULSION PAINT WITH ANTIBACTERIAL PAINT	WOOD POLYMER COMPOSIT(WPC) PANEL CEILNG	150MM HIGH WOODEN COLOUR MATT FINISH VITRIFIED TILE

Finishing Schedule for Phase- II block

(FOR IRIS(2 BHK Unit) & CLUB Building)

SL.NO	LOCATION	FLOORING	WALL FINISHES	CEILING	SKIRTING/ DADO
15	COMMON PASSAGE	WOODEN FLOORING	WASHABLE ACRYLIC EMULSION PAINT WITH ANTIBACTERIAL PAINT	DESIGNER PLASTER OF PARIS (POP) FALSE CEILING/PLYWOOD CEILING WITH LAMINATE FINISH	150MM HIGH WOODEN PROFILE MATCH WITH FLOORING
16	LIFT LOBBY	GRANITE FLOORING	OIL BOND DISTEMPER	WOOD POLYMER COMPOSIT(WPC) PANEL CEILNG	150MM HIGH GRANITE STONE
17	LIFT LOBBY- ARCHITRAVE		WOODEN PANELLING	WOOD POLYMER COMPOSIT(WPC) PANEL CEILNG	150MM HIGH GRANITE STONE
18	ALL WOODEN DOORS	WOODEN DOOR: HARD WOOD FRAME WITH 40MM THICK LAMINATED WOODEN FLUSH DOOR INCLUDING BRASS HARDWARE ASSESSORIES			
19	ALL WOODEN WINDOWS	WOODEN WINDOWS: HARD WOOD WINDOW FRAME WITH GLAZED WOODEN STYLED WINDOW WITH BRASS HARDWARE ASSESSORIES			
20	ALL WARDROBE	WOODEN WARDROBE: HARD WOOD FRAME WOODEN WARDROBE WITH BRASS HARDWARE ASSESSORIES			
	ATIC FLOOR				
1	STAIR CASE	GRANITE STONE IN TREAD	OIL BOND DISTEMPER	WOOD POLYMER COMPOSIT(WPC) PANEL CEILNG	150MM HIGH GRANITE STONE

Finishing Schedule for Phase- II block

(FOR IRIS(2 BHK Unit) & CLUB Building)

SL.NO	LOCATION	FLOORING	WALL FINISHES	CEILING	SKIRTING/ DADO
2	STAIR CASE	WOODEN PLANK IN RISER	OIL BOND DISTEMPER	WOOD POLYMER COMPOSIT(WPC) PANEL CEILNG	150MM HIGH GRANITE STONE
3	LIVING/ DINING HALL	WOODEN FLOORING	WASHABLE ACRYLIC EMULSION PAINT WITH ANTIBACTERIAL PAINT	DESIGNER PLASTER OF PARIS (POP) FALSE CEILING/PLYWOOD CEILING WITH LAMINATE FINISH	150MM HIGH WOODEN PROFILE MATCH WITH FLOORING
4	MASTER BED ROOM	WOODEN FLOORING	WASHABLE ACRYLIC EMULSION PAINT WITH ANTIBACTERIAL PAINT	DESIGNER PLASTER OF PARIS (POP) FALSE CEILING/PLYWOOD CEILING WITH LAMINATE FINISH	150MM HIGH WOODEN PROFILE MATCH WITH FLOORING
5	KIDS/STUDY ROOM	WOODEN FLOORING	WASHABLE ACRYLIC EMULSION PAINT WITH ANTIBACTERIAL PAINT	DESIGNER PLASTER OF PARIS (POP) FALSE CEILING/PLYWOOD CEILING WITH LAMINATE FINISH	150MM HIGH WOODEN PROFILE MATCH WITH FLOORING
6	KITCHEN(Modular finishes)	WOODEN FINISH VITRIFIED TILE	WASHABLE ACRYLIC EMULSION PAINT WITH ANTIBACTERIAL PAINT	DESIGNER PLASTER OF PARIS (POP) FALSE CEILING/PLYWOOD CEILING WITH LAMINATE FINISH	150MM HIGH WOODEN COLOUR MATT FINISH VITRIFIED TILE
7	TOILET-1	VITRIFIED TILE NON-SKIDING TYPE	VITRIFIED TILE CLADDING TILL BOTTOM OF FALSE CEILING	WOOD POLYMER COMPOSIT(WPC) PANEL CEILNG	VITRIFIED TILE CLADDING TILL BOTTOM OF FALSE CEILING
8	TOILET-2	VITRIFIED TILE NON-SKIDING TYPE	VITRIFIED TILE CLADDING TILL BOTTOM OF FALSE CEILING	WOOD POLYMER COMPOSIT(WPC) PANEL CEILNG	VITRIFIED TILE CLADDING TILL BOTTOM OF FALSE CEILING

Finishing Schedule for Phase- II block

(FOR IRIS(2 BHK Unit) & CLUB Building)

SL.NO	LOCATION	FLOORING	WALL FINISHES	CEILING	SKIRTING/ DADO
9	TOILET-1 & 2	GRANITE TOP VANITY COUNTER WITH MIRROR AND ALL SS FINISH BATH ASSESSORIES			
10	TOILET-1 & 2	10MM THICK TOUGHENED GLASS SHOWER PARTITION			
11	SHAFT FOR TOILET-1 & 2	CONCRETE FLOORING	CEMENT PAINT	POLYMER SHEET TRANPARANT ROOF	CONCRETE SKIRTING 150MM HIGH
12	BALCONY-1 FOR LIVING ROOM	VITRIFIED TILE WOODEN COLOUR MATT FINISH TYPE	WASHABLE ACRYLIC EMULSION PAINT WITH ANTIBACTERIAL PAINT	WOOD POLYMER COMPOSIT(WPC) PANEL CEILNG	150MM HIGH WOODEN COLOUR MATT FINISH VITRIFIED TILE
13	BALCONY-1 & 2	1 M HIGH STAIN LESS STEEL TOUGHENED GLASS RAILING			
14	BALCONY-2 FOR BED ROOM	VITRIFIED TILE WOODEN COLOUR MATT FINISH TYPE	WASHABLE ACRYLIC EMULSION PAINT WITH ANTIBACTERIAL PAINT	WOOD POLYMER COMPOSIT(WPC) PANEL CEILNG	150MM HIGH WOODEN COLOUR MATT FINISH VITRIFIED TILE
15	COMMON PASSAGE	WOODEN FLOORING	WASHABLE ACRYLIC EMULSION PAINT WITH ANTIBACTERIAL PAINT	DESIGNER PLASTER OF PARIS (POP) FALSE CEILING/PLYWOOD CEILING WITH LAMINATE FINISH	150MM HIGH WOODEN PROFILE MATCH WITH FLOORING
16	LIFT LOBBY	GRANITE FLOORING	OIL BOND DISTEMPER	WOOD POLYMER COMPOSIT(WPC) PANEL CEILNG	150MM HIGH GRANITE STONE
17	LIFT LOBBY- ARCHITRAVE		WOODEN PANELLING	WOOD POLYMER COMPOSIT(WPC) PANEL CEILNG	150MM HIGH GRANITE STONE

Finishing Schedule for Phase- II block

(FOR IRIS(2 BHK Unit) & CLUB Building)

SL.NO	LOCATION	FLOORING	WALL FINISHES	CEILING	SKIRTING/ DADO
18	ALL WOODEN DOORS	WOODEN DOOR: HARD WOOD FRAME WITH 40MM THICK LAMINATED WOODEN FLUSH DOOR INCLUDING BRASS HARDWARE ASSESSORIES			
19	ALL WOODEN WINDOWS	WOODEN WINDOWS: HARD WOOD WINDOW FRAME WITH GLAZED WOODEN STYLED WINDOW WITH BRASS HARDWARE ASSESSORIES			
20	ALL WARDROBE	WOODEN WARDROBE: HARD WOOD FRAME WOODEN WARDROBE WITH BRASS HARDWARE ASSESSORIES			

Finishing Schedule for Phase- II block

(FOR IRIS(2 BHK Unit) & CLUB Building)

SL.NO	LOCATION	FLOORING	WALL FINISHES	CEILING	SKIRTING/ DADO
	CLUB BUILDING				
SL.NO	LOCATION	FLOORING	WALL FINISHES	CEILING	SKIRTING/ DADO
1	STAIR CASE-1	GRANITE STONE IN TREAD	OIL BOND DISTEMPER	WOOD POLYMER COMPOSIT(WPC) PANEL CEILNG	150MM HIGH GRANITE STONE
2	STAIR CASE-2	GRANITE STONE IN RISER	OIL BOND DISTEMPER	WOOD POLYMER COMPOSIT(WPC) PANEL CEILNG	150MM HIGH GRANITE STONE
3	VIP LOUNGE	ITALIAN MARBLE	WASHABLE ACRYLIC EMULSION PAINT WITH ANTIBACTERIAL PAINT, IMPORTED WALL PAPER, DECORATIVE CURVING WORKS	DESIGNER PLASTER OF PARIS (POP) FALSE CEILING/PLYWOOD CEILING WITH LAMINATE FINISH	150MM HIGH ITALIAN MARBLE MACHING WITH FLOORING
4	RECEPTION LOBBY	ITALIAN MARBLE	WASHABLE ACRYLIC EMULSION PAINT WITH ANTIBACTERIAL PAINT, IMPORTED WALL PAPER, DECORATIVE CURVING WORKS	DESIGNER PLASTER OF PARIS (POP) FALSE CEILING/PLYWOOD CEILING WITH LAMINATE FINISH	150MM HIGH TALIAN MARBLE MATCH WITH FLOORING
5	CONFERENCE HALL	CARPET FLOORING	WASHABLE ACRYLIC EMULSION PAINT WITH ANTIBACTERIAL PAINT, WALL COVERING	DESIGNER PLASTER OF PARIS (POP) FALSE CEILING/PLYWOOD CEILING WITH LAMINATE FINISH	150MM HIGH WOODEN PROFILE MATCH WITH FLOORING
6	EXECUTIVE MEETING ROOM	GRANITE FLOORING	WASHABLE ACRYLIC EMULSION PAINT WITH ANTIBACTERIAL PAINT, WALL COVERING	DESIGNER PLASTER OF PARIS (POP) FALSE CEILING/PLYWOOD CEILING WITH LAMINATE FINISH	150MM HIGH GRANITE PROFILE MATCH WITH FLOORING

Finishing Schedule for Phase- II block

(FOR IRIS(2 BHK Unit) & CLUB Building)

SL.NO	LOCATION	FLOORING	WALL FINISHES	CEILING	SKIRTING/ DADO
7	CHAIRMAN'S CABIN	ITALIAN MARBLE	WASHABLE ACRYLIC EMULSION PAINT WITH ANTIBACTERIAL PAINT, IMPORTED WALL PAPER, DECORATIVE CURVING WORKS	DESIGNER PLASTER OF PARIS (POP) FALSE CEILING/PLYWOOD CEILING WITH LAMINATE FINISH	150MM HIGH ITALIAN MARBLE MACHING WITH FLOORING
8	CHAIRMAN OFFICE AND VISITOR'S LOUNGE	ITALIAN MARBLE	WASHABLE ACRYLIC EMULSION PAINT WITH ANTIBACTERIAL PAINT, IMPORTED WALL PAPER, DECORATIVE CURVING WORKS	DESIGNER PLASTER OF PARIS (POP) FALSE CEILING/PLYWOOD CEILING WITH LAMINATE FINISH	150MM HIGH ITALIAN MARBLE MACHING WITH FLOORING
9	CAFÉ AREA	ITALIAN MARBLE	WASHABLE ACRYLIC EMULSION PAINT WITH ANTIBACTERIAL PAINT, IMPORTED WALL PAPER, DECORATIVE CURVING WORKS	DESIGNER PLASTER OF PARIS (POP) FALSE CEILING/PLYWOOD CEILING WITH LAMINATE FINISH	150MM HIGH ITALIAN MARBLE MACHING WITH FLOORING
10	CUISINS	ITALIAN MARBLE	WASHABLE ACRYLIC EMULSION PAINT WITH ANTIBACTERIAL PAINT, IMPORTED WALL PAPER, DECORATIVE CURVING WORKS	DESIGNER PLASTER OF PARIS (POP) FALSE CEILING/PLYWOOD CEILING WITH LAMINATE FINISH	150MM HIGH ITALIAN MARBLE MACHING WITH FLOORING
11	BACK OF HOUSE AREA (BOH)	VITRIFIED TILE FLOORING	WASHABLE ACRYLIC EMULSION PAINT WITH ANTIBACTERIAL PAINT	DESIGNER PLASTER OF PARIS (POP) FALSE CEILING/PLYWOOD CEILING WITH LAMINATE FINISH	150MM HIGH VITRIFIED TILE MATCH WITH FLOORING

Finishing Schedule for Phase- II block

(FOR IRIS(2 BHK Unit) & CLUB Building)

SL.NO	LOCATION	FLOORING	WALL FINISHES	CEILING	SKIRTING/ DADO
12	KITCHEN(Modular finishes)	MATT FINISH VITRIFIED TILE FLOORING	WASHABLE ACRYLIC EMULSION PAINT WITH ANTIBACTERIAL PAINT	DESIGNER PLASTER OF PARIS (POP) FALSE CEILING/PLYWOOD CEILING WITH LAMINATE FINISH	150MM HIGH VITRIFIED TILE MATCH WITH FLOORING
13	DISH WASH, COLD STORAGE, STORE, STAFF CHANGE ROOM,PREPARATION COUNTERS, SERVICE COUNTERS	MATT FINISH VITRIFIED TILE FLOORING	EPOXY PAINT, OIL BOUND DISTEMPERS	PERFORATED G.I CEILING	150MM HIGH VITRIFIED TILE MATCH WITH FLOORING
14	TOILET(MALE)	ITALIAN MARBLE	ITALIAN MARBLE CLADDING ON WALL,OIL BOUND DISTEMPERS	DESIGNER PLASTER OF PARIS (POP) FALSE CEILING/PLYWOOD	150MM HIGH ITALIAN MARBLE MACHING WITH
15	TOILET(FEMALE)	ITALIAN MARBLE	ITALIAN MARBLE CLADDING ON WALL,OIL BOUND DISTEMPERS	DESIGNER PLASTER OF PARIS (POP) FALSE CEILING/PLYWOOD	150MM HIGH ITALIAN MARBLE MACHING WITH
16	STAFF TOILET(MALE)	VITRIFIED TILE NON-SKIDING TYPE	VITRIFIED TILE CLADDING TILL BOTTOM OF FALSE CEILING	WOOD POLYMER COMPOSIT(WPC) PANEL CEILNG	VITRIFIED TILE CLADDING TILL BOTTOM OF FALSE CEILING
17	STAFF TOILET(FEMALE)	VITRIFIED TILE NON-SKIDING TYPE	VITRIFIED TILE CLADDING TILL BOTTOM OF FALSE CEILING	WOOD POLYMER COMPOSIT(WPC) PANEL CEILNG	VITRIFIED TILE CLADDING TILL BOTTOM OF FALSE CEILING
18	SHAFT FOR TOILET-1 & 2	CONCRETE FLOORING	CEMENT PAINT	POLYMER SHEET TRANPARANT ROOF	CONCRETE SKIRTING 150MM HIGH

Finishing Schedule for Phase- II block

(FOR IRIS(2 BHK Unit) & CLUB Building)

SL.NO	LOCATION	FLOORING	WALL FINISHES	CEILING	SKIRTING/ DADO
19	OPEN PORCH LOUNGE	STONE FLOORING	WASHABLE ACRYLIC EMULSION PAINT WITH ANTIBACTERIAL PAINT	WOOD POLYMER COMPOSIT(WPC) PANEL CEILNG	150MM HIGH WOODEN COLOUR MATT FINISH VITRIFIED TILE
20	STAIN LESS STEEL RAILING RAILING WITH TOUGHNED GLASS	1 M HIGH STAIN LESS STEEL TOUGHENED GLASS RAILING			
21	UNISEX GYM	CARPET FLOORING	WASHABLE ACRYLIC EMULSION PAINT WITH ANTIBACTERIAL PAINT	WOODEN CEILING	150MM HIGH WOODEN COLOUR MATT FINISH VITRIFIED TILE
22	COMMON PASSAGE	WOODEN FLOORING	WASHABLE ACRYLIC EMULSION PAINT WITH ANTIBACTERIAL PAINT	DESIGNER PLASTER OF PARIS (POP) FALSE CEILING/PLYWOOD CEILING WITH LAMINATE FINISH	150MM HIGH WOODEN PROFILE MATCH WITH FLOORING
23	LIFT LOBBY	ITALIAN MARBLE	WASHABLE ACRYLIC EMULSION PAINT WITH ANTIBACTERIAL PAINT, IMPORTED WALL PAPER, DECORATIVE CURVING WORKS	DESIGNER PLASTER OF PARIS (POP) FALSE CEILING/PLYWOOD CEILING WITH LAMINATE FINISH	150MM HIGH ITALIAN MARBLE MACHING WITH FLOORING
24	LIFT LOBBY- ARCHITRAVE	ITALIAN MARBLE	WASHABLE ACRYLIC EMULSION PAINT WITH ANTIBACTERIAL PAINT, IMPORTED WALL PAPER, DECORATIVE CURVING WORKS	DESIGNER PLASTER OF PARIS (POP) FALSE CEILING/PLYWOOD CEILING WITH LAMINATE FINISH	150MM HIGH ITALIAN MARBLE MACHING WITH FLOORING

Finishing Schedule for Phase- II block

(FOR IRIS(2 BHK Unit) & CLUB Building)

SL.NO	LOCATION	FLOORING	WALL FINISHES	CEILING	SKIRTING/ DADO
25	GLAZED SHUTTER WITH WOODEN PROFILE DOORS	WOODEN DOOR: TEAK WOOD FRAME WITH 10MM THICK TOUGHENED GLASS SHUTTER WITH WOODEN STYLE FINISHED WITH PU POLISH , BRASS HARDWARE ASSESSORIES			
26	FULL HEIGHT GLAZING PARTITION	FULL HEIGHT 10MM THICK TOUGHENED GLASS PARTITION			
27	GYM LOCKERS	WOODEN LOCKERS: HARD WOOD FRAME WOODEN WARDROBE WITH BRASS HARDWARE ASSESSORIES			
28	INDOOR SWIMMING POOL	IMPORTED POOL TILE IN FLOOR AND DADO ALL AROUND, PROVISION OF HOT & COLD WATER 24 HOURS,SS GRAB BARS, CHANDILIERS, WPC FLOATED CEILING, FULLY AIR CONDITIONED			
29	ELECTRICAL LIGHTS	CONCEALED AND SUSPENDED LIGHTS WITH GOOD LUX ILLUMINATION			
30	SOUND SYSTEMS	THE LOBBY AND ALL PUBLIC AREAS HAVE SOUND SYSTEM, INTERACTIVE VOICE RECORDING AND CALLING SYSTEMS.			
31	CCTV SURVIELIENCE	TOTAL PREMISE IS COVERED UNDER CCTV FACILITIES			
32	IMPORTED FURNITURE	AMPLE FURNITURE IN EVERY PLACES AS PER THE REQUIREMENT			
33	GREEN WALL & GARDEN	FACILITIES HAVE B PROVIDED FOR GREEN WALL AND DECORATIVE GARDENS AT VISITOR'S LOUNGE			



**TECHNICAL SPECIFICATIONS
FOR
PLUMBING, ELECTRICAL AND HVAC WORKS
&
LIST OF APPROVED MAKES**

Phase -I (2BHK), Auramah valley,
Nalderah, Shimla

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TECHNICAL SPECIFICATIONS - PLUMBING WORKS

Section 1 General Requirements

1. Should be read in conjunction with General Conditions of Contract for any discrepancy General Conditions of Contract will prevail.

1.1 Scope of work

- 1.1.1 Work under this contract shall consist of furnishing all labour, materials, equipment and appliances necessary and required. The Contractor is required to completely furnish all the plumbing and other specialized services as described hereinafter and as specified in the schedule of quantities and/or shown on the plumbing drawings.

- 1.1.2 Without restricting to the generality of the foregoing the work shall include the following:

Plumbing Works includes:

- a) Plumbing Fixtures, Chrome Plated Fittings & Accessories.
- b) Soil, Waste & Vent Pipes & Fittings.
- c) Rainwater Pipes & Fittings.
- d) Internal Water Supply System (Cold & Hot).
- e) Drainage of campus up to external services.

2 Work Not Included In This Contract

2.2.1 To be executed by building contractor

- a) Manholes, Pipe Inserts and ladders for RCC water tanks.

3 Licence and Permits.

Contractor must hold a valid plumbing or any other licence as required by the municipal authority or other competent authority under whose jurisdiction the work falls.

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End Section 1

General Requirements

SECTION 2 PLUMBING FIXTURES

1.0 Scope of work

- 1.1. Work under this section shall consist of providing all materials & labour necessary and required to completely install all sanitary fixtures, chromium plated fittings and accessories as required by the drawings and specified in the Bill of Quantities.
- 1.2. Without restricting to the generality of the foregoing the sanitary fixtures shall include the following:-
 - a) Sanitary fixtures
 - b) Chromium plated fittings
 - c) Porcelain or stainless steel sinks
 - d) Accessories e.g. towel rods, toilet paper holders, soap dish etc.
 - e) Electrically operated fixtures
- 1.3. Whether specifically mentioned or not, the rates quoted for providing and installation of the fixtures, appliances and accessories shall include all tools and tackles, fixing devices, nuts, bolts, screws, hangers as required.
- 1.4. All exposed pipes within toilets and near fixtures shall be chromium plated brass or copper unless otherwise specified.

2.0 General

- 2.1 ***Sanitary ware and C.P. fittings as specified in Bill of Quantities shall be supplied free of cost to the contractor.*** All fixing devices for proper fixing arrangement, nuts, bolts, screws as required to complete the item in working condition, even if the same is not specifically mentioned the Bill of Quantities, Specifications or shown on the drawings shall be provided by the contractor.
- 2.2 Fixing screws shall be half round head stainless steel wood screws or bolts with Stainless Steel washers. Rusted iron screws will not be permitted.
- 2.3 All fittings and fixtures shall be fixed in a neat workmanlike manner true to level and heights shown on the drawings and in accordance with the manufacturer's recommendations. Care shall be taken to fix all inlet and outlet pipes at correct positions. Faulty locations shall be made good and any damage to the finished floor, tiling or terrace shall be made good at Contractor's cost.
- 2.4 Contractor shall provide poly-sulphide sealant appropriate for its use for all fixtures fixed near wall, marble and edges at no extra cost.

3.0 Sanitary Fixtures

European WC

- 3.1 European WC shall be wash down or siphonic type floor or wall mounted set flushed by means of flush valve, exposed or concealed type flush valve or by imported type flush valve which will be an integral part of the wall system. **Framework, walling and finishing will not form a part of the contractor's work.** Where applicable flush pipe/ bend shall be connected to the WC by means of a suitable rubber adapter. Wall hung WC shall be supported by CI floor mounted chair.
- 3.2 Each WC set shall be provided with a plastic seat shall be with rubber buffers and chromium plated hinges.
- 3.3 Plastic seat shall be so fixed that it remains absolutely stationary in vertical position without falling down on the WC. Each WC shall be suitable for flushing in low volume of water 5-6 litres.

- 3.4 Flush valve shall be provided with all internal flushing mechanism, any frame work required for fixing cistern has to be provided by the contractor.

4.0 Wash Basins

- 4.1 Wash basins shall be fixed at proper heights as shown on drawings. If height is not specified, the rim level shall be 79 cms or as directed by Project Manager.
- 4.2 Each basin shall be supported on **MS galvanized** or painted C.I. brackets and securely fixed to wall for under/above counter installation. The design of the brackets shall suit the basin selected and as recommended by the manufacturer.
- 4.3 Basin shall be provided with a single pillar tap/hot & cold CP mixer without pop up waste fittings, CP brass waste 32 mm dia. CP cast brass bottle trap, CP pipe to wall and flange as specified in the BOQ.

4.4 The edge between the fixture and the wall or the counter shall be sealed with approved type of poly-sulphide sealant at no extra cost.

- 4.5 Each wash basin connection (separately for hot and cold) shall be provided with C.P. angle valves with CP wall flange and C.P. copper connecting pipe of required length.

5.0 Sinks

Sinks used shall be of any of the following types:

- 5.1 For kitchens, pantries, and designated utility rooms the sinks shall be stainless steel sinks with or without drain boards as specified in the BOQ.
- 5.2 Each sink shall be supported by **MS galvanized** or painted C.I. brackets and clips and the basin securely fixed to wall or on the counter. The design of the brackets shall suit the basin selected and as recommended by the manufacturer.
- 5.3 Stainless steel sinks shall be provided with PVC flexible waste pipe, basket waste with plug (as supplied by manufacturer).
- 5.4 Each sink shall be provided with hot & cold CP mixer with approved type of swan neck spout or individual cock as specified in Bill of Quantities.

6.0 Urinals

- 6.1 Urinals shall be fixed with 15 mm dia CP spreader, 32 mm dia C.P. domical waste and C.P. cast brass bottle trap with pipe and wall flange, and shall be fixed to wall by C.I. brackets and C.I. wall clips as recommended by manufacturers. (CI brackets and clips shall be painted as approved by Project Manager)
- 6.2 The contractor shall provide chromium plated brass spreaders of required type.
- 6.3 Waste pipes for urinals shall be uPVC class 6 kg/cm² (IS: 4985) with all fittings and connected to the urinal trap independently or as directed by the Project Manager.

- 6.4 Flushing system comprising of Infra-red photocell electrical mains or battery operated solenoid valve concealed in recessed box with stainless steel plate shall be fixed with all accessories as specified in the BOQ., wiring and connecting piping complete as required to provide satisfactory functioning of system to be able to flush the urinal before and after use by a person.

6.5 The edge between the fixture and the wall shall be sealed with approved type of poly-sulphide sealant.

7.0 Urinal partitions

- 7.1 Urinal partitions shall be white glazed vitreous china or 25 mm thick marble of size specified in the Bill of Quantities or directed by the Project Manager /Architects.

7.2 Porcelain partitions shall be fixed at proper heights with stainless steel screws/ bolts, and anchor fasteners and painted MS clips as recommended by the manufacturer and directed by Project Manager.

7.3 The edge between the fixture and the wall or the counter shall be sealed with approved type of poly-sulphide sealant at no extra cost.

8.0 Accessories

- 8.1 Accessories shall be of the following types:

- Towel rails
- Towel rings
- Coat hooks
- Soap dispensers
- Soap dishes
- Health Faucet

- 8.2 Accessories shall be fixed with stainless steel half round head screws and cup washers in wall with rawl plugs or nylon sleeves and shall include cutting and making good the walls.

- 8.3 Porcelain accessories shall be fixed in walls and set in cement mortar 1 : 2 (1 cement : 2 coarse sand) and fixed in relation to the tiling work. The flange of the recessed fixture shall cover the recess in the wall fully.

9.0 Measurement

- 9.1 Sanitary fixtures shall be measured by numbers.

- 9.2 Rates for all items mentioned above shall be inclusive of cutting holes and chases and making good the same, stainless steel screws, nuts, bolts and any fixing arrangements required and recommended by manufacturers, testing and commissioning.

- 9.3 Project Manager's decision with respect to the correct interpretation regarding mode of measurement shall be final and binding on the contractor.

END OF SECTION 2
Plumbing Fixtures

SECTION 3 Soil, Waste, Vent & Rainwater Pipes & Fittings

1 Scope of work

- 1.1 Work under this section shall consist of furnishing all labour, materials, equipments and appliances necessary and required to completely install all soil, waste, vent and rain water pipes and fittings as required by the drawings and as given in the Schedule of Quantities.
- 1.2 Without restricting to the generality of the foregoing, the work shall include the following:-
- a) Vertical and horizontal soil, waste, vent and rain water pipes, and fittings, joints, clamps and connections to fixtures.
 - b) Soil & rainwater pipes in stilt floor ceiling up to external sewers/drains.
 - c) Connection of all pipes to sewer lines as shown on the drawings at ground floor levels.
 - d) Floor and urinal traps, cleanout plugs, inlet fittings and rainwater heads/Khurras.
 - e) Testing of all pipe lines.

2 General requirements

- 2.1 All materials shall be new and best quality conforming to Latest IS Code and specifications and subject to the approval of the Project Manager /Architect.
- 2.2 Pipes and fittings shall be fixed truly vertical, horizontal or in slopes as required in a neat workmanlike manner.
- 2.3 Pipes shall be fixed in a manner as to provide easy accessibility for repair and maintenance and shall not cause obstruction in shafts, passages etc.
- 2.4 Pipes shall be securely fixed to walls and ceilings by suitable clamps at intervals specified.
- 2.5 Access doors for fittings and cleanouts shall be so located that they are easily accessible for repair and maintenance.

3 Piping System

3.1 Soil, Waste & Vent Pipes

- a) The Soil & Waste pipe system above ground has been planned as a "two pipe system" as defined in IS: 5329, having separate pipes for waste from kitchen sinks, bath tubs, showers, washbasins, condensate drains and floor drains and is approved by the local authority.
- b) Vertical soil & waste stacks shall be connected to a common horizontal drain pipe at stilt floor ceiling or to an external manhole directly wherever feasible as shown on the drawings.
- c) *Floors of toilets, kitchens and other service areas located on structural slab are SUNK by 350 mm to accommodate waste pipes from fixtures*

3.2 Rainwater Pipes

- a) All terraces shall be drained by providing down-takes rainwater pipes.
- b) A separate piped drainage system for slopping roof with leaders shall be provided.
- c) Rainwater pipes are separate and independent connected to the external storm water drainage system as shown on the drawings.

- d) Rainwater in enclosed courtyards shall be collected in catch-basins and connected to storm water drains.
- e) Any dry weather flow from waste appliances, AHU's pump rooms, shall be connected to the sewerage system only.

3.3 Balcony/Planter drainage

Open balconies, terraces, planters and formal landscape areas will be drained by a separate pipe connected to external storm water drainage system.

- 3.4 uPVC pipes shall be used for SWR system in all typical floors and CI (IS:3989) shall be used for stilt to second floor (for soil waste and rain water).

4.0 PIPES MATERIALS

4.1 uPVC SWR

- 4.1.1 All pipes from third floor to terrace shall be straight and smooth and inside free from cracks and other manufacturing defects. Pipes shall be self fit conforming to IS: 13952 type B for soil & waste and rain water.
- 4.1.2 Pipes shall be joined by approved type solvent cement made with solvent cement.

4.2 Fittings

- 4.2.1 Fittings shall conform to the Indian Standard recommended for the pipes. Pipes and fittings must be of matching IS specification. Interchange of pipes of one standard with fittings on the other standard will not be permitted.
- 4.2.2 Fittings shall be of the required degree of curvature with or without access door.
- 4.2.3 Connection from a vertical stack or position to a horizontal line shall be made only by a "Y" junction.

4.3 Fixing

- 4.3.1 All vertical pipes shall be fixed truly vertical to walls with approved type clamp. Branch pipes shall be connected to the stack at the same angle as that of the fittings. No collars shall be used on vertical stacks. Each stack shall be terminated at top with a cowl (terminal guard). However shaft where more vertical pipes run, the pipes may be fixed to the slotted angle/channel supports fixed to walls at intervals specified here under:-
- 4.3.2 Horizontal pipes running along ceiling shall be fixed on **galvanized structural adjustable clamps** (Clevis clamps) of special design shown on the drawings or as directed. Horizontal pipes shall be laid to uniform slope and the clamps adjusted to the proper levels so that the pipes fully rest on them.
- 4.3.3 Contractor shall provide all sleeves, openings, hangers, inserts during the construction. He shall provide all necessary information to the Project Manager/Building Contractor for making such provisions in the structure as necessary. All damages shall be made good to restore the surfaces at no extra cost.

4.4 Clamps

- 4.4.1 Holder bat clamps shall be of standard design and fabricated from **galvanized MS standard flats** 40x3 mm thick and 12 mm dia MS rod and 6 mm nuts and bolts. Holder bat clamps shall be fixed in cement concrete 1 : 2 : 4 mix blocks 10x10x10 cms deep.
- 4.4.2 Where holder bat clamps are to be fixed in RCC column or slotted angles, walls or beam they shall be fixed with **galvanized** 40x3 mm flat iron "U" type clamps with anchor fasteners of approved design or 6 mm nuts and bolts.
- 4.4.3 For SWR pipes conforming to IS: 13592 shall be clamped to wall with approved type of clamp/U-clamp or as given in the Bill of quantities.

- 4.4.4 Structural clamps shall be fabricated by electro-welding from MS structural members e.g. rods, angles, channels flats as per detailed drawing. Contractor shall provide all nuts & bolts, welding material. All fabricated clamps, nuts, bolts and washers shall be not dipped galvanized.
- 4.4.5 Galvanized slotted angle/channel supports on walls shall be provided wherever shown on drawings. Angles/channels shall be of sizes shown on drawings or specified in schedule of quantities. Angles/channels shall be fixed to brick walls with bolts embedded in cement concrete blocks and to RCC walls with suitable anchor fasteners. The spacing of support bolts horizontally shall not exceed 1 m.
- 4.4.6 Wherever MS clamps are required to be anchored directly to brick walls, concrete slabs, beams or columns, nothing extra shall be payable for clamping arrangement and making good with cement concrete 1 : 2 : 4 mix (1 cement : 2 coarse sand : 4 mm stone aggregate 20 mm nominal size) as directed by the Project Manager.

4.5 CAST IRON PIPES

CI pipes shall be used stilt to second floor as per conforming to IS: 3989 for soil & waste and rain water.

Cast iron pipes and fittings shall be of good and tough quality and dark grey on fracture. The pipes and fittings shall be true to shape, smooth and cylindrical, their inner and outer surface being as nearly as practicable concentric. They shall be sound and nicely cast, shall be free from cracks, taps, pinholes and other manufacturing defects.

The pipes and fittings shall conform to IS: 3989 / IS: 1729 as called for. Fittings shall be of required degree with or without access door. All access doors shall be made up with 3mm thick insertion rubber gasket of white lead and tightly bolted to make the fittings air and water tight. The fittings shall be of the same manufacture as the pipes used for soil and waste.

All CI pipes and fittings shall bear the manufacturer's name and ISI specification to which it conforms.

All pipes and fittings shall be coated internally and externally with the same material at the factory, the fittings being preheated prior to total immersion in a bath containing a uniformly heated composition having a tar/other suitable base. The coating material shall have good adherence and shall not scale off. The coating shall be smooth and tenacious and hard enough not to flow when exposed to a temperature of 77 degree C but not so brittle at a temperature of '0' degree C as to chip off when scratched lightly with a pen knife.

All pipes and fittings before installation at site shall be tested hydrostatically to a pressure of 0.45 Kg/sq. cm without showing any sign of leakage, sweating or other defects of any kind. The pressure shall be applied internally and shall be maintained for not less than 15 minutes. All these tests shall be carried out in the presence of the representative of the Project Manager. Alternatively, a test certificate from manufacturers be obtained before despatch of material to site.

Cast Iron Specialities

If required, Cast iron speciality items such as deep seal floor traps, urinal traps, trap integral pieces with integral inlet/outlet connections, manhole cover with frame, chamber cover etc. shall be fabricated to suit individual location requirements. The contractor shall arrange the fabrication of these items from an approved source.

Lead Caulked joints with Pig Lead:

The approximate depth and weights of Pig Lead for various diameters of CI pipes and specials shall be as follows:

<u>Nominal size of Pipe (mm)</u>	<u>Lead per Joint (Kg)</u> <u>IS:3989</u>	<u>Lead per Joint (Kg)</u> <u>IS:1729</u>
50		0.77
75	0.60	0.88
100	0.85	0.99

150		1.5
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4.5 PIPES HANGERS, SUPPORTS, CLAMPS ETC.

All vertical pipes shall be fixed by clamps and angle brackets truly vertical. Branch pipes shall be connected to the stack at the same angle as that of the fittings. No collars shall be used on vertical stacks. Each stack shall be terminated at top with a cowl (terminal guard).

Horizontal pipes running along ceiling shall be fixed on structural adjustable clamps of special design shown on the drawings or as directed. Horizontal pipes shall be laid to uniform slope and the clamps adjusted to the proper levels so that the pipes fully rest on them.

Contractor shall provide all sleeves, openings, hangers, inserts during the construction. He shall provide all necessary information to the building contractor for making such provisions in the structure as necessary. All damages shall be made good to restore the surfaces.

Clamps shall be of approved design and fabricated from MS flats (which shall be enamel painted after fabrication) of thickness and sizes as per drawings or contractor's shop drawings. Clamps shall be fixed in accordance to manufacturer's details / shop drawings to be submitted by the contractors.

When required to be fixed on RCC columns, walls or beam they shall be fixed with approved type of expansion anchor fasteners (Dash fasteners) of approved design and size according to load.

Structural clamps e.g. trapeze or cluster hangers shall be fabricated by electro-welding from MS structural members e.g. rods, angles, channels flats as per contractors shop drawings shall be enamel painted after fabrication.

4.6 INSTALLATION OF SOIL, WASTE & VENT PIPES

Soil, waste & vent pipes in shafts under the floors / suspended below slab shall consist of cast iron pipes as described earlier. Waste pipes from bottle trap to floor/urinal traps for wash basin, urinal and sink shall be GI pipes and fittings.

All Horizontal pipes running below the slab and along the ceiling shall be fixed on structural adjustable clamps, sturdy hangers of the design as called for in the drawings. The pipes shall be laid in uniform slope and proper levels. All vertical pipes shall be truly vertical fixed by means of stout clamps in two sections, bolted together, built into the walls, wedged and neatly jointed. The branch pipes shall be connected to the stack at the same angle as that of fittings. All connections between soil, waste and ventilating pipes and branch pipes shall be made by using pipe fittings with inspection doors for cleaning. Pipes shall be fixed in a manner as to provide easy accessibility for repair and maintenance and shall not cause obstruction in shafts. Where the horizontal run off the pipe is long or where the pipes cross over building expansion joints etc. suitable allowance shall be provided for any movements in the pipes by means of expansion joint etc. such that any such movement does not damage the installation in any way.

All cast iron pipes and fittings shall be jointed with best quality soft pig lead free from all impurities conforming to IS 27.

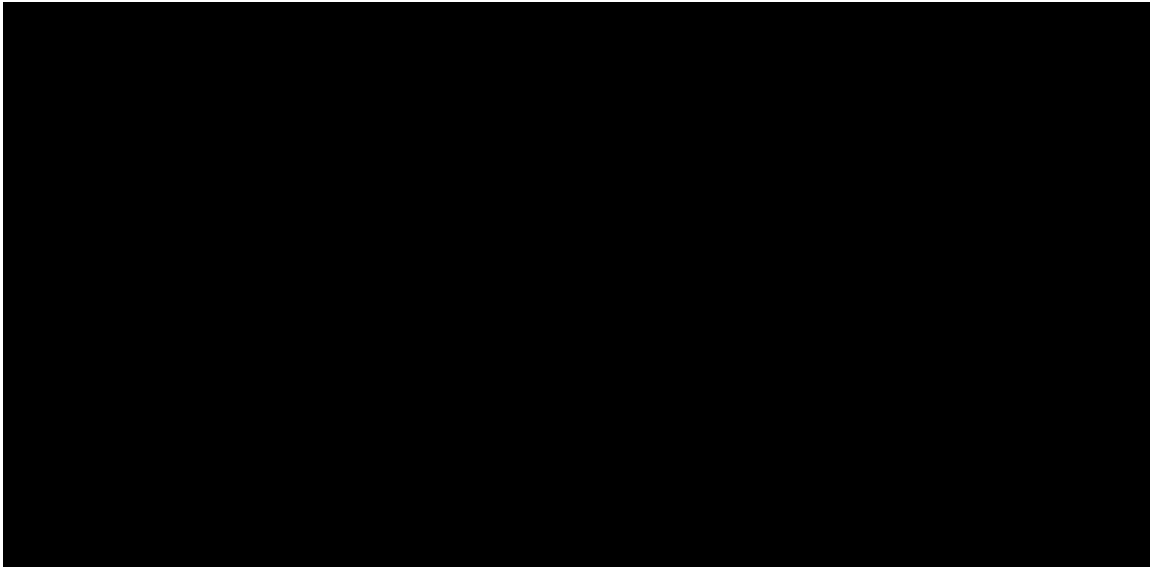
Before jointing, the interior of the socket and exterior of the spigots shall be thoroughly cleaned and dried. The spigot end shall be inserted into the socket right up to the back of the socket and carefully centered by two or three laps of threaded spun yarn, twisted into ropes of uniform thickness, well caulked into the back of the socket. No piece of yarn shall be shorter than the circumference of the pipe. The jointed pipe line shall be at required levels and alignment. The remainder of the socket is left for the lead caulking. Where the gasket has been tightly held, a jointing ring shall be placed round the barrel against the face of the socket. Molten pig lead shall be poured to fill the remainder of the socket in one pouring. The lead then shall be solidly caulked with suitable tools by hammering right round the joints to make up for the shrinkage of the molten metal on cooling and preferably finish 3mm behind the socket face.

The depth of the lead joints for the cast iron pipes shall be 45mm for the pipes upto 100mm dia. and 50mm for the pipes beyond 100mm dia. respectively.

The joint shall not be covered till the pipe line has been tested under pressure. Rest of pipe line shall be covered so as to prevent the expansion and contraction due to variation in temperature.

- 4.7 For sleeves, anchor fasteners and clamp spacing chart shall be as follows:

CLAMP AND PIPE SUPPORT SPACING



5.0 Traps**5.1 uPVC Floor traps**

Floor traps shall be siphon type full bore P or S type uPVC having a minimum 50 mm deep seal. The trap and main waste pipes in toilets having 100 mm sinking shall run below slab and shall be supported from the ceiling below. The trap and waste pipes in sunken area (where required) shall be set in cement concrete blocks firmly supported on the structural floor. The blocks shall be in 1 : 2 : 4 mix (1 cement : 2 coarse sand : 4 stone aggregate 20 mm nominal size) and extended to 40 mm below finished floor level. Contractor shall provide all necessary shuttering and centering for the blocks.

5.2 CI Floor/Urinal Traps

Floor traps where specified shall be siphon type full bore P or S type cast iron having a minimum 50 mm deep seal. The trap and waste pipes when buried below ground shall be set and encased in cement concrete blocks firmly supported on firm ground or when installed on a sunken RCC structural slab. The blocks shall be in 1:2:4 mix (1 cement : 2 coarse sand : 4 stone aggregate 20 mm nominal size).

Contractor shall provide all necessary shuttering and centering for the blocks. Size of the block shall be 30 x 30 cms of the required depth.

5.3 Floor trap inlet

Bath room traps and connections shall ensure free and silent flow of discharging water. Where specified, Contractor shall provide a special type inlet fitting (multi inlet height riser/reducing tee) from uPVC pipe without, with one, two or three inlet sockets fixed on side to connect the waste pipe. Joint between waste and hopper inlet socket of the trap shall be joined with solvent cement recommended by the manufacturer. Inlet shall be connected to an uPVC. P or S trap. Floor trap inlet hoppers and the traps if set in cement concrete blocks as specified in para above without extra charge. uPVC multi-inlet trap can be used where ever possible to be decided by the project Engineer.

Trap & Seals

All traps shall be self cleaning design and the seal depth shall be as specified below wherever the traps are not integral with the appliances:

Appliance or ware	Material	Trap Type	Seal depth(mm)
Lavatory /wash basin	C.P. cast brass	32 mm dia Bottle	75 mm
Kitchen floor drain of fabricated drain boxes	uPVC/C.I.	75/100 mm dia 'P' or 'S'	50 mm
Urinals	uPVC/C.I.	100 mm dia 'P' or 'S'	50 mm
AHU's	uPVC/C.I.	75 mm dia 'P' or 'S'	50 mm

5.4 Floor Gratings

Floor and urinal traps shall be provided with 100-150mm square or round CP/stainless steel grating, with rim of approved design and shape. Minimum thickness shall be as specified in the Schedule of Quantities.

5.5 Jointing

Jointing with solvent cement shall be applied to uPVC waste pipes (confirming to IS 4985) and fittings or as recommended by the manufacturers.

6 Cleanout Plugs

- 6.1 uPVC/CI clean out pipe for Soil, Waste or Rainwater pipes laid under floors shall be provided near pipe junctions bends, tees, “Ys” and on straight runs at such intervals as required as per site conditions. Cleanout pipe shall terminate flush with the floor levels.
- a) Cleanout pipe shall be provided on starting point of each drain and in between at locations indicated on plans or directed by the Project Manager. Cleanout pipe shall be of size matching the full bore of the pipe but not exceeding 160 mm OD.
- b) Cleanouts at ceiling level pipe shall be provided with a bend terminating at floor level above. The cap of the cleanout pipe shall have a cap flush with floor.

7.0 Waste pipe from appliances

7.1 General

- a) Waste pipe from appliances e.g. wash basins, sinks and urinals shall be of uPVC pipes 40, 50 or 63 mm OD conforming to IS: 4985 class II (6 kg/cm² or as given in the Schedule of Quantities or shown on the drawings.
- b) All pipes shall be fixed in gradient towards the outfalls of drains. Pipes inside a toilet room shall be in chase unless otherwise shown on drawings. Where required pipes may be run at ceiling level in suitable gradient and supported on galvanized structural clamps. Spacing for clamps for such pipes shall be as per the pipe spacing chart given in section 1.

8.0 Encasing pipe in Cement Concrete

uPVC soil and waste pipes and drainage under floor in sunken slabs and in wall chases (when cut specially for the pipe) shall be encased in cement concrete 1 : 2 : 4 mix (1 cement : 2 coarse sand : 4 stone aggregate 12 mm size) 75 mm in bed and all-round. When pipes are running well above the structural slab, the encased pipes shall be supported with suitable cement concrete pillars of required height at intervals of one metre. Rate for concreted round pipes shall be inclusive of pillars, supports, shuttering and centering.

9.0 Cutting and making good

- 9.1 Contractor's rate shall include for providing all necessary holes, sleeves, cut outs and chases in structural members as building work proceeds. Wherever holes are cut or left originally, they shall be made good with cement concrete 1 : 2 : 4 (1 cement : 2 coarse sand : 4 stone aggregate 20 mm nominal size) or cement mortar 1 : 2 (1 cement : 2 coarse sand) and the surface restored as in original condition.

10.0 Testing

- 10.1 Testing procedure specified below apply to all soil, waste and vent pipes above ground including pipes laid along basement ceiling.
- 10.2 Entire drainage system shall be tested for water tightness during and after completion of the installation. No portion of the system shall remain untested. Contractor must have adequate number of expandable rubber/bellow plugs, manometers, smoke testing machines, pipe and fitting work test benches and any other equipment necessary and required to conduct the tests. All testing equipment/motors etc. shall be certified for its calibration by an approved laboratory.
- 10.3 All materials obtained and used on site must have manufacturer's hydraulic test certificate for each batch of materials used on the site.
- 10.4 Testing soil, waste and rainwater pipes
- a) Apart from factory test all pipes and fittings shall be hydraulically tested for a head of 3 m preferably on a specially set up work bench. After applying pressure, strike the pipe with a wooden pallet and inspect for blow holes and cracks. Pressure may be applied for about 2 minutes. Reject and remove all defective pipes.

- b) After installation all connections from fixtures, vertical stacks and horizontal drains including pipes along ceiling shall be tested to a hydraulic pressure not exceeding 3 m. Such tests shall be conducted for each floor separately by suitable plugs.
- c) After the installation is fully complete, it should be tested by flushing the toilets, running at least 20% of all taps simultaneously and ensuring that the entire system is self draining, has no leakages, blockages etc. Rectify and replace where required.
- 10.5 Contractor shall maintain a test register identifying date and time of each area. All tests shall be conducted in presence of Project Manager and signed by both.

11 Measurements

11.1 General

- a) Rates for all items quoted shall be inclusive of all work and items given in the specifications and Schedule of Quantities.
- b) Rates are applicable for the work in basements, under floors, in shafts at ceiling level area for all heights and depths.
- c) Rates are inclusive of cutting holes and chase in RCC and masonry work and making good the same.
- d) Rates are inclusive of pre testing, on site testing, of the installations, materials and commissioning of the works.
- e) Pipes (unit of measurement. Linear meter to the nearest centimeter)

11.2 Pipes shall measured per running meter correct to a centimeter for the finished work which shall include fittings e.g. bends, tees, crosses, etc. The length shall be taken along centre line of the pipes and fittings. All pipes and fittings shall be classified according to their diameter, method of jointing and fixing substance, quality, and finish. The diameters shall be nominal outer diameter.

11.3 Cement concrete around pipes shall be measured along the center of the pipe line measured per linear meter and include any masonry supports, shuttering and centering cutting complete as described in the relevant specifications.

11.4 Slotted angles/channels shall be measured per linear meter of finished length and shall include support bolts, nuts and clamps embedded in masonry walls with cement concrete blocks and nothing extra will be paid for making good the same.

11.5 Fittings

Unit of measurement shall be the number of pieces. Pipe fittings are included in the rate for pipes. Urinal traps, trap gratings, hoppers, cleanout plugs shall be measured by number per piece and shall include all items described in the relevant specifications and Schedule of Quantities.

11.6 Excavation for soil pipes

No payment shall be admissible with respect to excavation, refilling and disposal of surplus earth for soil and waste pipes laid below ground, in sunken slabs or over basement rafts.

11.7 Project Manager's decision with respect to the correct interpretation regarding mode of measurement shall be final and binding on the contractor.

End of Section 3

Soil, Waste, Vent & Rainwater Pipes & Fittings

Section 4 Water Supply System

1 Scope of work

- 1.1 Work under this section consists of furnishing all labour, materials equipment and appliances necessary and required to completely install the water supply system as required by the drawings, specified hereinafter and given in the Schedule of Quantities.
- 1.2 Without restricting to the generality of the foregoing, the water supply system shall include the following:-
 - a) Rising main from stilt floor to terraces of buildings for domestic and flushing requirement.
 - b) Distribution system from overhead tank to each toilet in the building.
 - c) Distribution mains from hydro pneumatic system to all fixtures and appliances for cold and hot water to buildings.
 - d) Excavation and refilling of pipes trenches.
 - e) Control valves, masonry chambers and other appurtenances.

2 General requirements

- 2.1 All materials shall be new and of the best quality conforming to specifications. All works executed shall be to the satisfaction of the Project Manager.
- 2.2 Pipes and fittings shall be fixed truly vertical, horizontal or in slopes as required in a neat workmanlike manner.
- 2.3 Long bends shall be used on all main pipe lines as far as possible. Use of elbows shall be restricted for short connections.
- 2.4 Pipes shall be fixed in a manner as to provide easy accessibility for repair and maintenance and shall not cause obstruction in shafts, passages etc.
- 2.5 Pipes shall be securely fixed to walls and ceilings by suitable clamps at intervals specified. (See 4.7 for clamp spacing chart Section 3 above)
- 2.6 Valves and other appurtenances shall be so located as to provide easy accessibility for operations, maintenance and repairs.

3 Water Supply System

- 3.1 Contractor should study the site plan and water supply system diagram for an overview of the system.
- 3.2 Source
 - a) Water supply will be acquired from Municipal water mains through a service connection
 - b) Additional water supply will be obtained from captive tube-wells within the site or from the lake. The rising mains will be connected to the main fire static tank and then overflow into the main domestic water tank.
- 3.3 Water supply piping for garden hydrant and sprinkler and irrigation system will be separate and independently connected to a different pumping system.

4.0 GI pipes, fittings & valves

- 4.1 All pipes inside the buildings and where specified, outside the building shall be galvanized steel tubes conforming to IS: 1239 of class specified. When class is not specified they shall be heavy class.
- 4.2 Fittings shall be of malleable iron galvanized of approved make. Each fitting shall have manufacturer's trade mark stamped on it. Fittings for GI pipes shall include couplings, bends, tees, reducers, nipples, unions, and bushes. Fittings shall conform to IS: 1879-(Part I to X).
- 4.3 Pipes and fittings shall be jointed with screwed joints. The care shall be taken to remove burr from the end of the pipe with a proper file after cutting a pipe with a hacksaw or a cutting machine.
- 4.3.1 Pipe threaded joints will be made by applying suitable grade of TEFLON tape used for drinking water supply. **(Use of red or white lead and sutli will not be permitted for screwed joints)**
- 4.3.2 All pipes shall be fixed in accordance with layout and alignment shown on the drawings. Care shall be taken to avoid air pockets. GI pipes inside toilets shall be fixed in wall chases well above the floor. No pipes shall be run inside a sunken floor as far as possible. Pipes may be run under the ceiling or floors and other areas as shown on drawings.

5.0 PPR PIPES & FITTINGS

- 5.1 All polypropylene Random (PP-R). Pipes shall be manufactured as per the norms DIN 8077 – 8078, BS & ASTM Standard.
- 5.2 Fittings shall be polypropylene Random (PP-R) of approved make. Fitting shall be manufactured as per the norms DIN 16962, BS & ASTM Standard.
- 5.3 All fittings shall have manufacturers trademark stamped on it. Fittings of PPR pipes shall include couplings, bends, tees, nipples, unions, bushes. Threaded fittings shall be with brass insert duly nickel plated to stand non corrosion at elevated temperature.
- 5.4 Minimum operating pressure of pipes is 10 bar at 60 degree.
- 5.5 Pipes and fittings shall be joined with poly fusion device. Heat the pipes and fitting on the poly fusion device as per the recommended heating times. Care shall be taken to recommended heating times as per manufacturers. Heating times for jointing as per recommended by manufactures of pipes & fittings. Cutter shall be used for cutting of pipes. Deburr the cut end if necessary. All pipes shall be fixed in accordance with layout and alignment shown on the drawings. Care shall be taken to avoid air pocket. PPR pipes inside toilets shall be fixed in wall chases well above the floor. No pipes shall be run inside as sunken floor as for as possible. Pipes may be run under the ceilings or floors and other areas as shown on drawings.

5.6 Concealed Piping

All internal concealed plumbing for water supply shall be done with PP-R. The pipes & fittings shall conform to SDR-7.4 & SDR-11 as per DIN 16962, BS & ASTM Standard. All pipes and fittings from ½” upto 2” shall come under this category. Medium body PP-R solvent cement should be used for joining pipes to fittings.

5.6 Clamps

PP-R/GI Pipes in shafts and other locations shall be supported by galvanized MS clamps of design approved by Project Manager. Pipes in wall chases shall be anchored by GI hooks. Pipes at ceiling level shall be supported on structural clamps fabricated from MS structurals. Pipes in typical shafts shall be supported on slotted angles/channels as per standard drawings.

- 5.7 For sleeves, anchor fasteners and clamp spacing chart (See 4.7 for clamp spacing chart Section 3 above).
- 5.8 Unions

Adequate number of unions with metal inserting on pipes 50 mm OD and below shall be provided to enable easy dismantling later when required. Unions shall be provided near each gunmetal valve, stop cock, or check valve and on straight runs as necessary at appropriate locations as required and/or directed by Project Manager.

6.0 CPVC pipes, fittings & valves

- 6.1 All pipes inside the buildings and where specified, outside the building shall be CPVC pipes tubes conforming to Specific Gravity ASTM D 792 at 23⁰ C should be 1.55 as specified. With Tensile Strength as per ASTM D 638 at 23⁰C should be 55 N/mm²
- 6.2 All special fittings and accessories like internally or externally threaded brass adaptors, ball valves, globe valves, unions, diaphragm valves, butterfly valves etc shall be made of CPVC by Licensee.
- 6.3 The CPVC solvent cement used for installing CPVC piping systems shall conform to ASTM F493. Pipes from 1/2" upto 2" pipes and fittings, single step medium bodied CPVC solvent cement should be used. For CPVC pipes and fittings upwards of 2", a primer shall be used followed by heavy bodied solvent cement conforming to ASTM F493. PVC solvent cement should not be used.

6.4 Concealed Piping

All internal concealed plumbing for water supply shall be done with CPVC. The pipes & fittings shall conform to CTS (copper tube size) SDR-11 as per ASTM D2846 OR SDR-13.5. All pipes and fittings from 1/2" upto 2" shall come under this category. Medium body CPVC solvent cement conforming to ASTM F493 should be used for joining pipes to fittings.

6.5 Installation procedure:

All parameters pertaining to the installation of CPVC plumbing system such as cutting, joining, support spacing, expansion loops, insulation, type of support, special connections, etc. shall be as per the manufacturer's specifications.

- 6.6 All pipes shall be fixed in accordance with layout and alignment shown on the drawings. Care shall be taken to avoid air pockets.

6.7 Clamps

PPR/GI Pipes in shafts and other locations shall be supported by galvanized MS clamps of design approved by Project Manager. Pipes in wall chases shall be anchored by GI hooks. Pipes at ceiling level shall be supported on structural clamps fabricated from MS structurals. Pipes in typical shafts shall be supported on slotted angles/channels as per standard drawings.

- 6.8 For sleeves, anchor fasteners and clamp spacing chart (See 4.7 for clamp spacing chart Section 3 above).

6.9 Unions

Adequate number of unions with metal inserting on pipes 50 mm OD and below shall be provided to enable easy dismantling later when required. Unions shall be provided near each gunmetal valve, stop cock, or check valve and on straight runs as necessary at appropriate locations as required and/or directed by Project Manager.

6.10 Trenches

All water supply pipes below ground shall be laid in trenches with a minimum cover of 60 cms. The width and depth of the trenches shall be as follows:-

Dia of pipe	Width of trench	Depth of trench
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15 mm to 50 mm	30 cms	75 cms
65 mm to 100 mm	45 cms	100 cms

6.11 Sand filling

All GI pipes in trenches shall be protected with fine sand 15 cms thick. All - round before filling in the trenches.

- 4.12 Where shown on the drawings main pipe lines may be run in masonry trenches from the pump house to the buildings, filled up with sand and buried in ground as per architectural /landscape details.

5.0 Valves

All valves shall be of gun metal suitable for the particular service as specified. All valves shall be of the particular duty and design as specified. Valves shall either be of screwed type or flanged type, as specified, with suitable flanges and non-corrosive bolts and gaskets. Tail pieces as required shall be supplied along with valves. Gate, globe and check valves shall conform to Indian Standard IS:776 and non-return valves and swing check type reflux to IS:5312.

Sluice valves, where specified shall be flanged sluice valves of cast iron body. The spindle, valve seat and wedge nuts shall be gunmetal. They shall generally have non-rising spindle and shall be of the particular duty and design as specified. The valves shall be supplied with suitable flanges, non-corrosive bolts and asbestos fiber gaskets. Sluice valves shall conform to Indian standard IS:780 and IS:2906.

5.1 Ball valves

- 5.1.1 Valves 40 mm dia and below shall be screwed type ball valves with chrome plated balls, spindle, teflon seating and gland packing tested to a hydraulic pressure of 20 kg/cm² and accompanying couplings and steel handles to BS: 5351.

5.2 Butterfly Valves

- 5.2.1 Valves 50 mm dia and above shall be cast iron butterfly valve to be used for isolation and/or flow regulation. The valves shall be bubble tight, neoprene/EPDM body lining stainless steel upper stem, PTFE bush, suitable for flow in either direction and seal in both direction. Valves shall be provided with matching flanges with neoprene insertion gasket 3 mm thick
- 5.2.2 Butterfly valve shall be of best quality conforming to IS: 13095.

5.3 Non Return Valve

- 5.3.1 Where specified non return valve (swing check type) shall be provided through which flow can occur in one direction only. It shall be single door swing check type of best quality conforming to IS: 5312.
- 5.3.2 Each butterfly and slim type swing check valves shall be provided with a pair of flanges screwed to the main line by providing fittings with metal inserts and having the required number of galvanized nuts, bolts and washers of correct length.

5.4 PRESSURE REDUCING VALVE:

The item includes provision of pressure reducing valve of specified diameter as mentioned in the bill of quantities including fixing of PRV of different diameters.

- 5.4.1 **MATERIAL:** Pressure reducing valve is a device with suitable means of connection for insertion in a vertical/horizontal pipe line for controlling the water pressure. Valve shall be of brass and shall be vertical flow type, conforming to IS 9739-1981.
- 5.4.2 **FIXING:** The valve shall be fixed in position on the pipe line as shown in good for construction drawing or as directed by project manager. The screwed or flanged joint shall be made to obtain complete water tight joint.
- 5.4.3 **TESTING:** The joints shall be tested to a hydraulic pressure of 16 kg/cm² along with testing of pipe line for a minimum duration of 2 hrs.

5.4.4 **THE RATE INCLUDES FOR:**

1. Supplying Valve including fixing and testing.
2. All necessary labour, materials and use of tools.

5.4.5 **MODE OF MEASUREMENT:** The measurement shall be for each unit of valve of specified diameter fixed.

5.4.6 **MODE OF PAYMENT:** The contract rate shall be for each unit of valve of specified diameter fixed.

5.5 WATER METER:

5.5.1 **GENERAL:** The item includes provision of Water meter with or without end flanges or non-return valve of specified diameter as mentioned in the schedule with strainer, sockets, flange, union, nuts etc. including fixing and testing.

5.5.2 **MATERIAL:** Water Meter shall conform to IS 779 (Domestic type) or IS 2373 (Bulk type) as specified in Schedule of Quantities and should have ISI certification mark. Non return valve and strainer shall be of the same diameter as that of water meter. Strainer, sockets, flange, union, union nuts, rubber packing etc. shall be as per the description of item.

5.5.3 **FIXING:** Water meter shall be fixed in position on the inlet pipe line and the joints shall be made either screwed or flanged with necessary sockets, flanges and union nuts as required or as directed by the Engineer-in-charge.

5.5.4 **SCREWED JOINT:** A few turns of fine hemp yarn dipped in linseed oil shall be taken over the threaded ends to obtain complete water tight joint.

5.5.5 **FLANGED JOINT:** The flange joint shall be made for flange type water meter and the joint shall be as per the specification of flanged joint.

5.5.6 **TESTING:** The joints shall be tested to a hydraulic pressure of 1 MPa (10 kg/cm²) along with testing of pipe line for a minimum duration of two hours.

5.5.7 **THE RATE INCLUDES FOR:**

1. Water meter, hemp yarn, linseed oil, zinc, fixing and testing.
2. Supplying of strainer non-return valve, sockets, union nut etc.
3. Making screwed or flanged joints.
4. All necessary labour, material and use of tools.

5.5.8 **MODE OF MEASUREMENT:** The measurement shall be for each unit of water meter of specified diameter fixed.

5.5.9 **MODE OF PAYMENT:** The contract rate shall be for each unit Water Meter of specified diameter fixed. No extra payment shall be made towards making flanged and other joints and G.I. fittings used in fixing of the water meter.

5.6 MOTORISED VALVE:

- 5.6.1 GENERAL: The item includes providing, installation, testing & commissioning of motorized valve of specified diameter as mentioned in the bill of quantities.

2-port

The valve has 2 pipe connections (ports) and permits or blocks flow between the ports depending on whether it is actuated or not. Flow is permitted when the valve is actuated and blocked in its resting state.

When the valve is energized a synchronous motor drives the valve to the open position until the motor stalls and stays in that position. When the valve is required to close then power is removed and a spring pulls the mechanism (and the motor) back, returning it to its original, closed, position.

3-port

The valve has 3 pipe connections, in a T formation. The centre leg of the T is the inlet and the two short arms are the outlets, usually referred to as ports A and B. Actuation controls whether the flow from the inlet passes to the A or B port. In the resting state flow is to the B port (usually the hot water circuit).

There are two types of 3-port valve:

Diverter valve

This is a simple change-over version of a 3-port valve: when the valve is actuated all flow is diverted from one port to the other. When deactivated, a spring returns flow back to the original port - there is no mid position that can feed water to both ports at once.

- 5.6.2 MATERIAL: Motorized valve is a device with suitable means of connection for insertion in a vertical/horizontal pipe line for opening/stopping of the water flow. The direction for open/close of the valve gets signal from level controllers which submerge in domestic water tank as shown in drawings. Valve shall be of brass and shall be vertical flow type, conforming to IS 9739-1981: 42
- 5.6.3 FIXING: The valve shall be fixed in position on the pipe line as shown in good for construction drawing or as directed by project manager. The screwed or flanged joint shall be made to obtain complete water tight joint.
- 5.6.4 TESTING: The joints shall be tested to a hydraulic pressure of 1 MPa (10 kg/cm²) along with testing of pipe line for a minimum duration of 2 hrs.
- 5.6.5 THE RATE INCLUDES FOR:
1. Supplying Valve including fixing and testing.
 2. All necessary labour, materials and use of tools.
- 5.6.6 MODE OF MEASUREMENT: The measurement shall be for each unit of valve of specified diameter fixed.
- 5.6.7 MODE OF PAYMENT: The contract rate shall be for each unit of valve of specified diameter fixed.

5.7 DISINFECTION OF PIPING SYSTEM AND STORAGE TANKS

Before commissioning the water supply system, the contractor shall arrange to disinfect the entire system as described in the succeeding paragraph.

The water storage tanks and pipes shall first be filled with water and thoroughly flushed out. The storage tanks shall then be filled with water again and disinfecting chemical containing liquid chlorine (food grade sodium hypochlorite solution) added gradually while tanks are being filled to ensure thorough mixing. Sufficient chemical shall be used to give water a dose of 50 parts of chlorine to one million parts of water.

If a proprietary brand of chemical is used, the proportions shall be specified by the manufacturer. When the storage tanks are full, the supply shall be stopped and all the taps on the distributing pipes are opened successively

working progressively away from the storage tank. Each tap shall be closed when the water discharged begins to smell of chlorine. The storage tank shall then be filled up with water from supply pipe and added with more disinfecting chemical in the recommended proportions. The storage tank and pipe shall then remain charged at least for three hours. Finally the tank and pipes shall be thoroughly flushed out before any water is used for domestic purpose. The pipe work shall be thoroughly flushed before supply is restored.

Work under this section shall be executed without any additional cost. The rates quoted in this tender shall be inclusive of the works given in this section

6 Brick Masonry Chamber for meters and valves

Constructing brick masonry chambers 600 x 600 x 750 mm deep inside with class 75 bricks in cement mortar 1 : 5 with fine sand, excavation, refilling, 100 mm thick foundation concrete 1 : 5 : 10 with coarse sand, 12 mm thick inside plastering with cement mortar 1 : 3 with coarse sand, finished with a floating coat of neat cement, and 15 mm thick outside plastering in cement mortar 1 : 4 with fine sand, complete with one brick thick wall, ISI marked steel fiber reinforced concrete (SFRC) manhole cover and frame having hold fasts.

7 Storage Tanks

7.1 Overhead Tanks (Part of Civil Contractor)

Overhead water storage tanks for water supply shall be reinforced cement concrete. The tanks shall be provided with lockable DI manhole cover, MS ladders/Orange foot, inserts for all pipe connections and will be provided by the building contractor. Plumbing contractor shall make all connections and provide overflows etc.

7.2 POLYETHYLENE WATER TANK:

- 7.2.1 GENERAL: The item includes providing polyethylene plastic water tank with cover of capacity as mentioned in the schedule including fixing and making connections such as inlet, outlet, scour, overflow etc.
- 7.2.2 MATERIAL: The water tank shall be made out of best moulded Polyethylene plastic. It shall be vertical or horizontal type as specified, watertight and non-absorbent and shall not contaminate water. Adhesives shall not be used in joints. The cover shall be of polyethylene/M.S./C.I. as approved.
- 7.2.3 FIXING: The plastic water tank with cover shall be installed and fixed as per the manufacturer's specification. The connections such as inlet, outlets, over flow, scour etc. of specified diameter shall be made as mentioned in the schedule including the cost of fittings, fixtures and pipe of approximate 400 mm long.
- 7.2.4 THE RATE INCLUDES FOR:
 - 1. Supply of polyethylene plastic tank, cover, G.I. pipe, fittings etc.
 - 2. Installation of tank and making connections.
 - 3. All necessary materials, labour and use of tools.
- 7.2.5 MODE OF MEASUREMENT: The measurement shall be for each polyethylene water tank of specified capacity installed or per litre capacity of water tank.
- 7.2.6 MODE OF PAYMENT: The contract rate shall be for each polyethylene water tank of specified capacity installed. The support for the tank shall be paid under relevant item.

7.3 Tank connection and accessories

- 7.3.1 Contractor shall provide the following to each tanks:

- a) Inlet and outlet connections to pumps, equipment and main pipe lines.
- b) Tank overflows with mosquito proof gratings
- c) Scour drain and valve as per drawings
- d) Water level gauge with approved type of brass gauges, plastic tube, a wooden board with level marking.

7.3.2 Electronic level controllers, cabling, sequence controllers and all related equipment shall be provided by agency executing the pumping system work. Plumbing contractor shall provide necessary sleeves and co-operate with the contractor to ensure that the work is successfully executed.

8 Testing

- 8.1 All pipes, fittings and valves, after fixing at site, shall be tested by hydrostatic pressure of 1.5 times the working pressure or 10 kg/cm² whichever is more. Pressure shall be maintained for a period of at least 12 hours without any drop.
- 8.2 A test register shall be prepared and all entries shall be maintained date wise by Contractor and jointly signed by Contractor(s) and Project Manager.
- 8.3 In addition to the sectional testing carried out during the construction, Contractor shall test the entire installation after connections to the overhead tanks or pumping system or mains. He shall rectify all leakages and shall replace all defective materials in the system. Any damage done due to carelessness, open or burst pipes or failure of fittings, to the building, furniture and fixtures shall be made good by the Contractor during the defects liability period without any cost.
- 8.4 After commissioning of the water supply system, Contractor shall test each valve by closing and opening it a number of times to observe if it is working efficiently. Valves which do not effectively operate shall be replaced by new ones at no extra cost and the same shall be tested as above.

9 Measurement

- 9.1 Pipes
All piping work above ground shall be measured per linear meter (to the nearest cm) and shall be inclusive of all fittings e.g. couplings, tees, bends, elbows, unions, and flanges. Deduction for valves shall be made. Rate quoted shall be inclusive of all fittings, clamps, cutting holes chases and making good the same and all items mentioned in the specifications and Schedule of Quantities.
- 9.2 Pipes below ground shall be measured per linear meter (to the nearest cm) and shall be inclusive of fittings, e.g. couplings, tees, bends, elbows, unions, deduction for valves shall be made. Rates quoted shall be inclusive of all fittings, excavation, back filling, compaction and disposal of surplus earth, cutting holes and chases and making good and all other items mentioned in the specifications and Schedule of Quantities.
- 9.3 Gunmetal, cast iron, butterfly and non return valves puddle flanges, level indicators and meters shall be measured by numbers.
- 9.4 Brick masonry chamber for valves and meters shall be measured by number and include all items given in the Bill of quantities.
- 9.5 ISI code with respect to measurement of work is not applicable to this work.
- 9.6 Project Manager's decision with respect to the correct interpretation regarding mode of measurement shall be final and binding on the contractor.

End of Section 4
----- Water supply -----

Section 5 External Services (Sewers & Storm Water Drains)

1 Scope of work

- 1.1 Work under this section shall consist of furnishing all labour, materials, equipment and appliances necessary and required to completely install all the drainage system as required by the drawings and specified hereinafter or given in the Schedule of Quantities.
- 1.2 Without restricting to the generality of the foregoing, the drainage system shall include: -
 - a) Sewer lines including excavation, laying pipelines, manholes, drop connections and connections to the existing sewer.
 - b) Storm water drainage, excavation, laying pipelines, manholes, catch basins, drain channels and connections to the existing storm water drain.

2 General Scheme

The contractor shall install a drainage system to effectively collect; drain and dispose all soil and waste water from various parts of the buildings, appurtenances and equipment. The piping system shall finally terminate and discharge into the Sewage sump and finally discharge by pumping to Municipal Sewer line. The piping work mainly consists of laying of Salt glazed stoneware pipes, reinforced cement concrete pipes and cast iron soil pipes as called for on the drawings. All piping shall be installed at depth greater than 80 cm below finished ground level. The disposal system shall include construction of gully traps, manholes, intercepting chambers as indicated. The piping system shall be vented suitably at the starting point of all branch drains, main drains, the highest/lowest point of drain and at intervals as shown. All ventilating arrangements shall be unobstructive and concealed. The work shall be executed strictly in accordance with IS: 1742. The sewage system shall be subject to smoke test for its soundness as directed by the Project Manager. Wherever the sewerage pipes run above water supply lines, same shall be completely encased in cement concrete 1:2:4 all round with the prior approval of the Project Manager.

Without restricting to the generality of the foregoing, the drainage system shall inter-alia include:

- a. Sewer lines including earth work for excavation, disposal, back filling and compaction, pipe lines, manholes, drop connections and connections to the municipal or existing sewer.
- b. Storm water drainage, earth works for excavation, disposal, backfilling and compaction, pipe lines, manholes, catch basins and connections to the existing municipal storm water drain or connected as indicated by the Project Manager.

General requirements

- 2.1 All materials shall be new and best quality conforming to specifications and subject to the approval of the Project Manager.
- 2.2 Drainage lines and open drains shall be laid to the required gradients and profiles.
- 2.3 All drainage work shall be done in accordance with applicable municipal/mandatory laws.
- 2.4 Contractor shall obtain necessary approval and permission for the drainage system from the municipal or any other competent authority.
- 2.5 Location of all manholes, etc. shall be got confirmed from the Project Manager with relation to the landscape drawings.

3 Excavation

3.1 General

All the material shall be new of best quality conforming to specifications and subject to the approval of the Architects. Drainage lines shall be laid to the required gradients and profiles. All drainage work shall be done in accordance with the local municipal by-laws.

Contractor shall obtain necessary approval and permission for the drainage system from the municipal or any other competent authority. Location of all manholes, catch basins etc. shall be finalized and shown in approved shop drawings before the actual execution of work at site. All work shall be executed as directed by the Project Manager.

3.2 Alignment and grade

The sewer and storm water drainage pipes shall be carefully laid to levels and gradients shown in the plans but subject to modifications as shall be ordered by the Architects from time to time to meet the requirements of the works. Great care shall be taken to prevent sand etc. from entering the pipes. The pipes between two manholes shall be laid truly in straight lines without vertical or horizontal undulations. The body of the pipes shall rest on an even bed in the trench for its length and places shall be excavated to receive collar for the purpose of jointing. No deviations from the lines, depths of cuttings or gradients as called for on the drawings shall be permitted without the written approval of the Architect. All pipes shall be laid at least 60cms below the finished ground level or as called for on the drawings.

3.3 Setting out Trenches

The contractor shall set out all trenches, manholes, chambers and such other works to true grades and alignments as called for. He shall provide the necessary instruments for setting out and verification for the same. All trenches shall be laid to true grade and in straight lines and as shown on the drawings. The trenches shall be laid to proper levels by the assistance of boning rods and sight rails which shall be fixed at intervals not exceeding 10 meters or as directed by the Project Manager.

3.2 Trench Excavation

The trenches for the pipes shall be excavated with bottoms formed to level and gradients as shown on the drawings or as directed by the Project Manager. In soft and filled in ground, the Project Manager may require the trenches to be excavated to a greater depth than the shown on the drawings and to fill up such additional excavation with concrete (1:4:8) consolidated to bring the excavation to the required levels as shown on the drawings.

All excavations shall be properly protected where necessary by suitable timbering, piling and sheeting as approved by the Project Manager. All timbering and sheeting when withdrawn shall be done gradually to avoid falls. All cavities be adequately filled and consolidated. No blasting shall be allowed without prior approval in writing from the Architect. It shall be carried out under thorough and competent supervision, with the written permission of the appropriate authorities taking full precautions connected with the blasting operations. All excavated earth shall be kept clear of the trenches to a distance equal to 75 cms.

3.3 Opening out trenches

While excavating the trenches in tarred/paved roads or turfed areas, the solid road metalling, pavement, kerbing, etc. or the turf is to be placed on one side and preserved for reinstatement. Before any road metal is replaced, it shall be carefully sifted. The surface of all trenches and holes shall be restored and maintained to the satisfaction of the Project Manager.

The Contractor shall scrub up and clear the surface over the trenches and other excavations of all trees, stumps roots and all other encumbrances affecting execution of the work and shall remove them from the site to the approval of the Project Manager.

3.4 Protection of Pipes etc.

All pipes, water mains, cables etc. met in the course of excavation shall be carefully protected and supported. Care shall be taken not to disturb the cables, the removal of which shall be arranged by the contractor with the written consent from the Project Manager.

3.5 Obstruction of roads

The Contractor shall not occupy or obstruct by his operation more than one half of the width of any road or street and sufficient space shall then be left for public and private transit, he shall remove the materials excavated and bring them back again when the trench is required to be refilled. The Contractor shall obtain the consent of the Project Manager.

3.6 Removal of filth

All night soil, filth or any other offensive matter met with during the execution of the works, immediately after it is taken out of any trench, sewer or cess pool, shall not be deposited on to the surface of any street or where it is likely to be a nuisance or passed into any sewer or drain but shall be at once put into the carts and removed to a suitable site to be identified by Contractor and approved by the Project Manager.

3.7 Excavation to be taken to proper depths

The trenches shall be excavated to such a depth that the sewer/storm water drain shall rest on concrete as described in the several clauses relating there to and so that the inverts may be at the levels given in the sections. In bad ground, the Project Manager may order the contractor to excavate to a greater depth than that shown on the drawing. In all such cases, the trench will be filled up with cement concrete of the same mix as that of base concrete up to the required level.

3.8 Refilling

After the sewer or other work has been laid and tested to be water tight, the trench or other excavations shall be refilled. Utmost care shall be taken in doing this, so that no damage shall be caused to the sewer and other permanent work. The filling in the haunches and up to 75 cms above the crown of the sewer shall consist of the good earth placed carefully in 20 cms layers and flooded and consolidated. After this has been laid, the trench and other excavation shall be refilled carefully in 20 cms layers with materials taken from the excavation, each layer being watered to assist in the consolidation. The consolidation shall be done by power operated mechanical plate compactors as directed by the Project Manager.

3.9 Contractor to restore settlement and damages

The contractor shall at his own costs and expenses, make good promptly during the whole period for the works in hand if any settlement occurs in the surfaces of roads, beams, footpaths, gardens, open spaces etc. in the public or private areas caused by his trenches or by his other excavations and he shall be liable for any accident caused thereby. He shall also, at his own expense and charges, repair (and make good) any damage done to building and other property. If in the opinion of the Project Manager he fails to make good such works with all practicable dispatch, the Project Manager shall be at his liberty to get the work done by other means and the expenses thereof shall be paid by the contractor or deducted from any money that may be or become due to him or recovered from him by any other manner according to the laws of land.

The contractor shall at his own costs and charges provide places for disposal of all surplus materials not required to be used on the works. As each trench is refilled, surplus soil shall be immediately removed, the surface shall be properly restored and roadways and sides shall be left clear

3.10 Disposal of surplus soil

The Contractor shall at his own costs and charges provide places for disposal of all surplus materials not required to be used on the works. As each trench is refilled the surplus soil shall be immediately removed, the surface properly restored and roadways and sides left clear as directed by the Project Manager.

3.11 Timbering of sewer and trenches

The Contractor shall at all times support efficiently and effectively the sides of the sewer trenches and other excavations by suitable timbering, piling and sheeting. The trenches shall be closed timbered in loose or sandy strata and below the surface of the sub soil water level.

- a) All timbering, sheeting and piling with their walling and supports shall be of adequate dimensions and strength and fully braced and strutted so that no risk of collapse or subsidence of the walls of the trench shall take place.
- b) The Contractor shall be held responsible and will be accountable for the sufficiency of all timbering, bracings, sheeting and piling used as also for, all damage to persons and property resulting from improper quality, strength, placing, maintaining or removing of the same.
- d) Open or closed timbering where required in the opinion of Project Manager where decision shall be final, and done by the contractor shall be paid for separately.

3.12 Shoring of buildings

The Contractor shall shore up all buildings, walls and other structures, the stability of which is liable to be endangered by the execution of the work and shall be fully responsible for all damages to persons or property resulting from any accident.

3.13 Removal of water from sewer, trench etc.

- a) The Contractor shall at all times during the progress of the work keep the trenches and excavations free from water which shall be disposed of by him in a manner as will neither cause injury to the public health nor to the public or private property nor to the work completed or in progress nor to the surface of any roads or streets, nor cause any interference with the use of the same by the public.
- b) If any excavation is carried out at any point or points to a greater depth than the specified cross section of the sewer with its envelope, the additional depth of the trench shall be filled with concrete of the same mix as that of base concrete by the Contractor at his own expenses and charges to the requirements of the Project Manager.

3.14 Width of trench

The Project Manager shall have power by giving an order in writing to the Contractor to increase the maximum width/depth for excavation and backfilling in trenches for various classes of sewer, manholes and other works in certain length to be specifically laid down by him, where on account of bad ground on other unusual conditions, he considers that such increased width/depths are necessary in view of the site conditions.

Recommended width of trenches at the bottom shall be as follows:-

100 mm dia pipe	55 cms
150 mm dia pipe	55 cms
225-250 mm dia pipe	60 cms
300 mm dia pipe	75 cms

Maximum width of the bed concrete shall also be as above. Should the contractor excavate the trenches to width greater than specified above, no additional payment will be admissible for widths greater than specified. The contractor shall also fill the additional width with cement concrete for the pipe to the full width of the excavated trench without any extra cost.

4 PIPING MATERIAL

4.1 RCC pipes

All pipes shall be centrifugally spun RCC pipes NP2/NP3. Pipes shall be true and straight with uniform bore throughout. Cracked, warped pipes shall not be used on the work. All pipes shall be tested by the manufacturer and the Contractor shall produce, prior to use on site, a certificate to that effect from the manufacturer.

The pipes shall be with or without reinforcement as required and of the class as specified. These shall conform to IS: 458-1971.

All pipes shall be true to shape, straight, perfectly sound and free from cracks and flaws. The external and internal surface of the pipes shall be smooth and hard. The pipes shall be free from defects resulting from imperfect grading of the aggregate mixing or moulding.

Laying

RCC spun pipes shall be laid on cement concrete bed of cradles as specified and shown on the detailed drawings. The cradles may be precast and sufficiently cured to prevent cracks and breakage in handling. The invert of the cradles shall be left 12 mm below the invert level of the pipe and properly placed on the soil to prevent any disturbance. The pipe shall then be placed on the bed concrete or cradles and set for the line and gradient by means of sight rails and boning rods, etc. Cradles or concrete bed may be omitted, if directed by the Project Manager.

Jointing

Semi flexible type collar joint.

Hemp rope soaked in neat cement wash shall be passed round the joint and inserted in it by means of caulking tool. More skein of yarn shall be added and rammed home. Cement mortar with one part of cement and two part of sand and with minimum water content but on no account soft or sloppy, shall be carefully inserted, punched and caulked into the collar and more cement mortar added until the space of the collar has been filled completely with tightly caulked mortar. Provision of rubber sealing ring in the collar joint shall also be made. The joint shall then be finished off neatly outside the socket at an angle of 45 deg.

Curing:

The joint shall be cured for at least seven days. Refilling at joints will be permitted only on satisfactory completion of curing period.

Cement Concrete for Pipe Supports:

Unless otherwise directed by the Project Manager cement concrete for bed, all round or in haunches shall be in the mix 1:4:8 (1 cement: 4 coarse sand :8 graded stone aggregate 20 mm nominal size):

4.2 Cast Iron Class (LA) Pipe:

All drainage line passing under building, floors and roads with heavy traffic shall be Cast Iron Class (LA) Pipe.

Cast Iron Class (LA) pipe shall be such that they could be cut, drilled or machined. Pipe centrifugally cast in unlined water cooled moulds shall be heat treated in order to achieve the necessary mechanical properties and to relieve casting stresses; provide that the specified mechanical properties are satisfied.

Material

Cast iron pipe shall be centrifugally spun cast iron pipes and conforming to IS:1536-1976.

Fittings

Fittings shall be used for Cast Iron Class (LA) Pipes shall conform to IS:1538-1976. Whenever possible junction from branch pipe shall be made by Wyes.

Laying

Fittings used for C.I drainage pipe shall conform to IS:1538-1976. Whenever possible junction from branches pipes shall be made by a Wyes.

All cast iron pipes and fittings shall be jointed with best quality soft pig lead (conforming to IS 782-1966) which shall be free from impurities. In wet trenches joints shall be made from lead wool. Nothing extra will be paid for lead wool joints. Depth of pig lead and weight for joints shall be as given in table below:

Lead caulked Joints with Pig Lead

The approximate depth and weights of Pig Lead for various diameters of C I pipes and specials shall be as follows:

<u>Nominal Size of Pipe</u> <u>mm</u>	<u>Lead per joint</u> <u>Kg</u>	<u>Depth of Lead Joint</u> <u>mm</u>
80	1.8	45
100	2.2	45
125	2.6	45
150	3.4	50
200	5.0	50
250	6.1	50

The spigot of pipe or fittings shall be centred in the adjoining socket by caulking. Sufficient turns of tarred gasket shall be given to leave a depth of 45 mm when the gasket has been caulked tightly home. Joining ring shall be placed round the barrel and against the face of the socket. Molten pig lead shall then be poured to fill the remainder of the socket. This shall then be done in one pouring. The lead shall then be solidly caulked with suitable tools and hammers weighting not less than 2 Kgs.

4.3 Salt Glazed Stoneware Pipes

Stoneware pipes shall be new and of First Class quality salt glazed and free from rough texture inside and outside and straight. All pipes shall comply with IS:651 and have the manufacturers name marked on them.

Laying of Salt Glazed Stoneware Pipes:

Pipes are liable to be damaged in transit and notwithstanding tests that may have been made before dispatch each pipe shall be examined carefully on arrival at site. Each pipe shall be lightly struck with a wooden hammer or mallet and those that do not ring true and clear shall be rejected. Sound pipes shall be carefully stacked to prevent damage. All defective pipes shall be segregated, marked in a conspicuous manner and their use in the works prevented by expeditiously removing them from the work site.

The pipes shall be laid with sockets leading uphill and shall rest on solid and even foundations for the full length of the barrel. Socket holes shall be formed in the foundation sufficiently deep to allow the pipe jointer room to work right round the pipe and as short as practicable to admit the socket and allow the joint to be made.

Where pipes are not bedded on concrete the trench bottom shall be left slightly high and carefully bottomed up as pipes laying proceeds so that the pipe barrels rest on firm ground. If excavation has been carried to low it shall be made up with cement concrete 1:4:8 (1 cement: 4 coarse sand: 8 stone aggregate 20mm nominal size) at the Contractor's cost and charges

Jointing of Salt Glazed Stoneware Pipes:

Tarred gaskin shall first be wrapped round the spigot of each pipe and the spigot shall then be placed into the socket of the pipe previously laid, the pipe shall then be adjusted and fixed in its correct position and the gaskin caulked tightly home so as to fill not more than one quarter of the total length of the socket.

The remainder of the socket shall be filled with stiff mix of cement mortar (1cement: 1 clear sharp washed sand). When the socket is filled, a fillet shall be of 45 degrees with the barrel of that pipe. The mortar shall be mixed as needed for immediate use and no mortar shall be beaten up and used after it has begun to set.

After the joint has been made any extraneous materials shall be removed from the inside of the joint with a suitable scarper of "badger". The newly made joints shall be protected until set, from the sun, drying winds, rain or dust. Sackling or other materials which can be kept damp shall be used. The joints shall be exposed and space left all around the pipes for inspection by the Project Manager. The inside of the sewer must be left absolutely clear in bore and free from cement mortar or other obstructions throughout its entire length, and shall efficiently drain and discharge.

4.4 **S.W. Gully Trap**

Gully trap shall be stoneware conforming to IS:651. These shall be sound and free from visible defects such as fire cracks, or hair cracks. The glaze of the traps shall be free from cracks. They shall give a sharp clear note when struck with light hammer. There shall be no broken blisters. Each gully trap shall have one CI grating of square size corresponding to the dimensions of inlet of gully trap. It will also have a water tight CI cover with frame inside dimensions 300 x 300mm the cover weighing not less than 4.5 kg and the frame not less than 2.7kg. The grating cover and frame shall be of good casting and shall have truly square machined seating faces.

Fixing of S.W. Gully Trap

The excavation for gully traps shall be done true to dimensions and levels as indicated on plans or as directed by the Project Manager /Consultant / Architect. The gully traps shall be fixed on cement concrete foundation 65cm square and not less than 10cm thick. The mix for the concrete will be 1:4:8. The jointing of gully outlet to the branch drain shall be done similar to the jointing of S.W. Pipes described earlier. After fixing and testing gully and branch drain, a brick work of specified class in cement mortar 1:5 shall be built with a half brick masonry work round the gully trap from the top of the bed concrete upto ground level. The space between the chamber and trap shall be filled in with cement concrete 1:3:6. The upper portion of the chamber i.e. above the top level of the trap shall be plastered inside the cement mortar 1:3 finish with a floating coat of neat cement. The corners and bottom of the chamber shall be rounded off so as to slope towards the grating.

CI cover with frame 300 x 300 mm (inside) shall then be fixed on the top of the brick masonry with cement concrete 1:2:4 and rendered smooth. The finished top cover shall be so as to prevent the surface water from entering the gully trap.

5 **CONSTRUCTION OF MANHOLE**

Where manholes are to be constructed, the excavation, filling back and ramming, disposal of surplus earth, preparation of bottom and sides etc. shall be carried out as described earlier under trench excavation. Manhole shall be sized and depths as called for in the drawings and Bill of Quantities.

The manhole shall be built on a base concrete 1:3:6 of 150mm thickness for manholes upto 1500mm depth and 250mm thickness for manholes from 1500 to 2500mm depth and 300mm thickness manholes of depth greater than 2500mm. Reinforcement as shown shall be provided in the base slabs.

The walls shall be of brick work of thickness as shown in drawings built in cement mortar 1:5. The joints of brick work shall be raked and plastered internally in cement mortar 1:3 (at least 12 mm thick) and finish with a coat of neat cement, external plaster shall be rough plaster in 1:3, PCC benching & semi circular channels of the same diameter as the pipes shall be provided and finished with neat cement coating.

Above the horizontal diameter, the sides of channel shall be extended vertically to the same level as the crown of the outgoing pipe and the top edge shall be suitably rounded off. The branch channels shall also be similarly constructed with respect to the benching but at their junction with the main channel an appropriate fall suitably rounded off in the direction of flow in the main channel shall be given. All manholes / sumps shall be provided with poly propylene coated steel reinforced foot rest. The polypropylene shall conform to ASTM D-4101 specification, injection moulded around 12 mm dia IS-1786 grade FE-415 steel reinforcing bar. These rungs shall be set at 30cms interval in two vertical runs at 380mm apart horizontally. The top rung shall be 450mm below the manhole cover. Unless otherwise mentioned, manholes shall be constructed to the requirements of Indian Standard IS:4111 (Part I). All manholes shall be constructed so as to be water tight under test. All angles shall be rounded to a 75mm radius with cement plaster 20mm thick. The benching at the side shall be carried out in such a manner so as to provide no lodgment for any splashing in case of accidental flooding. Manhole cover with

frame shall be of cast iron of an approved make. The covers and frame shall generally be double seal as specified in the Bill of Quantities.

5.1 Making Connections

Contractor shall connect the new sewer line to the existing manhole by cutting the walls benching and restoring them to the original condition. A new channel shall be cut in the benching of the existing manhole for the new connection. Contractor shall remove all sewage and water if encountered in making the connection without additional cost.

6.0 Testing

All rights of the sewer and drain shall be carefully tested for water tightness by means of water pressure maintained for not less than 30 minutes. Testing shall be carried out from manhole to manhole. All pipes shall be subject to a test pressure of 1.5 meter head of water. The test pressure will however, not exceed 6 meters head at any point. The pipes shall be plugged preferably with standard design plugs or with rubber plugs on both sides, the upper end shall, however, be connected to a pipe for filling with water and getting the required head poured at one time.

Sewer lines shall be tested for straightness by :

- i. Inserting a smooth ball 12 mm less than the internal diameter of the pipe. In the absence of obstructions such as yarn or mortar projecting at the joints the ball shall roll down the invert of the pipe and emerge at the lower end.
- ii. means of a mirror at one end a lamp at the other end. If the pipe is straight the full circle of light will be seen otherwise obstructions or deviations will be apparent.
- iii. The contractor shall give a smoke test to the drain and sewer at his own expense and charges, if directed by the Owner's site representative.
- iv. A test register shall be maintained which shall be signed and dated by contractor and Owner's site representative.

7 Building Materials

(for cement concrete and masonry works in drainage system.)

7.1 Materials

a) Water

Water used for all the constructional purposes shall be clear and free from oil, acid, alkali, organic and other harmful matters, which shall deteriorate the strength and/or durability of the structure. In general, the water suitable for drinking purposes shall be considered well enough for constructional purpose.

b) Aggregate for concrete

The aggregate for concrete shall be in accordance with IS: 383 and IS: 515 in general, these shall be free from all impurities that may cause corrosion of the reinforcement. Before actual use these shall be washed in water, if required as per the direction of Project Manager. The size of the coarse aggregate shall be as per IS: 383.

c) Sand

Sand for various constructional purposes shall comply in all respects with IS: 650 and IS: 2116. It shall be clean, coarse hard, sharp, durable, uncoated, free from any mixture of clay, dust, vegetable matters, mica, iron impurities soft or flaky and elongated particles, alkali, organic matters, salt, loam and other impurities.

d) Cement

The cement used for all the constructional purposes shall be ordinary Portland cement or rapid hardening Portland cement conforming to IS: 269.

e) Mild steel reinforcement

The mild steel for the reinforcement bars shall be in the form of round bars conforming to all requirements of IS: 432 Grade I.

f) Bricks

Brick shall have uniform colour, thoroughly burnt but not over burnt, shall have plain rectangular faces with parallel sides and sharp right angled edges. They should give ringing sound when struck. Brick shall not absorb more than 20% to 22% of water, when immersed in water for 24 hours. Bricks except for manholes in sewerage system shall be of class designation 75. Bricks to be used for construction of manholes in sewerage line shall conform to IS 4885. All the bricks be got approved from the Project Manager before their use.

g) Other materials

Other materials not fully specified in these specifications and which may be required in the work shall conform to the latest relevant IS Codes. All such materials shall be approved by the Project Manager.

7.2 Cement concrete (plain or reinforced)

- a) Cement concrete in pipe bedding, cradles, foundations and in RCC slabs for all works shall be mixed by a mechanical mixer where quantities of the concrete poured at one time permit. Hand mixing on properly constructed platforms may be allowed for small quantities by the Project Manager. Rate for cement concrete shall be inclusive of all shuttering and centring at all depth and heights.
- b) Concrete work shall be of such thickness and mix as given in the Schedule of Quantities.
- c) All concrete work shall be cured for a period of at least 7 days. Such work shall be kept moist by means of gunny and water bags at all times.

7.3 Masonry work

Masonry work for manholes, chambers, septic tanks, and such other works as required shall be constructed with bricks and mortars as specified in the Schedule of quantities. All joints shall be properly raked to receive plaster.

7.4 Cement concrete for pipe support

- a) Wherever specified or shown on the drawings, all pipes shall be supported in bed, all round or upto haunches. The thickness and mix of the concrete shall be given in the Schedule of Quantities. Width of the bedding shall be as per para 3.14 of this section. .
- a) Unless otherwise directed by the Project Engineer, cement concrete for bed, around or in haunches shall be laid as follows :-
- b)

	upto 1.5 m depth	From 1.5 m upto 3 m depth	beyond 3 m depth
RCC/Stoneware pipes buried in open ground (no sub soil water)	All round (1 : 4 : 8)	All round (1 : 4 : 8)	All round (1 : 4 : 8)
RCC or SW in sub soil water	All round (1 : 4 : 8)	in Haunches (1 : 4 : 8)	in Haunches (1 : 4 : 8)
CI Pipes (in all conditions)	All round (1 : 4 : 8)	in Haunches (1 : 4 : 8)	in Haunches (1 : 4 : 8)

RCC pipes or CI pipes under or building	All round (1 : 4 : 8)	All round (1 : 4 : 8)	All round (1 : 4 : 8)
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(Ratio refers to cement: coarse sand: stone aggregate 40 mm nominal size)

- c) RCC pipes or CI pipes may be supported on brick masonry or pre-cast R.C.C. or in situ cradles. Cradles shall be as shown on the drawings.
- d) Pipes in loose soil or above ground shall be supported on brick or stone masonry pillars as shown on the drawings.

7.7 Manholes and chambers

Where not specified, manholes shall be constructed as follows:-
(all dimensions internal clear in cms)

S. No.	Size & type of manhole	900x800 Rect.	1200x900 Rect.	910 dia Conical	1220 dia Conical	1520 dia Conical
a)	Maximum depth in mm	1500	2400	1670	2290	9000
b)	Average thickness of RCC slab mm	150	150	-	-	-
c)	Size of cover and frame (mm)	610 x 455		560 dia		
d)	Weight of cover and frame (kg.)	23/15	58/58	182 kg.		

- 7.7.1 All manholes shall be provided with cement concrete benching in 1 : 2 : 4 mix (1 cement : 2 coarse sand : 4 stone aggregate 20 mm nominal size). The benching shall have a slope of 10 cms towards the channel. The depth of the channel shall be full diameter of the pipe. Benching shall be finished with a floating coat of neat cement as per standard details.
- 7.7.2 All manholes shall be plastered with 12/15 mm thick cement mortar 1 : 3 (1 cement : 3 coarse sand) and finished with a floating coat of neat cement inside. Manhole shall be plastered outside as above but with rough plaster mixed with water proofing compound.
- 7.7.3 All manholes with depths greater than 1 m. shall be provided with 20 mm² or 25 mm round rods plastic coated catch rings set in cement concrete blocks 25x10x10 cms in 1 : 2 : 4 mix 30 cms vertically and staggered. Foot rests shall be coated with coal tar before embedding.
- 7.7.4 All manholes shall be provided with cast iron/steel fibre reinforced plastic (SFRC) covers and frames as specified in BOQ and embedded in reinforced cement concrete slab. Weight of cover, frame and thickness of slab shall be as specified in the Schedule of Quantities or given above.
- 7.7.5 Road gullies, ramp drains, gratings in basement shall be cast iron with MS frame or Steel Fibre Reinforced Concrete (SFRC) with frame as specified in the Schedule of Quantities.
- 7.8 Drop Connection
- 7.8.1 In case where branch pipe sewer enters the manhole of main pipe sewer at a level higher than 600 m than the main sewer, a drop connection shall be provided. The drop connection shall be made with CI pipes and special conforming to IS: 1729 shall be of the same size as that of the branch pipe sewer as per standard design.
- 7.8.2 For 150 mm and 250 mm main line, if the difference in level between the invert level of main line and the invert level of the branch line is less than 60 cm connection may be provided by giving suitable slope.

9 Measurement

9.1 Excavation

- 9.2 Measurement for excavation of pipe trenches shall be made per linear meter under the respective category of soil classification encountered at site and specified in the tender.

- a) All soils
- b) in soft or hard rock

- 9.3 Trenches shall be measured between outside walls of manholes at top and the depth shall be the average depth between the two ends to the nearest cm. The rate quoted shall be for a depth upto 1.5 m or as given in the Schedule of Quantities.

- 9.4 Payment for trenches more than 1.5 m in depth shall be made for extra depth as given in the schedule of quantities and above the rate for depth upto 1.5 m.

9.5 Timbering and Shoring

The cost of Timbering and shoring shall be included in the relevant item in the Schedule of Quantities. Nothing extra shall be payable on this account.

9.6 Excavation below sub soil level

No extra payment for pumping and bailing out water shall be made for excavation with an average depth of 1.5 m in saturated soil, surface water from rain falls or broken pipes lines, and other similar sources. An extra rate as quoted in the schedule of quantities shall be paid for excavation below sub soil level for pipe trenches.

9.7 Refilling, Consolidation and Disposal of Surplus Earth

Rate quoted for excavation of trenches shall be inclusive of refilling, consolidation and disposal of surplus earth within the site premises as specified by the Project Manager.

9.8 Stoneware Pipes/RCC/CI pipes

Stoneware RCC/CI pipes shall be measured for the finished length of the pipeline per linear metre i.e.

- a) Lengths between manholes shall be recorded from inside of one manhole to inside of other manhole,
- b) Length between gully trap and manhole shall be recorded between socket of pipe near gully trap and inside of manhole. Rate shall include all items given in the schedule of quantities and specifications.

9.9 Gully Traps

Gully traps shall be measured by the number and rate shall include all excavation, foundation, concrete, brick masonry, cement plaster inside and outside, C.I. grating and sealed cover and frame.

9.10 Cement Concrete for Pipes

Cement concrete in bed and all round or in haunches shall be paid per running metre between the outside wall of manholes at bottom of the trench. No additional payment is admissible in respect of concreting done for depths and widths greater than specified, for shuttering or centring.

9.11 Manholes, Catch basins & Ramp drains

- a) All manholes and catch basins shall be measured by numbers and shall include all items specified above and necessary excavation, refilling & disposal of surplus earth.

- b) Manholes with depths greater than specified under the main item shall be paid for under "extra depth" and shall include all items as given for manholes measurement shall be done to the nearest cm. Depth of the manholes shall be measured from top of the manhole cover to bottom of channel.
- c) Ramp drains shall be measured per meter length.

9.12 Safety Footrest

Safety footrest shall be measured by nos. and rate shall include providing and fixing as specified in Bill of Quantities

9.13 Making Connections

Item for making connection to municipal sewer and storm water drain shall be paid for by number and shall include all items given in the Schedule of Quantities and specifications.

End of Section 5

----- External Services -----

Section 6 External Water Supply System

1. SCOPE OF WORK

Work under this section consists of furnishing all labor, materials, equipment and appliances necessary and required to completely install the water supply system as required by the drawings, specified hereinafter and given in the BOQ.

Without restricting to the generality of the foregoing, the water supply system shall include the following:

- a) All water lines to different parts of Township and making connection from source etc.
- b) Pipe protection.
- c) Control valves, masonry chambers and other appurtenances. Connections to all plots which shall be paid extra under separate items of the Tender Document.
- d) Excavation and refilling of the trenches shall be paid under separate Item of the Tender Document.

2. DUCTILE IRON PIPES

- a) DI Pipes and Fittings shall be fixed truly vertical, horizontal or in slopes as required in a neat workmanlike manner.
- b) Short or Long bends of DI Pipes shall be used on all main pipelines as far as possible. Use of Elbows shall be restricted for short connections.
- c) DI Pipes shall be fixed in a manner so as to provide easy accessibility for repair and maintenance and shall not cause obstruction in passages, other services etc.
- d) DI Pipes shall be securely laid on the brick padding with sand cushioning as required.
- e) Valves and other appurtenances shall be so located as to provide easy accessibility for operations, maintenance and repairs.
- f) The ferrule connection has to be provided as per the manufacturer standards with suitable fitting and accessories. These connections shall be paid under separate items of the Tender Document.
- g) Suitable anchor blocks shall be provided at all bends and tees to encounter the excessive thrust developed due to water hammer.
- h) DI pipes and fittings (Class K9/ K7 as mentioned in the BOQ) shall be in accordance with relevant IS. Pipes and fittings shall be procured from the approved manufacturer or supplier and with the **Owner's** approval. The **Owner** shall at all reasonable times have free access to the place where the pipes and fittings are manufactured for the purpose of examining and testing the pipes and fittings and for witnessing the test and manufacturing.
- i) All tests specified either in this specification or in the relevant Indian Standards specified above shall be performed by the supplier/contractor at his own cost and in presence of the Owner if desired. For this, sufficient notice before testing of the pipes and fittings shall be given to the Owner.
- j) If the test is found unsatisfactory the Owner may reject any or all pipes and fittings of that lot. The decision of the Owner in this matter shall be final and binding on the contractor and not subject to any arbitration or appeal.

- k) The pipes and fittings shall be stripped, with all precautions necessary to avoid warping or shrinking defects. The pipes and fittings shall be free from defects. Any defect in pipes and fittings in the opinion of the Owner shall be rejected and shall be replaced by new one. In the case of spigot and socket pipes and fittings the socket shall be without the center ring.
- l) In the case of flanged pipes, the flanges shall be at the right angles to the axis of the pipe and machined on face. The bolt holes shall be drilled and located symmetrically off the centre line. The bolt hole shall be concentric with the bore and bolt holes equally spaced. The flanges shall be integrally cast with the pipes and fittings and the two flanges of the pipe shall be correctly aligned.
- m) Jointing of DI pipes and fittings shall be done as per relevant IS and manufacturer's recommendations. After jointing, extraneous material, if any, shall be removed from the inside of the pipe. Rubber sealing rings/gaskets used for jointing shall conform to latest and amended BIS.
- n) Spigot and Socket joints: These shall have sockets which are integral with the pipe and incorporate an electrometric rubber ring gasket conforming to BIS. In particular the Contractor shall ensure that the spigot end of the pipe to be jointed is smooth and has been properly chamfered, so that the rubber ring as per relevant BIS is correctly positioned in line, before the joint is made. The rubber rings and any recommended lubricant shall be obtained only through the pipe, supplier or as otherwise directed by the Owner.
- o) These shall be of PN 0.6 rating and shall comply with dimensions and drilling details as specified in relevant IS. These shall have isolation gaskets between the flanges, isolation sleeves around all bolts and isolation washers under all bolt heads and nuts. All material shall be supplied by a reputed manufacturer and shall be approved by the Owner.
- p) All gaskets used between flanges of pipes shall be of natural rubber conforming to relevant IS of thickness 3 mm suitable for clear water conveyance and as specified by manufacturer. Each bolt should be tightened a little at a time taking care to tighten diametrically opposite bolts alternatively.
- q) The marking shall be done as per the direction of the Owner for distinguish between the potable water and grey water

3. HDPE PIPES

- a) HDPE Pipes and Fittings shall be fixed truly vertical, horizontal or in slopes as required in a neat workmanlike manner.
- b) Factory fabricated Short or Long bends of HDPE Pipes shall be used on all main pipelines as far as possible. Use of Elbows shall be restricted for short connections.
- c) HDPE Pipes shall be fixed in a manner so as to provide easy accessibility for repair and maintenance and shall not cause obstruction in passages, other services etc.
- d) HDPE Pipes shall be securely laid on the plain concrete padding with haunching, all-round concrete as mentioned in the BOQ.
- e) Valves and other appurtenances shall be so located as to provide easy accessibility for operations, maintenance and repairs.
- f) The ferrule connection has to be provided as per the manufacturer standards with suitable fitting and accessories.
- g) Suitable anchor blocks shall be provided at all bends and tees to encounter the excessive thrust developed due to water hammer.

- h) The pipes shall be reasonable round and shall be supplied in straight lengths with plain ends as specified. The internal and external surfaces of the pipes shall be smooth and clean, free from grooving and other defects.
- i) The Tenderers shall quote as per the make mentioned in the approved make.
- j) Laying and Jointing All excavation work for laying HDPE pipes shall be carried out and paid separately as mentioned in the Tender Document. The special care must be taken to ensure that the hard objects like stones, rock pieces, tree roots etc. are not present. Pipes shall be bedded on Plain Cement Concrete.
- k) HDPE pipes shall be butt jointed by heat fusion method in accordance with the procedure and method recommended by the manufacturer or relevant IS Codes. HDPE pipes shall not be threaded.
- l) Any kinks or buckles in pipe near its ends shall be removed by cutting out as a cylinder. The face of the joints to be welded shall be flat. Correct position and holding of pipe is necessary when sawing pipe to achieve this. For pipes 160 mm. OD and above, shaping tool may be used.
- m) Whether pipes have been sawn or not, joint faces shall be slightly scrapped with a knife, prior to welding, to remove exposed layers which may lead to unsatisfactory joint. Both the sections of pipe to be welded shall be positioned by using rollers and/or wooden supports.
- n) Butt heat-fusion joint procedure shall require the use of jointing device (welding jack) that holds the heat element (mirror) square to the ends of pipes, can compress the heated ends together and holds the piping in proper alignment while the plastic hardens.
- o) The electric heating mirror used shall be specially designed to meet the requirements of HDPE pipe welding. It should have a proper regulator to control and maintain its temperature during the welding procedure. Temperature of joints should be 200 deg C. Surface temperature, of the heating mirror, must, therefore, be 2100 C + 50 C. The faces of pipes to be joined shall be on either sides of the heating mirror and maximum of 0.4 kg/cm² contact pressure shall be applied. Contact pressure should not exceed this. Even with the lowest pressure a rim of molten material shall be formed on the ends of pipes being joined. Care shall be taken in the heating operation to prevent damage to the plastic material from overheating or having the material not sufficiently heated to ensure a sound joint. Direct application of heat, with a torch or other open flame is prohibited, The entire jointing process should be as per the recommendations of the manufacturer or relevant IS or International codes.
- p) The Contractor is required to arrange all the tools required i.e. regulator controlled heating Mirror, compression machine, cutting machine etc.

5.0 VALVES

5.1 Ball valves

- 5.1.1 Valves 40 mm dia and below shall be screwed type ball valves with chrome plated balls, spindle, teflon seating and gland packing tested to a hydraulic pressure of 20 kg/cm² and accompanying couplings and steel handles to BS: 5351.

5.2 Butterfly Valves

- 5.2.1 Valves 50 mm dia and above shall be cast iron butterfly valve to be used for isolation and/or flow regulation. The valves shall be bubble tight, neoprene/EPDM body lining stainless steel upper stem, PTFE bush, suitable for flow in either direction and seal in both direction. Valves shall be provided with matching flanges with neoprene insertion gasket 3 mm thick
- 5.2.2 Butterfly valve shall be of best quality conforming to IS: 13095.

5.3 Non Return Valve

5.3.1 Where specified non return valve (swing check type) shall be provided through which flow can occur in one direction only. It shall be single door swing check type of best quality conforming to IS: 5312.

5.3.2 Each butterfly and slim type swing check valves shall be provided with a pair of flanges screwed to the main line by providing fittings with metal inserts and having the required number of galvanized nuts, bolts and washers of correct length.

6.0 AIR RELEASE VALVES

Air release valves shall be single acting type air valves with cast iron body and bronze/gunmetal internal parts and plastic float.

Each air release valve shall be provided with a cast iron isolating sluice valve of specification given above.

7.0 VALVE CHAMBERS

Contractor shall provide suitable brick masonry chambers in cement mortar 1:5 (1 cement: 5 coarse sand) on cement concrete foundations 150 mm thick 1:5:10 mix (1 cement: 5 fine sand: 10 graded stone aggregate 40 mm nominal size) 12 mm thick cement plaster inside and outside finished with a floating coat of neat cement inside with cast iron surface box as approved or as specified in BOQ and in drawings including excavation, back filling complete.

8.0 WATER METER

Water meters of approved make and design shall be supplied for installation at locations as shown in the drawing. The water meters shall meet with the approval of the local municipal authorities. Suitable valves and chambers to house the meters shall also be provided along-with the meters.

All meters shall conform to BIS (Water meters-domestic and Bulk type). Where called for water meters shall be located in masonry chambers of appropriated size.

9.0 DISINFECTION

After completion of the work Contractor shall flush clean the entire system with the available/ city's filtered water after connection has been made.

After the first flushing, commercial bleaching powder is to be added to achieve a dosage of 2 to 3 mg/liter of water in the system added and flushed. This operation should be performed twice to ensure that the system is fully disinfected and usable.

10.0 PRE-COMMISSIONING:

- a. Ensure that all pipes are free from debris and obstructions.
- b. Check all valves for effective opening and closing action. Defects should be rectified or valves replaced.
- c. Ensure that all Connections to Branches have been made.
- d. Ensure that mains have been connected to the respective pumps, underground or overhead tanks.
- e. Water supply should be available at main Underground/ Overhead tank.
- f. All main line Valves should be closed.

- g. The hydraulic tests have to be carried out before commissioning of the project.

11.0 COMMISSIONING

- a. Fill Underground tank with water. Add 1 kg fresh bleaching powder after making a solution to be added near inlet.
- b. Start Water Supply Pump and allow water to fill main Underground tank. Water will first fill the Fire Tank and then overflow to the Raw Water tanks.
- c. After filling Overhead Reservoir drain the same to its one fourth capacities through tank scour valve. (This is to ensure removal of all mud, debris etc. from the tank).
- d. Fill Overhead tank to full.
- e. Release water in the main lines by opening Valves in each circuit. Drain out water in the system through scour valves. Ensure clean water is now coming out of the system.
- f. Open valves for individual clusters. Observe for leakages or malfunctions, check pressure & flow at end of line by opening valves etc. Remove and rectify defects noticed.
- g. Check all outlet points for proper operation by opening each valve and allowing water to flow for a few minutes. Also check for effective closure of valve.
- h. The entire water supply system should be disinfected with bleaching powder and system flush cleaned.
- i. Send four samples of water drawn from four extreme locations for testing for bacteriological test in sterilized bottles obtained from the concerned laboratory the same shall be witnessed by the Owner/ Consultant. (Laboratory personal may collect the samples themselves).

--- End of Section 6 ---
External Water Supply System

Section 7 Pipes & Fittings

1 Headers, piping and connections

- a) All pipe within the plant room building in exposed locations and shafts including connections buried under floor and for suction and delivery headers shall be GI pipes medium class and thickness specified. Pipes upto 150 mm dia shall conform to IS 1239.
- b) Pipe 200 mm dia and above shall be GI ERW tubes to IS: 3589. If black pipes are available they shall be galvanized before use.
- c) Fittings for GI pipes shall be approved type malleable iron or wrought iron screwed galvanized fittings for screwed joints. Fittings 200 mm dia may be shop fabricated but shall be shop galvanized after fabrication.
- d) All M.S. structural supports and clamps shall be galvanised. All the pipe work within plant room shall be adequately supported with MS structural supports from floor or ceiling as required and directed by Project Manager.

2 Jointing

2.1. GI Pipes (Screwed joints)

Pipe shall be provided with metal to metal threaded joints. Teflon tape shall be used for lubrication and rust prevention. (USE OF LEAD/ZINC BASED JOINTING COMPOUND ARE NOT PERMITTED)

2.2 Flanged joints

Flanges shall be provided on:

- a) Straight runs not exceeding 12-15 m on pipe lines 80 mm dia and above.
- b) Both ends of any fabricated fittings e.g. bends, tees etc. of 50 mm dia or larger diameter. (When Permitted)
- c) Both end of all suction delivery and other headers.
- d) For jointing valves, appurtenances, pumps, connections with pipes, to water tanks and other places necessary and required as good for engineering practice.
- e) Flanges shall be as per applicable IS with appropriate number of G.I. nuts and bolts, 3 mm insertion rubber gasket complete.
- f) **The cost of flanges is included in the rates of pipes along with fittings.**

2.3 Unions

Provide approved type of dismountable unions on pipes lines 50 mm and below near valves or inspector test/drain and assemblies and as required as per site conditions.

3 Vibration Eliminators

All suction and delivery lines and as shown on the drawings double flanged reinforced neoprene bellow type flexible pipe connectors shall be provided. Connectors should be suitable for a working pressure of each pump and tested to the test pressure given in the relevant head. Length of the connectors shall be as per site requirements in accordance with manufacturer's details.

4 Valves

4.1 Sluice valves

- a) Full way Sluice Valves shall be used on the suction connection to pumps and headers.
- b) Sluice valves (80 mm dia and above) shall be CI double flanged sluice valves with rising stem. Each sluice valve shall be provided with wheel in exposed positions and cap top for underground valves. Contractor shall provide suitable operating keys for sluice valves with cap tops.
- c) Sluice valves shall be of approved makes conforming to IS:780 PN 1.6 class

4.2 Butterfly Valves

- a) Butterfly Valves shall be used in all other locations as required conforming to IS 13095.
- b) They shall have a cast iron body.
- c) Disc shall be CI heavy duty electrolyses nickel plated abrasion resistant.
- d) The shaft is EN-8 Carbon Steel with low friction nylon bearings.
- e) The seat shall be drop tight constructed by bonding resilient elastomer inside a rigid backing.
- f) Built in flanged rubber seals.
- g) Actuator to level operated for valves above ground and T Key operated for valves below ground.
- h) Built in flanges for screwed on flanged connections. Manufacturer's details on fixing and installation will be followed.

4.3 Non Return Valves (NRV)

- a) Non return valves will be used at location to allow flow only in one direction and prevent flow in the opposite direction.
- b) NRV shall be cast iron slim type with cast iron body and gunmetal internal parts and accompanying flanges. Valves shall conform relevant IS or match the butterfly valves.
- c) Built in flanges for screwed on flanged connections.

4.5 Ball Valves

Ball Valves upto 40 mm dia shall be screwed type ball valves with stainless steel balls, spindle, Teflon seating and gland packing tested to a hydraulic pressure of 20 kg/cm² and accompanying coupling and steel handles (to BS: 5351).

6 'Y' Strainers

Provide cast iron 'Y' type strainers with gunmetal internal strainers, CI screwed plug to be provided on all water tank suction connections to pumps.

7 Measurements (Section 1, 2 & 3)**7.1 General**

- a) Unit rate for individual items, e.g. pressure tanks, MCC, level controller, water tank are for purposes of payments only. Piping, headers, valves, accessories, cabling and MCC to measured separately in this contract only.
- b) All items must include all accessories fittings as described in the specifications, BOQ and shown on the drawings.

7.2 Water supply pumps

Pumps shall be measured by numbers and shall include all items as given in the specifications and schedule of quantities to provide a complete working system.

7.3 Drainage Pumps & Sewage Pumps

Drainage pumps shall be measured by numbers and shall include all items as given in the specifications and schedule of quantities to provide a complete working system.

7.4 Level controllers & Alarms

Level controllers for each set of pumps shall be measured by number and inclusive of probes, cabling upto surface box near the pump and shall include all items as given in the specifications and schedule of quantities to provide a complete working system.

7.5 Piping Work

- a) Suction and delivery headers for each pumping system shall be measured per set with required length and shall include all items as given in the schedule of quantities. Painting shall be included in rate of headers.
- b) G.I. pipes between various filters and units shall be measured per linear meter of the finished length and shall include all fittings, flanges, jointing, clamps for fixing to walls or hangers and testing. Flanges shall include 3 mm thick insertion rubber gasket, nuts, bolts and testing.
- c) Vibration eliminators, “Y” strainers, butterfly valves, slim non return valves, ball valves shall be measured by numbers and shall include all items as given in the schedule of quantities and specifications.

--- End of Section 7 ---

Pipes & Fittings**SECTION 8 Specifications for Electrical Installation****1 Electrical Control Panels****1.1 General**

- All medium voltage switchboards shall be suitable for operation at three phase/three phase 4 wire, 415 volt, 50 Hz, neutral grounded at transformer system with a short circuit level withstand of 31 MVA at 415 volts or as per schedule of quantities.
- The Switch Boards shall comply with the latest edition with upto date amendments of relevant Indian Standards and Indian Electricity Rules and Regulations.

1.2 Switch Board Configuration

- The Switch Board shall be configured with Air Circuit Breakers, MCCB's, and other equipment as called for in the Schedule of Quantities.

- The MCCB's shall be arranged in multi-tier formation whereas the Air circuit breakers shall be arranged in Single or Double tier formation only to facilitate operation and maintenance.
- The Switch Boards shall be of adequate size with a provision of 25% spare space to accommodate possible future additional switch gear.

1.3 Equipment Specifications

All equipment used to configure the Switch Board shall comply to the relevant Standards and Codes of the Bureau of Indian Standards and to the detailed technical Specifications as included in this tender document.

1.4 Constructional Features

- The Switch Boards shall be metal enclosed, sheet steel cubicle pattern, extensible, dead front, floor mounting type and suitable for indoor mounting.
- The Switch Boards shall be totally enclosed, completely dust and vermin proof. Synthetic rubber gaskets between all adjacent units and beneath all covers shall be provided to render the joints dust and vermin proof to provide a degree of protection of IP 42/IP 54 as specified. All doors and covers shall also be fully gasketed with synthetic rubber and shall be lockable.
- The Switch Board shall be fabricated with CRCA Sheet Steel of thickness not less than 2.0 mm and shall be folded and braced as necessary to provide a rigid support for all components. The doors and covers shall be constructed from CRCA sheet steel of thickness not less than 1.6 mm. Joints of any kind in sheet metal shall be seam welded and all welding slag ground off and welding pits wiped smooth with plumber metal.
- All panels and covers shall be properly fitted and square with the frame. The holes in the panel shall be correctly positioned.
- Fixing screws shall enter holes tapped into an adequate thickness of metal or provided with hank nuts. Self threading screws shall not be used in the construction of the Switch Boards.

1.5 Switchboard Dimensional Limitations

- A base channel 100 mm x 50 mm x 6 mm thick shall be provided at the bottom.
- A minimum of 200 mm blank space between the floor of switch board and bottom most unit shall be provided.
- The overall height of the Switch Board shall be limited to 2300 mm
- The height of the operating handle, push buttons etc shall be restricted between 300 mm and 2000 mm from finished floor level.

1.6 Switch Board Compartmentalization

The Switch Board shall be divided into distinct separate compartments comprising

- A completely enclosed ventilated dust and vermin proof bus bar compartment for the horizontal and vertical bus bars.
- Each circuit breaker, and MCCB shall be housed in separate compartments enclosed on all sides.

- Sheet steel hinged lockable doors for each separate compartment shall be provided and duly interlocked with the breaker in "on" and "off" position.
- For all circuit breakers separate and adequate compartments shall be provided for accommodating instruments, indicating lamps, control contactors and control MCB etc. These shall be accessible for testing and maintenance without any danger of accidental contact with live parts of the circuit breaker, bus bars and connections.
- A horizontal wire way with screwed cover shall be provided at the top to take interconnecting control wiring between vertical sections.
- Separate cable compartments running the height of the Switch Board in the case of front access Boards shall be provided for incoming and outgoing cables.
- Cable compartments shall be of adequate size for easy termination of all incoming and outgoing cables entering from bottom or top.
- Adequate and proper support shall be provided in cable compartments to support cables.

1.7 Switch Board Bus Bars

- The Bus Bar and interconnections shall be of electrolytic Copper/Aluminium and of rectangular cross sections suitable for full load current for phase bus bars and half rated current for neutral bus bar. The maximum current density for copper shall be 1.6 amps per mm² and for Aluminum shall be 1 amp per mm² and suitable to withstand the stresses of a 31 MVA fault level or at 415 volts for 1 second or as per schedule of quantities. .
- The bus bars and interconnections shall be insulated with insulation tape/fiber glass.
- The bus bars shall be extensible on either side of the Switch Board.
- The bus bars shall be supported on non-breakable, non-hygroscopic insulated supports at regular intervals, to withstand the forces arising from a fault level of 31 MVA at 415 volts for 1 second.
- All bus bars shall be colour coded.
- All bus bar connections in Switch Boards shall be bolted with brass bolts and nuts. Additional cross section of bus bars shall be provided wherever holes are drilled in the bus bars.

1.8 Switch Board Interconnections

- All connections between the bus bars/Breakers/cable terminations shall be through solid tinned copper strips of adequate size to carry full rated current and PVC/fibre glass insulated.
- For unit ratings upto 100 amps PVC insulated copper conductor wires of adequate size to carry full load current shall be used. The terminations of all such interconnections shall be crimped and aluminium lugs shall be used.

1.9 Drawout Features

Air Circuit Breakers shall be provided in fully drawout cubicles. These cubicles shall be such that drawout is possible without disconnection of the wires and cables. The power and control circuits shall have self aligning and self isolating contacts. The fixed and moving contacts shall be easily accessible for operation and maintenance. Mechanical interlocks shall be provided on the drawout cubicles to ensure safety and compliance to relevant Standards. The MCCB's shall be provided in fixed type cubicles.

Instrument Accommodation

- Instruments and indicating lamps shall not be mounted on the Circuit Breaker Compartment door for which a separate and adequate compartment shall be provided and the instrumentation shall be accessible for testing and maintenance without danger of accidental contact with live parts of the Switch Board.
- For MCCB's instruments and indicating lamps can be provided on the compartment doors.
- The current transformers for metering and for protection shall be mounted on the solid copper/aluminium busbars with proper supports.

1.10 Wiring

All wiring for relays and meters shall be with PVC insulated copper conductor wires. The wiring shall be coded and labelled with approved ferrules for identification. The minimum size of copper conductor control wires shall be 1.5 mm².

1.11 Cable Terminations

- Knockout holes of appropriate size and number shall be provided in the Switch Board in conformity with the location of incoming and outgoing conduits/cables.
- The cable terminations of the Circuit Breakers shall be brought out to terminal cable sockets suitably located at the rear of the panel.
- The cable terminations for the MCCB's shall be brought out to the rear in the case of rear access switchboards or in the cable compartment in the case of front access Switch Boards.
- The Switch Boards shall be complete with tinned brass cable sockets, tinned brass compression glands, gland plates, supporting clamps and brackets etc for termination of 1100 volt grade aluminium conductor PVC/PVCA cables.

1.12 Space Heaters

The Switch Board shall have in each panel thermostatically controlled space heaters with a controlling 15 amp 230 volt switch socket outlet to eliminate condensation.

1.13 Ventilation Fans

The Switch Board shall be provided with panel mounting type ventilation fans in each panel with switchgear rated for 2500 amp and above. The fan shall be interlocked with switchgear operation.

1.14 Earthing

A main earth bar of G.I./copper as required shall be provided throughout the full length of the Switch Board with a provision to make connections to the sub-station earths on both sides.

1.15 Sheet Steel Treatment And Painting

- Sheet Steel materials used in the construction of these units should have undergone a rigorous rust proofing process comprising of alkaline degreasing, descaling in dilute sulphuric acid and a recognised phosphating process. The steel work shall then receive two coats of oxide filler primer before final painting. Castings shall be scrupulously cleaned and fettled before receiving a similar oxide primer coat.
- All sheet steel shall after metal treatment be spray or powder painted with two coats of shade 692 to IS 5 on the outside and white on the inside. Each coat of paint shall be properly stoved and the paint thickness shall not be less than 50 microns.

1.17 Name Plates And Labels

Suitable engraved white on black name plates and identification labels of metal for all Switch Boards and Circuits shall be provided. These shall indicate the feeder number and feeder designation.

2 Testing

Copies of type test carried out at ACB/MCCB manufacturers works and routine tests carried out at the switchboard fabricators shop shall be furnished along with the delivery of the switchboards. Project Manager reserves the right to get the switchboard inspected by their representative at fabricators works prior to dispatch to site to witness the routine tests as per clause 7.7 of SCC

3. TESTING AT SITE

Pre-commissioning tests as required and as per manufacturers recommendations shall be carried out on each switchboards at site before energizing the switchboards including but not restricted to the following.

- Physical checking of the switchboards including checking alignment of panels, interconnection of Bus bars, tightness of bolts/connections and evidence of damage/cracks in any components.
- Physical checking and inspections of Inter panel wiring
- Checking free movement of ACBs/MCCBs/SFUs
- Checking of operation of breakers
- Insulation tests of bus bar supports and control wiring etc. with 1.1 kV megger.
- Primary & secondary injection tests of relays and CTs.
- Checking of Interlocking function.

4. Cables**4.1. Medium Voltage Cables**

Medium voltage cables shall be aluminium conductor PVC insulated, PVC sheathed armoured conforming to IS 1554. Cables shall be rated for a 1100 Volts. The conductor of cables from 16 Sq. mm. to 50 mm² shall be stranded. Sector shaped stranded conductors shall be used for cables of 50 mm² and above. Conductors shall be made of electrical purity aluminium 3/4 H or H temper. Conductors shall be insulated with high quality PVC base compound. A common covering (bedding) shall be applied over the laid up cores by extruded sheath of unvulcanised compound. Armouring shall be applied over outer sheath of PVC sheathing. The outer sheath shall bear the manufacturer's name and trade mark at every meter length. Cores shall be provided with following colour scheme of PVC insulation.

1 Core	:	Red/Black/Yellow/Blue
2 Core	:	Red and Black
3 Core	:	Red, Yellow and Blue
3 1/2 / 4 Core	:	Red, Yellow, Blue and Black

Current ratings shall be based on the following conditions.

a) Maximum conductor temperature	70° C
b) Ambient air temperature	45° C
c) Ground temperature	30° C
d) Depth of laying	1000 mm

Short circuit rating of cables shall be as specified in IS 1554 Part-I.

Cables have been selected considering conditions of maximum connected loads, ambient temperature, grouping of cables and allowable voltage drop. However, the contractor shall recheck the sizes before cables are fixed and connected to service.

M.V. cables shall be PVC insulated aluminium/copper conductor and armoured cables conforming to IS Codes. Cables shall be armoured and suitable for laying in trenches, duct and on cable trays as required. Control cables and indicating panel cables shall be multi core PVC insulated copper conductor and un armoured cables.

4.2 On Trays/Walls

- 4.2.1 Wherever so specified, cables shall be laid along walls/ceiling or on cable trays. Cable shall be secured in position and dressed properly by means of suitable clamps, hooks, saddles etc. such that the minimum clear spacing between cables is diameter of the cable. Clamping of cables shall be at minimum intervals as below.

Type of cables	Size	Clamping by	Fixing intervals
MV	Upto and including 25 mm ²	Saddles 1 mm thick	45 cm
MV & HV	35 mm ² to 120 mm ²	Clamps 3 mm thick 25 mm wide	60 cm
MV & HV	150 mm ² and above	Clamps 3 mm thick 40 mm wide	60 cm

Note : The fixing intervals specified apply to straight runs. In the case of bends, additional clamping shall be provided at 30 cm from the centre of the bend on both sides.

4.2.2 Cable trays

Cable trays, of sizes as per schedule of quantities and drawings shall be of perforated doubled bend channel or of ladder design as specified in BOQ. Cable trays shall be fabricated from sheet steel of thickness as per BOQ and shall be complete with tees, elbows, risers, and all necessary hardware.

Trays shall have suitable strength and rigidity to provide proper support for all the contained cables. Trays shall not have sharp edges, burrs or projections injurious to cable insulation. Trays shall include fittings for changes in direction and elevation. Cable trays and accessories shall be painted with two coats of red oxide zinc chromate primer after proper surface preparation and two finishing coats of synthetic enamel paint of approved make or as specified in BOQ. Cable trays shall have side rails or equivalent structural members.

Cable trays shall be mounted on support structure as specified by means of specified size of threaded rods and suitable fasteners. Spacing of the support structure shall be such that the cable trays shall remain perfectly horizontal without buckling when fully loaded with cable runs. The support structure shall be suspended from ceiling slab or grouted to walls in an approved manner. Width of the horizontal arms of the support structure shall be same as the tray width plus length required for threading /bolting /welding to the vertical supports. The length of vertical supporting members for horizontal tray runs shall be to suit the number of tray tiers required. Cable trays shall be bolted/welded to the support structure. Minimum clearance between the top most tray tier and the ceiling shall be 300 mm. Trays shall be erected properly to present a neat and clean appearance. Trays shall be installed as a complete system. The entire cable tray system shall be rigid. Each run of cable tray shall be completed before laying of cables. Cable trays shall be erected so as to be exposed and accessible. Cables shall be fixed to the tray by clamps fabricated from minimum 3 mm thick GI sheets. The cables shall be dressed properly so as to provide minimum one cable diameter clearance between adjacent cables and from tray ends. Cable trays shall be earthed by 2 runs of 25 mm x 3 mm GI strips through out their lengths.

5. LAYING OF CABLES

Cables shall be so laid that the maximum bending radius is 12 times the overall diameter of the cable for medium voltage cables. Cables shall be laid in masonry trenches, directly on walls/cable trays, directly buried in ground or in pipes/ducts as elaborated below. Cables of different voltages and also power and control cables shall be laid in different trenches with adequate separation. Wherever available space is restricted such that this requirement cannot be met, medium voltage cables shall be laid above HT cables. Where more than one cable is laid side by side, cable marker tags of approved type inscribed with cable identification details shall be permanently attached to cables at entry points to the building, at specified intervals for cables laid direct in grounds and in locations like manholes, pull pits etc.

6. Drawings

Shop drawings for control panels and wiring of equipment showing the route of conduit cable shall be submitted by the contractor for approval of Project Manager before starting the fabrication of panel and starting the work. On completion, all details like location of panels, switches, junction/pull boxes and cables route etc. shall be furnished by the contractor.

7 Measurement

Panels shall be counted as number of units. The quoted rate of panel shall also include all accessories, switch gear, fuses, contractor, indicating meters and lights as per the specification. Cable tray, Power & Control cable shall be measured in running meter.

--- End of Section 8 ---
Electrical Installation

Section 9 Commissioning and Guarantees**1. Scope of work**

Work under this section shall consist of pre-commissioning, commissioning, testing and providing guarantees for all equipment, appliances and accessories supplied and installed by the contractor under this contract.

2 General requirements:

- 2.1. Work under this section shall be executed without any additional cost. The rates quoted in this tender shall be inclusive of the works given in this section
- 2.2. Contractor shall provide all tools, equipment, metering and testing devices required for the purpose.
- 2.3. On award of work, contractor shall submit a detailed proposal giving methods of testing and gauging the performance of the equipment to be supplied and installed under this contract.

3. Pre commissioning

- 3.1. On completion of the installation of all pumps, piping, valves, pipe connections, electrical wiring, motor control panels and water level controlling devices the contractor shall proceed as follows:-
 - a) Testing of MCC
 - b) Tests to be carried out for motor control centres shall be:
 - c) Insulation resistance test with 500 volt megger, before and after high voltage test, on all power and control wiring.
 - d) High voltage test sat 2000 volts AC for one minute on all power and control wiring.
 - e) Low voltage continuity test (6 volts) on power wiring of each feeder, between bus bars and the outgoing terminals with switches and contactors in closed position.
 - f) Low voltage continuity test (6 volts) on all control wiring.

- g) Operation test for all feeders with only control supply made 'on' to ensure correctness of control wiring, operation of the various equipment used such as push buttons, protective devices, indicating lamps and relays etc. All contactors shall be checked and there shall be no chattering.
- h) Earth continuity test with voltage not exceeding 6 volts between various non-current carrying metallic parts of equipment, steel work etc. And the earth bus provided in the MCC.
- i) Operation of all instruments and meters provided on the MCC.

3.2 Pipe work

- i) Check all clamps, supports and hangers provided for the pipes.
- ii) Fill up pipes with water and apply hydrostatic pressure to the system as given in the relevant section of the specifications. If any leakage is found, rectify the same and retest the pipes.
- iii) check all face piping and valves
- iv) check air blower connections

4 Commissioning & testing

4.1 All pumping sets

Start the duty pump on manual controls, check its operation and then test run on auto controls. Change over the duty pump and test it in the same manner as the first pump.

4.2 Test run the entire system to ensure satisfactory performance.

5 Handing Over

All commissioning and testing shall be done by the contractor to the complete satisfaction of the Project Manager and the job handed over to the Project Manager or his authorized representative.

Contractor shall also hand over, to the Project Manager charge, all maintenance & operation manuals, 4 sets of As Built drawings and all other items as per the terms of the contract.

6 Guarantees

- a) The contractor shall submit a warranty for all equipment, materials and accessories supplied by him against manufacturing defects, malfunctioning or under capacity functioning.
- b) The form of warranty shall be as approved by the Project Manager.
- c) The warranty shall be valid for a period of one year from the date of commissioning and handing over.
- d) The warranty shall expressly include replacement of all defective or under capacity equipment. Project Manager may allow repair of certain equipment if the same is found to meet the requirement for efficient functioning of the system.
- e) The warranty shall include replacement of any equipment found to have capacity lesser than the rated capacity as accepted in the contract. The replacement equipment shall be approved by the Project Manager.

- f) The contractor shall separately submit with this offer his charges per month for operation of mechanical equipments after commissioning and handing over.

--- End of Section 9 ---
Commissioning and Guarantees

Section 10 Technical Information for Water Supply & Drainage Pumps

1. Pumps

- a) Make
- b) Model
- c) Pump Discharge
Max/Min
- d) Pump Head Min/Max,
- e) Impeller Material
- f) Motor HP
(Specify make, class of insulation &
rated voltage \pm %)
- g) Shaft Seal Type & make
- h) Type of Coupling
- i) Efficiency of Pump
- j) Type of Bearings
- k) RPM

2. Pressure Tanks (Where specified)

- a) Make
- b) Material of Construction
- c) Internal finish
- d) External finish
- e) Air balloon/ diaphragm
specifications

3. Submersible pumps (If Applicable)

- a) Make
- b) Model No.
- c) Pump discharge lpm
max / min
- d) Pump head min/max,
- e) Impeller material
- f) Motor HP
(Specify make, class of insulation &
rated voltage \pm %)
- g) Shaft seal Type & make
- h) Type of coupling
- i) Efficiency of pump
- j) Type of bearings

k) RPM

4 Motor Control Centres

Give detail on separate sheets if required

- a) Make
- b) Type (floor/wall mounted)
- c) Make of switch gear
- d) Make of meters
- e) Make of accessories
- f) Confirm that all switch gear starters match the capacities of pumps offered.

5. Power & control cables

- a) Make

6. Electronic Level controllers

- a) Make
- b) Model No.

7. Electronic High Water Alarm

- a) Make
- b) Model No.

8. Electronic Level Indicator

- a) Make
- b) Model

9. Pipes

- a) Make offered
- b) Heavy Class 150 mm dia & below
- c) Heavy Class 200 mm dia & above

10. Butterfly Valves

- a) Make
- b) Material
- c) Test pressure

11. NRV Slim Type

- a) Make
- b) Material
- c) Test pressure

12. Vibration eliminators

- a) Make
- b) Material
- c) Test pressure

--- End of Section 10---

LIST OF APPROVED MAKES FOR EQUIPMENT & MATERIALS**PLUMBING APPROVED MAKES:**

S.No.	Material	IS No.	Brand Name
1.0	SANITARY WARE	771	PARRYWARE/ CERA/JAQUAR
2.0	CP FITTINGS		JAQUAR/ PARRYWARE/ CERA
3.0	GRATING		JAQUAR/ PARRYWARE/ CERA
4.0	URINAL SENSOR/ HAND DRIER/ AIR PURIFIER CONTAINER		BPE/EURONICS/ KOPAL
5.0	PAPER TOWEL DISPENSER/ SENSOR PILLAR TAP/ LIQUID SOAP DISPENSER		BPE/EURONICS/ KOPAL
6.0	SANITARY NAPKIN HYGIENE PANEL		BPE/EURONICS/ KOPAL
7.0	HANDICAPPED TOILET ACCESSORIES: SUPPORT ARMS AND BACKREST/ GRAB BAR		CERA/BPE/EURONICS JAQUAR
8.0	KITCHEN SINK		NIRALI/ NEELKANTH/ ANUPAM
9.0	WC PAN CONNECTOR		VIEGA/ McALPHINE
10.0	uPVC PIPES & FITTINGS (SWR, AGRI, PRESSURE PIPES FOR WATER SUPPLY SCH-40 & 80)	13592/ 4985	SUPREME/AKG/ASHIRVAD /FINOLEX
11.0	PPR PIPE		SUPREME/PRINCE
12.0	CAST IRON (CI)		KAPILANSH/NECO
13.0	CPVC PIPES & FITTINGS		ASHIRWAD/AJAY/SUPREME/FINOLEX
14.0	AIR ADMITTANCE VALVE		STUDOR/McALPHINE
15.0	HOT WATER HEATER		AO-SMITH/ RACOLD/ VENUS
16.0	BALL VALVE		ENOLGAS/NVR/ JAINSON/SANT/DRP
17.0	BUTTERFLY VALVE		NVR/ JAINSON/SANT/DRP
18.0	SLUICE VALVE		NVR/ JAINSON/SANT/DRP
19.0	NON-RETURN VALVES (NRV)	13095	NVR/ JAINSON/SANT /DRP

20.0	FERRULES, WATER LEVEL FITTINGS		NVR/ JAINSON/SANT /DRP
S.No.	Material	IS No.	Brand Name
21.0	PRESSURE REDUCING VALVE (PRV)		NVR/ JAINSON/SANT/DRP
22.0	AUTOMATIC AIR VENT		NVR/ JAINSON/SANT /DRP
23.0	MOTORISED VALVE		ENOLGAS/SANT/DRP
24.0	BALL COCK	1703	NVR/ JAINSON/SANT /DRP
25.0	HOT WATER INSULATION		CAREFLEX/THERMAFLEX/ KAIFLEX
26.0	GARDEN IRRIGATION SPRINKLERS		JAIN/ PREMIER / HARVEL/ CEPEX
27.0	STONEWARE PIPES & GULLY TRAPS		DEVRAJ ANAND/ PERFECT/ R.K. PRIYA
28.0	RCC PIPES	458	OM JI SPUN/KK SPUN/ DAYA SPUN
29.0	SFRC MANHOLE & ROAD GULLY COVERS/ GRATING		KK/ KKM
30.0	CI MANHOLE COVER & FRAME		KAPILANSH /NECO
31.0	DI MANHOLE COVERS & GRATING		KAPILANSH/CRESENT FOUNDRY
32.0	DI PIPES		ELECTROTHERM/ JINDAL/ TATA
33.0	GALVANIZED IRON PIPE SUPPORT (CLAMP)		INNOMOD/ EASYFLEX /GRIPPLE
34.0	DASH FASTNER		HILTI/ FISHER/ BOSCH
35.0	FRP DRAIN CHANNEL GRATING		THERMO DRAIN
36.0	SS DRAIN CHANNEL GRATING		ACO / CAMRY
37.0	PACKAGE TYPE GREASE TRAP		ACO
38.0	KHURRA GRATING		KAPILANSH / NECO
39.0	WATER METER		SANT / KRANTI

TECHNICAL SPECIFICATIONS FOR ELECTRICAL WORK

TECHNICAL SPECIFICATIONS FOR ELECTRICAL WORK

SECTION - 1

1.0 GENERAL

The electrical Installation work shall be carried out in accordance with Indian Standard Code of Practice. It shall also be in conformity with the current Indian Electricity rules and regulations and requirements of the Local Electricity Supply Authority and Fire Insurance regulations, so far as these become applicable to the installation. Electrical work in general shall be carried out as per following CPWD Specifications amended upto date.

General Specification for Electrical Works.

Part -I - Internal Electrical Work - 2013.

Wherever these specifications calls for a higher standard of material and or workmanship than those required by any of the above mentions regulations and specification then the specification here under shall take precedence over the said regulations and standards.

The details of scope of work subhead wise are given in the subsequent paras. The quantities worked out in schedule of quantities are based on particular equipment considered at design stage. The contractor is required to recheck the quantities based on equipment offered by him to achieve required parameters.

The bidder should note that the specifications furnished in the tender is of general nature only and it is the responsibility of the bidder to design, supply, install and commission the equipment and services required for the satisfactory performance of the installation. All the items of equipment required for the safe and satisfactory operation of the installation shall be supplied and installed by the bidder.

1.1 SCOPE:

- (i) These General Specifications indicate the requirements and precautions to be taken during the execution of Internal Electrical Installation works to ensure efficient, safe, economical and practical use of materials and equipments including prevention of risks and fire hazards.
- (ii) This Chapter also covers the general commercial requirements applicable to this works contracts for Electrical Installation works.

1.2 RELATED DOCUMENTS:

- (i) These General Specifications shall be read in conjunction with the standard conditions of contract contained in other parts of the document and their correction slips, the tender specifications, schedule of quantities, drawings and other documents in the tender papers connected with this work.

1.3 WORKS INCLUDED IN THIS SECTION:

- (i) 230V single phase, 2 wire and 400V 3phase 4 wire Power distribution system complete .
- (ii) An adequate equipment grounding system.
- (iii) Providing & fixing of distribution boards
- iv) Supply and Installation of Sandwich type Rising mains
- v) Supply and Installation of MDBs and Meter Boards
- vi) Supply and Installation of Intelligent type fire alarm and detection system
- vii) Lightning Protection System
- viii) Smart billing and metering system
- (iv) Supply and Fixing of luminaries and fans.
- (v) Conduit for LV/ FTTH System.
- (vi) Providing and laying of LT cables and Cable Trays.

1.4 INTERPRETATION OF AGREEMENT:

In the interpretation of the agreement, the order of descending importance for any ambiguity or discrepancy shall be as follows;-

- Schedule of Quantities
- Technical Specifications.
- Drawings.
- I.S.I. Codes/National Electrical Code/ latest CPWD Specifications/ B.S.S./ or any other International Standard.
- Clauses of Contract.
- General Directions.
- Sound Engineering practice.

1.5 DRAWINGS:

1.5.1 CONTRACT DRAWINGS:

Contract drawings are basic but shall be closely followed as actual construction permits. Any deviations made shall be in conformity with the Architectural and other services drawings. Shop drawings shall be submitted by the contractor and got approved from the consultants. Architectural drawings shall take precedence over

contract or other services drawings as to all dimensions. Any deviations in drawings will be brought to consultant's Notice before work is executed as directed by consultants. Contractor shall verify all dimensions at site and bring to the notice of the consultants any or all discrepancy or deviations noticed.

1.5.2 DETAILED WORKING DRAWINGS:

Detailed working drawings and detail drawings on the basis of which actual work is to be proceeded will be furnished to the contractor by the consultants from time to time. Variation of any nature from those indicated in the drawings made available to him at the tender stage which are as 'Advance Drawings' as a guide to generally describe the scheme will not entitle the contractor for claiming any additional payment, payments will be made on the actual measurement of the work done, as admissible, as per drawings, at the accepted rates entered in the Schedule of Quantities forming part of this tender document.

1.5.3 PREPARATION OF SHOP AND FABRICATION DRAWINGS:

All shop and fabrication drawings shall be prepared by Contractor based on the Consultant's drawing and got approved from the consultants. No extra payment shall be admissible to the contractor on this account.

1.5.4 SHOP DRAWING, MAINTENANCE MANUALS Etc.:

On the award of the work, the contractor shall immediately proceed with the preparation of detailed shop drawings, detailing the equipment that are to be installed and the ancillary works that are to be carried out. Six sets of all such working drawings shall be submitted to the consultants for their approval to ensure that the works will be carried out in accordance with the specifications and drawings, including such changes as may have been mutually agreed upon. The basic drawings shall be received by the consultants for his approval within two weeks of the award of work, and complete shop/detail drawings within four weeks of award of work.

1.5.5 Any drawing issued by the consultants for the work are the property of the consultants and shall not be lent, reproduced or used on any works other than intended without the written permission of the consultants.

1.5.6 The contractor shall provide the following drawings for approval to consultants before commencement of supply/fabrication.

1.5.6.1 Electrical Lighting/ power layout plan

- (i) General layout-Plan
- (iii) Wiring-Power & Controls

1.5.6.2 Distribution Boards

- (i) General layout-Plan, section, elevations

- (ii) Foundation/Fixing arrangement.
- (iii) Wiring-Power & Control

1.5.6.3 Internal Electrification System:

- (i) Conduit Lay-out with number and size of wires in it for various outlets.
- (ii) Details of Switch Boxes

1.5.6.4 Cable Routing and Earthing System:

- (i) General Cable layout-Plan with sizes of Cable and Cable Trays at different floor & in Substation area.
- (ii) Details of Earthing strip sizes & connections

1.5.6.5 : LT panels/ Meter boards and Rising Main GA drawings

1.5.6.6 All drawings as indicated in various sub-heads.

- 2 After completion of the work the contractor shall submit one original on R.T.F & three prints of as built drawings along with compact disc/s (CD.s/DVD.s) containing the same before the certificate of completion is issued to him. These drawing would include;
 - (i) The location of all the equipment supplied & erected by the contractor.
 - (ii) Cable routes clearly indicating the sizes & number of cables.
 - (iii) Earthing layout - indicating the type of earth station & size of earth conductor.
 - (iv) Wiring diagram of DB's.
 - (v) Complete single line diagram for Normal and Emergency supplies.
 - (vi) Any other information the consultants may deem fit.

3. APPROVALS:

- 3.1 The contractor shall obtain all information relating to local regulations, Bye-Laws, sanction and release of electrical connection, application of any and all laws relating to his work or profession and his having to execute work as required. No additional claims shall be admissible on this account.
- 3.2 Contractor shall obtain approval of the installation from the relevant inspection/sanctioning Authorities at all stages and on completion of the installation work. The Contractor shall also get the required electrical load sanctioned and released from the concerned authorities and nothing extra shall be paid for the same except for the money for which the contractor produces valid receipts from the Govt. departments. The contractor shall pass on these approvals to the consultants. The rates quoted by the contractor for various items of the work shall be deemed to include any money payable to the Government/ Local Authorities/Statutory Bodies/Electrical

Inspectorate for obtaining approvals and nothing extra shall be paid to the contractor on this account except for the money for which proper receipts are submitted by the contractor to the consultants.

4 CODE REQUIREMENTS:

All work shall be done in accordance with the I S S Code amended upto date/ Indian Electricity Rules.

5 MATERIALS:

All materials to be used in this work be new and bear the consultant's label of approval.

6 RATES:

(i) The work shall be treated as on works contract basis and the rates tendered shall be for complete items of work inclusive of all taxes (including works contract tax, service tax VAT if any), duties, and levies etc. and all charges for items contingent to the work, such as, packing, forwarding, insurance, freight and delivery at site for the materials to be supplied by the contractor, watch and ward of all materials for the Internal E.I. work at site etc.

(ii) Prices quoted shall remain firm during the prevalence of the project.

7 TAXES AND DUTIES:

(i) Being an indivisible works contract, sales tax, VAT, excise duty, service tax etc. are not payable separately.

(iii) Works contract tax, if any, for the work shall be included within the quoted rates for the various items. The works contract tax shall be deducted from the bills of the contractor, as applicable.

(iii) Octroi duty shall not be paid separately for the materials supplied by the contractor.

8 COMPLETENESS OF TENDER:

All sundry fittings, assemblies, accessories, hardware items, foundation bolts, termination lugs for electrical connections as required, and all other sundry items which are useful and necessary for proper assembly and efficient working of the various components of the work shall be deemed to have been included in the tender, whether such items are specifically mentioned in the tender documents or not.

9 WORKS TO BE DONE BY THE CONTRACTOR:

(i) Unless and otherwise mentioned in the tender documents, the following works shall be done by the contractor, and therefore their cost shall be deemed to be included in their tendered cost:-

- (ii) Cutting and making good all damages caused during installation and restoring the same to their original finish.
- (iii) Painting at site of all exposed metal surfaces of the installation other than pre-painted items like fittings, fans, switchgear/ distribution gear items, etc. Damages to finished surfaces of these items while handling and erection, shall however be rectified to the satisfaction of the consultants.
- (vi) Temporary shed if required over the storage space and locking arrangement thereof, and watch and ward of the materials and completed installation till completion of the work.
- (iv) Testing and commissioning of completed installation.

10 TOOLS FOR HANDLING AND ERECTION:

All tools and tackles required for handling of equipments and materials at site of work as well as for their assembly and erection and also necessary test instruments shall be the responsibility of the contractor.

11 CARE OF THE BUILDING:

Care shall be taken by the contractor to avoid damage to the building during execution of his part of the work. He shall be responsible for repairing all damages and restoring the same to their original finish at his cost. He shall also remove at his cost all unwanted and waste materials arising out of his work from the site.

12 STRUCTURAL ALTERATIONS TO BUILDING

- (i) No structural member in the building shall be damaged /altered, without prior approval from the consultants.
- (ii) Structural provisions like openings, cutouts, if any, provided for the work, shall be used. Where these require modifications, or where fresh provisions are required to be made, such contingent works shall be carried out by the contractor at his cost with prior approval of the consultants.
- (iii) All chases required in connection with the electrical works shall be provided and filled by the contractor at his own cost to the original architectural finish of the buildings.

SECTION - 2

POINT WIRING

1 GENERAL

1.1 Definition

A point (other than socket outlet point) shall include all work necessary in complete wiring to the following outlets from the controlling switch or MCB. The scope of wiring for a point shall, however, include the wiring work necessary in tapping from another point in the same distribution circuit.

Ceiling rose or screwless connector (in the case of points for ceiling/exhaust fan points, pre-wired light fittings, and call bells).

Ceiling rose (in the case of pendants except stiff pendants).

Back plate (in the case of stiff pendants).

Lamp holder (in the case of goose neck type wall brackets, batten holders and fittings which are not pre-wired) .

Note: - In the case of call bell points, the words "from the controlling switch or MCB" shall be read as "from the ceiling rose/connector meant for connection to bell push".

1.2 Scope

Following shall be deemed to be included in point wiring.

Conduit, accessories for the same and wiring cables between the switch box and the point outlet.

All fixing accessories such as screws, rawl plug etc. as required.

Metal switch boxes for control switches, regulators, sockets etc, recessed in walls.

Outlet boxes, junction boxes, pull-through boxes etc, including metal boxes if any, provided with switch boards for loose wires/conduit terminations.
Control switch or MCB, as specified.

Ceiling rose or connector as required.

Connections to ceiling rose, connector, socket outlet, lamp holder, switch etc.

Interconnecting wiring between points on the same circuit, in the same switch box or from another.

Protective (loop earthing) conductor from one metallic switch box to another in the distribution circuits, and for socket outlets. (The length of protective conductor run along with the circuits is included in the scope of points).

The circuit wiring in conduit and wiring between various switches/switch boxes on the same circuit.

1.3 SYSTEM OF DISTRIBUTION AND WIRING:

1.3.1. Control at the point of entry of supply

There shall be a circuit breaker on each live conductor of the supply mains at the point of entry.

1.3.2 Distribution:

The wiring shall be done on a distribution system through main and/or branch distribution boards. The system design as well as the locations of boards shall be as indicated in BOQ/drawings or as specified by the consultants.

Main distribution board shall be controlled by a circuit breaker. Each outgoing circuit shall also be controlled by a circuit breaker.

The branch distribution board shall be controlled by a circuit breaker. Each outgoing circuit shall be provided with a miniature circuit breaker (MCB) of specified rating on the phase or live conductor.

The loads of the circuits shall be divided, as far as possible, evenly between the number of ways of the distribution boards, leaving at least one spare circuit for future extension.

The neutral conductors (incoming and outgoing) shall be connected to a common link (multiway connector) in the distribution board and be capable of being disconnected individually for testing purposes.

'Power' wiring shall be kept separate and distinct from 'Lighting' wiring, from the level of circuits i.e., beyond the branch distribution boards.

Wiring shall be separate for essential loads (i.e., those fed through standby supply) and non essential loads throughout.

1.3.3. Balancing of Circuits:

The balancing of circuits in three wire or poly phase installations shall be arranged before hand to the satisfaction of the consultants.

1.3.4 Wiring System:

Wiring shall be done only by the "Looping system". Phase or live conductors shall be looped at the switch boxes and neutral conductors at the point outlets.

Lights, fans and call bells shall be wired in the 'lighting' circuits. 15A/16A socket outlets and other power outlets shall be wired in the 'Power' circuits. 5A/6A socket outlets shall be wired in the 'lighting' circuits.

The wiring throughout the installation shall be such that there is no break in the neutral wire except in the form of a linked switchgear.

1.3.5 Run of Wiring:

The wiring shall be in recessed/surface PVC conduit.

Due consideration shall be given for neatness, good appearance and safety.

1.3.6 Passing through walls or floors:

When wiring cables are to pass through a wall, these shall be taken through a protection (steel) pipe tube of suitable size such that they pass through in a straight line without twist or cross in them on either end of such holes. The ends of metallic pipe shall be neatly bushed with porcelain, PVC or other approved material.

All floor openings for carrying any wiring shall be suitably sealed after installation.

1.4 Joints in wiring:

No bare conductor in phase and/or neutral or twisted joints in phase, neutral, and/or protective conductors in wiring shall be permitted.

There shall be no joints in the through-runs of cables. If the length of final circuit or submain is more than the length of a standard coil, thus necessitating a through joint, such joints shall be made by means of approved mechanical connectors in suitable junction boxes.

Termination of multistranded conductors shall be done using suitable crimping type thimbles.

1.5 RATINGS OF OUTLETS:

Incandescent lamps shall be rated at 100W.

Ceiling fans shall be rated at 80W. Exhaust fan, fluorescent tubes, compact fluorescent tubes, HPMV lamps, HPSV lamps etc. shall be rated according to their capacity. Control gear losses shall be also considered as applicable.

5A/6A and 15A/16A socket outlet points shall be rated at 100 W and 500 W respectively, unless the actual values of loads are specified.

1.6 CAPACITY OF CIRCUITS:

'Lighting' circuit shall not have more than a total of 10 points of light, fan and socket outlets, or a total connected load of 800W, whichever is less.

'Power' circuit shall have only two outlet per circuit.

1.7 CONFORMITY TO IE ACT, IE RULES, AND STANDARDS:

All electrical works shall be carried out in accordance with the provisions of Indian Electricity Act, 1910 and Indian Electricity Rules, 1956 amended upto date. List of

Rules of particular importance to building installations is given in Appendix for reference.

The works shall also conform to relevant Indian Standard Codes of Practice (COP) for the type of work involved.(See Appendix B).

In all electrical installation works, relevant safety codes of practice shall be followed. Guidelines on safety procedure outlined in Appendix 'C' should be adopted.

1.8 GENERAL REQUIREMENTS OF COMPONENTS:

1.8.1 Quality of materials:

All materials and equipments supplied by the contractor shall be new. They shall be of such design, size and material as to satisfactorily function under the rated conditions of operation and to withstand the environmental conditions at site.

1.8.2 Ratings of components

All components in a wiring installation shall be of appropriate ratings of voltage, current, and frequency, as indicated in BOQ.

All conductors, switches and accessories shall be of such size as indicated in BOQ.

1.8.3 Conformity to Standards

All components shall conform to relevant Indian Standard Specification, wherever existing. Materials with ISI certification mark shall be preferred.

A broad list of relevant Indian Standards is given in Appendix 'A'. These Indian Standards, including amendments or revisions thereof upto the date of tender acceptance, shall be applicable in the respective contracts.

1.8.4 Interchangeability

Similar parts of all switches, lamp holders, distribution boards, switchgears, ceiling roses, brackets, pendants, fans and all other fittings of the same type shall be interchangeable in each installation.

1.9 CABLES:

1.9.1 Wiring cables

Conductors for internal wiring shall be of copper. The wiring cables shall be of certified FRLS type.

The smallest size of conductor for 'lighting' circuits shall have a nominal cross sectional area of not less than 1.5 sq mm. The minimum size of conductor for 'power' wiring shall be 4 sq mm.

1.10 WIRING ACCESSORIES

1.10.1 Control switches/Fan Regulator for points

Control switches (single pole switches) carrying not more than 16A shall be of clamp on type complete with plate, as specified, and the switch shall be "ON" when the knob is down. Fan regulator should be ISI marked and stepped type.

The type and current rating of switch controlling a group of points, or discharge lamps, or a single large load, shall be specified in the tender documents.

Control switch shall be placed only in the live conductor of the circuit. No single pole switch or fuse shall be inserted in the protective (earth) conductor, or earthed neutral conductor of the circuit.

1.10.2 Socket outlets

Socket outlets shall also be of clamp on type complete with plate. These shall be rated either for 5A/6A, or 15A/16A. Combined 5A/15A, or 6A/16A six pin socket outlet shall be provided in 'power' circuits wherever specified.

Socket outlets and plugs shall only be of 3 pin type; the third pin shall be connected to earth through protective (loop earthing) conductor. 2 pin or 5 pin sockets shall not be permitted to be used.

The control switches for the 5A/6A and 15A/16A socket outlets shall be kept along with the socket outlets.

1.10.3 Switch box covers

These shall be modular type of suitable size.

1.10.4 Lamp holders

Lamp holders may be of batten, angle, pendant or bracket holder type as indicated in BOQ. The holder shall be made of brass and shall be rigid enough to maintain shape on application of a nominal external pressure. There should be sufficient threading for fixing the base to the lamp holder part so that they do not open out during attention to the lamp or shade.

Lamp holders for use on brackets and the like shall have not less than 1.3 cm nipple, and all those for use with flexible pendant shall be provided with cord grips.

All lamp holders shall be provided with shade carriers.

1.11 FITTINGS:

1.11.1 Types:

The type of fittings shall be as specified in BOQ.

1.11.2 Indoor type fittings

The conductors are required to be drawn through tube popularly known as conduit. The tube or channel must be free from sharp angles or projecting edge, and of such size as will enable them to be wired with the conductors used for the final circuit without removing the braiding or sheathing. As far as possible all such tubes or channels should be of sufficient size to permit looping back.

Fittings using discharge lamps shall be complete with power factor correction capacitors, either integrally or externally. An earth terminal with suitable marking shall be provided for each fitting for discharge lamps.

1.12 SWITCHGEAR AND CONTROLGEAR - General aspects:

All items of switchgear and distribution boards (DBs) shall be metal clad type. The types, ratings and/or categories of switchgear and protective gear shall be as specified in the BOQ.

RCBs (ELCBs) where specified, shall conform to the requirements of current rating, fault rating, single phase or three phase configuration and sensitivity laid down in the BOQ.

While each outgoing way of distribution board (DB) shall be of miniature circuit breaker (MCB) as specified, and of suitable rating on the phase conductor, the corresponding earthed neutral conductor shall be connected to a common neutral terminal block and shall be capable of being disconnected individually for testing purposes.

(i) Independent earth terminal block:

Every distribution board (single phase as well as 3 phase) shall have an earth terminal block identical to, but independent from neutral terminal block, to enable termination of protective (loop earthing) conductors (incoming as well as outgoings) individually by screwed connection and without twisting.

Earthing terminal (1 for single phase and 2 for 3 phase) shall be provided on the metal cladding of switches and DBs for body earthing. These shall be suitably marked.

Knock out holes, with or without end plates as per standard design of manufacturers, shall be provided in the metal cladding of switches and DBs for termination of conduits/cables.

1.13 MCB DISTRIBUTION BOARDS:

MCB DBs shall be provided only where specified.

The complete board shall be factory fabricated and shall be duly pre-wired in the works, ready for installation at site.

The board shall be of wall mounted, cubical type construction, fabricated out of 1.6mm thick sheet steel,

The board shall also be provided with a loose wire box as a compartment for the complete width and, depth of the board, and of minimum height of 125mm in case of TPN DB's, and 100mm in case of SPN DB's.

The board shall be provided with a hinged cover of 1.6mm thick sheet steel in the front. Only the knobs of the MCBs shall protrude out of the front covers through openings neatly machine made for the purpose.

Knock out holes at the bottom, and detachable plate with knock out holes at the top of the board shall be provided.

Each distribution board shall be provided with a circuit list giving details of each circuit which it controls and the current rating of the circuit, and the size of the MCB.

The board shall be complete with the following accessories:-

- (a) 200 A copper busbar(s).
- (b) Neutral link.
- (c) Common earth bar.
- (d) DIN bar for mounting MCBs.
- (e) Wago type terminal connectors suitable for incoming and outgoing cables.
- (f) A set of indication lamps with HRC cartridge fuses for each phase of the incoming supply.
- (g) Earthing stud(s).

The board shall be fully prewired with single core PVC insulated copper conductors/insulated solid copper links, and terminated on to extended type terminal connectors, suitable for connections to the sizes of the respective conductors.

All incoming and outgoing wiring to the prewired MCBDB's shall be terminated only in the Elemex type extended terminal connectors to be provided within the DB. The terminal connectors shall, therefore, be so provided as to facilitate easy cable connections and subsequent maintenance.

A common copper earth bar shall be provided within the loose wire box. The common neutral bar as well as the terminal connectors shall, however, be provided within the main compartment just below the loose wire box.

1.14 MINIATURE CIRCUIT BREAKERS (MCB's):

Miniature circuit breakers shall be of approved design and make and must be tested and validated as per IS/IEC 60898, IEC/EN 60898 and IEC 60947-2 standards.

MCBs shall be suitable for operation at 230V/415V, 50Hz supply. The MCB ratings shall be available from 1--125A in 1P/2P/3P/4P versions. The rated short circuit capacity acc to IS/IEC 60898 shall be of 10,000A. MCBs shall be offered with B, C or D tripping characteristics should be as per the BOQ requirements. The MCBs shall be suitable for mounting on a 35mm DIN rail.

MCBs shall carry ISI and CE marking. The MCB manufacturer (through the bidder) has to submit the valid BIS license certificate at the time of offer submission.

MCBs shall ensure complete electrical Isolation of downstream circuit or equipment, when the MCB is switched OFF **(to be marked on the MCB in symbolic form)**

IP 20 Degree of Protection shall be ensured to prevent electrical shocks by accidental touch to any live parts, by providing finger touch proof terminals.

Energy Limitation Class-3 shall be to ensure minimum let through energy in the event of a fault, for safety & longevity of downstream circuit equipment. **(to be mentioned on the MCB as per standards)**

MCBs shall be line-load reversible with no derating.

MCBs shall have bi-connect facility to terminate fork type busbar and wires, simultaneously. Terminal capacity shall be minimum 25 sq.mm. for ratings up to 25A, and 35 sq.mm. for ratings 32A & above to ensure perfect termination of wires and cables. Terminals of MCBs shall have captive screws.

Basic technical parameters, rating, operating voltage, energy limiting class 3 etc. shall be printed on front face of MCB for ease of identification.

The devices must be capable of heavy-duty operation and to that end, the manufacturer shall guarantee the following performance levels, defined by IEC / EN 60947-2 standards:

- suitability for isolation (section 7.2.7)
- rated insulation voltage (section 4.3.1.2) : 500 V
- pollution degree (Part 1, section 6.1.3.2) : 3
- rated impulse-withstand voltage (section 4.3.1.3) : 6 kV
- Discrimination for power continuity
- Validated Cascading tables as per standard IEC 60947-2

Operating knob shall have provision to lock in ON / OFF condition without affecting any automatic tripping

Circuit-breakers shall be capable of operation under ambient temperature up to **50 °C**, **without derating** of their overload tripping threshold with respect to their rated operating current. The same must be tested and validated as per IEC 60947-2 standard.

The material used to manufacture MCB shall be 100% recyclable and must comply to **RoHS and REACH standards**.

MCBs shall be suitable for field-fittable Protection auxiliaries (viz. Over-voltage release, Under-voltage release, Shunt trip) and Indication Auxiliaries (like Auxiliary Contact, Trip alarm contact).

1.15 SWITCH BOARD LOCATIONS

1.15.1 General aspects

Switch boards shall be located as indicated on the drawings.

1.16 SWITCH BOARD INSTALLATION:

A switch board shall not be installed so that its bottom is within 1.25 m above the floor.

Where it is required to terminate a number of conduits on a board, it may be convenient to provide a suitable MS adopter box for the purpose. Such boxes shall be provided with the prior approval of the consultants and this will not be paid for separately.

All wires to the boards shall be bushed at the entries to avoid damage to insulation.

No apparatus shall project beyond any edge of the panel.

All unused holes in the boards and in the mountings shall be plugged suitably to avoid entry of insects.

1.17 WIRING OF SWITCH BOARDS AND DISTRIBUTION BOARDS:

All connections between pieces of apparatus, or between apparatus and terminals on a board shall be neatly arranged in a definite sequence, following the arrangement of the apparatus mounted thereon, avoiding unnecessary crossings.

Cables shall be connected to terminals either by crimped or soldered lugs, unless the terminals are of such a form that they can be securely clamped without cutting away of cable strands.

All bare conductors shall be rigidly fixed in such a manner that a clearance of at least 2.5 cm is maintained between conductors of opposite polarity or phase, and between the conductors and any material other than insulating material.

The incoming and outgoing cables shall be neatly bunched and shall be fixed in such a way that the door shall be capable of swinging through an angle of not less than 90 degrees.

1.18 MARKING OF APPARATUS:**(i) Marking of earthed neutral conductor**

On the switchgear, the earthed conductor of a two wire system, or an earthed neutral conductor of a multi-wire system, an indication of a permanent nature shall be provided to identify the earthed neutral conductor. In this connection Rule 32(1) of Indian Electricity Rules 1956 (see Appendix C) shall be referred to. The neutral conductor shall be black in colour.

(ii) Main earthing terminal

The main earthing terminal in the main switch board shall be permanently marked as "SAFETY EARTH - DO NOT REMOVE".

All distribution boards shall be marked 'L' for lighting, or 'P' for power, and 'E' for essential as the case may be.

When a board is connected to a voltage higher than 250V, all the terminals or leads of the apparatus mounted on it shall be marked in the following colours to indicate the different poles or phases to which the apparatus or its different terminals may have been connected:

Three phases - Red, Blue & Yellow AND Neutral - Black

Where a four wire, three phase wiring is done, the neutral shall preferably be in one colour, and the other three wires in another colour.

All marking required under this rule shall be clear and permanent.

1.19 ATTACHMENT OF FITTINGS AND ACCESSORIES:

1.19.1 Conduit wiring system

All accessories like switches, socket outlets, call bell pushes and regulators shall be fixed in flush pattern inside the switch/regulator boxes. Accessories like ceiling roses, brackets, batten holders, etc. shall be fixed on metal outlet boxes. The fan regulators shall also be fixed in metal outlet boxes.

Cadmium plated brass screws shall be used to fix the accessories to their bases.

The switch box / regulator box shall be mounted with their bottom 1.25m from floor level, unless otherwise directed by the consultants.

Dash fasteners shall be used for fixing to walls or ceiling.

1.20 FANS REGULATORS AND CLAMPS:

1.20.1 Ceiling fans

Ceiling fans including their suspension shall conform to relevant Indian Standards.

All ceiling fans shall be wired to ceiling roses or to special connector boxes, and suspended from hooks or shackles, with insulators between hooks and suspension rods. There shall be no joint in the suspension rod.

Recessed type fan clamp inside a metallic box as shown in tender drawings shall be used.

Canopies on top of suspension rod shall effectively hide the suspension.

All ceiling fans shall be hung 2.75m above the floor.

In the case of measurement of extra down rod for ceiling fan including wiring, the same shall be measured in units of 10cm. Any length less than 5cm shall be ignored.

The wiring of extra down rod shall be paid as supplying and drawing cable in existing conduit.

1.20.2 Exhaust fans:

Exhaust fans shall conform to relevant Indian Standards.

Exhaust fans shall be erected at the places indicated on the drawings. For fixing an exhaust fan, a circular hole shall be provided in the wall to suit the size of the frame, which shall be fixed by means of rag bolts embedded in the wall. The hole shall be neatly plastered to the original finish of the wall. The exhaust fan shall be connected to the exhaust fan point, which shall be wired as near to the hole as possible, by means of a flexible cord, care being taken to see that the blades rotate in the proper direction.

1.20.3 Regulators:

The metallic body of regulators of ceiling fans/exhaust fans shall be connected to earth by protective conductor. Fan regulator should be ISI marked and stepped type regulator.

1.21 WORKMANSHIP:

Good workmanship is an essential requirement to be complied with. The entire work of manufacture/fabrication, assembly and installation shall conform to sound engineering practice.

The work shall be carried out under the direct supervision of a first class licensed foreman, or of a person holding a certificate of competency issued by the State Govt. for the type of work involved, employed by the contractor, who shall rectify then and there the defects pointed out by the consultants during the progress of work.

1.22 COMMISSIONING ON COMPLETION:

Before the workman leaves the work finally, he must make sure that the installation is properly commissioned, after due testing.

1.23 COMPLETION PLAN AND COMPLETION CERTIFICATE:

Completion certificate after completion of work as given in Appendix-'D' shall be submitted to the consultants.

Completion plan drawn to a suitable scale in tracing cloth with ink indicating the following, along with three blue print copies of the same shall also be submitted.

- (a) General layout of the building.

- (b) Locations of distribution boards, indicating the circuit numbers controlled by them.
- (c) Position of all points and their controls.
- (d) Types of fittings, viz. fluorescent, pendants, brackets, bulk head, etc. fans and exhaust fans.

1.24 DRAWINGS

The work shall be carried out in accordance with the drawings enclosed with the tender documents and also in accordance with modification thereto from time to time as approved by the consultants.

All circuits shall be indicated and numbered in the wiring diagram and all points shall be given the same number as the circuit to which they are electrically connected.

SECTION - 3

P.V.C. CONDUIT WIRING SYSTEM

1 SCOPE:

This chapter covers the detailed requirements for wiring work in P.V.C. conduits.

2 MATERIALS

2.1 Conduits

All rigid conduit pipes shall be of P.V.C. and be ISI marked. The wall thickness shall be not less than 2.0 mm for conduits upto 32 mm dia. and not less than 2.5 mm for conduits above 32 mm dia.

The maximum number of PVC insulated cables conforming to IS:694-1990 that can be drawn in one conduit is given size wise in Table I, and the number of cables per conduit shall not be exceeded. Conduit sizes shall be selected accordingly in each run.

No P.V.C. conduit less than 20mm in diameter shall be used.

2.2 Conduit accessories

The conduit wiring system shall be complete in all respects, including their accessories.

All conduit accessories shall be of grip type.

Bends, couplers etc. shall be solid type.

All conduit accessories shall be fixed with the help of P.V.C. jointing compound.

2.3 Outlets

The switch box or regulator box shall be made of GI on all sides, except on the front. The wall thickness shall not be less than 1.2 mm (18 gauge) for boxes up to a size of 20 cm X 30 cm, and above this size 1.6 mm (16 gauge) thick GI boxes shall be used.

Where a large number of control switches and/or fan regulators are required to be installed at one place, these shall be installed in more than one outlet box adjacent to each other for ease of maintenance.

An earth terminal with stud and 2 metal washers shall be provided in each GI box for termination of protective conductors and for connection to socket outlet/metallic body of fan regulator etc.

Clear depth of the box shall not be less than 51 mm, and this shall be increased suitably to accommodate mounting of fan regulators in flush pattern.

3 INSTALLATION:

3.1 (i) Conduit joints.

The conduit work of each circuit or section shall be completed before the cables are drawn in.

Conduit pipes shall be joined by means of suitable P.V.C. jointing compound.

Cut ends of conduit pipes shall have no sharp edges, nor any burrs left to avoid damage to the insulation of the conductors while pulling them through such pipes.

The Project Director/Architect, with a view to ensuring that the above provision has been carried out, may require that the separate lengths of conduit etc., after they have been prepared, shall be submitted for inspection before being fixed.

(ii) Bends in conduit

All necessary bends in the system, including diversion, shall be done either by neatly bending the pipes without cracking with a bending radius of not less than 7.5 cm, or alternatively, by inserting suitable solid type normal bends, elbows or similar fittings, or by fixing MS inspection boxes, whichever is most suitable for the particular situation.

No length of conduit shall have more than the equivalent of four quarter bends from outlet to outlet.

(iii) Outlets

All outlets such as switches, wall sockets etc. shall be flush mounting type.

All switches socket outlets and fan regulators shall be fixed on sheet cover of the same manufacturer as that of the accessories.

3.2 Additional requirements

(i) Making chase

The chase in the wall shall be neatly made, and of ample dimensions to permit the conduit to be fixed in the desired manner.

The conduits shall be buried in the wall before plastering, and shall be finished neatly after erection of conduit.

(ii) Fixing conduits in chase

The conduit pipe shall be fixed by means of stapples, J-hooks, or by means of saddles, not more than 60 cm apart.

(iii) Fixing conduits in RCC work

The conduit pipes shall be laid in position and fixed to the steel reinforcement bars by steel binding wires before the concreting is done. The conduit pipes shall be fixed

firmly to the steel reinforcement bars to avoid their dislocation during pouring of cement concrete and subsequent tamping of the same.

Fixing of standard bends or elbows shall be avoided as far as practicable, and all curves shall be maintained by bending the conduit pipe itself with a long radius which will permit easy drawing in of conductors.

Location of inspection / junction boxes in RCC work should be identified by suitable means to avoid unnecessary chipping of the RCC slab subsequently to locate these boxes.

(iv) Fixing inspection boxes

Suitable inspection boxes to the minimum requirement shall be provided to permit inspection, and to facilitate replacement of wires, if necessary.

These shall be mounted flush with the wall or ceiling concrete. Minimum 65 mm depth junction boxes shall be used in roof slabs and the depth of the boxes in other places shall be as per IS:2667-1977.

Suitable ventilating holes shall be provided in the inspection box covers.

(v) Fixing switch boxes and accessories

Switch boxes shall be mounted flush with the wall. All outlets such as switches, socket outlets etc. shall be flush mounting type.

(vi) Fish wire

To facilitate subsequent drawing of wires in the conduit, GI fish wire of 1.2 mm (18 SWG) shall be provided along with the laying of the recessed conduit.

(vii) Bunching of cables

Cables shall always be bunched so that the outgoing and return cables are drawn into the same conduit.

Where the distribution is for three phase loads only, conductors for all the three phases and neutral wire shall be drawn in one conduit.

3.3 Earthing requirements

The entire system of metallic conduit work, including the outlet boxes and other metallic accessories, shall be mechanically and electrically continuous by proper joints. The conduit shall be continuous when passing through walls or floors.

Protective (loop earthing) conductor(s) shall be laid along the runs of the conduit between the metallic switch boxes and the distribution boards/ switch boards, terminated thereto. These conductors shall be of such size and material as specified. Depending upon their size and material, the protective earth conductors shall be either drawn inside the conduits along with the cables, or shall be laid external to the

conduits. When laid external to the conduits, this shall be properly clamped with the conduit at regular intervals.

The protective conductors shall be terminated properly using earth studs/ earth terminal block etc. as required.

Gas or water pipe shall not be used as protective conductor (earth medium).

TABLE I

Maximum number of PVC insulated 650/1100 V grade copper conductor cable conforming to IS:694-1990 which can be drawn through a conduit

Nominal cross-sectional area of conductor in sq. mm.	20 mm		25 mm		32 mm		38 mm		51 mm	
	-----		-----		-----		-----		-----	
	S	B	S	B	S	BS	B	S	B	
1	2	3	4	5	6	7	8	9	10	11
1.50	5	4	8	7	16	10	-	-	-	-
2.50	4	3	7	5	10	8	-	-	-	-
4	3	2	6	5	9	7	-	-	-	-
6	2	-	5	4	8	6	-	-	-	-
10	2	-	3	2	5	4	7	6	-	-
16	-	-	2	2	3	3	6	5	10	7
25	-	-	-	-	3	2	5	3	8	6
35	-	-	-	-	-	-	3	2	6	5

Note :

The above table shows the maximum capacity of conduits for a simultaneous drawing in of cables.

The columns headed 'S' apply to runs of conduits which have distance not exceeding 4.25 m between draw in boxes and which do not deflect from the straight by an angle of more than 15 degrees. The columns headed 'B' apply to runs of conduit which deflect from the straight by an angle of more than 15 degrees.

Conduit sizes are the nominal external diameters.

SECTION - 4

PAINTING

1.0 SCOPE

This chapter covers the requirements of painting work in internal electrical installations, carried out manually by brush. This does not cover spray painting work of factory made items.

1.1 PAINTING WORK IN GENERAL

1.1.1 Paints

Paints, oils, varnishes etc. of approved make in original tin to the satisfaction of the consultants shall only be used.

1.1.2 Preparation of the surface

The surface shall be thoroughly cleaned and made free from dust or foreign matter before painting is started. The proposed surface may be inspected by the consultants before the paint is applied.

1.1.3 Application

Paint shall be applied with brush. The paint shall be spread as smooth and even as possible. Particular care shall be paid to rivets, nuts, bolts and over-lapping. Before drawing out in smaller containers, it shall be continuously stirred with a smooth stick, while painting work is taken up.

Primer coat of anti-corrosive paint shall be given in the case of steel work, after preparing the surface. In all cases of painting work, finishing shall be with 2 coats of paint in approved shade.

Each coat shall be allowed to dry out sufficiently before a subsequent coat is applied.

1.1.4 Precautions

All furniture, fixtures, glazing, floors etc. shall be protected by suitable covering. All stains, smears, splashings, dropping etc. shall be removed. While painting of conduits etc. it shall be ensured that the painting of wall and ceiling etc. is not spoiled in any way.

1.2 PAINTING OF CONDUITS AND ACCESSORIES

Requirement of painting of metallic conduits before installation on surface shall be met as per clause 3.3.(iv)

SECTION – 5**ELECTROLYTIC MAINTENANCE FREE EARTHING**

The effective earthing connection surface should be smooth & free from paints and oxide coatings

1. MAINTENANCE FREE EARTHING**1.1. General**

- (i) Self-contained ground electrode(s) using electrolytically enhanced grounding where specifically indicated on the drawings.
- (ii) The electrode shall operate by hygroscopic ally extracting moisture from the atmosphere to activate the electrolytic process.
- (iii) Electrode shall be 100% self-activating, sealed and maintenance free. No additions of chemical or water solutions required.
- (iv) To achieve specific earth resistance, contact manufacturer for engineering and applications support.

1.2. Technical Specifications**1.2.1 Types & Technical Specifications (Long Life Maintenance Free Earthing Solution)**

System Model / Type	Soil	Warranty (years)	Current Capacity	Electrode Details			TF Qty (Bags)	Test Well Cover
				Length (feet)	Outer Dia. (inch)	Thickness (mm)		
C-TEG-10S/ TRIPODE-Cu-50-3	Non Rocky	30	1kA/ 9Sec	10	2	2	3	Poly-plastic

- (i) The specifications with performance warranty and technical spec details shown in the tables.
- (ii) The ground rod shall be filled from the factory with non-hazardous metallic salts to form the electrolytic process and enhance the grounding performance.
- (iii) Ground rod shall be a minimum of ten feet long. TerraDyne® Model # TG-10S or TRIPODE –Cu-50-3 may be used.

OR

Selection of models depends on the user choice.

- (iv) A Solid Tinned AWG Cu ground cable shall be exothermically welded to the side of the rod for conductor connection OR 40x5mm OR 50x5mm OR 100x150x6mm used for conductor connection.
- (v) For Rocky or excavation condition are poor Model # TerraDyne TG-10L may be used with same Dia and Thickness. Only the difference in this model is L shaped with 36" vertical riser (shape) and rest in horizontal shape.

OR

- (vi) The Crowfoot Bar earthing systems used for is one of the best alternate of Maintenance Free Earthing in the Rocky area.
- (vii) A Solid Tinned AWG Cu ground cable/50x5mm copper plate shall be exothermically welded to the side of the rod for conductor connection

1.3. *Protective Test Well*

- (i) Polyplastic well for non-traffic applications. Includes bolt down flush cover with "breather ports." TerraDyne® Model #910

—OR—

- (ii) Fiberlyte well for traffic and industrial applications. Wheel loading 4.5 Tons. TerraDyne® Model #FL8-TB

1.4.

Environment Friendly Backfill Material

- (i) Non-corrosive, electrically conductive and ground enhancing backfill. TerraFill® Model # TF-50. TerraFill /TRIPODE FILL will lower the contact resistance to earth by up to 63 % when used in conjunction with copper grounding equipment.

1.5. *Excavation*

- (i) Bore a hole into the earth (minimum diameter 6"). Hole should be bored to allow installed unit to be as close to vertical as possible
- (ii) A 14" hole must be provided for the cover box.
- (iii) Depth of hole must be 6" deeper than the vertical length of the system.
- (iv) Top vent ports must be left open to the atmosphere for continuous air circulation by using the protective test well provided.
- (v) Plate Type Earthing (Cu/GI), Crow Foot Earthing and Cu Claded rod earthing, the mixing procedure of Backfill will be same as like in the electrolytic Earthing.

1.6. Installation

- (i) Remove sealing tapes from the bottom of unit only. Tapes must be saved and made available to the electrical inspector to verify removal and proper installation. Do NOT remove the green and white “Bury to Here” marker from the top of the unit.
- (ii) Position the unit in the hole. Use green and white “Bury to Here” marker as a guide to depth in which unit shall be buried in TerraFill®. Three bags of TerraFill® are included with each 10' electrode.
- (iii) Pour TerraFill® around electrode in augured hole. Do not mound backfill past green and white marker.
- (iv) Place box with cover over the top of the electrode so that the cover is at grade level. Use backfill to stabilize box around the electrode. This keeps the breather holes free of obstruction and debris. Top of box should not contact the top of the electrode.
- (v) Remove top sealing tape ONLY after backfill is complete. This prevents soil from blocking the vent ports.

Above installation must be taken place in presence of UL listed company.

1.7. Connection

- (i) Connect grounding conductor to ground rod pigtail exothermally.
- (II) Bury grounding conductor 30inch below grade

SECTION - 6

EARTHING

1.1 SCOPE:

This chapter covers the essential requirements of earthing system components and their installation. For details not covered in these Specifications, IS Code of Practice on Earthing (IS: 3043-1987 ammended upto date) shall be referred to.

1.2 APPLICATION

The electrical distribution system in the campus is with earthed neutral (i.e., neutral earthed at the transformer/ generator end). In addition to the neutral earthing, provision is made for earthing the metallic body of equipments and non-current carrying metallic components in the sub-station, as well as in the internal electrical installations.

Earthing requirements are laid down in Indian Electricity Rules, 1956, as amended from time to time, and in the Regulations of the Electricity Supply Authority concerned.

1.3 MATERIALS

1.3.1 EARTH ELECTRODES

1.3.1.1 Types

The type of earth electrode shall be Chemical earth electrode.

1.3.2.1 Electrode materials and dimensions

The materials and minimum sizes of earth electrodes shall be as per BOQ.

1.3.2.2 EARTHING CONDUCTOR:

The earthing conductor (protective conductor from earth electrode up to the main earthing terminal/earth bus, as the case may be) shall be of the same material as the electrode, viz. GI or copper, and in the form of wire or strip as specified in BOQ.

1.3.2.3 HARDWARE ITEMS

All hardware items used for connecting the earthing conductor with the electrode shall be of GI in the case of GI pipe and GI plate earth electrodes, and forged tinned brass in case of copper plate electrodes.

1.3.2.4 PROTECTIVE (Earth continuity/Loop earthing) CONDUCTOR:

The material and size of protective conductors shall be as specified in the BOQ.

1.4 LOCATION FOR EARTH ELECTRODES

Normally an earth electrode shall not be located closer than 1.5 m from any building. Care shall be taken to see that the excavation for earth electrode does not affect the foundation of the building; in such cases, electrodes may be located further away from the building, with the prior approval of the consultants.

The location of the earth electrode will be such that the soil has a reasonable chance of remaining moist as far as possible. Entrances, pavements and road ways, should be avoided for locating earth electrodes.

1.5 INSTALLATION

1.5.1 ELECTRODES

1.5.1.1 Various types of electrodes

Plate electrode shall be buried in ground with its faces vertical, and its top not less than 3 m below the ground level.

When more than one electrode (plate/pipe) is to be installed, a separation of not less than 2 m shall be maintained between two adjacent electrodes.

1.5.2 Artificial treatment of soil

The electrode shall be surrounded by Chemical compound as indicated in tender drawings

1.6 EARTHING CONDUCTOR (Main earthing lead)

In the case of plate earth electrode, the earthing conductor shall be securely terminated on to the plate with two bolts, nuts, check nuts and washers.

The earthing conductor from the electrode up to the building shall be protected from mechanical injury by a medium class by 40 mm dia. medium class GI pipe in the case of strip. The protection pipe in ground shall be buried at least 30 cm deep (to be increased to 60 cm in case of road crossing and pavements). The portion within the building shall be recessed in walls and floors to adequate depth in due co-ordination with the building work.

The earthing conductor shall be securely connected at the other end to the earth stud/earth bar provided on the switch board by bolt, nut and washer.

1.7 PROTECTIVE (Loop earthing/earth continuity) CONDUCTOR

Earth terminal of every switch board in the distribution system shall be bonded to the earth bar/terminal of the upstream switch board by protective conductor(s).

Two protective conductors shall be provided for a switch board carrying a 3 phase switchgear thereon.

The earth connector in every distribution board (DB) shall be securely connected to the earth stud/earth bar of the corresponding switch board by a protective conductor.

All metallic switch boxes and regulator boxes in a circuit shall be connected to the earth connector in the DB by protective conductor (also called circuit protective or loop earthing conductor), looping from one box to another upto the DB.

The earth pin of socket outlets as well as metallic body of fan regulators shall be connected to the earth stud in switch boxes by protective conductor. Twisted earth connections shall not be accepted in any case.

1.8 EARTH RESISTANCE

The earth resistance at each electrode shall be measured. No earth electrode shall have a greater ohmic resistance than 5 ohms as measured by an approved earth testing apparatus.

Where the above stated earth resistance is not achieved, necessary improvement shall be made by additional provisions, such as additional electrode(s), different type of electrode, or artificial chemical treatment of soil etc., as may be directed by the consultants.

1.9 MARKING:

Earth bars/terminals at all switch boards shall be marked permanently, "E" or as;

Main earthing terminal shall be marked "SAFETY EARTH - DO NOT DISCONNECT".

TABLE VIII

MATERIALS AND SIZES OF EARTH ELECTRODES

Type of Electrode	Material	Size
Plate	Copper	60 cm x 60 cm x 3 mm thick.
Plate	GI	60 cm x 60 cm x 6 mm thick.

It shall be carried out as per C.P.W.D GENERAL SPECIFICATIONS FOR ELECTRICAL WORKS (PART-I INTERNAL) - 2007 with all upto date amendments.

SECTION – 7

TESTING OF INSTALLATION:-

1.0 SCOPE

This chapter describes the details of tests to be conducted in the completed internal electrical installations, before commissioning.

1.1 GENERAL

1.1.1 Tests

On completion of installation, the following tests shall be carried out :-

1. Insulation resistance test.
2. Polarity test of switch.
3. Earth continuity test.
4. Earth electrode resistance test.

1.2 Witnessing of tests

Testing shall be carried out for the completed installations, in the presence of and to the satisfaction of the consultants by the contractor.

All test results shall be recorded & submitted to the consultants.

1.3 Test instruments

All necessary test instruments for the tests shall be arranged by the contractor.

1.4 INSULATION RESISTANCE

- 1.4.1 The insulation resistance shall be measured by applying between earth and the whole system of conductors, or any section thereof with all MCB.s in place, and all switches closed, all lamps in position, or both poles of the installation otherwise electrically connected together, a direct current pressure of not less than twice the working pressure, provided it need not exceed 500 volts. Where the supply is derived from a poly phase A.C. system, the neutral pole of which is connected to earth either directly or through added resistance, the working pressure shall be deemed to be that which is maintained between the phase conductor and the neutral.
- 1.4.2 The insulation resistance shall also be measured between all the conductors connected to one pole, or phase conductor of the supply, and all the conductors connected to the neutral, or to the other pole, or phase conductors of the supply with all the lamps in position and switches in "off" position, and its value shall be not less than that specified in sub- clause 7.2.3.
- 1.4.3 The insulation resistance in megaohms measured as above shall not be less than 12.5 megaohms.

- 1.4.4** The term "outlet" includes every point along with every switch, except that a switch combined with a socket outlet, appliance or lighting fitting is regarded as one outlet.

1.5 POLARITY TEST OF SWITCH

- 1.5.1** In a two wire installation, a test shall be made to verify that all the switches in every circuit have been fitted in the same conductor throughout, and such conductor shall be labeled or marked for connection to the phase conductor of the supply.
- 1.5.2** In a four wire installation, a test shall be made to verify that every non-linked single pole switch is fitted in a conductor which is labeled, or marked for connection to one of the phase conductors of the supply.
- 1.5.3** The installation shall be connected to the supply for testing. The terminals of all switches shall be tested by a test lamp, one lead of which is connected to the earth. Glowing of test lamp to its full brilliance, when the switch is in "on" position irrespective of appliance in position or not, shall indicate that the switch is connected to the right polarity.

1.6 TESTING OF EARTH CONTINUITY PATH

The earth continuity conductor, including metal conduits shall be tested for electric continuity. The electrical resistance of the same along with the earthing lead, but excluding any added resistance, or earth leakage circuit breaker, measured from the connection with the earth electrode to any point in the earth continuity conductor in the completed installation shall not exceed one ohm.

1.7 MEASUREMENT OF EARTH ELECTRODE RESISTANCE

- 1.7.1** Two auxiliary earth electrode, besides the test electrode, shall be placed at suitable distance from the test electrode (see figure). A measured current is passed between the electrode 'A' to be tested and an auxiliary current electrode 'C', and the potential difference between the electrode 'A' and auxiliary potential 'B' is measured. The resistance of the test electrode 'A' is then given by
- 1.7.2** Stray currents flowing in the soil may produce serious errors in the measurement of earth resistance. To eliminate this, hand driven generator shall be used.
- If the frequency of the supply of hand driven generator coincides with the frequency of stray current, there will be wandering of instrument pointer. An increase or decrease of generator speed will cause this to disappear.
- 1.7.3** At the time of test, the test electrode shall be separated from the earthing system.
- 1.7.4** The auxiliary electrodes shall be of 13 mm diameter mild steel rod driven upto 1 m into the ground.
- 1.7.5** All the three electrodes shall be so placed that they are independent of the resistance area of each other. If the test electrode is in the form of a rod, pipe or plate, the auxiliary current electrode 'C' shall be placed at least 30 m away from it, and the auxiliary potential electrode 'B' shall be placed mid-way between them.
- 1.7.6** Unless three consecutive readings of test electrode resistance agree, the test shall be repeated by increasing the distance between electrodes A and C upto 50 m, and each time placing the electrode B midway between them.

1.8. TEST CERTIFICATE

On completion of an electrical installation, a certificate shall be furnished by the contractor, countersigned by the certified supervisor under whose direct supervision the installation was carried out. This certificate shall be in the prescribed form as given in Appendix ... in addition to the test certificate required by the local Electric Supply Authorities.

SECTION – 8**LV SYSTEM CONDUITING****1.0 GENERAL****1.1 INTENT OF SPECIFICATION**

- 1.1.1 These specifications are intended to cover only the Conduit work for LV System. It is not the intent to specify completely herein all aspects of design, construction features of equipment and detail to be carried out, out nevertheless the intent of the specification is to Indian standard Specifications, Codes of Practice, and other statutory regulations as may be applicable and to high standards of engineering, design and workmanship. The equipment and who shall perform in continuous operation in a manner acceptable to the of the Employer will interpret the meaning of the meaning of the specifications and drawings and shall have the right to reject or accept any equipment or work which in their assessment is not complete to meet the requirements of these specifications and/ or applicable Codes and standards.

1.2.0 SCOPE OF WORK

- 1.2.1 The scope of work under this specification shall include the design, manufacture, work' testing, supply, storage, erection, site testing and commissioning of the following :-
- a) All conduit work including junction Boxes, outlet boxes and wiring LV system.
 - b) Boxes and cover plates for telephone , TV and Data outlets.
 - c) Supplying and laying of telephone wire and copper cable for point outlets.
 - d) To do the ferruling and identification of all multi core cable at both the of each cable. The scope of work shall also include all civil works associated with erection of the conduit work and wiring and fixing of boxes and out let accessories and making good and painting the works as required.

The Contractor shall include for the supply of entire material in accordance with BILL OF QUANTITIES and these specifications and the whole of the work fixing necessary material for the complete installation as set down in these specifications and with the accompanying schedule of work and drawing. Materials and components not specifically stated in the specifications and / or bill of materials or noted on the drawing but which are necessary for satisfactory installation and operation of the system shall be deemed to have been included in the scope of work.

1.3 SPECIFICATIONS AND SCHEDULES

- 1.3.1 The Specifications and Schedule of quantities shall be considered as part of contract and any work or material shown in schedule and not called for in the specifications or vice versa, shall

be executed as if specially called for in both. The drawing indicated the extent and general arrangement of the telephone point outlet. Tag Block etc. and are essentially diagrammatic.

- 1.3.2 The work shall be installed as indicated on the drawing. However, are minor changes found essential to coordinate the installation of this work with other trades shall be made without any additional cost of the employer. The date given herein and on the drawing is as exact as could be of the Contractor. Exact locations, distances and levels will be governed by the site conditions

1.4 DEPARTURE FROM SPECIFICATION

- 1.4.1 Should the tender wish to depart from the provisions in these specifications, such departure shall be listed in a separate schedule with full particulars and reasons for the same. No conditions or departures from specifications etc. will be accepted after decisions are communicated by the employer / Architect.

1.5.0 MATERIALS AND EQUIPMENT

All materials and equipment shall be of the approved make and design. Only the best quality materials and equipment shall be used. The materials and equipment shall conform to relevant Standards.

1.5.1 APPROVED MAKES OF MATERIAL

Approved makes of material indications in the annexure to the Specifications. Only such material shall be used. Alternative makes shall be used only with the specific written approval of the Architect./Employer.

1.6 SAMPLES

A list of items of material and equipment, together with a sample of each shall be submitted to the Employer within 15 days of the award of the Contract.

1.7 DRAWINGS

1.7.1 DRAWING REQUIRED PRIOR TO COMMENCEMENT OF WORK

- 1.7.1.1 Prior to the laying fixing to the conduits, the Contractor shall submit to the employer/Architect detailed shop drawing of the conduit network and get same approved. The shop drawing shall indicate number, and route of the conduits, location of junction/inspection/pull boxes, location and of outlet boxes and number size of wires carried in each conduit.
- 1.7.1.2 The Contractor shall prepare and submit for the approval of Employer/ Architect detailed shop drawing of all junction boxes, special pull boxes and any other requirement to be fabricated by the Contractor within 10 days of signing of the contract.

- 1.7.1.3 General Arrangement drawing giving detail of cable, size and type of cable, number of cable, mode of installation etc.

1.8 COMPLETION DRAWINGS

- 1.8.1 After the completion of the work before issuance virtual, the contractor shall submit to the Owner completion drawing in the form of one complete set of original on sepi cloth in ink with two set of blue prints of layout drawing drawn at approved scale indicating the complete system as installed.

These drawing shall given the following:-

- 1.8.2 Run and of conduits, location of inspection, junction and pull boxes.
- 1.8.3 Number and size of conductors in each conduit for computer wiring.
- 1.8.4 Location of outlets and tag blocks
Complete schematic drawing as installed showing all connection in the complete computer system. Layout and particulars of all cable runs size and type cable, made of installation, etc. as installed.

1.6 CLEANING, FINAL PAINTING AND MARKING

- 1.6.1 All exposed steel work not actually embedded will be painted as instructed. All patch panels shall be properly labeled and numbered. The scope of work shall include the same without any extra charge. The contractor shall be required to clean all equipment under erection as well as the work area and site at regular intervals to the satisfaction of the Employer. In case the cleaning is not to Employers satisfaction the same will be done again at the Contractors cost.

1.7 COMPLETEION CERTIFICATE

- 1.7.1 On completion of the computer wiring and cabling installation a certificate shall be furnished by the Contractor counter signed by the licensed Supervisor, under who direct supervision the installation was carried out the contractor shall get the certificate of the complete system form the compeete authorities after commissioning.

1.8 WORKS INSPECTION

- 1.8.1 Prior to shipment of equipment the Owner reserves the right to inspect the same at the manufactures works and the Contractor shall provide and secure for the Architect and his authorized representative/ Employer or his authorize representatives every reasonable access and facility at the manufacturers work for inspection.

1.9 CO-ORDINATION OF WORK AT SITE

- 1.9.1 The Contractor shall work in co-ordination and co-operation with Building contractor and or any other agencies at site and shall arrange to place the conduits/ inserts etc. in the masonry

and concrete as required, as other works proceed. Any hold up of the building or other works proceed. Any hold up of the building or otherwise because of delay in placing the contract / inserts etc, or otherwise shall be the responsibility of the contractor and shall make liable for damages as may be considered and levied by the Employer.

1.10 PARTIAL OCCUPATION OF PREMISES

- 1.10.1 During progress of the work completed portions of the building/ floor may be occupied and put to use by the Employer. The Contractor shall be however remain fully responsible for the maintenance of the installation till the entire work covered by this Contract is satisfactorily completed by him and taken over by the Employer.

1.11 MATERIALS

1.11.1 PVC Conduits

as specified above

1.12 Conduit accessories

as specified above

1.13 INSTALLATION

- 1.13.1 Common aspects for both recessed and surface conduit works are given below:-

- 1.13.1.1 The erection of conduits of each section shall be completed before the cables are drawn in.

1.14 Conduit joints

- 1.14.1 All joints shall be sealed/cemented with an approve cement. Damaged conduit pipes/Damaged conduit pipes/ fitting shall be used in the work. Cut ends of conduit pipes shall no sharp edges burrs left to avoid damage to the insulation of conductors pulling them through such pipes.

- 1.14.2 The Engineer-in-charge, with a view to ensuring that the above provision has been carried out, may require that the separate lengths of conduit etc. after they have been prepared, shall be submitted for inspection before being fixed.

1.15 Bends in conduit

- 1.15.1 in the system may be formed either by bending the pipes an approved method of heating or inserting suitable accessories such as bends, elbows or similar fitting, or by fixing non-metallic inspection boxes., whichever is most suitable. Where necessary, solid type fitting shall be used.

1.15.2 Radius of in conduit pipes shall not be less than 7.5 cm. No length of conduit shall be have more than the equivalent of quarter bends outlet to out-let

1.15.3 Care shall be taken while bending the pipes to ensure that the conduit pipe is not injured, and that internal diameter is not effectively reduced.

1.16 OUTLET BOXES

1.16.1 16 SWG G.I. boxes of the required sized shall be provided to house the telephone outlets as may be required. These shall be so designed that there is ample space at the rear and at the side to accommodate conductors at the conduit entries. These shall be completely concealed leaving edges flush with surface. Should the outlets have mounting grid plates, adequate support shall be provided.

1.17 PULL BOXES

1.17.1 16 SWG mild steel pull boxes of adequate dimensions minimum size 75 mm x 75 mm shall be provided at convenient points on walls to facilitate long runs of conductors they will be completely concealed with 3 mm Perspex / hylam covers flush with plate work. These boxes will, as far as possible, be located where found suitable by the Employer / Architects.

1.18 INSPECTION BOXES

1.18.1 Inspection boxes of 16 SWG mild steel having adequate dimensions minimum size 75 mm x 75 mm and having smooth external and internal finish shall be provided to permit inspection and maintenance. The shall be mounted flush with wall / ceiling surface as required and shall screwed covers of 3 mm thick Perspex/ hylam sheet. Adequate ventilation holes shall be provided in the covers.

1.19 CROSS SECTION

1.19.1 The conduit shall be of ample sectional area to facilitate the drawing of cable. In no case shall be total cross section of measured overall be more than half the area of the conduit. The maximum number of wires can be accommodated in conduit of varying will limited as per detail given in this tender.

1.20 PROTECTION OF CONDUITS

1.20.1 To safeguard against filling up with plaster etc. all the outlet and switch boxes will be provided with temporary covers and plugs within the tendered cast which shall be replaced by sheet / plate covers as required. All screwed and socketed joint shall be made fully water tight by the use of white lead for steel conduit.

1.21 CLEANING OF CONDUIT RUNS

1.21.1 The entire conduit system including outlets and boxes shall be thoroughly cleaned after completion of erection and before drawing in of cables.

1.22 LAYING OF DUMMY CONDUIT

- 1.22.1 The dummy conduit shall be same as conduit for Electrical work as specified before. The minimum size shall be 20 mm dia. Junction boxes shall be provided at distance not exceeding 10 m. the consultation with the Owners / Architects. These conduits shall be provided steel draw boxes of least 14 SWG
- 1.22.2 All telephone conduits shall be at least 150 mm away from Electrical conduits

1.23 FISH WIRES

- 1.23.1 To facilitate drawing of wiring through conduit/ G.I / steel pipes etc., G.I. fish wire of 14 SWG, wherever needed, shall be provided along with recessed conduit / pipes, without any extra cost.

SECTION – 9

LIGHTING FIXTURES

All lighting fixtures shall be suitable for use on single Phase, 230 Volts, and 50 cycles AC supply system.

Fixtures shall be provided with heavy duty low loss open construction copper wound ballast, power factor improvement capacitor, lamp and starter holders and connector block. The control gear shall be rugged in construction and shall function without overheating over the entire length of its useful life. The starter shall be suitable for repeated switching operations without premature failure.

LED fixtures shall be complete with Drivers , Lamps , etc as required and shall comply to following:-

- a) LED shall be of high power with suitable optics/lenses (for increase in area of illumination).
- b) Lumen output is not less than 100 lumens per watt.
- c) Driver efficiency shall be more than 90%.
- d) Fitting shall be efficient heat dissipative designed for heat sink.

- e) Power factor shall be more than 0.90.
- f) The LED light fitting and its driver unit etc. shall have warranty for a period of 5 years from the date of installation and commissioning.
- g) Heat sink temperature raise above ambient is less than 15 °C.

All fixtures shall be duly wired with appropriate size of copper conductor, PVC insulated wire.

All wires, when passing near a heat source within the fixture, shall be provided with an additional protective sleeve.

Suitable earthing terminal shall be provided.

The Fixture body made of Aluminium/ CRCA MS shall be duly precision fabricated, duly finished, pretreated and powder coated / Stove enameled. The body shall be so designed to ensure sufficient heat dissipation and avoid overheating of control gear.

All hardware shall be MS zinc Passivated and shall resist rusting. Locking nuts/ washers shall be provided wherever required to prevent accidental loosening.

All aluminium reflectors wherever provided shall be electrochemically brightened and anodized.

The optical system shall be designed for optimum light distribution.

The fixtures shall be complete with all accessories and shall be ready for use.

SECTION – 10

TECHNICAL SPECIFICATIONS LT CABLES & CABLE TRAYS

1.1 SCOPE

This is to define the requirements for the Supply, Laying, testing and commissioning of the cabling system.

1.2 STANDARDS

The work shall be carried out in the best workman like manner in conformity with this specification, the relevant specification, codes of practice of Indian Standards Institution, approved drawings and instructions of project-in-charge or his authorized representative issued from time to time in case of any conflict between the standards, the instructions of Engineer-in-charge shall be binding.

1.3 GENERAL

The cables shall be visually inspected and the insulation resistance shall be checked before commencing the installation.

On the cables near the terminations, aluminum cable tags defining the connectivity details shall be tied / or the cable details shall be inscribed with white paint and direction of flow shall be marked on the cable.

The routing of cable trays shall be coordinated with other agencies. The cable tray sizes and routing shall be as per the approved shop drawings. Shop drawings shall be prepared and submit for approval as per site instruction and requirement to avoid ambiguity.

Cable trays shall be supported by suitable structural steel (ISA, ISMC, MS square) as per GFC drawings/ approved shop drawings.

Cable tags of suitable size and material as per sample approval shall be provided with cross reference details shall be provided.

The LT Cables laid on the cable tray shall clamp to the tray with suitable size of nylon cable ties.

Standard cable grips and reels, cable drum unwinding stand or jack shall be utilized for cable pulling. The maximum pulling tension shall not exceed the limits stipulated by the manufacturer.

Sharp bends & kinks shall be avoided in the installation. The bending radius shall not be less than 12 times the diameter of the cable.

Adequate extra lengths shall be provided near all the terminations.

Apart from the specification detailed for cable tags, Identification tags made of Aluminium Strips bearing cable number at either ends, at intervals of 30Mtrs shall be provided. Along straight runs and at every bends for cables laid in excavated trenches

Cable route markers shall be installed at every bend and at 30 Mts. intervals for cables laid in excavated trenches.

End terminations using Single Compression / Double compression / Flameproof Cable glands & heavy duty copper lugs as specified elsewhere shall be carried out.

Megger test and continuity test shall be conducted on the cable after carrying out the end terminations.

Hot dip galvanized/ Pregalvanised/ MS Powder coated MS Ladder type/ perforated trays as specified shall be used for all power cabling & perforated type for PLC signal / communication& LV cabling.

Cable tray sections shall be joined by fishplates.

The trays shall be supported at regular intervals of not more than 1.5m to 2m using engineered supports/ High-tech threaded rods as approved.

The supporting system shall be of approved design supplied by the tray manufacturer considering the full loading of the cable trays.

The earth continuity of the cable trays shall be ensured at each joint. Earth flat shall be run all along each of the trays and connected to earth grid.

Annular space around cable trays while crossing walls/ floors shall be filled up by fire resistant sealing material by contractor in accordance with the instructions. No extra claim shall be entertained, for the same

1.4 CABLE TRAYS, FITTINGS & ACCESSORIES

Applicable Standards:-

-IS-1255-1963(Revised to date) = C.O.P. for laying.

-IS-226-	-do-	Structural steel
-IS-2074-	-do-	Zinc-oxide-primer
-IS-2633-	-do-	Testing of zinc coating
-IS-2629-	-do-	Hot dip galvanizing iron

1.4.1 Hot Dip Galvanized Cable tray

Cable trays should have undergone rigorous rust proofing process before galvanizing, which should comprise of alkaline, degreasing and descaling in diluted sulfuric acid and a recognized phosphate process. All nuts, bolts, washers & hardware etc. shall be hot-dip galvanized. Galvanizing shall be uniform, smooth and free from any spots. The zinc deposit shall not be less than 610 Grams. Per Sq. meter of surface area and also the thickness of zinc along the surface shall not be less than 75 microns.

However, the amount of zinc deposit on the threaded portions of the bolts, nuts etc., shall not be less than 300 Grams (Per Sq. m. of surface area). The zinc deposit on the washers shall not be less than 340 Grams (per Sq. m. of surface area).

1.4.2 MS Powder coated

MS powder coated cable trays should have undergone rigorous rust proofing process, which should comprise of alkaline, degreasing and descaling in diluted sulfuric acid and a recognized phosphate process. The sheet work shall then be given two coats of oxide primer before final approved shade of powder coating. Cable trays shall be powder coated of colour as approved by Engineer-in-Charge and shall conform to IS - 2074 amended to date. Thickness of powder coating shall not be less than 70 microns.

Minimum size of main channel for ladder type trays and rung should be as under:-

-----Size of Tray	Size of Main Channel	Size of Rung
-----900 mm to 1500 mm	25 x 75 x 25 x 2.5 mm	20 X 50 X 20 X 2 @ 250 C/C
450 mm to 750 mm	25 x 75 x 25 x 2.0 mm	20 X 50 X 20 X 2 @ 250 C/C
150 mm to 300 mm	25 x 75 x 25 x 2.0 mm	15 X 30 X 15 X 2 @ 250 C/C

TABLE FOR ANGLES FOR CABLE TRAY SUPPORT AND HANGERS

-----Size of Cable Tray	Size of Angle	Spacing	Hangers
1200 to 1500 mm	50 x 50 x 5 mm	@ 1500 mm	10mm dia rod
900 to 1000 mm	40 x 40 x 5 mm	@ 1500 mm	10mm dia rod

750 to 600 mm	40 x 40 x 5 mm	@ 1800 mm	10mm dia rod
150 to 450 mm	40 x 40 x 3 mm	@ 1800 mm	10mm dia rod

In case of MS supports Contractor shall carry out 2 coat of primer and two coat of synthetic enamel paint (Spray paint or powder coating as specified& approved) of approved shade on all steel structures. Sizes of angles for cable tray supports and hangers shall be as per table given above or as specified in BOQ:

1.4.3 Cable Tray Mounting:

Unless otherwise specifically noted on the relevant layout drawing, all cable tray mounting works to be carried out as per following and to be approved by Engineer in charge (refer typical cable tray fixing details)

Hangers shall be of minimum 10 mm Dia Steel Round Bar or as specified in BOQ.

Maximum loading on a horizontal support arm to be 120 Kg per meter of cable tray run.

Width of the horizontal arms of the tray supporting structures to be same as the tray widths specified in tray layout drawings, plus length required, for welding/bolting to the vertical supports.

Spacing between horizontal support arms of vertical tray runs must be specified & as required.

1.5 LT POWER CABLES

LT Power cables shall be used for distribution of 415V power supply & control cables for controls and indications of the electrical system.

The insulation and sheath materials shall be resistant to oil, acid and alkali and shall be tough enough to withstand mechanical stresses during handling.

Armouring shall be single round/flat wire of galvanized steel for multicore cables & of non metallic material for all single core cables.

Core identification for multicore cable shall be provided by colour coding.

Drum Length & Tolerance

The cables shall be supplied in wooden drums. The length of the cable in the drum shall be based on site requirement in such a way that no straight through joints are required in any length of cable. Allowable tolerance on individual drum length is $\pm 2\%$.

Cable Identification

Cable identification shall be provided by embossing on the outer sheath the following:

- i) Manufacturer's name or trade mark
- ii) Voltage grade
- iii) Year of manufacture
- iv) Type of insulation
- v) Printing of cable length on each meter

Core Identification

Respective cores of Power/control cables shall be identified with the following pattern :

2 core	:	Red (R), Black (BK)
3 core	:	Red (R), Yellow (Y),Blue (BL)
4 core	:	Red (R),Yellow (Y),Blue (BL), Black (BK)
5 core	:	Red (R), Yellow (Y),Blue (BL), Black (BK) & Grey (GY)
7&14 cores	:	Cores shall be numbered.

The L.T power cables shall have Aluminum / copper conductor, XLPE insulation, inner sheathing, FRLS PVC outer sheathing and galvanized steel tape armoring. The cable shall be of the heavy duty type conforming to IS: 7098.

All L.T Cables shall be of 1100V grade.

The design shall permit continuous operation of the cable at a conductor temperature up to 70°C for PVC insulation / 90° C for XLPE insulation under normal conditions and 160° C / 250° C respectively during faults without causing any permanent damage.

1.5.1 FLEXIBLE CABLES

These shall be of 1100V grade, multistrand copper conductor, FR grade PVC insulated type conforming to IS: 694.

1.5.2 CONDUCTOR

The Aluminum conductor for the Cables shall be of Electrolytic grade, 99% purity.

The Copper Conductor for Control cables shall be of the Electrolytic grade and 99.9% purity.

The conductor shall be of circular/sector shaped type and insulation of phase and neutral shall be colour coded.

The Conductor shall be conforming to IS: 8130 – 1984.

1.5.3 TESTING

All routine tests shall be carried out on the cables as per relevant BIS standards and type and routine test certificates shall be furnished in six copies.

1.5.4 PACKING

All cables shall be supplied duly packed on non-returnable wooden/ steel drums.

The manufacturers name or brand name with logo and the ISI mark shall be embossed at regular intervals on all sizes of cables.

The length shall be marked at 1M interval

The following information shall be provided on the flange of each cable drum:-

Type & Size of cable

Length

ISI Mark

Gross weight

Direction of rolling & Year of manufacture

Both ends of the cables wound on the drums shall be sealed to prevent ingress of water.

1.5.5 INSTALLATION

1.5.5.1 General

The cable installation including necessary joints shall be carried out in accordance with the specifications given herein. For details not covered in these specifications, I.S. 1255 - 1967 shall be followed.

It should be ensured that both ends of the cable are properly sealed to prevent ingress / absorption of moisture with epoxy material of approved make.

1.5.5.2 Route

Before the cable laying work is undertaken, the route of the cable shall be decided by the Engineer-in-Charge.

While shortest practicable route should be followed without crossing if unavoidable then cables cross one another the cable of higher voltage shall be laid at a lower level than the

cable of lower voltage., cable runs shall generally follow fixed developments such as roads, foot-paths etc. with proper offsets so that future maintenance, identification etc. are rendered easy

While selecting cable routes, corrosive soils, ground surrounding sewage effluent etc. shall be avoided. Where this is not feasible, special precautions as decided by the Engineer-in-Charge, particularly for HV cable installations, shall be taken.

As far as possible, the alignment of the cable route shall be decided taking into consideration the present and future requirements of other agencies and utility services affected by it, the existence of any cable in the vicinity as may be indicated by cable markers or cable schedules or drawing maintained for that area, possibilities of widening of roads/lanes, storm water drains etc. Cable routes shall be planned away from the drains and near the property (especially in the case of MV/LV cables).

Whenever cables are laid along well demarcated or established roads, the LV/MV cables shall be laid farther from the kerb line.

Cables of different voltages and also power and control cables should be kept in different trenches with adequate separation. Where available space restricted, LV/MV cables shall be laid above HV cables.

1.5.5.3 Laying in cable Trays:

Where cables are laid on the trays, they shall be secured by nylon ties. The use of wire or similar material will not be permitted. Ties shall be spaced at not greater than 600 mm. along with cable and within 100 mm. of each bend or set.

Cables in vertical trays/supports, and at exposed areas to be clamped by saddle type clamps to be fabricated from 3 mm. Aluminium strip at site by the electrical contractor to suit cable groups.

1.5.5.4 Laying in Pipes/Closed ducts:

In locations such as road crossing, entry to building, on poles, in paved areas etc. cables shall be laid in pipes or closed ducts.

Stone ware pipes, G.I, PVC or spun RCC pipe shall be used for such purposes. The size of pipe shall not be less than 10 cm in diameter for a single cable and not less than 15 cm. for more than one cable or as specified in drawings/ directed by Engineer-In charge. The pipe shall be laid directly in ground without any special bed, however protective covering shall be provided over joints and for full length of PVC pipes of adequate thickness.

The pipes on road crossing shall be preferably be on the skew to reduce the angle of bends as the cable enters and leaves the crossings. This is particularly important for high voltage cables.

Manhole shall be provided to facilitate feeding / drawing in of cables and to provide working space for persons. Manholes shall be constructed of required size and depth as mentioned with respective BOQ Items and as shown on drawings. The manholes walls shall be in brick masonry, 230 mm thick for green areas and 345 mm thick for other areas like roads, driveways, walkways etc.

Pipes shall be continuous and clear of debris or concrete before cable is drawn. Sharp edges at ends shall be smoothened to prevent injury to cable insulation or sheathing.

Pipes for cable entries to the building shall slope downwards from the building and suitably sealed to prevent entry of water inside the building. Further the mouth of the pipes at the building end shall be suitably sealed to avoid entry of water.

All chases and passages necessary for allying of service cable connections to buildings shall be cut as required and made good to the original finish and to the satisfaction of the Engineer-in-Charge.

Cable grips/draw wires and winches etc. may be employed for drawing cables through pipes/closed ducts etc.

1.5.5.5 Cable Identification Tags

Wherever more than one cable is laid/run side by side, marker tags as approved, inscribed with cable identification details shall be permanently attached to all the cables in the manholes/pull pits/joints pits/entry pits in buildings/open ducts/ cable trays etc. Cable tags shall be made out of 2mm thick anodized aluminium sheets each tag 2 inch in dia made or 2" x 3" rectangular with one hole of 2.5 mm dia, 6mm below the periphery, or as approved by Engineer in-charge. Cable designations are to be punched with letters/number punches and the tags to be punched with letters/number punches and the tags are to be tied to cables with piano wires of approved quality & size. Tags shall be tied inside the panels beyond glanding as well as above the glands at cable entries. Along trays tags are to be tied at all bends and ends.

1.6 TESTING

All cables before laying shall be tested with a 500 V megger for 1.1 KV grade or with a 2,500/5,000 V megger for cables of higher voltages. The cable cores shall be tested for continuity, absence of cross phasing, insulation resistance to earth/sheath/armour and insulation resistance between conductors.

All cables shall be subject to above-mentioned tests during laying, before covering the cables by protective covers and back filling and also before the jointing operations.

After laying and jointing, the cable shall be subjected to a 15 minutes pressure test.

In the absence of facilities for pressure testing, it is sufficient to test for one minute with 1,000 V megger for cables of 1.1 KV grade and with 2,500/5,000 V megger for cables of higher voltages.

1.7 LT CABLE TERMINATION & ACCESSORIES:

Cable glands shall be of the heavy-duty Double/single compression as specified in BOQ, made of extruded brass and cadmium plated shall be used.

All cable glands shall be earthed using earth tags of suitable sizes.

The cable glands used in day tank room & fire pump room shall be of double compression flameproof type certified by CMRS.

The cable lugs shall be of heavy duty tinned copper / Aluminum and crimping type.

Crimping paste shall be used while crimping aluminum cable with lug.

Smaller size cables shall be crimped using hand crimping tool and cables including and above 70Sq.mm shall be crimped using hydraulic crimping tool.

Completion plan and completion certificate

The work shall be carried out in accordance with the drawings and also in accordance with the modification thereto from time to time approved by the Engineer-in-Charge.

Completion certificate, after completion of work, shall be submitted to the Engineer-in-Charge. Completion plan drawn to a suitable scale indicating the following along with three hard print copies& soft copy of the same shall be submitted.

- Layout of cable work
- Length, size, type and grade of cables.
- Method of laying i.e. direct in ground, in pipes/ ducts/ Cable trays etc.
- Location of each joint with jointing method followed.
- Route marker and joint maker with respect to permanent land marks available at site.

SECTION – 11

TECHNICAL SPECIFICATIONS_RISING MAINS AND METER BOARDS

1.1 GENERAL :

This section covers technical specifications of Sandwich Type Rising mains of Aluminium & associated equipments as per Bill of Quantities suitable for indoor installations.

Rising mains shall be used for distribution of power from apartments.

Rated operation voltage of the busbar trunking is 1000V. 3 – Phase, 4 Wire with internal earth busbar. The neutral conductor should have the same cross-sectional area as the phase conductor. The earth busbar must be one continuous piece without bolting on housing

The ampere ratings, approximate footage, fitting, plug-in units etc. are shown on the plan. The contractor shall be responsible for routing the busbar trunking to coordinate with the other trades. Final field measurements shall be made by the contractor prior to release to the busbar trunking for fabrication by the manufacturer.

Shop drawings shall be submitted for approval showing GA, busbar arrangements, isometric diagrams, and manufactured angle bends inline of site requirement etc.

The busbar trunking system both feeder and plug-in, shall be sandwich construction. All busbar trunking products and fittings (straight length, elbow, tees, flanged ends, cable tap box and circuit breaker, etc.) shall be in accordance with IEC 60439:2005 or CE/ UL and from the same manufacturer as the busbar trunking system. The degree of protection of the busbar trunking system should be IP54 in accordance to IEC 60529.

Annular space around rising mains or Bus Ducts while crossing walls/ floors shall be filled up by fire resistant sealing material by contractor in accordance with the manufacturer's instruction. No extra claim shall be entertained, for the same

Grounding bus shall be provided on either side throughout the length of bus-duct/ rising main.

The continuous current ratings of all bus ducts shall be as per SLD unless otherwise specified.

The ratings given in the SLD shall be for continuous duty at maximum ambient specified.

Short circuit ratings shall be as specified in Bill of Quantities.

Sandwich construction will be adopted for low impedance and compact size.

The bus-ducts shall be designed to operate on 415V, 3 phase and 4wire, 50Hz Supply with three phase & one neutral bus inside and earth bus on both sides of the bus-duct.

The insulation of the bus bars shall be of class 'F' grade or better.

The maximum temperature of bus bars while carrying rated current continuously shall not exceed 90° C.

The joint between the two lengths shall be with single insulated bolt joint pack with allowable tolerance as per IS / IEC.

The joint design shall have sufficient flexibility to handle minor misalignment and expansion.

The Bus Bar Systems offered shall be complete with all necessary accessories like elbows, off sets, reducers etc.

High tensile Zinc-passivated type fasteners & hardware required for assembling the units shall be supplied along with the unit and these shall be in metric units.

The design shall have to be type tested at CPRI or any premier testing laboratory and type test certificates shall be furnished.

1.2 STANDARDS

Updated and current Indian Standard Specifications and Codes of Practice will apply to the equipment and the work covered by the scope of this contract. In addition the relevant clauses of the following standards as amended upto date shall also apply. Wherever appropriate Indian Standards are not available, relevant British and/or IEC Standards shall be applicable.

In addition the relevant clauses of the Indian Electricity Act 2003, Indian Electricity Rules 1956, National Building Code 1994, National Electric Code 1985, Code of Practice for Fire Safety of Building (general) :General Principal and Fire Grading – IS 1641 as amended upto date shall also apply. Wherever appropriate Indian Standards are not available, relevant British and/or IEC Standards shall be applicable.

-Low voltage switchgear and controller assemblies: Part-1
Requirement for type tested and partially type tested assemblies

IS 8623 (Part-1) 1993

-Low voltage switchgear and controller assemblies: Part-2
Particular requirement for busbar trunking system (bus ways)

IS 8623 (Part-2) 1993

-Low voltage switchgear and controller assemblies: Part-3
Particular requirement for equipment where unskilled persons have access for their use

IS 8623 (Part-3) 1993

-Bus trunking systems
IEC 139 Parts 1 & 2

IEC 60439/2

1.3 SYSTEM PARAMETERS

Bus Ducts shall be suitable for following system parameters.

Type	:	Compact Sandwich type bus duct with insulated bus conductors
Supply system	:	3 phase 4 wire AC 1000 Volts 50 Hz
Rated insulation voltage	:	1000 Volts
Number of conductors	:	3 Phase 4/5 conductor
Power frequency withstand	:	2500 Volts
Current rating	:	As per Schedule of quantities
Working Voltage	:	415/ 433 Volts
Temperature rise	:	55 deg. C above ambient for Copper and 45 deg. C above ambient for aluminium. Design data in support of temperature rise being within permissible limits shall be furnished along with the tender.
Short circuit ratings	:	Minimum short circuit ratings (1 sec) shall be furnished along with the tender.

1.4 ENCLOSURE

The Bus Ducts shall be totally enclosed non ventilated type dust proof fabricated out of 14 SWG, pre-galvanized CRCA sheet steel or Extruded Aluminum.

The bus duct enclosure if made of CRCA sheet steel shall undergo thorough surface treatment involving degreasing, pickling, phosphating before powder coating. The colour shall be RAL 7032. The Aluminum enclosure if offered shall be anodized.

The enclosure shall be powder spray painted applied electro-statically and baked with epoxy polyester paint of RAL 7032 or approved colour shade for CRCA & GI construction, however in case of aluminium enclosure shall be anodized.

The degree of protection shall not be less than IP54 indoor application.

Enclosures shall be provided with M6 screws applied at every 10 cm along the entire length. Enclosure shall be rendered dust and vermin proof by adequate gasketing etc. to provide ingress protection of not less than that specified in the Bill of Quantities as per IS 2147. Neoprene rubber gaskets shall be provided between the covers and channels to ensure ingress protection as required.

The Bus Trunking System shall be manufactured in convenient sections to facilitate easy transportation and installation. The sections shall be connectable to form vertical and/or horizontal runs as required.

Each section shall be provided with suitable support arrangement from walls / ceilings as required.

Colour coded stickers indicating RYBN – phase sequence shall be available on the housing for phase sequence identification at each joint location.

1.5 BUSBARS

Busbars shall be fabricated from 99.9% EC grade tin plated aluminium or 99.9% pure silver flashed electrolytic copper as specified in bill of quantities. The tin plating/flashed copper shall be throughout length of bus bar. Rating of busbar shall be as specified in Bill of Quantities

Vendor to submit bus bar size calculation along with the drawing for approval considering all the derating factors, temperature rise, short circuit forces etc. before taking up the job for fabrication.

Busbar conductors insulated with fire resistant 2 layers of extruded polypropylene sleeves and 3 layers of F class Mylar between conductors or cast resin busbars shall be used to achieve die-electric strength & fire rating requirement. Electric connection shall be made at joints by single bolt joint construction and each joint shall have 2 “Belleville” washers. The joints shall be manufactured of glass reinforced polyester. Joints shall be realized by a torque spanner (wrench) set at 80 Nm. To prevent the joints to be damaged during transport, they shall be protected by plastic caps, which shall be removed before installation. To prevent the joints bolt from loosening there shall be locker pieces on both sides of the bolt. Conductors shall be fabricated from aluminium grade 19501. Rating of the busbars shall be as per Schedule of Quantities. Current density shall not be more than 1 amp per sq. mm each busbar shall be jointed to the adjacent section by single bolt-joint clamps without drilling the busbar. Joint between two sections shall be such that a complete sub assembly is removable so that isolation of individual sections is possible without disturbing other sections. Inspection windows shall be provided over the joints to check tightness.

Inspection windows shall be provided over the joints to check tightness.

Current density shall be as per IEC 60439 and limited by final temperatures stipulated in this document.

Expansion joints shall be provided as per manufacturer's design and recommendation/ as suggested by Consultant. These shall be made of braided or multi leafed copper for copper busbars and tin/ silver plated copper for aluminium busbars.

Each joint shall also have a colour coded thermal indicator for indicating the rise in temperature over and above ambient by changing colour at 60/70/80 degree centigrade to BLACK/GREEN/RED of that particular length, enabling clear visual inspection, without the use of any tools.

Aluminium Die Cast Housing End shall be provided for facilitating mounting of joint cover; furthermore there shall be an arrow mark indicating neutral direction - which will ensure correct phase sequence.

1.6 BUSBAR SUPPORTS

Busbar supports/ insulators shall be made of thermal resistant epoxy resin as insulation material; and shall be suitable to withstand the dynamic stresses due to short circuit levels as specified.

The bus bar shall be supported on fire retardant, non-hygroscopic supports.

1.7 THRUST PADS / SPRING HANGERS

Thrust Pads or spring Hangers shall be provided in the Vertical bus trunking system for necessary support to the Riser busbars and to prevent busbar expansion in down ward direction.

1.8 VOLTAGE DROP

The Voltage drop (input voltage minus output voltage) specified shall be based on the busbar trunking operating at full rated current and at stabilized operating temperature.

The three – phase, line-to-line voltage drop shall not exceed 3.1 volts per hundred feet at 40% power factor concentrated load which may exist during motor starting.

The line-to-line Voltage drop shall not exceed 4.0 volts per hundred feet at the load power factor which produces maximum voltage drop in the busbar trunking

1.9 FLEXIBLES

A set of tinned copper flexible shall be supplied for connection between transformer and bus-duct, DG and Bus-duct. These shall be of copper foil with tinned & brazed at the ends. Straight horizontal/ vertical bus ducts/ rising mains shall also be provided with tinned copper flexible connections as per manufacturer's standards at suitable intervals & where ever change in bus bar cross sections.

1.10 ACCESSORIES

The following accessories shall be supplied along with the Rising mains to suit the site requirement.

Right angle bends – Horizontal & Vertical to suit site conditions.

End covers if required.

Wall / Ceiling fixing brackets.

Phase cross-over units.

Tees, reducers, vertical anchors

Expansion joints, flexible connections

Adaptor boxes at either end complete with flexible copper terminals

Flanged end connections

Bus trunking systems shall be complete in all respects as required whether any item is not included above but required to complete the work shall be deemed to be included in the straight length of the rising mains.

1.11 EARTHING

A continuous Aluminium earth bus of following sizes riveted or bolted along the bus duct enclosure shall be provided.

- Upto 1000Amps. - 2Nos. 32x6mm
- 1000-2500 Amps. – 2Nos.50x6mm

1.12 TESTING AT MANUFACTURERS WORKS

The Rising Mains and Bus Ducts shall be type tested from CPRI or equivalent international testing agency i.e. (ASTA, KEMA, UL) tested for a fault level KA as specified in the BOQ for 1 sec. (Test certificates shall be submitted for approval). All relevant test including temperature rise test as per IS codes/ IEC shall be carried out in the presence of Clients representative at manufacturers works.

1.13 INSTALLATION

Installation of the Rising Main shall be carried out as per manufacturer's instruction.

The individual Standard / Non Standard lengths shall be assembled using the joint packs.

For Bus Duct horizontal runs, horizontal expansion units shall be provided at every 40 m and at expansion joints of the building structure and the system shall be supported at every

1.5 m. For vertical Rising Main runs, an expansion unit shall be provided at every floor and the system shall be fixed by suitable supports at every floor.

Hanger spacing shall be noted on layout drawings and shall not exceed manufacturer's recommendations.

Indoor feeder and plug-in busbar trunking shall be approved for hanger spacing of up to 3 meters for vertically mounted runs.

1.14 INCOMER (END FEED UNIT) / ADOPTER BOX

Being a highest rating, the incoming supply to the rising mains shall be controlled by suitable rated moulded case circuit breakers as mentioned in schedule of quantities having fault level not less than 35/ 50 KA in cubical panel as specified in BOQ. This includes incoming and outgoing links of rated capacity and connecting the same with rising mains. Rising mains shall be measured and paid beyond Adopter box.

1.15 PLUG – IN OPENINGS

Bus trunking shall have tap off positions as shown in drawings. Minimum 2 tap off positions per floor per riser.

The connecting jaw of the plug-in unit shall plug directly onto the busbar and have full contact with busbar itself. Welded tab at plug-in busbar is not allowed.

All contact on joint and plug-in opening should be silver plated copper.

On plug-in busbar trunking there shall be three dead front, hinged cover type plug-in openings on each side.

All openings shall be usable simultaneously.

Busbar trunking shall be installed so that plugs are side mounted to permit practical use of all plug-in openings.

It shall be possible to inspect the plug-in opening and busbars prior to the installation of the plug-in units.

1.16 PLUG – IN TAP-OFF BOXES

Plug – in tap-off boxes shall be provided for distribution of power for each floor as per BOQ. MCCB of rating as shown in BOQ/drawing shall be incorporated in tap off boxes, suitable to tap TPN supply. Detachable end plates shall be provided which can be drilled to suit conduit/compression glands.

Tap off boxes upto 630A shall be plug-in type. Above this rating they must be bolt on type.

Tap off boxes required to be fitted to the rising mains shall comprise of.

Tap off arrangement with bolted type rigid connection

MCCBs as specified in BOQ

Plug in points shall have a hinged sheet metal cover that provides protection. Rating of plug in tap off boxes shall be as per bill of quantities. Plug in tap off boxes shall have an electrical interlock mechanism which also ensures that plug in tap off box cannot be removed mechanically from the bus bar when the box is at ON position. Tap off boxes shall be suitable for any brand of MCCB. Contacts of plug in tap off box shall be silver plated. Tap off boxes shall be manufactured of sheet steel and shall be epoxy painted ANSI 49 Grey. Tap off boxes shall be plug in type with earth contact to make first and break last. Tap off boxes shall have spring loaded contacts for uniform contact pressure on busbars. Tap off boxes shall be provided with door interlocking and interlocking with bus trunking to ensure plug in and plug out possible on in OFF condition. Tap off outlets shall have safety shutters to prevent access to live busbars when not in use. Degree of protection in the open conditions of with shrouding shall be IP 2X offer personal safety protection

1.17 METER BOARDS

Compartment for mounting three-phase KWHr meter and MCCB/ MCB. The wiring (upto the MCCB and KWH meter) in meter compartment shall be done by using 10/16 mm² (as the case may be) FRLS PVC insulated copper wire and shall be terminated in a terminal box. Separate earth link to be provided in all compartments.

1.17.1 Compartment housing for MCCB/ MCB's for outgoing.

The meter boards shall be compartmentalized totally factory fabricated and assembled with all associated accessories including wiring etc.

Unit Nos. shall be marked on each KWH meter and outgoing MCCB compartments.

Suitable arrangement shall be made for fixing of KWH meter as approved by the Engineer.

Separate earth links / studs (2 Nos.) to be provided in all outgoing compartments.

Danger plates.

Base channels/ Wall Straps / mounting brackets as approved.

1.17.2 Moulded Case Circuit Breaker

The breakers shall comply with the requirements of IS: 13947 - 1993 (5 parts) – shorts circuit performance category P-2.

Moulded case circuit breakers shall be made of insulating case and cover made of high strength, heat resistant and flame-retardant thermosetting insulating material. MCCB shall be 3 or 4 poles as specified in schedule of quantities.

The switching mechanism shall be quick make / quick – break type utilizing a trip free toggle mechanism. The handle position shall give positive indication of whether the breaker is ON (top), OFF (down) or tripped (midway). MCCB's upto 250 A shall be provided with thermo-magnetic release for over load and short circuit protection. MCCB's above 250 A shall be provided with static releases or as specified in BOQ. All releases shall operate on a common trip bar so that all phase are disconnected in the event when fault occurs even on only one of them. MCCB's shall be U/V trip, shunt trip, aux. contacts, if called for in the schedule of quantities. The ICS shall be equal to 100% ICU for all MCCB's.

The contacts shall be made of silver alloy. Arc-chutes shall be housed in a vulcanized fiber casing. The arc-chutes shall be capable of quenching the arc rapidly and driving away the arc from contact tips.

The terminals shall have sufficiently large dimensions to accept links or cable lugs of suitable sizes.

1.8 TESTING AT SITE

Physical check including checking damage/crack in any components, tightness of bolts and connections etc.

Insulation test after installation according to manufacturer's test procedures.

Testing earth continuity.

1.9 COMMISSIONING

Before connecting mains supply after installation, pre-commissioning checks comprising megger test, checking the tightness of the connections body earth connection etc. shall be carried out and record.

SECTION – 12

TECHNICAL SPECIFICATIONS 415 V LT PANELS

1.1 DESIGN CRITERIA

Operating height of boards shall be limited within 350 mm to 1900mm from floor level.

The type and rating of the Panels covered herein shall be as follows:

System voltage	:	415V
System Frequency	:	50 Hz
No. of phases	:	3 (4 wires)

Fault withstand capacity	:	As specified in drawings.
Busbar rating	:	As specified in drawings.
High voltage Test	:	2.5KV for 1 minute.
Degree of Enclosure	:	IP52 (as per IS 2147)

All switchgear and its components provided in the panel shall have same fault withstand capacity as indicated for bus bar in single line diagram.

1.2 CONSTRUCTION FEATURES

Panels shall be indoor, metal clad, modular construction, fix type (except circuit breaker cubicles) air insulated and floor mounted type.

Unless otherwise mentioned, panels shall be of single front construction and shall be of dead front type.

All panels shall be extensible on both sides.

All panels shall be dust proof and vermin proof.

The panels shall have horizontal Busbar Chamber at top of the panel even for top cable entry.

All panels shall have provision for cable entry from top or from bottom or both as required. The same shall be confirmed to the Vendor during detailed engineering / approval of shop drawing of panel manufacturer.

All panels including capacitor panels shall be fully compartmentalized with metal / insulating partitions between individual compartments.

The Horizontal busbar chamber shall be separate & totally enclosed.

Minimum thickness of CRCA MS sheet member shall be 1.6 mm for non load bearing members and 2.0 mm for load bearing members.

All panels shall comprise a continuous line up of dead front, free standing vertical sections. The installation of circuit breakers shall be limited to the bottom two tiers only. In two tiers formation two nos. of upto 1000 Amp. breakers can be provided.

All doors and cutouts shall be provided with neoprene gaskets.

The back doors of the panels shall be double door leaf type where the panels have more than 400 mm width.

All doors shall be supported by strong concealed type hinges.

All relays, meters, and switches etc. shall be flush mounted type.

All incoming terminals shall be provided with shrouds. Supports / shrouds shall be transparent and shall be made of SMC/DMC material. However Bakelite/ Hylam material is not acceptable and shall not be used anywhere in panels.

The complete structure shall be rigid, self supporting free from vibration, twists and bends etc.

The panels housing circuit breaker feeders shall be in single front drawout execution. The incoming & bus coupler circuit breaker feeders shall be in single tier formation while the outgoing circuit breaker feeders may be in double tier formation, unless otherwise specified.

A suitable barrier shall be provided between the circuit breaker and the associated control.

The number of modules shall be so decided that the cable alley are not over crowded. However the number of module in any panel shall not exceed six. The minimum size of module shall be 300mm and 225mm for starter and switch fuse /MCCBs feeders respectively. The minimum clear width of cable alley shall be 300mm.

In cable alley, outgoing terminals shall be identified with feeder number.

1.3 BUS AND BUS TAPS

The main buses and connection shall be of high grade of aluminium bus bars conductivity aluminium / aluminium alloy (Grade EC-91 E), sized for specified current ratings with max. temp. limited to 85 deg.C (35 deg. above 50 deg. ambient temp.).

Vertical bus bars shall be designed depending upon the actual feeder requirement. Bimetallic connector shall be provided for connection between dissimilar metals.

Busbars and connections shall be fully insulated for working voltage with adequate phase / ground clearances. Insulating sleeves for Bus bars and shrouds for joint shall be provided. Minimum clearance of 25 mm is required between phases and between phase & earth.

Shrouds for busbars joints/ tapping points shall be of fiber glass only. Bus insulators shall be flame retardant, track resistant type with high creepage surface and of non-hygroscopic material such as epoxy/ SMC/ DMC.

Busbars shall be supported and braced to withstand the stresses due to max. short circuit current and also to take care of any thermal expansion.

The busbar size shall be of similar size as of busduct.

1.4 **MOULDED CASE CIRCUIT BREAKERS**

MCCBs / MPCBs shall be of 3 pole/ 4 pole, quick make & quick break type & suitable for the fault levels as specified in the enclosed single line diagram. The fault level indicated in the dwgs is Ics value (service rating) and not Icu.

All motor feeder MCCBs shall be suitable for motor duty and all MCCBs shall be provided with minimum 1 NO + 1 NC auxiliary contacts.

MCCBs shall have current limiting device and shall have line load reversibility feature.

MCCBs shall conform to IS-13947.

MCCBs shall be provided with operating handle/ front drive kit.

MCCBs shall be provided with phase barrier.

Shrouds to be provided for incoming link.

MPCBs shall have “Mag only” release and suitable for motor duty.

1.5 **MCBs/ ISOLATORS**

MCBs/ Isolators shall be suitable for 415V/220/240V, 3 – phase and neutral or 220/240V single phase and neutral system.

MCBs/ Isolators shall be heat resistant plastic moulded type.

MCBs shall have quick make and break, non-welding silver alloy contacts, both on the manual and automatic operation.

Each current carrying pole of the breaker shall be provided with inverse time overload and instantaneous short circuit tripping elements with trip free mechanism.

In case of multipole CBs, the tripping must be on all the pole and operating handle shall be common.

MCBs / Isolators shall be suitable operating in an ambient temperature of 50 deg. C without derating.

The short-circuit breaking capacity of MCBs shall not be less than as specified.

All motor feeder MCBs shall be suitable for motor duty.

All terminals shall be suitably shrouded.

Wherever MCB Isolators are specified, they are without the tripping elements.

1.6 CONTACTORS

Contactors shall be of double break, single throw and electromagnetic and non-gravity type.

Contactors shall be suitable for interrupted duty and shall be rated for class AC-3 duty.

Main contacts of contactors shall be silver faced.

Operating coils of contactors shall be suitable for operation on 220/240V AC, 1 phase, 50 Hz supply.

Contactors shall be provided with at least two pairs of 'NO' and 'NC' auxiliary contacts.

Contactors shall not drop out at voltages down to 70% of coil rated voltages and min. pick up voltage shall be 85%.

1.7 CURRENT TRANSFORMERS

Current Transformers shall be cast – resin type .All secondary connections shall be brought out to terminal blocks where wye or delta connection will be made.

Accuracy class of the current transformers shall be : -

- i) Class 5P20 for protection.
- ii) Class 1.0 for metering.
- iii) Class PS for differential Protection & REF.

Current transformer shall be provided with test links and shorting on both secondary leads for testing purpose.

All current transformers shall be earthed by a separate earth link on terminal blocks.

Additional name plate of CTs/ PTs shall be provided (if required) at such a place that it shall be possible to find out details of CTs/ PTs after mounting in the panel.

1.8 CONTROL AND SELECTOR SWITCHES

Control and selector switches shall be of rotary type having enclosed contacts, which are accessible by the removal of cover.

Control and selector switches shall be of flush mounted type and on front of panels.

Selector switches shall be of stay-put maintained contact type.

Control switches shall be provided with escutcheon plate clearly marked to show the position.

1.9 INDICATING METERS AND INSTRUMENTS

Indicating instrument (96 x 96 mm) shall be digital meter, switch board type and accuracy class of \pm (1% full scale + 1 count).

1.10 INDICATING LAMPS

Indicating lamps shall be of LED type, low watt consumption and provided with appropriate value of resistors. The LEDs shall also have an in-built surge suppressor

Bulbs and lenses shall be interchangeable and easily replaceable from the front of the panel.

1.11 PUSH BUTTONS

All push buttons shall be of the push to actuate the contact type.

All push buttons shall be oil tight and shall be provided with adequate no. of contacts.

1.12 POWER AND CONTROL CABLE TERMINATION

Suitable supporting arrangement shall be provided for all power and control cables entering the panel.

Removable undrilled gland plate of 3 mm thick of MS for multicore cables and 4mm thick of Aluminium for single core cables sufficient in size to accommodate all compression type, heavy duty brass glands shall be provided.

Adequate termination arrangement shall be provided for all power cables which shall be aluminium / copper conductor, PVC insulated, sheathed, armoured PVC sleeved overall, heavy duty cables, 1.1 KV grade. Power cables termination shall be by means of crimping type lugs on conductor cables.

The terminal blocks shall be bolted lug type for cables. These shall be protected type and rated for 1100 Volts service. The minimum current rating of terminal block shall be 16 Amp. The construction shall be such that after the connection of cable by means of lugs, necessary clearance and creepage distance are available.

Wherever there is more than one equipment connected on the same feeder, separate terminals shall be provided.

1.13 INTERNAL WIRING

All internal wiring shall be carried out with stranded copper conductors, PVC insulated, 1100/650 V grade.

Min. size of conductor for power wiring shall be 2.5 sq.mm, 1.5 sq.mm for AC control wiring and 4.0 sq.mm. for DC control wiring. Current transformer secondary wiring shall be with 2.5 sq.mm conductor.

All wiring shall be run on the sides of the panels and shall be neatly bunched and shall not affect access to equipment mounted in the panels.

Wiring shall be terminated on terminal blocks using crimping type lugs and without joints or tees on their runs.

Power wiring shall be done either by phase identifying coloured wires or suitably coloured PVC sleeves shall be provided at each end of wire. The following wiring codes shall be used.

Instrument Transformer	:	Red, yellow or blue depending upon phase with which wire is associated.
A-C phase wire	:	White
A-C Neutral wire	:	Black
Earth connection	:	Green

PVC identification ferrules, yellow colour with black engraved letter shall be provided at each end of all control wires marked to correspond with equipment designation & termination numbers.

Ferrules provided shall be oil tight and numbered from left to right.

1.14 TERMINAL BLOCKS

Terminal blocks for control wiring shall be 650V grade 10 sq.mm size.

Terminal blocks shall be grouped depending on circuit voltage. Different voltage groups of terminals blocks shall be segregated.

Terminals blocks shall be numbered for identification and provision shall be provided for terminal labels.

Terminal blocks requiring duplication shall be provided with solid bonding links.

Terminal blocks for current transformer secondary lead wires shall be provided with shorting, disconnecting / earthing facilities.

Terminal blocks and control wiring shall be so arranged that only one conductor of external wiring required to be terminated in at each terminal.

1.15 GROUND BUS

A ground bus, rated to carry maximum fault current, shall extend to full length of the panel.

The ground bus shall be provided with two-bolt drilling with G.I. bolts and nuts at each end

Each stationary unit shall be connected directly to the ground bus. The frame of each circuit breaker and shall be grounded through heavy multiple contacts at all times.

Wherever the schematic diagrams indicate a definite ground at the switchgear, a single wire for each circuit thus grounded shall be run independent to the ground bus and connected thereto.

C.T. shall be earthed through removable links so that earth of one circuit may be removed without disturbing other.

Frames and non current carrying metal parts of all equipment mounted shall be effectively to earth bus.

All hinged doors shall be connected to earth bus by flexible tinned bare copper wire.

Instrument and relay cabinets shall be connected to earth by 2.5 sq.mm stranded copper insulated wire 1100 V grade.

1.16 SPACE HEATERS :

Each cubicle shall be provided with thermostat controlled space heaters.

1.17 AC/DC POWER SUPPLY

The panels shall be suitable to receive following power supplies.

AC Supply : Single Feeder

DC Supply : Double Feeder

Isolating switch fuse units shall be provided at each switchgear for the incoming supplies, 4-pole, single throw for AC.

Bus-wires of adequate capacity shall be provided to distribute the incoming supplies to different cubicles. Isolating switch-fuse units shall be provided at each cubicle for AC supplies.

AC load shall be so distributed as to present a balance loading on three phase supply system.

1.18 NAME PLATES

Nameplates of anodized aluminium shall be furnished at cubicle and at each instrument, device mounted on and inside the cubicle.

Caution notice on suitable metal plate shall be affixed at the back of each vertical panel.

Name plates for feeders shall be provided on front and back of the panel.

1.19 TROPICAL PROTECTION

All equipment, accessories and wiring shall have fungus protection, involving special treatment of insulation and metal against fungus, insects and corrosion.

Screens of corrosion resistant material shall be furnished on all ventilating louvers to prevent the entrance of insects.

1.20 PAINTING

All surfaces shall be sand blasted, pickled and grounded as required to produce a smooth, clean surface free of scale, grease and rust.

After clearing, the surfaces shall be given a phosphate coating followed by 2 coats of high quality primer and stoved after each coat.

The panels shall be finished with two coats of Siemens Grey (Shade RAL7032) powder coated.

1.21 TESTS & INSPECTION

The following routine and acceptance tests shall be carried out during final acceptance list.

- i) Mechanical operation test.
- ii) Electrical operation test.
- iii) High voltage test on power circuits.
- iv) High voltage test on control circuits.
- v) Millivolt test on the circuit breakers.
- vi) Millivolt Drop test on Busbar joints

All tests shall be performed in the presence of Owner's representative, if so desired by the owner. The contractor shall give at least 15 days advance notice of the date when test are to be carried out.

Contractor shall furnish test certificate indicating that equipment has been tested by their quality control department for compliance of technical specification and approved drawings. The same shall be forwarded to owner/ consultants along with inspection call.

These inspection shall however, not absolve the vendor from the responsibility for making good any defect with may be noticed subsequently.

SECTION-13

ADDRESSABLE FIRE ALARM AND DETECTION SYSTEM

1.0 GENERAL

The following Standards and Codes shall be applicable to the Fire detection System and components thereof.

The tenderer shall furnish test certificates and approvals issued by EN, VDs or UL for the respective equipment. The compliant certificates as mentioned by the Manufacturer shall also be furnished along with the tender.

Kindly note that irrespective of the revision/year indicated the latest issue of the Standards and Codes shall be applicable.

NFPA 72 Chapter 3 2010	Guidelines for Fire Alarm Systems
NFPA 72 Chapter 5 2010	Guidelines for Heat and Smoke Detectors
NFPA 72 Chapter 6 2010	Guidelines for Notification Appliances
NFPA 72 Chapter 7 2010	Inspection Testing of Fire Alarm Systems
NFPA 90A	Installation of air conditioning and ventilation systems
NFPA 101	Code for Safety to Life from Fire in buildings

UL 864 Rev 9	Fire Alarm Panel and all Sub-Systems
UL 2572	Mass Notification System
UL 1711	Amplifiers
UL 1481	Power Supplies
BS 5839-1 : 2002	Code of Practice for System Design and Installation
EN 54 - 1	Introduction
EN 54 - 2	Control and Indicating equipment
EN 54 – 3	Audible Alarm Devices
EN 54 – 4	Power Supply Units
EN 54 – 5	Point type Heat Detectors
EN 54 – 7	Point type Smoke Detectors
EN 54 - 10	Flame Detectors
EN 54 – 11	Manual Call Points
EN 54 – 12	Linear Smoke Detectors
EN 54 - 13	System Requirements
EN 54 – 14	Planning and Installation
EN 54 – 15	Multi Sensor Detectors
EN 54 – 16, EN 60849	Voice Alarm Control Equipment
EN 54 – 17	Short Circuit Isolators
EN 54 – 18	Input/ Output Devices
EN 54 – 20	Aspirating Smoke Detectors
EN 54 – 21	Routing Equipment
EN 50082-2	Protection against RFI and EMI (Emissions for Industrial Environments)
VDE 0833 Part 1	Alarm systems for fire, burglary and robbery - Part 1: General requirements
VDE 0833 Part 2	Alarm systems for fire, burglary and robbery - Part 2: Requirements for fire alarm systems (FAS)
VDE 0833 Part 3	Alarm systems for fire, burglary and robbery - Part 3: Requirements for intrusion and hold-up alarm
VDE 0833 Part 4	Alarm systems for fire, burglary and robbery - Part 4: Requirements for equipment for voice alarm in case of fire
VdS 2095 : 2005	Guidelines For Automatic Fire Detection And Fire Alarm Systems - Planning And Installation

1.1 FIRE ALARM AND DETECTION PANEL

General

The Panel shall be UL 9th edition listed or EN listed and shall comply with latest amendments of NFPA 72.

The panel shall be a Microprocessor based, Analogue addressable networkable and Intelligent.

The panel shall have all necessary provisions for interfacing with BMS, smoke evacuation system, Air handling units, firefighting equipment, elevators, access control system, and other third party systems.

In the event of CPU failure, all Signaling Loop Circuits (SLC) modules shall fallback to degrade mode. Such degrade mode shall treat the corresponding SLC loop control modules and associated detection devices as conventional two-wire operation. Any activation of a detector in this mode shall automatically activate associated Notification Appliance Circuits.

MAIN FIRE ALARM CONTROL PANEL

The control panel shall be microprocessor based networked system designed specifically for fire, emergency voice evacuation, Two-way emergency fire fighter communications, smoke control, integration modules for BMS or any third party control/annunciation. The control panel shall include all required hardware, software and site specific system programming to provide a complete and operational system. The control panel(s) shall be designed such that interactions between any applications can be configured, and modified. The control panel operational priority shall assure that life safety takes precedence among the activities coordinated by the control panel.

The panel shall maintain a history, include all alarms, troubles, operator actions, and programming entries.

The Loop shall contain its own microprocessor and shall be capable of operating in a local/degrade mode (any addressable device input shall be capable of activating any or all addressable device outputs) in the unlikely event of a failure in the main CPU.

The loop interface board shall be able to drive an NFPA Style 6/7(class A) wiring, with each MACP taking directly with two other Main Fire Panel and the network will be a close loop.

The FAS shall have pre-signal and Positive Alarm Sequence that is the system shall provide means to cause alarm signals to only sound in specific areas with a delay of the alarm from 60 to up to 180 seconds after start of alarm processing.

To obtain early warning of incident or potential fire conditions, the system shall support a programmable option to determine system response to real-time detector sensing values above the programmed setting. Two levels of Pre-alarm indication shall be available at the control panel: alert and action.

The system shall provide means to allow panel programming either through an off-line software utility program away from the panel or while connected and on-line. The system shall

also support upload and download of programmed database and panel executive system program to a Personal Computer/laptop.

The system shall support two password levels, master and user. Up to 9 user passwords shall be available, each of which may be assigned access to the programming change menus, the alter status menus, or both. Only the master password shall allow access to password change screens.

The system shall provide means to obtain a variety of reports listing all event, alarm, trouble, supervisory, or security history.

The system shall provide means to link one detector to up to two detectors at other addresses on the same loop in cooperative multi-detector sensing. There shall be no requirement for sequential addresses on the detectors and the alarm event shall be a result or product of all cooperating detectors chamber readings.

The Addressable Main Power Supply shall operate on 240 VAC, 50 Hz, and shall provide all necessary power for the FACP.

1.2 FIRE ALARM SYSTEM DEVICES

1.2.1 GENERAL

Each device shall be UL/EN Listed.

Addressable devices shall use simple to install and maintain decade, decimal address switches. The contractors shall not install the detectors until after the construction cleanup of all trades is complete and final.

Initiating devices shall be installed in all areas, compartments, or locations where required by other NFPA codes and standards or as required by the authority having jurisdiction.

In the event of duplicate addressing of a device, the fire panel shall indicate this as a fault condition. However, the SLC should continue to function normally with the trouble condition display at the Fire panel.

Each addressable detector & device shall respond to Fire Alarm Panel scan for information with an analog representation of measured fire related phenomena (smoke density, particles of combustion, temperature).

The standard base of the Detector shall be interchangeable with other Smoke / Heat / Multicriteria Detectors.

Addressable devices shall use simple to install and maintain type address switches.

1.2.2 INITIATION DEVICES

1.2.2.1 INTELLIGENT MULTI CRITERIA DETECTOR

The intelligent multi criteria detector shall be an addressable device that is designed to monitor a minimum of photoelectric and thermal technologies in a single sensing device. The design shall include the ability to adapt to its environment by utilizing a built-in microprocessor to determine its environment and choose the appropriate sensing settings automatically i.e. have floating sensitivity. The detector design shall allow a wide sensitivity window, no less than 1 to 4% per foot obscuration. This detector shall utilize advanced electronics that react to slow smoldering fires and thermal properties all within a single sensing device.

The microprocessor design shall be capable of selecting the appropriate sensitivity levels based on the environment type it is in (office, manufacturing, kitchen etc.) and then have the ability to automatically change the setting as the environment changes (as walls are moved or as the occupancy changes).

The intelligent multi criteria detection device shall include the ability to combine the signal of the thermal sensor with the signal of the photoelectric signal in an effort to react hastily in the event of a fire situation. It shall also include the inherent ability to distinguish between a fire condition and a false alarm condition by examining the characteristics of the thermal and smoke sensing chambers and comparing them to a database of actual fire and deceptive phenomena.

1.2.2.2 ADDRESSABLE HEAT DETECTORS

The Heat Detector shall be an Addressable Detector with its own manually set digital code and shall be able to give a single digitized output to the Fire Alarm Panel regarding its condition. The Detector shall employ the thermistor principle for heat sensing and the fixed temperature setting shall be at 60-68 degrees Centigrade. It shall be able to communicate with the Fire Alarm Panel.

1.2.2.3 ADDRESSABLE MANUAL PULL STATIONS

Stations shall be of the dual action design. Addressable manual fire alarm boxes shall, on command from the control panel, send data to the panel representing the state of the manual switch and the addressable communication module status. They shall use a key operated test-reset lock, and shall be designed so that after actual emergency operation, they cannot be restored to normal use except by the use of a key.

All operated stations shall have a positive, visual indication of operation and utilize a key type reset. Manual fire alarm boxes shall be constructed of Lexan with clearly visible operating instructions provided on the cover. The word FIRE shall appear on the front of the stations in raised letters.

1.2.3 NOTIFICATION DEVICES

1.2.3.1 PROGRAMMABLE ELECTRONIC DIRECTIONAL SOUNDERS

Directional sounder shall incorporate different field selectable sound pulse patterns that consist of broadband noise which shall make it possible to locate where the sound is coming from. The pulse patterns shall be used to create an egress pathway out of a building and mark perimeter exits. The sound pattern shall become faster as the building occupant approaches the perimeter exit.

It shall be connected to the fire alarm system, made addressable by control module and shall be powered externally.

The direction sounder must be in accordance to NFPA 72, 2007 Edition, Annexure A clause A.7.4.6.1.

1.2.3.2 HOOTER

Hooters shall be suitable for indoor application. All hooters shall be 24 V DC operated. The minimum sound level shall be 75 db at 10 feet. Hooter shall be EN listed or UL Listed and shall be made addressable using a control module.

1.2.3.3 STROBES

Xenon strobes with clear lens shall be suitable for indoor, or outdoor, application. Listed to EN or UL 1971 and UL 464 and shall be approved for fire protective service. Strobes shall be wired as a primary signaling notification appliance.

The strobe shall flash at 1 Hz over the strobe's entire operating voltage range. The strobe light shall consist of a xenon flash tube and associated lens/reflector system. The hooter shall have two tone options, two audibility options (at 24 volts) and the option to switch between a temporal 3 pattern and a non-temporal continuous pattern

The strobe cum alarm hooter shall be made addressable by connected with addressable control module.

1.2.3.4 STROBE CUM ALARM HOOTERS (ADDRESSABLE)

Strobe cum Alarm hooters shall be suitable for indoor, or outdoor, application. All hooters shall be 24 V DC operated. The minimum sound level shall be 90 db at 10 feet. Listed to EN or UL 1971 and UL 464 and shall be approved for fire protective service. Strobe cum Alarm hooters shall be wired as a primary signaling notification appliance.

The strobe shall flash at 1 Hz over the strobe's entire operating voltage range. The strobe light shall consist of a xenon flash tube and associated lens/reflector system. The hooter shall have two tone options, two audibility options (at 24 volts) and the option to switch between a temporal 3 pattern and a non-temporal continuous pattern. Strobes shall be powered independently of the sounder. The horn on horn/strobe shall operate on a non-coded power supply.

The strobe cum alarm hooter shall be made addressable by connected with addressable control module.

1.2.4 MODULES

1.2.4.1 MONITOR MODULE (FOR INPUT TO FIRE ALARM PANEL)

The Input Device shall provide an addressable input for N.O. or N.C. contact devices such as manual water flow switches, sprinkler supervisory devices, etc. The input device shall provide a supervised initiating circuit.

An open-circuit fault shall be annunciated at the Fire Alarm panel (Subsequent alarm shall be reported.) The device shall contain an LED which blinks upon being scanned by the Fire Alarm panel. Upon determination of an alarm condition of an alarm condition, the LED shall be latched on. The operating voltage shall be in the range of 15 to 32 VDC, Maximum current draw 5.0 mA (LED on).

1.2.4.2 CONTROL MODULE (FOR OUTPUT FROM FIRE ALARM PANEL)

The control module shall provide an addressable output for a separately powered alarm indicating circuit or for a control relay. The control module shall provide a supervised indicating circuit where indicated on the plans. An open circuit fault shall be annunciated at the Fire Alarm panel.

The Output Device shall provide a control relay where indicated on the plans. The relay contacts shall be SPDT rated at two amps 24 V DC. The device module shall contain an LED which blinks upon being scanned by the Fire Alarm panel. Upon activation of the device, the LED shall be latched on.

1.2.4.3 FAULT ISOLATOR DEVICE

A wire-to-wire short circuit fault on any circuit, before or after the circuit has been activated, shall initiate a trouble signal and shall isolate that circuit from the rest of the system. The Fault Isolator Device shall detect and isolate a short-circuited segment of a fault-tolerant loop. The device shall automatically determine a return to normal condition of the loop and restore the isolated segment. The fault isolator device shall be placed every [20] devices to limit the number lost in the event of a short-circuit.

1.3 MAIN FIRE DETECTION AND ALARM SYSTEM SOFTWARE

General:

The monitoring and control graphical workstation shall communicate with the fire alarm network(s) via RS 485 port with full command and control capability.

Password protected to operate common control functions from the Workstation including acknowledging, silencing, and resetting of fire alarm functions.

Capable of generating reports in multiple formats with ability to filter by building/area, device type, and/or activation type.

Capable upon receipt of any event to activate an audio WAV file over the workstation speakers alerting the operator to an event, and providing detailed textual instructions on a 'per device' basis. Additionally, a visual graphical indication color coded for the event type shall appear for the affected device.

Support unlimited fire alarm Networks Systems via Ethernet using IP protocol communications. Networks can be monitored independently and all information shall be stored locally in a database format. Events can be emailed and filtered based on trouble and/or alarm activations.

Shall be able to activate preset switches on the MACP to perform operations related to fire system control and maintenance.

Graphical screens shall be provided to select a virtual switch.

Must allow for master node for control and slave nodes for auxiliary monitoring.

Operator interface:

The operator interface shall manage and configure the different screen (window) layouts for the operator System Control to be display simultaneously on the screen.

The operator interface shall provide support for dual monitor mode.

It shall be possible to assign layouts to access groups so that they load when a user from that access group logs in.

User authentication shall be provided using access groups with defined permissions and with support of multiple user accounts per access group.

Event list display:

All events shall be display in the order of priority and remain until they are acknowledged.

Each event and notification shall be color-coded.

The event type, description, location, date and time and count information shall be displayed for each event in columns on each tab.

Once the event has been acknowledged, a visual indicator showing the event has been acknowledged shall be presented to the operator and logged to the database.

The Current Events tab shall display all of the events that have taken place in the system up to a minimum of 1,000 events.

All other events shall be stored in the database and accessible via a separate "event log" window.

The following colour Coding of events and notifications shall be used

- Red – Mass Notification or Fire Alarms.
- Orange – Supervisory or Security Alarm
- Yellow – Troubles
- Blue – Monitor Points or Security Points
- Green – Restored to normal.

Workstation Event Logging and Reports Print Filter:

Filters shall be made available through configuration for events to be printed or reported from the workstation. The following filters shall be provided:

- Alarms,
- Supervisory,
- Monitor,
- Troubles and
- Security events
- Time of Day
- Location of the Event

The following pre-programmed reports shall be available:

- Alarm Report – Print only Alarm events.
- Alarm and Supervisory Report – Print only Alarm and Supervisory events.
- Maintenance Report – Print all events.
- Location Report – Print all events of a specific building/floor
- Time Period Report – Print all events from a date range

On Screen Controls:

The system shall provide on-screen buttons for;

- Acknowledge,
- Signal Silence,
- Fire Drill,
- Reset, and
- Silence Workstation
- Network View

1.4 FIRE DETECTION AND ALARM SYSTEM OPERATION

The system should be arranged for three categories of alarm inputs explained below and to provide output functions in accordance with the cause and effect matrix for the project.

SUPERVISORY INPUT:

This will only cause indication at the MACP's. The following inputs should be considered supervisory monitoring functions:

- Removal of a smoke detector from its base.
- Wiring faults.

Activation of a supervisory monitoring device will provide the following indications:

The MACP's will indicate an audible and visual "TROUBLE" condition. In addition, the "trouble alarm" will be displayed on the graphic display unit for the type of alarm.

Printer will print clear text message on the event log indicating the device which initiated a trouble alarm.

SEQUENCE OF OPERATION

Scope:

This section describes the steps and actions to be performed by the Fire Alarm & life Safety System in case on an emergency

Equipment:

1. Main Fire Alarm Panel:

- a. UL Listed or EN listed
- b. Intelligent and addressable

2. Detectors

- a. Complete coverage i.e. in all the areas
- b. Non photoelectric detectors in Kitchens

3. Manual Call Points

- a. At Reception area
- b. All entry/exits
- c. Every running 30 meters/or as per drawing

4. Hooters

- a. Required at all exits
5. Strobes
 - a. All entry/exit points of Public Areas, Corridors & Back of House (employee spaces, employee restrooms, laundry, offices, work areas, kitchen, storage areas, shops, etc.)
 - b. Strobes in bathrooms also for these rooms 'Handicap Accessible'
6. Speakers
 - a. Required in Public Areas, Corridors & Back of House (employee spaces, employee restrooms, laundry, offices, work areas, kitchen, storage areas, shops, etc.)
7. Control Modules
 - a. For AHU shutoff
 - b. Hooters and Strobes
 - c. Exhaust system
8. Monitor Modules
 - a. Input to panel from Water flow Switches
 - b. Input to panel from Fire Pump Signals
9. Isolator Modules
 - a. After every 20 address points
10. Door Hold Open Mechanism
 - a. All fire exits
11. Voice evacuation system
 - a. Required with Continuous cycle alert tone and automatic prerecorded voice message with manual voice communication override.
12. Fire Fighter Telephone System
 - a. UL/EN Listed Fire Fighter telephone system with fire jacks on all exits
13. Repeater Panel
 - a. As per drawing

Actions:

1. An alarm condition is reached ON THE PANEL/repeater panel if :
 - a. If any fire detectors (smoke, heat) goes in to alarm condition.
 - b. A Manual pull station is activated
 - c. Water flow switches, dry sprinkler pressure switches.
2. Audible and Visual Notification on affected floors if:
 - a. Smoke or heat detectors of that floor go into alarm
 - b. Manual Call point of that floor is activated
 - c. Water flow switch, dry sprinkler pressure switch are activated
3. Release of Assembly and fire exit doors
 - a. Smoke or heat detectors of that floor go into alarm
 - b. Water flow switch and dry sprinkler pressure switch activated
4. Activate Stairwell Pressurization fan
 - a. Smoke or heat detectors of that floor go into alarm
 - b. Manual Call point of that floor is activated
 - c. Water flow switch, dry sprinkler pressure switch are activated
5. Activate smoke exhaust system in affected zones
 - a. Smoke or heat detectors of that floor go into alarm
 - b. flow switch, dry sprinkler pressure switch of that zone is activated
6. Air Handler Shut off
 - a. detector is activated

SECTION -14

TECHNICAL SPECIFICATION

DIGITAL VOICE EVACUATION AND TWO WAY FIRE FIGHTER TELEPHONE SYSTEM

1.0 GENERAL

The DVC located with the FAS, shall contain all equipment required for all audio control, emergency telephone system control, signaling and supervisory functions. This shall include speaker zone indication and control, telephone circuit indication and control, digital voice units, microphone and main telephone handset. It shall be EN listed or UL Listed.

The DVC equipment shall perform the following functions:

- Operate as a supervised channel emergency voice communication system.
- Operate as a two-way emergency telephone system control center.
- Audibly and visually annunciate the active or trouble condition of every speaker circuit and emergency telephone circuit.
- Audibly and visually annunciate any trouble condition for digital tone and voice units required for normal operation of the system.

- Provide all-call Emergency Paging activities through activation of a single control switch.
- As required, provide vectored paging control to specific audio zones via dedicated control switches.
- Provide a factory recorded “library” of voice messages and tones in standard WAV. File format, which may be edited and saved on a PC running a current Windows® operating system.
- Provide a software utility capable of off-line programming for the VCC operation and the audio message files. This utility shall support the creation of new programs as well as editing and saving existing program files. Uploading or downloading the VCC shall not inhibit the emergency operation of other nodes on the fire alarm network.

The DVC shall be modular in construction, and shall be capable of being field programmable without requiring the return of any components to the manufacturer and without requiring use of any external computers or other programming equipment. **Testing of all the speakers shall be possible on a time to time basis by playing music.**

A gooseneck microphone shall be placed at the reception desk of the building for this purpose. The gooseneck microphone shall have zone selection switches as per zone requirement

1.1 DVC COMPONENTS

i.DIGITAL AUDIO AMPLIFIERS (DAA)

The Digital Audio Amplifiers shall form audio networks of up to 32 DAA terminating at a DVC. Each DAA shall be capable of accessing and processing one of up to multiple audio channels on the DVC audio loop, amplifying the signal, and distributing it via four Class B, two Class B and one Class A, or two Class A outputs at 50 watts. The DAA shall store backup alarm and trouble messages, and shall provide an adjustable background music input. It shall also support Firefighter’s Telephone operation; a dedicated FFT riser on each DAA shall connect to one of five dedicated FFT channels in order to communicate with other FFT stations associated with the controlling DVC.

The DAA shall be designed as per NFPA 72 2002 National Fire Alarm Code and be listed for EN or Underwriters Laboratories Standard UL 864.

ii.SPEAKERS:

All speakers shall operate on 70 VRMS or with field selectable output taps as per BOQ

Amplifier selection shall be based on minimum 2 watt/speaker strictly adhering to PA schematic for number of zones.

Speakers in corridors and public spaces shall produce a nominal sound output of 15dB above ambient noise level at 10 feet (3m). The output tapping can be chosen as below.

UL REVERBERANT (dBA @ 10ft/3.048m)			
2W	1W	1/2W	1/4W
84	81	78	75

Frequency response shall be a minimum of 400 HZ to 4000 HZ. The back of each speaker shall be sealed to protect the speaker cone from damage and dust.

iii. FIRE FIGHTERS TELEPHONE SYSTEM

The fire fighter telephone shall be connected to the DVC via a Power-limited Fire Fighter telephone (FFT) riser in Class A (Style Z) or Class B (Style Y) operation. Style Y two-wire connections. This FFT will be connected to receptacle single fire fighter phone jack. Portable fire fighter handsets will be provided to enable communication with the control room.

iv. INTERACTIVE FIREFIGHTER'S DISPLAY PANEL

The network shall interface and report the individually monitored system's alarm status via a user friendly Graphical User Interface (GUI) based software. The software shall operate under Microsoft® Windows® XP Embedded platform as manufactured by Microsoft Corporation.

The GUI based software must be capable of graphically representing the facility being monitored with floor plans and icons depicting the actual locations of the fire alarm device locations.

The software shall use a 1280 pixel x 1024 pixel GUI display capable of showing a large primary floor plan display, a site plan representative of an aerial view of the facility, the first active fire alarm on the system.

The software shall permit automatic navigation to the screen containing an icon that represents the first fire alarm device in alarm in the event of an off-normal condition.

The fire alarm device icon shall be visible only when it is in an alarm (or active) condition. The software shall display the activated smoke detectors in a time sequence to track smoke progression.

The software shall allow the importation of externally developed floor plans in Windows Metafile (WMF), JPEG (JPG), Graphics Interchange Format (GIF) and

Bitmap (BMP) format. The software shall provide a intuitive and easy way to navigate to different screens representing floors and areas within a facility.

The system shall provide for continuous monitoring of all fire alarm conditions regardless of the current activity displayed on the screen. The software shall display “YOU ARE HERE” along with icons representing standard building objects (stairs, elevators, etc) to be shown on the floor plan. The software shall allow icons that represent hazardous materials stored in a facility. The software shall provide a screen that displays preprogrammed building contact information.

The software shall provide a screen the displays building occupancy and other general building information. The software shall allow a site plan to be imported that shows an aerial view of the facility. The software shall display all active fire, supervisory, and security events within an event list.

1.2 TESTING

RANDOM SAMPLE TESTING:

About 5% of all fire alarm components shall be subjected to random testing by connecting to the panels.

All smoke detectors shall be tested as given above and later cleaned with a vacuum cleaner.

Hooters shall also be tested through direct 24V supply. It shall be tested for 10 minutes.

TESTING OF EARTHING SYSTEM:

The earth continuity conductor including metallic parts of the equipments shall be tested for earth to electrical continuity. All tests shall be carried out as per IS 3043 and resistance of complete installation shall not be more than one ohm.

TESTS AT SITE

Following test shall be conducted:-

- a. Loop Checking
- b. Checking of smoke detectors, Heat detectors etc. by simulation.
- c. Functional tests for fire alarm panel.
- d. The Mock trial of the complete Fire Detection and Alarm system.

1.3 COMMISSIONING AND ACCEPTANCE TESTS

The commissioning and acceptance tests shall be apart from the standard or routine tests prescribed and normally conducted by the manufacturer /Design-Build Contractor and will be irrespective of the fact whether the same are covered by such tests or not.

- a. Each sounder circuit shall be energized separately and the sound level reading taken to check for conformity with the minimum standards.
- b. Mains failure performance.
- c. Battery disconnection test.
- d. Open circuit of each sounder circuit to be tested.
- e. Short circuit of each sounder circuit to be tested.
- f. The results of the above tests either by fault warning or fire alarm shall be recorded in the log books which will be signed both by the Design-Build Contractor and the employer's Representative.

TECHNICAL SPECIFICATIONS

VENTILATION & EXHAUST FANS

1.0 **Scope:**

- a) Scope of this section comprises the supply, erection commissioning and testing of the ventilation and exhaust fans of the capacities set forth in the schedule of equipment.

2.0 **Axial Fans:**

- a) The Axial Fan Blades shall be of Cast Aluminium of aerofoil design for high efficiency and high static pressure. The blades shall be joined together on cast aluminium hub.
- b) The mounting ring shall be of CRCA/Sheet Steel with steel brackets to connect the frame with the Fan/Motor assembly. Rubber mounts shall be provided between the mounting frame and the mounting brackets.
- c) The fan assembly shall be statically and dynamically balanced.
- d) The fan motor shall be totally enclosed squirrel cage type. All Fan Motors shall be EFF-1 rating as per Leeds Green Building Requirement
- e) The axial flow fans should be provided with wire guard and back draft dampers as part of unit price (factory fabricated).
- f) The motor shall be selected for HP in 10% excess of BHP of Fan.

3.0 **Propeller Type Wall Exhaust Fans :**

- a) Propeller type of fans shall be G.E.C make or equivalent. Fan shall be of the broad type, ring or diaphragm mounted and the capacity shown in the schedule of equipment. Fans shall be provided with gravity type louvers unless otherwise stated.
- b) Fan drive shall be single phase or three phase motors as indicated in the schedule of equipment and shall be complete with starter.

4.0 **Centrifugal Fans:**

- a) The imported backward curved centrifugal blowers shall be double / single inlet, double/single width, non-overloading type of suitable construction. The blower performance must be rated in accordance with approved test codes and procedures. The centrifugal fans should conform to and shall be AMCA certified.
- b) The blower housing comprising of scroll/housing shall be fabricated out of 18 Gauge (min) G.I. sheet, sectional construction with the housing fixed to the side plates in "Pittsburg Lock" form system. Outlets shall be flanged to assure proper duct connections. Inlet cones shall be spun venture type, to ensure smooth air entry. The frame shall be of angle iron in welded construction with polyester powder coating.
- c) Impeller shall be fabricated from sheet steel with backward curved, properly designed, blades with heavy C.I. Hub and shall be both dynamically and statically balanced to a close tolerance for quiet and vibration free performance.
- d) Shaft shall be of C45 carbon steel, sized adequately and shall be accurately ground and polished to a close tolerance. It shall be coated with anti-corrosion varnish after assembly.
- e) Bearing shall be self aligning, heavy duty deep grooved ball or spherical roller type with integral dust and grease seals. They shall be mounted on cast iron supports with grease points.
- f) Fans shall be provided with suction inlet vane damper as wherever specified.

- Movable inlet vanes shall be complete with necessary linkages for actuation by automatic controls if required.
- g) The impeller shall be provided with polyester powder coating finish.
 - h) The fan shall be selected for a speed not exceeding 1800 RPM. The fan outlet velocity shall not exceed 2000 FPM.
 - i) The imported forward curved fans shall be double inlet double width type.
 - j) The wheel & housing shall be fabricated from heavy gauge galvanized steel. The fan impeller shall be mounted on a solid C40 carbon steel shaft supported to housing with angle iron frame & pillow block heavy duty ball.
 - k) The fan shall be selected for a speed not exceeding 1400 RPM. The impeller & fan shaft shall be statically and dynamically balanced. The fan outlet velocity shall not be more than 1800 FPM.
 - l) Fans shall be driven by are electric motor as specified in the schedule of equipment Motor ratings are only tentative and where a fan requires high capacity motor, the contractor shall clearly point out the requirement and make his offer accordingly. Motor rating shall be at least 10% over limit load plus transmission losses.
 - m) Drive assembly for each blower shall consist of blower pulley, motor pulley, a set of 'V' belts, belt guards and belt tension adjusting device.
 - n) Pulley shall be selected to provide the required speed. They shall be multi-groove type with section and grooves selected to transmit 33% more load than the required power and shall be statically balanced.
 - o) The belt guards shall be fabricated of M.S. Sheet (Powder coated at factory) with angle iron reinforcements and expanded metal screen to avoid finger insertion.
 - p) The motor for each blower shall be squirrel cage induction type and conform to specifications as given under section on control panel, motor and switchgear. The motor H.P. shall be atleast 20% more than the limit load of fan and of minimum rating as given under 'Schedule of Equipment'. The motors shall be as per IS-325-1996 (Revised to date) with F-Class of Insulation

TECHNICAL SPECIFICATIONS

DUCTING

1.0 Scope:

- 1.1 The work under this part shall consist of furnishing labor materials, equipment and appliances as specified necessary and required to install all sheet metal and other allied work to make the air conditioning supply, ventilating, and exhaust system ready for operation as per drawings.
- 1.2 Except as otherwise specified all duct work and related items shall be in accordance with these specifications.
Ductwork shall mean all ducts, casings, dampers, access doors, joints, stiffeners and hangers.

2.0 Duct Materials

- 2.1 The ducts shall be fabricated from galvanized steel sheets class VIII/ Galvanizing shall be of 120gms/sq.m. (total coating on both sides) conforming to ISS:277-1962 (revised) or aluminum sheets conforming to ISS:737-1955 (wherever aluminum ducts are specified).
- 2.2 All duct work, sheet metal thickness and fabrication unless otherwise directed, shall strictly meet requirements, as described in IS:655-1963 with amendment-I (1971 edition)

3.0 Governing Standards

- 3.1 Unless otherwise specified here, the construction, erection, testing and performance of the ducting system shall conform to the SMACNA-1995 standards ("HVAC Duct Construction Standards-Metal and Flexible-Second Edition-1995" SMACNA)

4.0 Raw Material

4.1 Ducting

- 4.1.1 All ducting shall be fabricated of LFQ (Lock Forming Quality) grade prime G.I. raw material furnished with accompanying Mill test Certificates.
- 4.1.2 Galvanizing shall be of 120gms/sq.m. (total coating on both sides).
- 4.1.3 In addition, if deemed necessary, samples of raw material, selected at random by owner's site representative shall be subject to approval and tested for thickness and zinc coating at contractor's expense.
- 4.1.4 The G.I. raw material should be used in coil-form (instead of sheets) so as to limit the longitudinal joints at the edges only irrespective of cross-section dimensions.

5.0 Duct Connectors and Accessories

- 5.1 All transverse duct connectors (flanges/cleats) and accessories/related hardware are such as support system shall be zinc-coated (galvanized).

6.0 Fabrication Standards

- 6.1 All ductwork including straight sections, tapers, elbows, branches, show pieces, collars, terminal boxes and other transformation pieces must be Rolastar factory-fabricated or Techno Fabriduct. Equivalency will require fabrication by utilizing the following machines and processes to provide the requisite quality of ducts and speed of supply.
- 6.2 Lines ensure location of longitudinal seams at comes/folded edges only to obtain the required duct rigidity and low leakage characteristics. No longitudinal seams permitted along any face side of the duct.
- 6.3 All ducts, transformation pieces and fittings to be made on CNC profile cutlers for required accuracy of dimensions, location and dimensions of notches at the folding lines.
- 6.4 All edges to be machine treated using lock formers, flanges and roller for fuming up edges.
- 6.5 Sealant dispensing equipment for applying built-in sealant in Pittsburgh lock where sealing of longitudinal joints are specified.

7.0 Selection of G.I. Gauge and Transverse Connectors

- 7.1 Duct Construction shall be in compliance with 1" (250 Pa) w.g. static norms as per SMACNA.
- 7.2 All transverse connectors shall be the Rolamate 4-bolt slip-on flange system or Techno Fabriduct imported makes of similar 4-bolt systems with built-in sealant if any to avoid any leakage additional sealant to be used.
- 7.3 The specific class of transverse connector and duct gauge for a given duct dimensions will be 1"(250 Pa) pressure class.
- 7.4 Non-toxic, AC-applications grade P.E. or PVC Casketing is required between all mating flanged joints. Gasket sizes should conform to flange manufacturer's specification.

8.0 Duct Construction

- 8.1 The fabricated duct dimensions should be as per approved drawings and all connecting sections are dimensionally matched to avoid any gaps.
- 8.2 Dimensional Tolerances: All fabricated dimensions will be within ± 1.0 mm of specified dimension. To obtain required perpendicularity, permissible diagonal tolerances shall be ± 1.0 mm per meter.
- 8.3 Each and every duct pieces should be identified by color coded sticker which shows specific part numbers, job name, drawing number, duct sizes and gauge.
- 8.4 Ducts shall be straight and smooth on the inside Longitudinal seams shall be airtight and at comers only, which shall be either Pittsburgh or Snap Button Punch as per SMACNA practice, to ensure air tightness.

- 8.5 Changes in dimensions and shape of ducts shall be gradual (between 1:4 and 1:7). Turning vanes or air splitters shall be installed in all bends and duct collars designed to permit the air to make the turn without appreciable turbulence.
- 8.6 Plenums shall be shop/factory fabricated panel type and assembled at site.
- 8.7 Factory Fabricated ducts shall have the thickness of the sheet shall be as follows

S.No.	Size of Duct	Sheet Thickness	Fastner Size	Type of Joints		Bracing with GI tie rods of following sizes	Support Angle
				For Rolastar duct & Rolamate flanges	For TDC four bolt Duct and flanges		
i)	Upto 450 mm	0.5 mm	3/8"	Fabricated out of G.I. sheet of 26 gauge at every 1.2 m internal.	The flanges shall be made out of the same duct sheet and all the four corner shall be fitted for fitting the bolt	Cross tie rods to be fitted of suitable dia GI rod for each piece of duct	25x25x3 mm with GI threaded rods of 10 mm dia
ii)	Upto 750 mm	0.63 mm	3/8"	Fabricated out of G.I. sheet of 24 gauge at every 1.2 m internal.			25x25x3 mm with GI threaded rods of 10 mm dia
iii)	751 mm to 1000 mm	0.80 mm	3/8"	E-24 type flange, shall be fabricated out of 24 G sheet at every 1.2 m internal.			25x25x3 mm with GI threaded rods of 10 mm dia
iv)	1001 mm to 1500 mm	0.80 mm	5/8"	E-22 type flange, shall be fabricated out of 22 G sheet at			40x40x5 mm with GI threaded rods of 10 mm dia

				every 1.2 m internal.			
v)	1501 mm to 2250 mm	1.00 mm	5/8"	J-16 type flange, shall be fabricated out of 16G sheet at every 1.2 m			40x40x6 mm with GI threaded rods of 12 mm dia
vi)	2251 mm and above	1.25 mm	5/8"	J-16 type flange, shall be fabricated out of 16G sheet at every 1.2 m internal.			50x50x6 mm with GI threaded rods of 12 mm dia.

8.8 The gauges, joints and bracings for sheet metal duct work shall further conform to the provisions as shown on the drawings.

8.9 Ducts larger than 600 MM shall be cross broken, duct sections upto 1200 MM length may be used with bracing angles omitted.

8.10 Changes in section of ductwork shall be affected by tapering the ducts with as long a taper as possible. All branches shall be taken off at not more than 45 DEG. Angle from the axis of the main duct unless otherwise approved by the Engineer-In-Charge.

8.11 All ducts shall be supported from the ceiling/slab by means of M.S. Rods of 10 MM (3/8") DIA with M.S. Angle at the bottom. The rods shall be anchored to R.C. Slab using metallic expansion fasteners.

9.0 Installations

9.1 During the construction, the contractor shall temporarily close duct openings with sheet metal covers to prevent debris entering ducts and to maintain opening straight and square, as per direction of Engineer-In-Charge.

9.2 Great care shall be taken to ensure that the duct work does not extend outside and beyond height limits as noted on the drawings.

9.3 All duct work shall be of high quality approved galvanized sheet steel guaranteed not to crack or peel on bending or fabrication of ducts. All joints shall be air tight and shall be made in the direction of air flow.

The ducts shall be re-in forced with structured members where necessary, and must be secured in place so as to avoid vibration of the duct on its support.

- 9.4 All air turns of 45 degrees or more shall include curved metal blades or vanes arranged so as to permit the air to make the abrupt turns without an appreciable turbulence. Turning vanes shall be securely fastened to prevent noise or vibration.
- 9.5 The duct work shall be varied in shape and position to fit actual conditions at building site. All changes shall be subjected to the approval of the Engineer-In-Charge. The contractor shall verify all measurements at site and shall notify the Engineer-In-Charge of any difficulty in carrying out his work before fabrication.
- 9.6 Sponge rubber or approved equal gaskets of 6 MM maximum thickness shall be installed between duct flanges as well as between all connections of sheet metal ducts to walls, floor columns, heater casings and filter casings. Sheet metal connections shall be made to walls and floors by means of wooden member anchored to the building structure with anchor bolts and with the sheet screwed to them.
- 9.7 Flanges bracings and supports are to be Rolamate or four bolt TDC duct. Accessories such as damper blades and access panels are to be of materials of appropriate thickness and the finish similar to the adjacent ducting, as specified.
- 9.8 Joints, seams, sleeves, splitters, branches, takeoffs and supports are to be as per duct details as specified, or as decided by Engineer-In-Charge.
- 9.9 Joints requiring bolting or riveting may be fixed by Hexagon nuts and bolts, stove bolts or buck bolts, rivets or closed centre top rivets or spot welding. Self tapping screws must not be used. All jointing material must have a finish such as cadmium plating or Galvanized as appropriate.
- 9.10 Fire retarding flexible joints are to be fitted to the suction and delivery of all fans. The material is to be normally double heavy canvass or as directed by Engineer-In-Charge. On all circular spigots the flexible materials are to be screwed or clip band with adjustable screws or toggle fitting. For rectangular ducts the material is to be flanged and bolted with a backing flat or bolted to mating flange with backing flat.
- 9.11 The flexible joints are to be not less than 75 MM and not more than 250 MM between faces.
- 9.12 The duct work should be carried out in a manner and at such time as not to hinder or delay the work of the other agencies especially the boxing or false ceiling contractors.
- 9.13 Duct passing through brick or masonry, wooden frame work shall be provided within the opening. Crossing duct shall have heavy flanges, collars on each side of wooden frame to make the duct leak proof.

TECHNICAL SPECIFICATION OF HVAC SYSTEM

TECHNICAL SPECIFICATIONS

DUCT ACCESSORIES

1.0 Dampers

1.1 Splitter Dampers

- 1.1.1 At the junction of each branch duct with main duct and split of main duct, volume dampers must be provided. Dampers shall be two gauges heavier than the gauge of the large duct and shall be rigid in construction.
- 1.1.2 The dampers shall be of an approved type, lever operated and complete with locking devices which will permit the dampers to be adjusted and locked in any positions and clearly indicating the damper position.
- 1.1.3 The dampers shall be of splitter, butterfly or louver type. The damper blade shall not be less than 1.25 MM (18) Gauge, reinforced with 25 MM angles 3 MM thick along any unsupported side longer than 250 MM. Angles shall not interfere with the operation of dampers, nor cause any turbulence.

1.2 Opposed Blade Dampers (Duct)

- 1.2.1 Automatic and manual volume opposed blade dampers shall be complete with frames and nylon bush as per drawings. Dampers and frames shall be constructed of 1.6 MM steel sheets and blades shall be of extruded aluminium of aerofoil design. The dampers for fresh air inlet shall additionally be provided with fly mesh screen, on the outside, of 0.8 MM thickness with fine mesh.
- 1.2.2 Wherever required for system balancing, a balancing opposed blade damper with quadrant and thumb screw lock shall be provided.
- 1.2.3 After completion of the duct work, dampers are to be adjusted and set to deliver air flow as specified on the drawings.

1.3 Fire Damper (Motorised)

- 1.3.1 All supply and return air ducts shall be provided with approved make fire and smoke dampers of at least 90 minutes fire rating certified by CBRI Roorkee as per UL 555: 1973.
- 1.3.2 Fire Damper blades & outer frame shall be formed of 1.5 mm galvanised sheet steel. The damper blade shall be pivoted on both ends using chrome plated spindles of self lubricated bronze bushes. Stop seals will be provided on top and bottom of the damper housing made of 16 G galvanised sheets steel. For preventing smoke leakage

side seals will be provided. In normal position damper blade shall be held in open position with the help of a 220V operated motorised actuators thereby providing maximum air passage without creating any noise or chatter.

- 1.3.3 The damper shall be actuated through electric motorize actuator. The actuator shall be motorize with the help of a signal from smoke detector. Smoke detector shall also be either provided by A/C contractor or Fire Fighting agencies. The Fire Damper shall be provided with micro switches with bakelite base to stop fan motor in the event of damper closure. The reopening of damper shall be manual.
- 1.3.4 The Fire Dampers shall be mounted in fire rated wall with a duct sleeve 600 MM long. The sleeve shall be factory fitted on fire damper. The joints at sleeve end shall be Slip on type minimum thickness of GI sheet shall be 18 G.
- 1.3.5 The damper shall be installed in accordance with the installation method recommended by the manufacturer.

2.0 Flexible Ducts

- 2.1 The flexible ducts shall be machine made of spiral design with aluminium sheets.
- 2.2 The duct shall be factory insulated.
- 2.3 The connections shall be complete with adjustable clip bands of G.I.

3.0 Access panel

- 3.1 A hinged and gasketed double skin, factory fabricated access panel measuring at least 450 MM x 450 MM shall be provided on duct work before each fire damper and at each control device that may be located inside the duct work.

4.0 Miscellaneous

- 4.1 All duct work joints are to be true right angle and with all sharp edges removed.
- 4.2 Sponge rubber gaskets also to be provided behind the flange of all grilles.
- 4.3 Each chute from the duct, leading to a grille, shall be provided with an air deflector to divert the air into the grille through the shoot.
- 4.4 Diverting vanes must be provided at the bends exceeding 600 MM and at branches connected into the main duct without a neck.
- 4.5 Proper hangers and supports should be provided to hold the duct rigidly, to keep them straight and to avoid vibrations. Additional supports are to be provided where required for rigidity or as directed by Engineer-In-Charge.
- 4.6 The ducts should be routed directly with a minimum of directional change.
- 4.7 All angle iron flanges to be welded electrically and holes to be drilled.
- 4.8 All the angle iron flanges to be connected to the GSS ducts by rivets at 100 MM centres.

- 4.9 The G.S.S. ducts should be lapped 6 MM across the flanges.
- 4.10 The ducts should be supported by approved type supports at a distance not exceeding 2.0 Metres.

5.0 Standard Grilles

- 5.1 The supply and return air grilles shall be fabricated from extruded aluminium sections. The supply air grilles shall have single/double louvers. The front horizontal louvers shall be of extruded section, fixed/adjustable type. The rear vertical louvers where required shall be of aluminium extruded sections and adjustable type. The return air grille shall have single horizontal extruded section fixed louvers. The grilles shall have an outer frame on all four sides.
- 5.2 The damper blades shall also be of extruded aluminium sections. The grill flange shall be fabricated out of aluminium extruded section. Grilles longer than 450 MM shall have intermediate supports for the horizontal louvers.

6.0 Diffusers

- 6.1 The ceiling type square diffusers shall be of aluminium extruded sections with flush face with fixed pattern and neck. The diffusers shall be provided with blank plate suitable of grid ceiling (T-Bar) of size 600 mm x 600 mm.
- 6.2 All supply diffusers shall be provided with extruded aluminium dampers, with arrangement for adjustment from the bottom, acoustically lined G.I. plenum, perforated diffusion plate and circular spigot.
- 6.3 The slot diffusers shall be of aluminium extruded sections with diffusion plate and sliding damper. It shall be provided with acoustically lined G.I. plenum box with circular spigot.
- 6.4 The acoustic lining shall be done with 12mm thick glasswool of 32 Kg/cu.m. density with rubberized lining on one face. The acoustic lining shall be fixed with self-adhesive stick pins.

7.0 Linear Diffusers/Grilles

- 7.1 The linear diffusers/grilles shall be fabricated from Aluminium extruded sections.
- 7.2 The diffusion blades shall be extruded, flush mounted type with single or double direction air flow.
- 7.3 The frame shall be of aluminium extruded section and shall hold the louvers tightly in fixed position. The frame shall be provided on all four sides.
- 7.4 The dampers as described under grilles shall be provided wherever specified.

8.0 Perforated Diffusers

- 8.1 The perforated diffusers shall be fabricated from aluminium sheet.
- 8.2 The sheet shall have uniform perforations to allow minimum 50% free area.
- 8.3 The supply air diffusers shall be provided with fully adjustable air pattern deflectors.

- 8.4 The frame shall be of extruded aluminium sections with blanking plate bonded to frame for grid ceiling (T-bar) application.

9.0 Exhaust Grilles

- 9.1 The exhaust grilles shall be fabricated from aluminium extruded sections.
- 9.2 The exhaust grilles shall be horizontal fixed bar grilles with 15° blade inclination.

10.0 Exhaust / Fresh Air Louvers

- 10.1 The louvers shall be fabricated from aluminium extruded sections.
- 10.2 The blades shall be extruded flush mounted type with single horizontal throw.
- 10.3 The frame shall be of aluminium extruded section and shall hold the louvers tightly in fixed position.

11.0 Variable Air Volume (Vav) Boxes

- 11.1 These shall be of the low velocity variable air volume boxes without re-heat coils, and shall be of open protocol as marketed by a firm specializing in this field. The contractor shall supply and install units to the quantity and locations as specified.
- 11.2 The unit shall be complete with damper, airflow ring, and solid-state electronic controls to provide accurate room temperature control. The damper shall be aero foil type construction with bearings.
- 11.3 Boxes shall be supplied with all internal attenuation treatment and acoustical damped casing necessary to achieve the required noise criteria. Casing shall be of 22G GSS minimum fitted with a completely sealed, easily removable means of access to all internal parts. Access to all boxes must be from the underside only.
- 11.4 The actuator shall be of 24V AC Bi-directional, direct coupled to the damper shaft. The required transformer to step down of the voltage range from 230V to 24V shall be part of the unit. The power point with an isolator near the VAV will be provided by other agencies.
- 11.5 The unit shall be complete with transformer, access panel and other accessories as per the standard.
- 11.6 The noise level shall be less than 35dbA.
- 11.7 Maximum allowable static pressure to the boxes for its satisfactory operation shall not exceed 0.10WG, otherwise fan and motor selections may be affected.
- 11.8 Boxes shall be able to reset any air flow between 10% and the maximum air quantity that the boxes can handle without changing orifices or other parts. Air quantity limiters will not be accepted.
- 11.9 A suitable device shall be provided for the field adjustment of minimum airflow. All boxes shall be initially factory set at minimum air quantity of 10% and maximum quantity of 110% of the design requirements.
- 11.10 Under shut-off conditions, all boxes shall not have air leakage more than 2% of the maximum air quantity at 75mm static pressure.

- 11.11 The VAVs shall be used in standalone mode complete with its own temperature sensor and controller and shall perform the function of maintaining the temperature and airflow.
- 11.12 Where ever specified, the VAVs shall be BMS compatible to enable to network the VAVs to a Network Control Unit and onto BMS. In this mode all VAV data shall be available at the BMS workstation and it shall be possible to change set points and flow settings from the BMS workstation. All such controllers used for the control of VAV boxes shall be compliant with BACnet/ MODBUS protocol and be freely communicable to third party BACnet/ MODBUS IP controllers.
- 11.13 All boxes shall be electrically controlled. The boxes shall be pressure independent.
- 11.14 VAV Box shall have provision to support from floor/ wall/ ceiling and in vertical/ horizontal condition.

12.0 Painting and Vision Barrier

- 12.1 All grilles, and diffusers shall be powder coated, before installation, in approved colour.
- 12.2 All ducts immediately behind the grilles/diffusers etc. are to be given two coats of black paint in matt finish.
- 12.3 The return air and dummy portion of all linear grilles shall be provided with a vision barrier made of 24 gauge galvanized sheets. The vision barrier shall be fixed to the false ceiling frame with self tapping screws and shall be given two coats of black paint in matt finish. Care shall be taken to ensure that the return air path is not obstructed.

13.0 Documentation to Measurements

- 13.1 For each drawing, all supply of ductwork must be accompanied by computer-generated detailed bill of material indicating all relevant duct sizes, dimensions and quantities. In addition, summary sheets are also to be provided showing duct areas by gauge and duct size range as applicable.
- 13.2 Measurement sheet covering each fabricated duct piece showing dimensions and external surface area along with summary of external surface area of duct gauge-wise.
- 13.3 All duct pieces to have a part number, which should correspond to the serial number, assigned to it in the measurement sheet. The above system will ensure speedy and proper site measurement, verification and approvals.

14.0 Testing

- 14.1 After duct installation, a part of duct section (approximately 5% of total ductwork) may be selected at random and tested for leakage. The procedure for leak testing should be followed as per SMACNA- "HVAC Air Duct Leakage Test Manual: (First Edition).

TECHNICAL SPECIFICATIONS

ELECTRICAL WORK

1.0 Scope

- 1.1 This chapter covers the requirements for the electrical works associated with heating, air conditioning, ventilation and cold room applications, namely, switch boards, power cabling, control wiring, earthing, p.f. capacitors and remote control-cum-indicating panels. Electric motors are not covered here, as these are covered as part of the respective equipment specifications.

2.0 General

- 2.1 Unless otherwise specified in the tender specifications, all equipments and materials for electrical works shall be suitable for continuous operations on 415 V / 240 V + 10%(3 phase/single phase), 50 Hz. AC system. Where the use of high voltage equipments is specified in particular works, all the respective equipments shall be suitable for continuous operation on such specified high voltage.
- 2.2 All electrical works shall be carried out complying with the Indian Electricity Rules, 1956 as amended to date.
- 2.3 All parts of electrical works shall be carried out as per appropriate CPWD General specifications for Electrical works, namely, Part I (Internal) 2013, Part II (External) 1994 work, and Part IV (Sub-station),2013 all as amended to date.
- 2.4 All materials and components used shall conform to the relevant IS specifications amended to date.

3.0 Switch Boards

- 3.1 The capacity of switch gear, starters etc. shall be suitable for the requirements of loads fed/controlled. Starting currents shall be duly considered in case of motor loads.
- 3.2 Switch fuse units shall be used upto and including 63 A and fuse switch units shall be used for 100 A and above. ACB shall be used for 630 A and above ratings.

- 3.3 All switch fuses/fuse switches dis-connector switches shall be of AC 23 duty as per IS: 4064-1978 as amended upto date. They shall be complete with suitable HRC cartridge type fuses.
- 3.4 Switch boards controlling motors shall house starters for motors, unless otherwise specified. Independent single phasing preventers for each such starter shall be provided. The starter and SPP shall be located adjacent to the controlling switch gear.
- 3.5 One volt meter with selector switch, a set of indicating lamps and fuses for voltmeter and lamps shall be provided at each switchboard. One ammeter with CTS, and selector switch shall be provided with each motor starter. Instruments shall be flush mounted with the panel and have a glass index not higher than 1.5. The instruments and accessories shall be provided whether or not specifically indicated in the tender specifications.
- 3.6 The fabrication of switchboard shall be taken up only after the drawings for the fabrication of the same are approved by the Engineer-in-charge.
- 3.7 Switchboards shall be fabricated as per specifications indicated in sub para above.
- 3.8 The layout of bus bars and cable alleys shall be designed for convenient connections and inter-connections with the various switchgear. Connections from individual compartments to cable alleys shall be such as not to shut down healthy circuits in the event of maintenance work becoming necessary on a defective circuit.
- 3.9 Care shall be taken to provide adequate clearances between phase bus bars as well as between phase bus bars, neutral and earth.
- 3.10 Where terminations are done on the bus bars by drilling holes therein, extra cross section shall be provided for the bus bars. Alternatively, terminations may be made by clamping.
- 3.11 Provision shall be made for proper termination of cables at the switchboards such that there is no strain either on the cables, or on the terminators. Cables connected to the upper tiers shall be duly clamped within the switchboard.
- 3.12 Identification labels shall be provided against each switchgear and starter compartment, using plastic engraved labels.
- 3.13 Metallic danger board conforming to relevant IS shall be fixed on each electrical switchboard.
- 3.14 Switchboard housing only isolators near cooling towers shall be housed in weather proof enclosure. The mounting arrangement shall be as approved by the Engineer-in-Charge to suit the site conditions.

4.0 Power Cabling

- 4.1 Unless otherwise specified, the power cables shall be XLPE insulated, PVC outer sheathed aluminium conductor, armoured cables rated for 1100 V grade. The power cables shall be of 2 core for single phase, 4 core for sizes upto and including 25 sq.mm, 3-1/2 core for sizes higher than 25 sq.mm for 3 phase. Where high voltage equipments are to be fed, the cables shall be rated for continuous operation at the voltages to suit the same.

- 4.2 Power cables shall be of sizes as indicated in the tender specifications. In all other cases, the sizes shall be as approved by the Engineer-in-Charge, after taking into consideration the load, the length of cabling and the type of load.
- 4.3 Cables shall be laid in suitable metallic trays suspended from ceiling, or mounted on walls, or laid directly in ground or clamped on structures, as may be required. Cable ducts shall not be provided in plant rooms.
- 4.4 Cable trays shall be fabricated from slotted angle/solid angles to make ladder type cable tray, designed with adequate dimensions for proper heat dissipation and also access to the cables. Alternatively, cable trays may be of steel sheet with adequate structural strength and rigidity, with necessary ventilation holes therein. In both the cases, necessary supports and suspenders shall be provided by the Air-conditioning Contractor as required.
- 4.5 Cable laying work shall be carried out in accordance with 13.4 (iii) above. The scope of work for the Air-conditioning Contractor shall include making trenches in ground and refilling as required, but excludes any masonry trenches for the cable work.

5.0 Control Wiring

- 5.1 ISI marked steel conduit pipes, wherever used, shall be of gauge not less than 1.6 mm thick for conduits upto 32 mm dia and not less than 2.0 mm thick for higher sizes. All conduit accessories shall be threaded type with substantial wall thickness.
- 5.2 Control cables shall be of adequate cross section to restrict the voltage drop.
- 5.3 In the case of control wires drawn through steel conduits, the wire drawing capacity of conduits as specified under the CPWD General Specifications for Electrical Works (Part I) 1994 shall not be exceeded.
- 5.4 Runs of control wires within the switchboard shall be neatly bunched and suitably supported/clamped. Means shall be provided for easy identification of the control wires.
- 5.5 Control wiring shall correspond to the circuitry/sequence of operations and interlocks approved by Engineer-in-Charge.
- 5.6 In cold storage involving temperatures below zero deg. C, polythene cables shall be used instead of PVC cables.

6.0 Earthing

- 6.1 Provision of earth electrodes and the type of earthing shall be as specified in the tender specifications.
- 6.2 The earth work shall be carried out in conformity with CPWD Specifications for Electrical works (Part-I), Internal 1994.
- 6.3 Metallic body of all medium voltage equipments and switch boards shall be connected by separate and distinct earth conductors to the earth stations of the installations; looping of such body earth conductors is acceptable from one equipment, or switch board to another.

6.4 G.I. plate earthing shall be provided for PTAC plants and reciprocating central AC plants upto 100 TR capacity. Above 100 TR reciprocating units and centrifugal/ screw chilling units copper plate earthing shall be provided.

6.5 The size of earth conductors for body earthing of equipments shall be as under: -

Motors upto & including 10 HP rating	-	2 Nos. 3 mm dia copper wire/ 2 nos. 4mm dia GI wire
12.5 HP to 40 HP	-	2 Nos. 4 mm dia copper wire/ 2 nos. 6mm dia GI wire
50 HP to 75 HP	-	2 Nos. 6 mm dia copper wire/ 2 nos. 25x3mm GI strip
Above 75 HP	-	2Nos. 25mm x 3mm copper strip/ 2 nos. 25x6mm GI strip
Switch boards with incoming rating		
Upto 100 A	-	2 Nos. 3 mm dia copper wire/ 2 nos. 4mm dia GI wire
125 A to 200 A rating	-	2 Nos. 6mm dia copper wire/ 2 nos. 25x3mm GI strip
Above 200 A rating	-	2 Nos. 25mm x 3mm copper strip/ 2 nos. 25x6 mm GI strip

6.6 Armouring of cables shall be connected to the body of the equipments/switch board at both the ends. Compression type glands shall be used for all such terminations in the case of PVC cables.

7.0 Power Factor Capacitors

7.1 PF capacitors shall be provided for all motor loads of 5 HP and above. These capacitors shall come into circuit when the respective motor load is switched on. For this purpose, necessary interconnections between the capacitors and the motors/starters shall be included in the scope of work of the Air-conditioning Contractor.

7.2 The power capacitors shall be of such value as to improve the PF to 0.90 lagging when the motor is running at full load. In the case of large size motors, the capacitors may be made in suitable banks so that the required bank(s) of capacitors may be switched under partial load conditions. Such operations of individual banks shall be automatic.

7.3 Where the PF capacitors are provided in banks, each bank shall be controlled by suitably rated switch gear with HRC fuses.

7.4 The capacitor banks and the controlling switchgear may be fabricated in independent cubical or may form part of the switchboard in the installations. In the latter case, the capacitors are permitted to be mounted on the switchboard, if so desired.

8.0 Remote Control cum Indicating Panel

- 8.1 Panel shall be fabricated from 1.6 mm thick steel sheet. This shall be of freestanding floor mounting type design. This shall be complete with necessary termination arrangements, multicore cables, tag blocks, control transformer, designation plastic labels, double earth studs etc. as required.

9.0 Motor Starter

- 9.1 The motor starter shall conform to IS: 1822 —Motor starters of voltage not exceeding 1000 volts|| and shall be air insulated and suitable for 415 volts, + 10%, 50 Hz., 3 phase AC supply. Enclosures shall have protection of IP 42 for Indoor applications and IP 55 for outdoor applications.
- 9.2 starter for the motor shall be direct on line (D.O.L) for motors up to and including 7.5 H.P. rating and automatic star-delta close transition type for motors of higher ratings unless otherwise specified in the tender specifications. Starters shall be rated for intermittent duty. Starting current should not exceed two times the full load current.
- 9.3 Reciprocating chiller shall be fitted with part winding starter and housed in chiller panel.
- 9.4 The starter shall be mounted on the main electrical control panel/ unit mounted/ self mounted as specified.
- 9.5 Each starter shall be provided with the following protections: -
- a) Thermal overload on all the three phases with adjustable settings,
 - b) Under voltage protection, and
 - c) Independent single phasing preventer. (Current sensing type)
- 9.6 Adequate number of extra NO/ NC contacts for interlocks, indicating lamps etc. shall be provided on the starter/ contactor.

10.0 Painting

- 10.1 All panels shall be supplied with the manufacturer's standard finish painting or as indicated in the Schedule of Work.

11.0 Motor Efficiency

- 11.1 All permanently wired poly-phase motors of 0.375 kW or more serving the building and expected to operate more than 1500 hours per year and all permanently wired poly phase motors of 50 kW or more serving the building and expected to operate more than 500 hours per year shall have a minimum acceptable nominal full load motor efficiency not less than IE3 class as per IS 12615 for Energy Efficient motors.
- 11.2 Motors of horsepower differing from those listed in the table shall have efficiency greater than that of the listed kW motor. See Annexure N.
- 11.3 Motor horsepower ratings shall not exceed 20% of the calculated maximum load.
- 11.4 Motor nameplates shall list the nominal full load motor efficiencies and the full load power factor.

- 11.5 Motor users should insist on proper rewinding practices for rewound motors. If the proper rewinding practices cannot be assured, the damaged motor should be replaced with a new, efficient one rather than suffer the significant efficiency penalty associated with typical rewind practices.
- 11.6 Certificates shall be obtained and kept on record indicating the motor efficiency. Whenever a motor is rewound, appropriate measures shall be taken so that the core characteristics of the motor is not lost due to thermal and mechanical stress during removal of damaged parts. After rewinding, a new efficiency test shall be performed and similar records shall be maintained.
- 11.7 Motors should be installed with soft start energy savers and Variable Speed drives based on the application required.

I.S. SAFETY CODES

I.S. 660 Safety Code for Mechanical Refrigeration

I.S. 659 Safety Code for air conditioning

I.S. 3016 Code of Practice for Fire precautions in welding and cutting operations

I.S. 818 Code of practice for safety and health requirements in electrical and gas welding and cutting operations.

I.S. 5216 Code for safety procedure and practice in electrical works

I.S. 3696 Safety code for scaffolds and ladders

LIST OF APPROVED MAKES

S. No	Description of Item	Approved Makes
1	Electrical Equipment	
1.1	Electrical Panel Board/ Motor Control Centre (Power Coated)	Application Control/ Advance panel/ Trisquare Switchgears
1.2	Electric Motor (TEFC)	Siemens/ Crompton/ Havells/ ABB
1.3	Starters/ Switch gear	Siemens/ L&T/ Group Schneider (MG) France/GE / Legrand
1.4	Miniature Circuit Breaker (MCB)	Siemens/ MDS Legrand/ Hager (L&T)/ GE/ Legrand
1.5	Moulded Case Circuit breaker (MCCB)	Siemens/ L&T/ GE Power/ Group Schneider (MG)NS / Legrand
1.6	Air Circuit Breaker (ACB)	Siemens/ L&T/ GE Power/ Group Schneider (MG)NW
1.7	Earth leakage circuit Breaker (ELCB)	MDS Legrand/ Hager (Larsen & Toubro)/ GE Power
1.8	Push Button Starter	Siemens/ L&T/Group Schneider (MG)
1.9	Auxiliary Relays/ Contactors	Siemens/ L&T/ Group Schneider (MG) France/ GE Power
1.1	Line Type Fuse	Siemens/ L&T/GE
1.11	Timer	Siemens/ L&T/GE
1.12	Terminal Block	Elmax
1.13	Voltmeter/ Ammeter (Digital)	Automatic Electric/ L&T/ Siemens / Enercon
1.14	Indicating Lamps (LED Type)/ Push Button	Siemens/ L&T/ Vashnio
1.15	Single Phase Preventor (Current Base)	L&T/ Minlec
1.16	Electronic Digital Meters (A/V/PF/Hz/KW/KWA) With Led Display	Enercon System Pvt. Ltd/ L&T
1.17	Overload Relays with built in single phase preventer	L&T/ Minlec/Siemens/Group Schneider (MG) France/ GE Power
1.18	Selector Switches/ Toggle Switch	Siemens/ L&T/ Kaycee
1.19	Change over switch	Siemens/ L&T/ HH Elcon/HPL-Socomech
1.2	Protection Relay	Alstom/ L&T/ Siemens/ Legrand
1.21	Control Transformer/ Potential Transformers	Precise/ Gilbert & Maxwell/AE
1.22	Current Transformer (Epoxy Cast Resin)	Precise/ Gilbert & Maxwell/ AE
1.23	Rubber Mats 1199 V, 6 mm thick (ISI approved)	Jyoti
1.24	Weather Proof Boxes (IP55)	Advance/ Adlec/ Milestone/ Legrand
1.25	Cable Trays	Ricco/ Slotco/ M. M Enterprises
S. No.	Description of Item	Approved Makes
2	Cables & Accessories	

2.1	Control Cables	Skytone/ Universal/ Delton/ Bonton
2.2	XLPE / PVC Insulated Aluminum Conductor Armoured Power Cables	Skytone/ Universal/ Delton/Bonton
2.3	Communication Cable	Fusion/ Comscope / Contemp
2.4	Cable Gland Double Compression with Earthing Links	Power/ Commet/ Gripwell/ Baliga Lighting Ltd./ Dowell's Electromech
2.5	PVC Insulated Copper Conductor Stranded Flexible Wires	Finolex/ National Cables - NC/ polycab/ Skytone
2.6	PVC Conduit & Accessories (ISI Approved)	BEC/ Precision/ D Plast/ Polypack
2.7	MS/ GI Conduit (ISI Approved)	BEC/ AKG/ STEEL KRAFT
2.8	Accessories for MS/GI Conduit (ISI Approved)	Sharma Sales Corporation/ Super Sales Corporation
2.9	Bimettalic Cable Lugs	Hax (Brass copper Alloy India Ltd)/ Dowell's (Biller india Pvt. Ltd.)
2.1	Lugs (Tinned Copper)	Dowell
3	Ducting & Grilles	
3.1	Grilles/ Diffusers/ Nozzles	Caryaire/ Ravistar/ Mapro/ Tristar/ Crystal
3.2	Fire Dampers / Motorized VCD/ Pressure Relief Dampers	Systemaire/ Conaire/ Trox/ Ruskin Titus
3.3	Fire Dampers motors	Belimo/Seimens
3.4	Thermafusers	Airmaster / Trox/ Ruskin Titus
3.5	Factory fabricated duct	Rolastar/ Eco Duct/ Zeco/ Waves/ Ductofab
3.6	Duct flange	Rolamate/Eco Duct / Zeco/ Ductofab/ Waves
3.7	Self Adhesive Sealing Gasket for Ducts	Prima Seal/ Air Flow/ Trocellen
3.8	Hessian (Fire treated)	Navair/ Pyroguard
3.9	Stick Pins	Prima Seal/ Air Flow
3.1	VCD/ Gravity louvers/ Exhaust& fresh air louvers	Systemaire/ Conaire/ Trox/ Ruskin Titus
4	Axial Flow Fans	Kruger/Systemaire/ Greenheck



ANNEXURE- 1B

**TECHNICAL SPECIFICATIONS
FOR
CIVIL AND INTERIOR WORKS**

Phase -I (2BHK), Auramah valley,
Nalderah, Shimla

PART A: CIVIL WORKS

PART B: INTERIOR WORKS

**&
LIST OF APPROVED MAKES**

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SCOPE OF WORK

I – EARTH WORK

1.1.0 Site Preparation

- 1.1.1 The **Contractor** shall remove all vegetation and foreign materials from the area as instructed by the **Engineer -in-charge**. The removed materials shall be burnt and taken to the approved disposal areas on or near the job site as directed by the **Engineer -in-charge**. The **Contractor** shall establish and maintain a reference Bench Mark and shall project all future benchmarks from this reference point.

1.2.0 Site Preparation & Excavation

- 1.2.1 This section of the specification covers excavation for foundations, basements, drains, culverts and underground facilities as shown on the drawings and as directed. The **Contractor** shall furnish all labour, plant and equipment to complete the work indicated or specified herein. **Care shall be taken to not damage the existing structures which are to be retained while excavating for fresh foundations.**

- 1.2.2 The **Contractor** shall remove all vegetation, hardscape and foreign materials from the area as instructed by the **Engineer -in-charge**. The removed materials shall be burnt and taken to the approved disposal areas on or near the job site as directed by the **Engineer -in-charge**. The **Contractor** shall establish and maintain a reference Bench Mark and shall project all future benchmarks from this reference point.

The contractor shall remove roots, break and remove old concrete or brick foundations, drains or manholes, empty and clear all old wells, cess pools, ponds and remove organic materials found during progress of excavation, seal up the services connections where required, remove all contaminated earth and fill in voids with hard materials and ram it well the cleared areas shall be maintained free from vegetation and any vegetation growth during the progress of work. All materials obtained from clearing shall be suitably disposed off as directed by the Engineer -in-charge. Any jungle clearance if required will be deemed to be included in the rates.

- 1.2.3 The **Contractor** shall excavate & remove material of any nature and excavate to the width, depth and inclinations as per the drawings. The **Contractor** shall arrange necessary tools and plants required by the nature of materials to be excavated and also arrange to maintain the bottom and sides of the excavation true to shape and levels as per drawings. Undercutting shall not be permitted.
- 1.2.4 When machines are used for excavations, thin layer shall be excavated by such implements that will leave the strata at the required final level in its natural condition.

- 1.2.5 If the bottom of any foundation is found to be soft, unsound or unstable, the **Contractor** shall inform the **Engineer -in-charge** and shall excavate the same as directed by the **Engineer -in-charge**. No foundation shall rest on loose/filled-up earth.
- 1.2.6 Every precaution shall be taken against slips and falls of earth, clay, sand or other materials in the excavations, but in the event of any such occurring, the **Contractor** shall make it good at his own expense. The **Contractor** shall be held responsible for any damage to any part of the work by the collapse of sides of excavation and this shall be made good by the **Contractor** at his own cost.
- 1.2.7 The **Contractor** shall plank and strut at the sides of excavation as required and wherever excavation requires bracing, strutting or shoring etc. the **Contractor** shall submit to the **Engineer -in-charge**, the drawings showing the arrangement and will do the needful at his own expense. This however will not relieve the **Contractor** from his responsibility for the safety and adequacy of bracing, strutting etc.
- 1.2.8 The **Contractor** shall control the grading in the vicinity of the excavation so that the surface of the ground is properly sloped or diked to prevent surface water from running in to the excavated areas during construction.

Wherever water table is met with during excavation the **Contractor** shall immediately inform the **Engineer -in-charge**. As per the directions of the **Engineer -in-charge**, the **Contractor** shall dewater and maintain the water table below the bottom of the excavation level during excavation, concreting and back filling. All water which gets accumulated in the excavated trenches during the progress of the works, from whatsoever cause or source, shall be pumped out as directed by the **Engineer -in-charge** at no extra cost to the **Owner**.

The rates quoted are for all types of hard /dense ordinary soil met at site, inclusive of cost of planking, shoring and de-watering.

1.3.0 Returning, Filling and Ramming

After completion of foundations, footings, basements and walls and other construction below the elevation of the final grades, and prior to back filling all forms of temporary shoring, timber, cement bags etc. shall be removed and the excavation cleaned off all trash, debris and perishable materials. Back fill shall begin only after the approval of the **Engineer -in-charge**.

Back filling shall be placed in horizontal layers not exceeding 200 mm in thickness and rammed, watered as required to consolidate properly. Before a new layer is laid, existing pods or other unevenness in the surface of the layer shall be removed and the surface shall be roughened by harrowing or ploughing to obtain good bond with the material to uniform thickness. Each layer shall be compacted to proper moisture content and with such equipment as may be required to obtain a density equal to **or greater than 94% of** the dry density of the soil as determined by the laboratory tests. Only consolidated earth volume shall be considered for payment and no allowance shall be made for bulking of earth etc.

Trucks or heavy equipment for depositing or compacting back fill shall not be used within 1.5 meters of building walls, or other facilities that may be damaged by their weight or operation. The methods of compaction shall be approved by the **Engineer -in-charge**. The filling under the floor shall be in layers not exceeding 150 mm in thickness. Each layer shall be thoroughly consolidated by watering and ramming. When the filling has reached an appropriate level, the filled area shall be flooded with water and the fill shall be allowed to settle. When the water has been absorbed by the soil, the whole area shall be finally rammed and dressed to the required level. Back fill adjacent to the pipes shall be hand placed, free of stones, concrete etc. compacted uniformly on both sides of the pipes. If sufficient quantity of suitable material is not available at the site, the same shall be brought to site from outside and the same shall be used after approval by the **Engineer -in-charge**. Stone/boulders, if obtained from excavation, will not be used in backfill.

On completion of the structures, the surrounding earth shall be accurately finished to the line and grade as shown on the drawings.

The **Contractor** shall arrange to transport surplus excavated materials and stack it or dispose it off at a place as directed by the **Engineer -in-charge**.

1.4.0 Anti-termite Treatment

Chemicals that may be used are Enosulphan, Chloropyrophas or any other approved brand as allowed by statutory authority/ Engineer-in-charge and diluted as per of the manufacturer's instructions. Treatment shall comprise of the following and shall conform to IS: 6313-1981 (Part-II).

- a) Foundation trenches treatment: After digging the foundation trenches and before laying concrete, holes shall be drilled 30 cms. apart and impregnated with the insecticide solution in the soil. Both side of the trench are to be sprayed and in case of isolated pits, all four sides of the pit are to be sprayed @ 5 liters per sqm of the chemical emulsion.
- b) Exterior trenches treatment: All sides of masonry, RCC, concrete that will come in contact with the soil in back-fill will be sprayed with the solution of insecticide before back-filling @ 7.5 liters per sqm of the chemical emulsion.
- c) If so directed, a chemical barrier one metre wide & 500 mm deep in the filled up earth all - round the external perimeter of the basement / building shall be made following the above mentioned specifications.
- d) It has to create a chemical barrier under and all around the column pits , wall trenches , basement excavation , top surface of plinth filling , junction of wall & floor , along the external perimeter of the building , expansion joints , surrounding of pipes & conduits etc., complete and as recommended by the manufacturer . The work shall be carried by speculated agencies with 10 years guarantee against Anti Termite Treatment works executed .

II – CONCRETE: PLAIN AND REINFORCED

2.1.0 Cement

The cement used shall be any of the following types with the prior approval of the **Engineer -in-charge**.

- | | |
|-----------------------------|-----------------|
| a) Ordinary Portland Cement | IS 8112, 112269 |
| b) Portland Pozzolana | IS 1489 – 1976 |

Unless otherwise specifically permitted ordinary Portland cement shall only be **used 53 grade**. Cement shall be used in the order in which it is received. Cement bags in storage for more than 3 months shall be re-tested & approval for use from Engineer -in-charge taken before use.

2.1.1 Testing

If the cement is not supplied by the **Owner**, a sample shall be taken once for every 1000 bags received at site. Tests shall be carried out for fineness, initial and final setting time and compressive strength as per IS 4031. The results shall be submitted to the **Engineer -in-charge** for approval. The methods and the procedure of sampling shall be in accordance with IS 3535. The **Engineer -in-charge** may specify any other form of sampling and testing including chemical analysis as per IS 4032, if the quality of the cement is found to be unacceptable. The cost of these tests shall be borne by the **Contractor**. The additional tests like the chemical analysis of the cement etc. shall be borne by the **Contractor**, if required, even in case cement is found conforming to the specifications.

2.2.0 Fine Aggregate

- 2.2.1 It shall pass through IS sieve no. 4.75 mm test sieve, leaving a residue of not more than 5%. The sand shall consist of natural sand, crushed stone sand or combination. The sand shall be hard, durable, chemically inert, clean and free from harmful impurities. It shall be washed, if required. The sand is graded into four zones as under:

I.S. Sieve Designation	Zone I	Zone II	Zone III	Zone IV
10 mm	100	100	100	100
4.75 mm	90-100	90-100	90-100	95-100
2.36 mm	60-95	75-100	85-100	95-100
1.18 mm	30-70	55-90	75-100	90-100
600 micron	15-34	35-59	60-79	80-100
300 micron	5-20	8-30	12-40	15-50
150 micron	0-10	0-10	0-10	0-15

2.2.2 Fine Sand

Fine sand shall be in Grading Zone IV and its fineness modulus shall not be less than 1.0.

2.2.3 Coarse Sand

It shall fall in Grading Zone I to III and its fineness modulus shall not be less 2.5.

2.2.4 Testing

Fine aggregate shall be tested as per IS – 2386 (1963)

2.3.0 Coarse Aggregate

- 2.3.1 It shall consist of natural gravels, broken stone or other suitable materials. It shall be hard, strong and durable and shall be clean and free from clay and other deleterious materials. The aggregate shall be washed, if necessary. Graded coarse aggregate of nominal size shall be used conforming to requirements given below.

I.S. Sieve Designation	40mm	% Passing 20 mm	12.5 mm
40 mm	95-100	100	100
20 mm	30-70	95-100	100
12.5 mm	-	-	100
10 mm	10-35	25-55	90-100
4.75 mm	0-5	0-10	0-10
2.36 mm	-	-	-

2.4.0 Water

Water from approved source shall be used for the Works. It shall be clean and free from any deleterious matter in solution or in suspension and be obtained from an approved source. The quality of water shall conform to I.S. 456. The water shall be stored in drums and tanks or cisterns to the approval of the **Engineer -in-charge**. Care shall be exercised to see that water is not contaminated in any way.

2.5.0 Mixers and Vibrators

- 2.5.1 For major structural concreting work, the **Contractor** shall provide automatic weigh-batching plant of 25-40cum per hour capacity. The weigh-batch plant shall conform to IS 4925.
- 2.5.2 The **Contractor** shall provide concrete mixers, batch type concrete mixer (IS 1791) and roller pan type mixers (IS 2439) with hopper only or as may be instructed by the **Engineer -in-charge**.
- 2.5.3 He shall also provide vibrators of the following types as required for concreting:
Immersion type (IS 2505), Screed board type vibrators (IS 2506) and form vibrators (IS 4656).

2.6.0 Concrete Mixes

- 2.6.1 The concrete shall be of specified grade with characteristic strength conforming to IS 456, unless otherwise specified.

2.7.0 Design of mixes

- 2.7.1 The **Contractor** is entirely responsible for the design of the Concrete mixes. The design is however to be approved by the **Engineer -in-charge** at least 2 weeks before commencing any concreting works. The **Contractor** shall make trial mixes using samples of coarse aggregates, sand, water and cement, typical of those to be used in the Works and which have been tested in an approved laboratory. A clean dry mixer shall be used and the first batch shall be discarded. The required average strengths at 28 days for which various mixes shall be as per IS 456.

- 2.7.2 The mixes are designed to yield mean strengths (f'_{cm}) greater than the corresponding specified characteristic strengths (f'_{ck}) as indicated in the table above. The difference between f'_{ck} and f'_{cm} is called the current margin. The value of the current margin has been set at 9 N/sqmm for all grades of concrete. The concrete mixes shall be designed on the basis of required strength, desired workability, the maximum size of the aggregate and also upon the various grades of cement. Accordingly the required quantity of cement shall be ascertained. The **Contractor** may be allowed to use either approved plasticizers or increased cement content to achieve the required strengths at his own cost. Minimum quantity of cement to be used in a specific grade of mix shall not be less than as specified in IS:456.

Wherever in the BOQ, control concrete mix as well as nominal mix is defined, control mix is to be adopted unless otherwise permitted by **Engineer -in-charge**. However consumption of cement in control mix shall not be more than nominal mix. If so, theoretical consumption shall be accounted for by adopting factor of cement consumption as per nominal mix.

- 2.7.3 For each grade, a total no. of 18 cubes shall be made. Of these 18 cubes made, not more than 6 may be made on any day, further of the 6 cubes made in one day not more than 2 cubes may be made from any single batch. Of these 9 cubes, each representing a batch of concrete shall be tested at the age of 7 days and the remaining 9 cubes shall be tested at the age of 28 days. The making of the cubes, their curing, storing, transporting and testing shall be in accordance with IS-516. The test shall be carried out at site laboratory or any designated laboratory approved by the **Engineer -in-charge**.
- 2.7.4 If the average strength of the concrete cube falls below the required strength, fresh preliminary mixes for that grade shall be made as before, until the trial mix yields cubes of compressive strength at 28 days greater than the required average strength at that age.
- 2.7.5 Whenever there is a significant change in the quality of any of the ingredients for concrete, the **Contractor shall** carry out fresh trial mixes. All costs for trial mixes and tests shall be to the **Contractor's** account and held to be included in the Contract rates.
- 2.7.6 Before commencing the works, the **Contractor** shall submit to the **Engineer -in-charge** for approval, full details of all preliminary trial mixes and tests.

- 2.7.7 When the proportions of a concrete mix have been approved by the **Engineer -in-charge**, the **Contractor** shall not vary the quality or source of the materials or the mix without the written approval of the **Engineer -in-charge**.

2.8.0 Concrete Cube Tests

- 2.8.1 The quality of the hardened concrete will be verified by the following procedure:

- a) The **Engineer -in-charge** shall select random batches of concrete for examination without any warning to the **Contractor** and sampling will generally be done at the point of discharge from the mixer.
- b) From the batches thus selected 6 concrete cubes shall be made in accordance with IS codes. However not more than 2 cubes be made from any single batch. Of these 6 cubes thus made, 3 cubes (each cube representing concrete of different batches) shall be tested at 7 days and the remaining 3 cubes shall be tested at 28 days.
- c) All cubes shall be made, cured, stored, transported and tested in accordance with IS codes. The tests shall be carried out in the Site Laboratory / a laboratory approved by the **Engineer -in-charge**.
- d) At least 6 cubes shall be made on each day's concreting until 60 cubes have been made for each grade of concrete. This is in the initial period.
- e) After the initial period, subject to the acceptance of the **Engineer -in-charge**, the frequency at which the cubes shall be made be reduced as follows :

(1 set = 6 cubes, each pair representing concrete from a different batch)
At least one set for each day's concreting consisting of:

One set for 10 cum or part thereof of concrete for critical structural elements like main beams, columns, masts, large cantilevers, plus one set for every 40 cum or parts thereof for all other elements.
- f) If concrete is batched at more than one point simultaneously, the above frequency of making cubes shall be allowed at each point of batching. 3 cubes of each set shall be tested at 7 days and the remaining 3 cubes shall be tested at 28 days from the day of casting the cubes.

2.9.0 Acceptability Criteria

- 2.9.1 The strength requirement of any particular grade of concrete will be considered satisfactory if the 28 days' compressive strength of individual sets (each set consisting of 3 cubes) and of individual cubes satisfy the following requirements:
- a) For the first five sets, the average strength determined from any group of three consecutive test cubes exceeds the specified characteristic strength (f'_{ck}) by not less than 0.8 times the current margin, only one individual cube test result in any set may fall below the specified characteristic strength provided that this value is not less than 95% of the specified characteristic strength.

- b) Provided that the average strength of any fifteen consecutive cubes exceeds the specified characteristic cube strength by at least 0.9 times the current margin. All the subsequent test results may be considered acceptable if:

The average strength as determined from any group of three consecutive cubes exceeds the specified characteristic strength (f'_{ck}) by not less than 0.6 times the current margin. Only one individual cube test result in any set may fall below the specified characteristic strength provided that this fall value is not less than 9% of the specified characteristic strength.

- 2.9.2 Whenever a mix is redesigned due to a change in the quality of aggregates or cement or for any other reason it shall be considered a new mix and initially subject to the acceptability criteria in 2.8.1 above.
- 2.9.3 The above specification is based on an assumed standard deviation of 5.5 N/sqmm, and a probability of concrete strengths falling below the desired minimum strength of 1 in 20. In case quality control is very good at the site and the cube test results consistently show a standard deviation better than the standard deviation assumed here the **Engineer -in-charge**, may in his discretion, reduce the target strength for any particular grade of concrete, and in consequence, the current margin.
- 2.9.4 If the concrete produced at site does not satisfy the above strength requirements, the **Engineer -in-charge** will reserve the right to require the **Contractor** to improve the method of batching, the quality of the ingredients and redesign the mix with increased cement content if necessary. The **Contractor** shall not be entitled to claim any extra cost for the extra cement used for the modifications stipulated by the **Engineer -in-charge** for fulfilling the strength requirements specified.
- 2.9.5 It is the responsibility of the **Contractor** to design the concrete mixes by approved standard methods and to produce the required concrete conforming to the specifications and the strength requirements approved by the **Engineer -in-charge**. It is expected that the **Contractor** will have competent staff to carry out this work.

2.9.6 Non-destructive Tests

Non-destructive tests are used to obtain estimation of the properties of concrete in the structure. The methods adopted include ultrasonic pulse velocity [see IS 13311 (Part 1)], probe penetration, pullout and maturity. Non-destructive tests provide alternatives to core tests for estimating the strength of concrete in a structure, or can supplement the data obtained from a limited number of cores. These methods are based on measuring a concrete property that bears some relationship to strength. The accuracy of these methods, in part, is determined by the degree of correlation between strength and the physical quality measured by the non-destructive tests.

2.9.6.1 Frequency

The minimum frequency of sampling of concrete of each grade shall be in accordance with the para 15.2.2 of IS 456:2000. The location of test shall be decided by the Engineer -in-charge (consultant) in consultation with the Client

2.10 Failure to meet specified requirements

- 2.10.2 If from the cube test results it appears that some portion of the Works has not attained the required strength, the **Engineer -in-charge** may order that portion of the structure be subjected to further testing of any kind whatsoever as desired by the **Engineer -in-charge**, including, if so desired by him, full load testing of the suspected as well as the adjacent portions of the structures as specified in the Conditions of Contract. Such testing shall be at the **Contractor's** cost. The **Engineer -in-charge** may also reject the work and order its demolition and reconstruction at the **Contractor's** cost.
- 2.10.3 If the strength of the concrete in any portion of the structure is lower than the required strength, but is considered nevertheless adequate by the **Engineer -in-charge** so that demolition is not necessary, the work shall be devalued by the **Engineer -in-charge** to that extent and amount of devaluation recovered from **Contractor's** RA bills.

2.11 Admixtures

Approved admixtures and air entraining agents may be permitted at no extra cost by the **Engineer -in-charge** at his discretion provided that the strength requirements are not affected by their use.

2.12 Volume batching with Weight control

Where volume batching with weight control is permitted by the **Engineer -in-charge**, all measurements of coarse/fine aggregates and waster shall be by volume and of cement by the bag, controlled by regular periodic weightings. In order to ensure correct proportioning, following precautions shall be taken:

- a) The **Contractor** shall maintain at site a suitable number of platform balances similar to the balances used for weighting luggage at railway platforms, capable of weighing upto 200 kg to the nearest 100 gms; the balance shall be used for weighing cement bags and occasional boxes of sand and coarse aggregate as specified below.
- b) The **Contractor** shall provide the mixer operator with standard measures for measuring the water to be used in the mix.
- c) The quantity of water to be added to the mix shall be approved by the **Engineer -in-charge** and may be adjusted as frequently as necessary in order to allow for the moisture content of the sand or coarse aggregate and workability desired. On no account shall the **Contractor** allow more water to be added to the mix than that specified by the **Engineer -in-charge**. Concrete containing water in excess of that specified shall be rejected and not allowed for use in the works.
- d) Fine and coarse aggregates shall be measured by volume. The size of measuring boxes or the depth to which they are filled or both shall be adjusted to obtain the correct weight of each material specified by the **Engineer -in-charge** for that mix.
- e) Every tenth measuring box of aggregate shall be weighed on the balance to ensure that filling of boxes is being uniformly done. Adjustment shall be made from time to time in the amount of each box filled to take into account variations in moisture content and consequent bulking of sand.

- f) More frequent weighing of boxes, particularly of sand if found to vary considerably in moisture content and bulking, may be required by the **Engineer -in-charge** and shall be done by the **Contractor** without additional cost.

2.13 Weigh Batching

All structural concrete shall be weigh batched using automatic weigh batching plant. Alternatively, if permitted, all concrete ingredients except water shall be batched by weight using a weigh batcher conforming to IS-2722 portable swing weigh batchers for concrete. Batching shall be done to an accuracy of not less than 500 gms and the batcher shall be tested for accuracy of calibration before commencement of the works and at least once a week thereafter or more frequently, if so required, by the **Engineer -in-charge**. Water shall be batched by weigh or by volume measures as approved by the **Engineer -in-charge**. The method of batching shall be such as will ensure accuracy to 0.5 litres or better.

2.14 Placing Temperature

- 2.14.1 During extreme temperatures, high or low, the concreting shall be done, as per procedures set out in IS 7861 (Part I & II). The aggregate shall be kept under shades and it shall be sprinkled with water for sufficient time before concreting in order to ensure that the temperature of these ingredients is as low as possible prior to batching. The mixer and batching shall also be kept under shades and if necessary painted white in order to keep their temperatures as low as possible. The placing temperature of concrete shall be as low as possible in warm weather and care shall be taken to protect freshly placed concrete from overheating by sunlight in the first few hours of its laying. The time of the day selected for concreting shall also be chosen so as to minimize placing temperature. In case of concreting in exceptionally hot weather the **Engineer -in-charge** may in his discretion specify the use of either ice flakes or chilled water for mixing the concrete.

2.15 Transporting, placing, compacting and curing

- 2.15.1 Transporting, placing, compacting and curing of concreting of any portion or section of the works shall be carried out in one continuous operation and no interruption of concreting work will be allowed without prior approval of the **Engineer -in-charges**.
- 2.15.2 The concrete shall be compacted with mechanical vibrators and over-vibration shall be discouraged until the air bubbles cease to come to the surface.

2.16 Construction Joints

- 2.16.1 Construction joints in concrete work shall be made as directed by the **Engineer -in-charge**. Where vertical joints are required, these shall be shuttered as directed and not allowed to take the natural slope of the concrete.
- 2.16.2 Before fresh concrete is placed against a vertical joint, the old concrete shall be chipped, cleaned and moistened. Where required, suitable expansion joints shall also be provided as directed by the **Engineer -in-charge**.

- 2.16.3 When a horizontal construction joint is formed, provision shall be made for interlocking with the succeeding layer by the embedment of saturated wooden blocks or strips bevelled on four sides to facilitate their removal. Prior to the next pour the wooden pieces shall be loosened and removed in such a manner as to avoid injury to the concrete.

2.17 Cracks

If any structural crack develops in the concrete construction, the Contractor shall dismantle the construction, carry away the debris, replace the construction and carry out all consequential work thereto at his own cost.

2.18 Defective Concrete

Should any concrete be found honeycombed or with hair-line shrinkage cracks, or in any way defective, such concrete shall on the instruction of the **Engineer -in-charge**, be cut out by the **Contractor** and made good at his own cost.

2.19 Exposed faces, Holes and Fixtures

On no account shall concrete surfaces be patched or covered up or damaged concrete rectified or replaced until the **Engineer -in-charge** has inspected the Works and issued written instructions for the rectification. Failure to observe this procedure will render that portion of the works liable to rejection which has failed to meet specified strength requirements. Holes for foundation or other bolts or for any other purposes shall be moulded and steel angles, holds fasts or other fixtures shall be embedded, according to the drawing or as instructed by the **Engineer -in-charge**.

2.20 Finishes

Unless otherwise instructed the face of the exposed concrete placed against formwork shall be rubbed down immediately on removal of the formwork to remove irregularities. The face of the concrete for which the form work is not provided other than slabs shall be smoothed with a float to give a finish equal to that of the rubbed down face, where form work is provided. Faces of concrete requiring surface treatment shall be plastered in mix of 1:4 of 5mm thickness.

2.21 Measurement

All concrete and reinforced cement concrete items are inclusive of the cost of formwork and only reinforcement shall be paid for separately unless specified otherwise. The volume of concrete measured shall include that occupied by:

- a) Reinforcement and other metal sections.
- b) Cast-in components each less than 0.01 cum in volume.
- c) Rebates fillets or internal splays each less than 0.005 Sqm in cross-sectional area.
- d) Pockets and holes not exceeding 0.01 cum in volume.
- e) For M15 and below concrete, no payment shall be made for any shuttering used, if any.

III - FORMWORK

- 3.1.0** Form work shall include all forms, moulds, sheeting, shuttering planks, walers, poles, post, shores, struts and strutting, ties, uprights, wallings, steel, bolts wedges and all other temporary supports to the concrete during the process of setting.

3.2.0 Design

Formwork shall be designed and constructed so that the concrete can be properly placed and thoroughly compacted to obtain the required shape, position and level subject to specified tolerances and got approved from the Engineer -in-charge. It is the responsibility of the **Contractor** to obtain the results required by the **Engineer -in-charge**, whether or not some of the works is sub contracted. Approval of the proposed formwork by the **Engineer -in-charge** will not diminish the **Contractor's** responsibility for the satisfactory performance of the formwork, nor the safety and the coordination of all operations.

3.3.0 Formwork for exposed surfaces

- 3.3.1** The facing form work as approved by **Engineer -in-charge** in writing, shall generally be made with materials not less than the thickness mentioned below:

- a) Plain slab soffits, and sides of beams, girders, joists and ribs and sides of walls, fins, parapets, pardas, sun-breakers etc. shall be made with:
- Steel plates not less than 3 mm thick of specified sizes stiffened with a suitable structural frame work, fabricated true to plane.
 - Timber planks of 20 mm actual thickness and of specified surface finish, width and reasonable length.
 - Ply wood boards not less than 12 mm thick (IS 4990 - Specification for plywood for concrete shuttering work) or 6 mm thick with 20 mm thick timber plank backing, of specified sizes stiffened with a suitable timber frame work.
- b) Bottoms of beams, girders and ribs, sides of columns shall be made with:
- Steel plate 3 mm thick of specified sizes stiffened with a suitable structural frame work, fabricated true to plane.
 - Timber planks of 35 mm actual thickness and of specified surface finish, width and reasonable length.
 - Plywood plates not less than 12 mm thick of specified sizes stiffened with a suitable timber framework.

3.4 Erection of Form work

3.4.1 The following shall apply to all formwork:

- a) To avoid delay and unnecessary rejection of the shuttering, the **Contractor** shall obtain the approval of the **Engineer -in-charge** for the design of forms and the type of material used before fabricating the forms.
- b) All shutter planks and plates shall be adequately backed to the satisfaction of the **Engineer -in-charge** by a sufficient number and size of walers or form work to ensure rigidity during concreting. All shuttering shall be adequately strutted, braced and propped to the satisfaction of the **Engineer -in-charge** to prevent deflection under dead weight of concrete and superimposed live load of workmen, materials and plant and to withstand vibrations. In case props are supported on a floor slab underneath, all the floors below the member / slab being laid shall be supported by designed propping unless the **Contractor** establishes adequacy of these floors and that propping may be dispensed with. For any damage on this account, sole responsibility will be of the **Contractor**. No joints in the props shall be allowed.

3.5 Vertical props shall be supported on wedges or other measures shall be taken where the props can be gently lowered vertically during removal of formwork. Props for an upper lowest prop shall bear on a sufficiently strong area.

- a) Care shall be taken that all formwork is set plumb and true to line and level or camber or batter where required and as specified by the **Engineer -in-charge**.
- b) Formwork shall be so arranged as to permit removal of forms without jarring the concrete. Wedges, clamps and bolts shall be used wherever practicable instead of nails. The formwork for beams and slabs shall be so erected so that forms on the side of the beams and the soffit of slabs can be removed without disturbing the beam bottoms or props under beams.
- c) Surfaces of formwork in contact with concrete shall be oiled with a mould oil of approved quality or clean diesel oil. If required by the **Engineer -in-charge** the **Contractor** shall execute different parts of the work with different mould oil to enable the **Engineer -in-charge** to select the most suitable. The use of oil that results in the blemishes to the surface of the concrete shall not be allowed. Oil shall be applied before reinforcement has been placed and care shall be taken that no oil comes in contact with the reinforcement while it is being placed in position. The formwork shall be kept thoroughly wet during concreting and the whole time that it is left in place.
- d) Formwork shall be continuously watched during the process of concreting. If during concreting, weakness develops and form work shows any distress the work shall be stopped and remedial action taken immediately.

3.6 **Exposed Concrete work**

Exposed concrete surfaces shall be even and smooth, originally as stripped without and finishing or rendering. Where directed by the **Engineer -in-charge**, the surface shall be rubbed with carborundum stone immediately on striking the forms. The **Contractor** shall exercise special care and supervision of form work and concreting to ensure that the cast members are made true to their sizes, shapes, and positions and to produce the surface patterns desired. No honeycombing

shall be allowed. Honeycombed parts of the concrete shall be removed by the **Contractor** as directed by the **Engineer -in-charge** and fresh concrete placed without any extra cost, as directed by the **Engineer -in-charge**. All materials, sizes, and layouts of formwork including the locations for their joints shall have the prior approval of the **Engineer -in-charge**.

3.7 Camber

Form and false work shall be generally cambered as indicated in drawings for works over 4 m span.

3.8 The tolerances and the age of concrete and removal of formwork shall be as per IS :456.

3.9 Stripping of Form work

Form work shall be removed carefully without jarring the concrete. Concrete surfaces to be exposed shall be rubbed down with carborundum stone to obtain a smooth and even finish. Where the concrete requires surface treatment, it shall be hacked immediately all over.

3.10 For multistoreyed buildings, the floors may need re-propping to support the loads of the upper floors under construction. The extent of such re-propping shall be as that directed by the **Engineer -in-charge** (this does not generally exceed one-fourth of the props provided above). Such props shall be deemed to have been included in the **Contractor's** rates.

3.11 The **Contractor** shall not be permitted reuse of timber facing form work brought new on the works more than 5 times for exposed concrete form work and 8 times for ordinary form work. Even these 5 or 8 uses respectively shall be permitted only if forms are properly cared for, stored and the ones which go bad are repaired after each use. The **Engineer -in-charge** may, in his absolute discretion, ask for removal from the site of any forms he considers unfit for use for particular item and other brought on the site will be proportionately allowed fewer uses as decided by the **Engineer -in-charge**. Use of different quality boards or the use of old and new boards in the same form work shall not be allowed.

3.12 Mode of Measurement

3.12.1 Only where form work is specified to be paid for separately, measurement shall be of the area of shuttering actually in contact with RCC/PCC requiring shuttering including curves, angles, splays, mitres, bevels etc., for which nothing extra shall be allowed. The rates shall be inclusive of all work connected with provision of form work, its erection and removal and treatment of the concrete surface immediately after the removal of the form work.

3.12.2 No extra payment shall be made for holes to be made in form work for inserting electrical conduits, hooks for fans and plumbing work or leaving chases for any work.

3.12.3 Where boxes or pockets are required to be formed in the concrete, they will be paid for separately as specified in the Bill of Quantities, but in measuring the area of concrete surface shuttered, no

deduction will be made for opening upto 0.4 sqm. For voids larger than 0.4 sqm the surface of form work forming the voids shall be paid at the rates of form work set out in the schedule and the area of voids deducted from the face area of shuttering.

- 3.12.4 No deduction shall be made from form work of main beams where the secondary beam intersects it. Form work to secondary beams shall be measured upto the sides of the main beams. No deduction shall be made from the form work to stanchion or column castings at intersections of beams.
- 3.12.5 No payment shall be made for temporary form work used in concreting, nor for joints or bulkheads, in floors, or elsewhere, whether such joints are to be covered later with concrete or bitumen mastic or other material as approved by the **Architect**.

IV - NIL

5.0 BURNT CLAY BRICKS

- 5.1 The bricks used shall conform to IS: 1077-1976 of size 25 cm x 11.5 cm x 7.5 cm. All bricks shall be chamber burnt bricks, sub-class 'A'. Samples should be got approved before the same is incorporated in the Works. Bricks shall be sound, hard and well burnt with sharp corners, uniform sizes and regular shapes, free from cracks, stone floats or modules of lime and other defects and shall emit a clear ringing sound when struck. They shall be uniform in colour and shall not be broken, cracked, stratified, under burnt or over burnt; the minimum compressive strength of the bricks shall be 75 kg / sqm. No brick after 24 hours of immersion in water shall absorb more than 20% of its own weight and shall not show any appreciable efflorescence either in dry or in wet state.
- 5.3 The Contractor shall construct brickwork to the respective dimensions, thickness and height as shown on the drawings. All bricks shall be thoroughly soaked in water before using till the bubbles cease to come up. All brick work shall be built in English bond and half brick walls and casing to pipes chase etc., in stretcher bond with frogs upward. No half or quarter brick shall be used except where required for closer. Joints in brick work shall not be more than 10 mm thick. All joints shall be thoroughly flushed with mortar at every course. Care shall be taken to see that the bricks are properly bedded and all joints completely filled to the full depth.
- 5.4 In case of half brick walls, two number 6 mm dia bar or equivalent hoop iron in every fourth course. The reinforcement shall be properly bedded in mortar, properly lapped etc. as directed which are included in the rate of this item.
- 5.5 The work shall be cured profusely and kept continuously damp for 14 days, or for such period as directed by the Engineer -in-charge. The new work shall be bonded with the old work by providing proper bond.
- 5.6 Where brickwork is to receive plaster, the joints shall be raked to a depth of 12 mm to provide proper bond.

5.7 The Contractor shall carry out the work in as clean a manner as possible and shall remove excess materials and mortar droppings and the surfaces shall be brush cleaned daily.

5.8 The Contractor shall provide double scaffolding i.e. it should have two sets of vertical supports. Where this is not possible, the inner end of the scaffolding pole shall rest in a hole provided in a header course only and only one header for each pole shall be left out.

5.9 Mode of Measurement

The rate of brick work shall include all the above said operations.

All brickwork of 25 cms thick and above shall be measured in cum.

All half-brick work shall be measured in sqm.

Deduction for openings shall be in accordance with IS code for measurement of brick work.

VI - AUTOCLAVED AERATED CONCRETE BLOCK MASONRY

6.1 Sand

It shall be as specified in clause 2.2.0, 2.2.1, 2.2.2 and 2.2.3

6.1.1 Autoclaved Cellular (Aerated) concrete blocks hereinafter-called AAC blocks, shall conform to IS: 2185-1984 and have the following technical specifications:

i)	Length	625 mm
ii)	Width	200 mm / 125 mm/ 100 mm
iii)	Thickness / Height	250 mm
iv)	Density	600-650 kg/cum
v)	Compressive strength	3.5 N/ Sqmm

AAC block shall be of high cellular structure made from quartzite, flyash, cement, lime and water added with foaming agents.

6.1.2 Storage

AAC Blocks are to be stored on pellets or properly on platform raised from ground. Damage which occurs during storage or transportation shall be repaired if these are minor in nature as per manufactures specifications.

6.1.3 Workability

AAC Blocks should be amenable to sawing, drilling and nailing without any wastage / breakage. It should be possible to cut filling pieces, bevels and overhangs of required size and shape from these blocks.

6.1.4 Samples

Samples of each consignment will be taken out at random and sent for test to check whether material conforms to standards. All the supply deliveries shall be upto the standard of the samples approved.

6.1.5 Wetting of AAC Block

AAC Blocks shall be lightly wetted in water placed in a tray before laying in position.

6.1.6 Mortar

Specification for mortar shall be same as given in item of work.

6.1.7 Laying

AAC Blocks masonry shall be laid in stretcher bond / staggered joints as normally done for half brick masonry. Each block shall be set with mortar and vertical face tilled thoroughly with a cream of mortar as specified under the respective item. The walls shall be taken up truly plumb. All courses shall be laid truly to horizontal and vertical joints shall be truly vertical. Vertical joints in alternate courses shall come directly one over other. Thickness of AAC block courses shall be kept uniform. Necessary tools comprising of wooden straight edge, masons spirit level, square, foot rule, plumb, line and pins etc. shall be frequently and fully used by the masons to ensure that the walls are taken up true to plumb, line and levels.

Before commencing any AAC Block masonry, the **Contractor** shall conform with other trades to ensure that all pipes conduits, drains, sleeves, bolts, hangers, or any other materials necessary to be installed in the AAC block masonry work at the time it is built have been fixed or provided for.

6.1.8 Joints

AAC Blocks shall be laid such that all joints are full of mortar and thickness of joints shall be not more than 10mm. The face shall be raked to a minimum depth of 8 mm by a racking tool during the progress of work when the mortar is still green, so as to provide proper key for the plastering. The face of AAC block masonry work shall be kept clean and mortar dripping removed.

VII : Design Mix concrete

7.1 Materials

7.1.1 Cement

(a) Cement used on work shall be as per sub head cement concrete of CPWD specifications- 2009 (Vol. – I).

7.1.2 Water : Water used on work shall conform to SH: cement concrete of CPWD, Specification 2009- Vol. I.

7.1.3 Coarse Aggregate : These shall be crushed or broken from hard stones obtained from approved quarry. These shall be clean strong, durable of fairly cubical shape and free from soft, friable, thin elongated and laminated disintegrated pieces. These shall also be free from dirt, organic deleterious and any other foreign matter and adherent coatings and shall satisfy the physical requirements laid down in para 16.37.19 under quality control.

7.1.4 Fine Aggregate : This shall be coarse sand conforming to CPWD Specification 2009 Vol. I.

7.1.5 Grading of Mixed Aggregates : The grading of all aggregates (coarse and fine aggregates) to be used in the work shall be determined in the laboratory. The coarse and fine aggregates shall be mixed in suitable proportions so that the grading of the mixed aggregates shall be in the range indicated in below Table

TABLE

I.S. Sieve Size (IS 460) %age passing by weight

45 mm	100
22.4 mm	55 - 60
11.2 mm	45 - 50
5.6 mm	35 - 40
2.8 mm	30 - 35
1.4 mm	20 - 25
710 microns	15 - 20
355 microns	10 - 14
180 microns	2 - 5

7.2 Mix Design

7.2.1 The mix shall be approved by Engineer -in-charge-in-Charge so as to obtain the following mean strength

that exceeds the minimum specified flexural strength by 1.64 times the designed standard deviation. Minimum works beam

flexural strength at 28 days = 300 kg/sqm. for M-30 or specified in item

Designed standard deviation = 60 kg/sqm. for M-30 or for specified grade(s)

Design flexural strength

at 28 days = $300 + 60 \times 1.64 = 398.4$ kg/sqm. ($f + 1.64 s$) says 400 kg.

Water cement ratio by weight = 0.5

Minimum slump not more than 25 mm

7.2.2 For the purpose of tendering the contractor shall base his rate on the assumption that the quantity of cement used for one cum. of finished concrete shall be 340 kg. or M - 30. If the actual quantity of cement required to be used as a result of the laboratory test is different from that assumed above, necessary adjustment in the cost due to short cement used shall be made on the basis of issue rate of cement including storage charges plus 2.5% for handling charges. However, under no circumstances the quantity of cement to be used shall either exceed 350 kg./cum or fall below 330 kg. per cum of finished concrete.

7.3 Statistical Field Check

7.3.1 Samples of concrete shall be taken at the mixer and works beams, made, cured and tested in accordance with IS 1199 and IS 516.

7.3.2 When a mix is used for the first time, it is important to get a large number of results, as soon as possible, in order to establish the level of control and then suitability of the mix proportions. A sample of concrete shall be taken at random on eight separate occasions during each of the first five days of using that mix. From each sample two beams shall be made one for test at 7 days and the other for test at 28 days.

7.3.3 The work beam results shall be examined both individually and in consecutive (but not

overlapping) sets of four, for which the average and the range of each set is calculated. The mix proportions shall be modified to increase the strength, if in the first ten consecutive (but not overlapping) sets any of the following conditions are not satisfied.

(I) Each sample has a test strength not less than the minimum specified strength i.e. 30 kg/sq. cm. (or otherwise specified in item).

OR

(II) (a) Not more than two individual results (Not more than one of first twenty) of the 40 beams tests shall fall below the minimum work beam strength but they shall not be less than 80% of the specified beam strength of 30 kg./sq. cm (or otherwise specified in item) or the minimum specified strength minus 1.35 times the standard deviation whichever is greater.

(b) No value of the range in any set shall exceed 3 times the designed standard deviation.

(c) The average for all samples (10 sets) shall not be less than the minimum specified strength i.e. 30 kg/sq. cm (or otherwise specified in item) plus 1.64 times the designed standard deviation 60 kg./sq.cm M-30.

7.3.4 If either of these conditions (16.37.3.3 I or 16.37.3.3 II) are not satisfied, the mix shall be modified and the procedure described above shall be repeated till results satisfying the above criterias are obtained.

7.3.5 Subsequently samples shall be taken at the rate of one for every 30 cubic metre of concrete laid. Eight beam specimen shall constitute one sample. A set of 4 specimen shall be tested after 7 days and another set of 4 specimen shall be tested after 28 days. These test results shall be checked individually and in sets of four as the work progresses. If at any stage it is found that either of conditions If above are not satisfied, the overall average and the standard deviation of the previous consecutive 40 beam test results including the non-complying set shall be calculated. If the overall average strength minus 1.64 times the standard deviation is more than the specified beam strength (30 kgm/sq.cm) (or otherwise specified in item) the concrete shall be accepted. But if it is less than the concrete work corresponding to these 40 beams tests shall be rejected and the mix proportion shall be modified forth with for further work. The rejected work shall be replaced by the contractor immediately at his own cost and expense.

7.3.6 The statistical field checks described in 16.37.3.1 to 16.37.3.2 are meant to control the quality of concrete. The standard of acceptance of concrete shall be governed by the provision of above para

7.4 Slump Test

The test shall be carried out as per IS 1199. A slump test shall be carried out at each mixer at least one in fifty batches mixed or more frequently if directed by the Engineer -in-charge-in-Charge. Any batch from which slump test is being made shall not be transferred to the place of laying till the slump test has been completed. Not only the batch which gives a slumps in excess of that specified shall be rejected but the concrete already laid immediately preceding the batch tested upto the nearest last transverse joint may be rejected by the Engineer -in-charge-in-Charge or his subordinate, if he is satisfied that such preceding batches were substandard in this respect. The decision of the Engineer -in-charge-in-Charge in this respect shall be final and binding on the contractor. Such rejected concrete shall be removed by the contractor immediately and replaced with proper slump concrete at his cost and expense.

7.5 Steel Forms

7.5.1 All side forms shall be of mild steel. The steel forms shall be of M.S. Channel sections and their depth shall be equal to the thickness of the pavement.

7.5.2 The side forms shall have a length of at least 3.0 metres except on curves of less than 4.5 metres radius where shorter lengths may be used. When set to grade and stacked in place the maximum deviation of the top surface of any section from a straight line shall not exceed 3 mm. The method of connection between sections shall be such that the joint formed shall be free from play or movement in any direction. The use of bent, twisted or worn out forms shall not be permitted. At least three stake pockets for bracing pins or stakes shall be provided for each 3.0 M length of forms. Bracing and supports must be ample to prevent the springing of forms under pressure of concrete or weight or thrust of the machinery (like screed vibrator) operating on the forms. Support to the forms shall be sufficiently rigid to hold them in position during the entire operation of laying and compacting and finishing and that they shall not at any time deviate more than 3 mm from straight edge 3 metres in length. Forms which show a variation from the required rigidity of the alignment and levels shown on the plans shall be reset or removed as directed. The length and number of pins or stakes shall be such as to maintain the forms at the correct line and grade.

7.5.3 The supply of forms shall be sufficient to permit their remaining in place for at least 12 hrs. after the concrete has been placed or longer, if in the opinion of the Engineer -in-charge-in-Charge, it is necessary.

7.5.4 The top line of the forms is not to vary from the correct level or alignment and the levels and alignment of the forms are to be checked and corrected as necessary immediately prior to the placing of concrete. The top edges and faces of the forms are to be carefully cleaned and maintained in clean condition.

7.5.5 While removing the steel forms, care shall be taken to withdraw them gradually, any damage to the bull nosed edges shall be made good while the concrete is still green.

7.5.6 Setting of Forms

(a) Setting of forms shall be according to the slab plan subject to the approval of Engineer -in-charge-in-Charge and concreting shall not commence until the setting of forms is approved.

(b) Forms shall be set for at least 50 metres in advance of the point where the concrete is being laid and shall not be removed until at least 12 hrs. of placing of the concrete or longer if in the opinion of Engineer -in-charge-in-Charge is necessary.

(c) After setting, the working faces shall be thoroughly oiled by using approved oil before concrete is placed against them.

(d) The pavement joints of overlay layer would overlap with the joints of underlay cement concrete.

7.6 Batching and Mixing

As detailed in SH: 5 of reinforced cement concrete work of CPWD specifications 2009.

7.7 Placing of Concrete

Reinforced cement concrete work of CPWD specifications 2009.

7.8 Compaction of Concrete

7.8.1 Compaction shall be carried out by electrically (or) diesel operated needle and screed vibrators as stipulated hereafter. Needle vibrator should be used all over the area for obtaining initial compaction of concrete. These should be of diameter not less than 4.5 cm. If the vibrator

are pneumatic the pressure must not be below 4 kg/sq.cm. If electrically operated, they should have a minimum frequency of 3500 impulses per minute.

7.8.2 There should be at least three needle vibrators working in any bay. A vibrating screed consisting of a steel or timber section weighing not less than 15 kg. per metre with a tamping edge of not less than 7 cm width and having a vibrator mounted thereon shall follow needle vibrators to obtain full compaction. The face of the wooden tamping edge of the screed shall be lined with M.S. Plate rigidly fixed by means of counter sunk screw. Where screed vibrators are used for compaction, a standby unit shall always be maintained ready for use, should the other one go out of order. Where electrically driven vibrators are employed, a standby diesel pneumatic unit shall be kept ready for use in case of power failure. At the discretion of the Engineer -in-charge-in-Charge, for compaction at edges and joints, vibrators may be supplemented by hand tamping and rodding for securing satisfactory results. Under no circumstances ,honey combing of concrete at joints or elsewhere shall be permitted.

7.8.3 When using screed vibrator for compaction it should not be dragged over the concrete. During the initial passes it shall be lifted to the adjacent forward position in short steps, subsequently, it shall be slowly slid over the surface with its axis slightly tilted away from the direction of sliding and the operation repeated until a close, dense surface is obtained.

7.8.4 Concreting shall be carried out in one operation between the expansion joints and construction joints without any break at the dummy joints.

7.8.5 Concrete shall be deposited on the base as near the joints as possible without touching them. It shall then be shoveled against the sides, maintaining equal pressure and deposited approx. 50 mm higher than the depth of the joints, care being taken that it is worked well around the joints. The concrete shall not be dumped from the bucket directly upon or against the joints.

7.8.6 Workmen shall not be allowed to walk on freshly laid concrete and proper cat walk shall be provided with independent supports beyond concreting bays.

7.9 Finishing of Concrete

7.9.1 During compaction, any low or high spots shall be made up by adding or removing concrete. After longitudinal floating has been completed but while concrete is still plastic, the slab surface shall be tested for trueness with a 3 m straight edge. Any depressions or high spots showing departure from the true surface shall be immediately rectified. High spots shall be cut down and refinished. Depressions shall be enlarged to about 8-10 cm and filled up with fresh concrete, compacted and finished.

7.9.2 The straight edge testing the refloating is to continue until the entire surface:

- (a) is free from observable departure from the straight edge,
- (b) conforms to the required levels and across section, and
- (c) shall conform to the specified surface when the concrete has hardened.

7.9.3 The foregoing work is to be carried out while the concrete is still plastic and workable.

7.10 Belting

7.10.1 Just before concrete becomes non-plastic, the surface shall be belted with a two ply canvas

belt not less than 20 cm wide and at least 1 metre longer than the width of the slab. Hand belts shall have suitable handles to permit controlled uniform manipulation. The belt shall be operated with short strokes transversed to the centre line of the pavement and with rapid advance parallel to the centre line.

7.11.3 Edging : After belting/brooming has been completed but before the initial setting of concrete, the edges of the slab shall be carefully finished with an edger of 6 mm radius, and the pavement edges shall be left smooth and true to line.

7.12 Honey Combing

7.12.1 The side forms shall not be removed until 12 hours or such longer period as the Engineer -in-charge-in- Charge may decide after the laying of concrete.

7.12.2 As soon as the side forms are removed, any minor honey combed area shall be filled with mortar composed of one part of cement and two parts of fine aggregate. Major honey combing areas or segregated concrete or other defective work or areas damaged by removal of the forms or concrete damaged by rain or due to any other reason whatsoever shall be considered as defective work and shall be removed and replaced by the contractor at his own expense. The total area of honey combed surface shall not exceed 4 per cent of the area of the slab side. However, no individual honeycomb patch shall exceed 0.1 sqm. Engineer -in-charge-in-Charge's decision as to whether the concrete is defective or not shall be final and binding.

7.13 Surface Accuracy

7.13.1 After the concrete has sufficiently hardened after about 12 hours and not later than 24 hours, the surface shall be tested again for high spots. All high spots shall be marked and those exceeding 3 mm shall be ground down immediately. Care shall be taken to see that the grinding does not in any way damage the concrete surface.

7.13.2 The final surface finish is to be such that when tested with a profilograph/roughness indicator/or a 3 metre long straight edge or an equivalent mechanical unevenness indicator placed anywhere within the same or adjoining slab in any direction on the surface, there shall be no variation greater than 3 mm.

7.13.3 If the surface irregularity exceeding 3 mm still remains despite grinding as per para 7.13.2 the concrete shall be removed to its full depth. The area of concrete to be removed shall be complete slab between the nearest joints, where the defective slab is less than 4.5 metres from the expansion joint, the whole area upto the expansion joint shall be removed to the full depth. The concrete so removed shall not be reused in the work. Fresh concrete shall be laid in the manner already described in above paras and shall again be subject to test for surface accuracy and other quality control measures. Nothing extra shall be paid on this account.

7.13.4 Every slab shall bear an impression not exceeding 3 mm in depth comprising the number allotted to the slab and the date on which it is laid. This impression shall be formed by the contractor when the concrete is green so as to leave permanent mark on setting.

7.13.5 Initial Curing

7.13.5.1 Immediately after completion of the finishing operations, the surface of the pavement shall be entirely covered with wetted burlap, cotton or jute mats. The mats used shall be of such

length (or width) that as laid they shall extend at least 45 cm beyond the edges of the slab. The mats shall be placed so that the entire surface and both edges of the slab are completely covered. This covering shall be placed as soon as, in the judgment of the Engineer -in-charge-in-Charge the concrete has set sufficiently to prevent damage to the surface prior to being placed, the mats shall be thoroughly saturated with water and shall be placed with the wettest side down. The mats shall be so placed and weighed down as to

cause them to remain in intimate contact with the surface covered, and the covering shall be maintained full wetted and in position for 24 hours after the concrete has been placed or until the concrete is sufficiently hard to be walked on without suffering damage. Water shall be gently sprayed so as to avoid damage to the fresh concrete. If it becomes necessary to remove a mat for any reason, the concrete slab shall not be exposed for a period of more than half an hour.

7.13.5.2 Worn burlap or burlap with holes shall not be permitted. Burlap reclaimed from previous use other than curing concrete shall be thoroughly washed prior to use for curing purposes. If burlap is obtained in strips, shall be laid to overlap by at least 150 mm.

7.14 Burlap shall be placed from suitable bridges. Walking on freshly laid concrete to facilitate placing burlap shall not be permitted.

7.15 Final Curing

7.15.1 Upon the removal of the burlaps, the slab shall be thoroughly wetted and then cured as follows:-

All joints shall be filled with filler in order to prevent the edges of joints from getting damaged and entry of clay materials into the joints during final curing. Exposed edges of the slab shall be banked with a substantial berm of earth. Upon the slab shall then be laid a system of transverse and longitudinal dykes of clay about 50 mm high immediately covered with a blanket of sandy soil free from stones to prevent the drying up and cracking of clay. The rest of slab shall then be covered with sufficient sandy

soil so as to produce a blanket of earth not less than 40 mm deep after wetting. The earth covering shall be thoroughly wetted while it is being placed on the surface and against the sides of the slab and kept thoroughly saturated with water for 21 days and thoroughly wetted down during the morning of the 22nd day and shall thereafter remain in place until the concrete has attained the required strength and permission is given by the Engineer -in-charge-in-Charge. Thereafter the covering shall be removed and the pavement cleaned and swept. If the earth covering becomes displaced during the curing period, it shall be replaced to the original depth and re-saturated.

7.15.2 Contractor shall appoint chowkidars at his expense to prevent workmen, cattle, etc., straying on the pavement concrete.

7.15.3 Concrete shall not be subjected to any load or weight of any plant until at least 28 days after laying.

7.16 Construction Joints

7.16.1 Construction joints shall be provided as shown in the drawing and also at places where concreting is stopped due to unforeseen circumstances. The joints shall be straight and vertical through the full thickness of the slab. While concrete in adjacent bay is still green, flats of suitable size shall be drawn along the edge and a groove of size 10 mm × 25 mm deep shall be neatly formed and finished. The edges of the groove shall be full nosed. After curing of concrete is complete, this groove shall be thoroughly cleaned of all sand dust and shall be perfectly dried

and filled with hot poured sealing compound conforming to grade B of IS 1834. Before filling with sealing compound the faces of concrete of the joint shall be coated with primer of approved brand to a depth of 25 mm at the rate of 2.6 liters per 10 square meters. Bitumen emulsion shall not be used as primer.

VIII - STEEL & IRON WORK

8.1 Reinforcement

All MS reinforcement shall conform strictly to latest Indian Standards. They shall be of test quality and the manufacturers test certificate shall be produced by the **Contractor**. Mild steel shall conform to IS 432 and high yield strength deformed (HYSD) bars shall conform to IS: 1786 and testing to be done as per relevant IS codes.

Reinforcement shall be fabricated placed in position all as shown on drawings and specified. All reinforcement shall be bent cold. The laps and splices shall be as specified in the drawings.

All reinforcement shall be free from rust and scales, tied with 16 SWG soft drawn annealed binding wire with suitable chairs, if required. Proper chairs and spacers shall be provided to maintain the cover requirements.

8.2 Structural Steel

It shall conform to IS-226 and shall be of tested quality, the manufactures test certificate to be provided by **Contractor**. The steel shall be clean rolled to the dimensions specified in IS subject to the specified tolerances. It shall be free from cracks, surface flaws, laminations, excessive rust and scaling.

8.2.1 Shop Drawings

These shall be submitted by **Contractor** for approval before the actual fabrication.

8.2.2 Straightening & Cutting

The steel sections as specified or required shall be straightened and cut square and to correct lengths and shall be done by pressure such that the members are free from twist. Any bending or cutting shall be carried out so as not to impair the strength of the metal.

8.2.3 Welding

It shall be of metal-arc process. It shall be carried out as per the provisions of IS-814-1963. Welds showing slag inclusion, porosity or lack of proper penetration shall be cut and re-welded. All slag shall be removed from each run before another run is super imposed and from the final run. All exposed welds shall be ground smooth. Painting work shall be carried out only after the **Engineer -in-charge** have approved the welds.

8.2.4 Hoisting and Erection

Steelwork shall be hoisted, erected and fixed in position carefully, without any danger to itself, other building work or injury to workmen. Frames shall be lifted at such points that these are not liable to buckle or deform or be unduly stressed. The steelwork may be erected in suitable sections as directed by the **Engineer -in-charge**. During erection, the steelwork shall be securely bolted or fastened and, if necessary, temporarily braced to provide for all loads, to be carried by the structure during erection including those due to erection equipment and its operation. Permanent bolting or welding shall not be done until proper alignment has been obtained.

8.2.5 Temperature Stresses

Oval holes shall be provided at one end in the base plate and sole plate to ensure free movement during contraction or expansion and no temperature stresses are developed in the structure.

8.6 Mode of Measurement

8.6.1 Reinforcement Steel

It shall be measured in running meter and shall include the splices, hook, chairs or spacer bars but excluding necessary laps & binding wire, which is deemed to be included in the cost for reinforcement. The running length shall be converted to corresponding weight by applying weight per running meter.

8.6.2 Structural Steel

All structural steel members, as specified, shall be worked out on running length and converted into their respective weights from standard steel tables. In case of riveted work, weight of rivet will not be added and the rivet hole will not be deducted. In case of welds, the weight of weld will not be allowed.

8.6.3 WELDING PROCESS

- (a) The work shall be positioned for downward welding wherever possible.
- (b) Arc length voltage and amperage shall be suited to the thickness of material, type of groove and other circumstances of the work. The welding current and electrode sizes for different types of joints shall be as per IS 9595.
- (c) The sequence of welding shall be such as will avoid undue distortion and minimize residual shrinkage stresses. Recommendation of IS 9595 shall be followed.

Process of Welding

The electrode manipulation during welding shall be such as to ensure that:

- (1) The parent metal is in a fused stage when the filler metal makes contact with it.
- (2) The weld metal does not overflow upon any unfused parent metal forming overlapping.
- (3) The parent metal is not under-cut along the weld toes.

(4) The flowing metal floats, the slag, the oxides, and the gas bubbles to the surface behind the advancing pool. In case any of these requirements is unattainable by manipulation, the current shall be adjusted or the electrode size changed. Each time the arc is started the electrode shall be moved in such a way that the fusion of base metal at the starting point is assured. At the completion of a run the movement of electrode shall be slowed down to fill the arc crater. After every interruption of the arc except at completion of a run, the arc shall be restarted ahead of the previous deposit and then move back to fill the crater or such alternative technique shall be used as will ensure complete filling of the crater, or complete fusion between the new and old deposit and the base metal at the point of junction, and result in continuity of weld. Before welding operation is completed, all traces of slag shall be removed from the deposit, by chipping if necessary, and the deposit and the adjoining base metal shall be wirebrushed and cleaned at all points. The requirements shall apply not only to successive layers, but also to successive beads, and to the over lapping area wherever a junction is made on starting a new electrode.

(5) The welds shall be free from cracks, discontinuity in welding and other defects such as (i) under-size (ii) over-size, (iii) under-cutting and (iv) over-cutting in the case of fillet welds and defects (ii), (iii) & (iv) in the case of butt welds.

All defective welds which shall be considered harmful to the structural strength shall be cut out and rewelded. In case of welded butt joints in steel of thickness upto 50mm the weld joint shall be subjected to radiographic examination as described in IS 1182.

All welds shall be cleaned of slag and other deposits after completion. Till the work is inspected and approved painting shall not be done. The surface to be painted shall be cleaned of spatter, rust, loose scale, oil and dirt.

8.7 MAIN STRUCTURAL STEEL FRAME SYSTEM: BUILT UP SECTION I-SHAPED:

Design, Fabrication and Supply of prefabricated Structural steel Framework with built up section for beams, columns, joist, rafter, purlins etc. The PEB Structural Steel built up sections are made from hot rolled steel plates confirming to ASTM A 525, Grade 50 or equivalent with a minimum yield strength of 345 Mpa. All structural columns, beam and joist shall be in same material and required depth as per approved GA Drawings. Structural steel shall be made of 345 mpa steel factory finished Zinc rich red oxide. Column depth 500mm and main Beam 450mm. These plates together on one side of the web by a continuous automatic submerged arc welding process to produce the section required. Primary member Hollow Section as per IS 4923.

8.8 Structural Framework: (LGFS)

Design, Supply of factory finished, custom designed cold formed light gauge steel frame (LGFS) superstructure manufactured out of minimum 0.95mm Pretreated, factory finished bare galvalume/HotDipped GI HighTensile steel sheet (275gsm Zinc coated steel and 550Mpa yield strength) conforming to AISI specification and IBC2009 for cold form steel framing and construction and shall also be as per IS:8750-1987, IS:800-1984 Part II. The wind loads shall be as per IS:875 (Part III). The framing section shall be cold form, C type, having minimum depth of (89mm x 39mm x 11mm) in required length as per structural design requirements duly punched with dimple slots at required locations as per approved drawings. The slots will be along the center line of the web, and shall be placed at a minimum of 250mm away from both edges of the member. The frame can be supplied in panelized or knock down condition, in specified dimension and fastened with designed screws (minimum 4mm dia galvanized wafer head screws)

8.9 ANCHOR BOLT SUPPLY FOR COLUMN IN FOUNDATION LEVEL:

Supplying of anchor bolt as per designed length and diameter when column pedestal in the foundation level is to be carried out. After casting of concrete pedestal, embedded anchor bolt to be checked by your supervisor for alignment, Nut and bolts, chequered plate 8mm thick shall be supplied.

8.10 Roof, Wall and finishing items

Roof Sheet piling: Supply of precoated galvanised iron profile sheets (size, shape and pitch of corrugation as approved by Engineer-in-charge) 0.50 mm +/- 5% total coated thickness (TCT) thick Zinc coating 120gsm as per IS: 277 in 240mpa steel grade, The sheet shall be fixed using self drilling /self tapping screws of size (5.5 x 55mm) with EPDM seal or with polymer coated J or L hooks, bolts and nuts 8mm diameter with bitumen and G.I. limpet washers including cutting to size and shape wherever required along with all flashings.

8.11 Roof Insulation

Providing thermal insulation with Resin Bonded glass wool conforming to IS :8183, having density 48 kg/m³, 50 mm thick with one side aluminium foil.

External Wall Substrate - 1st layer, This board combination shall provide the impact resistant and weather resistant substrate to receive the final finish as per Architects Specification. Else this surface can be painted as per specification.

Providing 9mm thick Heavy Duty Fiber cement board (FCB) as per IS 14862 with suitable fibre cement screw.

IX –Waterproofing

9.1 Membrane & Cementitious waterproofing Works

Providing and laying in situ seven course water proofing treatment with APP (Atactic Polypropylene) modified Polymeric membrane over roof consisting of first coat of bitumen primer @ 0.40 Kg per sqm, 2nd, 4th & 6th courses of bonding material @ 1.20 kg/sqm, which shall consist of blown type bitumen of grade 85/25 conforming to IS : 702, 3rd and 5th layers of roofing membrane APP modified Polymeric membrane 2.0 mm thick of 3.00 Kg/sqm weight consisting of five layers prefabricated with centre core as 100 micron HMHDPE film sandwiched on both sides with polymeric mix and the polymeric mix is protected on both side with 20 micron HMHDPE film.

9.2 Retaining Wall, UGT / OHT walls

Treatment to concrete defects like Construction Joints, Cold Joints, Honey Combs & Porous Concrete. Cleaning the surface thoroughly, providing and applying Aquacoat KS 988A or Vandex BB75 waterproofing system in two coats by trowelling as per manufacturer's specifications. The 1st coat of Aquacoat KS 988A shall be applied to the prepared surface at coverage of 1 kg/sqmt. Whilst the 1st coat is still "green" a second coat comprising of Aquacoat KS 988A

or Vandex BB75 at a coverage of 1 kg/Sqmt shall be applied. The slurry coatings shall be applied with a stiff masonry brush or stiff broom and worked into every irregularity on the surface by means of toweling or by spray only. Treatment to floor slabs shall be carried out by trowel application in 2.0 kg/Sqmt coverage of Aquacoat KS 988A or Vandex BB75 using a steel trowel into hardened concrete slab surface including curing, cleaning etc complete.

9.3 Terrace Waterproofing

The First part consist of all surface area should cleaned up to visible of hair cracks / aggregate texture. Cleaning of RCC member should be done by hacking tool, wire brush, wire grinder & air blower etc. Open cracks & construction joints should be sealed with cement mortar with additive. All clean & treated area should tested for water tightness by flooding water. All wet spots & water leakage area should mark for treatment.

The Second part consisting of providing and applying Tremproof 250 GC of Tremco, a high performance, low odour, one-part, fast curing, high solids, cold applied polyurethane elastomer waterproof membrane over uniform surface of slab. Apply minimum 1.6 kg/sqm to achieve the required minimum DFT of 1.5mm. PU waterproof coating shall be such which can be applied to damp/green concrete allowing faster construction and waterproofing wit PU can be executed in all weathers. PU which cannot be applied on damp concrete/green concrete inhibiting fast construction are not acceptable. PU should have following minimum properties:

- i) Solid % Vol: 84
 - ii) Tensile Strength > 200 PSI
 - iii) Elongation > 500%
 - iv) Chemical Resistance - Excellent
- shall be applied as per manufacturer specification.

9.4 Guarantee

- 1 Executions of water-proofing treatment through approved specialist Sub Contractor in the field and under their direct supervision and strictly as per specifications.
- 2 Minimum 10 years warranty as per Performa annexed in tender.
3. Testing of treated areas, as directed.
- 4 Treatment of down take pipes and other obstructions.
- 5 All cutting, dressing, trimming and waste.
6. Providing concrete fillet at the junction horizontal and vertical surfaces as per drawings.
7. Preparation of surface for water-proofing work, insulation and other related treatments.
8. Work in narrow widths, bands, strips and at all locations

X- NIL

XI - PLASTERING

11.1.0 Plastering in Cement Mortar (Grade of Cement shall be 43)

Materials required shall be as specified in concrete work. Lime required for neeru finish shall be good quality fat lime. Internal/external plastering shall be 15 mm thick in CM (1:6) and sand shall be washed before use. The joints of the masonry work shall be raked to a depth of 10 mm before plastering to provide a key. The wall shall be wetted thoroughly before plastering and screeds shall be fixed on the wall to maintain thickness of plaster.

The plastered surface shall be finished with good quality lime neeru as indicated. Neeru shall be prepared at site out of best quality fat lime reduced to a fine paste after slaking and shifting.

Plaster work shall generally proceed from top to bottom with all exposed angles carefully flushed to furnish a neat and even surface. The **Contractor** shall ensure that no craziness appears on the plastered surface. Chicken wire-mesh shall be provided at all junctions of masonry and RCC structure. The width of the mesh shall be 300 mm provided all along the junctions.

Grooves shall be provided at junction of wall and ceiling and between wall plaster and skirting as instructed by the **Engineer -in-charge**.

All RCC surfaces shall be hacked and plastered in C.M. 1:3, 5 mm thick.

11.2.0 Sand-faced Plaster

Preparation of surface shall be as described in clause 11.1.0 above.

11.2.1 Under-coat

This shall consist of C.M. 1:6, 13 mm thick from top to bottom and of a slightly greater thickness than specified. This shall be beaten with thin strips of bamboo about 1 m long to ensure filling of joints and then brought to a true surface by working a wooden straight edge and finally finished with trowel. The surface shall be left rough and furrowed 1.5 mm deep with a scratching tool, diagonally both ways to form a key for the top coat.

11.2.2 Top-coat

The top coat shall be 6 mm thick in C.M 1:3 with coarse sand applied after the under-coat has sufficiently set but not dried within 48 hours and finished smooth. The finished surface of the top coat shall be roughened with a cork sheet trowels and finished finally with a soft cloth pad to get a uniform granular surface.

11.3.0 Grit Plaster

This shall be carried out as for sand-faced plaster but the top coat shall consist of C.M 1:1 and 1 part of stone grit of size 6 mm and applied.

11.4.0 Mode of Measurement

For all types of plastering or rendering, the measurement shall be measured in sqm with all deductions as applicable. Provision of all grooves is deemed to be included in the rate for plastering. Chicken wire mesh shall be paid for separately in sqm.

11.5.0 Gyproc Elite 90 gypsum Plaster

“Gyproc Elite 90 is a gypsum-based one-coat plaster suitable for application on most internal surfaces, including brick, block and concrete. It consists of gypsum hemihydrate formulated with special additives to control working and setting characteristics and a lightweight exfoliated aggregate to improve the plaster's workability, coverage and application. When dry, it provides a white, smooth matt finish. Excellent surface finish and good impact strength are its primary properties. Gypsum Plaster provides Superior whiteness with the smooth matt finish which is ready for painting

Gyproc Elite 90 is a replacement for traditional sand-cement plastering and is suitable for all internal dry plastering applications”

11.5.1 Gypsum Powder Features :

- Superior whiteness
- Affordable & Cost effective

- Free from shrinkage cracks
- Provides excellent bonding
- Light in weight
- Imparts high coverage
- Zero maintenance

11.5.2 Preparation And Application:

Mix powder to water and not water to powder. Water to plaster ratio is (1 part water and 1.5 part of gypsum plaster gyp into it, be maintained to provide good cohesive workable mixture. Mix the gypsum plaster gyp to water by using electrical hand mixture rod to form uniform lump-free paste. Install the wooden strip / dhada or install the leveling strip in the area where the ready paste is to be appealed.

- Apply the first coat approx up to 8mm to 10 mm of thickness. before the first, coat sets rake and cross rake the surface.
- Fill in any hollow area, level off, and compact the surface, then apply the final finish coat.after complete drying for usually 72 hrs. (depending on the thickness and humidity), the plain smooth leveled surface is ready for painting application
- Once the mix has begun to set, additional thy material should not be added, as performance properties of plaster will get altered, thus affecting workability, cohesiveness, adhesion, and strength. o a single coat should not exceed more than 8 mm to 10 mm of thickness. if at all thickness required is more than 8 mm to 10 mm, then plaster is to be applied in multiple coats. o use the material instantly after mixing. o the surface on which the material needs to be applied should be in line and Levelled. O Gypsum Plaster Gypo Should Not Be Applied On Surface Which Is Subjected Continuous Seepage Or Dampness.

11.5.3 Precaution & Safety:

Wear eye protection, impervious gloves and protective clothing. Advised to avoid direct eye and skin contact and recommended to keep it out of reach of chicken.

11.5.4 Packaging & Storage:

Super white gypsum plaster is available in 25 kg bag. It has a shelf life of 6 months from the date of manufacturing if stored in a cool and dry location.

XII-WALL FINISHES/TREATMENT

12.1.0 White Washing

Lime for white washing / colour washing shall be of best quality as approved conforming to IS 712 and slaked as per IS 1635. The wash shall be prepared from fresh white lime stone thoroughly slaked, mixed and stirred with sufficient water to make a thick cream which shall be screened through a clean coarse cloth mixed with 5 kg/cum of cream of gum-arabic or glue mixed in hot water, all as per manufacturer's instructions. Three or more coats, as specified, shall be applied on new surfaces, removing mortar drops, scraping of scales and repairing of holes. Zinc oxide shall be added to white wash to obtain egg-white colour for white-washing ceilings and a small quantity of Indigo blue added to white wash for white washing of walls.

12.2.0 Cement based Paints

Preparation of surface shall be done as described above and the surface wetted with water. A priming coat of primer supplied by manufacturer shall be applied. The cement based paint solution of an approved colour and manufacturer shall then be applied with hair brushes to get a uniform finish. The second coat shall be applied after 24 hours after the first coat has sufficiently hardened. A minimum of three coats shall be applied to obtain a uniform colour and the surface cured for at least 7 days.

12.3 PAINTING PROCEDURE

12.3.1 Materials

12.4.1.1 Special Road marking paint of approved brand and manufacture shall be used. The paint shall conform to IS 164. Ready mixed paint as received from the manufacturer shall be used without adding any admixture.

12.4.1.2 During work, if the consistency of the paint gets thick and thinning becomes necessary it shall be done by use of thinner of the approved brand of paint recommended by the manufacturer and with the approval of the Engineer -in-charge-in-Charge.

12.4.1.3 The paint shall be brought to the site of work by the contractor in original sealed containers. The material shall be brought in one lot in adequate quantity to suffice for the entire work. The material shall be kept in the joint custody of the contractor and the Engineer -in-charge-in-Charge. The empty container shall not be removed from the site of work, till the work has been completed and permission obtained from the Engineer -in-charge-in-Charge.

12.4.2 Preparation of Surface

The surface shall be thoroughly cleaned and free from dust. All the dirt, scales, oil and grease shall be thoroughly removed before painting is started. The prepared surface shall be inspected and approved by the Engineer -in-charge-in-Charge before painting is commenced.

12.4.3 Application

12.4.3.1 Before pouring into smaller containers for use, the paint shall be stirred thoroughly in its original container. The paint shall be continuously stirred in the smaller container while applying to runway surface so that its consistency is kept uniform.

12.4.3.2 The painting shall be applied evenly and smoothly by means of crossing and laying off. The crossing and laying off consists of covering the area over with paint, brushing the surface hard for the first time over and then brushing alternatively in opposite direction, two or three times and then finally brushing lightly in a direction at right angle to the same. In this process, no brush marks shall be left after the laying off is finished. The full process of crossing and laying off will constitute one coat.

12.4.3.3 Each coat shall be allowed to dry out thoroughly before the next coat is applied.

12.4.3.4 Earlier applied coat shall be cleaned off dust before the next coat is laid.

12.4.3.5 No left over paint shall be put back into the stock tins. When not in use, the containers shall be kept properly closed.

12.4.3.6 No hair marks from the brush or clogging of paint puddles shall be left on the work.

12.4.3.7 The surface shall ordinarily not be painted until it has dried up completely. Trial patches of paint shall be laid at intervals to check if drying is satisfactory.

12.4.0 Mode of Measurement:

It shall be same as for plastering specified in clause 11.4.0.

XIII - NIL

XIV - GROUTING

14.0 Chemical Injection grouting

- 14.1 Holes about 50 mm dia and 25 mm to 40 mm deep shall be chiseled in grid pattern at spacing not exceeding 1.5 meter c/c all over base walls and top slab. In addition all construction joint shall be opened by making a groove as to reach the reinforcement.
- 14.2 M.S. grouting nozzles of 25 mm dia shall then be fixed in these holes and grooves.
- 14.3 After the nozzles are fully set, neat cement slurry admixed with water soluble monomer based chemical shall be injected through the network of nozzles with low pressure grout pumps at a pressure not exceeding the design strength of concrete. The grouting shall be started at every low pressure and increased gradually to the required pressure. The grouting shall continue till the hole refuses to take any further grout even at an increased pressure.
- 14.3.1 The water soluble monomer based chemical shall conform generally to IS: 2645- 1975. In addition it should conform to the following requirement:
- a) It should be soluble in water
 - b) The resultant grout solution should not have viscosity greater than 1.2 centipoise.
 - c) With addition of catalysts, gelatin should occur by polymerisation cross linking chain reaction i.e the water shall be bound into the gel structure and there shall not be any shrinkage of gel after and
 - d) The gelatin be such that it can be controlled to required time.
- 14.3.2 The nozzles shall be removed 24 hours after the grouting is over and the holes shall be finished off neatly.

APPLICABLE CODES, STANDARDS & PUBLICATIONS FOR STRUCTURAL & ARCHITECTURAL WORK

The more important Codes, Standards and Publications to Contract are listed hereunder:

General

SP 7 National Building Code of India

SP 23 (S&T) Hand Book on Concrete Mixes

Cement

IS: 8112 Specification for 43 grade ordinary Portland cement.

IS: 12269 Specification for 53 grade ordinary Portland cement.

IS: 12330 Specification for sulphate resistant Portland cement.

Concrete

IS: 456 Code of practice for plain and reinforced concrete.

IS: 460 (Parts I to III) Specification for Test Sieves

IS: 516 Methods of test for strength of concrete.

IS: 1199 Methods of sampling & analysis of concrete.

IS: 1200 Method of measurement of building and civil Engineer -in-chargeing

IS: 1343 Code of practice for prestressed concrete

IS: 1607 Method of Test Sieving

IS: 2386 Parts I-VIII. Methods of tests for aggregates for concrete.

IS: 2430 Methods of Sampling of Aggregates of Concrete

IS: 2438 Specification for roller pan mixer

IS: 2514 Specification for concrete vibrating tables

IS: 2722 Specifications for portable swing batchers for concrete (double bucket type)

IS: 2770 Methods of testing bond in reinforced concrete part I pull out test

IS: 3025 Methods of sampling and test (physical and chemical) for water & waste water

IS: 6925. Methods of test for determination of water soluble chlorides in concrete Admixtures

IS: 8142 Methods of test for determining setting time of concrete by penetration resistance

IS: 9103 Specifications for admixtures for concrete

IS: 9013 Method of making, curing and determining compressive strengths of accelerated cured concrete test specimens

IS: 9284 Method of test for abrasion resistance of concrete

IS: 10262 Recommended guidelines for concrete mix design.

Construction Plant and Machinery.

IS: 1791 Specification for batch type concrete mixers.

IS: 2505 General requirements for concrete vibrators: Immersion type.

IS: 2506 General requirements for screed board concrete vibrators.

IS: 3558 Code of Practice for use of immersion vibrators for consolidating concrete.

IS: 4925 Specification for concrete batching and mixing plant.

Formwork

IS: 4990	Specifications for plywood for concrete shuttering work.
Instruments For Testing Cement and Concrete	
IS: 5513	Specification for vicat apparatus.
IS: 5514	Specification for apparatus used in Le-Chatelier test.
IS: 5515	Specification for compaction factor apparatus.
IS: 7320	Specification for concrete slump test apparatus.
IS: 7325	Specification for apparatus to determine constituents of fresh concrete.
IS: 10080	Specification for vibration machine.
IS: 10086	Specification for moulds for use in tests of cement and concrete.
IS: 10510	Specification for vee-bee consistometer.
Reinforcement & Structural Steel	
IS: 280	Mild steel wire for general Engineer -in-chargeing purposes
IS: 432	Part I. Mild steel and medium tensile steel bars. Part II Hard drawn steel wire.
IS: 814	Parts I & II. Electrodes for metal arc welding of structural steel.
IS: 815	Classification coding of covered electrodes for metal arc welding of structural steels
IS: 816	Code of Practice for use of metal arc welding for general construction in mild steel.
IS: 1786	Specification for high strength deformed steel bars and wires for concrete reinforcement.
IS: 2502	Code of Practice for bending and fixing of bars for concrete reinforcement.
IS: 2629	Recommended practice for hot-dip galvanising of iron and steel.
IS: 2751	Code of Practice for welding of mild steel plain and deformed bars for reinforced concrete construction.
IS: 4759	Hot-dip zinc coating on structural steel and other allied products.
IS: 5525	Recommendations for detailing of reinforcement in reinforced concrete works
IS: 9417	Recommendations for welding cold-worked steel bars for reinforced concrete construction.
IS: 822	Code of practice for inspection of welds.
Sand	
IS: 383	Coarse and fine aggregates from natural sources for concrete.
Scaffolding	
IS: 2750	Specification for steel scaffoldings
IS: 3696 (Part 1)	Safety Code of scaffolds and ladders: Scaffolds
IS: 3696 (Part 2)	Safety Code of scaffolds and ladders: Ladders
IS: 4014 (Part 1)	Code of practice for steel tubular scaffolding: Definition and materials
IS: 4014 (Part 2)	Code of practice for steel tubular scaffolding: Safety regulations for scaffolding

wood

IS: 303 Plywood for General Purposes

OTHER PUBLICATIONS

CPWD Specifications 2002

NOTES : This list is not a limiting factor and only indicative. Latest editions/ correction slips to be referred for the purpose of this project.

PART B : INTERIOR WORKS

I. TECHNICAL SPECIFICATIONS

PREAMBLE TO SPECIFICATIONS

The conditions of contract and the drawings shall be read in conjunction with the specifications and matters referred to, shown or described in one are not necessarily repeated in the other. These specifications are comprehensive and may exceed the requirements of this project. Any ambiguity between the General Specifications, the Bill of Quantities and contract drawings, shall be referred to the Architect for clarification before the date fixed for delivery of Tenders. Any ambiguity may be referred to the Architect after signing of the contract and Architect shall give a ruling, which shall prevail. No claim for additional cost due to above, however, will be entertained.

Notwithstanding the sub-division of the specification into various headings, every part of it is to be deemed supplementary to every other part and is to be read with it, so far as it may be practicable so to do, or when the context so admits.

In this contract, reference is made to the Indian Standards and these references shall be deemed to include the latest editions or issue of standards, specifications or bye-Law including all revisions upto the date of invitation of Tenders. The contractor shall ensure that all materials and workmanship in so far as they apply to this contract shall comply in every specification or any other equivalent or specification approved by the Architect.

The Contractor shall keep at site copies of all relevant standards and codes of practice referred in these specifications throughout the period of contract. These shall be the latest editions and shall include all revisions/ addendum thereof.

Approved Manufacturers: Names of approved manufacturers are given in the specifications.

Reference in the specifications to approved manufacturers shall be construed as establishing a standard of quality and not as limiting competition.

The Contractor shall include in his prices for supplying the items or materials from the approved manufacturers listed or equal and approved.

All items or materials shall be delivered to the site in the manufacturers original unopened containers with the manufacturers brand and name clearly marked on.

All items or materials shall be assembled, mixed, fixed, applied or otherwise incorporated in the works in accordance with the printed instructions of the manufacturer of the item or materials.

1.0 GENERAL

1.1 Scope

This specification applies to the Civil Finishing works to be executed by the Contractor. It is to be read in conjunction with and subject to the general conditions of contract and in conjunction with the drawings, the schedule of rates and such other documents as may from time to time be agreed upon as comprising part of this contract. Where these specifications are not clear, CPWD specifications shall be followed.

1.2 Clearing

The contractor shall clear the site of all rubbish, remove all debris only after consultation with the Project Manager.

1.3 Cleaning up and handing over

After the fixtures, equipment and appliances have been installed and commissioned, Contractor shall clean-up the same and remove all plaster, paints, stains, stickers and other foreign matters or discolorations leaving the same in a ready to use conditions.

On completion of all works, contractor shall demolish all stores, remove all surplus materials and leave the site in a broom clean condition, failing which the same shall be done by the Project Manager at the Contractor's risk and cost. Cost of the clean-up shall be deducted from the contractor's bills on pro-rata basis in proportion to his contract value.

On completion of the work, contractor shall submit the following documents

- a) Written guarantees and certificates.
- b) Maintenance manuals and Keys.

1.4 Samples

The contractor shall submit to the Architect samples of all materials for approval and no work shall commence before such samples are duly approved. Samples of veneer, wood, stainless steel sheet/ bars, fabric, paints, finished hardware and plywood etc. and every other work requiring samples in the opinion of the Architects, shall be supplied to the Architects, and these samples will be retained as standards of materials and workmanship. The cost of the samples shall be borne by the contractor.

Throughout this specification, types of material may be specified by manufacturers' name in order to establish standard of quality, price and performance and not for the purpose of limiting competition. Unless

The Contractor for the material approvals, within one week of the order to commence shall submit a detailed programme. The detailed programme shall include but not limited to:

Date/s of submitting the various materials samples.

Date/s by which the Architects' approval is required.

Date/s of placing orders on the Manufacturers/Suppliers.

Date/s of arrival of the approved material/s on to the site.

Date/s of the completion of the 'Mock-ups', wherever required, and the Date/s by which the Architects' inspection of such 'Mock-ups' should be completed and the Date/s by which the Architect should fully approve the said Mock-ups.

1.5 Tests

All materials and methods of tests shall conform to the latest rules, regulation and/or specifications of the following authorities where specified herein as applicable. Bureau of Indian Standards (BIS), British Standards Code of Practice (BS) in case no equivalent BIS is available. The Architects will have the option to have any of the materials tested and if the test results show that the materials do not conform to the specifications, such materials shall be rejected. A reasonable number of representative tests will be deemed to be included in the rates tendered.

1.6 Rates

The item rates quoted in schedule of quantities are deemed to be included to execute the works in strict accordance with the relevant specifications read in conjunction with the appropriate Standard Specifications.

1.7 Mode of Measurements

All measurements will be taken in accordance with IS 1200 latest issue unless otherwise specified.

2.0 CARPENTRY AND JOINERY (WOOD WORK)

2.1 Timber

All timber shall be of first class quality as described and indicated on drawings and schedules. It shall be uniform in texture, free from large, loose head or cluster knots, veneer, injurious open shakes, bore holes, rot, decay discoloration, soft or spongy spots, hollow pockets, pit and all other defects and blemishes. The sizes shown or described are to be taken as net sizes when finished.

Delivery and Storage

All timber delivered to the site shall be stored above ground in such a manner as to provide proper drainage, ventilation and protection from the weather and shall be stored in the proper manner according to each material type.

2.2 Seasoning

All timber shall be fully seasoned, if necessary, in kilns, and the contractor shall produce satisfactory proof of the same.

The moisture content of timber during manufacture, delivery to site, storage, site working, assembly installation, shall not exceed 12% for internal work and 16% for external work with Tolerance of average moisture content of all the samples in a given lot $\pm 2\%$ and moisture content of individual sample $\pm 3\%$ of the maximum permissible moisture content as per CPWD

specifications.. The timber shall remain stable, free from expansion or contraction or any other movements, when fixed in position. The timber shall be free from drying defects and shrinkage.

2.3 Rough carpentry

Material

All framing and other concealed wood members shall be of sound wood or approved specials and shall be seasoned. All surfaces in contact with masonry or concrete, and in general, all surfaces hidden from view, shall be treated with two coats of approved wood preservative paint.

Workmanship

All carpenters' work shall be done by skilled workmen, with the longest nails that may be used without splitting the wood. In general top nailing and cross nailing shall be used. Wherever it is necessary, or an adequate joint can not be formed by nailing, the members shall be lapped or jointed by GI straps or extra wood blocks. All jointing and nailing shall be done with neatness, especially in exposed positions. Joints and nailing shall be approved by the Architect/Project Manager and done according to his direction when required. Cross bracing, solid blocking and bracing shall be provided according to best practice.

2.4 Joinery

Materials

Finished woodwork and joinery including doors shall be with straight grained specified wood of approved quality, unless noted otherwise. Wood shall be free from knots, and other blemishes and imperfections. All finished wood for joinery shall be seasoned as prescribed before. All joinery work shall be securely mortised and tenoned and glued with best quality synthetic waterproof glue equivalent of FEVICOL or as approved. All sections and dimensions shall be as shown on drawings. For all joinery work, nails shall not be permitted, and only wood screws of appropriate

sizes shall be used. Wherever practicable, means of fastening the various parts together shall be concealed.

Installation

Doors and cabinetwork shall be installed in position only after the plaster in the location for, which it is intended, is sufficiently dry.

All interior and exterior doors, cabinetwork and other fixed wooden equipment shall be fixed plumb and true. Wherever possible, the joints shall be bevelled. All exterior angles shall be mitred. Adjoining interior wood members shall match and harmonize. All woodwork in contact with masonry shall be painted with approved bitumen paint before placing in position. All concealed wood members shall be treated with two coats of fire retardant and anti-termite coating (Viper or as approved make) before placing in position.

2.5 Measurements

The Contractor shall be fully responsible for accuracy of all measurements and shall verify all dimensions given on the drawings, and shall make such site measurements as are necessary to complete the work properly.

2.6 Lipping Works

Lipping, where specified, shall be provided internally on all edges of the shutters. Lipping shall be done with battens of first class hardwood or as specified of depth not less than 25 mm. For double leaved shutters, depth of the lipping at meeting of stiles shall be not less than 35 mm. Joints shall not be permitted in the lipping.

2.7 Plywood

Plywood shall be best quality closed grained suitable for veneering, painting or bonded with plastic laminate. It shall be resin bonded and of waterproof and boil proof (BWP) brand. Exposed edges shall be finished with an edge strip of solid teakwood of C/S as shown in drawings.

2.8 Adhesives

Adhesives shall be resin based for all carpentry work and as per approval of the Project Manager. Lap joints with glue shall be permitted in wood skirting. The adhesives used for all wood work and MDF shall be FEVICOL or approved equivalent of appropriate Grade. Manufacturer's

recommendations shall be followed for adhesive other than above required for any specified / specialized work.

2.9 Chipboard

Wood chipboard shall be particleboard made from wood particles bonded with a synthetic resin (Phenol Formaldehyde). Chipboards shall not be used externally or in damp surroundings. Only approved brand by the Architect/Project Manager shall be used in the works.

2.10 Laminate

Decorative laminate sheeting shall be of the brand, catalogues number and indicated or approved. Plastic laminate shall be fire retardant to class I of BS : 476 or ISI code where specified.

Laminates shall be veneered to mounting surface with an approved adhesive, used in strict accordance with the manufacturer's instruction. Rubber based adhesives shall not be used. Sheeting shall not be applied to timber with moisture content of more than 15 or at a temperature of less than 15°C (60°F). The sheeting shall be applied only to close-grained plywoods such as Fir plywood. Edges not faced with laminate, as at field joints, shall be machined and sealed. Butt joint of laminates shall be minimized by using longest available lengths where required and all butt joints shall have 1mm groove to be sanded and painted with Duco paint to match colour of laminate. Grain direction of wood grain laminated sheeting shall be as required by the Architect / Project Manager.

2. 10.1 Specification of Laminate

The laminate shall confirm to specifications as described in IS 2046 – 1955 The details of which are as defined

Sl No.	Properties	Tolerances
1	Thickness	+/-1 mm
2.	Resistance to surface wear	>= 350 revolutions
3.	Resistance to immersion in boiling water	10%

	Mass Increase (%)	11.8%
	Thickness Increase (%)	
4.	Resistance to dry heat 180 deg C	Should pass test as per IS 2046
5.	Dimensional Stability at deviational Temp	

NOTE: All tests mentioned in the table shall be compulsory and any other tests as defined in the code shall also be done as desired by the Project Manager based on the sampling criteria as defined herein.

2.10.2. Moisture Content

Maximum permissible moisture content in timber shall be 12% confirming to IS 287:1993. The moisture content shall be measured randomly for each lot of material delivered at site under standard testing conditions as required by the Purchaser. All such necessary cost of the tests shall be borne by the Supplier for testing the samples at third party laboratories as finalised by the Purchaser.

2.10.3. Seasoning & Chemical Treatment

Timber shall be well seasoned by a suitable process confirming to IS 1141:1993, before being planned and shaped to the required dimensions. Timber shall also be treated chemically using suitable fungicidal additive against all termites or any other pest or insect attack which can damage the frame.

The vendor shall submit a methodology of the seasoning and chemical treatment process within 5 days of the Purchase Order for approval of the purchaser. The supplier shall arrange and bear the cost of factory inspection in case the purchaser would request for the same.

2.10.4. Density of Wood

The density of the wood used shall not be less than 650 Kg/Cum. The density shall be measured randomly for each lot of material delivered at site under standard testing conditions as required by the Purchaser. All such necessary cost of the tests shall be borne by the Supplier for testing the samples at third party laboratories as finalised by the Purchaser. The average minimum weight at 12% of moisture content.

2.10.5. Gluing of Joints

Adhesive used for bonding various components of flush door shutters namely, core, core frame, lipping, cross-bands, face veneers, plywood etc. and for bonding plywood shall conform to BWP type, phenol formaldehyde synthetic resin adhesive conforming to IS 848.79.

2.10.6. Tolerances

Tolerance on width and height shall be + 3 mm and tolerance on nominal thickness shall be ± 1.2 mm. The thickness of the door shutter shall be uniform throughout with a permissible variation of not more than 0.8 mm when measured at any two points. The samples shall be done as per the details mentioned for sampling. All such necessary cost of the tests shall be borne by the Supplier for testing the samples at third party laboratories as finalised by the Purchaser.

2.11 Measurement

Length and width of the shutters shall be measured to the nearest cm in closed position covering the rebates of the frames but excluding the gap between the shutter and the frame. Overlap of two shutters shall not be measured.

2.11.1 Jointing

All joints in the frames shall be either mortise tenon jointing or finger jointing only using the appropriate glue as mentioned in Clause "Gluing of Joints". All the joints should be pinned with 10 mm dia hard wood dowels or bamboo pins or start shaped metal pins. The joints shall be at right angle from the inside surface of respective members. The joints shall be pressed in position. Each assembled door frame shall be fitted with temporary stretchers and a temporary diagonal brace on the rebated faces.

2.12 MDF (Medium Density Fibre Board)

For Interior Works MDF of approved make/ manufacturer shall be of only INTERIOR GRADE AS per IS 12406 -1988. Wood screws are not to be used for MDF and only fully threaded parallel shank screws shall be used after drilling pilot holes. Veneering /lamination to the MDF surface shall be done by exterior grade adhesive only. Polyurethane primers shall be used for sealing the edges and painting the rear side. For specifications of various applications, the MANUFACTURER USERS MANUAL shall be followed.

2.13 Adhesives

The adhesives used for all woodwork and MDF shall be FEVICOL / Jivanjor of appropriate Grade. Manufacturer's recommendations shall be followed for adhesive other than above required for any specified / specialized work. All adhesives or sealants used should be VOC compliant.

Joinery

Joinery shall be carried out strictly in accordance with the drawings, where joints are not specifically indicated recognized forms of joints should be used. Joinery shall conform to IS Standards.

Panels shall be rendered flame retardant and to conform to local fire regulations.

The Contractor shall submit samples of all materials including samples of veneer for approval.

All materials pre-fabricated, delivered and assembled shall be in accordance with the approved sample.

The Contractor shall be responsible for protecting all items of woodwork done by him. The contractor shall replace at his own expense any damaged work caused through lack of adequate protection or care in installation or handling.

2.14 Polyurethane Based Transparent Coatings

Timber works shall be finished by the application of two component clear polyurethane for coating application. The two component Acrylic Polyol and Aliphatic Isocyanate clear lacquer is mixed in proportion 10:1 by weight or 12:1 by volume. Wherever it is indicated in the drawing/specified. The finish shall be a stain, semi-gloss finish and shall be carried out as follows:

-

- a) The base shall be sand papered to the desired finish and coated with a colour tint to give it shade. This shade shall be sealed with a coat of spirit finish.
- b) After the base, first coat of lacquer (PU coating) shall be applied evenly by a soft bristle brush or by spray to give an even coat to the veneer surface.
- c) After the first coat has become tack free, applying second coat / finish coat using the same method of application.

The acrylic polyurethane and aliphatic isocyanate shall have to be CBRI approved product.

3.0 GLASS AND GLAZING

3.1 Glazing

The contractor shall furnish all labour, material and equipment required completing the installation of all glass and related items. A glass shall be of the type, quality, and substance specified in the schedule of quantities. The contractor shall cut glass sizes by field measurements

or dimensions of the approved shop drawings. The responsibility for correct glass sizes shall rest with the contractor. No cracked, chipped or disfigured glass shall accepted, and the contractor shall replace all breakages or faulty installation without extra cost.

The glass shall be set in wood or metal glazing straps and metal sash with elastic glazing and compound. The glass shall be beaded first and so installed as to achieve a completely watertight result. The opaque glass, where called for, shall be set with the smooth surface outside. At the completion of the work all glass shall be thoroughly cleaned of paint and other marks removed. No cracked, chipped or disfigured glass shall be accepted, and the contractor shall replace all breakage or faulty installation without extra cost to the owner before acceptance of fitout.

All vision glasses shall be float glass of specified thickness. The edges shall be bevelled as indicated in drawings and shall be done at approved source.

The Etching wherever specified in drawings, shall be done at approved sources as per full-scale drawing approved by Architect / Project Manger. The etched panel shall be chemically washed /treated as per specialist specifications to have a permanent dust free surface.

The Contractor shall be responsible for protecting all mirrors and glasses fixed by him and shall replace at his own expense any broken or damaged mirror / glass caused through lack of adequate protection or care in installation or handling.

The glass shall be free from flaws, specks, bubbles and distortions of every kind. All glass panes shall be flattened sheet glass of fine quality unless otherwise specified. Thickness of glass for panes of various sizes is as below:

i) Greater than 0.80 sqm	6 mm thick
ii) DGU glass	As Specified
iii) Laminated Glass	As Specified

The glass used shall conform to IS 1761-1960 and shall be of a durable quality. The glass may be frosted with frosted face on inside where indicated.

3.2 Tempered / Toughened Glass:

Tempered /Toughened glass shall be examined by the glass manufacturer to detect and discard any glass which exceed the following tolerance: 1.5mm bow in 600mm: 3mm bow in 1500mm; 6mm bow in 3000mm; 9 mm bow in 4500mm. Where the strengthening process results in essentially parallel ripples or waves, the deviation from flatness at any peak shall not exceed 0.13mm, and the difference between adjacent peaks shall not exceed 0.13mm. Where bow tolerance and wave tolerance differ, the stricter requirements shall govern. Direction of ripples shall be consistent and in conformance with architectural design.

Following test shall be also carried out by the contractor at his own cost as per following provisions.

Thickness	Impact Strength	Fragmentation	Surface Compression	Bending Strength
IS-2835-1987	IS-2553-PART-I	IS-2553-PART-I	ASTM C-1048-90	DIN 1249-PART - 12

3.3 Float Glass

Glass that gives distorted reflections will not be accepted. Reflections due to pressure, paints poor manufacturing process, uneven thickness or poor storage are some of the reasons for distortion. All clear float glass quality should conform to BS – 952 and ASTM C 1036 – 90.

3.4 Mirrors

Mirrors shall be fabricated from best clear plate or float glass of approved quality in imported variety and shall match the International Standards. All fixed panel mirrors shall be +/- 0.30mm tolerance. The edges of mirrors shall be polished and bevelled and mitred as per IS specifications wherever, it's indicated in the drawing.

All vision glasses shall be float glass of specified thickness. The edges shall be bevelled as indicated in drawings and shall be done at approved source.

The Etching wherever specified in drawings, shall be done at approved sources as per full-scale drawing approved by the Project Manger. The etched panel shall be chemically washed /treated as per specialist specifications to have a permanent dust free surface.

Panels shall be securely fixed with screw on “Z” clips at minimum 600mm centers horizontally and 1200 mm centers vertically or as directed by the PM. Mirrors shall be fixed to backings by adhesive or special fixings as shown on the drawings or as otherwise specified using CP cap screws. Screws shall be of brass with collars and screw-on domes unless otherwise specified.

All visible metal fixings shall be of approved finish to match mirror finish and colour. Adhesives shall be as recommended by the silvering manufacturer and used in accordance with the manufacturer’s recommendations.

The Contractor shall be responsible for protecting all mirrors and glasses fixed by him and shall replace at his own expense any broken or damaged mirror / glass caused through lack of adequate protection or care in installation or handling.

3.5.0 HARDWARES

The contractor shall procure all the hardware as specified in the schedule. The rate shall include for making mechanical chases to receive the hardware, and also the cost of approved screws, nails, clamps etc. The fixing shall be done in the best workman like manner and in accordance with that employed for fixing hardware. Any damage to the joinery or the hardware shall be made good at no extra cost to the client.

4.0 FALSE CEILING

4.1 PLASTER OF PARIS (POP) False Ceiling

The false ceiling comprises of Plaster of paris, G.I runner, G.I suspender, C-channel, chicken mesh,. The Plaster of paris false ceiling is in different shapes. Such as Vaults, Coffers, cove’s and Plain. The technical assistance and guidance is to be taken from manufacturers and work has to be done according to the manufacturer’s specifications and manuals. A sample of each finish shall be got approved before proceeding for bulk production. GI framing shall be erected as per

recommendation of the manufacturer specification and approval of the Project Manager. The work shall be executed through the contractor recommend by the manufacturer.

Providing and fixing false ceiling in horizontal/ vertical and coves as ceiling detail at all heights and floor level including providing and fixing of frame work made of special sections, power pressed from M.S. sheets and galvanized with zinc coating of 120 gms/sqm (both side inclusive) as per IS : 277 and consisting of angle cleats of size 25 mm wide x 1.6 mm thick with flanges of 27 mm and 37mm, at 1200 mm center to center, one flange fixed to the ceiling with dash fastener 12.5 mm dia x 50mm long with 6mm dia bolts other flange of cleat fixed to the angle hangers of 25x10x0.50 mm of required length with nuts & bolts of required size and other end of angle hanger fixed with intermediate G.I. channels 45x15x0.9 mm running at the rate of 1200 mm center to center to which the ceiling section 0.5 mm thick bottom wedge of 80 mm with tapered flanges of 26 mm each having lips of 10.5 mm, at 450 mm center to center, shall be fixed in a direction perpendicular to G.I. intermediate channel with connecting clips made out of 2.64 mm dia x 230 mm long G.I. wire at every junction, including fixing perimeter channels 0.5 mm thick 27 mm high having flanges of 20 mm and 30 mm long, the perimeter of ceiling fixed to wall/partition with the help of rawl plugs at 450 mm center, with 25mm long dry wall screws @ 230 mm interval, including fixing of gypsum board to ceiling section and perimeter channel with the help of dry wall screws of size 3.5 x 25 mm at 230 mm c/c, including jointing and finishing to a flush finish of tapered and square edges of the board with recommended jointing compound , jointing tapes , finishing with jointing compound in 3 layers covering upto 150 mm on both sides of joint and two coats of primer suitable for board, all as per manufacturer's specification and also including the cost of making openings for light fittings, grills, diffusers, cut-outs made with frame of perimeter channels suitably fixed, all complete. Item also include providing & making arrangements for Cove lights as per design and drawing, specification complete all floor height and floor level, as per direction of Engineer-In-Charge. but excluding the cost of painting including making and cutting for electrical / AC / fire fighting fixture and providing and fixing MS angle/tee/flat/ perforated edge bead for suspended ceiling and GI angle beads, edge beads wherever AC/Light fittings are to be installed, trap door in ceiling where directed and providing and fixing in cove , providing two or more coats of acrylic emulsion paint of desired shade over a coat of primer including preparation of surface.

False ceiling work shall be carried out in accordance with the actual site conditions at different /split-levels. Any sagging, unlevelled stretch of work shall be redone /replaced and made good, at

no extra charge, to the satisfaction of Project Manager. No compensation shall be paid on account of provision /coverage of openings for lighting fixtures, air-conditioning ducts and the likes as detailed in drawings and /or directed.

4.2 Wood Plastic Composite (WPC)

Wood-plastic composites (WPCs) are produced by thoroughly mixing ground wood particles and heated thermoplastic resin. The most common method of production is to extrude the material into the desired shape, though injection molding is also used. WPCs may be produced from either virgin or recycled thermoplastics including HDPE, LDPE, PVC, PP, ABS, PS, and PLA. Polyethylene-based WPCs are by far the most common. Additives such as colorants, coupling agents, UV stabilizers, blowing agents, foaming agents, and lubricants help tailor the end product to the target area of application. Extruded WPCs are formed into both solid and hollow profiles. A large variety of injection molded parts are also produced, from automotive door panels to cell phone covers.

In some manufacturing facilities, the constituents are combined and processed in a pelletizing extruder, which produces pellets of the new material. The pellets are then re-melted and formed into the final shape. Other manufacturers complete the finished part in a single step of mixing and extrusion.

Due to the addition of organic material, WPCs are usually processed at far lower temperatures than traditional plastics during extrusion and injection molding. WPCs tend to process at temperatures of about 50 °F (28 °C) lower than the same, unfilled material, for instance. Most will begin to burn at temperatures around 400 °F (204 °C). Processing WPCs at excessively high temperatures increases the risk of shearing, or burning and discoloration resulting from pushing a material that's too hot through a gate which is too small, during injection molding. The ratio of wood to plastic in the composite will ultimately determine the melt flow index (MFI) of the WPC, with larger amounts of wood generally leading to a lower MFI.

WPC Boards are the best alternate for the traditional use of wood and plywood for its durability and thermoplastic for its flexibility. WPC Boards are the overcome of the entire problem faced with the plywood.

WPC Board has features such as highly resistant to extreme weather, moisture and termites and low maintenance. WPC boards outperform conventional timbers in many areas. The result is that WPC Board Product won't rot, crack, warp or splinter.

WPC Boards have revolutionized the look and feel of outdoor areas. Highly versatile WPC board blends beautifully with any architectural style.

4.2.1 TECHNICAL SPECIFICATION

Thickness	5mm to 45mm
Color	Beige
Material	WPC (Wood Plastic Composite)
Size	8 x 4 Feet (2440mm x 1220mm) and Customize
Pattern	Plain Board/Sheet
Surface	Smooth Surface
Sheet Type	Solid Board/Sheet
Density	0.58 g/cm ³ and more

4.3 Environmental Impact

The [environmental impact](#) of WPCs is directly affected by the ratio of renewable to [non-renewable](#) materials. The commonly used [petroleum](#)-based polymers have a negative environmental impact because they rely on non-renewable raw materials and the non-[biodegradability](#) of plastics.^[26]

4.4 Fire Hazards

The types of plastic normally used in WPC formulations have higher [fire hazard](#) properties than wood alone, as plastic has a higher chemical [heat content](#) and can melt. The inclusion of plastic as a portion of the composite results in the potential for higher fire hazards in WPCs as

compared with wood. Some code officials are becoming increasingly concerned with the fire performance of WPCs.

5.0 PAINTING/ FINISHING WORK

5.1 Painting priming coat of wood surface

Primer for woodwork shall be as specified in the description of the item. Surface to be primed shall be dry and thoroughly cleaned. All unevenness shall be rubbed down smooth with sand paper and shall be well dusted, knots, if any, shall be covered with preparation of red lead made by grinding red lead in water and mixing with strong glue sized and used hot. Appropriate wood filler material with same shade as paint shall be used where so specified.

The surface treated for knotting shall be dry before primer is applied. After the primer is applied the holes and indentation on the surface shall be stopped with glazier's putty or wood putty, stopping shall not be done before the priming coat.

5.2 Painting priming coat on Iron & Steel surfaces

All rust and scales shall be removed by scrapping or by brushing with steel wire brushes. Hard skin of oxide formed on the surface of wrought iron during raking which becomes loose by rushing, shall be removed. All dust and dirt shall be thoroughly wiped away from the surface.

5.3 Painting priming coat on plastered surface

The surface shall ordinarily not be painted until it has dried completely. Before primer is applied, holes and undulations shall be filled up with plaster of Paris and rubbed smooth.

The primer shall be applied with brushes, worked well into the surface and spread even and smooth. Painting shall be done by crossing and laying off. The crossing and laying off consists of covering the area over with paint, brushing the surface hard for the first time over and then brushing alternately in opposite direction, two or three times and then finally brushing lightly in a direction at right angles to the same. In this process, no brush marks shall be left the laying off is finished. The full process of crossing and laying off will constitute one coat.

5.4 **Rate**

Rate shall include cost of all labour and material involved in the operations described above including scaffolding etc.

Painting with enamel paint (conforming to IS:2933 - 1975) and with synthetic enamel paint (conforming to IS:2932 - 1964).

The surface to be painted shall have received the approval of the Architect after inspection, before painting is commenced.

5.5 **Application**

The number of coats including the under coat shall be stipulated in the item.

a) **Under Coat**

One coat of specified paint of shade suited to the shade of the topcoat shall be applied and allowed to dry overnight. It shall be rubbed next day with the finest grade of wet abrasive paper to ensure a smooth and even surface, free from brush marks and all loose particles dusted off.

b) **Top Coat**

tops coats of specified paint of desired shade shall be applied. Each coat shall be allowed to dry for not less than 24 hours and lightly rubbed down smooth with finest wet abrasion paper to get an even glossy surface. If, however, the surface is not satisfactory additional coats shall be applied as required.

5.6 **Cement Primer Coat**

Cement primer shall be used as lease on wall finish of cement lime or lime cement plaster or asbestos cement surfaces before oil distemper paints are applied on them. Only approved cement primer shall be used. Primer coat shall be preferably applied by brushing and not by spraying.

Preparation of surface

The surface shall be thoroughly cleaned of dust; old white or colours wash by washing and scrubbing. The surface then is allowed to dry for at east 48 hours. It shall then be sand papered to give a smooth and even surface. Any unevenness shall be made good by applying putty, made of plaster of Paris mixed with water on the entire surface including filling up the undulations and then sand papering the same after it is dry.

Application

Cement primer shall be applied with a brush. Horizontal strokes shall be given first and vertical strokes shall be applied immediately afterwards. The entire operation will constitute one coat. The surface shall be finished as uniformly as possible leaving no brush marks. It shall be allowed to dry for at least 48 hours, before oil emulsion paint is applied.

Rate shall include cost of all material and labour involved in all the operations described above including scaffolding.

5.7 **Cement Paint**

Cement paint shall be (conforming to IS: 5410 - 1969) of approved brand and manufacture.

Preparation of surface

The surface shall be thoroughly cleaned of all mortar dropping, dirt, dust, alga, grease and other foreign matter by brushing and washing. The surface shall be thoroughly wetted with clean water before the cement paint is applied.

Preparation of mix

Cement paint shall be mixed in such quantities as can be used up within an hour of its mixing as otherwise the mixture will set and thicken affecting flow and finish.

Cement paint shall be mixed with water in two stages. The first stage shall comprise of 2 parts of cement paint and one part of water stirred thoroughly and allowed standing for 5 minutes. Care shall be taken to add the cement paint gradually to the water and not vice versa. The second stage shall comprise of adding further one part of water to the mix and stirring thoroughly to obtain a liquid of workable and uniform consistency. In all cases the manufacturers instructions shall be followed meticulously. The lid of cement paint drums shall be kept tightly closed when not in use, as by exposure to atmosphere the cement paint rapidly becomes air set due to its hydrophobic qualities.

Application

The solution shall be applied on the clean and wetted surface with brushes or spraying machine. The solution shall be kept well stirred during the period of application. It shall be applied on the surface, which is on the shady side of the building so that the direct heat of the sun on the surface is avoided. The method of application shall be as per manufacturer's specifications. The completed surface shall be watered after day's work.

Water cement paint shall not be applied on surface already treated with white wash, colour wash distemper dry or oil bound, varnishes, paints etc. It shall not be applied on gypsum, wood and metal surfaces.

Rate shall include cost of all material and labour involved in all the operations described above including scaffolding.

5.8 Oil emulsion (Oil bound) distempering

Material: Oil emulsion (oil bound) distemper (IS: 428-1929) of approved brand and manufacture shall be used. The primer used shall be cement primer or distemper primer. This shall be of same manufacture as distemper. The distemper shall be diluted with water or any other prescribed thinner in a manner recommended by the manufacturer. Only sufficient quantity of distemper

required for one days work should be prepared. The distemper and primer shall be brought by the contractor in sealed tins in sufficient quantities, at a time to suffice for a fortnight's work. The empty tins shall not be removed from the site of work, till this item of work has been completed and passed by the Architect.

Preparation of surface

Before new work is distempered, the surface shall be thoroughly brushed free from mortar droppings and other foreign matter and sand papered smooth. Pitting in plaster shall be made good with plaster of Paris mixed with the colour to be used. The surface shall then be rubbed down again with fine grade sandpaper and made smooth. A coat of distemper shall be applied over the patches. The patched surface shall be allowed to dry thoroughly before the regular of distemper is applied.

A priming coat of whiting shall be applied over the prepared surface. No white washing coat shall be used as a priming coat for distemper.

Application

The priming coat shall be with distemper or cement primer, as required in the description of the item and as recommended by the manufacturer.

Note:

If the wall surface plaster has not dried completely cement primer shall be applied before distempering the walls. But if distempering is done after the wall surface is dried completely, distemper primer shall be applied.

Oil bound distemper is not recommended to be applied within six months of the completion of wall plaster.

After the primer coat has dried for at least 48 hours, the surface shall be lightly sand papered to make it smooth for receiving the distemper, taking care not to rule out the priming coat. All loose particles shall be dusted off after rubbing. One coat of distemper properly diluted with thinner

(Water or other liquid as stipulated by the manufacture) shall be applied with brushes in horizontal strokes followed immediately by vertical ones, which together constitute one coat. The subsequent coats shall be applied in the same way.

For distemper 15 cm double bristled brushes shall be used. After each days work, brushes shall be thoroughly washed in hot water with soap solution and hung down to dry.

The specifications in respect of scaffolding protective measures and rule shall be as described under.

5.9 **Textured paint**

The textured finish to external surfaces of walls as per manufacturer's specification and approved by the Architects including scaffolding etc. complete.

5.10 **Acrylic Emulsion paint low VOC (Premium, Washable & Anti-bacterial)**

Plastic emulsion paint as per IS: 5411 – 1969 of approved brand and manufacture and of the required shade shall be used.

Painting on New Surface

Preparation of surface

Before new work is painted, the surface shall be thoroughly brushed free from mortar droppings and other foreign matter and sand papered smooth. Pitting in plaster shall be made good with plaster of Paris mixed with the colour to be used. The surface shall then be rubbed down again with a fine grade sand paper and made smooth. A coat of paint shall be applied over the patches. The patched surface shall be allowed to dry thoroughly before the regular of acrylic emulsion paint is applied.

A priming coat shall be applied over the prepared surface. No white washing coat shall be used as a priming coat.

Application

The number of coats shall be as stipulated in the item. The paint will be applied in the usual manner with brush or roller. The paint dries by evaporation of the water content and as soon as the water has evaporated the film gets hard and the next coat can be applied. The time of drying varies from one hour on absorbent surfaces to 2 to 3 hours on non-absorbent surfaces.

The thinning of emulsion is to be done with water and not with turpentine. Thinning with water will be particularly required for the undercoat, which is applied on the absorbent surface. The quantity of water to be added shall be as per manufacturer's instructions.

The surface on finishing shall present a flat velvety smooth finish. If necessary more coats will be applied till the surface presents a uniform appearance.

Precautions

- a) Old brushes if they are to be used with emulsion paints, should be completely dried of turpentine or oil paints by washing in warm soap water.

Brushes should be quickly washed in water immediately after use and kept immersed in water during break periods to prevent the paint from hardening on the brush.

- b) In the preparation of walls for plastic emulsion painting, no oil base putties shall be used in filling cracks, holes etc.
- c) Splashes on floors etc. shall be cleaned out without delay, as they will be difficult to remove after hardening.
- d) Washing of surfaces treated with emulsion paints shall not be done within 3 to 4 weeks of application.

5.11 Synthetic Enamel Paint

Synthetic Enamel Paint (conforming to IS: 1932 – 1964) of approved brand and manufacture and of the required colour shall be used for the top coat and an undercoat of shade to match the top coat as recommended by the manufacturer shall be used.

5.11.1 Painting on New Surface

Preparation of surface

- a) Wood work: - The surface shall be cleaned and all unevenness removed. Knots if available, shall be covered with a preparation of red lead. Holes and indentations on the surface shall be filled in with glazire's putty or wood putty and rubbed smooth before painting is done. The surface should be thoroughly dry before painting.
- b) Iron and steel work: - The priming coat shall have dried up completely before painting is started. Rust and scaling shall be carefully removed by scraping or by brushing with steel wire brushes. All dust and dirt shall be carefully and thoroughly wiped away.
- c) Plastered surface:- The priming coat shall have dried up completely before painting is started. All dust and dirt that has settled on the priming coat shall be thoroughly wiped away before painting is started.

Application

The number of coats including the undercoat shall be as stipulated in the item.

Under Coat :- One coat of the specified paint of shade suited to the shade of the top coat shall, be applied and allowed to dry overnight. It shall be rubbed next day with the finest grade of wet abrasive paper to ensure a smooth and even surface, free from brush marks and all loose particles dusted off.

Top Coat :- Top coats of specified paint of the desired shade shall be applied after the undercoat is thoroughly dry. Additional finishing coats shall be applied if found necessary to ensure properly uniform glossy surface.

5.12 Polyurethane (PU) Paint

Polyurethane is widely revered as one of the most durable yet easy-to-apply protective wood finishes. Polyurethanes are now available in both oil-based and water-based, and there are differences in the way in which both are applied and in durability. However, for many projects that will see a lot of wear and tear, few finishes are as appropriate as applying polyurethane for the final touch.

Water-based polyurethane versions dry much more quickly, are a bit more self-leveling and have less odor when applying than the oil-based versions. However, the water-based polyurethanes tend to raise the grain of the wood, are susceptible to water marks and can be somewhat temperamental when using with stains. Water-based polyurethanes tend to have a milky whitish look when applying, but this should disappear as the finish dries.

5.13 Working with polyurethane

First of all, stir, but never shake a can of polyurethane.

Why? Shaking a can of polyurethane will introduce numerous bubbles into the product that will show up in your final finish. Instead, stir the product gently but thoroughly before each use.

With either type, always work in a clean but well-ventilated area. You may choose to thin oil-based polyurethanes with mineral spirits or naphtha, but for most applications, this will not be necessary.

5.14 Applying a Water-Based Polyurethane

Water-based polyurethanes don't match well with oil-based stains, so if you're applying over stain you'll want to "rough up" the stained surface slightly before applying your water-based polyurethane using some synthetic steel wool. Since oil and water don't mix, this will help the polyurethane to avoid beading on the surface like water on a freshly-waxed car. Apply a very thin coat of polyurethane with a fine brush, foam pad or cloth. Work with the grain, and avoid applying too much polyurethane to avoid raising the grain.

The initial coat should be dry within a couple of hours, and a second coat can be applied. If applying in this manner, one shouldn't need to sand between coats as with the oil-based version. However, in order to get the same amount of protection, you may need to add a dozen or more coats of the water-based polyurethane. When applying polyurethane on vertical surfaces, you may experience drips or runs. Be cognizant of this as you apply your remove it with a sharp razor blade (followed by a sanding to feather in the blemish).

5.15 Plaster of Paris (POP) Punning work

The POP used should be of the highest grade of material with a min setting time of 20-25 min. The density of the POP should be 750-800 Kg/Cum and the transverse strength should not be less than 18 Kg/Sqcm. The compressive strength should not be less than 10 K/Sqmm.

All POP work shall be of the best workmanship and in strict accordance with the dimensions of the drawings. The thickness shall be as mentioned in the BOQ. All POP shall be finished to true levels including plumbs, without any imperfections and undulations, and square with adjoining work. It shall be so finished so that the paint works can be directly applied on it. There should not be any visible undulations on the surface when tested with a light source and phanti Masonry and concrete surface to which plaster is to be applied shall be clean, free from efflorescence, sufficiently rough and keyed to ensure proper bond.

The joint between concrete and masonry in filling, chasing for conduits, pipes, boxes etc. shall be covered by fibremesh strips, 300 mm wide installed before plastering. The contractor shall supply all necessary labour, material, tools and scaffolding necessary for the completion of the work detailed. He shall be responsible to take proper precautions to all works from damage. Any work

rejected through non-compliance with the specifications or damaged work shall be removed and replaced at the expense of the contractor.

5.16 Base Preparation:

The surface should be hacked with minimum of 50 numbers per sqft of area with each hole should be 10-12mm deep. The surface should be cleaned with a wire brush and free from any dust or loose particles. Water should be sprinkled on the surface to make it wet before application of the plaster. All conduits should be properly packed with cements plaster before application of the same. Fibre mesh to be fixed at all joints of dissimilar materials.

5.17 POP Plaster Coat

The POP powder shall be added to the water and not the reverse in the ratio of 1:2 or 1: 1.5 depending upon the weather conditions or a directed by the Project Manager. The level marks/bull marks shall be done before commencement of the plaster and shall be duly checked with the Project manager. On approval the POP shall be done wherein the paste shall be applied using trowel in a direction from the bottom to the top using optimum pressure to ensure that there are no cavities or loose material to ensure a smooth finish without any surface undulations or unevenness. The entire application should be finished within the initial setting time of the POP after which there should not be any disturbance. The decision of the Project Manager shall be final and in case of any rectification suggested by the PM, the same shall be done at no extra cost by the Contractor.

5.18 Gypsum Plaster Coat:

The gypsum plaster power shall be added to the water and not the reverse in the ratio of 1:2 or 1: 1.5 depending upon the weather conditions or a directed by the Project Manager. The level marks/bull marks shall be done before commencement of the plaster and shall be duly checked with the Project manager. On approval the filling shall be done wherein the paste shall be applied using trowel in a direction from the bottom to the top using optimum pressure to ensure that there are no cavities or loose materials. The finishing shall be immediately started with a thin coat of slurry to ensure a smooth finish without any surface undulations or unevenness. The entire application should be finished within the initial setting time of the plaster after which there should not be any disturbance. The plaster shall be allowed to dry for 72 hours or as per the weather conditions. The

decision of the Project Manager shall be final and in case of any rectification suggested by the PM, the same shall be done at no extra cost by the Contractor.

5.19 Cement Putty Works

The cement putty should confirm to the testing standards as prescribed by the relevant codes and as per the standards proposed by the Supplier. The setting time of the putty should be in the range of 120 – 180 min. The density should not be less than 1800 Kg/Cum and the tensile strength should not be less than 1 N/Sqmm. The compressive strength should not be less than 9N/Sqmm.

All putty work shall be of the best workmanship and in strict accordance with the dimensions of the drawings. The thickness shall be as mentioned in the BOQ. All putty works shall be finished to true levels including plumbs, without any imperfections and undulations, and square with adjoining work. It shall be so finished so that the paint works can be directly applied on it. There should not be any visible undulations on the surface when tested with a light source and phanti Concrete surface to which putty is to be applied shall be clean, free from efflorescence, sufficiently rough and keyed to ensure proper bond.

The contractor shall supply all necessary labour, material, tools and scaffolding necessary for the completion of the work detailed. He shall be responsible to take proper precautions to all works from damage. Any work rejected through non-compliance with the specifications or damaged work shall be removed and replaced at the expense of the contractor.

All chasing, installation of conduits, boxes, etc. shall be completed before any putty works is commenced on a surface. Chasing or cutting of putty will not be permitted.

Base Preparation: The surface should be hacked with minimum of 50 numbers per sqft of area with each hole should be 10-12mm deep. The surface should be cleaned with a wire brush and free from any dust or loose particles. Water should be sprinkled on the surface to make it wet before application of the plaster. All conduits should be properly packed with cements plaster before application of the same. Fibre mesh to be fixed at all joints of dissimilar materials.

5.20 Putty Plaster Coat

The putty power shall be added to the water and not the reverse in the ratio of 1:2 or 1: 3 depending upon the weather conditions or a directed by the Project Manager. The putty shall be done wherein the paste shall be applied using trowel/blade in a direction from the bottom to the top using

optimum pressure to ensure that there are no cavities or loose materials. The subsequent quote shall be applied only after the first coat is completely dry. The entire application should be finished within the initial setting time of the putty after which there should not be any disturbance. The decision of the Project Manager shall be final and in case of any rectification suggested by the PM, the same shall be done at no extra cost by the Contractor.

5.21 weather Sealants

Neutral Cure Silicone weather sealant of make Dow Corning, GE Silicone or Wacker only shall be used for sealing the joints between the curtain wall and the adjacent parts of curtain wall flashing / wall/stone surface etc. The sealants and their primers shall be compatible with all materials and finishes with which they are likely to come in contact. No staining of silicone on walls is permitted.

The elastic sealants shall be applied over compatible backer rods set into the joint to control the depth of sealant and to prevent three-side adhesion.

Sealants utilized within the framing system to seal joints between components shall withstand all stresses during assembly, transportation and installation and shall provide air and watertight seal in service. The joint and the sealant shall be designed to maximize the life expectancy of the seal.

Sealants utilized to effect a seal between the curtain wall and the structure shall be of a type suitable to seal against air and water penetration whilst allowing differential movement. They shall have predominantly elastic characteristics and shall comply with BS 5889 or ASTM.

Application of sealants shall take place in clean and dust free environment as far as practicable.

6.0 FLOORING AND CLADDING

6.1 Preparation of MARBLE / GRANITE Floor

1. The surface to receive flooring shall be clean, free from dirt and free from foreign material.
2. Any undulations or mortar remaining on the floor shall be trimmed.

3. Base course shall be trimmed.
4. The base shall be cleaned and watered before laying the floor.
5. Provide a layer of mortar to the specified preparations in the case of slabs, tiles to correct levels and slopes as required.
6. Provide a layer of chemical additives for fixing ceramic tiles on to the floor slab or walls as per specifications to correct height and levels.
7. Work includes at all depths and heights.
8. The finished surface shall be kept wet for a maximum period of one week.

6.2 Ceramic / Vitrified Tile Flooring

General:

1. Ceramic tiles, glazed tiles in flooring and dadoing and skirting is included.
2. Ceramic tiles shall be from approved manufacturers conforming to IS specifications.
3. It shall be of specific size and thickness.
4. The colour and the texture of the tiles shall be as approved by the Architects.
5. Tiles shall be well soaked in water, washed and cleaned.
6. Ceramic tiles shall be of approved make, approved by Architect.

Execution:

1. Cement slurry of 1:3 proportion shall be laid over the surface of floor or wall to an average thickness of 12 mm.
2. Cement paste of good consistency shall be spread over the mortar to an extent of 25 Sq.ft. at a time.

3. Cement paste is also applied to the back of the tiles and fixed on to the floors or walls as the case may be.
4. Tiles shall be properly bedded with the cement mortar and gently tapped with wooden mallet to get the tiles in line/level with the adjoining tiles.
5. The joints shall be kept as thin as possible and in straight lines.
6. The joint shall be kept as per the pattern shown by the Architects.
7. Surplus cement shall be removed and cleaned off.
8. The joint shall be cleaned off grey cement grout with a wire brush or trowel to a depth of 5 mm.
9. All dust and loose mortars shall be removed from the surface.
10. Joints shall then be flush jointed with epoxy grout.
11. Epoxy grout shall be mixed with colour to match the colour of the tile where required.
12. After curing, the surface shall be washed with mild hydrochloric acid and cleaned with water.
13. Care shall be taken that there should be no hollow sound when tapped with wooden mallet.

Measurement:

Length, breadth and height shall be measured correct to a cm. The area shall be calculated in Square Metre, correct to two places of decimal. All measurement shall be taken as per IS:1200.

6.3 Granite/ Marble Stone :

Granite shall be approved by the Architect/ Project Manager and a sample piece should be kept in the office of the Project Manager. The quality shall be uniform and it shall be hard and free from any discolorations, cracks, flaws, veins of foreign materials or any other defects. When Granite of different colour and qualities are associated, care shall be taken to see that they are of equal hardness so as to wear evenly. The Granite slabs shall be machine cut true to the shape and size and machine polished. Care shall be taken to cut the slabs so as to provide a pattern as indicated. Granite stone slabs for wall lining and dado shall have machine polished edges. The wall

shall be lined with the Granite in courses as indicated and grain of the Granite shall be arranged in pattern as per detailed drawings. The Granite shall be bedded in cement mortar backing covering the full area of the Granite. The wall surface shall be cleaned from all dirt, mortar droppings etc. before applying the base plaster. The Granite shall be fixed to the wall by bronze/copper cramps 125 mm x 35 mm x 6 mm and Bronze pins 6 mm diameter 50mm long embedded firmly into wall by cutting/drilling holes and grouting. Alternately stainless steel cramps and pins as per design shall be used. The load of one Granite slab shall not be borne by the slab below. Joints between slabs shall be hair fine and filled with colored cement to match the Granite. The Granite lining and dadoes shall be finally hand polished by Carborundum stone, buffing with polishing felt and cleaned with diluted oxalic acid wash.

While fixing the stone shall be bedded in cement mortar backing covering the full area of the Granite. The slab or wall surfaces shall be cleaned thoroughly before applying cement slurry or mortar. Joints between slabs shall be hair fine and filled with white cement mixed with matching shade of pigment.

6.3.1 Sizes and Tolerances :

The size of marble blocks, slabs and tiles shall be as mentioned below :

Types	Length	Width	Thickness
Blocks	300 to 2500	300 to 1000	300 to 900
Slabs	700 to 2500	300 to 1000	20 to 150
Tiles	100 to 600	100 to 600	80 to 24

Notes:

- (1) All dimensions are in millimetre.
- (2) The length and width, of the blocks shall be in multiple of 300 mm.
- (3) Length and width of slab shall be in multiple of 1000 mm. and thickness in multiple of 10 mm.
- (4) Tiles shall be square cut and linear dimensions in multiple of 100 mm.
- (5) Only slabs and tiles shall be machine cut and factory made.
- (6) For 8 mm thick tiles, special precautions will be required for fixing them like using special adhesive as per manufacturer's specifications. Such tiles are not suitable for outside veneering work exposed to rains/sun if used in large areas in continuous stretches.

For tiles of thickness 20 mm and above cramps may be provided if approved by Project Manager

6.3.2 Tolerance

The following tolerances shall be allowed in the dimension of blocks, slabs and tiles:

Blocks Tolerance

- (a) Length + 2 per cent
- (b) Width + 2 per cent
- (c) Thickness + 2 per cent

Slabs

- (a) Length + 2 per cent
- (b) Width + 2 per cent
- (c) Thickness + 3 per cent

Tiles

- (a) Linear dimension + 3 per cent
- (b) Thickness + 1 per cent

The sizes other than those mentioned above may be provided as directed by the Project Manager and nothing extra shall be payable on this account.

6.3.4 Mandatory Tests : The mandatory tests on marble and granite shall be as per IS 1124 and IS 1122.

The charges for the same shall be part of the item. The following shall be the tests.

<i>Material</i>	<i>Clause</i>	<i>Test</i>	<i>Field/ Laboratory Test</i>	<i>Test Procedure</i>
Marble	8.3 (Table 8.2)	(i) Moisture Absorption	Laboratory	IS 1124
		(ii) Hardness Test	-do-	Mho's Scale
		(iii) Specific Gravity	-do-	IS 1122
Granite		(i) Moisture	-do-	IS 1124
		(ii) Specific Gravity	-do-	IS 1122

6.3.5 Physical

The physical properties of marble for blocks, slabs and tiles and method of tests are mentioned in Table

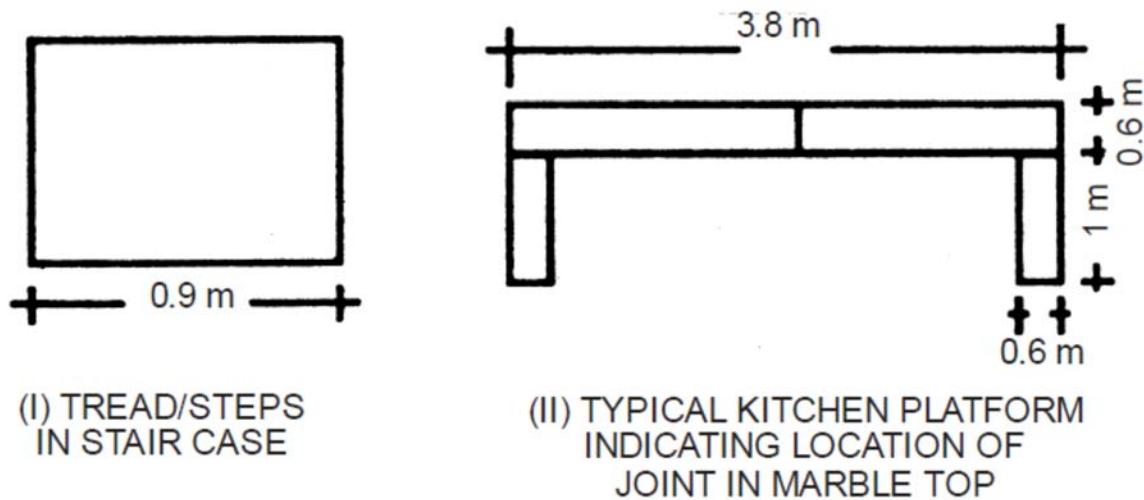
Characteristic	Marble		Granite	
Marble Requirements	Method of test		Granite Requirement	Method of test
Moisture absorption after 24 hrs immersion in cold water	Max. 0.4%	IS 1124	Max. 0.50% tion by weight	IS 1124
Hardness	Min. 3	Mhos scale	NA	NA
Specific Gravity	Min. 2.5	IS 1122	Min. 2.6	IS 1122

6.3.6 Polishing & Table Rubbed Works:

Marble work in steps, jambs, columns and other plain work shall be as specified below:

Joints in staircase treads, kitchen platforms shall be permitted only at curvature or when width/length is more than 0.6/2 mtrs. respectively. Number of joints in each direction shall not be

more than one number for every 2 mtrs. length beyond the initial 2.00 m length. Additional joints due to curvature or for providing fixture shall be provide judiciously as given in sketch below.



6.3.7 Dressing, Cutting and Rubbing

Every marble stone shall be gang saw/machine cut to the required size and shape, chisel dressed machine finished on all beds and joints, so as to be free from any waviness and to give truly vertical, horizontal, radial or circular joints as required. The exposed faces and sides of stones forming joints upto 6mm. from the face shall be fine tooled machine cut such that a straight edge laid along the face of the stone is in contact with every point on it. All window sills, tread of steps, counters vanities moulding edges etc. shall be machine cut & polished to give high gloss mirror finish as per direction of Project Manager. These surfaces shall then be rubbed smooth. All visible angles and edges shall be true, square and free from chipping. Beyond the depth of 6 mm from face, the joints shall be dressed with a slight splay so that the thickness of joint increases, in an inverted V shape .The surfaces of the stones coming in contact with backing need not be chisel dressed. A sample of dressed and rubbed stone shall be prepared for approval and it shall be kept on worksite after being approved by the Project Manager. The mortar used for jointing shall be as specified.

6.3.8 Laying :

All marble stones shall be wetted before placing in position. These shall then be floated on mortar and bedded properly in position with wooden mallets without the use of chips or under pinning of any sort. The walls and pillars shall be carried up truly in plumb or battered as shown in the drawings. All courses shall be laid truly horizontal and all vertical joints shall be truly vertical. In case of work without backing of brick work or coursed rubble masonry, face stone shall be laid in headers and stretchers alternatively unless otherwise directed. The headers shall be arranged to come as nearly as possible in the middle of stretchers above and below. Stone shall be laid in regular courses of not less than 15 cm in height and all courses shall be of the same height unless otherwise specified. For work facing with backing of brick work or coursed rubble masonry, face stone shall be laid in alternate courses of header and stretchers unless otherwise directed. Face stone and bond stone courses shall have break joint on the face of at least half the height of the standard course and the bond shall be carefully maintained throughout. All the connected masonry in a structure shall be carried up nearly at one uniform level throughout but where breaks are unavoidable the joints shall be made in good long steps so as to prevent cracks developing between new and old work. When necessary jib crane or other mechanical appliances shall be used to hoist the heavy pieces of stones and place these in to correct positions, care being taken that the corners of the stone are not damaged. Stone shall be covered with gunny bags, before putting chain or rope is passed over it, and it shall be handled carefully. No piece which has been damaged shall be used in work. The matching of grains shall be carried out as directed by the Engineer-in-Charge. Bond or through stones running right through the thickness of walls, shall be provided in walls up to 60 cm thick and in case of wall above 60 cm thickness a set of two or more bond stones overlapping each other by at least 15 cm shall be provided in a line from face to back. At least one bond stone or a set of bond stones shall be provided for every 0.5 sqm of the wall surface. All bond stones shall be marked suitably as directed by the Engineer-in-Charge.

Joints : The depth of joints 6 mm from the face shall be uniform and as fine as possible but shall be not more than 1.5 mm thick on the exposed face. Beyond the depth of 6 mm from face, the thickness of joints shall increase in an inverted V shape so as to give good mortar bond between two stones. The inverted portion of the joints shall be filled with bedding mortar and the face 6 mm portion with pointing mortar.

The work shall be kept constantly moist on all faces for a period of at least seven days.

Finishing : After the marble work is cured, it shall be rubbed with carborandum stone of different grades no. 60, 120 and 320 in succession or with electrical rubbing machines rubbed with carborandum items 0

to 6 nos.in succession, so as to give a plane true and highly smooth surface. It shall then be cleaned with a solution of oxalic acid, washed and finished clean.

6.4 Wall Lining / Cladding / Veneer Works:

Unless and otherwise specified in the nomenclature of the item, the marble slabs used for wall lining/veneer work shall be gang saw cut (polished & machine cut) and conform to dimensions given in Table above. Back shall not be polished/ cut in order to ensure a good grip with the hearting of backing. The cut slabs shall be of the thickness as specified with a tolerance permissible as mentioned above. The tolerance in wall lining when straight edge of 3 m length is placed should not be more than 2 mm.

6.4.1 Laying :

The stone shall be wetted before laying. They shall then be fixed with mortar in position without the use of chips or under pinning of any sort. Care shall be taken to match the grains of veneer work as directed by the Project Manager. For purpose of matching the grains, the marble slabs shall be selected judiciously having uniform pattern of veins/streaks. Preferably the slabs shall be those got out of the same block from the quarry. The area to be veneered shall be reproduced on the ground and the marble slabs laid in position and arranged in the manner to give the desired matching of grains. Any adjustment needed for achieving the best results shall be then carried out by replacing or interchanging the particular slabs. Special care shall be taken to achieve the continuity of grains between the two slabs one above the other along the horizontal joints. This shall then be got approved by the Project Manager and each marble slabs numbered properly and the same number shall be marked on a separate drawing as well as on the surface to be actually veneered, so as to ensure the fixing of the particular slabs in the correct location. For the facing of the columns also the same procedure as mentioned above shall be followed. Where so desired, the adjoining stones shall be secured to each other by means of copper pins 75 mm long and 6 mm diameter or as specified. The stones shall be secured to the backing by means of cramps. The material for cramps shall have high resistance to corrosion under conditions of dampness and against the chemical action of mortar or concrete in which cramps are usually embedded. Cramps shall be of 25 × 6 mm and 30 cm long in case of backing of stone masonry walls and block masonry walls thicker than 200 mm. In case of backing with brick masonry walls 200 mm or less thick or RCC members cramps shall be of 25 × 6 mm and length as per requirement made out of gun metal or any other metal specified. Generally the outer length of cramp in half brick work backing shall be 100 mm and in one brick work backing it shall be 150 mm. Typical shape & details of cramps for such backing are as per the

Project Manager. Cramps shall be spaced not more 60 cm apart horizontally. The adjoining stones shall be secured to each other by means of gun metal cramps or copper pins of the specified size. Cramps may be attached to its sides or top and bottom or sides, top and bottom. The actual number of cramps and their sections, however, shall be as per requirements of design to carry the loads. Where cramps are used to hold the unit in position

only, the facings shall be provided with a continuous support on which the stones rest at the ground level and other storey levels, the support being in the form of projection from or recess into the concrete floor slab, or a beam between the columns or a metal angle attached to the floor slab or beams. These supports shall preferably be at vertical intervals not more than 3.5 m apart and also over the heads of all openings. Such supports shall also be provided where there is transition from thin facing below to thick facings above. Alternatively cramps may be used to hold the units in position and in addition to support the units thus transferring the weight of the units to the backing. Such cramps should be properly designed as per IS 4101 (Part 1). The cramps may be of copper alloyed with zinc, tin, nickel, lead or stainless steel. The decision of the Project Manager shall be final in this regard. The pins, cramps and dowels shall be laid in cement mortar 1:2 (1 cement : 2 fine sand) and their samples got approved by the Project Manager and kept at site.

6.4.2 Joints : All joints shall be full of mortar. Special care shall be taken to see that groundings for veneer work are full of mortar. If any hollow groundings are detected by tapping the face stones, these shall be taken out and relaid. The thickness of the face joints shall be uniform, straight and as fine as possible, not more than 1.5 mm and in the face joint, the top 6 mm depth shall be filled with mortar specified for the pointing. The details of protection, curing and finishing shall be as mentioned above or as directed by the Project Manager.

6.6 Adhesives, Sealants and Grouts

All adhesives, sealants and grouts used should be VOC compliant and should be used as per manufacturer's specifications.

Adhesives : - For Vitrified / Ceramic Tiles – Laticrete 290 (water based) or approved equivalent
For Stones (Marbles and Granites) – Laticrete 111 + Laticrete 73 (Two Component System) or approved equivalent

Sealants (Antistainer) : - For Stones– Laticrete 511 Impregnator or approved equivalent

Grouts : - For Vitrified / Ceramic Tiles / Stones – Laticrete SP100 (epoxy based) or approved equivalent

6.7 Protection of Flooring and Cladding

All finished flooring works must be protected with two layers of polythene sheet and 30mm thick POP layer including the cost of POP and Polythene and removal when directed. Contractor shall replace all broken, damaged and scratched tiles/ marbles/ granite caused in execution of the work or by faulty installation before acceptance of the building without cost to the owner.

6.8 PROTECTION OF WORK AND PROPERTY

The Contractor shall continuously protect this and other Contractor's work, and the Owner's property from damage, injury or loss arising in connection with operations under the Contract Documents. He shall make good free of charge, any such damage, injury or loss, except such as may be caused solely by agents or employees of the Owner.

The Contractor shall protect all finished surfaces, including the jambs and soffits of all openings used as passageways or through which furniture and furnishings are handled, against any possible damage resulting from the conduct of work by his trades.

7.0 FINAL CLEANING OF FURNITURE AND FURNISHINGS

7.1 General

Provide final cleaning of the installed work, at a time indicated by the Project Manager/ Architect consisting of cleaning each installed surface or unit or work to normal "clean" condition expected for a first-class building cleaning and maintenance program. Comply with manufacturer's instructions for cleaning operations. The following are examples, but not by way of limitation, of cleaning levels are required.

a) Remove label which are not required as permanent labels.

b) Clean exposed hard-surfaced finished, including metals, painted surfaces, plastics, tile, wood, special coatings, and similar surfaces, to a free condition, free of dust, stains, films and similar

noticeable distracting substances. Restore reflective surfaces to original reflective conditions. Clean all furniture surfaces when so recommended by the manufacturers as a final clean-up for finish installation.

c) Vacuum clean carpeted surfaces and similar soft and upholstered surfaces.

7.2 Removal of Protection

Except as otherwise indicated or requested by Project Manager/ Architect, remove temporary protection devices and facilities, which were installed during course of the work to protect previously, completed work during remainder or construction period.

7.3 PROGRESS CLEAN-UP

7.3.1 Garbage Collection

Provide adequately sized covered trash bins centrally located in each building level. Additionally, provide covered garbage cans and keep premises free of garbage. Provide sufficient collection cans in each level of the building and at locations on the site. All packing materials not deposited in cans shall be picked up daily.

7.3.2 Cleaning Up Of Work Areas

The premises and the job site shall be maintained in a neat and orderly condition and kept free from accumulations of waste materials and rubbish during the entire installation period. Remove all crates and other flammable waste materials or trash from the work areas at the end of each working day.

7.3.3 Floors shall be “broom-cleaned”, or its equivalent during the course of the work. Additional cleaning of carpeting, and of all items which are provided as a part of the Contract including removal of dust, dirt, stains and finger marks from furniture and furnishings and all finished wood, metal and marble surfaces, shall be performed by the Contractor as required before acceptance of the work by the Project Manager/ Architect.

7.4 The Contractor shall be responsible for the general cleaning and maintenance of the premises and the job site and for the coordination and direction of the cleanup work of all furniture and

furnishings. The Contractor shall require that each trade shall clean and maintain its portion of the work as required and as directed by the Project Manager/ Architect.

- 7.5 All furniture and furnishings shall be new, in an undamaged, bright clean, polished condition. Re-cleaning will not be required after the work has been inspected and accepted unless later operations of the Contractor, in the opinion of the Project Manager/ Architect, make re-cleaning of certain portions necessary.

LIST OF APPROVED MAKE FOR CIVIL & STRUCTURAL WORKS

CIVIL ITEMS		
SL. NO.	ITEM / WORK	APPROVED MAKES / AGENCIES
1.	CEMENT	ACC/L & T (ULTRA-TECH)/ BIRLA / JK CEMENT / DALMIA CEMENT / JAYPEE CEMENT / GUJRAT AMBUJA/ GRASIM/ MYSORE CEMENT / INDIA CEMENT / SHREE CEMENT / LAKSHMI CEMENT
2.	REINFORCEMENT STEEL (TMT – FE500)	SAIL / RASHTRIYA ISPAT NIGAM / IISCO / TATA / JINDAL STEEL & POWER LTD/ JSW STEEL LTD
3.	STRUCTURAL STEEL/M.S. TUBE	SAIL / RASHTRIYA ISPAT NIGAM / TATA / JINDAL STEEL & POWER LTD/ JSW STEEL LTD
4.	PLASTICIZER, SUPER PLASTICIZER, ADMIXTURES, OTHER CONSTRUCTION CHEMICALS	M.C./ BAUCHEMIE/ FOSROC/ PIDILITE/ CICO/ SIKA/ BASF
5.	WATER PROOFING COMPOUND (CRYSTALLINE)	ACCOPROOF / XYPEX / BASF /SIKA /PENETRON/ KESHUN
6.	WATERPROOFING SELF ADHESIVE (HDPE) MEMBRANE	GRACE / FOSROC/ PIDILITE/ KINTOP / FIRE STONE
7.	EPDM WATERPROOFING MEMBRANE	CARLISLE / PIDILITE/ STP/FIRE STONE/ POLYGOMMA
8.	PU ELASTOMERIC MEMBRANE (SPRAY APPLIED) FOR DECK WATERPROOFING	BASF/ FOSROC/ SIKA/ KESHUN
9.	SWELLABLE BAR	PIDILITE/ FOSROC/ KESHUN/ HAYAKAWA
10.	DECKING STEEL SHEET	TATA STEEL /LLOYDS /JSW
11.	SHUTTERING PLY	ARCHID /CENTURY /MERINO/KITPLY
12.	REBARRING CHEMICAL	HILTI / 3M INDIA /BIRLA
13.	AAC BLOCK	AEROCON /ECOLITE/ BUILTECH/ INSTABLOCK/J K /MAGICRETE
14.	AAC MORTAR	FERROUSCRETE /ULTRATECH / JK
15.	CURING COMPOUND	FOSROC /SIKA/ CICO/STP /PIDILITE /BASF
16.	CEMENT PRIMER	BP WHITE (BERGER)/ DECOPRIME WT (ASIAN)/AKZONOBEL(DULUX)/ NEROLAC
17.	STEEL /WOOD PRIMER	AKZONOBEL (DULUX)/NEROLAC/ ASIAN PAINTS/BERGER/JENSON & NICHOLSON

CIVIL ITEMS		
SL. NO.	ITEM / WORK	APPROVED MAKES / AGENCIES
18.	WATER PROOFING COMPOUND	ACCOPROOF / PIDILITE / CICO / FOSROC / UMB, KRYTON, XYPEX
19.	EPOXY, GROUTING MORTAR/ ADMIXTURES	MBT, SIKA, SIKA, STP, FOSROC, BAL ENDURA
20.	CEMENT BASED PAINT	SNOWCEM SUPER / DURACEM / ACCROCEM
21.	CONCRETE ADDITIVE	SIKA / FOSROC / STP / CICO
22.	EXPANSION/ REBAR/ ANCHOR FASTENER	HILTI / FISCHER / DASH / ANCHOR/ BOSCH, FISHER
23.	EXPANSION JOINT-MODULAR	C.S/ HERCULUS/ Z-TECH/ VEXCOLT/ DEVIN /SANFIELD

LIST OF APPROVED MAKES FOR INTERIOR WORKS

SL.NO	ITEM DESCRIPTION	APPROVED MAKES
1.	Laminate	Merino, Greenlam, Century, Archidply or as approved equivalent.
2.	Ply Board/ Plywood	Merino, Greenlam, Century, Duro, Archidply, Sonear or approved equivalent.
3.	Locks in cabinets, furniture	Hettich, Hafele, Godrej, EBCO or approved equivalent
4.	Hardware	Dorma, Geze, Hafele, KICH , Asa Abloy or as approved equivalent.
5.	Fire retardant paint	Viper, Promat , AKW, Novel
6.	Veneer	Archid ply, Durian, Duro
7.	MDF	Nuwood, Green ply, Duratuff
8.	Adhesive for Wood	Jivanjor, Fevicol, Vemicol, BASF
9.	White Ash wood	Best quality 1st class Kail wood free from knots
10.	Anchor Fastener	Fischer, Hilti or as approved equivalent
11.	Glass/ Mirror	Saint Gobain, Asahi, Modiguard or as approved equivalent
12.	PU Foam	MM foam or equivalent density or as approved equivalent
13.	Seat and back cushion (Chairs, Sofas etc.)	MM foam or approved equivalent
14.	Polyurethane stainer and sealant for furniture and fixed items	Beck Bond, Sirca, MRF or as approved equivalent
15.	Fibre Glass Insulation	U.P.Twiga fibre glass insulations or approved equivalent

16.	Acoustical Ceiling Tiles	Armstrong, Ecophone, Nittobo, Knauf Danoline or approved equivalent
17.	Metal Tile Ceiling	Armstrong, Inter arch or approved equivalent
18.	Open Grid/Cell Ceiling	Durlum, Armstrong or as approved
19.	Baffle ceiling	Armstrong, Techno, Supersil
20.	Access Floor	Hewetson, LG or approved equivalent
21.	PVC Floor	Tarkett, Ger Floor, Polyflor, Armstrong, Forbo
22.	Antistatic PVC Floor	Tarkett, Ger Floor, Polyflor, Armstrong, Forbo
23.	Texture Paint	Unitile, Spectrum, Asian, ICI
24.	Tempering/ Toughening of Glass	Gurind, GSC, Gold Plus or as approved equivalent
25.	Sealents	Wacker, 3M,,Dow Corning or as approved equivalent
26.	Grouts	Pidilite, Bal Endura, Laticrete
27.	EPDM Acoustical/ Fire Seal	Enviroseal or approved equivalent
28.	Anti Bacterial Acrylic Emulsion Paint	'Royal lustre' by Asian paints/ Berger 'Easy Clean'/ 'Super Clean" by ICI- Dulux/ or approved equivalent
29.	Stainless Steel Railings	Renox,D-Line, Jindal, KICH, Ozone
30.	Laminated Wooden Flooring/ Skirting	Pergo/ Parquet/Haro
31.	Laquered Glass	Saint Gobain or equivalent
32.	Pin up Board Fabric	Response fabric, Mayur, Raymond
33.	Stone(Granite)	Grava, Mangla marble or as per approved sample
34.	Green Wall	Himalaya, ZTC,
35.	ALUMINIUM EXTRUSIONS	JINDAL, HINDALCO, BHORUKA
36.	CLEAR FLOAT GLASS	Saint Gobain/Modiguard/ Asahi
37.	SILICONE SEALANTS	WACKER, DOW CORNING
38.	FASTENERS AND BOLTS	HILTI / FISCHER
39.	POWDERCOATING MATERIALS (P.P)	INTERPON / BERGER

40.	Bought out Furniture	Tirupati/ Featherlite/VKS Concept/Recliners India/ Spanco Storage systems/Godrej
41.	WPC	Amulya/ Alstone/E3
42.	Digital printed PVC Wall paper	Muraspec Digital or equivalent
43.	Stretcher Guard	Inprocorp India system or equivalent
44.	Wall guard (wall covering)	Inprocorp India system or equivalent
45.	Wall guard (Ramp)	Honesty or approved equivalent
46.	Corner guard (corridor)	Inpro Wall protection system
47.	Corner guard (parking)	Honesty or approved equivalent
48.	Acrylic Solid surface	Dupont/Merino/Durlax aspiro/LG/Samsung/Denolex
49.	Medical Curtain & Track system	RD Plast, Vista, Gaddiel
50.	Toilet Urinal Partitions	Merino or equivalent
51.	Toilet/ Change room modular cubicle partitions	Merino or equivalent
52.	Frosted & printed Graphics film on glass	3M/ LG
53.	Full Body Vitrified Tiles/ Matt finish Vitrified Tiles	RAK/ Kajaria/Somany/Varmora/Johnson/AGL
54.	Ceramic Tiles	RAK/ Kajaria/Somany/Varmora/Johnson/AGL
55.	Adhesives	Fevicol, Araldite or approved equivalent
56.	Gypsum board Ceiling/ Grid ceiling	Armstrong/Saint Gobain or approved equivalent
57.	Calcium Silicate Board	Hilux or approved equivalent
58.	Metal Tile ceiling	Armstrong or approved equivalent
59.	Acrylic sheet/ Board	Dupont, Samsung, Merino Hanex Denolex

For any other item required to be incorporated in works sample shall be got approved from the Project Manager /Owner/Architect.

Council of Architecture

Certificate of Registration

This is to certify that the name of

Shri NITIN GAUTAM

has been entered in the register and his Registration No. is

CA/2002/29475

This certificate is valid from the twenty-first

day of June 2002 to the thirty-first

day of December 2003 inclusive.

List of Additional Qualifications :

Renewals

Valid upto

Signature of
Registrar

31.12.2004	Vinod Kumar	29.11.2004
(31.12.2004)	Vinod Kumar	28.11.2004
31.12.2005	Vinod Kumar	28.3.2005
31.12.2006	Vinod Kumar	23.1.2005
31.12.2007	Vinod Kumar	22.3.2007
31.12.2017	Vinod Kumar	24.3.2008
31.12.2027	Vinod Kumar	14.11.14

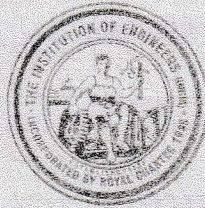
Given under the common Seal of the Council of Architecture,

this twenty-first day of June, 2002

Vinod Kumar
Secretary

Nitin Gautam
NITIN GAUTAM
Architect Town Planner
B. Arch. MCP, MCOA, etc.
CA No. 2002/29475
Premendra
President

019044



The Institution of Engineers (India)

By virtue of Qualification, Professional
training and Corporate Membership
of this Institution

KALYAN PRASUN DAS

OF

CIVIL ENGINEERING DIVISION

is hereby authorised to use the style and title of

Chartered Engineer [India]



M-1699290



Dated 01-10-2020

Bhattacharya

Secretary and Director General

**ANNEXURE -8****CHARTERED ACCOUNTANT'S CERTIFICATE**

(To be submitted at the time of Quarter update of the Project)

(For the Quarter April 22 to June 22)

Name of the Promoter- **MANAVINDER SINGH**Name of the Project- **AURAMAH VALLEY**HP RERA Registration No.- **RERAHPSH08170003**

(All figures in Lakh)

Sr. No.	Particulars		Amount (Rs.)
1	2		3
1.	I	Land Cost	
	A	Acquisition Cost of Land (as per Sale Deed) or Development Rights, Lease Premium, Lease Rent, interest cost incurred or payable on Land Cost (including all stamp duty, registration charges, legal cost etc). (As per Note-1)	NIL
		Sub-Total of Land Cost 1(i)	
2.		Development Cost / Cost of Construction	
Sr. No	Particulars		Incurred Amount/ Cost (Rs.)
1	I	2	3
	a.	(i) Actual expenditure/ cost of construction incurred as per the books of Accounts as verified by the CA Note: (for adding to total cost of construction actual incurred cost is to be considered)	29.36
		(ii) On-site expenditure for development of entire Project excluding cost of construction as per (i) above, i.e. salaries, consultants fees, site overheads, development works, cost of services (including water, electricity, sewerage, drainage, layout, roads etc.), cost of machineries and equipments including its hire and maintenance costs,	



		consumables etc. All costs directly incurred to complete the construction of the entire phase of the Project registered.	
		Total 2 (i)	29.36
	b.	Payment of taxes, cess, fees, charges, premiums, interest etc. to any statutory authority. Project Clearance Fees (i) Fees paid to HP RERA (ii) Fees paid to T&CP Deptt. (iii) Fees paid to Local Authority (Municipal / Panchayat) (iv) Consultant / Architect / Engineer Fees (directly attributable to Project) (v) Any other (specify) HPSEB	
	c.	Interest payable to financial institutions, scheduled banks, Non-Banking Financial Institution (NBFC) or money lenders on construction funding or money borrowed for construction;	2.66
3.	d.	Sub-Total of Development Cost and Construction Cost	a(i)+(ii)+(b)+(c)=3(d)
		Total Cost Incurred on the Real Estate Project [1(i) + 3(d)] of Incurred Column (Land cost + cost of all construction and development + taxes + interest)	32.02
4.		% Completion of Construction Work (As per Project Architect's Certificate) Certificate No.....dated.....	8.95 %

This Certificate is being issued on specific request of Mr. Manavinder Singh (Promoter's Name) for HP-RERA compliance. The Certificate is based on the information/records / documents / books of accounts of the Promoter and is true to the best of my knowledge and belief.

Place: New Delhi
Date: 06/08/2022
UDIN: 22071205AOKRFS7451




Signature of the Chartered Accountant
Alok Kumar Mittal
(Membership No. 071205)

NOTE-1 Cost of land shall be as per the sale deed executed.

NOTE-2 To be given as part of CA Certificate (Annexure 8) for quarterly updation

(Rs. In Lakhs)

Sr. No	Particulars	As per Certificate given for last Quarter	During the quarter	Total
1.	Total Land Cost as per Sr. No. 1 (i)	2.67	-	2.67
2.	Total Expenditure / Cost incurred as per Sr. No. 3 (d)	533.83	32.02	565.85

Advance from Customers

Sr. No.	Particulars	Amount received as per Certificate given for last Quarter	Amount received during the Quarter	Total Amount
1.	Advance received from Customers	975.67	218.37	1194.04

Separate Bank Account of the Project

Name of the Bank: HDFC Bank Ltd.

Branch: NEW FRIENDS COLONY, NEW DELHI

Account Number: 00892560006430

IFSC Code: HDFC0000089

Sr.No	Particulars	Amount in Rs. (Lacs)
1.	Opening Balance in the Separate Bank Account of the project at the start of the reported quarter.	0.53
2.	(Add): Deposits in the Separate Bank Account of the project during the reported quarter.	285.08
3.	(Less): Withdrawals from the Separate Bank Account of the project during the reported quarter.	264.77
4.	Closing Balance in the Separate Bank Account of the project at the end of the reported quarter.	20.84



GUIDELINES FOR THE CHARTERED ACCOUNTANT AT THE TIME OF ISSUE OF THIS CERTIFICATE:

1. The Chartered Accountant should be a "Practicing Chartered Accountant".
2. The Statutory Auditor doing annual audit and the Chartered Accountant issuing Certificate for Project registration and withdrawal from Separate Bank Account, should be different entities.
3. The Chartered Accountant shall be held responsible and accountable for any wrong information in the Certificate. The Chartered Accountant shall be liable for any penal action under the Real Estate (Regulation and Development) Act, 2016 including recommendation to the Institute of Chartered Accountants of India (ICAI) to initiate necessary disciplinary action including revocation of Membership.
4. This Certificate should be issued on the letter head of the Chartered Accountant, affixing his stamp/seal, along with Chartered Accountant's signature on each page. The Chartered Accountant shall also mention the Membership number below his signature.

ADDITIONAL INFORMATION FOR ONGOING PROJECTS

Sr. No	Particulars	Details (Amount in Lac)
1.	Estimated balance cost to be incurred for completion of the Real Estate Project. (Difference of total estimated project cost less cost incurred) (As per Project Architect's Certificate)	5623.78
2.	Balance amount of receivables from booked apartments as per A. of sub-Annexure-X to this Certificate (As certified by Chartered Accountant based upon verification of books of accounts)	1188.92
3.	i. (i) Balance unsold inventory to be certified by management and to be verified by Chartered Accountant from the records and books of account	
4.	ii. (ii) Estimated amount of sales proceeds in respect of unsold inventory as per B. of sub - Annexure- 'X' to this Certificate.	NIL



5.	Estimated receivables of ongoing Project. Sum of (2 + 4(ii))	1188.92
6.	Amount to be deposited in Separate Bank Account – 70% or 100% (If 4 is greater than 1, then 70% of the balance receivables of ongoing project will be deposited in Separate Bank Account.) and (If 4 is lesser than 1, then 100% of the balance receivables of ongoing Project will be deposited in the Separate Bank Account.)	

This Certificate is being issued by the Company as per the requirement of compliance in accordance with HP RERA Act and Rules for the Project / Phase under reference and is based on the records and documents produced before me and explanations provided to me by the management of the Company. It is based on the verification of books of accounts and other related documents till (date)_____.

Signature and Stamp / Seal of the Signatory CA

Name: Alok Kumar Mittal

Full Address: G-6, Saket, New Delhi

Membership No. 071205

Mobile No. +91-11-46113729

Email:- caalokmittal@gmail.com

Place: New Delhi

Date: 06/08/2022

UDIN: 22071205AOKRFS7451

SUB - ANNEXURE-X

Statement for calculation of Receivables from the Sales of the ongoing Real Estate Project:

A. BOOKED INVENTORY

1. In case of Plotted Colony:-

Sr. No.	Block /cluster/ Nomenclature as per sanctioned plan	No. of plots	Plot Area (in Sq. Mts.)	Total plot / unit consideration amount as per Agreement /letter of allotment	Received amount up to the end of previous Quarter (in Rs.)	Received amount up to the end of current Quarter (in Rs.)	Balance amount as on the end of current Quarter (in Rs.)
*Increase no. of rows to submit details of all Booked / Sold plots in the Real Estate Project Note- 1 sqm. =10.76 sft.							

2. In case of Flats/ Apartments:-

(Amount in Lac)

Sr. No.	Block/ Tower No. Nomenclature as per sanctioned plan	No. of Flats / Apartments/ units	Carpet Area (in Sq. Mts.)	Area of exclusive balcony / veranda/ covered parking (Sq. Mts.)	Total Unit consideration amount as per Agreement / letter of allotment (in Rs.)	Received amount up to the end of previous Quarter (in Rs.)	Received amount up to the end of current Quarter (in Rs.)	Balance amount as on the end of current Quarter (in Rs.)
1	IRIS	10	1247.68		699.03	699.03	699.03	0
2	Hydrangea	09	1312.77		1007.05	270.04	443.31	563.74
3	Magnolia	05	696.94		676.89	6.60	51.71	625.18
*Increase no. of rows to submit details of all Booked/ Sold Flats/ Apartments Note- 1 Sqm. =10.76 Sft.								

3. In case of Villas / Cottages:-

Sr. No.	Villa / Cottage name / no. Nomenclature as per sanctioned plan	No. of villas / cottages units	Carpet Area (in Sq. Mts.)	Area of exclusive balcony / veranda / covered parking / lawn (Sq. Mts.)	Total unit consideration amount as per Agreement / letter of allotment	Received amount up to the end of previous Quarter (in Rs.)	Received amount up to the end of current Quarter (in Rs.)	Balance amount as on the end of current Quarter (in Rs.)

			Mts.)		(in Rs.)			
	*							
*Increase no. of rows to submit details of all Booked / Sold villas / cottages Note- 1 sqm. =10.76 sft.								

4. In case of Garage/ Covered Parking:-

Sr. No.	Garage/ Covered Parking / no. Nomenclature as per sanctioned plan	No. of Garages / covered parking units	Carpet Area (in Sq. Mts.)	Total unit consideration amount as per Agreement/ letter of allotment (in Rs.)	Received amount up to the end of previous Quarter (in Rs.)	Received amount up to the end of current Quarter (in Rs.)	Balance amount as on the end of current Quarter (in Rs.)
	*						
*Increase no. of rows to submit details of all booked / sold Garage/ Covered Parking Note- 1 sqm. =10.76 sft.							

5. In case of Commercial Building:-

Sr. No.	Shop/ Commercial Unit no. Nomenclature as per sanctioned plan	No. of Shop/ Commercial unit	Carpet Area (in Sq. Mts.)	Area of exclusive balcony / covered parking / lawn (Sq. Mts.)	Total unit consideration amount as per Agreement/ letter of allotment (in Rs.)	Received amount up to the end of previous Quarter (in Rs.)	Received amount up to the end of current Quarter (in Rs.)	Balance amount as on the end of current Quarter (in Rs.)
	*							
*Increase no. of rows to submit details of all booked / sold shops/ commercial units Note- 1 sqm. =10.76 sft.								

6. Total Received and Balance Receivable from sold inventory:-

Sr. No.	Total Booked Inventory of all plots, flats / apartments, villas / cottages / garages / covered parkings, commercial units in the Real Estate Project as per A. of sub - Annexure-X	Total Received amount up to the end of current Quarter (Amount in Lac)	Total Balance Receivable amount as on the end of current Quarter (Amount in Lac)
1.	Total Balance Receivable Amount of Booked Inventory	1194.04	1188.92



B. UNSOLD INVENTORY VALUATION

1. In case of Plotted Colony:-

Sr. No.	Block /cluster/ Nomenclature as per sanctioned plan	No. of plots	Plot Area (in Sq. Mts.)	Total plot / unit consideration amount as assessed on the basis of Prevailing Market Rate (PMR) (in Rs.)	Total estimated amount of sale proceeds of all unsold plots (in Rs.)
*Increase no. of rows to submit details of all not booked/ unsold plots in the Real Estate Project. Note- 1 sqm. =10.76 sft.					

2. In case of Flats/ Apartments:-

(Amount in Lac)

Sr. No.	Block / Tower No. Nomenclature as per sanctioned plan	No. of Flats / Apartments / Units	Carpet Area (in Sq. Mts.)	Area of exclusive balcony / veranda/ covered car parking (Sq. Mts.)	Total Flats/ Apartments consideration amount as assessed on the basis of Prevailing Market Rate (PMR) (in Rs.)	Total estimated amount of sale proceeds of all unsold Flats/ Apartments (in Rs.)
1						
2						
*Increase no. of rows to submit details of all not booked/ unsold Flats/ Apartments in the Real Estate Project. Note- 1 sqm. =10.76 sft.						

3. In case of Villas / Cottages:-

Sr. No.	Villa / Cottage name / no. Nomenclature as per sanctioned plan	No. of Villas / Cottages units	Carpet Area (in Sq. Mts.)	Area of exclusive balcony / veranda / covered car parking / lawn (Sq. Mts.)	Total Villa / Cottage / consideration amount as assessed on the basis of Prevailing Market Rate (PMR) (in Rs.)	Total estimated amount of sale proceeds of all unsold Villas / Cottages/ (in Rs.)

	*					
*Increase no. of rows to submit details of all not booked/ unsold villas / cottages in the Real Estate Project. Note- 1 sqm. =10.76 sft.						

4. In case of Garage / Covered Parking:-

Sr. No.	Garage/ Covered Parking / no. Nomenclature as per sanctioned plan	No. of Garages / Covered Parking Units	Carpet Area (in Sq. Mts.)	Total Garage / Covered Parking consideration amount as assessed on the basis of Prevailing Market Rate (PMR) (in Rs.)	Total estimated amount of sale proceeds of all unsold Garages/ Covered Parking (in Rs.)
	*				
*Increase no. of rows to submit details of all not booked / unsold Garage / Covered Parking Note- 1 sqm. =10.76 sft.					

5. In case of Commercial Building:-

Sr. No.	Shop/ Commercial unit no. Nomenclature as per sanctioned plan	No. of Shops/ Commercial Units	Carpet Area (Sq. Mts.)	Area of exclusive balcony / Covered Parking / lawn (Sq. Mts.)	Total shops/ Commercial Unit consideration amount as assessed on the basis of Prevailing Market Rate (PMR) (in Rs.)	Total estimated amount of sale proceeds of all unsold shops/ Commercial Units (in Rs.)
	*					
*Increase no. of rows to submit details of all not booked/ unsold shops / commercial units in the Real Estate Project. Note- 1 sqm. =10.76 sft.						



6. Total Estimated Receivable from not Booked/ unsold inventory:-

Sr. No.	Total not booked/ unsold Inventory of all plots, flats/apartments, cottages/ villa/, garages/ covered parking, commercial units in the Real Estate Project as per B. of sub-Annexure-X	Total Estimated Amount (Amount in Lac)
-	Total Evaluated Amount of Unsold Inventory	NIL




Signature and Stamp / Seal of the Signatory CA)

Name: Alok Kumar Mittal

Full Address: G-6, Saket, New Delhi

Membership No. 071205

Mobile No. +91-11-46113729

Email:- caalokmittal@gmail.com

Place: New Delhi

Date: 06/08/2022

UDIN: 22071205AOKRFS7451



Alok Mittal & Associates

Chartered Accountants

G-8, Saket, Ground Floor

April 22 to June 2022 New Delhi 110 017

Tel : 011-46113729, 41655810

E-mail : caalokmittal@gmail.com

Web : www.caalokmittal.com

ANNEXURE -11

CHARTERED ACCOUNTANT'S CERTIFICATE

(To be submitted at the time of withdrawal from Separate Bank Account)

Certificate No. _____

To,
HDFC Bank Ltd,
New Friends Colony
New Delhi

Subject:- Certificate of estimated expenditure for Development/ Construction work in Auramah Valley (Project Name) bearing Registration No. RERAHPSP08170003, for withdrawal from Separate Bank Account.

Sir,

We Alok Mittal & Associates are the Chartered Accountants for the professional accountancy services for the above cited Project, coming up on Khasra No. 150,220,221,224,226,227,228,229,230,231,236,237,238,239, 240,241,242,243,244,245,247 and 228 at Mohal Tikkar, Naldhera Tehsil District Shimla Himachal Pradesh being developed by Mr. Manavinder Singh (Promoter's Name).

With respect to the aforesaid Real Estate Project, We certify that the total expenditure / cost incurred for the Development/ Construction work of Real Estate Project on the basis of information, records, documents and books of Accounts of the Promoter for **AURAMAH VALLEY** (project name), is **Rs 29.36 Lacs** as worked out in the April 22 to June 2022 Quarterly Progress Report submitted vide Certificate No.dated.....(copy enclosed).

Signature of the Chartered Accountant

Alok Kumar Mittal

(Partner)

Membership No. 071205

Place: New Delhi

Date: 06/08/2022

UDIN: 22071205AOKRFS7451



**GUIDELINES FOR THE CHARTERED ACCOUNTANT AT THE TIME OF
ISSUE OF THIS CERTIFICATE:**

1. The Chartered Accountant should be a "Practicing Chartered Accountant".
2. The Statutory Auditor doing annual audit and the Chartered Accountant issuing Certificate for Project registration and withdrawal from **Separate Bank** Account, should be different entities.
3. The Chartered Accountant shall be held responsible and accountable for any wrong information in the Certificate. The Chartered Accountant shall be liable for any penal action under the Real Estate (Regulation and Development) Act, 2016 including recommendation to the Institute of Chartered Accountants of India (ICAI) to initiate necessary disciplinary action including revocation of Membership.
4. This Certificate should be issued on the letter head of the Chartered Accountant, affixing his stamp/seal, along with Chartered Accountant's signature on each page. The Chartered Accountant shall also mention the Membership number below his signature.

PHASE 2











PHASE 2





