400 kV DC TOWER

(M/s. KEC Design)

Weight of Tower (in kg)

Type of Tower	Base Width M x M	Fabricated Steel members			Stub & Cleat		Bolts & Nuts (in kg)
		HT	MS	Total	HT	MS	
DA Normal	10.6 x 8.0	3236	5614	8850	253		419
+3M Extn	11.6 x 8.6	328	957	1285			51
+6M Extn	12.5 x 9.2	807	1908	2715			93
DB Normal	14.0 x 14.0	6190	8972	15162	452		509
+3M Extn	15.3 x 15.3	506	2314	2820			95
+6M Extn	16.5 x 16.5	751	3200	3951			100
DC Normal	16.0 x 16.0	6933	9930	16863	467		505
+3M Extn	17.5 x 17.5	485	2917	3402			105
+6M Extn	19.0 x 19.0	833	3772	4605			115
DD Normal	16.7 x 16.7	7760	11572	19332	660		614
+3M Extn	18.2 x 18.2	615	3070	3685			99
+6M Extn	19.7 x 19.7	1193	3848	5041			109
+9M Extn	21.3 x 21.3	1670	5205	6875			164
+12M Extn	22.8 x 22.8	2736	9926	12662	797		314
+18M Extn	25.9 x 25.9	5461	13921	19382			565
+25M Extn	29.0 x 29.0	10120	24071	34191			891

Note:

1. The towers are designed for
   a) Normal Span : 400 m
   b) Conductor : Twin ACSR Moose
2. These towers are used for 400 kV DC BTPS - Hiriyur line

400 kV DC TOWER

(M/s. DCIL Design)

Weight of Tower (in kg)

Type of Tower	Fabricated Steel members			Stub & Cleat		Bolts & Nuts (in kg)
	HT	MS	Total	HT	MS	
DA Normal	6694	8102	14796	410		579
+3M Extn	348	1688	2036			70
+6M Extn	647	2495	3142			88
+9M Extn	995	3284	4279			110
DB Normal	12079	12879	24958	809		763
+3M Extn	728	2958	3686			97
+6M Extn	1360	4018	5378			129
+9M Extn	2110	5260	7370			193
DC Normal	13742	13563	27305	931		817.9
+3M Extn	825	3538	4363			93
+6M Extn	1513	4651	6164			130
+9M Extn	2362	5934	8296			199
DD Normal	16198	16114	32312	1375		950
+3M Extn	1215	3976	5191			116
+6M Extn	2238	5171	7409			159
+9M Extn	3484	6564	10048			229
+18M Extn	7041	13421	20462			494
+25M Extn	9870	23960	33830			758

Note:

1. The towers are designed for
   a) Normal Span : 400 m

b) Conductor : Quad Moose ACSR

2. These towers are used for 400 kV DC Nandikur - Shanthigram line

Bill of Materials for 400 kV DC Towers suitable for Quad Moose Conductor

(M/s. KEC Design)

Type of Tower		Base width (in mm)	Tower weight (in kg)		Bolts, Nuts & Washers (in kg)	Stub weight (in kg)		Bolts, Nuts & Washers (in kg)
			HT	MS		HT	MS	
DA	BTB	10450.00	6660.04	5490.24	594.50	421.72	8.16	10.72
	0 ME	12457.22	720.81	1275.15	90.53			
	3 ME	13460.83	1147.35	1965.11	110.34			
	6 ME	14464.44	739.37	2090.97	89.81			
	9 ME	15468.05	970.96	3215.81	144.66			
DB	BTB	13200.00	16363.12	4608.00	751.99	849.20	8.20	14.46
	0 ME	16360.00	2393.00	1293.00	137.80			
	3 ME	17852.92	3793.50	1604.90	185.60			
	6 ME	19345.83	2476.96	3007.29	141.08			
	9 ME	20838.74	3494.81	3662.90	193.36			
DC	BTB	13450.00	19220.41	4358.28	782.59	939.44	8.17	17.03
	0 ME	16670.00	2893.16	1110.68	111.31			
	3 ME	18191.76	3828.37	2144.03	166.36			
	6 ME	19712.52	2972.35	3608.75	169.30			
	9 ME	21233.78	4558.31	3656.09	185.39			
DD	BTB	13084.00	21496.95	4237.54	870.77	1411.44	8.17	21.18
	0 ME	16825.10	4344.08	1061.01	132.92			
	3 ME	18352.08	5670.22	1908.80	197.92			
	6 ME	19879.06	5176.25	1657.90	153.86			
	9 ME	21406.04	7547.15	1675.83	220.13			
	18 ME	30000	18867.88	4189.58	550.33	1800.00	8.17	30.00
	25 ME	33000	37735.75	8379.15	1100.65			

Bill of Materials for 400 kV DC Towers suitable for Quad Moose Conductor

(YTPS - BPS Line - M/s. L & T Design)

Type of Tower		Base width (in mm)	Tower weight (in kg)		Bolts, Nuts & Washers (in kg)	Stub weight (in kg)		Bolts, Nuts & Washers (in kg)
			HT	MS		HT	MS	
DA	BTB		6502.31	4770.70	474.05			
	0 ME		824.74	1966.35	102.05			
	3 ME		1218.67	2493.42	138.90	386.02	0.00	9.41
	6 ME		674.82	1971.57	87.33			
	9 ME		1001.92	2647.98	129.63			
DB	BTB		13029.46	5387.11	830.63			
	0 ME		1800.61	3243.42	142.08			
	3 ME		2482.29	4386.84	183.09	824.09	0.00	15.01
	6 ME		1515.63	3362.25	127.85			
	9 ME		2116.24	4493.42	162.65			
DC	BTB		13198.25	7276.20	891.99			
	0 ME		2388.69	3131.32	155.52			
	3 ME		2857.50	4703.03	195.72	955.23	0.00	15.26
	6 ME		1573.03	3835.77	139.63			
	9 ME		2431.98	5043.84	207.32			
DD	BTB		16747.67	6892.30	915.33			
	0 ME		3442.82	3423.99	213.96			
	3 ME		4025.04	5600.44	252.82	1273.65	0.00	19.18
	6 ME		2345.06	4463.33	179.97			

	9 ME		4615.34	4712.88	232.08			
	18 ME		8461.80	13024.15	520.83	1316.51	0.00	19.18
	25 ME		11023.06	18144.35	665.66			

Bill of Materials for 400 kV DC Towers suitable for Quad Moose Conductor

(YTPS - BPS Line - M/s. L & T Design)

Type of Tower		Base width (in mm)	Tower weight (in kg)		Bolts, Nuts & Washers (in kg)	Stub weight (in kg)		Bolts, Nuts & Washers (in kg)
			HT	MS		HT	MS	
MA	BTB		21145.59	8272.32	969.26	956.23	0.00	15.78
	0 ME		2503.89	3140.81	192.04			
	3 ME							
	6 ME		1757.29	2944.38	149.42			
	9 ME							
MB	BTB		44288.45	15003.76	2650.13	2396.13	0.00	74.17
	0 ME		4687.78	5430.94	374.76			
	3 ME							
	6 ME		4079.88	5748.40	280.92			
	9 ME							
MD	BTB		65662.25	17114.77	3517.22	3487.50	0.00	62.83
	0 ME		14076.22	2672.73	714.27			
	3 ME		17442.02	4190.48	727.93			
	6 ME		8309.04	4589.90	412.30			
	9 ME		12238.68	6021.66	634.14			

ABSTRACT OF TOWER WEIGHTS AND BASE WIDTHS

Sl. No.	Basic Tower Extn	220 kV 'A' Type SC is M/s. KEC make & 220 kV 'B' & 'D' Type are M/s. S.A.E Design			220 kV DC KEC Design			220 kV DC L&T Design			220 kV DC Kalpatharu Design		
		Base width (in m)	Tower weight with Stub (in MT)	B&N weight (in kg)	Base width (in m)	Tower weight with Stub (in MT)	B&N weight (in kg)	Base width (in m)	Tower weight with Stub (in MT)	B&N weight (in kg)	Base width (in m)	Tower weight with Stub (in MT)	B&N weight (in kg)
1	A+0M	4.150	2.630	140	5.100	3.707	150	5.690	4.150	170	5.95	3.422	152
2	A+3M	4.629	3.060	158	5.651	4.244	173	6.300	4.810	198	6.63	3.884	167
3	A+6M	5.109	3.649	185	6.202	4.731	190	6.967	5.350	220	7.31	4.283	175
4	B+0M							7.450	5.350	215	8.50	5.327	190
5	B+3M							8.390	6.700	259	9.58	6.252	218
6	B+6M							9.340	7.350	280	10.65	6.805	225
7	C+0M	6.800	3.600	165	6.750	6.089	247	8.300	6.000	240	9.90	6.060	218
8	C+3M	7.852	4.321	196	7.683	7.114	279	9.400	7.490	290	11.25	7.227	251
9	C+6M	8.904	4.940	221	8.616	7.677	285	10.500	8.220	315	12.57	8.133	265
10	D+0M	8.000	4.980	188	10.150	8.588	268	10.200	7.925	300	10.60	7.597	275
11	D+3M	9.206	6.062	229	11.694	10.137	320	11.600	9.905	356	12.07	9.031	314
12	D+6M	10.412	6.777	249	13.328	11.692	364	13.000	10.875	385	13.54	10.175	343

Note:

1 Weight of Stubs is included in Normal Tower weights only
2 At present 220 kV DC Kalpatharu design is being used
3 220 kV SC 'A' Type Tower is of M/s. KEC make

A Type : 0° - 2° Deviation
B Type : 2° - 15° Deviation
C Type : 15° - 30° Deviation
D Type : 30° - 60° Deviation & DE Condition

220 kV DC TOWER

(M/s. RPG Design)
Weight of Tower (in kg)

Type of Tower	Base Width M x M	Fabricated Steel members			Stub & Cleat		Bolts & Nuts (in kg)
		HT	MS	Total	HT	MS	
MA Normal	5.7 x 5.7		4090	4090		190	190
+3M Extn	6.4 x 6.4		635	635			30
+6M Extn	7.1 x 7.1		1115	1115			50
MB Normal	8.0 x 8.0		6340	6340		340	520
+3M Extn	9.0 x 9.0		1140	1140			50
+6M Extn	9.9 x 9.9		1980	1980			75
MC Normal	8.9 x 8.9	1190	5360	6550	260	50	680
+3M Extn	10.0 x 10.0	250	920	1170			80
+6M Extn	11.2 x 11.2	470	1520	1990			155
MD Normal	9.5 x 9.5	1940	5940	7880	345	100	770
+3M Extn	10.7 x 10.7	320	1200	1520			110
+6M Extn	12.0 x 12.0	615	1720	2335			160

Note:

1. The towers are designed for
   a) Normal Span : 320 m
   b) Conductor : AAAC MOOSE
2. These towers are used in 220 kV DC Narendra - Ambewadi line

220 kV DC NARROW BASED TOWER

(M/s. L & T Design adopted for NRS - Laggere Line)

Weight of Tower (in kg)

Sl. No.	Type of Tower	Type 'DA'		Type 'DB & 'DE'		
		Super Structure	Bolt & Nuts	Super Structure		Bolt & Nuts
		MS	MS	HT	MS	MS
1	Normal Tower	5814	272	4325	6351	404
2	+3M Extn only	678	30	849	526	55
3	+6M Extn only	-	-	1572	815	74
4	Stub	761	2	1271	100	2

220 kV DC NARROW BASED TOWER

(M/s. L&T Design)

Weight of Tower (in kg)

Type of Tower	Base Width M x M	Fabricated Steel members			Stub & Cleat		Bolts & Nuts (in kg)
		HT	MS	Total	HT	MS	
DA Normal	3.0 x 3.0	1590	2060	3650	270		254
+3M Extn	3.3 x 3.3	200	194	394			19
+6M Extn	3.6 x 3.6	396	396	792			36
+9M Extn	3.8 x 3.8	594	607	1201			52
DB Normal	3.5 x3.5	2684	2802	5486	498		328
+3M Extn	3.8 x 3.8	379	260	639			27
+6M Extn	4.1 x 4.1	707	546	1253			42
+9M Extn	4.4 x 4.4	1086	827	1913			70
DC Normal	3.8 x 3.8	4077	2080	6157	641		368

+3M Extn	4.1 x 4.1	559	225	784			41
+6M Extn	4.5 x 4.5	1025	568	1593			80
+9M Extn	4.8 x 4.8	1508	913	2421			118
DD Normal	3.9 x 3.9	5301	2643	7944	856		403
+3M Extn	4.3 x 4.3	836	220	1056			60
+6M Extn	4.6 x 4.6	1548	484	2032			90
+9M Extn	4.9 x 4.9	2129	843	2972			132

Note:

1. The towers are designed for
   a) Normal Span : 200 m
   b) Conductor : AAAC Moose (61/3.55)
2. These towers are used for 220 kV DC Narrow Based Hoody - HAL line

220 kV DC TOWER

M/s. L&T Design (Gadag - Bagalkot line)

Type of Tower		Base width (in mm)	Tower weight (in kg)			Stub weight (in kg)		Bolts, Nuts & Washers (in kg)
			HT	MS	Total	HT	MS	
DA	DA+0	5049.20	963	2958	3921	150		224
	3M Extn	5624.19	238	406	644			35
	6M Extn	6199.17	303	715	1018			43
	9M Extn	6774.16	626	1114	1740	170		84
	12M Extn	7349.14	711	1460	2171			100
	15M Extn	7924.13	818	1993	2811			121
	18M Extn	8499.12	1246	2281	3527			167
	24M Extn	9649.10	1426	3528	4954			214
DB	DB + 0	7557.79	2237	3427	5664	227		250
	3M Extn	8478.90	398	636	1034			55
	6M Extn	9400.00	546	1047	1593			78
	9M Extn	10321.11	990	1536	2526	275		115
	12M Extn	11242.21	1354	2337	3691			157
	15M Extn	12163.31	1593	2907	4500			180
	18M Extn	13084.43	1987	3708	5695			225
DC	DC+0	8002.32	2619	3614	6233	278		310
	3M Extn	8952.06	328	770	1098			51
	6M Extn	9901.80	500	1284	1784			84
	9M Extn	10851.54	800	1941	2741	310		95
	12M Extn	11801.28	1266	2745	4011			153
	15M Extn	12751.02	1657	3221	4878			190
	18M Extn	13700.76	2048	4003	6051			211
DD	DD	10064.31	3859	3152	7011	325		300
	3M Extn	11385.26	428	980	1408			63
	6M Extn	12706.20	710	1457	2167			85
	9M Extn	14027.14	1170	2090	3260	360		120
	12M Extn	15348.09	1781	3388	5169			188
	15M Extn	16669.03	2422	3780	6202			217
	18M Extn	17989.97	2791	4778	7569			270

Normal Span Length - 320 m for Drake ACSR

Used in 220 kV Gadag - Bagalkote line (M/s. L&T design)

220 kV MC TOWER (4 Circuits)

(M/s. K Ramachandra Rao Design)

Weight of Tower (in kg)

Type of Tower	Base Width M x M	Fabricated Steel members			Stub & Cleat			Bolts & Nuts (in kg)
		HT	MS	Total	HT	MS	Total	

MA Normal	6.0 x 6.0	2574	5716	8290	436	84	520	492
+3M Extn	6.6 x 6.6	371	311	682				44
+6M Extn	7.2 x 7.2	438	937	1375				56
MB Normal	9.0 x 9.0	3026	11660	14686	613	121	734	776
+3M Extn	10.0 x 10.0	470	1189	1659				98
+6M Extn	11.1 x 11.1	911	1919	2830				98
MD Normal	11.0 x 11.0	7478	18316	25794	1140	225	1365	772
+3M Extn	12.4 x 12.4	882	1546	2428				82
+6M Extn	13.9 x 13.9	1646	2895	4541				155

Note:

1. The towers are designed for
   a) Normal Span : 320 m
   b) Conductor : Drake ACSR
2. These towers are used for 220 kV MC Shimoga - Dugudimane line

220 kV DC Monopole

(M/s. Volmount - Jigani Line)

Monopole Type		Weight of the pole (in kg)	Embedded Foundation Details				
		HT Total	L	D	Excavation in m^3	Steel	RCC (M30)
P1 (0° - 10°)	P1+0M	8183	6.50	1.50	11.60	222	7.48
	P1+3M	9812	6.50	1.50	11.60	222	7.39
	P1+9M		7.30	1.50	13.03	246	7.58
P2 (11° - 30°)	P2+0M	9450	7.30	1.50	13.03	246	7.90
	P2+3M	10858	7.30	1.50	13.03	246	7.14
	P2+9M	14858	7.45	1.50	13.30	249	6.62
P3 (60° - 70°)	P3+0M P3+3M P3A+3M(90°)	17687	8.10 8.10	1.70 1.70	18.58 18.58	334 334	9.72 9.46
PS4/PS5 +0 DC Monopole with single sided cross arm	0M	20585					
PS6 +0 SC Monopole with single sided cross arm	0M	8069					

Design Span Length - 150 m
Conductor - Drake ACSR

220/110 kV MC TOWER

(M/s. L&T Design)

Weight of Tower (in kg)

Type of Tower	Base Width M x M	Fabricated Steel members			Stub & Cleat		Bolts & Nuts (in kg)
		HT	MS	Total	HT	MS	
MA Normal	7.5 x 7.5	1421	4203	5624	200	-	313
+3M Extn	8.3 x 8.3	167	589	756		-	31
+6M Extn	9.2 x 9.2	315	721	1036		-	40
MB Normal	9.3 x 9.3	3808	5421	9229	354	-	477
+3M Extn	10.3 x 10.3	284	810	1094		-	45
+6M Extn	11.3 x 11.3	527	1378	1905		-	74
MC Normal	10.2 x 10.2	3378	7331	10709	406	-	490
+3M Extn	11.3 x 11.3	331	927	1258		-	55
+6M Extn	12.5 x 12.5	622	1680	2302		-	88
MD Normal	11.5 x 11.5	4651	7658	12309	503	-	505

+3M Extn	12.7 x 12.7	408	1177	1585		-	62
+6M Extn	14.0 x 14.0	796	1830	2626		-	84
+9M Extn	15.3 x 15.3	750	2349	3099		-	101

Note:

1. These towers are designed for
   a) Normal Span : 320 m
   b) Conductor : 220 kV circuit : Drake ACSR
   110 kV Circuit : Lynx ACSR
2. These towers are used for 220/110 kV MC line from Khemar to Guruvayankere

220/110 kV MC TOWER (4 Circuits)

(M/s. L&T Design)

Weight of Tower (in kg)

Type of Tower	Base Width M x M	Fabricated Steel members			Stub & Cleat			Bolts & Nuts (in kg)
		HT	MS	Total	HT	MS	Total	
MA Normal	3.96 x 3.96	2007	4493	6500	0	0	0	391
+3M Extn	4.13 x 4.13	0	0	0	0	0	0	0
+6M Extn	4.23 x 4.23	672	911	1583	0	0	0	102
MB Normal	5.95 x 5.95	3625	4627	8252	689	0	689	440
+6M Extn	6.58 x 6.58	876	1312	2188	689	0	689	95
+9M Extn	6.89 x 6.89	1528	2003	3531	689	0	689	151
MC Normal	6.27 x 6.27	4503	8401	12904	0	0	0	579
+3M Extn	6.58 x 6.58	626	863	1489	0	0	0	72
+6M Extn	6.90 x 6.90	1157	1508	2665	0	0	0	112
MD Normal	7.20 x 7.20	6757	7809	14566	905	0	905	572
+3M Extn	7.57 x 7.57	972	914	1886	905	0	905	91
+6M Extn	7.94 x 7.94	0	0	0	0	0	0	0

Note:

1. The towers are designed for
   a) Normal Span : 320 m
   b) Conductor : 220 kV - Drake ACSR
   : 110 kV - Lynx ACSR
2. These towers are used for 220/110 kV MC VARAHI - KEMAR - KAVOOR Line

220 kV MC TOWER

(M/s. L&T Design)

Weight of Tower (in kg)

Type of Tower	Base Width MxM	Fabricated Steel members			Stub & Cleat			Bolts & Nuts (in kg)
		HT	MS	Total	HT	MS	Total	
MA Normal	3.335 x 3.335	4507	4585	9092	516	0	516	500
+3M Extn								
+6M Extn								
MB Normal	3.760 x 3.760	8110	6209	14319	962	0	962	600
+3M Extn		890	506	1396				70
+6M Extn								
MD Normal	4.0 x 4.0	17852	7093	24945	2495	0	2495	1500
+3M Extn		4967	668	5635				329
+6M Extn		7488	1025	8513				492

Note:

1. The towers are designed for
   a) Normal Span : 200 m
   b) Conductor : AAAC Moose
2. These towers are used for 220 kV MC OHL for Vikas Tech Park

220/66 kV MC TOWER

(M/s. CPRI Design)

Weight of Tower (in kg)

Sl. No.	Type of Tower	220/66kV MC Type 'MA'		220/66kV MC Type 'MB'		220/66kV MC Type 'MC'		220/66kV MC Type 'MD'	
		Super Structure	Bolt & Nuts	Super Structure	Bolt & Nuts	Super Structure	Bolt & Nuts	Super Structure	Bolt & Nuts
1	Normal Tower	9372	332	-	-	17303	622	31110	1191
2	+3M Extn only	1031	34	-	-	1996	90	3529	144
3	+6M Extn only	2120	81	-	-	3587	132	6257	223
4	Stub	637	5	-	-	1025	12	2340	54

220/66 kV MC TOWER

(M/s. L&T Design)

Weight of Tower (in kg)

Type of Tower	Base Width M x M	Fabricated Steel members			Stub & Cleat		Bolts & Nuts (in kg)
		HT	MS	Total	HT	MS	
MA Normal	6.0 x 6.0	2175	3672	5847	206	-	374
+3M Extn	6.8 x 6.8	264	582	846		-	846
+6M Extn	7.6 x 7.6	438	937	1375		-	1375
MB Normal	8.0 x 8.0	5400	3906	9306	403	-	449
+3M Extn	8.9 x 8.9	381	850	1231		-	45
+6M Extn	9.9 x 9.9	787	1289	2076		-	77
MC Normal	10.0 x 10.0	5108	5578	10686	391	-	484
+3M Extn	11.4 x 11.4	568	1040	1608		-	60
+6M Extn	12.7 x 12.7	887	1670	2557		-	87
MD Normal	11.5 x 11.5	6638	5982	12620	494	-	562
+3M Extn	13.0 x 13.0	603	1388	1991		-	65
+6M Extn	14.6 x 14.6	1043	2100	3143		-	99

Note:

1. The towers are designed for
   a) Normal Span : 275 m
   b) Conductor : Drake ACSR (220 kV Circuit)
   : Coyote ACSR (66 kV Circuit)
2. These towers are used for 220/66 kV MC Hoskote - BIAL line

66 kV MCMV Narrow Based Tower

220/66/11 kV Chamarajanagar R/S to 66/11 kV Badanaguppe S/S

Sl. No.	Type of Tower	Soil Classification	Base Width M x M	EXCA (in CMT/Twr)	Fabricated Steel Members (in MT)			Stubs and Cleats (in MT)		Bolts & Nuts (in kg)		
					HT	MS	Total	HT	MS	Tower	Stub	Total
1	A	DFR	5.4 x 5.4	90.88	3.5745	3.9489	7.5234	0.4259	0	602.30	5.70	608.00
2		PS	7.9 x 7.9	187.23								
3		WBC	9.3 x 9.3	259.47								
4	A + 3	DFR	6.6 x 6.6	134.80	0.3945	0.3762	0.7707	0.4529	0	539.30	5.70	545.00
5		PS	8.1 x 8.1	196.83								
6		WBC	9.7 x 9.7	282.27								
7	A + 6	DFR	6.6 x 6.6	134.80	0.7899	0.7669	1.5568	0.4259	0	111.70	5.70	117.40
8		PS	8.1 x 8.1	196.83								
9		WBC	9.7 x 9.7	282.27								
10	B	DFR	7.4 x 7.4	169.33	6.6163	5.6518	12.2681	0.7953	0	681.60	9.90	691.50
11		PS	9.3 x 9.3	259.47								

12		WBC	10.65 x 10.65	340.26								
13	B + 3	DFR	7 x 7	152.90	0.7524	0.5058	1.2582	0.7953	0	76.90	9.90	86.80
14		PS	9.7 x 9.7	282.27								
15		WBC	11.2 x 11.2	376.32								
16	D	DFR	7.4 x 7.4	226.39	14.0299	7.3966	21.4265	2.2797	0	1504.50	67.70	1572.20
17		PS	11.1 x 11.1	492.84								
18		WBC	11.1 x 11.1	492.84								
19	D + 3	DFR	8.4 x 8.4	291.33	2.6665	0.3233	2.9898	2.2797	0	256.00	67.70	323.70
20		PS	11.6 x 11.6	538.24								
21		WBC	11.9 x 11.9	566.44								
22	D + 6	DFR	8.4 x 8.4	291.33	5.0249	0.6667	5.6916	2.2797	0	517.40	67.70	585.10
23		PS	11.6 x 11.6	538.24								
24		WBC	11.9 x 11.9	566.44								
25	D + 9	DFR	8.4 x 8.4	320.463	7.3859	1.0193	8.4052	2.2797	0	776.70	67.70	844.40
26		PS	11.6 x 11.6	592.064								
27		WBC	11.9 x 11.9	623.084								
28	D + 12	DFR	8.4 x 8.4	320.463	9.7670	1.4100	11.1770	2.2797	0	957.60	67.70	1025.30
29		PS	11.6 x 11.6	592.064								
30		WBC	11.9 x 11.9	623.084								

ABSTRACT OF TOWER WEIGHTS AND BASE WIDTHS

Sl. No.	Basic Tower Extn	110 kV SC Design			110 kV DC S.A.E Design			110 kV SC Kalpatharu Design			110 kV DC Kalpatharu		
		Base width (in m)	Tower weight with Stub (in MT)	B&N weight (in kg)	Base width (in m)	Tower weight with Stub (in MT)	B&N weight (in kg)	Base width (in m)	Tower weight with Stub (in MT)	B&N weight (in kg)	Base width (in m)	Tower weight with Stub (in MT)	B&N weight (in kg)
1	A+0M	3.334	1.660	91	4.200	2.700	135	3.400	1.525	84	4.30	1.974	71
2	A+3M	3.820	2.004	108	4.705	3.128	155	3.868	1.808	100	4.87	2.301	79
3	A+6M	4.306	2.362	129	5.211	3.596	178	4.325	2.122	119	5.44	2.672	88
4	B+0M	4.826	1.933	131					2.218	77	6.00	3.315	86
5	B+3M	5.624	2.325	147					2.645	101	6.84	4.039	96
6	B+6M	6.410	2.857	165					2.902	126	7.68	4.493	108
7	C+0M	4.826	2.380	131	6.700	3.790	195		2.218	77	6.00	3.315	86
8	C+3M	5.624	2.875	150	7.699	4.594	220		2.645	101	6.84	4.039	96
9	C+6M	6.410	3.545	159	8.698	5.240	250		2.902	126	7.68	4.493	108
10	D+0M	4.826	3.070	174	7.400	4.910	258	5.000	3.006	141	7.20	4.61	182
11	D+3M	5.624	3.707	201	8.498	5.880	297	5.729	3.540	166	8.36	5.66	210
12	D+6M	6.410	4.453	219	9.596	6.690	331	6.400	4.130	193	9.52	6.127	218

Note:

1 Weight of Stubs is included in Normal Tower weights only
2 At present 110 kV DC Kalpatharu design is being used

A Type : 0° - 2° Deviation
B Type : 2° - 15° Deviation
C Type : 15° - 30° Deviation
D Type : 30° - 60° Deviation & DE Condition

110 kV DC NARROW BASED TOWER

(KPTCL Design)

Weight of Tower (in kg)

Type of Tower	Base Width M x M	Fabricated Steel members			Stub & Cleat		Bolts & Nuts (in kg)
		HT	MS	Total	HT	MS	
DA Normal	2.0 x 2.0		2793	2793		201	200
+3M Extn	2.1 x 2.1		415	415		-	19
+6M Extn	2.3 x 2.3		810	810		-	20
DC Normal	2.5 x 2.5		4830	4830		505	284
+3M Extn	2.65 x 2.65		773	773		-	34
+6M Extn	2.82 x 2.82		1517	1517		-	45
DD Normal	3.2 x 3.2		6297	6297		617	163

+3M Extn	3.47 x 3.47		983	983		-	23
+6M Extn	3.75 x 3.75		1921	1921		-	23

Note:

1. The towers are designed for
   a) Normal Span : 320 m
   b) Conductor : ACSR LYNX

110 kV MC TOWER

(M/s. CPRI Design)

Weight of Tower (in kg)

Type of Tower	Base Width M x M	Fabricated Steel members			Stub & Cleat		Bolts & Nuts (in kg)
		HT	MS	Total	HT	MS	
MA Normal	6.0 x 6.0	-	6901	6901	-	362	317
+3M Extn	6.8 x 6.8	-	864	864	-		33
+6M Extn	7.6 x 7.6	-	1737	1737	-		68
+9M Extn	8.4 x 8.4	-	1761	1761	-		67
MC Normal	6.8 x 6.8	-	12402	12402	-	820	435
+3M Extn	7.8 x 7.8	-	1543	1543	-		45
+6M Extn	8.8 x 8.8	-	2900	2900	-		96
+9M Extn	9.9 x 9.9	-	3008	3008	-		96
MD Normal	7.8 x 7.8	-	17280	17280	-	1039	512
+3M Extn	8.5 x 8.5	-	2013	2013	-		50
+6M Extn	9.2 x 9.2	-	3750	3750	-		105
+9M Extn	9.9 x 9.9	-	3888	3888	-		105

Note:

1. The towers are designed for
   a) Normal Span : 320 m
   b) Conductor : LYNX ACSR

ABSTRACT OF TOWER WEIGHTS AND BASE WIDTHS

Sl. No.	BASIC TOWER /EXTN	66 kV Single Circuit					
		KPTCL / S.A.E Design			L&T Design		
		Base width (in m)	Tower Weight With Stub (in MT)	B&N wt (in kg)	Base width (in m)	Tower Weight With Stub (in MT)	B&N wt (in kg)
1	A+0M	2.000	1.126	137.72	2.495	1.210	75.000
2	A+3M	2.311	1.454	176.98	2.948	1.545	96.007
3	A+6M	2.622	1.756	213.82	3.404	1.888	111.761
4	B+0M				3.347	1.436	76.800
5	B+3M				4.019	1.796	95.916
6	B+6M				4.691	2.172	109.519
7	C+0M	3.000	1.619	156.69	4.250	1.669	84.700
8	C+3M	3.549	1.992	183.01	5.156	2.143	106.164
9	C+6M	4.099	1.395	209.33	6.063	2.566	120.388
10	D+0M	4.300	1.885	224.44	4.700	2.279	127.720
11	D+3M	5.162	2.506	258.16	5.518	2.821	149.926
12	D+6M	6.024	2.886	277.62	6.636	3.335	174.170

Sl. No.	BASIC TOWER /EXTN	66 kV Double Circuit								
		KEC Design			L&T Design			Kalpatharu Design		
		Base width (in m)	Tower Weight With Stub (in MT)	B&N wt (in kg)	Base width (in m)	Tower Weight With Stub (in MT)	B&N wt (in kg)	Base width (in m)	Tower Weight With Stub (in MT)	B&N wt (in kg)
1	A+0M	2.800	1.506	93.220	3.323	1.658	83.000	4.200	1.293	56
2	A+3M	2.257	1.839	109.880	3.899	2.041	104.551	4.852	1.578	65

3	A+6M	3.727	2.164	127.140	4.476	2.443	121.000	5.695	1.897	70
4	B+0M							5.200	1.645	53
5	B+3M							6.205	2.029	61
6	B+6M							7.198	2.416	68
7	C+0M	4.600	2.355	129.700	4.360	2.500	150.400	5.250	1.910	63
8	C+3M	5.480	2.865	152.510	5.240	3.046	173.801	6.250	2.304	73
9	C+6M	6.361			6.113	3.504	198.109	7.206	2.762	80
10	D+0M	5.700	3.112	142.020	4.428	3.620	188.770	7.800	2.487	83
11	D+3M	6.660	3.744	168.870	5.325	4.296	215.157	6.868	3.030	97
12	D+6M	7.620	4.291	180.020	6.222	4.936	238.838	7.936	3.699	115

Note:

1 Weight of Stubs is included in Normal Tower weights only
2 At present 66 kV DC Kalpatharu design is being used
3 For 66 kV SC KPTCL design is being used

A Type : 0° - 2° Deviation
B Type : 2° - 15° Deviation
C Type : 15° - 30° Deviation
D Type : 30° - 60° Deviation & DE Condition

66 kV DC (NARROW BASED TOWER)

(KPTCL Design)

Weight of Tower (in kg)

Type of Tower	Base Width M x M	Fabricated Steel members			Stub & Cleat			Bolts & Nuts (in kg)
		HT	MS	Total	HT	MS	Total	
DA Normal	1.4 x 1.4		1824	1824		179	179	135
+3M Extn	1.898 x 1.898		333	333				25
+6M Extn	1.549 x 1.549		649	649				35
DC Normal	1.6 x 1.6		2710	2710		418	418	165
+3M Extn	1.767 x 1.767		583	583				35
+6M Extn	1.934 x 1.934		1132	1132				70
DD Normal	1.8 x 1.8		3428	3428		553	553	180
+3M Extn	1.967 x 1.967		781	781				35
+6M Extn	2.134 x 2.134		1491	1491				50

Note:

1. The towers are designed for
   a) Normal Span : 250 m (Coyote ACSR)
   140 m (AAAC Moose)
   140 m (ACSR Drake)

66 kV DC (Single Side Cross Arm)

(M/s. Deepak Cables India Ltd. Design)

Weight of Tower (in kg)

Type of Tower	Base Width M x M	Fabricated Steel members			Stub & Cleat			Bolts & Nuts (in kg)
		HT	MS	Total	HT	MS	Total	
DA Normal	1.5 x 1.5	1382	1545	2927	215	23	237	212
+3M Extn	1.7 x 1.7	223	151	374				30
+6M Extn	1.9 x 1.9	430	284	714				41
+9M Extn	2.1 x 2.1	653	445	1098				65
+12M Extn	2.3 x 2.3	859	595	1405				75
DB Normal	1.8 x 1.8	2102	1756	3858	410	59	469	248
+3M Extn	1.9 x 1.9	367	168	535				28
+6M Extn	2.0 x 2.0	707	317	1024				39
+9M Extn	2.2 x 2.2	1074	501	1574				64
+12M Extn	2.3 x 2.3	1413	672	2085				76
DC Normal	2.0 x 2.0	2255	1917	4171	434	59	493	262
+3M Extn	2.1 x 2.1	374	226	599				39
+6M Extn	2.3 x 2.3	713	438	1151				55
+9M Extn	2.4 x 2.4	1087	686	1773				87
+12M Extn	2.5 x 2.5	1427	463	1890				103
DD Normal	2.6 x 2.6	2440	2409	4849	546	59	605	319

+3M Extn	2.8 x 2.8	280	287	567				40
+6M Extn	3.0 x 3.0	926	545	1471				56
+9M Extn	3.2 x 3.2	1406	876	2282				89
+12M Extn	3.4 x 3.4	1853	1184	3036				108

Note:

1. The towers are designed for
   a) Normal Span : 200 m
   b) Conductor : Coyote ACSR
2. These towers are used for 66 kV DC Kushalnagara - Madikere line

66 kV MC TOWER (4 CIRCUITS)

(M/s. CPRI Design)

Weight of Tower (in kg)

Type of Tower	Base Width M x M	Fabricated Steel members			Stub & Cleat		Bolts & Nuts (in kg)
		HT	MS	Total	HT	MS	
MA Normal	4.2 x 4.2	-	4178	4178	-	297	259
+3M Extn	4.8 x 4.8	-	557	557	-		29
+6M Extn	5.3 x 5.3	-	1201	1201	-		57
+9M Extn	5.9 x 5.9	-	1295	1295	-		57
MC Normal	5.2 x 5.2	-	6794	6794	-	550	257
+3M Extn	5.8 x 5.8	-	1054	1054	-		31
+6M Extn	6.5 x 6.5	-	2223	2223	-		68
+9M Extn	7.1 x 7.1	-	2301	2301	-		68
MD Normal	5.8 x 5.8	-	8688	8688	-	712	356
+3M Extn	6.5 x 6.5	-	1317	1317	-		39
+6M Extn	7.2 x 7.2	-	2664	2664	-		91
+9M Extn	7.9 x 7.9	-	2780	2780	-		95

Note:

1. The towers are designed for
   a) Normal Span : 275 m
   b) Conductor : Coyote ACSR

DETAILS OF FOUNDATION OF TRANSMISSION LINE TOWERS NORMALLY USED

FDN TYPE	BASIC TOWER EXTINS	66 kV SC KPTCL Design (S.A.E Modified Design)			66 kV SC L&T Design			66 kV DC KEC Design			66 kV DC Kalpatharu Design				BASIC TOWER EXTINS
		CONC (in CMT)	EXCA (in CMT)	REINF (in kg)	CONC (in CMT)	EXCA (in CMT)	REINF (in kg)	CONC (in CMT)	EXCA (in CMT)	REINF (in kg)	CONC (in CMT)		EARTH EXCA (in CMT)	Steel REINF (in kg)	
											01:02:04	01:03:06			
Normal	A	3.53	24.82	-	3.195	20.620		3.05	21.17		1.54	-	14.20	-	A
D	B	-	-	-	3.302	22.250					2.08	-	20.60	-	B
R	C	3.50	25.14	-	3.417	23.912		5.76	37.98		2.64	-	27.65	-	C
Y	D	3.64	26.44	-	4.013	31.232		5.49	48.58		4.03	-	41.07	-	D
Normal	A	4.91	39.02	-	4.600	37.363		5.06	37.26		3.50	-	23.00	-	A
W	B	-	-	-	4.600	37.363					4.72	0.59	38.79	133	B
E	C	6.78	48.92	-	5.073	41.760		9.00	73.73		5.82	0.72	52.27	166	C
T	D	7.08	50.72	-	7.260	59.050		11.33	95.00		8.27	1.11	84.27	219	D
Partially Submerged	A	10.55	66.01	939	4.600	37.363		8.39	56.44		4.51	0.62	36.99	118	A
	B	-	-	-	5.331	44.042					6.48	0.93	57.62	175	B
	C	11.13	71.63	-	5.332	44.020		11.83	91.25		7.83	1.11	75.84	215	C
	D	11.67	74.08	-	9.910	76.250		13.24	107.03		10.46	1.51	111.63	274	D
Fully Submerged	A	10.55	66.01	939	6.712	56.400		14.20	82.42		6.05	0.80	50.69	154	A
	B	-	-	-	6.712	56.400					8.37	1.28	76.89	222	B
	C	17.73	99.29	-	8.059	64.538		18.36	125.40		9.73	1.46	97.2	240	C
	D	18.49	102.18	-	15.475	106.170		19.54	144.02		13.04	1.99	142.83	351	D
Soft Rock	A	7.12	16.87	-	3.104	5.155		5.81	16.76		1.90	-	4.99	41	A
	B	-	-	-	3.195	5.978					2.50	-	6.20	44	B

Soft Rock	C	9.51	26.72	-	3.304	6.863		7.27	22.19		2.60	-	7.91	51	C
	D	10.03	25.83	-	4.830	17.568		8.29	24.28		4.03	-	17.97	56	D
Wet Black Cotton	A	8.30	76.82	-	9.693	106.171	261.42	17.07	127.00	592	8.84	1.36	74.00	206	A
	B	-	-	-	9.693	106.175	261.42				11.94	1.91	110.00	291	B
	C	14.35	85.78	-	10.293	113.490	282.27	23.14	194.69	797	14.03	2.25	143.88	382	C
	D	14.85	87.87	-	14.779	167.020	548.24	35.95	246.96	1245	18.90	3.04	211.68	593	D
Hard Rock	A	1.21	1.03	37	1.190	1.010		1.06	0.93	51	-	-	-	-	A
	B	-	-	-	1.190	1.010					-	-	-	-	B
	C	1.62	1.44	65	1.191	1.008		1.12	1.00	61	-	-	-	-	C
	D	1.62	1.44	65	4.830	17.568		1.55	1.43	73	-	-	-	-	D
Wet Fissured Rock (WFR)	A	-	-	-							3.12	-	5.49	44	A
	B	-	-	-							4.77	-	13.61	50	B
	C	-	-	-							5.96	-	22.03	56	C
	D	-	-	-							9.51	-	40.11	61	D
Submerged Fissured Rock (SFR)	A	-	-	-							5.91	-	18.98	44	A
	B	-	-	-							8.95	-	29.23	50	B
	C	-	-	-							10.87	-	42.45	56	C
	D	-	-	-							16.50	-	67.79	60	D

DETAILS OF FOUNDATION OF TRANSMISSION LINE TOWERS NORMALLY USED

ABSTRACT OF CONCRETE AND EXCAVATION VOLUMES

(Common for Normal, + 3M, +6M and Body Extension)

FDN TYPE	BASIC TOWER EXTINS	110 kV SC L&T Design									110 kV SC Kalpatharu Design			
		CONC (in CMT)			EXCA (in CMT)			REINF (in kg)			CONC (in CMT)		EXCA (in CMT)	REINF in kg
											01:02:04	01:03:06		
Normal Dry	A	2.59	2.64	2.68	16.90	17.60	18.22				2.24		21.07	
	B	2.72	2.77	2.86	18.40	19.20	20.40				3.37		32.32	
	C	3.10	3.23	3.35	24.34	25.48	26.63				3.81		37.36	
	D	4.77	4.91	5.10	42.86	44.28	45.70				5.03		48.27	
Normal Wet	A	4.70	4.83	4.94	31.55	32.41	43.37				4.83	0.56	35.38	110
	B	5.30	5.58	5.88	36.60	38.60	40.70				6.94	0.90	59.74	118
	C		7.27			49.46					8.16	1.06	73.01	212
	D		14.51			96.43					13.35		94.08	
Partially Submerged	A	6.82	7.22	7.59	45.50	47.67	49.85				6.69	0.9	52.71	166
	B	6.93	7.65	8.50	47.20	51.80	56.60				9.21	1.30	82.85	242
	C		12.23			75.14					10.60	1.49	99.15	303
	D		14.20			142.20		468			12.97	1.76	129.10	331
Fully Submerged	A	10.42	10.98	11.54	64.40	67.02	69.63				8.49	1.87	71.27	218
	B	11.70	12.90	14.20	72.30	78.00	83.90				11.79	1.75	108.40	341
	C		13.60			109.60		384			13.37	1.97	127.80	421
	D		20.36			187.10		538			13.81	1.52	138.72	369
Dry Soft Rock	A	3.59	3.63	4.43	8.43	9.42	10.40				2.38		7.60	25
	B	3.98	4.25	4.55	9.00	10.00	11.10				2.49		8.57	41
	C	6.47	6.72	6.59	18.03	18.52	19.49				2.68		9.65	41
	D	12.07	12.07	13.00	35.26	35.89	39.52				9.398		43.01	
Wet Soft / Fissured Rock	A							381	454	505	4.07		9.93	25
	B							505	520	532	4.84		13.15	41
	C							674			5.36		17.55	119
	D							864			11.91	0.38	38.32	284
Wet Black Cotton	A	12.25	13.00	14.36	105.50	192.50	116.50	34			12.17	1.86	101.00	308
	B	14.36	15.20	14.62	116.50	1223.70	131.00	39			16.21	2.52	151.59	515
	C		18.10			163.00		39			18.30	2.83	178.02	651
	D		31.30			250.00		49			22.13	3.36	232.32	713

Hard Rock	A		1.60			1.40					1.66		1.13	52
	B		2.00			1.80					1.92		1.39	52
	C		2.30			2.00					2.13		1.62	89
	D		3.40			3.24					2.33		1.84	92
Submerged Fissured Rock (SFR)	A										6.37		17.88	25
	B										7.81	0.38	24.32	41
	C										7.95		35.93	194
	D										18.316	0.63	120.66	404

DETAILS OF FOUNDATION OF TRANSMISSION LINE TOWERS NORMALLY USED

ABSTRACT OF CONCRETE AND EXCAVATION VOLUMES

(Common for Normal, + 3M, +6M and Body Extension)

FDN TYPE	BASIC TOWER EXTINS	110 kV DC S.A.E Design							110 kV DC R&C Design			110 kV DC Kalpatharu Design			
		CONC (in CMT)			EXCA (in CMT)			REINF (in kg)	CONC (in CMT)	EXCA (in CMT)	REINF (in kg)	CONC (in CMT)		EARTH EXCA (in CMT)	Steel REINF (in kg)
												01:02:04	01:03:06		
Normal Dry	A		3.64			26.24			3.440	24.986		2.35		23.06	
	B								5.048	42.439		3.34		35.82	
	C		5.18			42.21			6.359	54.684		4.32		43.77	
	D		8.10			64.03			8.736	71.424		7.70		66.27	
Normal Wet	A	6.23	6.71	6.71	50.92	54.44	54.44					5.08		41.53	
	B											8.54		66.64	
	C	10.50	10.93	10.93	78.64	81.12	81.12					9.41	1.22	92.06	260
	D		21.28			130.68						12.88	1.56	134.87	427
Partially Submerged	A		8.45			66.27			8.158	58.538		6.69	1.00	61.94	179
	B								13.991	95.287		8.38	1.20	90.75	248
	C		11.70			109.44		486	21.980	135.200		14.62	2.18	155.52	459
	D		17.51			166.06		950	27.007	161.312		15.97	2.42	171.40	615
Fully Submerged	A		9.54			93.41		328	11.385	68.920		8.78	1.39	82.98	241
	B								16.295	117.211		10.55	1.60	117.50	319
	C		15.51			147.00		624	26.519	152.352		14.62	2.18	155.50	450
	D		22.80			215.73		1233	31.575	180.000		19.42	3.04	211.60	835
Dry Soft Rock	A		4.39			7.80		181	6.742	9.236		2.01		7.59	46
	B								7.865	10.934		3.41		11.62	56
	C		7.35			28.66		369	14.667	28.572		4.50		20.08	57
	D		11.04			54.64		618	15.063	35.334		7.74		34.00	59
Wet Soft / Fissured Rock	A		10.59			50.87		366	9.659	21.946		5.05		14.48	51
	B								13.399	27.953		7.14		28.50	61
	C		17.07			101.11		718	24.227	57.897		10.23		42.50	61
	D		24.57			158.32		1410	30.813	67.829		16.34		66.45	61
Wet Black Cotton	A		14.81			151.23		468	10.425	68.926		12.34	2.04	117.60	359
	B								12.713	80.162		15.60	2.52	177.80	558
	C		20.34			204.68		765	21.864	139.392		20.31	3.20	221.86	738
	D		29.46			281.66		1636	25.703	156.800		26.43	4.29	291.00	1276
Hard Rock	A		1.49			1.31		43							
	B														
	C		2.66			2.48		83							
	D		4.24			4.50		154							
Submerged Fissured Rock (SFR)	A											9.96		34.90	51
	B											12.56		62.06	61
	C											17.95		72.21	61
	D											14.56	2.18	102.39	509

DETAILS OF FOUNDATION OF TRANSMISSION LINE TOWERS NORMALLY USED

ABSTRACT OF CONCRETE AND EXCAVATION VOLUMES

(Common for Normal, + 3M, +6M and Body Extension)

FDN TYPE	BASIC TOWER EXTINS	220 kV SC (S.A.E Design)			220 kV DC KEC Design			220 kV DC L&T Design			220 kV DC Kalpatharu Design			
		CONC (in CMT)	EXCA (in CMT)	REINF (in kg)	CONC (in CMT)	EXCA (in CMT)	REINF (in kg)	CONC (in CMT)	EXCA (in CMT)	REINF (in kg)	CONC (in CMT)		EXCA (in CMT)	REINF (in kg)
											01:02:04	01:03:06		
Normal Dry	A	2.92	18.54		3.340	22.580		3.637	29.70		3.54		32.15	
	B							5.696	51.80		5.33		47.80	
	C	4.08	29.07		6.400	50.270		7.148	63.40		6.82		56.66	
	D	5.46	41.28		7.820	60.550		12.672	98.40		9.37	1.48	109.44	492
Normal Wet	A	4.82	33.93		5.910	41.990		7.816	56.60		6.14	0.76	50.63	167
	B							10.992	116.10	512.80	10.73	1.27	95.43	294
	C	8.27	57.92		14.123	96.180		12.708	138.30	713.70	11.00	1.51	111.63	301
	D	11.60	85.64		16.720	111.080		19.016	197.40	990.84	17.34	2.66	187.13	806
Partially Submerged	A	9.60	59.69		9.520	61.250		8.792	86.10	427.52	9.11	1.12	71.29	226
	B							14.620	157.20	666.00	13.60	1.80	130.68	350
	C	16.38	95.48		22.772	134.400		17.212	194.80	846.50	13.79	2.02	145.32	431
	D	20.46	128.86		24.870	146.110		24.308	256.70	1354.70	21.07	3.43	236.50	1270
Fully Submerged	A	14.94	80.14		18.680	94.170		11.842	118.20	580.56	11.88	1.53	94.25	297
	B							19.140	206.40	854.00	16.80	2.38	168.70	498
	C	24.06	122.33		38.740	186.440		22.764	241.20	1072.20	16.86	2.58	181.59	602
	D	29.28	162.53		39.910	196.020		30.848	328.90	1793.20	26.67	4.25	289.30	1409
Soft Rock	A				7.930	17.080		5.184	29.91	267.04	6.26		24.98	47
	B							9.374	60.00	440.20	11.26		47.04	59
	C				13.300	39.060		10.626	71.40	551.68	14.19		56.84	60
	D				16.490	46.720		16.472	114.60	815.08	25.83		98.36	62
Wet Black Cotton	A				18.390	85.290		16.696	167.80	844.40	14.14	2.24	133.23	461
	B							26.528	286.90	1218.00	22.45	3.39	234.40	704
	C				39.250	179.480		30.304	327.60	1560.80	23.22	3.72	255.00	985
	D				44.120	188.790		41.068	428.70	2347.80	34.13	5.64	377.60	2134
Hard Rock	A	2.09	1.90	46										
	B													
	C	2.53	2.34	55										
	D	3.85	3.66	110										
Wet Fissured Rock (WFR)	A										10.98		36.32	53
	B										11.99	1.71	77.48	297
	C										13.16	1.98	92.15	432
	D										21.30	3.23	167.20	1035
Submerged Fissured Rock (SFR)	A										11.16	1.80	68.92	310
	B										16.92	2.61	125.26	523
	C										18.59	2.96	144.56	734
	D										29.69	4.71	249.80	1706

FOUNDATION VOLUMES FOR 66 kV MC TOWERS

(Common for Normal, + 3M & + 6M Body Extension Towers)

Type of Soil/ Foundation	Tower Type	Concrete Mix. (in CMT/Twr)		Earth Exvn. (in CMT/Twr)	Steel Re inf (in kg/Twr)
		M20	1:3:6		
Normal DRY	MA	11.5	1.20	90	760
	MB	-	-	-	-

Normal DRY	MC	21.0	2.05	150	1612
	MD	29.9	2.90	205	2332
Normal WET	MA	20.3	2.04	150	1120
	MB	-	-	-	-
	MC	40.0	4.04	280	2700
	MD	54.0	5.40	365	4584
Partially Sub-Merged	MA	25.00	2.75	183	1284
	MB	-	-	-	-
	MC	45.08	4.60	315	3136
	MD	54.00	5.40	364	4324
Fully Sub-Merged	MA	30.08	3.20	222	1444
	MB	-	-	-	-
	MC	44.28	4.60	315	3136
	MD	54.00	5.40	364	4452
Wet Black Cotton	MA	30.70	3.20	222	1496
	MB	-	-	-	-
	MC	52.76	5.40	365	3728
	MD	71.21	7.20	476	5816
Dry Fissured Rock	MA	20.00	2.05	165	1132
	MB	-	-	-	-
	MC	39.00	4.04	215	2828
	MD	50.08	5.40	292	4452
Submerged Fissured Rock	MA	30.70	3.20	170	1440
	MB	-	-	-	-
	MC	45.08	4.60	250	3136
	MD	58.01	5.80	316	4548

FOUNDATION VOLUMES FOR 110 kV MC TOWERS

(Common for Normal, + 3M, & + 6M Body Extension Towers)

Type of Soil/ Foundation	Tower Type	Concrete Mix. (in CMT/Twr)		Earth Exvn. (in CMT/Twr)	Steel Re inf (in kg/Twr)
		M20	1:3:6		
Normal DRY	MA	12.0	1.3	95	836
	MB	-	-	-	-
	MC	32.8	3.2	225	2856
	MD	43.0	4.0	270	4148
Normal WET	MA	24.6	2.5	175	1300
	MB	-	-	-	-
	MC	58.9	6.0	390	5100
	MD	84.6	7.7	510	8384
Partially Sub-Merged	MA	28.4	2.9	205	1388
	MB	-	-	-	-
	MC	66.7	6.8	450	5832
	MD	86.0	8.7	575	8676
Fully Sub-Merged	MA	33.2	3.6	245	1544
	MB	-	-	-	-
	MC	75.0	7.7	510	6224
	MD	105.0	10.0	640	9080
Wet Black Cotton	MA	33.8	3.6	245	1604
	MB	-	-	-	-
	MC	76.0	7.7	510	6468
	MD	96.5	10.0	640	9788
Dry Fissured Rock	MA	24.2	2.5	130	1252
	MB	-	-	-	-
	MC	58.0	6.0	320	4872
	MD	76.0	7.7	425	8032
	MA	33.8	3.6	185	1608

Submerged Fissured Rock	MB	-	-	-	-
	MC	76.0	7.7	425	6192
	MD	96.5	10.0	545	9972

FOUNDATION VOLUMES FOR 220 kV/110 kV & 220 kV/66 kV MC TOWERS

(Common for Normal, + 3M, & + 6M Body Extension Towers)

Type of Soil/ Foundation	Tower Type	Concrete Mix. (in CMT/Twr)		Earth Exvn. (in CMT/Twr)	Steel Re inf (in kg/Twr)
		1:2:4	1:3:6		
Normal DRY	MA	3.53	0.40	39	82
	MB	9.20	1.35	101	707
	MC	12.14	1.74	125	935
	MD	16.93	2.45	173	1390
Normal WET	MA				
	MB				
	MC				
	MD				
Partially Sub-Merged	MA	12.14	1.51	112	82
	MB	20.64	3.36	232	1688
	MC	28.00	4.05	276	1888
	MD	36.47	5.20	350	2849
Fully Sub-Merged	MA	17.20	1.68	123	82
	MB	28.89	4.23	288	1559
	MC	36.90	5.00	337	1968
	MD	44.96	6.50	432	3258
Wet Black Cotton	MA				
	MB				
	MC				
	MD				
Dry Fissured Rock	MA	6.12	0.76	33	82
	MB	12.93	2.05	101	965
	MC	16.77	2.52	127	1291
	MD	23.08	3.36	173	1778
Submerged Fissured Rock	MA	22.70	2.05	101	82
	MB	31.29	4.61	243	1654
	MC	36.74	5.41	288	2246
	MD	48.12	6.96	376	3513

FOUNDATION VOLUMES FOR 220 kV/110 kV & 220 kV/66 kV MC TOWERS

(Common for Normal, + 3M & + 6M Body Extension Towers)

Type of Soil/ Foundation	Tower Type	Concrete Mix. (in CMT/Twr)		Earth Exvn. (in CMT/Twr)	Steel Re inf (in kg/Twr)
		1:2:4	1:3:6		
Normal DRY	MA	100.50	12.10	383	6930
	MB				
	MC	395.00	32.40	1005	31804
	MD	491.00	40.00	1236	57521
Normal WET	MA	160.15	19.60	613.5	14073
	MB				
	MC	486.00	40.00	1236	38828
	MD	646.00	53.00	1629	67899
Partially Sub-Merged	MA	160.15	19.60	613.5	14073
	MB				

Partially Sub-Merged	MC	486.00	40.00	1236	38828
	MD	646.00	53.00	1629	67899
Fully Sub-Merged	MA	160.15	19.60	613.5	14073
	MB				
	MC	486.00	40.00	1236	38828
	MD	646.00	53.00	1629	67899
Wet Black Cotton	MA	160.15	19.60	613.5	14073
	MB				
	MC	587.00	48.40	1492	51348
	MD	646.00	53.00	1629	67899
Dry Fissured Rock	MA	118.50	14.40	417.1	10370
	MB				
	MC	395.00	32.40	953	33927
	MD	491.00	40.00	1180	57520
Submerged Fissured Rock	MA	160.15	19.60	570	14646
	MB				
	MC	486.00	40.00	1180	38828
	MD	646.00	53.00	1564	67899

FOUNDATION VOLUMES FOR 220 kV MC TOWER

(Common for Normal, +3M & +6M Body Extension Tower)

Type of Soil/ Foundation	Tower Type	Concrete Mix. (in CMT/Twr)		Earth Exvn. (in CMT/Twr)	Steel Re inf (in kg/Twr)
		1:2:4	1:3:6		
Normal DRY	MA	-	-	-	-
	MB	-	-	-	-
	MC	-	-	-	-
	MD	-	-	-	-
Normal WET	MA	17.16	2.244	191.8	1887
	MB	47.96	5.100	401.0	4916
	MC	-	-	-	-
	MD	-	-	-	-
Partially Sub-Merged	MA	20.24	2.82	236.2	2057
	MB	61.06	6.73	521.0	6167
	MC	-	-	-	-
	MD	-	-	-	-
Fully Sub-Merged	MA	-	-	-	-
	MB	-	-	-	-
	MC	-	-	-	-
	MD	-	-	-	-
Wet Black Cotton	MA	-	-	-	-
	MB	-	-	-	-
	MC	-	-	-	-
	MD	145.96	12.0	933	11225
Dry Fissured Rock	MA	14.95	2.8	98.1	1508
	MB	35.5	3.2	190.9	3602
	MC	-	-	-	-
	MD	40.1	5.0	273	6190
Submerged Fissured Rock	MA	-	-	-	-
	MB	-	-	-	-
	MC	-	-	-	-
	MD	95.6	10.36	637	9030

FOUNDATION VOLUMES FOR 220 kV DC N.B. TOWER

[M/s. L&T Design adopted in NRS - Laggere line]

(Common for Normal, +3M & +6M Body Extension Towers)

Type of Soil / Foundation	Tower Type	Concrete Mix. (in CMT/Twr)		Earth Exvn. (in MT/Twr)	Steel Re inf (in kg/Twr)
		1:2:4	1:3:6		
Soft Rock	DA	27.00	1.80	142	988
	DB & DE	67.43	4.14	343	2482
Wet Soft Rock	DA	34.70	2.45	199	1275
	DB & DE	-	-	-	-
Hard Rock	DA	-	-	-	-
	DB & DE	65.93	-	93.26	3141

BOQ AS PER THE APPROVED DESIGN FOR 220/66 kV MC TOWER

ADOPTED FOR HOSKOTE - BEGUR (BIAL) LINE

Soil Classification										1:3:6	M20	Steel
Tower Type	NDS	Wet	PS	FS	WBC	DFR	SFR	PSFR	Hard Rock	Cmtr	Cmtr	kg
A+0, +3, +6						16.90				0.41	3.40	86.50
									1.35	0.00	1.50	91.20
	47.70									0.51	4.13	86.50
					154.00					1.95	12.28	832.00
				123.00						1.51	10.20	584.00
			96.00							1.15	8.36	527.00
B+0, +3, +6						90.99				1.62	12.11	912.00
	103.97									1.30	9.98	781.00
					387.00					5.41	32.83	2317.00
C+0, +3, +6	122.88									1.68	12.34	1042.82
						102.12				1.92	13.74	1108.00
					390.00					5.83	37.81	2586.00
D+0, +3, +6									6.73	0.00	7.03	212.13
						133.15				2.38	17.88	1377.34
	172.50									2.20	16.72	1496.00
					483.00					6.60	44.27	3262.00

BOQ AS PER THE APPROVED DESIGN FOR 220 kV DC NARROW BASED TOWER

ADOPTED FOR HOODY - HAL LINE, Bengaluru

Soil Classification										1:3:6	M15	Steel
Tower Type	NDS	Wet	PS	FS	WBC	DFR	SFR	PSFR	Hard Rock	Cmtr	Cmtr	kg
A+0, +3, +6, +9				221.00						2.94	33.30	1636
			213.00							2.81	32.30	1586
						109.76				1.74	22.94	1148
B+0, +3						136.00				2.11	28.55	1483
B+6, +9						154.00				2.38	31.32	1533
C+0, +3, +6						213.90				3.00	40.04	2060
C+9				485.20						6.05	67.41	5262
						213.80				3.00	40.93	2035
D+0, +3, +6									15.29	0.00	15.73	605
						235.10				3.28	51.80	2777
DD/DE +9									15.29	0.00	15.73	605
						237.80				3.28	50.74	2771

BOQ AS PER THE APPROVED DESIGN FOR 400 kV DC LINE

(BTPS to HIRIYUR Station)

Soil Classification										1:3:6	M20	Steel
Tower Type	NDS	Wet	PS	FS	WBC	DFR	SFR	PSFR	Hard Rock	Cmtr	Cmtr	kg

A+0, +3, +6, +9									77.14	1.68	11.71	613.00
							124.03			2.56	16.85	987.00
				158.12						2.22	14.77	865.00
			125.19							1.72	11.86	667.00
	62.38									0.78	5.78	405.81
		100.23								1.34	9.74	509.00
					224.99					3.25	21.15	1178.00
						43.60				1.03	7.02	504.00
B+0, +3, +6, +9									178.30	3.56	24.60	2334.00
			255.03							3.72	25.85	2197.00
				312.12						4.61	31.47	2680.00
					400.00					6.00	43.93	2734.00
	130.68									1.80	14.77	1331.00
		203.69								2.92	20.85	1895.00
						116.44				2.42	17.13	1674.00
C+0, +3, +6, +9									199.23	3.94	27.08	2574.00
				339.63						5.04	34.15	3081.00
			279.95							4.10	28.32	2590.00
						127.92				2.64	18.48	1933.00
					434.88					6.54	47.49	2995.00
		224.99								3.24	22.92	2158.00
	136.28									1.88	16.18	1447.00
D+0, +3, +6, +9									279.67	5.58	42.14	3972.00
				467.25						7.06	53.55	5118.00
			389.88							5.83	44.73	4496.00
						183.27				3.80	29.78	3007.00
					591.36					9.03	75.21	4831.00
		320.75								4.74	36.77	3533.00
	202.71									2.90	25.02	2189.00
D+12				476.28						7.20	56.24	5550.00
						191.81				3.96	32.62	3221.00
D+18/25									324.17	6.38	49.59	4610.00
				538.88						8.19	63.72	6012.00
			439.23							6.61	52.02	5289.00
						185.89				4.14	33.83	3628.00
					675.00					10.36	86.99	5583.00
		363.00								5.41	42.98	4479.00
	221.88									3.20	28.32	2548.00

BOQ AS PER THE APPROVED DESIGN FOR 400 kV DC LINE

(SHANTHIGRAMA - NANDIKUR LINE)

Soil Classification								1:3:6	M20	Steel
Tower Type	**NDS**	**Wet**	**PS**	**FS**	**WBC**	**DFR**	**SFR**	**PSFR**	**Cmtr**	**Cmtr**	**kg**
D+3	453.96								7.20	64.50	7544.20
						421.85			8.00	78.71	8385.90
					1078.00				17.30	168.20	14523.20
							811.30		14.80	151.28	12906.50
				923.42					14.80	142.02	12690.40
			790.60						12.64	121.26	10768.20
								598.65	11.10	108.10	10834.40
		672.60							10.73	99.68	10009.70
D+6						429.05			8.13	79.98	8515.10
							826.30		15.05	153.32	13427.50
				934.06					14.96	143.27	12777.60
		672.60							10.73	99.68	10009.70
								607.23	11.25	109.51	10894.40
					1101.50				17.67	171.10	15107.60
	468.97								7.44	66.11	7949.30
			805.40						12.88	120.77	11520.70

D+9						445.15			8.19	81.75	8366.90
							836.36		15.23	154.49	13517.30
			805.40						12.88	120.77	11520.70
								615.86	11.40	110.95	11048.70
				944.77					15.14	144.60	13156.80
		695.43							11.10	102.49	10503.90
	468.97								7.44	66.11	7949.30
D+18							851.57		15.49	156.91	13942.30
		695.43							11.10	103.14	10406.70
								633.31	11.70	115.39	11303.20
						467.52			8.58	84.42	9326.10
D+25							861.80		15.66	162.33	14179.80
		704.67							11.25	108.17	10425.20
								633.31	11.70	117.61	11412.60
						467.52			8.58	84.42	9326.10
B+3	243								3.87	29.01	3760.70
						230.71			4.51	36.28	4374.40
					661.57				10.73	80.61	8143.40
							492.00		8.91	70.19	6965.50
				546.75					8.84	69.15	6460.70
			457.57						7.38	55.97	5714.30
		376.32							6.05	48.45	4748.30
								353.58	6.50	51.15	5716.10
B+6	245.71								3.92	29.69	3763.90
						233.35			4.56	35.45	4619.60
							489.12		8.98	71.16	7070.80
				550.81					8.91	69.22	6443.40
			461.28						7.44	57.25	5655.50
		379.69							6.11	48.55	4833.00
								353.58	6.50	51.15	5716.10
					675.00				10.95	81.88	8461.40
B+9						236.00			4.61	35.73	4635.50
							492.96		9.05	72.70	7005.70
				554.88					8.98	69.86	6726.80
			465.00						7.50	59.03	5657.60
									6.61	52.14	5758.30
		386.47							6.22	49.29	4930.10
					675.00				10.95	81.88	8461.40
	248.43								3.96	29.93	3776.70
A+3	93.95								1.43	10.28	1273.50
						88.50			1.71	12.29	1463.40
					326.72				5.15	32.99	2618.40
							210.41		3.92	27.11	2375.20
				244.31					3.83	24.62	2169.30
			200.11						3.12	20.35	1862.00
		164.77							2.56	17.38	1608.70
								141.29	2.70	19.79	1791.60
A+6						90.14			1.74	12.63	1453.20
					329.89				5.20	33.20	2729.00
							212.95		3.96	27.64	2359.60
				249.80					3.92	24.90	2241.90
		164.77							2.56	17.61	1567.20
								143.38	2.74	20.11	1801.30
	95.65								1.46	10.73	1295.20
			207.59						3.24	20.85	1960.70
A+9	95.65								1.46	10.73	1295.20
		167.10							2.59	17.81	1573.10
C+3	314.22								4.95	41.61	4878.80
						297.00			5.62	48.38	5690.40
					800.44				12.80	107.42	10549.60
							603.58		10.80	93.77	9391.50

			568.28						9.05	73.33	7587.60
		472.76							7.50	61.32	6496.90
								436.84	7.94	67.02	7599.40
				695.43					11.10	86.94	9671.20
C+6						303.05			5.72	49.00	5791.50
					810.35				12.96	110.47	10413.30
							604.71		10.95	95.74	9471.50
		484.22							7.69	63.49	6753.80
								444.17	8.06	68.17	7651.90
	323.57								5.10	42.47	5105.70
			589.29						9.38	75.44	7941.50
C+9						306.10			5.78	49.31	5944.50
							620.86		11.10	98.10	9623.60
		484.22							7.69	63.64	6757.60
								451.56	8.19	70.10	7617.30
	323.57								5.10	42.47	5105.70
			589.29						9.38	75.44	7941.50
				695.43					11.10	86.94	9671.20
					820.33				13.12	111.55	10659.80

BOQ AS PER THE APPROVED DESIGN
FOR 66 kV DC NARROW BASED TOWER DESIGNED BY KPTCL

Soil Classification								1:3:6	M20	Steel
Tower Type	**NDS**	**PSS**	**FSS**	**WET**	**WBC**	**DFR**	**SFR**	**Cmtr**	**Cmtr**	**kg**
A NT	32.67							0.45	5.44	198.40
		50.43						0.72	7.34	313.41
			48.00					0.68	7.07	288.16
				48.00				0.68	7.07	288.16
					52.92			0.76	7.61	323.42
						16.38		0.33	4.35	168.74
							28.02	0.57	7.14	268.44
A+3M, +6M	38.88							0.54	6.09	233.38
		58.08						0.84	8.97	343.50
			60.75					0.88	9.30	376.82
				55.47				0.80	8.64	337.16
					63.48			0.92	10.19	373.11
						22.46		0.45	5.02	213.51
							33.92	0.68	9.22	418.46
C NT (03˚ to 10˚ deviation)	50.43							0.72	9.70	363.83
		72.03						1.05	12.21	486.18
			75.00					1.10	12.67	508.84
				75.00				1.10	12.67	506.74
					81.12			1.20	14.51	291.57
						29.88		0.61	7.71	307.29
							45.23	0.92	11.77	522.69
C+3M, +6M (03˚ to 10˚ deviation)	60.75							0.88	11.32	424.41
		90.75						1.35	15.95	610.80
			94.08					1.40	16.51	655.24
				90.75				1.35	15.95	628.95
					97.47			1.45	17.07	719.66
						38.00		0.76	9.39	352.91
							50.21	1.01	14.44	695.96
C NT (11˚ to 20˚ deviation)	58.08							0.84	10.97	424.44
		84.27						1.25	15.50	596.50
			90.75					1.35	16.49	630.63
				81.12				1.20	14.97	571.63
					94.08			1.40	17.05	696.74
						33.92		0.68	9.22	363.35
							52.69	1.05	15.02	660.99
	72.03							1.05	14.11	565.77

C+3M, +6M (11˚ to 20˚ deviation)		104.43						1.56	18.18	843.13
			104.43					1.56	18.40	868.00
				97.47				1.45	17.22	796.75
					111.63			1.68	19.62	996.49
						38.78		0.84	10.66	484.96
							71.63	1.40	18.16	869.50
C NT (21˚ to 30˚ deviation)	63.48							0.92	11.77	492.37
		94.08						1.40	16.65	774.11
			97.49					1.45	17.07	819.62
				90.75				1.35	15.95	734.65
					99.18			1.48	17.36	877.21
						34.24		0.70	10.03	481.93
							59.18	1.25	18.33	842.90
D+3M, +6M (41˚ to 50˚ deviation)	94.08							1.40	20.05	904.77
		138.72						2.11	29.58	1398.09
			147.00					2.24	31.36	1482.35
				142.83				2.17	30.47	1388.54
					151.23			2.31	32.28	1650.95
						67.43		1.40	20.42	977.67
							110.40	2.24	33.57	1506.32
D NT (51˚ to 60˚ deviation)	84.27							1.25	17.61	886.14
		126.75						1.92	25.56	1264.49
			130.68					1.98	26.35	1341.82
				122.88				1.86	24.79	1197.17
					138.72			2.11	27.97	1558.46
						55.86		1.15	17.02	802.01
							95.22	1.92	27.24	1349.22
D+3M, +6M (51˚ to 60˚ deviation)	115.32							1.74	24.78	1268.42
		153.36						2.34	32.61	1597.27
			155.52					2.38	33.20	1771.85
				151.23				2.31	32.76	1596.53
					168.75			2.59	36.34	2095.58
						76.21		1.56	23.79	1058.23
							110.29	2.17	38.59	1694.63
C+3M, +6M (21˚ to 30˚ deviation)	81.12							1.20	15.64	684.76
		115.32						1.74	20.24	1012.36
			119.07					1.80	20.88	1057.46
				115.32				1.74	20.24	1049.01
					126.75			1.92	22.18	1332.43
						43.69		0.92	13.32	616.37
							76.65	1.62	23.00	1098.97
D NT (31˚ to 40˚ deviation)	75.00							1.10	15.30	630.56
		111.63						1.68	22.54	933.56
			111.63					1.68	22.54	1051.28
				108.00				1.62	21.82	946.37
					115.32			1.74	23.28	1077.89
						39.55		0.88	12.53	602.11
							68.86	1.43	20.78	1068.76
D+3M, +6M (31˚ to 40˚ deviation)	90.75							1.35	19.35	841.61
		126.75						1.92	27.01	1143.26
			130.68					1.98	27.85	1229.83
				126.75				1.92	27.01	1143.26
					138.72			2.11	29.58	1458.76
						51.47		1.10	16.37	788.57
							92.27	1.86	28.22	1294.43
D NT (41˚ to 50˚ deviation)	81.12							1.20	16.50	756.47
		119.07						1.80	24.03	1160.78
			119.07					1.80	24.03	1123.50
				122.88				1.86	24.79	1140.29
					130.68			1.98	26.35	1302.63
						54.45		1.12	15.75	750.87

							88.78	1.80	25.79	1219.40

BOQ AS PER THE APPROVED DESIGN FOR 220 kV DC LINE

GADAG - BAGALKOT LINE (L&T DESIGN)

Soil Classification

Tower Type	NDS	WBC	FSS	PSS	WET	DFR	SFR	PSFR	WFR	1:3:6	M20	Steel
										Cmtr	Cmtr	kg
DA (NT,+3,+6)	34.68									0.39	3.11	145.00
		127.53								1.75	9.16	417.00
			77.41							1.00	5.96	267.00
				58.08						0.72	4.86	202.00
					51.91					0.63	4.52	185.00
						19.17				0.42	3.22	148.00
							64.00			1.24	6.89	336.00
								44.00		0.89	5.52	246.00
									30.00	0.63	4.52	185.00
DB (NT,+3,+6)	58.00									0.72	5.59	243.80
		241.92								3.51	19.69	1106.65
			171.46							2.42	13.32	921.44
				136.28						1.88	11.21	717.38
					103.00					1.38	9.12	506.00
						46.28				0.92	6.61	373.15
							149.84			2.77	15.20	971.63
								112.63		2.11	11.87	822.60
									83.24	1.59	9.50	657.52
DC (NT,+3,+6)	70.27									0.90	6.88	371.00
		286.94								4.21	23.04	1558.00
			208.68							3.00	16.95	1219.00
				167.85						2.37	13.99	1004.00
					129.88					1.79	11.24	732.00
						60.41				1.18	8.45	493.00
							181.45			3.39	19.24	1331.00
								139.83		2.59	14.61	1145.00
									106.11	2.00	11.45	1044.00
DD (NT,+3,+6)	81.12									1.06	7.86	445.29
		312.12								4.61	25.42	1968.29
			232.32							3.36	19.07	1545.32
				186.28						2.65	16.84	1025.70
					145.32					2.02	13.22	830.71
						69.91				1.35	10.29	558.16
							206.00			3.75	22.03	1430.90
								156.70		2.89	17.78	1112.78
									118.59	2.22	14.38	878.20

BOQ AS PER THE APPROVED DESIGN FOR 220 kV DC LINE

GADAG - BAGALKOT LINE (L&T DESIGN)

Soil Classification

Tower Type	NDS	WBC	FSS	PSS	WET	DFR	SFR	PSFR	WFR	1:3:6	M20	Steel
										Cmtr	Cmtr	kg
DA (+9 +12 +15 +18 +24)	34.68									0.39	3.11	145.00
		138.72								1.92	9.83	522.27
			85.55							1.12	6.43	334.22
				69.12						0.88	5.49	264.36
					55.99					0.69	4.75	207.70
						19.18				0.42	3.22	147.72
							71.08			1.37	7.41	424.51
								50.13		0.99	5.93	307.81
									34.44	0.71	4.81	209.15

DB (+9 +12 +15 +18)	58.08									0.72	5.38	243.76
		247.34								3.60	20.03	1137.17
			176.03							2.49	13.60	982.80
				140.36						1.95	11.45	755.80
					106.56					1.44	9.33	524.85
						47.23				0.94	6.67	374.58
							154.11			2.84	15.49	981.96
								115.60		2.16	12.08	846.21
									85.79	1.64	9.68	664.40
DC (+9 +12 +15 +18)	75.00									0.97	7.53	441.42
		300.00								4.42	23.85	1746.44
			218.80							3.15	17.56	1338.44
				177.87						2.52	14.59	1129.56
					137.09					1.90	11.73	806.55
						64.80				1.26	8.87	525.28
							190.87			3.56	19.98	1418.84
								148.15		2.74	15.18	1287.00
									111.90	2.10	12.10	1068.45
DD (+9 +12 +15 +18)	87.48									1.15	8.23	537.00
		324.48								4.80	26.19	2205.91
			243.00							3.53	19.73	1698.00
				192.96						2.75	17.25	1105.42
					150.38					2.10	13.53	918.80
						75.83				1.46	10.71	597.12
							213.00			3.87	22.51	1533.70
								165.49		3.04	18.39	1202.84
									123.16	2.30	14.69	937.80

BOQ AS PER THE APPROVED DESIGN FOR 400 kV DC LINE

VASANTHANARASAPURA TO KELAGINAKANIVE LIMITS (KEC)

Soil Classification

Tower Type	NDS	Wet	PS	FS	WBC	DFR	SFR	PSFR	1:3:6	M20	Steel
									Cmtr	Cmtr	kg
A NT +3						52.88			1.10	9.49	634.45
							190.30		3.38	23.17	1470.74
					333.23				4.32	28.84	1902.41
A NT +6						53.41			1.10	9.54	668.00
A NT +9						54.49			1.12	9.65	671.25
A NT / +3/ +6/ +9	95.51								1.10	9.54	727.50
			194.32						2.42	17.09	1180.80
		152.63							1.86	13.85	964.87
A +6/ +9							194.39		3.44	23.55	1480.70
					340.00				4.42	29.38	2019.00
A NT /+3/+6/+9	HR										
DD NT/ +3						319.96			6.01	61.76	4471.58
					1126.22				15.49	150.77	12021.67
DD +6/ +9						322.60			6.05	62.13	4484.00
					1138.63				15.66	152.31	12258.78
DD NT/ +3/ +6/ +9							801.98		13.81	129.23	12114.11
		691.38							9.33	90.35	7472.00
	434.15								5.72	59.35	4324.71
			816.85						11.10	105.68	9368.27
	HR										
DD NT/ +3					668.31				9.00	77.25	6200.00
	HR										
DB NT/ +3/ +6/ +9	212.19						449.98		2.66	25.36	1991.68
									7.71	59.42	5874.00
						162.13			3.06	27.98	2157.18
			449.65						5.94	47.39	4074.00

		374.85			670.21				4.90 9.03	40.36 77.46	3284.49 5689.27

BOQ AS PER THE APPROVED DESIGN FOR 400 kV DC LINE

VASANTHANARASAPURA TO KELAGINAKANIVE LIMITS (KEC)

Soil Classification

Tower Type	NDS	Wet	PS	FS	WBC	DFR	SFR	PSFR	1:3:6 Cmtr	M20 Cmtr	Steel kg
DC NT/ +3/ +6						216.77			3.96	35.82	2971.81
DC NT/ +3/ +6/ +9	281.55 HR		565.79		821.07		573.12		7.56 3.61 9.66 11.16	60.20 33.28 75.35 87.59	6128.78 2766.20 7657.47 8763.28
DC+9						271.86			3.98	35.94	2976.45
DD+18 +25	434.15	691.39	816.85		1138.63	322.60	806.16		6.05 13.88 15.66 5.72 11.10 9.33	62.13 129.81 152.31 59.35 105.68 90.35	4484.00 12248.00 12258.78 4324.71 9275.36 7472.00

Bill of Materials for 400 kV MC Towers suitable for Quad Moose Conductor

(YTPS-BPS Line - M/s. L&T Design)

Type of Tower		Base width (in mm)	Tower weight (in kg)		Bolts, Nuts & Washers (in kg)	Stub weight (in kg)		Bolts, Nuts & Washers (in kg)
			HT	MS		HT	MS	
MA	BTB	17417 x 14639 19612 x 16212	21145.59	8272.32	969.26	956.23	0.00	15.78
	0 ME		2503.89	3140.81	192.04			
	6 ME		1757.29	2944.38	149.42			
MB	BTB	18636 21100	44288.45	15003.76	2650.13	2396.13	0.00	74.17
	0 ME		4687.78	5430.94	374.76			
	6 ME		4079.88	5748.40	280.92			
MC	BTB	19803 22482	50215.68	14313.10	2701.88	2774.16	0.00	86.99
	0 ME		6707.74	6651.88	431.02			
	6 ME		4552.74	6119.81	308.44			
MD	BTB	20196 23000	65662.25	17114.77	3517.22	3487.50	0.00	62.83
	0 ME		14076.22	2672.73	714.27			
	3 ME		17442.02	4190.48	727.93			
	6 ME		8309.04	4589.90	412.30			
	9 ME		12238.68	6021.66	634.14			

STATION STRUCTURES AND MOUNTING STRUCTURES

Sl. No.			Specifications	Unit	Weight of Steel in MT	Weight of B&N in MT	Total in MT
I			**Station Structures - 220 kV Station**				
	A		**220 kV side Station structure**				
		i	Station structures Tower - 2T1 with peak	No.	1.502	0.076	1.578
		ii	Station structures Tower - 2T2 without peak	No.	1.272	0.053	1.325
		iii	Station structures Beam - 2B1 suitable for fixing under hung isolator	No.	1.631	0.064	1.695
		iv	Station structures Beam - 2B2 without under hung isolator	No.	1.112	0.055	1.167
	B		**110 kV side Station structure**				
		i	Station structures Tower - 1T1 with peak	No.	0.908	0.044	0.952
		ii	Station structures Tower - 1T1 with peak with 2.5 metre Extn	No.	1.290	0.062	1.352
		iii	Station structures Tower - 1T2 without peak	No.	1.020	0.066	1.086
		iv	Station structures Beam - 1B1 suitable for fixing under hung isolator	No.	0.524	0.028	0.552
		v	Station structures Beam - 1B2 without under hung isolator	No.	0.429	0.036	0.465
	C		**66 kV side Station structure**				
		i	Station structures Tower - 6T1 with peak	No.	0.891	0.041	0.932
		ii	Station structures Tower - 6T2 without peak	No.	0.732	0.042	0.774
		iii	Station structures Tower - 6T3 with peak	No.	0.865	0.047	0.912
		iv	Station structures Tower - 6T3 with peak with 5 metre Extn	No.	1.359	0.063	1.422
		v	Station structures Beam - 6B1 suitable for fixing under hung isolator	No.	0.443	0.030	0.473
		vi	Station structures Beam - 6B2 without under hung isolator	No.	0.417	0.031	0.448
		vii	Station structures Beam - 6B3 suitable for fixing under hung isolator	No.	0.555	0.039	0.594
	D		**33 kV side Station structure**				
		i	Station structures Tower - 3T1 with peak	No.	0.348	0.017	0.365
		ii	Station structures Beam - 3B1	No.	0.184	0.010	0.194
	E		**Mounting structures for**				
		1	**Isolator**				
		a	**220 kV Isolator**				
		i	Live point height 8250 mm	No.	1.404	0.034	1.438
		ii	Live point height 5750 mm	No.	0.911	0.026	0.937
		b	**110 kV Isolator**				
		i	Live point height 6350 mm	No.	0.894	0.030	0.924
		ii	Live point height 4600 mm	No.	0.726	0.015	0.741
		c	**66 kV Isolator**				
		i	Live point height 5500 mm	No.	0.612	0.014	0.626
		ii	Live point height 4250 mm	No.	0.463	0.012	0.475
		d	**33 kV Isolator**				
		i	Live point height 4750 mm	No.	0.320	0.010	0.330
		ii	Live point height 3750 mm	No.	0.240	0.008	0.248
		2	**Current Transformer**				
		a	For 220 kV CTs and NCTs	No.	0.160	0.010	0.170
		b	For 110 kV CTs and 11 kV NCTs	No.	0.140	0.012	0.152
		c	For 66 kV CTs and NCTs	No.	0.140	0.011	0.151
		d	For 33 kV CTs and NCTs	No.	0.142	0.010	0.152
		3	**Voltage Transformers / CVTs**				
		a	For 220 kV VTs and CVTs	No.	0.170	0.010	0.180
		b	For 110 kV VTs	No.	0.131	0.011	0.142

Sl. No.			Specifications	Unit	Weight of Steel in MT	Weight of B&N in MT	Total in MT
		c	For 66 kV VTs	No.	0.163	0.010	0.173
		d	For 33 kV CTs	No.	0.142	0.010	0.152
		4	**Surge Arrestors**				
		a	For 198 kV LAs	No.	0.180	0.005	0.185
		b	For 96 kV LAs	No.	0.100	0.011	0.111
		c	For 60 kV LAs	No.	0.142	0.005	0.147
		d	For 30 kV LAs	No.	0.070	0.005	0.075
		5	**For Post insulator of Rigid bus**				
		a	For 220 kV side	No.	0.127	0.017	0.144
		b	For 110 kV side	No.	0.129	0.012	0.141
		c	For 66 kV side	No.	0.133	0.010	0.143
		d	For 33 kV side	No.	0.070	0.005	0.075
		6	**For High Post insulator of Transformers & CBs**				
		a	For 100 MVA Transformer both on 220 kV side & 110 kV/66 kV side	No.	0.204	0.017	0.221
		b	110/66 kV Capacitor Bank	No.	0.201	0.017	0.218
		c	110/11 kV or 66/11 kV Transformer	No.	0.201	0.017	0.218
II			**Station structures - 110 kV & 66 kV Stations**				
	A		**110 kV/66 kV side Station structures fabricated out of galvanised mild steel**				
		i	Station Towers (Verticals 1T1)	No.	0.91	0.0455	0.956
		ii	Station Beams 1B1	No.	0.48	0.024	0.504
	B		**33 kV side Station structures fabricated out of galvanised mild steel**				
		i	Station Towers (Verticals 3T1)	No.	0.57	0.0285	0.599
		ii	Station Beams 3B1	No.	0.23	0.0115	0.242
	C		**11 kV side Station structures**				
		i	Columns out of 8.0 metre Length RCC pole of working load 115 kg (using TOR Steel)	No.	As per ESCOM SR		
	D		**Beam out of Channel 100 x 50 with arrangements for stringing power conductor on 11 kV side**				
		i	1B1 7.45 metre Long	No.	0.068	0.0034	0.071
		ii	1B2 4.00 metre Long	No.	0.036	0.0018	0.038
	E		**8.0 metre Long RCC pole of WL 115 kg for 11 kV Double pole structures for mounting roaster Isolator (1 for Aux, Distribution Transformer)**	No.	As per ESCOM SR		
	F		**Mounting Structures**				
	i		110/66 kV Isolators	No.	0.724	0.036	0.760
	ii		33 kV Isolators	No.	0.24	0.012	0.252
	iii		Current Transformers 110/66 kV + 11 kV NCT	No.	0.142	0.007	0.149
	iv		Current Transformers 33 kV	No.	0.142	0.007	0.149
	v		Voltage Transformers 110/66 kV	No.	0.142	0.007	0.149
	vi		Voltage Transformers 33 kV	No.	0.142	0.007	0.149
	vii		Surge Arrestors 96/60 kV	No.	0.069	0.003	0.072
	viii		Surge Arrestors 30 kV	No.	0.069	0.003	0.072
	ix		11 kV cable terminating structure of LV side of 110/66/11 kV Tr.	No.	0.069	0.003	0.072
	x	a	For Pedestal Insulator 110/66 kV	No.	0.14	0.007	0.147
		b	For Pedestal Insulator 33 kV	No.	0.14	0.007	0.147

Sl. No.			Specifications	Unit	Weight of Steel in MT	Weight of B&N in MT	Total in MT
		c	For High Pedestal Insulator 110/66 kV	No.	0.22	0.011	0.231
		d	For High Pedestal Insulator 33 kV (with bolted type foundation)	No.	0.22	0.011	0.231
		e	For High Pedestal Insulator 11 kV (with bolted type foundation)	No.	0.22	0.011	0.231