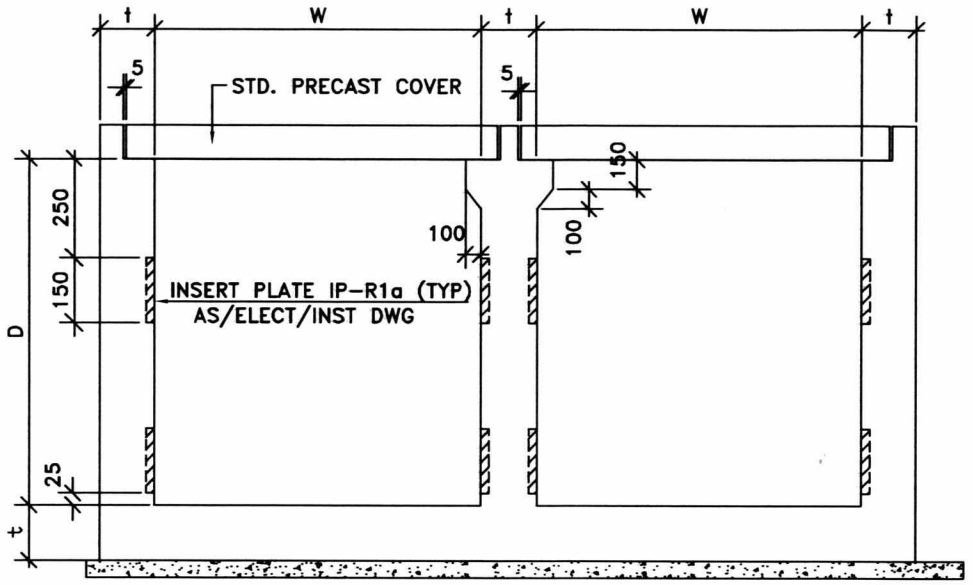
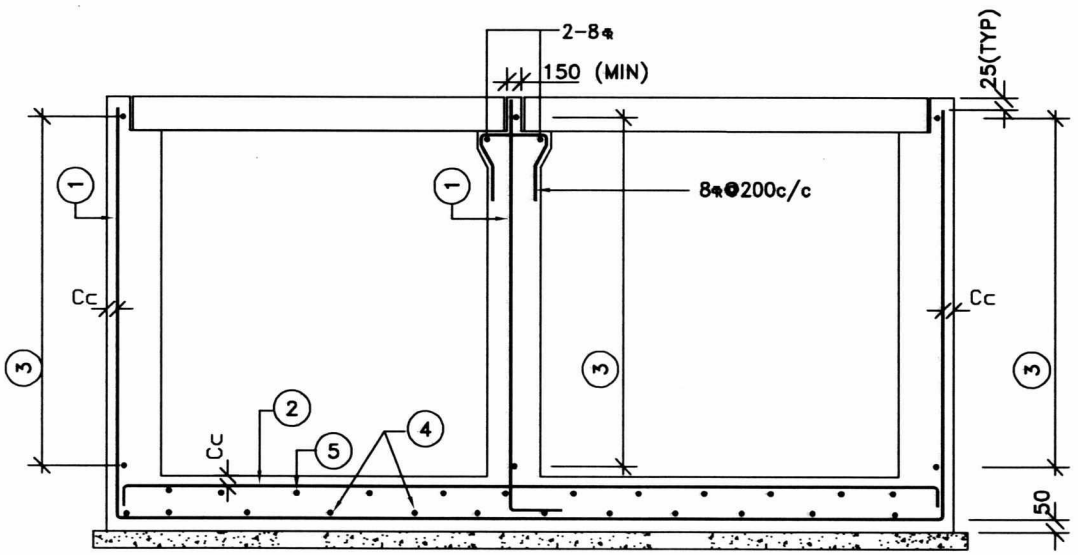


CABLE TRENCH SECTION WITH PARTITION



CABLE TRENCH SECTION WITH PARTITION

(FOR DETS OF R/F BARS ① TO ⑤ REFER TABLE-1 SHT 5 OF 16)

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TABLE-1 DETAIL OF CABLE TRENCH REINFORCEMENT

S.NO.	WORKING DIMENSIONS				R/F CONFORMING TO GRADE Fe-500D(TMT) OF IS:1786.					APPROX. QUANTITIES PER METRE LENGTH.		
	DEPTH	WIDTH	THICK-NESS	CLEAR COVER	BAR MARK (REF. SHT. 10 & 11 OF 16)					LEAN CONC. 1:5:10	CONC.	REBARS
	D (mm)	W (mm)	t (mm)	Cc (mm)	(1)	(2)	(3)	(4)	(5)	(m^3)	(m^3)	(kg)
1.	300	300	125	30	8ϕ-200C/C.	—	8ϕ-300C/C.	8ϕ-300C/C.	ϕ —	0.045	0.15	3.80
2.	300	500	125	30	8ϕ-200C/C.	—	8ϕ-300C/C.	8ϕ-300C/C.	—	0.048	0.17	4.70
3.	500	500	125	30	8ϕ-200C/C.	—	8ϕ-300C/C.	8ϕ-300C/C.	—	0.060	0.22	5.60
4.	750	750	125	30	8ϕ-200C/C.	10ϕ-150C/C.	8ϕ-300C/C.	8ϕ-300C/C.	8ϕ-300C/C.	0.079	0.32	19.0
5.	1000	1000	125	30	10ϕ-150C/C.	8ϕ-200C/C.	8ϕ-300C/C.	8ϕ-300C/C.	8ϕ-300C/C.	0.098	0.41	26.0
6.		1250	125	30	10ϕ-150C/C.	8ϕ-150C/C.	8ϕ-300C/C.	8ϕ-300C/C.	8ϕ-300C/C.	0.116	0.44	29.0
7.		1500	150	30	10ϕ-150C/C.	12ϕ-150C/C.	8ϕ-300C/C.	8ϕ-300C/C.	8ϕ-300C/C.	0.139	0.57	36.0
8.		2000	175	30	10ϕ-150C/C.	12ϕ-150C/C.	8ϕ-250C/C.	8ϕ-300C/C.	8ϕ-300C/C.	0.180	0.77	49.0
9.	1250	500	150	30	10ϕ-150C/C.	8 ϕ-250C/C.	8ϕ-300C/C.	8ϕ-300C/C.	8ϕ-300C/C.	0.063	0.50	27.1
10.		750	150	30	10ϕ-150C/C.	8 ϕ-200C/C.	8ϕ-300C/C.	8ϕ-300C/C.	8ϕ-300C/C.	0.08	0.54	29.5
11.		1000	150	30	10ϕ-150C/C.	10ϕ-200C/C.	8ϕ-300C/C.	8ϕ-300C/C.	8ϕ-300C/C.	0.101	0.57	32.0
12.		1250	150	30	10ϕ-150C/C.	10ϕ-150C/C.	8ϕ-300C/C.	8ϕ-300C/C.	8ϕ-300C/C.	0.120	0.61	37.0
13.		1500	150	30	10ϕ-150C/C.	12ϕ-150C/C.	8ϕ-300C/C.	8ϕ-300C/C.	8ϕ-300C/C.	0.139	0.65	43.0
14.		2000	175	30	10ϕ-150C/C.	12ϕ-150C/C.	8ϕ-250C/C.	8ϕ-300C/C.	8ϕ-300C/C.	0.180	0.85	49.0
15.	1500	1000	175	30	12ϕ-200C/C.	8ϕ-250C/C.	8ϕ-250C/C.	8ϕ-300C/C.	8ϕ-300C/C.	0.105	0.76	36.0
16.		1250	175	30	12ϕ-200C/C.	8ϕ-175C/C.	8ϕ-250C/C.	8ϕ-300C/C.	8ϕ-300C/C.	0.124	0.81	40.0
17.		1500	175	30	12ϕ-200C/C.	10ϕ-175C/C.	8ϕ-250C/C.	8ϕ-300C/C.	8ϕ-300C/C.	0.143	0.85	44.0
18.		2000	175	30	12ϕ-200C/C.	12ϕ-175C/C.	8ϕ-250C/C.	8ϕ-300C/C.	8ϕ-300C/C.	0.180	0.94	56.0
19.	2200	2250	250	30	12ϕ-150C/C.	12ϕ-150C/C.	8ϕ-200C/C.	8ϕ-250C/C.	8ϕ-250C/C.	0.206	1.80	95.0

NOTES-

1. THE QUANTITIES GIVEN IN THIS TABLE ARE FOR ESTIMATION PURPOSE ONLY.
2. PREFERABLY THE DEPTH OF CABLE TRENCH SHALL NOT BE MORE THAN THE WIDTH.
3. TRENCHES OF DEPTH 300 & 500mm IN BRICK MASONRY WHEREVER SPECIFIED.

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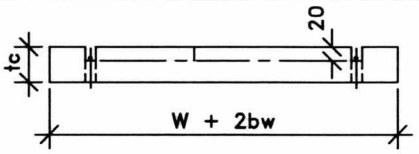
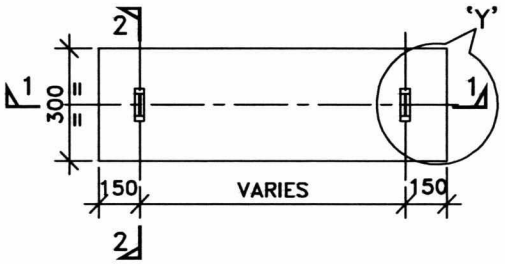
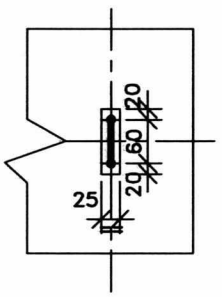


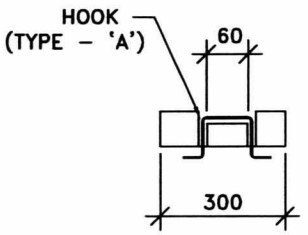
SEC. 1–1



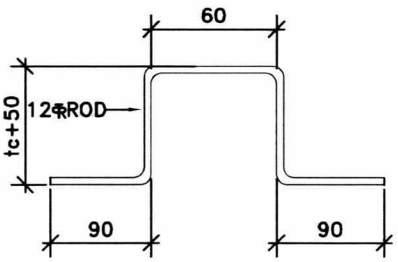
PRECAST R.C.C. COVERS



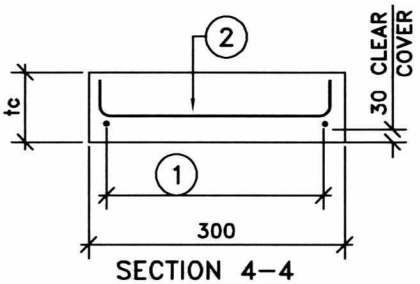
DETAIL – 'Y'
(TYP.)



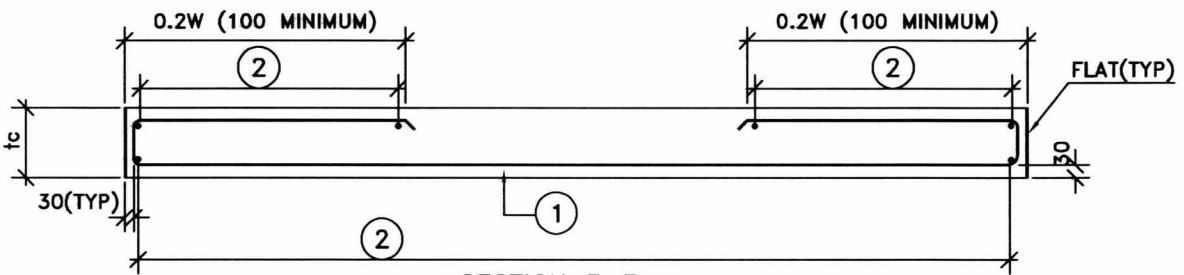
SEC. 2–2



HOOK TYPE 'A'



SECTION 4–4



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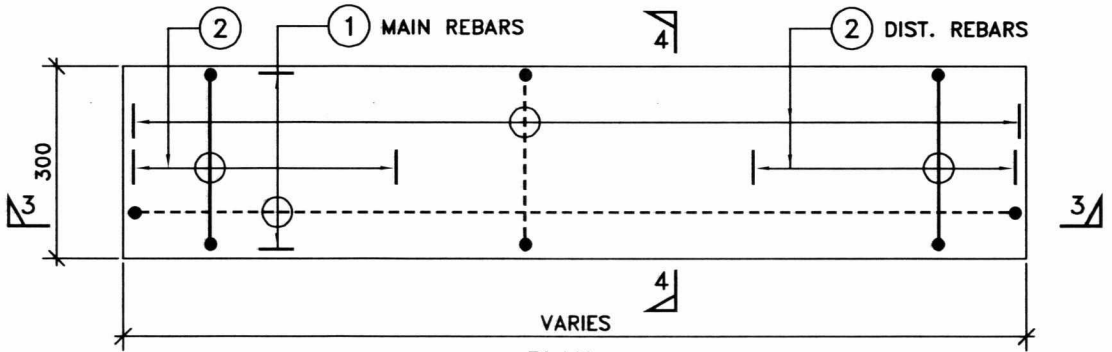

PLAN
(STANDARD PRECAST COVER)

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TABLE-2: DETAIL OF STANDARD PRECAST COVERS

S.NO.	TYPE	WORKING DIMENSIONS				DESIGN LOAD ON EACH COVER		FOR ONE UNIT OF WIDTH 300 mm				
		CLEAR WIDTH OF TRENCH W (mm)	BEARING OF COVER bw (mm)	TOTAL LENGTH OF COVER W+2bw (mm)	THICK-NESS OF COVER tc (mm)	TOTAL U.D.L. (KG/m^2)	EQUV. CONCEN. LOAD AT CENTRE OF SPAN (kgs)	REINFORCEMENT CONFORMING TO GRADE Fe-500D(TMT) OF IS:1786		APPROX. QUANTITIES		SELF WEIGHT (kgs)
								BAR MKD. (1)	BAR MKD. (2)	CONCRETE	REINF. (kg)	
1.	PC-1	300	50	400	100	≤2000	≤1000	3-8ϕ	3-8ϕ	0.012	0.94	30
2.	PC-2	500	50	600	100	≤2000	≤1000	3-8ϕ	3-8ϕ	0.018	1.18	45
3.	PC-3A	750	50	850	100	≤1500	≤750	3-8ϕ	4-8ϕ	0.026	1.62	64
4.	PC-3B				100	>1500 ≤2000	>750 ≤1000	4-8ϕ	4-8ϕ	0.026	1.96	64
5.	PC-4A	1000	50	1100	100	≤1500	≤750	4-8ϕ	5-8ϕ	0.033	2.57	83
6.	PC-4B				120	>1500 ≤2000	>750 ≤1000	4-8ϕ	5-8ϕ	0.040	2.57	99
7.	PC-5A	1250	50	1350	120	≤1500	≤750	4-8ϕ	5-8ϕ	0.049	2.98	122
8.	PC-5B				120	>1500 ≤2000	>750 ≤1000	4-10ϕ	5-8ϕ	0.049	4.22	122
9.	PC-6A	1500	75	1650	120	≤1500	≤750	3-10ϕ	6-8ϕ	0.060	3.96	149
10.	PC-6B				130	>1500 ≤2000	>750 ≤1000	4-10ϕ	6-8ϕ	0.065	4.99	161
11.	PC-7A	2000	75	2150	130	≤1500	≤750	4-10ϕ	7-8ϕ	0.083	6.36	210
12.	PC-7B				140	>1500 ≤2000	>750 ≤1000	4-12ϕ	7-8ϕ	0.090	8.67	226
13.	PC-8A	2250	75	2400	140	≤1500	≤750	4-10ϕ	8-8ϕ	0.101	6.89	252
14.	PC-8B				150	>1500 ≤2000	>750 ≤1000	4-12ϕ	8-8ϕ	0.108	9.50	270

NOTES :-

1. FOR LOCATION OF BARS MKD. (1) AND (2) REFER SHT. 6 OF 16.
2. ALL PRECAST COVERS SHALL BE MARKED (T) ON THE TOP FOR PROPER PLACEMENT.
3. THE QUANTITIES GIVEN IN THIS TABLE ARE FOR ESTIMATION PURPOSE ONLY.
4. DESIGN IS VALID FOR EITHER TOTAL UDL OR EQUV. POINT LOAD AT CENTRE OF SPAN.

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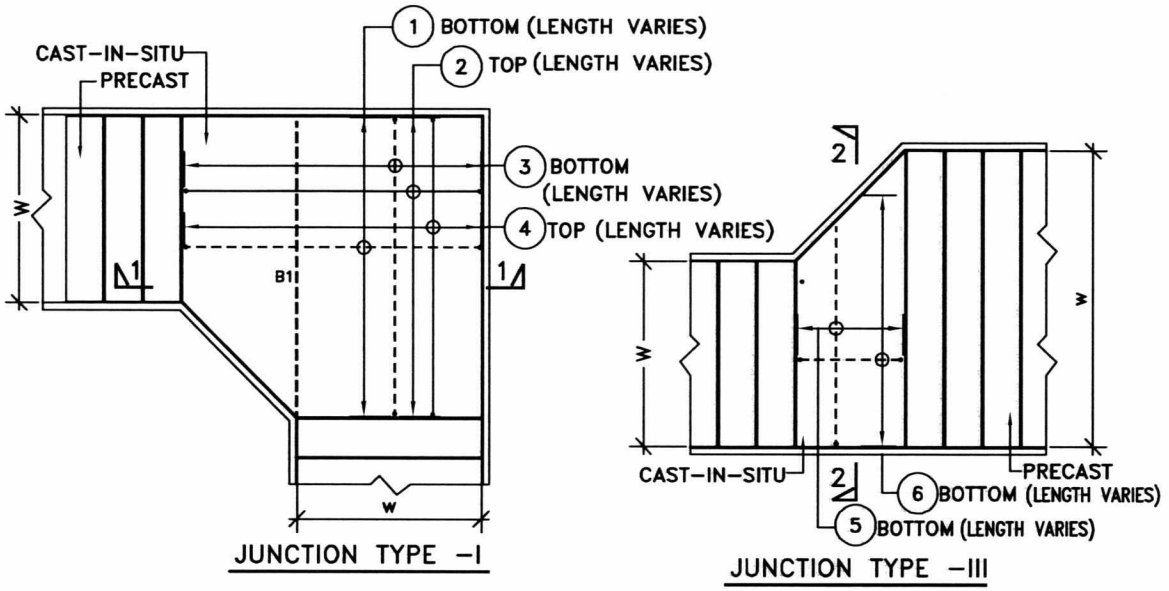

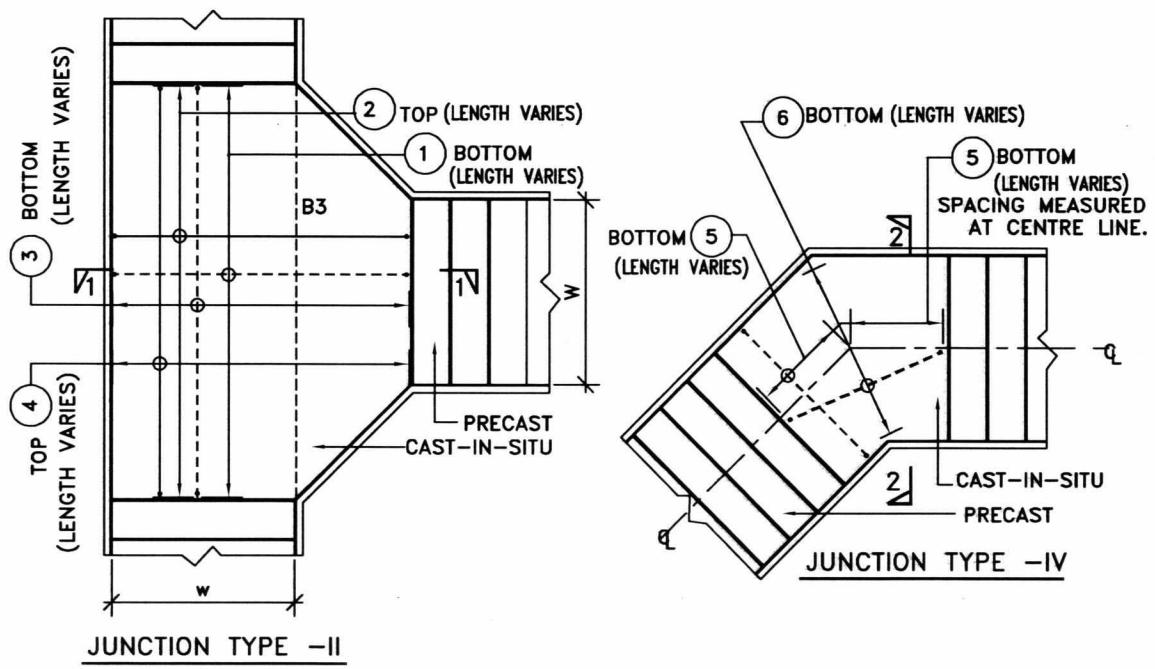

CAST-IN-SITU COVERS

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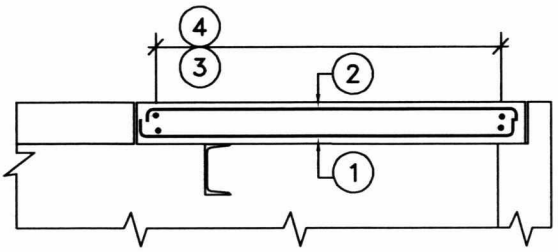
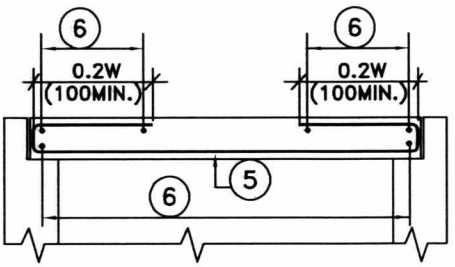


SECTION 1–1



SECTION 2–2

TABLE–3:DETAIL OF CAST–IN–SITU COVERS

S.NO.	W (mm)	tc (mm)	REINFORCEMENT DETAIL FOR CAST–IN–SITU COVERS					
			JUNCTION TYPE I & II				JUNCTION TYPE III & IV	
			BAR MARK (1)	BAR MARK (2)	BAR MARK (3)	BAR MARK (4)	BAR MARK (5)	BAR MARK (6)
1.	300	100	8ϕ@120c/c	–	8ϕ@150c/c	–	8ϕ@150c/c	8ϕ@200c/c
2.	500	100	8ϕ@120c/c	–	8ϕ@150c/c	–	8ϕ@150c/c	8ϕ@200c/c
3.	750	100	8ϕ@120c/c	8ϕ@200c/c	8ϕ@200c/c	8ϕ@200c/c	8ϕ@150c/c	8ϕ@200c/c
4.	1000	120	8ϕ@120c/c	8ϕ@200c/c	8ϕ@300c/c	8ϕ@300c/c	8ϕ@150c/c	8ϕ@300c/c
5.	1250	120	10ϕ@120c/c	8ϕ@200c/c	8ϕ@300c/c	8ϕ@300c/c	10ϕ@150c/c	8ϕ@300c/c
6.	1500	130	10ϕ@120c/c	8ϕ@200c/c	8ϕ@300c/c	8ϕ@300c/c	10ϕ@150c/c	8ϕ@300c/c
7.	2000	140	12ϕ@120c/c	8ϕ@200c/c	8ϕ@300c/c	8ϕ@300c/c	12ϕ@150c/c	8ϕ@300c/c
8.	2250	150	12ϕ@120c/c	8ϕ@200c/c	8ϕ@300c/c	8ϕ@300c/c	12ϕ@150c/c	8ϕ@300c/c

NOTES :–

1. THE CAST–IN–SITU COVERS ARE DESIGNED FOR TOTAL UDL OF 2000 kg/m. OR AN EQUIVALENT POINT LOAD OF 1000 kg ACTING AT MID SPAN.
2. FOR CONNECTION DETAIL AND SIZES OF B1 & B3 REFER SHT.8 OF 16 & 12 OF 16.
3. FOR LOCATION OF BAR MARKS (1) TO (6) REFER ABOVE SECTIONS 1–1 & 2–2.

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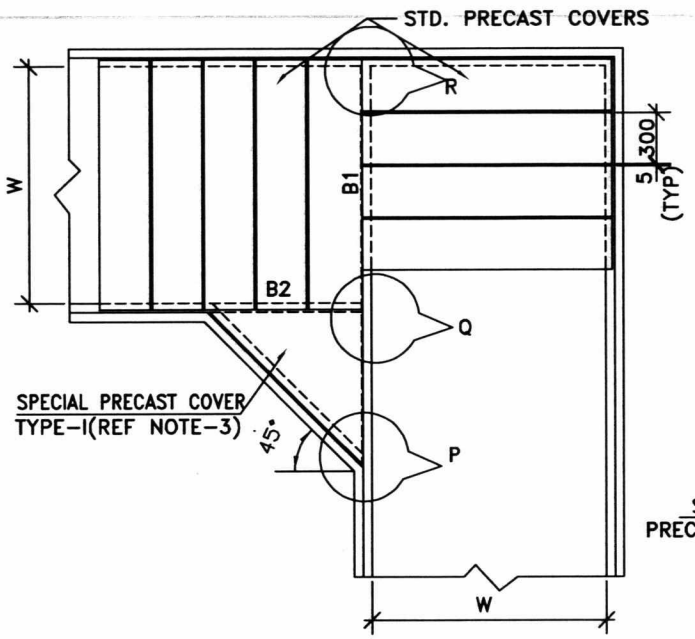
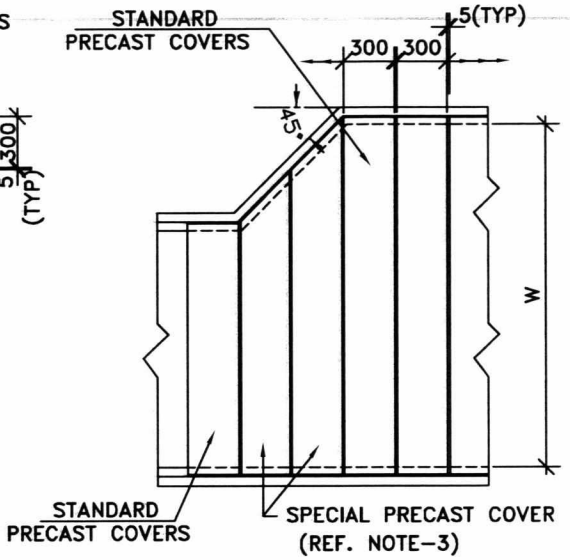


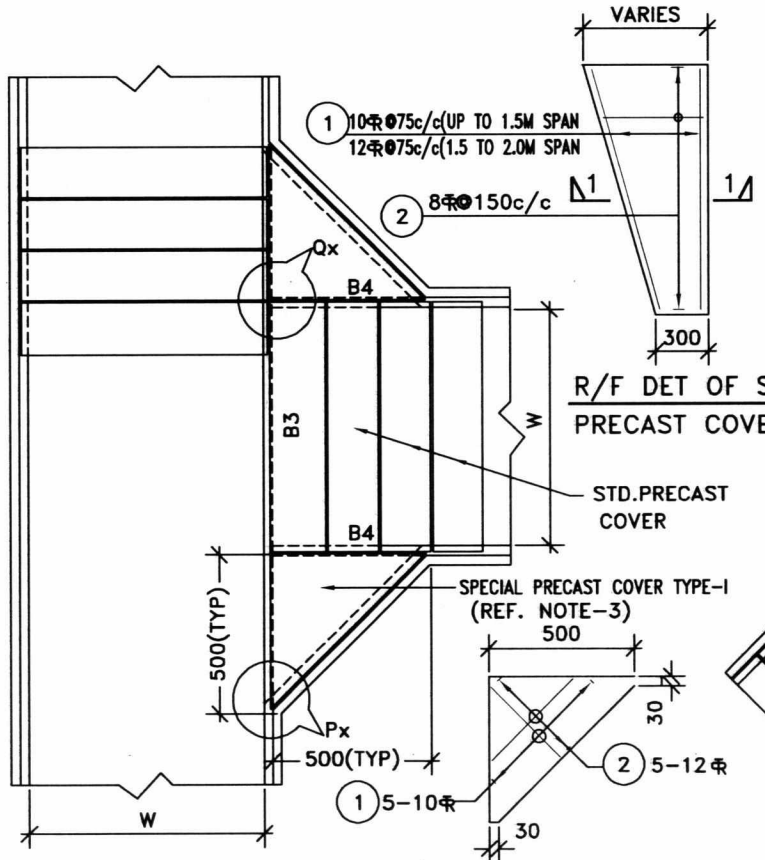
JUNCTION TYPE – I



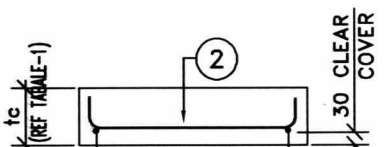
JUNCTION TYPE – III

NOTES :

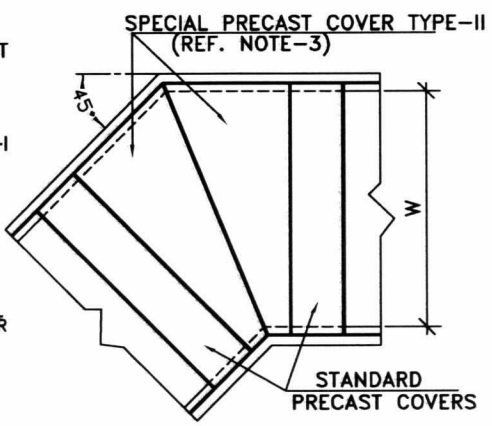
1. FOR DETAILS P, Q, Px, Qx & R REFER SHT. 11 OF 16.
2. FOR DETAIL OF BEAMS B1 TO B4 REF. TABLE 4 SHT 12 OF 16.
3. SPECIAL PRECAST COVER AT JUNCTION OF CABLE TRENCH PREFERABLY BE IN CAST-IN-SITU (REF SHT 8 OF 16)



R/F DET OF SPECIAL
PRECAST COVER TYPE-II



SECTION 1–1



JUNCTION TYPE – II

R/F DET OF SPECIAL
PRECAST COVER TYPE-I

JUNCTION TYPE – IV

SPECIAL PRECAST COVERS

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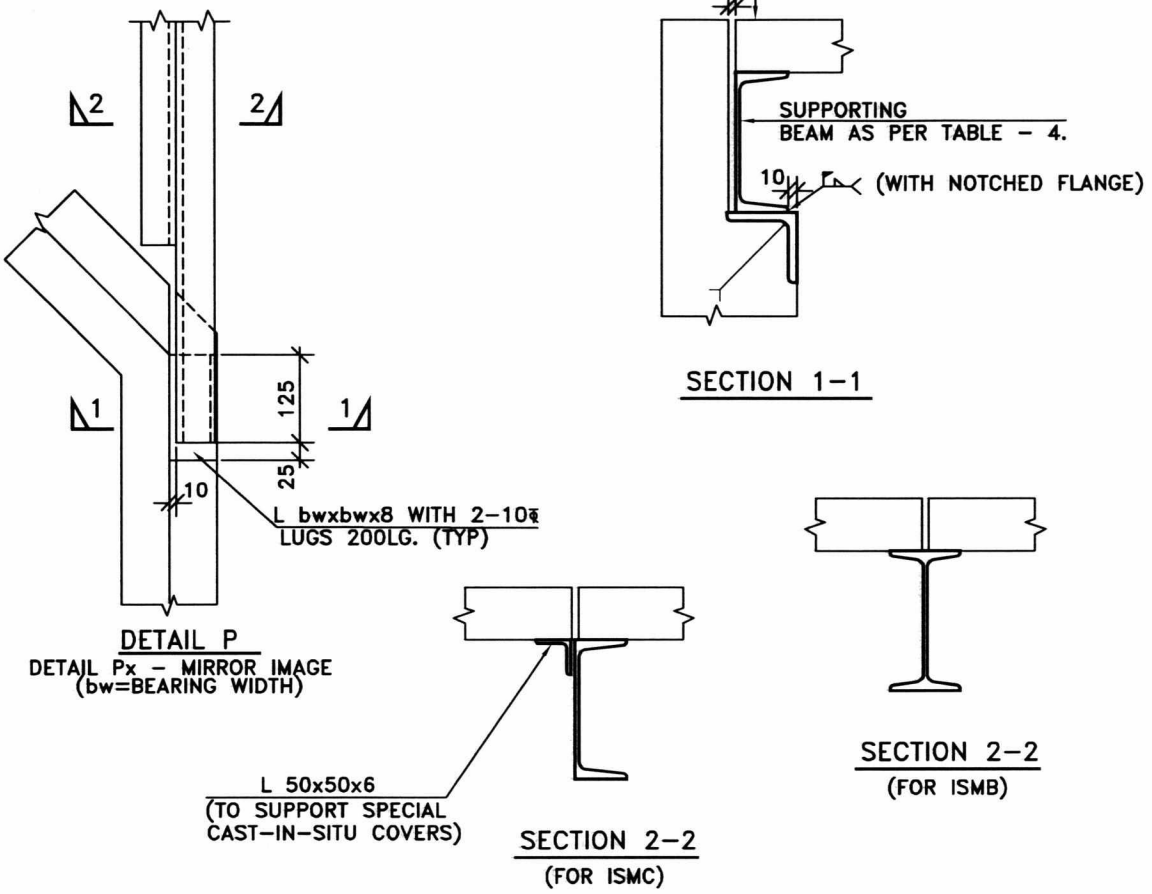

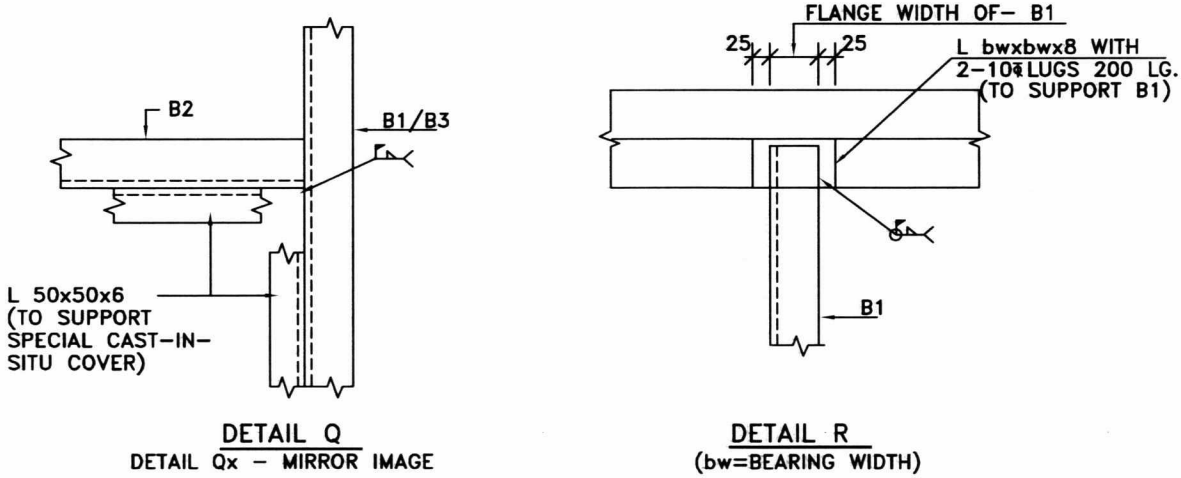

SUPPORTING MEMBERS

(FOR LOCATION OF DET. P, Q, Px, Qx & R REF. SHT. 10 OF 16)

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TABLE–4: DETAIL OF SUPPORTING MEMBERS AT JUNCTIONS

S.NO.	WIDTH OF MAIN TRENCH W	JUNCTION TYPE – I				JUNCTION TYPE – II			
		SUPPORTING MEMBER B1		SUPPORTING MEMBER B2		SUPPORTING MEMBER B3		SUPPORTING MEMBER B4	
		SIZE	LENGTH	SIZE	LENGTH	SIZE	LENGTH	SIZE	LENGTH
1.	300	MC 100	1020	MC 100	625	MC 100	1650	MC 100	625
2.	500	MC 100	1220	MC 100	625	MC 150	1850	MC 100	625
3.	750	MC 100	1470	MC 100	625	MC 150	2100	MC 100	625
4.	1000	MC 100	1720	MC 100	625	MC 150	2350	MC 100	625
5.	1250	MC 150	1970	MC 100	625	MC 150	2600	MC 100	625
6.	1500	MC 150	2270	MC 100	625	MC 150	2900	MC 100	625
7.	2000	MC 150	2770	MC 100	625	MC 200	3400	MC 100	625
8.	2250	MC 150	3020	MC 100	625	MC 200	3650	MC 100	625

NOTE

THE SUPPORTING MEMBERS ARE DESIGNED FOR COVER WT. PLUS A POINT LOAD OF 1000 KG. AT MID SPAN.

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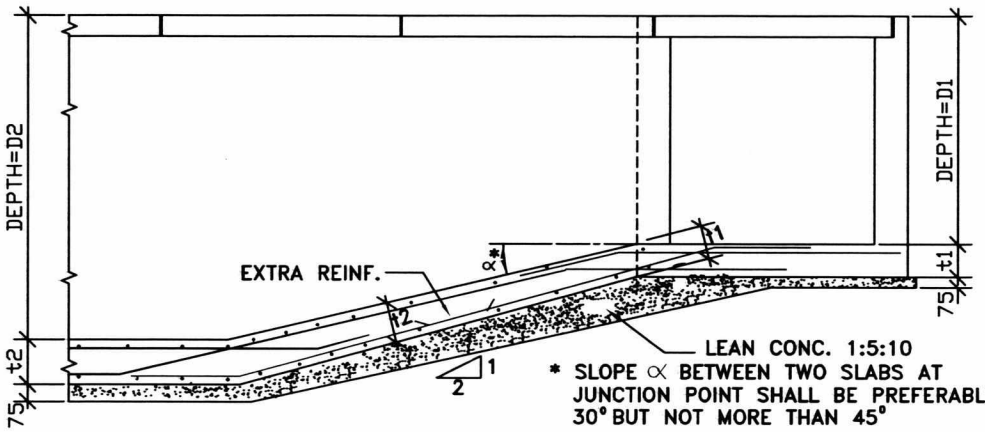

TYPICAL DETAIL AT JUNCTION FOR DIFFERENT DEPTHS OF TRENCH.

(R/F DETAIL OF TRENCH IN SLOPE SHALL BE BASED ON DEPTH D2).

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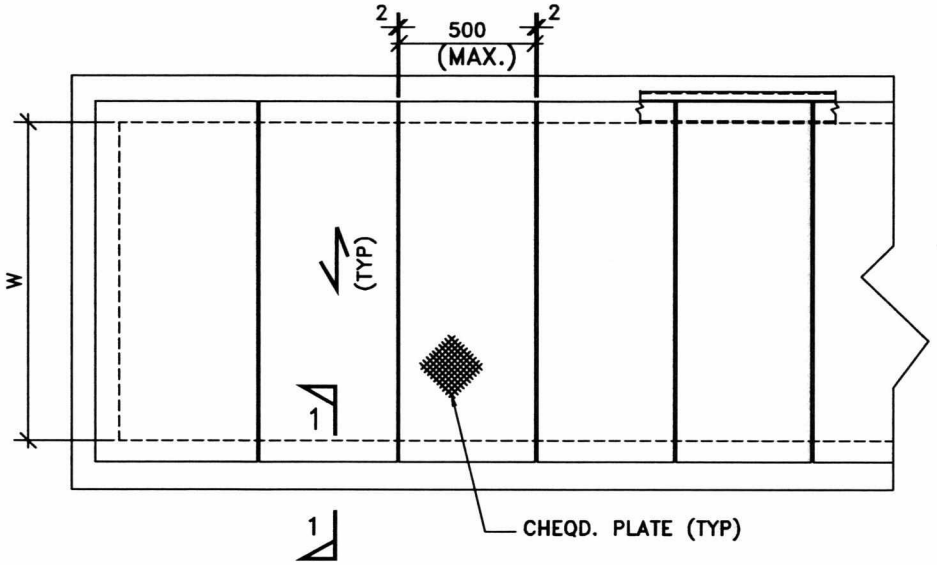
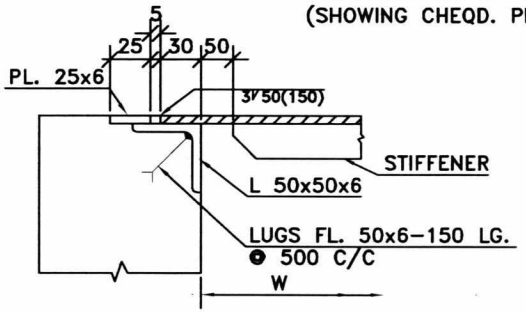
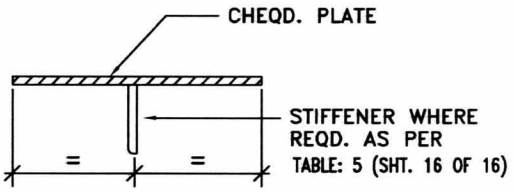


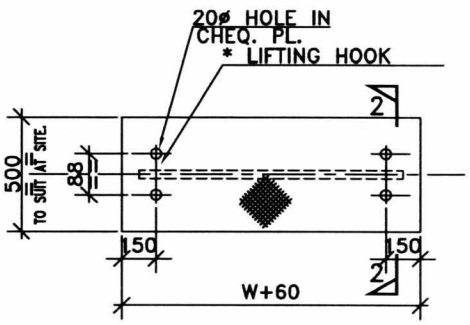
TYPICAL TRENCH PLAN
(SHOWING CHEQD. PLATE)



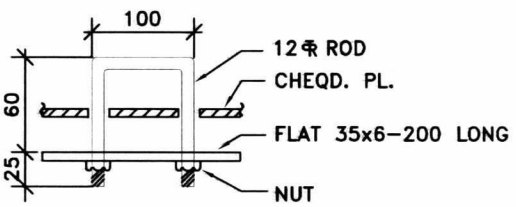
SECTION 1–1



SECTION 2–2



TYP. CHEQD. PLATE DETAIL
(SHOWING CHEQD. PLATE)



TYP. LIFTING HOOK DETAIL

* ONE HOOK FOR SPAN UPTO 500
TWO HOOKS FOR SPAN ABOVE 500.

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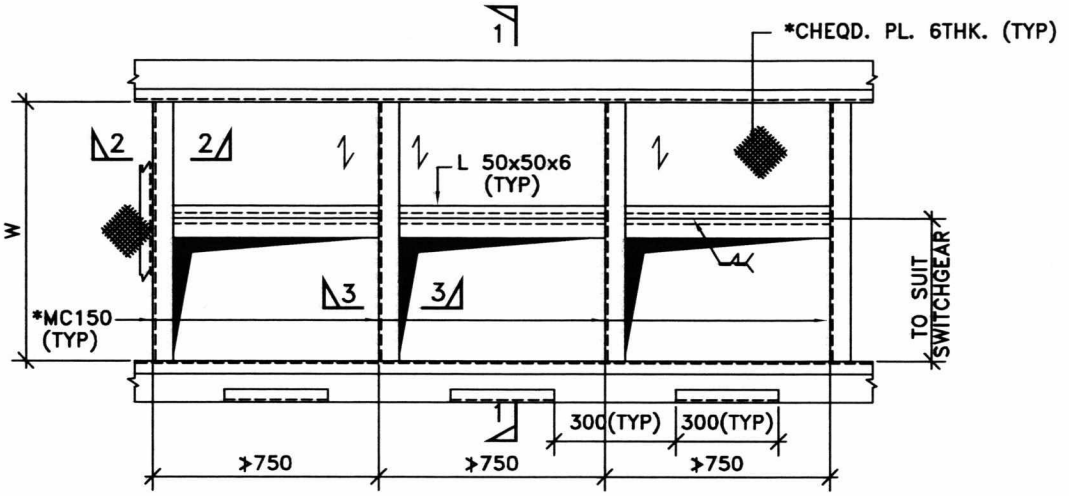
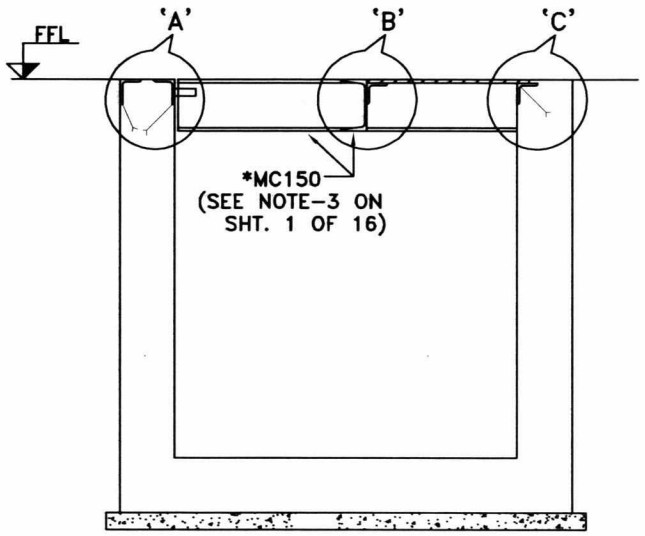
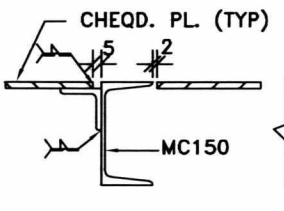


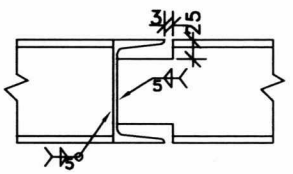
TYPICAL TRENCH PLAN
(AT SWITCH GEARS)



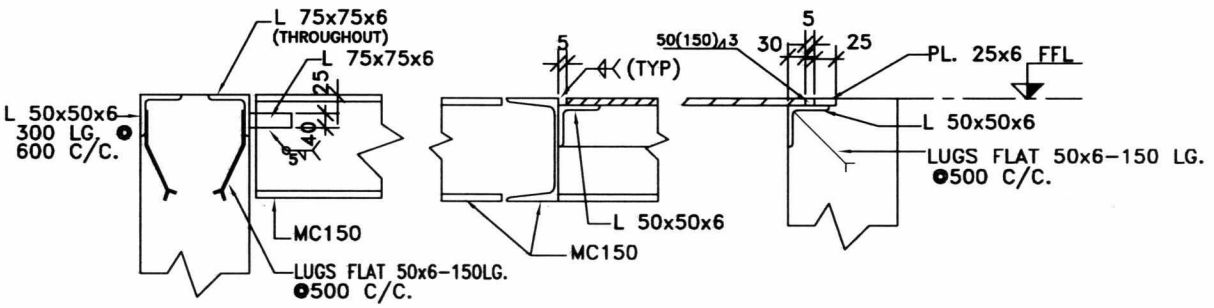
SECTION 1-1



SECTION 2-2



SECTION 3-3



DETAIL A DETAIL B DETAIL C

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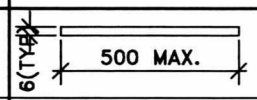
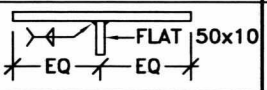
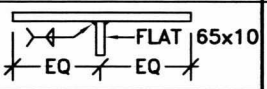
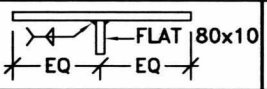
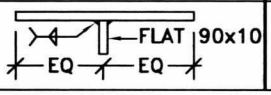
TABLE– 5: DETAIL OF CHEQUERED PLATE COVER

S.NO.	TYPE	SECTION	SECTION PROPERTIES FOR 500mm WIDE PLATE			RECOMMENDED SPAN (W) mm
			WT. kg/m	I=cm^4	Zmin =cm^3	
1.	I		23.55	0.90	3.00	W < 500
2.	II		27.45	44.90	9.16	500 < W ⩽ 1250
3.	III		28.62	91.00	14.76	1250 < W ⩽ 1500
4.	IV		29.79	160.30	21.66	1500 < W ⩽ 2000
5.	V		30.62	221.16	26.97	2000 < W ⩽ 2250

NOTE–

THE DESIGN IS BASED ON A LIVE LOAD OF 500 Kg/m^2 AND MAXIMUM ALLOWABLE DEFLECTION = W/200 (W = SPAN)

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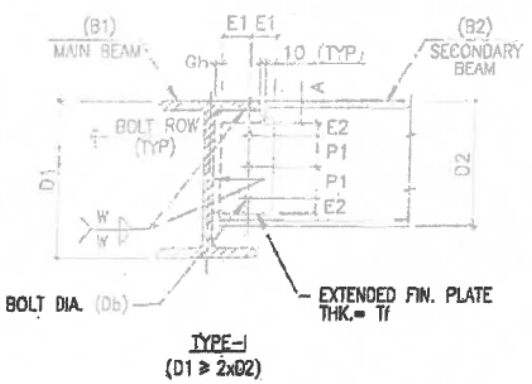
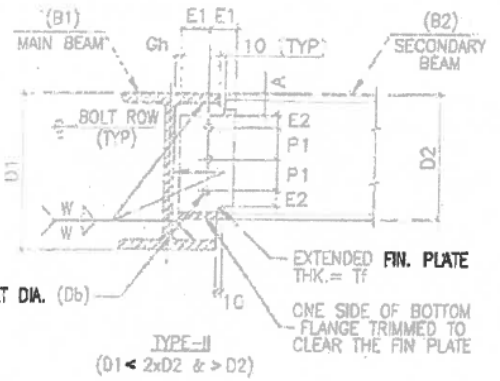
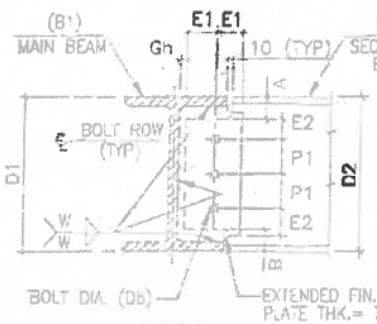


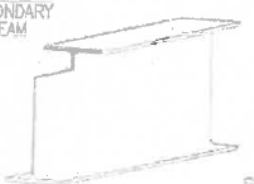
TYPE–I
(D1 ≥ 2xD2)



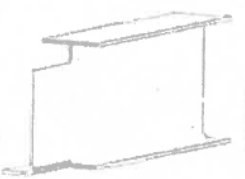
TYPE–II
(D1 < 2xD2 & > D2)



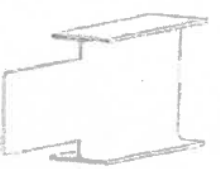
TYPE–III
(D1 ≤ D2)



SEC. BEAM NOTCH DETAIL
(FOR TYPE –I)



SEC. BEAM NOTCH DETAIL
(FOR TYPE –II)



SEC. BEAM NOTCH DETAIL
(FOR TYPE –III)

NOTES:–

1. ALL DIMENSIONS ARE IN mm.
2. THIS STANDARD IS VALID FOR STRUCTURAL STEEL OF GRADE E350 & E250 CONFIRMING TO IS 2062.
3. BEAM SECTIONS SHALL CONFIRM TO IS 808.
4. CONNECTION DESIGN IS AS PER CLAUSE 10.3 (BEARING TYPE BOLTS) OF IS 800 : 2007.
5. ALL CONNECTION BOLTS SHALL BE OF PROPERTY CLASS 8.8 CONFORMING TO IS 3757 & IS 4000.
6. HEXAGONAL NUTS SHALL CONFIRM TO IS 6623.
7. WASHERS SHALL CONFORM TO IS 6649.
8. ALL BOLTS, NUTS & WASHERS SHALL BE GALVANIZED AS PER IS. 1367, PART XIII.
9. WELDING ELECTRODE SHALL BE COMPATIBLE WITH CORRESPONDING GRADE OF STEEL.
10. THIS STANDARD IS ALSO APPLICABLE FOR NPB SECTIONS EQUIVALENT TO ISMB SECTIONS.

* % SHEAR CAPACITY OF CONNECTION W.R.T. SECONDARY BEAM SECTION SHEAR CAPACITY.

\# % AXIAL CAPACITY OF CONNECTION W.R.T. SECONDARY BEAM SECTION AXIAL CAPACITY.

ABBREVIATIONS:–

ISMB – MB ; ISMC – MC ; ISNPB – NPB ; ISWPB – WPB

Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman
1	28.01.2025	REVISED AND ISSUED AS STANDARD	SS/SS	SP/DA	ANURAG SINHA	MAINAK NANDI
0	24.10.2020	ISSUED AS STANDARD	GR	SS/PM	ANURAG SINHA	SM

Approved by

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TABLE FOR CONNECTION SCHEDULE

Secondary Beam (B2)	Main Beam (B1)	Connection Type	Bolt Dia (Db) (mm)	No. of Bolt Rows	Gap (Gb) (mm)	Edge Dist. (E1) (mm)	End dist. (E2) (mm)	Bolt Spacing (P1) (mm)	Thk. of Fin Plate (Tf) (mm)	Weld Size (w) (mm)	Top Notch (A) (mm)	Bottom Notch (B) (mm)	Shear Capacity (%) *	Axial Capacity (%) #	STEEL GRADE E350 Shear Capacity (MT)	STEEL GRADE E350 Axial Capacity (MT)	STEEL GRADE E250 Shear Capacity (MT)	STEEL GRADE E250 Axial Capacity (MT)
WPB900x300x291.46	WPB900x300x291.46	III	36	7	20	75	75	100	16	14	65	65	42	4	128.5	47.3	91.0	33.8
	WPB800x300x262.34	III	36	7	20	75	65	90	16	14	65	165	40	4	122.4	47.3	87.4	33.8
WPB800x300x262.34	WPB900x300x291.46	II	36	7	20	75	65	90	16	14	65	0	47	5	120.9	53.1	86.3	38.2
	WPB800x300x262.34	III	36	7	20	75	65	90	16	14	65	65	47	5	120.9	53.1	86.3	36.0
	WPB700x300x240.51	III	36	6	20	75	60	90	16	14	65	160	40	5	102.9	53.1	73.5	36.0
WPB700x300x240.51	WPB900x300x291.46	II	36	6	20	75	65	90	16	14	65	0	45	5	98.4	48.7	70.2	34.8
	WPB800x300x262.34	II	36	6	20	75	65	90	16	14	65	0	45	5	98.4	48.7	70.2	34.8
	WPB700x300x240.51	III	36	6	20	75	65	90	16	14	60	60	45	4	98.4	38.9	70.2	27.8
	WPB700x300x204.48	III	36	6	20	75	60	90	16	14	60	65	45	4	98.4	38.9	70.2	27.8
	WPB600x300x177.78	III	36	5	16	75	55	90	16	12	60	165	39	4	85.3	38.9	60.9	27.8
WPB700x300x204.48	WPB900x300x291.46	II	36	5	20	75	75	90	16	14	65	0	45	5	82.7	41.4	59.1	29.5
	WPB800x300x262.34	II	36	5	20	75	75	90	16	14	65	0	45	5	82.7	41.4	59.1	29.5
	WPB700x300x240.51	III	36	5	20	75	75	90	16	14	60	55	45	5	82.7	41.4	59.1	29.5
	WPB700x300x204.48	III	36	5	20	75	75	90	16	14	55	55	45	5	82.7	41.4	59.1	29.5
	WPB700x300x149.89	III	36	5	20	75	75	90	16	12	55	65	45	4	82.7	33.1	59.1	23.6
	WPB600x300x177.78	III	36	5	16	75	60	90	16	12	55	155	43	4	79.0	33.1	56.5	23.6
WPB700x300x149.89	WPB900x300x291.46	II	36	5	20	75	75	90	16	12	65	0	53	5	84.8	30.4	60.6	21.7
	WPB800x300x262.34	II	36	5	20	75	75	90	16	12	65	0	53	5	84.8	30.4	60.6	21.7
	WPB700x300x240.51	III	36	5	20	75	75	90	16	12	60	45	53	5	84.8	30.4	60.6	21.7
	WPB700x300x204.46	III	36	5	20	75	75	90	16	12	55	45	53	5	84.8	30.4	60.6	21.7
	WPB700x300x149.89	III	36	5	20	75	75	90	16	12	45	45	50	5	80.0	30.4	57.2	21.7
	WPB600x300x177.78	III	36	5	20	75	60	90	16	12	55	135	45	5	72.0	30.4	51.4	21.7
	WPB600x300x128.79	III	36	5	20	75	60	90	16	12	45	145	45	5	72.0	30.4	51.4	21.7

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TABLE FOR CONNECTION SCHEDULE (CONT.)

Secondary Beam (B2)	Main Beam (B1)	Connection Type	Bolt Dia (Db) (mm)	No. of Bolt Rows	Gap (Gb) (mm)	Edge Dist. (E1) (mm)	End dist. (E2) (mm)	Bolt Spacing (P1) (mm)	Thk. of Fin Plate (T) (mm)	Weld Size (w) (mm)	Top Notch (A) (mm)	Bottom Notch (B) (mm)	Shear Capacity (%) *	Axial Capacity (%) #	STEEL GRADE E350 Shear Capacity (MT)	STEEL GRADE E350 Axial Capacity (MT)	STEEL GRADE E250 Shear Capacity (MT)	STEEL GRADE E250 Axial Capacity (MT)
WPB600x300x177.78	WPB900x300x291.46	II	36	5	14	75	60	90	14	12	65	0	53	5	74.7	36.0	53.3	25.7
	WPB800x300x262.34	II	36	5	14	75	60	90	14	12	65	0	53	5	74.7	36.0	53.3	25.7
	WPB700x300x240.51	II	36	5	14	75	60	90	14	12	60	0	53	5	74.7	36.0	53.3	25.7
	WPB700x300x204.48	II	36	5	14	75	60	90	14	12	55	0	53	5	74.7	36.0	53.3	25.7
	WPB700x300x149.89	II	36	5	14	75	60	90	14	12	55	0	50	4	70.5	28.8	50.3	20.6
	WPB600x300x177.78	III	36	5	14	75	60	90	14	12	55	55	50	4	70.5	28.8	50.3	20.6
	WPB600x300x128.79	III	36	4	14	75	75	100	14	12	55	65	45	4	63.4	28.8	45.3	20.6
WPB600x300x128.79	WPB900x300x291.46	II	36	5	12	75	60	90	14	10	65	0	55	5	69.2	26.1	49.4	18.6
	WPB800x300x262.34	II	36	5	12	75	60	90	14	10	65	0	55	5	69.2	26.1	49.4	18.6
	WPB700x300x240.51	II	36	5	12	75	60	90	14	10	60	0	55	5	69.2	26.1	49.4	18.6
	WPB700x300x204.48	II	36	5	12	75	60	90	14	10	55	0	55	5	69.2	26.1	49.4	18.6
	WPB700x300x149.89	II	36	5	12	75	60	90	14	10	45	0	55	4	69.2	20.9	49.4	14.9
	WPB600x300x177.78	III	36	5	12	75	60	90	14	10	55	0	55	4	69.2	20.9	49.4	14.9
	WPB600x300x128.79	III	36	5	12	75	60	90	14	10	45	45	50	4	63.0	20.9	45.0	14.9
	MB600	III	36	5	12	75	60	90	14	10	45	0	50	4	63.0	20.9	45.0	14.9
	MB500	III	30	5	12	60	55	75	12	10	45	110	45	3	56.7	15.7	40.5	11.2
MB600	WPB900x300x291.46	II	36	5	14	75	75	90	14	12	65	0	55	5	72.8	24.5	52.0	17.5
	WPB800x300x262.34	II	36	5	12	75	75	90	14	10	65	0	55	5	72.8	24.5	52.0	17.5
	WPB700x300x240.51	II	36	5	12	75	75	90	14	10	60	0	55	5	72.8	24.5	52.0	17.5
	WPB700x300x204.48	II	36	5	12	75	75	90	14	10	55	0	55	5	72.8	24.5	52.0	17.5
	WPB700x300x149.89	II	36	5	12	75	75	90	14	10	45	0	55	5	72.8	24.5	52.0	17.5
	WPB600x300x177.78	III	36	5	12	75	60	90	14	10	55	65	50	5	66.2	24.5	47.3	17.5
	WPB600x300x128.79	III	36	5	12	75	60	90	14	10	45	75	50	5	66.2	24.5	47.3	17.5
	MB600	III	36	5	12	75	75	90	14	10	45	45	55	5	72.8	24.5	52.0	17.5
	MB500	III	30	5	12	60	60	75	12	10	45	135	45	3	59.5	14.7	42.5	10.5

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TABLE FOR CONNECTION SCHEDULE (CONT.)

Secondary Beam (B2)	Main Beam (B1)	Connection Type	Bolt Dia (Db) (mm)	No. of Bolt Rows	Gap (Gh) (mm)	Edge Dist. (E1) (mm)	End dist. (E2) (mm)	Bolt Spacing (P1) (mm)	Thk. of Fin Plate (T1) (mm)	Weld Size (w) (mm)	Top Notch (A) (mm)	Bottom Notch (B) (mm)	Shear Capacity (%) *	Axial Capacity (%) #	STEEL GRADE E350 Shear Capacity (MT)	STEEL GRADE E350 Axial Capacity (MT)	STEEL GRADE E250 Shear Capacity (MT)	STEEL GRADE E250 Axial Capacity (MT)
MB500	WPB900x300x291.46	II	30	5	12	60	60	75	12	10	65	0	57	5	53.4	17.5	38.1	12.5
	WPB800x300x262.34	II	30	5	12	60	60	75	12	10	65	0	57	5	53.4	17.5	38.1	12.5
	WPB700x300x240.51	II	30	5	12	60	60	75	12	10	60	0	57	5	53.4	17.5	38.1	12.5
	WPB700x300x204.48	II	30	5	12	60	60	75	12	10	55	0	60	5	56.2	17.5	40.1	12.5
	WPB700x300x149.89	II	30	5	12	60	60	75	12	10	45	0	60	5	56.2	17.5	40.1	12.5
	WPB600x300x177.78	II	30	5	12	60	60	75	12	10	55	0	60	5	56.2	17.5	40.1	12.5
	WPB600x300x128.79	II	30	5	12	60	60	75	12	10	45	0	60	5	56.2	17.5	40.1	12.5
	MB600	II	30	5	12	60	60	75	12	10	45	0	60	5	56.2	17.5	40.1	12.5
	MB500	III	30	5	12	60	60	75	12	10	35	35	55	5	51.5	17.5	36.8	12.5
	MB450	III	24	5	10	50	50	60	10	8	35	85	42	2	39.4	7.0	28.1	5.0
	MB400	III	24	5	10	50	45	60	10	8	35	130	42	2	39.4	7.0	28.1	5.0
	MC400	III	24	5	10	50	45	60	10	8	35	135	36	2	33.8	7.0	24.1	5.0
MB450	WPB900x300x291.46	I	30	4	12	60	60	75	12	10	65	0	58	3	45.1	8.8	32.2	6.3
	WPB800x300x262.34	II	30	4	12	60	60	75	12	10	65	0	58	3	45.1	8.8	32.2	6.3
	WPB700x300x240.51	II	30	4	12	60	60	75	12	10	60	0	58	3	45.1	8.8	32.2	6.3
	WPB700x300x204.48	II	30	4	12	60	60	75	12	10	55	0	58	3	45.1	8.8	32.2	6.3
	WPB700x300x149.89	II	30	4	12	60	60	75	12	10	45	0	58	3	45.1	8.8	32.2	6.3
	WPB600x300x177.78	II	30	4	12	60	60	75	12	10	55	0	58	3	45.1	8.8	32.2	6.3
	WPB600x300x128.79	II	30	4	12	60	60	75	12	10	45	0	58	3	45.1	8.8	32.2	6.3
	MB600	II	30	4	12	60	60	75	12	10	45	0	58	3	45.0	8.8	32.2	6.3
	MB500	II	30	4	12	60	60	75	12	10	35	0	58	3	45.0	8.8	32.2	6.3
	MB450	III	24	5	10	50	50	60	10	8	35	35	52	3	40.4	8.8	28.9	6.3
	MB400	III	24	5	10	50	45	60	10	8	35	80	47	3	36.5	8.8	26.1	6.3
	MC400	III	24	5	10	50	45	60	10	8	35	85	47	3	36.5	8.8	26.1	6.3
MB400	WPB900x300x291.46	I	24	5	10	50	40	60	10	8	65	0	54	3	35.3	7.5	25.2	5.3
	WPB800x300x262.34	I	24	5	10	50	40	60	10	8	65	0	54	3	35.3	7.5	25.2	5.3

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TABLE FOR CONNECTION SCHEDULE (CONT.)

Secondary Beam (B2)	Main Beam (B1)	Connection Type	Bolt Dia (Db) (mm)	No. of Bolt Rows	Gap (Gb) (mm)	Edge Dist. (E1) (mm)	End dist. (E2) (mm)	Bolt Spacing (P1) (mm)	Thk. of Fin Plate (Tf) (mm)	Weld Size (w) (mm)	Top Notch (A) (mm)	Bottom Notch (B) (mm)	Shear Capacity (%) *	Axial Capacity (%) #	STEEL GRADE E350 Shear Capacity (MT)	STEEL GRADE E350 Axial Capcity (MT)	STEEL GRADE E250 Shear Capacity (MT)	STEEL GRADE E250 Axial Capcity (MT)
MB400	WPB700x300x240.51	II	24	5	10	50	50	60	10	8	60	0	55	3	36.0	7.5	25.7	5.3
	WPB700x300x204.48	II	24	5	10	50	50	60	10	8	55	0	55	3	36.0	7.5	25.7	5.3
	WPB700x300x149.89	II	24	5	10	50	50	60	10	8	45	0	55	3	36.0	7.5	25.7	5.3
	WPB600x300x177.78	II	24	5	10	50	50	60	10	8	55	0	55	3	36.0	7.5	25.7	5.3
	WPB600x300x128.79	II	24	5	10	50	50	60	10	8	45	0	57	3	37.3	7.5	26.6	5.3
	WPB360x300x125.81	III	24	4	10	40	40	60	8	8	45	95	35	1	22.9	2.5	16.3	1.8
	MB600	II	24	5	10	50	50	60	10	8	45	0	57	4	37.3	10.0	26.6	7.1
	MB500	II	24	5	10	50	50	60	10	8	35	0	57	4	37.3	10.0	26.6	7.1
	MB450	II	24	5	10	50	50	60	10	8	35	0	57	4	37.3	10.0	26.6	7.1
	MB400	III	24	5	10	50	50	55	10	8	30	30	54	5	35.3	12.5	25.2	8.9
	NC400	III	24	5	10	50	50	55	10	8	30	35	54	3	35.3	7.5	25.2	5.3
	MB300	III	20	4	10	40	40	55	8	6	30	130	33	1	21.6	2.5	15.4	1.8
	MC300	III	20	4	10	40	40	55	8	6	30	130	33	1	21.6	2.5	15.4	1.8
MB300	WPB900x300x291.46	I	24	3	10	50	45	60	10	10	65	0	45	1	19.1	1.9	13.6	1.3
	WPB800x300x262.34	I	24	3	10	50	45	60	10	10	65	0	45	1	19.1	1.9	13.6	1.3
	WPB700x300x240.51	I	24	3	10	50	50	60	10	8	60	0	45	1	19.1	1.9	13.6	1.3
	WPB700x300x204.48	I	24	3	10	50	50	60	10	8	55	0	45	1	19.1	1.9	13.6	1.3
	WPB700x300x149.89	I	24	3	10	50	50	60	10	8	45	0	45	1	19.1	1.9	13.6	1.3
	WPB600x300x177.78	II	24	3	10	50	50	60	10	8	55	0	45	1	19.1	1.9	13.6	1.3
	WPB600x300x128.79	II	24	3	10	50	50	60	10	8	45	0	45	2	19.1	3.7	13.6	2.7
	WPB360x300x125.81	II	24	3	10	50	50	60	10	8	45	0	45	1	19.1	1.9	13.6	1.3
	WPB300x300x100.85	III	24	3	10	50	40	60	10	8	45	50	29	1	12.3	1.9	8.8	1.3
	MB600	I	24	3	10	50	50	60	10	8	45	0	45	2	19.1	3.7	13.6	2.7
	MB500	II	24	3	10	50	50	60	10	8	35	0	45	2	19.1	3.7	13.6	2.7
	MB450	II	24	3	10	50	50	60	10	8	35	0	45	2	19.1	3.7	13.6	2.7
	MB400	II	24	3	10	50	50	60	10	8	30	0	45	2	19.1	3.7	13.6	2.7

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TABLE FOR CONNECTION SCHEDULE (CONT.)

Secondary Beam (B2)	Main Beam (B1)	Connection Type	Bolt Dia (Db) (mm)	No. of Bolt Rows	Gap (Gh) (mm)	Edge Dist. (E1) (mm)	End dist (E2) (mm)	Bolt Spacing (P1) (mm)	Thk. of Fin Plate (Tf) (mm)	Weld Size (w) (mm)	Top Notch (A) (mm)	Bottom Notch (B) (mm)	Shear Capacity (%) *	Axial Capacity (%) #	STEEL GRADE E350 Shear Capacity (MT)	STEEL GRADE E350 Axial Capacity (MT)	STEEL GRADE E250 Shear Capacity (MT)	STEEL GRADE E250 Axial Capacity (MT)
MB300	MC 400	II	24	3	10	50	50	60	10	8	30	0	34	1	14.4	1.9	10.3	1.3
	MB300	III	20	4	10	40	40	50	8	6	30	30	45	1	19.1	1.9	13.6	1.3
	MC 300	III	20	4	10	40	40	50	8	6	30	30	34	1	14.4	1.9	10.3	1.3
	MB250	III	20	3	10	40	40	50	8	6	30	80	33	1	14.0	1.9	10.0	1.3
	MC 250	III	20	3	10	40	40	50	8	6	30	80	24	1	10.2	1.9	7.3	1.3
MB250	WPB900x300x291.46	I	20	3	10	40	35	50	8	8	65	0	42	1	13.3	1.5	9.5	1.1
	WPB800x300x262.34	I	20	3	10	40	35	50	8	8	65	0	42	1	13.3	1.5	9.5	1.1
	WPB700x300x240.51	I	20	3	10	40	40	50	8	8	60	0	42	1	13.3	1.5	9.5	1.1
	WPB700x300x204.48	I	20	3	10	40	40	50	8	8	55	0	42	1	13.3	1.5	9.5	1.1
	WPB700x300x149.89	I	20	3	10	40	40	50	8	8	45	0	42	1	13.3	1.5	9.5	1.1
	WPB600x300x177.78	I	20	3	10	40	40	50	8	8	55	0	42	1	13.3	1.5	9.5	1.1
	WPB600x300x128.79	I	20	3	10	40	40	50	8	8	45	0	42	1	13.3	1.5	9.5	1.1
	WPB360x300x125.81	II	20	3	10	40	40	50	8	8	45	0	42	1	13.3	1.5	9.5	1.1
	WPB300x300x100.85	II	20	3	10	40	40	50	8	8	45	0	42	1	13.3	1.5	9.5	1.1
	WPB250x250x73.15	II	20	3	10	40	35	50	8	8	40	0	42	1	13.3	1.5	9.5	1.1
	MB600	I	20	3	10	40	40	50	8	8	45	0	42	1	13.3	1.5	9.5	1.1
	MB500	I	20	3	10	40	40	50	8	8	35	0	42	1	13.3	1.5	9.5	1.1
	MB450	II	20	3	10	40	40	50	8	8	35	0	42	1	13.3	1.5	9.5	1.1
	MB400	II	20	3	10	40	40	50	8	8	30	0	42	1	13.3	1.5	9.5	1.1
	MC 400	II	20	3	10	40	40	50	8	8	30	0	34	1	10.8	1.5	7.7	1.1
	MB300	II	20	3	10	40	40	50	8	6	30	0	42	1	13.3	1.5	9.5	1.1
	MC 300	II	20	3	10	40	40	50	8	6	30	0	33	1	10.5	1.5	7.5	1.1
	MB250	III	20	3	10	40	40	50	8	6	30	30	42	1	13.3	1.5	9.5	1.1
	MC 250	III	20	3	10	40	40	50	8	6	30	30	33	1	10.5	1.5	7.5	1.1
	MB200	III	20	2	10	40	40	70	8	5	25	75	28	1	8.9	1.5	6.3	1.1
	MC 200	III	20	2	10	40	40	70	8	5	25	75	25	1	7.9	1.5	5.6	1.1

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TABLE FOR CONNECTION SCHEDULE (CONT.)

Secondary Beam (B2)	Main Beam (B1)	Connection Type	Bolt Dia (Db) (mm)	No. of Bolt Rows	Gap (Gh) (mm)	Edge Dist. (E1) (mm)	End dist. (E2) (mm)	Bolt Spacing (P1) (mm)	Thk. of Fin Plate (Tf) (mm)	Weld Size (w) (mm)	Top Notch (A) (mm)	Bottom Notch (B) (mm)	Shear Capacity (%) #	Axial Capacity (%) #	STEEL GRADE E350 Shear Capacity (MT)	STEEL GRADE E350 Axial Capacity (MT)	STEEL GRADE E250 Shear Capacity (MT)	STEEL GRADE E250 Axial Capacity (MT)
MB200	WPB900x300x291.46	I	20	2	10	40	40	55	8	8	65	0	29	1	6.1	1.0	4.4	0.7
	WPB800x300x262.34	I	20	2	10	40	40	55	8	8	65	0	29	1	6.1	1.0	4.4	0.7
	WPB700x300x240.51	I	20	2	10	40	40	60	8	8	60	0	31	1	6.5	1.0	4.7	0.7
	WPB700x300x204.48	I	20	2	10	40	40	60	8	8	55	0	34	1	7.1	1.0	5.1	0.7
	WPB700x300x149.89	I	20	2	10	40	40	60	8	8	45	0	34	1	7.1	1.0	5.1	0.7
	WPB600x300x177.78	I	20	2	10	40	40	60	8	8	55	0	34	1	7.1	1.0	5.1	0.7
	WPB600x300x128.79	I	20	2	10	40	40	60	8	8	45	0	34	1	7.1	1.0	5.1	0.7
	WPB360x300x125.81	II	20	2	10	40	40	60	8	8	45	0	37	1	7.7	1.0	5.6	0.7
	WPB300x300x100.85	II	20	2	10	40	40	60	8	8	45	0	39	1	8.2	1.0	5.9	0.7
	WPB250x250x73.15	II	20	2	10	40	40	60	8	8	40	0	39	1	8.2	1.0	5.9	0.7
	WPB200x200x42.26	III	20	2	10	40	40	50	8	6	30	40	25	1	5.2	1.0	3.8	0.7
	MB600	I	20	2	10	40	40	60	8	8	45	0	34	1	7.1	1.0	5.1	0.7
	MB500	I	20	2	10	40	40	60	8	8	35	0	34	1	7.1	1.0	5.1	0.7
	MB450	I	20	2	10	40	40	60	8	8	35	0	34	1	7.1	1.0	5.1	0.7
	MB400	I	20	2	10	40	40	60	8	8	30	0	34	1	7.1	1.0	5.1	0.7
	MC400	I	20	2	10	40	40	60	8	8	30	0	34	1	7.1	1.0	5.1	0.7
	MB300	II	20	2	10	40	40	60	8	6	30	0	34	1	7.1	1.0	5.1	0.7
	MC300	II	20	2	10	40	40	60	8	6	30	0	34	1	7.1	1.0	5.1	0.7
	MB250	II	20	2	10	40	40	60	8	6	30	0	34	1	7.1	1.0	5.1	0.7
	MC250	II	20	2	10	40	40	60	8	6	30	0	34	1	7.1	1.0	5.1	0.7
	MB200	III	20	2	10	40	40	65	8	5	25	25	34	1	7.1	1.0	5.1	0.7
	MC200	III	20	2	10	40	40	65	8	5	25	25	34	1	7.1	1.0	5.1	0.7
MC400	WPB900x300x291.46	I	24	5	10	50	45	60	10	10	65	0	42	4	27.1	8.1	19.4	5.8
	WPB800x300x262.34	I	24	5	10	50	45	60	10	10	65	0	42	4	27.1	8.1	19.4	5.8

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TABLE FOR CONNECTION SCHEDULE (CONT.)

Secondary Beam (B2)	Main Beam (B1)	Connection Type	Bolt Dia (Db) (mm)	No. of Bolt Rows	Gap (Gh) (mm)	Edge Dist. (E1) (mm)	End dist. (E2) (mm)	Bolt Spacing (P1) (mm)	Thk. of Fin Plate (Tf) (mm)	Weld Size (w) (mm)	Top Notch (A) (mm)	Bottom Notch (B) (mm)	Shear Capacity (%) *	Axial Capacity (%) #	STEEL GRADE E350 Shear Capacity (MT)	STEEL GRADE E350 Axial Capacity (MT)	STEEL GRADE E250 Axial Capacity (MT)
MC400	WPB700x300x240.51	II	24	5	10	50	45	60	10	8	60	0	42	4	27.2	8.1	5.8
	WPB700x300x204.48	II	24	5	10	50	45	60	10	8	55	0	42	4	27.2	8.1	5.8
	WPB700x300x149.89	II	24	5	10	50	45	60	10	8	45	0	42	4	27.2	8.1	5.8
	WPB600x300x177.78	II	24	5	10	50	45	60	10	8	55	0	42	4	27.2	8.1	5.8
	WPB600x300x128.79	II	24	5	10	50	45	60	10	8	45	0	42	4	27.2	8.1	5.8
	WPB360x300x125.81	III	24	4	10	50	40	60	10	8	45	95	36	4	23.3	8.1	5.8
	MB600	II	24	5	10	50	50	60	10	8	45	0	44	4	28.5	8.1	5.8
	MB500	II	24	5	10	50	50	60	10	8	35	0	44	4	28.5	8.1	5.8
	MB450	II	24	5	10	50	50	60	10	8	35	0	44	4	28.5	8.1	5.8
	MB400	III	24	5	10	50	50	60	10	8	30	30	42	3	27.2	6.1	4.3
	MC400	III	24	5	10	50	50	60	10	8	30	30	42	3	27.2	6.1	4.3
	MB300	III	20	4	10	40	40	53	8	6	30	130	25	1	16.2	2.0	1.4
	MC300	III	20	4	10	40	40	53	8	6	30	130	25	1	16.2	2.0	1.4
MC300	WPB900x300x291.46	I	24	3	10	50	45	60	10	8	65	0	44	1.5	18.9	2.2	1.6
	WPB800x300x252.34	I	24	3	10	50	45	60	10	8	65	0	44	1.5	18.9	2.2	1.6
	WPB700x300x240.51	I	24	3	10	50	50	60	10	8	60	0	44	1.5	18.9	2.2	1.6
	WPB700x300x204.48	I	24	3	10	50	50	60	10	8	55	0	44	1.5	18.9	2.2	1.6
	WPB700x300x149.89	I	24	3	10	50	50	60	10	8	45	0	44	1.5	18.9	2.2	1.6
	WPB600x300x177.78	II	24	3	10	50	50	60	10	8	55	0	44	1.5	18.9	2.2	1.6
	WPB600x300x128.79	II	24	3	10	50	50	60	10	8	45	0	44	1.5	18.9	2.2	1.6
	WPB360x300x125.81	II	24	3	10	50	50	60	10	8	45	0	44	1.5	18.9	2.2	1.6
	WPB300x300x100.85	III	24	3	10	50	40	60	10	8	45	50	28	1	12.0	1.5	1.1
	MB600	I	24	3	10	50	50	60	10	8	45	0	44	1.5	19.0	2.2	1.6
	MB500	II	24	3	10	50	50	60	10	8	35	0	44	1.5	19.0	2.2	1.6
	MB450	II	24	3	10	50	50	60	10	8	35	0	44	1.5	19.0	2.2	1.6
	MB400	II	24	3	10	50	50	60	10	8	30	0	44	1.5	19.0	2.2	1.6

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TABLE FOR CONNECTION SCHEDULE (CONT.)

Secondary Beam (B2)	Main Beam (B1)	Connection Type	Bolt Dia (Db) (mm)	No. of Bolt Rows	Gap (Gk) (mm)	Edge Dist. (E1) (mm)	End dist. (E2) (mm)	Bolt Spacing (P1) (mm)	Thk. of Fin Plate (Tf) (mm)	Weld Size (w) (mm)	Top Notch (A) (mm)	Bottom Notch (B) (mm)	Shear Capacity (%) *	Axial Capacity (%) #	STEEL GRADE E250 Shear Capacity (MT)	STEEL GRADE E250 Axial Capacity (MT)	STEEL GRADE E250 Shear Capacity (MT)	STEEL GRADE E250 Axial Capacity (MT)
MC300	MC400	II	24	3	10	50	50	60	10	8	30	0	37	1.5	16.0	2.2	11.3	1.6
	MB300	III	20	4	10	40	40	50	8	6	30	30	37	1.5	16.0	2.2	11.3	1.6
	MC300	III	20	4	10	40	40	50	8	6	30	30	37	1.5	16.0	2.2	11.3	1.6
	MB250	III	20	3	10	40	40	50	8	6	30	80	20	0.5	8.6	0.7	6.1	0.5
	MC250	III	20	3	10	40	40	50	8	6	30	80	20	0.5	8.6	0.7	6.1	0.5
MC250	WPB900x300x291.46	I	20	3	10	40	35	50	8	8	65	0	32	1	10.6	1.2	7.5	0.9
	WPB800x300x262.34	I	20	3	10	40	35	50	8	8	65	0	32	1	10.6	1.2	7.5	0.9
	WPB700x300x240.51	I	20	3	10	40	40	50	8	8	60	0	32	1	10.6	1.2	7.5	0.9
	WPB700x300x204.48	I	20	3	10	40	40	50	8	8	55	0	32	1	10.6	1.2	7.5	0.9
	WPB700x300x149.89	I	20	3	10	40	40	50	8	8	45	0	32	1	10.6	1.2	7.5	0.9
	WPB600x300x177.78	I	20	3	10	40	40	50	8	8	55	0	32	1	10.6	1.2	7.5	0.9
	WPB600x300x128.79	I	20	3	10	40	40	50	8	8	45	0	32	1	10.6	1.2	7.5	0.9
	WPB360x300x125.81	II	20	3	10	40	40	50	8	8	45	0	32	1	10.6	1.2	7.5	0.9
	WPB300x300x100.85	II	20	3	10	40	40	50	8	8	45	0	32	1	10.6	1.2	7.5	0.9
	WPB250x250x73.15	II	20	3	10	40	35	50	8	8	40	0	32	1	10.6	1.2	7.5	0.9
	MB600	I	20	3	10	40	40	50	8	8	45	0	32	1	10.6	1.2	7.6	0.9
	MB500	I	20	3	10	40	40	50	8	8	35	0	32	1	10.6	1.2	7.6	0.9
	MB450	II	20	3	10	40	40	50	8	8	35	0	32	1	10.6	1.2	7.6	0.9
	MB400	II	20	3	10	40	40	50	8	8	30	0	32	1	10.6	1.2	7.6	0.9
	MC400	II	20	3	10	40	40	50	8	8	30	0	32	1	10.6	1.2	7.6	0.9
	MB300	II	20	3	10	40	40	50	8	6	30	0	32	1	10.6	1.2	7.6	0.9
	MC300	II	20	3	10	40	40	50	8	6	30	0	32	1	10.6	1.2	7.6	0.9
	MB250	III	20	3	10	40	40	50	8	6	30	30	32	1	10.6	1.2	7.6	0.9
	MC250	III	20	3	10	40	40	50	8	6	30	30	32	1	10.6	1.2	7.5	0.9
	MB200	III	20	2	10	40	40	70	8	5	30	75	20	0.5	6.3	0.6	4.5	0.4
	MC200	III	20	2	10	40	40	70	9	5	30	75	20	0.5	6.3	0.6	4.5	0.4

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TABLE FOR CONNECTION SCHEDULE (CONT.)

Secondary Beam (B2)	Main Beam (B1)	Connection Type	Bolt Dia (Db) (mm)	No. of Bolt Rows	Gap (Gh) (mm)	Edge Dist. (E1) (mm)	End dist. (E2) (mm)	Bolt Spacing (P1) (mm)	Thk. of Fin Plate (Tf) (mm)	Weld Size (w) (mm)	Top Notch (A) (mm)	Bottom Notch (B) (mm)	Shear Capacity (%) *	Axial Capacity (%) #	STEEL GRADE E350 Shear Capacity (MT)	STEEL GRADE E350 Axial Capacity (MT)	STEEL GRADE E250 Shear Capacity (MT)	STEEL GRADE E250 Axial Capacity (MT)
MC200	WPB600x300x291.46	I	20	2	10	40	30	60	8	6	65	0	28	1	6.4	0.9	4.6	0.6
	WPB600x300x262.34	I	20	2	10	40	30	60	8	6	65	0	28	1	6.4	0.9	4.6	0.6
	WPB700x300x240.51	I	20	2	10	40	35	60	8	6	60	0	30	1	6.8	0.9	4.9	0.6
	WPB700x300x204.48	I	20	2	10	40	40	60	8	6	55	0	30	1	6.8	0.9	4.9	0.6
	WPB700x300x149.89	I	20	2	10	40	40	60	8	6	45	0	30	1	6.8	0.9	4.9	0.6
	WPB600x300x177.78	I	20	2	10	40	40	60	8	6	55	0	30	1	6.8	0.9	4.9	0.6
	WPB600x300x128.79	I	20	2	10	40	40	60	8	6	45	0	34	1	7.8	0.9	5.5	0.6
	WPB360x300x125.81	II	20	2	10	40	40	60	8	6	45	0	34	1	7.8	0.9	5.5	0.6
	WPB300x300x100.85	II	20	2	10	40	40	60	8	6	45	0	34	1	7.8	0.9	5.5	0.6
	WPB250x250x73.15	II	20	2	10	40	40	60	8	6	40	0	34	1	7.8	0.9	5.5	0.6
	WPB200x200x42.26	III	20	2	10	40	35	60	8	6	30	40	25	1	5.7	0.9	4.1	0.6
	MB600	I	20	2	10	40	40	60	8	6	45	0	34	1	7.8	0.9	5.5	0.6
	MB500	I	20	2	10	40	40	60	8	6	35	0	34	1	7.8	0.9	5.5	0.6
	MB450	I	20	2	10	40	40	60	8	6	35	0	34	1	7.8	0.9	5.5	0.6
	MB400	I	20	2	10	40	40	60	8	6	30	0	34	1	7.8	0.9	5.5	0.6
	MB300	II	20	2	10	40	40	60	8	6	30	0	34	1	7.8	0.9	5.5	0.6
	MB250	II	20	2	10	40	40	60	8	6	25	0	34	1	7.8	0.9	5.5	0.6
	MC400	I	20	2	10	40	40	60	8	6	30	0	34	1	7.8	0.9	5.5	0.6
	MC300	II	20	2	10	40	40	60	8	6	30	0	34	1	7.8	0.9	5.5	0.6
	MC250	II	20	2	10	40	40	60	8	6	30	0	34	1	7.8	0.9	5.5	0.6
	MB200	III	20	2	10	40	40	65	8	5	25	25	34	1	7.8	0.9	5.5	0.6
	MC200	III	20	2	10	40	40	65	8	5	25	25	34	1	7.8	0.9	5.5	0.6
MC150	WPB600x300x128.79	I	16	2	10	30	22	50	8	6	40	0	24	1	3.8	0.7	2.7	0.5
	WPB300x300x100.85	II	16	2	10	30	25	50	8	6	43	0	24	1	3.8	0.7	2.7	0.5
	WPB250x250x73.15	II	16	2	10	30	25	50	8	6	40	0	30	1	4.7	0.7	3.4	0.5
	WPB200x200x42.26	II	16	2	10	30	25	50	8	6	30	0	32	1	5.0	0.7	3.6	0.5

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TABLE FOR CONNECTION SCHEDULE (CONT.)

Secondary Beam (B2)	Main Beam (B1)	Connection Type	Bolt Dia (Db) (mm)	No. of Bolt Rows	Gap (Gb) (mm)	Edge Dist. (E1) (mm)	End dist. (E2) (mm)	Bolt Spacing (P1) (mm)	Thk. of Fin Plate (Tf) (mm)	Weld Size (w) (mm)	Top Notch (A) (mm)	Bottom Notch (B) (mm)	Shear Capacity (%) *	Axial Capacity (%) #	STEEL GRADE E350 Shear Capacity (MT)	STEEL GRADE E350 Axial Capcity (MT)	STEEL GRADE E250 Shear Capacity (MT)	STEEL GRADE E250 Axial Capcity (MT)
MC150	MB600	I	16	2	10	30	22	50	8	6	40	0	32	1	5.0	0.7	3.6	0.5
	MB500	I	16	2	10	30	25	50	8	6	35	0	32	1	5.0	0.7	3.8	0.5
	MB450	I	16	2	10	30	25	50	8	6	30	0	32	1	5.0	0.7	3.8	0.5
	MB400	I	16	2	10	30	25	50	8	6	30	0	32	1	5.0	0.7	3.8	0.5
	MC400	I	16	2	10	30	25	50	8	6	30	0	32	1	5.0	0.7	3.8	0.5
	MB300	I	16	2	10	30	25	50	8	6	30	0	32	1	5.0	0.7	3.8	0.5
	MC300	I	16	2	10	30	25	50	8	6	30	0	32	1	5.0	0.7	3.8	0.5
	MB250	II	16	2	10	30	25	50	8	6	25	0	32	1	5.0	0.7	3.8	0.5
	MC250	II	16	2	10	30	25	50	8	6	30	0	32	1	5.0	0.7	3.8	0.5
	MB200	II	16	2	10	30	25	50	8	5	25	0	32	1	5.0	0.7	3.6	0.5
	MC200	II	16	2	10	30	25	50	8	5	25	0	32	1	5.0	0.7	3.6	0.5
	MC150	III	16	2	10	30	25	50	8	5	20	20	32	1	5.0	0.7	3.6	0.5
MC100	MC400	I	12	2	10	20	16	30	6	5	30	0	25	1	2.3	0.4	1.7	0.3
	MC300	I	12	2	10	20	16	30	6	5	30	0	25	1	2.3	0.4	1.7	0.3
	MC250	I	12	2	10	20	16	30	6	5	30	0	25	1	2.3	0.4	1.7	0.3
	MC200	I	12	2	10	20	18	30	6	5	25	0	25	1	2.3	0.4	1.7	0.3
	MC150	II	12	2	10	20	18	30	6	5	20	0	25	1	2.3	0.4	1.7	0.3

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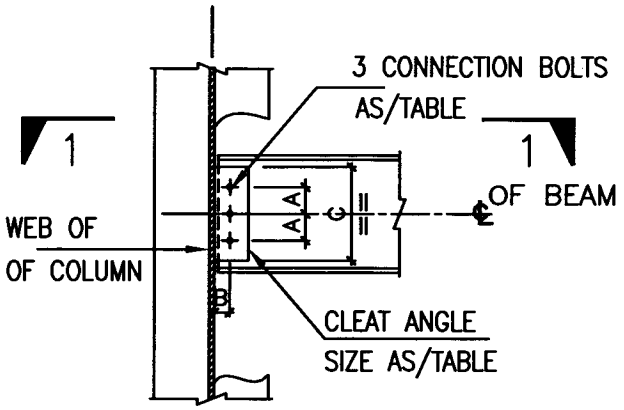

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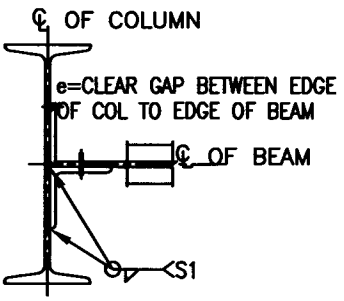

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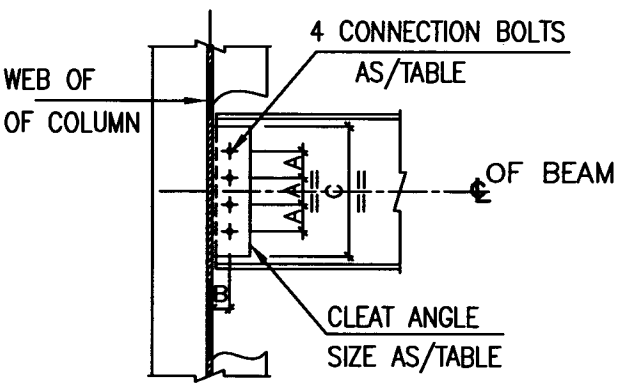

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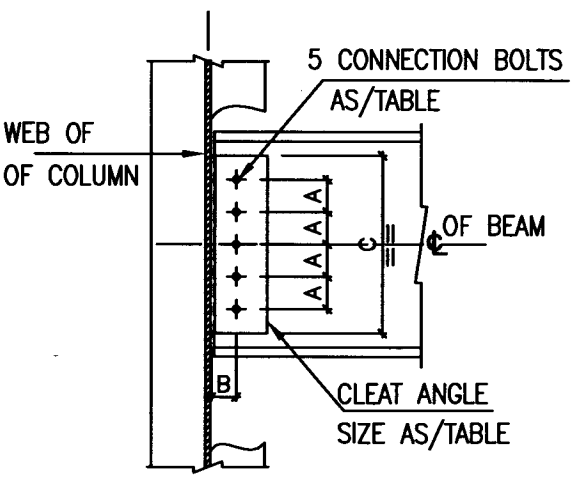

TYPE–III

Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman
					Approved by	
0	24.12.20	ISSUED AS STANDARD	GR	SS/PM	AS	SM

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SHEAR CONNECTION BETWEEN BEAM AND COLUMN

SL. NO	BEAM SIZE	TYPE	CLEAT ANGLE SIZE	NO OF BOLTS	DIA OF BOLTS	A	B	C	S1	e	% SHEAR CAPACITY OF THE CONNECTION WRT TO BEAM SHEAR CAPACITY	MINIMUM SHEAR CAPACITY (MT) OF THE CONNECTION
1	MB200	I	90x90x10	3	16	40	50	135	6	15	30	6.3
2	MB250	I	90x90x10	3	20	50	50	180	6	10	43	13.6
3	MB300	II	90x90x10	4	20	50	50	230	6	10	52	21.5
4	MB400	II	130x130x12	4	24	60	80	300	8	30	47	30.7
5	MB450	II	130x130x12	4	24	60	80	340	8	30	33	25.6
6	MB500	III	150x150x16	5	24	60	90	420	8	40	36	33.7
7	MB600	III	150x150x16	5	30	75	90	480	8	30	48	59.9

NOTES:–

1. ALL DIMENSIONS ARE IN mm.
2. THIS STANDARD IS VALID FOR STRUCTURAL STEEL OF GRADE E350 CONFIRMING TO IS:2062
3. COLUMN & BEAM SECTIONS SHALL CONFIRM TO IS:12778/IS:808
4. CONNECTION DESIGN IS AS PER CLAUSE 10.3 (BEARING TYPE BOLTS) OF IS:800–2007
5. ALL CONNECTION BOLTS SHALL BE OF PROPERTY CLASS 8.8 (AS PER TABLE) CONFORMING TO IS:3757 & IS:4000
6. HEXAGONAL NUTS SHALL CONFIRM TO IS:6623
7. WASHERS SHALL CONFORM TO IS:6649
8. ALL BOLTS, NUTS & WASHERS SHALL BE GALVANISED AS PER IS:1367, PART XIII.
9. WELDING ELECTRODE SHALL BE COMPATIBLE WITH E350 GRADE OF STEEL.
10. THIS STANDARD IS NOT APPLICABLE FOR EQUIPMENT SUPPORTING BEAMS.

Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman
0	24.12.20	ISSUED AS STANDARD	GR	SS/PM	AS	SM

Approved by

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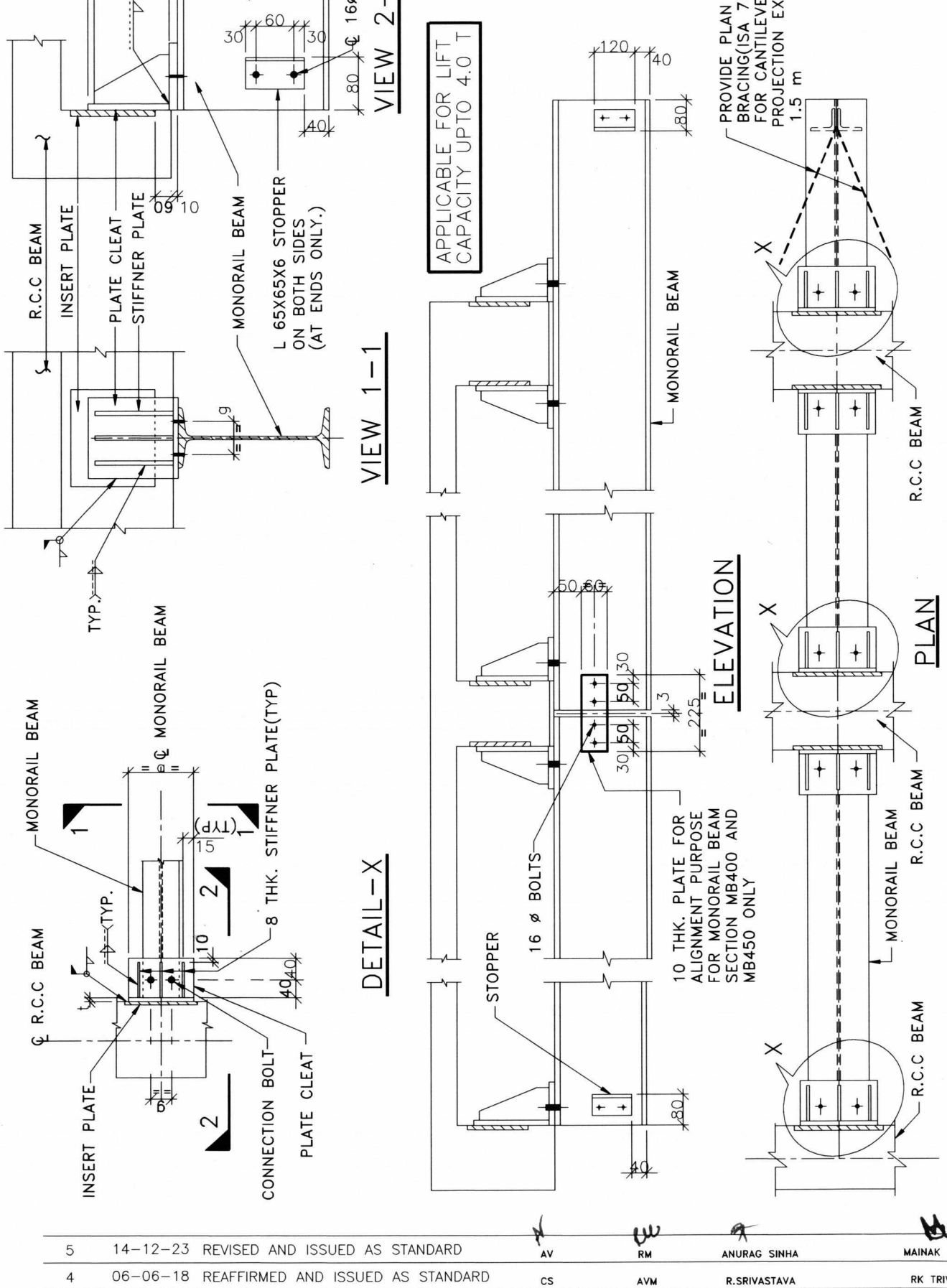
इंजीनियर्स इंडिया लिमिटेड (भारत सरकार का उपक्रम) ENGINEERS INDIA LIMITED (A Govt. of India Undertaking)

MONORAIL FIXING DETAIL WITH R.C.C BEAM

STANDARD No.
7-68-0684 Rev. 5



Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman
5	14-12-23	REVISED AND ISSUED AS STANDARD	AV	RM	ANURAG SINHA	MAINAK NANDI
4	06-06-18	REAFFIRMED AND ISSUED AS STANDARD	CS	AVM	R.SRIVASTAVA	RK TRIVEDI

Approved by

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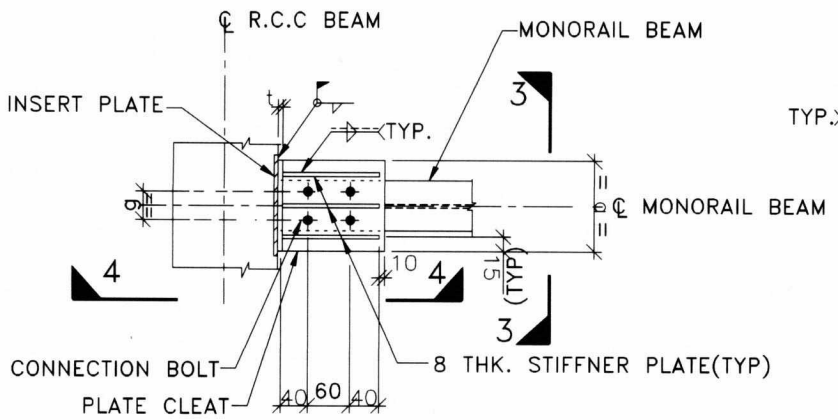
Page 2120 of 2811 : B895-TENDER DOC-B895-999-81-46-CF-T-8202 : Rev. A



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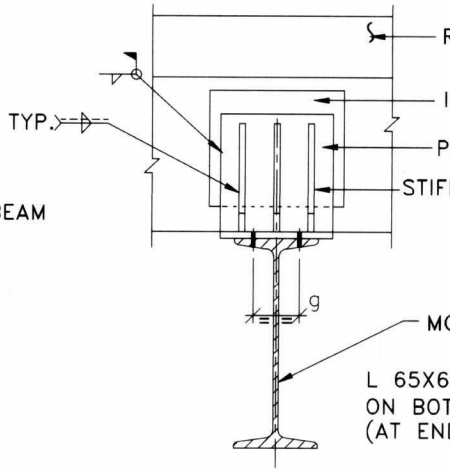
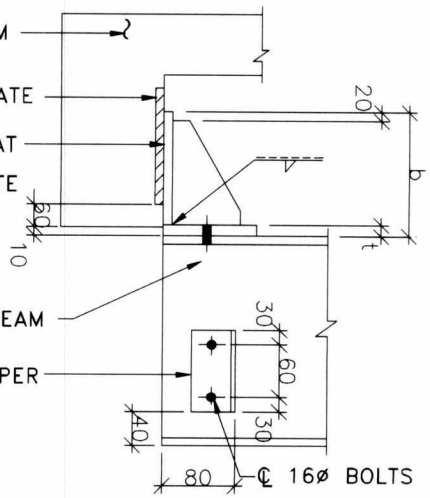
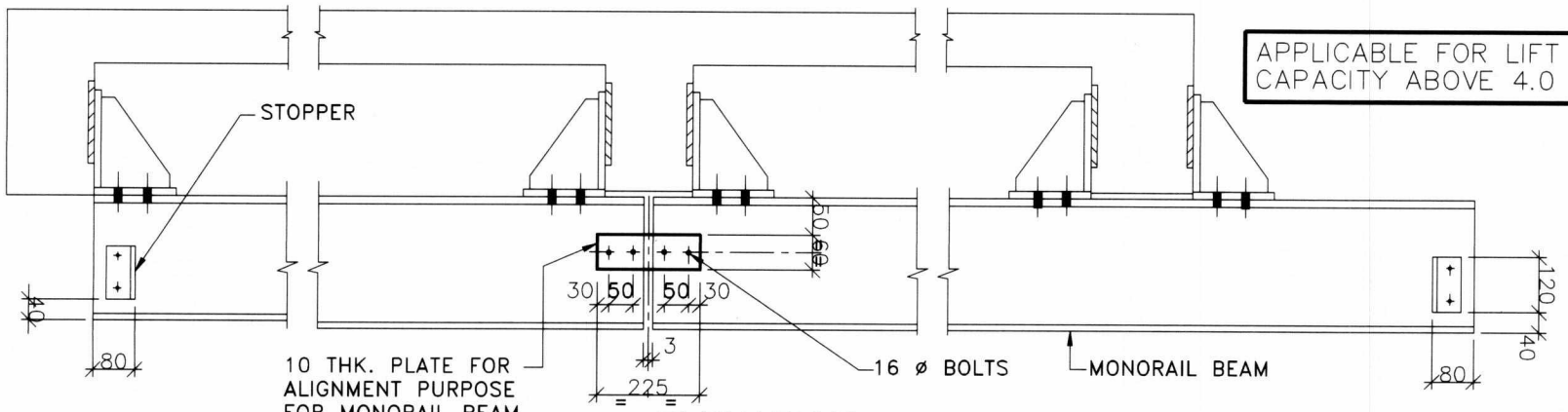


VIEW 3–3

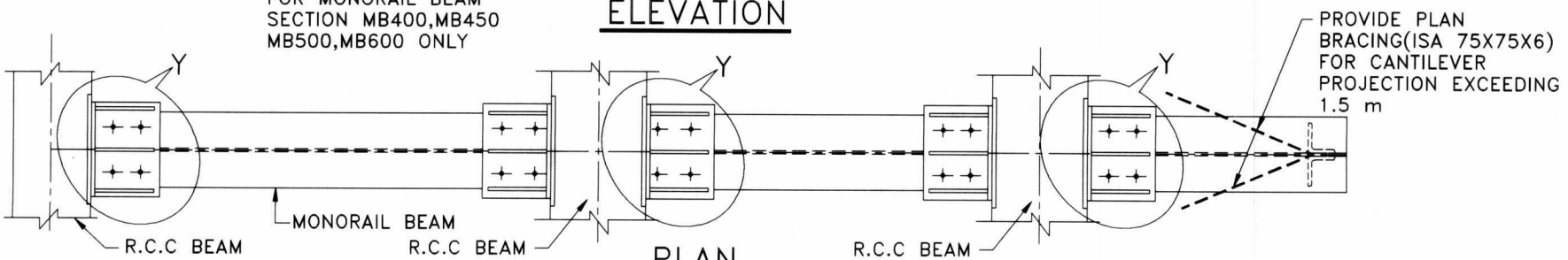


VIEW 4–4

APPLICABLE FOR LIFT CAPACITY ABOVE 4.0 T



ELEVATION



PLAN

इंजीनियर्स इंडिया लिमिटेड
ENGINEERS INDIA LIMITED
(A Govt. of India Undertaking)

MONORAIL FIXING DETAIL
WITH R.C.C BEAM

STANDARD No.
7-68-0684 Rev. 5

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SCHEDULE OF MONORAIL BEAM CONNECTION

(FOR SKETCH, REFER SHT. 1 OF 3 AND 2 OF 3)

MONORAIL BEAM	DIA OF CONNECTION BOLT(mm)	DIMENSION IN mm			
		a	b	g	t
MB 200	M-16	150	200	55	10
MB 250	M-20	170	250	65	10
MB 300	M-20	200	250	80	12
MB 350	M-20	200	250	80	16
MB 400	M-20	200	250	80	16
MB 450	M-20	220	350	90	16
MB 500	M-22	240	350	100	16
MB 600	M-22	240	350	140	16

NOTES :

GENERAL NOTES OF THE PROJECT SHALL ALSO BE REFERRED.

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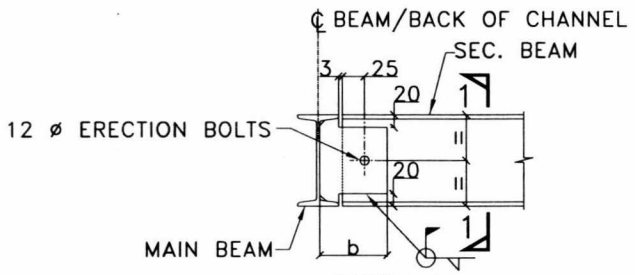

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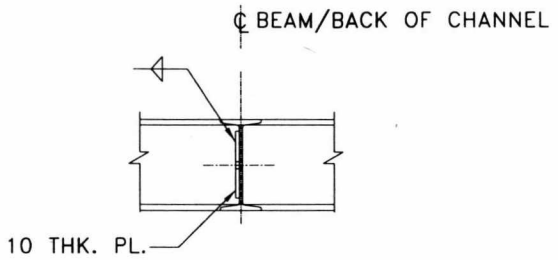
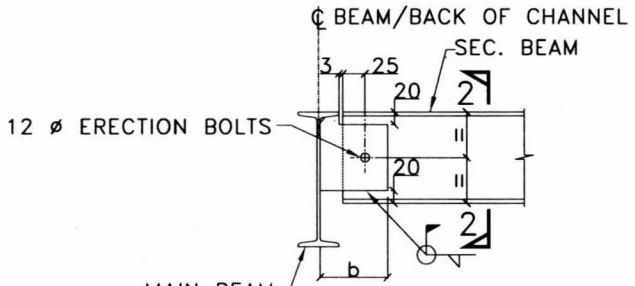


SECTION 1–1



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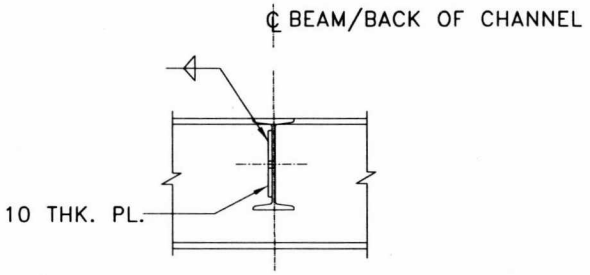
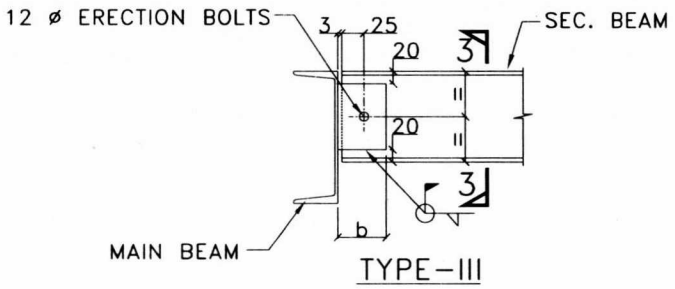


SECTION 2–2



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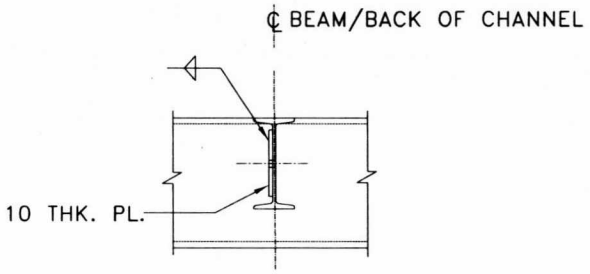

SECTION 3–3

SEC. BEAM	CONN TYPE	DIMENSION	MAIN BEAM																	
			MB100	MB125	MB150	MB200	MB250	MB300	MB350	MB400	MB450	MB500	MB600	MC100	MC125	MC150	MC200	MC250	MC300	MC400
MB100/ MC100	I	b	90	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
	II	b	–	90	95	105	115	125	125	125	130	145	160	–	–	–	–	–	–	–
	III	b	–	–	–	–	–	–	–	–	–	–	–	55	55	55	55	55	55	55
MB125/ MC125	I	b	–	105	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
	II	b	–	–	110	120	130	140	140	140	145	160	175	–	–	–	–	–	–	–
	III	b	–	–	–	–	–	–	–	–	–	–	–	–	70	70	70	70	70	70

NOTES:–

1 CONNECTION HAS BEEN DESIGNED TO CATER FOR FOLLOWING SHEAR STRENGTH.

MB100/MC100 = 2.5 T.
MB125/MC125 = 3.5 T.

Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman
						Approved by
4	02.12.22	REAFFIRMED AND ISSUED AS STANDARD	HIMANSHU	VIKRAM GUPTA	ANURAG SINHA	S. MAZUMDAR
3	02.12.15	REVISED AND ISSUED AS STANDARD	JITENDER GUPTA	AMARJEET SINGH	RAJANJI SRIVASTAVA	S. CHANDA

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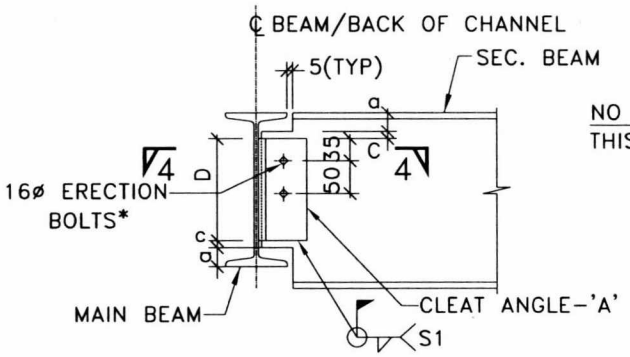

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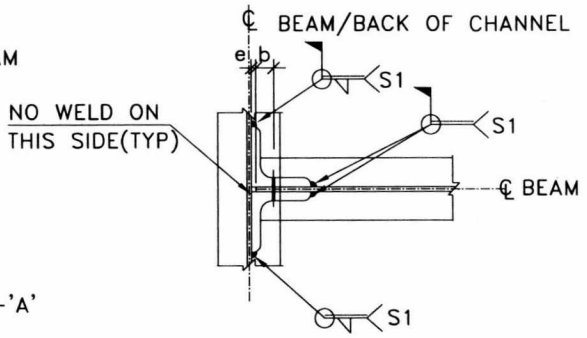

SECTION 4–4
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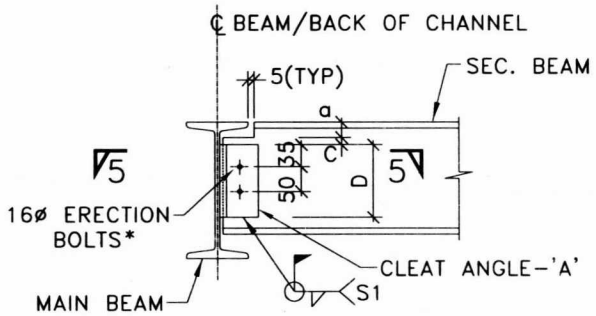

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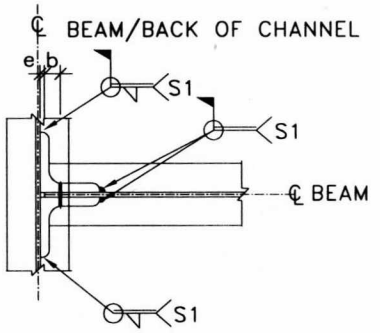

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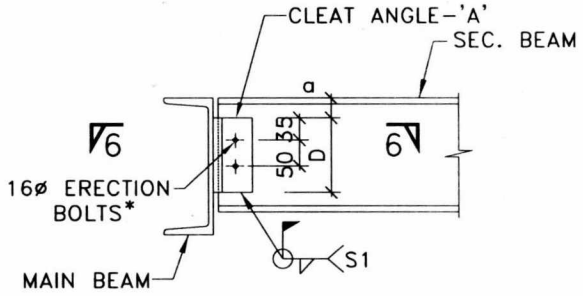

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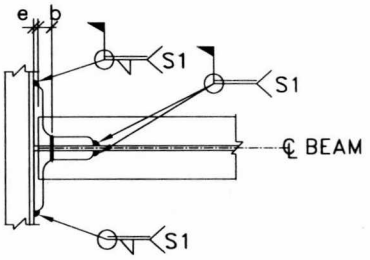

SECTION 6–6
(DRAWN FOR SEC. BEAM AS MB)

c= 15 FOR SEC. BEAM MB600
c= 10 FOR OTHERS
e= 2 mm CLEAR GAP
* 2 NOS. ERECTION BOLTS SHALL BE PROVIDED FOR SEC. BEAM ⩾ MB250 / MC250

CLEAT ANGLE SIZE	b
L 65x65x6	35
L 75x75x8	40
L 90x90x10	45
L 100x100x12	45

Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman
4	02.12.22	REAFFIRMED AND ISSUED AS STANDARD	HIMANSHU	VIKRAM GUPTA	ANURAG SINHA	S. MAZUMDAR
3	02.12.15	REVISED AND ISSUED AS STANDARD	JITENDER GUPTA	AMARJEET SINGH	RAJANJI SRIVASTAVA	S. CHANDA

Approved by

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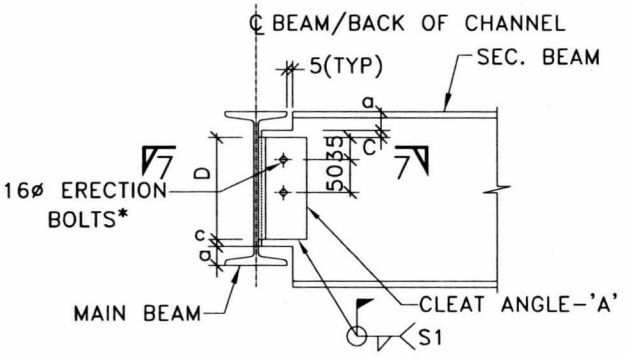

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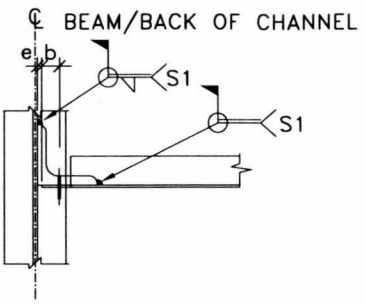
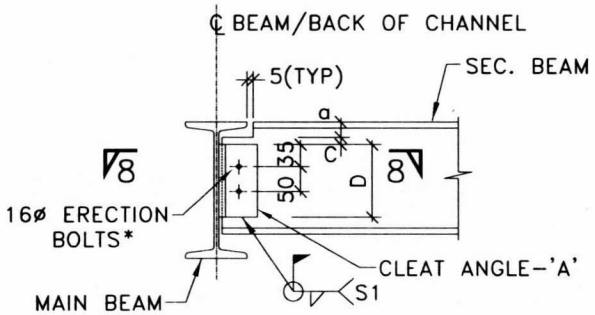


SECTION 7–7



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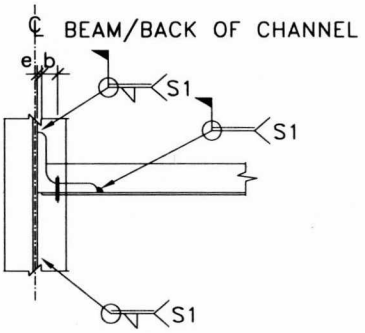
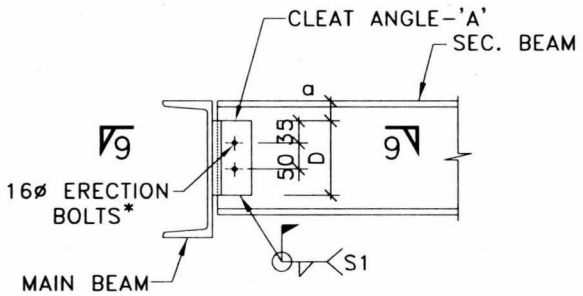


SECTION 8–8



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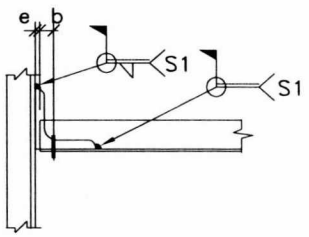

SECTION 9–9

e= 2 mm CLEAR GAP

* 2 NOS. ERECTION BOLTS SHALL BE PROVIDED FOR SEC. BEAM ≥ MB250 / MC250

CLEAT ANGLE SIZE	b
L 65x65x6	35
L 75x75x8	40
L 90x90x10	45
L 100x100x12	45

VALID FOR SEC. BEAM AS CHANNELS ONLY

Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman Approved by
4	02.12.22	REAFFIRMED AND ISSUED AS STANDARD	HIMANSHU	VIKRAM GUPTA	ANURAG SINHA	S. MAZUMDAR
3	02.12.15	REVISED AND ISSUED AS STANDARD	JITENDER GUPTA	AMARJEET SINGH	RAJANJI SRIVASTAVA	S. CHANDA

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SCHEDULE OF CONNECTION

SEC. BEAM	CONN. TYPE	DIMENSION	MAIN BEAM														CLEAT ANGLE 'A'		WELD SIZE	MIN. SHEAR CAPACITY
			MB150	MB200	MB250	MB300	MB350	MB400	MB450	MB500	MB600	MC150	MC200	MC250	MC300	MC400	D	SIZE	S1	IN MT
MB150	IV	a	25	–	–	–	–	–	–	—	–	25	–	—	–	–	80	L65x65x6	6	4.0
	V	a	–	25	30	30	35	35	35	40	45	–	25	30	30	35	60			3.0
	VI	a	–		–	–	–	–	–	–	–	25	25	25	25	25	80			4.0
MB200	IV	a	25	25	–	–	–	–	–	–	–	25	25	–	–	–	80	L65x65x6	6	4.0
	V	a	–	–	30	30	35	35	35	40	45		–	30	30	35	100			6.5
	VI	a	–	–	–	–		–	–	–	–	25	25	25	25	25	100			6.5
MB250	IV	a	–	30	30	–	–	–	–	–	–	–	30	30	–	–	120	L75x75x8	6	7.5
	V	a	–	–	–	30	35	35	35	40	45	–	–	–	30	35	150			10.0
	VI	a	–	–		–	–	–	–	–	–	–	30	30	30	30	150			10.0
MB300	IV	a	–	–	30	30	–	–	–	–	–	–	–	30	30		170	L75x75x8	6	11.0
	V	a	–	–	–	–	35	35	35	40	45	–	–	–	–	35	200			13.5
	VI	a	–	–	–	–	–	–	–	–	–	–	–	30	30	30	200			13.5
MB350	IV	a	–	–	–	35	35	–	–	–	–	–	–	–	35	–	210	L75x75x8	6	14.0
	V	a	–	–	–	–	–	35	35	40	45	–	–	–	–	35	250			16.5
	VI	a	–	–	–	–	–	–	–	–	–	–	–	–	35	35	250			16.5
MB400	IV	a	–	–	–	35	35	35	–	–	–	–	–	–	35	35	210	L90x90x10	6	14.0
	V	a	–	–		–	–	–	35	40	45	–	–	–	–	–	300		8	25.0
	VI	a	–	–	–	–	–	–	–	–	–	–	–	–	35	35	250		6	16.5
MB450	IV	a	–	–	–	–	35	35	35		–	–	–	–	–	35	260	L90x90x10	8	21.0
	V	a	–	–	–	–	–	–	–	40	45	–	–	–	–		350			30.0
	VI	a	–	–	–	–	–	–	–	–	–	–	–	–	–	35	350			30.0
MB500	IV	a	–	–	–	–	–	40	40	40	–	–	–	–	–	40	300	L90x90x10	8	26.0
	V	a	–	–	–	–	–	–	–	–	45	–	–	–	–		390			36.0
	VI	a	–	–	–	–	–	–	–	–	–	–	–	–	–	40	300			26.0
MB600	IV	a	–	–	–	–	–	–	–	45	–	–	–	–	–	–	380	L100x100x12	10	40.0
	IV	a	–	–	–	–	–	–	–	–	45	–	–	–	–	–	480			50.0
MC150	IV/VII	a	25	–	–	–	–	–	–	–	–	25	–	–	–	–	80	L65x65x6	6	4.0
	V/VIII	a	–	25	30	30	35	35	35	40	45	–	25	30	30	35	60			3.0
	VI/IX	a	–	–	–	–	–	–	–	–	–	25	25	25	25	25	80			4.0
MC200	IV/VII	a	25	25	–	–	–	–	–	–	–	25	25	–	–	–	80	L65x65x6	6	4.0
	V/VIII	a	–	–	30	30	35	35	35	40	45	–	–	30	30	35	100			6.5
	VI/IX	a	–	–	–	–	–	–	–	–	–	25	25	25	25	25	100			6.5
MC250	IV/VII	a	–	30	30	–	–	–	–	–	–	–	30	30	–	–	120	L75x75x8	6	7.5
	V/VIII	a	–	–	–	30	35	35	35	40	45	–	–	–	30	35	150			10.0
	VI/IX	a	–	–	–	–	–	–	–	–	–	–	30	30	30	30	150			10.0
MC300	IV/VII	a	–	–	30	30	–	–	–	–	–	–	–	30	30		170	L75x75x8	6	11.0
	V/VIII	a	–	–	–	–	35	35	35	40	45	–	–			35	200			13.5
	VI/IX	a	–	–	–	–	–	–	–	–	–	–	–	30	30	30	200			13.5
MC400	IV/VII	a	–	–	–	35	35	35	–	–	–	–	–	–	30	35	210	L90x90x10	6	13.5
	V/VIII	a	–	–	–	–	–	–	35	40	45	–	–	–	–	–	300		8	25.0
	VI/IX	a	–	–	–	–	–	–	–	–	–	–	–	–	35	35	210		6	13.5

NOTES:

1 ALL WELDS SHALL BE 6 mm. THK. UNLESS NOTED OTHERWISE.

2 NO AXIAL FORCES ARE INCLUDED AND SHALL BE CHECKED AS PER ACTUAL DESIGN.

3 THIS STANDARD IS NOT APPLICABLE FOR COMBINATION OF BEAM MKD.

4 SHEAR CAPACITY GIVEN IN THE TABLE IS FOR CONNECTION– TYPE IV, V & VI.

5 CONNECTION TYPE I, II, III, VII, VIII & IX SHALL NOT BE USED FOR EQUIPMENT SUPPORTING MEMBERS.

Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman / Approved by
4	02.12.22	REAFFIRMED AND ISSUED AS STANDARD	HIMANSHU	VIKRAM GUPTA	ANURAG SINHA	S. MAZUMDAR
3	02.12.15	REVISED AND ISSUED AS STANDARD	JITENDER GUPTA	AMARJEET SINGH	RAJANJI SRIVASTAVA	S. CHANDA

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NOTES :–

1. ALL DIMENSIONS ARE IN mm.
2. THE TYPE OF GRATING TO BE USED SHALL BE CALLED OUT ON THE DESIGN DRAWING.
3. MATERIAL FOR THE GRATING SHALL CONFORM TO FOLLOWING STANDARDS:

		CARBON STEEL (CS) GRATING	STAINLESS STEEL (SS) GRATING
(a)	MAIN MEMBER & END FLAT	IS 2062 (GRADE E250) SUB QUALITY–A/BR/BO	GRADE 409M CONFORMING TO ASTM 240/480 (UNS S40977)
(b)	CROSS MEMBER (SQ.TWISTED ACROSS BAR)	IS 7887	GRADE 409M CONFORMING TO ASTM 240/480 (UNS S40977) OR DESIGNATION X12Cr13 CONFORMING TO IS 6527/6528
(c)	FLAT FOR CLAMP	IS 513	GRADE 409M CONFORMING TO ASTM 240/480 (UNS S40977) OR DESIGNATION X12Cr12 CONFORMING TO IS 6603
(d)	DISC	CS 1038 GRADE	GRADE 1.4404 CONFORMING TO DIN EN 1.4404 OR GRADE 316/316L CONFORMING TO ASTM 240/480
(e)	STUD	CS 1038 GRADE	GRADE 1.4462 CONFORMING TO DIN EN 1.4462 OR GRADE F51 CONFORMING TO ASTM A182

4. ALL GRATINGS SHALL BE MANUFACTURED BY ELECTRO–FORGING PROCESS.
5. CARBON STEEL GRATINGS INCLUDING TOE PLATES & FLATS (AROUND OPENINGS) AND CLAMPS SHALL BE HOT DIP GALVANISED IN ACCORDANCE WITH IS 2629 AND TESTED AS PER IS 2633 & IS 6745. QUANTITY OF ZINC COATING SHALL BE MINIMUM 900 gm/sqm OF SURFACE AREA (0.12 mm MINIMUM AVERAGE THICKNESS). CLAMP BOLTS & NUTS SHALL HAVE MINIMUM AVERAGE ZINC COATING OF 375 gm/sqm (0.054 mm MINIMUM AVERAGE THICKNESS).
6. THE PANEL WIDTH SHOWN ON SUBSEQUENT SHEETS IS INDICATIVE. IT MAY BE INCREASED OR DECREASED AS REQUIRED TO SUIT THE GEOMETRY OF PLATFORM & CONVENIENCE OF HANDLING.
7. GRATINGS SHALL NOT BE USED FOR SUPPORTING THE PIPES DIRECTLY. ADDITIONAL MEMBERS (MINIMUM MC125) SHALL BE PROVIDED UNDER THE GRATING FOR SUPPORTING THE PIPE HAVING A MAXIMUM LOAD OF 500 Kg. THIS MEMBER SHALL SPAN IN SAME DIRECTION AS GRATING.
8. GRATING PANEL SHALL BE ALIGNED AND TACK WELDED TO THE SUPPORTING MEMBERS. FIXING OF GRATING PANEL WITH SUPPORTING MEMBERS SHALL EITHER BE DONE BY CLAMPS/ DISC (WITHOUT REMOVING TACK WELD) OR ALTERNATIVELY BY INTERMITTENT/STITCH WELDING 50(50).

   REMOVABLE GRATING PANEL AS SHOWN IN DRAWINGS SHALL BE FIXED BY CLAMPS/ DISC ONLY.
9. FOR GRATING PANELS WITH CUTOUTS/ OPENINGS; STRENGTHENING SHALL BE CARRIED OUT AS PER THE DETAILS GIVEN ON SHEET 6. ADDITIONAL MEMBERS WHEREVER SHOWN SHALL BE PROVIDED IN THE STRUCTURE.
10. THE FABRICATED GRATING SHALL FULFILL THE FOLLOWING MINIMUM REQUIREMENTS:
    (a) UNFUSED JOINTS ARE NOT IN EXCESS OF 5% OF TOTAL JOINTS AND ARE WELDED BY SMAW/GMAW PROCESS.
    (b) THE JOINTS ARE ABLE TO SUSTAIN A MINIMUM PULL OUT LOAD OF 1.2 TIMES THE SHEAR CAPACITY OF THE CROSS MEMBER.
11. EVERY FIFTH MAIN MEMBER SHALL NECESSARILY BE WELDED TO THE END FLAT FROM ONE SIDE. HOWEVER, THE END MAIN MEMBER SHALL ALWAYS BE WELDED TO THE END FLATS.
12. OPENINGS UP TO 200 mm DIA ARE NOT SHOWN ON THE DRAWING. THE SAME SHALL BE MADE AT SITE DURING ERECTION OF PIPING.
13. FOR CARBON STEEL GRATING, REPAIR TO THE DAMAGED AREA OF GALVANIZED COATING DUE TO WELDING AFTER ERECTION SHALL BE CARRIED OUT AS PER RECOMMENDED PRACTICE OF IS 11759 USING COLD GALVANIZING SPRAY PROCESS. ORGANIC PAINT SYSTEM IS NOT ACCEPTABLE.
14. MAXIMUM LENGTH OF SINGLE CONTINUOUSLY SUPPORTED GRATING SHALL BE FIXED ON THE BASIS OF HANDLING. HOWEVER PREFERABLY LENGTH OF GRATING SHALL BE RESTRICTED TO 6 M.
15. GRATING FASTENER DISC AND THREADED STUDS SHALL BE CERTIFIED BY EOTA (EUROPEAN ORGANIZATION FOR TECHNICAL ASSESSMENT). FOR INSTALLATION, PILOT HOLE SHALL BE DRILLED WITHOUT SELF–TAPPING. THE STUD WITH PRE–MOUNTED NEOPRENE (FOR CS)/ CHLOROPRENE (FOR SS) WASHER SHALL BE FASTENED INTO THE PILOT HOLE WITH PREDEFINED TORQUE VALUE BASED ON THE MANUFACTURER'S GUIDELINES. THE GRATING DISC SHALL THEN BE FIXED WITH ALLEN–TYPE BIT. VENDOR SHALL PROVIDE THE ENTIRE ARRANGEMENT INCLUDING THE SPECIALIZED TOOLS WITH INSTALLATION INSTRUCTIONS. VENDOR SHALL CARRY OUT PULL OUT LOAD TEST (WITH A LOAD VALUE SPECIFIED FOR THE GRATING PANEL) ON A SAMPLE STUD. THE VENDOR SHALL ALSO PROVIDE INSTALLATION TRAINING TO THE SITE WORKERS. HOT WORK PERMIT (NON–OPEN FLAME TYPE) MAY BE REQUIRED FOR INSTALLATION OF GRATING WITH DISC MECHANISM BASED ON HEAT DISSIPATION REPORT PROVIDED BY THE VENDOR.

    CARBON STEEL STUDS & DISC SHALL BE HOT DIP GALVANIZED (MIN. 900 gm/sqm FOR DISC & MIN. AVERAGE 375 gm/sqm FOR STUDS) OR SHALL HAVE A COATING THAT CAN WITHSTAND NEUTRAL SALT SPRAY TEST OF 2000H AS PER DIN EN ISO 9227.
16. STAINLESS STEEL GRATINGS INCLUDING LOCALIZED WELDING AREAS SHALL BE CHEMICALLY TREATED AS PER ASTM A380/A380M.
17. FOR STAINLESS STEEL GRATINGS, ELECTRODE OF GRADE E309L SHALL BE USED.

Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman
					Approved by	
6	04.07.24	REVISED & ISSUED AS STANDARD	JITENDER	AMARJEET	ANURAG SINHA	MAINAK NANDI
5	29.12.22	REVISED & ISSUED AS STANDARD	JITENDER	AMARJEET	ANURAG SINHA	S.MAZUMDAR

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TABLE–1

USE OF GRATING TYPE AT VARIOUS LOCATIONS & NET SAFE WORKING LOADS FOR GRATING TYPE–I & II

TYPE	APPLICATION	l	500 TO 800	900	1000	1100	1250	1400
		EITHER OF w(UDL IN KN/SQM) OR P(LINEAR LOAD IN KN/M)						
I	1. EQUIPMENT PLATFORM 2. WALKWAY FOR CABLE TRAY IN PIPE RACK 3. OPERATING PLATFORM FROM GRADE/SUPER STRUCTURE 4. APPROACHES	w	19.60	14.80	10.80	8.10	5.30	3.40
		P	9.00	8.00	6.60	5.40	4.00	2.70
II	1. STAIRS 2. FLOOR GRATING FOR a) COMPRESSOR HOUSE b) TECHNOLOGICAL STRUCTURE c) PIPE RACK WITH VALVE / PIPE SUPPORTS d) MAINTENANCE PLATFORM	w	19.60		17.60	13.20	8.70	5.50
		P	14.60	13.00	10.70	8.80	6.30	4.40

NOTE:– THE NET SAFE WORKING LOADS GIVEN ON TABLE–1 ARE BASED ON LIMITING VERTICAL DEFLECTION OF SPAN/200 OR 6mm, WHICHEVER IS LESS.

SYMBOLS :–

l = EFFECTIVE SPAN IN mm

b = BEARING WIDTH IN mm

w = UDL IN KN/SQM

P = LINEAR LOAD IN KN/M AT MID SPAN ALONG PANEL WIDTH.

= GRATING SPAN DIRECTION

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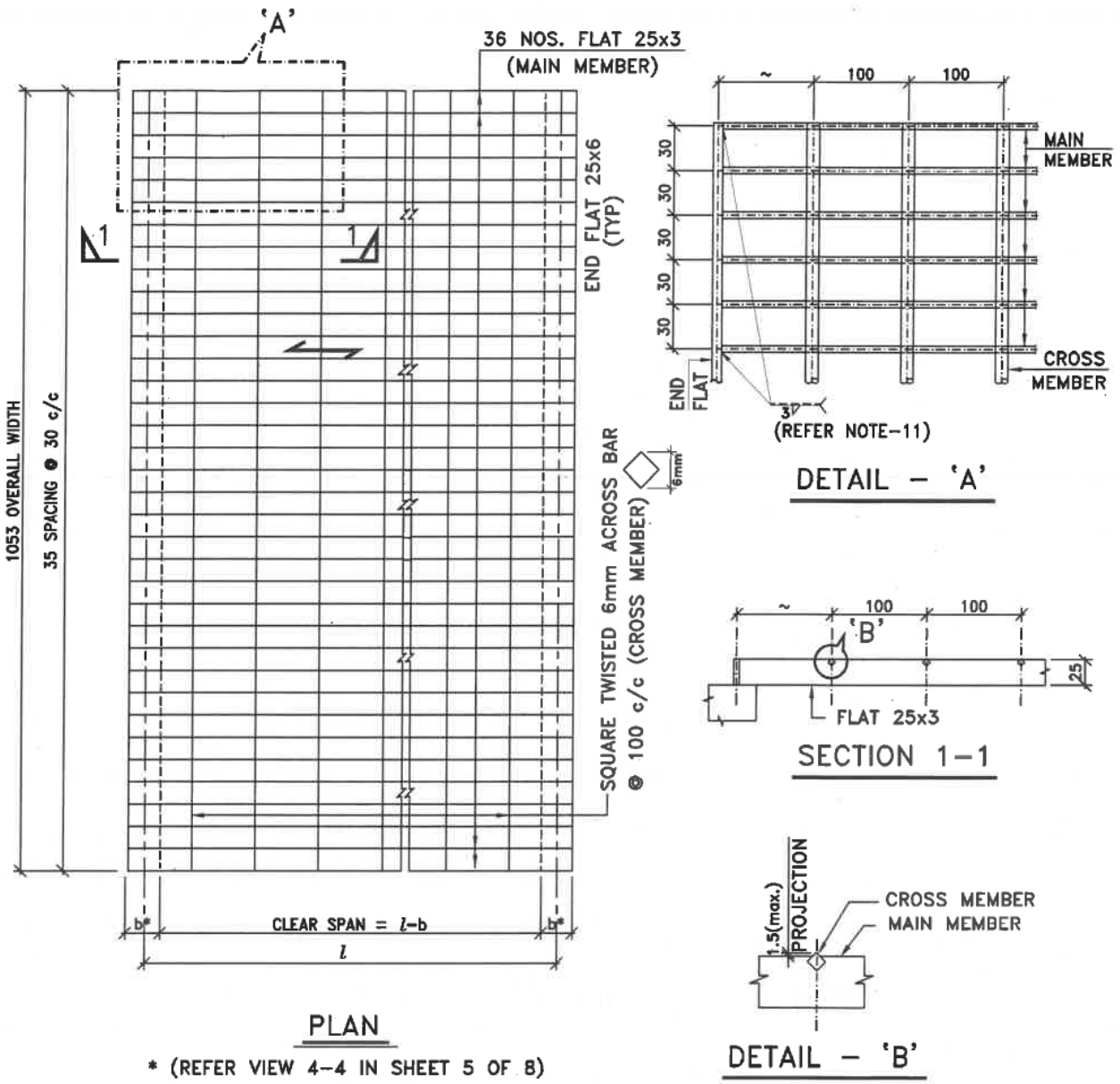

TABLE-2

WT. OF GRATING IN kg/m² (INDICATIVE ONLY, NOT FOR PAYMENT)				PROPERTIES WIDTH = 1053mm			REMARKS
FLAT 25x6	FLAT 25x3	SQUARE TWISTED 6mm ACROSS BAR	TOTAL	Ixx cm^4	Zxx cm^3	MR kgm	WEIGHT OF WELD, CLAMPS/DISC, GALVANISATION, ETC. NOT CONSIDERED
2.35	19.89	1.80	24.04	14.84	11.87	195.94	

GRATING TYPE - I

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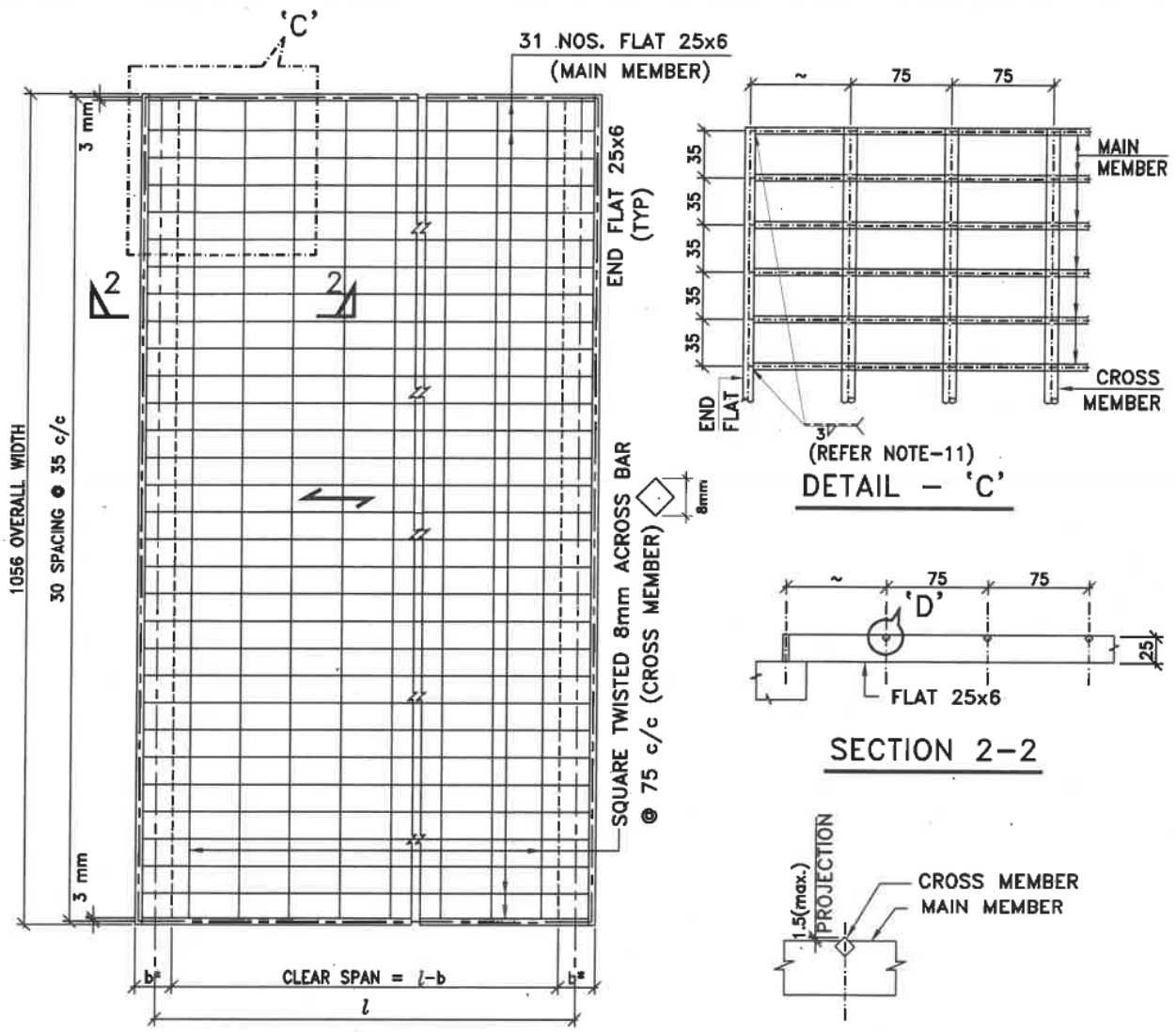

TABLE-3

WT. OF GRATING IN kg/sqm (INDICATIVE ONLY, NOT FOR PAYMENT)			PROPERTIES WIDTH = 1056mm			REMARKS
FLAT 25x6	SQUARE TWISTED 8mm ACROSS BAR	TOTAL	Ixx cm^4	Zxx cm^3	MR kgm	WEIGHT OF WELD, CLAMPS/DISC, GALVANISATION, ETC. NOT CONSIDERED
36.49	3.23	39.72	24.2	19.4	319.69	

GRATING TYPE – II

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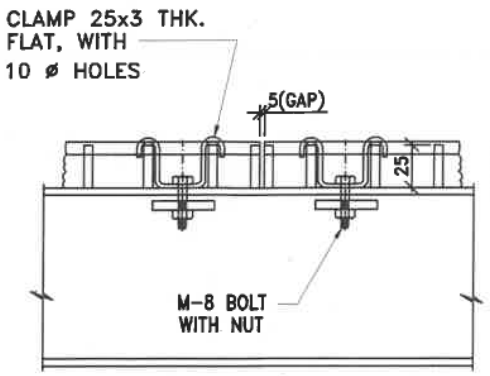
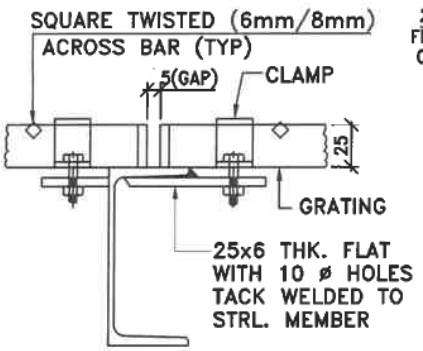
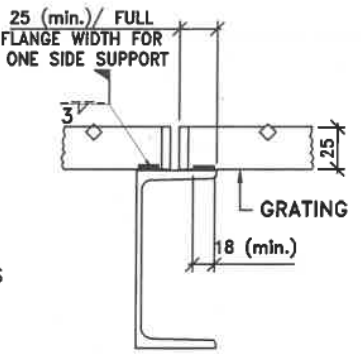


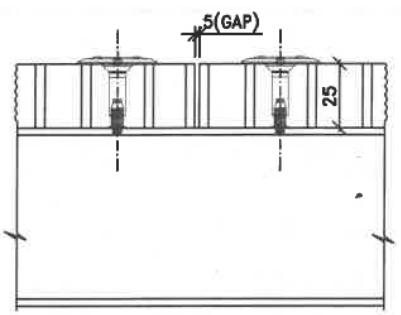
VIEW 3-3
GRATING FIXED WITH CLAMP



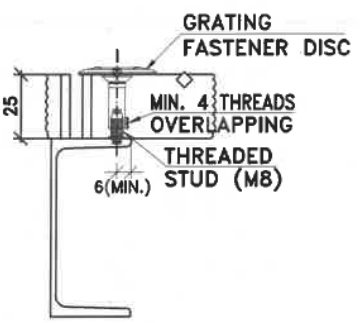
VIEW 4-4
GRATING FIXED WITH CLAMP
(REFER NOTE-8, 13 & 16)



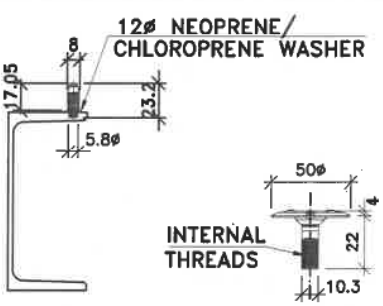
VIEW 4-4/VIEW 4B-4B
GRATING FIXED WITH WELDING
(REFER NOTE-8, 13 & 16)



VIEW 4A-4A
GRATING FIXED WITH DISC

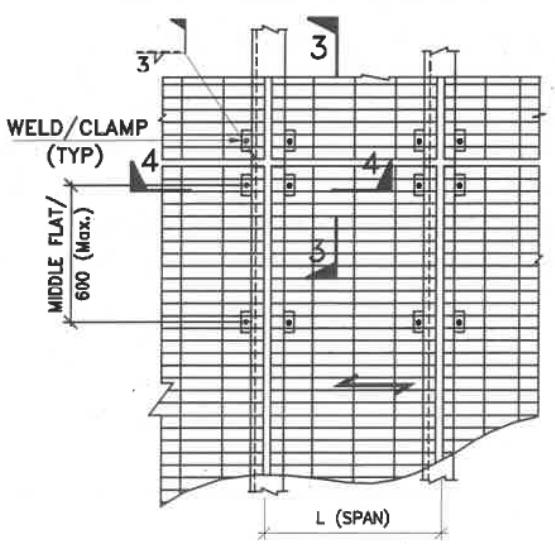


VIEW 4B-4B
GRATING FIXED WITH DISC
(REFER NOTE-8, 13, 15 & 16)

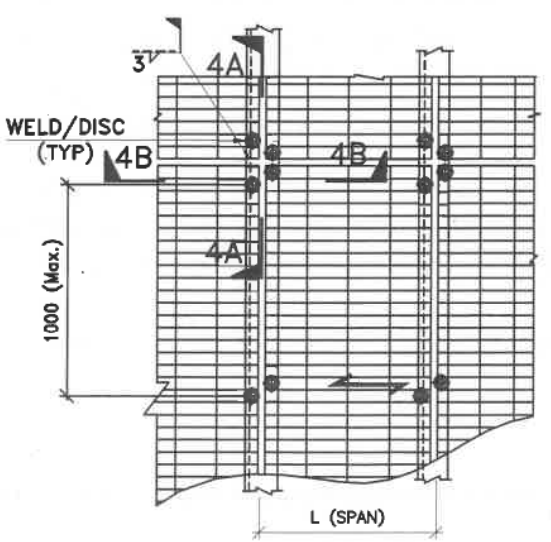


THREADED STUD FIXING DETAILS (REFER NOTE-15)

GRATING FASTENER DISC DETAILS (REFER NOTE-15)



OPTION-1
(WITH CLAMP)



OPTION-2
(WITH DISC)

FIXING DETAIL OF GRATING PANELS

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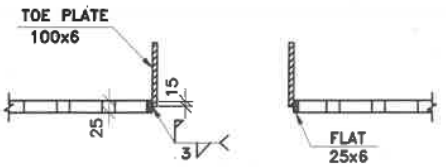
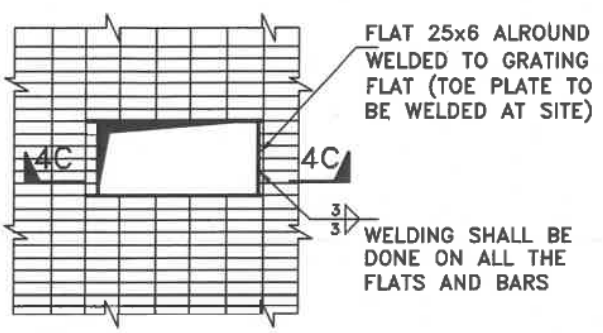
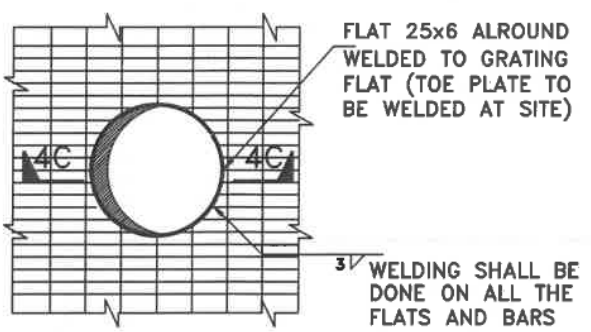


SEC. 4C–4C

(REFER NOTE–5, 13 & 16)



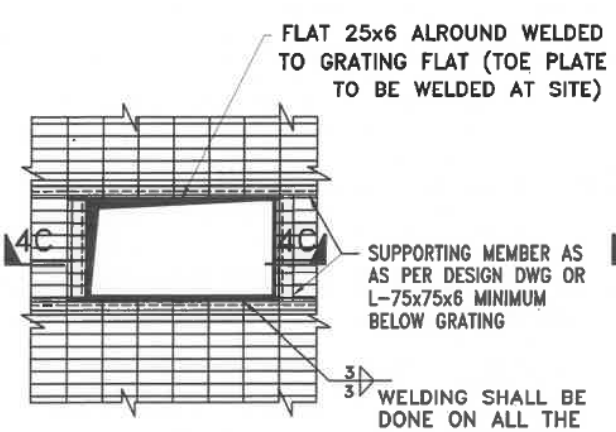
RECTANGULAR



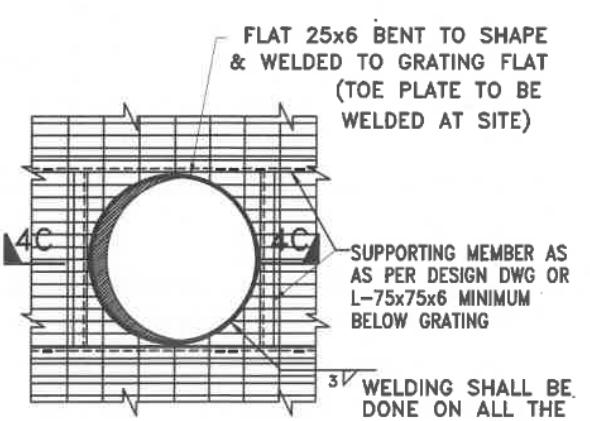
CIRCULAR

(SIZE OF OPENING >200 & UP TO 400 mm)

(FOR OPENING UP TO 200 MM REFER NOTE–12)



RECTANGULAR



CIRCULAR

SIZE OF OPENING GREATER THAN 400 mm

TYPICAL DETAIL OF GRATING STRENGTHENING AT OPENINGS

(REFER NOTE–9)

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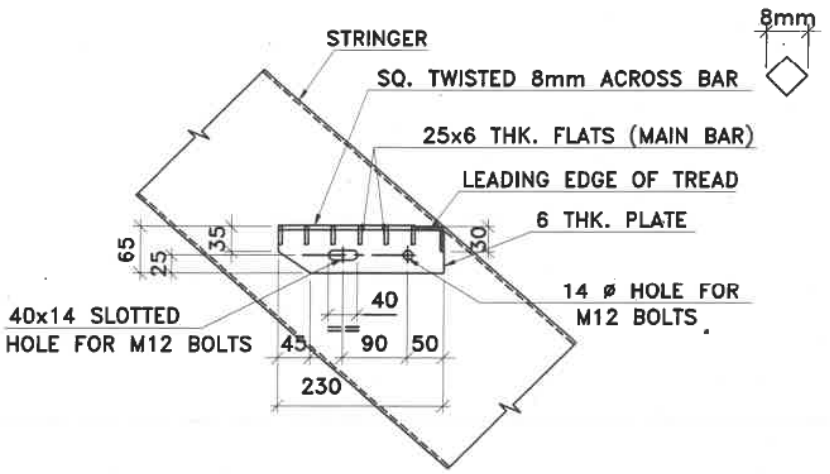
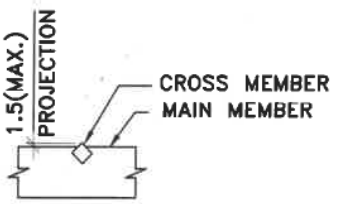
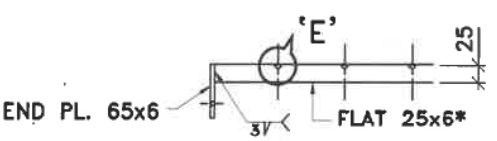
DET. OF 25 THK. GRATING STAIRCASE TREAD FOR 750 & 1000 WIDE STAIR



VIEW 6–6

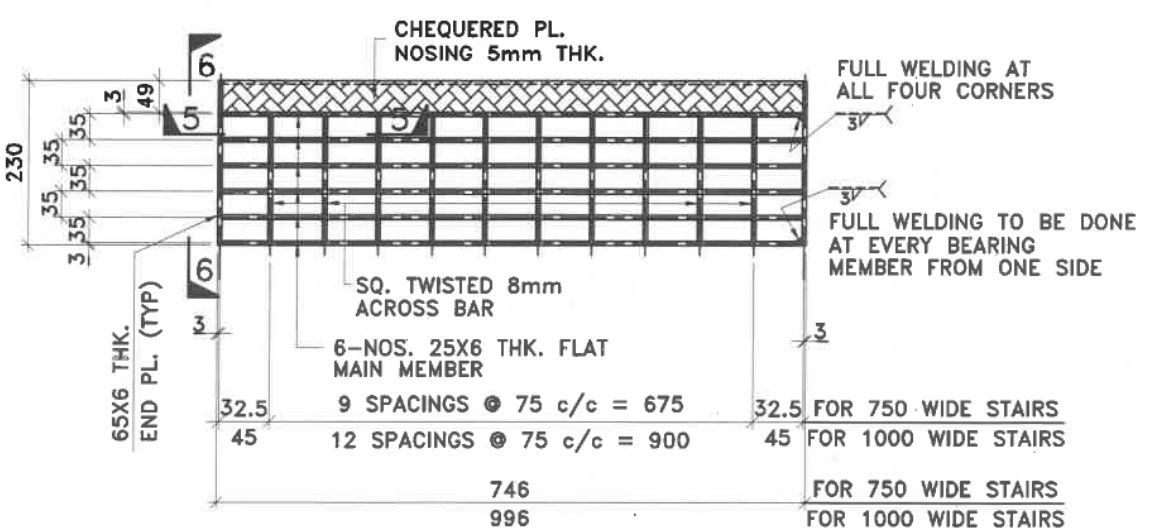


DETAIL– 'E'



SECTION 5–5

*ALL THE FLATS TO BE WELDED TO THE END FLATS



PLAN

(REFER NOTE–13 & 16)

TYP. DETAIL OF GRATING TO BE USED AS TREAD FOR 750/1000 WIDE STAIRS

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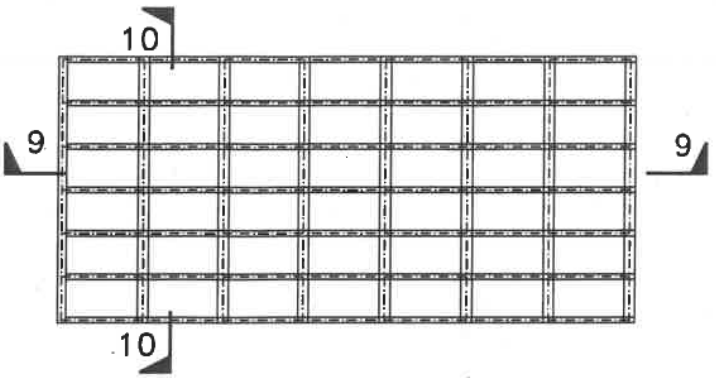

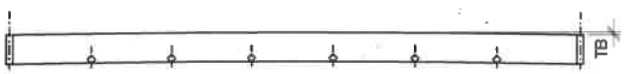

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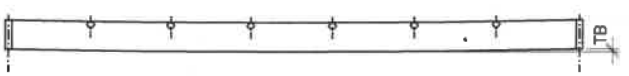
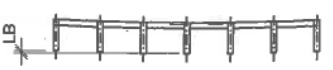


SECTION 9–9
(TB=TRANSVERSE BOW)

OR



SECTION 10–10
(LB=LONGITUDINAL BOW)

TABLE–4 (PERMISSIBLE AND MANUFACTURER TOLERANCES)

PERMISSIBLE TOLERANCES LOCATION	TOLERANCE (MM)
LENGTH OF GRATING PANEL OR INDIVIDUAL BEARING BAR	+0 / –5
WIDTH OF GRATING	+0 / –5
DEPTH OF BEARING BAR: FOR 25MM	+1 / –0.5
THICKNESS OF BEARING BAR:	±0.4
BINDING: TOP OF CROSS BAR ABOVE MAIN BAR	+0.5 / –0.5
MANUFACTURING TOLERANCES LOCATION	TOLERANCE (MM)
DIFFERENCE BETWEEN THE LENGTH OF DIAGONALS	±5 (OUT OF SQUARENESS OF GRATING PANEL)
CROSS BARS IN EITHER DIRECTION FROM PERPENDICULAR ALIGNMENT WITH MAIN BARS	1:100
CROSS BAR SPACING	±5 PER 1500 LENGTH OF BEARING BARS
BEARING BAR LEAN	1:10
TRANSVERSE BOW (TB) OF PANEL BEFORE FASTENING TO SUPPORTS	1:100
LONGITUDINAL BOW (LB) OF PANEL BEFORE FASTENING TO SUPPORTS	1:200

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ABBREVIATIONS

ABD	AMINE BLOW DOWN
A/G	ABOVE GROUND
API	AMERICAN PETROLEUM INSTITUTE
ANSI	AMERICAN NATIONAL STANDARD INSTITUTE
AWWA	AMERICAN WATER WORKS ASSOCIATION
BC	BOX CULVERT
BCR	BEARING COOLING RETURN
BE	BEVEL END
BF	BLIND FLANGE
BL	BED LEVEL
BOP	BOTTOM OF PIPE
BOTT.EL	BOTTOM ELEVATION(CABLE DUCT ETC)
CBD	CLOSE BLOW DOWN
CI	CAST IRON
C/C	CENTRE TO CENTRE
℄	CENTRE LINE
CONC.RED	CONCENTRIC REDUCER
CONC	CONCRETE
CPLG	COUPLING
CS	CARBON STEEL
CONN	CONNECTION
CONT	CONTINUATION
CRWS	CONTAMINATED RAIN WATER SEWER
CW	CONSTRUCTION WATER/CARRIAGE WAY
CWPH	COOLING WATER PUMP HOUSE
CWS	CAUSTIC WASTE SEWER
COL	COLUMN
DIA	DIAMETER
DWG	DRAWING
DISCH.	DISCHARGE
ETP	EFFLUENT TREATMENT PLANT
ECC	ECCENTRIC
EL	ELEVATION
ERC	ELECTRIC CABLE ROAD CROSSING
EWSS	EYE WASH & SAFETY SHOWER
FCR	FOR CONTINUATION REFER
FF	FLAT FACE
FGL	FINISHED GROUND LEVEL
F TO F	FACE TO FACE
FFL	FINISHED FLOOR LEVEL
FLGD.	FLANGED
FDN	FOUNDATION
GLV	GALVANISED
GT	GALVANISED BLACK STEEL TUBE
GR	GROUND/GRADE
HC	HOSE COUPLING
HP	HORSE POWER
HS	HOSE STATION
HPP	HIGH POINT OF PAVEMENT
ID	INSIDE DIAMETER
INST	INSTRUMENT
INV	INVERT
IRC	INSTRUMENT CABLE ROAD CROSSING
MDS	MECHANICAL DATA SHEET
MK	MARK
MR	MATERIAL REQUISITION
MTO	MATERIAL TAKE OFF
MS	MILD STEEL
MH	MANHOLE
NGL	NATURAL GROUND LEVEL
OD	OUTSIDE DIAMETER
OHT	OVERHEAD TANK
OWS	OILY WATER SEWER
PC	PIPE CULVERT
PDS	PROCESS DATA SHEET
PE	PLAIN END
PR	PURCHASE REQUISITION
PWS	PROCESS WASTE SEWER
PWB	PIPE WAY BRIDGE
RCC	REINFORCED CEMENT CONCRETE
R	RADIUS
RF	RAISED FACE
REF	REFERENCE
RW	ROAD WAY
SO	SLIP ON
SOR	SCHEDULE OF RATES
SS	STORM SEWER
STD	STANDARD
SCRC	STREET CABLE ROAD CROSSING
STN	STATION
SWS	SANITARY WASTE SEWER
TEMP	TEMPERATURE
TOS	TOP OF SLEEPER
TYP	TYPICAL
TWDK	TEMPORARY DRINKING WATER
U/G	UNDER GROUND
WCS	COOLING WATER SUPPLY
WCR	COOLING WATER RETURN
WDK	DRINKING WATER
WF	FIRE WATER
WR	RAW WATER
WH	HORTICULTURE WATER
WT	TREATED WATER
WF	FILTERED WATER
WWS	WASTE WATER SYSTEM

Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman
5	14.03.2024	REVISED & ISSUED AS STANDARD	MK	AK	SKN	MN

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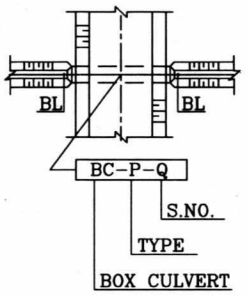
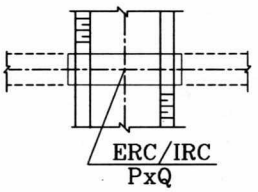
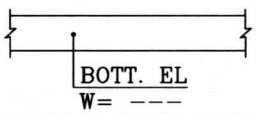
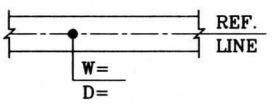
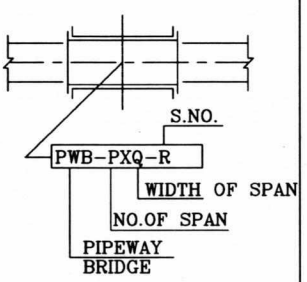
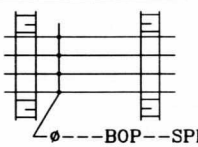
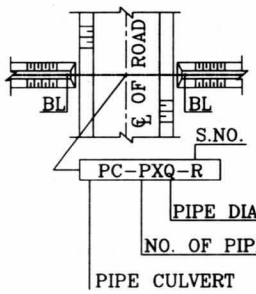
LEGENDS

○	NATURAL GROUND LEVEL		BOX CULVERT REPRESENTATION ON AREA DRAWING
●	FINISHED GROUND LEVEL		
⊖	ROAD TOP LEVEL/ PAVEMENT TOP LEVEL		
⊕	FINISHED FLOOR LEVEL OF BUILDING		
—·—·—	CENTRE LINE		
— — —	LAND ACQUISTION LIMIT		ERC–ELELCTRIC CABLE PxQ ROAD CROSSING NO.OF PIPE IN EACH LAYER NO. OF LAYERS
▬▬▬	COMPOUND WALL		
———	BATTERY LIMIT		
—·—·—	MATCHING LINE		R.C.C. CABLE TRENCH
ROAD–A	ROAD–A REPRESENTATION ON LAYOUTS (A=COORDINATE OF ROAD ℄)		
ROAD–A	ROAD–A REPRESENTATION IN AREA DRAWINGS (A=COORDINATE OF ROAD ℄)		BURIED CABLE TRENCH D=DEPTH W=WIDTH
HIGHER EDGE / LOWER EDGE	SIDE SLOPE		PIPEWAY BRIDGE
BL	TRAPEZOIDAL DITCH REPRESENTATION ON AREA DRAWING		
BL TYPE---	RECTANGULAR DITCH REPRESENTATION ON AREA DRAWING		
BL	TRAPEZOIDAL DITCH REPRESENTATION ON LAYOUT DRAWING		
BL TYPE---	RECTANGULAR DITCH REPRESENTATION ON LAYOUT DRG.		PIPE SLEEVES
BL BL PC/BC---	PIPE CULVERT BOX CULVERT REPRESENTATION ON LAYOUT DRG.		
	PIPE CULVERT REPRESENTATION ON AREA DRAWING	ø--- -CW-PIPE CLASS---	CONSTRUCTION WATER PIPE LINE
		ø--- -WT-PIPE CLASS---	TREATED WATER PIPE LINE
		ø--- -TWDK-PIPE CLASS---	TEMPORARY DRINKING WATER PIPE LINE
		ø--- -WDK-PIPE CLASS---	DRINKING WATER PIPE LINE

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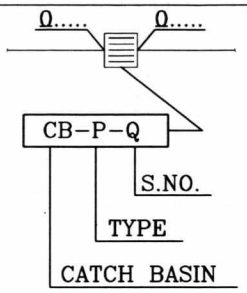
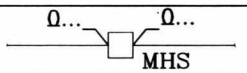
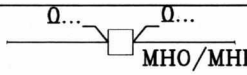
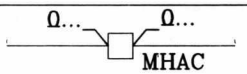
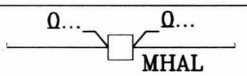
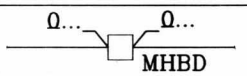
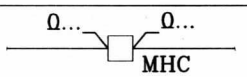
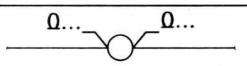
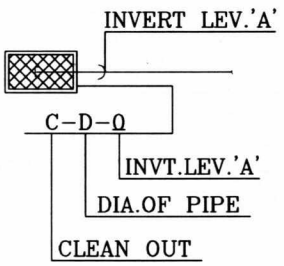
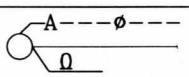
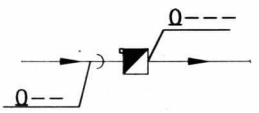
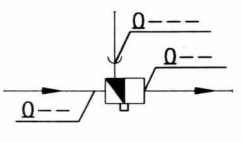
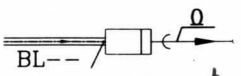
ø--- -WCS-PIPE CLASS---	COOLING WATER SUPPLY PIPE		45° BEND (TURNED DOWN)
ø--- -WCR-PIPE CLASS---	COOLING WATER RETURN PIPE		CATCH BASIN
ø--- -WF-PIPE CLASS---	FIRE WATER PIPE LINE		
ø--- -WH-PIPE CLASS---	HORTICULTURE WATER PIPE LINE		
ø--- -WS-PIPE CLASS---	SERVICE WATER PIPE LINE		
ø--- -SS-PIPE CLASS---	STORM SEWER		PIPE INVERT LEVEL
ø--- -DS-PIPE CLASS---	SANITARY WATER SEWER		SANITARY SEWER MANHOLE
ø---OWS/PWS-PIPE CLASS--	OILY WASTE SEWER/ PROCESS WASTE SEWER		OILY/PROCESS SEWER MANHOLE
ø--- -CTBD-PIPE CLASS--	COOLING TOWER BLOW DOWN		ACIDIC SEWER MANHOLE
ø--- -ACID-PIPE CLASS--	ACIDIC SEWER		ALKALI SEWER MANHOLE
ø---ALKALI-PIPE CLASS--	ALKALI SEWER		CTBD SEWER MANHOLE
ø---SANITARY PUMPING-PIPE CLASS---	SANITARY PUMPING MAIN		CHEMICAL SEWER MANHOLE
	GATE VALVE		CIRCULAR MANHOLE
	GLOBE VALVE		CLEAN OUT
	BUTTERFLY VALVE		
	CHECK VALVE		
	FLOAT VALVE		
	PIPE WITH FLANGED END		FUNNEL FOR STORAGE TANK DRAIN
	BLIND FLANGED END		RECTANGULAR SEALED MANHOLE (SINGLE COMPARTMENT)
TYPE	VALVE PIT IN PIPE LINE		
	90° BEND (TURNED UP)		RECTANGULAR SEALED MANHOLE (DOUBLE COMPARTMENT)
	90° BEND (TURNED DOWN)		
	45° BEND (TURNED UP)		SAND TRAP

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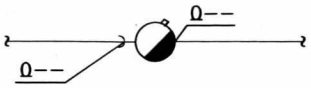
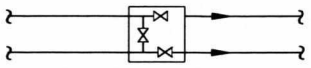
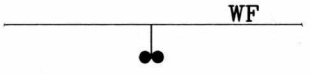
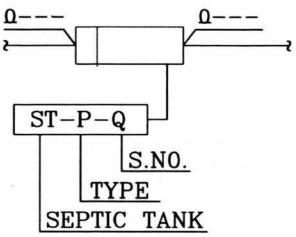
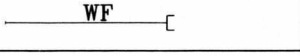
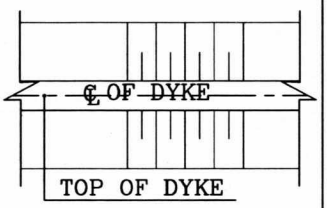
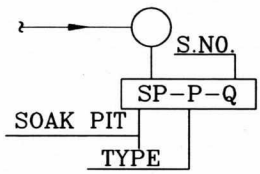
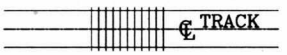
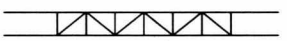
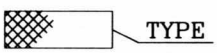
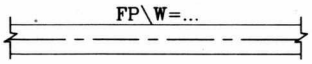
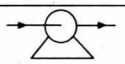
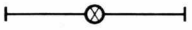
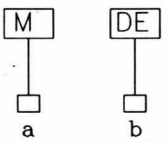
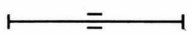
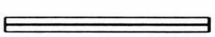
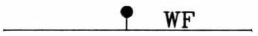
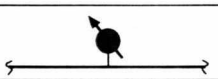
	SEALED MANHOLE (CIRCULAR)		WATER MONITOR FOR FOR FIRE WATER SYST.
			FOAM MONITOR FOR FOR FIRE WATER SYST.
	THREE WAY VALVE PIT (VALVE PITS OUTSIDE TANKFARM AREA FOR DRAINAGE)		DOUBLE HEADED FIRE HYDRANT AWAY FROM HEADER
	SEPTIC TANK		FIRE HOSE COUPLING
			EARTHEN DYKE
	SOAK PIT		RAILWAY TRACK REPRESENTATION ON LAYOUT
			RAILWAY TRACK REPRESENTATION ON AREA DWG.
	GULLY TRAP		PIPE RACK
	GATE		PIPE WAY
	BARBED WIRE FENCING	EQPT. SYMBOLS	
	CHAIN LINK FENCING		HOSE CABINET
	R.C.C. PAVEMENT		HOSE REEL
	FOOTPATH W=WIDTH OF FOOTPATH		DELUGE VALVE ASSEMBLY
	SLIDING SLEEPER		PUMP (HORIZONTAL)
	ANCHOR SLEEPER		PUMP VERTICAL a) ELECT. DRIVE b) DEISEL DRIVE
	GUIDE SLEEPER		
	JUMP OVER SLEEPER		
	FIRE HYDRANT SINGLE HEADED		WATER CUM FOAM MONITOR
	FIRE HYDRANT DOUBLE HEADED		

Rev. No	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman
5	14.03.2024	REVISED & ISSUED AS STANDARD	MK	AK	SKN	MN

Approved by

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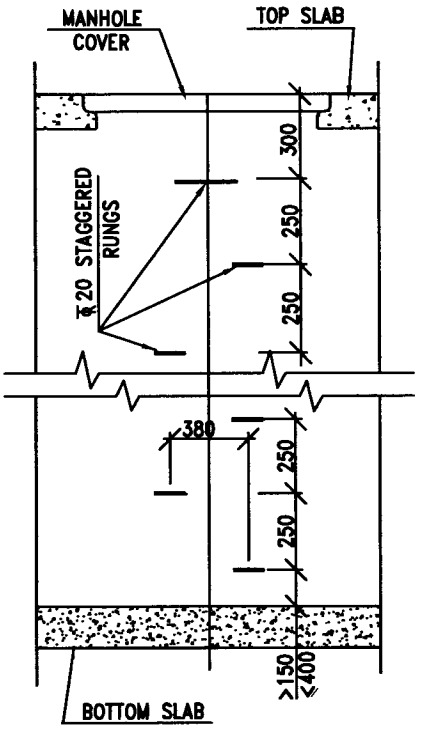
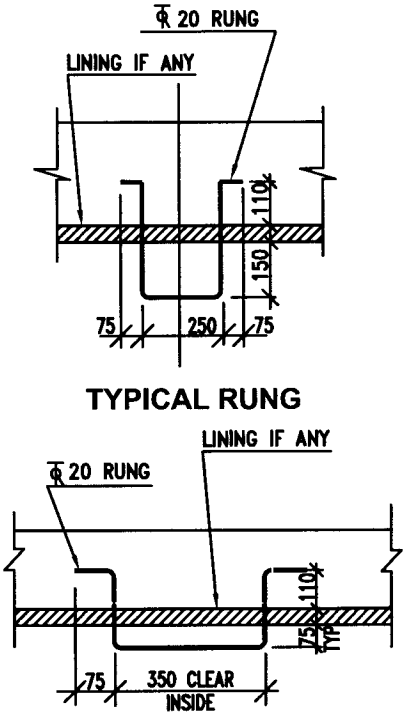
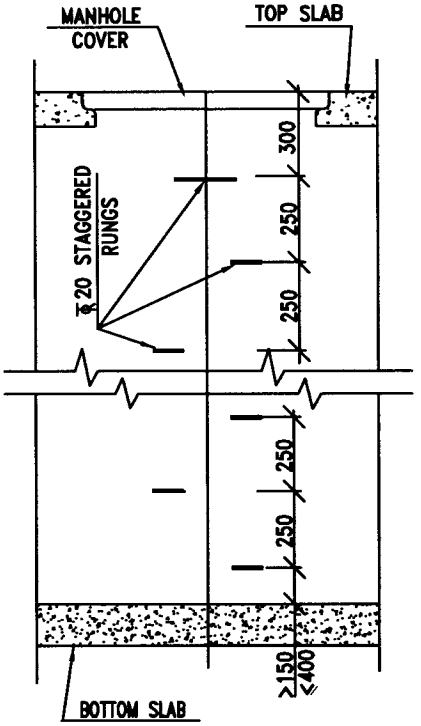


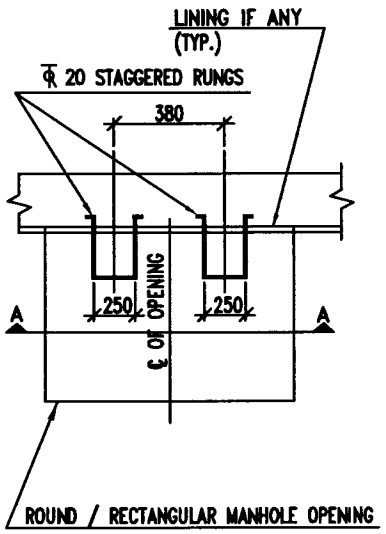
VIEW. A–A (TYP.)



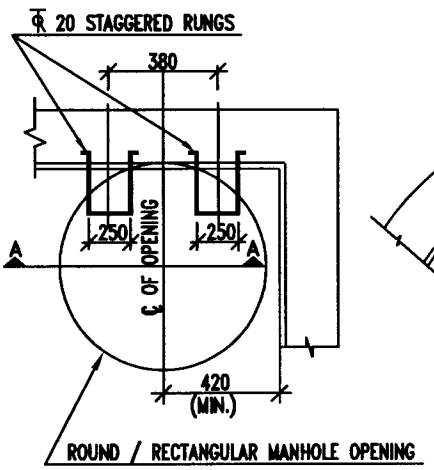
DETAIL OF TOP RUNG



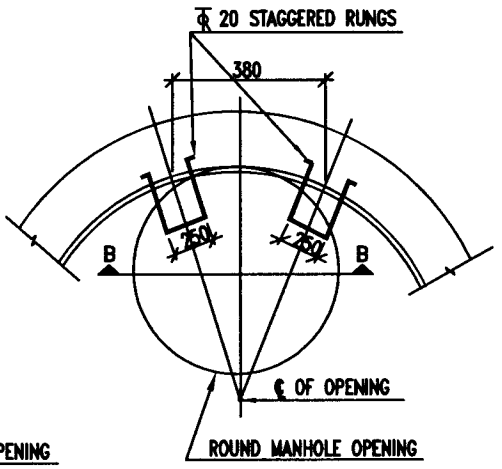
VIEW. B–B



CASE –1



CASE – 2



CASE – 3

NOTE:-

1. ALL DIMENSIONS ARE IN MILLIMETER UNLESS SPECIFIED.
2. RUNGS SHALL BE EPOXY COATED OR PAINTED AS PER RELEVANT SPECIFICATION.
3. REFER STRUCTURAL GENERAL NOTES OF THE PROJECT FOR REINFORCED CONCRETE STRUCTURES FOR FOLLOWING:
   a) GRADE OF CONCRETE
   b) GRADE AND TYPE OF CEMENT
   c) REINFORCEMENT STEEL BARS
   d) CLEAR COVER IN R.C.C. WORKS

Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman
					Approved by	
5	30.12 19	REVISED & ISSUED AS STANDARD	YR	DCB	R SRIVASTAVA	RK TRIVEDI
4	05.06.14	REVISED & ISSUED AS STANDARD	JKU	RKS	RBB	SC

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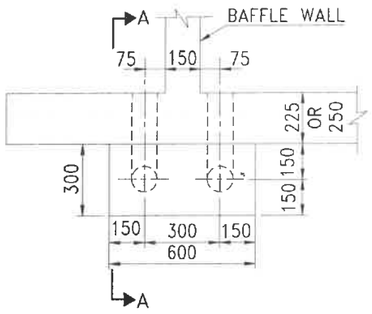
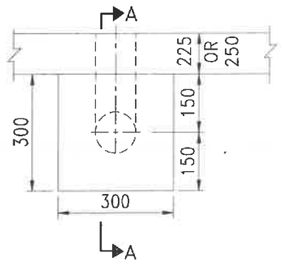
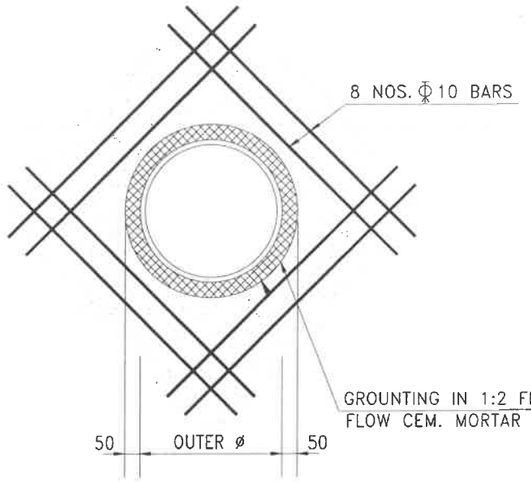


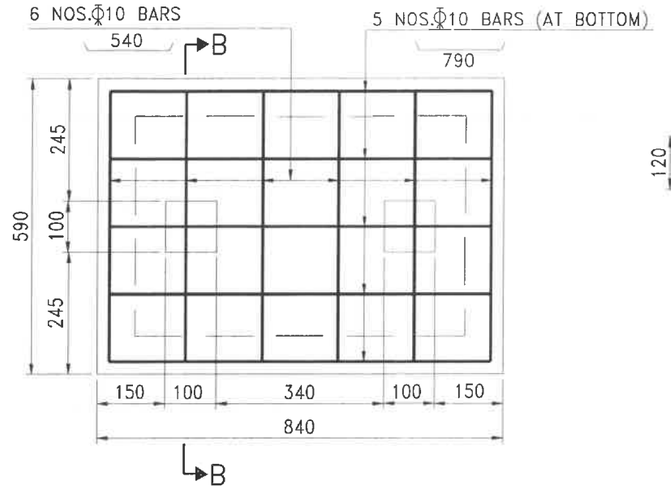
PLAN
DOUBLE VENT PIPE



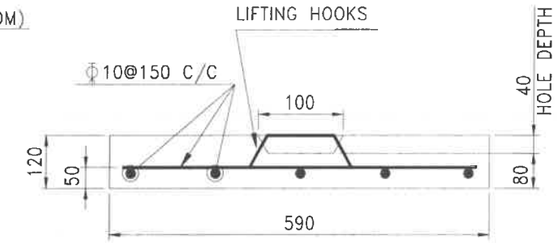
PLAN
SINGLE VENT PIPE



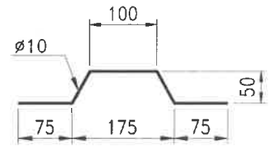
FOR R.C.C.WALL
(PIPE ø>500)



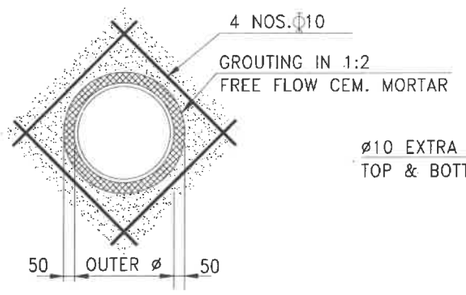
REINFORCEMENT PLAN
DETAIL OF PRECAST CONC. COVER



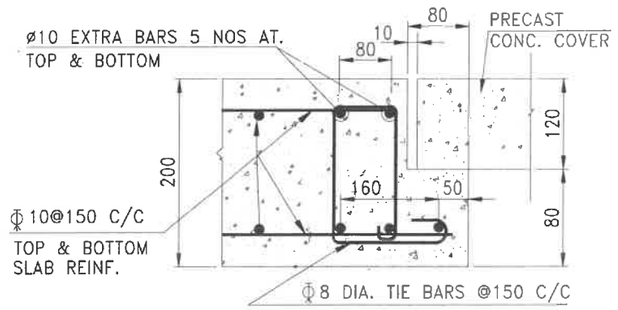
SECTION B–B



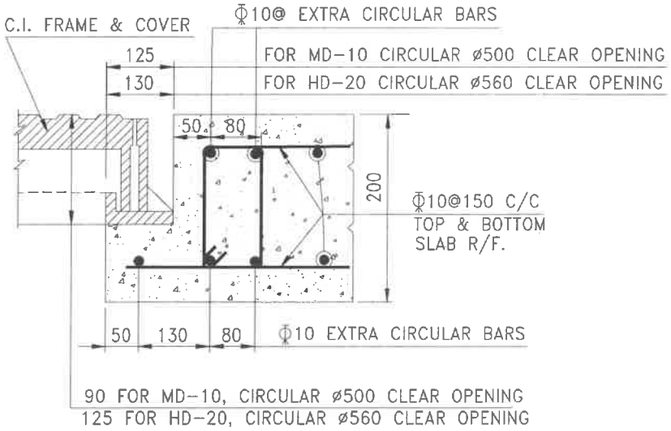
DET. OF LIFTING HOOK



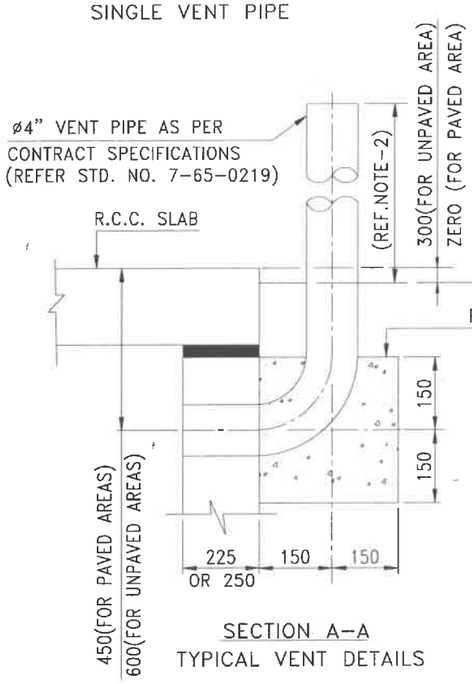
FOR R.C.C.WALL
(PIPE ø≤500)



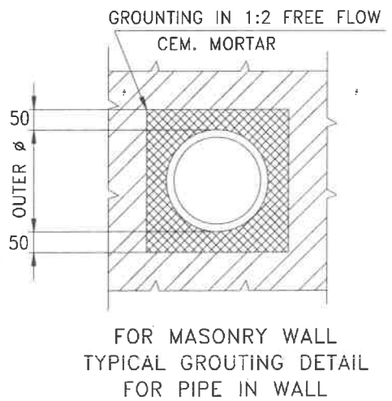
FIXING PRECAST CONC.COVER



FIXING C.I. COVER



SECTION A–A
TYPICAL VENT DETAILS



FOR MASONRY WALL
TYPICAL GROUTING DETAIL
FOR PIPE IN WALL

NOTES:

1. ALL DIMENSIONS ARE IN MM UNLESS NOTED OTHERWISE.
2. FOR VENT PIPE DETAILS IN UNIT AREA AND OFFSITE AREA, REFER STANDARD NO. 7–65–0219.
3. REFER STRUCTURAL GENERAL NOTES OF THE PROJECT FOR REINFORCED CONCRETE STRUCTURES FOR THE FOLLOWING :.
   a. GRADE OF CONCRETE.
   b. GRADE AND TYPE OF CEMENT.
   c. REINFORCEMENT STEEL BARS.
   d. CLEAR COVER IN CONCRETE WORKS.
   e. ADMIXTURES IN CONCRETE.
4. REFER STD. NO. 7–68–0630 FOR DETAIL OF PUDDLE PLATE.
5. REFER GEOTECHNICAL RECOMMENDATIONS OF THE PROJECT FOR PROTECTIVE COATING FOR R/F, IF ANY.

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Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman
6	31.05.24	REVISED & ISSUED AS STD.	TP	GYAS	S K NASKAR	M NANDI
5	30.12.19	REVISED & ISSUED AS STD.	YR	DCB	RS	RK TRIVEDI
					Approved by	

STANDARD MISCELLANEOUS DETAIL FOR MANHOLES

STANDARD No.
7-65-0212 Rev. 6
Page 1 of 1

Format No. 8-00-0001-F5 Rev. 0

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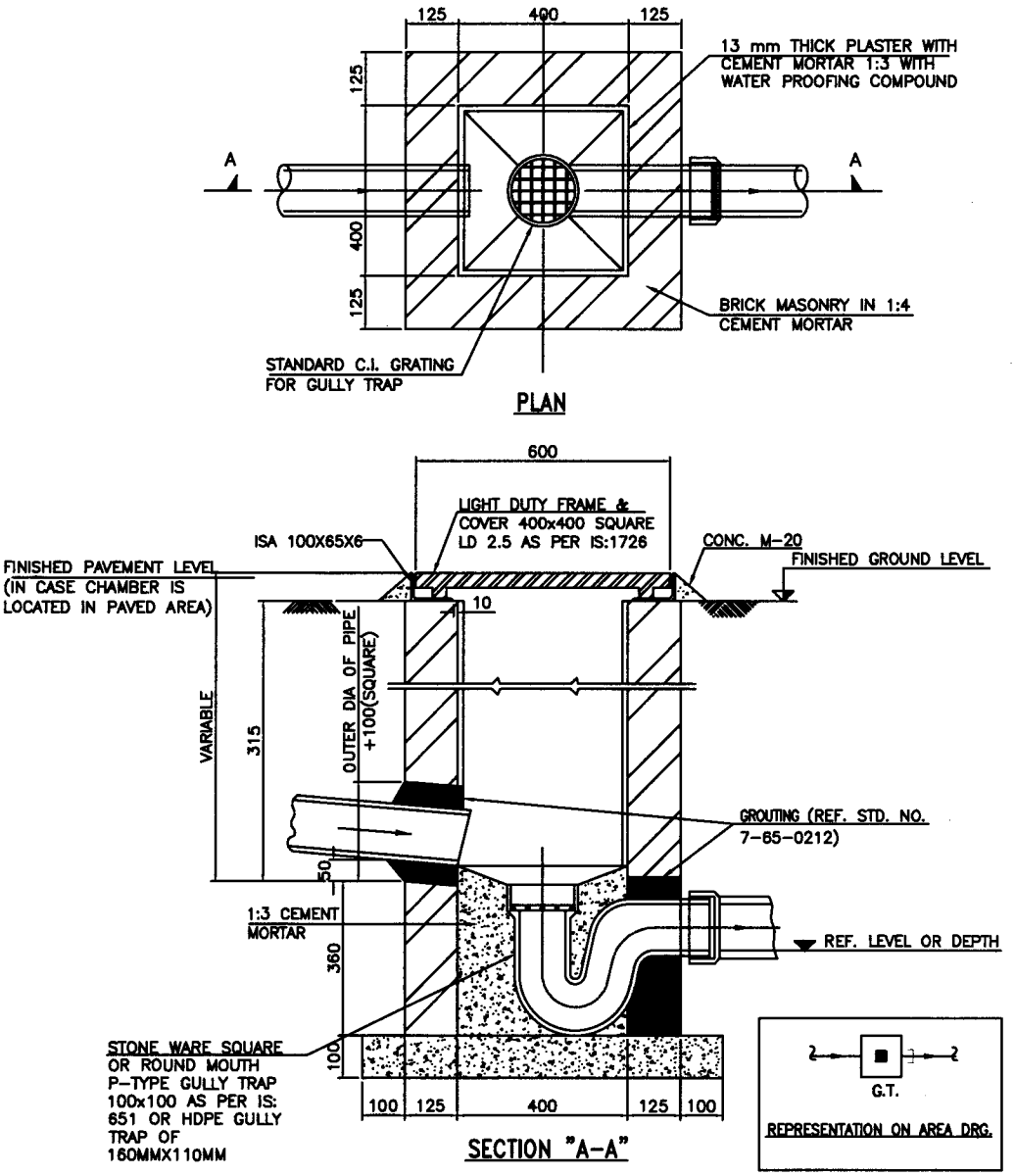

NOTE:

1. ALL DIMENSIONS ARE IN MM.
2. THE BRICKS SHALL CONFORM TO IS: 1077 (CLASS 5.0 MIN.).
3. EXACT THICKNESS OF BRICK MASONRY WALL SHALL BE AS PER LOCALLY AVAILABLE BRICKS. (HERE WALL THICKNESS HAS BEEN GIVEN AS PER BRICK SIZE OF 250X125X75).
4. HDPE GULLY TRAP MAY BE USED IN PLACE OF STONEWARE GULLY TRAP.

Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman
7	16.08.21	REVISED & ISSUED AS STANDARD	ADP	GYAS	A.SINHA	S.MAZUMDAR
6	30.12.19	REAFFIRMED & ISSUED AS STANDARD	YR	DCB	R SRIVASTAVA	RK TRIVEDI
5	05.06.14	REAFFIRMED & ISSUED AS STANDARD	GAURAV	RKS	RBB	SC

Approved by

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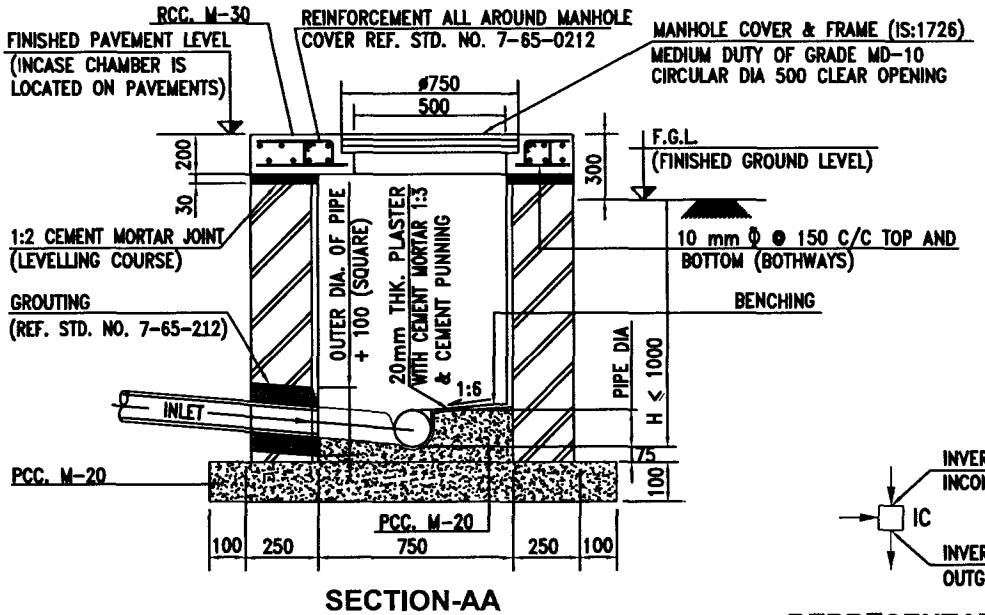
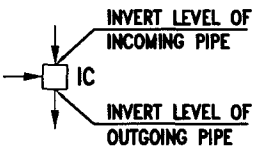
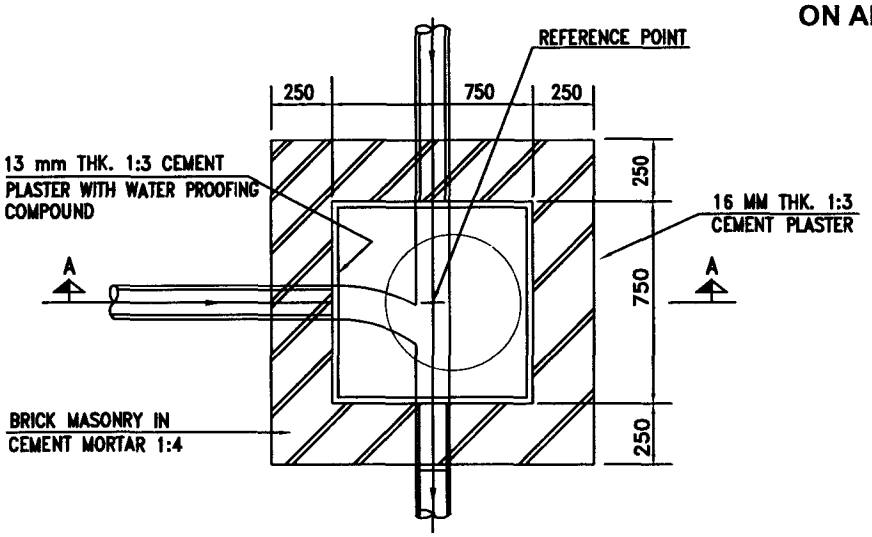


SECTION-AA



REPRESENTATION ON AREA DRAWING



PLAN

NOTE:

1. ALL DIMENSIONS ARE IN MILLIMETER UNLESS NOTED OTHERWISE.
2. REFER STRUCTURAL GENERAL NOTES OF THE PROJECT FOR REINFORCED CONCRETE STRUCTURES FOR FOLLOWING
   a. GRADE OF CONCRETE b. GRADE AND TYPE OF CEMENT
   c. REINFORCEMENT STEEL BARS d. CLEAR COVER IN RCC WORKS
3. BAR BENDING SHALL CONFORM TO IS: 2502.
4. TOP SLAB SHALL BE CAST-IN-SITU AND REINFORCEMENT ON WALL SIDE OF MANHOLE OPENING SHALL BE ADJUSTED AT SITE.
5. THE BRICKS SHALL CONFORM TO IS: 1077 (CLASS 5.0 MINIMUM).
6. EXACT THICKNESS OF BRICK MASONRY WALL SHALL BE AS PER LOCALLY AVAILABLE BRICKS (HERE WALL THICKNESS HAS BEEN GIVEN AS PER BRICK SIZE OF 250 X 125 X 75).

Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman
					Approved by	
5	30.12.19	REAFFIRMED & ISSUED AS STANDARD	YR	DCB	R SRIVASTAVA	RK TRIVEDI
4	05.06.14	REVISED & REISSUED AS STANDARD	GAURAV	RKS	RBB	SC

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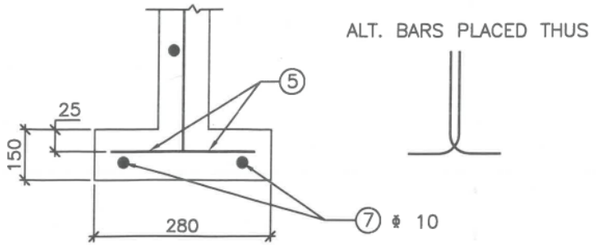
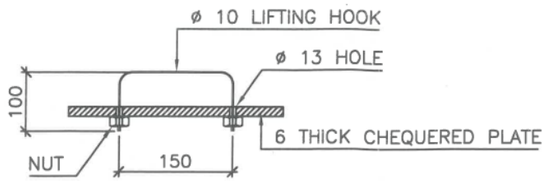
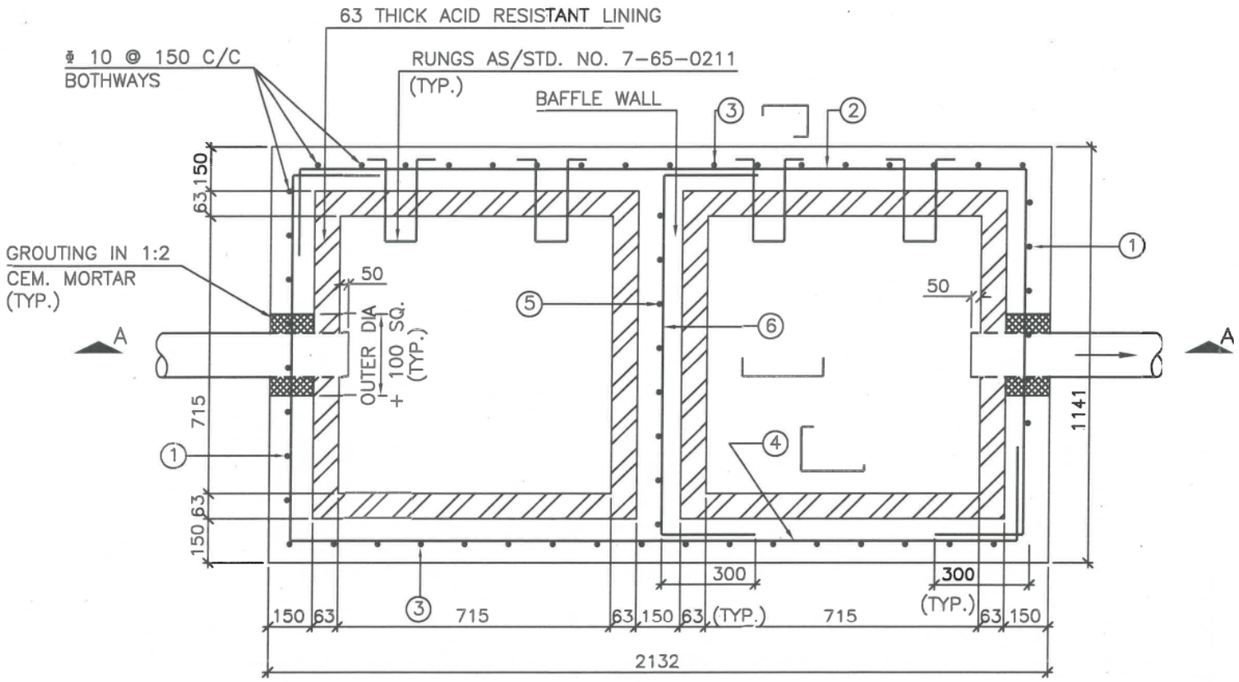


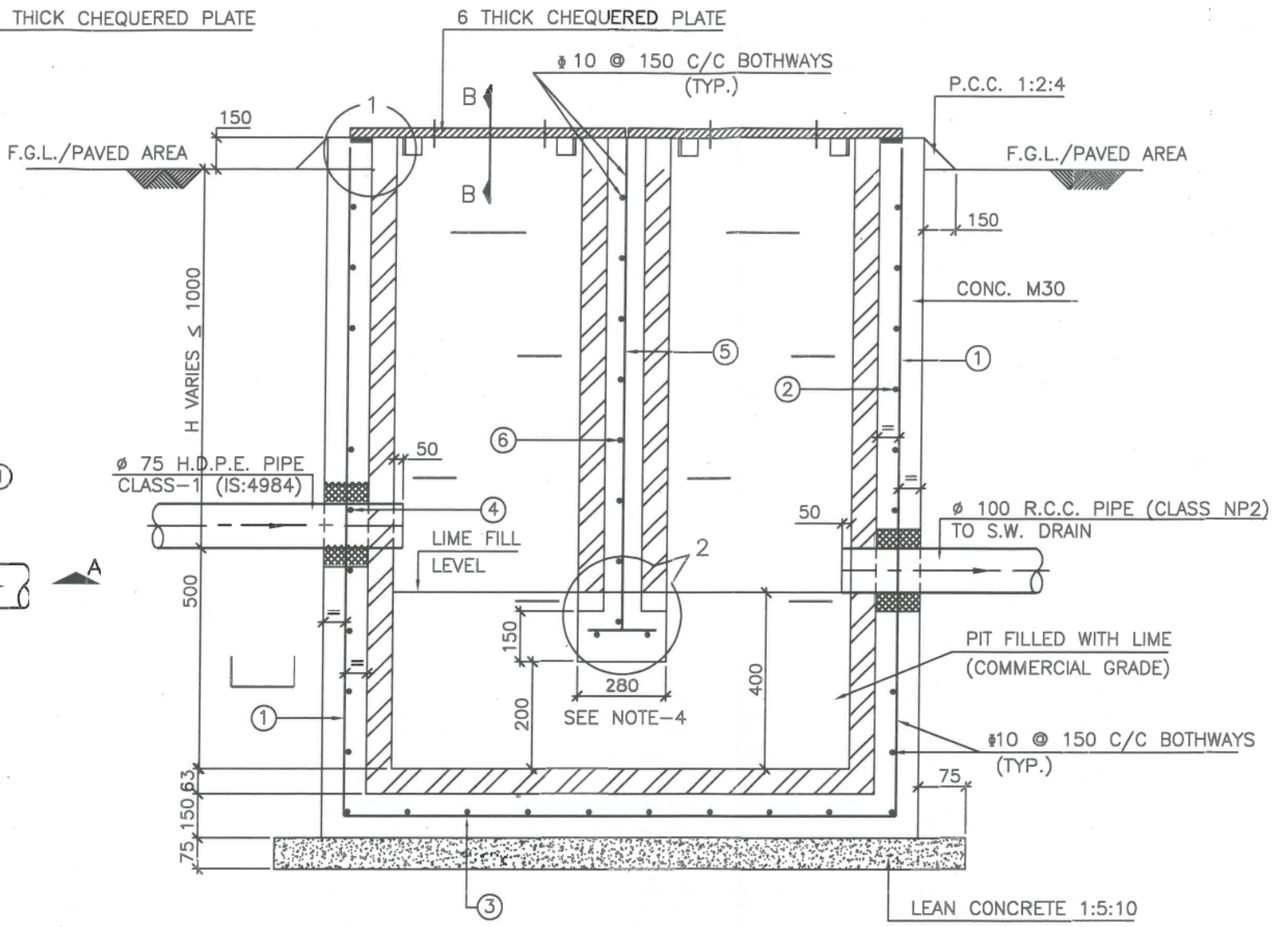
DETAIL–2



SECTION B–B



PLAN



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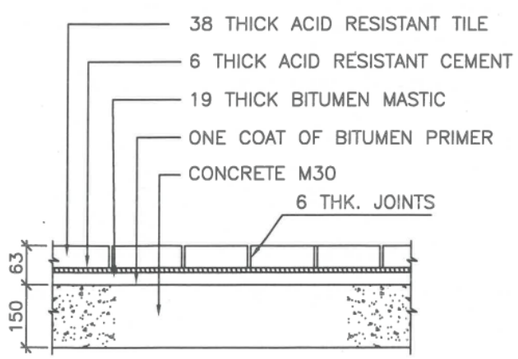
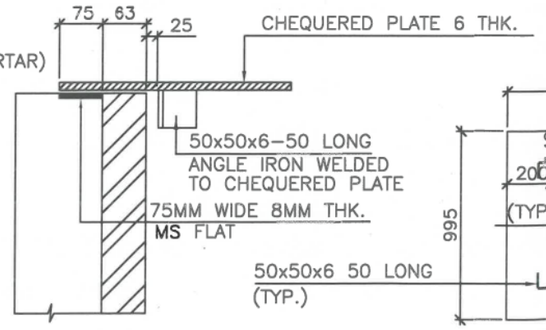
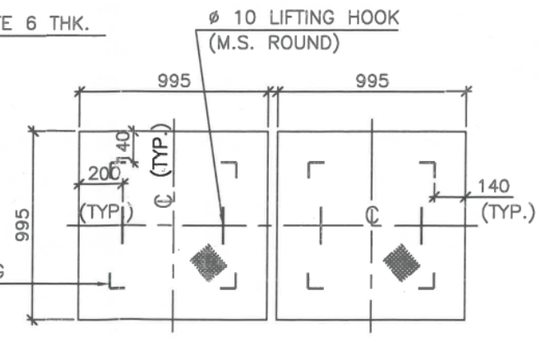


ACID RESISTANT LINING DETAIL

(REFER STD. NO. 7–65–0412)



DETAIL–1



PLAN

CHEQUERED PLATE

(REFER STD. NO. 7–65–0224)

NOTES: –

1. ALL DIEMNSIONS ARE IN MILLIMETERS
2. HYD. BARS SHALL CONFORM TO IS:1786 (FE 500)
3. UNDER SIDE OF THE CHEQUERED PLATE COVER, ANGLE IRON AND RUNGS SHALL BE PAINTED WITH AMBIENT TEMPERATURE CURING TYPE TWO COMPONENT EPOXY PHENOLIC COATING CURED WITH AMINE ADDUCT HARDENER IN THREE COATS OF 100 MICRON DFT / COAT AFTER SURFACE PREPARATION BY GRIT BLASTING.
4. EXPOSED BOTTOM AND SIDES OF THE BAFFLE WALL (CONCRETE SURFACE) SHALL BE PROVIDED WITH ONE COAT OF BITUMEN PRIMER 25 MICRON AND TWO COATS OF EPOXY PAINT 100 MICRON EACH.
5. THIS STANDARD IS APPLICABLE FOR ACID WASTE.

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Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman
5	29.10.25	REVISED & REISSUED AS STD.	RA/PPC	AK	SKN	M NANDI
4	28.06.18	REAFFIRMED & ISSUED AS STD.	RP	DCB	RS	RK TRIVEDI
					Approved by	

DETAIL OF NEUTRALISATION PIT FOR FLOODED LEAD ACID BATTERIES

STANDARD No.

7-65-0310 Rev. 5

Format No. 8-00-0001-F5 Rev. 0

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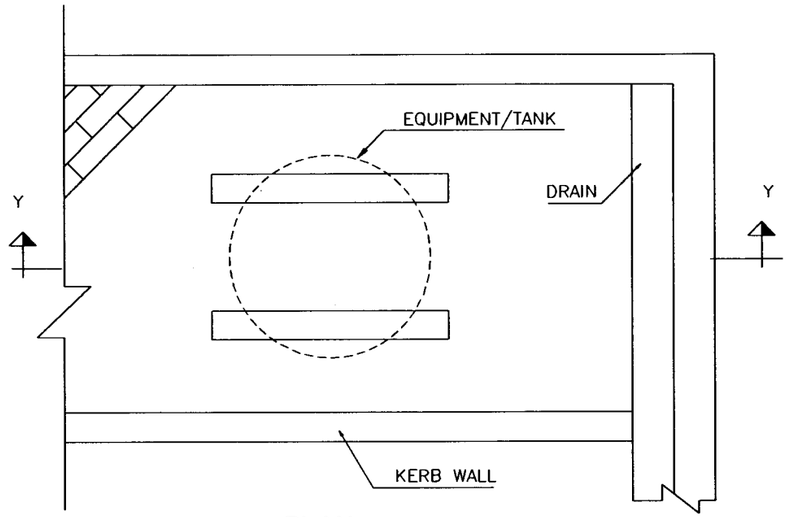
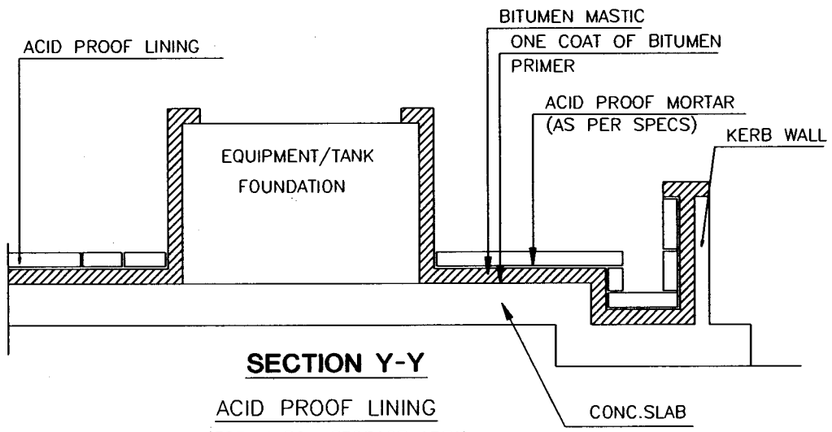


PLAN

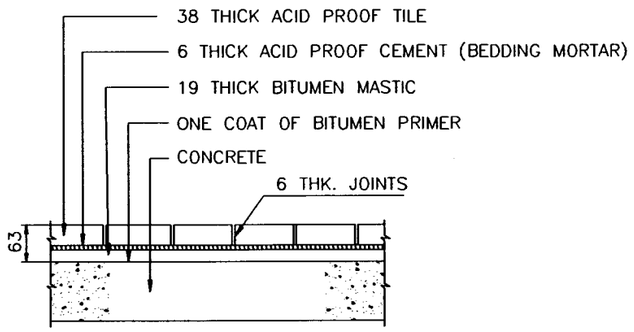


SECTION Y-Y

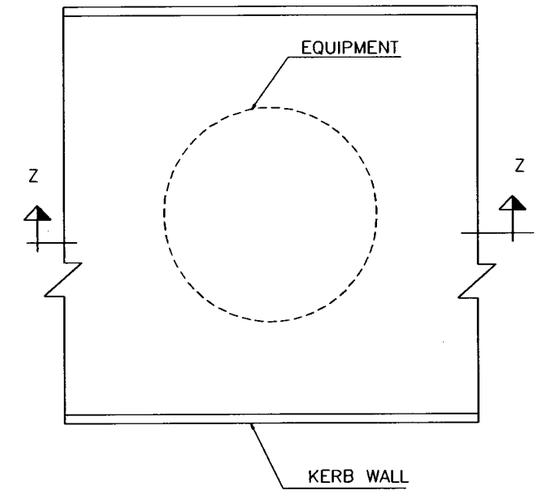
ACID PROOF LINING

(FOR H_2SO_4 STORAGE AREA)

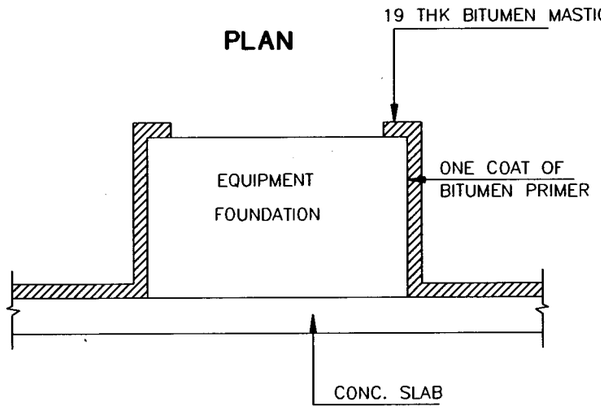
(REFERENCE SPEC. NO 6-65-0062)



ACID PROOF LINING DETAIL



PLAN



SECTION Z-Z

ACID/ALKALI PROOF LINING WITH BITUMEN MASTIC

(REFERENCE SPEC.NO. 6-65-0061)

Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman
					Approved by	
4	28.09.20	REAFFIRMED & ISSUED AS STD.	SK	RKS	AS	SM
3	25.07.14	REAFFIRMED & ISSUED AS STD.	KC	RKS	RBB	SC

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TYP. DETAIL OF ACID / ALKALI PROOF LINING

STANDARD No.

7-65-0412 Rev. 4

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Format No. 8-00-0001-F5 Rev. 0

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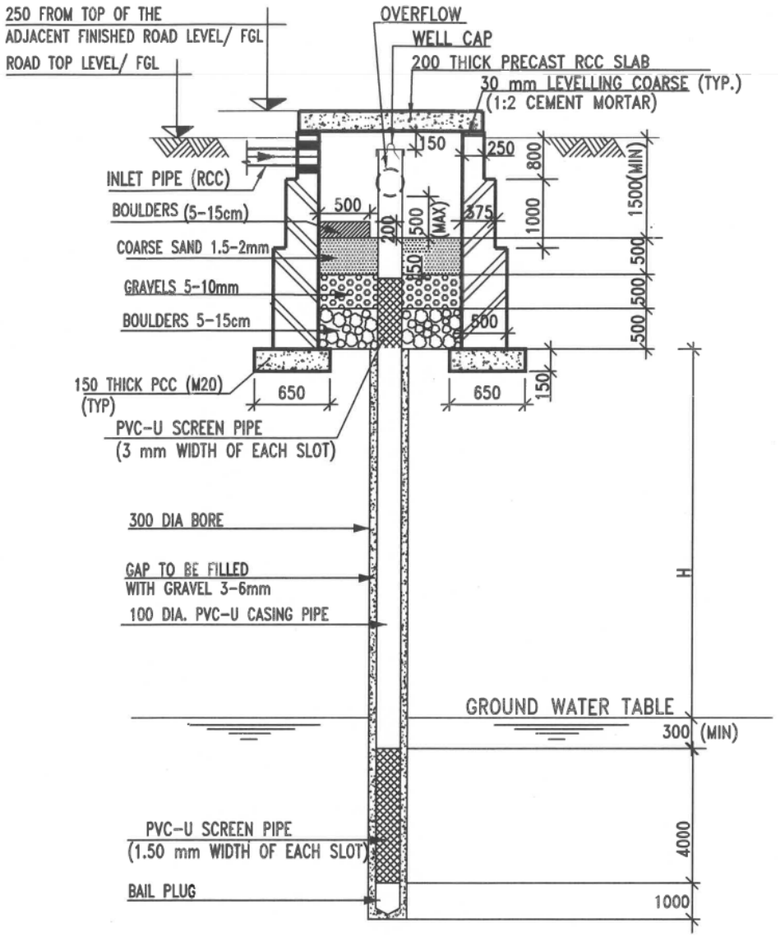
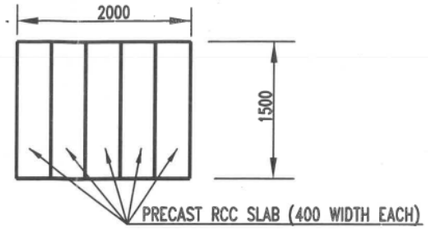
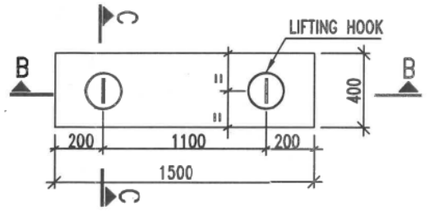


SECTION-AA



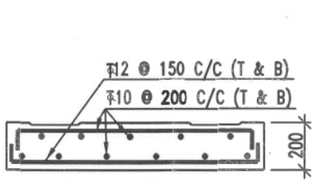
PRECAST SLAB



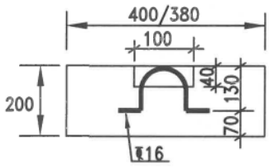
TYP DETAIL OF EACH PRECAST SLAB

NOTES:-

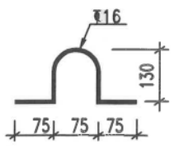
1. ALL DIMENSIONS ARE IN MILLIMETRE UNLESS OTHERWISE SPECIFIED.
2. 'H' SHALL BE AS PER GEOTECH RECOMMENDATION.
3. INLET TOWARDS RECHARGE PIT MAY BE ONE OR TWO NUMBERS.
4. LOCATION & LEVELS OF INLET & OUTLET RCC PIPE SHALL BE AS PER RELEVANT LAYOUT DRAWING(S).
5. EXACT THICKNESS OF BRICK MASONRY WALL SHALL BE AS PER LOCALLY AVAIBLE BRICKS. HERE WALL THICKNESS HAS BEEN GIVEN CONSIDERING BRICK SIZE OF 250X125X75.
6. PVC-U CASING AND SCREEN PIPES SHALL SHALL CONFORM TO IS: 12818.
7. THIS DRG. SHALL BE READ IN CONJUNCTION WITH THE SPEC. NO. 6-65-0055 (ERECTION OF TUBE WELLS.)
8. REFER STRUCTURAL GENERAL NOTES OF THE PROJECT FOR REINFORCED CONCRETE STRUCTURES FOR FOLLOWING :
   a) GRADE OF CONCRETE
   b) GRADE AND TYPE OF CEMENT
   c) REINFORCEMENT STEEL BARS
   d) CLEAR COVER IN R.C.C. WORKS.
9. BAR BENDING SHALL CONFORM TO IS:2502
10. THIS DWG. IS APPLICABLE FOR RECHARGING OF GROUND WATER TABLE BY UNCONTAMINATED RAIN WATER (ROOF TOP RAIN WATER AND RUN-OFF OF STORM WATER DRAIN ONLY).



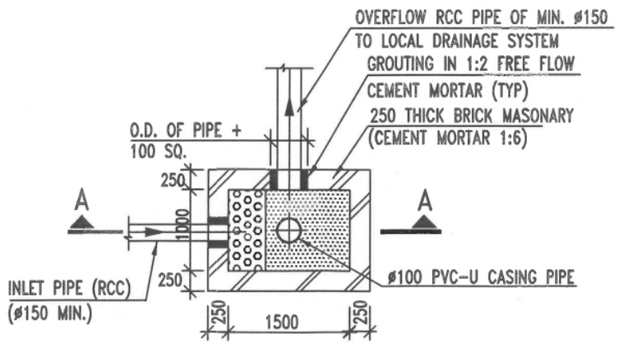
SECTION-BB



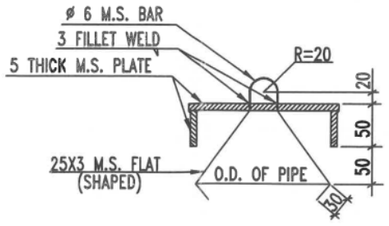
SECTION-CC



DETAIL OF LIFTING HOOK



PLAN



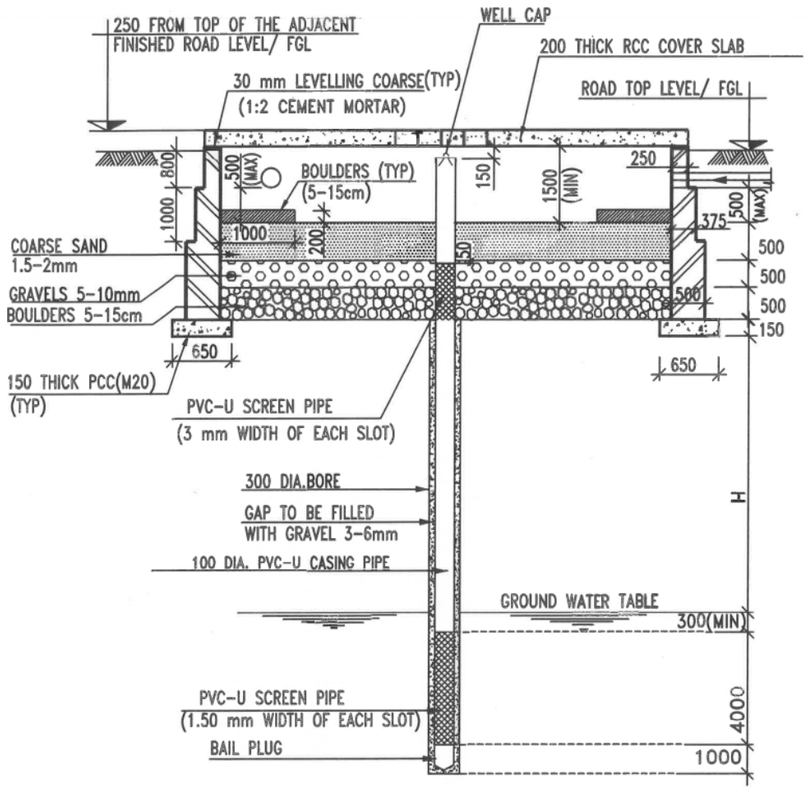
DETAIL OF WELL CAP

Rev. No.	Date	Purpose	Prepared by	Checked by	Approved by: Stds. Committee Convenor	Approved by: Stds. Bureau Chairman
4	23.06.25	REVISED & ISSUED AS STANDARD	PREETI	RKS	SKN	M. NANDI
3	20.06.18	REVISED & ISSUED AS STANDARD	MK	RKS	RS	RKT

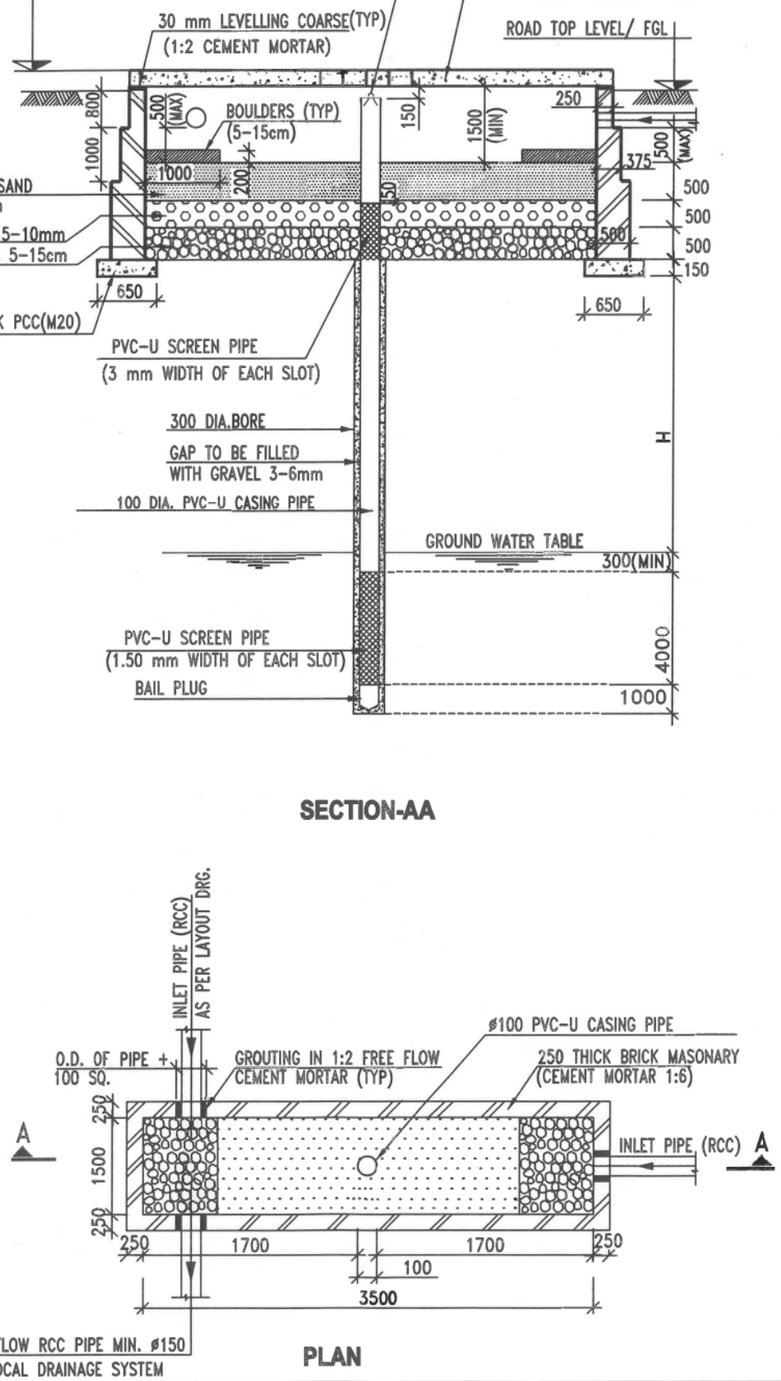
इंजीनियर्स इंडिया लिमिटेड (भारत सरकार का उपक्रम) ENGINEERS INDIA LIMITED (A Govt of India Undertaking)

DETAIL FOR RAIN WATER HARVESTING (CATCHMENT AREA ≃500 SQ.M.)

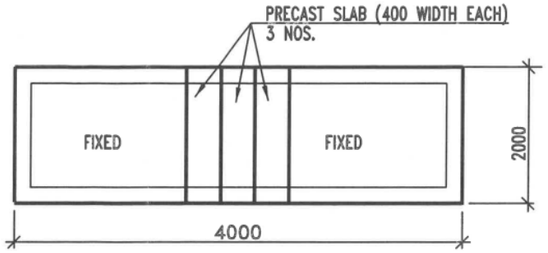
STANDARD No.
7-65-0442 Rev. 4
Page 1 of 1



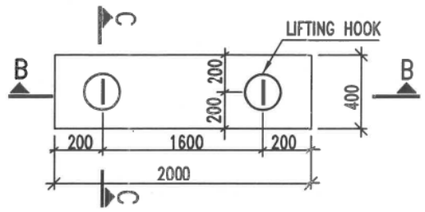
SECTION-AA



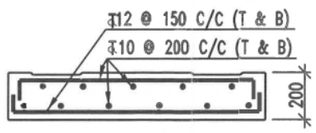
PLAN



COVER SLAB

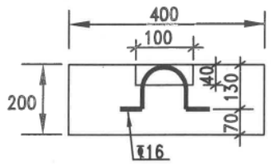


TYP DETAIL OF EACH PRECAST SLAB

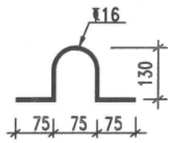


SECTION-BB

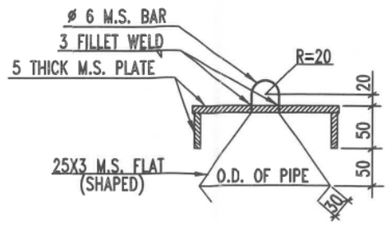
(REINFORCEMENT STEEL SHALL BE COMMON FOR BOTH FIXED & PRECAST SLAB)



SECTION-CC



DETAIL OF LIFTING HOOK



DETAIL OF WELL CAP

NOTES:-

1. ALL DIMENSIONS ARE IN MILLIMETRE UNLESS OTHERWISE SPECIFIED.
2. 'H' SHALL BE AS PER GEOTECH RECOMMENDATION.
3. INLET TOWARDS RECHARGE PIT MAY BE ONE OR TWO NUMBERS.
4. LOCATION & LEVELS OF INLET & OUTLET RCC PIPE SHALL BE AS PER RELEVANT LAYOUT DRAWING(S).
5. EXACT THICKNESS OF BRICK MASONRY WALL SHALL BE AS PER LOCALLY AVAIBLE BRICKS. HERE WALL THICKNESS HAS BEEN GIVEN CONSIDERING BRICK SIZE OF 250X125X75.
6. PVC-U CASING AND SCREEN PIPES SHALL SHALL CONFORM TO IS: 12818.
7. THIS DRG. SHALL BE READ IN CONJUNCTION WITH THE SPEC. NO. 6-65-0055 (ERECTION OF TUBE WELLS.)
8. REFER STRUCTURAL GENERAL NOTES OF THE PROJECT FOR REINFORCED CONCRETE STRUCTURES FOR FOLLOWING :
   a) GRADE OF CONCRETE
   b) GRADE AND TYPE OF CEMENT
   c) REINFORCEMENT STEEL BARS
   d) CLEAR COVER IN R.C.C. WORKS.
9. BAR BENDING SHALL CONFORM TO IS:2502
10. THIS DWG. IS APPLICABLE FOR RECHARGING OF GROUND WATER TABLE BY UNCONTAMINATED RAIN WATER (ROOF TOP RAIN WATER AND RUN-OFF OF STORM WATER DRAIN ONLY).

इंजीनियर्स इंडिया लिमिटेड (भारत सरकार का उपक्रम) ENGINEERS INDIA LIMITED (A Govt. of India Undertaking)

Rev. No.	Date	Purpose	Prepared by	Checked by	Approved by: Stds. Committee Convenor	Approved by: Stds. Bureau Chairman
4	23.06.25	REVISED & ISSUED AS STANDARD	PREETI	RKS	SKN	M. NANDI
3	20.06.18	REVISED & ISSUED AS STANDARD	MK	RKS	RS	RKT

DETAIL FOR RAIN WATER HARVESTING (CATCHMENT AREA ≃1500 SQ.M.)

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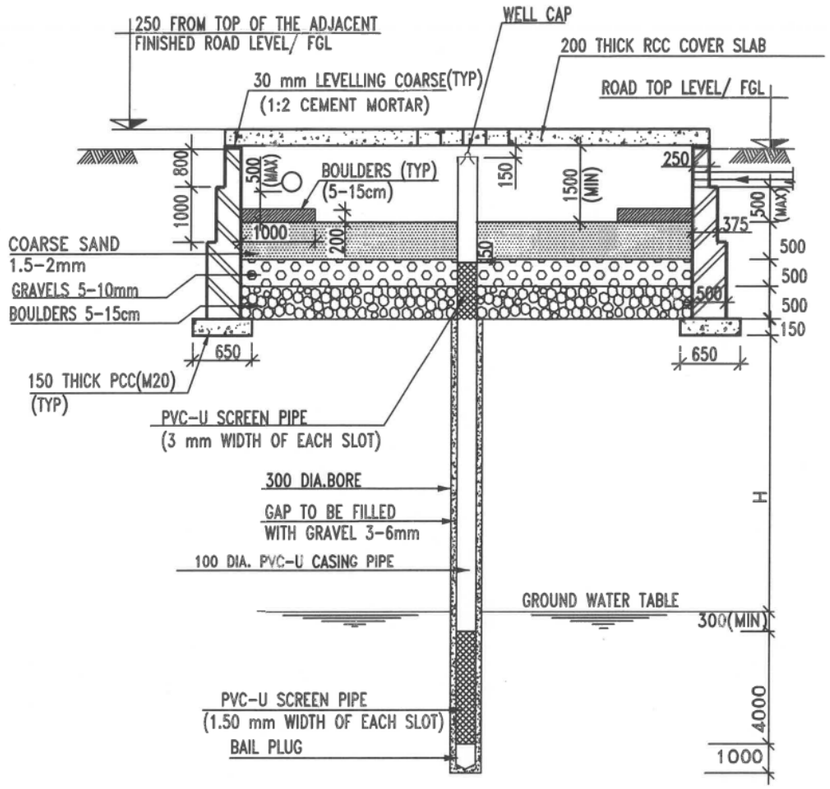
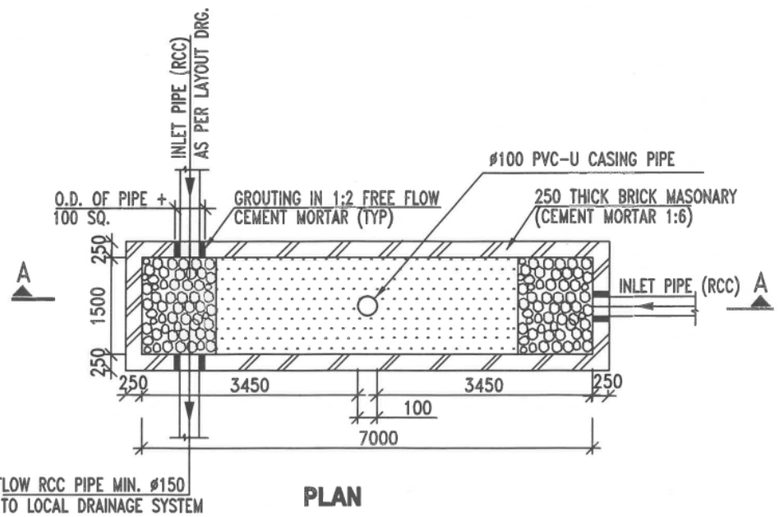
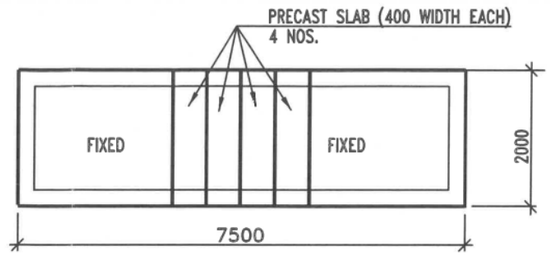


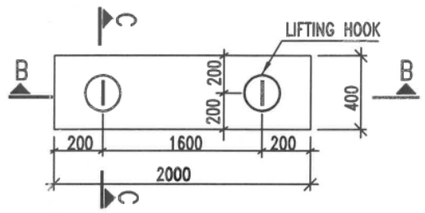
SECTION-AA



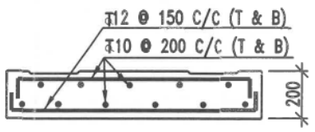
PLAN



COVER SLAB

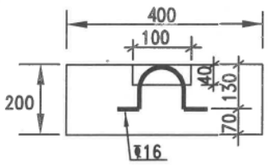


TYP DETAIL OF EACH PRECAST SLAB

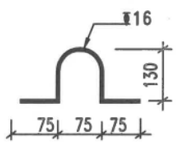


SECTION-BB

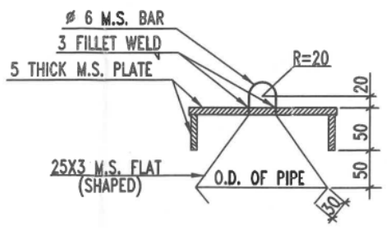
(REINFORCEMENT STEEL SHALL BE COMMON FOR BOTH FIXED & PRECAST SLAB)



SECTION-CC



DETAIL OF LIFTING HOOK



DETAIL OF WELL CAP

NOTES:-

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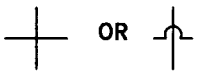
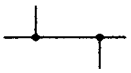
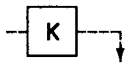
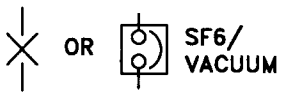
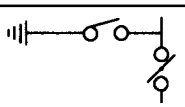
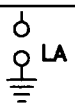
ENGINEERS INDIA LIMITED (A Govt. of India Undertaking)

Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman
					Approved by	
4	23.06.25	REVISED & ISSUED AS STANDARD	PREETI	RKS	SKN	M. NANDI
3	20.06.18	REVISED & ISSUED AS STANDARD	MK	RKS	RS	RKT

DETAIL FOR RAIN WATER HARVESTING (CATCHMENT AREA ~3000 SQ.M.)

STANDARD No.
7-65-0444 Rev. 4
Page 1 of 1

	BUS
	CROSSING OF CONDUCTORS–NOT CONNECTED
	CONNECTIONS OF CONDUCTORS
	KEY INTERLOCK, K–KEY, ARROW TERMINATES AT DEVICE
	SF6 / VACUUM CIRCUIT BREAKER
	AIR CIRCUIT BREAKER
	DRAWOUT FEATURE
	CABLE GLAND
	AIR BREAK ISOLATOR/DISCONNECT SWITCH
	OIL IMMERSED ISOLATOR/DISCONNECT SWITCH
	FUSE
	AIR CIRCUIT BREAKER WITH INHERENT RELEASES
	DOUBLE BREAK ISOLATOR
	ISOLATOR WITH EARTH SWITCH
	LIGHTNING ARRESTOR
	CONTACTOR

Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman
					Approved by	
6	01.11.21	REAFFIRMED & ISSUED AS STANDARD	JSK	VKS/HK	PG	SM
5	08.11.16	UPDATED & ISSUED AS STANDARD	BP	FA/HK	BRB	RN
4	27.06.11	REAFFIRMED & ISSUED	BP	RKS/RSC	UAP	DM

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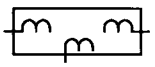
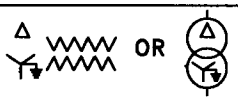
	CURRENT TRANSFORMER
	SUMMATION CT
	INTERPOSING CT
	CORE BALANCE CURRENT TRANSFORMER
	POTENTIAL TRANSFORMER
	POWER/DISTRIBUTION TRANSFORMER–DESCRIPTION AS NOTED (PRIMARY DELTA CONNECTED, SECONDARY STAR CONNECTED. STAR POINT SOLIDLY EARTHED)
	TRANSFORMER WITH OLTC
	INSTRUMENT, A– AMMETER, V– VOLTMETER, W– WATTMETER, KWH– KILOWATT HOUR METER, F– FREQUENCY METER, pf– POWER FACTOR METER, HM– HOUR RUN COUNTER MF – MULTI FUNCTION METER
	AS– AMMETER SELECTOR SWITCH, VS– VOLTMETER SELECTOR SWITCH
	FREQUENCY RECORDER
	VOLTAGE RECORDER
	TRI VECTOR METER
	INDICATING LIGHT R– RED, W– WHITE, B– BLUE, Y– YELLOW G– GREEN AND A– AMBER
	415V, 3 PHASE POWER/WELDING RECEPTACLE
	BUS DUCT
	BATTERY

Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman
6	01.11.21	REAFFIRMED & ISSUED AS STANDARD	JSK	VKS/HK	PG	SM
5	08.11.16	UPDATED & ISSUED AS STANDARD	BP	FA/HK	BRB	RN
4	27.06.11	REAFFIRMED & ISSUED	BP	RKS/RSC	UAP	DM

Approved by

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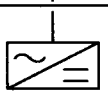
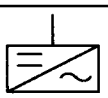
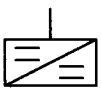
PMG	PERMANENT MAGNET GENERATOR
~ OR G	GENERATOR–DESCRIPTION AS INDICATED
M	INDUCTION MOTOR
M	SYNCHRONOUS MOTOR
	MINIATURE CIRCUIT BREAKER (MCB)
	MINIATURE CIRCUIT BREAKER WITH EARTH LEAKAGE CIRCUIT BREAKER (MCB + ELCB)
	MOULDED CASE CIRCUIT BREAKER (MCCB)
	RECTIFIER
	INVERTER
	DC – DC CONVERTER
SVR	STATIC VOLTAGE REGULATOR
AVR	AUTOMATIC VOLTAGE REGULATOR
	PUSH BUTTON STATION / LOCAL CONTROL STATION
	PUSH BUTTON STATION WITH AMMETER
	PUSH BUTTON STATION WITH INDICATING LAMP
	CAPACITOR, VARIABLE CAPACITOR

Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman
					Approved by	
6	01.11.21	REAFFIRMED & ISSUED AS STANDARD	JSK	VKS/HK	PG	SM
5	08.11.16	UPDATED & ISSUED AS STANDARD	BP	FA/HK	BRB	RN
4	27.06.11	REAFFIRMED & ISSUED	BP	RKS/RSC	UAP	DM

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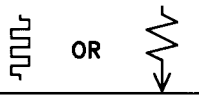
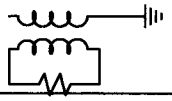
	NEUTRAL GROUNDING RESISTOR
	NEUTRAL GROUNDING TRANSFORMER
	TWO WAY SELECTOR SWITCH
	THREE WAY SELECTOR SWITCH
(2)	TIME DELAY RELAY
(21)	DISTANCE PROTECTION RELAY
(25)	CHECK SYNCHRONISING RELAY
(27)	27 – UNDER VOLTAGE RELAY 27R – RESIDUAL VOLTAGE CHECK RELAY 27M – UNDER VOLTAGE RELAY (MOTOR PROTECTION) 27C – VOLTAGE HEALTHY CHECK RELAY
(32)	REVERSE POWER RELAY
(37)	LOW FORWARD POWER RELAY
(40)	LOSS OF EXCITATION RELAY
(46)	NEGATIVE PHASE SEQUENCE RELAY
(49)	THERMAL OVERLOAD RELAY
(50)	INSTANTANEOUS OVER CURRENT RELAY
(50N)	INSTANTANEOUS EARTH FAULT RELAY

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51	IDMTL OVER CURRENT RELAY
51G	STANDBY EARTH FAULT RELAY
51N	IDMTL EARTH FAULT RELAY
51V	VOLTAGE RESTRAINED IDMTL OVER CURRENT RELAY
59	OVER VOLTAGE RELAY
60	NEUTRAL DISPLACEMENT RELAY
63TX	AUX. RELAY FOR TRANSFORMER TROUBLE/TRIP
64F	ROTOR EARTH FAULT RELAY
64G 1,2	STATOR EARTH FAULT MAIN AND BACKUP RELAY
64R	RESTRICTED EARTH FAULT RELAY
67	DIRECTIONAL OVER CURRENT RELAY
67N	DIRECTIONAL EARTH FAULT RELAY
78	OUT OF STEP RELAY
80	CONTROL SUPPLY SUPERVISION RELAY
81	UNDER FREQUENCY / df/dt RELAY
86	LOCKOUT RELAY

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87CH	CHECK DIFFERENTIAL RELAY
87F	DIFFERENTIAL RELAY F– FEEDER, G– GENERATOR, T– TRANSFORMER, M– MOTOR, GT– GENERATOR+TRAFORMER COMBINED
95	TRIP CIRCUIT SUPERVISION RELAY
97	PT MONITORING RELAY
98	DEAD BUS RELAY
99	OVERFLUXING RELAY
MPR	MOTOR PROTECTION RELAY
ELR	EARTH LEAKAGE RELAY
	THERMAL OVERLOAD RELAY

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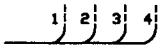
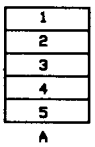
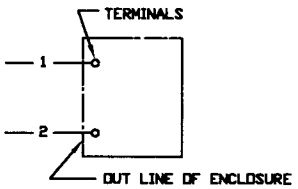
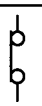
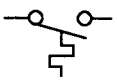
	GROUPING OF CONDUCTORS, LINE BEND INDICATES DIRECTION OF CONDUCTOR JOINING CABLE, NUMERAL INDICATES WIRE NUMBER
	TERMINAL BLOCK 'A', NUMERAL INDICATES TERMINAL NUMBER
	WIRES DESIGNATED 1 & 2 ARE CONNECTED TO TERMINALS OF AN APPARATUS
	HOOTER H – HORN S – SIREN LSP – LOUDSPEAKER
	RELAY COIL, 2 – INDICATES RELAY NUMBER
	BREAK CONTACT DELAYED BREAK
	MAKE CONTACT DELAYED MAKE
	BREAK CONTACT DELAYED MAKE
	MAKE CONTACT DELAYED BREAK
	OPEN CONTACT – THE POSITION OF THE CONTACT IN A RELAY IS SHOWN WITH COIL DE-ENERGISED
	CLOSED CONTACT – THE POSITION OF THE CONTACT IN A RELAY IS SHOWN WITH COIL DE-ENERGISED
	MOTOR, 3 PHASE
	NORMALLY OPEN
	NORMALLY CLOSED

TEMPERATURE ACTUATED SWITCH

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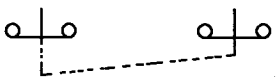
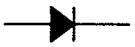
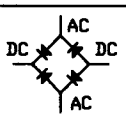
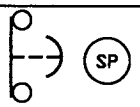
	HELD CLOSE	LIMIT SWITCH
	HELD OPEN	
	NORMALLY OPEN (OPEN ON LOW PRESSURE)	VACUUM/ PRESSURE SWITCH
	NORMALLY CLOSE (CLOSED ON LOW PRESSURE)	
	PUSH BUTTON – CLOSING, SINGLE CIRCUIT, MOMENTARY OR SPRING RETURN	
	PUSH BUTTON – OPENING, SINGLE CIRCUIT, MOMENTARY OR SPRING RETURN	
	PUSH BUTTON, TWO CIRCUIT, MOMENTARY OR SPRING RETURN	
	PUSH BUTTON, TWO CIRCUIT, MAINTAINED OR NON–SPRING RETURN	
	SEMICONDUCTOR DIODE	
	SILICON CONTROL RECTIFIER	
	FULL WAVE RECTIFIER	
	FUSE	
	EMERGENCY STOP (MUSHROOM HEAD)	
	STAY PUT EMERGENCY STOP (MUSHROOM HEAD) PUSH BUTTON WITH RESETTING FEATURE	
	EARTH CONNECTION	

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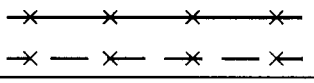
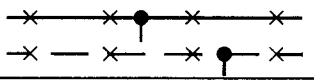
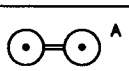
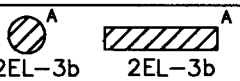
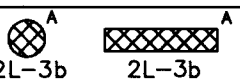
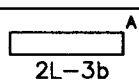
	EARTH CONDUCTOR–EXPOSED EARTH CONDUCTOR–BURIED SIZE AS SHOWN OR SPECIFIED ON PLANS
	EARTH STRIP / WIRE TAP, SIZE AS SHOWN OR SPECIFIED ON PLANS
	EARTH ELECTRODE IN TEST PIT
	DIRECTLY BURIED EARTH ELECTRODE
	EARTH PLATE
	LIGHTNING ARRESTOR
	POLE MOUNTED LIGHTING FIXTURE (IN ELEVATION)
	LIGHTING FIXTURE (IN ELEVATION)
A 2L–3b	CEILING MOUNTED LIGHTING FIXTURE
A 2L–3b	BRACKET MOUNTED LIGHTING FIXTURE
A 2L–3b	POLE MOUNTED LIGHTING FIXTURE
A 2L–3b	POLE MOUNTED STREET LIGHTING FIXTURE
A 2L–3b	POLE MOUNTED FLOOD LIGHTING FIXTURE
 A	DOUBLE OBSTRUCTION AVIATION LIGHTING FIXTURE
 A A 2EL–3b 2EL–3b	EMERGENCY LIGHTING FIXTURE
 A A 2L–3b 2L–3b	CRITICAL LIGHTING FIXTURE
 A 2L–3b	FLUORESCENT FIXTURE
	A – FIXTURE TYPE (AS PER DATASHEET FOR LIGHTING FIXTURE SCHEDULE) 2L – LIGHTING PANEL NO. 2, 3 – CIRCUIT NO., b – CONTROLLING SIWTCH
LP–2L 	LP – LIGHTING PANEL 2L – LIGHTING PANEL NO.
PP–2P 	PP – POWER PANEL 2P – POWER PANEL NO.
ELP–2L 	ELP – EMERGENCY LIGHTING PANEL 2EL – EMERGENCY LIGHTING PANEL NO.

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MDB–501	MDB – MAIN DISTRIBUTION BOARD MDB–501 – MAIN DISTRIBUTION BOARD NO.
FLM–1	FLOOD LIGHT MAST–LATTICE STRUCTURE FLM–1 – FLOOD LIGHT MAST NO.
HM–1	HM – HIGH MAST HM–1 – HIGH MAST NO.
2e	5A, 240V SINGLE POLE SWITCH 2 – CIRCUIT NO., e – SWITCH NUMBER
	5A, 240V DOUBLE POLE SWITCH
	5A, 240V SINGLE POLE 2 WAY SWITCH
	15A, 240V SINGLE POLE SWITCH
	20A, DP MCB UNIT FOR WINDOW TYPE AC
	CEILING FAN
	AIR CIRCULATOR
	EXHAUST FAN
	5A, 240V, 3/5 PIN SOCKET/RECEPTACLE
	15/5A, 240V, 6 PIN SOCKET/RECEPTACLE
	10A, 240V, 3 PIN INDUSTRIAL TYPE SOCKET/RECEPTACLE
	20A, 240V, 3 PIN INDUSTRIAL TYPE SOCKET/RECEPTACLE
	5A, 24V, 3 PIN SOCKET/RECEPTALE
	15A, 240V, 3 PIN SOCKET /RECEPTACLE
	415V, 3 PHASE POWER/WELDING RECEPTACLE
	PUSH BUTTON STATION
	LIGHTING JUNCTION BOX (3WAY)
	LIGHTING JUNCTION BOX (4WAY)

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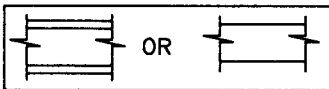
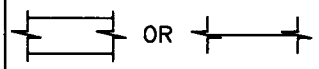
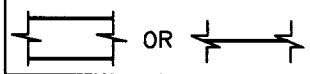
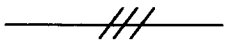
 OR	LINED (RCC) CABLE TRENCH
 OR	DIRECTLY BURIED CABLE TRENCH
 OR	CABLE TRAY
ERC–1	ERC – ELECTRICAL ROAD CROSSING ERC–1 – ELECTRICAL ROAD CROSSING NO.
SCRC–1	SCRC – STREET LIGHTING AND COMMUNICATION/FIRE ALARM CABLES ROAD CROSSING SCRC–1 – STREET LIGHTING AND COMMUNICATION/FIRE ALARM CABLES ROAD CROSSING NO.
	CONDUIT / CABLE RUN EXPOSED
	CONDUIT / CABLE RUN CONCEALED OR EMBEDDED
	CONDUIT / CABLE BEND UP
	CONDUIT / CABLE BEND–DOWN
	CONDUIT RUN, NUMBER OF OBLIQUE LINES INDICATING NUMBER OF WIRES
	HOME RUN OF CIRCUIT TO PANEL/DISTRIBUTION BOX/JUNCTION BOX
LS	LIMIT SWITCH
VS	VIBRATION SWITCH
FC	MULTISENSOR FIRE ALARM DETECTOR FC – FALSE CEILING, TC – TRUE CEILING, FF – FALSE FLOORING
R	RESPONSE INDICATOR
BG	MANUAL BREAK GLASS UNIT
H	HOOTER H – HORN LSP – LOUDSPEAKER S – SIREN
FAJB	JUNCTION BOX FAJB – FIRE ALARM JUNCTION BOX TJB – TELEPHONE JUNCTION BOX PAJB – PLANT COMMUNICATION JUNCTION BOX
EXIT	EXIT SIGN
	END OF LINE RESISTANCE
	TELEPHONE

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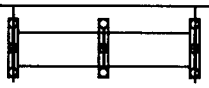
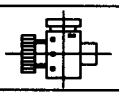
	2 PIN SOCKET FOR TELEPHONE
	CIRCUIT BREAKER (SWITCHYARD)
	ISOLATOR (SWITCHYARD)
	GANTRY (SWITCHYARD)
	TRANSFORMER (SWITCHYARD)
	POTENTIAL TRANSFORMER (SWITCHYARD)
	CURRENT TRANSFORMER (SWITCHYARD)
	LIGHTNING ARRESTOR (SWITCHYARD)

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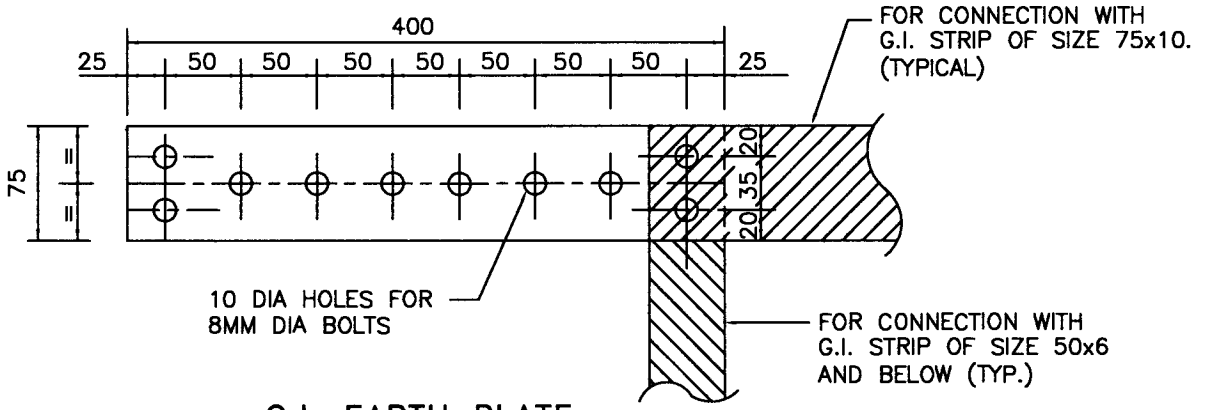
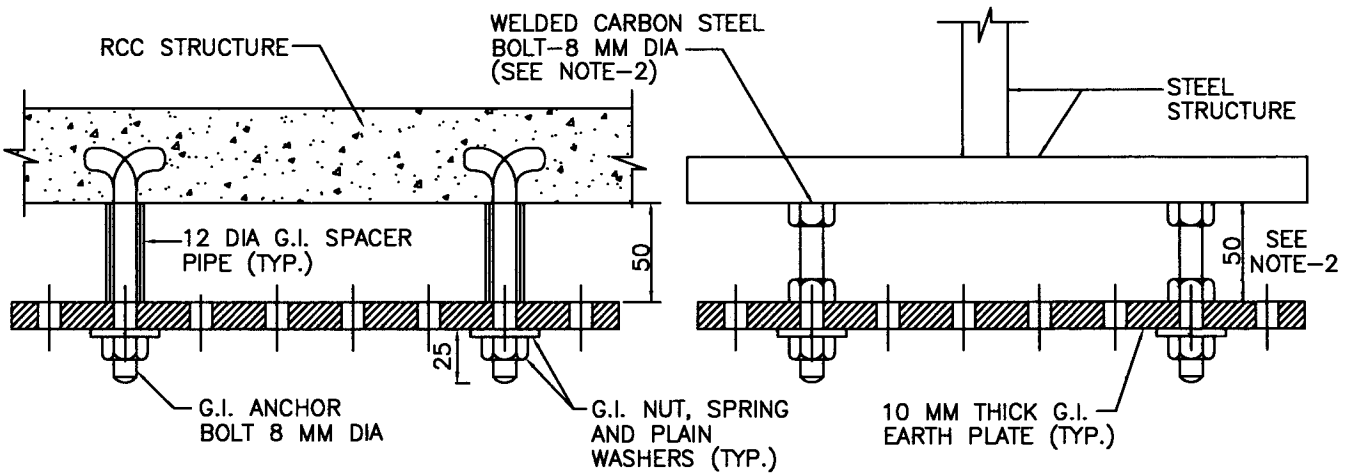
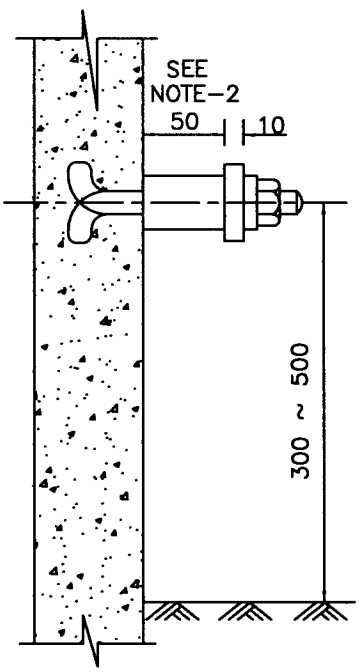
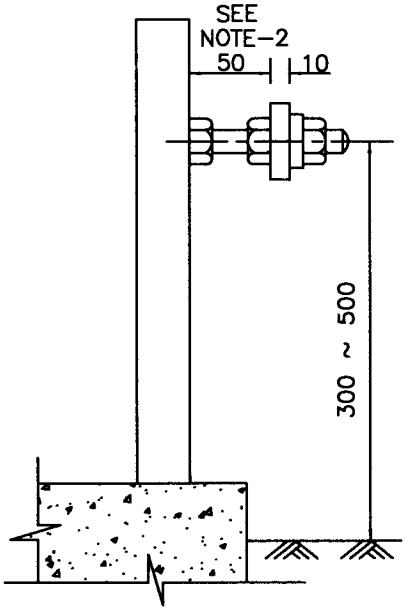


G.I. EARTH PLATE

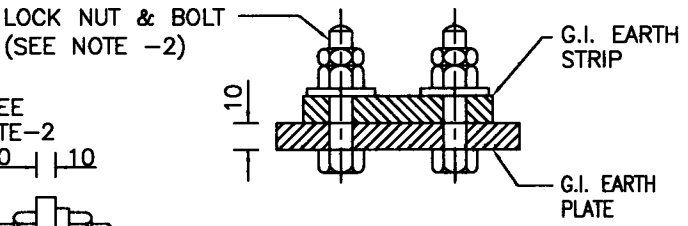




TYPICAL INSTALLATION OF EARTH PLATE ON R.C.C. STRUCTURES



TYPICAL INSTALLATION OF EARTH PLATE ON STEEL STRUCTURES



TYPICAL FIXING DETAIL OF G.I. EARTH STRIP TO EARTH PLATE

NOTES:–

1. ALL DIMENSIONS ARE IN MM.
2. WHERE FIRE PROOFING OF STEEL STRUCTURES ARE ENCOUNTERED LENGTH OF CARBON STEEL BOLTS SHALL BE SUITABLY INCREASED FOR FIXING OF EARTH PLATE.
3. ALL CONNECTIONS WITH EARTH PLATE SHALL BE MADE WITH 8MM DIA. G.I. BOLT, NUT, SPRING AND PLAIN WASHERS.
4. CRIMP TYPE CABLE LUGS SHALL BE USED FOR CONNECTION WITH G.I. WIRE ROPE/CU/AL CABLES.

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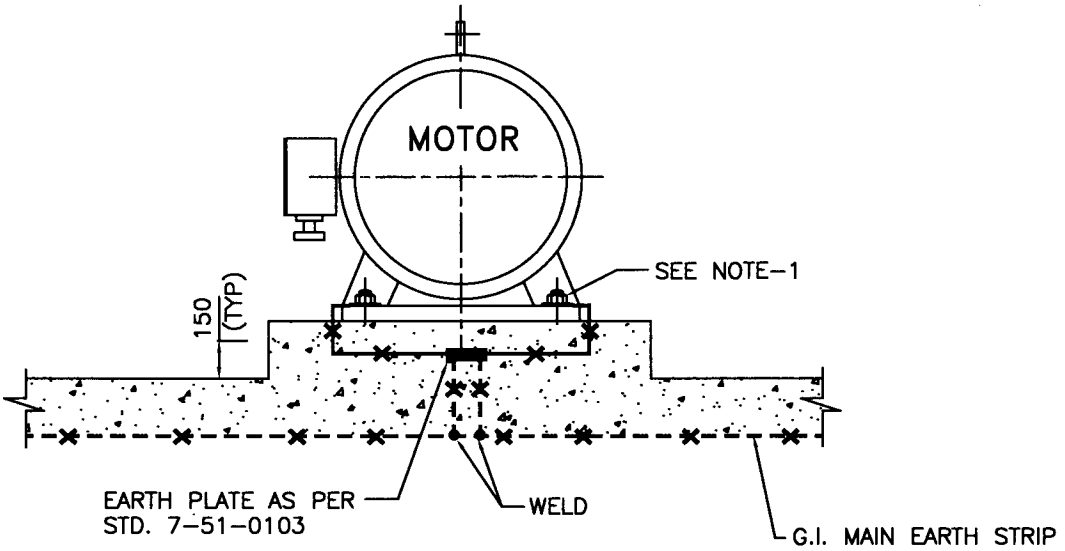
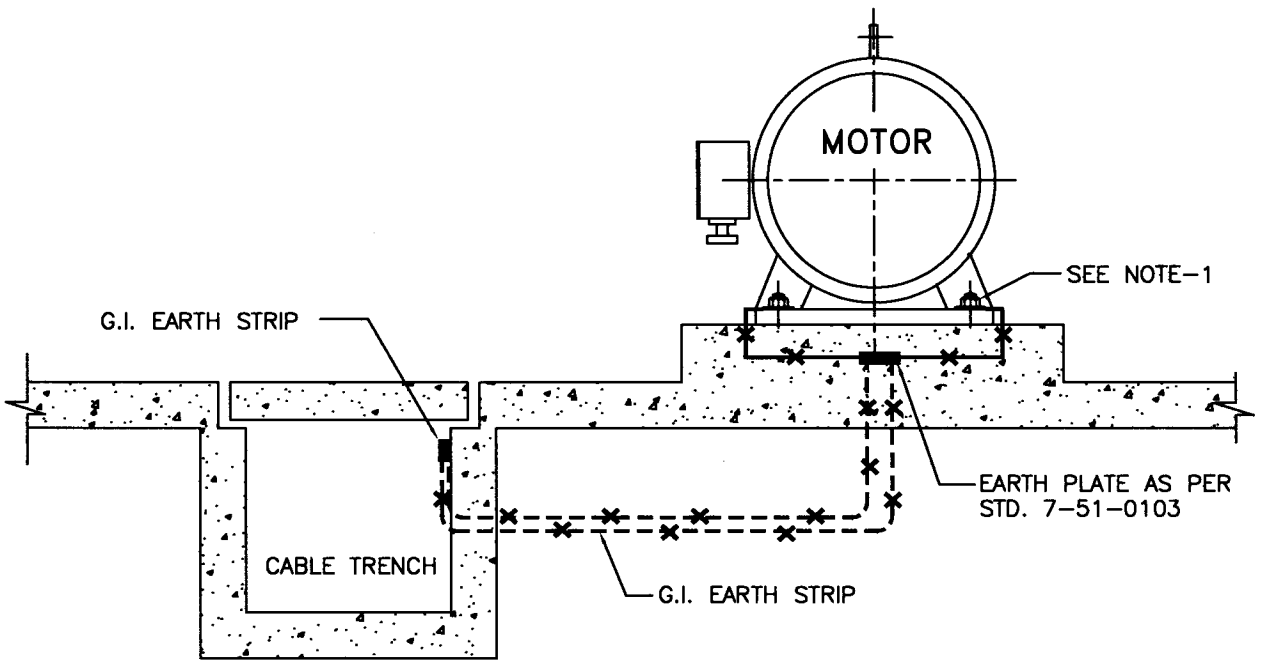


DETAIL–1
CONNECTION WITH BURIED EARTH GRID



DETAIL–2
CONNECTION WITH EARTH GRID IN RCC TRENCH

NOTE:–

1. MOTOR FOUNDATION BOLT SHALL NOT BE USED FOR EARTHING.
2. EARTHING OF P.B. STN. INSTALLED NEAR MOTOR FOUNDATION SHALL BE DONE BY TAPPING 8 SWG G.I. WIRE FROM EARTH PLATE.

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4	27.06.11	REAFFIRMED & ISSUED	BP	RKS/RSC	UAP	DM

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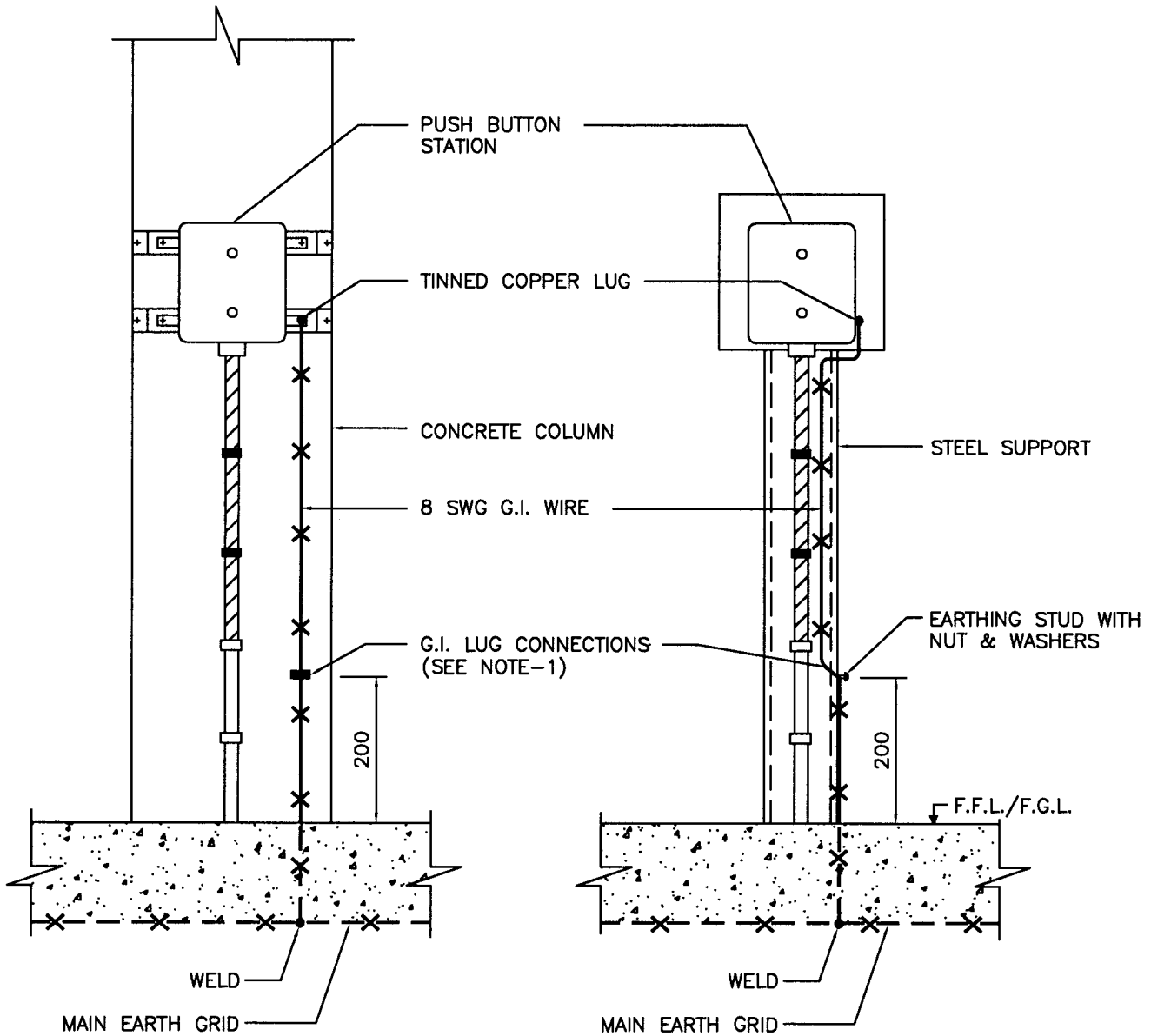

NOTES:-

1. ALTERNATIVELY, CONNECTION SHALL BE TAKEN FROM THE NEAREST AVAILABLE EARTH PLATE.

Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman
6	29.11.21	REAFFIRMED & ISSUED AS STANDARD	JSK	VKS/HK	PG	SM
5	08.11.16	REAFFIRMED & ISSUED	BP	FA/HK	BRB	RN
4	27.06.11	REAFFIRMED & ISSUED	BP	RKS/RSC	UAP	DM

Approved by

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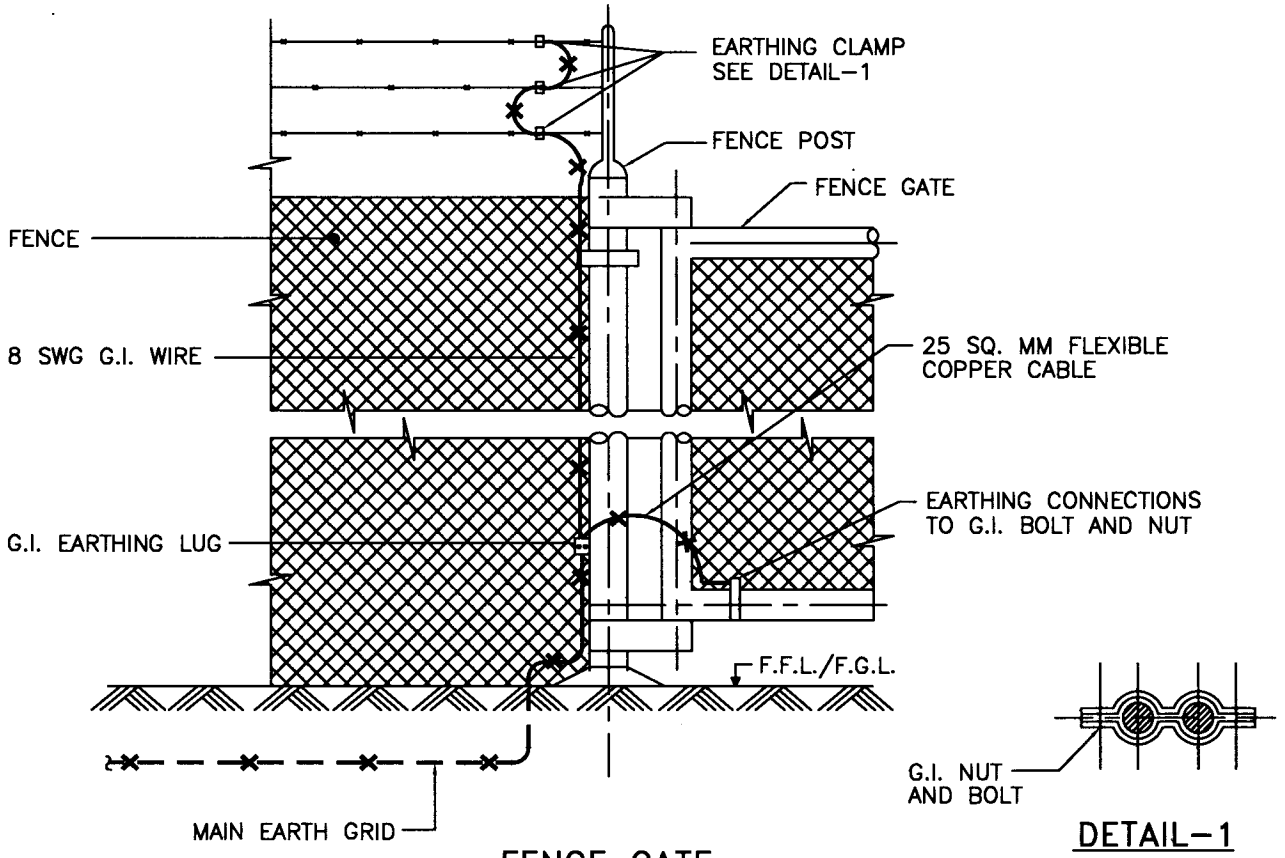
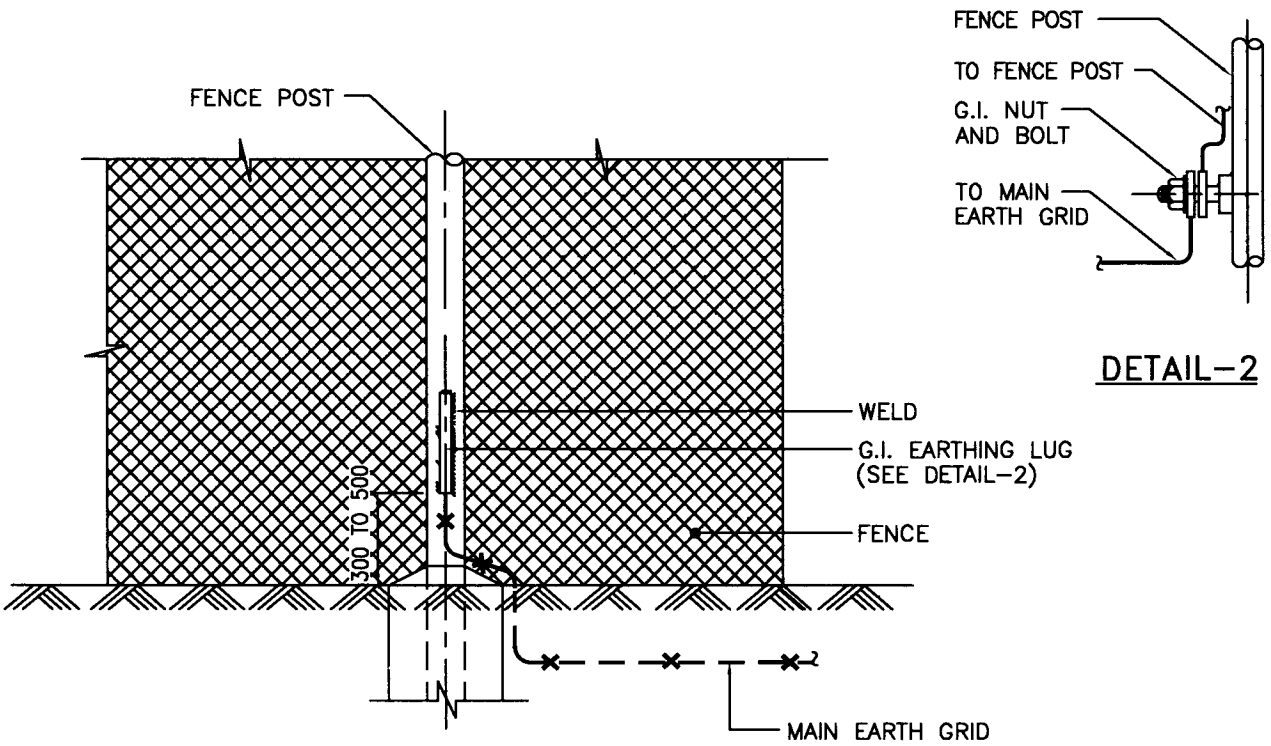


FENCE GATE

DETAIL–1



DETAIL–2

FENCE POST

Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman
					Approved by	
6	01.11.21	REAFFIRMED & ISSUED AS STANDARD	JSK	VKS/HK	PG	SM
5	08.11.16	REAFFIRMED & ISSUED	BP	FA/HK	BRB	RN
4	27.06.11	REAFFIRMED & ISSUED	BP	RKS/RSC	UAP	DM

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TYPE OF EQUIPMENT	EARTH CONDUCTOR SIZE (SEE NOTE-1)
LV MOTORS UPTO 3.7KW	8 SWG SOLID G.I. WIRE
LV MOTORS FROM 5.5KW TO 30KW & WELDING RECEPTACLES	10 MM (3/8") DIA G.I. WIRE ROPE
LV MOTORS ABOVE 30KW INCLUDING MV MOTORS	16 MM (5/8") DIA G.I. WIRE ROPE/ 40x5 MM G.I. STRIP
BUILDING COLUMNS	40 x 5 G.I. STRIP
STORAGE TANKS (VERTICAL & HORIZONTAL)	40 x 5 G.I. STRIP
LOADING RACKS	40 x 5 G.I. STRIP
VESSELS & HEAT EXCHANGERS	40 x 5 G.I. STRIP
SMALL EQUIPMENT & INSTRUMENTS	8 SWG SOLID G.I. WIRE
LIGHTING, POWER & INSTRUMENT PANELS	10 MM (3/8") DIA G.I. WIRE ROPE
MAIN EARTH BUS / LV, MV, HV & EHV SWITCH GEAR INTERCONNECTIONS/ POWER TRANSFORMER	AS SPECIFIED
EHV, HV & MV SUB-STATIONS	AS SPECIFIED
PUSH BUTTON STATIONS	8 SWG SOLID G.I. WIRE
STREET LIGHT POLES	10 MM (3/8") DIA G.I. WIRE ROPE
LIGHTING TRANSFORMER	16 MM (5/8") DIA G.I. WIRE ROPE
PIPE RACK	40 X 5 G.I. STRIP
BONDING OF PIPE	25 SQ. MM INSULATED FLEXIBLE CU. CABLE
LIGHTNING PROTECTION	25 X 3 MM G.I. EARTH STRIP
CABLE TRAYS	40 X 5 G.I. STRIP

Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman
9	31.07.24	UPDATED AND ISSUED AS STANDARD	SKC	SKS/HK	MKS	MN
8	01.11.21	UPDATED AND ISSUED AS STANDARD	JSK	VKS/HK	PG	SM
7	08.11.16	REVISED AND ISSUED AS STANDARD	BP	FA/HK	BRB	RN

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TYPE OF EQUIPMENT	ALUMINUM CABLE (SEE NOTE-1&2)	COPPER CABLE (SEE NOTE-1&2)
LV MOTORS UPTO 3.7KW	16 SQ MM	10 SQ MM
LV MOTORS FROM 5.5KW TO 30KW	16 SQ MM	10 SQ MM
LV MOTORS ABOVE 30KW TO 55KW	25 SQ MM	16 SQ MM
LV MOTORS ABOVE 55KW TO 160KW	70 SQ MM	50 SQ MM
MV MOTORS	120 SQ MM	95 SQ MM
STORAGE TANKS (VERTICAL & HORIZONTAL)	70 SQ MM	50 SQ MM
VESSELS & HEAT EXCHANGERS	25 SQ MM	16 SQ MM
LIGHTING, POWER & INSTRUMENT PANELS	10 SQ MM	10 SQ MM
PUSH BUTTON STATIONS	10 SQ MM	10 SQ MM
STREET LIGHT POLES & FLOOD LIGHT MAST	16 SQ MM	10 SQ MM
PIPE RACK	25 SQ MM	16 SQ MM
WELDING RECEPTACLES	25 SQ MM	16 SQ MM

NOTE:-

1. TYPE OF EARTH CONNECTIONS TO INDIVIDUAL EQUIPMENT (I.E. WIRE ROPE / STRIP OR CABLE) FROM NEAREST EARTH PLATE / GRID SHALL BE SELECTED AS SPECIFIED ELSEWHERE. CABLE/WIRE ROPE CONNECTIONS SHALL BE MADE USING CRIMP TYPE OF LUGS.

2. EARTHING CABLE SHALL BE SINGLE CORE PVC INSULATED GREEN COLOR/GREEN WITH YELLOW COLOR STRIPE OUTER SHEATH.

Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman
9	31.07.24	UPDATED AND ISSUED AS STANDARD	SKC	SKS/HK	MKS	MN
8	01.11.21	UPDATED AND ISSUED AS STANDARD	JSK	VKS/HK	PG	SM
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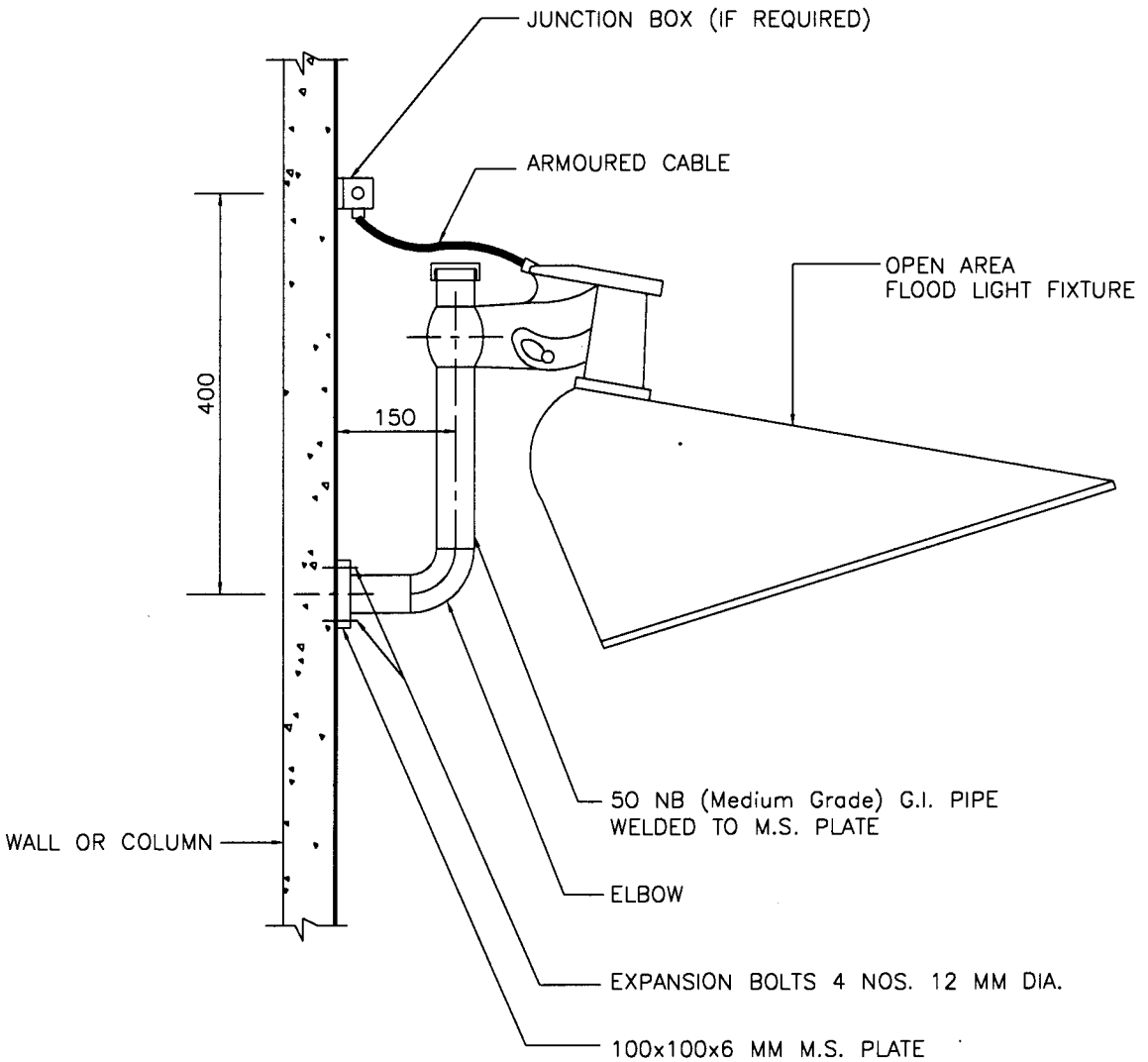

NOTES:–

1. ALL DIMENSIONS ARE IN MM.

Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman
					Approved by	
6	29.09.20	UPDATED & ISSUED AS STANDARD	JSK	VKS/HK	SA	SM
5	10.07.17	REAFFIRMED & ISSUED AS STANDARD	BP	FA/HK	BRB	RN

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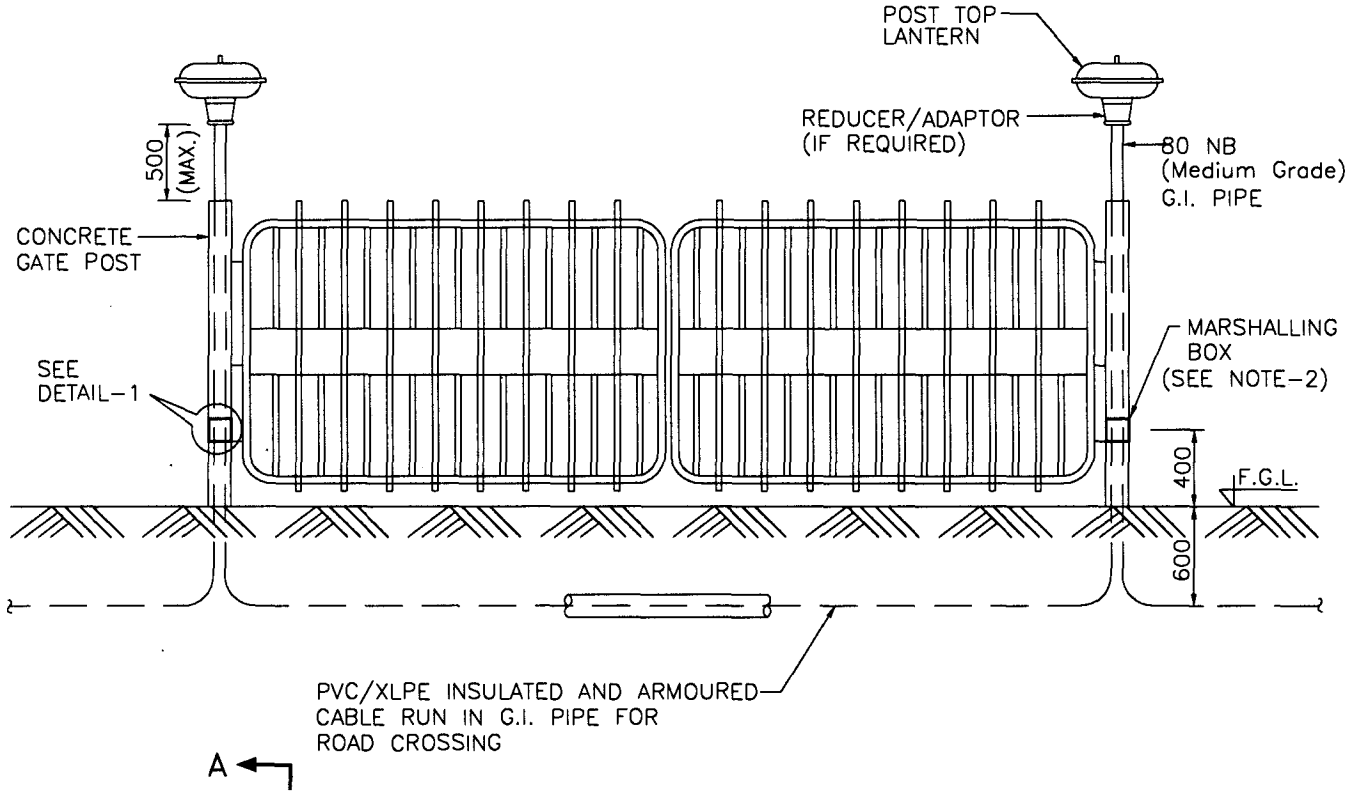
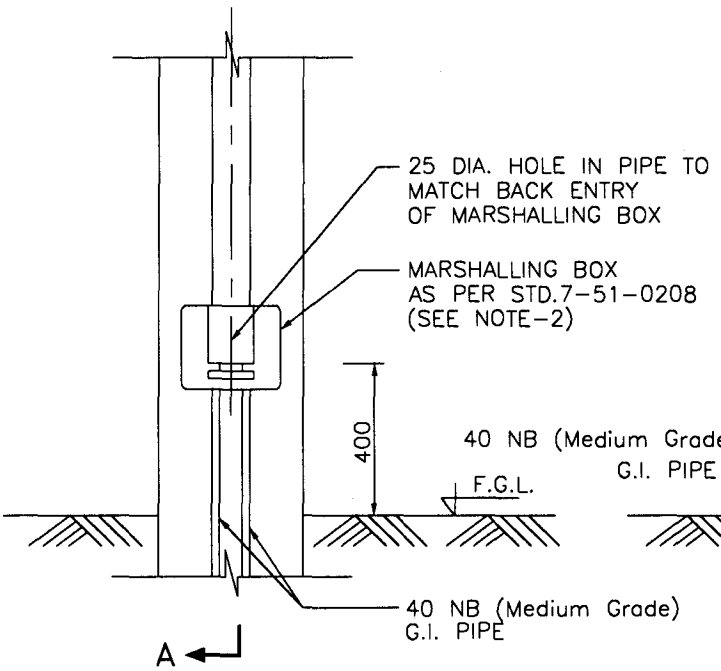
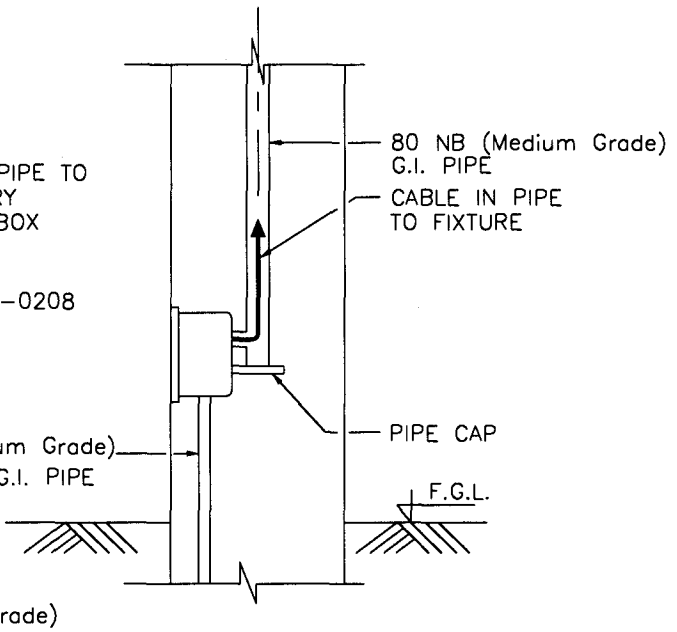




DETAIL-1



SECTION A-A

NOTES:-

1. ALL DIMENSIONS ARE IN MM.
2. USE WEATHER PROTECTED SINGLE PHASE JUNCTION BOX IN PLACE OF MARSHALLING BOX IF SUPPLY IS SINGLE PHASE.
3. ALL G.I. PIPES SHALL BE MEDIUM GRADE.

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6	29.09.20	UPDATED & ISSUED AS STANDARD	JSK	VKS/HK	SA	SM
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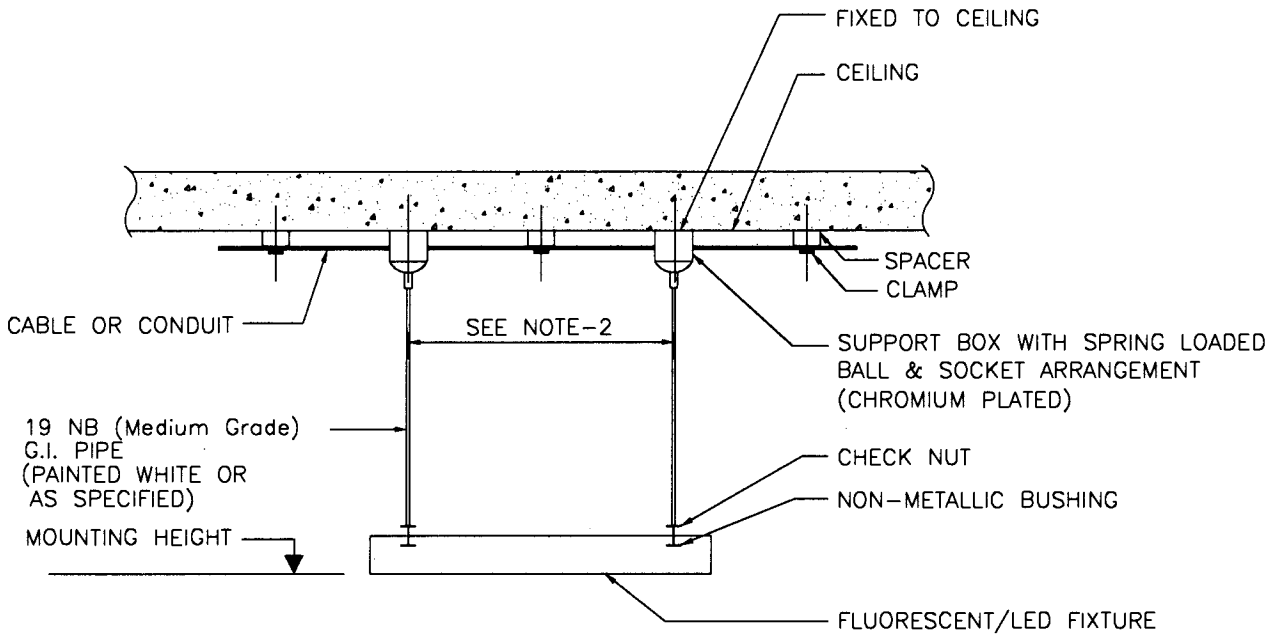
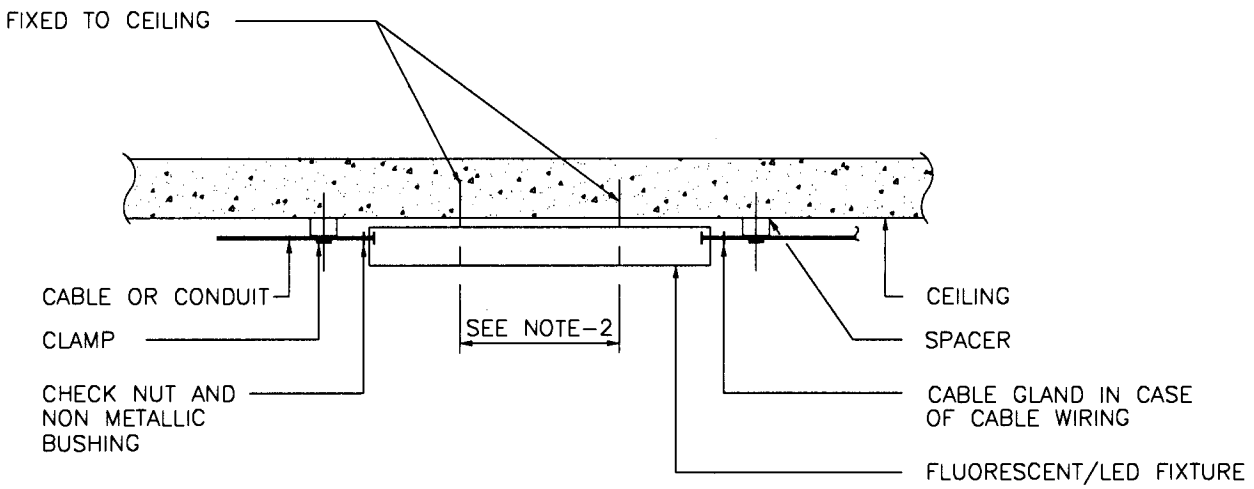


DETAIL-1
SUSPENSION MOUNTING



DETAIL-2
CEILING MOUNTING

NOTES:-

1. ALL DIMENSIONS ARE IN MM.
2. SUSPENSION/FIXING CENTRES SHALL BE AS PER FIXTURE MANUFACTURER'S DETAILS.
3. IN CASE OF CABLE WIRING ONE NO. JUNCTION BOX COMPLETE WITH CABLE GLANDS SHALL BE PROVIDED NEAR EACH FIXTURE.

Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman
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6	29.09.20	UPDATED & ISSUED AS STANDARD	JSK	VKS/HK	SA	SM
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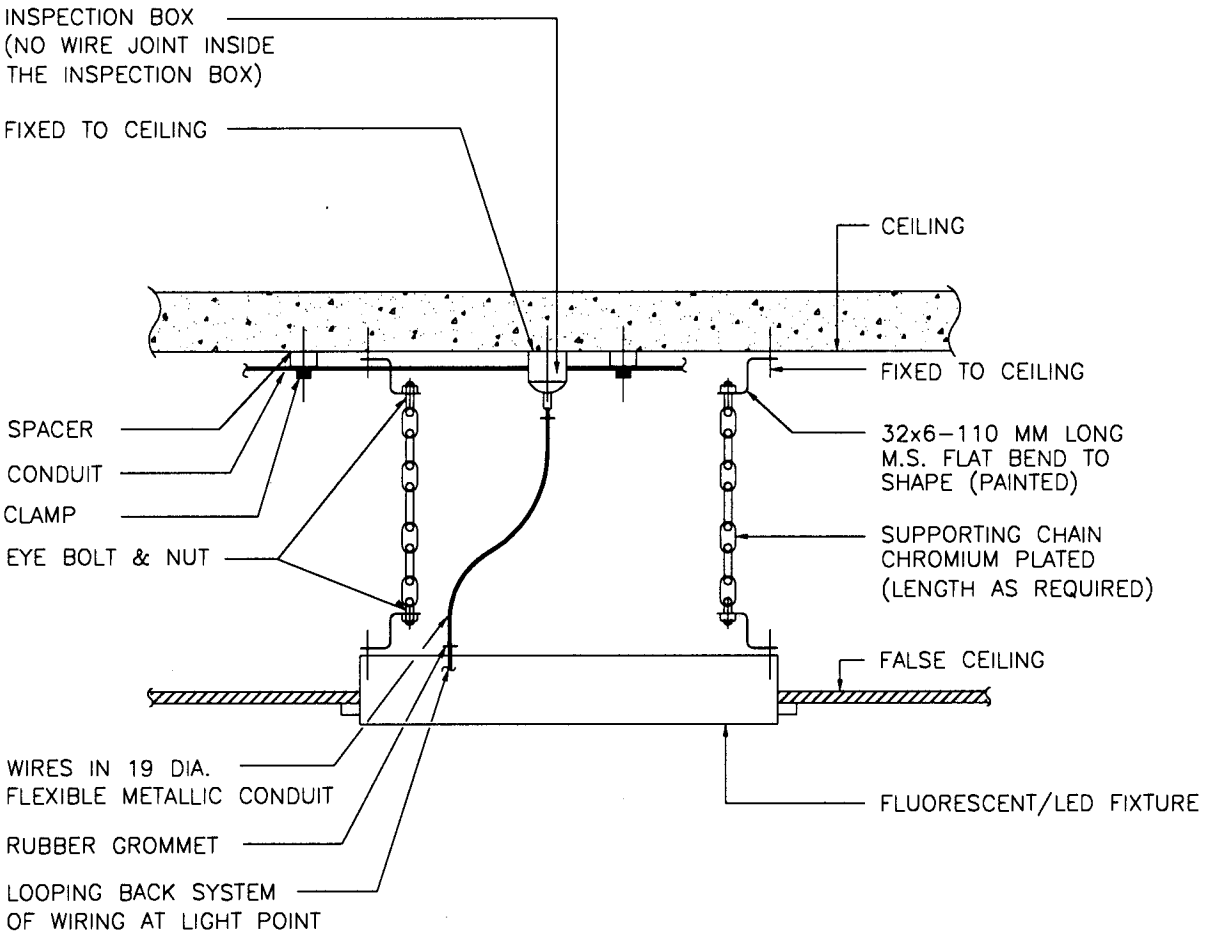

MOUNTING ARRANGEMENT WITH CHAIN SUPPORT

NOTES:–

1. ALL DIMENSIONS ARE IN MM.

Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman
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6	29.09.20	UPDATED & ISSUED AS STANDARD	JSK	VKS/HK	SA	SM
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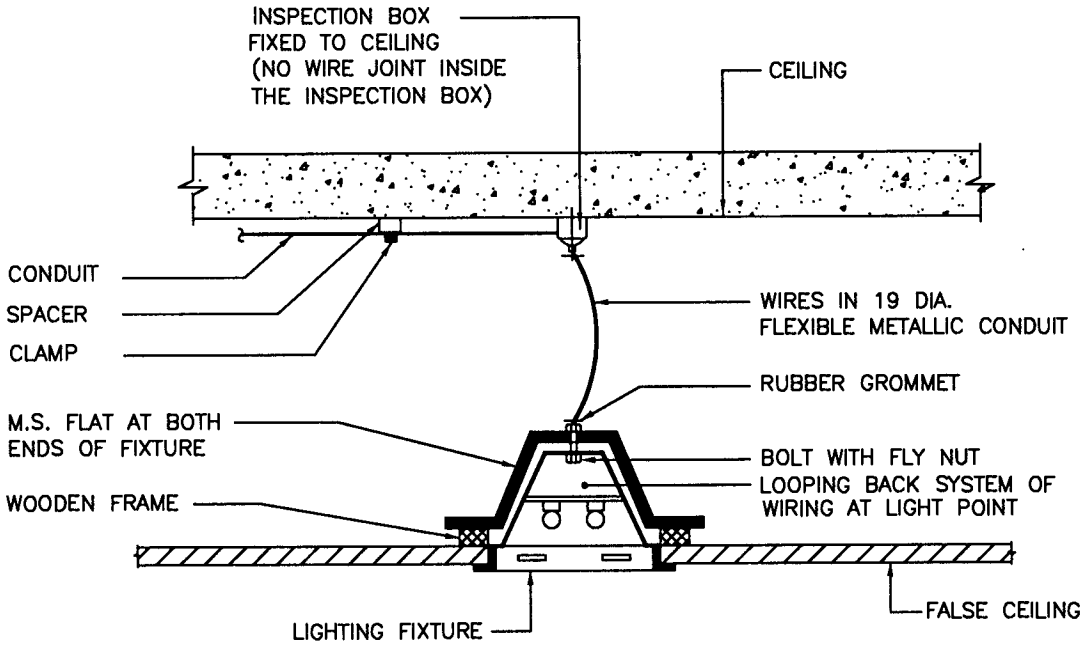
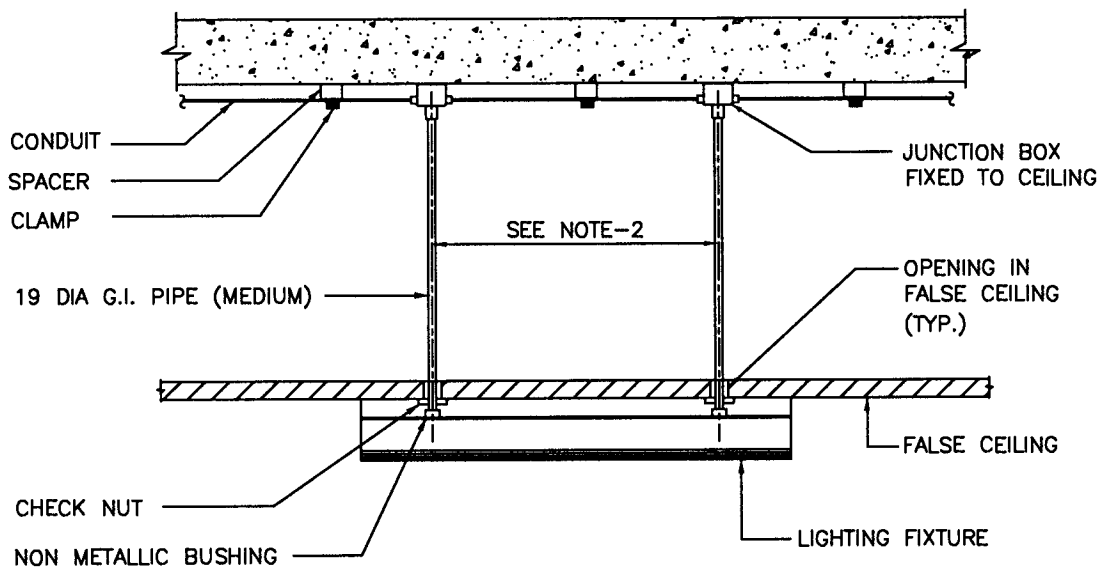


DETAIL–1
RECESS MOUNTED FIXTURE SUPPORTED ON WOODEN FRAME



DETAIL–2
FIXTURE MOUNTING BELOW FALSE CEILING

NOTES:–

1. ALL DIMENSIONS ARE IN MM.
2. SUSPENSION/FIXING CENTRES SHALL BE AS PER FIXTURE MANUFACTURER'S DETAILS.

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					Approved by	
6	29.11.21	REAFFIRMED & ISSUED AS STANDARD	JSK	VKS/HK	PG	SM
5	21.10.16	REVISED & ISSUED AS STANDARD	BP	FA/HK	BRB	RN
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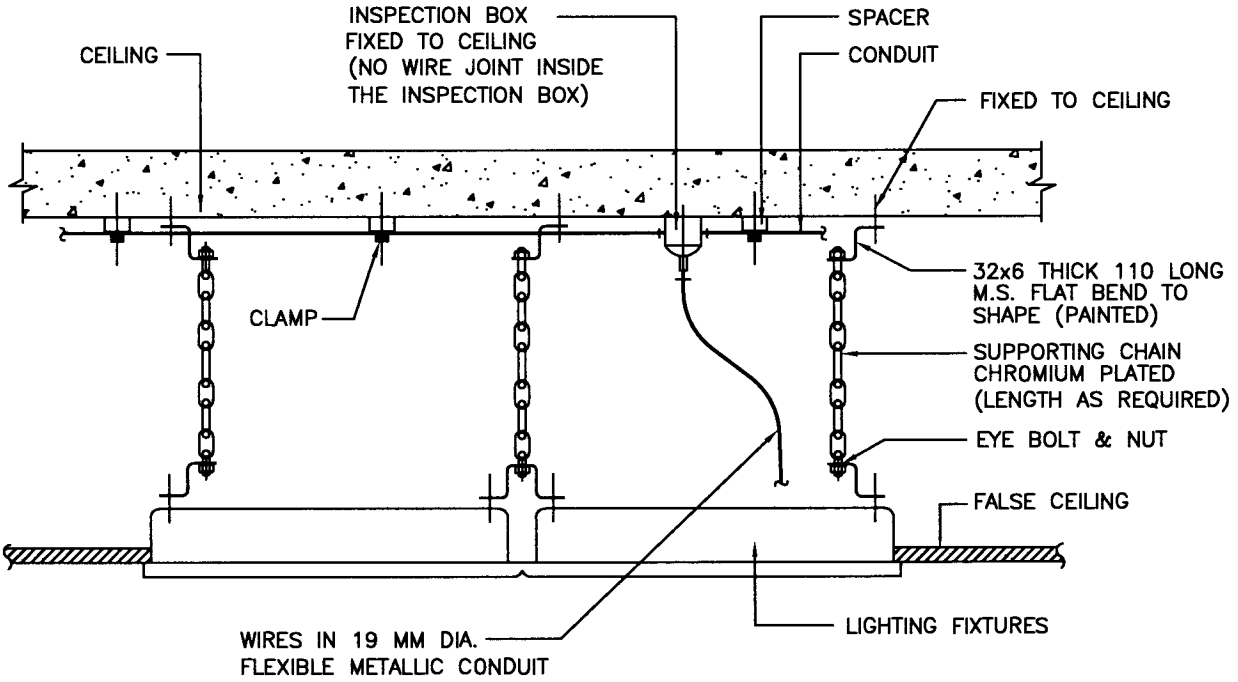

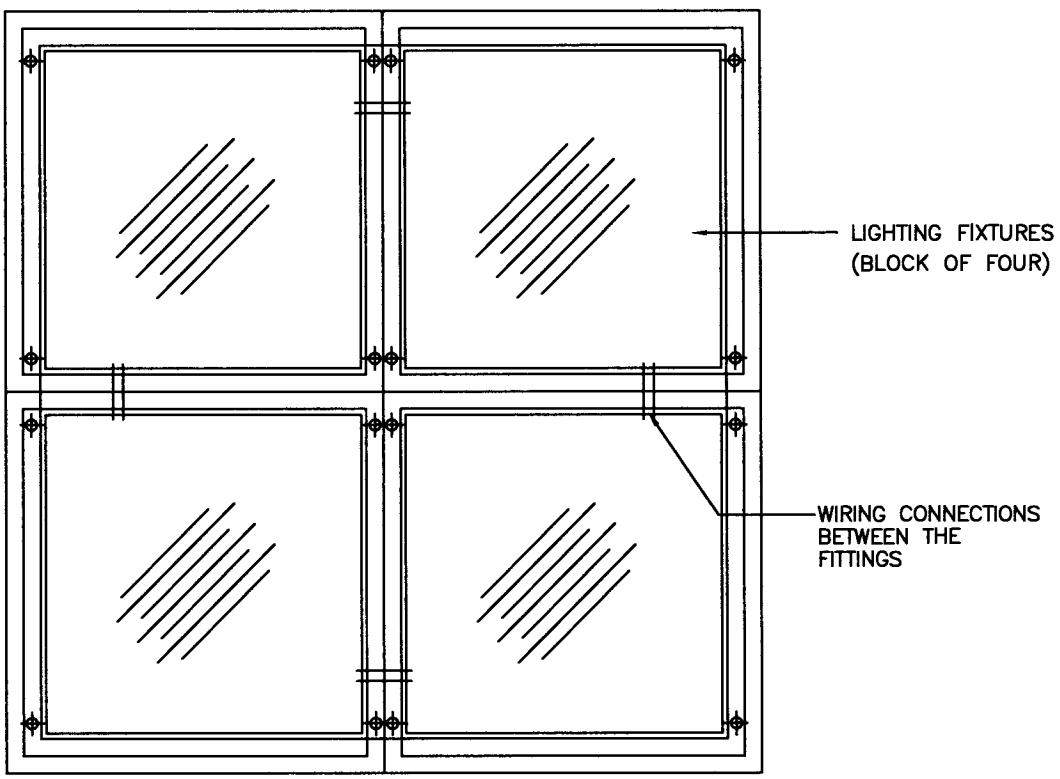

NOTES:–

1. ALL DIMENSIONS ARE IN MM.
2. SUSPENSION/FIXING CENTRES SHALL BE AS PER FIXTURE MANUFACTURER'S DETAILS.

Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman
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6	01.11.21	REAFFIRMED & ISSUED AS STANDARD	JSK	VKS/HK	PG	SM
5	21.10.16	REVISED & ISSUED AS STANDARD	BP	FA/HK	BRB	RN
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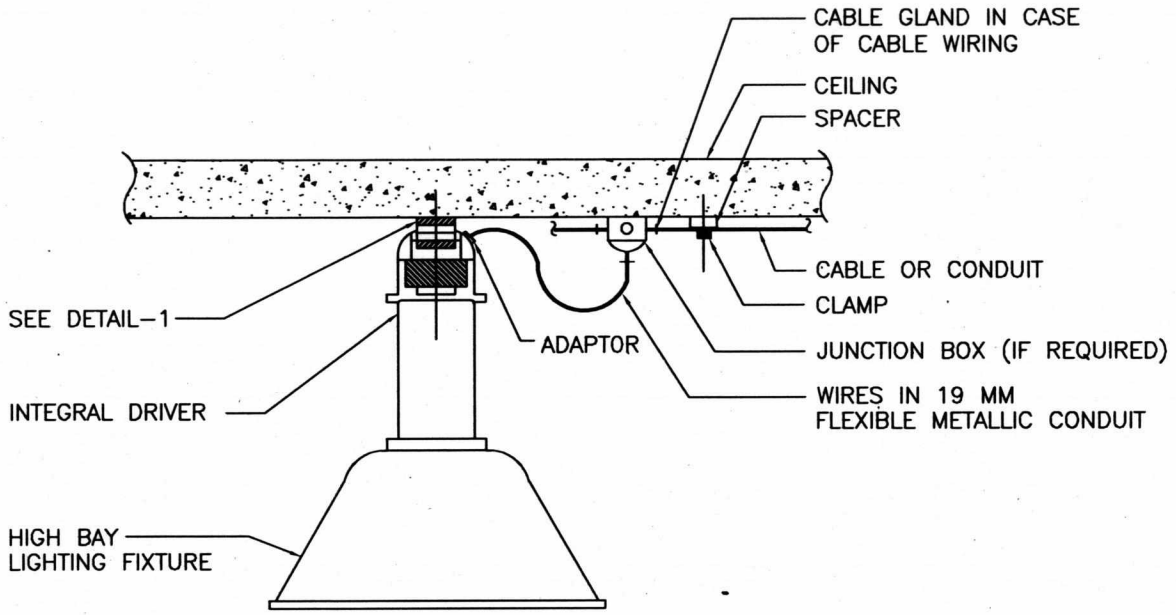

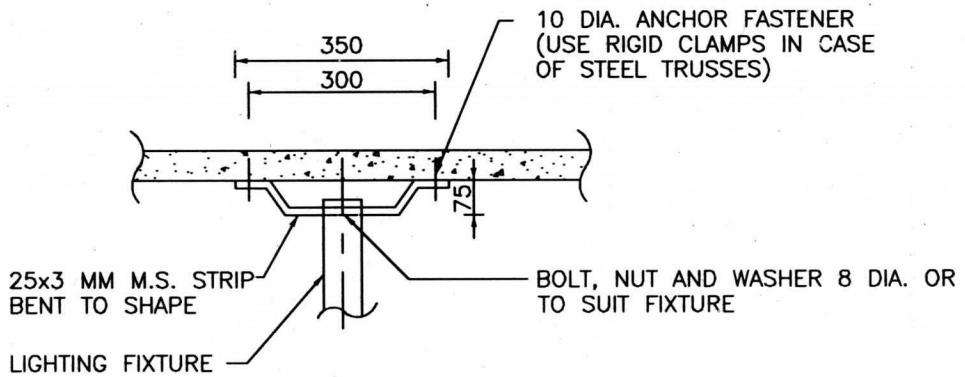

DETAIL–1

NOTES:–

1. ALL DIMENSIONS ARE IN MM.

Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman
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6	15.09.22	UPDATED & ISSUED AS STANDARD	JSK	VKS/HK	MKS	SM
5	22.02.18	UPDATED & ISSUED AS STANDARD	BP	VKS/HK	BRB	RN
4	17.07.13	REAFFIRMED & ISSUED AS STANDARD	BP	FA/SA	UAP/JMS	DM

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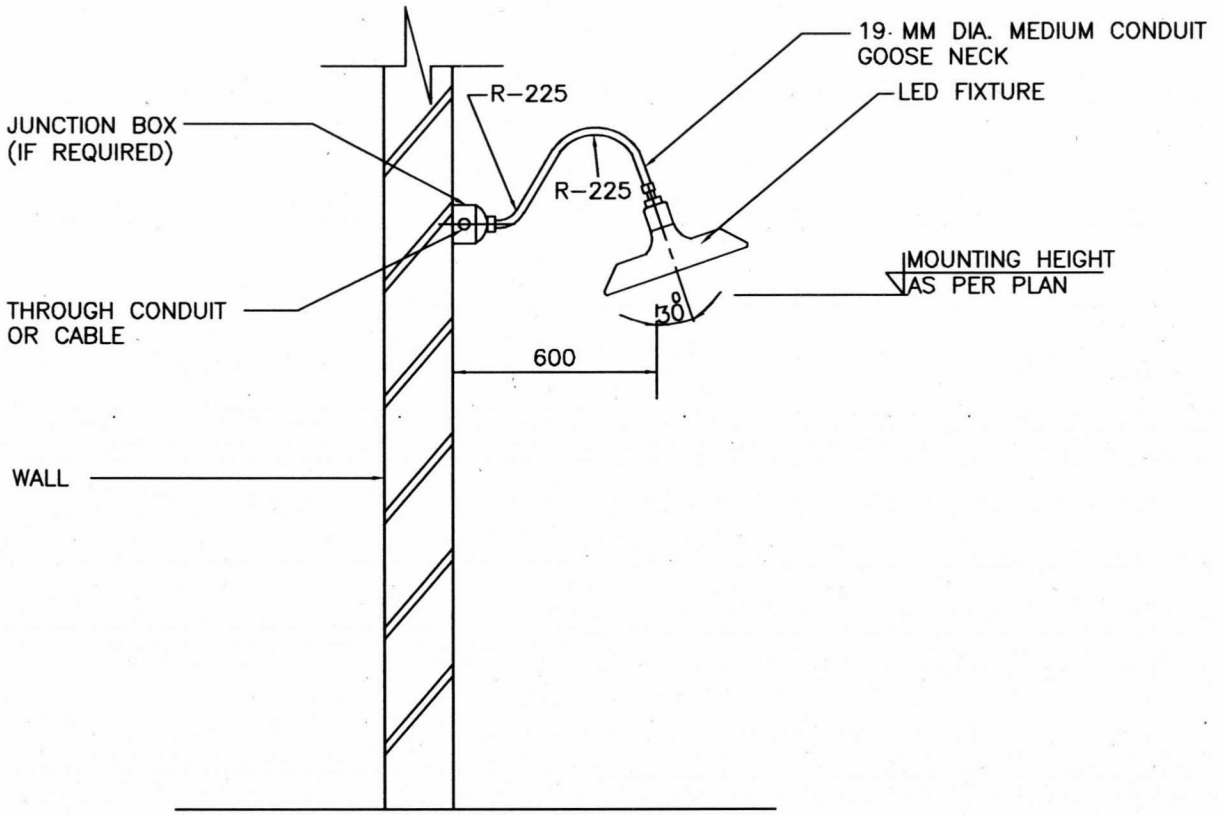
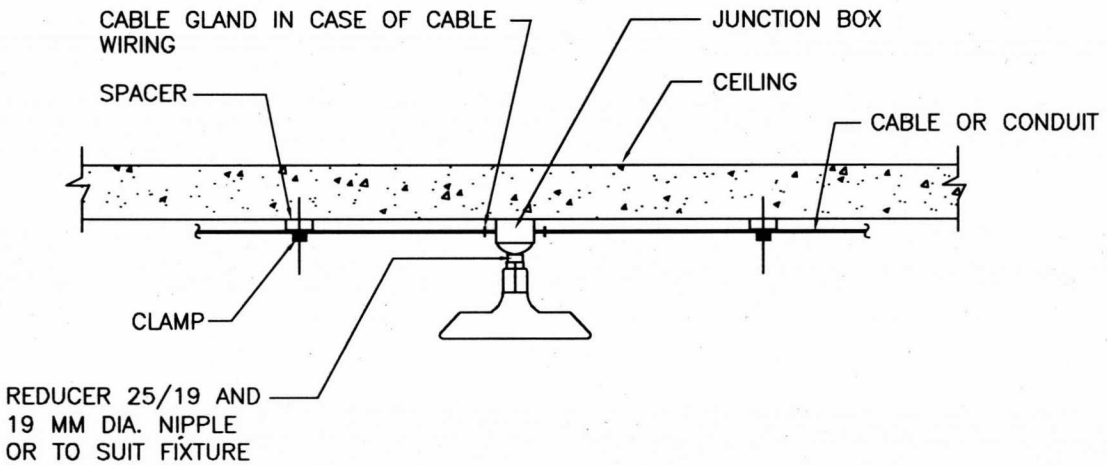


WALL-MOUNTED



CEILING-MOUNTED

NOTES:-

1. ALL DIMENSIONS ARE IN MM.
2. APPLICABLE FOR SAFE AREAS.

Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman
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6	15.09.22	UPDATED & ISSUED AS STANDARD	JSK	VKS/HK	MKS	SM
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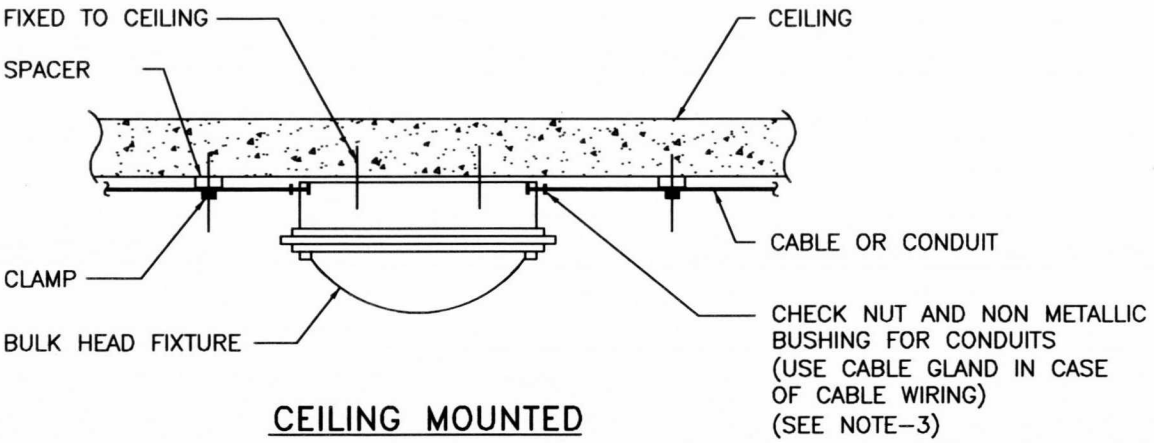
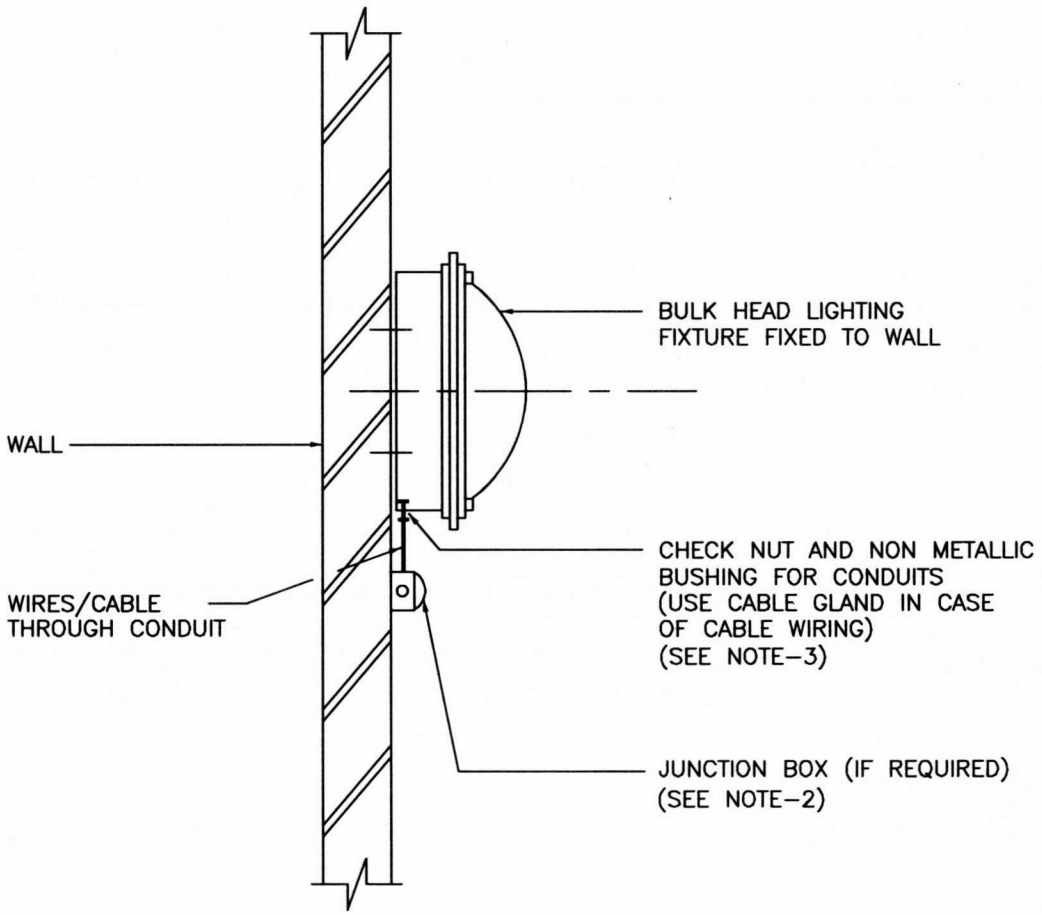


CEILING MOUNTED



WALL MOUNTED

NOTES:–

1. ALL DIMENSIONS ARE IN MM.
2. FOR INSTALLATION IN OUT DOOR FIXTURES, FIXTURES & JUNCTION BOX SHALL BE IP–55 (WEATHER PROTECTED).
3. PROPER SEALING SHALL BE ENSURED WHEREVER REQUIRED TO PREVENT INGRESS OF WATER.

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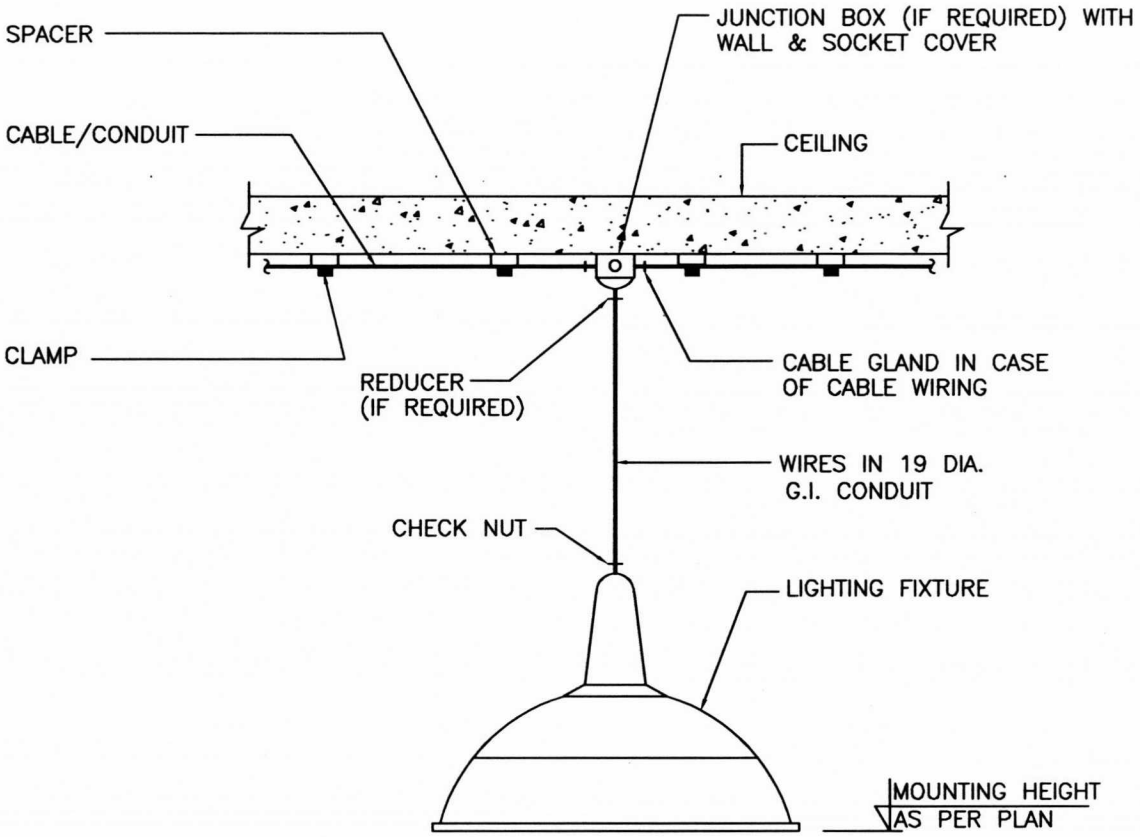

NOTES:–

1. ALL DIMENSIONS ARE IN MM.

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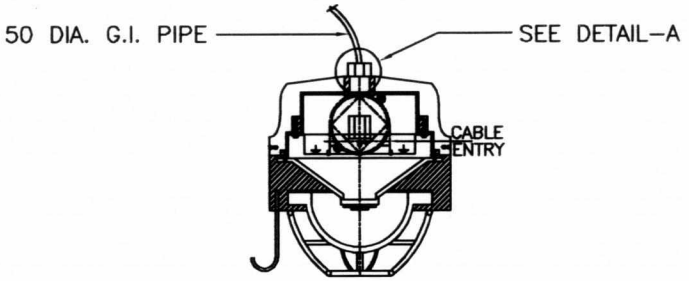
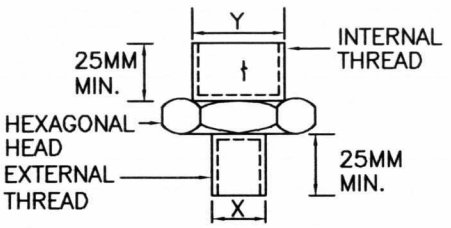


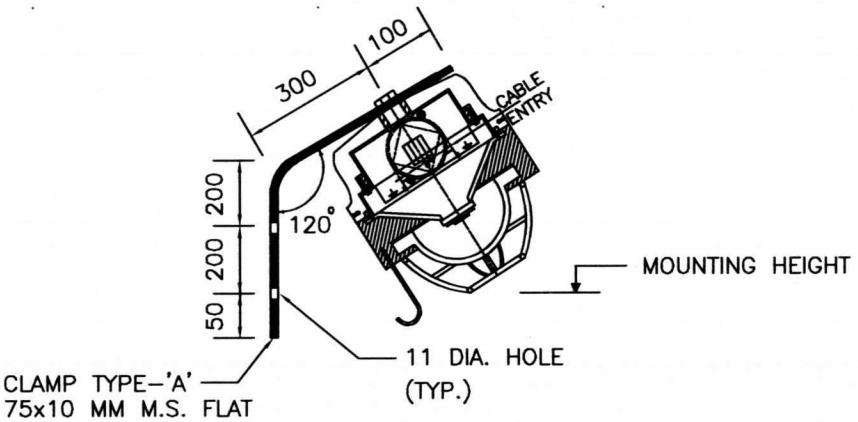
DETAIL–1
POLE MOUNTED



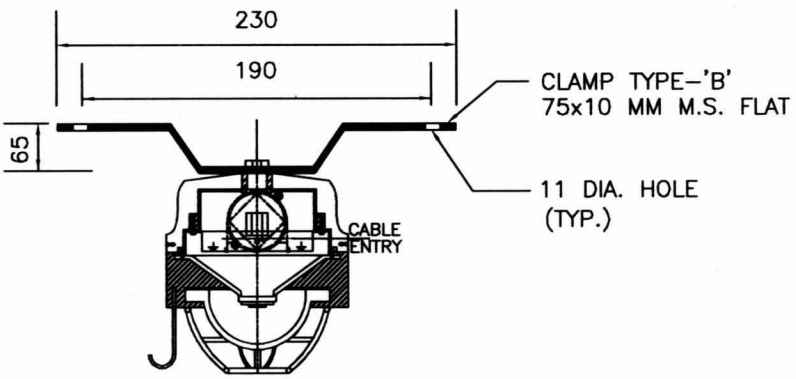
DETAIL–A
(ADAPTOR)

DIMENSIONS	
X	Y
*TO SUIT 19 DIA.	TO SUIT 50 DIA.

* ALTERNATIVELY SIZE TO SUIT FIXTURE



DETAIL–2
BRACKET MOUNTED



DETAIL–3
CEILING MOUNTED

NOTES:–

1. ALL DIMENSIONS ARE IN MM.
2. SUPPORT ACCESSORIES VIZ THE BRACKET, CEILING ADAPTOR SHALL BE PAINTED WITH EPOXY BASED PAINT.

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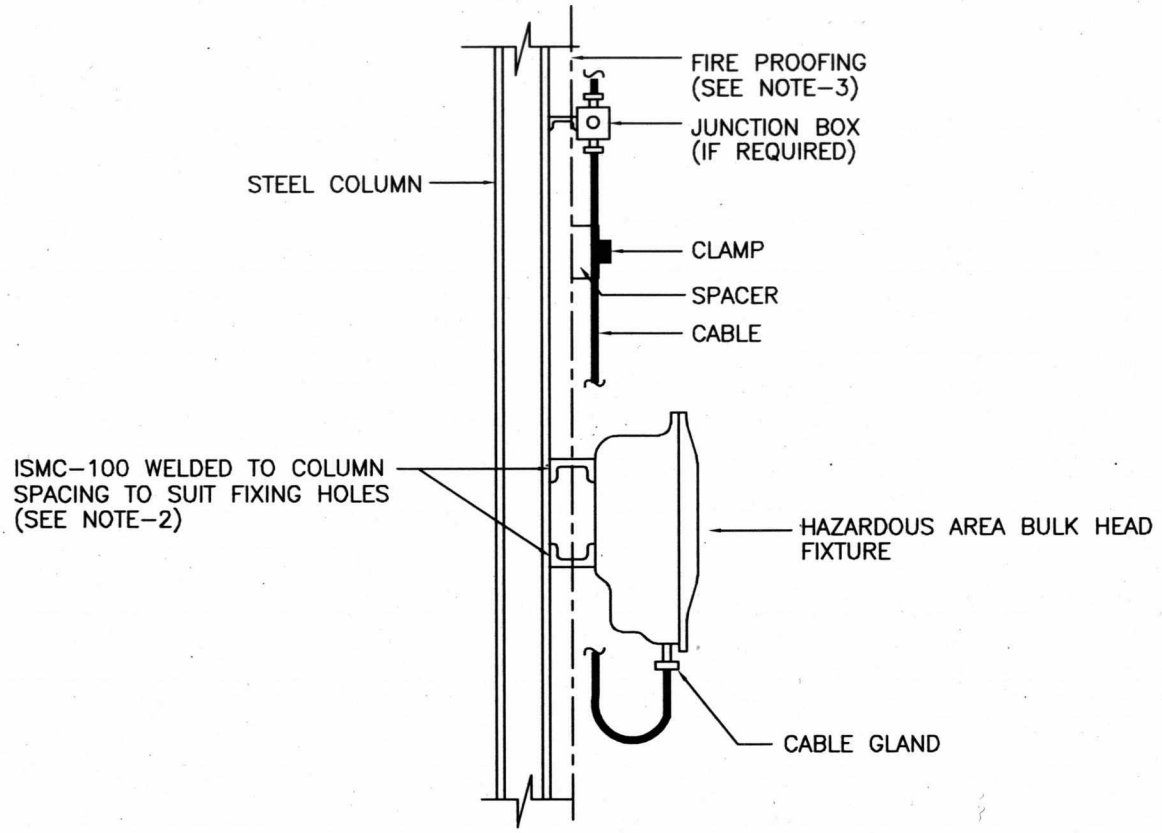
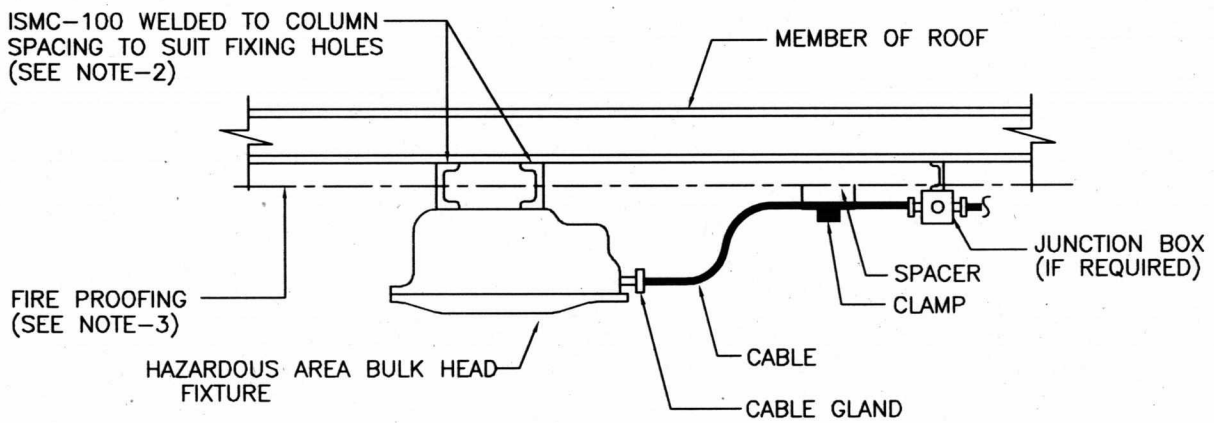


DETAIL–1
COLUMN MOUNTED



DETAIL–2
CEILING MOUNTED

NOTES:–

1. ALL DIMENSIONS ARE IN MM.
2. USE ANCHOR BOLTS FOR INSTALLATION OF FIXTURES ON CONCRETE COLUMNS.
3. WHERE FIRE PROOFING COLUMNS / STRUCTURES ARE ENCOUNTERED FIXTURE/ JUNCTION BOX AND CABLE/CONDUIT SHALL BE INSTALLED ON A SUITABLE DEEP LEGGED ANGLE IRON FRAME / DISTANCE BRACKET.

Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman
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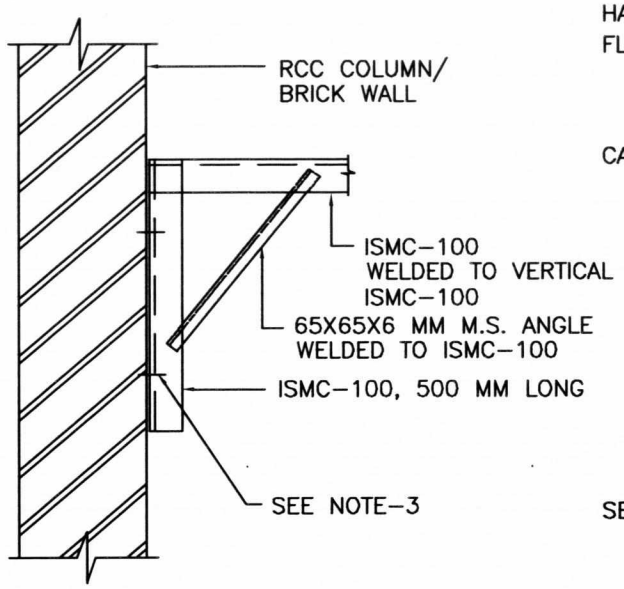
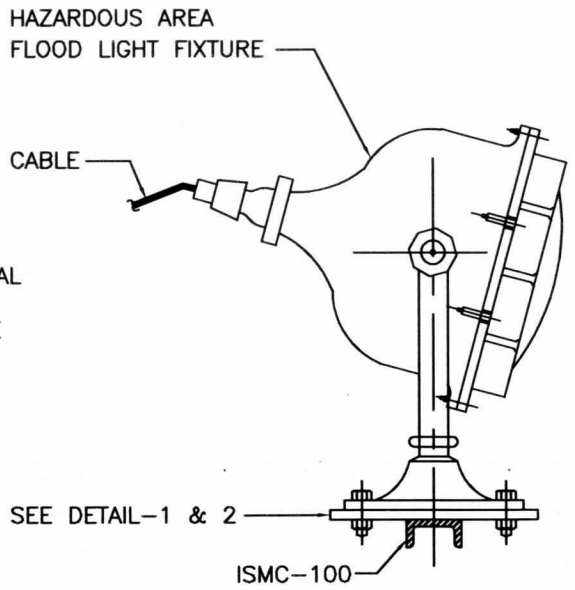
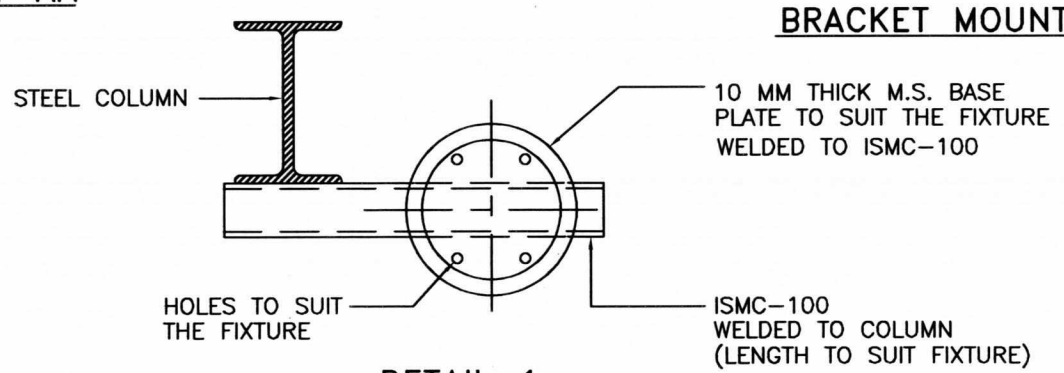


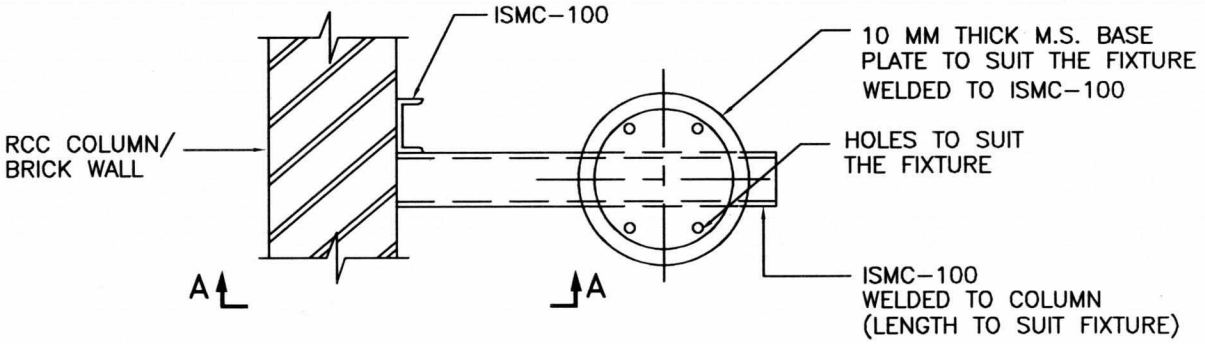
VIEW–AA



ELEVATION
BRACKET MOUNTED



DETAIL–1
MOUNTED ON STEEL COLUMN



DETAIL–2
MOUNTED ON RCC COLUMN/BRICK WALL

NOTES:–

1. ALL DIMENSIONS ARE IN MM.
2. WHERE FIRE PROOFING COLUMNS / STRUCTURES ARE ENCOUNTERED FIXTURE/ JUNCTION BOX AND CABLE/CONDUIT SHALL BE INSTALLED ON A SUITABLE DEEP LEGGED ANGLE IRON FRAME / DISTANCE BRACKET.
3. SUPPORT FOR FLOOD LIGHT FIXTURE SHALL BE SUITABLY FIXED TO RCC COLUMN/ BRICK WALL BY USING ANCHOR FASTENER.

Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman
					Approved by	
6	15.09.22	REAFFIRMED & ISSUED AS STANDARD	JSK	VKS/HK	MKS	SM
5	22.02.18	UPDATED & ISSUED AS STANDARD	BP	VKS/HK	BRB	RN
4	17.07.13	REAFFIRMED & ISSUED AS STANDARD	BP	FA/SA	UAP/JMS	DM

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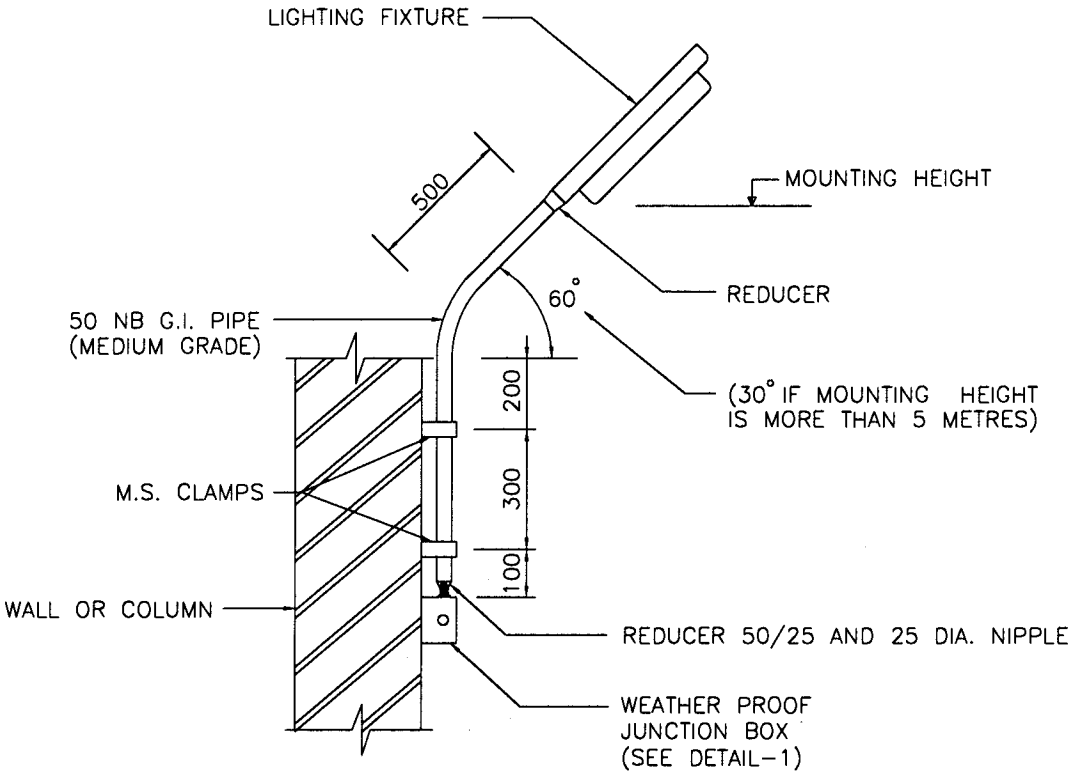
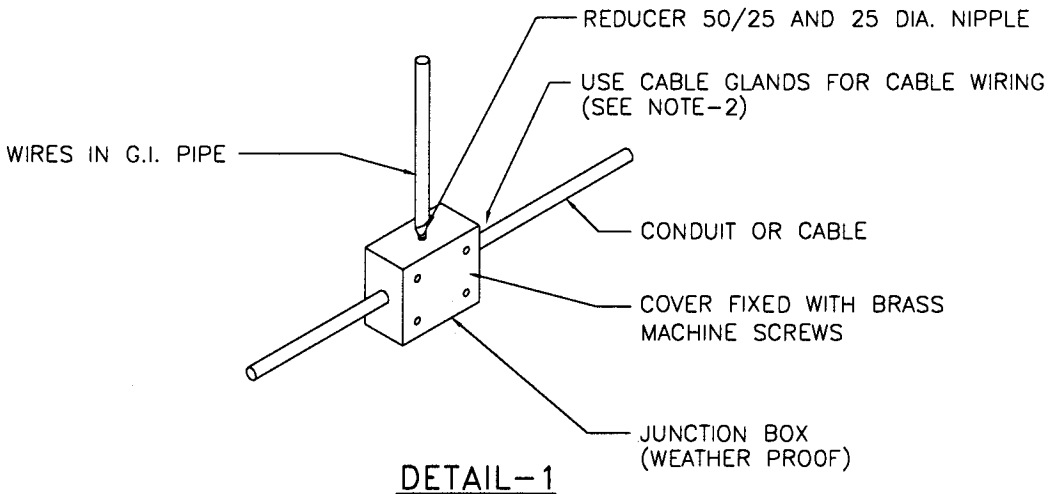


MOUNTED ON WALLS OR COLUMNS



DETAIL-1

NOTES:-

1. ALL DIMENSIONS ARE IN MM.
2. PROPER SEALING SHALL BE ENSURED TO PREVENT INGRESS OF WATER.
3. WHERE FIRE PROOFING COLUMNS / STRUCTURES ARE ENCOUNTERED FIXTURE/ JUNCTION BOX AND CABLE/CONDUIT SHALL BE INSTALLED ON A SUITABLE DEEP LEGGED ANGLE IRON FRAME / DISTANCE BRACKET.

Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman
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6	29.09.20	UPDATED & ISSUED AS STANDARD	JSK	VKS/HK	SA	SM
5	22.02.18	UPDATED & ISSUED AS STANDARD	BP	VKS/HK	BRB	RN

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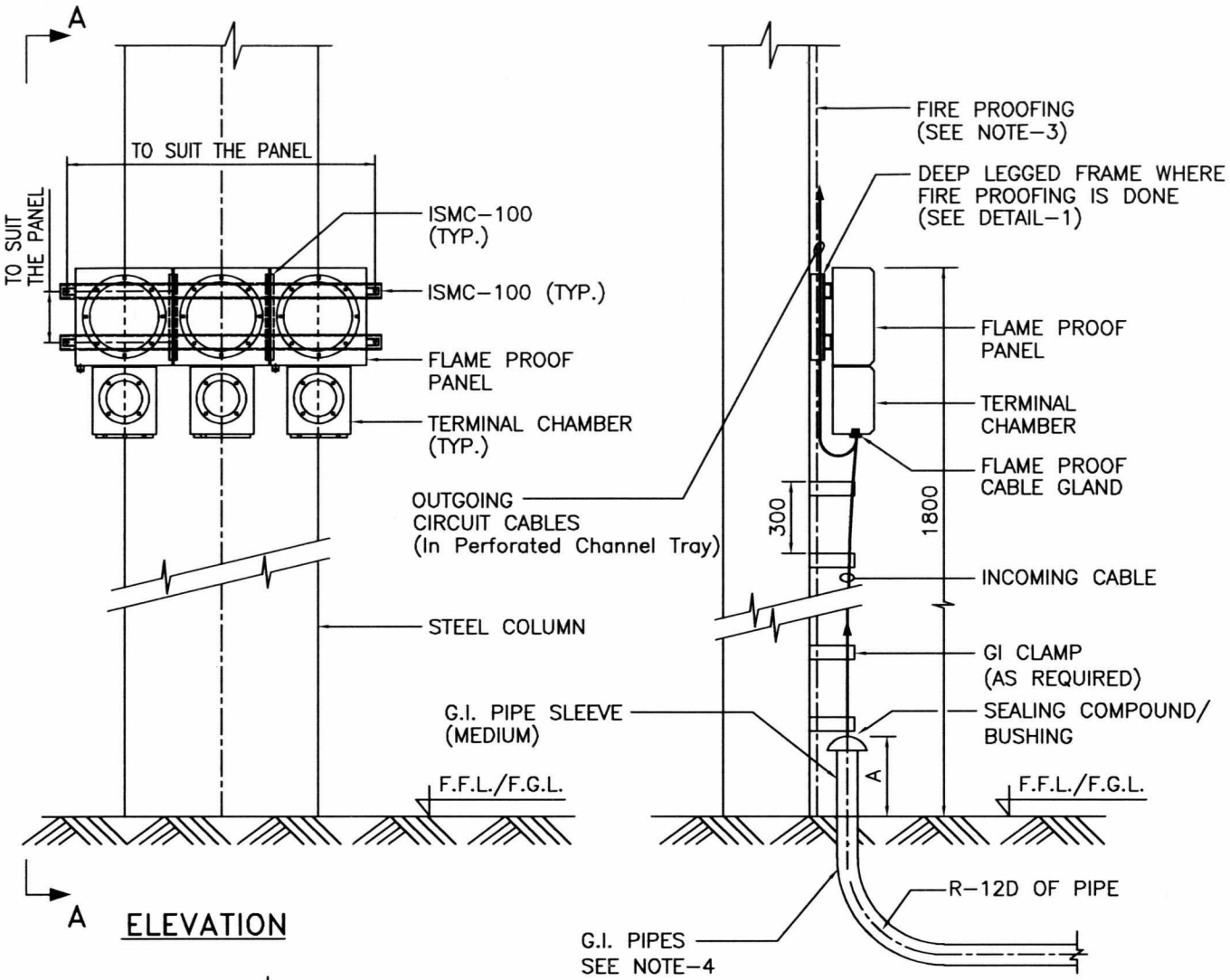

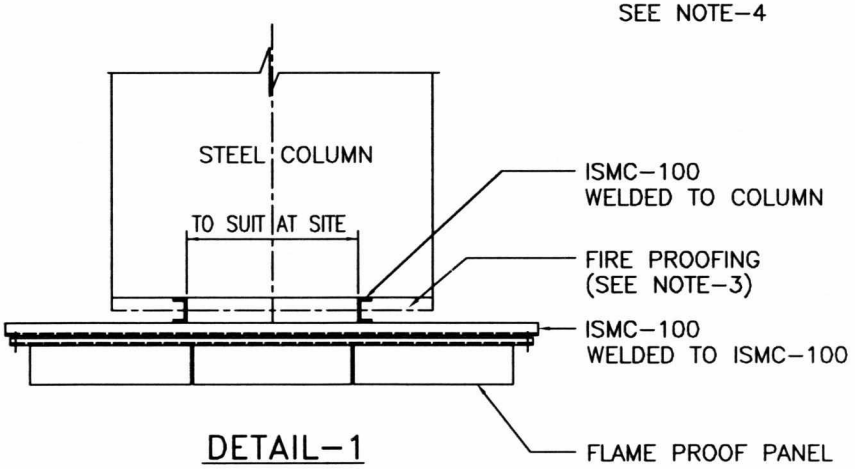

NOTES:–

A= { 150 MM (MIN.) FOR INDOOR LOCATIONS. / 300 MM (MIN.) FOR OUTDOOR LOCATIONS.

1. ALL DIMENSIONS ARE IN MM.
2. THE SUPPORT STRUCTURES SHALL BE PAINTED WITH SAME PAINT, AS FOLLOWED FOR CORRESPONDING STRUCTURE.
3. WHERE FIRE PROOFING COLUMNS / STRUCTURES ARE ENCOUNTERED, FLAME PROOF PANEL AND CABLE SHALL BE INSTALLED ON A SUITABLE DEEP LEGGED CHANNEL FRAME / DISTANCE BRACKET.
4. QUANTITY AND SIZE OF PIPE SLEEVES SHALL BE AS PER LAYOUT DRAWINGS.

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6	25.08.23	UPDATED & ISSUED AS STANDARD	SONU	VKS/HK	MKS	SM
5	16.07.18	UPDATED & ISSUED AS STANDARD	RSD	VKS/HK	BRB	RKT
4	17.07.13	REAFFIRMED & ISSUED AS STANDARD	BP	FA/SA	UAP/JMS	DM

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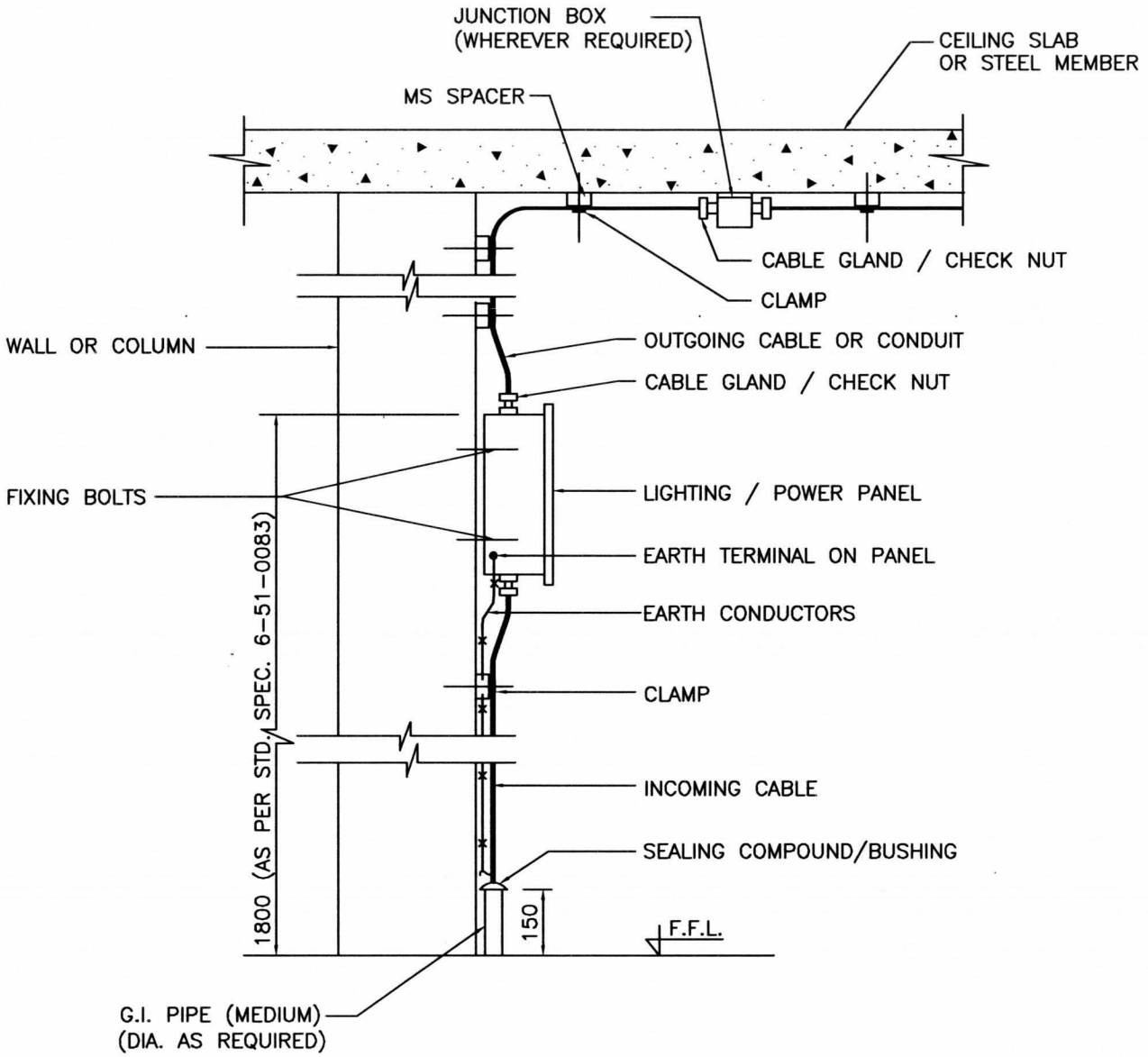

NOTES:-

1. ALL DIMENSIONS ARE IN MM.
2. WHERE FIRE PROOFING COLUMNS / STRUCTURES ARE ENCOUNTERED FIXTURE/ PANEL/ JUNCTION BOX AND CABLE/CONDUIT SHALL BE INSTALLED ON A SUITABLE DEEP LEGGED ANGLE IRON FRAME / DISTANCE BRACKET.

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					Approved by	
6	15.09.22	REAFFIRMED & ISSUED AS STANDARD	JSK	VKS/HK	MKS	SM
5	22.02.18	UPDATED & ISSUED AS STANDARD	BP	VKS/HK	BRB	RN
4	17.07.13	REAFFIRMED & ISSUED AS STANDARD	BP	FA/SA	UAP/JMS	DM

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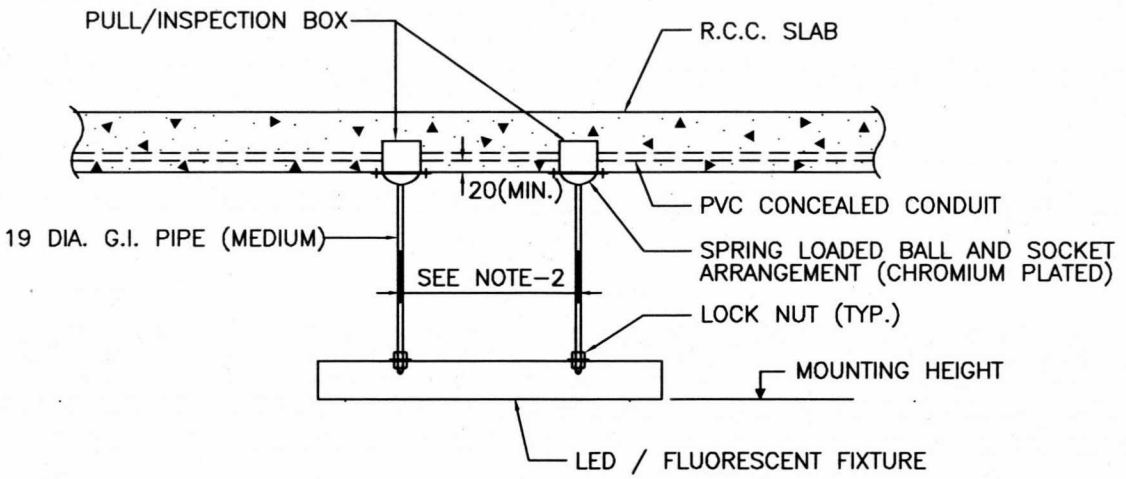
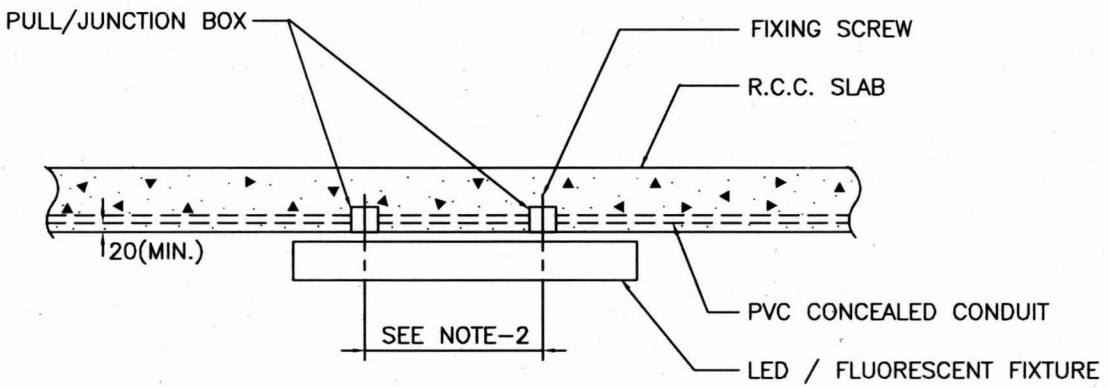


SUSPENSION MOUNTING



CEILING MOUNTING

NOTES:-

1. ALL DIMENSIONS ARE IN MM.
2. SUSPENSION/FIXING CENTERS SHALL BE AS PER FIXTURE MANUFACTURER'S DETAILS.

Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman
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6	15.09.22	REAFFIRMED & ISSUED AS STANDARD	JSK	VKS/HK	MKS	SM
5	09.03.18	UPDATED & ISSUED AS STANDARD	RSD	VKS/HK	BRB	RN
4	17.07.13	REAFFIRMED & ISSUED AS STANDARD	BP	FA/SA	UAP/JMS	DM

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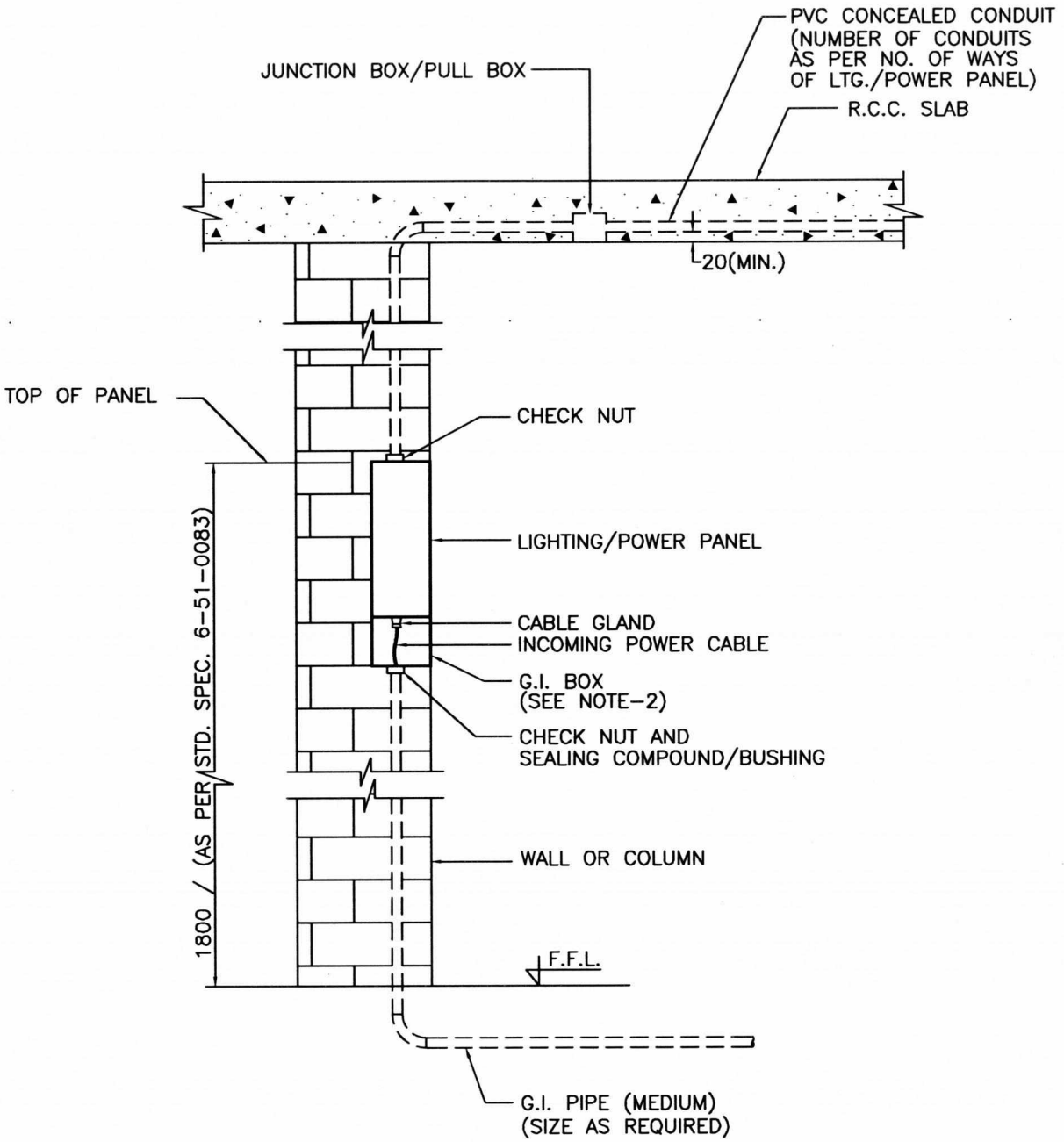

NOTES:-

1. ALL DIMENSIONS ARE IN MM.
2. G.I. ADAPTOR BOX OF SUITABLE SIZE WITH REMOVABLE COVER SHALL BE PROVIDED BELOW THE PANEL TO FACILITATE CABLE TERMINATION.

Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman
					Approved by	
6	15.09.22	REAFFIRMED & ISSUED AS STANDARD	JSK	VKS/HK	MKS	SM
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4	17.07.13	REAFFIRMED & ISSUED AS STANDARD	BP	FA/SA	UAP/JMS	DM

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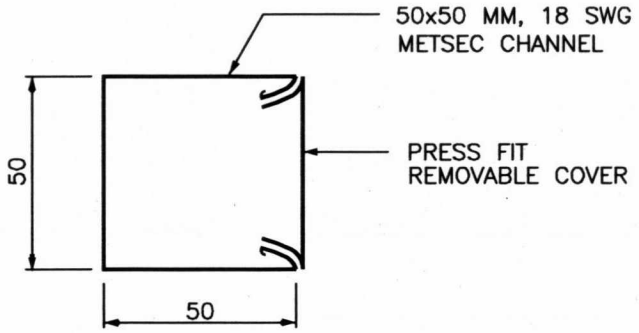
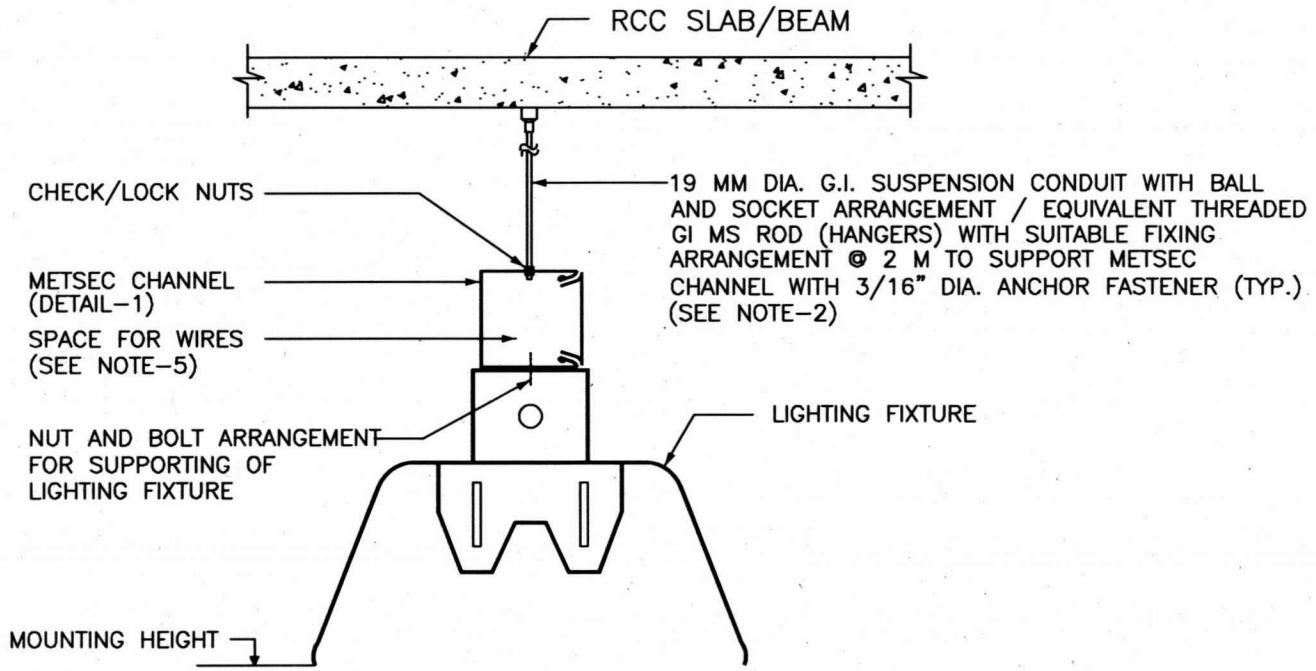


DETAIL–1
METSEC CHANNEL



INSTALLATION OF LIGHTING FIXTURE BELOW METSEC CHANNEL

NOTES:–

1. ALL DIMENSIONS ARE IN MM.
2. LENGTH OF SUSPENSION CONDUITS / MS ROD SHALL BE ADJUSTED AS PER MOUNTING HEIGHT OF LIGHTING FIXTURES.
3. IN CASE, METSEC CHANNEL IS NOT TO BE SUSPENDED, IT SHALL BE DIRECTLY FIXED TO THE CEILING BY 3/16" DIA. ANCHOR FASTENERS @ 2 M INTERVALS.
4. METSEC CHANNEL SHALL BE SPRAY PAINTED AFTER INSTALLATION.
5. WIRES FOR EACH TYPE OF CIRCUIT (LIGHTING/POWER/DC LIGHTING) SHALL BE NEATLY BUNCHED IN METSEC CHANNEL.

Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman
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5	15.09.22	UPDATED & ISSUED AS STANDARD	JSK	VKS/HK	MKS	SM
4	09.03.18	UPDATED & ISSUED AS STANDARD	RSD	VKS/HK	BRB	RN
3	17.07.13	REAFFIRMED & ISSUED AS STANDARD	BP	FA/SA	UAP/JMS	DM

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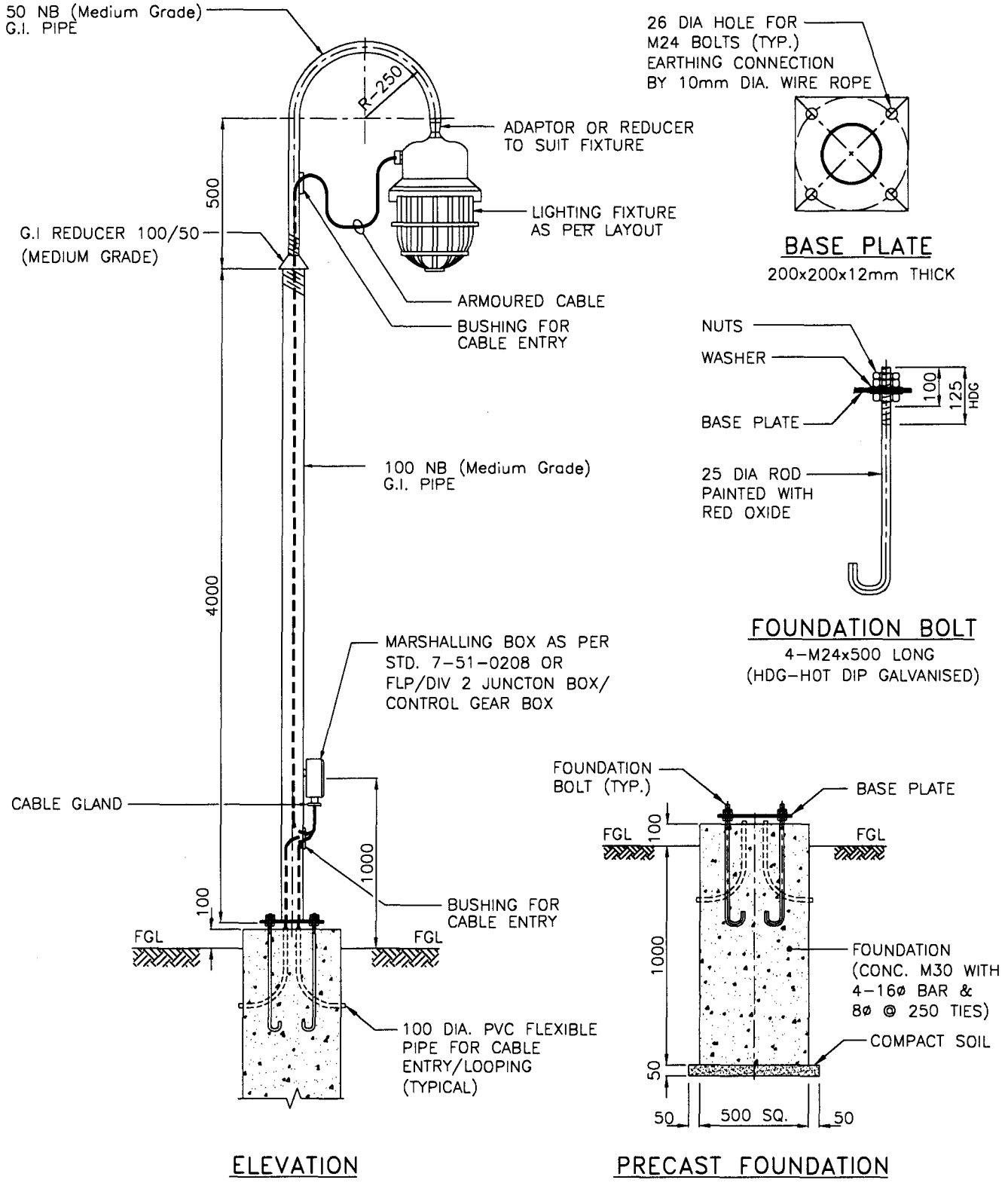

NOTES :

1. ALL DIMENSIONS ARE IN MILLIMETERS UNLESS OTHERWISE SPECIFIED.
2. THE LIGHTING POLE AND ACCESSORIES DETAILS SHOWN HERE ARE INDICATIVE ONLY. ACTUAL DESIGN & ARRANGEMENT SHALL BE AS PER MANUFACTURER'S DETAILS.

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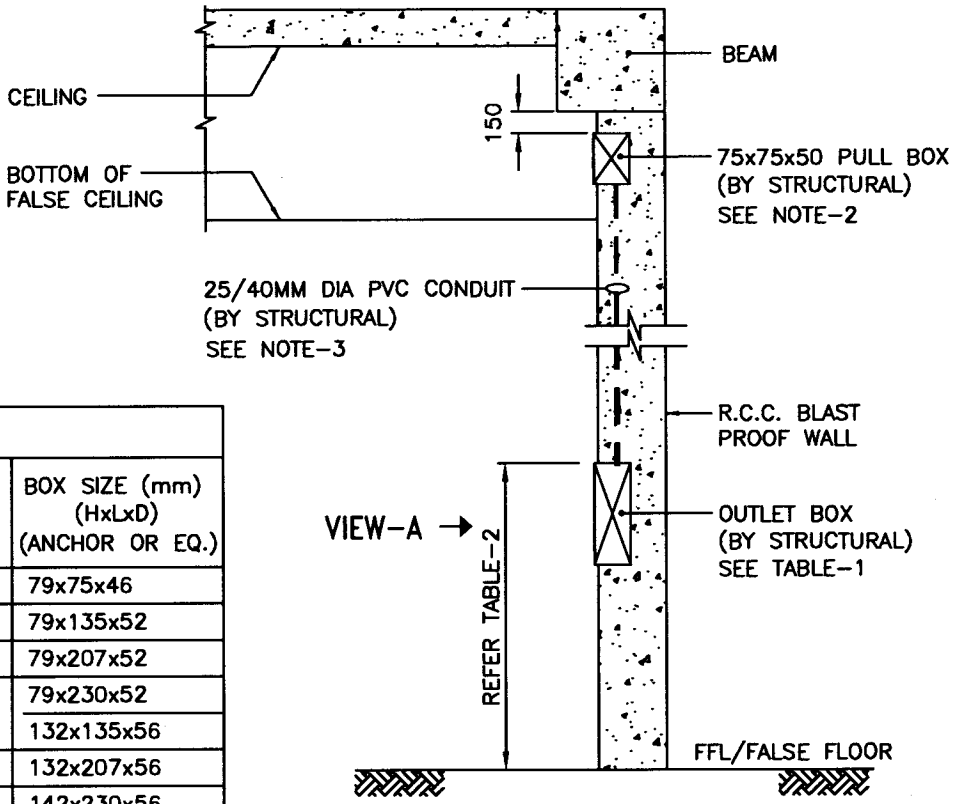


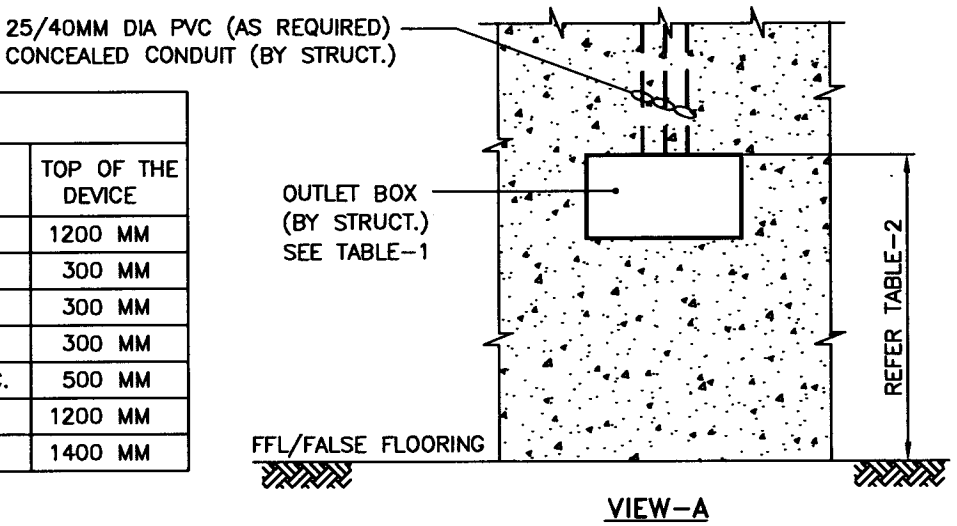
DETAIL-1

TYPICAL ARRANGEMENT FOR LIGHTING/MCP/FCS OUTLET BOX IN BLAST PROOF WALL WITH FALSE CEILING

TABLE-1

S. NO.	NO. OF MODULES*	BOX SIZE (mm) (HxLxD) (ANCHOR OR EQ.)
1	2 MODULES	79x75x46
2	4 MODULES	79x135x52
3	6 MODULES	79x207x52
4	8 MODULES	79x230x52 132x135x56
5	12 MODULES	132x207x56
6	16 MODULES	142x230x56
7	18 MODULES	207x207x60

* 1 MODULE FOR 1 SWITCH/REGULATOR
* 2 MODULES FOR 1 POWER SOCKET



VIEW-A

TABLE-2

S. NO.	DEVICE NAME	TOP OF THE DEVICE
1	LIGHTING SWITCH BOX	1200 MM
2	POWER RECEPTACLE	300 MM
3	LAN SOCKETS/SWITCH	300 MM
4	TELEPHONE SOCKET	300 MM
5	DP MCB BOX FOR A.C.	500 MM
6	MCP	1200 MM
7	FCS	1400 MM

NOTES:-

1. NO. OF CONDUITS FOR LIGHTING/POWER CIRCUITS SHALL BE PROVIDED AS PER LAYOUT DRAWING/OUTLET BOX.
2. 75x75x50MM PULL BOX TO BE PROVIDED IN RCC BLAST PROOF WALL/CEILING AT END OF CONDUITS TO ENABLE WIRING BY ELECTRICAL CONTRACTOR (NO. OF BOXES SHALL BE AS PER NO. OF CONDUITS). THE PULL BOXES SHALL BE COVERED WITH FACE PLATE AFTER LAYING OF WIRING.
3. 25MM PVC CONDUIT SHALL BE USED FOR LIGHTING/POWER AND 40MM PVC CONDUIT SHALL BE USED FOR FIRE ALARM AND PLANT COMMUNICATION SYSTEM.
4. JUNCTION BOX FOR FIRE DETECTORS/CEILING FANS SHALL BE PROVIDED AS PER LAYOUT DRAWINGS.

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1	31.03.22	REAFFIRMED & ISSUED AS STANDARD	JSK	VKS/HK	MKS	SM
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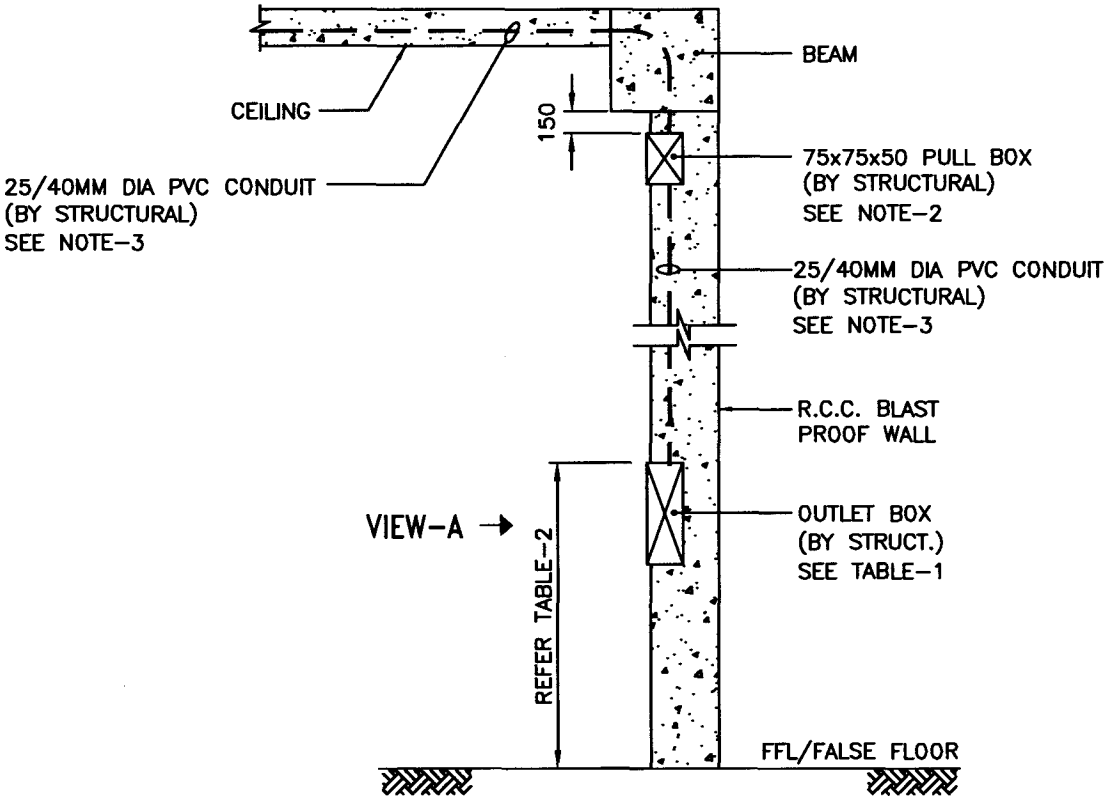
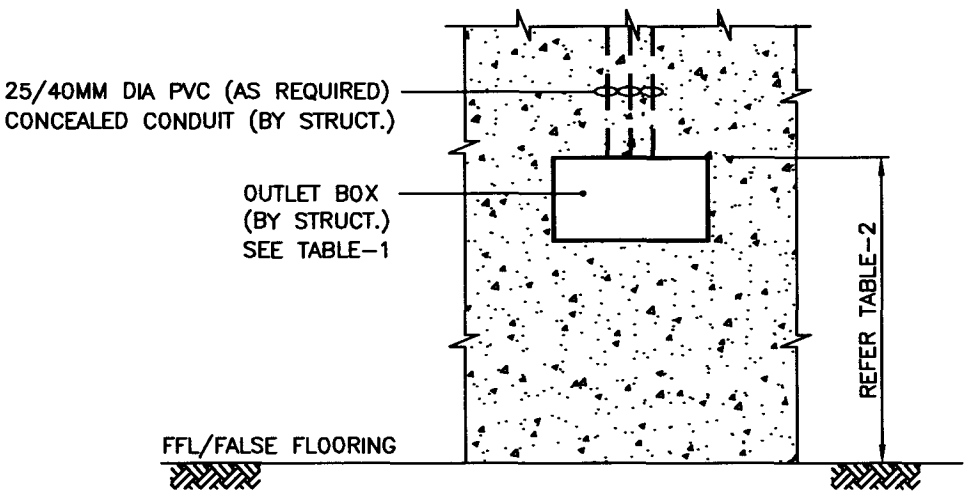


DETAIL-2

TYPICAL ARRANGEMENT FOR LIGHTING/MCP/FCS OUTLET BOX IN BLAST PROOF WALL WITHOUT FALSE CEILING



VIEW-A

Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman
					Approved by	
1	31.03.22	REAFFIRMED & ISSUED AS STANDARD	JSK	VKS/HK	MKS	SM
0	23.02.17	ISSUED AS STANDARD	PC	FA/HK	BRB	RN

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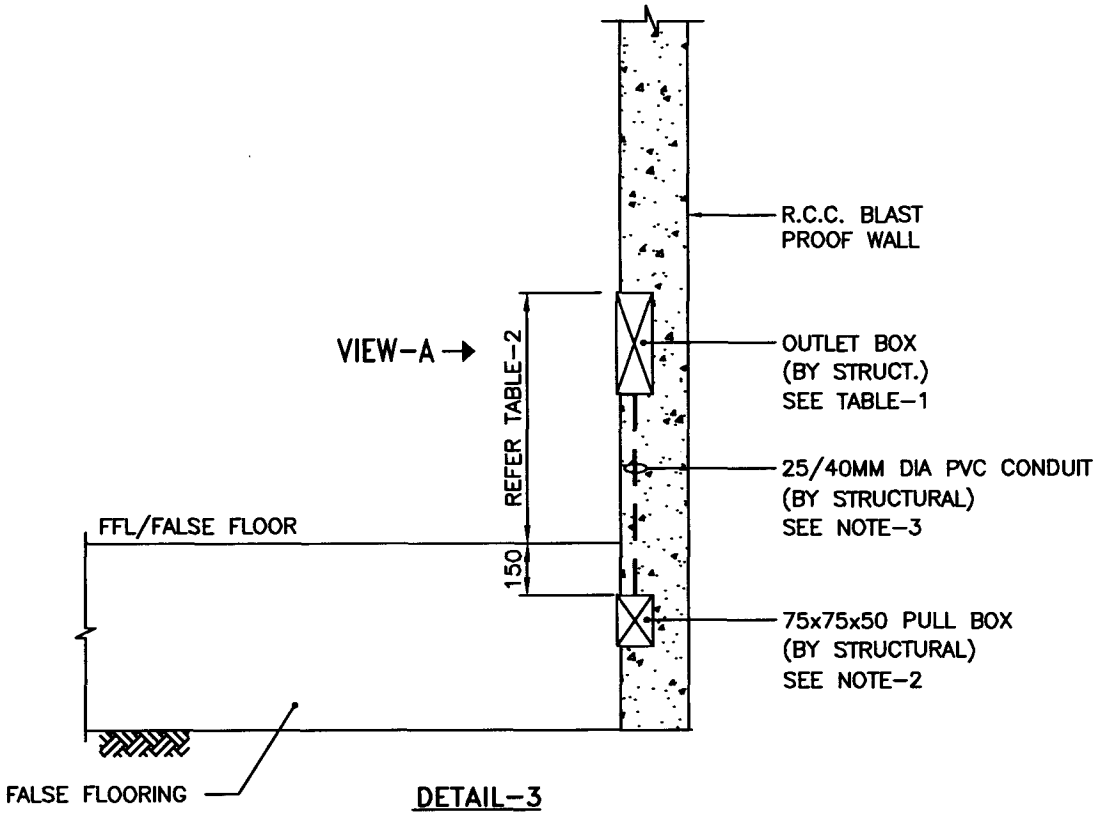
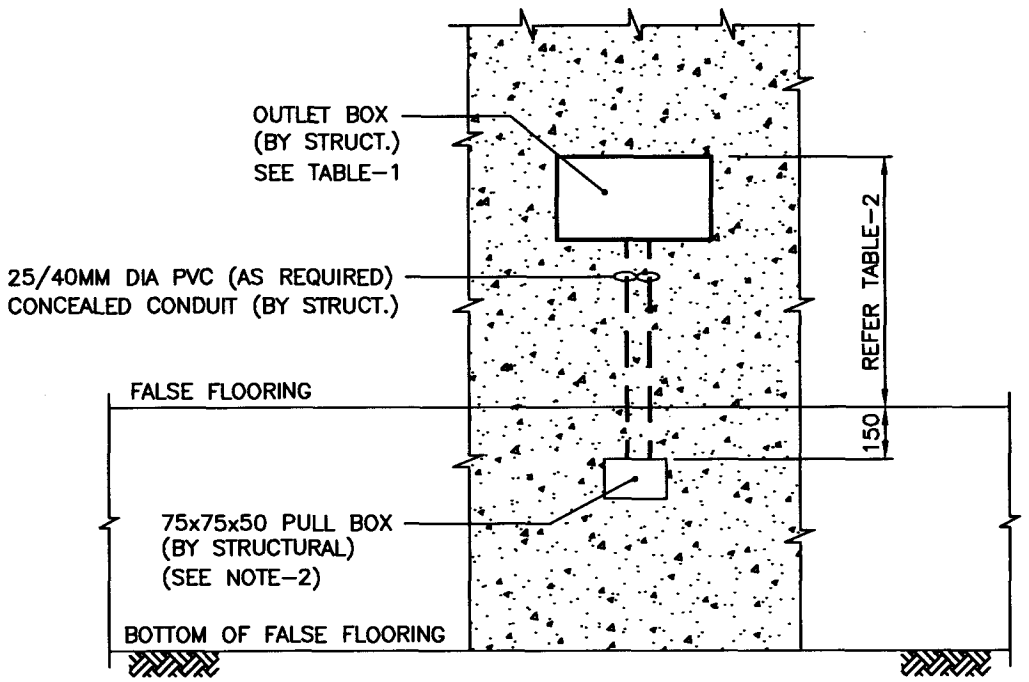


DETAIL-3

TYPICAL ARRANGEMENT FOR POWER/TELEPHONE SOCKET OUTLET BOX IN BLAST PROOF WALL WITH FALSE FLOORING



VIEW-A

Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman
					Approved by	
1	31.03.22	REAFFIRMED & ISSUED AS STANDARD	JSK	VKS/HK	MKS	SM
0	23.02.17	ISSUED AS STANDARD	PC	FA/HK	BRB	RN

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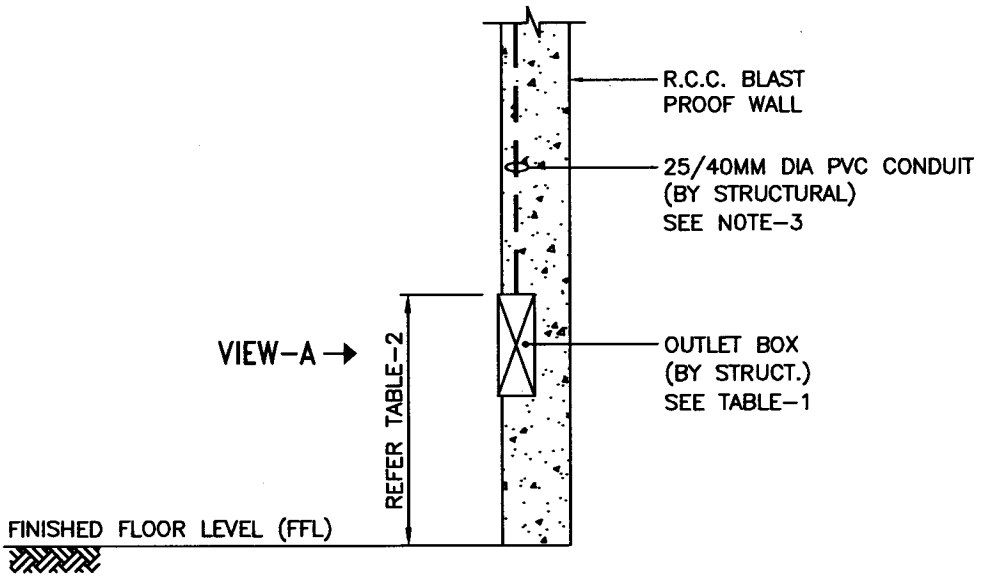
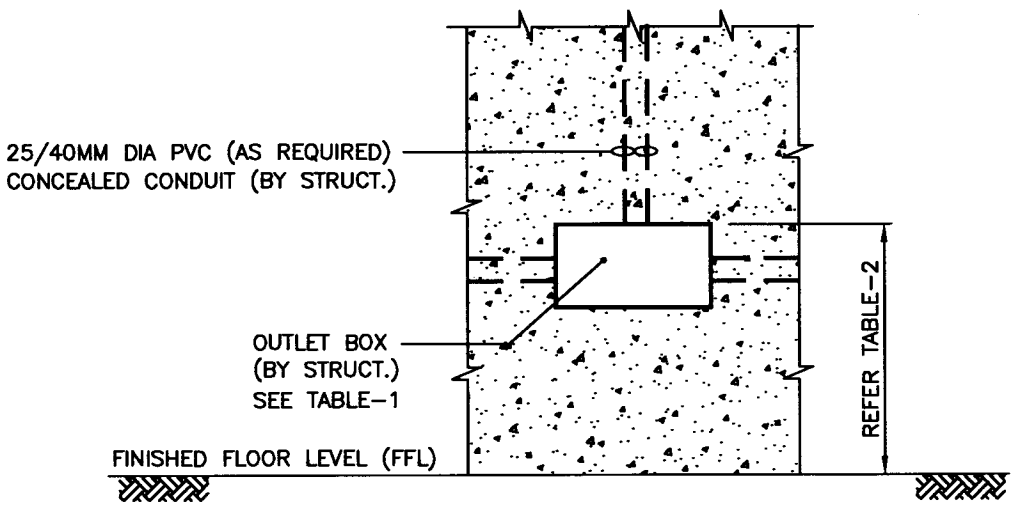


DETAIL-4

TYPICAL ARRANGEMENT FOR POWER/TELEPHONE SOCKET OUTLET BOX IN BLAST PROOF WALL WITHOUT FALSE FLOORING



VIEW-A

Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman
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1	31.03.22	REAFFIRMED & ISSUED AS STANDARD	JSK	VKS/HK	MKS	SM
0	23.02.17	ISSUED AS STANDARD	PC	FA/HK	BRB	RN

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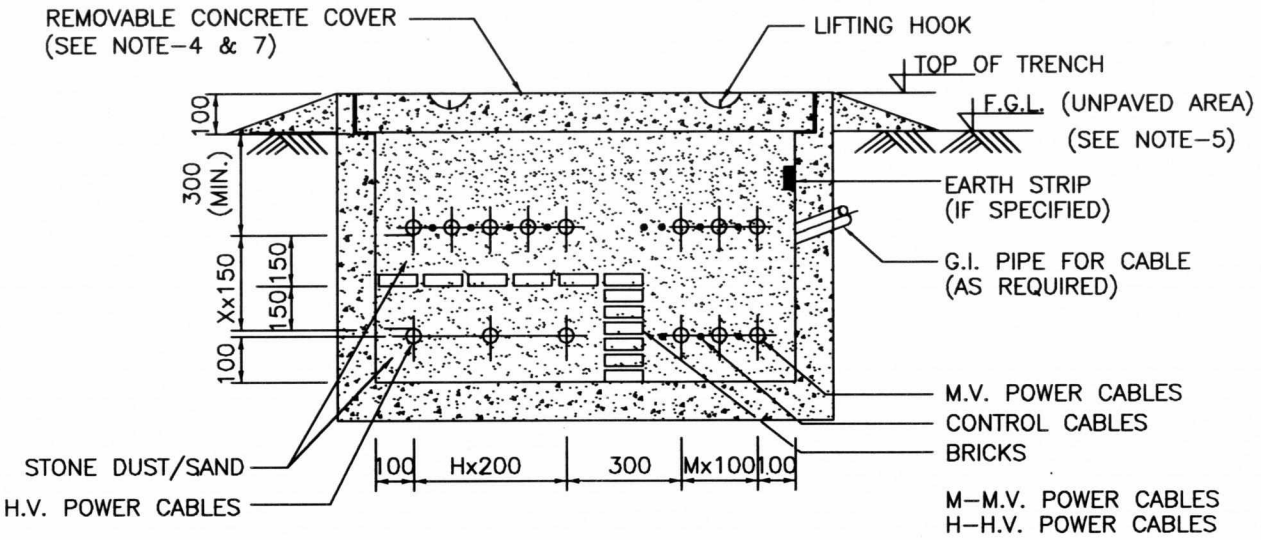
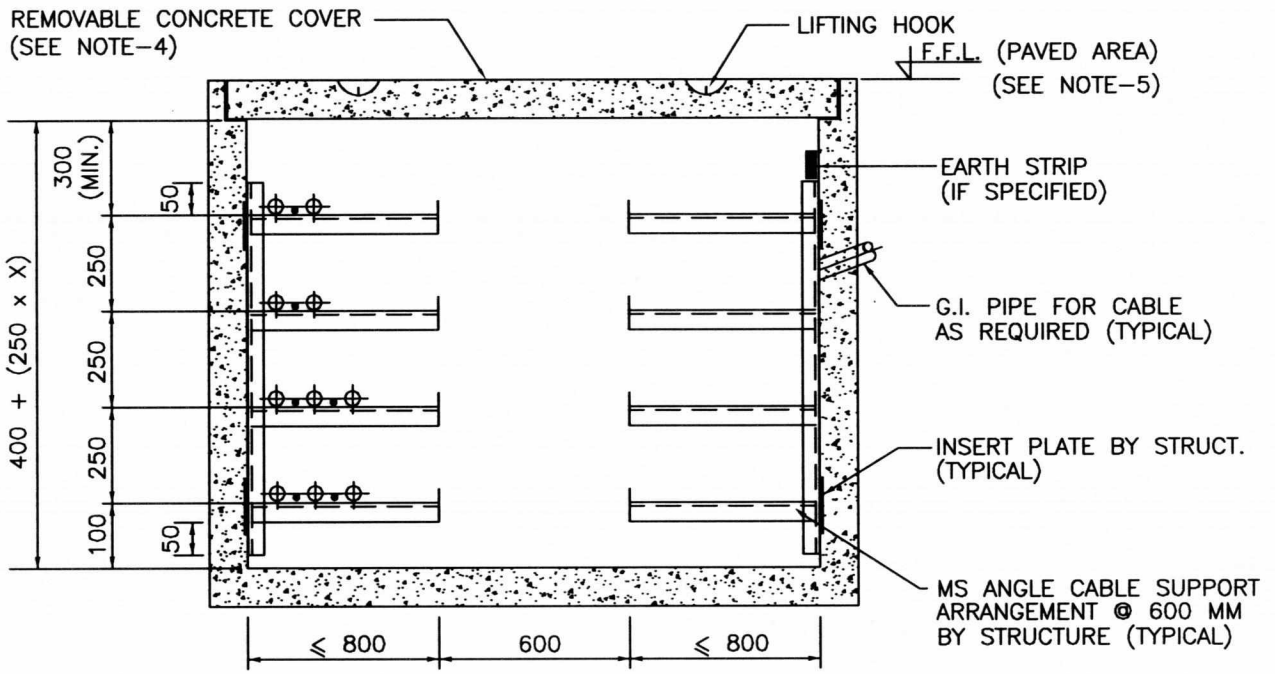
TYPICAL SECTION OF RCC CABLE TRENCH



TYPICAL SECTION OF RCC CABLE TRENCH WITHOUT RACKS



TYPICAL SECTION OF RCC CABLE TRENCH WITH RACKS

NOTES:–

1. ALL DIMENSIONS ARE IN MM.
2. WIDTH OF RACKS ON ONE SIDE OR BOTH SIDES SHALL BE DECIDED AS PER JOB REQUIREMENT.
3. THE EXACT HEIGHT OF OPENING IN TRENCH WALL FOR G.I. PIPE FOR TAKING CABLE SHALL BE SUITABLY DECIDED AT SITE.
4. THE REMOVABLE CONCRETE COVERS SHALL BE SEALED WITH MASTIC ASPHALT FILLER / BITUMEN TO PREVENT INGRESS OF WATER / HYDROCARBONS IN CABLE TRENCH.
5. TOP OF THE TRENCH SHALL BE 100 MM ABOVE FINISHED GRADE LEVEL (F.G.L.) IN CASE OF UNPAVED AREAS AND SHALL BE FLUSHED WITH FINISHED FLOOR LEVEL (F.F.L.) IN CASE OF PAVED AREAS.
6. MINIMUM GAP OF 250MM SHALL BE PROVIDED BETWEEN FA / COMMUNICATION / TELEPHONE CABLES AND ALL OTHER POWER / CONTROL CABLES.
7. INSTEAD OF REMOVABLE CONCRETE COVER, PCC/LEAN CONCRETE SHALL BE PROVIDED IF SPECIFIED IN JOB SPECIFICATION. THE THICKNESS OF PCC SHALL BE MININUM 100mm OR AS SPECIFIED IN STRUCTURAL SPECIFICATION.

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5	21.11.13	REVISED & REISSUED AS STANDARD	BP	FA/SA	UAP/JMS	SC

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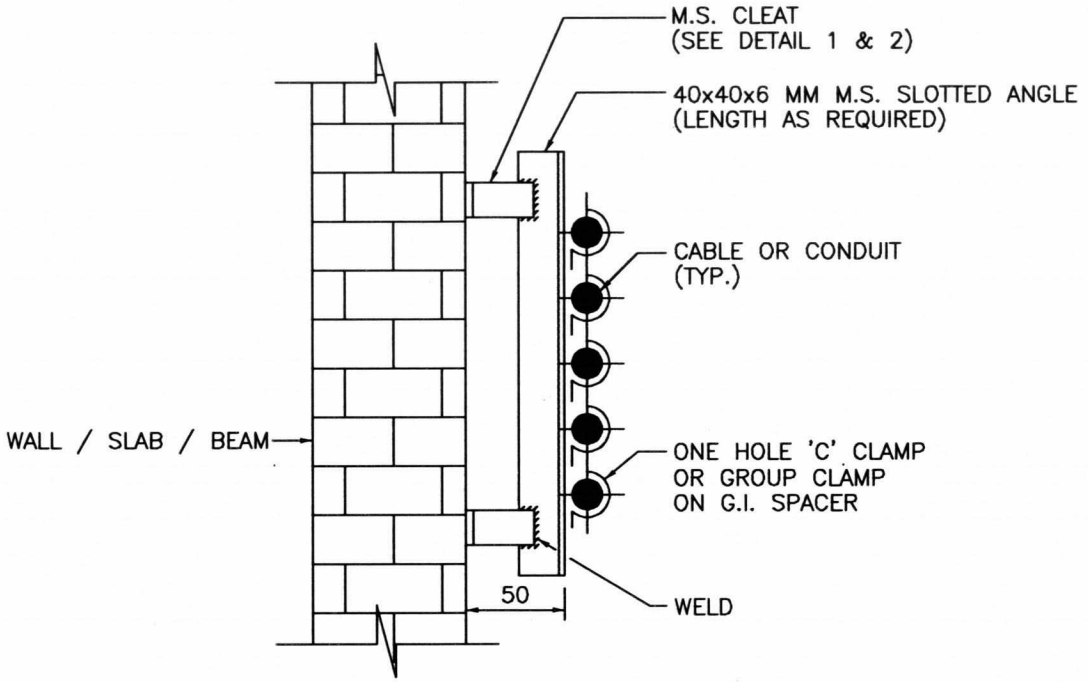
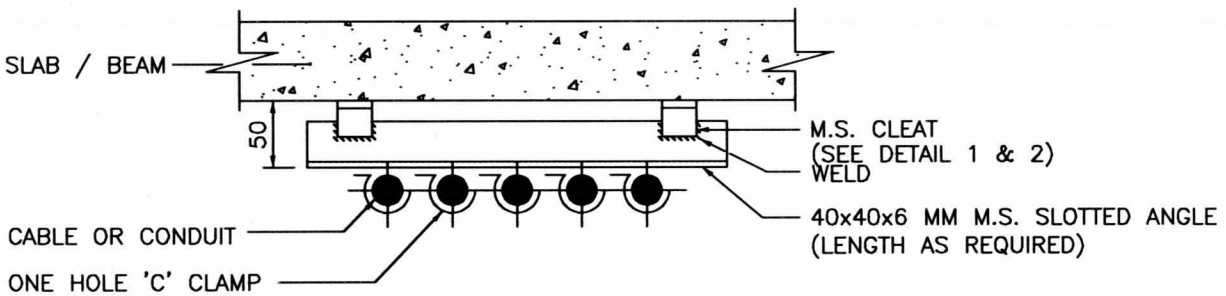
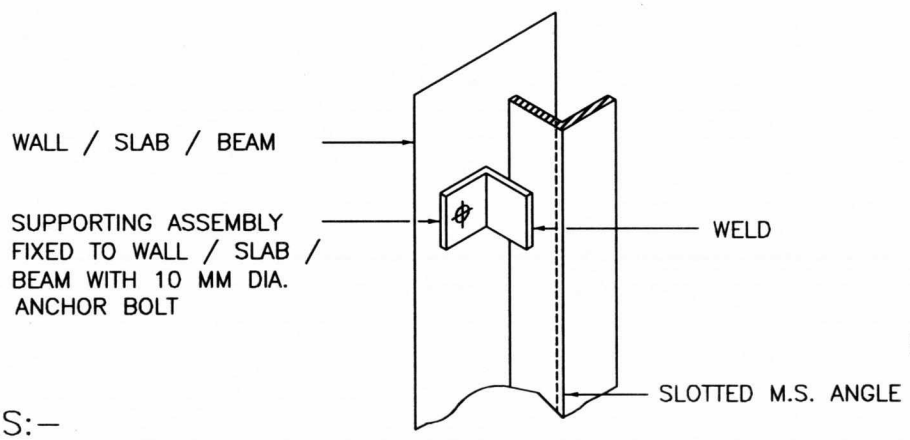


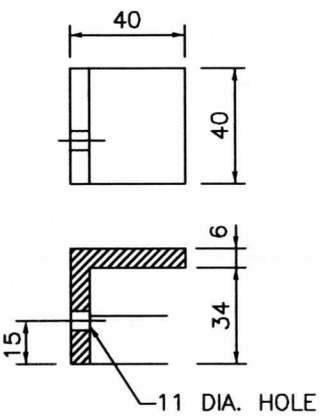
SUPPORT ON WALL



SUPPORT ON SLAB / BEAM



DETAIL–1



DETAIL–2
M.S. CLEAT

NOTES:–

1. ALL DIMENSIONS ARE IN MM.

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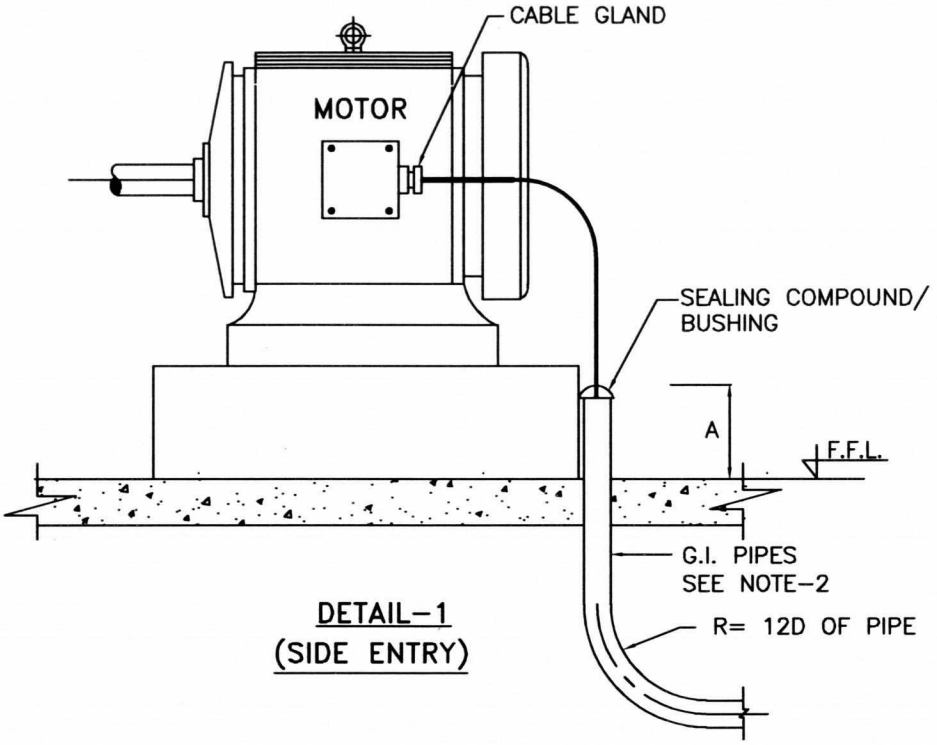
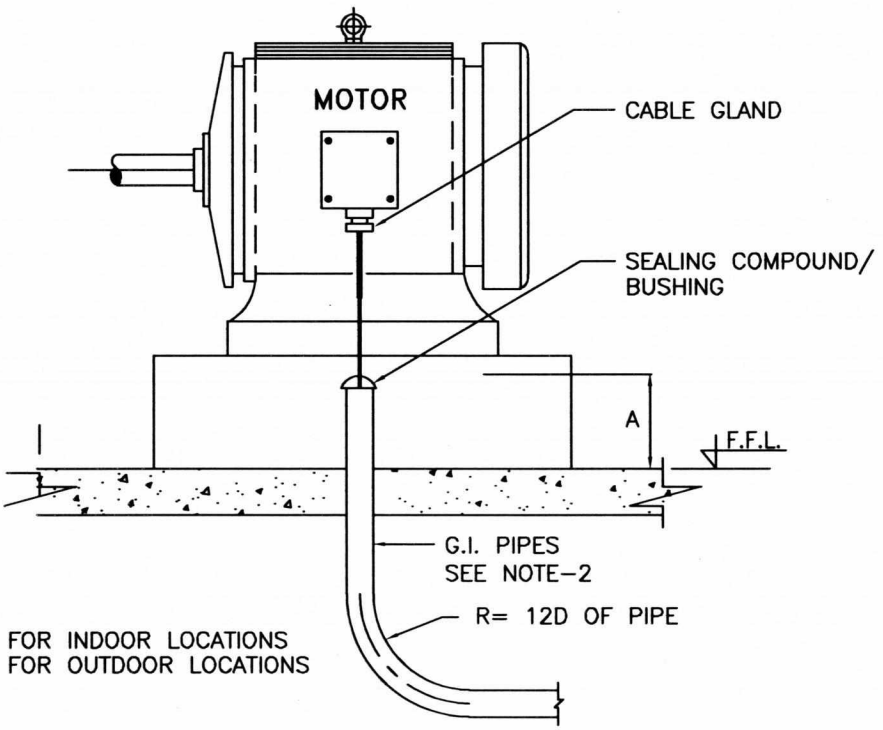


DETAIL-1
(SIDE ENTRY)



A = 150 MM (MIN.) FOR INDOOR LOCATIONS
300 MM (MIN.) FOR OUTDOOR LOCATIONS

DETAIL-2
(BOTTOM ENTRY)

NOTES:-

1. ALL DIMENSIONS ARE IN MM.
2. QUANTITY AND SIZE OF PIPE SLEEVE SHALL BE AS PER LAYOUT DRAWINGS.
3. UNDER NORMAL CONDITION DETAIL-1 SHALL BE FOLLOWED. ONLY IN EXCEPTIONAL CASES DETAIL-2 SHALL BE FOLLOWED.

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6	15.09.22	REAFFIRMED & ISSUED AS STANDARD	JSK	VKS/HK	MKS	SM
5	14.03.18	REAFFIRMED & ISSUED AS STANDARD	RSD	VKS/HK	BRB	RN
4	21.11.13	REVISED & REISSUED AS STANDARD	BP	FA/SA	UAP/JMS	SC

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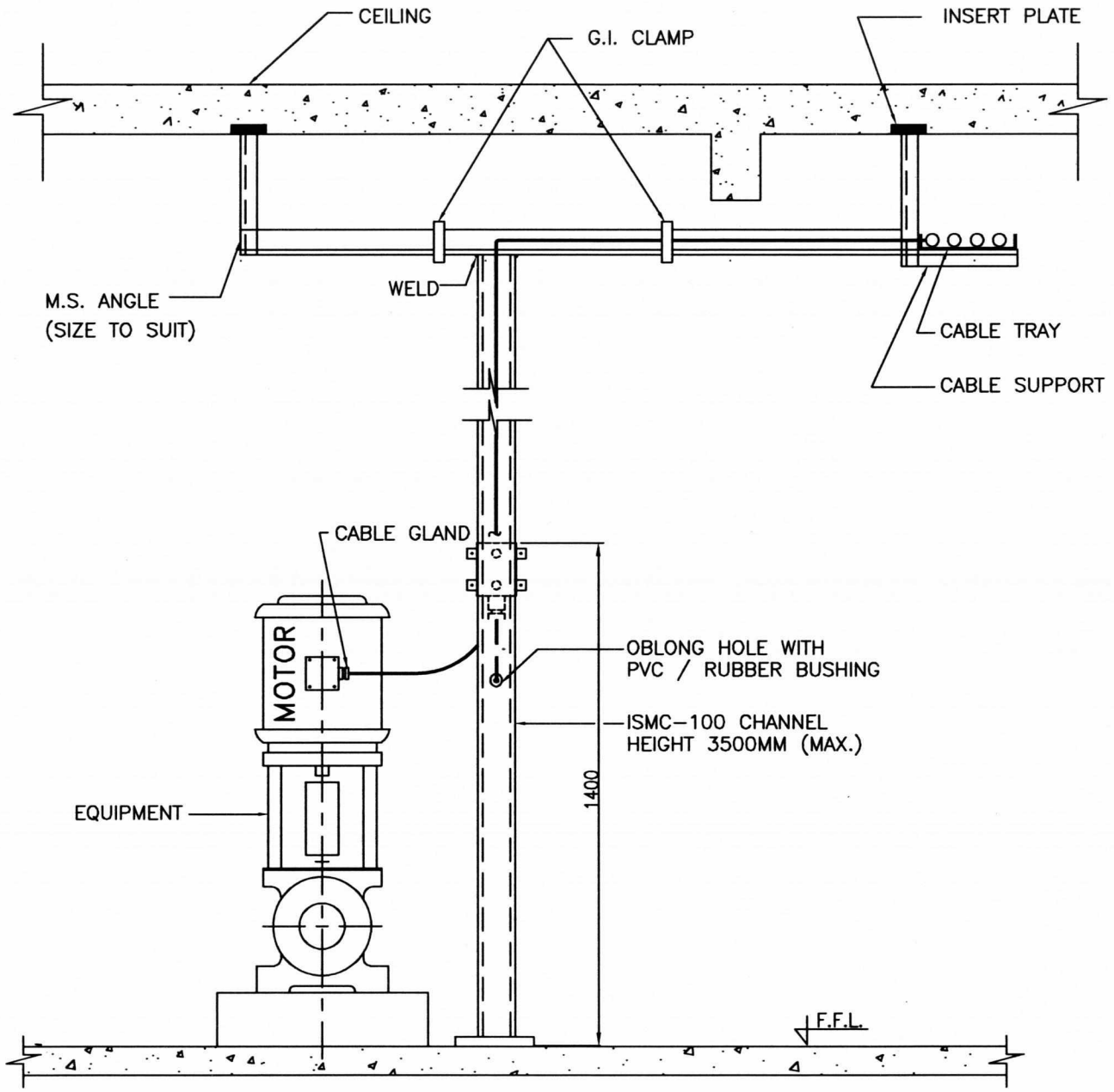

NOTES:–

1. ALL DIMENSIONS ARE IN MM.
2. WHEREVER FEASIBLE, MAIN CABLE TRAY CAN BE ROUTED IN SUCH A WAY THAT ISMC CHANNEL CAN BE DIRECTLY WELDED TO TRAY SUPPORT.

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6	15.09.22	REAFFIRMED & ISSUED AS STANDARD	JSK	VKS/HK	MKS	SM
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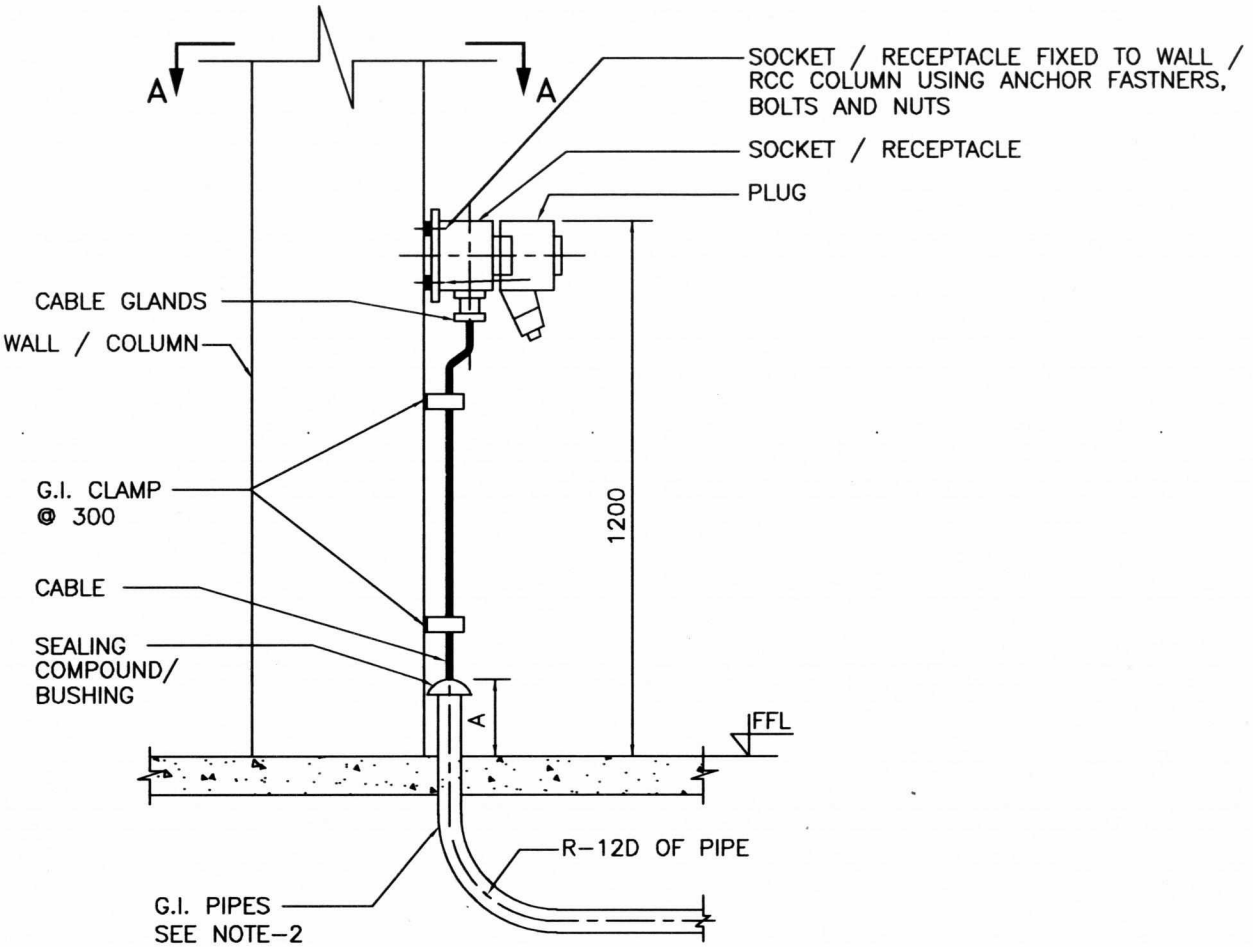
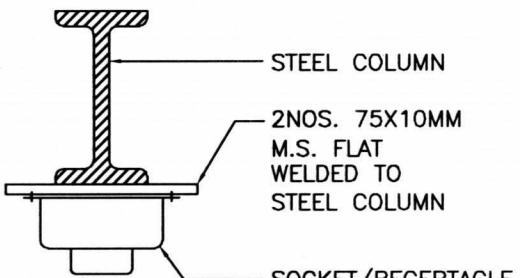
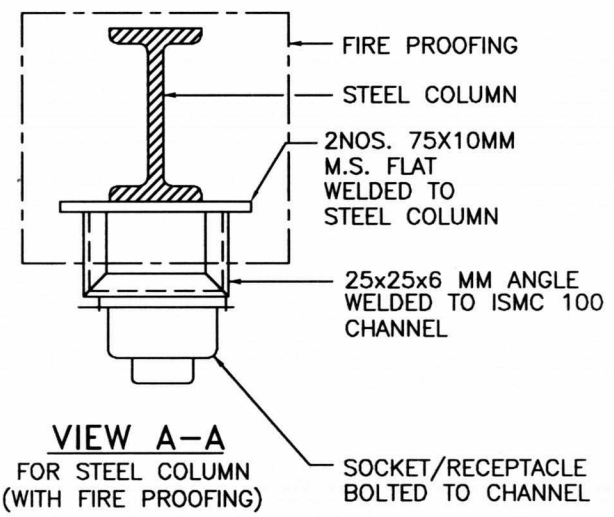




VIEW A-A
(FOR STEEL COLUMN WITHOUT FIRE PROOFING)

A = 150 MM (MIN.) FOR INDOOR LOCATIONS.
300 MM (MIN.) FOR OUTDOOR LOCATIONS.



VIEW A-A
FOR STEEL COLUMN (WITH FIRE PROOFING)

NOTES:-

1. ALL DIMENSIONS ARE IN MM.
2. QUANTITY AND SIZE OF PIPE SLEEVES SHALL BE AS PER LAYOUT DRAWINGS.
3. WHERE STEEL STRUCTURES ARE ENCOUNTERED, SOCKET / RECEPTACLE SHALL BE MOUNTED ON SUITABLE ANGLE IRON FRAME WELDED TO STEEL STRUCTURE.
4. WHERE FIRE PROOFING COLUMNS / STRUCTURES ARE ENCOUNTERED SOCKET / RECEPTACLE AND CABLE SHALL BE INSTALLED ON A SUITABLE DEEP LEGGED ANGLE IRON FRAME / DISTANCE BRACKET.

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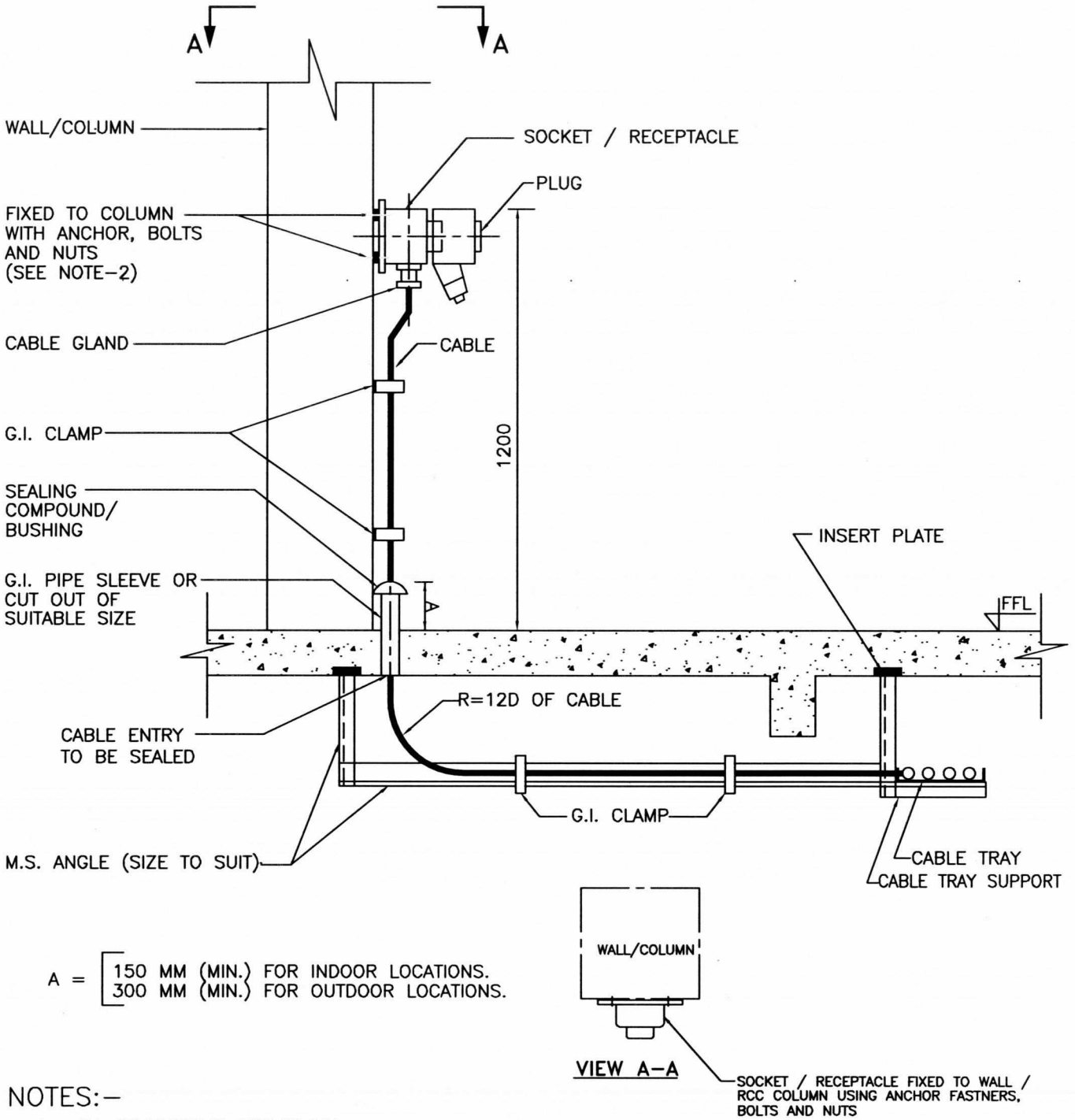

A = 150 MM (MIN.) FOR INDOOR LOCATIONS.
300 MM (MIN.) FOR OUTDOOR LOCATIONS.

VIEW A-A

NOTES:-

1. ALL DIMENSIONS ARE IN MM.
2. WHERE STEEL STRUCTURES ARE ENCOUNTERED, SOCKET / RECEPTACLE SHALL BE MOUNTED ON SUITABLE ANGLE IRON FRAME WELDED TO STEEL STRUCTURE.
3. WHERE FIRE PROOFING COLUMNS / STRUCTURES ARE ENCOUNTERED SOCKET / RECEPTACLE AND CABLE SHALL BE INSTALLED ON A SUITABLE DEEP LEGGED ANGLE IRON FRAME / DISTANCE BRACKET.
4. QUANTITY AND SIZE OF PIPE SLEEVES SHALL BE AS PER LAYOUT DRAWINGS.

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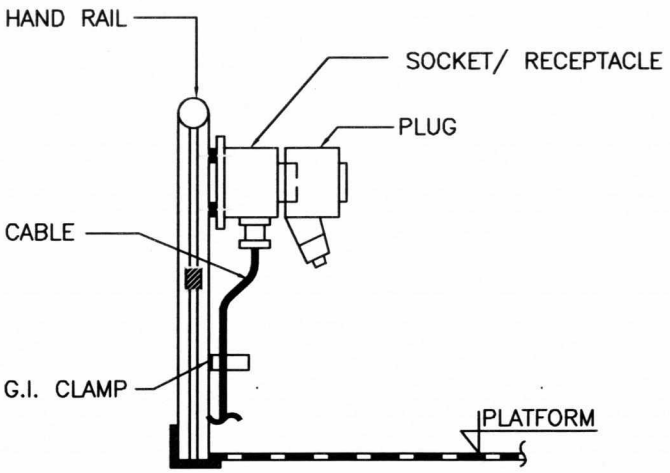

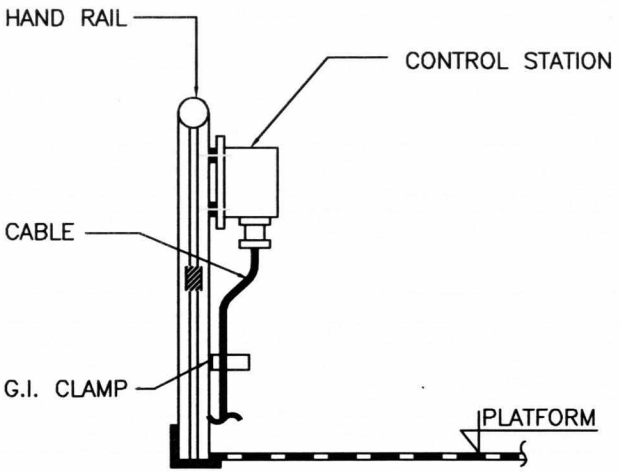

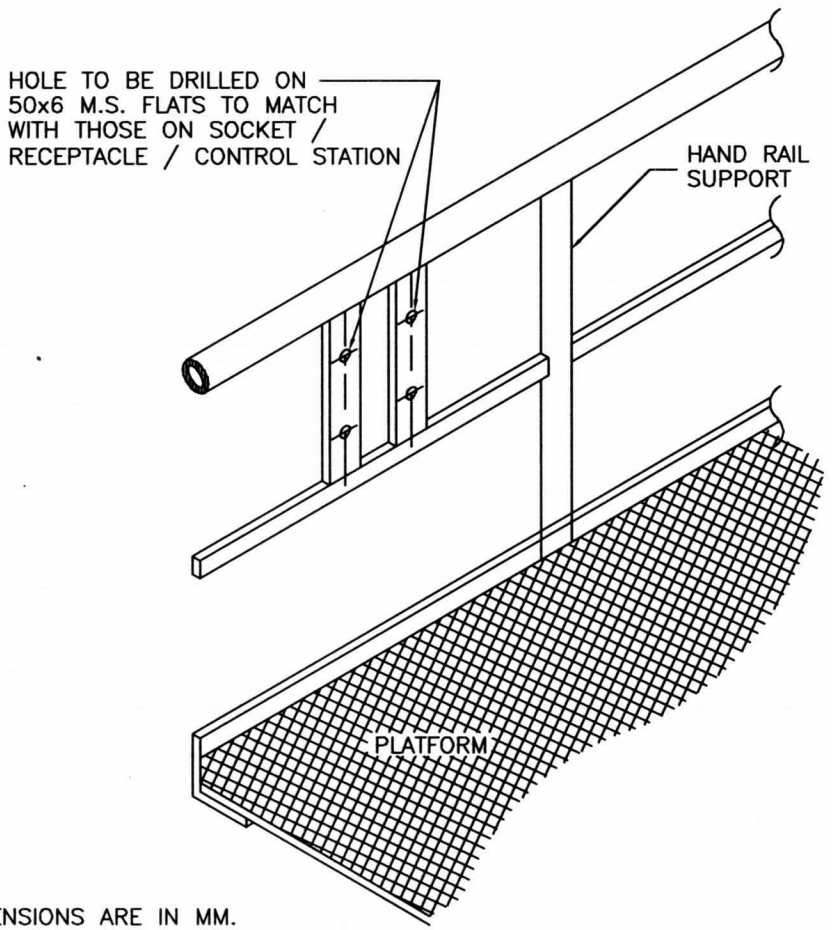

NOTES:–

1. ALL DIMENSIONS ARE IN MM.
2. CABLE SHALL NOT BE ROUTED ALONG HAND RAIL.

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ELECTRICAL POWER IS THE MAINSTAY OF ANY CONSTRUCTION ACTIVITY. AT THE SAME TIME IT REQUIRES UTMOST CARE IN IT'S UTILISATION TO AVOID ACCIDENTS DUE TO ELECTRICAL SHOCK, FIRE INCIDENTS OR ELECTRIC SHORT CIRCUITS. EXPOSURE OF ELECTRICAL INSTALLATION TO ADVERSE ENVIRONMENTAL CONDITIONS INCREASE THE RISK OF SUCH ACCIDENTS. HENCE IT IS NECESSARY TO TAKE EXTRA PRECAUTIONS FOR SUCH INSTALLATIONS TO ENSURE SAFETY OF PERSONNEL AND EQUIPMENT. THIS STANDARD ADDRESSES THE SAFETY MEASURES REQUIRED TO BE ADOPTED FOR THE ELECTRICAL INSTALLATIONS BY ALL CONTRACTORS DURING CONSTRUCTION PHASE.

1. ALL ELECTRICAL CONNECTIONS/WORK FOR ELECTRICAL INSTALLATIONS SHALL BE CARRIED OUT AS PER PROVISIONS OF THE LATEST REVISION OF THE FOLLOWING CODES AND STANDARDS IN ADDITION TO THE REQUIREMENTS OF STATUTORY AUTHORITIES AND CEA REGULATIONS–2010.
   OISD–STD–173 : FIRE PREVENTION AND PROTECTION SYSTEM FOR ELECTRICAL INSTALLATIONS.
   OISD–STD–192 : SAFETY PRACTICE DURING CONSTRUCTION.
   SP–30 (BIS) : NATIONAL ELECTRIC CODE.
   THE INSTALLATION SHALL HAVE APPROVAL FROM CONCERNED STATUTORY AUTHORITIES.

2. ALL ELECTRICAL CONNECTIONS SHALL BE DONE BY AN ELECTRICIAN WITH VALID LICENCE AND TO THE SATISFACTION OF ENGINEER–IN–CHARGE.

3. ONE COMPETENT LICENCED ELECTRICIAN SHALL BE MADE AVAILABLE BY CONTRACTOR AT SITE ROUND THE CLOCK TO ATTEND TO THE NORMAL/EMERGENCY JOBS.

4. ALL SWITCH BOARDS/WELDING MACHINES SHALL BE KEPT IN WELL VENTILATED & COVERED SHED. THE SHED SHALL BE ELEVATED TO AVOID WATER LOGGING. NO FLAMMABLE MATERIALS SHALL BE USED FOR CONSTRUCTING THE SHED. ALSO FLAMMABLE MATERIALS SHALL NOT BE STORED IN AND AROUND ELECTRICAL EQUIPMENT/SWITCHBOARD. ADEQUATE CLEARANCES AND OPERATIONAL SPACE SHALL BE PROVIDED AROUND THE EQUIPMENT.

5. FIRE EXTINGUISHERS AND INSULATING MATS SHALL BE PROVIDED IN ALL POWER DISTRIBUTION CENTERS.

6. TEMPORARY ELECTRICAL EQUIPMENT SHALL NOT BE EMPLOYED IN HAZARDOUS AREAS WITHOUT OBTAINING SAFETY PERMIT.

7. PROPER HOUSE KEEPING SHALL BE DONE AROUND THE ELECTRICAL INSTALLATIONS.

8. ALL TEMPORARY INSTALLATIONS SHALL BE TESTED BEFORE ENERGISING, TO ENSURE PROPER EARTHING, BONDING, SUITABILITY OF PROTECTION SYSTEM, ADEQUACY OF FEEDERS/CABLES ETC.

9. ALL WELDERS SHALL USE HAND GLOVES IRRESPECTIVE OF HOLDER VOLTAGE.

10. MULTILINGUAL (ENGLISH, HINDI AND LOCAL LANGUAGE) CAUTION BOARDS, SHOCK TREATMENT CHARTS AND INSTRUCTION PLATE CONTAINING LOCATION OF ISOLATION POINT FOR INCOMING SUPPLY, NAME & TELEPHONE NO. OF CONTACT PERSON IN EMERGENCY SHALL BE PROVIDED IN SUBSTATIONS AND NEAR ALL DISTRIBUTION BOARDS/LOCAL PANELS.

11. OPERATION OF EARTH LEAKAGE DEVICE SHALL BE CHECKED REGULARLY BY PORTABLE ELCB/RCCB TESTER.

12. THE FOLLOWING DESIGN FEATURES SHALL BE ENSURED FOR ALL ELECTRICAL INSTALLATIONS DURING CONSTRUCTION PHASE.

12.1 EACH INSTALLATION SHALL HAVE A MAIN SWITCH WITH A PROTECTIVE DEVICE, INSTALLED IN AN ENCLOSURE ADJACENT TO THE METERING POINT. THE OPERATING HEIGHT OF THE MAIN SWITCH SHALL NOT EXCEED 1.5 M. THE MAIN SWITCH SHALL BE CONNECTED TO THE POINT OF SUPPLY BY MEANS OF ARMOURED CABLE.

12.2 THE OUTGOING FEEDERS SHALL BE DOUBLE OR TRIPLE POLE SWITCHES WITH FUSES/MCBs. LOADS IN A THREE PHASE CIRCUIT SHALL BE BALANCED AS FAR AS POSSIBLE AND LOAD ON NEUTRAL SHOULD NOT EXCEED 20% OF LOAD IN THE PHASE.

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12.3 THE INSTALLATION SHALL BE ADEQUATELY PROTECTED AGAINST OVERLOAD, SHORT CIRCUIT AND EARTH LEAKAGE BY THE USE OF SUITABLE PROTECTIVE DEVICES. FUSES WHEREVER USED SHALL BE HRC TYPE. USE OF REWIRABLE FUSES SHALL BE STRICTLY PROHIBITED. THE EARTH LEAKAGE DEVICE SHALL HAVE AN OPERATING CURRENT NOT EXCEEDING 30 mA.

12.4 ALL CONNECTIONS TO THE HANDTOOLS/WELDING RECEPTACLES SHALL BE TAKEN THROUGH PROPER SWITCHES, SOCKETS AND PLUGS.

12.5 ALL SINGLE PHASE SOCKETS SHALL BE MINIMUM 3 PIN TYPE ONLY. ALL UNUSED SOCKETS SHALL BE PROVIDED WITH SOCKET CAPS.

12.6 ONLY 3 CORE (P+N+E) OVERALL SHEATHED FLEXIBLE CABLES WITH MINIMUM CONDUCTOR SIZE OF 1.5 MM^2 COPPER SHALL BE USED FOR ALL HAND TOOLS.

12.7 ONLY METALLIC DISTRIBUTION BOXES WITH DOUBLE EARTHING SHALL BE USED AT SITE. NO WOODEN BOXES SHALL BE USED.

12.8 ALL POWER CABLES SHALL BE TERMINATED WITH COMPRESSION TYPE NICKEL PLATED BRASS CABLE GLANDS. LUGS OF COPPER/ALUMINIUM/BIMETALLIC MATERIAL, AS APPLICABLE SHALL BE USED FOR MULTISTRAND WIRES/CABLES HAVING MUTISTRAND/SOLID CONDUCTOR.

12.9 CABLES SHALL BE FREE FROM ANY INSULATION DAMAGE.

12.10 CABLES SHALL BE LAID IN UNDERGROUND AT A MINIMUM DEPTH OF 750 MM, FOR LV & CONTROLS AND 900MM FOR HV CABLES COVERED WITH SAND, BRICK AND SOIL FOR ENSURING MECHANICAL PROTECTION. CABLES SHALL NOT BE LAID IN WATER LOGGED AREA AS FAR AS PRACTICABLE. CABLE ROUTE MARKERS SHALL BE PROVIDED AT EVERY 25 M OF BURIED TRENCH ROUTE. WHEN LAID ABOVE GROUND, CABLES SHALL BE PROPERLY CLEATED OR SUPPORTED ON RIGID POLES OF ATLEAST 2.1 M HIGH. MINIMUM HEAD CLEARANCE OF 6 METERS SHALL BE PROVIDED AT ROAD CROSSING.

12.11 UNDER GROUND CABLES SHALL NOT BE ALLOWED TO CROSS THE ROADS WITHOUT PIPE SLEEVE.

12.12 ALL CABLE JOINTS SHALL BE DONE WITH PROPER JOINTING KIT. NO TAPED/TEMPORARY JOINTS SHALL BE USED.

12.13 AN INDEPENDENT EARTHING FACILITY SHOULD PREFERABLY BE ESTABLISHED WITHIN THE TEMPORARY INSTALLATION PREMISES. ALL APPLIANCES AND EQUIPMENT SHALL BE ADEQUATELY EARTHED. IN CASE ARMOURED CABLES ARE USED, THE ARMOUR SHALL BE BONDED TO THE EARTHING SYSTEM.

12.14 ALL CABLES AND WIRE ROPE USED FOR EARTH CONNECTIONS SHALL BE TERMINATED THROUGH LUGS OF TINNED COPPER/ALUMINIUM/ BIMETALLIC MATERIAL, AS APPLICABLE.

12.15 IN CASE OF LOCAL EARTHING, EARTH ELECTRODES SHALL BE BURIED NEAR THE SUPPLY POINT AND EARTH CONTINUITY WIRE SHALL BE CONNECTED TO LOCAL EARTH PLATE FOR FURTHER DISTRIBUTION TO VARIOUS APPLIANCES. ALL INSULATED WIRES FOR EARTH CONNECTION SHALL HAVE INSULATION OF GREEN COLOUR.

12.16 SEPARATE CORE SHALL BE PROVIDED FOR NEUTRAL. EARTH/STRUCTURES SHALL NOT BE USED AS A NEUTRAL IN ANY CASE.

12.17 ON/OFF POSITION OF ALL SWITCHES SHALL BE CLEARLY DESIGNATED/PAINTED FOR EASY ISOLATION IN EMERGENCY.

13. ALL INSULATIONS AND ELECTRICAL INSTALLATIONS SHALL BE INSPECTED BY ENGINEER-IN-CHARGE ATLEAST ONCE IN A MONTH.

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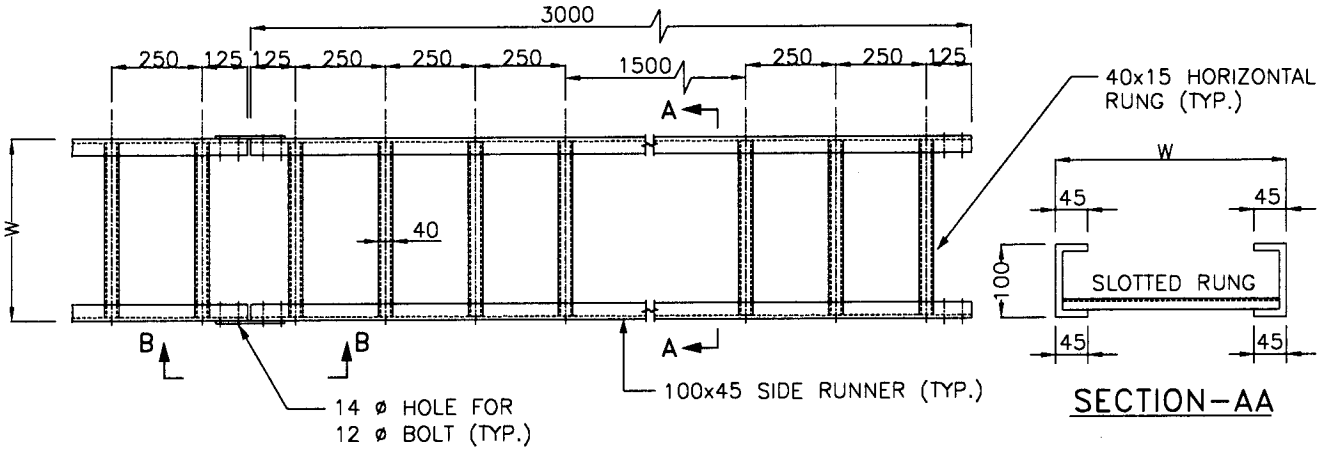
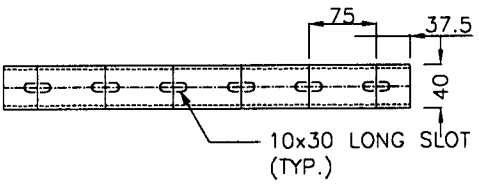
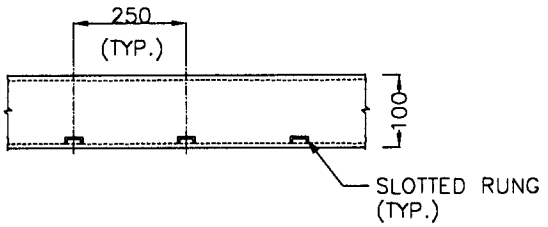


SECTION–AA

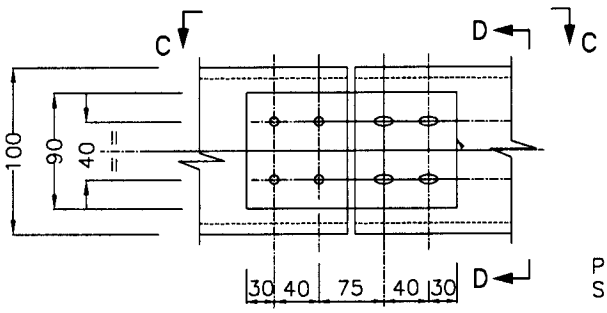
LADDER TYPE CABLE TRAY
(W=300/450/600/750/1000)



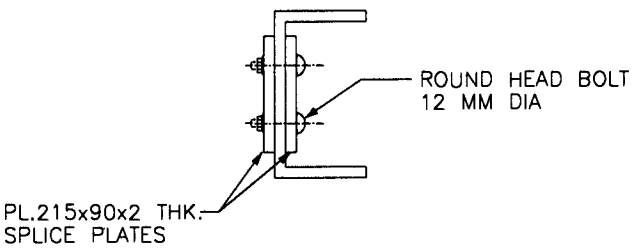
SLOTTED RUNG



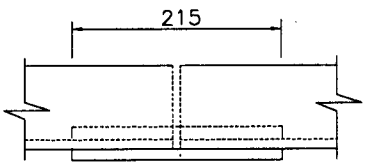
SIDE RUNNER



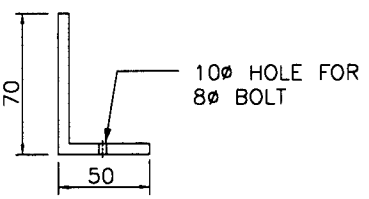
VIEW B–B



SECTION D–D



VIEW C–C



BARRIER PLATE
(100 MM LONG)

NOTES:–

1. 12 DIA ROUND HEAD BOLT WITH WASHERS & NUTS CONFORMING TO IS 1367 SHALL BE USED FOR FIXING OF SPLICE PLATE.

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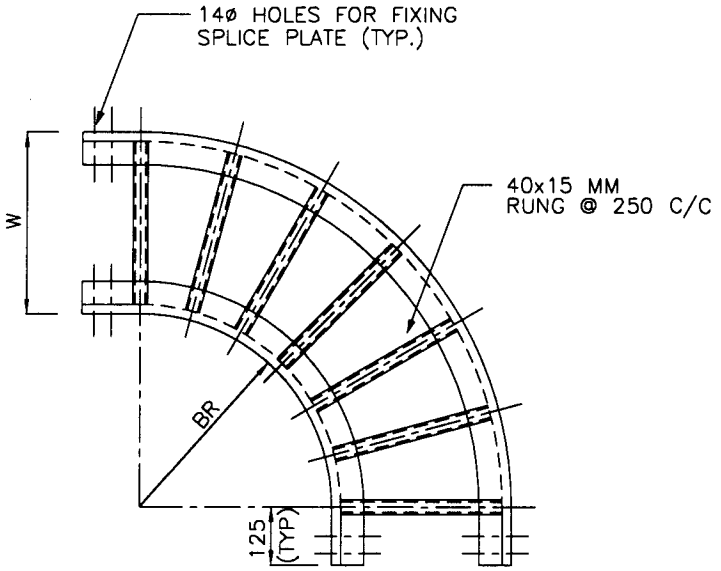
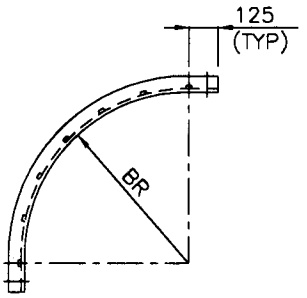
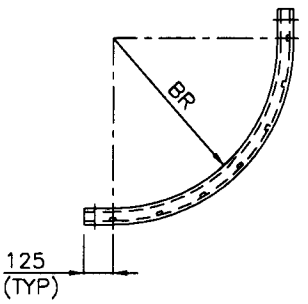


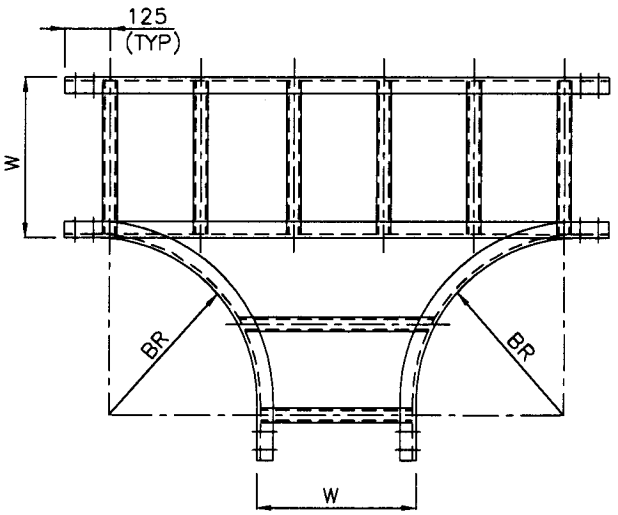
HORIZONTAL BEND



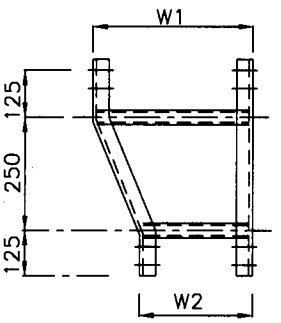
VERTICAL OUTSIDE BEND



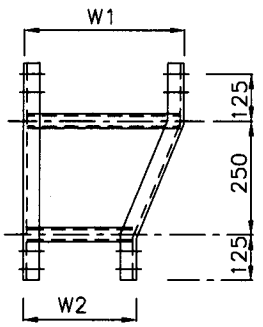
VERTICAL INSIDE BEND



'T' JOINT



LEFT HAND REDUCER



RIGHT HAND REDUCER

W – WIDTH OF CABLE TRAY (300/450/600/750/1000 MM)
W1 – WIDTH OF CABLE TRAY ON ONE SIDE
W2 – WIDTH OF CABLE TRAY ON OTHER SIDE
BR – BENDING RADIUS (750/1000/1250/1600/2000 MM)

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GENERAL NOTES:–

1. THE CABLE TRAYS AND ACCESSORIES SHALL COMPLY WITH LATEST EDITION OF INDIAN STANDARDS IS: 1367(PART–13), IS:2629, IS:5986.
2. THE CABLE TRAYS SHALL BE LADDER TYPE PREFABRICATED, HOT DIP GALVANIZED. THE LADDER TYPE TRAYS SHALL CONSIST OF SIDE RUNNERS & HORIZONTAL RUNGS AS PER DETAILS SHOWN IN PAGE 1 & 2.
3. THE LADDER TYPE TRAYS AND ACCESSORIES SHALL HAVE RIGID WELDED CONSTRUCTION AND SHALL BE FABRICATED OUT OF 2 mm THICK HOT ROLLED SHEET STEEL. THE RUNGS SHALL BE WELDED TO THE SIDE RUNNERS.
4. SIDE RUNNERS SHALL BE 100 x 45 mm CHANNEL INCLUDING FOR HOIZONTAL & VERTICAL BENDS WITH THE FLANGES FACING INSIDE. RUNGS SHALL BE 40 x 15 mm SLOTTED CHANNEL TYPE.
5. CABLE TRAYS SHALL BE SUITABLE FOR A CABLE WEIGHT OF 75 kg PER METRE OF RUNNING LENGTH OF TRAY AND SHALL BE SUPPORTED AT 3 m INTERVALS. IN ADDITION, TRAYS SHALL BE SUITABLE FOR A POINT LOAD OF 70 kg (EQUIVALENT WEIGHT OF A MAN WORKING ON THE CABLE TRAY).
6. EACH SIDE RUNNER CHANNELS SHALL BE CONNECTED AT ENDS USING 2 SPLICE PLATES ONE ON EACH SIDE AS SHOWN IN PAGE 1.
7. THE SIDE RUNNER WILL ALSO HAVE SUITABLE HOLES AT EVERY METRE FOR CLEATING EARTHING STRIP. SUITABLE THREADED HOLES SHALL BE PROVIDED ON THE RUNNER TOP AND BOTTOM FOR SUPPORTING AND FIXING TRAY COVERS WITH SCREWS AT EVERY METRE.
8. HOT DIP GALVANIZING SHALL BE DONE AFTER FABRICATION AS PER THE RELEVANT INDIAN STANDARD SPECIFICATIONS. THE AMOUNT OF GALVANIZING SHALL BE MINIMUM 610 g/m^2.
9. THE TYPE OF CONSTRUCTION SHALL BE SUCH AS TO FACILITATE EASY HANDLING, ASSEMBLY AND INSTALLATION AT SITE. FOR THE CONSTRUCTION OF CABLE TRAYS THE STANDARD STRAIGHT LENGTH OF CABLE TRAY SHALL BE 3 METERS UNLESS OTHERWISE SPECIFIED.
10. SPLICE PLATE OF CABLE TRAYS SHALL BE PLACED NOT MORE THAN 750 MM FROM SUPPORT ANGLE.
11. THE WORKMANSHIP SHALL BE SUCH AS TO ENSURE EASY LAYING OF CABLES WITHOUT CAUSING DAMAGE TO CABLES. ALL SURFACES SHALL BE FREE FROM DEFECTS SUCH AS BURRS, SHARP EDGES ETC.
12. THE HARDWARE SHALL CONFORM TO THE RELEVANT INDIAN STANDARD SPECIFICATIONS AND SHALL BE ABLE TO WITHSTAND THE MAXIMUM LOADING CONDITIONS AS REQUIRED. ALL HARDWARE AND FITTINGS SHALL BE STAINLESS STEEL SS–304. HARDWARE SHALL INCLUDE BOLTS, NUTS, WASHERS ETC.
13. THE BENDS, TEES, REDUCERS AND DROPPERS SHALL HAVE A BENDING RADIUS AS DESCRIBED IN THE SCHEDULE OF RATES.
14. THE FOLLOWING TESTS FOR THE AMOUNT OF ZINC COATING SHALL BE CARRIED OUT:
    - THICKNESS OF GALVANIZED COATING BY ELCOMETER.
    - MASS OF GALVANIZED COATING BY STRIPPING TEST.
    - DETERMINATION OF UNIFORMITY OF GALVANIZED COATING.

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3	10.07.17	REAFFIRMED & ISSUED AS STANDARD	BP	FA/HK	BRB	RN

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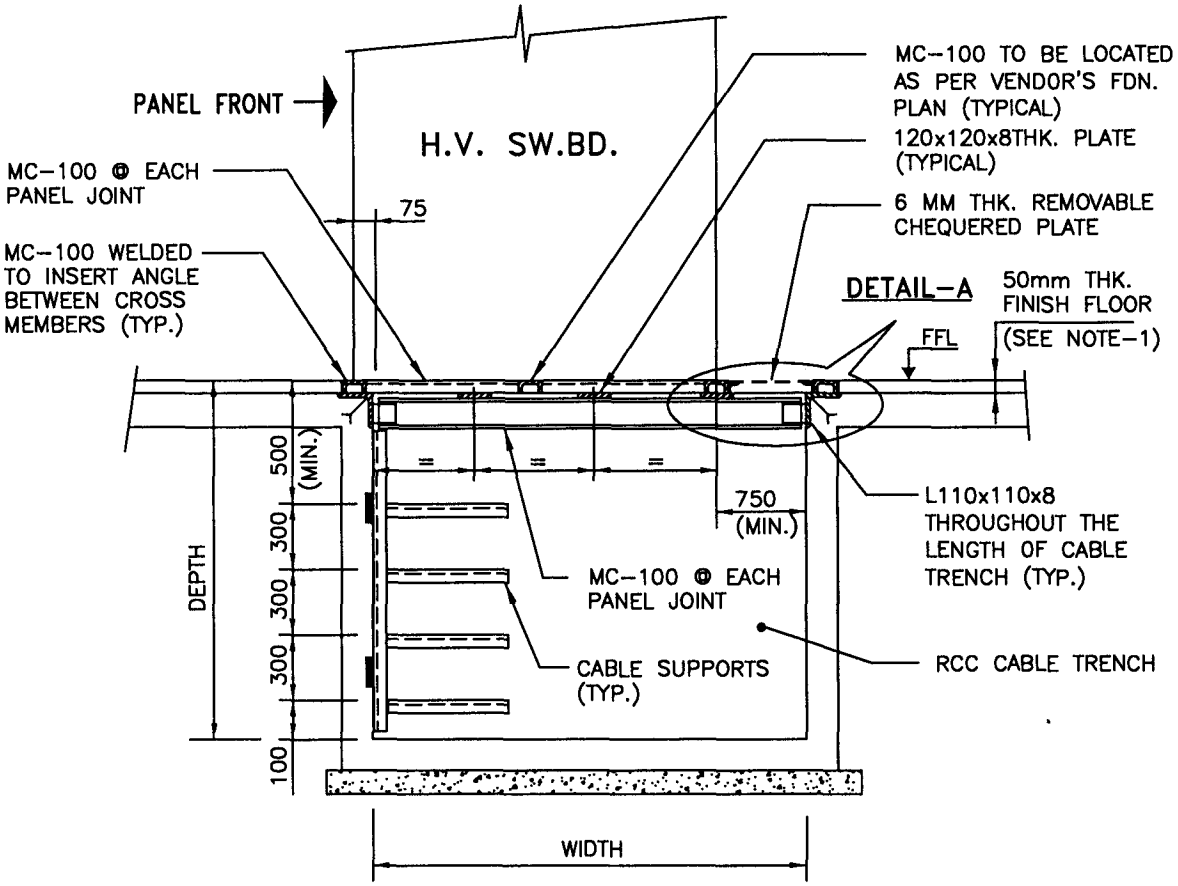
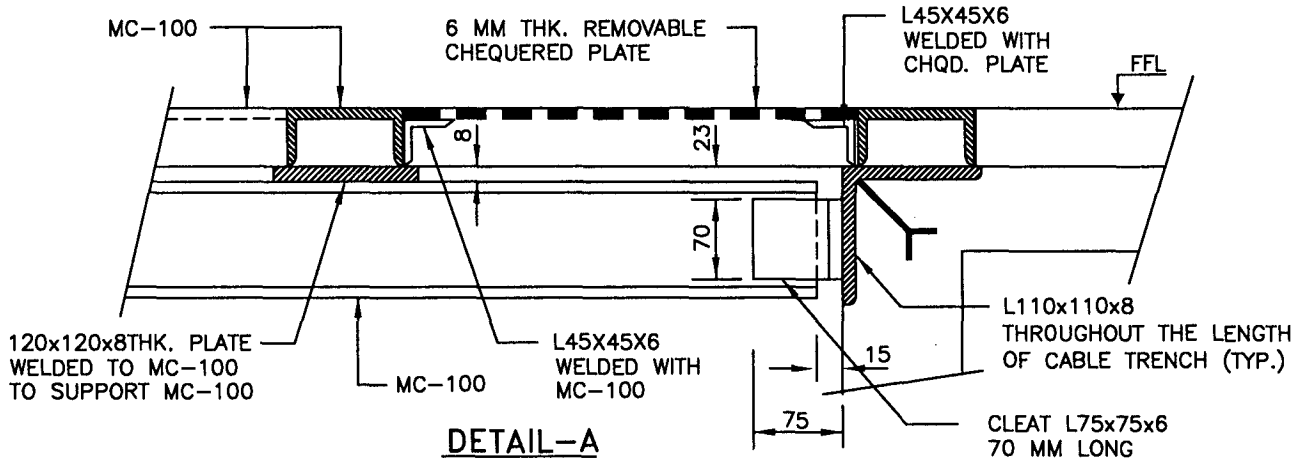


TYPICAL INSTALLATION DETAIL OF H.V. SWITCHBOARD (FOR REMOTE LOCATION SUB STATION)

(UPTO 11KV AND FOR MAXIMUM 3 CABLES PER PHASE)



NOTES:-

1. 50 THICK FINISH FLOORING SHALL BE DONE ONLY AFTER INSTALLATION OF BASE FRAME
2. ALL PANELS SHALL BE TACK WELDED WITH BASE FRAME OF SWITCHBOARD.
3. UNUSED PORTION OF CUTOUTS SHALL BE COVERED WITH 6 MM THICK CHEQUERED PLATES.
4. WIDTH OF TRENCH TO SUIT THE DIMENSIONS OF SWITCHBOARD SHALL BE AS PER AFC DRAWING OF THE PROJECT.

Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman
4	29.11.21	UPDATED & ISSUED AS STANDARD	JSK	VKS/HK	PG	SM
3	08.11.16	REVISED & ISSUED AS STANDARD	BP	FA/HK	BRB	RN
2	02.03.12	REAFFIRMED & ISSUED	BP	RKS/RSC	UAP/JMS	DM

Approved by

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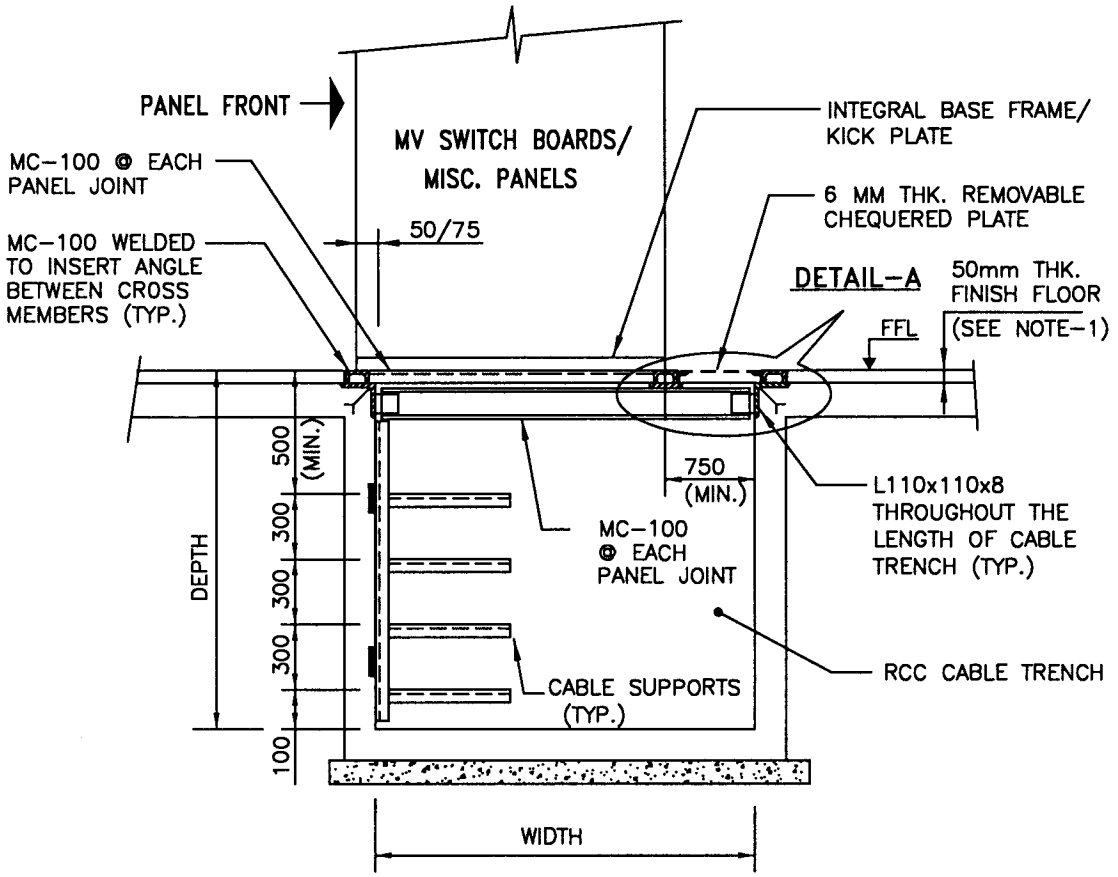
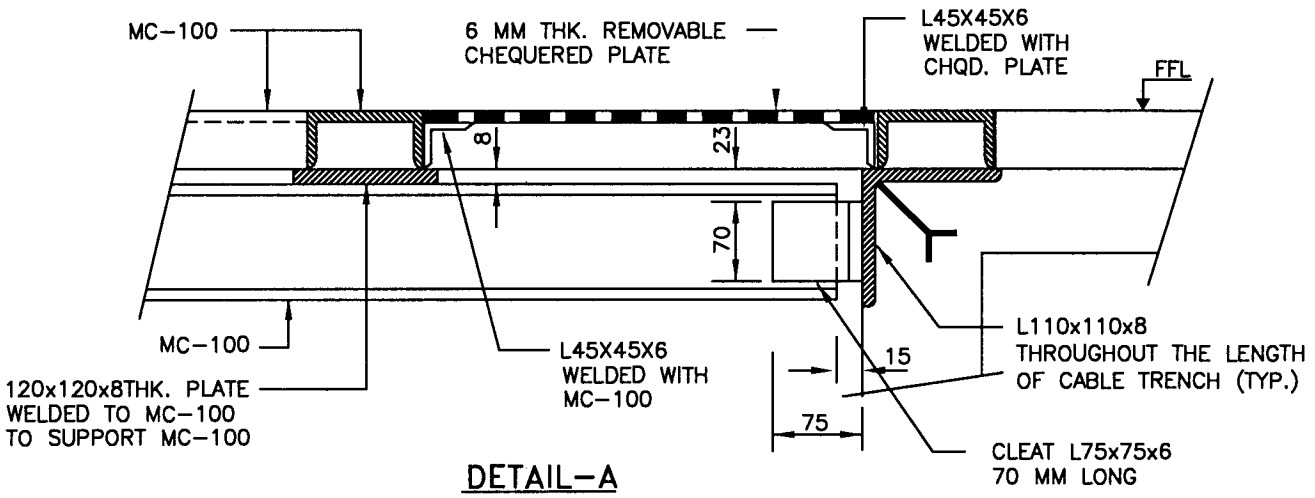


TYPICAL INSTALLATION DETAIL OF M.V. PANELS ON CABLE TRENCH



DETAIL–A

NOTES:–

1. 50 THICK FINISH FLOORING SHALL BE DONE ONLY AFTER INSTALLATION OF BASE FRAME
2. ALL PANELS SHALL BE TACK WELDED WITH BASE FRAME OF SWITCHBOARD.
3. UNUSED PORTION OF CUTOUTS SHALL BE COVERED WITH 6 MM THICK CHEQUERED PLATES.
4. WIDTH OF TRENCH TO SUIT THE DIMENSIONS OF SWITCHBOARD SHALL BE AS PER AFC DRAWING OF THE PROJECT.

Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman
					Approved by	
4	29.11.21	UPDATED & ISSUED AS STANDARD	JSK	VKS/HK	PG	SM
3	08.11.16	REVISED & ISSUED AS STANDARD	BP	FA/HK	BRB	RN
2	02.03.12	REAFFIRMED & ISSUED	BP	RKS/RSC	UAP/JMS	DM

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पैकेज इकाइयों के लिए साइट निष्पादन गारंटी अपेक्षाएँ तैयार करने हेतु विक्रेता को अनुदेश

INSTRUCTIONS TO VENDOR FOR SITE PERFORMANCE GUARANTEE REQUIREMENTS FOR PACKAGE UNITS

Rev. No	Date	Purpose	Prepared by	Checked by	Standards Committee Convenor	Standards Bureau Chairman
					Approved by	
2	30.03.2019	Reaffirmed & Reissued	RRS	PPP	RP	RKT
1	30.05.2008	Revised & Reissued	SMA	PKR	AA	VC
0	10.11.2003	ISSUED AS STANDARD	PKR	PM	VC	SKG

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Abbreviations:

LSTK	:	Lumpsum Turnkey
PG	:	Performance Guarantee

General Engg. Standards Committee

Convenor : Ms R Priyamvada (Convenor)

Members :
Mr BR Bhogal (Elect.)
Mr Rajan Srivastava (Strl.)
Mr RB Bhutda (EWS)
Mr Amrendra Kumar (Piping)
Ms NP Guha (Projects)
Mr Amit Prakash (FEM)
Mr KJ Harinarayanan (SME)
Mr VK Tonger (Process-1)
Mr Satyabrata Biswas (Process-2)

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1.0 INTRODUCTION

As a part of engineering services, EIL procures different types of Package Units for various Projects, for and on behalf of the Owner/Purchaser. The vendor is required to design, engineer, manufacture/ procure, inspect, test and supply to site, and also in many cases construct/erect, commission and Performance test the Package Units before handing over the same to Owner/Purchaser, based on Process and Technical requirements defined in the Inquiry/Order document.

2.0 PURPOSE

This document provides instructions to Vendor for Site Performance Guarantee (PG) Requirements for Package Units and shall form a part of the contract, wherever site performance guarantee test is specified in the Inquiry/Order document. The aim is to provide clarity to the Vendor as well as the Commissioning team on site performance guarantee parameters, their measurements during PG Test, and the acceptance of the Package Unit by the Owner/Purchaser after the successful PG Test.

3.0 SCOPE

The requirements of this standard are applicable for all Package Units including LSTK Bid Packages, which require Performance Guarantee Test, after installation and commissioning of the unit at site.

4.0 DEFINITIONS

4.1 "Vendor" means the person(s), company, organization from whom EIL procures products/services as a part of services rendered to the Owner/Purchaser. "Contractor", "Supplier" are considered synonymous to "Vendor".

4.2 "Owner" means the person(s), company, organization to whom EIL is rendering services for the Project.

4.3 "Purchaser" means the person(s), company, organization which awards order for the Package Unit on the Vendor.

5.0 PERFORMANCE GUARANTEE TESTING AT SITE

5.1 General

5.1.1 The overall performance testing of the completely assembled/erected Package unit as a whole shall be carried out at site to establish the performance guarantee parameters specified in Inquiry/Order document. In addition, certain critical equipment/sub-packages may also be performance tested at site if so specified in Inquiry/Order document. The duration of site performance guarantee run shall be as defined in the Inquiry/order document.

The measured parameters, where necessary, shall be adjusted to account for the variation in ambient/operating conditions actually prevailing at site during performance testing, before comparing it with the guaranteed value.

5.1.2 Performance test shall be carried out as per relevant Codes, Standards and Specifications. The Vendor shall submit the following during detail engineering and the same shall be subject to Owner/Purchaser's approval:

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- Detailed Test procedure including measurement tolerances, if applicable, calculations/ correction curves for changes in ambient/ operating conditions, and complete test layout, etc.

- Site Performance Guarantee Test Proforma completed in line with enclosed format 7-76-0103-F1.

- Vendor shall list out parameters to be measured and corresponding installed instrument type and tag no. to be used for measurements. Any instrument/measurement device, (required for testing) not installed at site, shall be arranged by vendor. Vendor shall furnish list of such instruments alongwith instrument details.

- Log sheets indicating all parameters that are to be recorded.

- Method of computation of test results including interpretation of test results.

5.2 Test Instruments

All necessary test instruments required for measuring the performance guarantee parameters shall be arranged by the vendor free of charge. These instruments shall be tested & calibrated from reputed test houses like National Physical Laboratories (NPL), Institute for Design of Electrical Measuring Instruments (IDEMI), Electronics Regional Test Laboratories (ERTL) or any other test house approved by the Owner. All test instruments shall have valid calibration reports. The Vendor shall furnish calibration certificates before putting them to use and also, wherever applicable, after completion of the PG test.

5.3 Performance Guarantee Parameters

Guarantee performance parameters shall be as defined in the Process/Mechanical data sheets, Specification, etc. included in the Inquiry/Order document.

5.4 Repair/Rectification/Modification

5.4.1 In case the unit fails to meet the guaranteed parameters, the Vendor shall carryout, necessary repair, rectification and modification within the time frame defined in the contract or as mutually agreed with the Owner/Purchaser, at his own risk and cost to establish the guaranteed parameters in the final performance test. All costs involved for above activities i.e. supply of manpower, materials, consumables and machines etc. shall be to Vendor's account.

5.4.2 Inspite of repair/rectification, incase the guaranteed performance parameters are not met, penalty/rejection as defined in the contract document for shortfall from guaranteed performance parameters shall be applied.

6.0 SITE PERFORMANCE GUARANTEE TEST PROFORMA

Typical Proforma shown in enclosed Format 7-76-0103-F1, shall be used for assessment of Performance guarantee parameters during site PG test.

7.0 ATTACHMENTS

Format No. 7-76-0103-F1	:	SITE PERFORMANCE GUARANTEE TEST PROFORMA.

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Page 2209 of 2811 : B895-TENDER DOC-B895-999-81-46-CF-T-8202 : Rev. A

SITE PERFORMANCE GUARANTEE TEST PROFORMA

Client : *
Package Unit/System: *

Project/Location : *
Order No. : *

EIL Job No. : *
Vendor : *

1. **PACKAGE OPERATING CONDITION (FOR GUARANTEE):**

Operating Parameter	Values as per Inquiry/Order	Value (Actual at site)
*	*	

2. **PERFORMANCE :**

SITE PERFORMANCE TEST PROCEDURE DOC. NO: *

TEST PERIOD:

Parameter (1) *	Measuring Unit (2) *	Guaranteed Value (3) *	Permissible Tolerance (4) *	Measured Value at site (5)	Value after correction for site conditions (6)	Deviation (6) w.r.t.- (3)	Remarks (Acceptable-Y/N) (7)
a)							
b)							
c)							
d)							
e)							

Vendor's Representative
Date

Owner's Commissioning Incharge
Date

Owner
Date

* TO BE FILLED-UP AND/OR DEVELOPED BY VENDOR & SUBMITTED ALONGWITH PERFORMANCE TEST PROCEDURE.

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3. OBSERVATIONS:

4. CONCLUSIONS :

Vendor's Representative	**Owner's Commissioning Incharge**	**Owner**
Date	Date	Date

Copy : Engineer-In-Charge.

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PROJECT	PMC & EPCM SERVICES FOR PPU & REVAMP OF PFCC	CLIENT	BPCL, KOCHI		
PLANT	PPU, KOCHI REFINERY	JOB NO	B895	UNIT	999

GENERAL			
	CODES		IS: 5290 AND EIL SPEC. 6-66-0012.
	LOCATION		OUTDOOR
	TYPE		WET BARREL, VERTICAL STAND POST WITH TYPE-A LANDING VALVES, DOUBLE HEADED (2 TYPE-A LANDING VALVES PER HYDRANT POST) WITHOUT PUMPER CONNECTION, 75 MM SIZE.
OPERATING CONDITIONS			
	FLUID HANDLED		FRESH WATER
	TEMPERATURE		AMBIENT
	PRESSURE	MAX.	13.50 KG/CM2g
		MIN.	7.0 KG/CM^2g
	FLOW RATE		900 lpm PER VALVE @ 7 KG/CM^2g
	HEIGHT OF HORIZONTAL ARMS		AS PER DRAWING
DESIGN FEATURES			
	VERTICAL POST DIAMETER.		100 MM
	HORIZONTAL HYDRANT ARM DIAMETER.		75 MM
	HOSE CONNECTOR	COUPLING	INSTANTANEOUS, FEMALE, 63 MM AS PER IS: 903.
		VALVE	TYPE A, IS: 5290, 75 MM SIZE (2 VALVES PER HYDRANT POST)
MATERIALS			
	HYDRANT VERTICAL POST/ARMS/CAP		AS PER PIPING MATERIAL SPECIFICATION CLASS
	FLANGE	BASE	AS PER PIPING MATERIAL SPECIFICATION CLASS
		ARM	ANSI B 16.5, S.O., FF, 150# (ASTM A-105)
	LANDING VALVES		SS 316
	HOSE CONNECTOR		SS-316
	CAP		SS-316
	CHAIN		SS-316
TEST & INSPECTION			
	DIMENSION & WORKMANSHIP		YES
	HYDROSTATIC TEST PRESSURE		21KG/CM^2.G
	WATER TIGHTNESS		14KG/CM^2.G
	FLOW		YES, 900 LPM PER VALVE @ 7 KG/CM^2g
PAINTING			
	VALVES	OUTSIDE	THE VALVE TOP EXCEPT THE FACE OF FLANGE AND THE INSTANTANEOUS OUTLET SHALL BE PAINTED FIRE RED AS PER IS: 5. THE OUTSIDE OF INSTANTANEOUS OUTLET SHALL BE HIGHLY POLISHED. THE HANDWHEEL SHALL BE PAINTED BLACK. PAINTS SHALL CONFORM TO IS: 2932.
	STAND POST & ITS ARMS	OUTSIDE	3 COATS OF ANTI-COROSIVE FIRE RED PAINT AS PER IS: 2932 AND CONFORMING TO SHADE NO. 536 OF IS: 5, OVER 2 COATS OF RED OXIDE ZINC CHROMATE PRIMER OR SINGLE COAT OF ALUMINIUM PAINT. THE HANDWHEEL SHALL BE PAINTED BLACK. PAINTS SHALL CONFORM TO IS: 2932.
		INTERNAL SURFACE	3 COATS OF CHLORINATED RUBBER BASED RESIN PAINT OR ZINC CHROMATE PAINT, OVER 2 COATS OF RED OXIDE ZINC CHROMATE PRIMER OR SINGLE COAT OF ALUMINIUM PAINT.

2

NOTES:

1. FOR DETAILED SPECIFICATION, REFER EIL SPEC. NO. 6-66-0012. REFER DRAWING NO B895-999-81-45-30205 FOR DETAIL DRAWING FOR HYDRANT ASSEMBLY. ANNEXURE-1 ATTACHED WITH THE EIL SPEC. NO. 6-66-0012 IS NOT BE APPLICABLE FOR HYDRANT ASSEMBLY.
2. IN CASE OF ANY CONFLICT BETWEEN DATA GIVEN HERE WITH DATA GIVEN IN THE STD. SPEC. NO. 6-66-0012, DATA SHEET SHALL BE GIVEN PREFERENCE.
3. HYDRANTS SHALL BE BIS MARKED AND APPROVED.

NO	DATE	REVISION	BY	CHK.	APP.
2	27.03.2025	REISSUED FOR BIDS	BSM	LP	AK
1	20.02.2025	REISSUED FOR BIDS	BSM	LP	AK
0	28.11.2024	ISSUED FOR BIDS	BSM	LP	AK

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PROJECT	PP PROJECT	CLIENT	BPCL, KOCHI		
		JOB NO	B895	UNIT	999

GENERAL			
	CODES		IS: 884
	LOCATION		INDOOR / OUTDOOR
	TYPE		SWINGING TYPE (WALL MOUNTED)
OPERATING CONDITIONS			
	FLUID HANDLED		FRESH WATER
	TEMPERATURE		AMBIENT
	PRESSURE	MAX.	13.5KG/CM^{2}g
		MIN.	7.0 KG/CM^{2}g
DESIGN FEATURES			
	BODY	OPERATION TYPE	MANUAL.
		MOVEMENT	SWINGING (180°) WALL MOUNTING TYPE
		INLET CONNECTION	SIZE 1" (25mm)
		OUTLET CONNECTION	THREADS AS PER IS: 2643 (PART I).
	PERFORMANCE	NOZZEL PRESSURE	7.0 KG/CM^{2}g.
		FLOW RATE	SHALL NOT BE LESS THAN 24 LPM AT 7 KG/CM2 g
		MIN. DISCHARGE RANGE	SHALL NOT BE LESS THAN 6m AT 7 KG/CM2g.
MATERIALS			
	HUB		M.S. IS: 513
	SIDES		M.S. IS: 513
	SUPPORT FRAME		M.S. IS: 513
	SWIVEL JOINT		SS-316
	HOSE REEL TUBING		BRAIDED RUBBER
	STRAIGHT JET TYPE NOZZLE WITH BRANCH PIPE AND COUPLING		SS 316
	STOP VALVE		SS 316
TEST & INSPECTION			
	DIMENSION & WORKMANSHIP		AS PER IS:884
	PERFORMANCE TEST		AS PER IS:884
	HYDROSTATIC TEST PRESSURE FOR HOSE		7 KG/CM^{2}g FOR 5 MINUTES WITHOUT ANY LEAKAGE.
	BURSTING PRESSURE FOR HOSE		30 KG/CM^{2}g.
PAINTING			
	BODY (ABOVE GROUND)		FIRE RED PAINT AS PER IS: 2932 (CONFORMING TO SHADE NO. 536 OF IS: 5), OVER 2 COATS OF RED OXIDE ZINC CHROMATE PRIMER OR SINGLE COAT OF ALUMINIUM PAINT& SHALL BE SUITABLE FOR CORROSIVE ENVIRONMENT.

NOTES:

1. FOR DETAILED SPECIFICATION, REFER EIL SPEC. NO. 6-66-0018.
2. IN CASE OF ANY CONFLICT BETWEEN DATA GIVEN HERE WITH DATA GIVEN IN THE STD. SPEC. NO. 6-66-0018, DATA SHEET SHALL BE GIVEN PREFERENCE.
3. HOSE REEL TUBING LENGTH SHALL BE 40 M WITH INTERNAL BORE 25 MM.ONE 6MM BORE JET ON/OFF SPRAY NOZZLE.
4. HOSE REEL VALVES SHALL BE OF SS 316.
5. VENDOR / CONTRACTOR TO PROVIDE ADDITIONAL CANTILEVER SUPPORT FOR THE WALL-MOUNTED HOSE REEL. IT SHALL BE WITH STAND AFTER CHARGING WITH WATER.

REV.	DATE	REVISION	BY	CHK	APP.
1	27.03.2025	REISSUED FOR BIDS	BSM	LP	AK
0	26.11.2024	ISSUED FOR BIDS	BSM	LP	AK

1

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PROJECT	PP PROJECT	CLIENT	BPCL, KOCHI		
		JOB NO	B895	UNIT NO	999

1	**GENERAL**	
2	TYPE	TYPE-II
3	LOCATION	INDOOR/OUTDOOR
4		
5	**MECHANICAL DATA**	
6	DELIVERY HOSE SIZE	63 MM
7	LENGTH OF HOSE	15 M
8		
9	**MATERIALS**	
10	BODY	18 GAUGE M.S. SHEET
11	DOORS	M.S. FRAME WITH GLASS COVER
12	HAMMER	MILD STEEL
13	CHAIN	G.I.
14	UNIVERSAL BRANCE PIPE	SS 316, CONFORMING TO IS:2871
15	END COUPLING/JET NOZZLE/BRANCH PIPE	SS 316, CONFORMING TO IS:903
16	DELIVERY HOSE	TYPE 3, AS PER IS:636
17	STANDARD HANDLE TYPE LOCKS	MAKE-GODREJ, MORTISE OR EQUIVALENT
19	**PAINTING**	
20	OUTSIDE	3 COATS OF ANTICORROSIVE FIRE RED PAINT CONFIRMING TO SHADE NO.
		536 OF IS:5. THIS PAINT SHALL CONFIRM TO IS: 2932
21	INSIDE	WHITE PAINT
22		
23	**UNIT WEIGHT**	
24	EMPTY	*
25	TOTAL	*

NOTES:

1. * TO BE FILLED BY VENDOR.
2. FOR DETAILED SPECIFICATION, REFER EIL SPEC. NO. 6-66-0047.
3. TYPE-II HOSE CABINET SHALL BE SUPPLIED WITH TWO TYPE '3' DELIVERY HOSES WITH END COUPLINGS, ONE JET NOZZLES WITH BRANCH PIPE (BORE DIA 1 INCH) AND ONE UNIVERSAL BRANCH PIPE, SELF SUPPORTING TYPE, NECESSARY HANGERS AND BRACKET FOR HOSE, NOZZLE AND BRANCH PIPE WITH DOUBLE PANEL GLASS DOOR.
4. IN CASE OF ANY CONFLICT BETWEEN DATA GIVEN HERE WITH DATA GIVEN IN THE STD. SPEC. NO. 6-66-0047, DATA SHEET SHALL BE GIVEN PREFERENCE.

NO	DATE	REVISION	BY	CHK	APP
0	28.11.2024	ISSUED FOR BIDS	BSM	LP	AK

ENGINEERS INDIA LTD NEW DELHI	**HOSE CABINET**	DATASHEET B895-999-81-45-DS-8013	REV 0

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EIL-0241-676-123-REV-0/97

PROJECT	PMC & EPCM SERVICES FOR PPU & REVAMP OF PFCC	CLIENT	BPCL, KOCHI		
		JOB NO	B895	UNIT	999

GENERAL	
CODES	AS PER MANUFACTURER STANDARD
WORKING PRESSURE	7.0 KG/CM^2
INLET CONNECTION	1" (MALE, NPT THREADED)
MATERIAL OF CONSTRUCTION	
BODY	SS 316 CONFORMING TO IS: 3444, GR - IV
BALL & 'O'- RING	RUBBER CONFORMING TO IS: 937
TEST & INSPECTION	
SHAPE, DIMENSION & WORKMANSHIP	AS PER MANUFACTURER STANDARD
HYDROSTATIC TEST FOR EACH ASSEMBLED UNIT	21 KG/CM^2 FOR 2 ½ MINUTE (SHALL SHOW NO SIGN OF LEAKAGE)
MARKING	EACH AIR RELEASE VALVE SHALL BE CLEARLY MARKED ON ITS BODY WITH FOLLOWING INFORMATION ALONG WITH THE PURCHASER'S NAME 1. MANUFACTURER'S NAME OR TRADEMARK 2. YEAR OF MANUFACTURE

NOTES:

1. CLIENT OR ITS AUTHORIZED REPRESENTATIVE SHALL ALWAYS HAVE ACCESS TO THE MANUFACTURER'S WORK IN WHICH THE AIR RELEASE VALVES ARE MANUFACTURED, ASSEMBLED AND/OR TESTED. INSPECTION OF EQUIPMENT SHALL BE AS PER APPROVED QAP.
2. HYDROSTATIC PRESSURE TEST CERTIFICATES OF AIR RELEASE VALVE SHALL BE SUBMITTED AT THE TIME OF DELIVERY OF MATERIAL.

REV.	DATE	REVISION	PREPD	CHKD	APPD
A	21.02.2025	ISSUED FOR COMMENTS/TEDNER	LP	AK	AK

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DATASHEET FOR LED LIGHTING FIXTURE SCHEDULE

PROJECT : PPU & REVAMP OF PFCCU

UNIT NO. : 000

CLIENT : M/s BPCL, KOCHI REFINERY

EPCM : M/s ENGINEERS INDIA LTD.

JOB NO. : B895

Rev	Date	Purpose	Prepared By	Checked By	Approved By
B	20.02.2025	ISSUED WITH BID PACKAGE	NNB	AS	RS
A	04.10.2024	ISSUED WITH BID PACKAGE	NNB	AS	RS

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S. No.	Light Fixture - Description	Makes & Catalogue Nos.
1.	**LED IND-1**: Surface mounted / Pendant Type LED Tube Lights for Office or Commercial Buildings – completely integral with in-built linear SMD LEDs/ electronic drivers / length of 1200 mm (4 Feet) for a minimum rating of 20 Watts.	• Bajaj : BLRB 18W LED XE • Crompton : LSDL –20- CDL ; • Philips : TMC501 With TLED 1X18W/4FT Master LED Tube • Pyrotech: PC-14-D-L-WXOA/18W Or Equivalent Models.
2.	**LED IND-2**: Surface mounted / Pendant Type Integral LED Tube Lights for Industrial Warehouses /Workshops / Sub-Stations – completely integral with in-built linear SMD LEDs / electronic drivers / length of 1200 mm (4 Feet) for a minimum rating of 36 Watts. An alternative solution for conventional 2x28 W/2x36 W fluorescent Battens.	• Philips : TMC 501 With TLED 2X18W/4FT Master LED Tube • Crompton : LDL -36 – CDL; • Bajaj : BLRB 218W LED XE • Pyrotech: PC-14-D-L-WXOA/36W Or Equivalent Models
3.	**LED IND-3**: Surface mounted / Pendant Type Integral LED Tube Lights for industrial outdoor /weatherproof applications & IP-65 Ingress Protection – completely integral with in-built linear SMD LEDs / electronic drivers / length of 1200 mm (4 Feet) for a minimum rating of 36 Watts.	• Bajaj : Linea Excel {BIPC 40W LED XE}; • Crompton : Shield {IPFC1LT8/16 & 2X LGT8-20-865-2; • Philips : Endura LED Waterproof – 42 Watts; WT550 C LED 40S CW PSU S1 PC; Or Equivalent Models.
4.	**LED IND-4**: Surface mounted / Pendant Type Integral LED Tube Lights for Industrial Warehouses /Workshops / Sub-Stations – completely integral with in-built linear SMD LEDs / electronic drivers / length of 1200 mm (4 Feet) for a minimum rating of 36 Watts. An alternative solution for conventional 2x28 W/2x36 W fluorescent Battens.(Suitable for Mounting on Metsec Channel with white enameled reflector)	• Crompton: Master LED tube 1200mm-18W 869 T8 • Bajaj: BLRB 218W LED XE Or Equivalent Models.
5.	**LED-1:** Recess mounted, compact / slim panel / tile light in square shape – suitable for mounting in 2 Feet X 2 Feet Grid type False Ceiling with minimum 35 Watts rating & White Color – with built-in driver & all mounting accessories.	• Bajaj : ""Armstorme" {BZRSQL 36W WH GZi}; • Crompton : LCTLRNI-36-FO-CDL • Philips : RC 420B LED 35S PSU W60L60 • Pyrotech: PB-12-D-L-WXOA/36W Or Equivalent Models.
6.	**LED-2:** Recess mounted, compact / slim panel / tile light in square shape – suitable for mounting in 2 Feet X 2 Feet Grid type False Ceiling White Color – with minimum 50 Watts rating and with built-in driver & all mounting accessories.	• Crompton: LCTLRN-50-FO-CDL • Bajaj: BZRSQL 43W LED GZi WH Or Equivalent Models.

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7.	**LED -3:** Recess mounted, compact / flat, round or square shaped LED down-lighter in white finish – suitable for mounting in gypsum / Armstrong type false ceiling – with minimum 18 Watts rating & White Color – with built-in driver and all mounting accessories.	• Bajaj : SLEEK Round / Square {BGSLO Sleek 18W WH RD / SQ}; • Crompton : QUARTZ Round / Square {LCDE or LSDE-18W-CDL/NW }; • Philips : Green LEDi {DN 195B LED 20S – 6500PSU WHS1}; • Pyrotech: PB-12-D-L-WXOA/18W Or Equivalent Models.
8.	**LED -4:** Recess Mounted Adjustable / Swivel LED spot-light / COB Light with tilting (Gimbal) feature and a minimum rating of 20 Watts & golden yellow / white color light – with white round / square frame, built-in driver, suitable for mounting on gypsum false-ceiling & all mounting accessories.	• Philips : ECO Accent Recessed Adjustable {RS271B LED 20/850 PSU-E WB WH}; • Bajaj : KLASS Series COB {BRDCSL 16 W WW}; • Crompton : AQUA COB LED {LR-RAD-20-CDL/NDL-24/50D}; Or Equivalent Models.
9.	**LED -5:** Surface Mounted – Ceiling Tile LED Fixture of dimensions 2 Feet X 2 Feet – suitable for direct ceiling mounting - with minimum 35 Watts rating & White Color – with built-in driver & all mounting accessories.	• Crompton : ORION-I – LCTLSN-36-CDL • Bajaj : BZSSQL 36W LED • Philips : CIRRUS – SM365C LED33-6500 PSU-OD WH • Pyrotech: PB-12-D-L-WXOA/36W Or Equivalent Models.
10.	**LED -6 :** Surface mounted round or square shaped LED down-lighter in white finish – suitable for direct ceiling mounting – with minimum 18 Watts rating & White Color – with built-in driver and all mounting accessories.	• Crompton : Pearl II – Round / Square {LCDSPLN- R-18-CDL / LCDSPLN-S-18-CDL}; • Bajaj : Sleek – Round / Square– BGSLO Sleek Surface 18 W WH RD / BGSLO Sleek Surface 18W WH SQ}; • Philips : Cirrus Mini {SM5 18C LED 16S 6500PSU OD WH} • Pyrotech: PB-13-D-L-WXOA/18W Or Equivalent Models.
11.	**LED -7:** Surface mounted round or square shaped LED Dome -lights – suitable for direct wall mounting – with minimum 18 Watts rating & White Color – with built-in driver and all mounting accessories.	• Philips : CoreLine Wall-Mounted {WL120V LED12S / 840 PSR WH}; • Bajaj : Sleek – Round / Square– BGSLO Sleek Surface 18 W WH RD / BGSLO Sleek Surface 18W WH SQ}; • Crompton : Orbit {LCDSPLN-R-18-CDL}; Or Equivalent Models.
12.	**LED -8:** Rechargeable Batten type LED Fixtures of minimum 4 Watts rating - with inbuilt sealed rechargeable Battery / Cell suitable for operation at 240 Volts AC and with a minimum battery back-up time of 2 hours.	• Philips – Ujjwal Plus LED Lantern; • Bajaj LED Glow 648 LR Rechargeable Lantern; • Crompton - CG-LL30 LED Rechargeable Lantern; Or Equivalent Models.

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13.	**LED RSD-10:** LED Fixture suitable for 110V DC complete with 18W LED Lamp, driver, including other materials as applicable for installation (Recess mounted)	• Pyrotech (PB-13-P-L-WXOA/18W) Or Equivalent Models.
14.	**LED SFD-12:** LED Fixture suitable for 110V DC complete with 18W LED Lamp, driver, including other materials as applicable for installation (Surface mounted)	• Pyrotech (PB-13-P-L-WXOB/18W) Or Equivalent Models.
15.	**LED LB–1:** Indoor Industrial Low Bay LED Luminaries - with high pressure die-cast aluminum housing, mirror / lens optics (heat- resistant) for symmetric light distribution and high system efficacy for a rating of 80 Watts up to 100 Watts – complete with integral electronic LED drivers, heat sinks for efficient heat dissipation & all mounting accessories.	• Bajaj : Duranto Highbay Luminaire 100 Watts{BGHB 100W LED GV}; • Crompton : SURROUND -II LHB11-70-CDL/60 - 70Watts; • Philips : GreenPerform Highbay G2 – 80 Watts{BY689P LED 90/NW PSU S-NB}; • Pyrotech: PD-17-D-L-WXOA/90W Or Equivalent Models.
16.	**LED HB-1:** Indoor Industrial Medium Bay LED Luminaries - with high pressure die-cast aluminum housing, mirror / lens optics (heat- resistant) for symmetric light distribution and high system efficacy for a rating of 120 Watts up to 150 Watts – complete with integral electronic LED drivers, heat sinks for efficient heat dissipation & all mounting accessories.	• Bajaj : Duranto Highbay Luminaire 150 Watts{BGHB 150W LED}; • Crompton : : SURROND-II {LHB11-110-CDL/60 -110 Watts}; • Philips : GreenPerform Highbay G2 – 130 Watts{BY688P LED 140/NW PSR S-NB}; • Pyrotech: PD-17-D-L-WXOA/150W Or Equivalent Models.
17.	**LED –HB2:** Indoor Industrial High Bay LED Luminaries - with high pressure die-cast aluminum housing, mirror / lens optics (heat- resistant) for symmetric light distribution and high system efficacy for a rating above 180 Watts – complete with integral electronic LED drivers, heat sinks for efficient heat dissipation & all mounting accessories.	• Bajaj : Duranto Highbay Luminaire 200 Watts{BGHB 200W LED}; • Crompton : Crompton : LHB11-180-CDL/60- 180Watts; • Philips : Green Perform Highbay G2 – 200 Watts{BY687P LED200/NW PSR S-WB L3000}; • Pyrotech: PD-17-D-L-WXOA/180W Or Equivalent Models.
18.	**LED STP-12** Flexible LED Strip with IP65 protection with IP65 LED driver for continuous operation.	• PHILIPS : BGC201 RGB L5000 • BAJAJ : - STRIP LIGHT BENT • CROMPTON: LED STRIP LST SERIES IP65 WH / WW / NW+IP 65 Driver

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OUTDOOR LED LIGHT FIXTURES		
19.	**LED BK -1:** Outdoor Surface Mounted Bulkhead LED Lights – with die-cast aluminum housing / toughened glass lens and minimum IP -65 ingress protection of minimum 10 watts rating – complete with integral type electronic drivers & all mounting accessories.	• Bajaj : Wee Plus {BIBWP 10 W LED} Crompton : Sunrise LED Bulkhead {LBH-10- CDL}; • Philips : Vista Glow WT140W LED7S CW PSU S1 PC; • Pyrotech: PP-11-D-L-WXOA/10W Or Equivalent Models.
20.	**LED BK -2:** Outdoor Surface Mounted Bulkhead LED Lights – with die-cast aluminum housing / toughened glass lens and minimum IP -65 ingress protection of minimum 30 watts rating – complete with integral type electronic drivers & all mounting accessories.	• Pyrotech: PP-11-D-L-WXOA/30W Or Equivalent Models.
19A.	**LED BK-3:** Outdoor type well glass light fixture with LED lamp, LED driver, reflectors, mounting hardwares, clamps and brackets etc. and minimum IP-65 ingress protection. This lighting shall be suitable for operation on 240V AC supplies and platform type light poles. Light Output i.e. LUMENS of fixture 6000 to 6500 LM and min. 100 LM/Watt.	Equivalent models
21.	**LED ST-4 :** LED Street Light Fixtures with Leaf / Sleek Type design & SMD or COB Type LEDs for high system efficacy & rating of 80 Watts to 100 Watts – having powder coated Pressure Die-Cast Aluminum Body & toughened glass visor fitted in a frame & completely integral – with all mounting accessories. The fixture enclosure shall have minimum IP 65 ingress protection.	• Bajaj : EDGE Streetlight – 90 Watts {BRLEP 90W LED}; • Crompton : NEXUS STAR - 90 Watts {LSTP-90-CDL}; • Philips : Green Line V2 BRP410 LED 092 CW HE NR FG S2 PSU GR; • Pyrotech: PP-11-D-L-WXOA/10W Or Equivalent Models.
22.	**LED ST-10 :** LED Street Light Fixtures with Leaf / Sleek Type design & SMD or COB Type LEDs for high system efficacy & rating of 120 Watts having powder coated Pressure Die-Cast Aluminum Body & toughened glass visor fitted in a frame & completely integral – with all mounting accessories. The fixture enclosure shall have minimum IP 65 ingress protection.	• Crompton: LSTP120 CDL • Bajaj:- BRTFG 120W LED Or Equivalent Models.
23.	**LED ST-11 :** LED Street Light Fixtures with Leaf / Sleek Type design & SMD or COB Type LEDs for high system efficacy & rating of 120 Watts to 150 Watts – having powder coated Pressure Die-Cast Aluminum Body & toughened glass visor fitted in a frame & completely integral – with all mounting accessories. The fixture enclosure shall have minimum IP 65 ingress protection.	• Bajaj : Edge Streetlight – 150 Watts {BRTFG 135W LED}; • Crompton : 135 Watts {LSTP-135- CDL};; • Philips : Greenline Extra BRP322 LED 122 CW HE MR PC S3 XT; • Pyrotech: PE-11-D-L-WXOA/150W Or Equivalent Models.
24.	**LED FD-1:**	• Philips : Uniflood 2 Series Flood Light -

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	LED Flood-Light Fixtures with COB or SMD Type LEDs and high system efficacy for a rating of 80 Watts up to 110 Watts – complete with integral electronic LED drivers, heat sinks for efficient heat dissipation & all mounting accessories – suitable for outdoor installation & having a minimum IP 65 ingress protection. The Flood-Light fixtures shall have powder-coated pressure die-cast & Aluminum Body & toughened glass front cover.	110Watts {BVP122 LED110 CW FLNB FG XTFC}; • Crompton : OMEGA LED Flood Light – 110 Watts{LFLN11-110-CDL/60}; • Bajaj : Force Flood Light – 100 Watts {BJFL 100W LED I}; • Pyrotech: PD-17-D-L-WXOA/110W Or Equivalent Models.
25.	**LED FD-2:** LED Flood-Light Fixtures with COB or SMD Type LEDs and high system efficacy for a rating of 150 Watts up to 200 Watts – complete with integral electronic LED drivers, heat sinks for efficient heat dissipation & all mounting accessories – suitable for outdoor installation & having a minimum IP 65 ingress protection. The Flood-Light fixtures shall have powder-coated pressure die-cast & Aluminum Body & toughened glass front cover.	• Philips : Tempo Series LED Flood Lights – 172Watts { BVP410 LED 172 CW HE NB FG S3 XT}; • Crompton : 200 Watts LED Flood Lights {LFLN11-200-CDL/60};; • Bajaj : Turbo Flood Light – 200 Watts {BJFL 200W LED I}; • Pyrotech: PD-17-D-L-WXOA/200W Or Equivalent Models.
26.	**LED FD-3:** LED Flood-Light Fixtures with COB or SMD Type LEDs and high system efficacy for a rating of 250 Watts & above – complete with integral electronic LED drivers, heat sinks for efficient heat dissipation & all mounting accessories – suitable for outdoor installation & having a minimum IP 65 ingress protection. The Flood-Light fixtures shall have powder-coated pressure die-cast & Aluminum Body & toughened glass front cover.	• Philips : Tempo Series LED Flood Lights – 252Watts {BVP410 LED 252 CW HE AK55 FG S3XTFC}; • Crompton : MAGPIE – 250 Watts LED Flood Lights{LFLPI-250-CDL/60}; • Bajaj : Turbo Flood Light – 350 Watts {BJFL 350W LED I}; • Pyrotech: PD-17-D-L-WXOA/250W Or Equivalent Models.
27.	**LED FD-9:** LED Flood-Light Fixtures with COB or SMD Type LEDs and high system efficacy for a rating of 400 Watt & above – complete with integral electronic LED drivers, heat sinks for efficient heat dissipation & all mounting accessories – suitable for outdoor installation & having a minimum IP 65 ingress protection. The Flood-Light fixtures shall have powder-coated pressure die-cast & Aluminum Body & toughened glass front cover.	• Crompton: MAGPIE+ LFLPI-400-CDL/60 • Bajaj: BJFL 400W LED IP66 • Philips: Tango G3 BVP383 LED450/CW 400W 220-240V SWB IN; • Pyrotech: PD-17-D-L-WXOA/500W Or Equivalent Models
28.	**LED BL-1:** Integral decorative LED Bollard Luminaries with opal acrylic diffusers of minimum 8 Watts rating & suitable for landscape lighting with IP-65 Ingress Protection and anti-corrosive powder-coated die-cast aluminum housing – complete with all mounting accessories (anchor bolts / base-plates)	• Bajaj : Tetris LED Bollard {BGBOS 600 9W LED}; • Crompton : Maya-III COB LED Bollard {LBLA3-10- CDL}; • Philips : City Cube Series LED Bollard - 8.5 Watts{BCP400 LED04 U CW PSU GR S1}; • Pyrotech: PD-15-D-L-WXOA Or Equivalent Models.
29.	**LED PT-1** LED Post Top Lantern type fixture. Lumen Output shall be equivalent to that of 80W HPMV	• Bajaj BLTSP 25W NW LED (Globe) Or Equivalent Models.

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OUTDOOR TYPE FIXTURES			
FLAMEPROOF LIGHTING FIXTURE (ZONE-1 AND 2)			
S.NO.	**FIXTURE NO.**	**DESCRIPTION**	**WATTAGE**
1.	FLP-LED-1	Flameproof well glass/linear LED lighting fixture suitable for use in zone-1/2 & gas group IIA/IIB classified areas complete with LED lamp, LED driver, reflectors, mounting hardwares, clamps & brackets etc. This Lighting fixtures shall be suitable for operation on 240V AC supplies. **(Light Output i.e. LUMENS of fixture 4000 to 4500 LM and min. 100 LM/Watt.)**	Up to 45 W
2.	FLP-LED-1 IIC	Flameproof well glass/linear LED lighting fixture suitable for use in zone-1/2 & gas group IIC classified areas complete with LED lamp, LED driver, reflectors, mounting hardwares, clamps & brackets etc. This Lighting fixtures shall be suitable for operation on 240V AC supplies. **(Light Output i.e. LUMENS of fixture 4000 to 4500 LM and min. 100 LM/Watt.)**	Up to 45 W
3.	LED FLP-2 IIA/IIB	Flameproof and weatherproof LED cluster based aviation obstruction light suitable for use in zone-1/2 & gas group IIA/IIB classified areas complete with LEDs (Twin type) with LED Lamp, driver, including other materials as applicable for installation.	Up to 60W (Medium Intensity)
4.	LED FLP-2 IIC	Flameproof and weatherproof LED cluster based aviation obstruction light suitable for use in zone-1/2 & gas group IIC classified areas complete with LEDs (Twin type) with LED Lamp, driver, including other materials as applicable for Installation.	Up to 60W (Medium Intensity)
5.	LED FLP IIC-3	Flameproof & WP Well glass lighting fixture with LED Lamp, driver, including other materials as applicable for installation for use in IIC classified areas. **(Light Output i.e. LUMENS of fixture 4000 to 4500 LM and min. 100 LM/Watt.)**	Up to 45 W
6.	LED ExnR-4	Weatherproof well glass non sparking restricted breathing type lighting fixture for use in zone-1/2 & gas group IIA/IIB classified areas but with LED lamp, LED driver, reflectors, mounting hardwares, clamps & brackets etc. **(Light Output i.e. LUMENS of fixture 6000 to 6500 LM and min. 100 LM/Watt.)**	Upto 65 W

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7.	LED FLP-4 IIA/IIB	Flameproof & WP Well glass lighting fixture with LED Lamp, driver, including other materials as applicable for installation for use in zone-1/2 & gas group IIA/IIB Classified areas. **(Light Output i.e. LUMENS of fixture 6000 to 6500 LM and min. 100 LM/Watt.)**	Upto 65 W
8.	LED FLP-4 IIC	Flameproof & WP Well glass lighting fixture with LED Lamp, driver, including other materials as applicable for installation for use in zone-1/2 & gas group IIC Classified areas. **(Light Output i.e. LUMENS of fixture 6000 to 6500 LM and min. 100 LM/Watt.)**	Upto 65 W
9.	LED ExnR-5	Weatherproof well glass non sparking restricted breathing type lighting fixture for use in zone-1/2 with LED lamp with LED driver, reflectors, mounting hardwares, clamps & brackets etc.. **(Light Output i.e. LUMENS of fixture 13500 to 14000 LM and min. 100 LM/Watt.)**	Upto 140 W
10.	LED FLP-5 IIA/IIB	Flameproof & WP Well glass lighting fixture with LED Lamp, driver, including other materials as applicable for installation for use in zone-1/2 & gas group IIA/IIB Classified areas. **(Light Output i.e. LUMENS of fixture 13500 to 14000 LM and min. 100 LM/Watt.)**	Up to 140 W
11.	LED FLP-5 IIC	Flameproof & WP Well glass lighting fixture with LED Lamp, driver, including other materials as applicable for installation for use in zone-1/2 & gas group IIC, Classified areas. **(Light Output i.e. LUMENS of fixture 13500 to 14000 LM and min. 100 LM/Watt.)**	Up to 140 W
12.	LED ExnR-6	Weatherproof well glass non sparking restricted breathing type lighting fixture for use in zone-1/2 with LED lamp with LED driver, reflectors, mounting hardwares, clamps & brackets etc.. **(Light Output i.e. LUMENS of fixture 22500 to 23000 LM and min. 100 LM/Watt.)**	Up to 230 W
13.	LED FLP-6 IIA/IIB	Flameproof and weatherproof flood Lighting fixture with LED Lamp, driver, including other materials as applicable for installation for use in zone-1/2 & gas group IIA/IIB, Classified areas. **(Light Output i.e. LUMENS of fixture 22500 to 23000 LM and min. 100 LM/Watt.)**	Up to 230 W
14.	LED FLP-6 IIC	Flameproof and weatherproof flood Lighting fixture with LED Lamp, driver, including other materials as applicable for installation for use in zone-1/2 & gas group IIC, Classified areas. **(Light Output i.e. LUMENS of fixture 22500 to 23000 LM and min. 100 LM/Watt.)**	Up to 230 W

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15.	LED ExnR-7	Weatherproof flood light non sparking restricted breathing type lighting fixture for use in zone-1/2 & with LED lamp with LED driver, reflectors, mounting hardwares, clamps & brackets etc.. **(Light Output i.e. LUMENS of fixture 13500 to 14000 LM and min. 100 LM/Watt.)**	Up to 140 W
16.	LED FLP-7 IIA/IIB	Flameproof and weatherproof flood Lighting fixture with LED Lamp, driver, including other materials as applicable for installation for use in zone-1/2 & gas group IIA/IIB, Classified areas. **(Light Output i.e. LUMENS of fixture 13500 to 14000 LM and min. 100 LM/Watt.)**	Up to 140 W
17.	LED FLP-7 IIC	Flameproof and weatherproof flood Lighting fixture with LED Lamp, driver, including other materials as applicable for installation for use in zone-1/2 & gas group IIC, Classified areas. **(Light Output i.e. LUMENS of fixture 13500 to**	Up to 140 W
18.	FLP LED1 IIA/IIB	Flameproof well glass/linear LED lighting fixture suitable for use in zone-1/2 & gas group IIA/IIB classified areas complete with LED lamp, LED driver, reflectors, mounting hardwares, clamps & brackets etc. This Lighting fixtures shall be suitable for operation on 240V AC supplies. **(Light Output i.e. LUMENS of fixture 6000 to 6500 LM and min. 100 LM/Watt.)**	Up to 65 W
19.	FLP LED2 IIA/IIB	Flameproof well glass/linear LED lighting fixture suitable for use in zone-1/2 & gas group IIA/IIB classified areas complete with LED lamp, LED driver, reflectors, mounting hardwares, clamps & brackets etc. This Lighting fixtures shall be suitable for operation on 240V AC supplies. **(Light Output i.e. LUMENS of fixture 10000 to 10500 LM and min. 100 LM/Watt.)**	Up to 100 W
20.	FLP LED FD3	Flameproof and weatherproof flood Lighting fixture with LED Lamp, driver, including other materials as applicable for installation for use in zone-1/2 & gas group IIA/IIB, Classified areas. **(Light Output i.e. LUMENS of fixture 15000 to 15500 LM and min. 100 LM/Watt.)**	Up to 150 W
21.	FLP IIC-10	Flameproof and weatherproof type twin tube lighting fixture with LED lamp, driver including other materials as applicable for installation for use in zone-1/2 & gas group IIC, Classified areas. **(Light Output i.e. LUMENS of fixture 3600LM for each tube and min. 100 LM/Watt.)**	Up to 2 X 36 W

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Notes:

1. All fixtures shall be latest energy efficient type.Power factor shall be >= 0.95.
2. For Hazardous Area Lighting Fittings Lumen Efficacy shall be 100 Lumen/Watt (min.).
3. LED lamps and Drivers shall be provided with min. 5 years warranty period. Driver shall have valid BIS certification and copy of same shall be furnished during drawing review stage.
4. The LED light fixtures should be tested for luminous lux level as per IES-LM-79. Type test certificates shall be furnished in compliance to same. Type test certificates for LM-79 for all fixtures shall be from a NABL (National Accreditation Board for Testing and Calibration Laboratories) accredited Lab or UL Laboratory.
5. The LED's used in the lighting fixtures should be tested for the service life as per IES-LM-80. Type test certificates shall be furnished in compliance to same.
6. The LED Driver shall comply with the requirement of IEC 61347-2-13.
7. All fixtures shall be suitable for installation in Zone-1/Zone-2 areas. Flameproof LED lighting fixtures shall comply with the requirement of IEC 60079-1 & 0. Fixtures shall be suitable for dust classification wherever applicable.
8. Fixture life time (L70) shall be > 50000 hrs.
9. LED fixtures shall be complete with internal reflectors. No external reflector is envisaged for LED.
10. 2 nos cable entries shall be provided for loop in & loop out with internal wiring for driver & lamp for all LED FLP/Exn'R' fixtures.
11. All mirror optics luminaries should be epoxy powder coated.
12. Make of fixtures shall be embossed on the body of the lighting fixtures.
13. Colour rendering Index (CRI) for LED lamps shall be greater than 80.
14. Colour temperature for LED lamps shall be 6500K.
15. LED lamps shall have wide beam angle suitable for uniform light distribution.
16. LED lamps shall be provided with highly translucent diffusers with advance optical system with high internal reflectivity material of excellent and smooth output for glare free light and no visibility of LED to eyes.
17. All lighting fixtures shall be supplied complete with associated LED lamp and driver.
18. All LED fixtures including driver shall be provided with 5 years warranty.
19. All lighting fixtures shall be supplied with fixture mounting nuts and bolts of stainless steel SS-304.
20. For corrosive areas, die-cast Aluminium enclosed light fixtures shall be installed with die cast aluminium JBs / DBs (in hazardous areas).
21. All above Luminaries with controllers & drivers must be suitable for a working voltage range of 150 to 270 Volts – 50 / 60 Hz - AC.
22. The rates for all above luminaries are inclusive of LED lamps / Electronic Drivers / Transformers / RGB Controllers / internal luminaries wiring.
23. In case any of the above referred models / makes are discontinued, prior approval from the engineer-in- charge has to be taken for supplying any alternate makes / models.
24. Retrofit type of flameproof LED fixtures will not be acceptable (implies LED bulbs fixed inside flameproof enclosures). All flameproof fixtures shall have integral panelled LED clusters (COB - Chip on Board or SMD - Surface mount Device).
25. Loop in and Loop out facility to be provided for all safe area lighting fixtures and in case same is not possible from vendor side, then provision of JB for loop in loop out facility to be provided by subject to meeting following requirements:
    a) The material of JB shall be SS.
    b) Vendor to clearly indicate the location of JB i.e where it is being mounted on fixture and to be indicated in revised drawing.
    c) Vendor to confirm that there shall be no cost and time implication owing to meeting the above requirement.

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Project PMC & EPCM Services for PPU & Revamp of PFCCU at Kochi Refinery **Client** BPCL - KOCHI REFINERY

Unit Common **Location** **Job No.** B895 **Unit No.** 000

PURCHASER'S DATA

A.	**Site Conditions**		
1.	Maximum Ambient Temperature	°C	46
2.	Minimum Ambient Temperature	°C	1
3.	Design Ambient Temperature	°C	45
4.	Relative Humidity	%	95
5.	Altitude Above MSL	mm	<1000
6.	Environment		Humid & Highly Corrosive
B.	**Technical particulars**		
1.	Area classification		Safe
2.	Type of panel enclosure		Weatherproof
3.	Gas group		
4.	Surface temperature		T3
5.	Degree of ingress protection		IP 55
6.	Cable entry		Bottom
7.	Panel Mounting		Column
8.	Exterior painting		RAL 7032
9.	Interior painting		EIL Spec.6-51-0008
10.	Earthing Terminals		10mm stud(External-2nos,Internal-1no.)
11.	Incoming supply		415 V, 50 Hz, TPN
12.	Outgoing supply		240 V, 50 Hz, SPN
13.	Incomer feeder rating		
14.	Outgoing feeder rating		
15.	Short Circuit capacity-MCB/ELCB		9 kA (M9 Category)
16.	Applicable standard		EIL std. 6-51-0008
17.	Type test		Required

MANUFACTURER'S DATA

	Equipment.	LP ---ways	LP ---ways	LP ---ways	PP ---ways	PP ---ways	PP ---ways	PP ---ways	PP ---ways
1.	MR item no.								
2.	Explosion protection class								
3.	Tag no.								
4.	Type reference no.								
5.	Ref. No. & date of CIMFR/ other test certificates of recognised test authority								
6.	Ref. No. & date of CCE/PESO approval certificates								
7.	Ref. No. & date of DGFASLI approval certificates								
8.	Ref. No. & date of DGMS approval certificates								
9.	BIS license no. date								
10.	Dimension L x D x H (mm)								
11.	Weight (kg)								

Rev. No.	Date	Purpose	Prepared By	Reviewed By	Approved By
A	05-MAR-2025	ISSUED WITH MR	NAGARAJU NAIK BHUKYA	ACHUTUNI SAI	RAMAN SOOD

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Project	PMC & EPCM Services for PPU & Revamp of PFCCU at Kochi Refinery		**Client**	BPCL - KOCHI REFINERY	
Unit	Common	**Location**	**Job No.**	B895	**Unit No.** 000

Eil Notes

1 RCCB with 30mA rating shall be provided for all outgoing single phase feeders/ circuits in lighting panels (normal & emergency), power panels etc. for human safety.

2 Incomer Feeder rating:
63A, 4 Pole MCB for 18 Way
40A, 4 Pole MCB for 12 Way
40A, 4 Pole MCB for 06 Way

Outgoing Feeder rating:
10A, 2 Pole for lighting panels
16A, 2 Pole for power panels

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A	05-MAR-2025	ISSUED WITH MR	NAGARAJU NAIK BHUKYA	ACHUTUNI SAI	RAMAN SOOD

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इंजीनियर्स इंडिया लिमिटेड ENGINEERS INDIA LIMITED (A Govt. of India Undertaking)

MV SWITCH BOARD DATA SHEET

Project PMC & EPCM Services for PPU & Revamp of PFCCU at Kochi Refinery **Client** BPCL - KOCHI REFINERY

Unit Common **Location** **Job No.** B895 **Unit No.** 000

PURCHASER'S DATA

A.	**Site Conditions**		
1.	Maximum Ambient Temperature	°C	46
2.	Minimum Ambient Temperature	°C	1
3.	Design Ambient Temperature	°C	45
4.	Relative Humidity	%	95
5.	Altitude Above MSL	m	<1000
6.	Environment		Humid & Highly Corrosive
B.	**Operating Conditions**		
1.	Voltage	V	415 +/- 10 TPN
2.	Frequency	Hz	50 +/- 3 %
3.	No of phases		Three
4.	System fault level	kA	50kA for 1 sec
5.	System earthing		Solidly Earthed
6.	Auxiliary supply		
	AC	V	240 +/- 10 % SPN
	DC	V	110 +/- 10 % DC
7.	Power supply for spring charging motor	V	Not Applicable AC
C.	**Electrical Data**		
1.	Short circuit withstand capacity for 1 sec.	KA	50
2.	Busbar current rating inside panel at specified ambient		As per job spec
3.	Busbars		Heat shrunk PVC sleeved
4.	System breaking capacity	kA	50
5.	System making capacity	kA(peak)	
6.	Circuit breaker		
	Type		Not Applicable
	Duty cycle		0-3 min-co-3 min-co
	Rating		Not Applicable
7.	Incoming power entry		Cable
8.	Cable entry (I/C & O/G)		Top/ Bottom
9.	Bus duct entry		NA
10.	Cable gland/lugs		Included
11.	Painting/paint shade		RAL-7032
12.	Feeder arrangement & Execution		Single Front, Fixed type
13.	Minimum motor starter module size		240 mm
14.	Minimum switchfuse module size		Not Applicable
15.	Floor fixing		Integral base frame & tack welding to floor channel
16.	Seperate bolted removablegland plate		Reqd.(Gland Plate Drilled at side)
17.	Minimum MCCB module		Vendor standard

MANUFACTURER'S DATA

A.	**Switchboards**	
1.	Tag no.:	
2.	Make	
3.	Type designation	

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Project PMC & EPCM Services for PPU & Revamp of PFCCU at Kochi Refinery **Client** BPCL - KOCHI REFINERY

Unit Common **Location** **Job No.** B895 **Unit No.** 000

4.	Degree of protection	
5.	CB panel	
	Overall weight	
	Incomer	
	Outgoing	
	Overall dimensions	
	Length*Depth*Height	
6.	Overall dimensions of MCC/ contactor controlled feeder panel	
	Length*Depth*Height	
7.	Overall dimensions of each PCC	
	Length*Depth*Height	
8.	Overall dimensions of each PMCC/ EPMCC	
	Length*Depth*Height	
9.	Overall dimensions of each MCC	
	Length*Depth*Height	
10.	Overall dimensions of each ASB	
	Length*Depth*Height	
11.	Overall dimensions of each LDB	
	Length*Depth*Height	
12.	Largest shipping section:	
	Max. overall weight	
	Length*Depth*Height	
13.	Recommended clearances for SWBD	
	Front*Rear*Above	
14.	Shock loading on foundation	
15.	Max. size/no. of cables that can be terminated	
	with rear extension	
	without rear extension	
16.	Size of rear extension panel	
17.	Clearance in air	
	Phase to Phase	
	Phase to Earth	
18.	Main horizontal bus bar	
	Bus bar current rating at	
	design ambient temp.	
	Main bus bar size	
	Main bus bar material	
	Main bus bar location	
19	Vertical bus bars	
	Bus bar current rating at	
	design ambient temp.	
	Bus bar size	
	Bus bar material	
	Bus bar location	
20.	Insulating material	

Rev. No.	Date	Purpose	Prepared By	Reviewed By	Approved By
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Project PMC & EPCM Services for PPU & Revamp of PFCCU at Kochi Refinery **Client** BPCL - KOCHI REFINERY

Unit Common **Location** **Job No.** B895 **Unit No.** 000

21.	Earth bus bar size	
	Material	
22.	1min power freq voltage	
23.	Short circuit	
	1 second	
	Peak dynamic	
24.	Whether adaptor panel required	
	between PCC/MCC panel	
	If Yes, furnish dimensions	
B.	**Circuit breaker**	
1.	Type designation	
2.	Make	
3.	Mounting	
4.	No. of poles/phases	
5.	Current rating (in air)	
6.	Current rating (inside panel	
	at design temperature)	
7.	Short time rating (1 sec)	
8.	Sym breaking capacity	
	% DC component	
9.	Peak making capacity	
10.	Power frequency withstand	
11.	Impulse withstand voltage	
12.	Duty cycle	
13.	Total opening time	
14.	Total closing time	
15.	Power requirement	
	Opening	
	Closing	
	Spring charge motor	
16.	Time for spring charging	
17.	Breaker is trip free	
18.	Closing mechanism	
19.	Provision of manual spring charging	
20.	Tripping mechanism	
21.	Mechanical trip PB provided	
22.	Mechanical ON/OFF indicator provided	
23.	Operation counter provided	
24.	Time taken for spring charging	
25.	No. of auxiliary contacts	
26.	Derating required for capacitor switching	
C.	**Contractor**	
1.	Type designation	
2.	Make	
3.	Rated Voltage	
4.	Rated current	

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Project PMC & EPCM Services for PPU & Revamp of PFCCU at Kochi Refinery **Client** BPCL - KOCHI REFINERY

Unit Common **Location** **Job No.** B895 **Unit No.** 000

	AC-3 Duty	
	AC-4 Duty	
5.	Thermal rating	
6.	Making capacity	
7.	Breaking capacity	
8.	Switching frequency	
9.	Life	
	Electrical	
	Mechanical	
10.	Coil consumption	
	Pick up	
	Hold on	
11.	Closing time	
12.	Opening time	
13.	No of aux. contacts	
14	Maximum permitted back up fuse rating	
D.	**Switch**	
1.	Rated voltage	
2.	Rated current	
3.	AC 23 rating	
4.	Rated making capacity	
5.	Rated breaking capacity	
6.	Rated short circuit withstand current with	
	max. permissible rated fuses	
7.	Mechanical life	
8.	Maximum permitted back up fuse rating	
E.	**Thermal Overload Relay**	
1.	Make	
2.	Type	
3.	Setting range	
4.	Single phasing preventor	
5.	Type of operation	
6.	Maximum permitted back up fuse rating	
F.	**Fuses**	
1.	Make	
2.	Type	
3.	Current rating	
G.	**Electronic Motor protection relay**	
1.	Make	
2.	Type	
3.	Setting range	
4.	Single phasing preventor	
5.	Type of operation	
6.	Maximum permitted back up fuse rating	
7.	Earth fault protection available	
H.	**MCCB/MCB**	
1.	Make	

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Project PMC & EPCM Services for PPU & Revamp of PFCCU at Kochi Refinery **Client** BPCL - KOCHI REFINERY

Unit Common **Location** **Job No.** B895 **Unit No.** 000

2.	Type	
3.	Rated voltage	
4.	Rated current	
5.	Rated frequency	
6.	No. of poles	
7.	Derating factor for operation under site conditions	
8.	Rated 10 sec short time rating	
9.	Rated breaking capacity at service voltag	
10.	No. of operations at full fault	
11.	No. of operations at partial fault	
12.	No. of guaranteed mech. operations	
13.	1 min dry p.f with stand voltage	
14.	Shunt trip feature (for MCCB only)	
15.	Operating voltage range for MCCB shunt trip	

Eil Notes

1

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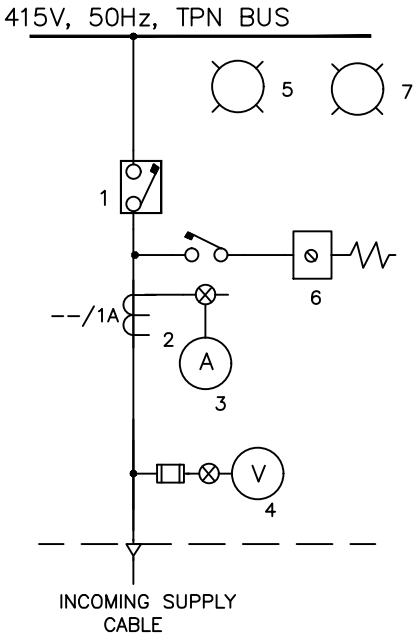
PROJECT: PP & REVAMP OF PFCCU CLIENT: M/s BPCL	REV	DATE	PURPOSE	BY	CHKD	APPRV
	A	04.03.2025	ISSUED WITH TENDER	NNB	AS	RS



EQUIPMENT DATA FOR INCOMER

ITEM NO.	NEMA NO.	QTY.	DESCRIPTION
1	–	1	MCCB WITH OVERLOAD, SHORT CIRCUT, E/F RELEASE & SHUNT TRIP
2	–	3	METERING CT, CL–1
3	–	1	AMMETER WITH 4WAY SELECTOR SWITCH.
4	–	1	VOLTMETER WITH 4WAY SELECTOR SWITCH & FUSE
5	–	3	R Y B INDICATING LAMPS – LED TYPE
6	–	1	PANEL SPACE HEATER WITH MCB AND THERMOSTAT
7	–	1	TRIP INDICATION LAMP – LED TYPE

NOTES

1. THE ONE LINE DIAGRAM SHOWN ABOVE IS ONLY INDICATIVE . ALL THE ITEMS SPECIFIED UNDER "EQUIPMENT DATA" AND IN RESPECTIVE JOB SPECIFICATION/STANDARD SPECIFICATION SHALL BE IN CONTRACTOR'S SCOPE.

2. MCCB SHALL BE SUITABLE FOR THE SYSTEM FAULT LEVEL 50kA/ 65kA (1 SEC).

3 VA BURDEN OF CT SHALL BE DECIDED BY THE SWITCHBOARD VENDOR.

ENGINEERS INDIA LIMITED NEW DELHI	POWER DISTRIBUTION BOARD DATA SHEET PDB INCOMER	DATA SHEET	REV
		B895-000-16-50-DS-1211	A

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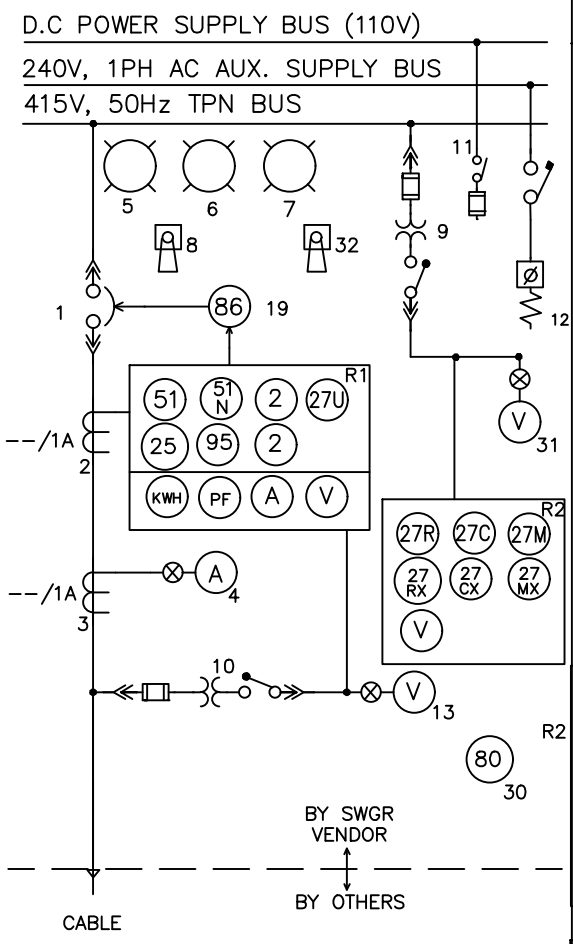
PROJECT: PPU & REVAMP OF PFCCU

CLIENT: M/S BPCL-KOCHI

REV	DATE	PURPOSE	BY	CHKD	APPRV
A	24.09.2024	ISSUED WITH MR/TENDER	NNB	AS	RS
B	05.03.2025	ISSUED WITH MR/TENDER	NNB	AS	RS



R1 ▭ —PART OF NUMERICAL RELAY-1

R2 ▭ —PART OF NUMERICAL RELAY-2

NOTES:

1. ANTIPUMPING RELAY USED, IF ANY, SHALL BE CONSIDERED AS PART OF BREAKER MECHANISM.
2. THE ONE LINE DIAGRAM SHOWN ABOVE IS ONLY INDICATIVE ALL THE ITEMS SPECIFIED UNDER "EQUIPMENT DATA" AND IN SPECIFICATION 6-51-18 SHALL BE IN VENDOR'S SCOPE.
3. FOR THE OTHER REQUIREMENTS OF RELAYS AND METERS, REFER JOB SPECIFICATION.
4. FOR THE REQUIREMENTS OF ECS INTERFACE, REFER I/O LIST ENCLOSED SEPARATELY IN MR/TENDER
5. ALL PROTECTIVE RELAYS SHALL BE NUMERICAL, COMMUNICABLE TYPE OF APPROVED MAKES. METERING SHALL BE PART OF NUMERICAL RELAY. TRIPPING RELAY [86] SHALL BE ELECTRO MECHANICAL TYPE.
6. VA BURDEN OF CT & PT SHALL BE DECIDED BY THE SWITCHBOARD VENDOR.
9. ONE NO. DC SUPPLY SUPERVISION RELAY (80) SHALL BE PROVIDED FOR EACH INCOMING DC SUPPLY TO SWBD & ONE NO. AC SUPPLY SUPERVISION RELAY (80) SHALL BE PROVIDED FOR EACH INCOMING AC SUPPLY TO SWBD.

EQUIPMENT DATA

ITEM NO.	NEMA NO.	QTY.	DESCRIPTION
1	52	1	AIR CIRCUIT BREAKER (WITH 4-POLES)
2	–	3	PROTECTION CT, CL-5P10
3	–	3	METERING CT CL-1.0
4	–	1	ANALOGUE AMMETER WITH 4WAY SELECTOR SWITCH
5	–	AS REQ	INDICATING LAMP (LED TYPE) AND CUBICLE LAMPS
6	–	1	TRIP CKT. HEALTHY INDICATION LAMP (LED TYPE)
7	–	3	UPSTREAM BREAKER ON/OFF/TRIP INDICATION
8	52C/S	1	BREAKER CONTROL SWITCH CLOSE-NEUTRAL -TRIP(LOCKABLE WITH SPRING RETURN TO NEUTRAL)
9	–	1 SET	PT 415V/110V, CL-1.0 CONNECTED WITH FUSE ON PRIMARY & 4 POLE MCB ON SECONDARY
10	–	1 SET	PT 415V/110V, CL-1.0 CONNECTED WITH FUSE ON PRIMARY & 4 POLE MCB ON SECONDARY
11	–	1	DP SWITCH FUSE 10A FOR DC SUPPLY
12	–	1	PANEL SPACE HEATER WITH MCB & THERMOSTAT
13	–	1	ANALOGUE VOLTMETER 0-500V WITH 4 WAY SELECTOR SWITCH
14	27R	1	RESIDUAL VOLTAGE CHECK RELAY WITH 40% SETTING
15	27C	1	HEALTH CHECK RELAY WITH TIMER
16	27M	1	U/V RELAY FOR TRIPPING MOTOR SETTING RANGE 40-80%
17	–	AS REQ	AUX. RELAYS FOR 27M, 27C & 27R
18	–	1	VOLTMETER.
19	86	1	TRIPPING RELAY
20	51 & 51N	1	IDMTL O/C RELAY 2 NOS O/C (50-200%) & 1NO E/F (10-40%)
21	95	1	TRIP CIRCUIT SUPERVISION RELAY
22	–	1	KWH METER
23	–	1	POWER FACTOR METER
24	–	1	AMMETER (3-PHASE)
25	–	1	VOLTMETER (3-PHASE)
26	27U	2	U/V RELAY SETTING RANGE 40-80%
27	2	1	TIME DELAY ON PICK-UP TIMER 0.5-5.0SEC.
28	2	1	TIME DELAY ON DROP-OFF TIMER 0.5-5.0SEC.
29	25	1	SYNCH. CHECK RELAY
30	80	1	CONTROL SUPPLY FAILURE CHECK RELAY WITH 60% SETTING.
31	–	1	VOLTMETER WITH SELECTOR SWITCH
32		1	UPSTREAM BREAKER TRIP SWITCH (2 POSITION, STAYPUT TYPE & LOCKABLE)

ENGINEERS INDIA LIMITED
NEW DELHI

M.V. SW. BD. DATA SHEET
PMCC/MCC/EPCC/EPMC
INCOMER
(FROM UPSTREAM 415V FEEDER)

DATA SHEET	REV
B895-000-16-50-DS-1804	B

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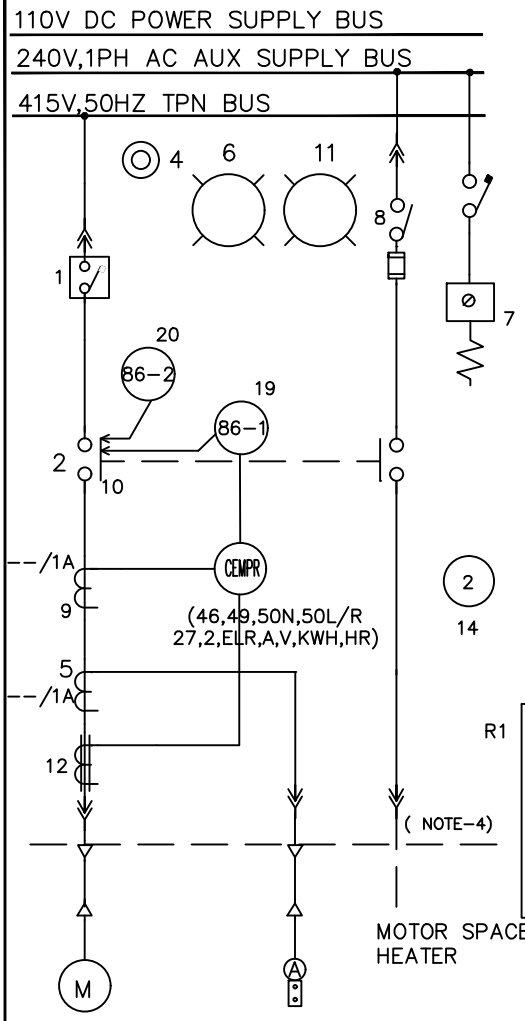
PROJECT: PPU & REVAMP OF PFCCU
CLIENT: M/S BPCL-KOCHI

REV	DATE	PURPOSE	BY	CHKD	APPRV
A	13.09.2024	ISSUED WITH MR/TENDER	NNB	AS	RS
B	05.03.2025	ISSUED WITH MR/TENDER	NNB	AS	RS



EQUIPMENT DATA

ITEM NO.	NEMA NO.	QTY.	DESCRIPTION
1	–	1	MCCB NON-MICROPROCESSOR BASED WITH SHUNT TRIP & SHORT CIRCUIT PROTECTION
2	–	1	AIR BREAK CONTACTOR, DUTY-AC3 WITH 2NO+2NC AUXILIARY CONTACTS.
3	–	–	–
4	–	1	STOP PUSH BUTTON
5	–	3	METERING CT, CL-1.0, 15VA BURDEN
6	–	AS REQD	INDICATING LAMPS – LED TYPE
7	–	1	PANEL SPACE HEATER WITH MCB AND THERMOSTAT
8	–	1	DP SWITCH & FUSE FOR MOTOR SPACE HEATER
9	–	3	PROTECTION CT CL-5P20
10	–	AS REQD	AUX.CONTACTORS WITH MIN.2NO+2NC CONTACTS
11	–	1	MOTOR SPACE HEATER ON INDICATION – LED TYPE
12	–	1	CORE BALANCE CURRENT TRANSFORMER
13	CEMPR	1	COMMUNICABLE ELECTRONIC MOTOR PROTECTION RELAY
14	2	2	ON DELAY AND OFF DELAY TIMER
15	–	1	AMMETER (3-PHASE)
16	–	1	VOLTMETER (3-PHASE)
17	–	1	KWH METER
18	–	1	HOUR RUN METER
19	86-1	1	LOCKOUT RELAY FOR ELECTRICAL TRIP (ELECTROMECHANICAL RELAY-LATCH TYPE)
20	86-2	1	LOCKOUT RELAY FOR PROCESS TRIP (ELECTROMECHANICAL RELAY-SELF RESET TYPE)

NOTES:

1. THE ONE LINE DIAGRAM SHOWN ABOVE IS ONLY INDICATIVE. ALL THE ITEMS SPECIFIED UNDER "EQUIPMENT DATA" AND IN RESPECTIVE JOB SPECIFICATION/STANDARD SPECIFICATION SHALL BE IN VENDOR'S SCOPE.
2. COMPONENT RATING SHALL BE AS PER MV SWITCHBOARD COMPONENT DATA SHEET
3. NO. OF CONTROL TERMINALS PROVIDED SHALL INCLUDE 20% SPARE TERMINALS SUBJECT TO A MINIMUM 24 TERMINALS.
4. MOTOR SPACE HEATER CKT. TO BE PROVIDED FOR MOTORS RATED 30kW AND ABOVE.
5. VA BURDEN OF CTs (EXCEPT METERING CT) SHALL BE DECIDED BY THE SWITCHBOARD VENDOR.
6. MOTOR PROTECTION RELAY SHALL BE SUITABLE FOR 110V DC CONTROL SUPPLY.
7. CEMPR SHALL BE TYPE-2 COORDINATED WITH THE OTHER MV COMPONENTS IN THE FEEDER.
8. CEMPR SHALL BE SUITABLE FOR IE-4 MOTORS.
9. CONTROL SUPPLY FOR CONTACTOR SHALL BE 110V DC.
10. CT FOR AMMETER SHALL BE PROVIDED FOR ALL MOTORS RATED ABOVE 5.5 KW.
11. TIMER FOR DELAYED TRIPPING ON BUS UNDER VOLTAGE SHALL BE PROVIDED FOR CONTACTOR CONTROLLED MOTOR FEEDER.

ENGINEERS INDIA LIMITED
NEW DELHI

MV SWITCHBOARD
DATASHEET
CONTACTOR CONTROLLED MOTOR FEEDER
(FOR MOTORS <=55kW)

DATA SHEET	REV
B895-000-16-50-DS-1811	B

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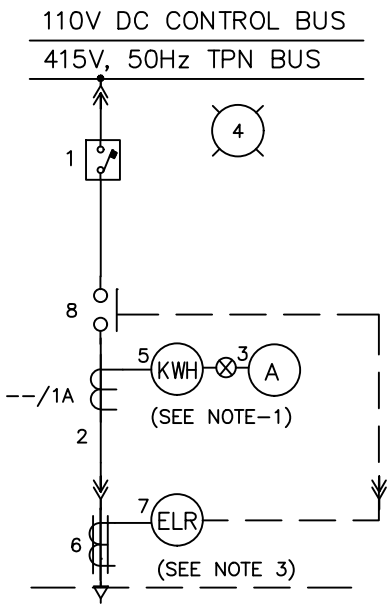
PROJECT: PPU & REVAMP OF PFCCU CLIENT: M/S BPCL-KOCHI	REV	DATE	PURPOSE	BY	CHKD	APPRV
	A	23.09.2024	ISSUED WITH MR/TENDER	NNB	AS	RS



EQUIPMENT DATA

ITEM NO.	NEMA NO.	QTY.	DESCRIPTION
1	–	1	MCCB WITH SHUNT TRIP, S/C & O/C RELEASE
2	–	3	METERING CT, CL-1
3	–	1	AMMETER WITH 4WAY SELECTOR SWITCH.
4	–	3	INDICATING LAMPS – LED TYPE
5	–	1	KWH METER WITH ACCURACY CL.1.0
6	–	1	CORE BALANCE CURRENT TRANSFORMER
7	–	1	EARTH LEAKAGE RELAY SETTING RANGE (1-16%) WITH BUILT-IN TIMER
8	–	1	CONTACTOR WITH 2NO+2NC AUX. CONTACTS

NOTES:

1. CT, AMMETER AND KWH METER SHALL BE PROVIDED FOR FEEDERS RATED 250A & ABOVE.
2. THE ONE LINE DIAGRAM SHOWN ABOVE IS ONLY INDICATIVE. ALL THE ITEMS SPECIFIED UNDER "EQUIPMENT DATA" AND IN SPECIFICATION 6-51-0018 SHALL BE IN VENDOR'S SCOPE.
3. CBCT RATIO SHALL BE SELECTED TO SUIT E/F RELAY SETTING RANGE
4. ELR SHALL BE SUITABLE FOR 110V DC CONTROL SUPPLY.
5. VA BURDEN OF CTs SHALL BE DECIDED BY SWITCHBOARD VENDOR.
6. MCCB SHALL BE SUITABLE FOR SYSTEM FAULT LEVEL.

ENGINEERS INDIA LIMITED NEW DELHI	M.V. SW. BD. DATA SHEET MCCB CONTACTOR FEEDER	DATA SHEET	REV
		B895-000-16-50-DS-1813 Sheet 1 of 1	A

DATA SHEET FOR MEDIUM VOLTAGE SWITCHBOARD COMPONENTS

FEEDER TYPE	MOTOR RATING KW	MAX. CABLE SIZE	COMPONENT RATING (A)			
			DMPR	CT RATIO	MCCB	CONTACTOR
FVNR-15 FVR-15 FVNR-15HD	≤5.5	3*16	CEMPR (46,49,27,50N,50LR & ELR)	15/1 (See note-1)	32	15
FVNR-30 FVR-30 FVNR-30HD	5.5 < KW≤11	3*50	CEMPR (46,49,27,50N,50LR & ELR)	30/1 (See note-1)	63	30
FVNR-60 FVR-60 FVNR-60HD	11< KW ≤22	3*95	CEMPR (46,49,27,50N,50LR & ELR)	60/1 (See note-1)	125	60
FVNR-100 FVR-100 FVNR-100HD	22< KW≤45	2R*3*95	CEMPR (46,49,27,50N,50LR & ELR)	100/1 (See note-1)	250	100
FVNR-150 FVR-150 FVNR-150HD	45< KW≤55	2R*3*120	CEMPR (46,49,27,50N,50LR & ELR)	150/1 (See note-1)	250	150
ACB Feeder	55< KW≤160	4R*3*240	MOTOR PROTECTION RELAY (46,50,49,27,50N,50LR), ELR)		ACB	
MCCB, Contactor, CBCT & ELR -32A	MCCB	3.5*50	32A MCCB WITH SHUNT TRIP, OVERLOAD & S/C RELEASES	30/1	16/32	32
MCCB, Contactor, CBCT & ELR -63A	MCCB	3.5*95	63A MCCB WITH SHUNT TRIP, OVERLOAD & S/C RELEASES	60/1	63	63
MCCB, Contactor, CBCT & ELR -125A	MCCB	2*3.5*120	125A MCCB WITH SHUNT TRIP, OVERLOAD & S/C RELEASES	100/1	125	125
MCCB, Contactor, CBCT & ELR -160A	MCCB	2*3.5*185	160A MCCB WITH SHUNT TRIP, OVERLOAD & S/C RELEASES	150/1	160	160
MCCB, Contactor, CBCT & ELR -250A	MCCB	2*3.5*300	250A MCCB WITH SHUNT TRIP, OVERLOAD & S/C RELEASES	250/1	250	250
MCCB, Contactor, CBCT & ELR -400A	MCCB	3*3.5*300	400A MCCB WITH SHUNT TRIP, OVERLOAD & S/C RELEASES	400/1	400	400

NOTES:

1. ALL MOTORS SHALL BE PROVIDED WITH CBCT BASED EARTH FAULT PROTECTION.
   i. FEEDERS FOR MOTORS RATED UPTO 55 KW SHALL BE CONTROLLED THROUGH MCCB, CONTACTOR, COMMUNICABLE ELECTRONIC MOTOR PROTECTION RELAY (CEMPR), CBCT & ELR. ELR SHALL BE PART OF EMPR.
   ii. FEEDERS FOR MOTORS RATED ABOVE 55 KW SHALL BE CONTROLLED THROUGH AIR CIRCUIT BREAKER (ACB) WITH NUMERICAL MOTOR PROTECTION RELAY. ELR SHALL BE PROVIDED SEPARATELY.
2. CBCT & ELR SHALL BE PROVIDED FOR MCCB WITH CONTACTOR OUTGOING FEEDER RATING UPTO 400A.
3. CT FOR METERING SHALL BE PROVIDED FOR MOTOR RATING MORE THAN 5.5 KW.
4. TYPICAL MCCB & CONTACTOR RATING ARE SPECIFIED ABOVE FOR MOTOR FEEDERS RATED UPTO 55KW. FINAL MCCB RATINGS, CONTACTOR RATING AND BIMETAL RANGE (EMPR) SHALL BE SELECTED BY THE MANUFACTURER MEETING THE TYPE -2 CO-ORDINATION AS PER IS-13947 & IS/IEC: 60947 CONSIDERING THE ENERGY EFFICIENT MOTORS OF IE3 FOR HAZARDOUS & IE4 FOR SAFE AREA.
5. MAJOR COMPONENTS ARE SHOWN ABOVE, ALL OTHER ITEMS AS SPECIFIED IN EQUIPMENT DATA SHEET AND SPECIFICATION: 6-51-0018/ 6-51-0012 SHALL ALSO BE IN VENDOR'S SCOPE.
6. RCCB WITH 30mA SHALL BE PROVIDED IN OUTGOING FEEDERS OF LDB/ ASB FOR LP/ PP.
7. NUMERICAL RELAY AND EMPR DATA SHALL BE TRANSMITTED TO ECS THROUGH SAS. FURTHER, STATUS SIGNALS SHALL BE TRANSFERRED FROM ECS TO DCS ON MODBUS TCP/IP PROTOCOL.

Rev. No	Date	Purpose	Prepared by	Checked by	Approved by
A	24.09.2024	ISSUED WITH MR/TENDER	NNB	AS	RS

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DATA SHEET – VARIABLE FREQUENCY DRIVE (GREATER THAN 55kW & UPTO 315 kW)
Part-I (Data to be filled in by purchaser)

1.	Applicable standards		:	EIL spec. 6-51-0038
2.	Rated output capacity (KW)		:	*
3.	Rated Output voltage		:	415V, 50Hz, 3phase
4.	Motor Details			
	a)	Motor tag no.	:	#
	b)	Type of motor	:	Squirrel cage induction motor
	c)	KW rating	:	*
	d)	Starting condition	:	Soft start
	e)	Frequency range	:	*
	f)	Voltage range	:	*
	g)	Full load current	:	*
	h)	Full load PF		
		- pf at lowest KW	:	*
		- pf at Highest KW	:	*
	i)	Starting current	:	*
	j)	Load torque details	:	*(As per Cl . 5.1.2 of 6-51-0038)
5.	**SITE CONDITIONS:**			
	a)	Ambient temperature	:	#
	b)	Design temperature	:	45° C
	c)	Altitude	:	Less than 1000M above MSL
	d)	Installation	:	Indoor
	e)	Location	:	Substation
6.	**INPUT POWER SUPPLY SYSTEM CONDITIONS**			
	a)	No. of phases	:	3
	b)	AC input voltage	:	415V
	c)	Voltage fluctuation	:	± 10%
	d)	Rated frequency	:	50 Hz
	e)	Frequency fluctuation	:	± 3%
	e)	System fault Level	:	Max 65 kA & Min. (As per Job Specification)
7.	**SYSTEM REQUIREMENTS**			
	a)	Speed range required	:	As per process requirement
	b)	Adjustment of speed	:	Auto (from DCS) & Manual (from LCS)
	c)	Speed Reference by measurement of the stator voltage frequency through voltage transformer	:	*
	d)	Reference Signal	:	4 - 20 mA (from DCS).
	e)	By pass Contactor	:	#
	f)	Acceleration time	:	*
		Deceleration time	:	*
	i)	Fault diagnostic	:	Required
	j)	Braking	:	
	k)	Regeneration	:	

Rev. No	Date	Purpose	Prepared by	Checked by	Approved by
B	19.12.2024	ISSUED WITH MR/TENDER	PS	AS	RS
A	31.07.2024	ISSUED WITH MR/TENDER	PS	AS	RS

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l)	EMC Compatibility (Conductive & Radiative)	:	Required
m)	Cable length between swbd and VFD.	:	#
n)	Cable length between VFD and Motor	:	#
o)	Cable length between VFD and DCS	:	#
p)	Communication facility with ECS on open protocol	:	Required

*** - Data to be provided by vendor/equipment supplier**

 # - As per job specifications

PART-II (to be filled in by vendor and submitted with bid)

1.	Make	:		
2.	Model No.	:		
3.	Rating	: * (Refer Note-1)		
4.	Applicable code/standards	:		
5.	Speed range	:		
6.	Speed reference	:		
7.	Input power supply ratings			
	a) Voltage	:	±	%
	b) Frequency	:	±	%
8.	Overload capability			
	a) 125%	:	minutes	
	b) 150%	:	secs.	
	c) Inrush current 250% I_n for	:	secs.	
9.	Overall efficiency at			
	a) 100% load	:		
	b) 75% load	:		
	c) 50% load	:		
	d) 25% load	:		
10.	Overall power factor at			
	a) 100% load	:		
	b) 75% load	:		
	c) 50% load	:		
	d) 25% load	:		
11.	AC Output			
	a) Output voltage range	:		
	b) Voltage accuracy	:		
	c) Frequency range	:		
	d) Frequency accuracy	:		
12.	Output short circuit capability and duration	:		
13.	Deration of motor at			
	a) Maximum speed	:		
	b) Minimum speed	:		
14.	**Rectifier/Inverter**			
	a) Make	:		
	b) Type/Model No.	:		
	c) Diodes/GTOs configuration	:		
	d) Total No. of Diodes/GTOs	:		
	e) Cooling system			
	- Type	:		

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- Redundancy in cooling Units :

f) Type of feedback for speed control :

15. **DC Reactor**

a) Make :
b) Type :
c) Rating :
d) Inductance of the reactor :
e) Air Core/Iron Core :

16. **Output Filter**

a) Make :
b) Type / Model No. :
c) Rating :
d) Rated Voltage :

17. **Output Power Isolating Device**

a) Make :
b) Type :
c) Model No. :
d) Cont. Current Rating :
e) Short Circuit Rating :
f) Rated Voltage :
g) Applicable Standard :
h) Panel details
- Overall Length :
- Height :
- Depth :
- Degree of protection :

18. **VFD PANEL DETAILS**

a) Overall Length :
b) Height :
c) Depth :
d) Weight of cubicle :
(Dimensional details of all panels shall be furnished)
e) Degree of protection for enclosure. :
f) Paint shade :
g) Heat output of Panel :
h) Type of cooling :

19. **Auxiliary Power Requirement:**

a) KW :
b) Voltage :

20. LCS/LCP required as per spec : Yes
21. Requirement of earthing cable between motor & drive : No
22. Address of Manufacturing Location :
23. Address of Shop Testing Location :
24. Since when the proposed type of semiconducting power devices are being used in the offered drive model :
25. List of equipments / Components to be sourced from India :

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NOTE:

1. VFD rating shall take into account voltage drop on incoming supply, voltage drop within VFD and voltage drop across motor cable.
2. Joint declaration shall be provided by Contractor, Package Vendor, VFD Vendor and Motor vendor conforming that VFD and motor are compatible, and motor is suitable for converter duty application.

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DATA SHEET – VFD (TYPICALLY UPTO 55kW-NON CRITICAL APPLICATION)
Part-I (Data to be filled in by purchaser)

1.	Applicable standards		:	EIL spec. 6-51-0049
2.	Rated output capacity (KW)		:	*
3.	Rated Output voltage		:	415V, 50Hz, 3phase
4.	Motor Details			
	a)	Motor tag no.	:	#
	b)	Type of motor	:	Squirrel cage induction motor
	c)	KW rating	:	*
	d)	Starting condition	:	Soft start
	e)	Frequency range	:	*
	f)	Voltage range	:	*
	g)	Full load current	:	*
	h)	Full load PF		
		- pf at lowest KW	:	*
		- pf at Highest KW	:	*
	i)	Starting current	:	*
	j)	Load torque details	:	*(As per Cl . 5.1.2 of 6-51-0049)
5.	**SITE CONDITIONS:**			
	a)	Ambient temperature	:	#
	b)	Design temperature	:	45° C
	c)	Altitude	:	Less than 1000M above MSL
	d)	Installation	:	Indoor
	e)	Location	:	Substation
6.	**INPUT POWER SUPPLY SYSTEM CONDITIONS**			
	a)	No. of phases	:	3
	b)	AC input voltage	:	415V
	c)	Voltage fluctuation	:	± 10%
	d)	Rated frequency	:	50 Hz
	e)	Frequency fluctuation	:	± 3%
	e)	System fault Level	:	Max 65 kA & Min. (As per Job Specification)
7.	**SYSTEM REQUIREMENTS**			
	a)	Speed range required	:	As per process requirement
	b)	Adjustment of speed	:	Auto (from DCS) & Manual (from LCS)
	c)	Speed Reference by measurement of the stator voltage frequency through voltage transformer	:	*
	d)	Reference Signal	:	4 - 20 mA (from DCS).
	e)	By pass Contactor	:	#
	f)	Acceleration time	:	*
		Deceleration time	:	*
	i)	Fault diagnostic	:	Required
	j)	Braking	:	
	k)	Regeneration	:	

Rev. No	Date	Purpose	Prepared by	Checked by	Approved by
B	19.12.2024	ISSUED WITH MR/TENDER	PS	AS	RS
A	31.07.2024	ISSUED WITH MR/TENDER	PS	AS	RS

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l)	EMC Compatibility (Conductive & Radiative)	:	Required
m)	Cable length between swbd and VFD.	:	#
n)	Cable length between VFD and Motor	:	#
o)	Cable length between VFD and DCS	:	#
p)	Communication facility with ECS on open protocol	:	Required

*** - Data to be provided by vendor/equipment supplier**

 # - As per job specifications

PART-II (to be filled in by vendor and submitted with bid)

1.	Make	:			
2.	Model No.	:			
3.	Rating	: *(Refer Note-1)			
4.	Applicable code/standards	:			
5.	Speed range	:			
6.	Speed reference	:			
7.	Input power supply ratings				
	a) Voltage	:		±	%
	b) Frequency	:		±	%
8.	Overload capability				
	a) 125%	:		minutes	
	b) 150%	:		secs.	
	c) Inrush current 250% I_n for	:		secs.	
9.	Overall efficiency at				
	a) 100% load	:			
	b) 75% load	:			
	c) 50% load	:			
	d) 25% load	:			
10.	Overall power factor at				
	a) 100% load	:			
	b) 75% load	:			
	c) 50% load	:			
	d) 25% load	:			
11.	AC Output				
	a) Output voltage range	:			
	b) Voltage accuracy	:			
	c) Frequency range	:			
	d) Frequency accuracy	:			
12.	Output short circuit capability and duration	:			
13.	Deration of motor at				
	a) Maximum speed	:			
	b) Minimum speed	:			
14.	**Rectifier/Inverter**				
	a) Make	:			
	b) Type/Model No.	:			
	c) Diodes/GTOs configuration	:			
	d) Total No. of Diodes/GTOs	:			
	e) Cooling system				
	- Type	:			

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		- Redundancy in cooling Units	:	
	f)	Type of feedback for speed control	:	
15.	**DC Reactor**			
	a)	Make	:	
	b)	Type	:	
	c)	Rating	:	
	d)	Inductance of the reactor	:	
	e)	Air Core/Iron Core	:	
16.	**Output Filter**			
	a)	Make	:	
	b)	Type / Model No.	:	
	c)	Rating	:	
	d)	Rated Voltage	:	
17.	**Output Power Isolating Device**			
	a)	Make	:	
	b)	Type	:	
	c)	Model No.	:	
	d)	Cont. Current Rating	:	
	e)	Short Circuit Rating	:	
	f)	Rated Voltage	:	
	g)	Applicable Standard	:	
	h)	Panel details		
		- Overall Length	:	
		- Height	:	
		- Depth	:	
		- Degree of protection	:	
18.	**VFD PANEL DETAILS**			
	a)	Overall Length	:	
	b)	Height	:	
	c)	Depth	:	
	d)	Weight of cubicle	:	
		(Dimensional details of all panels shall be furnished)		
	e)	Degree of protection for enclosure.	:	
	f)	Paint shade	:	
	g)	Heat output of Panel	:	
	h)	Type of cooling	:	
19.	**Auxiliary Power Requirement:**			
	a)	KW	:	
	b)	Voltage	:	
20.		LCS/LCP required as per spec	:	Yes
21.		Requirement of earthing cable between motor & drive	:	No
22.		Address of Manufacturing Location	:	
23.		Address of Shop Testing Location	:	
24.		Since when the proposed type of semiconducting power devices are being used in the offered drive model	:	
25.		List of equipments / Components to be sourced from India	:	

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NOTE:

1. VFD rating shall take into account voltage drop on incoming supply, voltage drop within VFD and voltage drop across motor cable.
2. Joint declaration shall be provided by Contractor, Package Vendor, VFD Vendor and Motor vendor conforming that VFD and motor are compatible, and motor is suitable for converter duty application.

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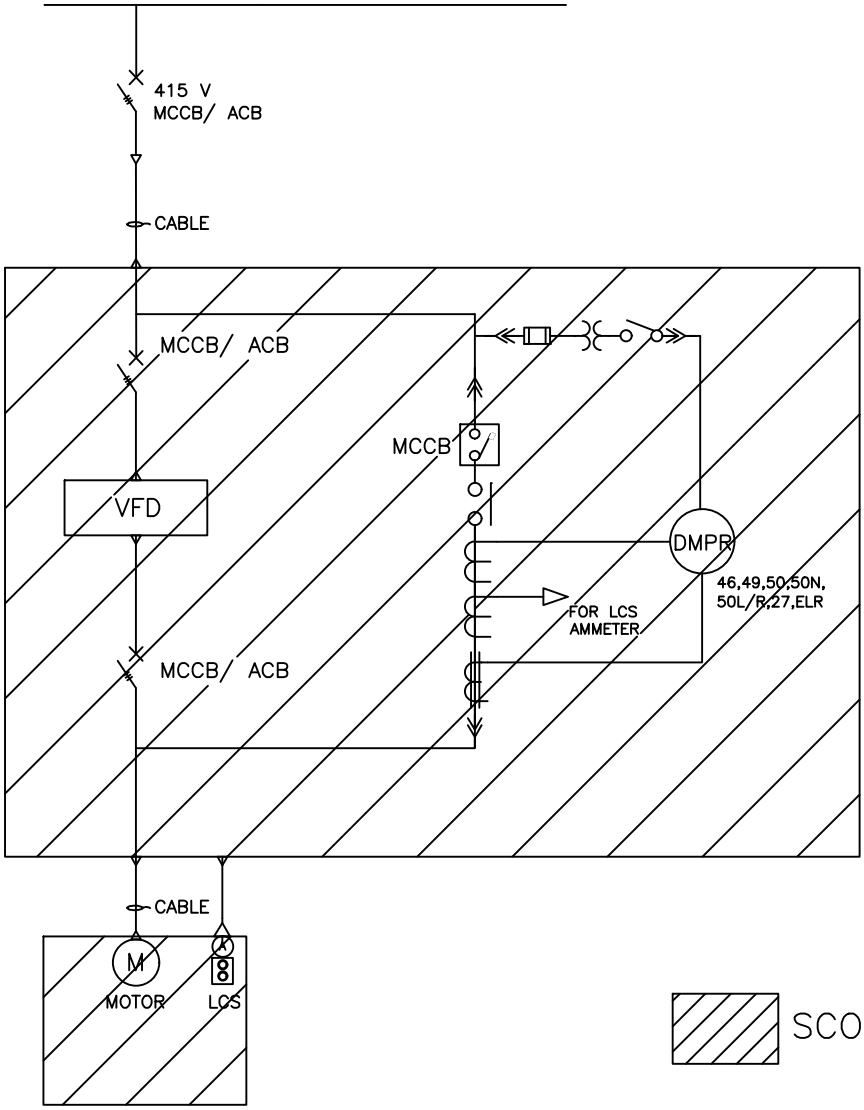
PROJECT: PP UNIT PROJECT CLIENT: BPCK KOCHI	REV	DATE	PURPOSE	BY	CHKD	APPRV
	A	01.08.24	ISSUED WITH MR	PS	AS	RS

110 V DC CONTROL SUPPLY (BY OWNER)

240 V AC UPS CONTROL SUPPLY (BY OWNER)

240 V SPACE HEATER SUPPLY (BY OWNER)

415 V SWITCHGEAR (OWNER)



SCOPE OF THIS MR

NOTES:

1. **THE ONE LINE DIAGRAM SHOWN ABOVE IS ONLY INDICATIVE. ALL THE EQUIPMENTS ASSOCIATED WITH VFD AND BYPASS CIRCUIT, AS PER SHALL BE IN SCOPE OF VENDOR.**
2. **LCS AMMETER SHALL BE SUITABLE FOR 4-20 mA SIGNAL UNDER BOTH VFD AND BYPASS MODE OF OPERATION. TRANSDUCERS (AS REQD.) IN BYPASS CIRCUIT SHALL BE PROVIDED BY VENDOR.**
3. **DIGITAL MOTOR PROTECTION RELAY SHALL BE SUITABLE FOR 240V AC UPS CONTROL SUPPLY.**
4. **DMPR SHALL BE TYPE 2 CO-ORDINATED WITH THE OTHER MV COMPONENTS IN THE FEEDER. IT SHALL BE SUITABLE FOR IE3 MOTORS.**
5. **CT FOR AMMETER SHALL BE PROVIDED FOR MOTORS RATED ABOVE 5.5 KW.**
6. **CBCT SHALL BE PROVIDED FOR MOTORS RATED ABOVE 22 KW.**
7. **MOTOR SPACE HEATER CKT. TO BE PROVIDED FOR MOTORS RATED 30kW AND ABOVE.**
8. **ALL MCCB/ COMPONENTS SHALL BE SUITABLE FOR 65 KA.**

ENGINEERS INDIA LIMITED NEW DELHI	DATA SHEET TYPICAL SLD FOR VFD WITH BYPASS (MOTOR RATING UPTO 55 KW)	DATA SHEET	REV
		B895-000-16-50-DS-4902 Sht.1 OF 1	A

Project	PMC & EPCM Services for PPU & Revamp of PFCCU at Kochi Refinery		**Client**	BPCL - KOCHI REFINERY	
Unit	Common	**Location**	**Job No.**	B895	**Unit No.** 000

PURCHASER'S DATA

A.	**Site Conditions**		
1.	Maximum Ambient Temperature	°C	46
2.	Minimum Ambient Temperature	°C	1
3.	Design Ambient Temperature	°C	45
4.	Relative Humidity	%	95
5.	Altitude	mm	<1000
6.	Environment:		Humid & Highly Corrosive
B.	**Technical particulars**		
1.	Motor Tag no.:		
2.	Driven Equipment name:		
3.	Voltage:	V	415 +/- 10 %
4.	Phase:		Three
5.	Frequency:	Hz	50 +/- 3 %
6.	Fault level:	kA	65
7.	Method of starting:		D.O.L
8.	Winding Connection:		Delta
9.	No of Terminals:		6
10.	Cable size:	mm²	
11.	Cable type:		Cu/Al
12.	Temperature rise:	°C	
13.	Cooling:		TEFC
14.	Insulation class:		F
15.	Temperature rise Limited to insulation class		B
16.	Hazardous area classification:		As per area classification
17.	Dust classification		NA
18.	Gas group:		As per area classification
19.	Dust Group		NA
20.	Type of explosion protection:		As per MR/ Tender
21.	Prestart purging for Ex(n) motor		Not Required
22.	Type of ingress protection:		IP 55
23.	Color shade:		RAL-7031
24.	Thermisters:		Not Required
25.	RTD:		Not Required
26.	BTD:		Not Required
27.	RTD/BTD monitoring device:		Not Required
28.	Applicable specification:		6-51-0064
29.	Efficiency:		IE3 for Hazardous Area and IE4 for Safe Area

DRIVEN EQUIPMENT MANUFACTURER's DATA

1.	Suggested motor rating:	kW	
2.	Manufacturer:		
3.	BkW at Full load:	kW	
4.	kW:at end of Curve	kW	

Rev. No.	Date	Purpose	Prepared By	Reviewed By	Approved By
B	27-FEB-2025	ISSUED WITH MR	NAGARAJU NAIK	ACHUTUNI SAI	RAMAN SOOD
A	25-JUL-2024	ISSUED WITH MR	PUNEET SHRIVASTAVA	ACHUTUNI SAI	RAMAN SOOD

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Project PMC & EPCM Services for PPU & Revamp of PFCCU at Kochi Refinery **Client** BPCL - KOCHI REFINERY

Unit Common **Location** **Job No.** B895 **Unit No.** 000

5.	Speed:	RPM	
6.	Rotation of eqpt. from coupling end:		
7.	Driven equipment:		
8.	Coupling type:		
9.	Torque required starting	mkg	
	Torque required Maximum	mkg	
10.	GD2 of eqpt including flywheel	kgm²	
	excluding flywheel:	kgm²	
11.	thrust Up:	kg	
	thrust Down:	kg	
12.	Starting condition:		

MOTOR MANUFACTURER's DATA

1.	Rating:	kW	
2.	Manufacturer:		
3.	No. of poles:		
4.	Frame designation:		
5.	Full load speed:	RPM	
6.	Mounting:		
7.	Full load torque (FLT):	mkg	
8.	Starting torque:	% of FLT	
9.	Break down or pull out torque:	% of FLT	
10.	Full load current (FLC):	A	
11.	Starting current at 100% voltage:	% of FLC	
12.	Rotation viewed from coupling end:		
13.	Starting time at 75% voltage:	sec.	
	100% voltage:	sec.	
14.	Locked rotor withstand time (cold/hot) at,		
	75% voltage	sec.	
	100% voltage:	sec.	
15.	Time (Te) for Increased Safety Motor at 100% Voltag	sec.	
16.	Heating/Cooling Time Const. (min.)	min	
17.	Space heater - voltage & power:		
18.	Efficiency at 75% Load:	%	
	100% Load: voltage:	%	
19.	Power factor at 75%/ Load:		
	100% Load:		
	starting		
20.	Moment of inertia, GD2:	kgm²	
21.	NDE bearing type & no		
22.	DE bearing type & no.:		
23.	Type of lubrication:		
24.	Weight of motor:	kg	

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Project	PMC & EPCM Services for PPU & Revamp of PFCCU at Kochi Refinery		**Client**	BPCL - KOCHI REFINERY	
Unit	Common	**Location**	**Job No.**	B895	**Unit No.** 000

25.	Thermisters, quantity	no.	
	make: type:		
26.	RTD, quantity:	no.	
	make: type:		
27.	BTD, quantity	no.	
	make: type:		
28.	Shaft voltage:	V	
29.	Critical speed, 1st/2nd stage:	RPM	
30.	Canopy:		

Notes

1 FRP canopy shall be provided for all outdoor motors.
2 Starting time calculations shall be based on operating conditions specified on Material Requisition e.g. open valve condition/closed valve condition, at no load/full load, as applicable.
3 Space heater shall be provided for motors rated 30 kW and above.

Rev. No.	Date	Purpose	Prepared By	Reviewed By	Approved By
B	27-FEB-2025	ISSUED WITH MR	NAGARAJU NAIK	ACHUTUNI SAI	RAMAN SOOD
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ELECTRICAL LOAD DATA

NOTES: -

1. Vendor shall fill the details of all electrical power consumer loads, which are included in the scope of this MR/Tender and submit with the offer.
2. Motors/load requiring emergency power supply shall be separately identified in this Electrical load data format.

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MOTOR

S.NO	TAG NO.	SERVICE	Make	Type of enclosure	Applicable standard for hazardous area application	Motor Kw	Duty (continuous /intermittent)	No. of poles	Type designation for cooling

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OTHER ELECTRICAL LOADS

S.NO	TAG NO.	SERVICE	Make	Type of enclosure	Applicable standard for hazardous area application	Rated KW	Duty (continuous /intermittent)	Voltage

Project PMC & EPCM Services for PPU & Revamp of PFCCU at Kochi Refinery **Client** BPCL - KOCHI REFINERY

Unit Common **Location** **Job No.** B895 **Unit No.** 000

PURCHASER'S DATA

A.	**Site Conditions**		
1.	Maximum Ambient Temperature	°C	46
2.	Minimum Ambient Temperature	°C	1
3.	Design Ambient Temperature	°C	45
4.	Relative Humidity	%	95
5.	Altitude Above MSL	mm	<1000
6.	Environment		
B.	**Technical particulars**		
1.	System Voltage		
	Nominal		415 V
	Highest		500 V
	Voltage grade		650/1100 V
2.	Frequency	Hz	50 +/- 3 %
3.	Conductor material		
	HV Power cable		NA
	MV Power cable		Copper & Aluminium (Refer Note 1)
	MV control cable		NA
4.	Installation under DGMS jurisdiction (See Note)		No
5.	Applicable spec.		6-51-0051 Rev 9
6.	Insulation		XLPE
7.	PVC compound type		ST-2
8.	Type of conductor		As per 6-51-0051
9.	Conductor class		AS PER IS
10.	Types of cable		Flame retardant low smoke / Fire survival
11.	Armour		
	Type		AS PER IS 1554
	Size of armour		As per Table -3 of IS 1554
12.	Type of drum		Steel

MANUFACTURER'S DATA

A.	**Technical particulars**		
1.	Name of manufacturer		
2.	MR/PR item no.		
3.	Cable type/ code		
4.	Conductor material		
5	Conductor semiconducting screen (HV cables)		
	Material		
	Thickness	mm	
6.	Insulation		
	Type of compound		
	Thickness	mm	
7.	Insulation semiconducting screen (HV cables)		
	Material		

Rev. No.	Date	Purpose	Prepared By	Reviewed By	Approved By
A	20-SEP-2024	ISSUED WITH MR	PUNEET SHRIVASTAVA	ACHUTUNI SAI	RAMAN SOOD

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Project PMC & EPCM Services for PPU & Revamp of PFCCU at Kochi Refinery **Client** BPCL - KOCHI REFINERY

Unit Common **Location** **Job No.** B895 **Unit No.** 000

	Thickness	mm	
8.	Copper tape		
	Thickness	mm	
9.	Inner sheath		
	Type of compound		
	Thickness	mm	
10.	Nominal dia under armour	mm	
11.	Calculated dia under armour	mm	
12.	Armour		
	Material		
	Type		
	Size		
13.	Nominal dia under outersheath	mm	
14.	Calculated dia under outersheath	mm	
15.	Outersheath		
	Type of compound		
	Thickness	mm	
16.	Nominal outer dia of cable	mm	
17.	Tolerance on outer dia	%	
18.	Weight of cable per km	kg	
19.	Maximum drum length	mtr.	
20.	Maximum DC resistance of conductor at 20 °C		
21.	AC resistance at 90 °C		
22.	Reactance of cable at 50 Hz		
23.	Capacitance of cable		
24.	Zero sequence impedance of cable		
25.	Capacitive charging current per km		

Notes

1 All power cables 2.5 sqmm to 16 sqmm shall be with copper conductor and above 16 sqmm shall be aluminium conductor.

2 Medium voltage power cable for motors shall be minimum 4 sqmm (Copper).

Rev. No.	Date	Purpose	Prepared By	Reviewed By	Approved By
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PAIRED CONTROL CABLES

DATA SHEET

Document No. B895-000-16-50-DS-5201
Rev. No. A

Project PMC & EPCM Services for PPU & Revamp of PFCCU at Kochi Refinery **Client** BPCL - KOCHI REFINERY

Unit Common **Location** **Job No.** B895 **Unit No.** 000

PURCHASER'S DATA

A.	**Site Conditions**		
1.	Maximum Ambient Temperature	°C	46
2.	Minimum Ambient Temperature	°C	1
3.	Design Ambient Temperature	°C	45
4.	Relative Humidity	%	95
5.	Altitude Above MSL	m	<1000
6.	Environment		
B.	**Technical particulars**		
1.	Cable Type/Code		Control Cable
2.	Embossing Details		As per specification
3.	Details of Color Coding		As per Specification
4.	Details of Pairing		As per Specification
5.	Standard Drum Length		As per Specification

MANUFACTURER'S DATA

A.	**Twisted Pair Unshielded Cables**		
1.	Name of Manufacturer		
2.	Material Specifications		
	Conductor dia.	mm	
	Insulation Thickness	mm	
	Inner Sheath Thickness	mm	
	Outer Sheath Thickness	mm	
3.	Performance Data		
	Rated Voltage	V	
	Max. Resistance at 20°C	ohms	
	Max. Core-Core Capacitance	nF	
	Max. Inductance	mH	
	Nominal Impedance	ohms	
4.	Technical Particulars		
	Approx. overall diameter	mm	
	Approx. dia. over armour	mm	
	Approx. dia. under armour	mm	
	Armour Galvanised Steel wire thickness		
	Minimum outer sheath thickness	mm	
B.	**Twisted Pair Shielded Cables**		
1.	Name of Manufacturer		
2.	Material Specifications		
	Conductor dia.	mm	
	Insulation Thickness	mm	
	Inner Sheath Thickness	mm	
	Outer Sheath Thickness	mm	
3.	Performance Data		
	Rated Voltage	V	
	Max. Resistance at 20°C	ohms	
	Max. Core-Core Capacitance	nF	

Rev. No.	Date	Purpose	Prepared By	Reviewed By	Approved By
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Project PMC & EPCM Services for PPU & Revamp of PFCCU at Kochi Refinery **Client** BPCL - KOCHI REFINERY

Unit Common **Location** **Job No.** B895 **Unit No.** 000

	Max. Core-Screen Capacitance	nF	
	Maximum Inductance	mH	
	Nominal Impedance	ohms	
4.	Shielding Data		
	Material of Shielding		
	Minimum Thickness	mm	
	Coverage and Overlap		
5.	Drain Wire for Overall Sheath		
	Drain Wire Material		
	Area of Cross Section	mm sq	
	No. of Strands		
	Diameter	mm	
6.	Technical Particulars		
	Conductor Size	mm sq	
	Approx. overall diameter	mm	
	Approx. dia. over armour	mm	
	Approx. dia. under armour	mm	
	Armour Galvanised Steel wire thickness		
	Minimum outer sheath thickness	mm	

Eil Notes

1 Control cable shall be twisted pair, individual as well as overall screened/ shielded type. The conductor shall be stranded.
2 Applicable spec: 6-51-0052.

Rev. No.	Date	Purpose	Prepared By	Reviewed By	Approved By
A	20-SEP-2024	ISSUED WITH MR	PUNEET SHRIVASTAVA	ACHUTUNI SAI	RAMAN SOOD

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इंजीनियर्स इंडिया लिमिटेड ENGINEERS INDIA LIMITED (A Govt. of India Undertaking)

COMMUNICATION & FIRE ALARM CABLES DATA SHEET

Project PMC & EPCM Services for PPU & Revamp of PFCCU at Kochi Refinery **Client** BPCL - KOCHI REFINERY

Unit Common **Location** **Job No.** B895 **Unit No.** 000

PURCHASER'S DATA

A.	**Site Conditions**		
1.	Maximum Ambient Temperature	°C	46
2.	Minimum Ambient Temperature	°C	1
3.	Design Ambient Temperature	°C	45
4.	Relative Humidity	%	95
5.	Altitude Above MSL	m	<1000
6.	Environment		
B.	**Technical particulars**		
1.	Cable Type/Code		Fire Alarm & Communication
2.	Embossing Details		Sequential markings every mtr
3.	Details of Color Coding		As per ITD specification
4.	Details of Pairing		As per Specification
5.	Standard Drum Length		As per Specification

MANUFACTURER'S DATA

A.	**Twisted Pair Unshielded Cables**		
1.	Name of Manufacturer		
2.	Material Specifications		
	Conductor dia.	mm	
	Insulation Thickness	mm	
	Inner Sheath Thickness	mm	
	Outer Sheath Thickness	mm	
3.	Performance Data		
	Rated Voltage	V	
	Max. Resistance at 20°C	ohms	
	Max. Core-Core Capacitance	nF	
	Max. Inductance	mH	
	Nominal Impedance	ohms	
4.	Technical Particulars		
	Approx. overall diameter	mm	
	Approx. dia. over armour	mm	
	Approx. dia. under armour	mm	
	Armour Galvanised Steel wire thickness		
	Minimum outer sheath thickness	mm	
B.	**Twisted Pair Shielded Cables**		
1.	Name of Manufacturer		
2.	Material Specifications		
	Conductor dia.	mm	
	Insulation Thickness	mm	
	Inner Sheath Thickness	mm	
	Outer Sheath Thickness	mm	
3.	Performance Data		
	Rated Voltage	V	
	Max. Resistance at 20°C	ohms	
	Max. Core-Core Capacitance	nF	

Rev. No.	Date	Purpose	Prepared By	Reviewed By	Approved By
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Project PMC & EPCM Services for PPU & Revamp of PFCCU at Kochi Refinery **Client** BPCL - KOCHI REFINERY

Unit Common **Location** **Job No.** B895 **Unit No.** 000

	Max. Core-Screen Capacitance	nF	
	Maximum Inductance	mH	
	Nominal Impedance	ohms	
4.	Shielding Data		
	Material of Shielding		
	Minimum Thickness	mm	
	Coverage and Overlap		
5.	Drain Wire for Overall Sheath		
	Drain Wire Material		
	Area of Cross Section	mm sq	
	No. of Strands		
	Diameter	mm	
6.	Technical Particulars		
	Conductor Size	mm sq	
	Approx. overall diameter	mm	
	Approx. dia. over armour	mm	
	Approx. dia. under armour	mm	
	Armour Galvanised Steel wire thickness		
	Minimum outer sheath thickness	mm	

Eil Notes

1 Applicable spec: 6-51-0052

Rev. No.	Date	Purpose	Prepared By	Reviewed By	Approved By
A	20-SEP-2024	ISSUED WITH MR	PUNEET SHRIVASTAVA	ACHUTUNI SAI	RAMAN SOOD

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1.	**OPERATING CONDITIONS**	
2.	Duty	Continuous
3.	Installation	Indoor
4.	Area Classification	Safe/Hazardous
5.	Type (Double skin)	Draw through/forced through
6.	Quantity	
7.	Working	
8.	Stand by	
9.	Arrangement	Horizontal floor mounted
10.	**MANUFACTURER SPECIFICATION**	
11.	Make / Model	
12.	**FILTER AT AHU INLET**	
13.	Make / Model	
14.	Total air flow rate	m^3/hr
15.	Quantity of filter elements	nos.
16.	Filtration efficiency	Microns
17.	Size of filter elements	mm x mm x mm
18.	Face velocity	m/sec
19.	Pressure drop in clean condition	mm WC
20.	Maximum allowable pressure drop	mm WC
21.	Fixing	Flange/channel
22.	Type of filter	Dry fabric cleanable
23.	**COOLING COIL SECTION**	
24.	Make /Model	
25.	Air entering condition	^oC DB/ ^oC WB
26.	Air leaving condition	^oC DB/ ^oC WB
27.	ADP	^oC
28.	LMTD	^oC
29.	Capacity	TR
30.	Total air flow rate	m^3/hr
31.	Face area	m^2
32.	Coil size	mm x mm
33.	Velocity of air across coil (face velocity)	m/sec
34.	No. of rows	
35.	Tube per row	
36.	Type	DX/Chilled Water
37.	By pass factor	
38.	Pressure drop (Air side)	mm WC
39.	Pressure drop (Refrigerant/Water side)	mm WC
40.	Tube OD	mm
41.	Tube thickness	mm
42.	Bend thickness	mm
43.	Fin spacing	FPI
44.	Bonding of fins (Hydraulically/with mandrel)	
45.	**BLOWER SECTION**	
46.	Type	Centrifugal
47.	Blade profile	~~Forward~~/Backward/~~Radial~~
48.	No. of impellers	nos.
49.	Impeller diameter	mm
50.	Air flow rate	m^3/hr
51.	Static pressure	Minimum 65 mm WC
52.	Impeller speed	RPM.
53.	Power consumption at shaft	kW
54.	Guaranteed power consumption at motor	kW
55.	Air out velocity	Not more than 9.2 m/sec

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56.	Drive arrangement	V-belt drive	
57.	Motor	kW/ RPM	
58.	No. of belts		
59.	Bearings	Self aligning heavy duty ball	
60.	Noise level		
61.	**DIMENSIONS / WEIGHTS**		
62.	Overall size & Overall weight	Kg.	
63.	**ACCESSORIES**		
64.		**Purchaser's**	**Vendor's confirmation**
65.	**Requirement**		
66.	Guard for moving parts	Required	
67.	Slide rail below motor	Required	
68.	Fire resistant flexible connection at AHU outlet	Required	
69.	Insulated drain pan with drain connection	Required	
70.	Grease nipple for bearings	Required	
71.	Painting on MS parts	Required	
72.	Vibration isolator (ribbed neoprene rubber	Required	
73.	Bronze/gun metal bushes at spindle ends of	Required	
74.	Drain piping	Required	
75.	V-belt drive with V-belts, pulleys	Required	
76.	Common base frame	Required	
77.	Volume control damper at AHU outlet	Required	
78.	Insulation of fan section & coil section	Required	
79.	**ACCESSORIES/INSTRUMENTS/CONTROLS (REFRIGERANT CIRCUIT ONLY)**		
80.	Liquid strainer	Required	
81.	Drier	Required	
82.	Sight glass	Required	
83.	Pressure gauge for Refrigerant in/out	Required	
84.	Solenoid valve	Required	
85.	Expansion valve	Required	
86.	**MATERIAL**		
87.	Coil tubes	Seamless copper tubes	
88.	Filter Media	HDPE mesh	
89.	Fins	Aluminium	
90.	AHU casing		
91.	Drain pan	18 Gauge SS Sheet	
92.	Impeller	M.S. sheets	
93.	Blower shaft	C-40/EN-8	
94.	V-pulley	C.I. Grooved	
95.	Face & bypass damper blade	16 Gauge G.I. Sheet	
96.	Filter casing	Aluminium	
97.	Face & bypass damper frame	16 Gauge CRCA	
98.	Bearings at face & bypass damper	Nylon / Sintered Brass / Gun Metal	
99.	Filter mounting frame	Zinc sprayed M.S. Sections	
100.	Coil header	MS	
101.	Coil casing	GSS	
102.	**INSPECTION AND TESTING**		
103.	As per EIL Standard Specification No. 6-61-0017 & 6-81-0154		

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1.0	**OPERATING CONDITIONS**	
1.1	Location	
1.2	Total quantity of air handled	CFM (m^3/hr.)
1.3	Type of filter media	
1.4	Expected impurities in air	As generally present in ambient air
2.0	**MANUFACTURER SPECIFICATION**	
2.1	Make/ Model	
2.2	Capacity per filter element	CFM (m^3/hr.)
2.3	Quantity of filter element	Nos.
2.4	Size of filter element	610 mm x 610 mm x 305 mm
2.5	Face velocity	~500 FPM
2.6	Filtration efficiency	95% down to 5 micron
2.7	Pressure drop in clean condition	6.5 mm WC
2.8	Maximum allowable pressure drop (When due for cleaning)	mm WC
2.9	Fixing	Flange / ~~Channel~~
2.10	Weight of each filter element	Kg.
2.11	Method to clean filter	Wash in water / ~~Compressed air jet~~
2.12	Mounting of filter	~~Horizontal~~ / Vertical
2.13	Direction of air flow	Horizontal / ~~Vertical~~
3.0	**ACCESSORIES**	
3.1	Nuts, bolts, rubber bushes, springs as necessary for mounting	To be provided by Vendor
3.2	The filter modules in ladder type	
4.0	**MATERIAL**	
4.1	Filter casing	~~Carbon steel~~ / Aluminium / ~~SS~~
4.2	Filtering media	HDPE/~~Nylon mesh/Non woven felt/G.I. wire mesh~~
4.3	Separators	Aluminium
4.4	Wire mesh to support filter media	G.I. / ~~S.S.~~
4.5	Gasket	~~Felt~~ / Neoprene sponge rubber
4.6	Nuts/bolts/bush/springs	Galvanised
4.7	Filter mounting frame	Ladder type made of MS rolled sections, Spray galvanised
5.0	**INSTRUMENT**	
5.1	Pressure drop measurement device	~~DPG~~ / Water tube manometer
6.0	**INSTRUMENT**	
6.1	As per EIL's Standard Specification No. 6-61-0017. Dust test not required. Type test will suffice.	

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1.	Location/Building	
2.	Installation	Outdoor/Indoor
3.	Make/Model	
4.	Operating air flow	
5.	Velocity through filter max/min	
6.	Overall size.	
7.	Construction of filter chamber	REFER NOTE
8.	Construction mat. of filter packs	
9.	Qty/Type of filter media/modules	
10.	Type of chemical used	
11.	Qty of chemicals required	
12.	Initial overall pressure drop in filter	
13.	Final overall pressure drop in filter	
14.	Qty/Type of pre filter	
15.	Qty/Type of final filter	
16.	Efficiency of pre filter	As per Standard Spec. No. 6-61-0017
17.	Efficiency of final filter	As per Standard Spec. No. 6-61-0017
18.	Total wt. of filter with all internals	
19.	Mounting arrangement of filter unit	Floor Mounted
20.	Operating condition, input	As per Standard Spec. No. 6-61-0017
21.	Operating condition, output	As per Standard Spec. No. 6-61-0017
22.	Size of inlet/outlet flanges	
23.	Nature & properties of chemical used	
24.	NOTE: Min.16 G galvanised steel sheets with sloping roof. Painted inside & outside with 2 coats of epoxy paint over epoxy primer. Stainless steel door latches & hinges for servicing access doors. Compressible gaskets to prevent air leakage around doors & between doors & filters. All joints shall be sealed with silicone rubber.	

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1.	**OPERATING CONDITIONS**				
2.	Duty	Continuous/~~Intermittent~~			
3.	Installation	Indoor/~~Outdoor~~			
4.	Quantity				
5.	Working	__ Nos.			
6.	Stand by	__ Nos.			
7.	Area classification	Safe/~~Hazardous~~			
8.	Driver	Electric motor			
9.	Refrigerant	R134a/R-407a/R407c/R410a			
10.	Capacity of each chiller package – Nominal	___ TR			
11.	Capacity of each chiller package – Actual	___ TR			
	MANUFACTURER SPECIFICATION				
12.	**Compressor**				
13.	Make				
14.	Model				
15.	Type	Scroll/ Screw			
16.	No of stages/ No. of compressor/ Unit				
17.	Capacity				
18.	Saturated suction pressure				
19.	Saturated suction temperature				
20.	Saturated discharge pressure				
21.	Saturated discharge temperature				
22.	Compressibility				
23.	Drive	V-belt / flexible coupling			
24.	**Screw Compressor**				
25.	Rotor Diameter				
26.	No of lobes – Male/Female				
27.	Rotor length to diameter ratio(L/D)				
28.	Rotor Clearance				
29.	Shaft Diameter	mm			
30.	Shaft seal type				
31.	**General Parameters**				
32.	Compressor speed	RPM			
33.	Guaranteed shaft power (All losses inclusive)				
34.	Motor power & speed				
35.	Motor suitable for loaded starting	Yes/No			
36.	Description of unloaded starting arrangement				
37.	Min compressor speed for proper lubrication/capacity control	RPM			
38.	**LUBRICATION**				
39.	Type	Splash/Pressure			
40.	Oil pump driven by	Compressor shaft/ Electric motor			
41.	Grade of lubrication oil				
42.	Lubrication oil charge				
43.	**CAPACITY CONTROL**				
44.	Type				
45.	Actuators	Automatic cum manual			
46.	Actuators operated by	Microprocessor controlled			
47.	Compressor to unload on power failure/stoppage	Automatic cum manual			
48.	Capacity regulation steps	%	%	%	%
49.	Capacity (TR)	100	75	50	25

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50.	Shaft power (kw)				
51.					
52.	**DIMENSIONS / WEIGHTS**				
53.	Compressor weight				
54.	Maximum erection weight				
55.	Maximum maintenance weight with component name				
56.	Overall size				
57.	**MATERIAL**				
58.	**Screw Compressor**				
59.	Casing				
60.	Rotors				
61.	Shaft				
62.	Shaft Sleeve				
63.	Shaft Seals				
64.	**Scroll Compressor**				
65.	Casing				
66.	Rotors/Scroll				
67.	Shaft				
68.	Shaft Sleeve				
69.	Shaft Seals				
70.	**Condenser**				
71.	Type	Shell & Tube water cooled			
72.	Model				
73.	Heat Rejection	TR			
74.	Cooling water temperature at inlet	^oC			
75.	Cooling water temperature at outlet	^oC			
76.	Cooling water pressure at inlet	Kg/cm^2 (g)			
77.	Cooling water pressure at outlet	Kg/cm^2 (g)			
78.	Fouling resistance, water side	0.0004 m^2 hr ^oC/Kcal			
79.	LMTD	^oC			
80.	Overall heat transfer coefficient	Kcal/hr m^2 ^oC			
81.	Cooling water flow rate	m^3/hr			
82.	No. of passes, tube side	Nos.			
83.	Water velocity inside tube	m/sec			
84.	Pressure drop, water side	Kg/cm^2			
85.	Design pressure, shell side	Kg/cm^2 a			
86.	Design pressure, tube side	Kg/cm^2 a			
87.	Hydraulic test pressure, shell side	Kg/cm^2 a			
88.	Hydraulic test pressure, tube side	Kg/cm^2 a			
89.	Pneumatic test pressure, shell side	Kg/cm^2 a			
90.	Pneumatic test pressure, tube side	Kg/cm^2 a			
91.	Design temperature, shell side	^oC			
92.	Design temperature, tube side	^oC			
93.	Total no. of tubes	Nos.			
94.	Tube OD at plain end	mm			
95.	Tube thickness at plain end	mm			
96.	Tube length between tube sheets	mm			
97.	Tube type	Integrally finned copper tubes			
98.	Fin spacing	FPI			

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99.	Total tube surface areas, m^2	
100.	Water side	
101.	Refrigerant side	
102.	Shell OD	mm
103.	Shell thickness	mm
104.	Tube to tube sheet joint, expanded/welded	
105.	Water inlet flange	Size mm
106.	Water outlet flange	Size mm
107.	**Material**	
108.	Shell	
109.	Channel/channel covers	
110.	Tube sheet	
111.	Baffles/Tube supports	
112.	Tubes	Integrally finned copper tubes
113.	Flanges	
114.	Gasket	
115.	Bolts & Nuts	
116.	**Chiller (Evaporator)**	
117.	Type	Shell & Tube
118.	Make	
119.	Model	
120.	Capacity	TR (actual)
121.	Chilled water temperature at inlet	^oC
122.	Chilled water temperature at outlet	^oC
123.	Chilled water pressure at inlet	Kg/cm^2 (g)
124.	Chilled water pressure at outlet	Kg/cm^2 (g)
125.	Fouling resistance, water side	0.0002 m^2 hr ^oC/Kcal
126.	LMTD	^oC
127.	Overall heat transfer coefficient	Kcal/hr m^2 ^oC
128.	Chilled water flow rate	m^3/hr
129.	No. of passes, tube side	Nos.
130.	Pressure drop, water side	Kg/cm^2
131.	Design pressure, shell side	Kg/cm^2 a
132.	Design pressure, tube side	Kg/cm^2 a
133.	Hydraulic test pressure, shell side	Kg/cm^2 a
134.	Hydraulic test pressure, tube side	Kg/cm^2 a
135.	Pneumatic test pressure, shell side	Kg/cm^2 a
136.	Pneumatic test pressure, tube side	Kg/cm^2 a
137.	Design temperature, shell side	^oC
138.	Design temperature, tube side	^oC
139.	Total no. of tubes	Nos.
140.	Tube OD at plain end	mm
141.	Tube thickness at plain end	mm
142.	Tube length between tube sheets	mm
143.	Tube type	copper tubes
144.	Fin spacing	FPI
145.	Total tube surface areas, m^2	
146.	Water side	
147.	Refrigerant side	
148.	Shell OD	mm
149.	Shell thickness	mm

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150.	Tube to tube sheet joint, expanded/welded		
151.	Water inlet flange	Size	mm
152.	Water outlet flange	Size	mm
153.	**Material**		
154.	Shell		
155.	Channel/channel covers		
156.	Tube sheet		
157.	Baffles/Tube supports		
158.	Tubes		
159.	Flanges		
160.	Gasket		
161.	Bolts & Nuts		
162.	**INSPECTION AND TESTING**		
163.	As per Job Specification and EIL Standard Specification No. 6-61-0017		

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VENDOR DATA REQUIREMENTS
FOR
MISC. BUILDING WORKS

Rev. No.	Date	Purpose	Prepared by	Checked by	Approved by
A	02-APR-2026	ISSUED WITH TENDER	NNB	AS	VK

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VENDOR DATA REQUIREMENTS

The following drawings/documents marked "✔" shall be furnished by the bidder.

COMMUNICATION FIRE ALARM CABLES

S. NO.	DESCRIPTION	WITH BID	POST ORDER			REMARKS
			FOR REVIEW	FOR RECORD	WITH DATA BOOK (FINAL)	
1.	Data Sheets (Duly filled-in)			✔	✔	
2.	Test Records			✔	✔	
3.	Inspection & Test Plan (ITP) -For review by Inspection Dept.		✔		✔	
4.	Type Test Certificate for similar cables			✔	✔	
5.	Data Books/ Manuals : Installation Manual			✔	✔	
6.	Data Books/ Manuals : Operating/ Maintenance Manual				✔	
7.	Data Books/ Manuals : Catalogues/ Brochures				✔	
8.	Equipment storage procedure at site				✔	

CONTROL STATIONS

S. NO.	DESCRIPTION	WITH BID	POST ORDER			REMARKS
			FOR REVIEW	FOR RECORD	WITH DATA BOOK (FINAL)	
1.	Dimensional/Assembly Drawings : GA Drawings (For control station and canopy)		✔		✔	
2.	Dimensional/Assembly Drawings : Installation and mounting details			✔	✔	
3.	Wiring Diagram And Terminal Details			✔	✔	
4.	Type Test Certificate from Independent Test Lab			✔	✔	
5.	Statutory approval certificate			✔	✔	
6.	BIS Licence			✔	✔	
7.	List of Maintenance Spares			✔	✔	
8.	List of Special Tools & Tackles			✔	✔	
9.	Inspection & Test Plan (ITP) -For review by Inspection Dept.		✔		✔	
10.	Test Records				✔	
11.	Data Books/ Manuals : Installation Manual				✔	
12.	Data Books/ Manuals : Operating/ Maintenance Manual				✔	
13.	Data Books/ Manuals : Catalogues/ Brochures				✔	

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S. NO.	DESCRIPTION	WITH BID	POST ORDER			REMARKS
			FOR REVIEW	FOR RECORD	WITH DATA BOOK (FINAL)	
14.	Equipment storage procedure at site				✔	

LIGHTING AND POWER PANELS

S. NO.	DESCRIPTION	WITH BID	POST ORDER			REMARKS
			FOR REVIEW	FOR RECORD	WITH DATA BOOK (FINAL)	
1.	Data Sheets (Duly filled-in)		✔		✔	
2.	Dimensional Drawings : G.A. Drawing			✔	✔	
3.	Dimensional Drawings : Terminal details, wiring diagram			✔	✔	
4.	Test Records				✔	
5.	Inspection & Test Plan (ITP) -For review by Inspection Dept.		✔		✔	
6.	Type Test Certificate from Independent Test Lab			✔	✔	
7.	Statutory approval certificate			✔	✔	
8.	BIS Licence			✔	✔	
9.	List of spares			✔	✔	
10.	List of Special Tools & Tackles			✔	✔	
11.	Data Books/ Manuals : Installation Manual				✔	
12.	Data Books/ Manuals : Operating/ Maintenance Manual				✔	
13.	Data Books/ Manuals : Catalogues/ Brochures				✔	
14.	Equipment storage procedure at site				✔	

PLUG, SOCKET AND HANDLAMPS

S. NO.	DESCRIPTION	WITH BID	POST ORDER			REMARKS
			FOR REVIEW	FOR RECORD	WITH DATA BOOK (FINAL)	
1.	Dimensional/Assembly Drawings : GA Drawings			✔	✔	
2.	Type Test Certificate from Independent Test Lab			✔	✔	
3.	Statutory approval certificate			✔	✔	
4.	BIS Licence			✔	✔	
5.	List of spares			✔	✔	
6.	List of Special Tools & Tackles			✔	✔	

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S. NO.	DESCRIPTION	WITH BID	POST ORDER			REMARKS
			FOR REVIEW	FOR RECORD	WITH DATA BOOK (FINAL)	
7.	Test Records				✔	
8.	Inspection & Test Plan (ITP) -For review by Inspection Dept.		✔		✔	
9.	Data Books/ Manuals : Installation Manual				✔	
10.	Data Books/ Manuals : Operating/ Maintenance Manual				✔	
11.	Data Books/ Manuals : Catalogues/ Brochures				✔	
12.	Equipment storage procedure at site				✔	

LIGHT FITTINGS FOR HAZARDOUS LOCATIONS

S. NO.	DESCRIPTION	WITH BID	POST ORDER			REMARKS
			FOR REVIEW	FOR RECORD	WITH DATA BOOK (FINAL)	
1.	Dimensional/Assembly Drawings : GA Drawings			✔	✔	
2.	Dimensional/Assembly Drawings : Installation Plan/Mounting Details			✔	✔	
3.	Dimensional/Assembly Drawings : Terminal Box Arrangement			✔	✔	
4.	Performance Curves : Polar Curves For Each Type Of Fixture			✔	✔	
5.	Performance Curves : Photomatric Data For Each Type Of Fixture			✔	✔	
6.	Test Records				✔	
7.	Inspection & Test Plan (ITP) -For review by Inspection Dept.		✔		✔	
8.	Statutory approval certificate			✔	✔	
9.	Type Test Certificate from Independent Test Lab			✔	✔	
10.	List of Commissioning Spares			✔		
11.	List of Maintenance Spares			✔		
12.	List of Special Tools & Tackles			✔		
13.	Data Books/ Manuals : Installation Manual				✔	
14.	Data Books/ Manuals : Operating/ Maintenance Manual				✔	
15.	Data Books/ Manuals : Catalogues/ Brochures				✔	
16.	Equipment storage procedure at site				✔	

MEDIUM VOLTAGE SWITCHBOARD

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S. NO.	DESCRIPTION	WITH BID	POST ORDER			REMARKS
			FOR REVIEW	FOR RECORD	WITH DATA BOOK (FINAL)	
1.	Data Sheets (Duly filled-in)		✔		✔	
2.	Dimensional/Assembly Drawings : GA Drawings			✔		
3.	Dimensional/Assembly Drawings : Installation Plan/Mounting Details			✔	✔	
4.	Dimensional/Assembly Drawings : Cross Sectional View			✔	✔	
5.	Electrical Wiring Drawings : Single Line Diagram		✔		✔	
6.	Electrical Wiring Drawings : Block and Logic Diagrams			✔		
7.	Electrical Wiring Drawings : Control Schematics			✔		
8.	Electrical Wiring Drawings : Wiring Diagram and Terminal Details			✔	✔	
9.	Electrical Wiring Drawings : Interpanel Wiring Diagram			✔	✔	
10.	Electrical Wiring Drawings : System Architecture			✔		
11.	Bill Of Material			✔	✔	
12.	Relay Characteristic Curve			✔	✔	
13.	Auxiliary Power Requirement Data (AC & DC)			✔	✔	
14.	Test Records				✔	
15.	Inspection & Test Plan (ITP) -For review by Inspection Dept.		✔		✔	
16.	Type Test Certificate for Panel, Breakers & Bus ducts				✔	
17.	List of Commissioning Spares				✔	
18.	List of Maintenance Spares				✔	
19.	List of Mandatory Spares		✔			
20.	List of Special Tools & Tackles				✔	
21.	Data Books/ Manuals : Installation Manual				✔	
22.	Data Books/ Manuals : Operating/ Maintenance Manual				✔	
23.	Data Books/ Manuals : Catalogues/ Brochures				✔	
24.	Relay Parameterisation			✔		
25.	Data Mapping Details			✔		
26.	ECS I/O List			✔		

MV MOTOR

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S. NO.	DESCRIPTION	WITH BID	POST ORDER			REMARKS
			FOR REVIEW	FOR RECORD	WITH DATA BOOK (FINAL)	
1.	Data Sheets (Duly filled-in)		✔		✔	
2.	Dimensional/Assembly Drawings : GA Drawing For motors < 75kW			✔	✔	
3.	Dimensional/Assembly Drawings : GA Drawing For motors >= 75kW		✔		✔	
4.	Dimensional/Assembly Drawings : Installation Plan/Mounting Details			✔	✔	
5.	Dimensional/Assembly Drawings : Terminal Box Arrangement			✔	✔	
6.	Dimensional/Assembly Drawings : Name Plate Drawing			✔	✔	
7.	Performance Curves : Speed Torque Curves			✔	✔	
8.	Performance Curves : Speed-Current/Time Curves			✔	✔	
9.	Performance Curves : Thermal Withstand Curves (Hot & Cold)			✔	✔	
10.	Performance Curves : P.f. & Efficiency Curves			✔	✔	
11.	Inspection & Test Plan (ITP) -For review by Inspection Dept.		✔		✔	*Refer Note-'*'*
12.	Test Records			✔	✔	
13.	Type Test Certificates for similar equipment			✔	✔	
14.	List of Commissioning Spares			✔	✔	
15.	List of Maintenance Spares			✔	✔	
16.	List of Mandatory Spares		✔		✔	
17.	List of Special Tools & Tackles			✔	✔	
18.	Data Books/ Manuals : Installation Manual				✔	
19.	Data Books/ Manuals : Operating/ Maintenance Manual				✔	
20.	Data Books/ Manuals : Catalogues/ Brochures				✔	
21.	Equipment storage procedure at site				✔	

PACKAGED EQUIPMENT

S. NO.	DESCRIPTION	WITH BID	POST ORDER			REMARKS
			FOR REVIEW	FOR RECORD	WITH DATA BOOK (FINAL)	
1.	Single line diagram		✔		✔	
2.	Electrical load data			✔	✔	
3.	Area classification		✔		✔	
4.	Block Diagram- FA & PA			✔		
5.	Equipment layout		✔		✔	

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S. NO.	DESCRIPTION	WITH BID	POST ORDER			REMARKS
			FOR REVIEW	FOR RECORD	WITH DATA BOOK (FINAL)	
6.	Cable layout			✔	✔	
7.	Sizing calculation		✔		✔	
8.	Cable schedule			✔	✔	
9.	Interconnection diagram			✔	✔	
10.	Electrical interface with owner		✔		✔	
11.	Technical details/Data sheets for major equipment			✔	✔	
12.	Motor data sheet			✔	✔	
13.	GA and internal arrangement drawing for panels (PDB, Lighting/Power Panels, Local Control Stations, Telephobe Junction Boxes etc.			✔	✔	
14.	Schematic/Logic diagrams			✔	✔	
15.	Interconnection/Wiring diagrams			✔	✔	
16.	Bill Of Material			✔	✔	
17.	List of Mandatory Spares			✔	✔	
18.	List of recommended maintenance spares			✔	✔	
19.	Type Test certificates			✔	✔	
20.	Inspection & Test Plan (ITP) -For review by Inspection Dept.		✔		✔	
21.	Test certificates			✔	✔	
22.	Catalogues and brochures				✔	
23.	Installation manual				✔	
24.	Operation/maintenance manual				✔	
25.	Equipment storage procedure at site				✔	

POWER/ CONTROL CABLES AND ACCESSORIES

S. NO.	DESCRIPTION	WITH BID	POST ORDER			REMARKS
			FOR REVIEW	FOR RECORD	WITH DATA BOOK (FINAL)	
1.	Data Sheets (Duly filled-in)			✔	✔	
2.	Technical particulars of cables eg., impedance, inductance, resistance, current carrying capacity etc)			✔	✔	
3.	Inspection & Test Plan (ITP) -For review by Inspection Dept.		✔		✔	*Refer Note-'*'*
4.	Test Records			✔	✔	
5.	Type Test Certificate for similar cables			✔	✔	
6.	Type Test Certificate for cable accessories			✔	✔	

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S. NO.	DESCRIPTION	WITH BID	POST ORDER			REMARKS
			FOR REVIEW	FOR RECORD	WITH DATA BOOK (FINAL)	
7.	DGMS approval certificate, where applicable			✔	✔	
8.	Data Books/ Manuals : Installation Manual				✔	
9.	Data Books/ Manuals : Operating/ Maintenance Manual				✔	
10.	Data Books/ Manuals : Catalogues/ Brochures				✔	
11.	Equipment storage procedure at site				✔	

MV VFD

S. NO.	DESCRIPTION	WITH BID	POST ORDER			REMARKS
			FOR REVIEW	FOR RECORD	WITH DATA BOOK (FINAL)	
1.	Schedule of Vendor Documents		✔		✔	
2.	Confirmation of Technical Compliance					
3.	Dimensional/Assembly Drawings : GA Drawings		✔		✔	
4.	Dimensional/Assembly Drawings : Installation Plan/Mounting Details			✔	✔	
5.	Dimensional/Assembly Drawings : Terminal Box Arrangement			✔	✔	
6.	Dimensional/Assembly Drawings : Name Plate Drawing			✔	✔	
7.	Performance Curves : Speed Torque Curves			✔	✔	
8.	Performance Curves : Speed-Current/Time Curves			✔	✔	
9.	Performance Curves : Thermal Withstand Curves (Hot & Cold)			✔	✔	
10.	Performance Curves : P.f. & Efficiency Curves			✔	✔	
11.	Schemactic and Logic Diagram			✔	✔	
12.	Block Diagram/ Interconnection Diagram			✔	✔	
13.	Wiring Diagram			✔	✔	
14.	Inspection & Test Plan (ITP) -For review by Inspection Dept.		✔		✔	
15.	Test Records				✔	
16.	Combined Test Certificate (For similar Motor & VFD)			✔	✔	
17.	List of Commissioning Spares			✔	✔	
18.	List of Maintenance Spares			✔	✔	
19.	List of Mandatory Spares		✔			
20.	List of Special Tools & Tackles			✔		
21.	Data Books/ Manuals : Installation Manual				✔	

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S. NO.	DESCRIPTION	WITH BID	POST ORDER			REMARKS
			FOR REVIEW	FOR RECORD	WITH DATA BOOK (FINAL)	
22.	Data Books/ Manuals : Operating/ Maintenance Manual				✔	
23.	Data Books/ Manuals : Catalogues/ Brochures			✔	✔	
24.	Equipment storage procedure at site				✔	

Notes :

1. "TICK" denotes applicability.
2. Post order, drawing / document review shall commence only after approval of Document Control Index (DCI).
3. All post order documents shall be submitted / approved through EIL eDMS portal.
4. Final documentation shall be submitted in hard copy (Six prints) and soft (two CDs/DVDs) in addition to submission through EIL eDMS.
5. Refer - 6-78-0001: Specification for quality management system from Bidders.
6. Refer - 6-78-0002: Specification for documentation requirements from Contractors.
7. Refer - 6-78-0003: Specification for documentation requirement from Suppliers.
8. All drawings & documents shall be submitted in A4 or A3 paper sizes. Documents in higher paper size shall be submitted in exceptional circumstances or as indicated in the MR/Tender.
9. Post order- The schedule of drawing / data submission shall be mutually agreed between EIL & the bidder / contractor / supplier during finalization of Document Control Index (DCI).
10. Bill of Material shall form part of the respective drawing.
11. '*' indicates the following:

a. Equipments whose ITP is attached with Contract -ITP for respective equipment shall be followed. Therefore, no ITP is to be furnished for review for those equipments.

b. Equipments whose ITP is not attached with Contract-Manufacturer's ITP shall be submitted by Packager/ Vendor/Contractor to respective Regional Procurement Office (RPO) near to manufacturer's works for approval by EIL Inspection.

12. All technical details and documents furnished with bids shall be treated as data for engineering. These shall however be subject to Purchasers review after order placement and bidder shall comply to MR/Tender requirements without any cost & time implication to EIL/Owner.
13. "*" indicates submission of documents to Inspection Agency.

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VENDOR DATA REQUIREMENTS
FOR
GENERAL CIVIL WORKS

Rev. No.	Date	Purpose	Prepared by	Checked by	Approved by
A	06-MAR-2026	ISSUE FOR BIDS	LP	AK	AK

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VENDOR DATA REQUIREMENTS

The following drawings/documents marked "✔" shall be furnished by the bidder.

S. N O.	DESCRIPTION	WITH BID	POST ORDER			REMARKS
			FOR REVIEW	FOR RECORD	WITH DATA BOOK (FINAL)	
1.	Approval certificate from BIS/ UL/FM /PESO		✔		✔	
2.	Data Sheet & GA drawings of each firefighting equipment		✔		✔	
3.	Instruction book(s) for guidance of the user including both the operating and normal maintenance procedures shall be supplied. The book(s) shall include an itemized and illustrated part list/spare parts list giving reference number of all the wearing parts.			✔	✔	
4.	Data Sheet for fire Extinguishers		✔		✔	
5.	As Built Drawings			✔		

Notes :

1. "TICK" denotes applicability.
2. "TICK" denotes applicability.
3. "TICK" denotes applicability.
4. Post order, drawing / document review shall commence only after approval of Document Control Index (DCI).
5. All post order documents shall be submitted / approved through EIL eDMS portal.
6. Post order, drawing / document review shall commence only after approval of Document Control Index (DCI).
7. Refer - 6-78-0001: Specification for quality management system from Bidders.
8. Post order, drawing / document review shall commence only after approval of Document Control Index (DCI).
9. All post order documents shall be submitted / approved through EIL eDMS portal.
10. Refer - 6-78-0002: Specification for documentation requirements from Contractors.
11. Refer - 6-78-0003: Specification for documentation requirement from Suppliers.
12. All post order documents shall be submitted / approved through EIL eDMS portal.
13. Bill of Material shall form part of the respective drawing.
14. Final documentation shall be submitted in hard copy (Six prints) and soft (two CDs/DVDs) in addition to submission through EIL eDMS.
15. Final documentation shall be submitted in hard copy (Six prints) and soft (two CDs/DVDs) in addition to submission through EIL eDMS.
16. 'WITH DATA BOOK (FINAL)¿ shall be read as `AS-BUILT (FINAL)¿.
17. Refer - 6-78-0001: Specification for quality management system from Bidders.
18. Refer - 6-78-0001: Specification for quality management system from Bidders.
19. Refer - 6-78-0002: Specification for documentation requirements from Contractors.
20. Refer - 6-78-0002: Specification for documentation requirements from Contractors.

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21. Refer - 6-78-0003: Specification for documentation requirement from Suppliers.
22. Refer - 6-78-0003: Specification for documentation requirement from Suppliers.
23. All drawings & documents shall be submitted in A4 or A3 paper sizes. Documents in higher paper size shall be submitted in exceptional circumstances or as indicated in the MR/Tender.
24. All drawings & documents shall be submitted in A4 or A3 paper sizes. Documents in higher paper size shall be submitted in exceptional circumstances or as indicated in the MR/Tender.
25. Post order- The schedule of drawing / data submission shall be mutually agreed between EIL & the bidder / contractor / supplier during finalization of Document Control Index (DCI).
26. Post order- The schedule of drawing / data submission shall be mutually agreed between EIL & the bidder / contractor / supplier during finalization of Document Control Index (DCI).
27. Bill of Material shall form part of the respective drawing.
28. "@" indicates submission of documents to Inspection Agency.
29. "@" indicates submission of documents to Inspection Agency.
30. Bill of Material shall form part of the respective drawing.
31. Also refer other department's VDR :-
32. Also refer other department's VDR :-
33. Electrical
34. All FINAL DOCUMENTS shall be submitted in 3 Sets and same shall be placed in Proper Folders.
35. Instrumentation
36. Electrical
37. Packaged Equipment
38. Static Equipment
39. Rotating Equipment
40. General Civil
41. Piping
42. Structures
43. Architecture
44. Heat & Mass Transfer

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VENDOR DATA REQUIREMENTS
FOR
STATIC & MACHINERY EQUIPMENT
(PACKAGED EQUIPMENT)

Rev. No.	Date	Purpose	Prepared by	Checked by	Approved by
0	05-MAR-2026	ISSUED WITH TENDER	NJ	DV	SPC

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VENDOR DATA REQUIREMENTS

The following drawings/documents marked "✔" shall be furnished by the bidder.

HVAC

S. NO.	DESCRIPTION	WITH BID	POST ORDER			REMARKS
			FOR REVIEW	FOR RECORD	WITH DATA BOOK (FINAL)	
1.	Filled in Technical Checklist (Doc. No. B895-999-80-42-TCL-8202)	✔				
2.	Cooling/Heating Load Calculation and de-rating calculation of main HVAC Equipment such as Chiller etc as per ARI/AHRI		✔		✔	*Cooling/Heating Load Calculation To be performed in HAP 6.1 version (minimum)*
3.	Sizing/ Selection Calculation		✔		✔	
4.	Package P&IDs & PFDs (as applicable)		✔		✔	
5.	Ducting layout, Air-conditioning plant layout, Piping and Equipment layout including battery limit interface drawings for each building		✔		✔	
6.	Sub-Ordered Package Details: Duly filled-in Mechanical Data Sheet of main equipment and auxiliaries		✔		✔	
7.	GA drawing and cross section drawing of individual equipment showing major dimensions and MOC including nozzle orientation details			✔	✔	
8.	Equipment load data and foundation/anchor plan with pocket details			✔	✔	
9.	List of recommended spare parts for 2(two) years normal operation and maintenance (with itemized price)			✔	✔	
10.	List of Mandatory Spares		✔		✔	
11.	List of Special Tools & Tackles, if any			✔	✔	
12.	List of commissioning spares			✔	✔	
13.	Utility consumption figures (with power consumption)			✔	✔	
14.	Installation, operation & maintenance manuals containing all certified drawings & documents including prolonged storage procedure			✔	✔	
15.	Vendor Catalogues/ Charts for Equipment Selection			✔	✔	
16.	List of sub-vendors		✔		✔	
17.	Performance Gaurantee Test Procedure as applicable		✔		✔	
18.	Quality Assurance Plan				✔	@
19.	Inspection Test Reports & Certificates				✔	@
20.	As Built Drawings			✔	✔	

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Notes :

1. "TICK" denotes applicability.
2. Post order, drawing / document review shall commence only after approval of Document Control Index (DCI).
3. All post order documents shall be submitted / approved through EIL eDMS portal.
4. Final documentation shall be submitted in hard copy (Six prints) and soft (two CDs/DVDs) in addition to submission through EIL eDMS.
5. Refer - 6-78-0001: Specification for quality management system from Bidders.
6. Refer - 6-78-0002: Specification for documentation requirements from Contractors.
7. All drawings & documents shall be submitted in A4 or A3 paper sizes. Documents in higher paper size shall be submitted in exceptional circumstances or as indicated in the MR/Tender.
8. Post order- The schedule of drawing / data submission shall be mutually agreed between EIL & the bidder / contractor / supplier during finalization of Document Control Index (DCI).
9. "@" indicates submission of documents to Inspection Agency.
10. Bill of Material shall form part of the respective drawing.
11. Also refer other department's VDR :-
12. Refer - 6-78-0003: Specification for documentation requirement from Suppliers.

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VENDOR DATA REQUIREMENTS
FOR
CP SYSTEM FOR RCC PILES

Rev. No.	Date	Purpose	Prepared by	Checked by	Approved by
A	25-MAR-2026	ISSUED FOR TENDER (T-8202)	-AD-	-PTR-	-RC-

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VENDOR DATA REQUIREMENTS

The following drawings/documents marked "✔" shall be furnished by the bidder.

S. NO.	DESCRIPTION	WITH BID	POST ORDER			REMARKS
			FOR REVIEW	FOR RECORD	WITH DATA BOOK (FINAL)	
1.	Schedule of Vendor Documents		✔			
2.	Soil/Sand resistivity report			✔		
3.	CP material Data Sheets MMO Wire/Tubular anode		✔		✔	
4.	CP material Data Sheets CPTR unit		✔		✔	
5.	CP material Data Sheets Remote Monitoring Unit for CP		✔		✔	
6.	CP material Data Sheets Reference cell, Surge Diverter and Polarisation Cell, CP cables		✔		✔	
7.	CP material Data Sheets CP Junction boxes (Anode Junction Box(AJB), Cathode Junction Box(CJB) and Monitoring Junction Box(MJB))		✔		✔	
8.	CP material Data Sheets CP Central monitoring system		✔		✔	
9.	CP material Vendor list		✔			
10.	Inspection & Test Plan (ITP) -For review by Inspection Dept. (Refer Note-*)		✔		✔	
11.	CP Design Document		✔		✔	
12.	CP Drawings : MMO anode dimensional GA drawing			✔	✔	
13.	CP Drawings : Anode Bed/Arrangement GA drawings (Clearly showing the clear distance between Bullet surface to anode, clear distance between pile/vessel/tank bottom surface to anode, inter anode spacing and reference cell positions etc.)		✔		✔	
14.	CP Drawings : AJB/CJB/MJB GA drawing			✔	✔	
15.	CP Drawings : CPTR Unit GA drawing			✔	✔	
16.	CP Drawings : RMCP Unit GA drawing			✔	✔	

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S. NO.	DESCRIPTION	WITH BID	POST ORDER			REMARKS
			FOR REVIEW	FOR RECORD	WITH DATA BOOK (FINAL)	
17.	CP Drawings : CPTR Unit installation layout			✔	✔	
18.	CP Drawings : Overall CP system layout drawings indicating CPTR, RMCP, AJB, CJB, MJB Central Monitoring system location			✔	✔	
19.	CP Equipment Installation Procedures/QAPs			✔	✔	
20.	CP Commissioning procedure/QAPs			✔	✔	
21.	CP Commissioning reports			✔	✔	
22.	CP Material Test reports			✔	✔	
23.	List of Commissioning Spares			✔	✔	
24.	List of Mandatory Spares		✔		✔	
25.	Data Books/ Manuals : Operating/ Maintenance Manual/ CP Material Manufacturer catalogues				✔	
26.	Equipment storage procedure at site				✔	

Notes :

1. "TICK" denotes applicability.
2. Post order, drawing / document review shall commence only after approval of Document Control Index (DCI).
3. All post order documents shall be submitted / approved through EIL eDMS portal.
4. Final documentation shall be submitted in hard copy (Six prints) and soft (two CDs/DVDs) in addition to submission through EIL eDMS.
5. Refer - 6-78-0001: Specification for quality management system from Bidders.
6. Refer - 6-78-0002: Specification for documentation requirements from Contractors.
7. Refer - 6-78-0003: Specification for documentation requirement from Suppliers.
8. All drawings & documents shall be submitted in A4 or A3 paper sizes. Documents in higher paper size shall be submitted in exceptional circumstances or as indicated in the MR/Tender.
9. Post order- The schedule of drawing / data submission shall be mutually agreed between EIL & the bidder / contractor / supplier during finalization of Document Control Index (DCI).
10. "@" indicates submission of documents to Inspection Agency.
11. Bill of Material shall form part of the respective drawing.
12. Also refer other department's VDR :-
13. Electrical
14. Packaged Equipment
15. Static Equipment
16. General Civil
17. Piping
18. Structures
19. Heat & Mass Transfer

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20. '*' indicates the following:

a. Equipments whose ITP is attached with Contract -ITP for respective equipment shall be followed. Therefore, no ITP is to be furnished for review for those equipments.

b. Equipments whose ITP is not attached with Contract-Manufacturer's ITP shall be submitted by Packager/ Vendor/Contractor to respective Regional Procurement Office (RPO) near to manufacturer's works for approval by EIL Inspection.

21. All technical details and documents furnished with bids shall be treated as data for engineering. These shall however be subject to Purchasers review after order placement and bidder shall comply to MR/Tender requirements without any cost & time implication to EIL/Owner.

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JOB SPECIFICATION
STATIC & MACHINERY EQUIPMENT
(PACKAGED EQUIPMENT)

FOR

MISCELLANEOUS BUILDING WORKS FOR PP PROJECT

TENDER No. B895-999-81-46-CF-T-8202

PROJECT	**:**	**PMC AND EPCM SERVICES FOR POLYPROPYLENE PROJECT AT BPCL KOCHI REFINERY**
OWNER	**:**	**BHARAT PETROLEUM CORPORATION LIMITED**
PMC/EPCM	**:**	**ENGINEERS INDIA LIMITED**
EIL JOB No.	**:**	**B895**

Rev. No.	Date	Purpose	Prepared by	Checked by	Approved by
0	06.03.2026	ISSUED AS TENDER INPUT	NJ	DV	SPC

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1.0 GENERAL CONSIDERATION

1.1 Specific requirements and guidelines pertaining to individual equipment and system are listed in subsequent sections. However, the following general considerations have to be kept in view for all items while formulating their specifications and for procurement engineering activities:

- All sub ordered items / bought out items shall be sourced from Owner/EIL approved vendors.
- Reliability in service (assessed from contractors' relevant track record and improved by incorporating certain minimum design features or requirements in the specifications).
- Standardization of components wherever feasible.
- Equipment shall be complete in all respects and any item or feature not covered in the specification but essential for proper operation and safety shall be included by the contractor.
- Equipment layouts shall be prepared taking into consideration various factors like requirement of convenient operability, approach, safety, withdrawal space requirement, maintenance, foundation requirements etc.
- Equipment shall be designed for the given site condition. Extreme climatic/ environment conditions shall be taken into consideration while selection of equipment, materials and arrangement/ provisions.
- Ease of operation and maintenance including any necessary measures for ensuring safety of personnel and equipment as well as a conducive working environment.
- Equipment layouts shall be prepared taking into consideration various factors like requirement of operability, approach, safety, withdrawal space requirement, maintenance, foundation requirements etc. for convenient operation.
- Adherence to any limitations of space available for the equipment and its operation / maintenance.
- Compliance with applicable national or overseas codes and standards as well as any statutory regulation in existence for a specific item.
- Electrical, Instrumentation and controls, wherever applicable for the equipment and packages, shall be engineered as per the respective sections described in the Bid package.
- All the equipment, electrical, instrumentation and controls shall be suitable for electrical area classifications in which they are installed.
- **Makes of all equipment/packages shall be as per approved Vendor List attached with the tender documents. For any item, where no vendor list is provided in the tender document, the vendor proposed by Contractor shall have sufficient Proven Track Record (PTR) and shall be subject to Owner / EIL approval during detailed engineering without any commercial implication to Owner/EIL**
- All equipment shall be of proven design. Prototypes, new designs, or extensive modifications of standard designs are unacceptable.

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1.2 PLANT LOCATION

1	Site Location	
	State/Country	Kerala, India
	Nearest Railway Station	Tripunithura
	Nearest Town/ City	Kochi
	Nearest Airport	Kochi International Airport
	Nearest State Highway	Kochi
	Nearest Port	Kochi
2	Rainy season	Mid-May-September
3	Source of Water	Fresh Water (River/RO)
	Cooling Water	Treated Raw water.

1.3 METEOROLOGICAL DESIGN DATA

S.No.	Parameter	Unit	Min.	Nor.	Max.	Design
1	Barometric pressure	Mmhg	750	754	759	
2	Ambient temperature	DEG C	15	30	40	42
3	Relative humidity @ ambient temperature	%			88	95
4	Rainfall data for 1-hour period	Mm			125	
5	Rainfall data for 24-hour period	Mm			217	
h6	Wind Velocity	km/hr	4		140.4 or as per IS-875, whichever is higher	

S.No.	Parameter	UOM	Design Value
1	Elevation	M	9.75

S.No.	Parameter	UOM	Design Value
2	Wind Direction		North – East / East in the morning and West & North west in the evening

1.4 DATA FOR EQUIPMENT DESIGN

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S.No.	Parameter	UOM	Design Value
1	Dry bulb temperature	DEG C	22.5 (during raining season)/38(during summer season)
2	Wet bulb temperature	DEG C	21(min)/28(max)
3	Ambient temperature for MDMT	DEG C	15
4	Air temperature for air cooled exchangers where followed by water cooling	DEG C	Design Dry Bulb Temperature + 2 Deg C (Note-1)
5	Air temperature for air cooled exchangers where not followed by water cooling	DEG C	Design Dry Bulb Temperature + 5 Deg C (Note-2)
6	Air temperature for GT's	DEG C	NA
7	Coincident temperature for Air Blower / Air Compressor	DEG C	30@ 95% relative humidity
8	Relative humidity for Air Blower / Air Compressor	%	Refer point no.7
10	Earthquake Design factor (Code IS-1893 Zone-III/Site spectra whichever is governing)		Zone 3, refer site specific seismic spectra
11	Soil Data		To be added based on latest - soil investigation report

Note:
1. Design value for Air temperature for air cooled exchangers where followed by water cooling shall be 40 degC (38+2)
2. Design value for Air temperature for air cooled exchangers where not followed by water cooling shall be 43 degC (38+5)

Note: Above given condition are for the Equipment design. However, for HVAC Heat Load Calculation Purpose, Contractor to follow following:

1.5 **Outdoor Design conditions for HVAC Heal Load Calculation Purpose**

S.No.	SEASON	DBT (DEG C)	WBT (DEG C)
1	Summer	35.0	27.8
2	Monsoon	29.5	27.8
3	Winter	22.2	18.3

Notes: 1) Outdoor design conditions specified shall be followed for Air conditioning system heat load calculation.
2) Design temperature for sizing of air cooled heat exchanger/condenser shall be as per BEDB Part-B

2.0 SPECIAL REQUIREMENT

2.1 Contractor shall develop technical specification of equipment taking into consideration the requirements defined in specifications, data sheets and the requirements given elsewhere in the Tender.

2.2 Selection of material for each component of equipment shall be based on the design pressure, temperature and other conditions of operation and in no case shall be inferior to the material indicated elsewhere in the Tender.

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2.3 Electrical equipment and material shall be in accordance with the attached electrical specification.

3.0 CODES AND STANDARDS

3.1 EIL Standard Specification for Air Conditioning System (6-61-0017),

3.2 EIL Standard Specification for Centrifugal pumps (Water service) (6-41-0003)

3.3 EIL standard specification for health, safety & environment (HSE) management at construction sites (6-82-0001).

3.4 Inspection and Testing Plan for air conditioning package (6-81-0154)

3.5 Inspection & Test Plan for Pump Centrifugal Horizontal (General Water Service) (6-81-0038)

3.6 The main codes, standards, and EIL specifications along with any amendment/ supplementary requirement applicable to each equipment or system are indicated in the subsequent sections for compliance by the Contractors.

4.0 SAFETY REQUIREMENTS

4.1 It is the intent of the Owner that operational hazards shall be reduced to a minimum. Contractor shall use sound engineering judgment to complete an installation that will perform the required function without compromising this aim.

4.2 Piping shall be arranged in a manner so as to avoid tripping or headroom problem. Piping or Copper tubing of insufficient mechanical strength for standing or hanging shall be protected from personnel traffic. GI Trays etc. shall be used for such arrangements to protect Copper Tubings/Piping.

4.3 The requirements of Noise Limits and Equipment Vibration as defined in the standard specification shall be met. In general OSHA requirements shall be complied with.

4.4 Couplings, gears and exposed rotating parts shall be provided with adequate guards. For hazardous area installation, these guards shall be of non-sparking construction. Drive belts, if used, shall be antistatic type.

4.5 Electrical devices shall meet the requirements for the area classifications in which they are installed.

5.0 PACKAGE/ EQUIPMENT SPECIFICATION

5.1 HVAC System

5.1.1 HVAC System shall be provided for all Buildings as specified in Scope of Works (Doc No. B895-999-80-42-SOW-8202).

5.1.2 **The entire work of design, engineering, equipment selection, installation, commissioning and performance testing of equipment/ HVAC systems shall be executed by an approved vendor from the Project Vendor list for HVAC SYSTEM- CENTRAL AIR CONDITIONING (item code 06AA) (Refer Annexure-1 of Doc. No. B895-999-80-42-VL-8202) attached elsewhere in the tender.**

Make of all sub components / equipment part of HVAC system shall be as per owner's / EIL approved vendor for Air Conditioning System (Refer Annexure-2A & 2B of Doc. No. B895-999-80-42-VL-8202) attached elsewhere in the tender. For any item, where no vendor list is provided in the tender document, the vendor

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proposed by Contractor shall have sufficient Proven Track Record (PTR) and shall be subject to Owner / EIL approval during detailed engineering without any commercial implication to Owner/EIL.

5.1.3 The Contractor shall submit HVAC system configuration for Owner/ EIL's approval before starting the detail engineering work.

5.1.4 **Design Information / Data**

Hours of Operation	:	24 hours/day, 365 days
Room Occupancy	:	As mentioned in the table below
Lighting Load	:	5 Watts/m^2
Outdoor (fresh) Air	:	Minimum one (1) air change/hr or 17 CFM per person whichever is higher shall be considered for calculating fresh air quantity for all air-conditioned buildings. (Unless specified otherwise for specific building area due to special requirement of ventilation) (Also refer Sl. No. 5.1.6)
Temperature of chilled water entering Chiller	:	12.0º C
Temperature of chilled water leaving Chiller	:	7.0º C
Fouling factor for cooling water Condenser	:	0.0004 hr.m^2.ºC/kcal
Fouling factor for chilled water side	:	0.0002 hr.m^2.ºC/kcal
Under/over deck insulation	:	To be considered as indicated in respective Architecture drawings.
Electrical and Electronic Equipment Load (Room Wise)	:	Refer Annexure-1 & Annexure-2 of this Job Specification

5.1.5 Minimum Occupancy if specified in the Architectural Drawings is to be considered. If not specified in Architectural Drawings, below table shall be used in AC calculations for reference. The below data is tentative and for reference purposes. Actual Data in case of variation during detailed engineering shall be communicated to The Contractor. In case of unavailability of Occupancy Data during detailed engineering, ASHRAE norms shall be considered.

5.1.6 **Inside design condition**

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Sl. No.	Area	DBT, Deg C	% RH	Chemical Filter Required	AHU Installed Stand by Fan of 100 % Capacity	System Type
1.	Substation JU-1& SRR-12	23 ± 1 (For Cooling) [For SRR-12]	50 ± 5	Yes (Refer Note-ii)	Not Required	Return air shall be used in circulation
		26 ± 1 (For Cooling) [For SS JU-1]	50 ± 5	Yes (Refer Note-ii)	Not Required	Return air shall be used in circulation
2.	Peroxide Storage Building	23 ± 2	50 ± 5	No	Required with automatic switchover facility	Once Through Type System [Refer Note-iii below]

General Note:

i. Areas to be air-conditioned shall be as marked in Architectural drawing.

ii. Chemical filter shall be provided to meet the indoor air quality as per Class G1 of ISA Standard 71.04. Refer Clause no. 5.1.7 for Outdoor Air Quality.

- H2S < 3ppb
- SO2/SO3<10ppb
- Cl2<1ppb
- NOx<50ppb.

iii. System shall be "Once Through" Type; Air Quantity (CFM) shall be determined based on the "Once-Through" ventilation system.

5.1.7 Outdoor Air Quality

S.No.	Air Quality (As per Class GX(severe) of doc.ISA-S71.04)
1	H_2S <= 50 ppb
2	SO_2/SO_3 <= 300 ppb
3	Cl_2 <= 10 ppb
4	NO_X <= 1250 ppb (All component of (NOx viz. NO_2, NO) be considered.)

5.1.8 **Technical Requirements for HVAC System**

i. EIL standard specification for Air conditioning System (6-61-0017), shall be followed for applicable items.

ii. Chillers shall be complied with "ECBC" requirements of Energy Conservation Building Code (ECBC) for COP & IPLV.

iii. Reciprocating/scroll compressor shall be used up to 80 TR and screw compressor for 81-250 TR. Centrifugal Compressor shall be used for 250 TR and above.

If reciprocating compressors are provided, not more than 3 working compressors shall be provided for a system.

iv. **Contractor** shall consider Heat Dissipation from Electrical/ Electronic Equipment, Lighting Load & Occupancy while estimating the capacity of air-conditioning system.

v. **Safety** factor shall be considered as minimum 12.5% in respect of Room Sensible Heat and minimum 10% in respect of Room Latent Heat.

vi. **Air conditioning system load/ capacities specified in "Scope of Work/ Supply" are minimum to be considered by the contractor for each HVAC System/ Equipment and same are given for estimation purpose only. HVAC vendor of**

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Contractor shall do the detailed heat load calculations as per the approved/ AFC building drawings & other design criteria specified in this document in HAP software (*Version 6.1 minimum*) and shall submit the heat load calculation (HAP Output) to EIL for approval during detailed engineering. HVAC System/ Equipment shall be selected for the higher of the two capacities i.e. capacities as specified in Scope of Work/ Supply and capacities as per approved heat load calculation. No price or time implication shall be admissible to the contractor due to above increase in heat load values/ capacities.

Contractor shall be solely responsible to demonstrate the specified inside conditions throughout the year irrespective of any variation in the outside condition. Accordingly, Contractor shall cross check the estimated plant capacity in his own interest before bidding.

vii. Refrigerant for vapour compression system shall be R407a/ R407c/ R-410a/ R-134a or equivalent environmental friendly. Refrigerant for Windows/Split AC shall be equivalent environmental friendly and as per manufacturer's standard

viii. Central air conditioning units shall provide cooling and dehumidification in summer/monsoon by handling mixture of fresh and return air. Reheating shall be provided in monsoon to achieve specified inside conditions by means of finned strip heaters actuated by humidistat, backed up by safety thermostat. Winter heating shall be achieved by finned strip heaters actuated by heating thermostat backed-up by safety thermostat.

ix. Electric heaters shall be provided inside the duct/plenum in properly distributed number of banks. Suitable maintenance access shall be provided.

x. Ducting work shall be carried out by the contractor as per IS-655/SMACNA. Contractor shall submit AC duct layout fires during detailed engineering.

xi. Pan type Humidifier in stainless steel construction shall be provided to meet specified humidity requirement in winter season.

xii. Combined Fire & Smoke Dampers shall be pneumatically operated Substation JU-1& SRR-12 and Peroxide Storage Building.

All combined fire & smoke dampers shall be fail safe type (Closed position under power failure) and shall be UL-555 and UL-555S certified and shall have minimum 90 minutes fire rating.

xiii. RCC hood shall be provided at the fresh air intake for all the blast proof buildings. In case RCC hood is not provided, the Blast Damper in fresh air intake shall be provided for blast proof buildings.

xiv. The contractor shall ensure that fresh air is drawn from a safe location. If it is necessary to extend the fresh air duct outside the building, the contractor will be responsible for the same.

xv. Contractor shall refer risk zone for clean agent firefighting system drawings attached elsewhere in the tender. Accordingly fire dampers to be provided to isolate different fire zones, in case of fire in addition to Damper requirement in the AHU Room/PAC Room.

xvi. Combined fire damper & smoke damper shall be selected for maximum face velocity limited to 1800 fpm when these are installed at main supply air ducts and 1200 fpm when installed at return air paths/openings.

xvii. Velocity of return air shall be restricted to 300 fpm at return air slit.

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xviii. Air Conditioning equipment shall be interlocked with gas/smoke detection and firefighting systems. HVAC vendor to provide the potential free contacts in the Panel for connecting it to the gas/smoke detection and firefighting systems.

xix. Air/ water facility with proper draining arrangement for cleaning and washing of filters shall be provided in the AHU rooms.

xx. All the air-conditioning equipment, electrical, instrumentation and controls shall be suitable for electrical area classifications in which they are installed.

xxi. For air-conditioning system, PLC/ Microprocessor based control system shall be provided.

xxii. For Satellite Rack Room & Substation Buildings, provision for installation Hydrocarbon & Toxic Gas (H2S) detection system shall also be made in fresh air duct.

xxiii. Chemical filtration shall be provided in fresh air circuit of AC system for Sub Station & Satellite Rack Room Buildings to maintain air quality (G1 environment). Chemical filters shall be selected to capture Group-A gases as per ISA-S71.04 standard from outdoor air (GX environment).

xxiv. Supply air ducts shall be provided with air flow switch which shall trigger alarm in case of no/ low air flow.

xxv. Two-stage air filtration shall be provided. In first stage, pre-filters shall be provided at upstream of packaged unit/AHU. Pre-filters shall have filtering capacity of 90% efficiency upto 10 microns for AHU and 80% efficiency upto 20 microns for Package Units. In second stage, fine filters downstream of packaged unit/AHU shall be provided which shall have minimum 95% efficiency upto 5 microns. Fine filters shall be mounted in a suitable G.I. Plenum or may be in AHU. Bag type filter is not acceptable

xxvi. Chipping of RCC slab for duct hangers is not allowed. Contractor shall provide anchor fasteners. Complete supporting structure for duct/cable/pipe/tubing etc. shall be provided by Contractor.

xxvii. Colour/shades of diffuser/grilles etc. shall be informed to contractor during detail engineering and same shall be complied by the contractor without any commercial implication.

xxviii. Air Distribution

Supply Air Distribution:

Supply air will be distributed through insulated ductwork to maintain temperature control and enhance energy efficiency.

Return Air Collection:

In areas with a false ceiling, return air will be collected through the plenum space between the false ceiling and the RCC (Reinforced Cement Concrete) roof. In spaces without a false ceiling, return air will be directed through insulated ducts to ensure effective air circulation and maintain system efficiency.

xxix. Contractor shall ensure that fixing arrangement of diffusers is such that there is no load on false ceiling. Size of diffusers shall match with light fittings. Diffusers shall be firmly fixed with the ductwork. Diffusers shall be placed closer to heat intensive equipment. The same will be reviewed after finalisation of equipment layout.

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xxx. All foundations including requisite multi-layer virgin neoprene pads shall be provided by the Contractor between foundation blocks & equipment e.g. Condensing units, AHU etc.

xxxi. Piping and valves shall be as per the applicable Piping Material Specification (PMS) and valve material specification (VMS) mentioned below and attached elsewhere in this tender document:

- Instrument air
- Cooling water
- Chilled water
- Service Water

xxxii. Utility conditions & Water quality shall be as per this specification. The data mentioned are at process unit / consumer battery limit. Contractor may get the final confirmation regarding utility conditions available at the respective Building B/L and water quality during detailed engineering and follow the same without any commercial implication to EIL/Owner. If any Control valve/ instruments/ devices are required to match with Contractor's operating conditions, the same shall be designed & provided by Contractor.

xxxiii. **Special air distribution requirements for Peroxide Storage Building**:

For Peroxide Storage Building - Fresh air shall be supplied based on the design condition specified in clause 5.1.6 above. Air quantity equal to fresh air quantity shall be simultaneously exhausted from the space through proper exhaust arrangement of square stainless-steel duct and **explosion proof** axial flow fan (suitable for applicable area classification). Exhaust shall be located near floor level and shall be designed to sweep the floor. Supply air location shall be decided by contractor during detailed engineering which shall be subject to review by Owner/EIL. Exhaust air system shall have common standby fan.

6.0 PROTECTION AND PAINTING

6.1 Surface preparation and painting for all equipment/ packages shall be as per painting specification attached elsewhere with the tender. Touch up painting shall be done at site after installation & testing.

6.2 The units shall be disassembled into major components suitable for shipment and shall be properly packed to provide adequate protection during shipment. All assemblies shall be properly match marked for site erection.

6.3 All machined and bearing surfaces shall be protected against rust with a thick coat of grease.

6.4 Each equipment shall have an identification plate giving salient equipment data, make, year of manufacture, equipment number etc.

7.0 GUARANTEE

7.1 All equipment and components shall be guaranteed by the Contractor against any defective material, design and workmanship for the period specified in commercial part of the tender document.

7.2 The Contractor shall have final and total responsibility for the design and mechanical performance of the entire system under this specification for entire guarantee/ warrantee period.

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8.0 INSPECTION AND TESTING

8.1 All equipment shall be subjected to stage wise expediting, inspection and testing at vendor's/sub-vendor's works by purchaser/ authorized inspection agency. Contractor shall submit Quality Assurance (QA) procedure before commencement of fabrication for review. Approved QA procedure shall form the basis for equipment inspection.

8.2 Manufacturer's test certificates for Chilled water pumps are acceptable in place of inspection and testing of the same at works.

8.3 Inspection and Testing shall be carried out as per the applicable Codes and Standards and approved Manufacturer's Quality Assurance (QA) Plan.

8.4 Inspection and testing at vendor's and sub-vendor's works for Air-conditioning system shall be as per the respective Standard Specification attached with this tender.

8.5 Any or all the tests, at purchaser's option, shall be witnessed by Purchaser / its authorized inspection agency. However, such inspection shall be regarded as check up and in no way absolve the Vendor of his responsibility.

9.0 PERFORMANCE GUARANTEE

9.1 Performance Guarantee for Air-conditioning system shall be as per the Standard Specification for Air Conditioning Plant (Doc. No. 6-61-0017).

9.2 In case the system/equipment does not meet the guaranteed parameters, Contractor shall carryout within a period as mutually agreed with owner from completion of first performance guarantee test, necessary repair, rectification, modifications and even replacement (in case of non-performing equipment) at his own risk and cost to improve upon and to prove the guaranteed parameters in the final performance test.

10.0 UTILITIES

10.1 Owner shall provide utility connections (one point per service) at 5 m (approx) distance of contractor's battery limit (i.e. Plant Room/ AHU Room). Contractor shall carry out necessary hook-ups and further internal distribution including supply of any condition changing device within his battery limit. All pipe terminating points at contractor's battery limit shall be provided with suitable isolation valves, as per EIL piping material specifications. Any reducer/expander (if required) to match with purchaser's supply/return connection at battery limit shall be provided by contractor. Water quality shall be as per **Annexure – 3** of this specification.

10.2 Following Utilities shall be provided for HVAC System:

Sl. No.	Building Name	Cooling Water Availability	Service Water Availability	Instrument Air Availability
1.	FOR SUBSTATION JU-1 & SATELLITE RACK ROOM-12	Yes	Yes	Yes
2.	FOR PEROXIDE STORAGE BUILDING	Yes	Yes	Yes

10.3 Utility Conditions at B/L [All B/L Pressures are as measured at Grade]

S.No.	Describe	Parameter	Min.	Nor.	Max.	Design	Remarks

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6	**SERVICE WATER**						
		Pressure, KG/CM²G		4		10.5	
		Temp., DEG C		AMB.		65	
7	**RECIRCULATINGCOOLING WATER**						
		Supply Pressure, KG/CM²G	5	5.5	6.5	10.5	
		Return Pressure, KG/CM²G	3	3.5	4	10.5	
		Supply Temperature, DEGC		33	35	65	
		Return Temperature, DEGC		43	45	65	
11	**INSTRUMENT AIR**						
		Pressure, KG/CM² G	5	7.5		10.5	
		Temp., DEG C	AMB.	AMB.		65	

10.4 Electrical power shall be provided as per specified in Electrical Job Specification attached elsewhere in the Tender Document.

11.0 CONFLICT

In case of conflict between various documents forming part of this tender, following order of precedence shall govern:-

i) Scope of Work/ Supply
ii) Job Specification
iii) Standard Specifications
iv) Other National/International Codes and Standards.

Contractor shall submit all such conflicts in writing before proceeding with the design, manufacture or purchase for OWNER/EIL approval. In case of conflicting requirements amongst any of the specifications/ standards, the specification/ standard having the most stringent requirement shall be governing. However, OWNER/EIL's decision shall be final and binding on the contractor, for which commercial implication (if any) shall not be entertained.

Before award of job "Contractor" implies "Bidder"

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Annexure-1

Building Wise Heat Dissipation Data (Electrical Equipment)

Building	**Room / Area**	**Electrical Equipment Heat Dissipation Data kW**
Nitrogen Package Substation JU-1 & SRR-12	Switchgear Hall	100
	UPS Room	45
	Rack Room	2

Notes:

1. Diffusers shall be placed closer to heat intensive equipment. The same will be reviewed after finalisation of equipment layout.

2. Equipment load as indicated, however there may be ±10% variations in values during detail engineering for which no price implication will be considered.

3. For all other areas, rooms coming in the above buildings such as office area, conference room etc, equipment loads shall be considered as per applicable ASHRAE norms, in case not unavailable

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Annexure-2

Building Wise Heat Dissipation Data (Electronic Equipment)

Building	**Room / Area**	**Electrical Equipment Heat Dissipation Data BTU/hr**
Nitrogen Package Substation JU-1 & SRR-12	Engineering Room	23000
	Rack Room	70000

Notes:

1. Diffusers shall be placed closer to heat intensive equipment. The same will be reviewed after finalisation of equipment layout.

2. Equipment load as indicated, however there may be ±10% variations in values during detail engineering for which no price implication will be considered.

3. For all other areas, rooms coming in the above buildings such as office area, conference room etc, equipment loads shall be considered as per applicable ASHRAE norms, in case not unavailable

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Annexure-3

Water Quality

Sr. No.	Parameter	Filtered Raw Water Quality	DM Water	BFW	Recirc. Cooling Water	
					Normal	Max
1	pH	6.8-7.5	6.7-7.3	8.5-9.5	7-7.5	7.8
2	Turbidity, NTU (5min settled)	10-20	Nil	Nil	10-15	60
3	Total Suspended Solids, mg/l	10-20	Nil	Nil	10	60
4	Total Dissolved Solids, mg/l	335	<0.2	0.5 max	1000-1200	1500
5	Conductivity @ 20°C, micromho/cm	-	<0.2	<1	-	-
6	M. Alkalinity as $CaCO_3$, ppmw	20	-	-	-	80
7	Ca Hardness as $CaCO_3$, ppmw	13.2	-	-	40-50	60
8	Total Hardness as $CaCO_3$, mg/l	22	Nil	Nil	65-90	100
9	Total reactive Silica as SiO2, mg/l	11	<0.02	0.02 Max	35-50	75
10	Colloidal Silica as SiO_2, mg/l	-	-	-	-	
11	Chlorides as Cl, ppmw	40 max	-	-	100	200 max
12	Free Chloride dioxide Clo2, mg/l	-	-	0.6	0.2-0.4	0.4
13	Sulphates as SO_4, mg/l	12.8	-	-	40	50
14	Organophosphate as PO4, mg/l	-	-	-	2-3	3
15	Dissolved Oxygen, mg/l	6.3	<0.03 ppm	0.005	-	-
16	Dissolved Iron (as Fe), mg/l	-	-	-	-	
17	Total Iron, mg/l	0.1-0.3	<0.03 ppm	0.03 max	<1	1
18	Organic matter as KMnO4 @100°C, mg/l		1 max	5 max	30-40	50
19	Total copper as Cu, mg/l		0.003 max	0.003		
20	Zinc as Zn, mg/l	-	-	-	1-2	2
21	Zinc Sulphate as Zn, mg/l				1-2	2
23	Benzotriazole, mg/l				-	

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JOB SPECIFICATION OF CATHODIC PROTECTION SYSTEM FOR RCC FOUNDATION PILES

(TENDER NO. B895-999-81-46-CF-T-8201)

PROJECT : PMC AND EPCM SERVICES FOR POLYPROPLENE PROJECT OF BPCL KOCHI REFINERY

OWNER : M/s BHARAT PETROLEUM CORPORATION LTD.

PMC : ENGINEERS INDIA LIMITED

JOB NO : B895

Rev. No	Date	Purpose	Prepared by	Reviewed by	Approved by
0	28.02.2025	ISSUED FOR ENGINEERING/TENDER	AK Das	PT Reddy	NS. Bhattacharya

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1.0 SCOPE OF WORK

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1.0 SCOPE OF WORK

The CP contractor shall be OWNER/ PMC approved vendor. The CP contractor shall carryout the complete Cathodic Protection work strictly as per the requirement of this document.

The work shall comprise of following Soil resistivity survey, design, detailed engineering, supply, installation, testing, and commissioning of impressed current **close distributed replacable anode** bed CP System for soil side corrosion prevention for RCC foundation piles of the buildings and other structures (as applicable, according to the scope of the tender).

This document is not intended to be all-inclusive and the use of the guidelines set forth here do not relieve the CONTRACTOR of his responsibility of providing adequate CP System, which shall be proved performing to the entire satisfaction of OWNER/ PMC. The contractor needs to supply all materials, consumables in his scope of supply and provide all construction tools, tackles, equipment and personnel necessary for the work and prepare construction drawings and as built drawings including soft copies in latest version of AutoCAD and operating manuals after completion of work.

The Contractor needs to keep vigilance and take all precautionary measures to prevent fire hazards during execution of job. The maker of all the CP System equipment / materials shall be strictly as per the OWNER/ PMC approved makes. The items which are not listed, the same shall be proposed based on regular supply in similar Industries application on past OWNER/ PMC Job or proven track record (PTR) for application of minimum one year period with satisfactory performance record of such items for similar applications, need to be furnished by the CP System contractor.

1.2 SCOPE OF WORK FOR CATHODIC PROTECTION SYSTEM INSTALLATION

Item wise works envisaged under this Contract will comprise of the following:

Preparation and submission of detail Engineering package as per given scope, Design basis and job specifications enclosed in this bid document.

Carry out soil resistivity survey at minimum 3 locations at the facility by wenner-4 Pin method (at each depth of 2m interval of pile upto 30m depth of the pile) and presentation of result to OWNERL/ PMC. The detail engineering package shall include, as a minimum, design calculations, Bill of quantities, layout drawings of all materials/ equipment of CP System, Connection schemes and wiring diagrams, Installation procedures, Name of equipment suppliers, shop/ field Testing & Inspection plan for equipment, necessary technical information/datasheets, fabrication/construction drawings, Testing and commissioning procedures and formats, Quality control/ Quality assurance documents etc. & obtain approval from OWNER/ PMC before execution of work. CP System contractor needs to obtain approval on all layout drawings of

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Cathodic Protection materials/ equipment at site from OWNER/ PMC before starting the installation work.

1.2.2 Carry out detailed engineering, Supply all materials, equipment and perform all erection and installation work as per approved detail engineering package. Provision of service connection to T/R units shall be in CP System contractor's scope of work.

1.2.3 Shop testing of all major CP System contractor supplied CP equipment (T/R, Anode, Cables and Junction Boxes etc.) and submission to OWNER/ PMC of Test results/ certificates for approval before delivery of equipment.

1.2.4 Field-testing of individual components of CP System as per approved detail engineering package. Final commissioning of installed system as per approved procedure and submission to OWNER/ PMC of results thereof.

1.2.5 Liaison with other agencies, seek and obtain all permission related and obligatory to his part of the work.

1.2.6 Preparation and submission of 1 set of soft copy and 6 sets of hard copies of as built CP System package comprising of operation and maintenance manual for equipment, as-built drawings, Material specifications and Pre-commissioning/ Commissioning results.

1.2.7 After Commissioning of the CP System, if it is found that structure to electrolyte potential achieved at some location is in the range which is below acceptable limit as per code, then a supplementary CP System need to be installed to bring the potential level at such locations within acceptable limit as mentioned vide section 2.0 for "Design Basis/Philosophy for CP System".

1.2.8 CP CONTRACTOR shall give performance guarantee for CP System of all structure as per design basis and job specifications and operation guarantee of the material and equipment supplied as well as guarantee against defective workmanship for installation work carried out.

1.3 INSTRUCTION TO BIDDERS

1.3.1 Site Particulars

It shall be the bidder's responsibility to have a thorough understanding of the reference documents, site conditions and specification included therein. The intending bidders shall be deemed to have visited the site and have studied the conditions before submitting the Bids. Non-familiarity with the site conditions will not be considered are as on either for extra claims or for not carrying out the work in strict conformity with the drawings and specifications.

1.3.2 Every item of work and supply by CONTRACTOR shall be subject to Engineer-In-Charge scrutiny, supervision and approval. Any work carried out or supplies affected without such approval shall

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stand automatically rejected and his claim for compensation for such unauthorized work shall be null and void.

1.4 SPECIFIC REQUIREMENTS FOR CP SYSTEM WORKS

1.4.1 General

Clauses given under specific requirements for CP System works shall be read in conjunction with General conditions of contract and in case of any conflict, the provisions of specific requirements for CP System works will override the provision of general conditions of contract.

1.4.2 PMC/ OWNER shall have the right to inspect the following if required:

- Workshop & production facilities available with CP System contractor or its tie up agency.
- Fabrication/ testing of material/equipment to be supplied by CP System contractor or its tie up agency for CP system.

1.4.3 Any approval from electrical inspector required for the electrical installation shall be in CP System contractor's scope.

1.4.4 Materials

1.4.4.1 No materials for CP System shall be supplied by OWNER.

1.4.4.2 Material Supplied by CP System contractor

The CP System contractor shall procure supply all materials, equipment and consumables required for the work in his scope. Technical specifications of major items are given in section 3.0 for "Job specification for CP System", of this document. Supply of all balance materials, consumables not covered in section 3.0 for "Job specification for CP System", but required for completion of work as per this specification shall be entirely CP System contractor's responsibility. The rates quoted for the execution of the Contract shall be inclusive of all CP System contractor supplied material and equipment.

1.4.5 Contractor needs to provide design guarantee for the system as per codes and standards & the protection criteria mentioned in the section Design basis/ Philosophy of this document also shall replace/ repair or reinstall free of cost any material/ equipment supplied or installed by him in case it fails to operate due to defective material or workmanship as per requirements of this specification within 12 (Twelve) months from the date of issue of completion certificate or 24 Months from the date of provisional acceptance of the CP System by OWNER. Contractor shall replace at his own cost if any item found defective or missed before handing over the system to OWNER.

1.4.6 Construction Aids, Equipment, Tools and Tackles

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CP System contractor shall be solely responsible for making available for executing the work, all requisite construction Equipment, special Aids, tools, tackles and testing equipment and appliances, all instruments including automatic Programmable current interrupters required for commissioning and interference testing of the system. Such construction equipment shall be in first class operating condition. Any discrepancies pointed out by OWNER/ PMC shall be immediately got rectified, repaired or the equipment replaced all together by CP System contractor. OWNER/ PMC shall not in any way be responsible for providing any such equipment, machinery tools and tackles etc. The OWNER/ PMC reserves the right to re-arrange such deployment depending upon the progress and priority of work in various sections at no extra cost to OWNER.

1.4.7 Transportation, Packing and Handling

CP System contractor shall be responsible for transportation of all equipment/materials required for CP system work and unload the same at allotted area at site.

1.4.7.1 To protect all the material during period of dispatch, storage and erection against corrosion, incidental damage due to vermin, sunlight, rain, high temperature, humid atmosphere, rough handling in transit and storage in open during monsoon including delays in transit. Bidder shall be responsible for any damage to equipment/ material due to above reasons.

1.4.8 Time schedule

The CP System contractor shall mobilize at site along with materials and equipment for installation of anode beds before installation of the piles. For this purpose CP System contractor need to coordinate with other contractors so that other work is not delayed due to CP System activity.

For this purpose one staggered time schedule shall be given to the CP System contractor, so that they can mobilize and demobilize from site depending on the availability of the work front.

1.4.9 Bidder to refer part 2.0 for "Design Basis/ Philosophy for CP System", part 3.0 for "Specification for CP System material & equipment", part 4.0 for “Mandatory Spares for Cathodic Protection”.

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2.0 DESIGN BASIS/ PHILOSOPHY FOR CP SYSTEM

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2.0 DESIGN REQUIREMENTS FOR CATHODIC PROTECTION SYSTEM

2.1 Codes and Standards

The entire work shall be performed as per the following codes/standards:

* AMPP (Formerly NACE International): SP-0169, SP-0285, SP0100, SP0408, SP0572
* DIN EN 50162 VDE 015 : Protection against corrosion by stray current from direct current (DC) systems.
* BS EN 12954 : Cathodic protection of buried or immersed metallic structures
* IEC/ NEC/ IS : Relevant codes
* IS/ IEC: 60079 : Electrical Apparatus for Explosive Gas Atmosphere
* IS/ IEC: 60529 : Classification of Degree of Protection Provided by Enclosures
* country electricity act and rules framed there under.
* Fire insurance regulations.
* Regulations laid by Chief Electrical Inspector of State.
* Regulations laid by Chief Inspector of Explosives.
* Regulation laid by Factory Inspector of State.
* Wherever the requirements in this specification are in conflict with any of the above standards, the requirements of this specification or stringent shall be followed.

2.2 **Type of Cathodic Protection (C.P) System**:

Impressed Current Cathodic Protection (C.P) System shall be installed for RCC foundation piles.

2.2.1 CP System contractor shall carryout the detail engineering/ procurement/ installation / testing/ commissioning of the CP System as described below:

a) **Transformer/ Rectifier (T/R) units:**

T/R unit shall be suitable for safe area as per relevant IS/IEC/ NEC standards of **25V/25A capacity**. Suitable number of T/R units to be considered for entire piling in scope. Each T/R unit shall be of suitable capacity with additional 25% capacity margin for future need. All T/R units shall be air cooled indoor type and shall be installed at non-classified location.

All T/R units shall be automatic Voltage/Current controlled type, the power supply for the TR Units shall be drawn from the nearest Electrical substation. Each T/R Unit shall control its respective Zone through its AJB and CJB considering maximum output current shall not be more than 75% rated capacity of the T/R Unit.

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Positive terminal of each T/R unit shall be connected to one or more Anode junction box (AJB) & Negative terminal of each T/R unit shall be connected to one or more Cathode junction box cum test station (CJB)

b) Anode Beds:

For RCC foundation (Piles): Anodes employed for CP System of RCC foundation Structures (piles) shall be MMO Tubular Titanium Anode of suitable capacity. The anode bed shall be **closed distributed and replacable type** and shall be designed to avoid shielding effect. The quantity of anode to be calculated Considering 5mA/m2 (minimum) as average current density of re-bar and its layout arrangement shall be furnished to PMC/ OWNER for review and approval during the detailed engineering stage. Overall minimum 30% additional incidental structural area to be considered for protection.

c) **Junction Boxes:** All field junction boxes shall be SS316 type. The enclosure of junction boxes shall be suitable for type "Exd" protection Zone 2/ Group IIA/IIB application, Temp. Class: T-3, as per relevant IS/ IEC/ NEC standards and shall be installed near to the structure. Anode Beds should be designed and grouped for each AJB in such a manner that approximately uniform anode current is discharged through each AJB. While deciding no. of Anode outlets for each AJB, at least two nos. of cable entries and cable terminals should be kept spare at each AJB for connection of Anodes as per supplementary design, if required. The spare cable entries (if any) should be closed with a threaded plug. From each anode, one anode lead cable shall be terminated to AJB and from each group of RCC Pile 1 No. drainage cables shall be terminated to CJB. For current (A) measurement purposes, shunt of suitable rating shall be provided in AJBs.

For each 10 nos. pile combination, 1no. Permanent Ref. cell cable & 1 no. measurement cables shall also be terminated to CJB/MJB

d) **Cable to Rebar Connection:** Drainage cable/ measurement cable-to-rebar connections shall be done by utilizing the suitable process. Drainage cable/ measurement cable-to-rebar connections shall be done at 1/4th and 3/4th depth of each location before casting of the pile. The 10mm thick plate to be welded on rebar and cable to be cad welded on plate.

e) **Monitoring Junction Box (MJB):** All field monitoring junction boxes shall be SS316 type. One Monitoring junction box (MJB) suitable for type "Exd" protection Zone 2/Group IIA/IIB application, Temp. Class: T-3, as per relevant IS/ IEC/ NEC standards shall be installed near each TR Unit at for manual measurement of rebar to Concrete potential. One multi core Reference cell cable and measurement cable shall be connected between CJB and monitoring junction box (MJB). All Permanent Reference cable shall be terminated at in Monitoring Junction Box.Contractor shall prepare the layout/construction drawings and a prototype of MJB showing internal terminal

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arrangements and wiring arrangements and submit to OWNER/ PMC for approval before procurement / installation of the same. Each TR Unit shall have 1No. MJB.

f) **Permanent Reference cells for RCC piles**:

For each 10 nos. pile combination, 1no. Permanent Ref. cell shall be provided. The reference cell shall be Ag/ AgCl Permanent ref. electrode saturated with KCl suitable for Concrete applications along with measurement cable connection as required for monitoring purpose.

Reference cell and Measurement cable connections from each facility/Building to TR Unit shall be done through respective TR Unit cathode junction box cum Test station (CJB) & MJB. Half of the reference cells shall be installed near the grade level of the pile and other half at the bottom of the pile. The Reference cell which shall be installed at the bottom of the pile shall be lowered through suitable size PVC cable conduit pipe so that it can be replaced in future in case required. Before lowering the Reference cell, the chemical backfill of the Reference cell shall be soaked in water.

g) Bottom plugged Perforated PVC pipes are to be driven upto the pile depth for checking the rebar to soil potential profile from top to bottom of the pile with the help of portable Cu/CuSO4 Reference cell in case the permanent Ag/AgCl Reference cell does not give proper potential reading. Provision shall be made for measurement with Portable Reference cells. Also, access to rebar shall be provided at that location. One rebar from the nearest pile in front of each Perforated PVC pipe shall be kept exposed for checking the rebar to soil potential with the help of portable Reference cell.

h) **Continuity of rebar**: Continuity of rebar is to be checked with the help of multimeter before lowering the cage for casting. Incase adequate continuity is not achieved; spot welding of the cage is to be done at suitable places to achieve adequate continuity of the cage from one corner to other.

2.3 Approach for CP System design of RCC piles:

a) No Insulating joints shall be installed to isolate any incidental structures from CP System within Battery limit. Hence the structures intended to be cathodically protected shall be in electrical continuity with many foreign structures within the plant complex such as earthing grids, other U/G structures, which are not intended to be protected. The CP current requirement, therefore shall be governed by following factors:

- Surface area of structures to be protected.
- Surface area and surface condition of nearby foreign structures.
- Relative position of anode between foreign structure and structure intended to be protected.

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To take care of such situation CP System shall be designed & installed in two stages by providing one preliminary design and another supplementary design as follows:

1. **Preliminary design**: A preliminary design shall be made based on the scheme mentioned in section 1.2 above. The quantities required for T/R units, Power Distribution Boards, anodes/ conductor bars of various configurations, Junction boxes, Cables of various sizes, TIG/ spot/ thermit weld connections details, test points/ test stations(MJB) and other materials as required shall be calculated by CONTRACTOR. The locations of T/R units, Power Distribution Boards, anodes/ conductor bars of various configurations, Junction boxes, Cables of various sizes, TIG/ thermit weld connections, test points/ test stations(MJB) shall be marked by CONTRACTOR in appropriate layout drawings and shall be submitted along with Detail engineering package to OWNER/ PMC for approval. The T/R Units, PDB and MJB shall be installed at a suitable location in non-classified area near the Buildings or Electrical Sub-station. The power supply for the T/R Unit/PDB shall be drawn from the identified cubical of the electrical substation nearest to the Buildings. The locations for installation of all CP system materials/ equipment shall be verified at site by OWNER/ PMC to check the practical feasibility of installation as well as its suitability for optimum/ effective performance as envisaged in the design. CONTRACTOR shall start installation work of CP System only after site verification and approval of locations by OWNER/ PMC at site. Detailed Engineering works to be performed by CONTRACTOR are mentioned in Section 1.5. After completion of installation work, CONTRACTOR shall carry out testing/ commissioning activities before installation of the Building/facility so that any installation as per the supplementary design if required can be undertaken.

2. **Supplementary design**: After energizing CP System as per preliminary design, the unprotected/ under protected and over protected areas (if any) shall be identified and a supplementary design is to be made to bring all structures intended to be protected within acceptable potential limits. For identification of under protected/ over-protected areas, at first natural rebar to Concrete potential is to be taken at all test points in presence of OWNER/PMC. Then the system as per preliminary design shall be energized at different current levels. For each current level, protection potential of cathode structure for each ref.cell shall be observed until predetermined current limits of Anodes or T/R units are reached or desired protection potential levels are achieved. These observations shall be recorded in a tabular form and marked or graphically plotted on RCC Structure layout drawings and to be submitted to OWNER/ PMC for review. OWNER/ PMC after review/interpretation of the instant commissioning results, shall decide for requirement of any additional Deep well / shallow depth Anode bed locations or additional T/R unit requirements or disconnection of some anodes/ anode beds if required or any other remedial measures and the contractor shall update the CP System accordingly at no additional cost and within a specified time acceptable to PMC/ OWNER.

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Incase supplementary design is required because of non-achievement of adequate potential through Main design, additional Deep well Anode beds Considering MMO Tubular anodes, need to be installed in between piles or outside piles near Building/facility rim depending on availability of space.

a) The following criteria shall be followed to determine the protection levels:

- Rebar to concrete potential : Negative 850 mV CSE (–784 mV AgCl [KCl 0.5M/seawater]; –733 mV AgCl [KCl sat]) Polarized Potential
- Rebar to concrete OFF potential with respect to Cu/CuSO4 ref. Cell : -100mV polarization shift from initial native potential to the CP potential. Discretion to use any of the criteria shall solely rest with OWNER/OWNER's Representative.
- Polarized Potentials more negative than –1000mV with respect to Cu/CuSO4 ref. Cell (VCSE) at 25 °C, or –0.934 V AgCl (KCl 0.5M/seawater); –0.883 V AgCl (KCl sat), shall be avoided to prevent hydrogen generation and possible hydrogen embritlement of the rebar.
- Interference Criteria: +50mV positive shift

b) Design life of Anode (while calculating design life of anode, it is to be considered entire current is discharged through anode only and coke breeze backfill is not discharging current in case of tubular anode) = 30 years (minimum).

c) While deciding number of modular type automatic Structure to soil potential controlled T/R units, considerations must be given to see no T/R unit is loaded more than 75% of its rated output voltage & current capacity throughout design life while feeding load to a single or group of anode beds.

d) While making preliminary design contractor should make the entire endeavor to ensure the adequacy of the design so that the requirement of supplementary design is bare minimum.

e) Identification and mitigation of interference between structures to be protected as well as between the structures to be protected and foreign structures need to be carried out by contractor as per the requirements of the codes mentioned in this document.

f) Earthing of all T/R Units, PDB, junction boxes need to be done by connecting the same with plant earthing grids, wherever plant earthing grids are not available nearby, a separate earth pit approved by OWNER/PMC may be considered by

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contractor, this separate earth pit should also be connected to the plant earthing grids by the contractor.

g) To avoid cable damage in the long run, all cables are to be laid at the cable trays wherever possible; underground cable laying should be considered only when no cable trays are available nearby. Underground cable shall be laid through conduit only. All CP System cables need to be laid at power cable trays, all multi core-monitoring cables need to be laid at instrumentation cable trays.

h) For road crossing and all underground laying of CP System cables, suitable RCC duct or PVC PIPE duct embedded in concrete at proper depth need to be prepared by Contractor. Contractor should get the construction drawing approved by OWNER/ PMC before execution of the work.

i) The type of concrete & Soil resistivity at the Pile location should be taken into consideration for all detail-engineering calculations.

j) All AJB/ CJB need to be provided near the rim of each Building for termination of anode lead cables/ drainage cables/ measurement cables and permanent ref. cell cables from each pile.

2.4 **RCC PILE CAP CATHODIC PROTECTION SYSTEM:**

RCC pile cap need not included in CP System if it located in the atmospheric zone.

2.5 Detailed Engineering Works to be performed by Contractor for CP System of RCC Structure

Following detailed engineering works are to be performed by contractor based on Type of CP System given vide item no.1.2 and Approach for CP System design of RCC Structure given vide item no. 1.3 of this document:

- List of materials/ equipment to be procured.
- Item wise list of vendors with their reference lists for supply of materials/ equipment.
- Calculation and Preparation of Bill of Quantities for all C.P System materials and equipment required and drawings.

Bill of quantity along with detailed calculations and preparation of specifications, installation work procedures & fabrication/ construction drawings for following items:

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- CP System power distribution board: Total quantity and connection scheme showing group of T/R units or single TR Unit to be connected with each CP System PDB and connection details between OWNER's switch board and each CP System PDB.

- T/R unit: Total quantity, detailed circuit diagrams and their installation drawings.

- AJB/ CJB/ MJB: Total quantity and connection Scheme showing how group of anodes, anode beds and piles are to be connected with each AJB/ MJB/ CJB. Also fabrication drawing & schematic drawing for internal terminal arrangements and installation drawings for a typical AJB/ CJB/ MJB.

- Anodes: Detailed layout arrangement of MMO Tubular Titanium Anodes for entire CP System and their layout drawings showing number and location of MMO Tubular Titanium Anodes for each structure/group of piles.

- Design calculations

- Cables: Total quantity of cables and their layout drawing for each CP Station as well as for entire CP System for +ve header cables, -ve header cables, anode lead cables, earthing cables, drainage cables, power supply cables and multi-core monitoring cables.

- Cable to rebar joint: Total quantity of joints and details of a typical joint.

- T/R unit wise CP System layout drawing showing how each T/R unit is connected with group of anodes/ RCC Structures through AJB/ CJB/ MJB.

- Test points: All test points and anode beds should be marked in a single layout drawing.

- Overall CP System layout drawing including all test points, anodes, anode beds, AJB, CJB, MJB, cable routes on a plot plan. All CP System materials/ equipment shall be marked properly for easy identification on all appropriate drawings as well as on site.

- Preparation of testing & commissioning procedure for CP System.

- Preparation of construction drawings with soft copies before starting of installation/ procurement work, Preparation of Soft & hard copies of as built drawings after completion of CP System work, shall also be furnished.

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- Quality Assurance Plans/ Procedure

The CONTRACTOR shall establish document and maintain an effective Quality Assurance system as outlined in recognized codes etc. and Quality Assurance Plans included in Specifications etc. to ensure that the work is performed in a planned, systematic manner to the best quality standards and properly documented to provide confidence that materials supplied and/ or work executed and services performed conform to the applicable specifications and all the requirements of contract document and work executed shall perform satisfactorily over the entire period of its life.

The Quality Assurance Systems Plans/ Procedures of the CONTRACTOR shall generally cover the following aspects/ details, which shall be furnished by BIDDER along with, his detail-engineering package.

i) A Quality Assurance Organogram with curriculum vitae of key personnel responsible for the Quality Assurance at site.

ii) Complete details pertaining to the responsibility authority and accountability of the Quality Assurance Organization of the CONTRACTOR at site.

iii) Equipments, material, Erection, Installation, Testing and commissioning control plans for quality testing/ inspection etc.

iv) Quality Control of processes such as reinforcement bar cable connection, anode to cable jointing etc.

v) Control Procedures/ Plans for calibration and safe up-keep of instruments, gauges and similar testing equipments etc.

vi) Quality audit & Maintenance/ records/ procedures etc.

vii) Other relevant details.

Quality Assurance System Plans/ Procedures of the CONTRACTOR shall be furnished in the form of a QA manual. In addition, all the Quality Assurance Programs/Plans as per specifications enclosed with the Contract shall be fully complied with by the Contractor.

- Precautionary measures to be taken to prevent fire hazard during Pin Brazing or connecting wire for the purpose of cable to reinforcement bar joint as well as during installation, operation & maintenance of CP System.

- All other information as required in individual job specifications shall be furnished by CONTRACTOR in his detail-engineering package.

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2.6 TESTING/ COMMISSIONING OF CP SYSTEM

2.6.1 Energisation of T/R Unit

After installation of each CP Station is complete piles, Connections of all materials/ equipment shall be checked by Contractor as per approved connection scheme. Contractor shall check all cable connections for proper continuity in all circuits.
Insulation resistance check shall be performed on all power cables and on positive header cable between T/R unit to Anode Junction Box. Contractor shall then momentarily energize the T/R unit in the presence of the Engineer/ Company to check the functioning of the T/R unit & CP System. All test points shall be checked for proper compaction of natural soil.

2.6.2 Commissioning of CP System

Once construction of the entire CP System is complete, Contractor shall commission the system under the supervision of Company, the formats for recording commissioning results shall be submitted by Contractor for Company's approval at least 2 months before commissioning. Key persons from Contractor's side who were involved in the construction work shall take part in commissioning. Interference test shall also be conducted during commissioning using mostly the existing test points.

- For CP of piles, Contractor shall make available Transformer-Rectifier Unit manufacturer's representative at site during commissioning of CP System for carrying out necessary adjustment (if required) at the TR Unit control circuitry for auto mode operation of TR Unit at site load.

- CP system commissioning will be conducted by AMPP (Formally NACE International) Certified CP Level – 2 personnel of CP contractor (minimum level) with at least 7 Years of successful experience in relevant field of concrete CP System.

- Final commissioning report shall be submitted to OWNER/PMC for review and approval.

Note- Contractor shall visit site every quarter for one year after commissioning for Monitoring & maintenance of CP system & submit the reports to the PMC/OWNER.

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3.0 SPECIFICATION FOR CP SYSTEM EQUIPMENT AND MATERIALS

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3.1 SPECIFICATION FOR NATURAL AIR COOLED TRANSFORMER/ RECTIFIER UNIT

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3.0 Specifications and Testing of Air Cooled Transformer Rectifier Units

The specifications and testing procedure for T/R units for installation in Safe are given as follows:

3.1 TRANSFORMER RECTIFIER UNITS(T/R UNITS)

The transformer rectifier units shall be a standard product of a manufacturer regularly engaged in production of cathodic protection power supplies. The units shall be supplied in accordance with the following specifications and data sheets.

3.1.1 CODES AND STANDARDS

In general the T/R Unit covered by this specification shall unless otherwise specified, be in line with the requirements of any of the latest applicable standard of:

a) International Electro technical commission (IEC)
b) American Standards Institution (ANSI)
c) British Standards Institution (BS)

Wherever the requirements in this specification are in conflict with any of the above standards, the requirements under this specification shall be binding.

3.1.2 TRANSFORMER

The main transformer will be the isolation type having separate primary and secondary windings. An electrostatic shield, composed of heavy copper foil, shall be placed between the two windings and grounded to the rectifier cabinet, for this purpose a visible lead should be brought out from the copper foil which shall be connected to any of the mounting stud of the transformer core. Transformer winding wire insulation, winding interlayer insulation, core to winding insulation shall be class F type. The transformer core and winding will be dipped in thermosetting varnish and baked. Transformer varnish will meet the standards for 155 degree C operation. The transformer winding shall withstand 2,000 volt (RMS at 50 hertz) applied for one minute between the windings and between each winding and the transformer core. Maximum temperature of transformer will not exceed 85 deg C and air temperature inside the upper cabinet will not exceed 65 deg C at full load current at ambient temperature of upto 45 deg C. Transformer full load efficiency will not be less than 90%.

3.1.3 RECTIFYING ELEMENTS

The power rectification shall be done by Silicon diodes of sufficient size to prevent the diode case temperature from exceeding 85 ^{o}C at ambient temperature as per data sheet. The peak inverse voltage rating and current ratings of the diodes shall be as per data sheet. The diodes shall be connected in Bridge circuitry for full wave rectification.

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3.1.4 A.C. INPUT

The transformer rectifier units shall be designed to operate on 240 volts (+/- 10%) Single phase, 50 Hz (+3%) power supply. Inrush current limiting reactor of suitable rating to be provided at input line of the main transformer to avoid possibility of abnormal tripping of MCB while closing circuit using MCB.

3.1.5 D.C. OUTPUT

The transformer rectifier shall be designed to operate continuously at 100% rated output current and 100% rated output voltage at input supply voltage 240V (+/-10%) without exceeding specified hot spot temperature limit and without damaging any components.

3.1.6 D.C. OUTPUT ADJUSTMENTS

The D.C. output control shall be available in any of the following modes, with the help of a selector switch.

3.1.6.1 MANUAL MODE

Output voltage at 24 equal steps upto 100% rated voltage shall be available by means of coarse and fine tap changing switches for rated input supply voltage and 100% rated output current.

3.1.6.2 AUTO MODE:

Unit shall have CONSTANT OUTPUT CURRENT/VOLTAGE CONTROL (AVCC MODE) in AUTO MODE as per Data Sheet.

i) CONSTANT CURRENT AND VOLTAGE CONTROL (AVCC MODE)

Constant voltage control feature shall be achieved by automatically adjusting T/R unit output voltage between 0 to 100% rated voltage through close loop control using T/R unit output voltage as feedback taken from the divider inside the T/R unit so that T/R unit output voltage of any value between 0 to 100% rated voltage does not vary more than $\pm$0.5V of set value when there is a change input supply voltage of $\pm$10% or change in load resistance over a specified range decided by the ratio of output voltage & current rating of the T/R unit.

Constant current control feature shall be achieved by automatically adjusting T/R unit output voltage between 0 to 100% rated voltage through close loop control using T/R unit output current as feedback taken from the shunt inside the T/R unit so that T/R unit output current of any value between 0 to 100% rated current does not vary more than $\pm$0.5A of set value when there is a

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change input supply voltage of ±10% or change in load resistance over a specified range decided by the ratio of output voltage & current rating of the T/R unit.

ii) CONSTANT PIPE TO SOIL POTENTIAL CONTROL

Constant Pipe to soil potential (PSP) control feature shall be achieved by automatically adjusting T/R unit output voltage between 0 to 100% rated voltage through close loop control using PSP as feedback taken from external reference cell, to cause change in output current of T/R unit so that PSP as measured by external reference cell always remains constant and does not vary more than ±0.04% of the set potential. For feedback PSP reference, 2 nos. Cu/CuSO4 ref. cells to be used one operating and other standby to be selected manually with the help of a selector switch.

Continuously adjustable potentiometer to be used for setting T/R unit output current/PSP.

Silicon controlled Rectifiers (SCR's) shall be used in the Primary Circuit of main Transformer for close loop control of the output voltage in auto mode. The SCR's of the transformer rectifiers will be controlled by commands from electronic circuit cards. These cards shall be the plug-in type Printed Circuit Board (PCB) mounted on the front panel of the rectifier for easy field replacement.

The printed circuit board contact pads will be chromium plated to provide easy conduction and to eliminate contact corrosion. Complete printed circuit boards will be sealed with a circuit card sealant to prevent atmospheric corrosion and fungus contamination. Circuit elements in the control cards shall be derated properly and proper heat dissipation arrangements shall be made in the PCB so that they function properly for full load operation of T/R unit at ambient temperature as per data sheet.

3.1.7 DC OUTPUT RIPPLE

The filter circuit shall be designed in such a manner that ripple factor does not exceed 5% at rated load both in Auto and manual mode.

3.1.8 INPUT OVERLOAD PROTECTION

Protection from overloads on the input will be provided by Miniature circuit breakers of suitable rating on the input side. The trip point will be unaffected by ambient temperature. The trip handles of individual poles of circuit breaker will be mechanically linked so that all lines are opened when an overload occurs. In addition to above MCB, HRC fuse of suitable rating should be connected before MCB so that A.C. input current is limited to max. 10% excess rated input current as per data sheet.

3.1.9 OUTPUT OVERLOAD PROTECTION

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HRC fuse and 2 pole MCB at the output to disconnect T/R unit quickly in case of over loads in the output circuit or for ease of isolating T/R Unit from the circuit when it is desired to keep the T/R Unit in standby mode.

3.1.10 VOLTAGE SURGE PROTECTION

Each silicon controlled rectifier (SCR) and Diodes shall be protected from voltage surges by means of R-C circuitry/ MOV . This R-C circuitry / MOV will be rated as recommended by the manufacturer of the SCR/ Diodes so that they will conduct heavily before the peak inverse voltage ratings of the SCR/ Diodes are reached. In addition, lighting arrestors and zener Barrier type or MOV type surge Diverters shall be provided in the A.C. input and D.C. output circuit of the Transformer rectifier as per data sheet.

3.1.11 COOLING

The transformer/ rectifier will be Natural Air (AN) cooled, completely enclosed IP55 construction. The maximum air temperature of the upper cabinet should not be more than 65 ^{O}C for ambient temperature of upto 45 ^{O}C.

3.1.12 INPUT AND OUTPUT TERMINALS

DC terminals made of tinned plated copper shall be located convenient to the cable entrance. The terminals shall be suitable for cable sizes as per data sheet. One negative and one positive output terminals shall be provided.

AC terminals shall be insulated to withstand 2000 volts 50Hz to the enclosure, shall be shielded to prevent accidental contact and shall be sized to take cable sizes as per data sheet.

3.1.13 METERS

The transformer rectifier units shall be equipped with separate continuous reading voltmeter and ammeter for the D.C. output and the A.C. input voltage, current and PSP measurement meter. All meters shall be electronic digital type with LED display arrangement or Analog type and should be able to indicate the current and voltage ranges as per data sheet as per data sheet. Digit size should be 10.0mm (minimum). All meters shall be rectangular in shape and accurate to within 2% at full load at ambient temp. as per data sheet. They shall be temperature compensated to vary no more than 1% per 10% temperature changes.

3.1.14 ANNUNCIATION

Not applicable

3.1.15 ENCLOSURES

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The Enclosure shall be completely enclosed type having IP 55 Degree protection suitable for direct outdoor/ indoor installation in Safe Area. The Enclosure shall be provided with a perspex viewing window to view the Indications & Meters Inside the enclosure. Construction of the TR Unit shall be for outdoor application Natural Air cooled (AN) type.

The transformer rectifier shall be provided with the following accessories.

- Steel channel under the base for plinth mounting.
- Lifting lugs of size suitable for lifting complete transformer rectifier unit when full of oil to be welded at the 3mm thick bottom plate of upper cabinet.
- Sunshade/ rain shade.
- A toughened glass window through which the meters and indications can be viewed.
- Lockable control cabinet with viewing window to IP55 as a minimum.

Accessibility shall be provided by hinged and removable front shutters. A toughened glass viewing window shall be provided at the front shutter to allow the meters to be read without opening the front shutter. The enclosure shall be supplied with an engraved warning level with the words "DANGER". A flame proof junction box shall be provided at sides of the upper compartment, for A.C. cable entries and for D.C. cable entries. Junction Box will have double compression flameproof cable glands for A.C, DC control/monitoring cables. After fabrication the entire enclosure shall be sand blasted to a SA 2 1/2 surface. The finish coat shall be Powder Coating of thickness 100-125 Microns.

3.1.16 ENCLOSURE EARTHING

All normally dead metallic parts shall be electrically continuous, earthing terminals shall be suitable for 35mm square cable connection, one earthing terminal shall be made for earthing connection to power supply earthing and two earthing terminals shall be made for earthing connection to the local earthing pits.

The earth connection points shall be protected against corrosion. It shall not be necessary to scrape the paint away in order to make an effective earth connection. Provision shall also be made adjacent to each gland plate for cable gland earthing connection.

3.1.16.1 Cable Terminations

i) Cable glanding and terminating facilities and terminals shall be suitable for the specified cable type and conductor size. Consideration and provision shall be taken by the manufacturer on the equipment design for the use of cables with Aluminium conductors. Cable glands & cable lugs shall be in the scope of supply for CP system installation CP System contractor.

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ii) Terminal blocks shall be arranged and positioned to afford easy access for carrying out external cable termination, testing, inspection and maintenance. There shall be ample clear space allowed between the terminal block and the gland plate for the spreading and termination of external conductors.

iii) All terminal blocks shall be shrouded or provided with transparent covers. Pinch screw type terminals are not acceptable.

iv) One positive and one negative post type D.C. output terminals shall be provided for the T/R Unit. Each post shall be fitted with double nuts and washers.

v) Terminals for different voltages shall be separated by partitions.

vi) A terminal box or chamber withDouble Compression Flameproof glands terminate the specified incoming and outgoing cables shall be provided. Direction of cable entry shall be from below.

vii) Termination of single core cables shall be through double compression flameproof glands and provision made for bonding and earthing any armour and/or concentric ground conductors.

viii) Cable terminal arrangements for power and control cables may be integrated provided that a barrier separates the two.

ix) Auxiliary wiring shall have copper conductors of the manufacturer's standard sizing (subject to Buyer’s approval).

x) Suitable terminals for upto 8 nos. ref. cell cables, one no. measurement cables and a selector switch for permanent ref. cell to be provided for T/R unit panel for connection to PSP meter.
(Out of 8 Ref Inputs, only 2 Ref need to be monitored locally on T/R Unit Ref Voltmeter. All the 8 Nos. Ref Inputs will be monitored in Central PC through RMRC system).

Wiring shall be crimped using self-insulated compression type terminal blocks which shall be suitably identified. Conductors shall be fitted with sleeve ferrules bearing the same identification as the terminal to which they are connected. Minimum conductor size shall be 1.0mm2 (current density shall not be more than 3A/mm2 for copper conductor).

3.1.17 NAME PLATE

A permanently stamped stainless steel metal plate shall be attached to outside of the case with the following information.

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a. Manufacturer's name
b. AC input voltage and current rating
c. AC frequency
d. Phase
e. Output DC volts and Amps. rating
f. Weight in Kg of T/R unit
g. Model number
h. Serial number
i. Year of Manufacture

3.1.18 DATA SHEET OF 10V, 10A T/R UNIT

A.	AC input voltage three phase	:	240 volts +/-10%, 50HZ+/- 3%,
B.	AC input current	:	Less than 4A
C.	DC power output	:	100W
D.	KVA rating of transformer	:	400VA
E.	DC output voltage	:	10V
F.	DC output current	:	10A

G. Current rating SCR : SCR/Diode rating will be chosen with 300% margin over rated full load current.

H. Full load efficiency
- Transformer alone : More than 90%
- Transformer Rectifier Assembly : More than 65%

I. Full load power factor : 0.8 lagging

J. Insulation level : 2KV

K. Peak Inverse Voltage
- Diodes/ SCR's : 1200V (PIV)

L. Filtering circuit : L.C.filter

M. Ripple and Hum at rated output : Not more than 5%

N. Surge Diverters

i) For diodes/ SCR's : R-C circuitry/MOV of rating as advised by manufacturer of SCR/ Diodes

ii) For input of T/R unit : MOV type surge diverters.

iii) For output of T/R : MOV type surge diverters.

O. Lightening arrestor: 2 nos. each at the input and output of the T/R unit of suitable voltage rating and Minimum Impulse current discharge capacity of 10KA(Peak)

P. Protection : MCB suitable for motor load having thermal over load and magnetic short circuit Protection for input current, MCB in DC output , HRC fuse at out put and input terminals.

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Q. Construction : Plinth mounted outdoor type. Confirming to IP55 degree of protection.

R. Cooling : Natural Air Cooled (AN)

S. Meters/ Instruments: As per Sec.3.1.13.

1 No. DC voltmeter 0-10V
1 No. DC Ammeter 0-10A
1 No. AC voltmeter 0-300V
1 No. Corrosion voltmeter, 0-5000 mV, 10M ohm input resistance.
1 No. AC Ammeter 0-10A

Other accessories:
Sun shade/ rain shade.

T. Enclosure : Per sec. 3.1.15

U. Cable entry : Through Double compression Flameproof glands of suitable sizes for individual cables.
+ve and -ve header : 25mm2 1-core, 2nos.
Power supply cable : 6mm2 , 3-core, 1 No.
Monitoring cable : 6mm2, 1-core, 9 nos.
(Monitoring cable to be used in case permanent reference cell is used for monitoring pipe/ structure to soil potential)
RS 485 Cable for RMRC : 1.0mm2 X Twisted pair cable – 1 No.

V. Enclosure painting : As per sec. 3.1.15

W. Fabrication, Schematic: Supplier to furnish for PMC approval schematic wiring diagram and fabrication drawing prior to fabrication of T/R units.

X. Spare parts & Additional features : Supply as per Sec.3.1.18.

Y. Ambient temp. : 45 deg.C

Z. Type of control required in Auto mode: Constant current control and constant voltage control (AVCC MODE)

3.1.20 Testing of T/R units

All T/R units shall be tested by CP System contractor and inspected by PMC/ OWNER before despatch, testing shall be conducted in accordance with codes and standards enclosed in this document, as per routine tests done by manufacturer and additional tests as mentioned below:

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3.1.20.1 Efficiency test of Transformer Rectifier Assembly at 100% rated output current both in Auto and manual mode of operation. Efficiency test of Transformer alone after isolating rectifier at 100% rated output current.

3.1.20.2 No load output voltage test in Manual mode for each voltage setting using coarse and fine tap switches at rated input voltage of 240V AC.

3.1.20.3 Output voltage and current test in Manual mode for each voltage setting using coarse and fine tap switches for rated Input voltage conditions.

Output current and voltage shall be recorded for each of above conditions.

3.1.20.4 Output voltage Regulation test at rated output current in Auto mode for the +/- 10% variation of Input voltage conditions.

Output CurrentRegulation test at rated output current setting in Auto mode for the +/- 10% variation of Input voltage conditions.

Output current and voltage shall be recorded for each of above conditions.

3.1.20.5 Heat run test for max. temp rise to be conducted for main transformer, Auto transformer, filter choke, Diodes and SCR's, at rated output current for 24 hours continuous operation. Number of T/R units to be considered for Heat run tests and actual duration for which test to be conducted up to 24 hours (max.) shall be decided by PMC and OWNER. Thermocouple instrument shall be used for measurement of temperature. The sensors shall be clamped at different locations inside the closed T/R unit cubical and the cable of the sensors shall be connected to temperature indicator through a selector switch outside the T/R unit cubical during heat run test.

3.1.20.6 Insulation resistance test using 500V megger for Auto transformer and Main transformer between primary and secondary, primary and earth, secondary and earth.

3.1.20.7 Dielectric strength test using 2KV for 1 min. duration for Auto transformer, main transformer between Primary and secondary, primary and earth, secondary and earth.

3.1.20.8 Polarity test in Auto and manual mode of operation of T/R unit.

3.1.20.9 Calibration test for all Ammeters and volt meters.

3.1.20.10 Auto mode over load protection test:

Set back Current Limit control at 18 Amp. and try to increase current from zero to max. possible using Voltage Setter Potentiometer.

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In case of Auto PSP control T/R unit ref. feedback signal to be varied from min. to max. set potential of T/R unit using battery & rheostat in place of ref. half-cell signal.
Current during the test should not exceed more than 18A in both cases.

3.1.20.10.1 Constant Current Test

D.C Current Regulation against variation in AC Input

Put the unit in constant current mode and set the output current at rated value by the help of current setting potentiometer and observe the variation in, if any, of output current with variation of AC input voltage at the +/- 10% steps keeping the output load constant:

i) D.C Current Regulation against variation in Load Voltage

Keeping the AC input voltage at 240 V constant , set the output D.C current at rated value and observe for any variation of DC current with variation of output load at three different values ensuring that for each output load, voltage limit set value is not exceeded.

3.1.20.11.1 D.C Voltage Regulation against variation in Load Current

Keeping the AC input Voltage at 240 V constant, set the output D.C voltage at Rated Value and observe for any variation of D.C. Voltage with variation of output load current at three different values ensuring that each output load current, current limit set value is not exceeded .

3.1.20.12 Ripple factor test

T/R unit shall be operated at full load both in Auto and Manual mode. In each case ripple voltage to be checked on a cathode ray oscilloscope (CRO). Ripple voltage should be limited to less than 5% RMS voltage.

3.1.20.13 Annunciation check:

Not applicable.

3.1.20.14 Auto mode constant PSP operation test: (Not applicable for this Project)

Connect one battery with variable rheostat in place of reference cell feedback signal and conduct the following test:

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i) Make both T/R unit set potential & feedback signal from battery 1.0V, Switch on T/R unit & note T/R output current. Increase feedback signal from 1.0V to 1.5V and again bring back to 1.0V. Note change in the T/R output current.

ii) Conduct similar test as item (i) above with decrease of feedback signed from 1.0V to 0.5V and again back to 1.0V. Note change in the T/R output current.

3.1.20.17 Test certificate/ documents in 6 copies are to be furnished by vendor before despatch of T/R unit to site. The test certificate shall contain results for the tests from 3.1.20.1 to 3.1.20.16 given above in addition the following observations:

- Sl. No. of T/R unit
- D.C. output rating of T/R unit
- External dimensions of T/R unit
- Weight of T/R unit
- Thickness of M.S. sheet steel used for T/R unit enclosure.
- Painting details of enclosure.
- Visual inspection details of T/R unit stating:

a) All components of T/R unit are as per specification

b) All items are labelled properly for identification purpose.

c) Number used in ferrules of cable leads are matching with schematic/wiring diagram of T/R unit furnished.

3.1.21 DRAWINGS/ DOCUMENTS

Following drawings/ documents shall be furnished by vendor within 15 days from award of contract for approval of the same by PMC/ OWNER before starting of fabrication. Approved drawings after incorporation of comments (if any from PMC/ OWNER shall be furnished in 6 copies along with reproducible during the delivery of T/R units:

3.1.21.1 Fabrication drawings and data sheet of T/R unit giving dimensions, rating, weight, including installation/ foundation arrangement details.

3.1.21.2 Front view and typical sections of T/R unit panel with arrangement of equipment, control, protection and metering.

3.1.21.3 Data sheet of all accessories and circuit element of T/R unit including ratings.

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3.1.21.4 Schematic and wiring diagram of T/R unit circuitry giving Auto/Manual Mode of control including circuit details of all control cards.

3.1.22 INSTRUCTION BOOK

3.1.22.1 The instruction book in 10 copies shall be presented in such manner as to enable it to be used by personnel who are unfamiliar with the operation and maintenance of the T/R unit. The instruction book to be furnished along with supply of T/R unit.

3.1.22.2 CONTENTS

The instruction book shall contain

- A description of the T/R unit.

- Instruction for the installation, testing commissioning and safe operation and maintenance.

The information shall be presented as follows:

1. Index of contents

2. General description giving brief description of the T/R and its use.

Detailed description of T/R unit

This description shall include the technical characteristics, physical and mechanical limitations, and item wise the components, accessories and spare parts.

4. Description of the operation of the T/R unit. This description shall be clear, concise and in a logical sequence, using schematic diagram, wiring diagram and fabrication drawing.

5. Procedures for testing and adjusting the T/R unit:

The complete procedure for testing and adjusting the T/R unit during plant operation, periodic maintenance and overhaul shall be covered.

6. Maintenance Instructions:

This section shall be divided into two parts:

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a) Preventive maintenance which shall indicate the periodic inspection required, the inspection procedure and cleaning procedures.

b) Break down maintenance which shall include instruction for trouble shooting of the electrical circuits. The procedure for the removal and replacement of all parts listed as spares shall be given.

7. Spare parts

The instruction books shall give all the necessary details so as to procure all the spare parts from the manufacture or from open market.

8. Each instruction book shall be accompanied with one set of final approved Drawing/ documents as listed vide item 3.1.21.

- COVERING OF THE INSTRUCTION BOOKS: The instruction book shall be presented in a stiff covered binder with the following information printed on the cover:
  - the OWNER's name
  - the location of the installation
  - the name of the installation
  - the title of the instruction book.

3.1.23 Following additional features are to be provided with T/R Unit

i) RMRC System :

Complete RMRC system as per specifications in clause 5.0 will be provided for the T/R unit. RMRC unit will be a built-in feature of the T/R unit and will be housed inside the T/R unit.

ii) T/R UNIT INTERRUPTION

T/R Units should be provided with inbuilt electronic current interruption (GPS based interruption) facility for auto mode operation. Programmable interrupter ON/OFF cycle varying in any ratio from 1 sec. to 999 sec. shall be made available at T/R unit for operation of the interruption circuitry.

iii) MANDATORY SPARE PARTS

One set of Mandatory spare parts as mentioned at this document need to be supplied common for all the T/R Units.

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3.2 SPECIFICATION FOR CP SYSTEM POWER DISTRIBUTION BOARD (PDB)

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3.2 Power Distribution Board (PDB):

The Power distribution board (PDB) shall be plinth mounted outdoor type and shall be installed at non-classified locations near a single or group of T/R Unit under a sun/ rain shed. The enclosure of shall be IP-55 as per relevant IEC/ NEC/ IS codes. The Power distribution board (PDB) shall be composed of one no.3 phase, 4-wire 250A/ 63A, incoming MCCB and 12/3 no. 1 phase, 63A outgoing MCB for input power supply to TR Unit as well as 6No.6A outgoing MCB for central monitoring system power supply. The incoming switch shall be 3-pole and outgoing switches shall be 2-pole. 4 Nos. of 25x 5mm tinned copper bus bar shall be used which should be taped by PVC tape of red, yellow and blue colours for dentification of the three phases and black colour for neutral. Wiring inside PDB shall be done using 50mm2, 1-core, copper conductor, PVC insulated, unarmored cable between TPN switch neutral and neutral bus whereas rest of the wiring shall be done by 25mm2, 1-core, copper conductor, PVC insulated unarmored cable. All single core cables shall be used red, yellow and blue coloured for phase connections and black coloured for neutral connection. All cables terminations shall be through Tinned copper cable lugs of matching cable size. All cable entries to the PDB panel shall be through Aluminium single compression glands. One gland for 300mm2 / 50mm2, 3-phase, 4-core incoming cable connection shall be provided at left side bottom of the panel, 12/3/6 glands to be provided at right side bottom of the panel for outgoing cable connections for 63A PDB. The outgoing cables shall be 25mm2, 1-phase, 3-core Aluminum conductor cables for TRU power input and 16mm2, 1-phase, 3-core Aluminum conductor cables for central monitoring system power supply. Size of the PDB Panel enclosure shall be adequate to accommodate all components easily and shall be made of 12 SWG sheet steel. Two nos. hinged front shutters shall be provided. The shutters shall be screwed to the panel enclosure structure at the centre in addition it shall have lockable handles. Painting details of inside and outside surfaces of the PDB panel shall be as follows: After fabrications the entire enclosure shall be sand blasted to a SA2½ surface. An inorganic zinc primer shall then be sprayed to a total thickness of 3 mils. The finish coat shall be of polyamide cured epoxy in three coats to achieve total thickness of 15 mils. The finish coat shall be a dark grey or yellow shade as per choice of PMC/ OWNER.

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3.3 SPECIFICATION FOR MIXED METAL OXIDE COATED TITANIUM TUBULAR ANODE FOR CP SYSTEM

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3.3.1 Scope

Mixed Metal Oxide Coated Titanium single tubular anodes shall be of standard manufacturer for use in Impressed current Cathodic Protection system in similar application.

3.3.1.1 Anodes

Mixed Metal oxide coated Titanium tube anodes shall be dimensionally stable and will be supplied with anode lead cable connected to it.

3.3.1.2 ANODE DATA SHEET

S.No.	Description	Details
1.	Anode Type	Dimensionally stable Anode (DSA)
2.	Anode Shape & Dimension	Hollow Tubular 750mm long x 25.4mm OD, 0.7-0.9mm W.T
3.	Anode weight	0.41 kg + 5%
4.	Anode Material	Titanium seamless tube of Grade 1/2, ASTM B 338 overlayed with mixed oxide of noble metals.
5.	Anode design life	30 years
6.	Anode consumption rate (Kg/A-yr) at 100 A/m2 Current density	2 mg/A-yr.
7.	Metal Oxide coating thickness weight (gm/M2)	6 gms/m2(at 100 A/m2 for 30 years design life)
8.	Optimum Recommended anode current density (A/m2) i) With Carbonaceous backfill in soil ii) Without backfill in soil iii) Fresh water	 100A/M2 Vendor to furnish Vendor to furnish
9.	Rated current output	6 Amps
10.	Anode Centralizer for 8" NB casing pipe	1 Nos. per anode. Vendor to furnish details.
11.	Mechanical & Physical Properties: i) Electrical Resistivity (ohm Cm) of Metal Oxide ii) Contact resistance of anode to cable Pull out strength Anode fabrication Anode to cable connection details Anode to cable joint insulation details	 10-5 Ohm Cm 0.9 milli ohms(max.) 200 kg(min) or breaking strength of cable Vendor to furnish details Vendor to furnish details Vendor to furnish details
12.	Dead Weight for Anode	Each anode to be supplied with a dead weight. Details of the same to be furnished by vendor

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Note: All information to be furnished by vendor as per data sheet shall be furnished with his offer.

3.3.1.3 Anod Lead Cable

Anode lead cables to be connected between each anode and AJB shall be 7 strands, 10mm2 stranded copper conductor, single core, unarmored, with a double insulation system. The primary insulation shall be 0.20 inch thick cross-linked polyvinylidene floride (PVDF) 1100 Volt grade. The secondary insulation shall be 0.065 inch thick high molecular weight polyethelene (HMWPE) sheathing jacket over the primary insulation.

Anode to Lead cable jointing and insulation shall be done by using straight through jointing kit which is to be provided by anode manufacturer. Anode to Lead cable jointing and insulation shall be done at manufacturer's work shop .

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3.4 SPECIFICATIONS FOR PERMANENT REFERENCE CELL

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3.4 SPECIFICATIONS FOR PERMANENT REFERENCE HALF CELL

3.4.1 For monitoring of soil side potential:

a. Type of ref. half cell : Cu/ CuSo4 type or Ag/AgCl.

b. Body : Impact resistance

d. Each reference shall be supplied (as per manufacturer recommendation) and complete with 25m (minimum) cable as per specification. Contractor to measure the actual length of measurement cable required at site during detailed engineering stage and cut the required length from cable drum so as to avoid cable-to-cable joint.

e. Location of half cell : 150 mm from reinforcement structure

f. Design life : 25 years

g. Stability : ±10 mv with 3 Micro- A load.

h. Make : Shall be suitable for 15-40 deg.C temperature application in sand.

i. Measurement Cable : 4-6mm2, stranded Cu conductor, Single core, screened/ armoured, PVC insulated and sheathed , 1100 V grade .

Reference Cell Cable: 4-6mm2, stranded Cu conductor, Single core, screened/ armoured, PVC insulated and sheathed, 1100 V grade .

Contractor shall get the electrodes approved before placement of order. Necessary test certificates from manufacturer giving calibration test, results, date of manufacture shall be furnished during delivery. Any delivery effected without prior approval of OWNER will be at suppliers risk & cost.

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3.5 JOB SPECIFICATION FOR ANODE, CATHODE & MONITORING JUNCTION BOXES FOR CP SYSTEM

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3.5.1 All Junction Boxes shall be classified type.

3.5.1.1 Anode Junction Boxes and Cathode Junction Box cum test station shall be suitable for Classified Area applications

All field junction boxes shall be SS 316 type. An anode lead junction box (AJB) will be provided to feed T/R Unit output current to anode strings. These junction boxes will have provision for independent current measurement of each anode output. This will be accomplished by means of individual shunts for each anode circuit.

Cathode junction box cum test station (CJB) will be required for bonding multiple Buildings at drain point as well as for measurement of potential for each building. One CJB shall be provided for each building and shall be installed at one end along the longitudinal axis of the building. Drainage cable, reference cell cables and measurement cables from each building shall terminate in its respective cathode junction box cum test station. All the above-mentioned reference cell cables and measurement cables from each CJB shall be terminated into a single Monitoring junction box (MJB). Each CJB shall be connected to the negative terminal of the T/R unit through loop in loop out arrangement for return of drainage current from multiple Buildings to the T/R unit.

The enclosure of CJB shall be structure/ wall mounted type. Shutter should be provided with closed cell neoprene sealing gaskets. The terminal board shall be of 10mm WT Phenolic laminated sheet on which all terminals and shunts are to be mounted. The terminals shall be made of cadmium plated steel or stainless steel stud nut and washers of M-10 size for termination of anode and cathode lead cables and M-4 size for termination of reference cell and measurement cables. All cable entries shall be through Aluminium double comprehension glands. The external bolt, nuts and clamps to be used for mounting the junction box with back plate/ structures shall be MS electro-galvanised or Cadmium plated.

For classified areas, Junction box enclosure shall be of type "Exd" protection Zone 2/Group IIA/IIB application, Temp. Class: T-6, as per relevant IS/ IEC/NEC standards. The cable glands shall be FLP double compression type made of Aluminium. Enclosure need to be of stainless steel and certified by CMRI. The shutter of the junction box shall be screwed to the body of junction box by using MS electro galvanised/ Cadmium plated nut, bolt and washers. The enclosure of the junction box shall be made of cast aluminium. One earthing terminal shall be provided for earthing the junction box.

3.5.1.2 Monitoring Junction Boxes for Classified Areas:

All field monitoring junction boxes shall be SS 316 type. Monitoring junction boxes (MJB) will be installed near the T/R Unit and shall be required for monitoring potentials of multiple Buildings. The enclosure for the MJB shall be of type "Exd" protection for Zone 2/Group IIA/IIB application, Temp. Class: T-3, as per relevant IS/ IEC/ NEC standards

The Enclosure need to be of stainless steel and certified by CMRI having removable front shutter. Shutter should be provided with closed cell neoprene sealing gaskets. The terminal board shall be of 8mm thick Phenolic laminated sheet on which all terminals shall be made of stainless steel

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stud, nut and double spring washers of M-4 size for reference cell/measurement cables. The terminal arrangement shall be such that bottom row is utilized for termination of measurement cables from each building and upper rows one each is allotted for the reference cell cable termination from each building, hence total number of rows shall be one more than the total number of Buildings. All cable entries shall be through Aluminum double compression glands. The external bolt, nuts and clamps to be used for mounting the junction box with back plate/ structures shall be MS electro-galvanized or Cadmium, plated. Shutter should be provided with closed cell neoprene sealing gaskets.

3.5.1.3 Proper fitting of cables at cable glands

It is essential that all cables should fit tight at cable glands. For this purpose vendor need to make openings for glands at junction box or cast/ procure cable glands as per cable samples to be procured for CP System.

3.5.1.4 Painting

Enclosures of all non classified type anode and Cathode junction boxes shall be surface finished with paint as per guidelines outlined in Section3.9.

3.5.1.5 Inspection & Testing

Fabrication drawing showing internal terminal arrangement of each type of junction box to be submitted by vendor to OWNER/ PMC to obtain approval for a Prototype construction. After inspection and approval of prototype the mass production shall be started. Calibration test for shunts for each junction box to be inspected by OWNER/ PMC before dispatch.

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3.6 SPECIFICATION FOR CABLES FOR CP SYSTEM

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3.6.1 SCOPE

3.6.1.1 CODES & STANDARDS

In general the cables covered by this specification shall unless otherwise specified be in the line with the requirements of any of the latest applicable standard of Relevant IS/ IEC/ NEC standards.Wherever the requirements in this specification are in conflict with any of the above standard, the requirements under this specification shall be binding.

3.6.1.2 ANODE LEAD CABLE

Anode lead cables shall be 7 strands, 10mm2 stranded copper conductor, single core, unarmoured, with a double insulation system. The primary insulation shall be 0.2 inch thick cross-linked polyvinylidene floride (PVDF) 1100 Volt grade. The secondary insulation shall be 0.065 inch thick high molecular weight polyethylene (HMWPE) sheathing jacket over the primary insulation.

Insulation Type	Insulation Specifications**	
Polyvinylidene Fluoride (PVDF) Irradiation Cross-Linked	Tensile Break Strength Break Elongation Flexural Strength Resistivity Dielectric Constant	4500 PSI min. 50% min. 8600 PSI min. 2×10^{14} ohm-cm min. 8.0 min. at 100 Hz
Ethylene Chlorotrifluoroethylene (ECTFE)	Tensile Break Strength Break Elongation Resistivity Dielectric Constant	6500 PSI min. 100% min. 1×10^{15} ohm-cm min. 2.5 min. at 1 Mhz
High Density High Molecular Weight Polyethylene (HMWPE)	Color Density (minimum) ASTM D1248, Type 3, Class C, Category 5, or IEC 60502-1 Temperature Rating	Black 0.941 grams per cm^3 90°C.

** Standard Test Method ASTM D638 shall be used to determine the tensile strength, flexural strength and break elongation. For the resistivity and dielectric constant tests, Standard Test Methods ASTM D257 and ASTM D150 shall be utilized.

3.6.1.3 +VE, -VE HEADER CABLE

+ve header and -ve header cables shall be 95mm2, stranded Aluminium conductor, single core, Aluminium wire armoured, PVC insulated and PVC sheathed 1100V grade cable.

3.6.1.4 DRAINAGE CABLE

Drainage cables shall be 50mm2, stranded Copper conductor, single core, Aluminium wire armoured, PVC insulated and sheathed 1100V grade cable.

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3.6.1.5 POWER SUPPLY CABLE (Between PDB & T/R Unit)

Power supply cable between Power source or CP System DB and T/R unit shall be 25mm2, stranded Aluminium conductor, 3-core, Aluminium wire armoured, PVC insulated and sheathed1100V grade cable.

3.6.1.6 POWER SUPPLY CABLE (between Power Source & PDB).

Power supply cable between Power source & CP System DB shall be 300mm2 /50mm2, stranded Aluminium conductor, 4-core, Aluminium wire armoured, PVC insulated & sheathed 1100 V grade cable.

3.6.1.7 EARTHING CABLE

Earthing cable shall be 35mm2 , stranded Aluminium conductor, 1-core unarmoured, PVCinsulated and sheathed 1100V grade cable.

3.6.1.8 REFERENCE CELL / MEASUREMENT CABLE TO CJB.

Instrumentation cable, 4mm2, 1-core, stranded copper conductor, PE/PVC insulated and PVC sheathed, screened and armoured cable, PE/PVC insulation of each core shall be Numbered or colour coded for easy identification of each core.

3.6.1.9 REFERENCE CELL / MEASUREMENT CABLE BETWEEN CJB TO MJB & MJB TO TRU

Instrumentation cable, 2.5mm2, 10-core, stranded copper conductor, PE/PVC insulated and PVC sheathed, screened and armoured cable, PE/PVC insulation of each core shall be Numbered or colour coded for easy identification of each core.

3.6.1.14 CABLE DRUMS

All cables to be supplied in wooden drums. Cable lengths in each cable drum shall be 600m (min.)wherever cable lengths are more than 600m

3.6.1.15 INSPECTION

All cables along with manufacturer's test certificate as per IS/IEC/NEC standards shall be inspected by OWNER/PMC at the vendor's shop before dispatch. Minimum 15 days advance notice to be furnished by vendor for this purpose. In case of any doubt OWNER/PMC may insist vendor to conduct the tests as per IS/IEC/NEC standards in presence of OWNER/ PMC at vendor’s work shop or some third party reputed laboratory approved by OWNER/ PMC at no

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extra cost.

3.6.1.16 CABLE IDENTIFICATION

For easy identification of cable, the over sheath of the cable should have yellow colour and "CP SYSTEM CABLES" should be printed using black colour at one meter interval throughout the length of the cable.

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3.7 JOB SPECIFICATION FOR CALCINED PETROLEUM COKE BREEZE FOR CP SYSTEM

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3.7 SPECIFICATION FOR CALCINED PETROLEUM COKE BREEZE

Calcined Petroleum Coke Breeze shall conform to the following specifications as per latest NACE- SP 0572 std .

A	Chemical Composition:	
	Moisture (on Dry Basis)	< 0.1 (% by mass)
	Fixed Carbon	Minimum 99.0 (% by mass)
B	Bulk density	800 Kg/m3 to 1200 Kg/m3
C	Real density	2.03 gm/cc
D	Particle Size	1.00mm (max.), Dust free
E	Resistivity	0.1 ohm-cm. at 150 PSI.

3.7.1 Test Certificates

Test Certificate shall be furnished for the following:

1. Make of coke breeze
2. Batch no.
3. Chemical composition
4. Bulk density and Real density
5. Particle size analysis
6. Resistivity(ohm-Cm.) at 150 psi compaction

Any delivery effected without prior approval of test certificate by PMC/ OWNER will be at suppliers risk & cost.

Above mentioned specification for coke breeze shall be considered for MMO tubular anodes incase required for supplementary design, the coke breeze to be considered for MMO wire anode may be of make as per the anode manufacturer's choice meeting the requirements of the specifications mentioned above.

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3.8 MATERIALS/ EQUIPMENTS FOR OPERATION AND MAINTENANCE OF CP SYSTEM

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3.8 Materials/ Equipment for Operation and Maintenance of CP System

Following materials/ equipment shall be supplied by the CP System sub-contractor for operation and maintenance of CP system.

Sl .No.	Quantity	Description
1.0	2 Nos.	Digital Multimeter having minimum input resistance 10 Mohm, complete with leads and leather case
2.0	8 Nos.	Reference electrodes: Portable Copper/ Copper sulphate type having PVC SCH 40 body with transparent window and threaded ceramic porous plug suitable for 15-40 deg.C temperature application in sand.
3.0	1 No.	DC Clip on Ammeter having current range 0-10A, 0-20A, 0-50A, 0-100A

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3.9 CORROSION PROTECTION FOR PDB, CABLE MARKERS AND JUNCTION BOXES SUPPORT STRUCTURES

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3.9.1 Corrosion Protection for PDB, Cable markers and junction Boxes support structures

All PDB and their support structures, MS channels for T/R mounting if any, cable marker Posts shall be galvanized & painted in following manner.

i) Surface preparation

Grit/shot Blasted to SA2 1/2 as per swedish standard SIS 055900

ii) Galvanizing

Hot dip or spray galvanized to achieve a minimum zinc thickness of 150µm.

iii) Primer Application

Etch Primer with 10 µ DFT based on Polyvinyl Butyral resin + 1 coat of epoxy zinc phosphate primer @40 µ DFT/coat

iv) Paint Application

1 Coat of 2 Pack high build epoxy with Polyamide hardener cure @100 µ DFT/coat followed by 1 Top coat of Acrylic Polyurethane finish paint @40 µ DFT/coat.

Primer & Paint application procedure shall be standard airless spray and as per paint manufacturer's procedure. Name of Paint manufacturer and product should be approved by PMC prior to application. Colour of top coat shall be yellow or grey as per choice of PMC/ OWNER.

3.9.1.1 MS covers for shallow vertical Beds shall be painted with 2 coats of synthetic enamel paint of Asian Paint/ Berger or equivalent make. Colour of paint shall be yellow.

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3.10 SPECIFICATION FOR SOIL RESISTIVITY TEST

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1.0 SCOPE

The scope of this standard is to conduct the following tests within a plant complex:

- Soil resistivity up to pile depth to be measured in situ using Wenner's 4-pin method in offsite/ unit areas.

2.0 OBJECTIVE

The objective of the tests given by Para 1.0 is to assess the corrosiveness of the soil & to decide suitable locations for anode beds for CP System for prevention of external corrosion of underground metallic structure and piping within a plant complex.

3.0 SOIL RESISTIVITY TEST

In general soil resistivity tests covered by this specification shall unless otherwise specified, be in line with the requirements of BS CP 1021. Wherever the requirements in this specification are in conflict with the above standard, the requirements under this specification shall be binding.

3.1 SOIL RESISTIVITY TEST BY WENNER 4-PIN METHOD

Soil resistivity by Wenner 4-Pin method to be conducted at 4 anode bed locations as per instructions of PMC, at each location soil resistivity readings to be taken for 2m, 4m, 6m, 10m, 15m , 20m 25m and 30m depth for distributed anode beds.

$$\rho = 2\pi AR$$

where,

ρ	=	Soil resistivity in ohm-cm
A	=	Inter electrode spacing in cm
R	=	Resistance observed from soil resistivity meter in ohm.

While inserting electrodes in soil for taking soil resistivity care should be taken to make good contact of electrodes with the soil, for this purpose limited watering may be required at the electrode penetration points wherever soil is dry or less compact. The depth of penetration of electrodes should not exceed 1/10th of the electrode spacing.

3.2 CALIBRATION OF SOIL RESISTIVITY METER

Soil resistivity meter should be calibrated at a reputed laboratory before use. The calibration certificate must be furnished to ENGINEER-IN-CHARGE for approval of the meter before use of the same for soil resistivity test at site.

4.0 REPORT PREPARATION

All soil resistivity readings shall be typed and presented in a tabular form giving co-ordinates and other location reference of each test locations & depth of each reading. The soil resistivity is to be expressed in ohm-cm.Six copies each of soil resistivity report to be furnished to OWNER/ PMC for record.

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4.0 MANDATORY SPARES FOR CATHODIC PROTECTION SYSTEM

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4.1.0 The Bidder shall supply the following spares for each T/R unit:

-	D.C.Voltmeter	Nos.	1
-	D.C.Ameter	Nos.	1
-	A.C.Voltmeter	Nos.	1
-	A.C.Ammeter	Nos.	1
-	Diodes	Nos.	2
-	SCR's	Nos.	2
-	D.C.Fusesforoutputside	Nos.	5
-	HRCfuseforDiodes	Nos.	5
-	A.C.fusesforinputside	Nos.	5
-	D.C.Lighteningarrestor	Nos.	2
-	A.C.Circuitbreaker(MCB)	Nos.	2
-	ElectronicControlCardseachtype	Nos.	2
-	Filtercircuitcapacitor	Nos.	2
-	Signallightassemblyforannunciation	Nos.	2
-	R.C.SurgeDiverter	Nos.	2
-	Controltransformer	Nos.	2
-	Coarsevoltagecontrolswitch	Nos.	2
-	Coarsecurrentcontrolswitch	Nos.	2
-	Finevoltagecontrolswitch	Nos.	2
-	Finecurrentcontrolswitch	Nos.	2
-	AutoManualModeselectorswitch	Nos.	2
-	Toggleswitches	Nos.	2
-	AssortedGlasscartridgefuses	set.	15

-

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CENTRAL MONITORING & CONTROL SYSTEM (RMC)

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1.0 SYSTEM OVERVIEW

Computerized Central monitoring and Control is required for the CP System. For this purpose, the T/R unit &permanent reference cells located in the protection zone should be connected to field based RTU/ PLC units consisting of Microcontroller based CPS controller with alpha-numeric LCD display, memory, real time clock, keypad, battery backup and communication ports or an equivalent PLC-SCADA system.

The Field RTU/PLC units for TR Unit will acquire the analogue and digital parameters for CP data from the T/R units & Reference Cells as specified and communicate the same to Central Monitoring Panel (CMP) located in the control room in real time through RS485 over Cu/Fibre Optics network to be supplied and installed by CP System contactor. The data logging interval will be settable by the user as required through the Central Monitoring Panel (CMP). The Field RTU/ PLC units shall communicate the CP parameter to Central control room. In the event of any alarm, the Field RTU/PLC units shall instantly notify the user for the occurrence of alarm .

The field RTU/ PLC units will have capability to control the T/R unit Voltage/ Current/ & Current interruption by means of commands from the Central Monitoring Panel(CMP). The operator will be in a position to set all the parameters of T/R unit like DC Voltage, DC current, level & T/R unit current interruption timings/ schedules from the Central Monitoring Panel (CMP).

The Central Monitoring panel will have a PC with suitable software to monitor and control all the above mentioned operations in real time. The software will be specially developed and customized for CP system. The software will store all the data in standard database like MS SQL and will have facility for generation of various reports, graphs as desired. The complete system will be modular in nature and will be robust in design to ensure maximum uptime and reliability. The software will be user friendly and easy to use.

2.0 Field RTU/PLC UNITS

2.1 RTU/ PLC units to be considered for TR Unit monitoring and control:

RTU/ PLC units to be considered for TR Unit monitoring and control shall be capable of acquiring and processing the following signals from each TR unit:

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- Analog input signals from T/R unit, namely TR DC output voltage, TR DC output current, AC input Voltage and Pipe to Soil Potential for permanent reference cells located in the influence zone, through proper signal conversion and conditioning.

All the RTU/ PLC should also have inbuilt mechanisms to reduce / nullify induced AC interference voltages.

All the RTU/ PLC units to be considered for TR Unit monitoring and control shall have following facility:

- **Digital input signal Facility for sensing and generation of following alarms to each TR Unit**
  - TR Unit AC supply Fail
  - Over Protection
  - Under Protection
  - T/R unit Reference Fail

- **Digital Output signal Facility for T/R unit ON/OFF**

The RTU/PLC Unit will provide 1 No. digital output for switching operation of each TR Unit. This output shall be used to turn the rectifier OFF and ON for depolarised and instant "OFF" potential readings. The TR Unit shall have in-built facility to accept these signals and interrupt its output supply.

- **Analog Output signal Facility for T/R unit Control**

RTU/ PLC shall also provide analogue output that can be used for controlling the various modes of each TR unit for remote control through Central Station. The analog output should be with proper signal conditioning and isolation.

Thus RTU/ PLC system to be considered for monitoring and controls of TR Unit shall have minimum facility for 8 analogue inputs, 4 Digital Alarm inputs, 1 digital output and additional analogue control outputs as required for each T/R unit and adequate spare analogue & digital input/ output signal channels.

Either single RTU/ PLC system common for all TR Unit located under the common shed or each TR Unit along with their built-in RTU/ PLC within the TR Unit enclosure shall be considered.

The system shall have facility for GPS based Time synchronization for all the field RTU/ PLC units for current interruption and measurement of true instant OFF potential.The RTU/ PLC should be

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capable of generating alarms instantly when the parameter limits are violated and it should reflect on the Alarm page of the Central Monitoring Software.

2.2 Communication between field RTU/ PLC units & central control room:

All CP System parameters shall be monitored and controlled from central control room using suitable software. The communication link between the field RTU/PLC and Central monitoring and Control station should be through twisted pair copper wire RS485 or RS485 over Fibre Optics network to be supplied and installed by CP System contactor.

RS485 network cable, 1.0mm2, 2-Pair, each pair twisted and Laid, Numbered or colour coded, solid copper conductor, PE/PC insulated and sheathed, provided with polyester tape over it, screened with Poly Aluminium tape of 0.3mm and armoured with one layer of GI wire cable, to be laid between RTU & FO Junction box located at each TRU shed as well as between Master Computer & FO Junction box located at Central Control room. Fibre Optic Cable, 6 Core, single mode, for Central Monitoring system to be laid between the FO Junction box located at each TRU shed and the FO Junction box located at Central Control room

CP System Contractor should design, procure and install the requisite communication system and the connecting cables required for this purpose.

3.0 CENTRAL MONITORING PANEL (CMP)

Central Monitoring Panel (CMP) will be located in the control room. This panel will acquire data from all the field based RTUs in real time and process the same to display the results in Tabular & Graphical form.

The Central Monitoring Panel (CMP) shall have Data Acquisition and Control software operating in Real Time on a PC having minimum specification mentioned elsewhere in this specification. The Central Monitoring Panel will communicate with the field RTU/ PLC through RS485 over twisted pair copper wire or RS485 over Fibre Optics network.

A Server PC will be provided in the Central Monitoring Panel and will be responsible for managing the entire communication traffic between the CMP and field RTU/ PLC.

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4.0 TECHNICAL SPECIFICATIONS

4.1. CENTRAL MONITORING PANEL (CMP)

The Central Monitoring Panel (CMP) will be located in the control room. This panel will acquire data from all the field based RTUs in real time and process the same to display the results in Tabular & Graphical form. This panel will consist of a a Server PC running on Windows 10

The PC in the Central Monitoring Panel shall have the specially developed Data Acquisition and Control software operating in Real Time. This PC will communicate with the field RTU/ PLC in real time through RS485 over twisted pair copper or Fibre Optics network. The operator will be able to review and control all the field parameters by using the software in this PC.

The Server in the Central Monitoring Panel will be responsible for managing the entire communication traffic between the PC and field RTU/ PLC. The Serverwill accept the data from field RTU/ PLC through RS485 over twisted pair copper or Fibre Optics network and transmit the same to PC in appropriate format for further processing & storage.

4.2. CENTRAL MONITORING PC SPECIFICATIONS

Central monitoring and Control station computer to be provided by the contractor shall consist of standalone computer suitable for CP monitoring application with following minimum specifications:

- Intel i7 processor (latest generation)
- Genuine Windows 10 operating system with License
- 16GB DDR3 RAM
- 512 GB SSD
- 24in Flat Panel LCD Color Monitor
- CD Rom
- Intel Integrated 10/ 100 Ethernet Network Card
- 1 Serial, 1 Parallel, 4 USB Ports
- MS SQL Database Latest
- A3 Laser jet printer (HP make)
- Inbuilt UPS system which can operate up to 30 minutes on full load in case of power failure

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- Other standard accessories

4.3 CENTRAL MONITORING SOFTWARE:

The Remote Monitoring and Control System shall monitor and control all process parameters of Cathodic Protection system. The Monitoring software shall be user friendly, Windows 10 compatible. The Software shall have built-in graphic package to display graphical representation of the process on-screen with embedded buttons for switching ON/ OFF TR units and facility for setting of various T/R unit parameters like Voltage, & Current. The operator should be able to set the periodic logging interval for fetching the field data. It should have provisions to accommodate future need of addition of new TR Units as may be required from time to time.

The monitoring software should be capable of generating E-mails for Alarm Reports . It should suitable generate tabular reports. The software shall allow configuration of E-mail address of the OWNERS employees who are responsible for maintenance and in the event of any malfunctioning of the CP system, the software shall send an E-mail to the concerned person to enable him to take the corrective action to ensure that system is restored to normal at the earliest. Utility software should be provided for Calibration / Scaling of Analog Input Channels.

4.3.1 Data Base:

The RMCP Software should use MS SQL Database. The Version of SQL shall be SQL 2005 or above

4.3.2 Data Presentation

It should be possible to view all the field data in Tabular & graphical format with automatic color changes for any data outside the defined limits. It should be possible to define the pages as per the area/ zone and also to have a common overview of the entire system data.

4.4 REMOTE TERMINAL UNIT (RTU) / PLC DATA-SHEET:

Sl No	Parameter	Specifications
1	Model	As per manufacturer
2	Local display & Local Keypad	The RTU shall consist of a 3 x 6 matrix membrane keypad and a 16 x 2 LCD Display with back-lighting for entering local settings and viewing TR parameters locally. Following Local settings can be done using the Key Pad &

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		Display : Setting Date/ Time Select Channels to be displayed as individuals or in Scroll mode. Setting Field ID. The LCD will normally display • TR Voltage • TR Current • Reference Potential • AC supply Voltage The **RTU/ PLC** should be able to be remotely configured for most of the above parameters with Utility Software to be run from the central station. The data logger shall consist of a 3 x 6 matrix membrane keypad and a 16 x 2 LCD Display with back-lighting for entering local settings and viewing TR parameters locally.
3	Programmable Periodic Interval	The TRU Data should be stored in SQL Database. The Logging frequency should be programmable from 1 reading per five minutes to 1 reading per day, through the central monitoring Software.
4	CPU	High Performance ARM Based Microcontroller Built-in Real Time Clock (+/- 1 minute accuracy over one month)
5	Local Memory	The RTU shall store all the calibration parameters in an EEprom Memory. It should also be able to store TR unit's parameters @ 1 reading / hour which could be downloaded by the utility SW. The locally stored data should be retained for upto10 years without external power to RTU/PLC. It will be possible to download the locally stored RTU data on a field Laptop reader through the local communication port in the RTU/ PLC whenever desired.
6	Analog Inputs for each TR Unit (11 T/R Unit parameters viz • DC Voltage • DC Current • Ref. Cell Potential (8 No.) • AC supply Voltage	Fully differential Inputs, 16-bit resolution Should nullify the effect of AC interferences. High accuracy, High Impedance, with high common mode rejection ratio CMRR. CH-1: 0 – 100V DC (For DC Output Voltage) (impedence: 100K ohms) CH-2: 0 - 100mV DC (For DC Output Current through T/R shunt) (impedence : 10 K ohms)

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		CH-3 to 10: -5.0V to +5.0 V DC (For 5 No. Reference potential)(Impedence: 10 M ohms) CH-11: 0 - 300V AC (For AC supply Voltage Monitoring. Internal Channel) (Impedence : 10 K ohms)
7	Digital Inputs for Alarm generation. As required by design	Local LED indication. shall also continuously scan and check for Alarm conditions listed below ○ TR Unit AC supply Fail ○ Over Protection ○ Under Protection ○ T/R unit Reference Fail Each Digital Channel should be Isolated.
8	Analog Control Outputs for T/R unit control As required by design	4-20mA / 0-4VDC / 0-10 VDC with isolation of 2500Vrms. Resolution – 12 Bit
9	Digital Output – 1 No. For T/R unit Current Interruption	5V DC operated SSR outputs relay 2500 V RMS optical Isolation. Contact rating 2A@ 240 V AC/ 1A @200 V DC On / off delay times 3 msec. Local LED status
10	Communication	Through RS485 over twisted pair copper wire or Fibre Optics network for transmistting data and alarm to the Central monitoring PC.
11	GPS Interface	Each RTU/ PLC will have built-in GPS module to synchronise the RTC to GPS time. This will ensure uniform real time for all the RTU/ PLCs.
12	Power Supply	230V ± 20%AC, 50 Hz • 20V to 70V DC • 12 VDC
13	Battery Backup	Battery Back-up for up to 2 Hrs of operation for notifying AC power failure.
14	Communication Ports	As required by design
15	Protection	Short Circuit Protection Surge Protection using MOV. Over Voltage protection EMI / EMC protection
16	Enclosure	ABS / M.S. With IP 55 degree of protection
17	Mounting	Preferably inside TR Unit if not possible then Wall / Pole

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		mounting
18	Operating Temperature range	0 to 55 deg C
19	Humidity	95% condensing
20	Time Stamping	The RTU/ PLC shall have precise, accurate Real Time Clock (**RTC**) for exact time stamping of data.
21	Enclosure	The RTU/ PLC shall be housed in a compact & sturdy non corroding enclosure suitable for installation inside the shed common for all TR units Mounting : Either mounting inside each TR unit or common for all TR unit located under a single shed with Plinth mounting arrangement. Cable Entry : From Bottom
22	Serial Port	The RTU/ PLC Unit shall have RS485 port through which the logged data can be downloaded onto the laptop.
23	Centralised Monitoring	The RTU shall scan all the TR parameters and will communicate over RS485 network to the Central Monitoring Server PC. The Central Monitoring Server will acquire this Data, Store it in SQL Database at the set Logging interval and will also display this data in the Summary Screen. The Central monitoring software will also display the Alarms generated with exact Date and time Stamp on the Alarm Summary Page. Setting Date/Time, Setting/ changing Periodic Interval, Calibration and scaling of input channels can be done remotely using the utility software. PC Software should be able to Monitor and receive data from up to 50 field RTU/PLC at a time.
24	Compliance	Relevant BIS/ IEC EMI/ EMC standards (The Data Logger shall be complying to IEC – 60068-2-1 / IEC – 60068-2-2 /IEC – 60068-2-30 / IEC – 60068-2-78)

4.5 Reports

The software should generate reports, which can be viewed as well as printed as listed below:

- A daily/ monthly report showing readings from every system. The reports shall highlight readings outside defined limits
- A report for each single parameter of remote monitoring. This shall be used to show the trend of this parameter over the chosen time range.
- Alarm Reports: This particular report shall give all information about the alarms, which occurred in any abnormal conditions.

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- Report can be exported to PDF and Excel Formats..
- All above reports of different type should be available in graphical presentation, on screen and printer.

4.6 Audit Trail

It should be possible to have audit trail of each and every activity/ Task performed from the central PC onto the field RTU/ PLC. The Audit trail should be generated on the basis of individual user as well as general.

The Audit report should be generated and the same should be exported to MS EXCEL. Start and stop of the Central Monitoring System application should also be logged into the Audit report.

4.7 Admin and User Rights

It should be possible to generate multiple users with individual Login name and password for individual user by the administrator. It should be possible to assign different system operational rights to individual user.

5.0 Suppliers Experience & Expertise in C.P.

The software and hardware for the proposed RMC system shall have a proven track record and successful operation in the field of CP monitoring and shall be procured from the established CP unit suppliers/ Reputed PLC manufacturers.

6.0 DESIGN REVIEW:

Contractor should prepare detailed engineering package for central monitoring and control system along with schematic drawings and equipment/ materials list including make/model of the same and get the same approved by PMC/ OWNER before procurement/execution.

7.0 INSPECTION

The prototype inspection along with simulation tests shall be done at specialist agency's office / workshop by PMC/ OWNER before the dispatch of the equipment and materials at site. For this purpose contractor should furnish notice to PMC/ OWNER minimum 15 days before the date of inspection.

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SPECIFICATION FOR QUALITY MANAGEMENT SYSTEM REQUIREMENTS FROM BIDDERS / SUPPLIERS / CONTRACTORS

Rev. No.	Date	Purpose	Prepared by	Checked by	Approved by: Standards Committee Convener	Approved by: Standards Bureau Chairman
3	29-09-2025	General Revision	QMS Standards Committee	QMS Standards Committee	AK	MN
2	12-06-2020	General Revision	QMS Standards Committee	QMS Standards Committee	SKB	SKS
1	12-03-2015	General Revision	QMS Standards Committee	QMS Standards Committee	MPJ	SC
0	04-06-2009	Issued as Standard Specification	QMS Standards Committee	QMS Standards Committee	SCT	ND

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Abbreviations:

EIL	Engineers India Limited
ISO	International Organization for Standardization
MR	Material Requisition
PO	Purchase Order
PR	Purchase Requisition
QMS	Quality Management System

QMS Standards Committee

Convener: Mr. Anil Kumar

Members: Mr. Himangshu Pal (SCM-Inspection)
Mr. Ravindra Kumar (Const.)
Mr. Vinod Kumar (CQA)
Mr. Swapnil Vaishnav (Projects)
Mr.Vijay Kumar Garg (SCM)
Mr.Raju Kumar Pandey (Equipment Division)

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1.0 SCOPE

This specification establishes the Quality Management System requirements to be met by BIDDER for following purpose:

- QMS requirements to be met by suppliers/contractors after award of work/duringcontract execution.

2.0 DEFINITIONS

2.1 Bidder

For the purpose of this specification, the word "BIDDER" means the person(s), firm, company or organization who is under the process of being contracted by EIL / Owner for delivery of some products (including service).The word "Bidder" is considered synonymous to supplier, contractor or vendor.

2.2 Project Quality Plan (PQP)

Document tailored from Standard Quality Management System Manual of BIDDER, specifying how the quality requirements of the project will be met.

2.3 Owner

Owner means the owner of the project for which services / products are being purchased and includes their representatives, successors and assignees.

3.0 REFERENCE DOCUMENTS

- Specification for Documentation Requirements from Contractors (Doc. No. 6-78-0002)
- Specification for Documentation Requirements from Suppliers (Doc. No. 6-78-0003)

4.0 QUALITY MANAGEMENT SYSTEM – GENERAL

Unless otherwise agreed with EIL / Owner, the BIDDER proposed quality system shall fully satisfy all relevant requirements of ISO 9001 "Quality Management Systems – Requirements."Evidence of compliance shall be current certificate of quality system registration to ISO 9001 or a recent compliance audit recommending registration from a certification agency.The quality system shall provide the planned and systematic control of all quality related activities for execution of contract.Implementation of the system shall be in accordance with BIDDER'S Quality Manual and PROJECT specific Quality Plan.

5.0 QUALITY SYSTEM REQUIREMENTS

5.1 BIDDER shall prepare and submit for review / record, Project Quality Plan / Quality Assurance Plan for contracted scope / job.The BIDDER'S Quality Plan shall address all of the applicable elements of ISO 9001, identify responsible parties within BIDDER'S organization, for the implementation / control of each area, reference the applicable procedures used to control / assure each area, and verify the documents produced for each area.The Project Quality Plan shall necessarily define control or make reference to the relevant procedures, for design and engineering, purchase, documentation, record control, bid evaluation, inspection, production/manufacturing, preservation, packaging and storage, quality control at construction site, pre-commissioning, commissioning and handing over (as applicable) in line with contract requirement and scope of work.

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5.2 BIDDER shall identify all specified or implied statutory and regulatory requirements and communicate the same to all concerned in his organization and his sub contractor's organization for compliance.

5.3 BIDDER shall deploy competent and trained personnel for various activities for fulfilment of PO / contract.BIDDER shall arrange adequate infrastructure and work environment to ensure that the specification and quality of the deliverable are maintained.

5.4 BIDDER shall do the quality planning for all activities involved in delivery of order.The quality planning shall cover as minimum the following:

- Resources
- Product / deliverable characteristics to be controlled.
- Process characteristics to ensure the identified product characteristics are realized
- Identification of any measurement requirements, acceptance criteria
- Records to be generated
- Need for any documented procedure

The quality planning shall result into the quality assurance plan, inspection and test plans (ITPs) and job procedures for the project activities in the scope of bidder. These documents shall be submitted to EIL/Owner for review/approval, before commencement of work.

5.5 Requirements for sub-ordering of outsourced items /sub-contracting / purchasing of services specified in MR/ contract / tender shall be adhered to. In general all outsourced items will be from approved vendors of EIL. Wherever requirements are not specified, or approved sub vendors do not exist, the sub-contractor shall establish and maintain a system for purchasing / sub-contracting to ensure that purchased product / service conforms to specified requirements in concurrence with EIL / Owner.Criteria for selection of sub-contractor, evaluation, re-evaluation, maintenance of purchasing data and verification of purchased product (sub-contractor services), constitute important components of this requirement.

5.6 BIDDER shall plan and carry production and service provision under controlled conditions.Controlled conditions shall include, as applicable

a) the availability of information that describes the characteristics of the product
b) the availability of work instructions
c) the use of suitable equipment
d) the availability and use of monitoring and measuring devices
e) the implementation of monitoring and measurement
f) the implementation of release, delivery and post-delivery activities

5.7 BIDDER shall validate any processes for production and service provision where resulting output cannot be verified by subsequent monitoring and measurement. This includes any process where deficiencies become apparent only after the product is in use or service has been delivered.

5.8 BIDDER shall establish a system for identification and traceability of product / deliverable throughout product realization.Product status with respect to inspection and testing requirements shall be identified.

5.9 BIDDER shall identify, verify, protect and safeguard EIL / Owner property (material / document) provided for use or incorporation into the product.If any Owner / EIL property is lost, damaged or otherwise found to be unsuitable for use, this shall be reported to the EIL / Owner.

Signature Not Verified
Digitally signed by MD MAZHER ALI
Date: 2026.05.14 16:20:55 IST
Location: eProcure-EPROC

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