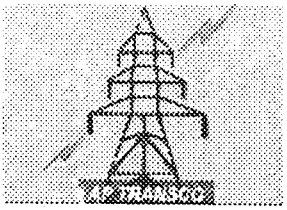
REFERENCE BOOK
on
220 kV & 132kV
TRANSMISSION LINE
TOWERS
in
APTRANSCO



PREFACE

APSEB was established in the year 1956. Since than it started procurement of difference types of transmission line towers required for it from various manufacturers like Kamani, SAE, EMC, MPEB, L&T etc., through 28 to 30 specifications.

The following towers depicted in the table are in general use.

Sl. No	Description	Original Spec. No. Under which procured	Remarks
	132 kV towers.		
1	132 kV lines with panther ACSR	APT-19/75	Kamani towers (P,R,S)
2	132 kV Multi-circuit lines (4 circuits with panther ACSR)	APT-32/88	SAE towers (K,L,M)
3	132 kV Narrow base towers	-	$(0,30^0,60^0)$ towers
	220 kV towers.	-	
4	220 kV lines with Moose/Zebra ACSR	APT-39/90	L&T towers (A,B,C,D)
5	220 kV Twin Moose lines	APT-16/91	EME towers (A,B,C,D)
6	220 kV Multi-circuit lines (4 circuits with Zebra ACSR)	APT-32/88	SAE towers (X,Y,Z)
7	220 kV Narrow Base towers	-	60^0 towers
8	220 kV lines with Moose/Zebra (with less base width)	APT-21/76	TSP towers (A,B,C)
9	River crossing with Moose/Zebra	MPEB towers	JCM type towers

INDEX OF TOWERS

ANNEXURE - 1

OVERVIEW OF INDIAN STANDARD CODE OF PRACTICE FOR DESIGN OF TRANSMISSION LINE TOWER

- Code formulation initiated by Central Electrical Commissic -- 1950
- Code of practice published by CW and PC (pw) -- 1952
- Code of practice (IS: 802) - published by ISI -- 1967
- Revision of IS: 802 - by ISI -- 1973 and 1977
- Revision of IS: 802 (Probabilistic Approach) - by BIS
  - Part 1 : Material, loads and permissible stress
  - Sec 1 : Material and loads -- 1995
  - Sec 2 : Permissible stress -- 1992
  - Amendment no. 1 to Sec 2 -- 1994
  - Amendment no. 1 to Sec 2 -- under finalization

WIND LOADING ON TOWER AND CONDUCTOR

Wind Pressure (kg/m^2)		CW/C Code 1952	IS : 802 - 1967	IS : 802 - 1973 Amendment 8/74	IS : 802 - 1977 Amendment 8/81	IS : 802 - 1995 Part 1 / Sec 1
	ZONE					
Tower	I	48.85	100	120 / 130	130	219 xx
	II	65.08	150	200 / 195	195	306 xx
	III	97.05	200	250 / 26	260	389 xx
	IV					444 xx
	V					502 xx
	VI					908 xx
Conductor	I	48.85	75.0 +	40.0 x	43.0 x	73.0 xxx
	II	65.08	122.5 +	45.0 x	45.0 x	102.0 xxx
	III	97.05	150.0 +	50.0 x	52.0 x	130.0 xxx
	IV					148.0 xxx
	V					168.0 xxx
	VI					203.0 xxx
Combination of loading			Min. temp. and Maximum wind pressure	32^0C + maximum wind pressure	32^0C + maximum wind pressure (or) minimum temp. + $2/3^{rd}$ maximum wind	32^0C + maximum wind pressure (or) minimum temp. and 36% of maximum wind pressure

Note:

1) + -$2/3^{rd}$ projected area.
2) x - on full projected area.
3) xx - based on the following assumption and for 30m height.
   Solidity ratio = 0.25, Drag coefficient = 2.7, Gust factor = 2.3
4) xxx - gust response factor - 2.08
   Corresponding to:
   Span - 400 m, Terrain category II
   Height - 30 m, Reliability level - 1
   (Considering wind pressure remains unaltered within height of 30m)

STATEMENT OF TYPES OF TOWERS USED FOR 220 KV LINES

Sl. No.	Types of Towers Nomenclature	Designer's Identity	Lines for which Towers Are used
1	220 kV Single circuit Horizontal formation towers types. A1 mkd A B1 mkd B C1 mkd C	Kamani's towers against APSEB's Spec.No.APT 5/61 design for 150 kg/sqm wind pressure W.O : 364 APT 5/61	i. Upper Sileru - Gazuwaka. ii. Upper Sileru - KTPS. iii. Part of Srisailam - Mydakur Kadapa up to Allagadda re-crossing. iv. KTPS - Nagarjuna Sagar.
2	220 kV Single circuit Horizontal formation towers types. A2 mkd P B2 mkd Q C2 mkd C	Kamani's towers designed for 100 kg/sqm wind pressure 'C' type tower common for both designs. W.O : 412 APT 11/63	i. Part of Srisailam - Cuddapah line from Allagadda road crossing. ii. Cuddapah - Chittoor - Tiruvalam (Madras Border) iii. KTPS - Gunadala part requirement. iv. Nagarjuna Sagar - Srisailam.
3	220 kV Single circuit Vertical formation towers types. K, L and M	SAE's Towers against APSEB's Spec.IDA11.	i. VTS - Ongole ii. Ongole - Nellore. iii. Lower Sileru - KTPS. iv. VTS -Gunadala. v. VTS -Guntur.
4	220 kV Single circuit Vertical formation towers types. A2/X, B2/Y, C2/Z	Kamani's towers against APSEB's Spec.No.APT 29/70 'A' type tower designed for 150 kg/sqm wind pressure 'B' and 'C' type designed for 150 kg/sqm wind pressure. APT 29/70	i. Nellore - Sullurpet ii. Sullurpet - Tamil Nadu Border 132 kV from Nellore to 220 kV SS Navlok - Garden (Nellore South) 132 kV erected on 220 kV vertical format towers.
5	220 kV Single circuit Vertical formation towers types. A, B & C	Kamani's towers against APSEB's Spec.No.APT 29/70 'A' type tower designed for 100 kg/sqm wind pressure 'B' and 'C' type designed for 150 kg/sqm wind pressure. APT 29/70 are used on Hampi - Gooty and Nellore - Tamilnadu 220 kV SC lines.	i. Hampi - Gooty.

Sl. No.	Types of Towers Nomenclature	Designer's Identity	Lines for which Towers Are used
6	220 kV Single circuit Vertical formation towers types. X mkd AA Y mkd BB Z mkd CC	SAE's towers against APSEB's Spec.No.APT 35/70 'A' type tower designed for 150 kg/sqm wind pressure.	i. Lower Sileru - Bommur.
7	220 kV Single circuit Vertical formation towers types. A, B and C	SAE's towers against APSEB's Spec.No.APT 35/70 'A' type tower designed for 100 kg/sqm wind pressure.	i. KTPS - Shapurnagar.
8	220 kV Double circuit towers types. AS, BS and CS	SAE's towers against APSEB's Spec.No.APT 21/76.	i. Bommuru - Gazuwaka.
9	220 kV Double circuit towers types. AS, BS and CS	TSP's tower against APSEB's Spec.No.APT 21/76. AS type tower designed for 100 kg/sqm wind pressure. BS and CS towers designed for 150 kgs wind pressure.	1) Gajuwaka - Garividi (A-type SAE, B&C, TSP). 2) VTS - Gunadala. 3) Kandapalli - Chillakallu. 4) VTS - Tadikonda. 5) Chinakampally - Rajampet. 6) Rajampet - Kodur. 7) Kodur - Renigunta. 8) Gooty - Anantapur 9) Anantapur - Hindupur 10) Srisailam - Somayajulapally. 11) Somayajulapally - Gooty. 12) Srisailam - Podili. 13) Podili - Ongole. 14) Shapurnagar - Gachibowli. 15) Gachibowli - Tandur (LILO to Gachibowli from Hyd-Shapur). 16) Shapurnagar - Malkaram. 17) Malkaram - Ghanapur. 18) Chandrayanagutta - Ghanapur. 19) Ch.gutta - Shapurnagar. 20) LILO to Yeddaumailaram (from Shapurnagar - Tandur line). 21) Ramagundam - Warangal. 22) Kalwakurthy - Mahaboobnagar. 23) LILO to Kalikiri (from Chinakampally to Chittoor line).

Sl. No.	Types of Towers Nomenclature	Designer's Identity	Lines for which Towers Are used
			24) Srisailam - Chandrayanagutta LILO to Kalwakurthi (from Srisailam to Chandrayanagutta line). 25) LILO to Anantapur. 26) Ramagundam - Nizamabad. 27) LILO to Somayajulapplly. 28) Somayajulapplly - Nandyal. 29) Somayajulapplly - AP Carbides. 30) LILO to Tadikonda. 31) KTPS - Seetharampuram (AS).
10	220 kV Double circuit towers types. AV, B and C	TSP's tower against APSEB's Spec.No.APT 25/76. AV type tower designed for 150 kg/sqm wind pressure.	i. VTS - Bommuru. ii. Nagarjunasagar - Srisailam. iii. VTS - Tallapalli LILO to Bhimadolu (from VTS - Bommuru line (AV)) iv. LILO to Nunna v. KTPS -Gunadala.
			vi. VTPS - Nunna. vii. LILO - Mydukur. viii. LILO - Gachibowli. ix. LILO to Moulali (from Shapurnagar - Ghanapur). x. Hyderabad - Shahabad DC (upto Chennaram). AS, B,C. xi. Manugur - Heavy Water plant LILO to Miryalagda. xii. Shapurnagar - Ghanapur. xiii. Kurnool - Somayajulapalli.
11	220 kV Double Circuit Towers types B and C.	Modified TSP's towers of APSEB's Spec.APT25/76 suitable for Moose ACSR.	1. Nagarjunasagar PH - Tallapally (AV).
12	220 kV Double Circuit Towers types A, B, C&D.	L&T towers against APSEB's Spec.APT39/90	1) VTS - Podili 2) Podili - Nellore 3) Nellore - Renigunta 4) Renigunta - Chittoor 5) Gooty - Bhogasamudram 7) Bhogasamudram - Tadipatri 8) Narketpally - Malkaram

Sl. No.	Types of Towers Nomenclature	Designer's Identity	Lines for which Towers Are used
			9) Medchal - Minpur 10) LILO to Waddekothapally 11) Ramagundam - Durshed (Karimnagar) 12) Durshed (KRM) - Siddipet 13) Ramagundam - Nirmal 14) VSS to VSP 15) LILO to Bhimadole (from VTS Bommur line) 16) LILO to Vijjeswaram (from VTS Bommur line) 17) LILO to Nidadavolu (from VTS Bommur line) 18) Bommuru - Jegurupadu 19) LILO to Pendurthi 20) LILO to Nunna 21) Interconnection lines from Ramagundam STPP to Malayalapally 22) LILO to GBTS (from Bommuru - Gajuwaka line) 23) LILO to Kakinada (from Bommuru - Gajuwaka line) 24) Ramagundam - Jagityal 25) LILO to Tandur. 26) Mamidipally - Yeddumailaram 27) LILO to Chalakurthi
			28) VSS - Pendurthi 29) Gajuwaka - VSS 30) LILO to Peddapuram switching station. 31) Peddapuram - BSES 32) Nunna - VTS 33) Kondapally - Lanco 34) LILO lines to Dindi swithcing station. 35) LILO to Ramagiri (from Gooty - Hindupur) 36) LILO to Anantapur (from 400)

Sl. No.	Types of Towers Nomenclature	Designer's Identity	Lines for which Towers Are used
			37) Direction of 220 kV DC line of Srisailam - Somayajulapally at 38) Khammam - Miryalaguda 39) Peddapuram - Vemagiri - Bommuru 40) LILO to Sivarampally (from Mamidipally - Gachibowli) 41) Pendurthi - Diary forum 42) Nidadavolu - Bhimadolu 43) LILO to Mamidipally (from Ch.gutta - Gachibowli) 44) Interlinking lines at Nannur. 45) LILO to Markapur (from Srisailam - Podili)
13	220 kV DC tower	EMC towers	1) RTPP - Cuddapah (Chinakampalli)
14	220 kV DC tower	KEC design (designed to RSEB)	1) Muddanur (RTPP) - Anantapur 2) RTPP - Yerraguntla.
15	220 kV DC tower	SAE designed	1) LILO to Gachibowli 2) Shapurnagar - Ch.gutta

220 kV DC Muddanuru - Kadapa DC Transmission line with Twin Moose ACSR

Spec. No. APT 16/91

Make - EMC

Sl. No.	Structure Type	Approx Unit Weight in MT	Approximate weight bolts &
I) Type of Tower : A (EMC Design)			
1	Stub & Cleat	0.328	0.00211
2	SST for NT, +3,+6 & +9	0.912	
3	Normal Tower	6.35968	0.30707
4	+ 3 meters extensions	1.12156	0.0365
5	+ 6 meters extensions	1.9282	0.06601
6	+ 9 meters extensions	2.55516	0.08447
7	+ 12 meters extensions	3.37708	0.10782
II) Type of Tower : B (EMC Design) (15^0)			
1	Stub & Cleat	0.635	0.00803
2 a	SST for 0 , 3 & 6	1.31396	0.035
2 b	SST for +9 & +12	1.526	0.035
3	Normal Tower	10.30953	0.45269
4	+ 3 meters extensions	1.6796	0.0394
5	+ 6 meters extensions	2.84816	0.10634
6	+ 9 meters extensions	3.99836	0.12898
7	+ 12 meters extensions	5.3986	0.18353
III) Type of Tower : C (EMC Design) (30^0)			
1	Stub & Cleat	0.82816	0.01373
2 a	SST for NT,+3 & +6	2.182	0.037
2 b	SST for +9 & +12	2.549	0.045
3	Normal Tower	12.41561	0.5014
4	+ 3 meters extensions	2.2962	0.08273
5	+ 6 meters extensions	3.6272	0.10669
6	+ 9 meters extensions	4.95875	0.15175
7	+ 12 meters extensions	6.4922	0.18041
IV) Type of Tower : D (EMC Design) (60^0)			
1	Stub & Cleat	1.21804	0.01443
2 a	SST for NT, +3 & +6	2.836	0.043
2 b	SST for +9 & +12	3.273	0.052
3	Normal Tower	17.01223	0.78771
4	+ 3 meters extensions	3.14544	0.14493
5	+ 6 meters extensions	4.57215	0.17948
6	+ 9 meters extensions	6.34963	0.23759
7	+ 12 meters extensions	7.99832	0.27091

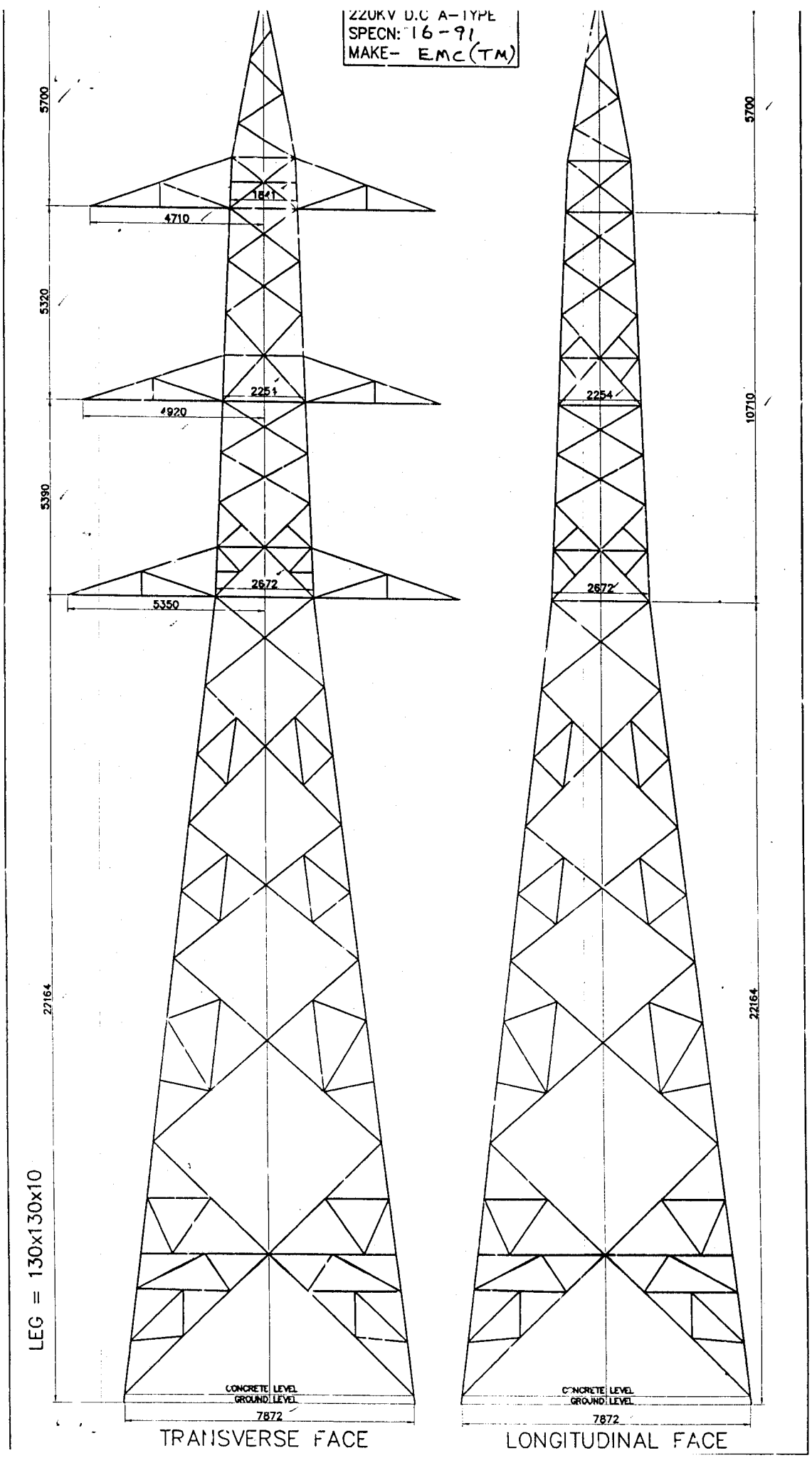
Spec. No. APT 16/91

Make - EMC

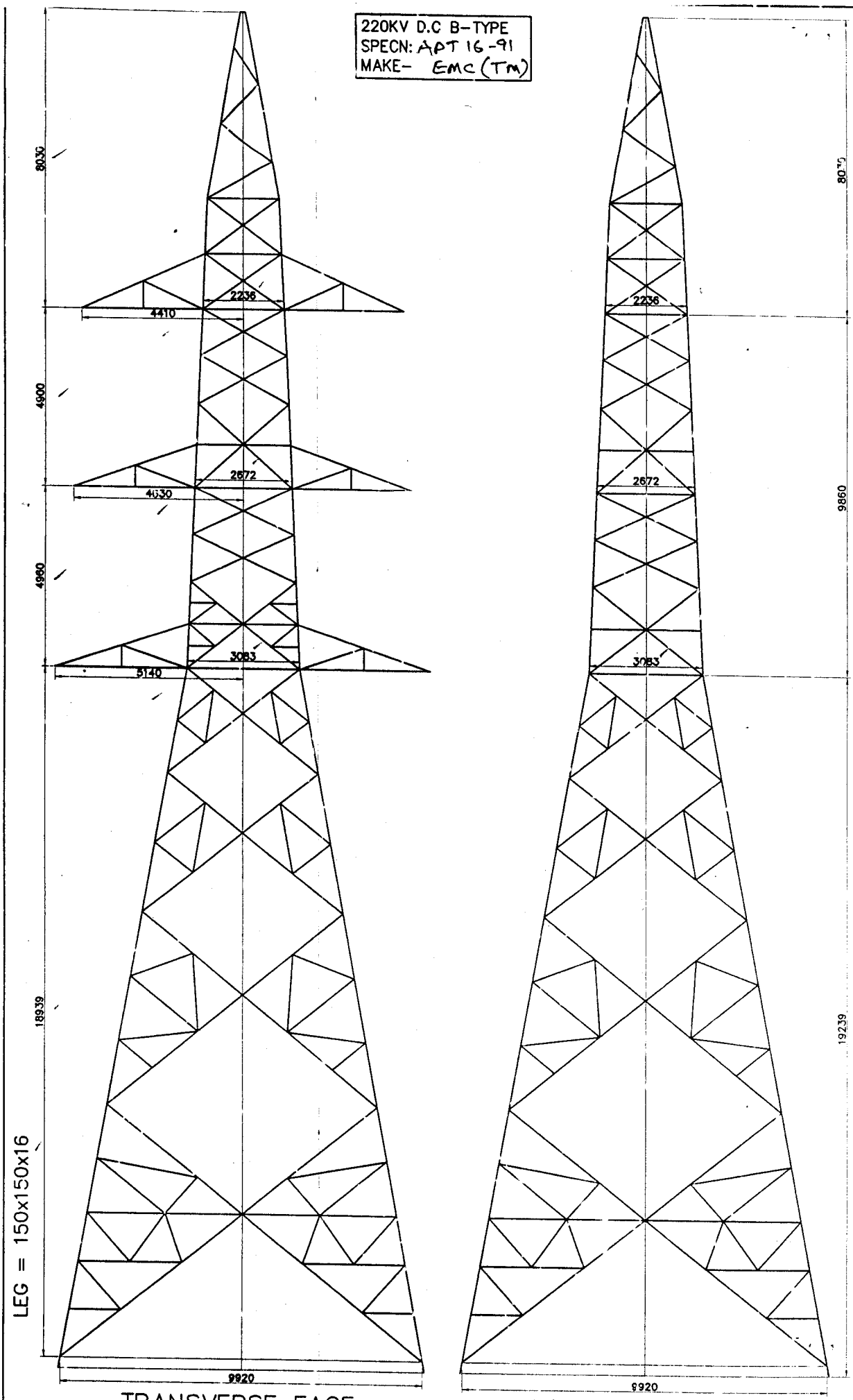
220 kV DC transmission line Muddanuru - Kadapa DC line with Twin Moose ACSR

S. No	Type of tower	Type of classification	Excavation volume in Cu.m.	Sand Bed in Cu.m.	PCC 1:3:6 in Cu.m.	PCC 1:2:4 in Cu.m.	Reinforcement Steel in kgs
1	A	Dry	47.47		--	5.12	--
2		Wet	92.67		--	11.9	--
3		PS	101.28		--	19.13	--
4		FS	128.49		--	26.38	--
5		Hard Rock	4.8		--	5.04	--
6		F & F rock	--		--	--	--
7	B	Dry	108.73		--	16.13	--
8		Wet	208.98		--	37.07	--
9		PS	228.62		--	53.26	--
10		FS	269.31		--	69.47	--
11		Hard Rock	8.79		--	9.03	--
12		F & F rock	--		--	--	--
13	C	Dry	140.69		2.1	13.33	0.94
14		Wet	277.24		3.45	23.78	1.85
15		PS	338.89		4.27	29.26	2.19
16		FS	442.18		5.66	42.76	2.83
17		Hard Rock	10.14		--	10.38	--
18		F & F rock	--		--	--	--
19	D	Dry	246.96		3.04	26.13	1.91
20		Wet	399.22		5.08	40.68	3.48
21		PS	487.34		6.27	50.9	3.71
22		FS	586.05		7.62	64.41	3.82
23		Hard Rock	12.18		12.54	12.18	7.23
24		F & F rock	--	--	--	--	--

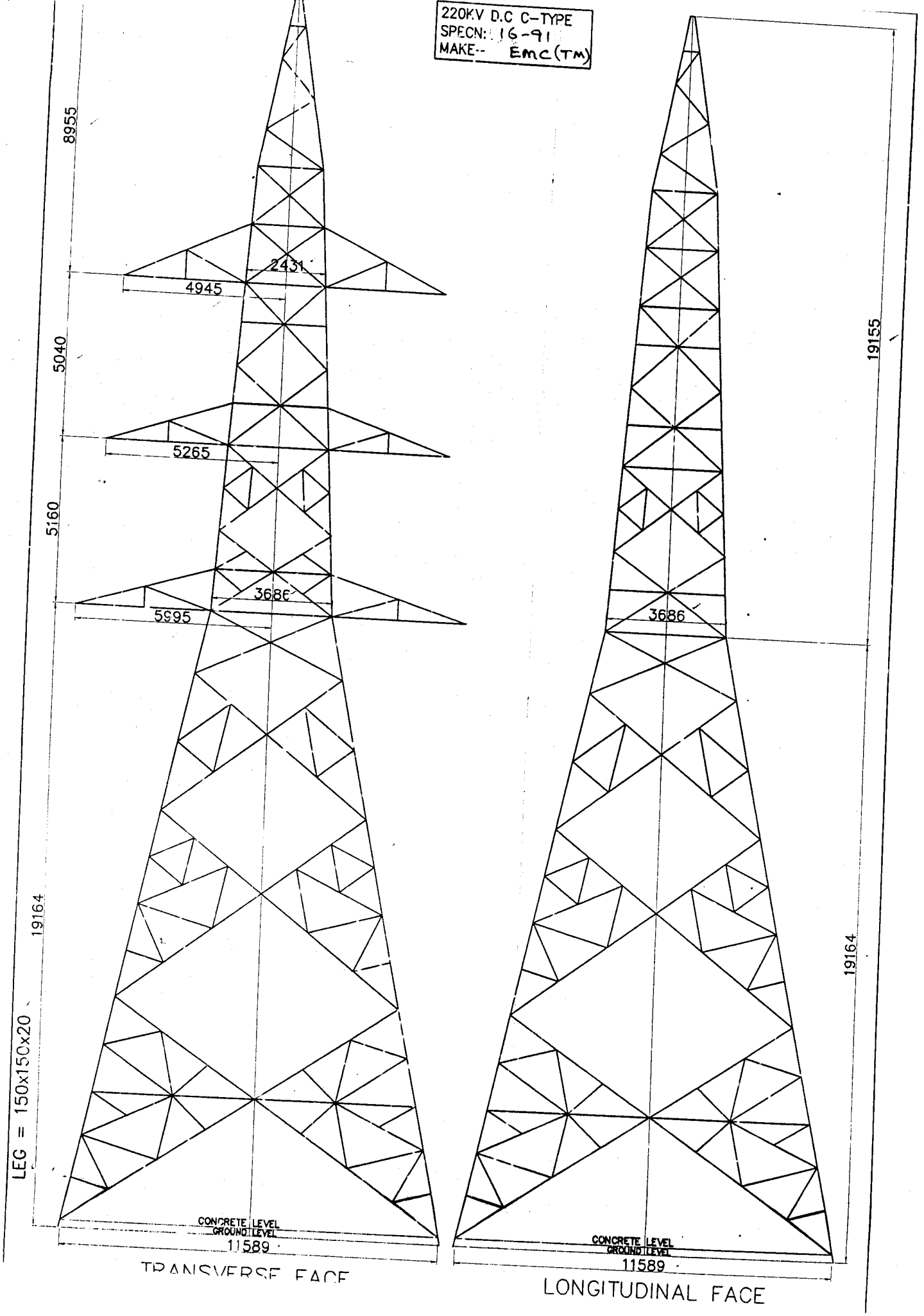
220KV D.C A-TYPE
SPECN: 16-91
MAKE- EMC(TM)



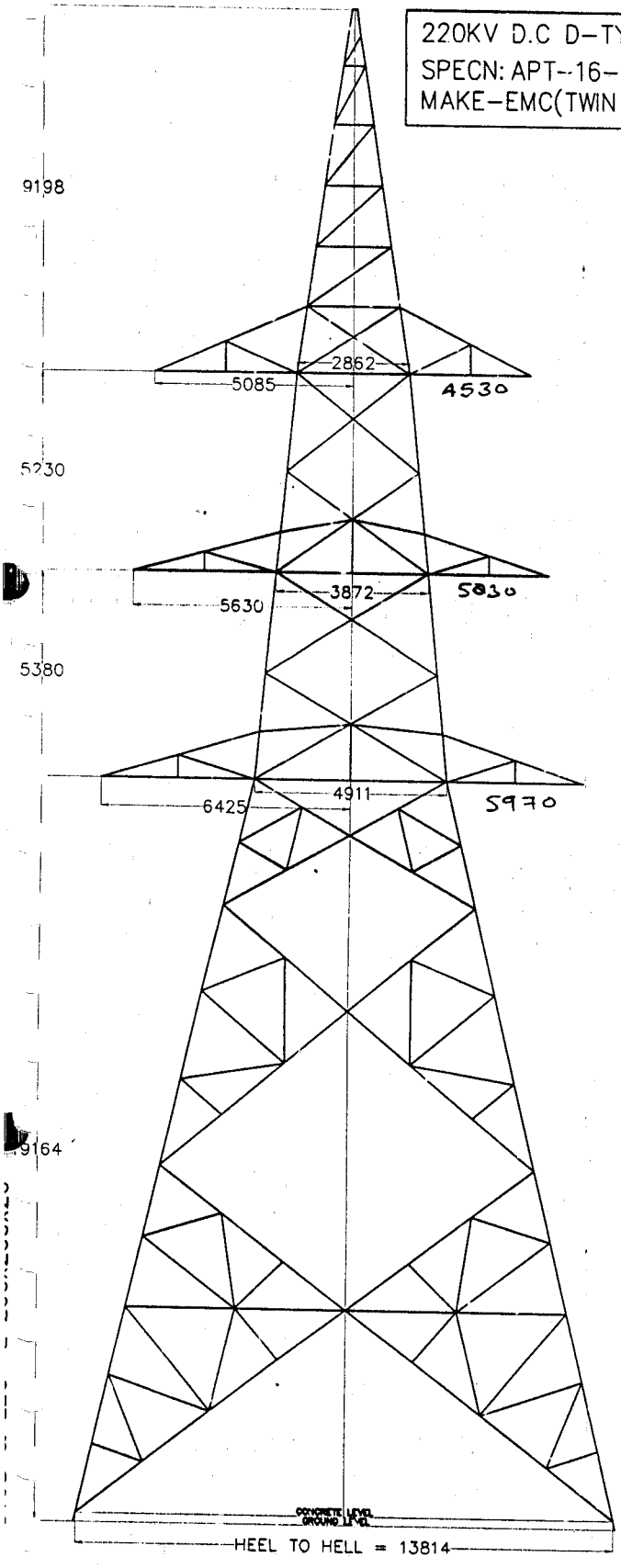
220KV D.C B-TYPE
SPECN: APT 16-91
MAKE- EMC (TM)



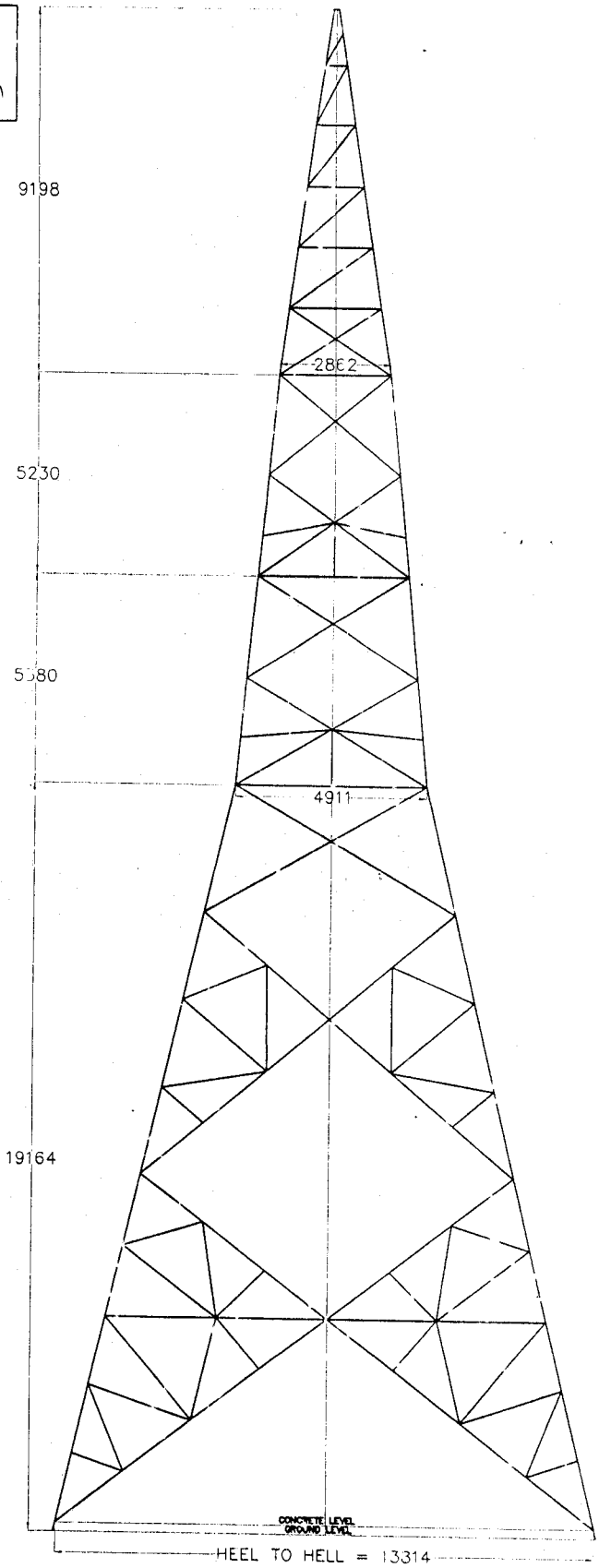
220KV D.C C-TYPE
SPECN: 16-91
MAKE-- EMC(TM)



220KV D.C D-TYPE
SPECN: APT--16-91
MAKE-EMC(TWIN MOOSE)



TRANSVERSE FACE



LONGITUDINAL FACE

220 kV DC Transmission Line Spec. APT 16/91

MUDDANUR TPS - YERRAGUNTLA & MUDDANUR TPS - DHARMAVARAM

Make: - KEC

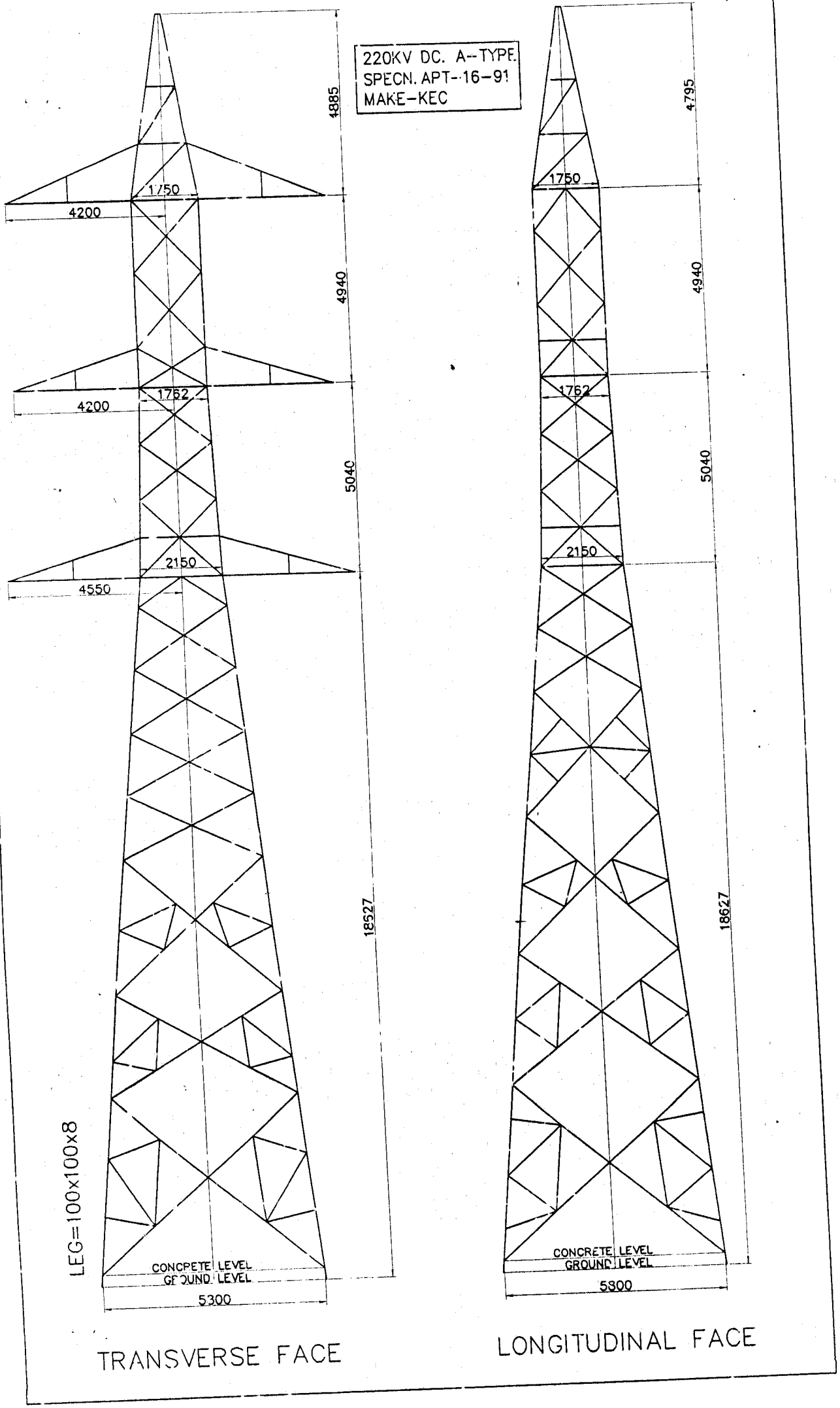
Sl. No.	Structure Type	Approx. Unit Weight in MT	Weight of Bolts & Nuts
I)	**Type of Tower : A**		
1	Super Structure #	3565.28	166.75
2	Stub & Cleats L 100 x 100 x 8		
3	Stub Setting Templates	882.96	22.77
4	+ 3 meters extensions	504.20	25.00
5	+ 6 meters extensions	946.200	39.38
6	+ 9 meters extensions	1770.08	73.81
7	+ 12 meters extensions	2498.80	101.71
II)	**Type of Tower : B**		
1	Super Structure		
2	Stub & Cleats		
3	Stub Setting Templates NT +3, +6	1084.60	23.16
4	+ 3 meters extensions		
5	+ 6 meters extensions	1660.310	41.72
6	+ 9 meters extensions	2935.39	82.51
7	+ 12 meters extensions		
III)	**Type of Tower : C**		
1	Super Structure		
2	Stub & Cleats		
3	Stub Setting Templates NT, +3, +6	1079.32	22.70
4	+ 3 meters extensions		
5	+ 6 meters extensions		
6	+ 9 meters extensions	3759.49	163.93
7	+ 12 meters extensions	4679.48	204.17
IV)	**Type of Tower : D**		
1	Super Structure		
2	Stub & Cleats		
3	Stub Setting Templates NT, +3, +6	1747.32	35.65
4	+ 3 meters extensions	2164.52	69.99
5	+ 6 meters extensions		
6	+ 9 meters extensions		
7	+ 12 meters extensions		

Inclusive Addl. Members + Hangers + U-Bolts + Step bolts.
All black weights.

Muddanur - Yerraguntla

FOUNDATION DETAILS APT16/91 (KEC)

Sl. No.	Types	Type of foundation	Stub size	Depth of foundation	Vol. of Concrete (Cum)	Vol. of Excavation (Cum)	Reinforcement steel (Kgs)
I)	**Type of Tower : A**						
1	Dry	Frustrum	100 x 100 x 8	2800	2.596	26.562	
2	Wet	Frustrum		2850	7.036	54.676	
3	PS	Frustrum		--	10.713	76.713	
4	FS	Pad & Chimney		2900	9.656	98.905	474.739
5	Rock	Frustrum		2800	6.003 to 2.863	--	
6	Fissured	Frustrum		2800	5.190	25.686	
II)	**Type of Tower : B**						
1	Dry	Frustrum	110 x 110 x 10	3050	3.267	34.844	
2	Wet	Frustrum		3100	10.170	78.745	
3	PS	Frustrum		--	15.091	105.727	
4	FS	Pad & Chimney		3150	12.641	133.087	663.52
5	Rock	Frustrum		3050	8.058 to 4.060	--	
6	Fissured	Frustrum		3050	8.185	35.804	
III)	**Type of Tower : C**						
1	Dry	Frustrum	130 x 130 x 10	3250	4.816	47.425	
2	Wet	Frustrum		3300	11.991	94.101	
3	PS	Frustrum		--	17.353	124.409	
4	FS	Pad & Chimney		3350	14.887	154.904	709.743
5	Rock	Frustrum		3250	9.690 to 5.514	--	
6	Fissured	Frustrum		3250	10.257	43.168	
IV)	**Type of Tower : D**						
1	Dry	Frustrum	150 x 150 x 12	3450	5.974	59.704	
2	Wet	Frustrum		3500	15.275	118.553	
3	PS	Frustrum		--	21.891	153.385	
4	FS	Pad & Chimney		3550	17.238	186.082	891.75
5	Rock	Frustrum		3450	13.307to7.818	--	
6	Fissured	Frustrum		3450	13.036	54.732	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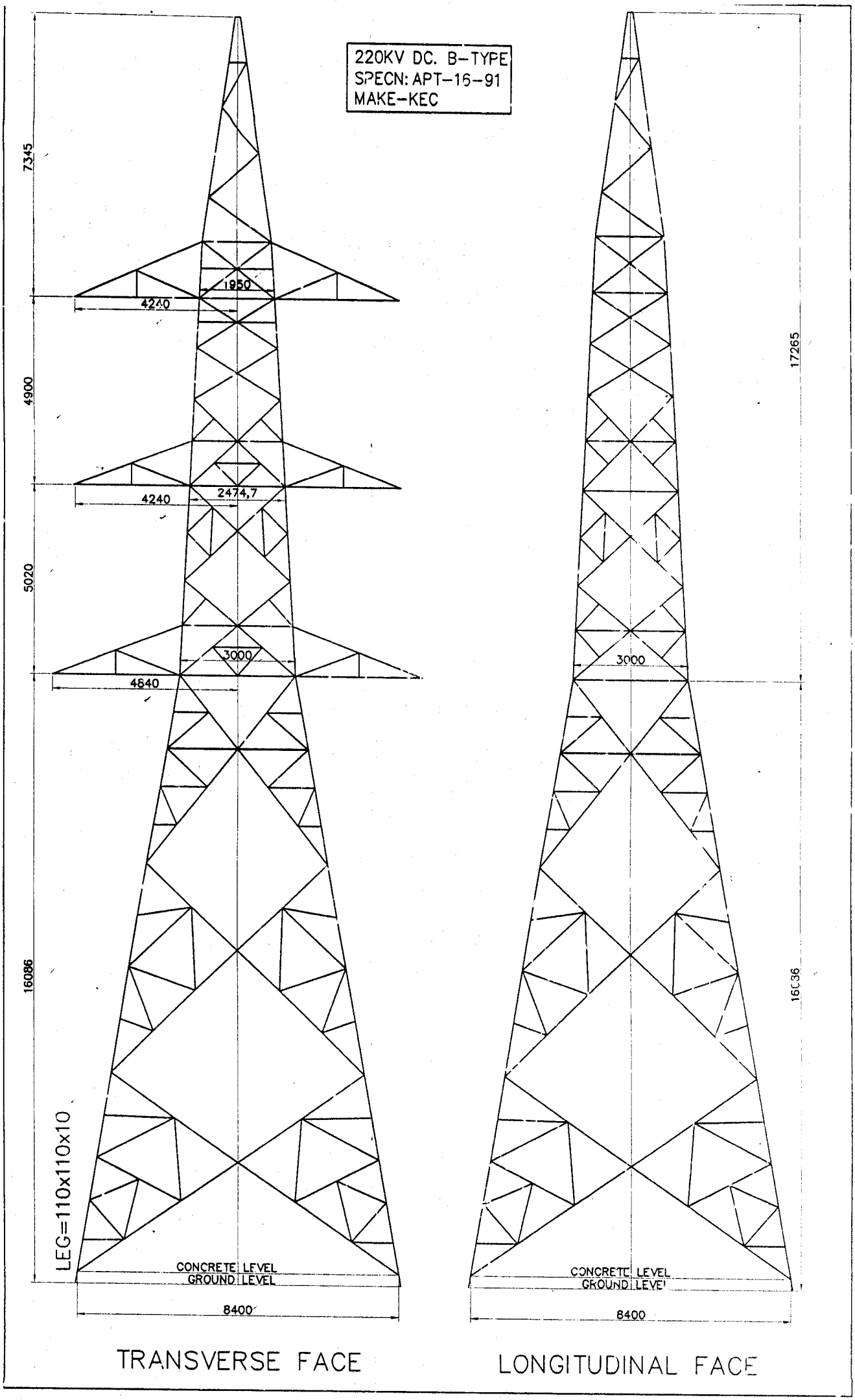
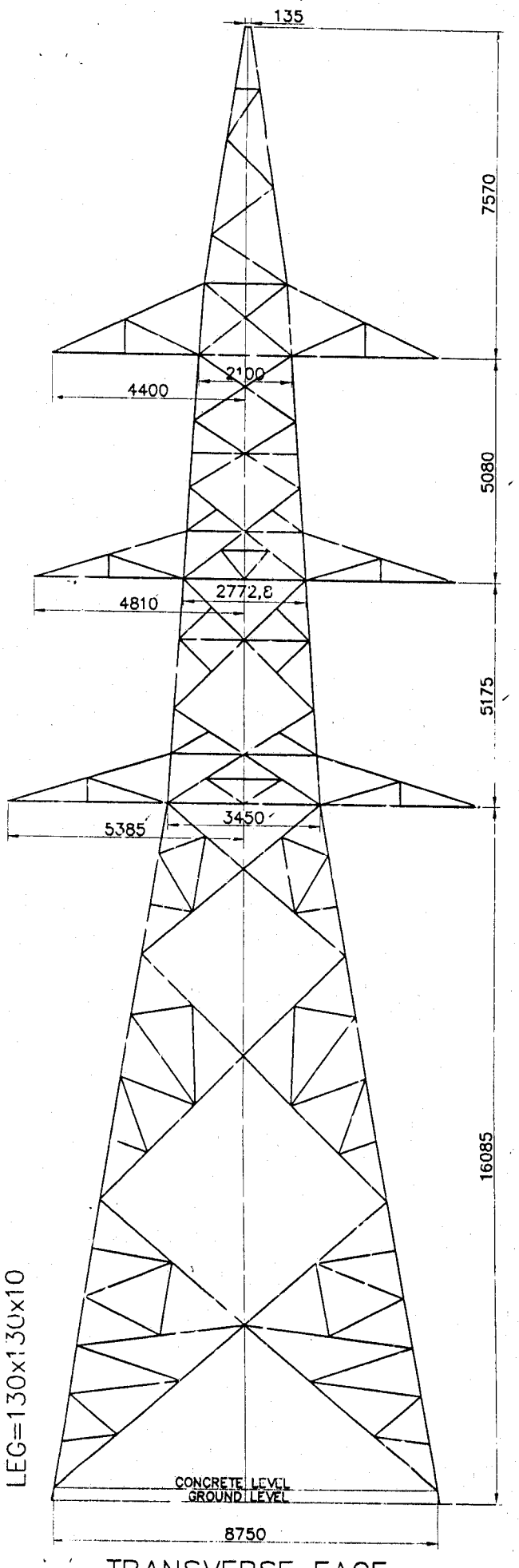
SPECN. APT--16-91
MAKE-KEC
4885
4940
5040
18527
1750
4200
1762
4200
2150
4550
LEG=100x100x8
CONCRETE LEVEL
GROUND LEVEL
5300
TRANSVERSE FACE
4795
4940
5040
18627
1750
1762
2150
CONCRETE LEVEL
GROUND LEVEL
5300
LONGITUDINAL FACE



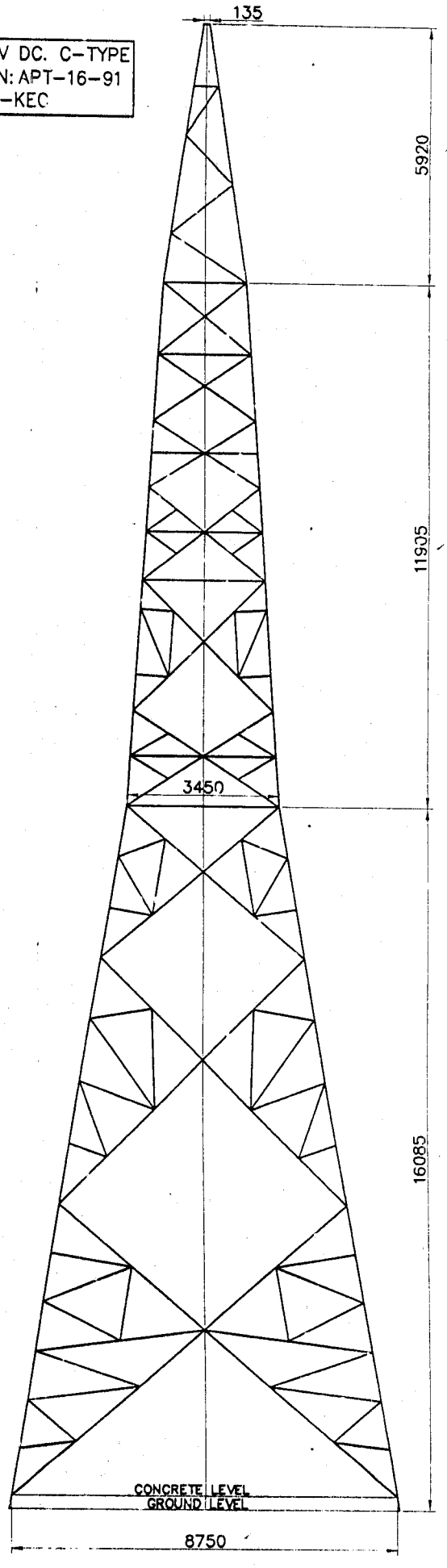
TRANSVERSE FACE

LONGITUDINAL FACE

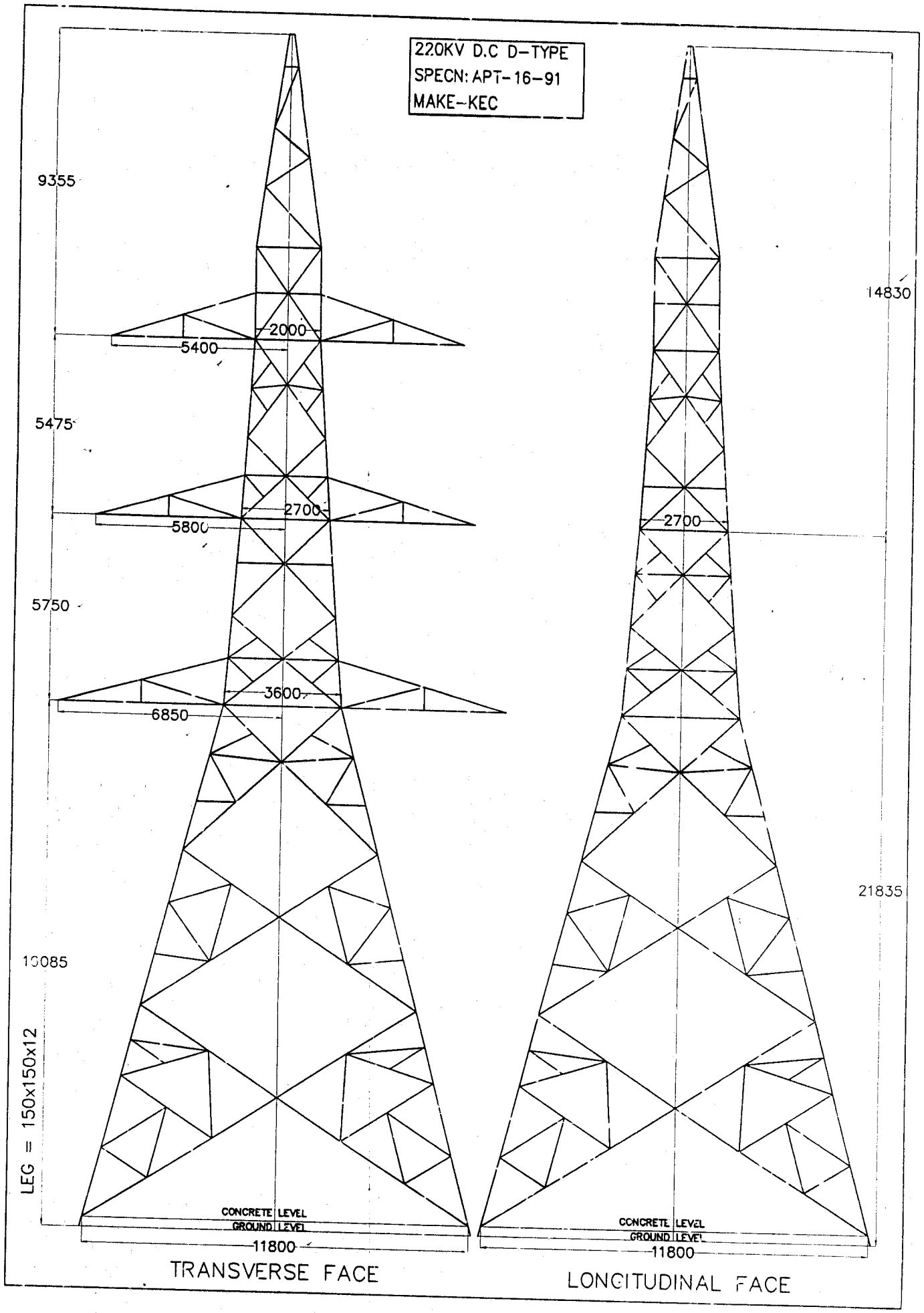
220KV DC. C-TYPE
SPECN: APT-16-91
MAKE-KEC



TRANSVERSE FACE



LONGITUDINAL FACE


220KV D.C D-TYPE
SPECN: APT-16-91
MAKE-KEC
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5475
5750
10085
14830
21835
2000
5400
2700
5800
3600
6850
2700
LEG = 150x150x12
CONCRETE LEVEL
GROUND LEVEL
11800
CONCRETE LEVEL
GROUND LEVEL
11800
TRANSVERSE FACE
LONGITUDINAL FACE

220 kV DC Transmission line

Spec - APT 39/90
Make - L&T

Sl. No.	Structure Type	Approx Unit Weight in Kg	Weight of Bolts & Nuts
I)	**Type of Tower : A**		
1	Stub & Cleat for NT,+3,+6	222.92	2.26
2	Stub & Cleat for +9 & +12	247.72	2.26
3	SST for NT, +3,+6	756.14	28.66
4	SST for +9, +12	877.34	28.83
5	Normal Tower	4120	274.262 *
6	+ 3 meters extensions	639	29.04
7	+ 6 meters extensions	1172.72	45.907
8	+ 9 meters extensions	2190	
II)	**Type of Tower : B**		
1	Stub & Cleat for NT,+3,+6	337.28	2.26
2	SST for NT, +3 +6	1021.8	28.572
3	Normal Tower	6571.4	342.389
4	+ 3 meters extensions	1120.46	34.424
5	+ 6 meters extensions	2095.85	84.709
6	+ 9 meters extensions	3270	
III)	**Type of Tower : C**		
1	Stub & Cleat for NT,+3,+6&+12	484.24	2.24
2	Stub & Cleat for +9	484.24	2.24
3	SST for NT,+3,+6,+9 &+12	1331.72	23.508
4	Normal Tower	7815.94	376.126
5	+ 3 meters extensions	1261.92	51.14
6	+ 6 meters extensions	2177.4	74.78
7	+ 9 meters extensions	3283.52	102.763
8	+ 12 meters extensions	4795.02	145.117
IV)	**Type of Tower : D**		
1	Stub & Cleat for NT, +3, +6&+9	630	
2	Stub & Cleat for +12	770	
3	SST for NT, +3, +6 +9	1517	25.464
4	SST for +12	1653.12	36.846
5	Normal Tower	9535.74	375.759
6	+ 3 meters extensions	1748.02	50.972
7	+ 6 meters extensions	3000.72	103.968
8	+ 9 meters extensions	4021.68	113.2
9	+ 12 meters extensions	6755.14	218.712

As per IS 802 1995 certain changes recommended by 400 kV wing for 220 kV Evacuation lines from Kalpaka 400 kV SS

Changes in 'B' Type tower

S. No.	Description	Existing	New
1	LB 300, 601, 602, 301E	130 x 130 x 10	130 x 130 x 12
2	1, 2, 2S, 3, 4, 4S	130 x 130 x 10	130 x 130 x 12
3	11, 12, 12S	90 x 90 x 6	90 x 90 x 8
4	15, 16, 16S	65 x 65 x 5	65 x 65 x 6

Changes in 'C' Type tower

S. No.	Description	Existing	New
1	Leg 62, 62S, 63	110 x 110 x 10	130 x 130 x 10
2	68, 69	45 x 45 x 4	50 x 50 x 4
3	78, 78S, 79	100 x 100 x 6	100 x 100 x 8
4	80, 80X	75 x 75 x 6	80 x 80 x 6
5	92, 92X	60 x 60 x 5	65 x 65 x 6
6	104, 104X	65 x 65 x 5	65 x 65 x 6
7	144, 144X	50 x 50 x 4	50 x 50 x 5

* Including Bolts & Nuts, Washers, Step bolts, U bolts, Hanger

FOUNDATION DETAILS

Spec. No. APT39/90 Make - L&T

S. No	Type of tower	Type of classification	Excavation volume in Cu.m.	Sand Bed in Cu.m.	PCC 1:4:8 in Cu.m.	PCC 1:2:4 in Cu.m.	Reinforcement Steel in kgs
1	A	Dry	44.76	-	1.02	3.7	-
2		Wet	77.5	-	1.94	10.16	-
3		PS	120.93	5.58	3.03	17.73	-
4		FS	159.25	7.35	4.1	26	-
5		Hard Rock	4.8	-	-	5.04	-
6		F & F rock	34.68	-	-	9.66	-
7	B	Dry	66.56	-	1.37	6.29	-
8		Wet	133.96	-	3.03	17.48	-
9		PS	183.75	7.35	4.1	27.44	-
10		FS	240	9.6	5.48	40.53	-
11		Hard Rock	8.79	-	-	9.03	-
12		F & F rock	77.32	-	-	27.02	-
13	C	Dry	90	-	1.94	8.56	-
14		Wet	176.4	-	4.1	24.79	-
15		PS	240	9.6	5.48	37.7	-
16		FS	304.33	12.42	7.23	27.7	1974.86
17		Hard Rock	10.14	-	-	10.38	-
18		F & F rock	94.64	-	-	37.18	-
19	D	Dry	125.32	-	2.81	16.35	-
20		Wet	254.02	-	6.08	46.56	-
21		PS	338.69	13.82	8.1	34.51	2248.13
22		FS	412.92	16.85	10	43.02	2876.45
23		Hard Rock	10.82	-	-	11.06	-
24		F & F rock	117.74	-	-	58.89	-
25	TB /TC		32.63	9	1.76	4.38	105

Spec.No.APT 39/90

RIVER CROSSING TOWER IN VTS - NELLORE
(L&T MAKE)

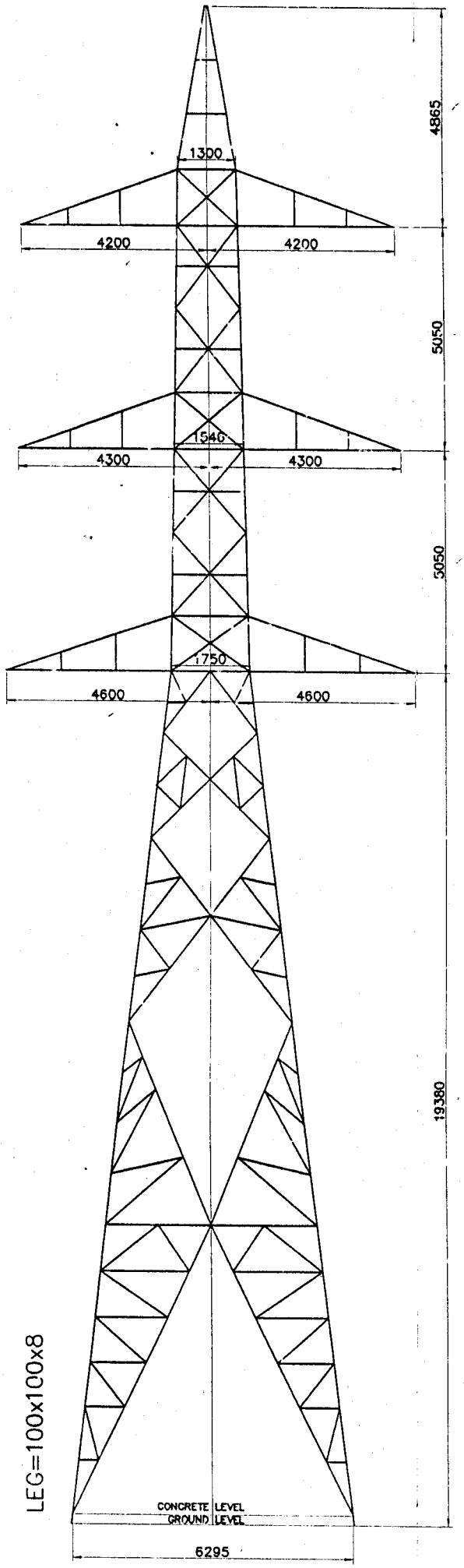
Stub	=	L200 x 200 x 20
Leg	=	L200 x 200 x 20
Total weight	=	38699.67 Kgs.
Bolts & Nuts	=	?

Details in the design sheet

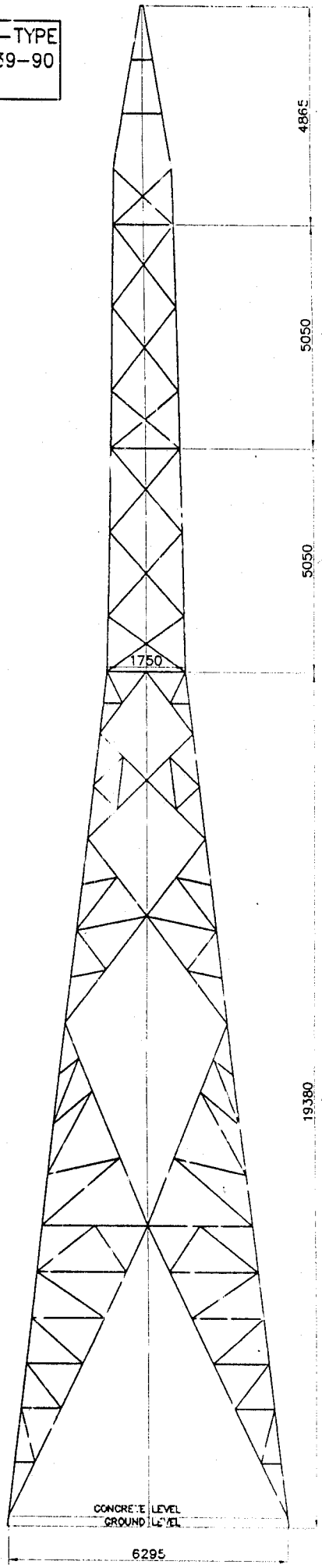
Weight of Main leg & Bracings	=	23482
Weight of Sub-Bracings	=	12100
Weight of Joints & Plates	=	2500
Weight of Bolts & Nuts	=	1500
Total	=	**39582** *

* Excluding ladder & platform.

220KV DC. A-TYPE
SPECN: APT-39-90
MAKE-L&T

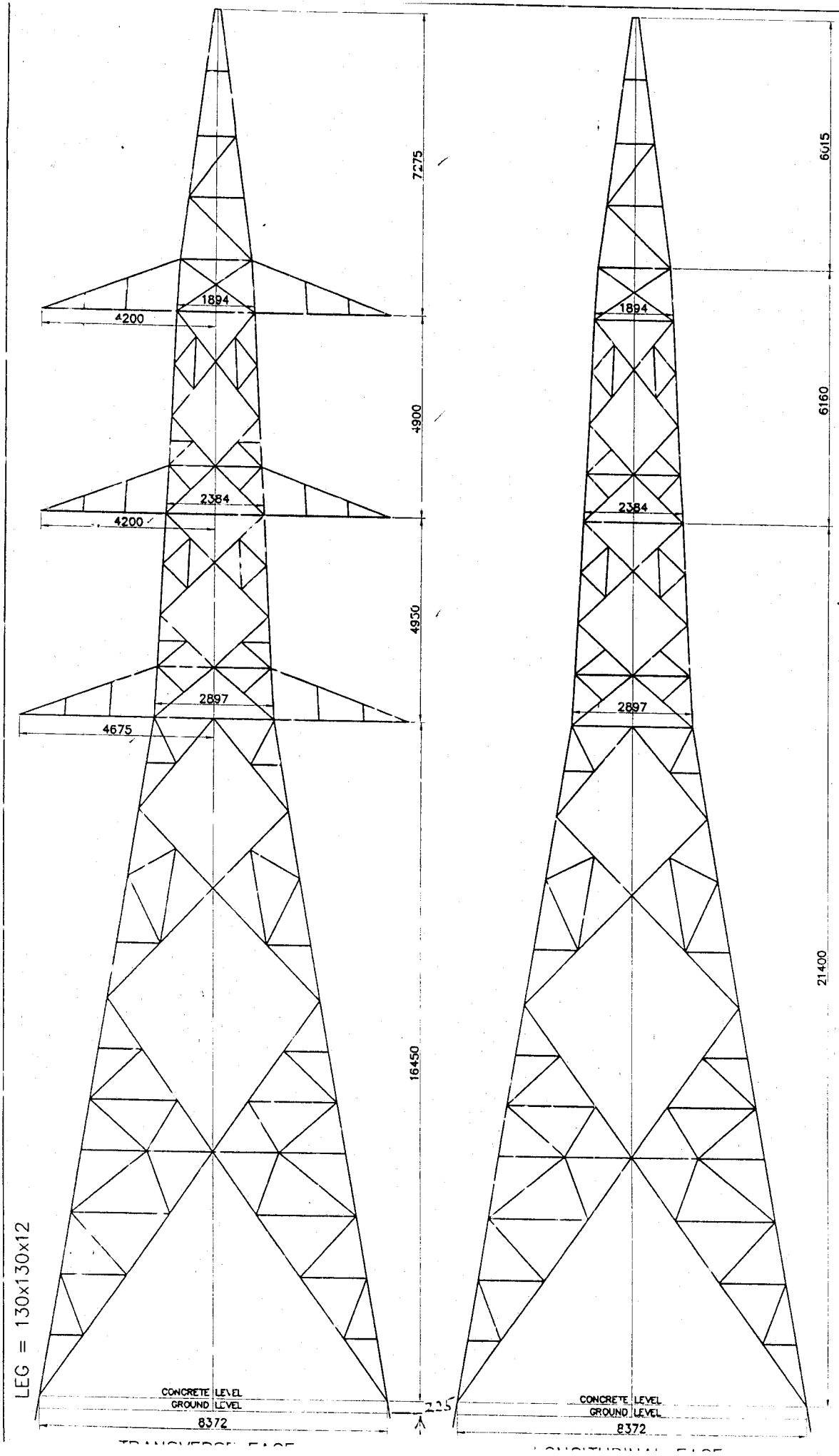


TRANSVERSE FACE

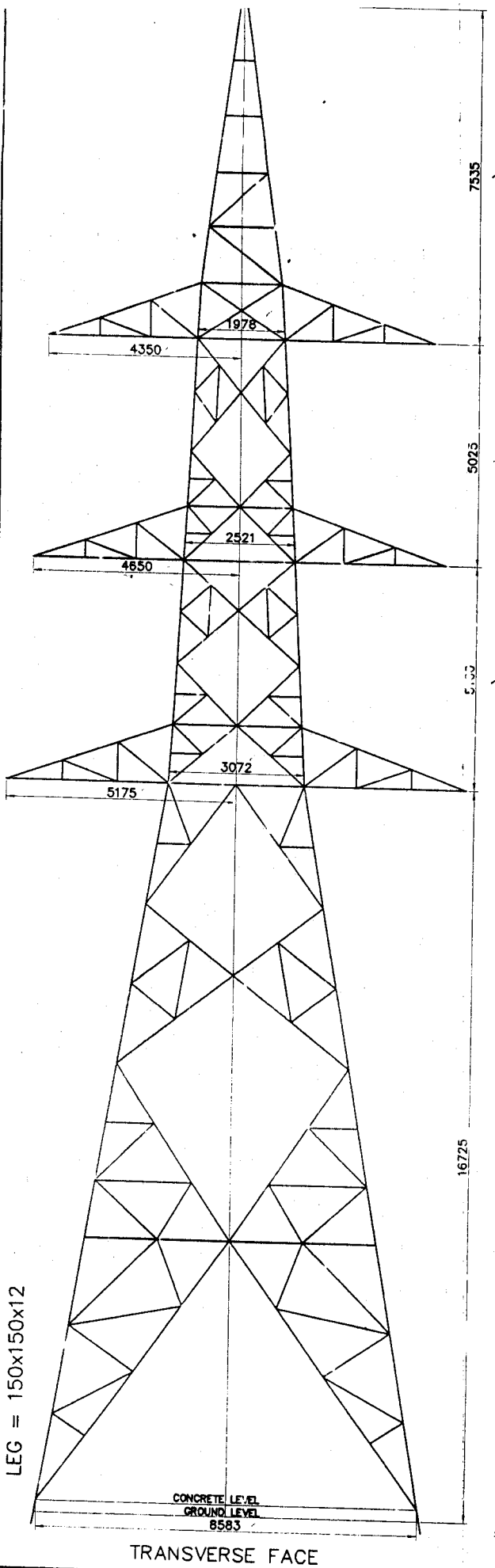


LONGITUDINAL FACE

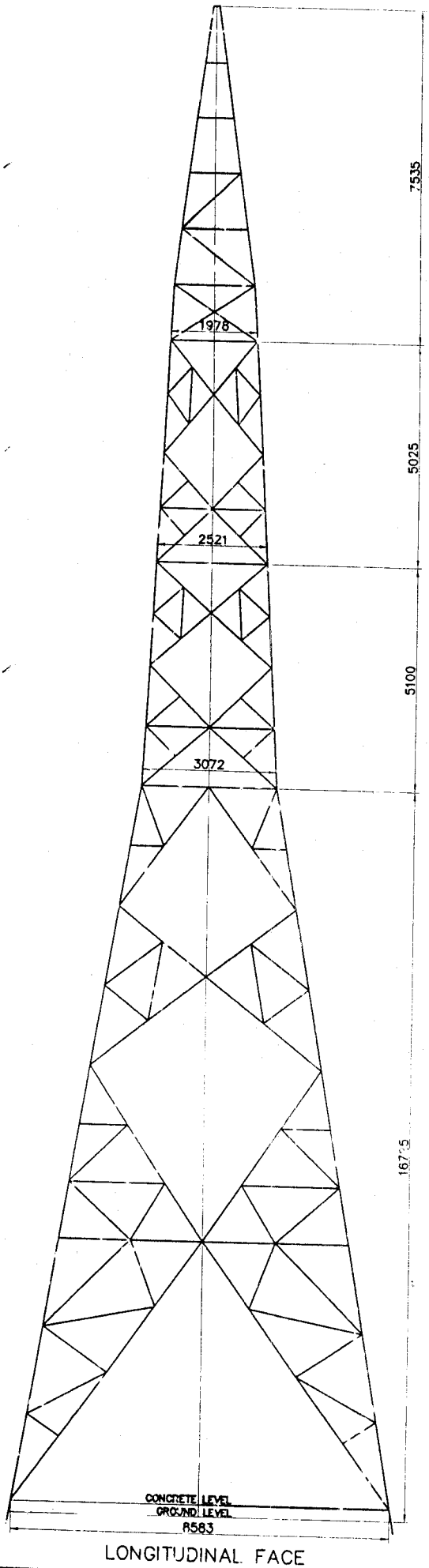
220KV D.C B-TYPE
SPECN: APT-39-90
MAKE-L&T



220KV D.C C-TYPE
SPECN: APT-39-90
MAKE-L&T



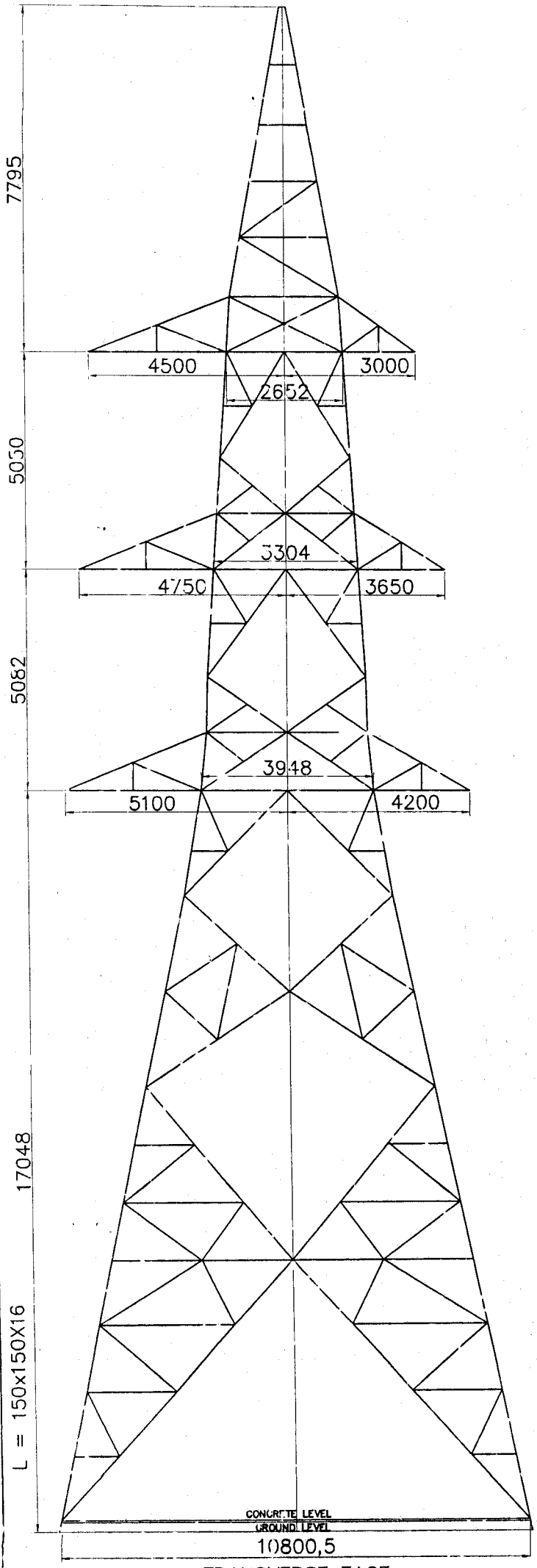
TRANSVERSE FACE



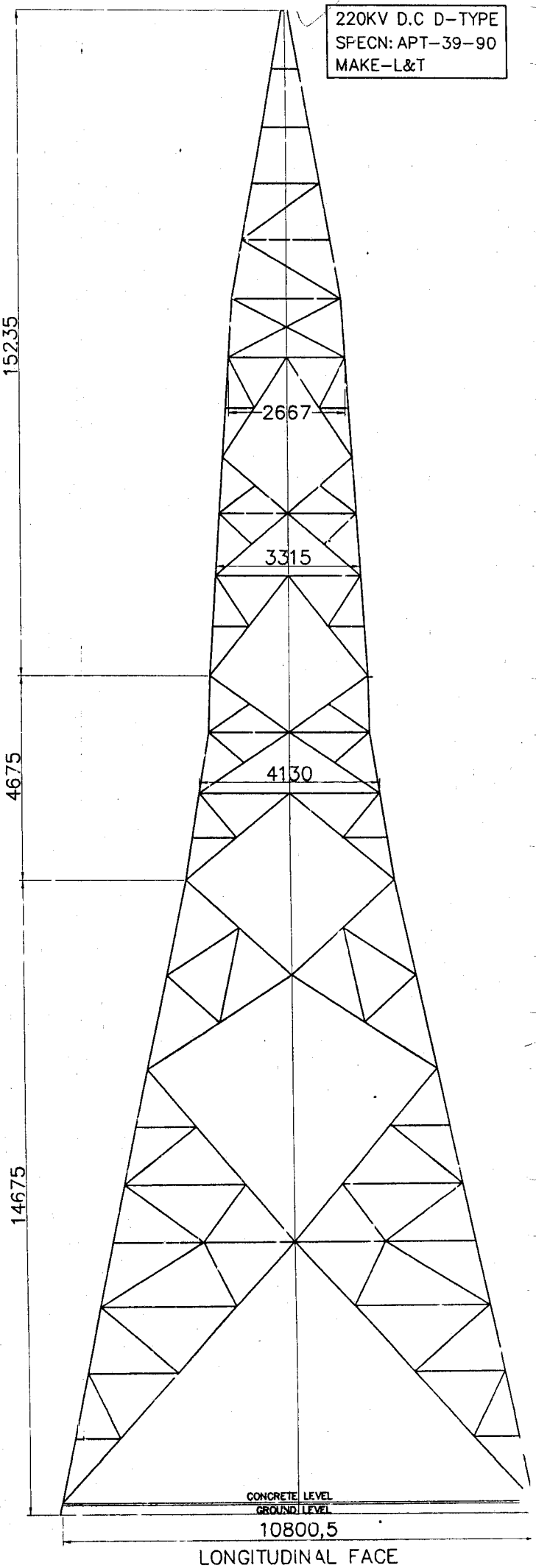
LONGITUDINAL FACE

LEG = 150x150x12

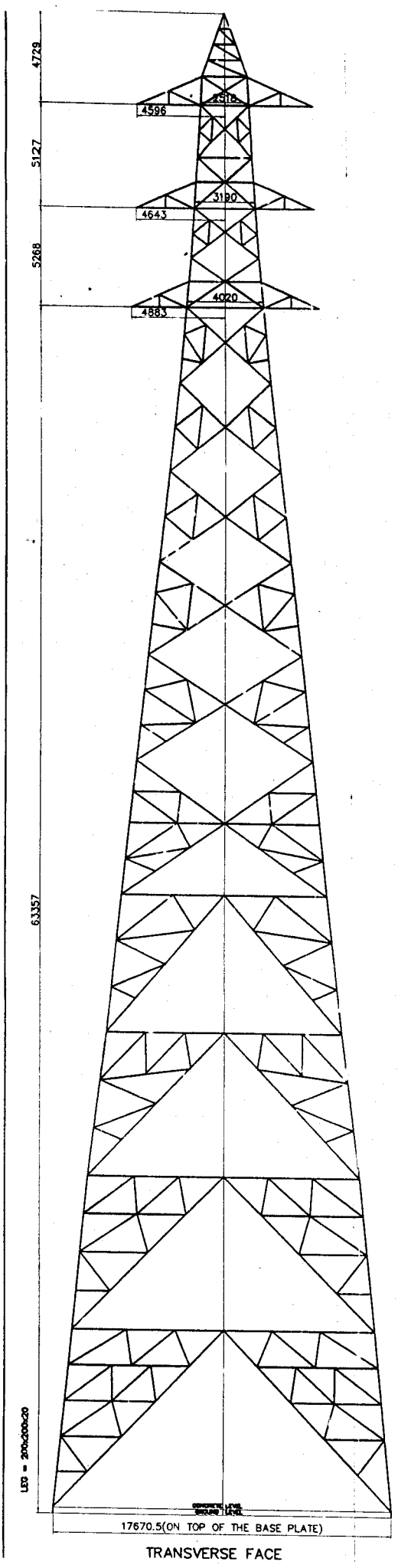
220KV D.C D-TYPE
SPECN: APT-39-90
MAKE-L&T



TRANSVERSE FACE



LONGITUDINAL FACE



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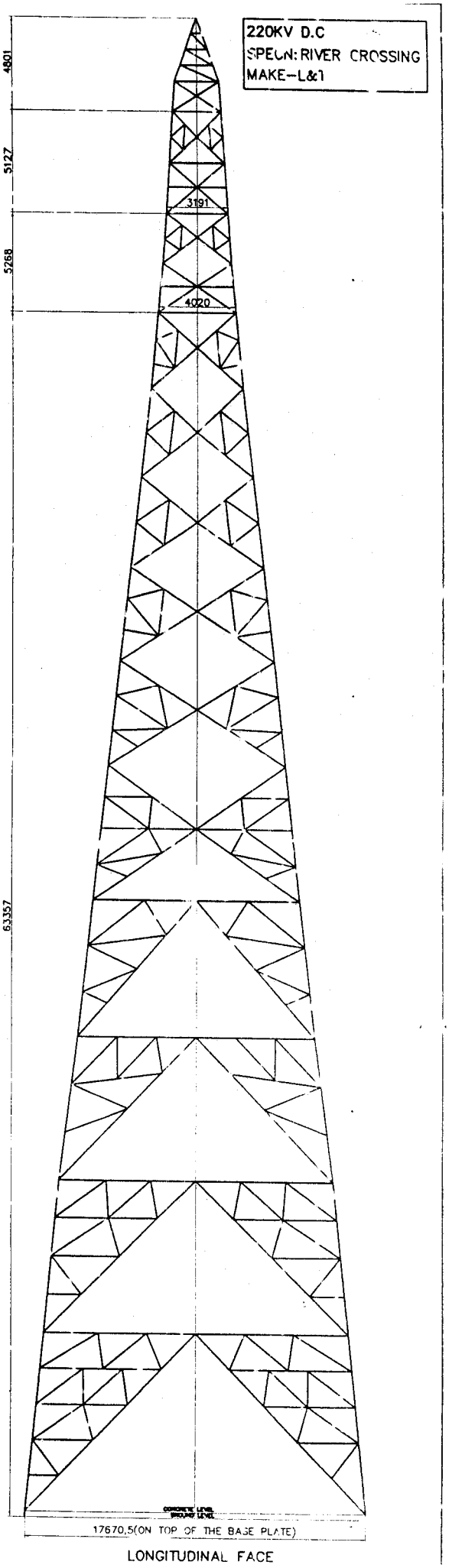


LONGITUDINAL FACE

Spec. APT 32/88

220 kV Multi Circuit Tower Weights

Make - SAE

Sl. No.	Structure Type	Approx. Unit Weight in (Kg.)	Weight of Bolts & Nuts (Kgs)
	I) Type of Tower : X		
1	Stub & Cleat for NT, +3,+6	387.16	3.77
2	SST for NT, +3, +6	1143.28	24.99
3	Normal Tower	* 9666.2	325.44
4	+ 3 meters extensions	1645.18	30.66
5	+ 6 meters extensions	2593.95	62.91
	II) Type of Tower : Y		
1	Stub & Cleat for NT, +3 & +6	1027.32	8.30
2	SST for NT, +3 & +6	#.1859.28	33.77
3	Normal Tower (incl ± Base)	@ 19463.93	596.12
4	+ 3 meters extensions (Excl. ± Base)	@ 1534.26	44.23
5	+ 6 meters extensions (Excl. ± Base)	@ 2736.84	64.88
	III) Type of Tower : Z		
1	Stub & Cleat for NT, +3 & +6	1311.6	8.64
2	SST for NT, +3 & +6	3123.44	72.26
3	Dead end Tower	% 25596.03	774.89
4	+ 3 meters extensions	5019.87	127.9
5	+ 6 meters extensions	7299.85	148.01

\# Partly painted as per drawing.

@ Including step bolts.

* Including D-Shackle, Extn link, U-Bolts & Step bolts.

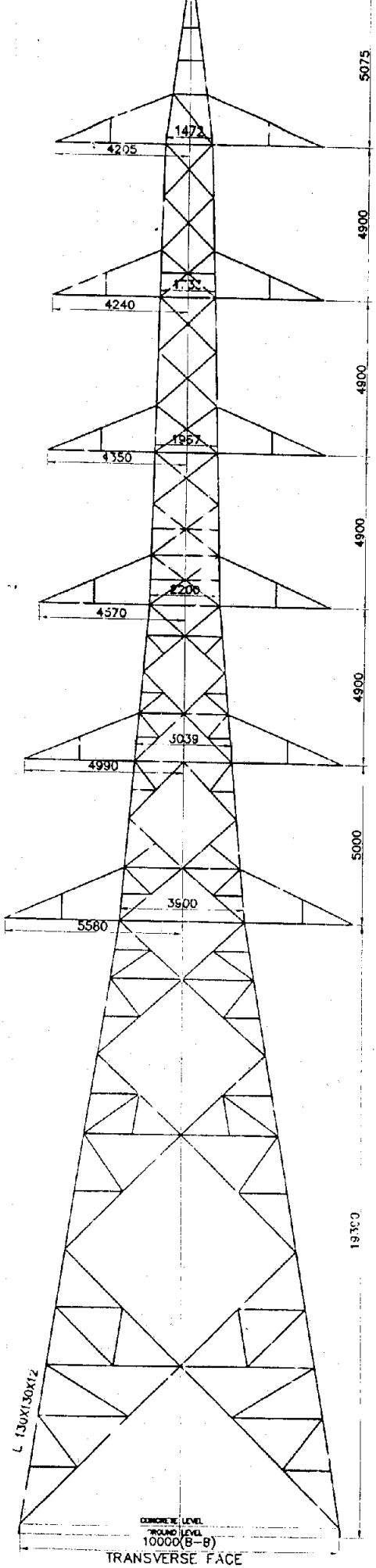
% Incl., D-Shackle, Extn link type E_1, Extn link type E_2 & step bolts.

Note: - The above are black weights.

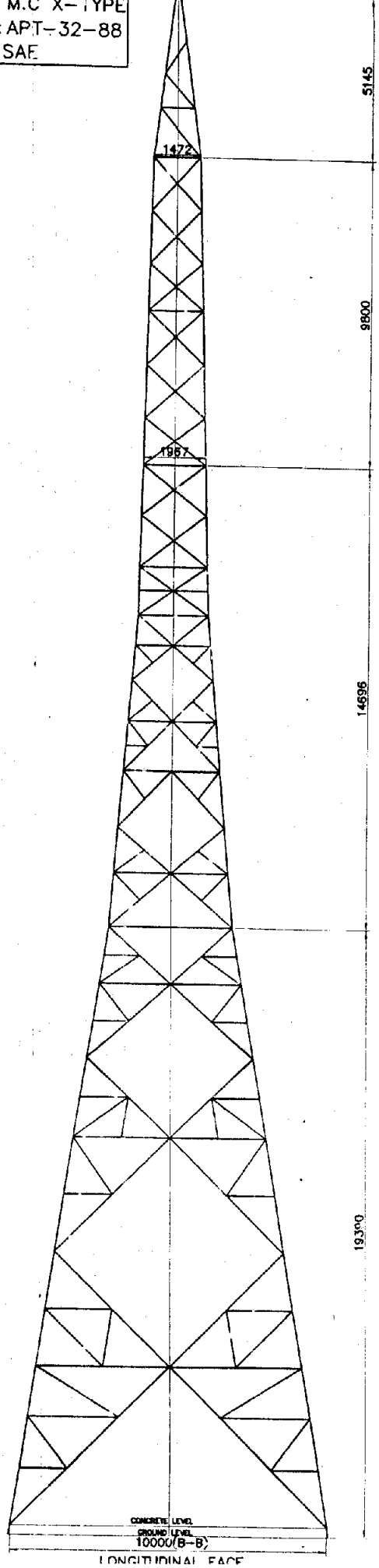
220 kV Multi Circuit Tower Foundations

Sl. No.	Types	Type of foundation	Stub size	Depth of foundation	Vol. of Concrete (Cum)	Vol. of Excavation (Cum)	Reinforcement steel (MT)
I)	**Type of Tower : X**						
1	Dry	Pad & Chimney	130 x 130 x 12	2850	5.62	52.92	0.00
2	Wet	Stepped	- do -	--	8.97	96.33	0.605
3	PS	- do -	- do -	--	11.52	127.28	0.713
4	FS	- do -	- do -	--	14.34	160.76	0.938
II)	**Type of Tower : Y**						
1	Dry	Pad & Chimney	200 x 200 x 16	3450	16.27	129.60	0.00
2	Wet	Stepped	- do -	--	27.25	289.12	1.694
3	PS	- do -	- do -	--	33.34	351.98	2.114
4	FS	- do -	- do -	--	39.74	417.89	2.502
III)	**Type of Tower : Z**						
1	Dry	Pad & Chimney	200 x 200 x 20	3500	26.54	184.00	0.00
2	Wet	Stepped	- do -	- do -	39.43	392.53	2.422
3	PS	- do -	- do -	- do -	47.55	470.78	2.835
4	FS	- do -	- do -	- do -	56.22	554.33	3.499

220KV M.C X-TYPE
SPECN: APT-32-88
MAKE-SAE

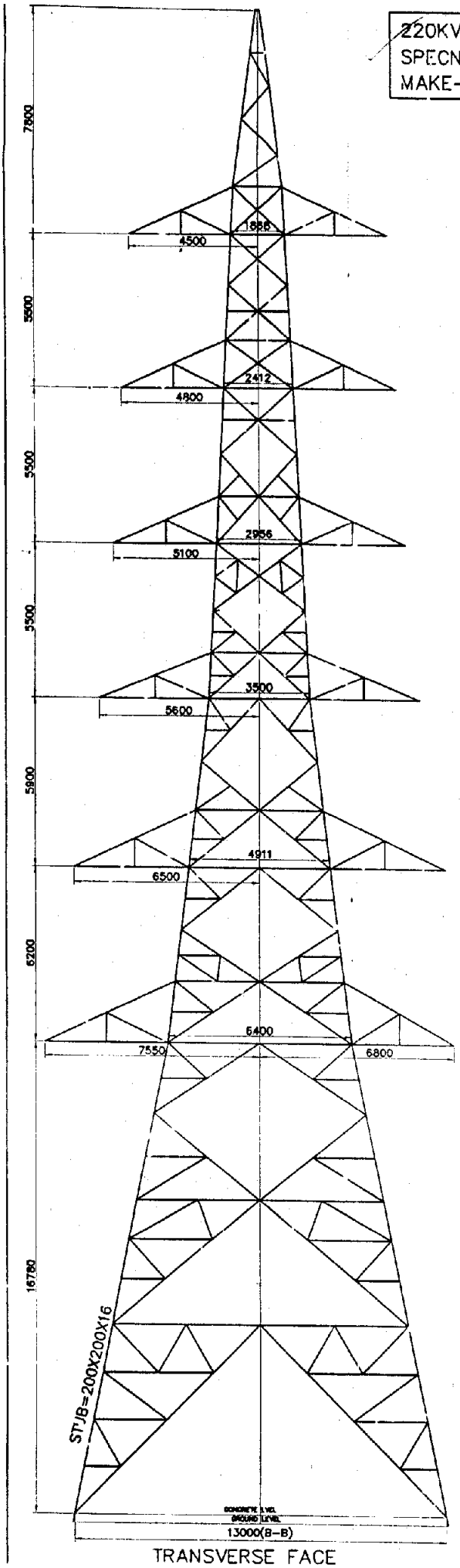


TRANSVERSE FACE

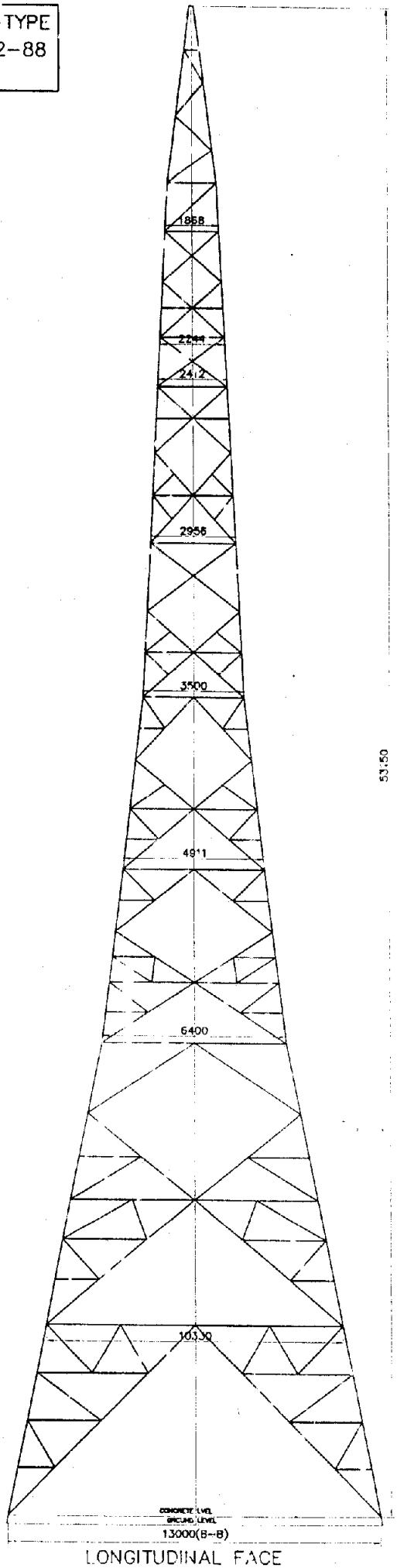


LONGITUDINAL FACE

220KV M.C Y-TYPE
SPECN: APT-32-88
MAKE-SAE

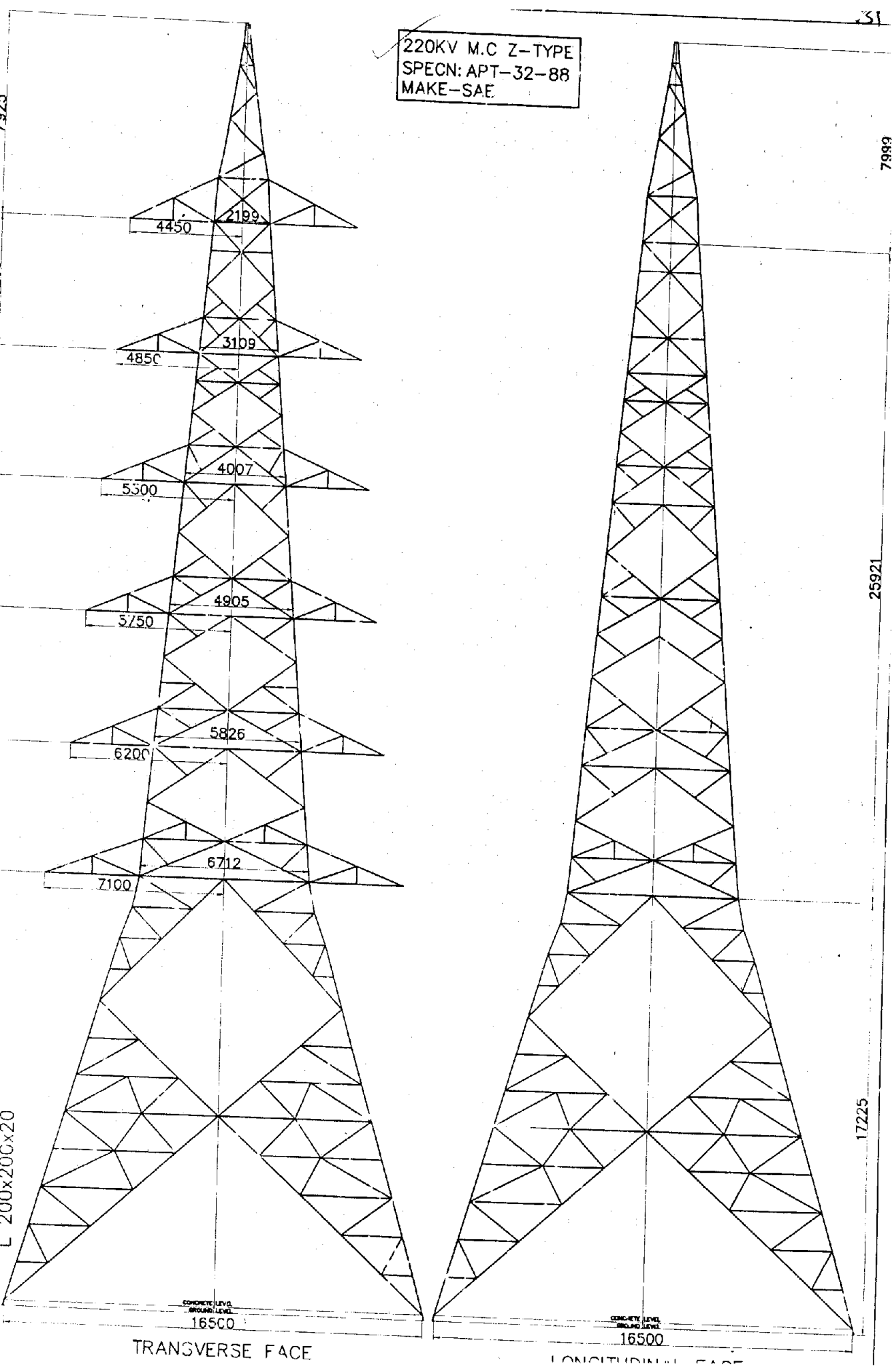


TRANSVERSE FACE



LONGITUDINAL FACE

220KV M.C Z-TYPE
SPECN: APT-32-88
MAKE-SAE



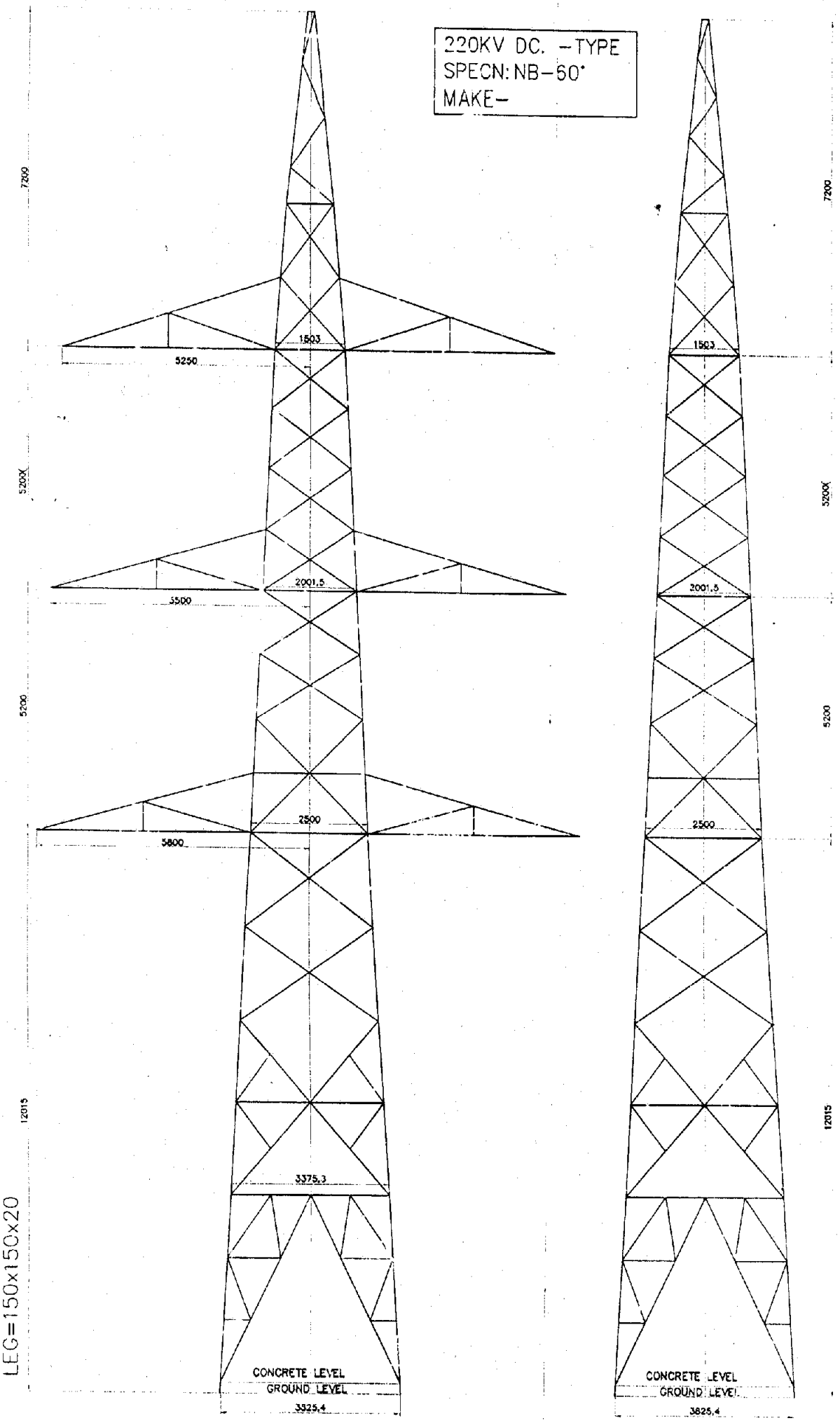
TRANSVERSE FACE

DC tower Spec. NB-60

220 kV NB towers

		Approx. Unit Weight in MT	Weight of Bolts &
App. Weight of 60^0 Dev tower	=	11.538	
App. Weight of DE tower	=	10.817	
Weight of Stub	=		
Weight of Stubsetting template	=		
Weight of +3m extension	=		

220KV DC. -TYPE
SPECN: NB-60°
MAKE-



LEG=150x150x20

220 kV DC Transmission Line

Spec No. APT 25/76
Make: - TSP

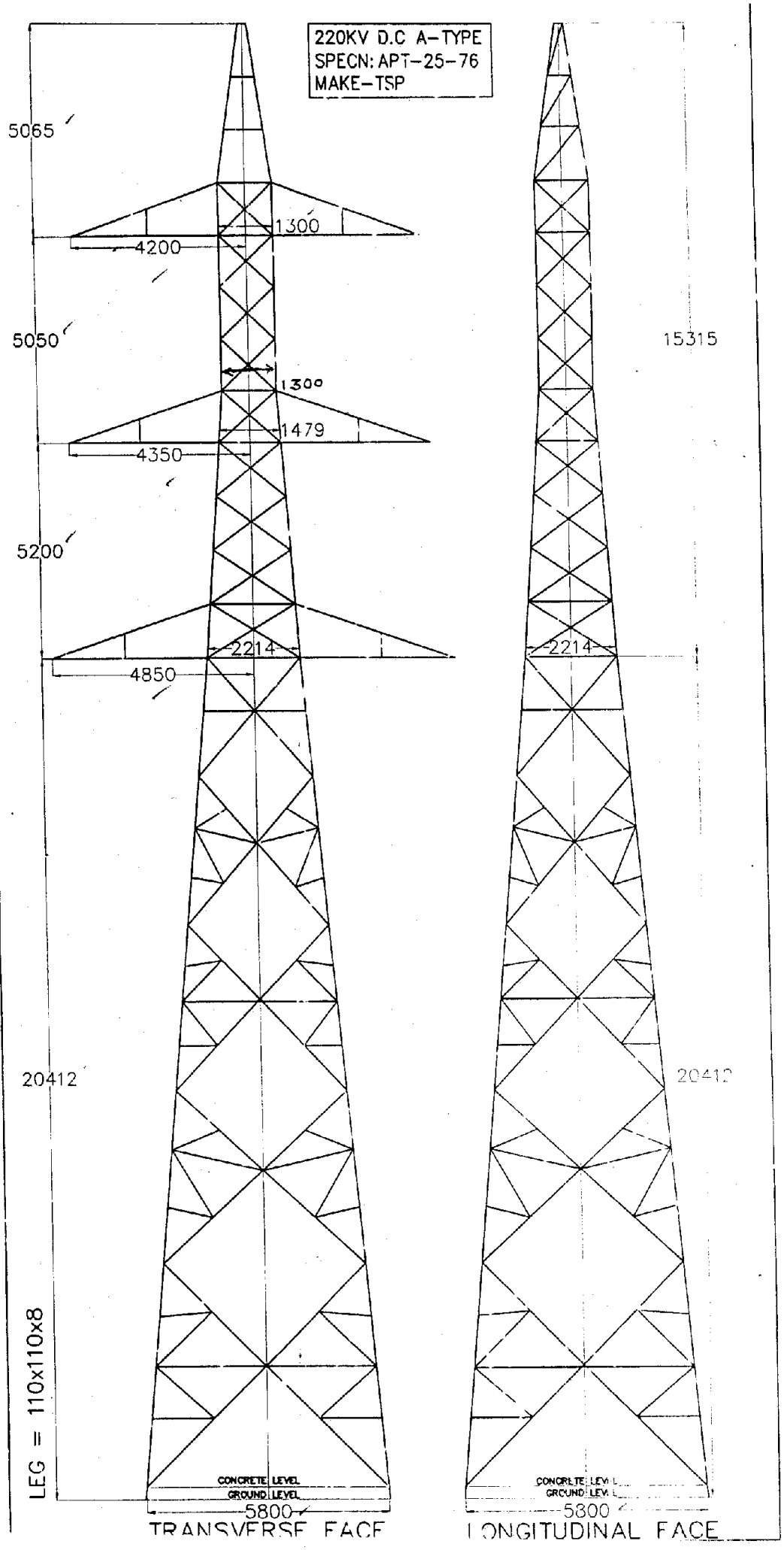
Sl. No.	Structure Type	Approx. Unit Weight in MT	Weight of Bolts & Nuts	
	I) Type of Tower : AS			
1	Super Structure	4837.86	275.66	
2	Stub & Cleats L110x110x8	199.52	1.66	
3	Stub Setting Templates	874.00	21.72	
4	+ 3 meters extensions	710.665	35.53	
5	+ 6 meters extensions	1485.960	63.69	
6	+ 9 meters extensions	2511.00	83.15	
7	+ 12 meters extensions			
	II) Type of Tower : BS			
1	Super Structure	7688.66	407.14	
2	Stub & Cleats L150x150x16	594.00	2.99	
3	Stub Setting Templates	1135.76	28.93	
4	+ 3 meters extensions	1642.80	62.19	
5	+ 6 meters extensions	2668.88	90.52	
6	+ 9 meters extensions	4421.67	136.63	
7	+ 12 meters extensions			
	III) Type of Tower : CS			
1	Super Structure	11553.23	559.26	
2	Stub & Cleats L150x150x20	761.72	2.99	
3	Stub Setting Templates	1259.60	39.97	
4	+ 3 meters extensions	1800.720	68.25	
5	+ 6 meters extensions	3737.44	117.63	
6	+ 9 meters extensions	5928.98	174.63	
7	+ 12 meters extensions	9196.12	245.98	
	IV) Type of Tower : AV			
1	Super Structure	5392.20	293.73	(Up to VI joint to peak)
2	Stub & Cleats			
3	Stub Setting Templates			
4	+ 3 meters extensions	790.920	47.83	
5	+ 6 meters extensions	1671.08	66.14	
6	+ 9 meters extensions			
7	+ 12 meters extensions			

Q What is the difference in AV?

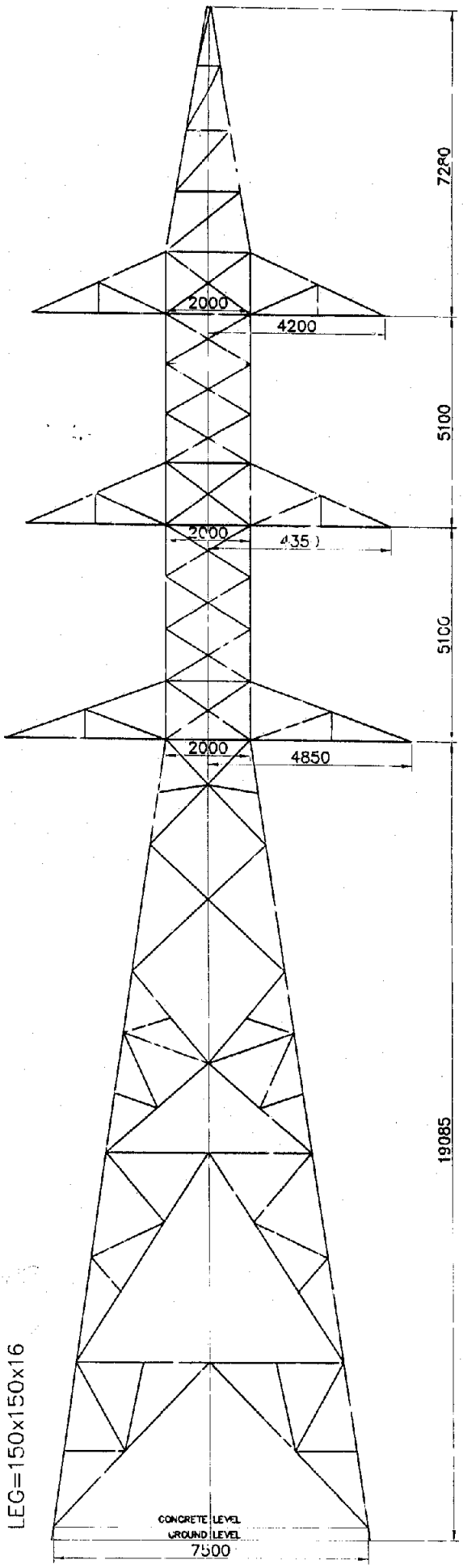
Tower Foundations (APT25/76)

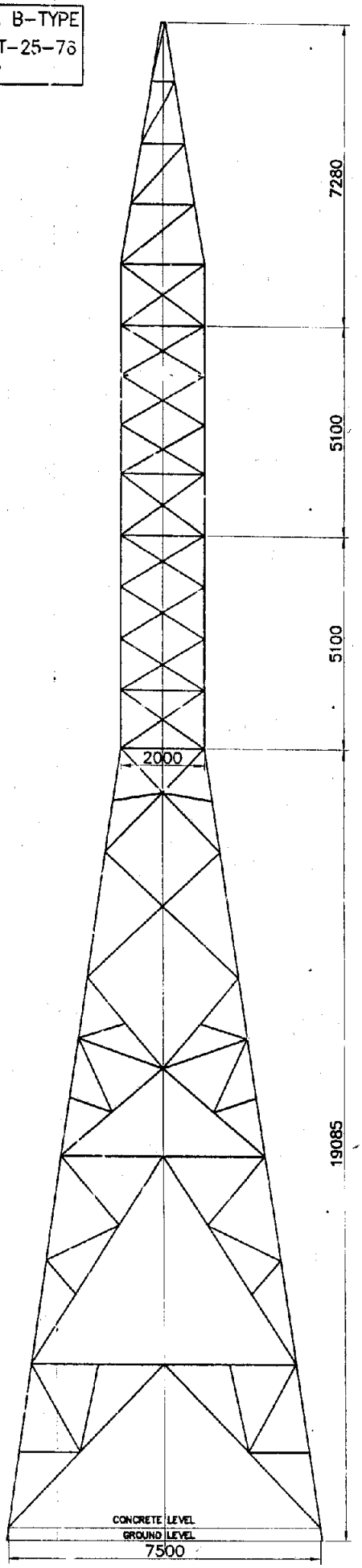
Spec No. APT 25/76
Make: - TSP

Sl. No.	Types	Type of foundation	Stub size	Depth of Stub	Vol. of Concrete (Cum)	Vol. of Excavation (Cum)	Reinforcement steel (MT)	Width of Foundation
I)	Type of Tower : A							
1	Dry	Frustrum	100 X 100 X 10	3050	2.8700			1550
2	Wet	Frustrum	100 X 100 X 10	3050	6.1672			2130
3	PS	Frustrum	100 X 100 X 10					
4	FS	Frustrum	100 X 100 X 10	3450 ?	21.7484			
5	H R		100 X 100 X 10	1600	7.9124 to 9.1228			1100 + ?
II)	Type of Tower : B							
1	Dry	Frustrum	130 X 130 X 10	3380	10.0300			2400
2	Wet	Frustrum	130 X 130 X 10	3380	31.1540			3600
3	PS	Frustrum	130 X 130 X 10					
4	FS	Frustrum	130 X 130 X 10	3380	55.2208			
5	H R		130 X 130 X 10	1800	23.5136 to 24.7772			1800 + ?
III)	Type of Tower : C							
1	Dry	Frustrum	150 X 150 X 20	3550	19.3280			3100
2	Wet	Frustrum	150 X 150 X 20	3550	55.7976			4800
3	PS	Frustrum	150 X 150 X 20					
4	FS	Frustrum	150 X 150 X 20	3550	94.4972			
5	H R		150 X 150 X 20	2200	35.3988 to 36.7188			1200 + ?

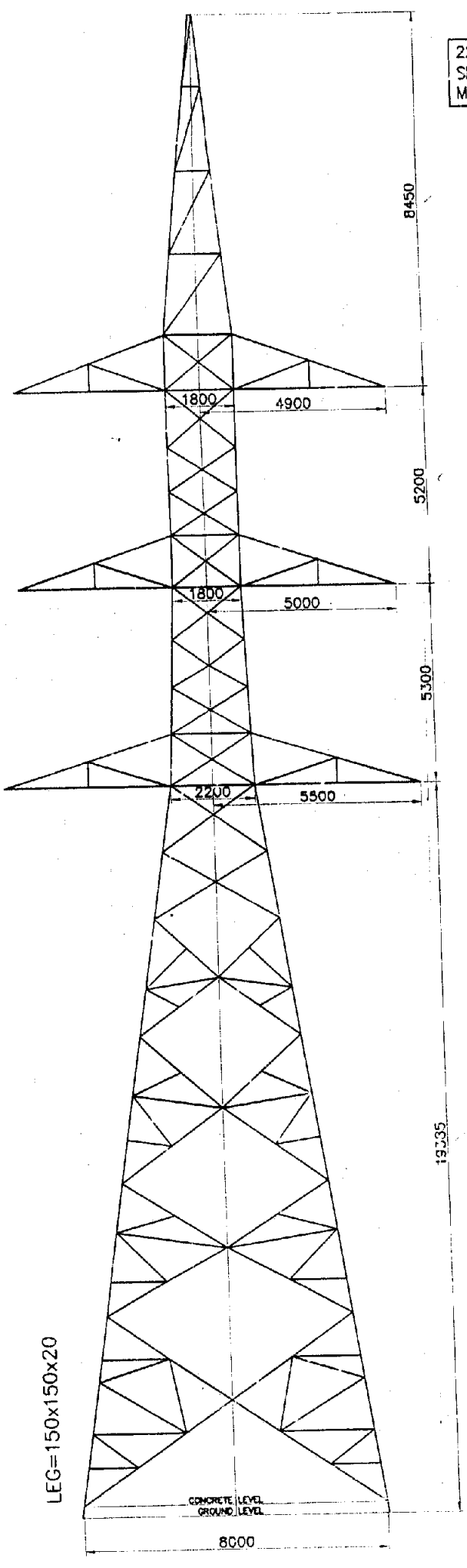

220KV D.C A-TYPE
SPECN: APT-25-76
MAKE-TSP
5065
1300
4200
5050
15315
1300
1479
4350
5200
2214
2214
4850
20412
20412
LEG = 110x110x8
CONCRETE LEVEL
GROUND LEVEL
5800
TRANSVERSE FACE
CONCRETE LEVEL
GROUND LEVEL
5800
LONGITUDINAL FACE

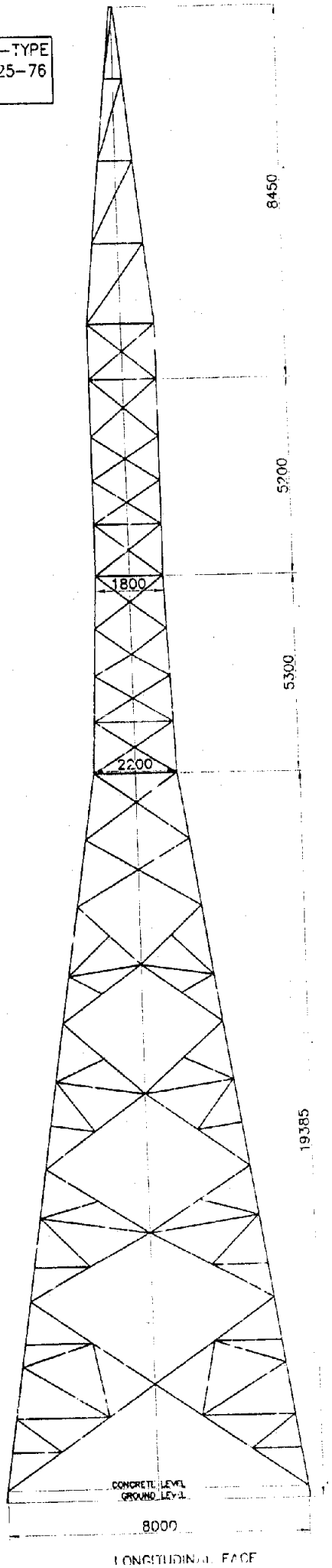
220KV DC. B-TYPE
SPECN: APT-25-78
MAKE-TSP





220KV D.C C-TYPE
SPECN: APT-25-76
MAKE--TSP





Spec.APT21/76

220 kV DC Bommuru - Gazuwaka line

Make: - SAE

Sl. No.	Structure Type	Approx. Unit Weight in kg	Weight of Bolts & Nuts	
	I) Type of Tower : A			
1	Super Structure	5242.54	241.87	@
2	Stub & Cleats L110x110x8	227.64	4.92	
3	S&C for +9 & +12 Extn	278.84	4.92	
4	Stub Setting Templates	835.16	20.16	
5	+ 3 meters extensions	849.08	20.65	
6	+ 6 meters extensions	1551.48	28.48	
7	+ 9 meters extensions	2941.48	54.57	
8	+ 12 meters extensions	3703.74	71.22	
	I) Type of Tower : B			
1	Super Structure	7991.71	316.25	#
2	Stub & Cleats L150x150x12	474.12	5.59	
3	Stub Setting Templates	1663.24	22.28	
4	+ 3 meters extensions	1544.60	37.50	
5	+ 6 meters extensions	3029.32	46.56	
	I) Type of Tower : C			
1	Super Structure	10504.14	402.09	#
2	Stub & Cleats L150x150x20	788.44	9.30	
3	Stub Setting Templates	2452.12	26.31	
4	+ 3 meters extensions	1919.09	49.18	
5	+ 6 meters extensions	3336.23	77.30	
6	+ 9 meters extensions	5103.96	106.02	
7	+ 12 meters extensions	7291.80	154.60	

@ Including U-Bolts, spring washers, hangers etc.

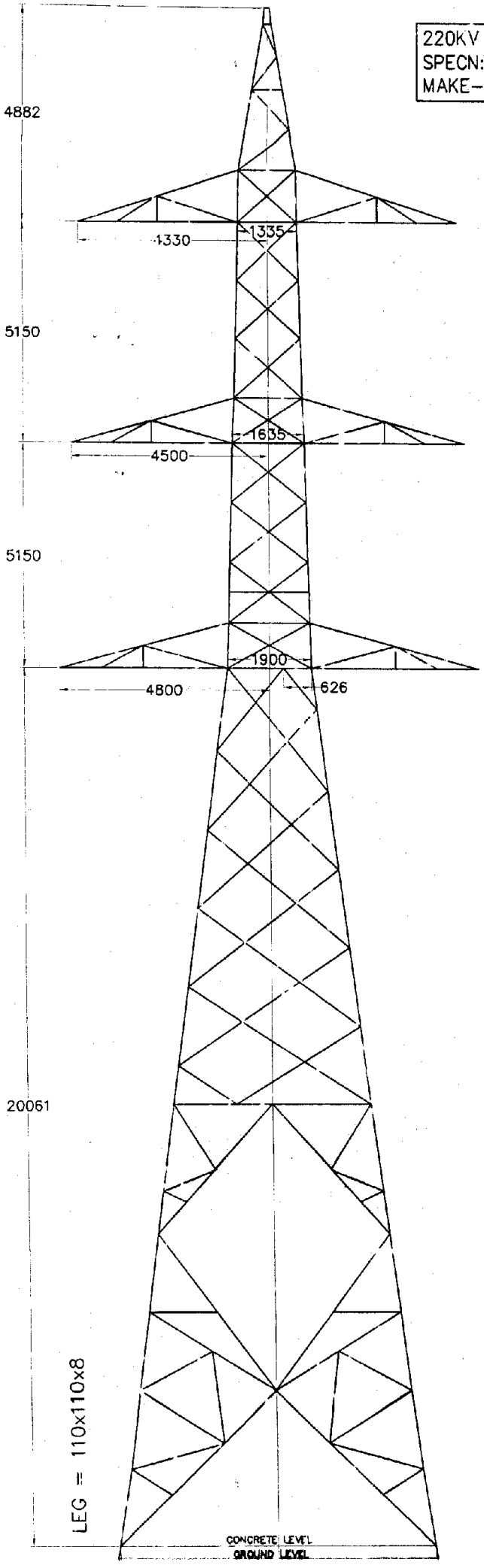
including pack washers & step bolts.

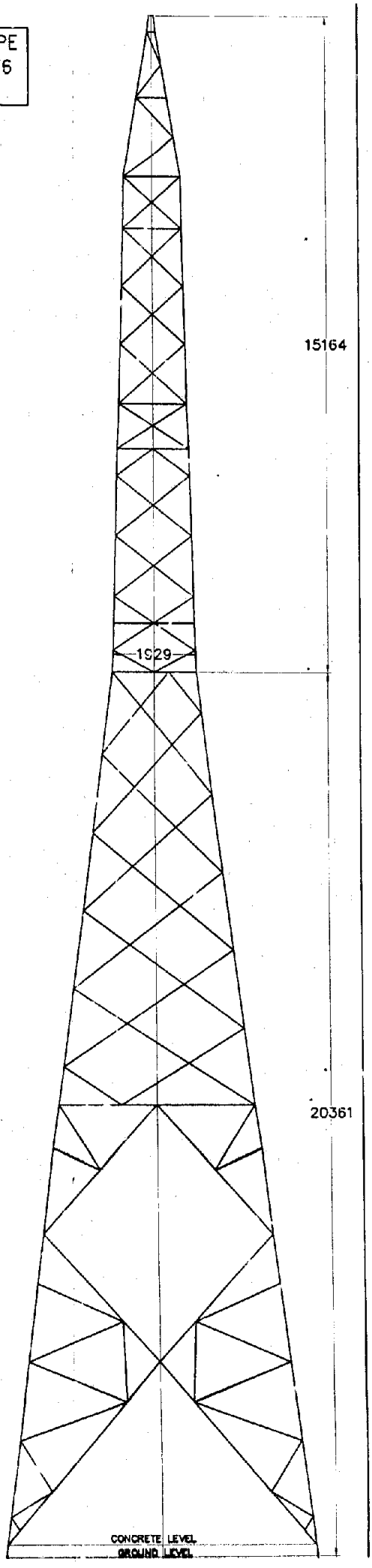
Foundations (APT21/76)

Make - SAE

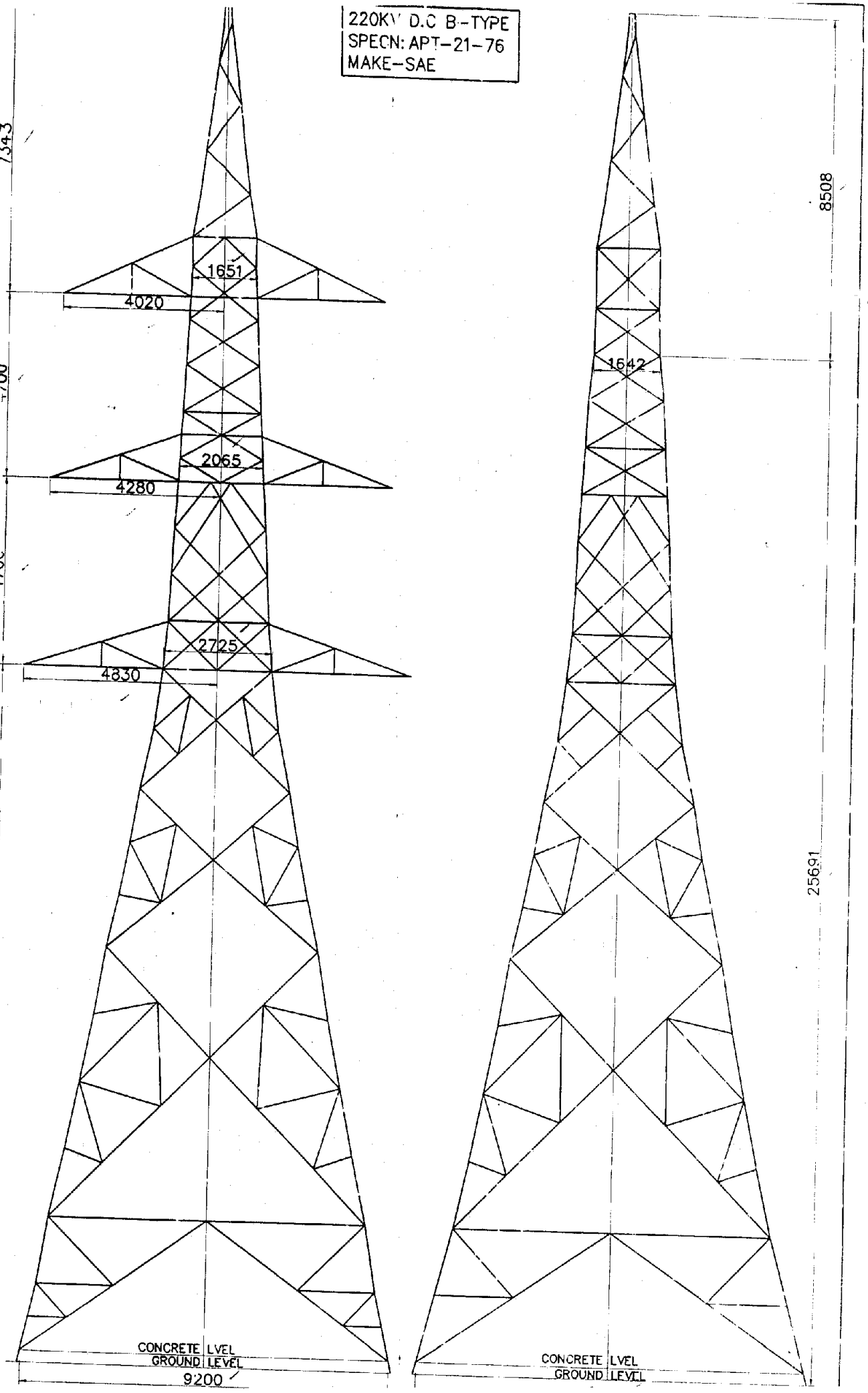
Sl. No.	Types	Type of foundation	Stub size	Depth of Foundation	Vol. of Concrete (Cum)	Vol. of Excavation (Cum)	Reinforcement steel (MT)
I)	**Type of Tower : A**						
1	Dry						
	upto +6 mtr						
	+9 & +12 mtr				3.11	34.73	
2	Wet						
	upto +6 mtr						
	+9 & +12 mtr						
3	PS						
	upto +6 mtr						
	+9 & +12 mtr						
4	FS						
	upto +6 mtr						
	+9 & +12 mtr						
II)	**Type of Tower : B**						
1	Dry				5.35	52.78	--
	upto +6 mtr				5.95	58.28	
	+9 & +12 mtr						
2	Wet						
	upto +6 mtr				15.08	113.72	--
	+9 & +12 mtr						
3	PS						
	upto +6 mtr				15.59	159.94	735
	+9 & +12 mtr						
4	FS						
	upto +6 mtr				19.33	207.52	1120
	+9 & +12 mtr						
III)	**Type of Tower : C**						
1	Dry						
	upto +6 mtr				11.82	98.38	--
	+9 & +12 mtr						
2	Wet						
	upto +6 mtr				18.36	225.12	2190
	+9 & +12 mtr						
3	PS						
	upto +6 mtr				22.58	283.56	3194
	+9 & +12 mtr						
4	FS						
	upto +6 mtr				27.64	364.14	4546
	+9 & +12 mtr						

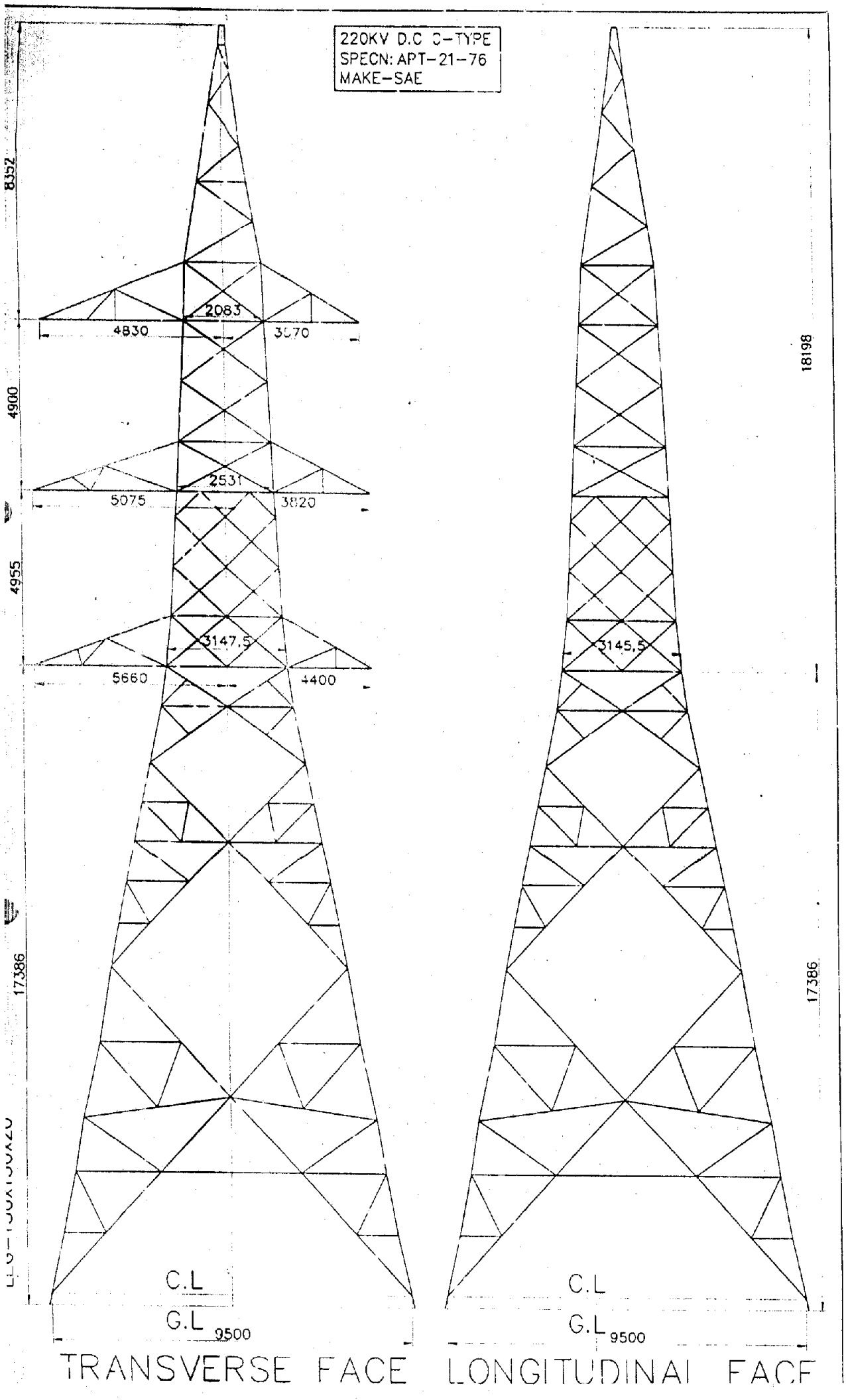
220KV D.C A-TYPE
SPECN: APT-21-76
MAKE-SAE





220KV D.C B-TYPE
SPECN: APT-21-76
MAKE-SAE

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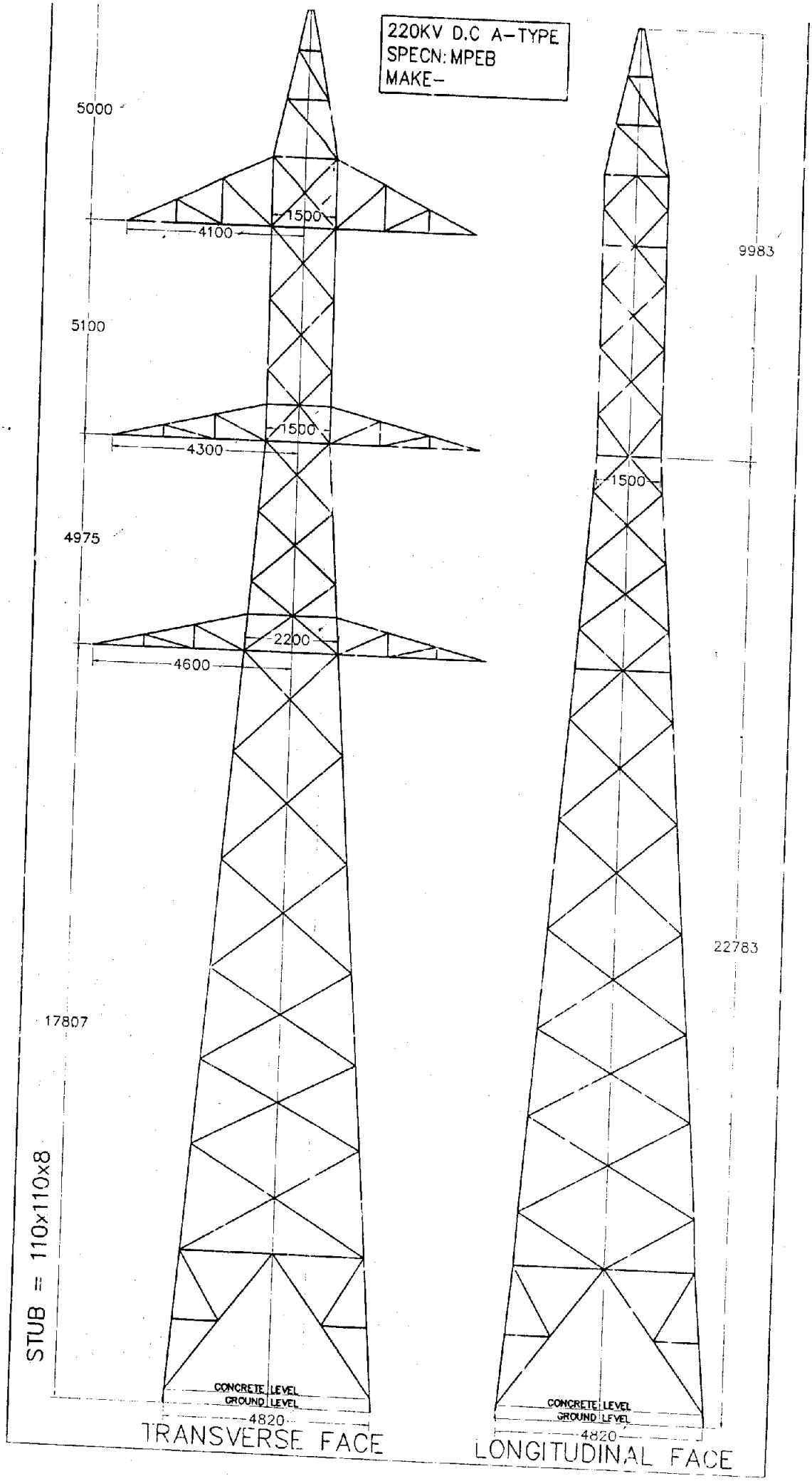
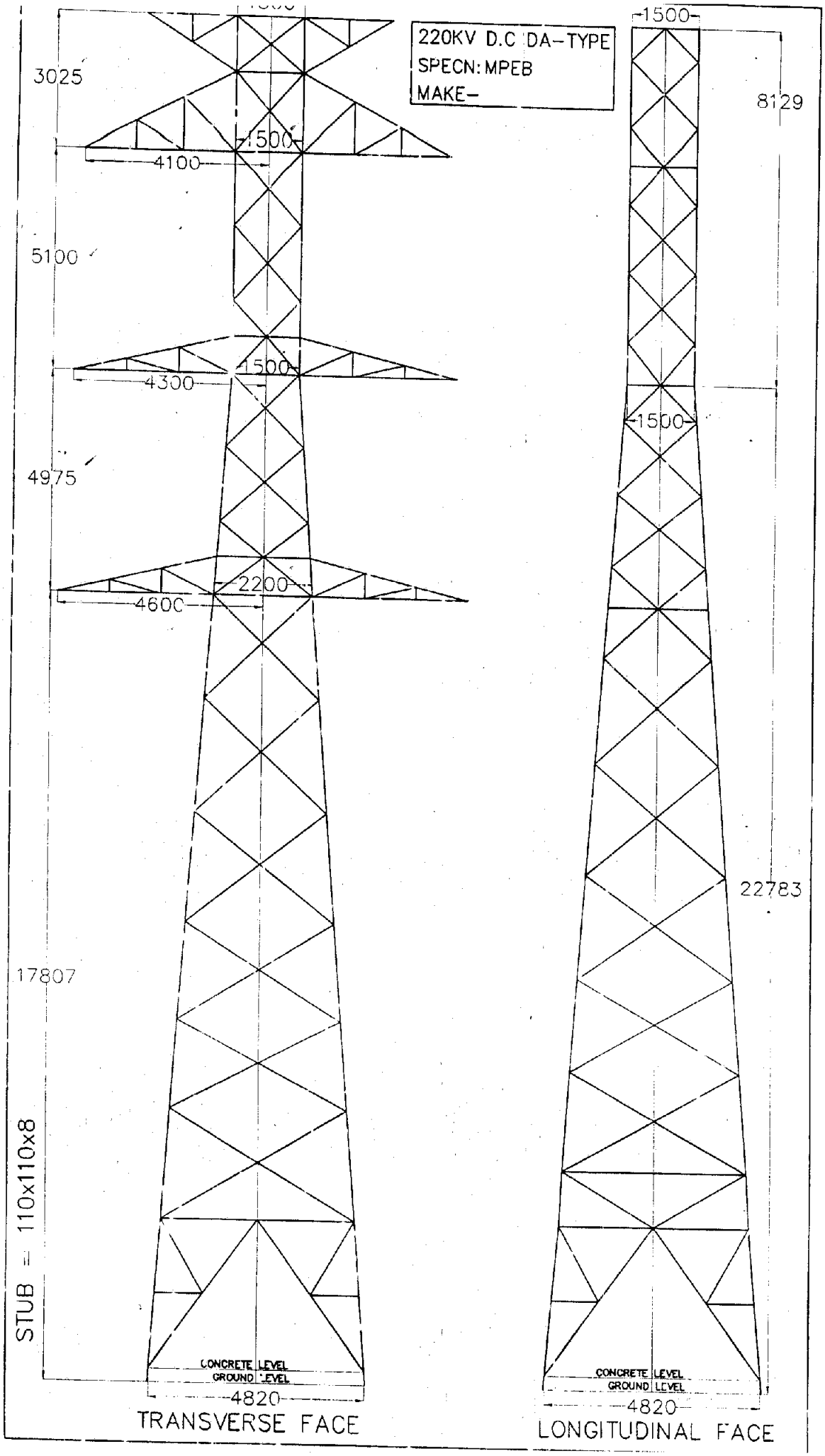
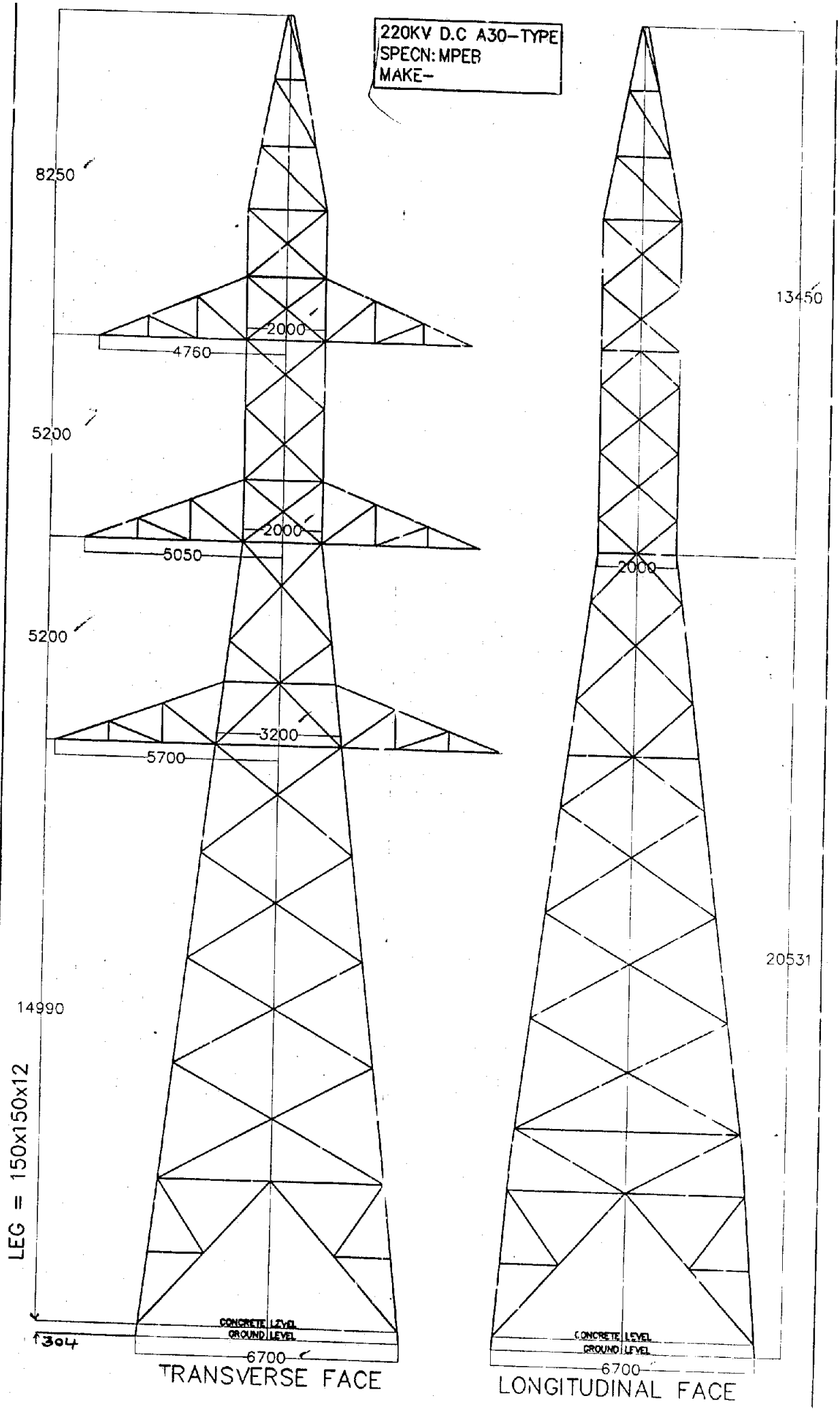
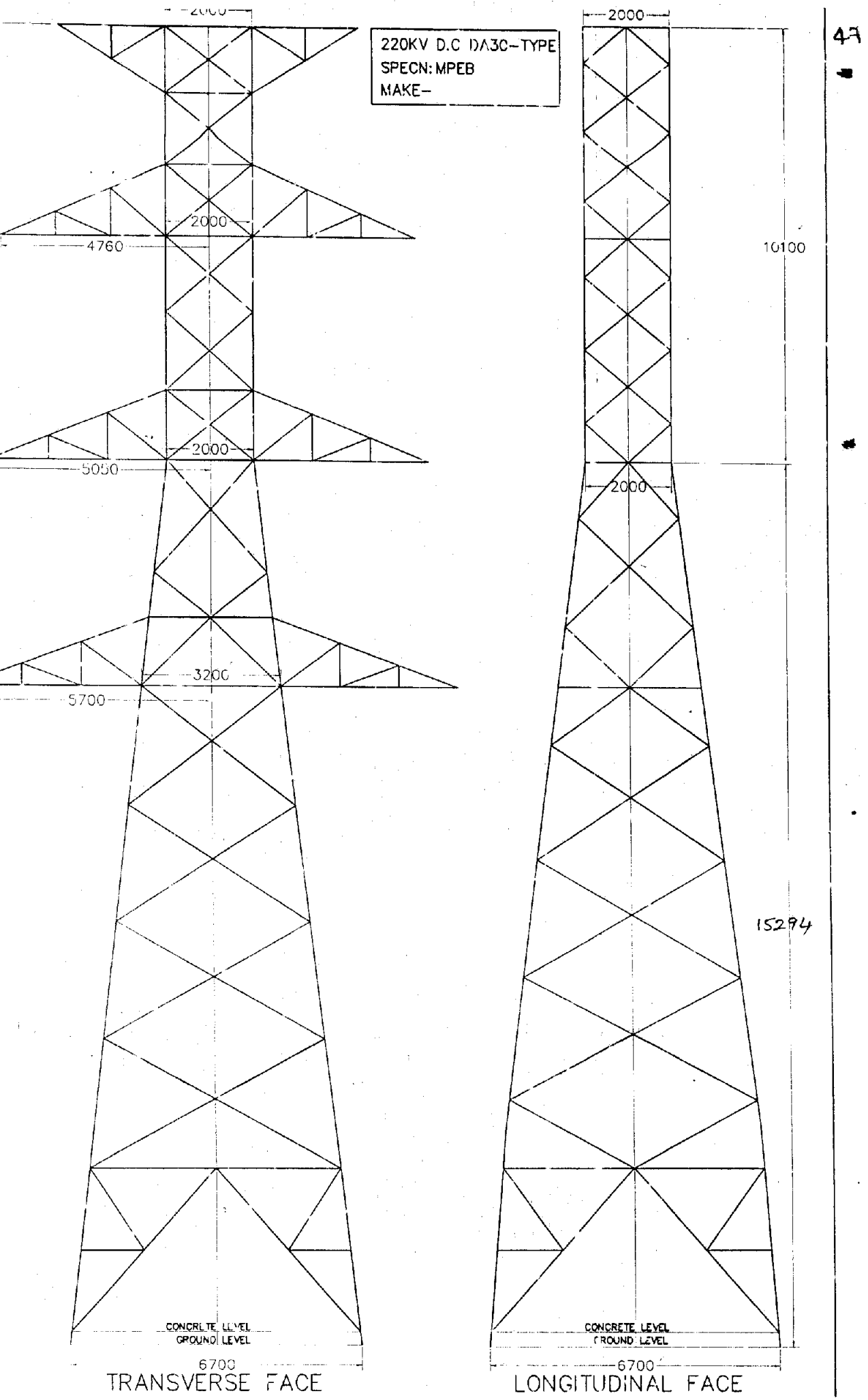
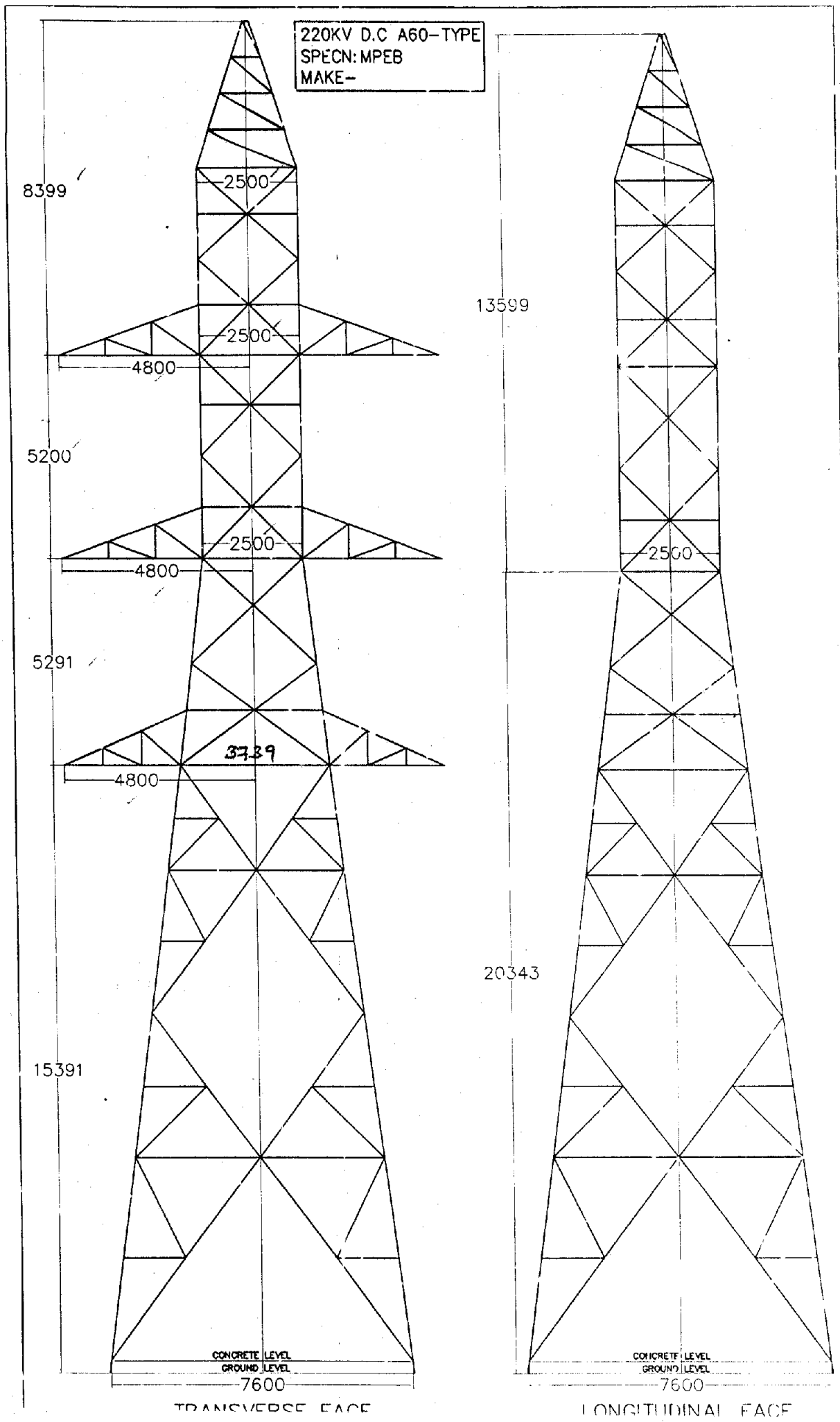
SPECN: APT-21-76
MAKE-SAE
8352
4900
4955
17386
2083
4830
3670
2531
5075
3820
3147.5
5660
4400
18198
3145.5
17386
C.L
G.L 9500
C.L
G.L 9500
TRANSVERSE FACE
LONGITUDINAL FACE

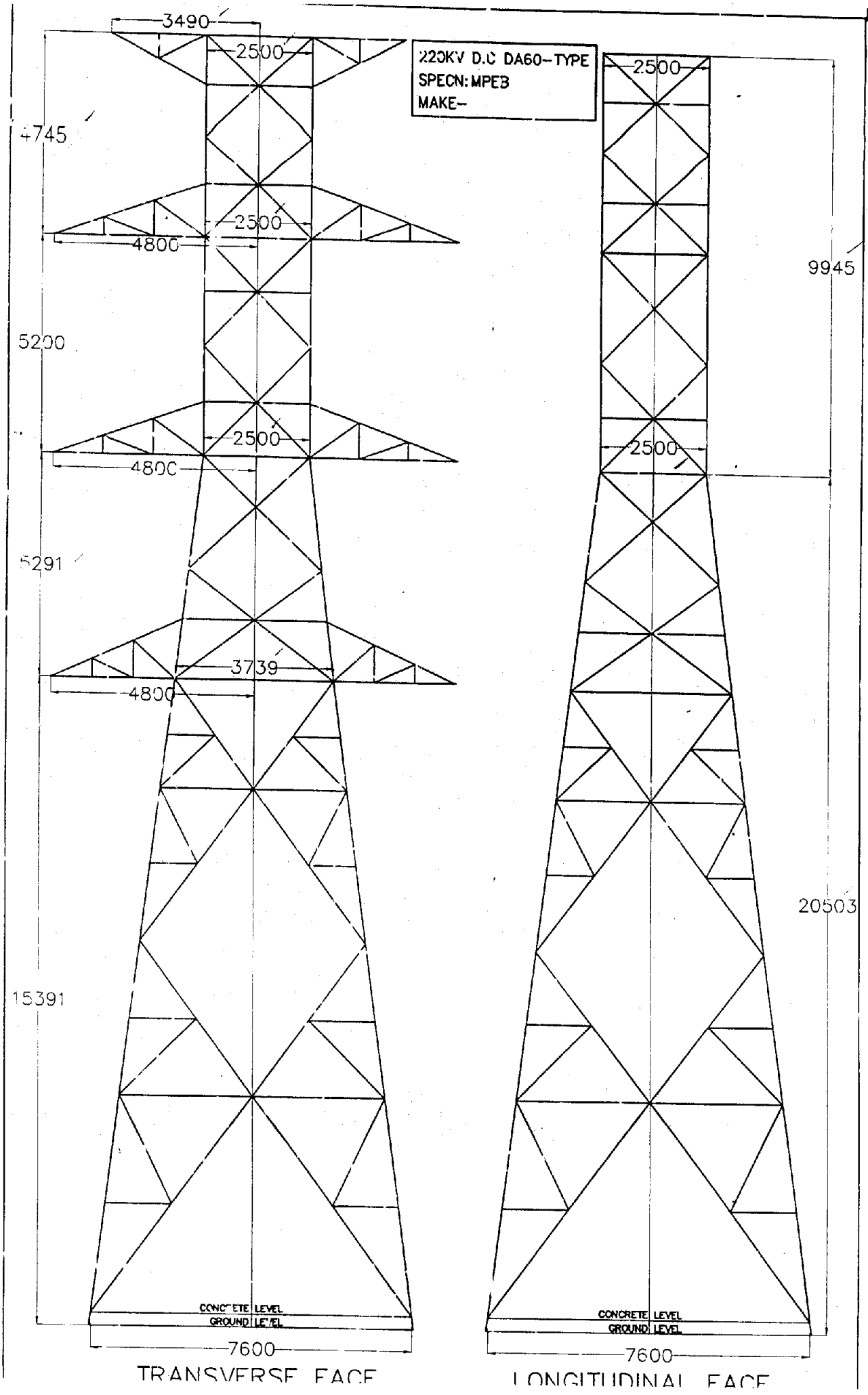

220KV D.C A-TYPE
SPECN: MPEB
MAKE-
5000
1500
4100
5100
1500
4300
4975
2200
4600
17807
STUB = 110x110x8
CONCRETE LEVEL
GROUND LEVEL
4820
TRANSVERSE FACE
9983
1500
22783
CONCRETE LEVEL
GROUND LEVEL
4820
LONGITUDINAL FACE


220KV D.C DA-TYPE
SPECN: MPEB
MAKE-
3025
1500
4100
5100
1500
4300
4975
2200
4600
17807
STUB = 110x110x8
CONCRETE LEVEL
GROUND LEVEL
4820
TRANSVERSE FACE
1500
8129
1500
22783
CONCRETE LEVEL
GROUND LEVEL
4820
LONGITUDINAL FACE


220KV D.C A30-TYPE
SPECN: MPEB
MAKE-
8250
2000
4760
5200
2000
5050
5200
3200
5700
14990
LEG = 150x150x12
304
CONCRETE LEVEL
GROUND LEVEL
6700
TRANSVERSE FACE
13450
2000
20531
CONCRETE LEVEL
GROUND LEVEL
6700
LONGITUDINAL FACE


220KV D.C DA3C-TYPE
SPECN: MPEB
MAKE-
2000
4760
2000
5050
2000
3200
5700
CONCRETE LEVEL
GROUND LEVEL
6700
TRANSVERSE FACE
2000
10100
2000
15294
CONCRETE LEVEL
GROUND LEVEL
6700
LONGITUDINAL FACE


220KV D.C A60-TYPE
SPECN: MPEB
MAKE-
8399
2500
2500
4800
5200
2500
4800
5291
3739
4800
15391
CONCRETE LEVEL
GROUND LEVEL
7600
TRANSVERSE FACE
13599
2500
20343
CONCRETE LEVEL
GROUND LEVEL
7600
LONGITUDINAL FACE


220KV D.C DA60-TYPE
SPECN: MPEB
MAKE-
3490
2500
4745
2500
4800
5200
2500
4800
5291
3739
4800
15391
CONCRETE LEVEL
GROUND LEVEL
7600
TRANSVERSE FACE
2500
9945
2500
20503
CONCRETE LEVEL
GROUND LEVEL
7600
LONGITUDINAL FACE

220 kV SC Transmission Line Spec.APT 35/70

LOWER SILERU - BOMMUR

Make: - SAE

Sl. No.	Structure Type	Approx. Unit Weight in MT	Weight of Bolts & Nuts
I)	**Type of Tower : 'X - (AA)'**		
1	Super Structure	3395.34	146.57
2	Stub & Cleats L75x50x6	190.72	2.62
3	Stub Setting Templates	477.04	8.94
4	Normal Tower		
5	+ 3 meters extensions	532.95	13.96
6	+ 6 meters extensions	1162.59	30.46
7	+ 9 meters extensions	1827.75	46.96
8	+ 12 meters extensions		
I)	**Type of Tower : 'Y - (B-B)'**		
1	Super Structure	3944.15	146.82
2	Stub & Cleats L130x130x10	362.36	4.19
3	Stub Setting Templates	498.20	9.01
4	Normal Tower		
5	+ 3 meters extensions	651.63	17.88
6	+ 6 meters extensions	1444.39	39.62
7	+ 9 meters extensions	2280.63	61.28
8	+ 12 meters extensions		
I)	**Type of Tower : 'Z - (C-C)'**		
1	Super Structure	5286.38	205.03
2	Stub & Cleats L150x150x12	514.00	6.29
3	Stub Setting Templates	957.24	15.73
4	Normal Tower		
5	+ 3 meters extensions	913.38	24.26
6	+ 6 meters extensions	1994.00	24.00
7	+ 9 meters extensions	3289.51	24.39
8	+ 12 meters extensions		

220 kV SC Transmission Line Spec.APT35/70
HYDERABAD - KOTHAGUDEM

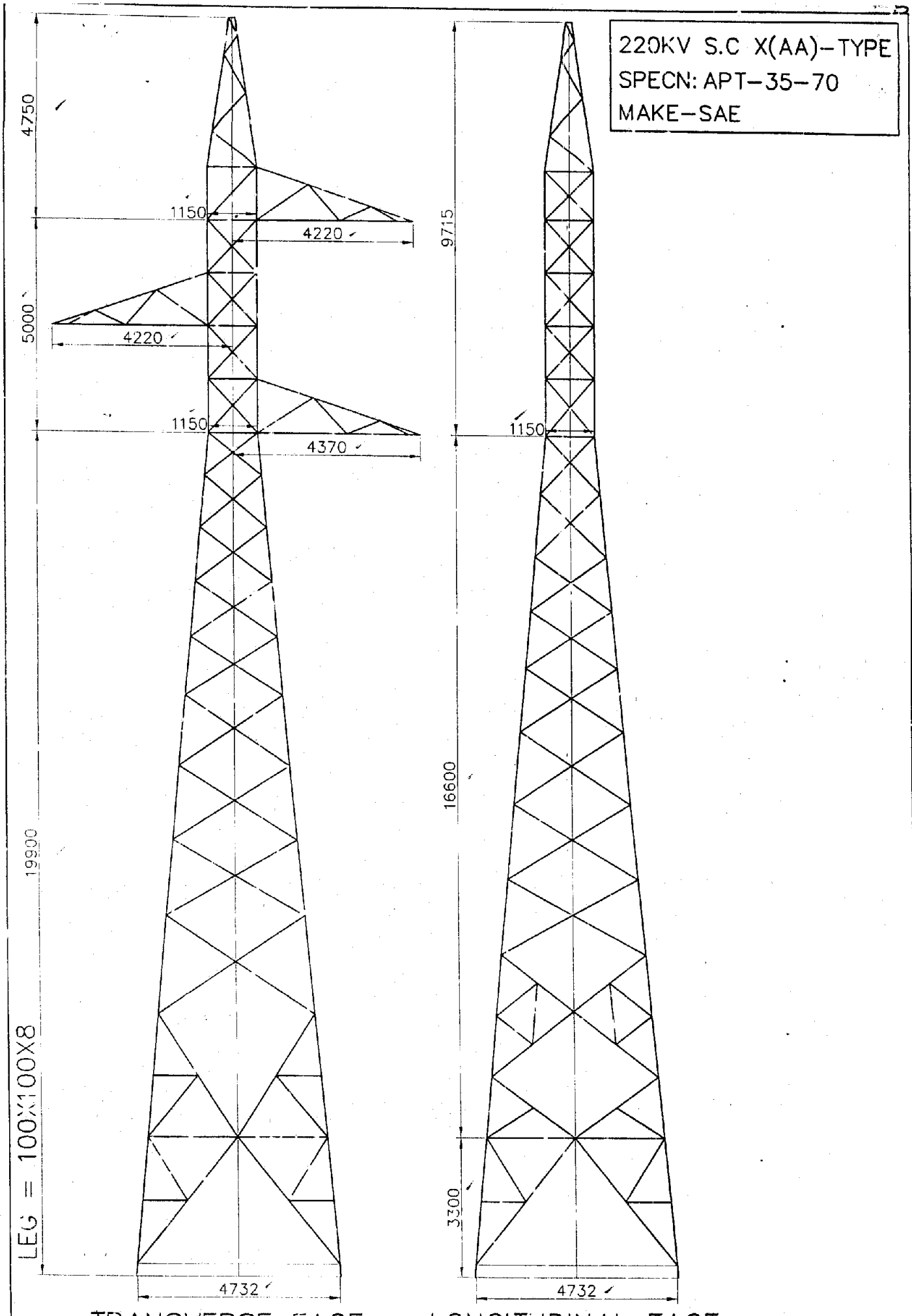
Make: - SAE

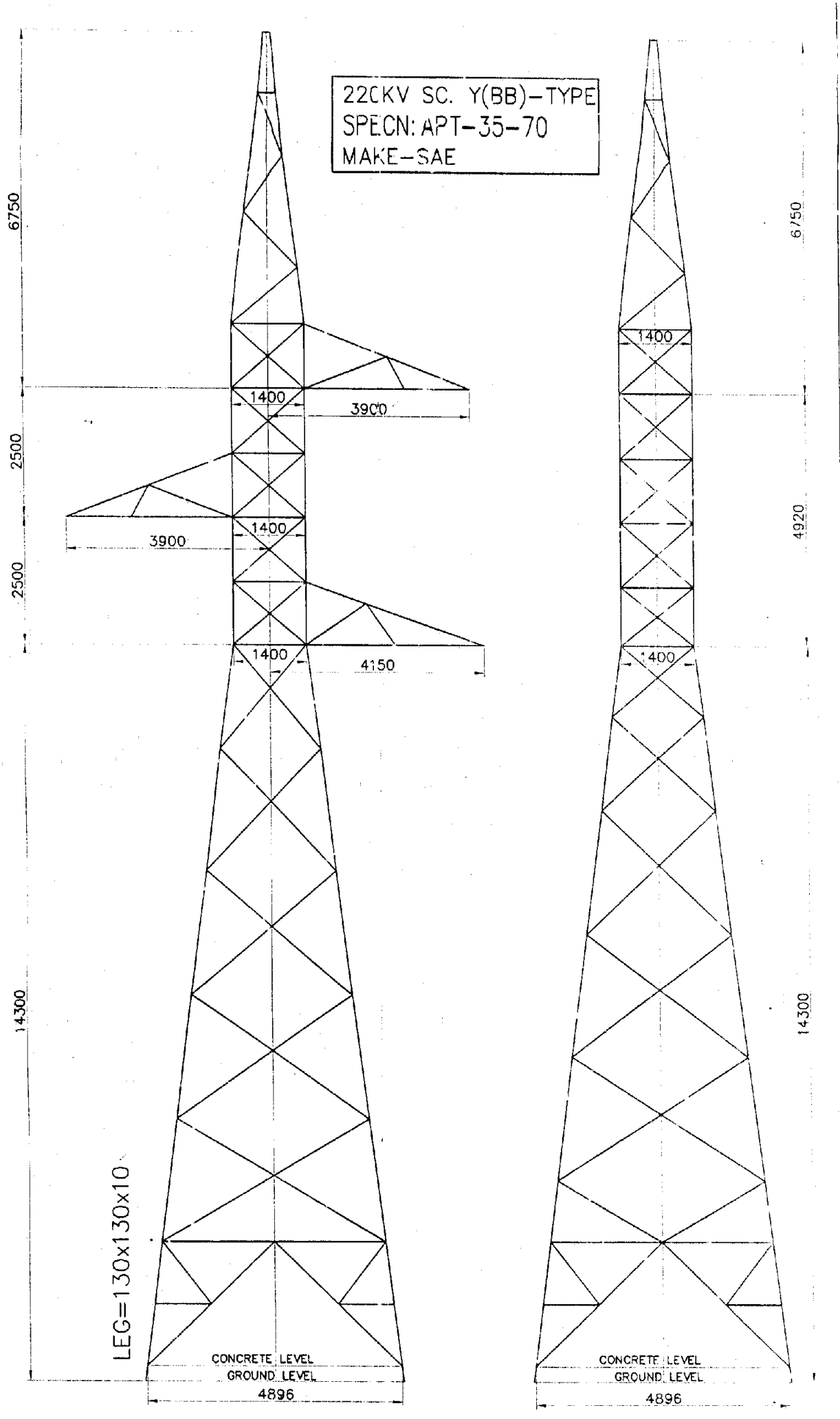
Sl. No.	Structure Type	Approx. Unit Weight in MT	Weight of Boits & Nuts
	I) Type of Tower : A		
1	Super Structure	2963.73	132.20
2	Stub & Cleats L90x90x8	161.84	2.46
3	Stub Setting Templates	369.08	8.62
4	+ 3 meters extensions	532.83	21.65
5	+ 6 meters extensions		
6	+ 9 meters extensions		
7	+ 12 meters extensions		
	I) Type of Tower : B		
1	Super Structure	3614.66	153.31
2	Stub & Cleats L130x130x10	340.76	4.08
3	Stub Setting Templates	415.92	8.69
4	+ 3 meters extensions	599.24	19.83
5	+ 6 meters extensions	1224.56	39.66
	I) Type of Tower : C		
1	Super Structure	4758.17	180.56
2	Stub & Cleats L130x130x12	442.32	6.27
3	Stub Setting Templates	625.00	8.69
4	Dead end Tower	4671.41	181.29
5	+ 3 meters extensions	730.68	25.05
6	+ 6 meters extensions	1621.64	49.68
7	+ 18 meters extensions	6513.60	570.17
8	Steel for X-arm only Angle Tower Dead end tower	 592.50 445.18	

Foundation details of 220 kV SC towers under APT 35/70

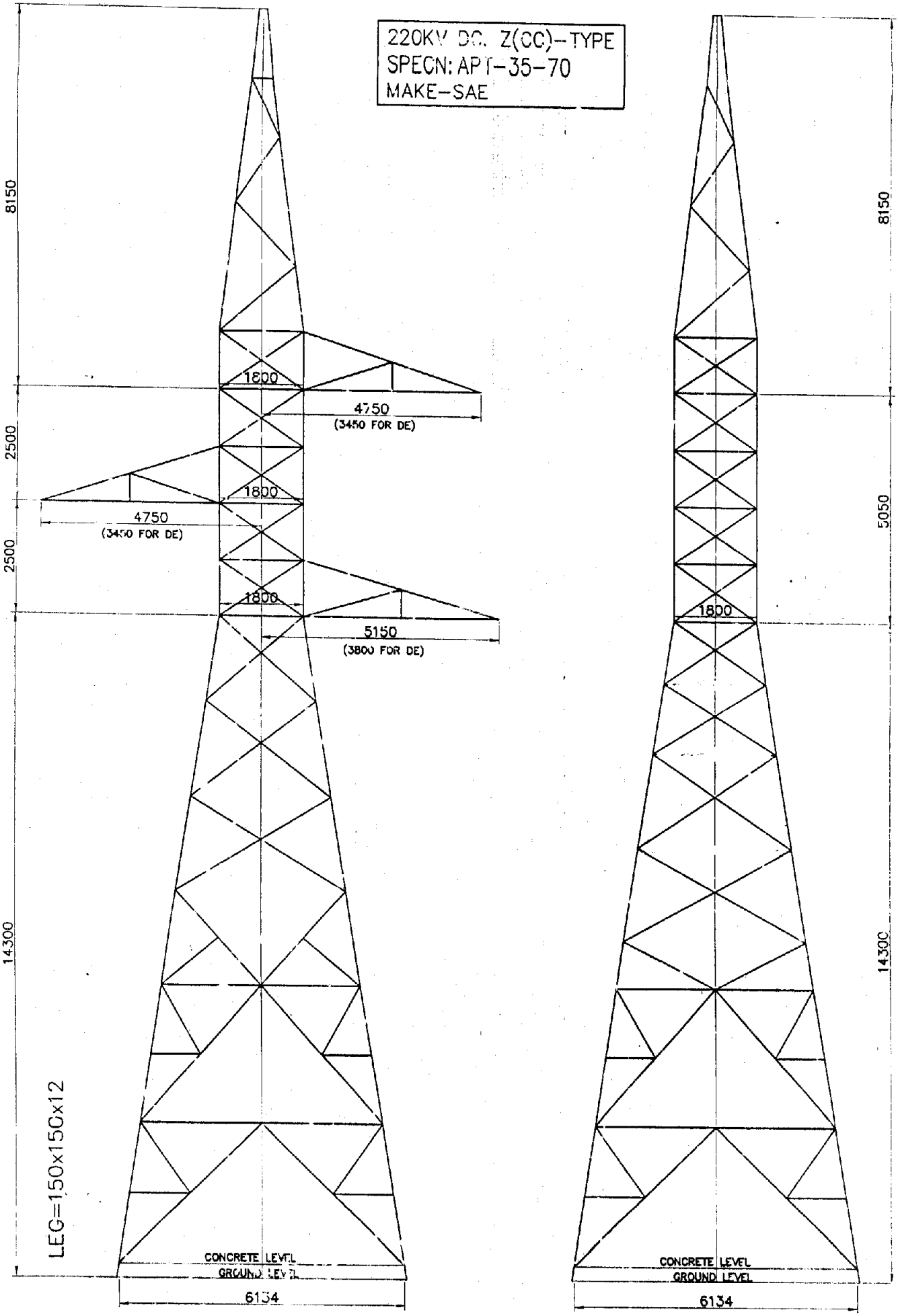
* HS: - Half submerge

Sl. No.	Types	Type of foundation	Stub size	Depth of foundation	Vol. of Concrete (Cum)	Vol. of Excavation (Cum)	Reinforcement steel (MT)
I)	**Type of Tower : A**						
1	Dry	Frustum		2840	1.91	16.80	20.36
2	HS	Frustum		2890	4.39	33.10	38.80
3	PS	Frustum		2940	6.65	50.00	56.40
4	FS	Frustum		2940	10.36	55.90	51.84
II)	**Type of Tower : B**						
1	Dry	Pad & Chimney			4.04	36.40	
2	HS	Pad & Chimney			11.87	87.00	
3	PS	Pad & Chimney			18.09	121.84	
4	FS	Pad & Chimney			25.20	156.50	
III)	**Type of Tower : C**						
1	Dry	Pad & Chimney			5.15	47.06	
2	HS	Pad & Chimney			18.07	120.96	
3	PS	Pad & Chimney			24.76	153.39	
4	FS	Pad & Chimney			34.17	204.00	
IV)	**Type of Tower : AA**						
1	Dry	Frustum		2940	2.08	22.70	
2	HS	Frustum		3040	5.73	47.60	
3	PS	Frustum			7.63	53.54	
4	FS	Frustum			11.26	56.00	
V)	**Type of Tower : BB**						
1	Dry	Frustum		3450	4.12	44.80	
2	HS	Frustum		3500	11.26	95.00	
3	PS	Frustum			16.51	114.53	
4	FS	Frustum			23.08	114.20	
VI)	**Type of Tower : CC**						
1	Dry	Frustum		3425	5.19	54.40	
2	HS	Frustum		3675	18.00	130.00	
3	PS	Frustum					
4	FS	Frustum					


220KV S.C X(AA)-TYPE
SPECN: APT-35-70
MAKE-SAE
4750
1150
4220
5000
4220
1150
4370
19900
LEG = 100X100X8
4732
TRANSVERSE FACE
9715
1150
16600
3300
4732
LONGITUDINAL FACE


220KV SC. Y(BB)-TYPE
SPECN: APT-35-70
MAKE-SAE
6750
2500
2500
14300
1400
3900
1400
3900
1400
4150
LEG=130x130x10
CONCRETE LEVEL
GROUND LEVEL
4896
6750
4920
14300
1400
1400
CONCRETE LEVEL
GROUND LEVEL
4896

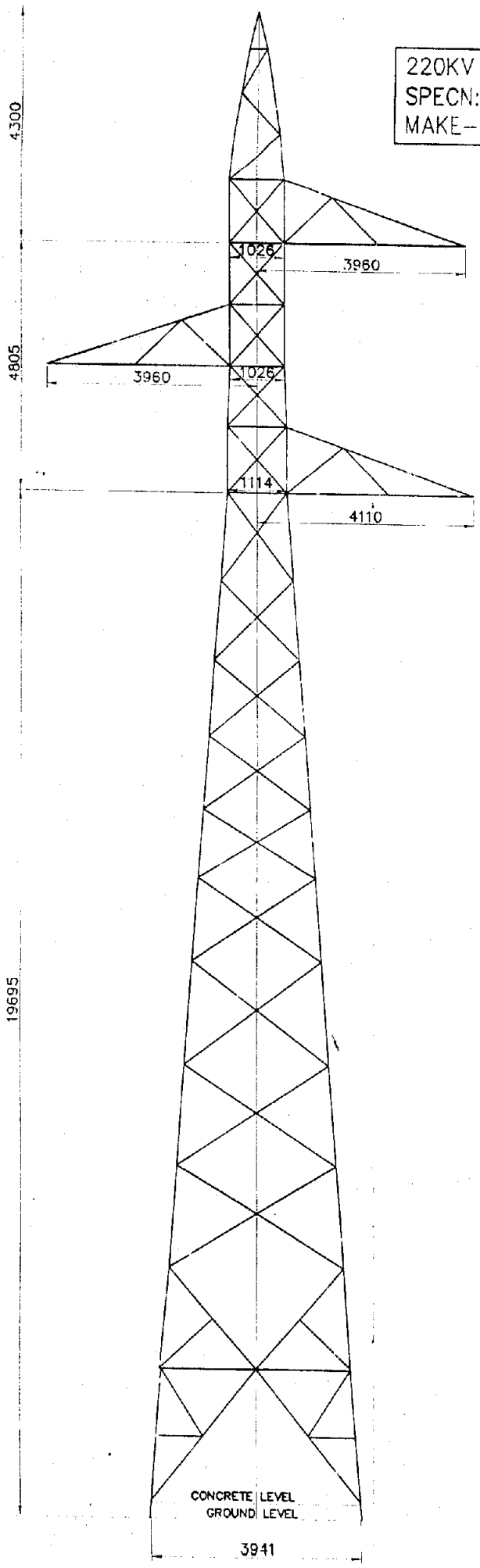
220KV DC. Z(CC)-TYPE
SPECN: APT-35-70
MAKE-SAE



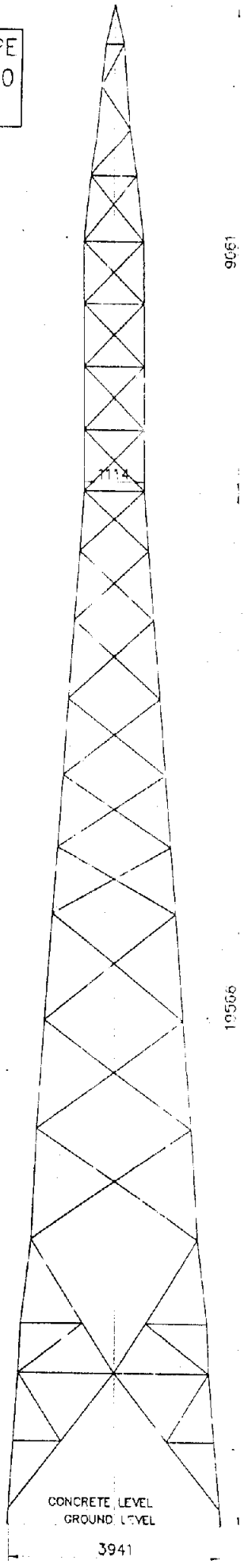
TRANSVERSE FACE

LONGITUDINAL FACE

220KV SC. A-TYPE
SPECN: APT-35-70
MAKE-SAE



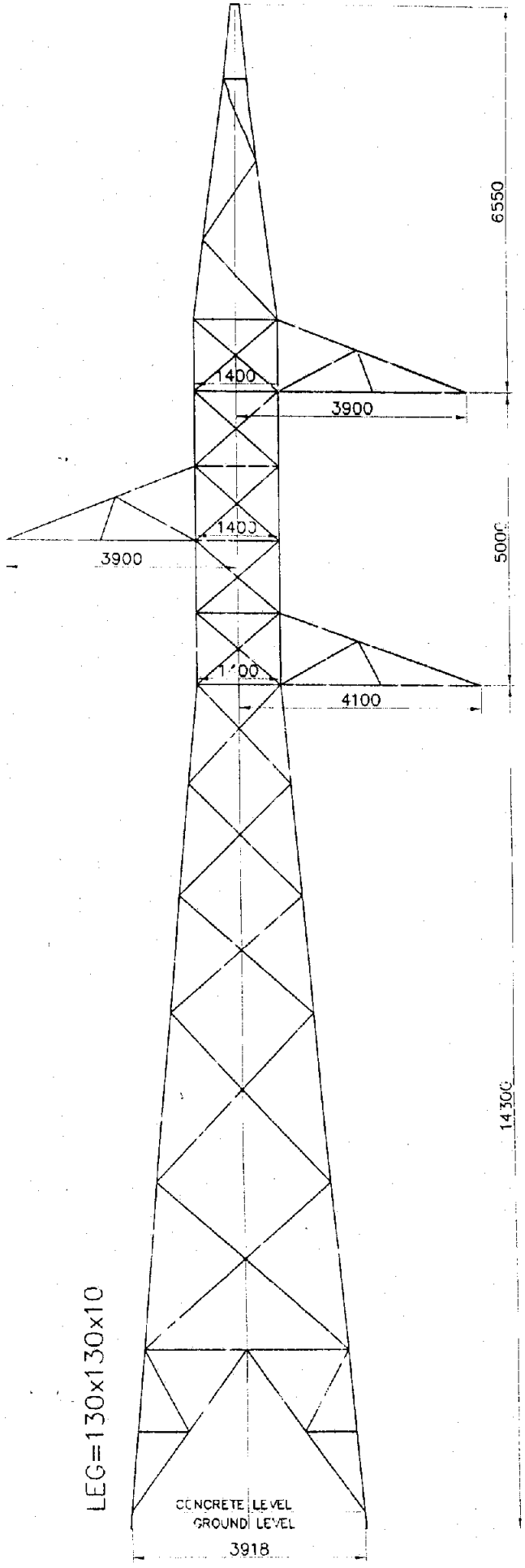
TRANSVERSE FACE



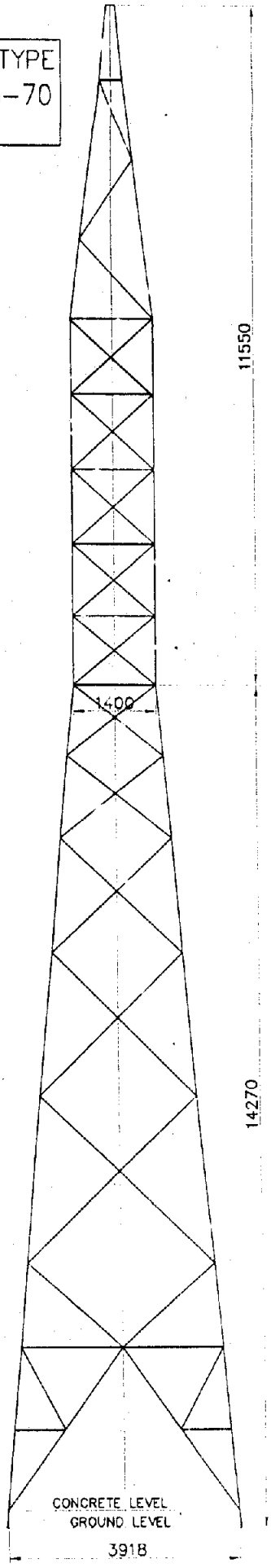
LONGITUDINAL FACE

LEG=90x90x6

220KV DC. B-TYPE
SPECN:,APT-35-70
MAKE-SAE

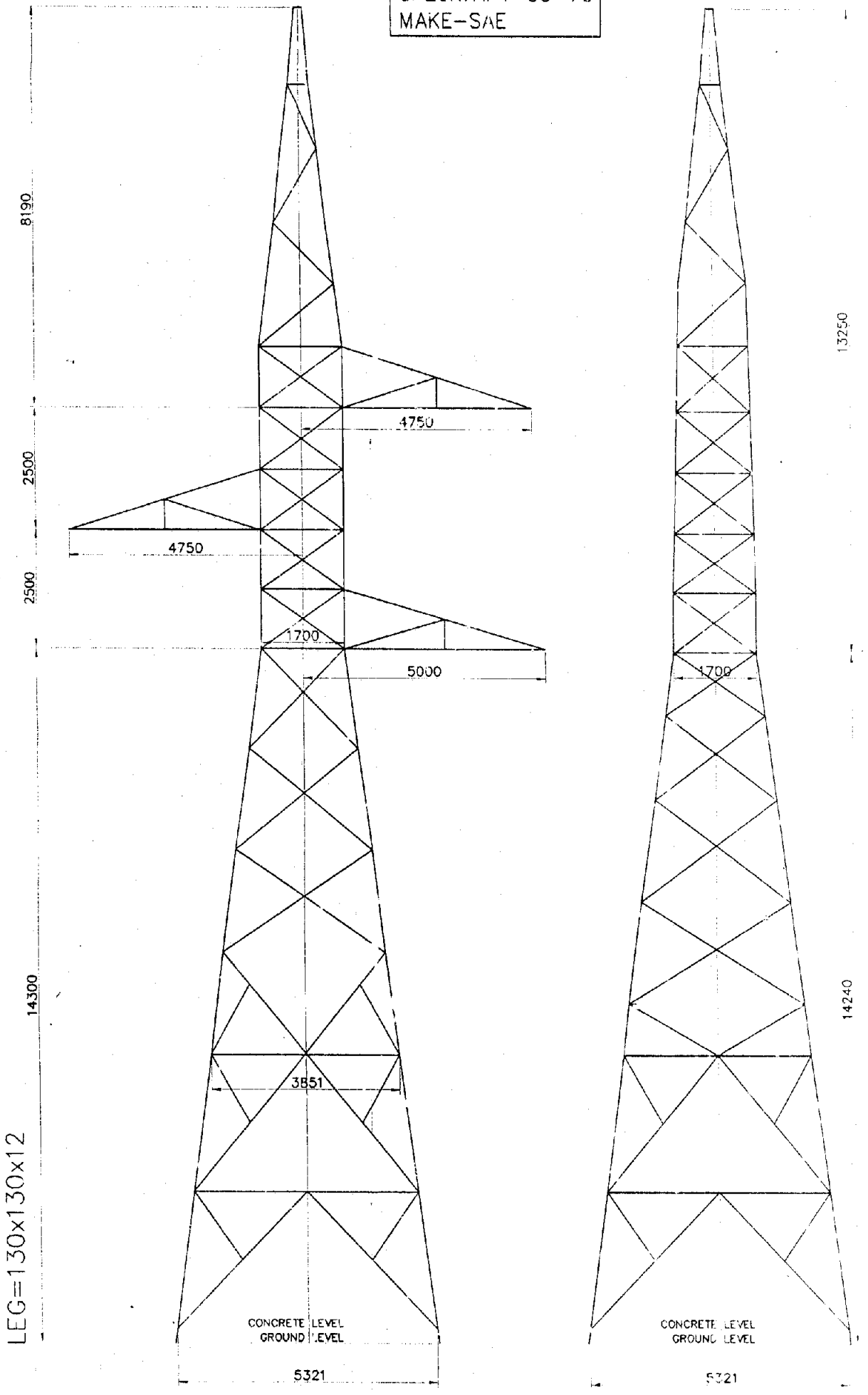


TRANSVERSE FACE



LONGITUDINAL FACE

220KV SC. C-TYPE
SPECN. APT-35-70
MAKE-SAE



220 kV SC Transmission Line APT - 29/70

Make: - KAMANI

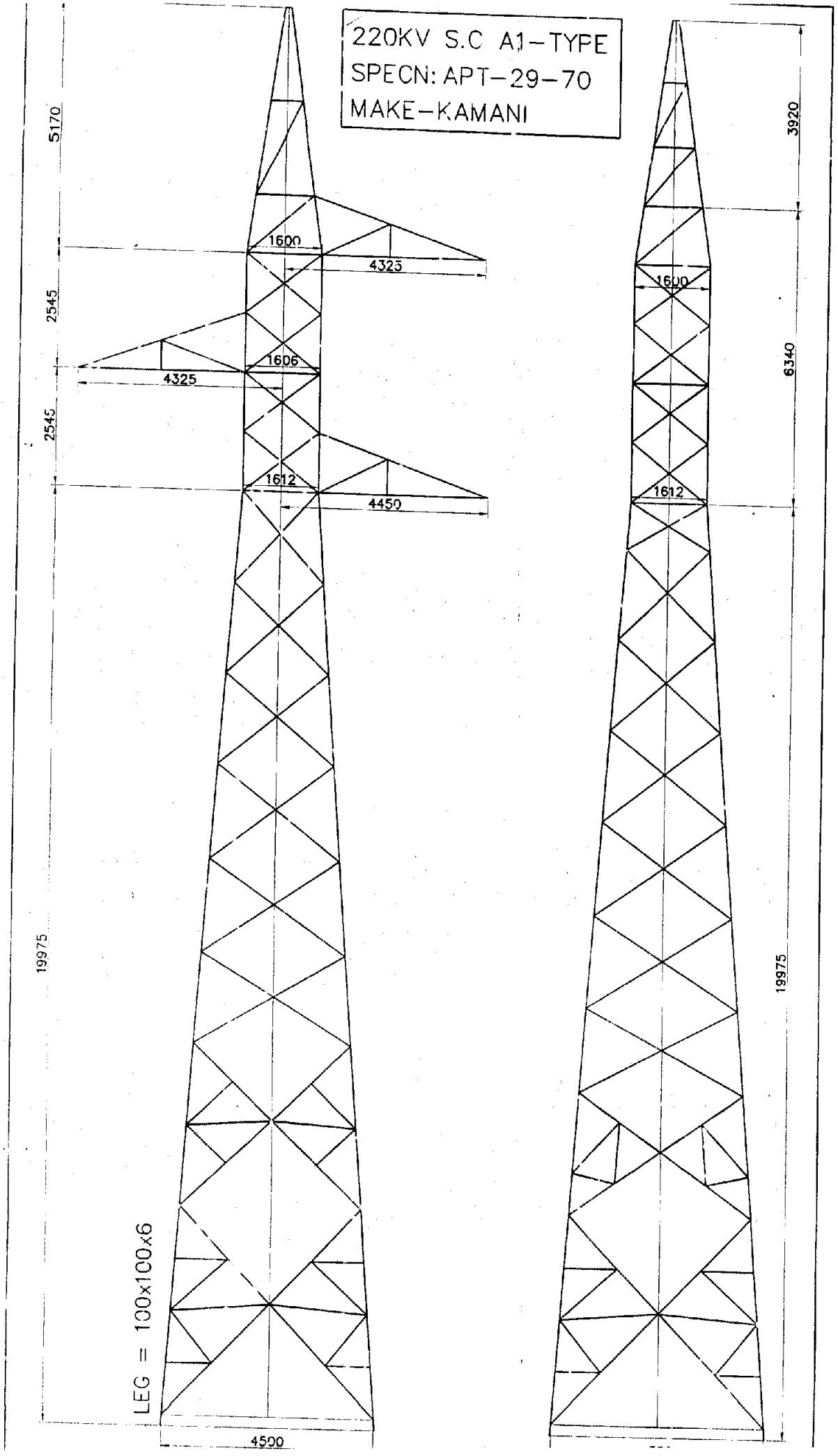
Sl. No.	Structure Type	Approx. Unit Weight in MT	Weight of Bolts & Nuts
I)	**Type of Tower : A1**		
1	Super Structure	3032.92	168.25
2	Stub & Cleats L90x90x8	155.54	3.00
3	Stub Setting Templates	403.92	13.56
4	+ 3 meters extensions	570.84	27.72
5	+ 6 meters extensions	1246.40	53.38
6	+ 9 meters extensions		
7	+ 12 meters extensions		
II)	**Type of Tower : A2**		
1	Super Structure	3451.66	182.38
2	Stub & Cleats L110x110x8	197.69	1.29
3	Stub Setting Templates	564.20	17.99
4	+ 3 meters extensions	662.520	
5	+ 6 meters extensions	1427.000	
6	+ 9 meters extensions		
7	+ 12 meters extensions		
III)	**Type of Tower : B1**		
1	Super Structure	4468.68	208.43
2	Stub & Cleats L130x130x10	331.68	10.46
3	Stub Setting Templates	770.16	
4	+ 3 meters extensions	909.20	34.51
5	+ 6 meters extensions	2068.20	71.05
6	+ 9 meters extensions	3358.40	108.34
7	+ 12 meters extensions		
IV)	**Type of Tower : C1 & C2**		
1	Super Structure	6371.73	267.81
2	Stub & Cleats	416.48	
3	Stub Setting Templates	1097.92	
4	+ 3 meters extensions	1489.04	43.80
5	+ 6 meters extensions	3214.80	85.53
6	+ 9 meters extensions	5288.72	142.35
7	+ 12 meters extensions		
V)	**River crossing tower - J**		
1	Base Assembly for Anchor bolts per tower	1342.80	
2	Anchor bolts per tower	1141.76	
3	Super Structure (part 1 to 8)	28526.41	
4	Super Structure (part 9)	8607.96	
5	Ladder	938.82	

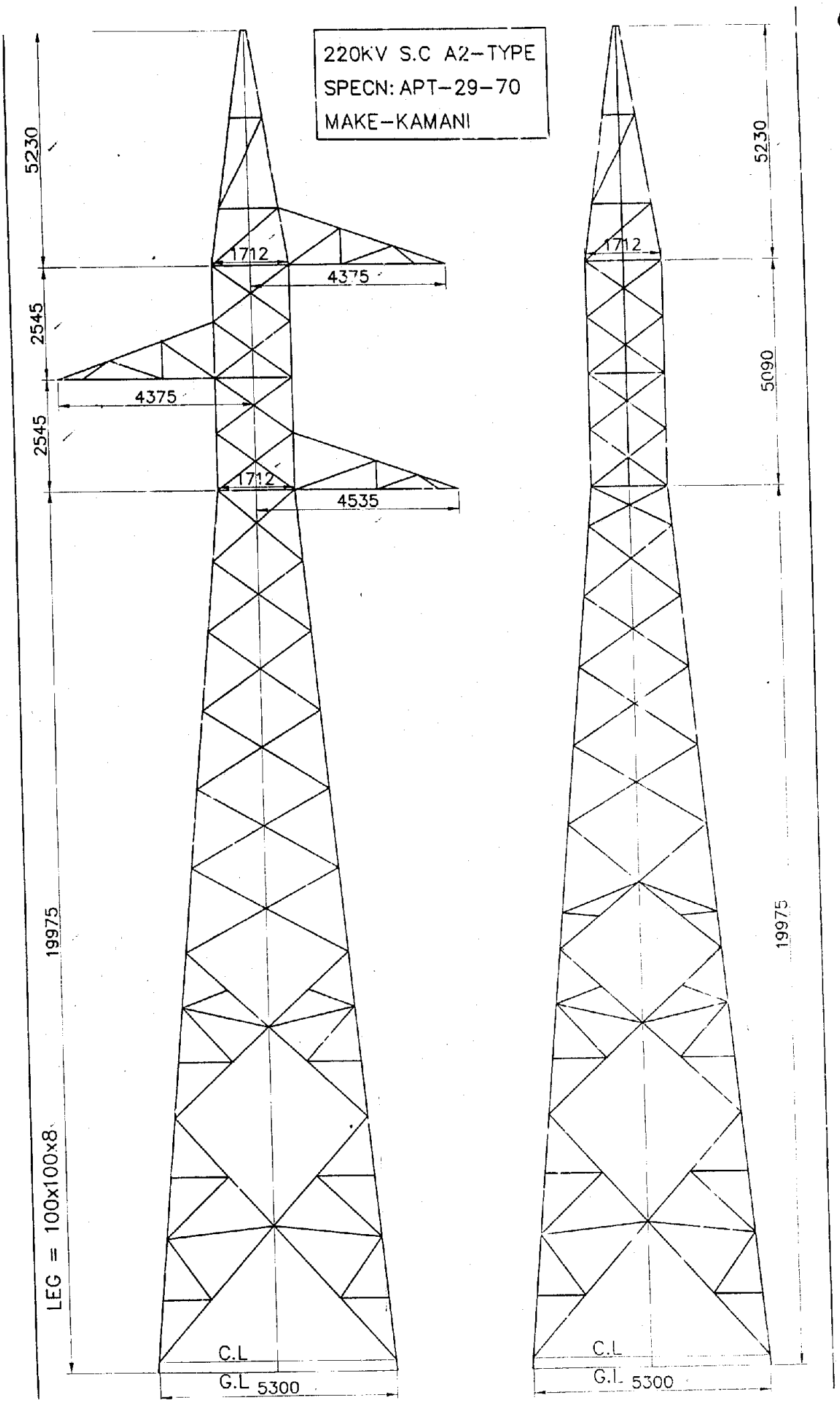
FOUNDATION DETAILS APT 29/70

220 kV SC Transmission Line

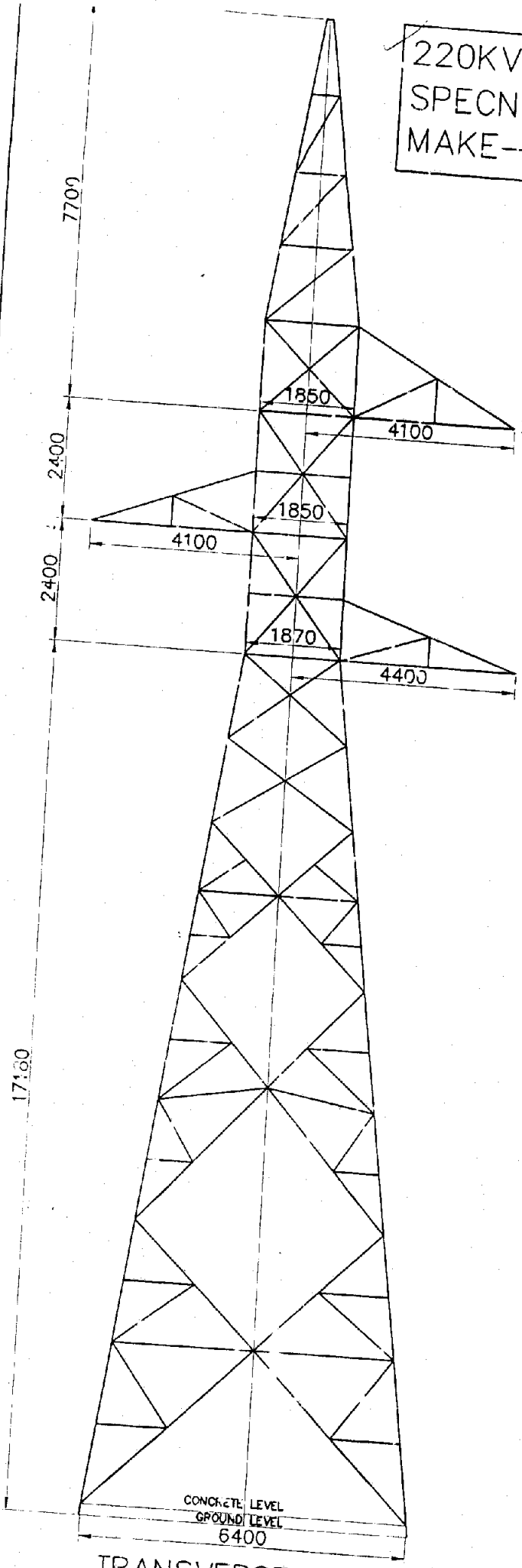
Sl. No.	Types	Type of foundation	Stub size	Depth of foundation	Vol. of Concrete (Cum)	Vol. of Excavation (Cum)	Reinforcement steel (MT)
I) Type of Tower : A1							
1	Dry		100 x 100 x 6				
2	Wet				4.484	38.95	
3	PS				8.04	53.25	
4	FS						
IV) Type of Tower : A2							
1	Dry		100 x 100 x 8		2.09	20.9	
2	Wet				5.232	41.80	
3	PS				5.69	53.25	98.00
4	FS				8.79	58.90	98.00
V) Type of Tower : B1 & B2							
1	Dry		130 x 130 x 10		2.442	27.85	
2	Wet				10.022	84.04	
3	PS				16.34	122.00	
4	FS				24.52	134.00	
VI) Type of Tower : C1 & C2							
1	Dry		130 x 130 x 12		4.76	34.8	#
2	Wet				12.308	102.40	
3	PS				20.20	143.50	
4	FS				31.04	157.00	

- for 6 & 9 mts Extension

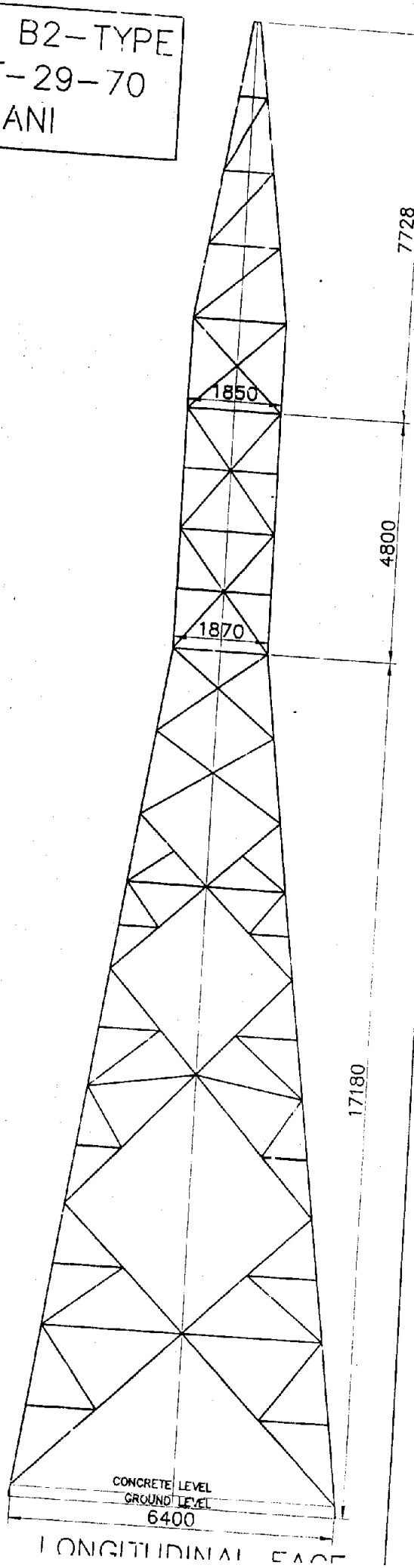

220KV S.C A1-TYPE
SPECN: APT-29-70
MAKE-KAMANI
5170
2545
2545
19975
1600
4325
1606
4325
1612
4450
4500
LEG = 100x100x6
3920
6340
19975
1600
1612


220KV S.C A2-TYPE
SPECN: APT-29-70
MAKE-KAMANI
5230
2545
2545
19975
LEG = 100x100x8
1712
4375
4375
1712
4535
C.L
G.L 5300
5230
5090
19975
1712
C.L
G.L 5300

220KV S.C B2-TYPE
SPECN: APT-29-70
MAKE--KAMANI

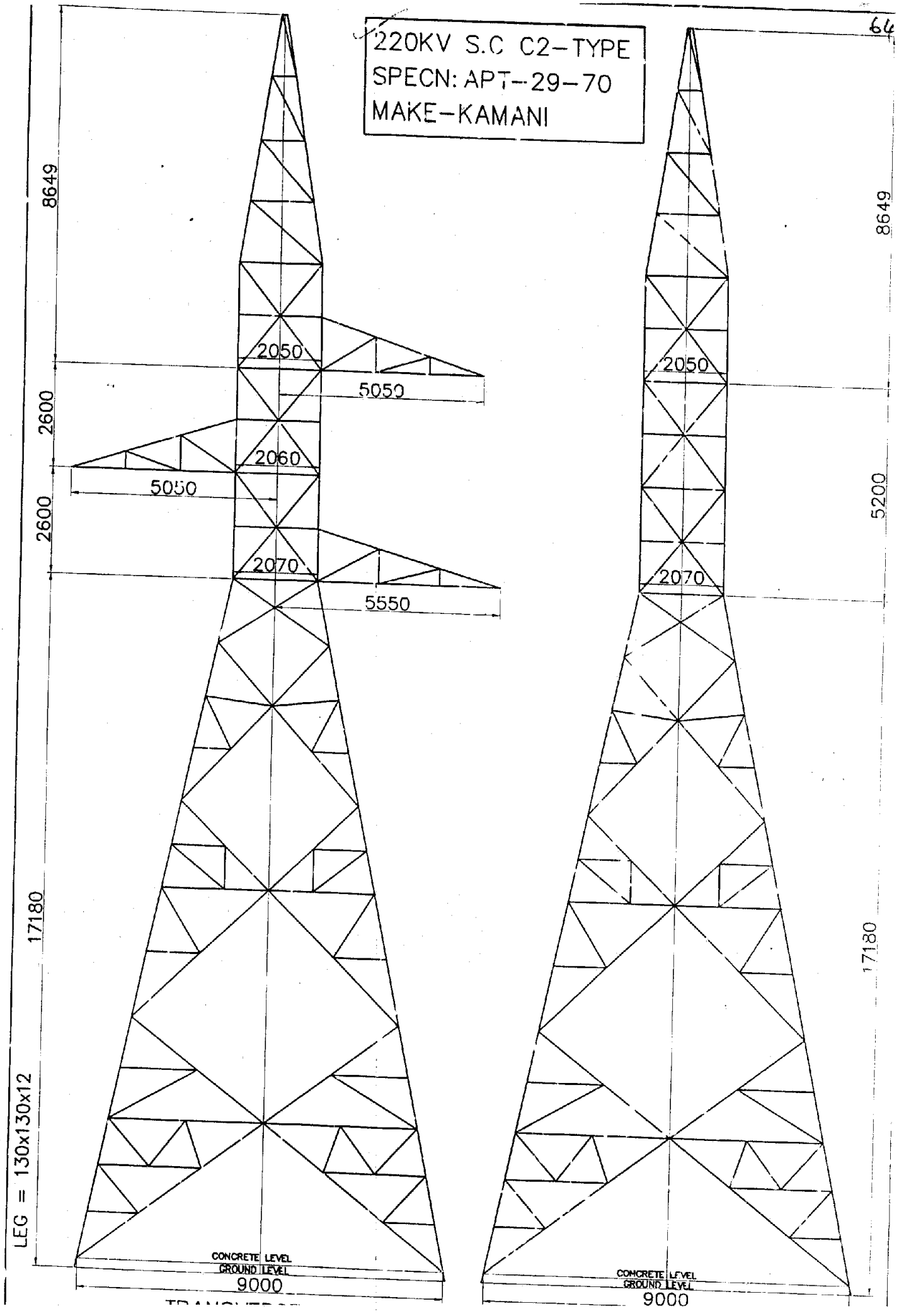


TRANSVERSE FACE

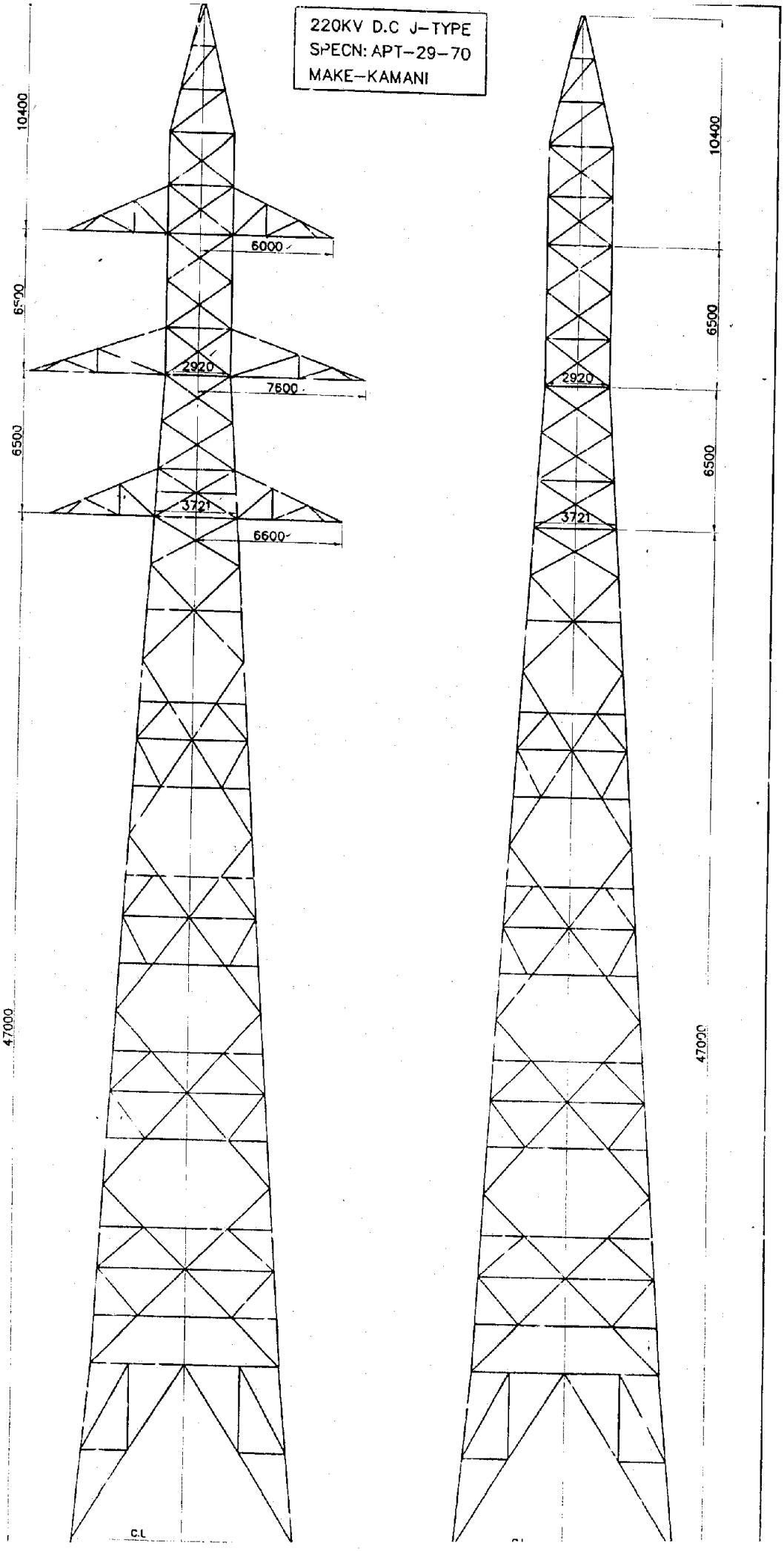


LONGITUDINAL FACE

220KV S.C C2-TYPE
SPECN: APT-29-70
MAKE-KAMANI



220KV D.C J-TYPE
SPECN: APT-29-70
MAKE-KAMANI



IDA - 11

220 kV SC Transmission Line Spec IDA 11

Make: - SAE

Sl. No.	Structure Type	Approx. Unit Weight in MT	Weight of Bolts & Nuts	
	I) Type of Tower : K			
1	Super Structure	3155.54	171.45	
2	Stub & Cleats L100x100x8	184.36	3.69	
3	Stub Setting Templates	534.16	13.47	
4	Normal Tower			
5	+ 3 meters extensions	489.88	18.37	
6	+ 6 meters extensions	1066.80	36.74	+3 mtr externsion
7	+ 9 meters extensions			
8	+ 12 meters extensions			
	II) Type of Tower : L			
1	Super Structure	4256.12	211.50	
2	Stub & Cleats L130x130x10	340.68	5.24	
3	Stub Setting Templates	822.40	14.47	
4	Normal Tower			
5	+ 3 meters extensions	641.92	22.29	
6	+ 6 meters extensions	1361.61	44.58	
7	+ 9 meters extensions			
8	+ 12 meters extensions			
	III) Type of Tower : M			
1	Super Structure	5338.29	242.09	
2	Stub & Cleats	498.64	5.59	*
3	Stub Setting Templates	1102.12	14.47	
4	Normal Tower			
5	+ 3 meters extensions	990.64	24.48	
6	+ 6 meters extensions	2095.00	50.77	
7	+ 9 meters extensions	3688.16	82.95	
8	+ 12 meters extensions			

* S & C for +6m extended tower = 504.12 + 5.59 B&N

FOUNDATION DETAILS IDA 11

220 kV SC Transmission Line

Make - SAE

Sl. No.	Types	Type of foundation	Stub size	Depth of foundation #	Vol. of Concrete (Cum)	Vol. of Excavation (Cum)	Reinforcement steel (MT)	Width of Foundation
I)	Type of Tower : K							
1	Dry	Frustrum		2600	2.0352	20.38		1410
2	Wet	Frustrum		2700	8.520	43.20 * 57.13 **		2300
3	Rocky	---	100 x 100 x 8	2600	2.648 to 3.242	--		800
4	PS	Frustrum		2700	12.63	62.21		2400
5	FS	Frustrum		2700	14.68	67.37		-----
II)	Type of Tower : L							
1	Dry	Frustrum		3100	3.846	39.68		1790
2	Wet	Frustrum		3200	15.940	80.0 * 100.35 **		2800
3	Rocky	---	130 x 130 x 10	3100	5.2614 to 6.0673	--		1000
4	PS	Frustrum		3200	23.48			3200
5	FS	Frustrum		3200	28.34	131.592		-----
III)	Type of Tower : M							
1	Dry	Frustrum		3280	5.4284	44.11		1990
2	Wet	Frustrum		3380	24.810	121.68 * 147.23 **		3300
3	Rocky	---	150 x 150 x 12	3280	7.494 to 8.4887	--		1250
4	PS	Frustrum		3380	34.44	175.22		3600
5	FS	Frustrum		3380	40.08	179.72		-----

* Without clearance

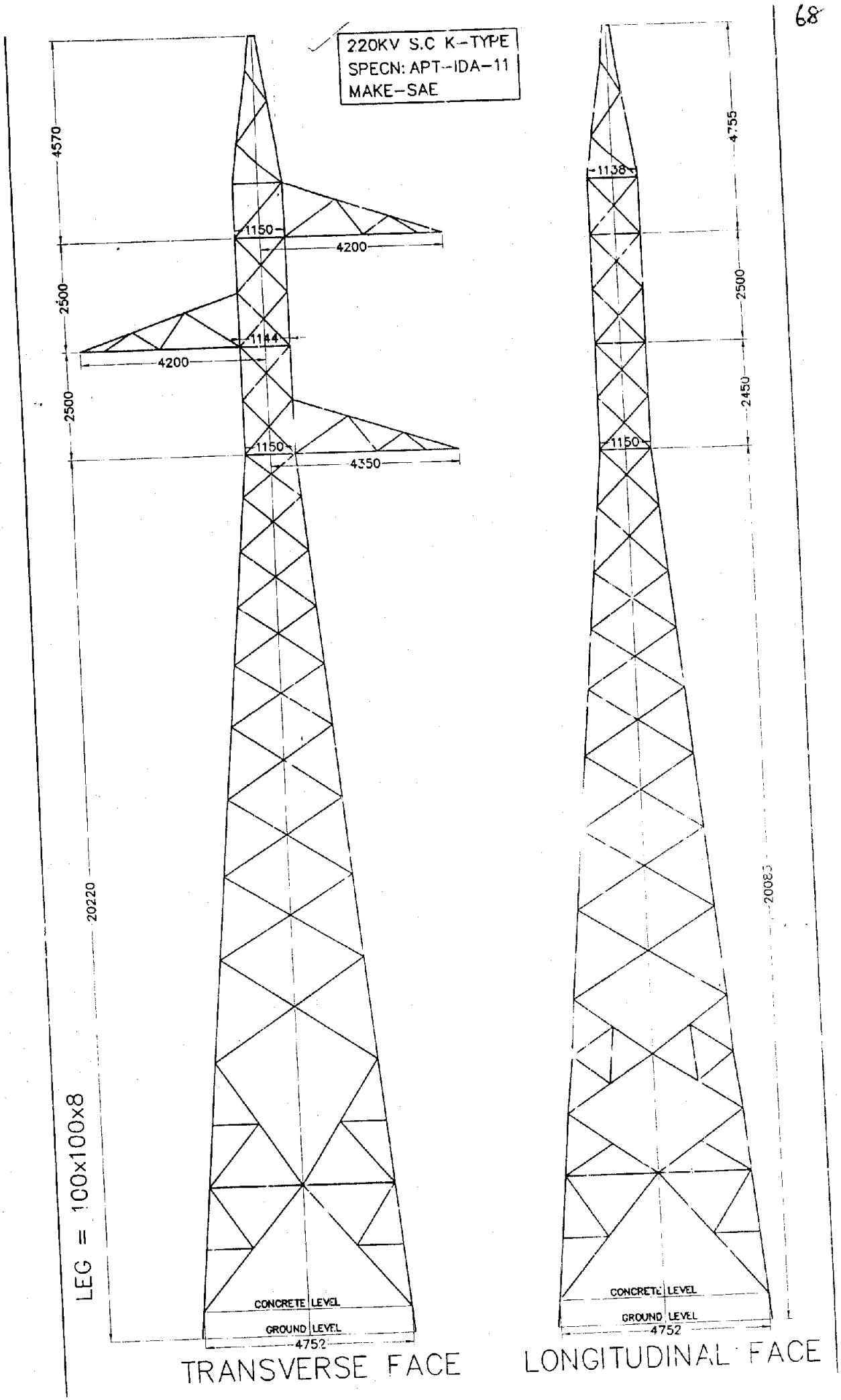
** With 150 mm clearance

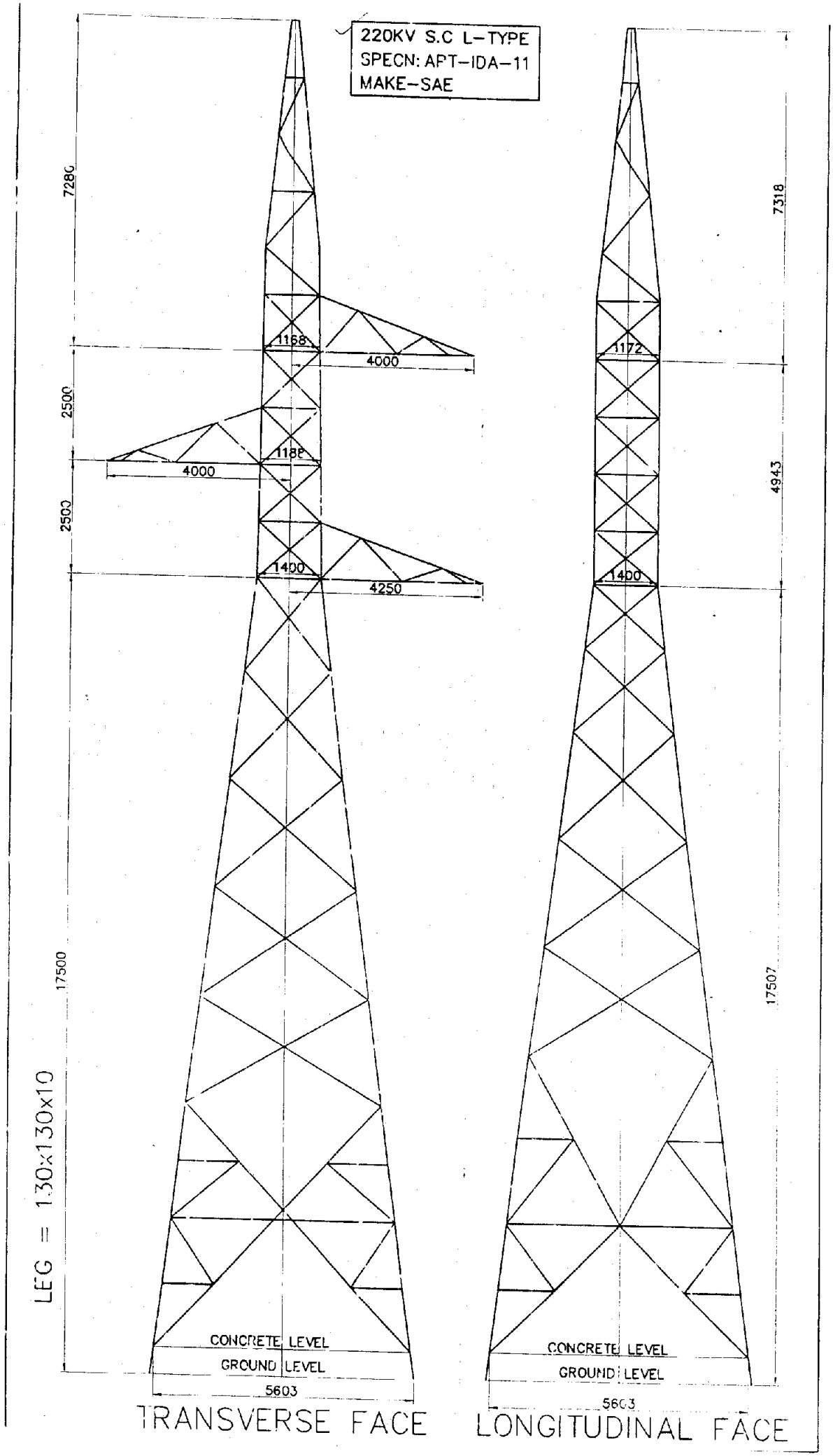
Note: - FS values shown above pertain to Nellore - Gunadala & Bommuru - Gazuwaka 220 kV SC line.

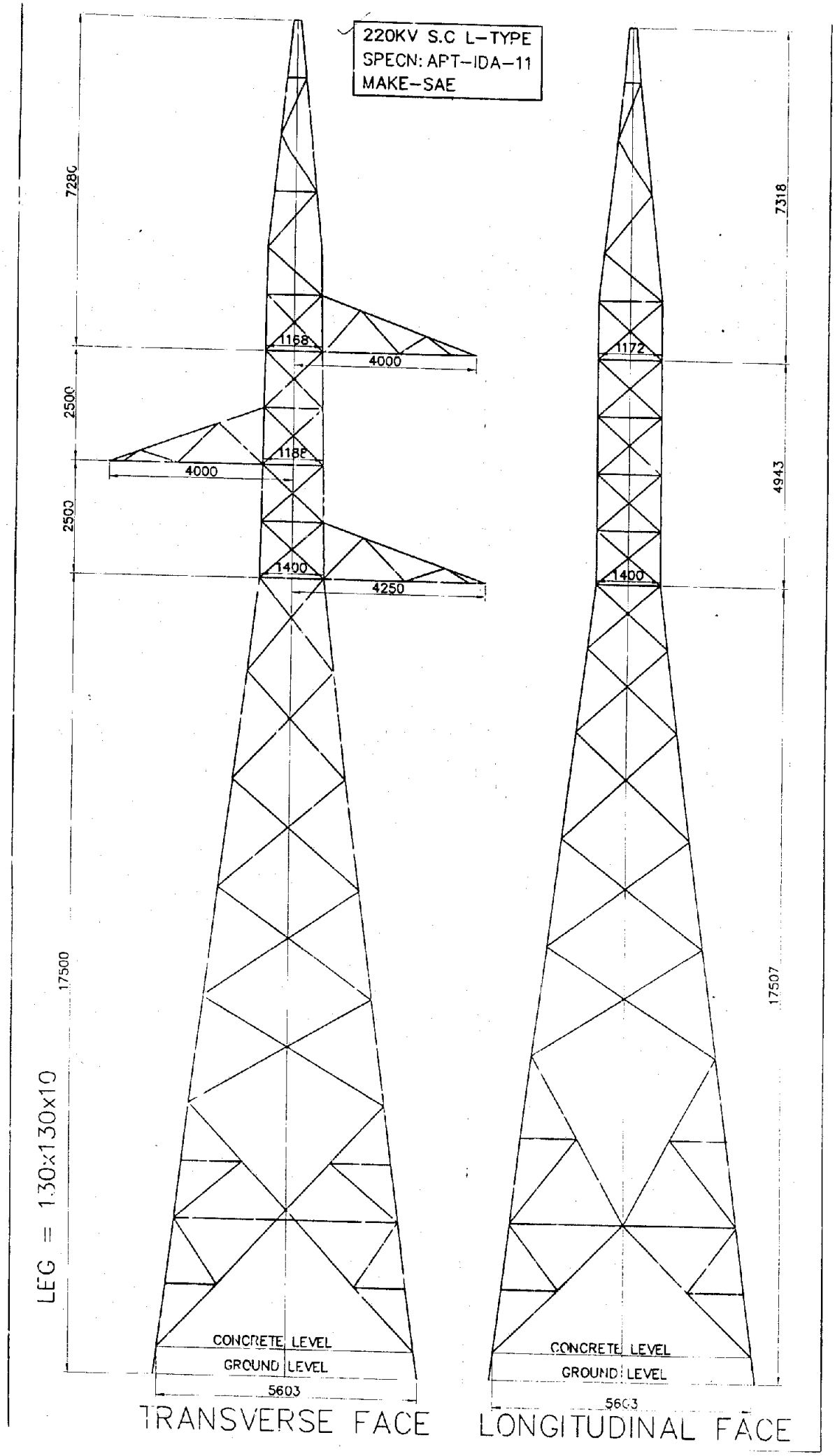
In another tracing sheet the following quantities given(with steel reinforcement)

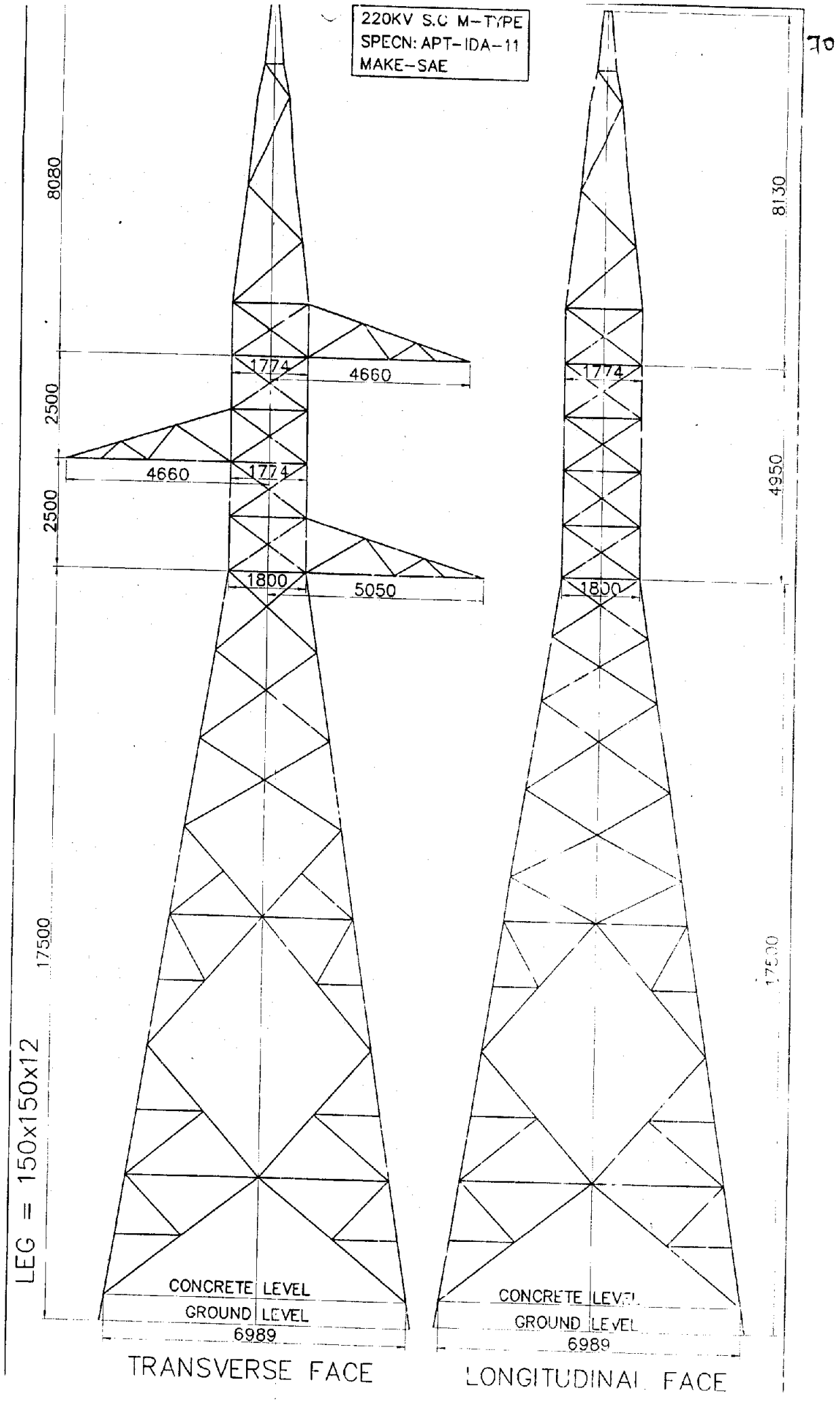
	K	L	M
Concrete	17.273	29.812	43.056
With 150 mm clearanc	108.0	191.66	223.89
Without clearance	87.48	161.84	259.66
Depth #	3000	3500	3680
Width	2700	3400	3900

Excluding coping height of 300mm


220KV S.C K-TYPE
SPECN: APT-IDA-11
MAKE-SAE
4570
2500
2500
20220
1150
4200
1144
4200
1150
4350
LEG = 100x100x8
CONCRETE LEVEL
GROUND LEVEL
4752
TRANSVERSE FACE
1138
4755
2500
2450
1150
20083
CONCRETE LEVEL
GROUND LEVEL
4752
LONGITUDINAL FACE


220KV S.C L-TYPE
SPECN: APT-IDA-11
MAKE-SAE
7280
2500
2500
17500
1168
4000
1188
4000
1400
4250
7318
1172
4943
1400
17507
LEG = 130x130x10
CONCRETE LEVEL
GROUND LEVEL
5603
TRANSVERSE FACE
CONCRETE LEVEL
GROUND LEVEL
5603
LONGITUDINAL FACE


220KV S.C L-TYPE
SPECN: APT-IDA-11
MAKE-SAE
7280
2500
2500
17500
1168
4000
1188
4000
1400
4250
LEG = 130x130x10
CONCRETE LEVEL
GROUND LEVEL
5603
TRANSVERSE FACE
7318
4943
17507
1172
1400
CONCRETE LEVEL
GROUND LEVEL
5603
LONGITUDINAL FACE


220KV S.C M-TYPE
SPECN: APT-IDA-11
MAKE-SAE
8080
2500
2500
17500
LEG = 150x150x12
1774
4660
4660
1774
1800
5050
CONCRETE LEVEL
GROUND LEVEL
6989
TRANSVERSE FACE
8130
4950
1774
1800
CONCRETE LEVEL
GROUND LEVEL
6989
LONGITUDINAL FACE

JC (MODIFIED)

Make: - MPEB

Sl. No.	Structure Type	Approx. Unit Weight in MT	Weight of Bolts & Nuts
I)	**Type of Tower : JCM**		
1	Super Structure		
2	+/- Stub (Normal)	1980.64	30.35
3	Stub (Extended +/- 0 base)	1955.00	27.71
4	Stub Setting Templates	2750.88	
5	Normal Tower	31866.93	494.75
6	Extended +/-0M. BASE	14085.48	202.46

Step Bolt Dia 16 x 175	=	38.446
U' Bolt Dia 20 x 275	=	1.003
Hanger	=	21.66
JCM base plate	=	1980.64
Weight of foundation bolts including Nut & Washers	=	783.36

Q1 What is this extended + / - 0 Base?

JC TYPE TOWER (OLD) APT 68/77

Make: - MPEB

Sl. No.	Structure Type	Approx. Unit Weight in MT	Weight of Bolts & Nuts
	I) **Type of Tower : JC** (Special truncated tower)		
1	Super Structure		
2	+/- Stub	1980.64	30.35
3	Stub (Extended +/- 0 base)	1955.00	27.71
4	Stub Setting Templates	2750.88	
5	Normal Tower	43443.98	
6	Extended +/-0M, BASE		

Q: What are the changes from Old JC to New JC?

Spec.No.APT 68/77

Design Data for 'JC' type Towers

I

1) Total height upto ground wire peak	--	88.2 M
2) Base width	--	12.53 M
3) Vertical Spacing between X-arms	--	7 M
4) Horizental Spacing between X-arms'		
a) Bottom X-arm	--	11.2 M
b)Middle X-arm	--	10.2 M
c) Top X-arm	--	9.7 M
5) Height of bottom X-arm above Ground level	--	68.6 M

II JC tower is a double circuit tower designed for six Deer ACSR having 23.88 mm dia & one Earthwire of 7/9 SWG.

FOS at Normal conditions	--	2.5	
FOS at BWC	--	1.5	
Designed wind span	--	600 mtr	
Designed weight span	--	1200 mtr	
Max. river crossing span	--	960 mtr	(#)

(#) (assuming that adjacent spans are limited to about 243 mtr).i.e 800 feet

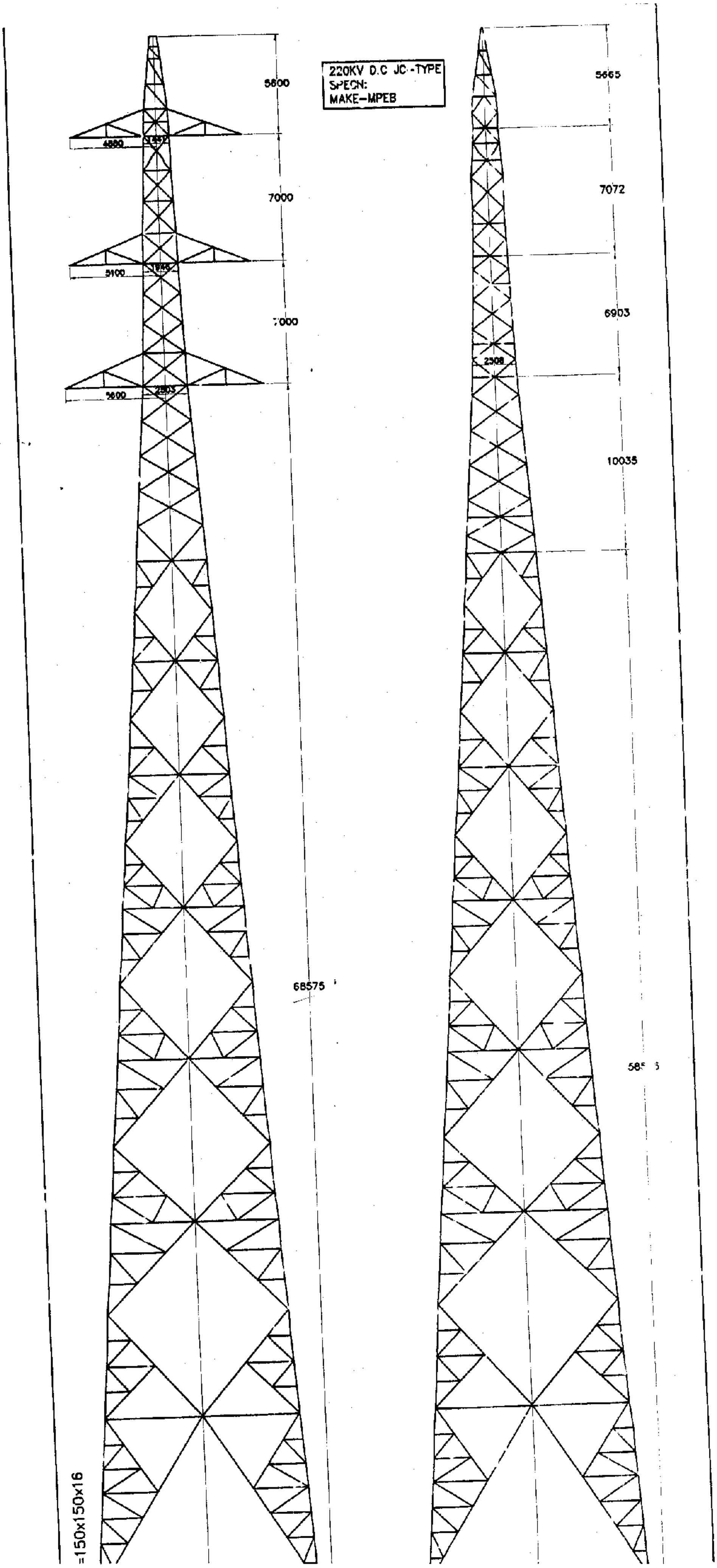
Assumed wind load = 150 Kg/m^2 on 2/3rd projected area of conductor

Assumed wind on towers = 146.5 Kg/m^2 acting on 1 1/2 times projected area of one face.

III While using Zebra conductor with 28.60 mm dia; the maximum crossing span is 1013 mtr.

Weight of tower including stubs as per designed section	=	about 43 MT
Allowing for substitution for unequal angles and wastages etc.,Steel required for tower (excluding platform and cage type ladder)	=	55 MT

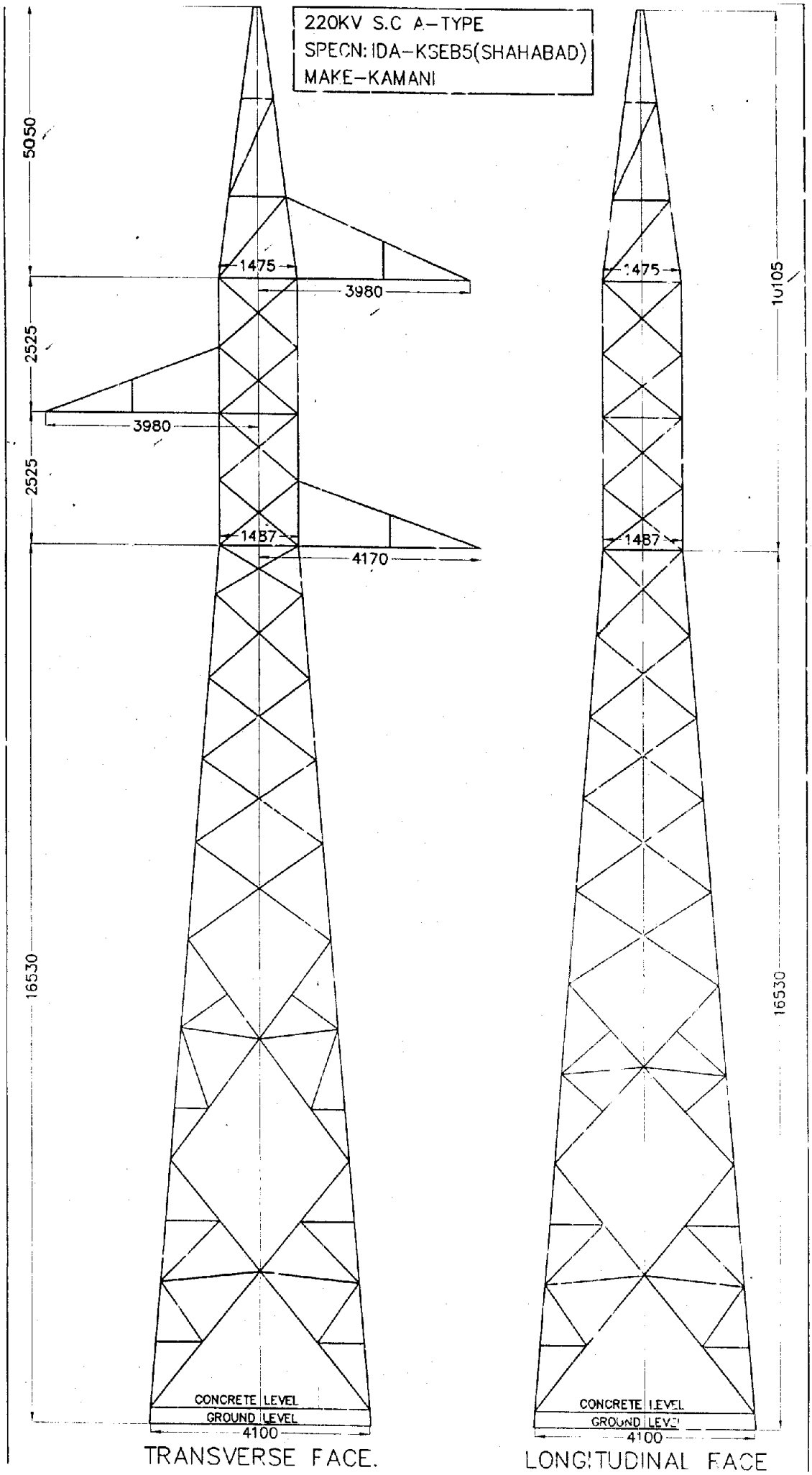
74

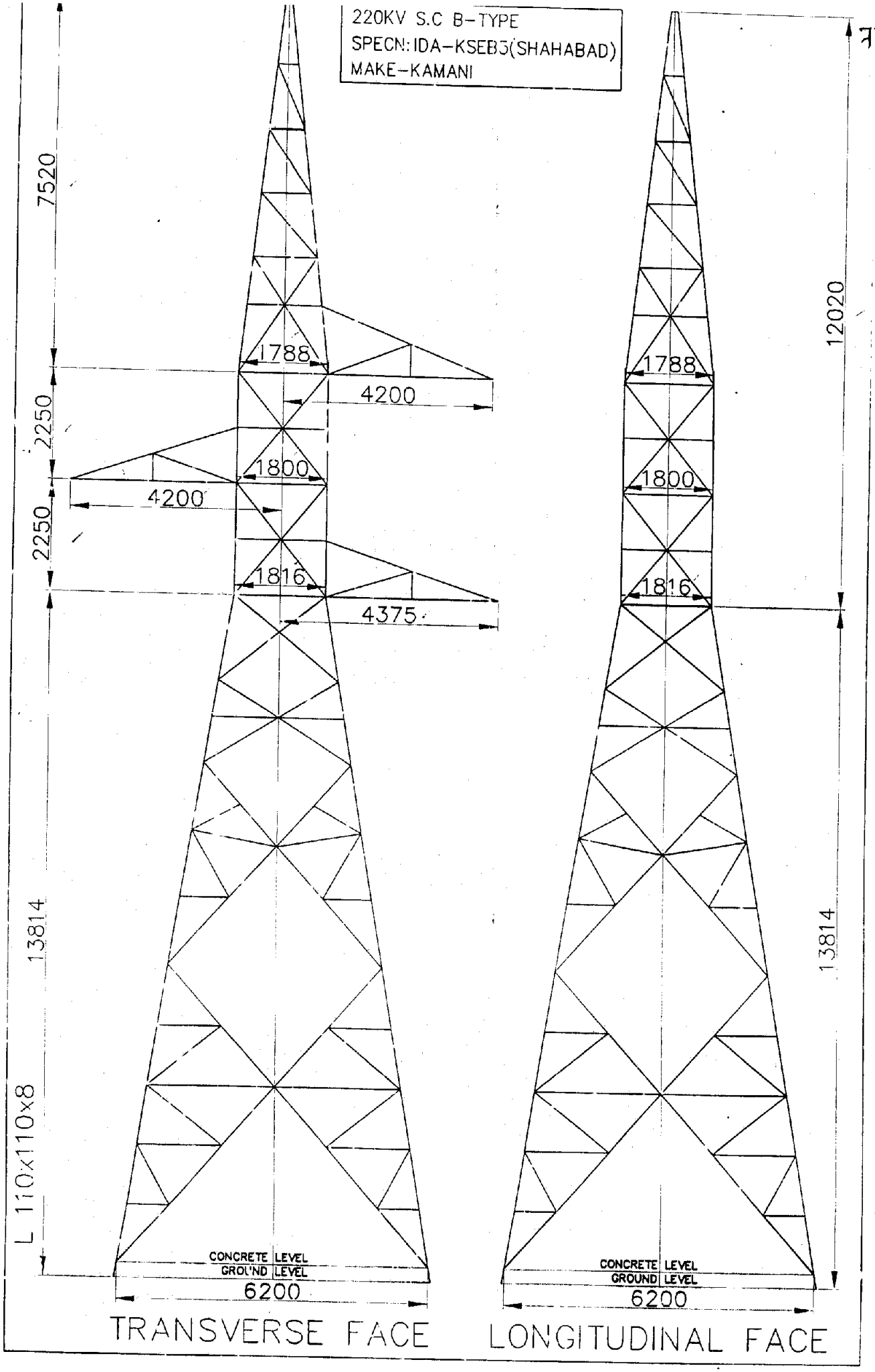

220KV D.C JC-TYPE
SPECN:
MAKE-MPEB
5800
7000
7000
5100
5600
68575
5665
7072
6903
2508
10035
=150x150x16

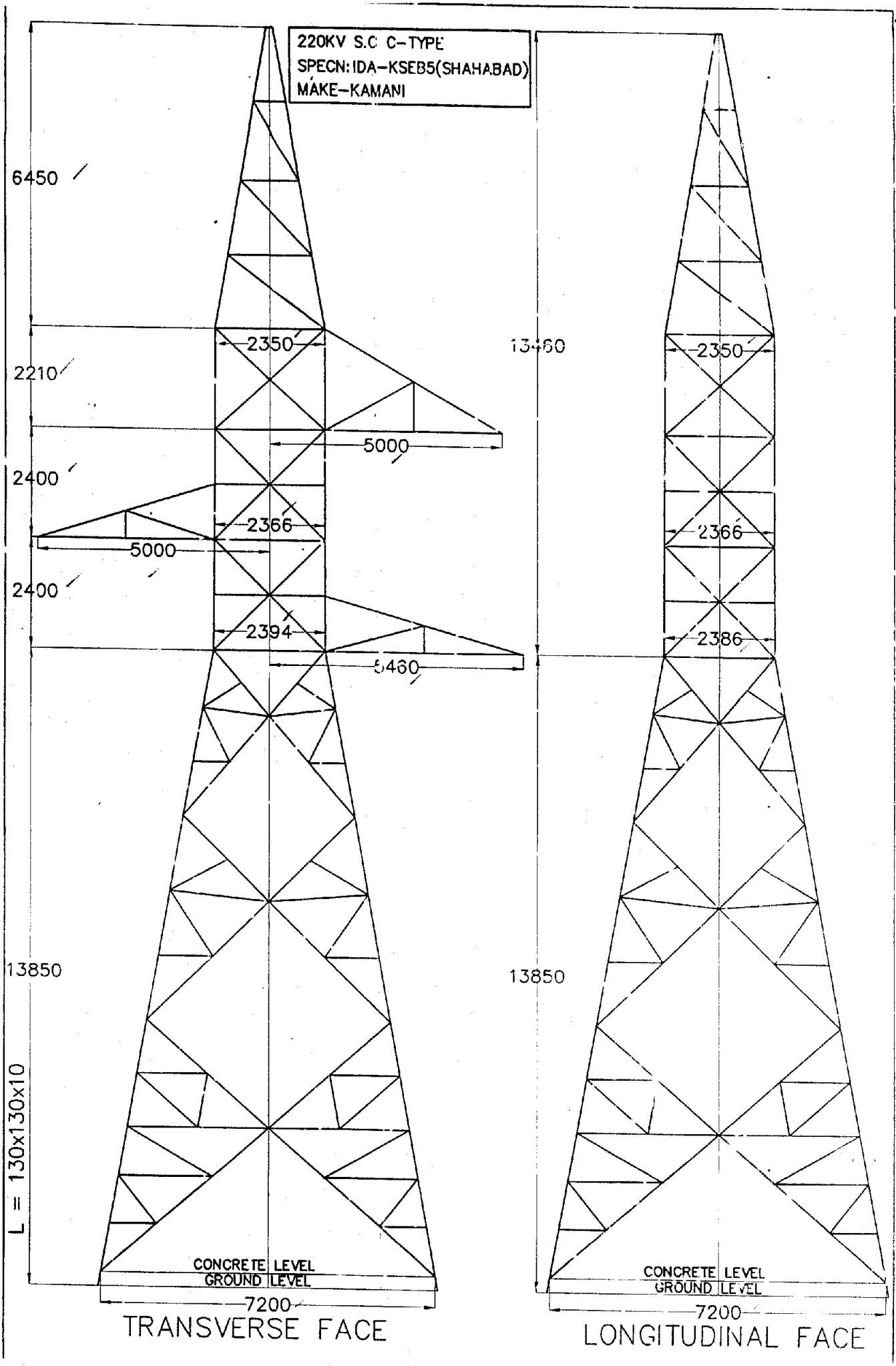
220 kV SC Transmission Line Hyderabad - Shahab

Spec No. IDA - KSEB 5
Make - Kamani

Sl. No.	Structure Type	Approx. Unit Weight in MT	Weight of Bolts & Nuts	
	I) Type of Tower : A			
1	Super Structure	2611.87	170.58	
2	Stub & Cleats	186.68	1.26	
3	Stub Setting Templates	406.24	15.82	
4	+ 3 meters extensions	564.280	38.48	
5	+ 6 meters extensions			
6	+ 9 meters extensions			
7	+ 12 meters extensions			
	II) Type of Tower : B			
1	Super Structure	3643.79	196.75	
2	Stub & Cleats	269.88	1.34	
3	Stub Setting Templates	853.28	27.92	
4	+ 3 meters extensions	827.000	41.20	
5	+ 6 meters extensions	1759.960	82.98	Black Weights
6	+ 9 meters extensions			
7	+ 12 meters extensions			
	III) Type of Tower : C			
1	Super Structure	4974.66	222.89	Black Weights
2	Stub & Cleats	396.28	1.34	
3	Stub Setting Templates	998.72	1.07	
4	+ 3 meters extensions	1126.600	48.82	Black Weights
5	+ 6 meters extensions	1892.080	77.95	Black Weights
6	+ 9 meters extensions			
7	+ 12 meters extensions			


220KV S.C A-TYPE
SPECN: IDA-KSEB5(SHAHABAD)
MAKE-KAMANI
5050
2525
2525
16530
1475
3980
3980
1487
4170
CONCRETE LEVEL
GROUND LEVEL
4100
TRANSVERSE FACE.
1475
10105
1487
16530
CONCRETE LEVEL
GROUND LEVEL
4100
LONGITUDINAL FACE


220KV S.C B-TYPE
SPECN: IDA-KSEB(SHAHABAD)
MAKE-KAMANI
7520
2250
2250
13814
L 110x110x8
1788
4200
1800
4200
1816
4375
CONCRETE LEVEL
GROUND LEVEL
6200
TRANSVERSE FACE
12020
1788
1800
1816
13814
CONCRETE LEVEL
GROUND LEVEL
6200
LONGITUDINAL FACE


220KV S.C C-TYPE
SPECN: IDA-KSEB5(SHAHABAD)
MAKE-KAMANI
6450
2210
2400
2400
13850
L = 130x130x10
2350
5000
2366
5000
2394
5460
CONCRETE LEVEL
GROUND LEVEL
7200
TRANSVERSE FACE
13460
13850
2350
2366
2386
CONCRETE LEVEL
GROUND LEVEL
7200
LONGITUDINAL FACE

220 kV SC Transmission Line Lengapur to Hampi

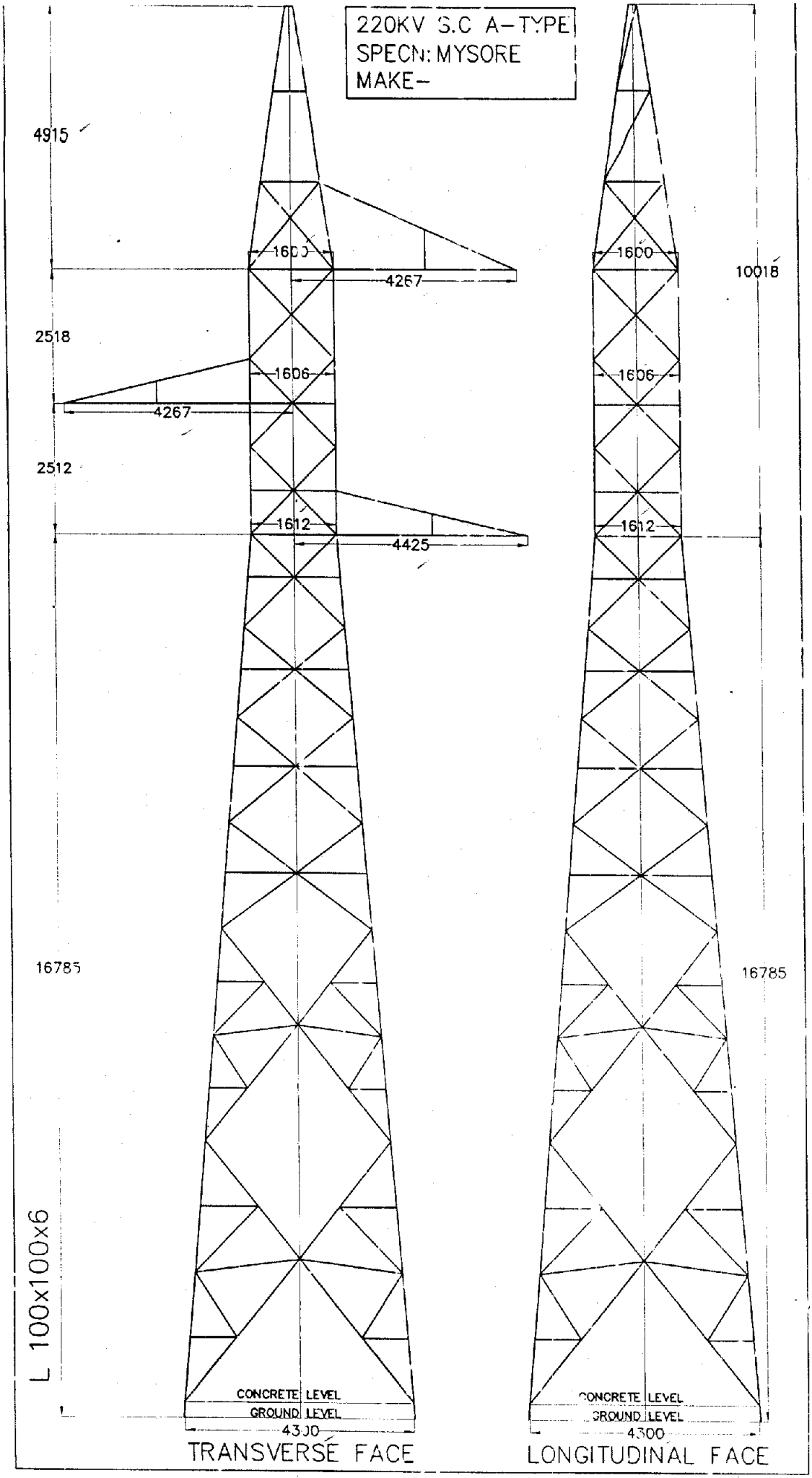
Make - Kamani

Sl. No.	Structure Type	Approx. Unit Weight in MT	Weight of Bolts & Nuts
	I) Type of Tower : A		
1	Super Structure *	3043.70	135.43
2	Stub & Cleats	118.11	--
3	Stub Setting Templates	345.89	13.56
4	+ 3050	564 080	15.42
5	+ 6 meters extensions		
6	+ 9 meters extensions		
7	+ 12 meters extensions		
	II) Type of Tower : B		
1	Super Structure	4128.52	179.95
2	Stub & Cleats	50.88	--
3	Stub Setting Templates	656.64	31.80
4	+ 3 meters extensions	975.808	31.27
5	+ 6 meters extensions		
6	+ 9 meters extensions		
7	+ 12 meters extensions		
	III) Type of Tower : C & D		
1	Super Structure	5934.33	250.08
2	Stub & Cleats	73.78	--
3	Stub Setting Templates		
4	+ 3 meters extensions		
5	+ 6 meters extensions		
6	+ 9 meters extensions		
7	+ 12 meters extensions		

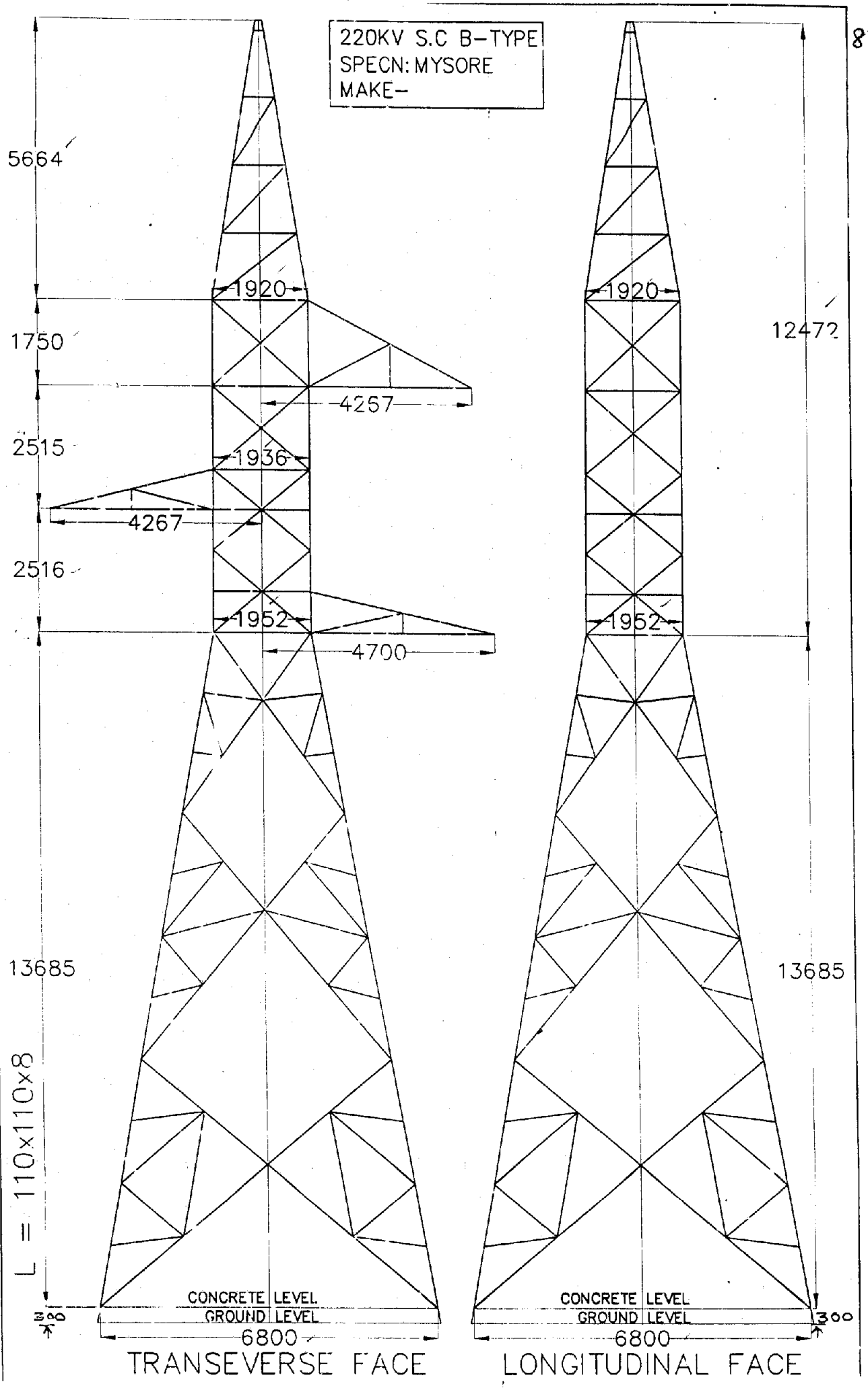
2 1/2% Extra.

* including

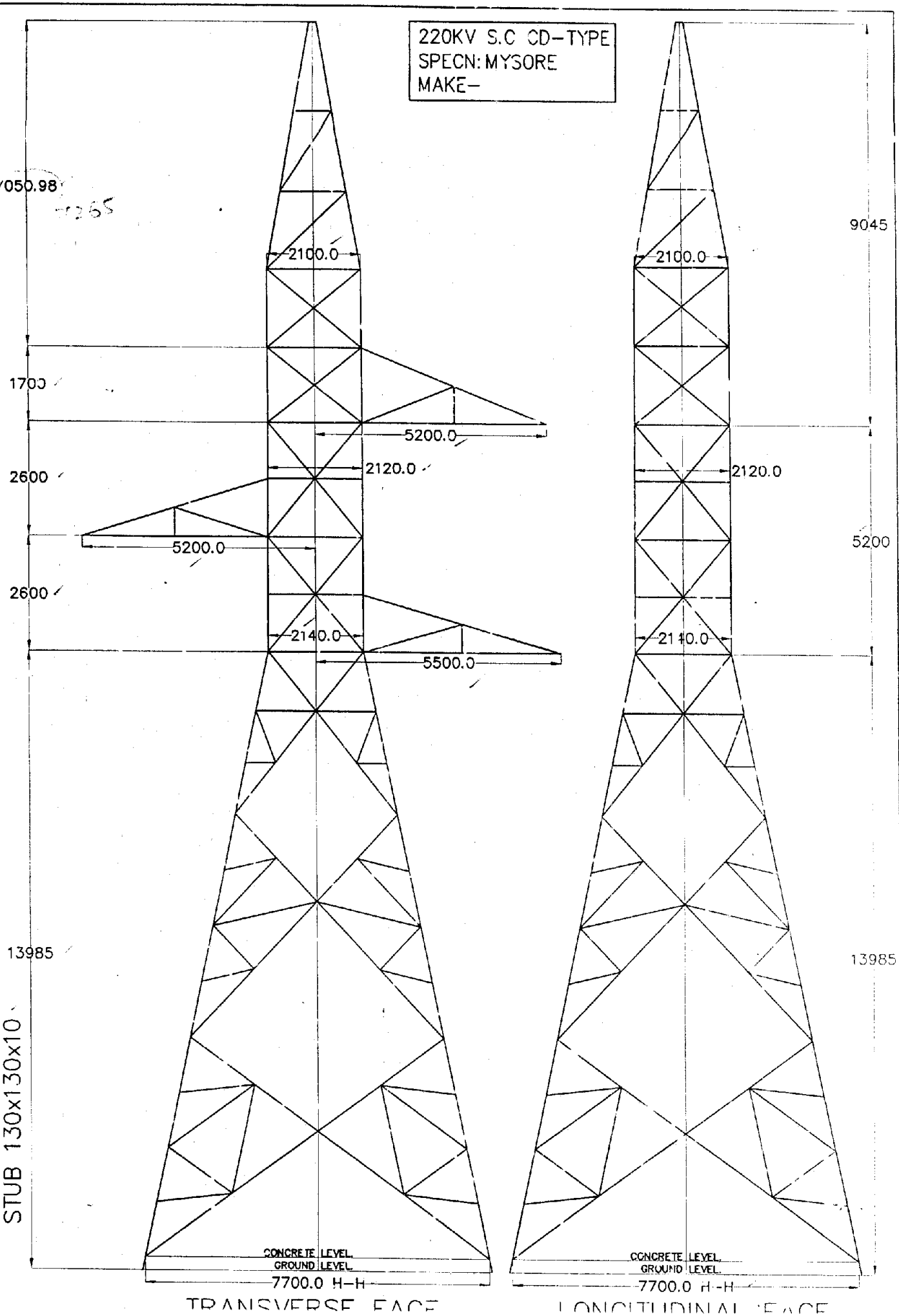
Stepbolts =	18.718
U - Bolts =	1.180
D Shadel =	4.200
	24.098 Kgs


220KV S.C A-TYPE
SPECN: MYSORE
MAKE-
4915
1600
4267
2518
1606
4267
2512
1612
4425
16785
L 100x100x6
CONCRETE LEVEL
GROUND LEVEL
4300
TRANSVERSE FACE
1600
10018
1606
1612
16785
CONCRETE LEVEL
GROUND LEVEL
4300
LONGITUDINAL FACE

220KV S.C B-TYPE
SPECN: MYSORE
MAKE-



220KV S.C CD-TYPE
SPECN: MYSORE
MAKE-



220 kV SC Transmission Line

Nagarjunasagar - Srisailam - Cuddapah - Madras border

Specn.- APT-11/63

Make: - KAMANI

Sl. No.	Structure Type	Approx. Unit Weight in MT	Weight of Bolts & Nuts	
I)	**Type of Tower : A1**			
1	Super Structure	2849.23	213.59	(Total black weight of sub-materials - 109.50)
2	Stub & Cleats L100x100x6	127.48	1.26	
3	Stub Setting Templates	479.33	20.48	(Painted)
4	+ 3 meters extensions	576.500	31.52	
5	+ 6 meters extensions			
6	+ 9 meters extensions			
7	+ 12 meters extensions			
8	Adj stub template			
I)	**Type of Tower : A2**			
1	Super Structure	2808.23	212.08	Black weight
2	Stub & Cleats	108.24	1.26	Only stub weight.
3	Stub Setting Templates	420.00	10.73	
4	+ 3 meters extensions			
5	+ 6 meters extensions			
6	+ 9 meters extensions			
7	+ 12 meters extensions			
8	Adj stub template			
I)	**Type of Tower : B1**			
1	Super Structure			
2	Stub & Cleats L150x150x10	386.24	1.34	
3	Stub Setting Templates	574.52	13.93	(Painted)
4	+ 3 meters extensions	852.080	36.35	
5	+ 6 meters extensions			
6	+ 9 meters extensions			
7	+ 12 meters extensions			
8	Adj stub template			
I)	**Type of Tower : B2**			
1	Super Structure	4327.51	230.60	
2	Stub & Cleats L130x130x10	309.96	1.34	
3	Stub Setting Templates	566.64	12.74	
4	+ 3 meters extensions			
5	+ 6 meters extensions			
6	+ 9 meters extensions			
7	+ 12 meters extensions			
8	Adj stub template			

Sl. No.	Structure Type	Approx. Unit Weight in MT	Weight of Bolts & Nuts	
I)	**Type of Tower : C1**			
1	Super Structure	1637.19	61.50	
2	Stub & Cleats			
3	Stub Setting Templates	592.20	14.82	(Painted)
4	+ 3 meters extensions	1066.480	43.97	
5	+ 6 meters extensions			
6	+ 9 meters extensions			
7	+ 12 meters extensions			
8	Adj stub template	585.32	14.75	
I)	**Type of Tower : BT1**			
1	Super Structure	5072.10	249.20	
2	Stub & Cleats L150x150x10	377.56	1.34	
3	Stub Setting Templates			
4	+ 3 meters extensions			
5	+ 6 meters extensions			
6	+ 9 meters extensions			
7	+ 12 meters extensions			
I)	**Type of Tower : BS1**			
1	Super Structure	4958.32	234.95	
2	Stub & Cleats L150x150x10	388.24	1.34	
3	Stub Setting Templates			
4	+ 3 meters extensions			
5	+ 6 meters extensions			
6	+ 9 meters extensions			
7	+ 12 meters extensions			
I)	**Type of Tower : Y ***			
1	Super Structure	4468.68	208.43	
2	Stub & Cleats	334.32	1.34	
3	Stub Setting Templates	770.16	22.76	
4	+ 3 meters extensions			
5	+ 6 meters extensions			
6	+ 9 meters extensions			
7	+ 12 meters extensions			

* Same for B1 mkd Y for Hampi - Gooty line

132 kV DC Transmission Line

BARAUNI - MUZAFFARPUR; BARAUNI - KATIHAR & HATHIDAH - SULTANGANJ

Make: - KAMANI

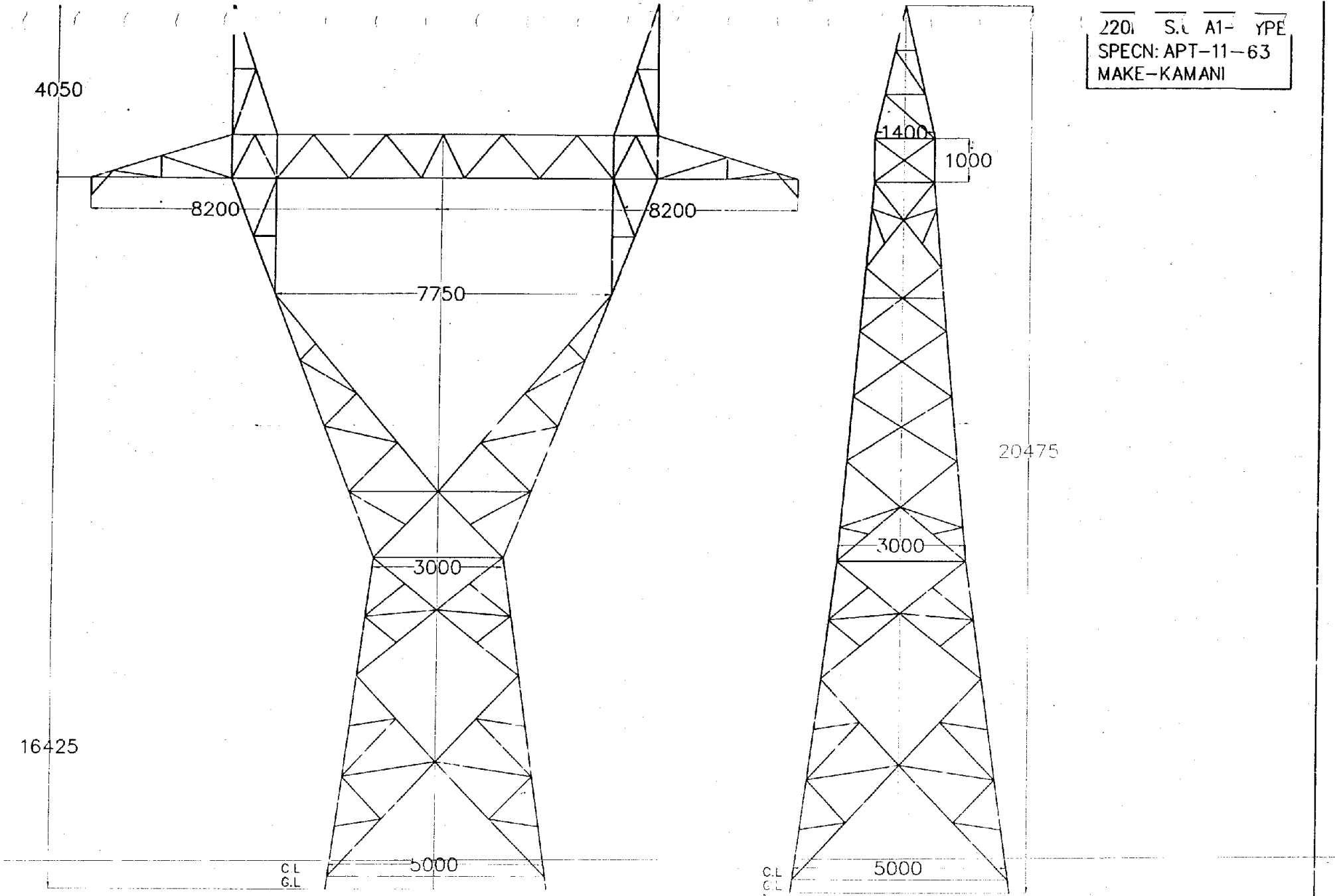
Sl. No.	Structure Type	Approx. Unit Weight in MT	Weight of Bolts & Nuts	
	I) Type of Tower : DTA			
1	Super Structure			
2	Stub & Cleats L150x150x12	475.16	1.34	inclusive of 5% extra
3	Stub Setting Templates			
4	+ 3 meters extensions			
5	+ 6 meters extensions	1843.98	70.82	inclusive of 5% extra
6	+ 9 meters extensions			and 2.5% add
7	+ 12 meters extensions			

220 kV SC Horizontal

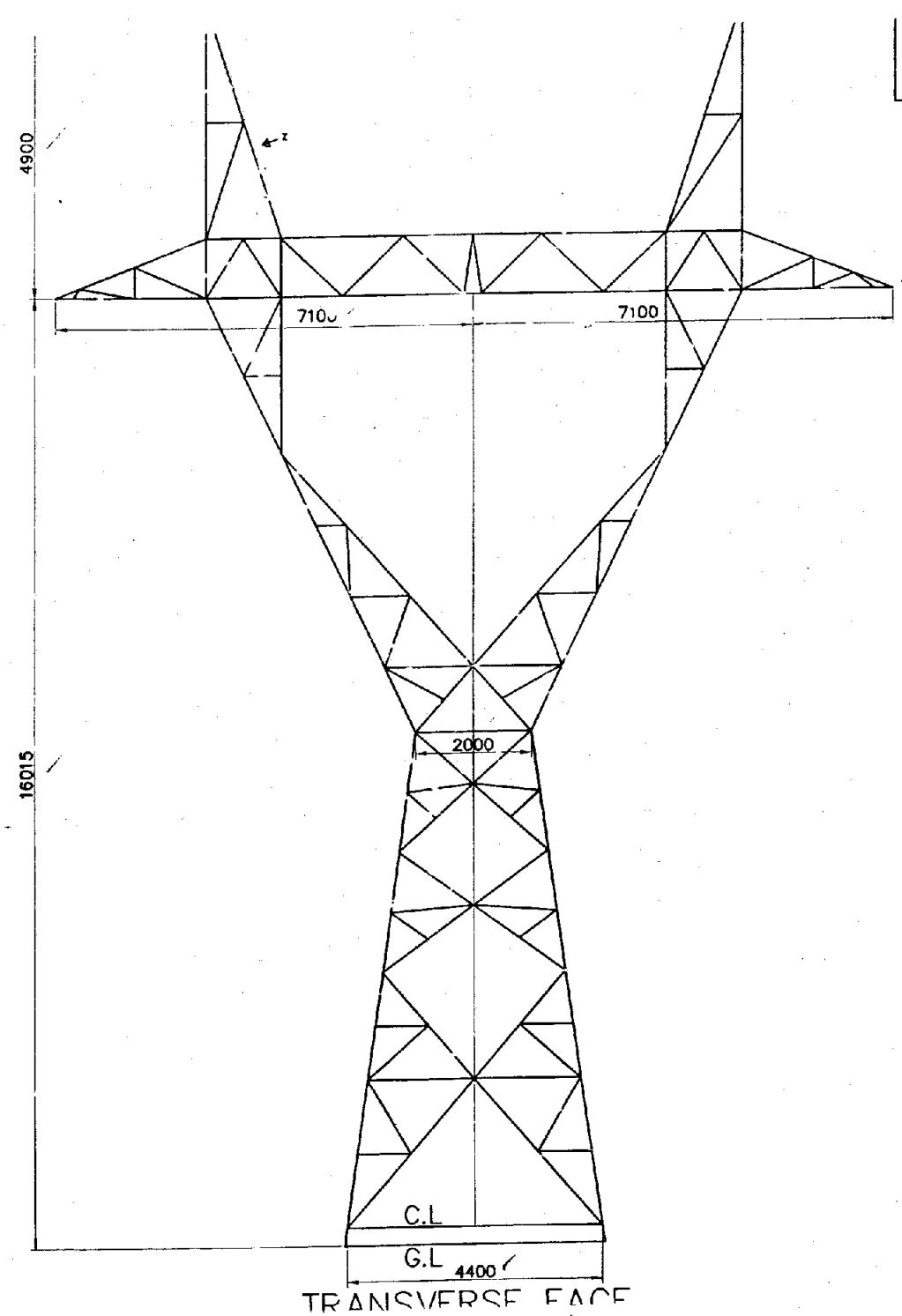
APT 11/63

Sl. No.	Types	Type of foundation	Stub size	Depth of foundation	Vol. of Concrete (Cum)	Vol. of Excavation (Cum)	Reinforcement steel (MT)	Remarks
I)	**Type of Tower : A1**							
1	Dry	Frustrum		2500	19.60			Width of Ex = 1400
2	Wet	- do -		2500	44.10			Width of Ex = 2100

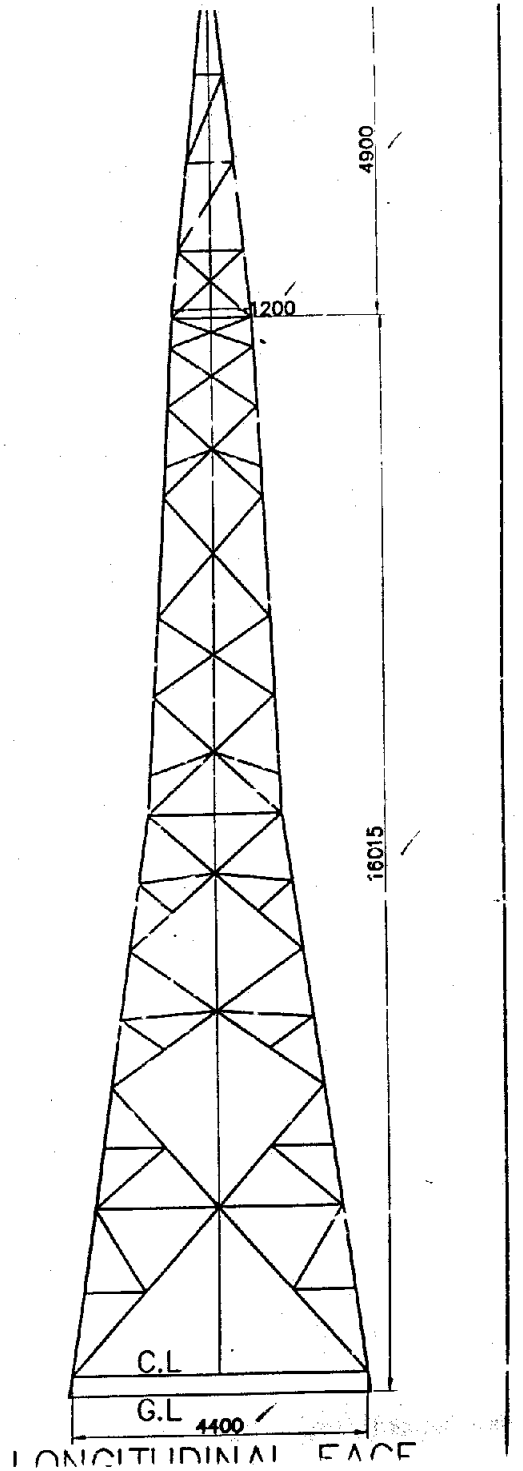
220 S.C A1- TYPE
SPECN: APT-11-63
MAKE-KAMANI



SPECN: APT-11-63
MAKE-KAMANI

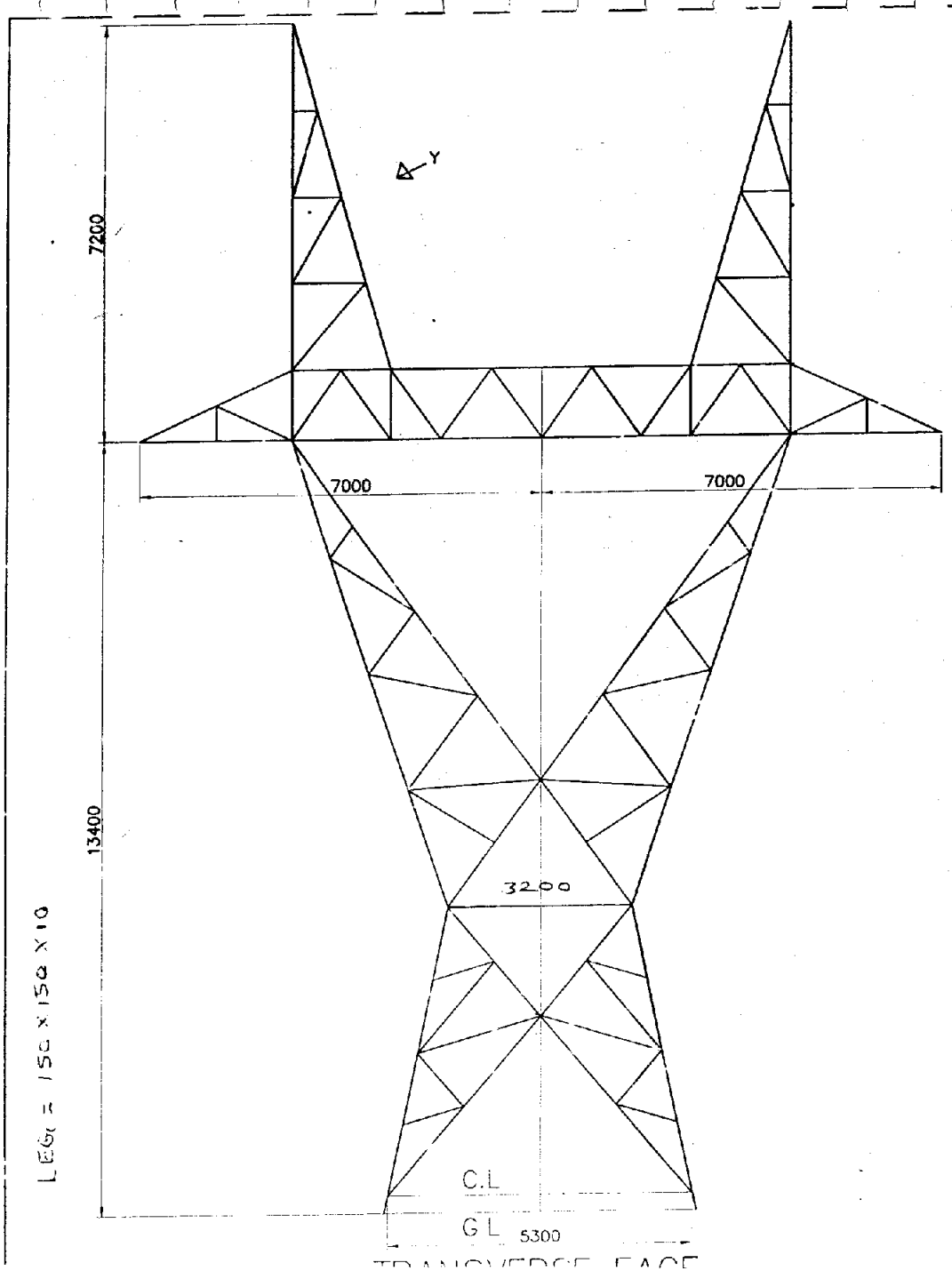


TRANSVERSE FACE

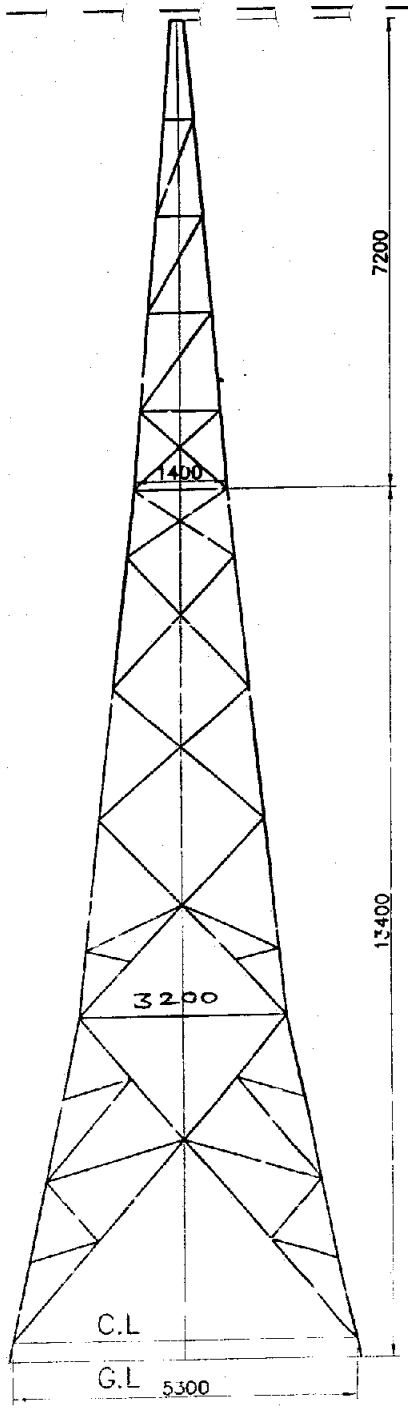


LONGITUDINAL FACE

220KV S.C B1-TYPE
SPECN: APT-11-63
MAKE-KAMANI

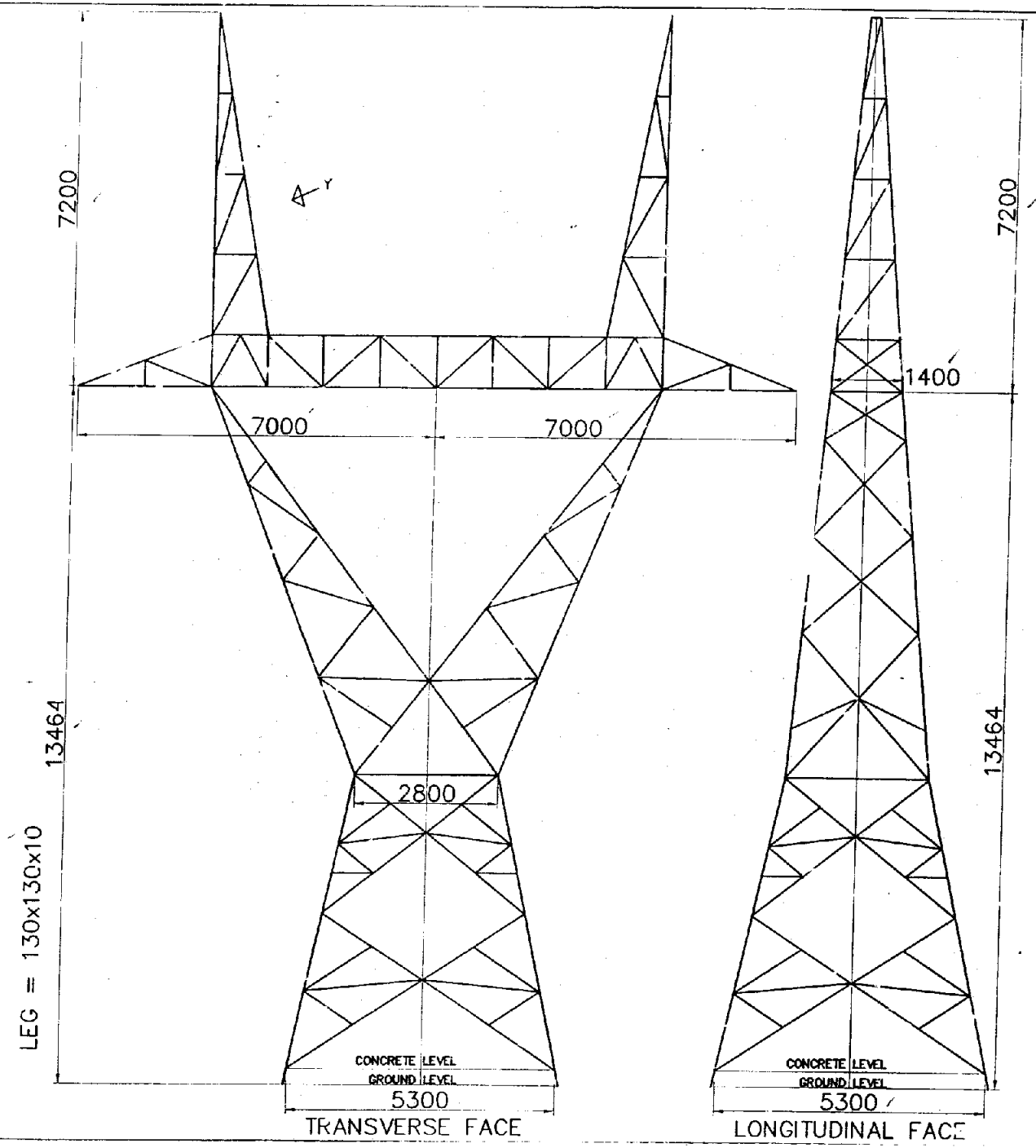


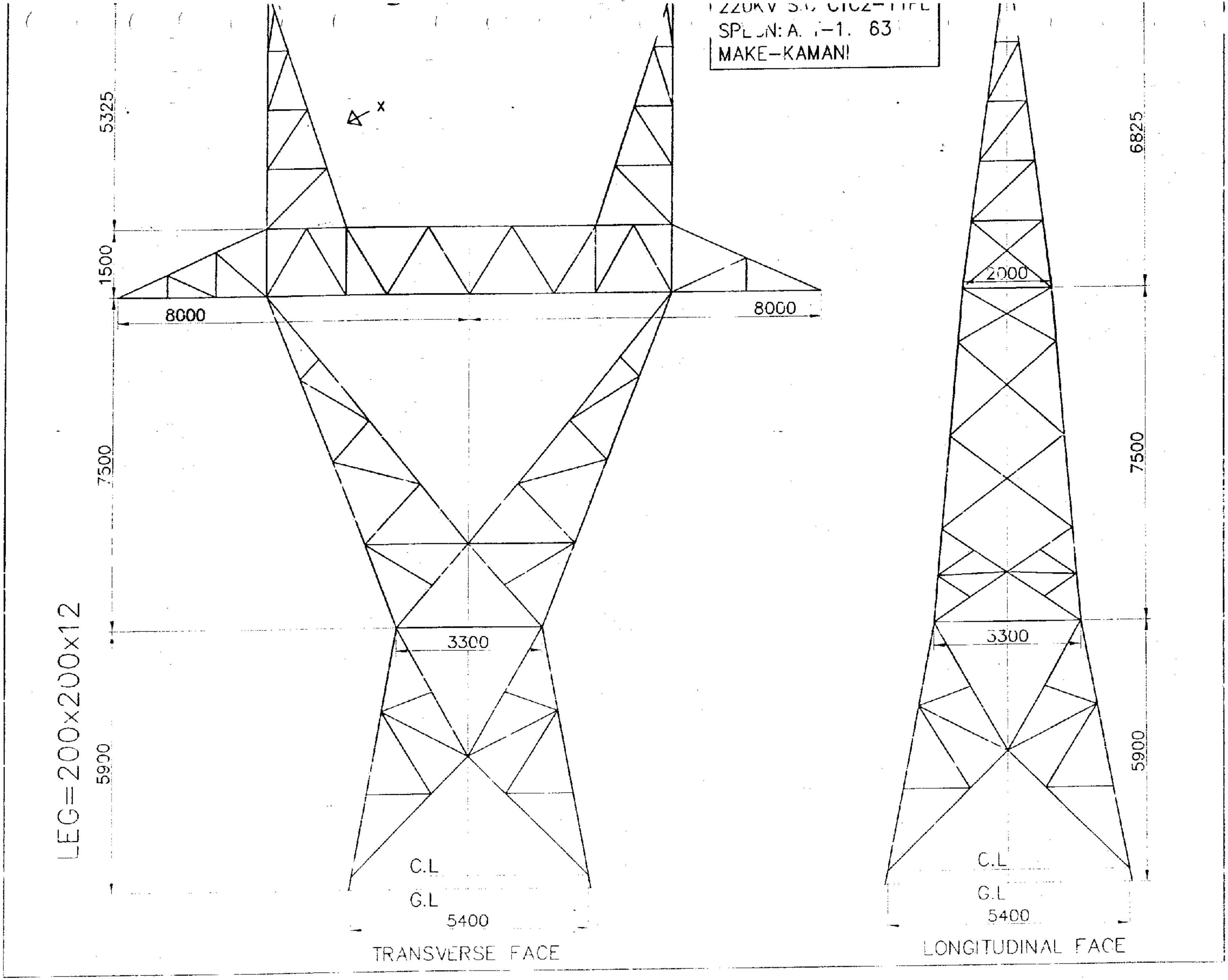
TRANSVERSE FACE



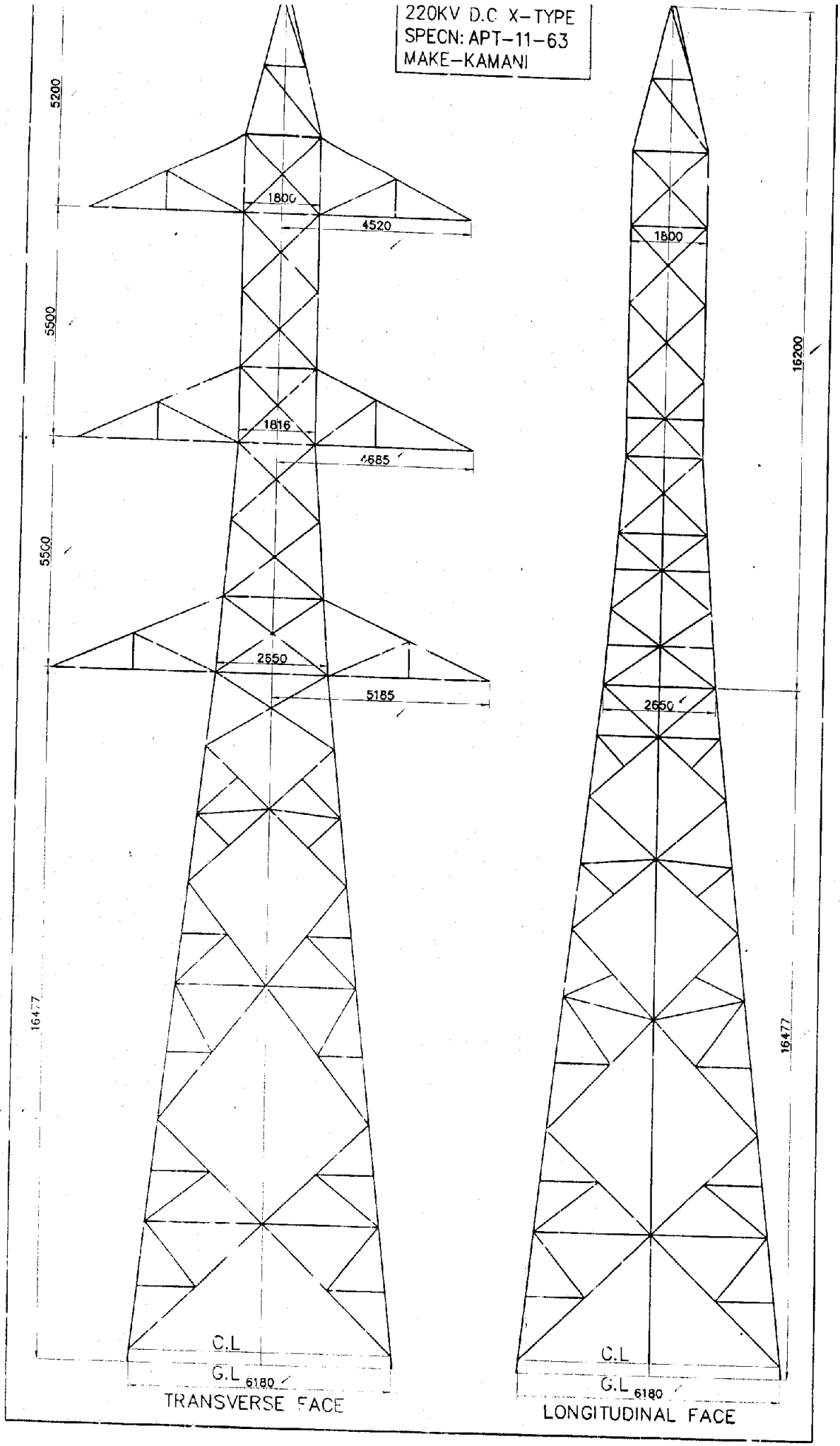
LONGITUDINAL FACE

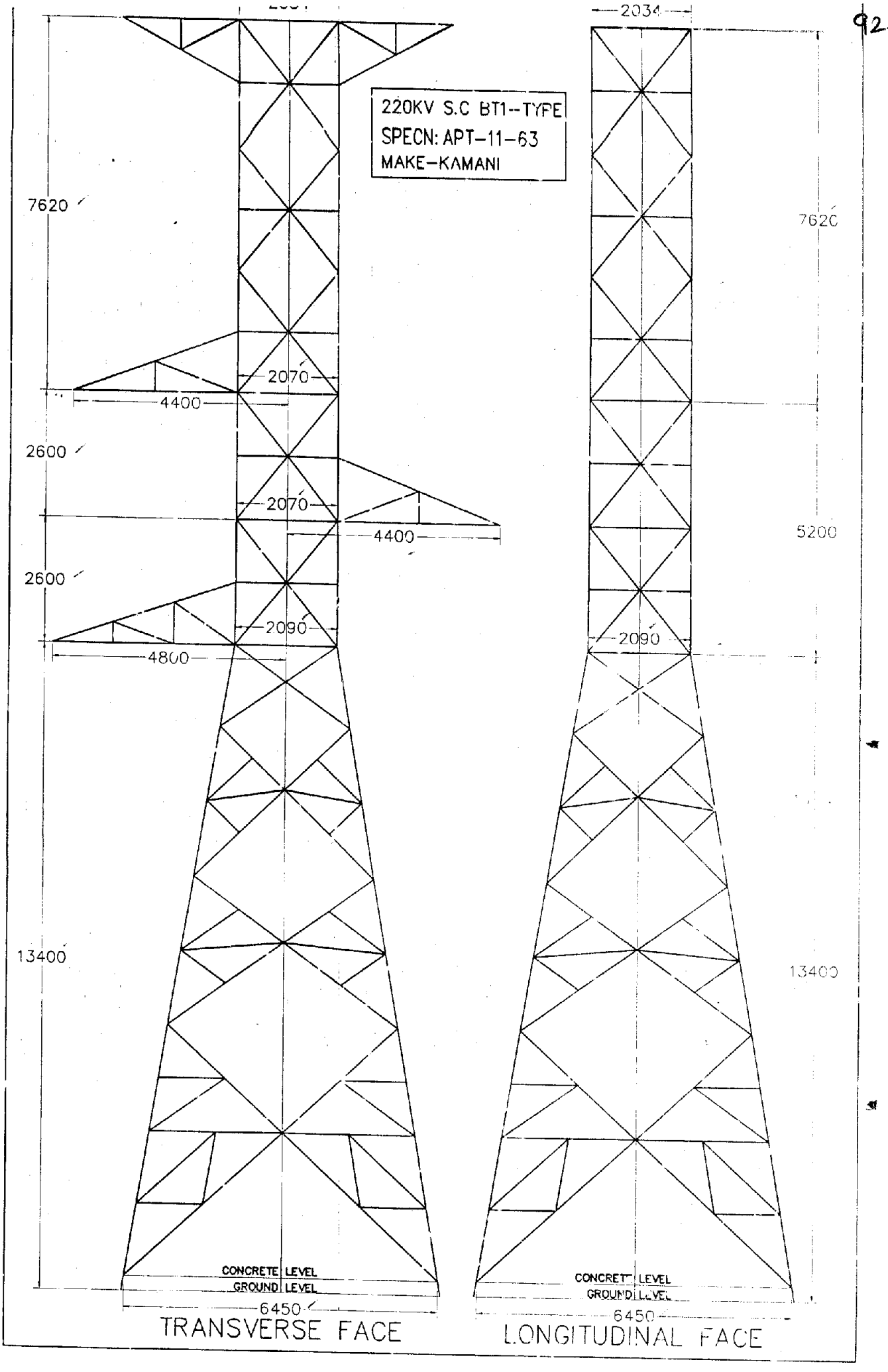
220KV S.C B2-TYPE
SPECN: APT-11-83
MAKE-(KAMANI)




MAKE-KAMANI
LEG=200×200×12
5325
1500
7500
5900
8000
8000
3300
C.L
G.L
5400
TRANSVERSE FACE
6825
2000
7500
3300
5900
C.L
G.L
5400
LONGITUDINAL FACE

90


220KV D.C X-TYPE
SPECN: APT-11-63
MAKE-KAMANI
5200
5500
5500
16477
1800
4520
1816
4685
2650
5185
C.L
G.L 6180
TRANSVERSE FACE
16200
1800
2650
16477
C.L
G.L 6180
LONGITUDINAL FACE


220KV S.C BT1--TYPE
SPECN: APT-11-63
MAKE-KAMANI
7620
2070
4400
2600
2070
4400
2600
2090
4800
13400
CONCRETE LEVEL
GROUND LEVEL
6450
TRANSVERSE FACE
2034
7620
5200
2090
13400
CONCRETE LEVEL
GROUND LEVEL
6450
LONGITUDINAL FACE

220 kV SC Transmission Line

UPPER SILERU - KOTHAGUDEM; KOTHAGUDEM - NAGARJUNASAGAR;

UPPER SILERU - SIMHACHALAM

Make: - KAMANI

Sl. No.	Structure Type	Approx. Unit Weight in MT	Weight of Bolts & Nuts	
I)	**Type of Tower : A1**			
1	Super Structure	3314.18	236.62	inclusive of 2.5% extra
2	Stub & Cleats L100x100x6	127.48	1.26	(")
3	Stub Setting Templates			
4	Normal Tower			
5	+ 3 meters extensions	576.62	31.66	(")
6	+ 6 meters extensions			
7	+ 9 meters extensions			
8	+ 12 meters extensions			
I)	**Type of Tower : A2**			
1	Super Structure	2807.51	212.08	(")
2	Stub & Cleats L90x90x6	108.24	1.26	(")
3	Stub Setting Templates			
4	Normal Tower			
5	+ 2.45 meters extensions	853.56	119.61	(")
	+ 3 meters extensions			
6	+ 6 meters extensions			
7	+ 9 meters extensions			
8	+ 12 meters extensions			
I)	**Type of Tower : B1**			
1	Super Structure			
2	Stub & Cleats			
3	Stub Setting Templates			
4	Normal Tower			
5	+ 3 meters extensions	852.08	36.66	(")
6	+ 6 meters extensions			
7	+ 9 meters extensions			
8	+ 12 meters extensions			
9	Additional members	13.32	1.05	(Upper sileru - K.gudem and Simhachalem line only) and inclusive of 2.5% extra.
I)	**Type of Tower : B2**			
1	Super Structure			
2	Stub & Cleats			
3	Stub Setting Templates			
4	Normal Tower			
5	+ 3 meters extensions			
6	+ 6 meters extensions			
7	+ 9 meters extensions			
8	+ 12 meters extensions			
9	Additional members	13.64	1.05	(Kothagudem - N.sagar line only) and inclusive of 2.5% extra.

I)	**Type of Tower : BS1**			
1	Super Structure	4939.24	237.75	inclusive of 2.5% extra
2	Stub & Cleats L150x150x10	388.24	1.34	(")
3	Stub Setting Templates			
4	Normal Tower			
5	+ 3 meters extensions			
6	+ 6 meters extensions			
7	+ 9 meters extensions			
8	+ 12 meters extensions			
I)	**Type of Tower : C1**			
1	Super Structure	6744.61	364.71	(")
2	Stub & Cleats L200x200x12	684.16	1.34	(")
3	Stub Setting Templates			
4	Normal Tower			
5	+ 1.5 & 4.5 mts Hill extensions	1515.65	60.26	
6	+ 1.5 & 3 mts Hill extensions	1121.94	51.83	
7	+ 3 meters extensions	1066.48	45.87	
8	+ 6 meters extensions			
9	+ 9 meters extensions			
10	+ 12 meters extensions			
11	Additional members	19.44	1.14	(Kothagudem - N.sagar line only) and inclusive of 2.5% extra.
I)	**Type of Tower : S & T.T.S1**			
1	Super Structure	22945.05	2027.13	Inclusive of 2.5% extra.
2	Stub & Cleats L150x150x16	655.44	2.70	Inclusive of 2.5% extra.
3	Stub Setting Templates			
4	Normal Tower			
5	+ 3 & 4.5 mts Hill extensions	2107.36	56.25	(Upper Sileru - Kothagudem; Upper Sileru - Simhachalam line only)
6	+ 3 & 6 mts Hill extensions	2449.07	71.85	(")
7	+ 3 meters extensions	1622.56	44.64	
8	+ 9 meters extensions			
9	+ 12 meters extensions			
10	Additional members			

1) Common for S & S1	= 9692.66
2) Spl. Items for tower type 'S'	= 1397.96
3) Anchor bolts for S1	= 771.48
4) Base assbly for Anchor bolts TTS1	= 592.20
5) Anchor Flat per tower	= 97.72
6) 3% item for TTS1	= 13253.39
7) B&N for S	= 385.26
8) B&N for S1	= 565.73
9) Summary of weights for TTS	12134.02
10) Summary of weights for TTS1	24973.18

220 kV DC Transmission Line

Nagarjunasagar - Srisailam

Make: - KAMANI

Sl. No.	Structure Type	Approx. Unit Weight in MT	Weight of Bolts & Nuts
I)	**Type of Tower : X**		
1	Super Structure	5738.82	255.84
2	Stub & Cleats L110x110x10	243.58	1.34
3	Stub Setting Templates	465.08	18.22
4	+ 3 meters extensions		
5	+ 6 meters extensions		
6	+ 9 meters extensions		
7	+ 12 meters extensions		
I)	**Type of Tower : Y**		
1	Super Structure		
2	Stub & Cleats		
3	Stub Setting Templates	753.92	30.10
4	+ 3 meters extensions		
5	+ 6 meters extensions		
6	+ 9 meters extensions		
7	+ 12 meters extensions		
I)	**Type of Tower : Z**		
1	Super Structure		
2	Stub & Cleats		
3	Stub Setting Templates	973.04	32.41
4	+ 3 meters extensions		
5	+ 6 meters extensions		
6	+ 9 meters extensions		
7	+ 12 meters extensions		

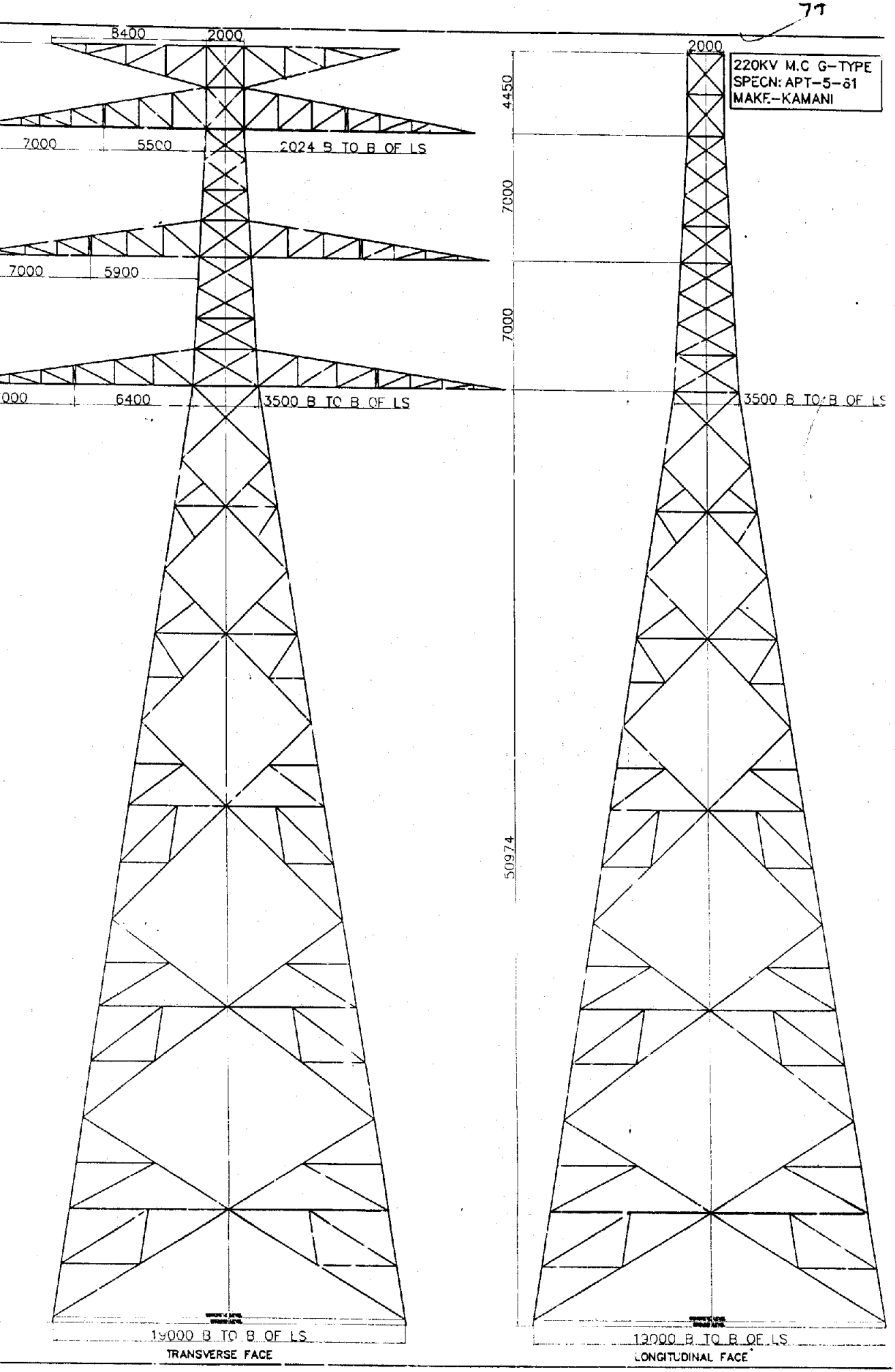
FOUNDATION DETAILS APT 5/61

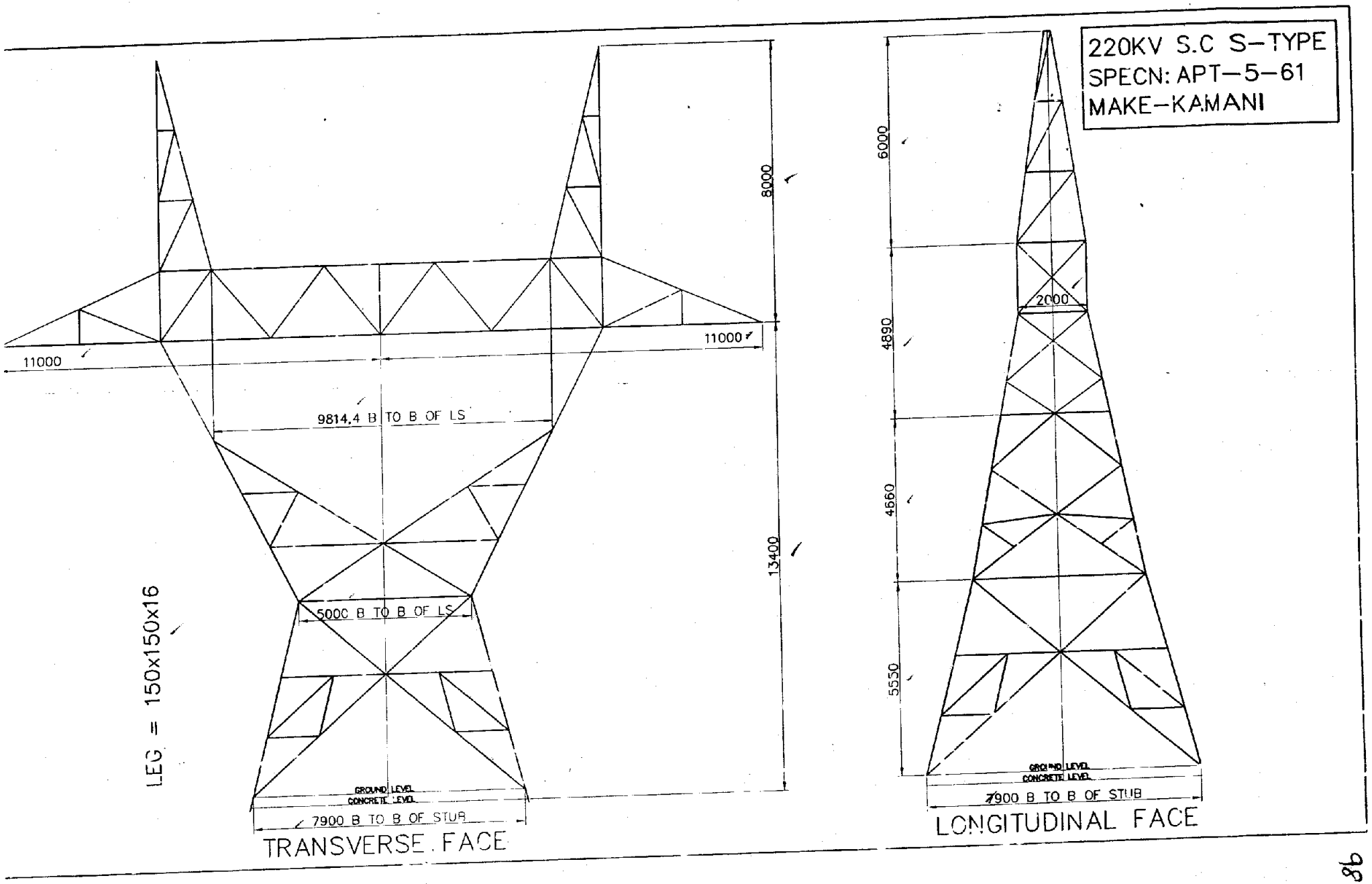
220 kV SC Transmission Line

Sl. No.	Types	Type of foundation	Stub size	Depth of foundation	Vol. of Concrete (Cum)	Vol. of Excavation (Cum)	Reinforcement steel (MT)
I)	**Type of Tower : A1**						
1	Dry						
2	Wet						
3	PS						
4	FS						
II)	**Type of Tower : B1**						
1	Dry Fn?				6.51	39.80	
2	Wet						
3	PS						
4	FS						
I)	**Type of Tower : A2**						
1	Dry Fn?				2.04	9.50	
2	Wet						
3	PS						
4	FS						
II)	**Type of Tower : B2**						
1	Dry						
2	Wet						
3	PS						
4	FS				(3.6+34.92)#1	233.00	
5	Block cotton				(5.2+62.40)#2	365.00	
III)	**Type of Tower : C1 & C2**						
1	Dry				12.684	75.00	
2	Wet						
3	PS						
4	FS						
III)	**Type of Tower : S**						
1	Dry Fn?				10.80	57.20	
2	Wet						
3	PS						
4	FS						
III)	**Type of Tower : X**						
1	Dry Fn?				3.844	20.14	
2	Wet				10.381	49.83	
3	PS						
4	FS						
IV)	**Type of Tower : Z**						
1	Dry Fn?						
2	Wet				59.912(F&C) 55.798 (for Stepped)	267.28	
3	PS						
4	FS						

#1 Lean 50mm thick = 3.6 Cum 1:2:4 = 34.92 R.Steel = 3260 Kgs.

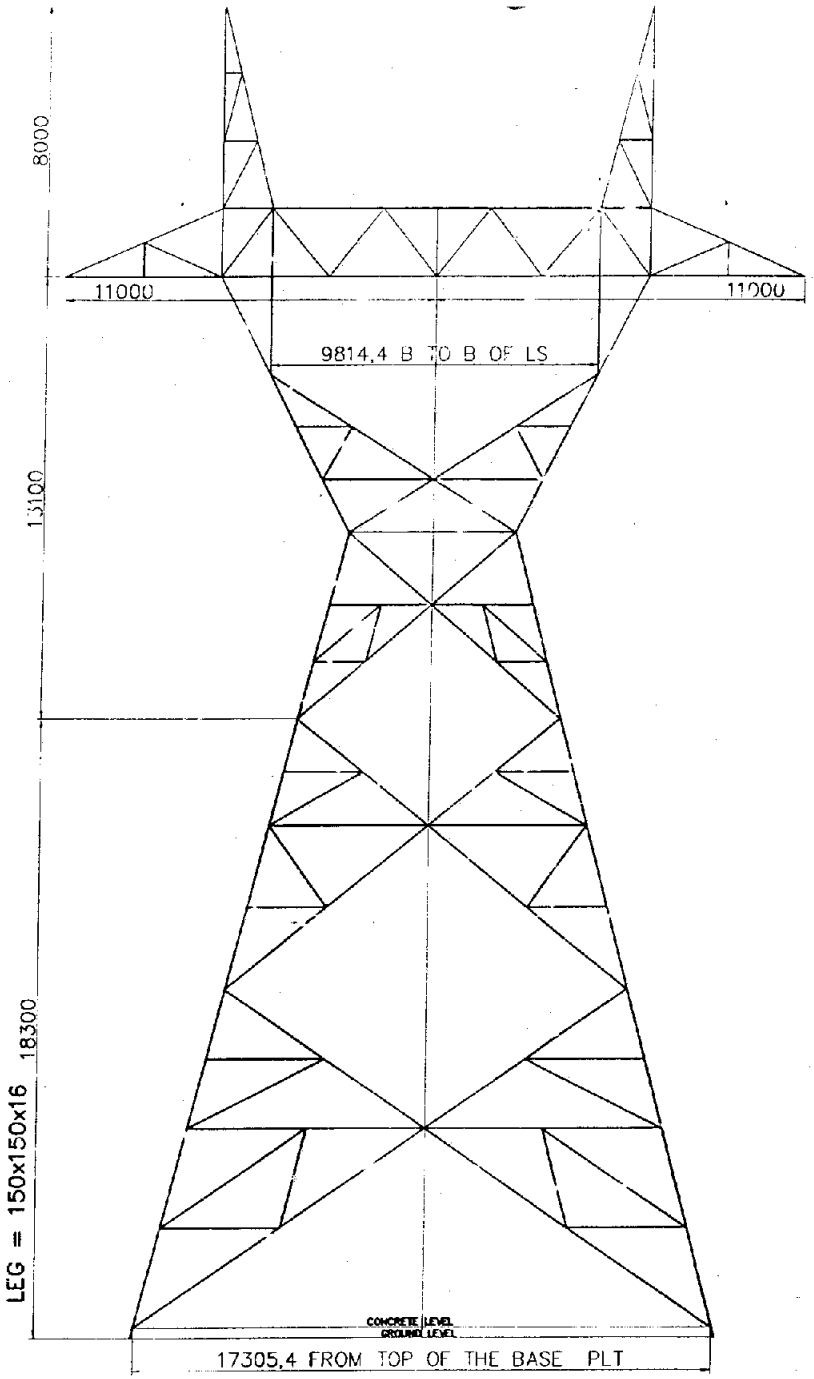
#2 Lean 50mm thick = 5.4 Cum 1:2:4 = 62.40 R.Steel = 5056 Kgs.


8400
2000
7000
5500
2024 B TO B OF LS
7000
5900
000
6400
3500 B TO B OF LS
19000 B TO B OF LS
TRANSVERSE FACE
2000
220KV M.C G-TYPE
SPECN: APT-5-61
MAKE-KAMANI
4450
7000
7000
3500 B TO B OF LS
50974
13000 B TO B OF LS
LONGITUDINAL FACE

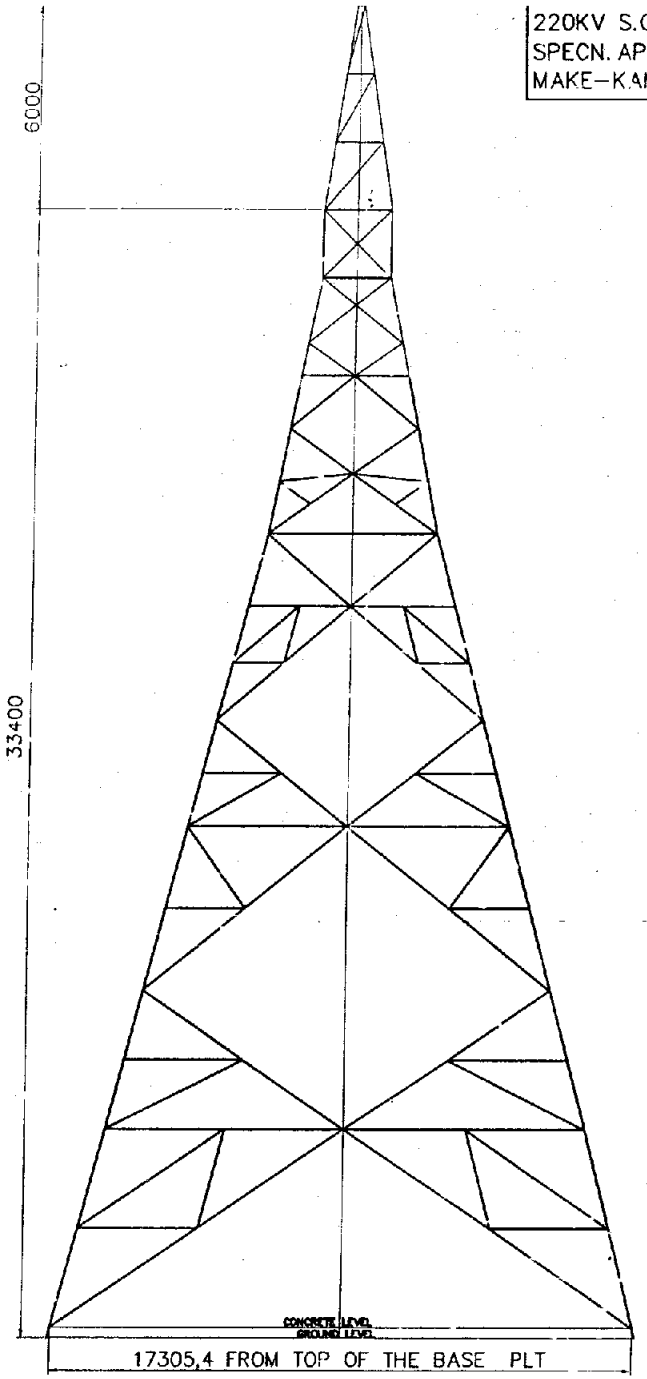

220KV S.C S-TYPE
SPECN: APT-5-61
MAKE-KAMANI
11000
11000
9814.4 B TO B OF LS
5000 B TO B OF LS
8000
13400
LEG = 150x150x16
GROUND LEVEL
CONCRETE LEVEL
7900 B TO B OF STUB
TRANSVERSE FACE
6000
4890
4660
5550
2000
GROUND LEVEL
CONCRETE LEVEL
7900 B TO B OF STUB
LONGITUDINAL FACE

86

220KV S.C S1--TYPE
SPECN. APT-5-61
MAKE-KAMANI



TRANSVERSE FACE



LONGITUDINAL FACE

STATEMENT OF TYPES OF TOWERS USED FOR 132 KV LINES

Sl. No.	Types of Towers Nomenclature	Designer's Identity	Lines for which Towers Are used
1	Old 132 kV DC towers for Machkund lines.	Imported towers.	1) Machnkund - T.B.Vara 2) T.B.Vara - Simhachalam 3) Simhachalam - Bommur 4) Bommur - Gunadala 5) Gunadala - Tadepalli
2	132 kV SC towers types A/P, B/R, C/S and D/T.	SAE towers designed for 100 kg/sqm. Wind pressure against spec. APT16/64.	1) Nagarjunasagar - Nalgonda 2) Gooty - Dharmavaram 3) Srisailam - Kurnool 4) Kurnool - Gooty 5) Cumbham - Srisailam 6) Kalikiri - Chittoor 7) Chittoor - Renigunta
3	Old 132 kV SC towers	Details not available	1) Tadepally - Ongole 2) Ongole - NTS
4	Old 'A' frames	Details not available	1) Cuddapah - Nellore 2) Ch.gutta - Mahaboobnagar 3) T.B.Vara - Garividi one of the two circuits.
5	132 kV SC towers types XA, YA and ZA.	APT 5/60 other details not available.	1) Tadepally - Macherala 2)Nagarjunasagar - Erragadda. 3) Shapurnagar - Erragadda.
6	132 kV SC towers types A, B and C	Kamani's towers Spec. APT12/61	1) Cuddapah - Gooty 2) Gooty - Hampi
a)	132 kV SC towers types A/P, B/Q and C/R	Kamani's towers Spec. IDA 11-100 kg/sqm wind pressure.	1) Gooty - Adoni 2) Hyderabad - Sadasivpet 3) Kothagudem - Khammam
b)	132 kV SC towers types ABC designed for 150 kg/sqm wind pressure A/A, B/B and C/C	Kamani Spec. IDA 11-150 kg/sqm wind pressure.	1) Nellore - Sullurpet - Renigunta 2) Kanumolu - Nuzvid
7	132 kV SC towers types A/P, B/Q and C/R	Kamani's towers designed for 150 kg/sqm. wind pressure IDA 11.	1) Nellore - Sullurpet - Renigunta
8	132 kV SC towers types F, G and H	SAE towers against spec. IDA 20	1) K.Mallepally to Kalwakurthi 2) Bhimadole - Kamavarapukota 3) Bommuru - Ramachandrapuram 4) Panyam - Nandyal
9	132 kV SC towers types A,B,C and D	SAE's towers against spec. APT10/71	1) Kurnool - Panyam 2) Kanumolu - Pamarru 3) Ramagundam - Karimnagar 4) Pochampad - Nizamabad

Sl. No.	Types of Towers Nomenclature	Designer's Identity	Lines for which Towers Are used
10	132 kV SC towers types A/W, B/X, C/Y and D/Z.	SAE's towers against APSEB's spec. APT14/68 (Dimension same as 10/71) for 'B' For 'A' base width in 2961.5 again 2926.5 IN APT 10/71 'A'.	1) Warangal - Ramagundam
11	Old 132 kV DC towers types A, B, C and D.	Kamani's towers other details not available APT11/61.	1) Warangal - Ramagundam 2) Warangal - KTPS 3) Warangal - Shapurnagar
12	Old 66 kV DC towers modified / upgraded for 132 kV DC line.	Details not available	1) Nizamsagar - Erragadda
13	Old 132 kV DC towers	MPEB towers other details not available	1) Kurnool - Wanaparthy 2) Wanaparthy - Mahaboobnagar
14	Narrow based 132 kV DC tower types A,B and C	SERC design	
15	MPEB 132 kV DC towers types A/D, B/R, C/S	MPEB	1) Ramagundam - Pochampad 2) Ramagundam - Ballampally 3) Ramagundam - Karimnagar 4) Hyderabad - Siddipet - Karimnagar 5) Kurnool - Wanaparthy - Mahaboobnagar 6) Ramagundam - Kamalapuram - Manugur 7) Nara bharath fello Alloys - Sitarampatnam
16	132 kV SC tower types P, R and S	Kamani's tower Spec. APT19/75	1) Sullurpet - Sriharikota 132 kV SC lines.
17	132 kV DC tower types P, R and S	Kamani's tower Spec. APT19/75	1) List of lines enclosed.
18	132 kV DC tower types A, B, C and D	EMC's tower under CERP (Cyclone Emergency Rectification Project) other details not available.	1) Guntur - Tenali 2) Tenali - Repally 3) Repally - Bapatla

LIST OF 132 KV LINES
(P, R and S towers)

S. No.	Name of the lines
1	LILO to Palakonda DC
2	LILO to Chilakapalem DC
3	Tekkali - Palasa SC
4	Tekkali - Vasavi SC
5	LILO to Ontitadi (Vizianagaram)
6	Araku - Tyada DC
7	LILO to Gold Star DC
8	LILO to Kothavalasa DC
9	Simhachalam - Commonpoint - N.V.Palem Port SS - Nawal Wharf
10	Nawal Wharf to DGNP, RCL, Hindustan Ship Yard, HPCL
11	LILO to Koruprolu DC
12	LILO to Payakaraopet (Tuni) DC
13	LILO to Prathipadu SC
14	Ramachandrapuram - Amalapuram DC / SC
15	Amalapuram - Razole DC / SC
16	Nidadavolu - Kovvuru - Andhra Sugars
17	BMR - Yanam
18	BMR - Nidadavolu DC
19	Nidadavolu - Bhimadolu DC
20	Nidadavolu - Bhimavaram DC
21	Bhimavaram - Narasapuram SC
22	LILO to Tanuku DC
23	Nidadavolu - Saggonda
24	Kamavarapukota - Aswaraopet SC
25	Kamavarapukota - Jangareddigurem SC
26	Karumolu - Pamaru DC
27	Pamaru - Machilipatnam SC
28	Machilipatnam - Konkepudi
29	LILO to Gangur DC
30	Kanumolu - Nuziveedu DC/SC
31	Nuziveedu - Kondapalli
32	Kondapalli - Vijayawada II
33	Piduguralla - Macherla (Tap line to Macherla)
34	Tadikonda - Guntur DC
35	LILO to Nagarjunasagar RCPH
36	Piduguralla - Wadapalli
37	Wadapalli - Miryalaguda DC
38	Miryalaguda - Nalgonda
39	Miryalaguda - Suryapet
40	Miryalaguda - Chillakallu DC
41	LILO to Mattampalli
42	Chillakallu - Khammam DC
43	LILO to Kusumanchi
44	Khammam - Dornakal
45	Budidampadu - Dornakal
46	Khammam - Sitharampatnam
47	Paloncha - Bhadrachalam
48	TCNFA, SCC, BPB from Paloncha
49	Ramagundam - Kamalapuram
50	Kamalapuram - Manugur
51	LILO to Chelpur
52	Kamalapuram - AP Rayons
53	LILO to Manthani
54	LILO to OCM

S. No.	Name of the lines
55	LILO to Ayyagaripalli DC
56	LILO to Nekkonda
57	Nekkonda - Wardannapet
58	LILO to Rachunathpalli
59	Raghunathpalli - Ghanpur DC
60	LILO to Musthyal
61	LILO to Bhongir
62	Nalgonda - Narketpalli
63	Narketpalli - Ramannapet
64	Ramannapet - Choutuppal
65	Narketpalli - Shaligouraram
66	LILO to NS LC.PH
67	Kalvakurthi - Nagarkurnool SC
68	LILO to Ibrahimpatnam
69	LILO to Sivannaguda
70	LILO to Medchal; LILO - Tukkapur
71	Durshed - Husnabad.
72	Husnabad - Huzurabad
73	LILO to Jagithyal
74	LILO to Bhimagal SC
75	Pochampad - Adilabad
76	Nirmal - Bhainsa
77	LILO to Nirmal
78	LILO to Nandipet
79	Nizamabad - Renzal
80	Renzal - Jakora
81	Jakora - Bichikonda
82	Nizamabad - Dichpalli - two lines DC
83	Dichpalli - Kamareddy
84	Kamareddy - Siricilla
85	Siricilla - Mallaram
86	LILO to Domakonda
87	Kamareddy - Minpur
88	LILO to Medak
89	Minpur - Narayankhed
90	Minpur - Nizamsagar - two lines
91	LILO to Kaudipalli
92	LILO to Gummadidala
93	Shapurnagar - RC Puram, Kandi - Sadasivpet - Zaheerabad
94	LILO to Patha Mailaram
95	LILO to Chevella
96	LILO to Bollaram, LILO to Gunrock
97	Mahaboobnagar - Puttapahad
98	Puttapahad - Kodangal
99	Mahaboobnagar - KNL
100	LILO to Wanaparthi
101	LILO to Gadwal
102	LILO to RP Mills
103	LILO to Atmakur (Knl. Dist.)
104	LILO to Yerragondapalem

S. No.	Name of the lines
105	Cumbum - Giddalur
106	Cumbum - Markapur
107	Parachur - Chirala
108	Bapatla - Parachur
109	Parachur - Chilakaluripet
110	Chilakaluripet - Vinukonda
111	Tadikonda - Chilakaluripet
112	Ongole - Kanigiri
113	LILO to Medarametla
114	Ongole - Kavali - NTS (Tap lien to Kavali)
115	LILO to Nellore 220 kV SS
116	Atmakur - Udayagiri
117	Godur - Chendodu
118	RGT - Puttur
119	Puttur - Nagari
120	LILO to Srikalahasti
121	Srikalahasti - Venkatagiri
122	LILO to Tirupathi
123	RGT - Chandragiri - Tirumala
124	LILO t Kottapalli Mitta
125	Chittoor - Palamaneru
126	Palamaneru - Shantipuram
127	Shantipuram - Kuppam
128	Palamaneru - Punganur
129	Punganur - Madanapalli
130	Madanapalli - Burrakayalakota
131	LILO to Pakala
132	Kalikiri - Rompicherla
133	Rajampet to Timmayagaripalli
134	LILO to Badvel
135	LILO to Vontimitta
136	Cuddapah - Yerraguntla
137	Yerraguntla - Proddatur
138	Yerraguntla - Pulivendula
139	Pulivendula - Kadiri
140	Kadiri - Hindupur
141	LILO to Puttaparthi
142	Hindur - Jammalabanda
143	Anantapur - Kalyandurg SC
144	Kalyandurg - Rayadurg SC
145	LILO to Penna Ahobilam PH DC
146	Gooty - Anantapur SC
147	LILO to Tadipatri
148	LILO to Penna Cement
149	LILO to SJK Steels
150	LILO to Pattikonda
151	Adoni - Yemmiganur
152	Yemmiganur - Kurnool
153	LILO to Mancherial
154	LILO to Dharmapuri

S. No.	Name of the lines
155	Tap Line to Orient Cements SCC Near Ramagundam
156	Interconnecting lines at RGM
157	LILO to ACC from Piduguralla - Vadapalli
158	LILO line to Allur from Kavali - NTS line
159	LILO to Balanagar from Hyderabad - Mahaboobnagar line
160	LILO to Chinnakampalli from Cuddapah - Rayachoti line
161	LILO to Dhone from Gooty - Kurnool line
162	LILO to Eluru from Bhimadole - Kanumolu line
163	Sadasivpet - Singur HES - Jogipet
164	LILO to Gajewel from Hyderabad - Siddipet line
165	Kakinada - GFCL
166	LILO to Jammikunta
167	LILO to Kandukur
168	Tap line to Kolanpak
169	Tap line to Kothur from Chandrayanagutta - Mahaboobnagar
170	Tap line SCC, OCM from Ramagundam - Kamalapuram line
171	Tap line to Madikonda from Hyderabad - Warangal line
172	Tap line to Madras Cements
173	Tap line to Priya Cements
174	Tap line to Vishnu Cements
175	Tap line to Mallaiahpet (RJY)
176	DC tap line to Manoharabad
177	Tap line to Mattampalli
178	Tap line to Medak
179	Tap line to Medchal
180	Tap line to Nakkavanipalem
181	Tap line to Pedatadepalli
182	Tap line to Shapurnagar from Erragadda - Nizamsagar line.
183	DC Tap line to Sivarampalli from Chandrayanagutta - S.Nagar line
184	Tap line to Tadikonda from Tadepalli to Piduguralla line
185	Tap line to Yerraguntla (Cuddapah Dist.)
186	Tap line to Alair
187	Adilabad - CCI
188	Bapatla - Railways
189	Bellampalli - RTS, Bellampalli - SCC
190	Pendurti - Birla Periclass
191	Peddapuram - Railways
192	Eluru - Railways - I
193	Eluru - Railways - II
194	Nidadavolu to Nidadavolu 220 kV SS - I
195	Nidadavolu to Nidadavolu 132 kV SS - II
196	Kanumolu - Sribha Industries
197	Cement Nagar - Panyam Cements
	Around Hyderabad City
198	LILO to Gun Rock
199	LILO to HMT
200	LILO to Maulali
201	LILO to Imeliban
202	LILO to Madhapur
203	Ghanapur to Sanghi
204	LILO to Bandlaguda
205	LILO to Bollaram
206	Tap line to DRDC (from Chandrayanagutta - Nagarjunasagar line)
207	Tap line to Jubili Hills
208	Tap line to RCI

Spec.No.APT 19/75

132 kV DC Transmission line

Make - Kamani

Sl. No.	Structure Type	Approx. Unit Weight in kgs	Weight of Bolts & Nuts
I)	**Type of Tower : P**		
1	Stub & Cleat for NT, +3,+6 & +9	189.04	0.992
2	SST for NT, +3, +6 & +9	444.6	13.4
3	Normal Tower	2809.51	157.31 #
4	+ 3 meters extensions	468.48	19.904
5	+ 6 meters extensions	1000.6	35.595
6	+ 9 meters extensions	1506.12	50.847
II)	**Type of Tower : R**		
1	Stub & Cleat for NT, +3 & +6	330.8	0.992
2	SST for NT, +3 & +6	935.48	28.94
3	Normal Tower	4356.25	179.07
4	+ 3 meters extensions	1047.88	42.36
5	+ 6 meters extensions	2319.84	81.18
6	+ 9 meters extensions	3865.04	134.131
III)	**Type of Tower : S**		
1	Stub & Cleat for NT, +3 & +6	453.44	1.056
2	SST for NT, +3 & +6	1137	29.97
3	Normal Tower	5763.51	221.176
4	+ 3 meters extensions	1354.32	38.948
5	+ 6 meters extensions	2932.52	77.77
6	+ 9 meters extensions	4845.32	122.49

- including

Hangers(6 Nos)	5.420 kgs / Piece
U-Bolts(1 Nos)	1.003kgs / Piece
Bird Guards(6 Nos)	0.50kgs / Piece

Spec.No.APT 19/75

FOUNDATION DETAILS (PRS)

Make - Kamani

S. No	Type of tower	Type of classification	Excavation volume in Cu.m.	Sand Bed in Cu.m.	PCC 1:4:8 in Cu.m.	PCC 1:2:4 in Cu.m.	Reinforcement Steel in kgs
1	P	Dry	32.37	-	0.78	2.47	-
2		Wet	59.25	-	1.6	5.76	-
3		PS	99.24	5.05	2.7	12.43	-
4		FS	132.43	6.75	3.72	15.26	202.34
5		Hard Rock	2.56	-	-	2.8	-
6		F & F rock	15.55	-	-	4.91	-
7	R	Dry	40.52	-	0.96	3.6	-
8		Wet	92.83	-	2.5	8.8	-
9		PS	143.81	6.94	3.84	18.65	-
10		FS	179.63	8.66	4.9	21.62	336.29
11		Hard Rock	4.34	-	-	5.76	-
12		F & F rock	35.04	-	-	8.85	-
13	S	Dry	69.83	-	1.6	7.21	-
14		Wet	135.17	-	3.36	18.14	-
15		PS	231.98	10.09	5.78	40.08	-
16		FS	261.13	11.35	6.56	49.13	487.82
17		Hard Rock	9.86	-	-	11.13	-
18		F & F rock	51.2	-	-	18.78	-

Spec.No.APT 19/75

132 kV DC Transmission line

Make - Kamani

Sl. No.	Structure Type	Approx. Unit Weight in kgs	Weight of Bolts & Nuts
I)	**Type of Tower : P**		
1	Stub & Cleat for NT, +3,+6 & +9	189.04	0.992
2	SST for NT, +3, +6 & +9	444.6	13.4
3	Normal Tower	2809.51	157.31 #
4	+ 3 meters extensions	468.48	19.904
5	+ 6 meters extensions	1000.6	35.595
6	+ 9 meters extensions	1506.12	50.847
II)	**Type of Tower : R**		
1	Stub & Cleat for NT, +3 & +6	330.8	0.992
2	SST for NT, +3 & +6	935.48	28.94
3	Normal Tower	4356.25	179.07
4	+ 3 meters extensions	1047.88	42.36
5	+ 6 meters extensions	2319.84	81.18
6	+ 9 meters extensions	3865.04	134.131
III)	**Type of Tower : S**		
1	Stub & Cleat for NT, +3 & +6	453.44	1.056
2	SST for NT, +3 & +6	1137	29.97
3	Normal Tower	5763.51	221.176
4	+ 3 meters extensions	1354.32	38.948
5	+ 6 meters extensions	2932.52	77.77
6	+ 9 meters extensions	4845.32	122.49

- including

Hangers(6 Nos)	5.420 kgs / Piece
U-Bolts(1 Nos)	1.003kgs / Piece
Bird Guards(6 Nos)	0.50kgs / Piece

Spec.No.APT 19/75

FOUNDATION DETAILS (PRS)

Make - Kamani

S. No	Type of tower	Type of classification	Excavation volume in Cu.m.	Sand Bed in Cu.m.	PCC 1:4:8 in Cu.m.	PCC 1:2:4 in Cu.m.	Reinforcement Steel in kgs
1	P	Dry	32.37	-	0.78	2.47	-
2		Wet	59.25	-	1.6	5.76	-
3		PS	99.24	5.05	2.7	12.43	-
4		FS	132.43	6.73	3.72	15.26	202.34
5		Hard Rock	2.56	-	-	2.8	-
6		F & F rock	15.55	-	-	4.91	-
7	R	Dry	40.52	-	0.96	3.6	-
8		Wet	92.83	-	2.5	8.8	-
9		PS	143.81	6.94	3.84	18.65	-
10		FS	179.63	8.66	4.9	21.62	336.29
11		Hard Rock	4.34	-	-	5.76	-
12		F & F rock	35.04	-	-	8.85	-
13	S	Dry	69.83	-	1.6	7.21	-
14		Wet	135.17	-	3.36	18.14	-
15		PS	231.98	10.09	5.78	40.08	-
16		FS	261.13	11.35	6.56	49.13	487.82
17		Hard Rock	9.86	-	-	11.13	-
18		F & F rock	5 .2	-	-	18.78	-

Spec.No. APT 19/75

Sullurpet - Sriharikota 132 kV SC Transmission Line

APT - 19/75 Make: - KAMANI

Sl. No.	Structure Type	Approx. Unit Weight in MT	Weight of Bolts & Nuts	
	I) Type of Tower : A			
1	Super Structure	2166.05	123.22	
2	Stub & Cleats L100x100x8	144.16	1.26	Add. 10% extra (Galvd)
3	Adj stub Templates	442.36	15.82	(")
4	+ 3 meters extensions	503.08	28.95	
5	+ 6 meters extensions	1076.92	58.39	
6	+ 9 meters extensions			
7	+ 12 meters extensions			
	I) Type of Tower : B			
1	Super Structure	2700.94	153.96	Add. 10% extra (Galvd)
2	Stub & Cleats L100x100x8	187.56	1.26	
3	Adj stub Templates	691.08	35.02	
4	+ 3 meters extensions	707.24	32.15	
5	+ 6 meters extensions	1660.44.	68.55	
6	+ 9 meters extensions			
7	+ 12 meters extensions			
	I) Type of Tower : C			
1	Super Structure	3828.76	187.25	
2	Stub & Cleats L110x110x10	250.88	1.34	
3	Adj stub Templates	1051.52	38.02	
4	+ 3 meters extensions	1153.16	44.83	
5	+ 6 meters extensions	2526.40	90.86	
6	+ 9 meters extensions			
7	+ 12 meters extensions			

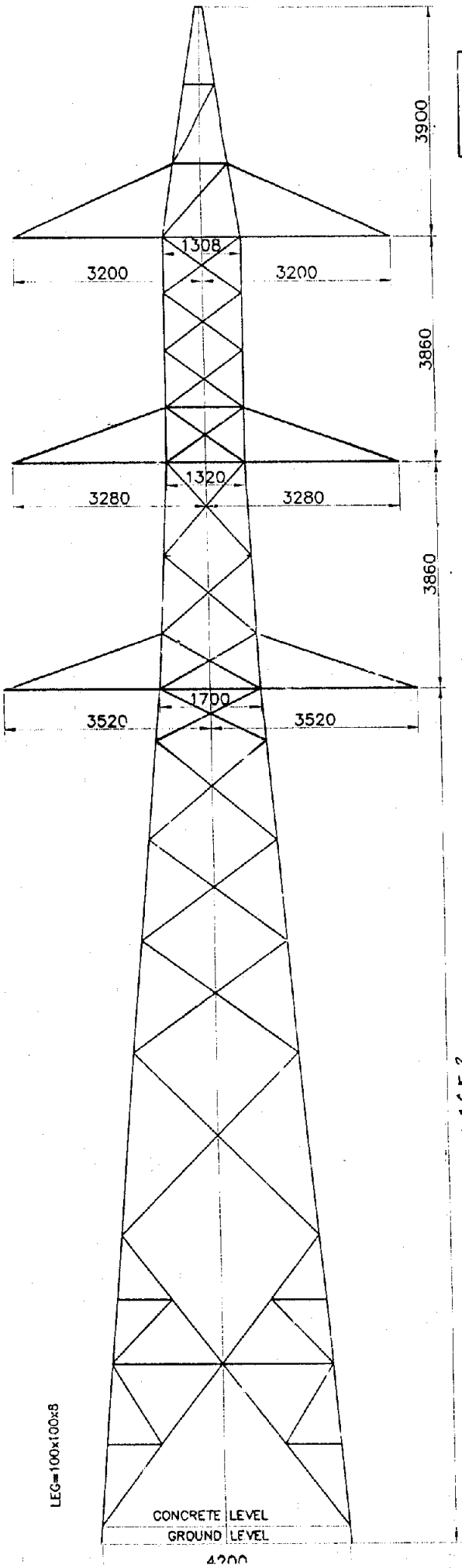
Sullurpet - Sriharikota 132 kV SC Transmission Line

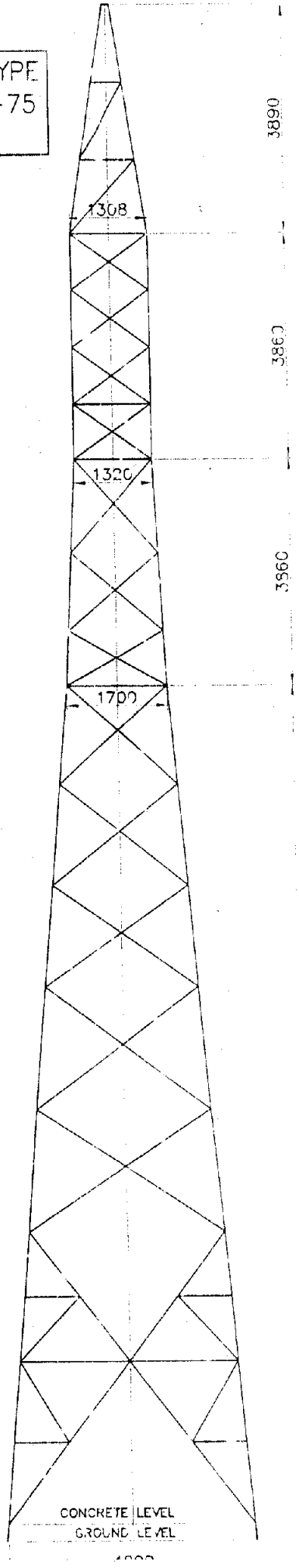
APT - 19/75 **Foundation details**

Make - Kamani

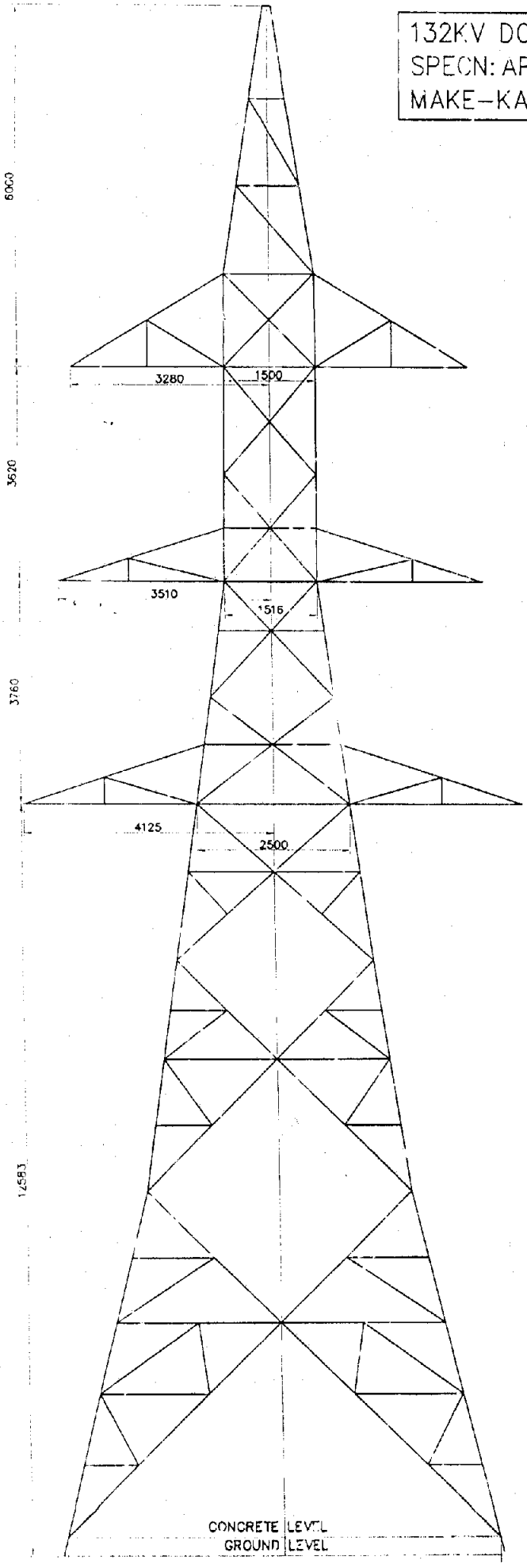
Sl. No.	Types	Type of foundation	Stub size	Depth of foundation	Vol. of Concrete (Cum)	Vol. of Excavation (Cum)	Reinforcement steel
I)	**Type of Tower : A**						
1	Dry	Frustrum	100 x 100 x 6	2500	1.6884	13.1103	
2	Wet	- do -	- do -	2500	5.0524	20.00	
3	PS						
4	FS						
II)	**Type of Tower : B**						
1	Dry	Frustrum	100 x 100 x 8	2750	2.2928	18.5339	
2	Wet	- do -	- do -	2750	6.0136	50.8478	
3	PS						
4	FS						
III)	**Type of Tower : C**						
1	Dry	Frustrum	110 x 110 x 10	2850	3.2556	26.6863	
2	Wet	- do -	- do -	2850	9.5024	62.9565	
3	PS						
4	FS						

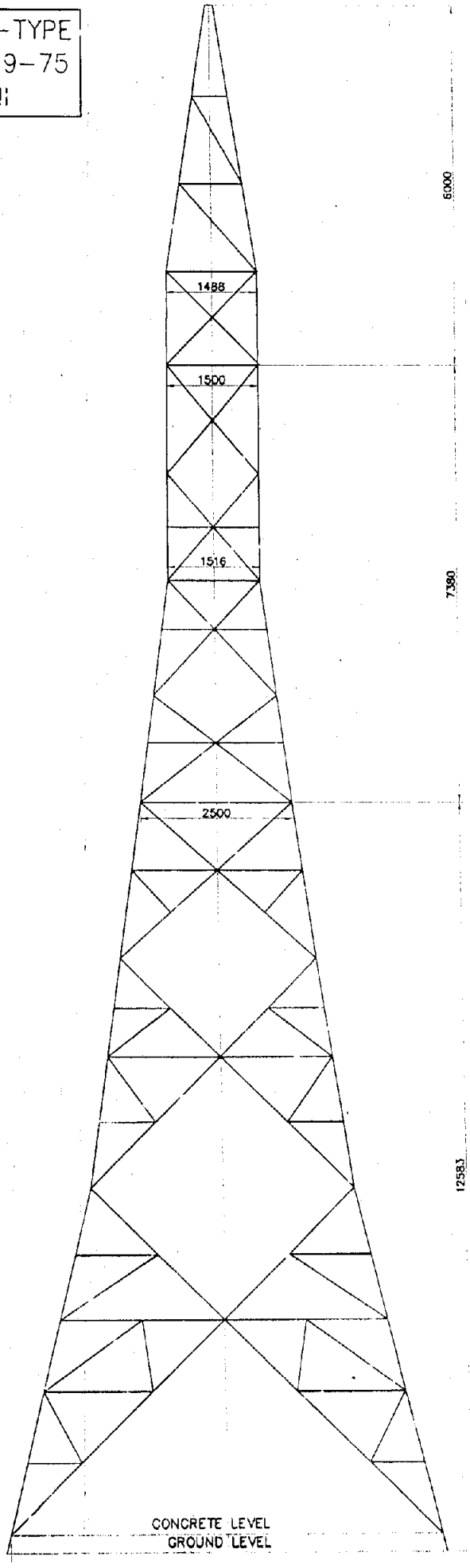
132KV DC. P-TYPE
SPECN: APT-19-75
MAKE-KAMINI



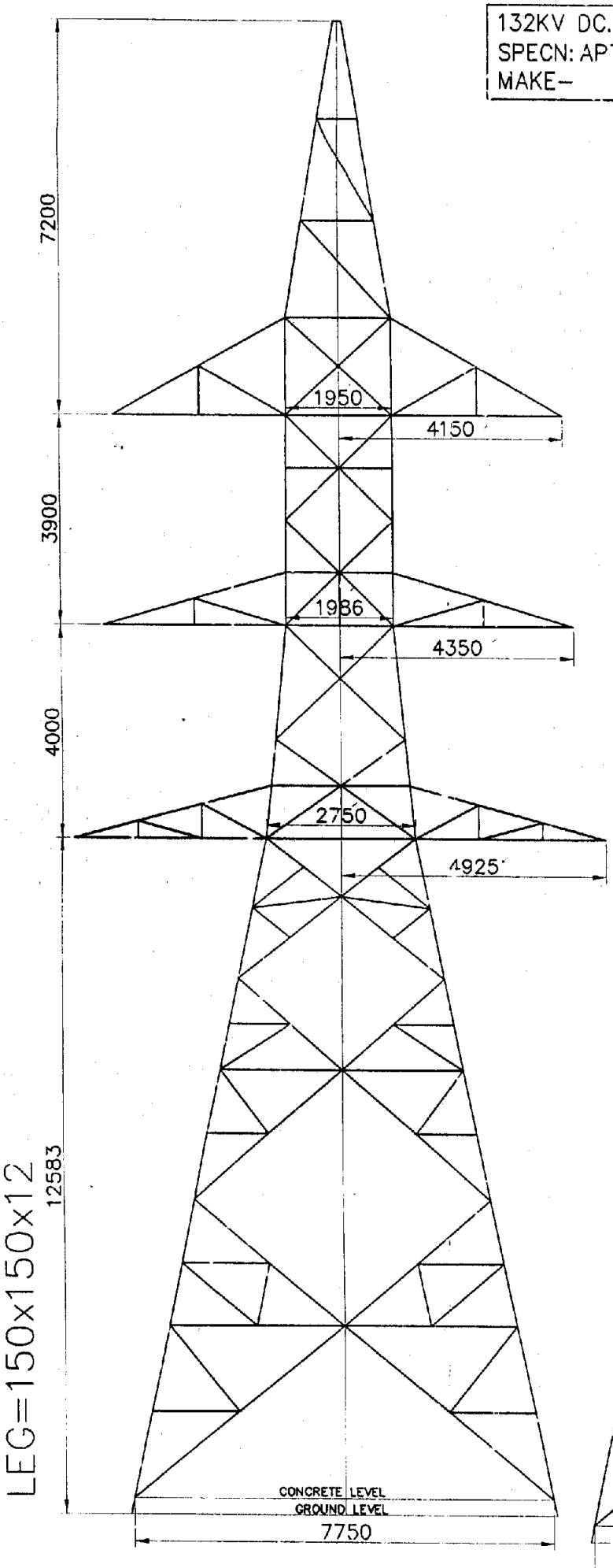


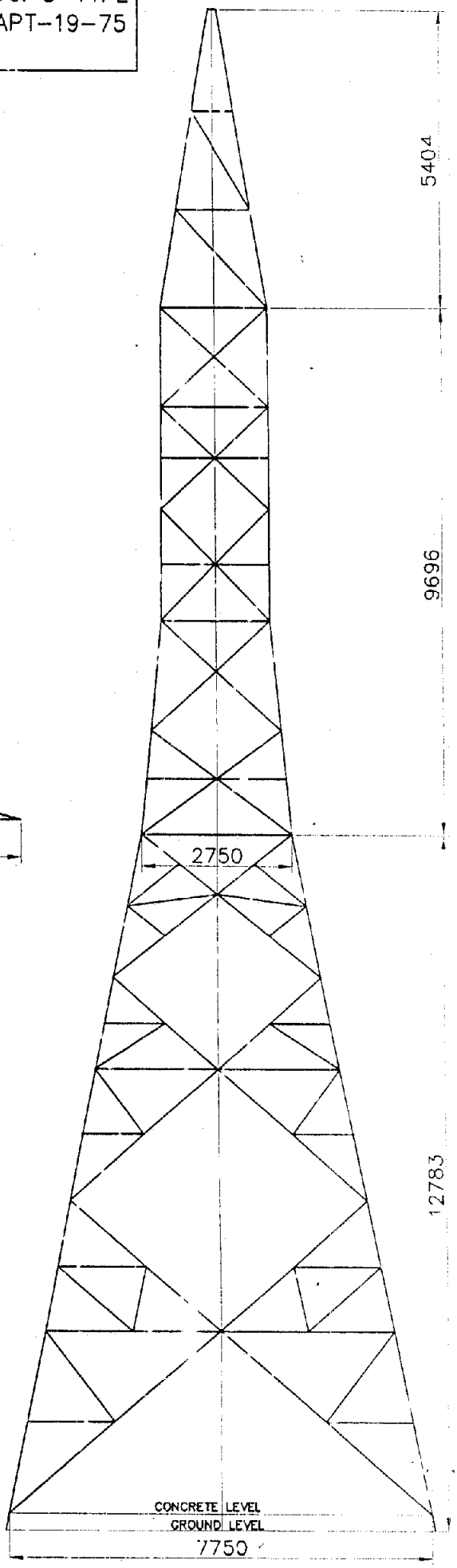
132KV DC. R-TYPE
SPECN: APT-19-75
MAKE-KAMANI





132KV DC. S-TYPE
SPECN: APT-19-75
MAKE-





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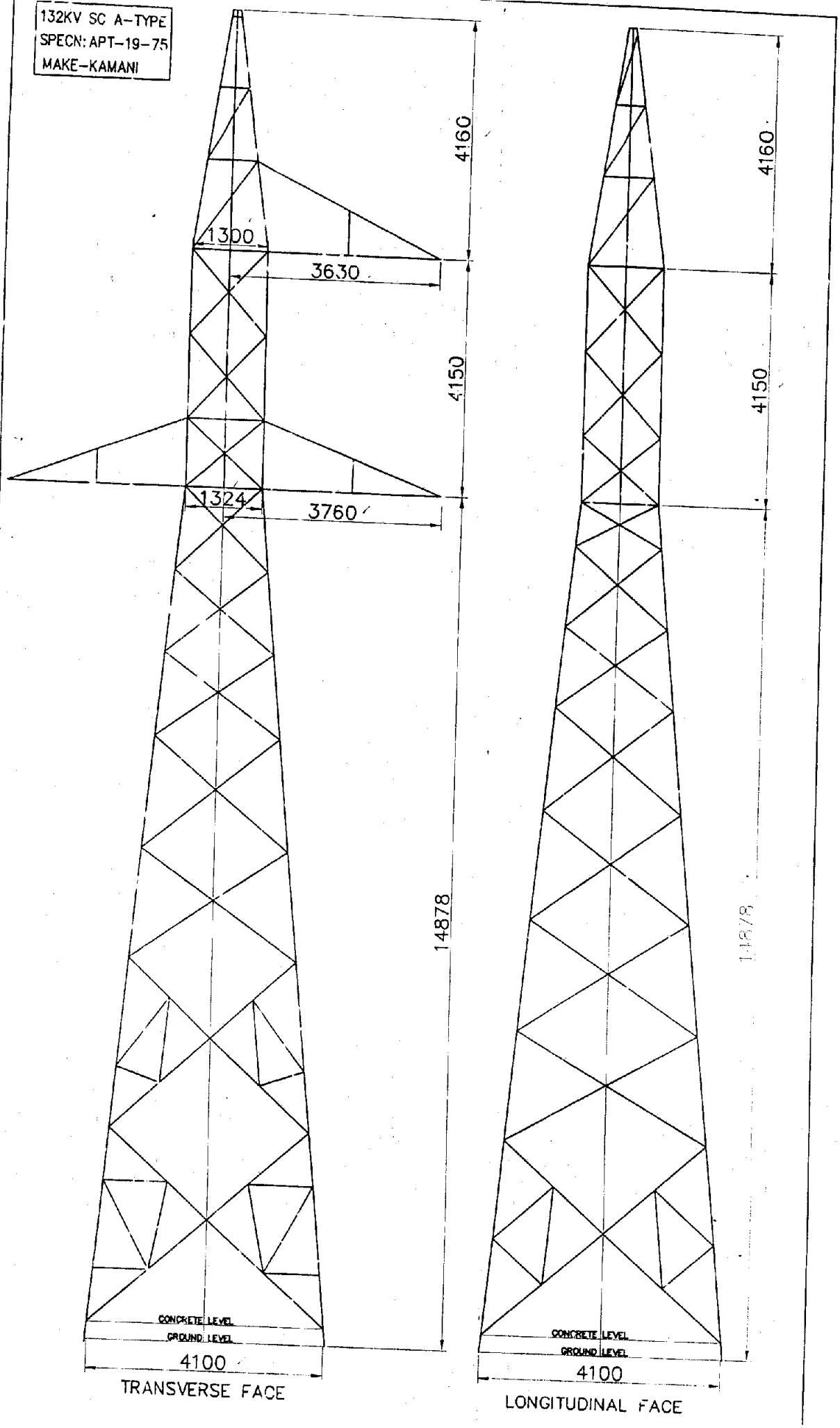
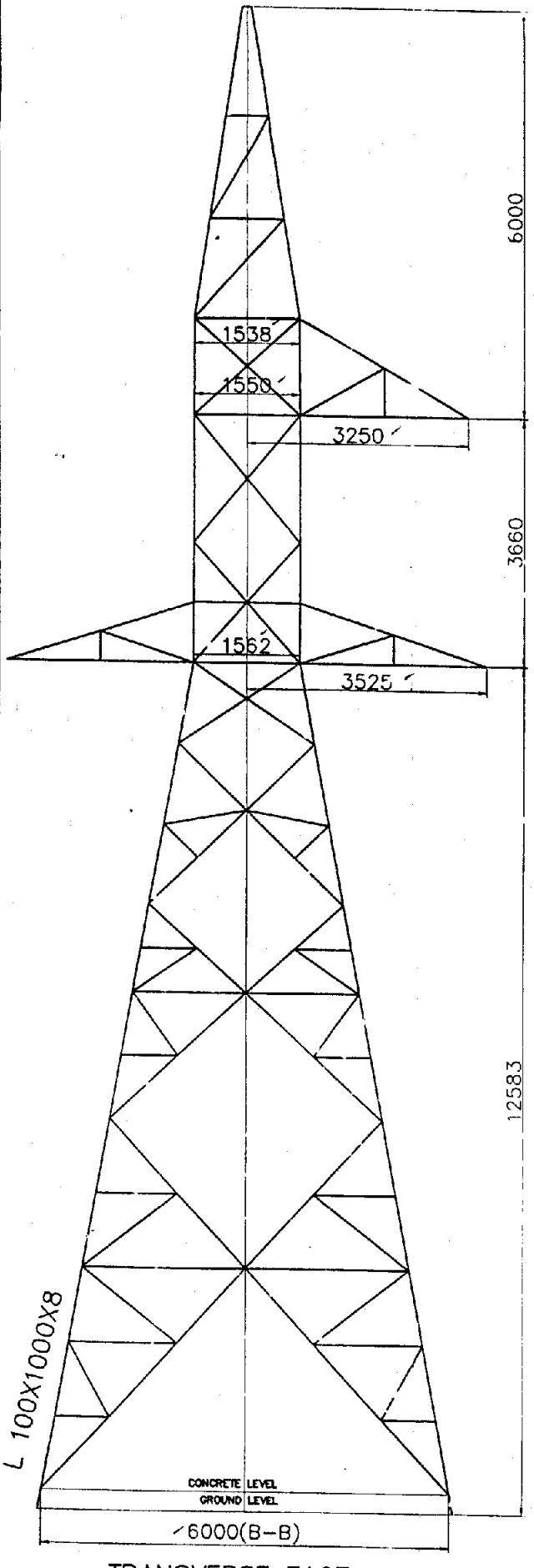
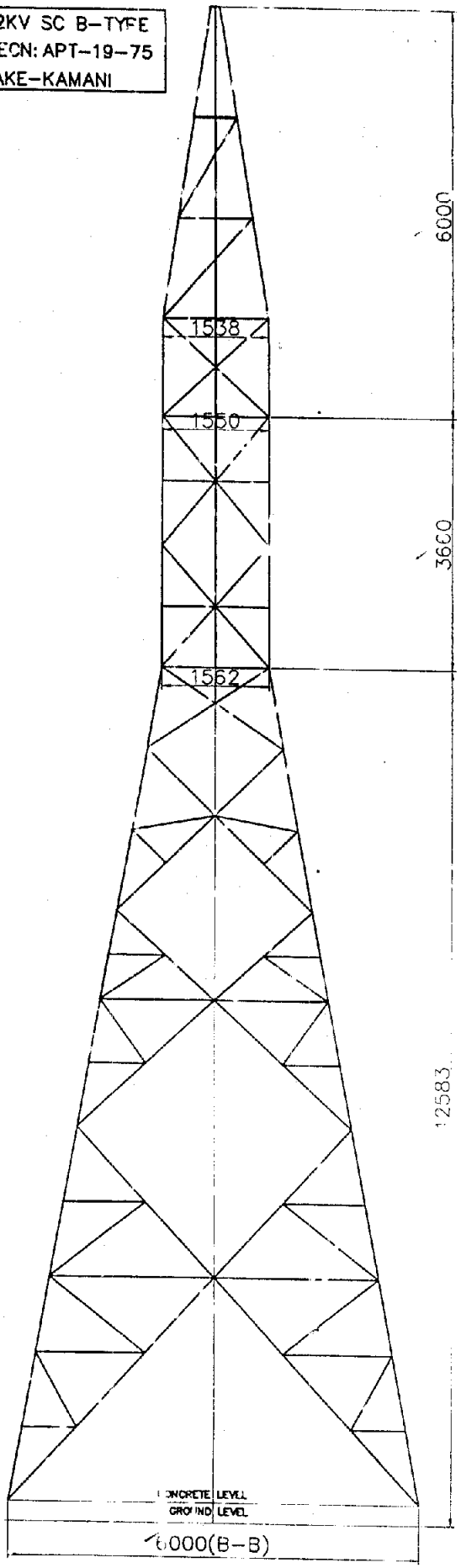
132KV SC A-TYPE
SPECN: APT-19-75
MAKE-KAMANI



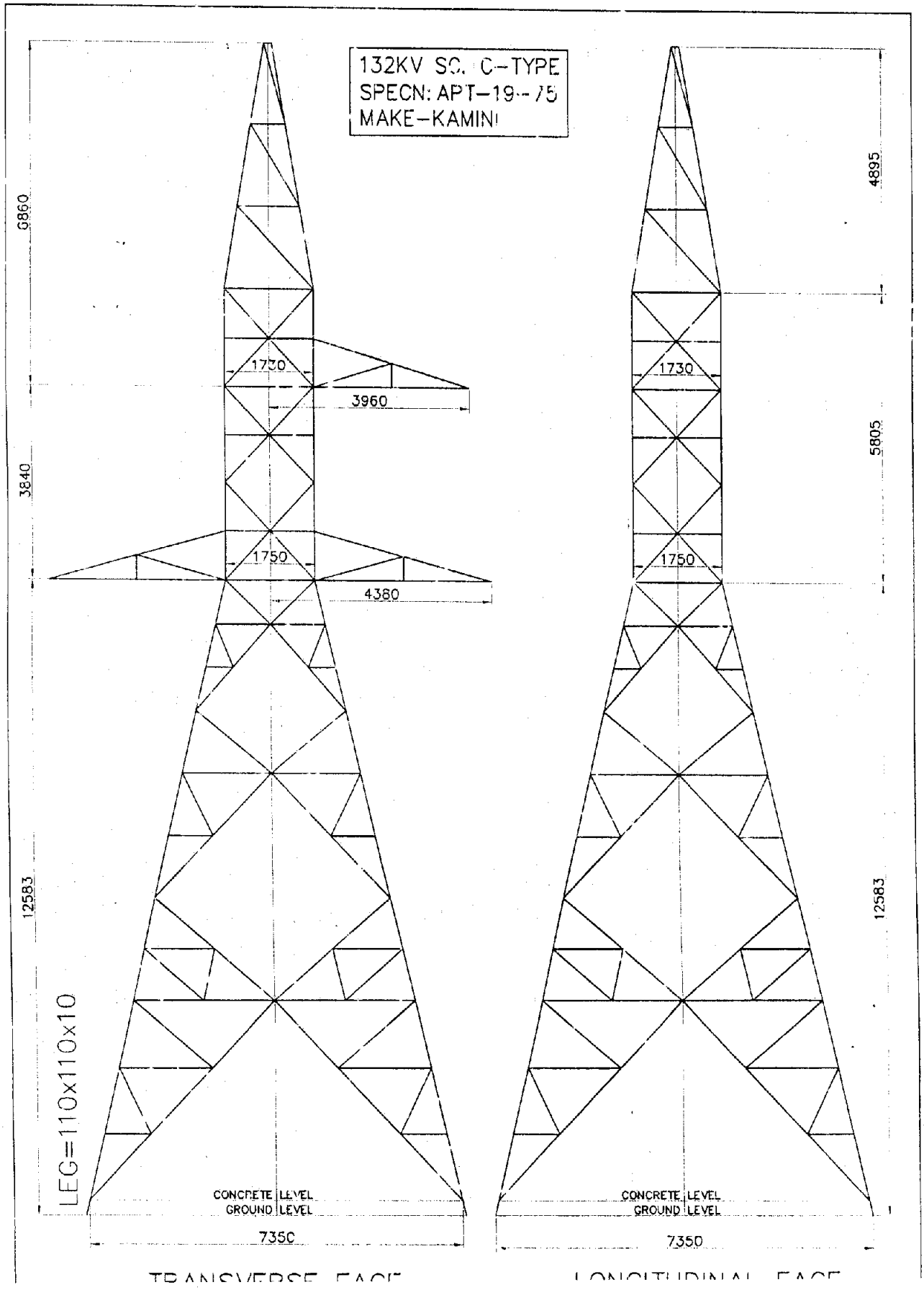
132KV SC B-TYPE
SPECN: APT-19-75
MAKE-KAMANI



TRANSVERSE FACE



LONGITUDINAL FACE



TRANSVERSE FACE

LONGITUDINAL FACE

132 kV DC Transmission Line Spec.No.APT 7/90

Design -A&B - EMC; C&D - KEC

AP CYCLONE EMERGENCY RECONSTRUCTION PROJECT

Make: - EMC

Sl. No.	Structure Type	Approx. Unit Weight in MT	Weight of Bolts & Nuts
	I) Type of Tower : A		
1	Super Structure	2362.11	99.99
2	Stub & Cleats	121.52	
3	Stub Setting Templates	1152.13	
4	+ 3 meters extensions	584.96	
5	+ 6 meters extensions	1106.72	
6	+ 9 meters extensions	1648.64	
7	+ 12 meters extensions		
	II) Type of Tower : B		
1	Super Structure	3210.17	148.89
2	Stub & Cleats	181.28	
3	Stub Setting Templates	565.65	
4	+ 3 meters extensions	778.80	
5	+ 6 meters extensions	1360.88	60.60
6	+ 9 meters extensions	2036.68	
7	+ 12 meters extensions		
	III) Type of Tower : C		
1	Super Structure	3482.00	
2	Stub & Cleats	252.88	
3	Stub Setting Templates	720.27	
4	+ 3 meters extensions	905.92	
5	+ 6 meters extensions	1438.36	
6	+ 9 meters extensions	2640.12	
7	+ 12 meters extensions		
	IV) Type of Tower : D		
1	Super Structure	4485.86	
2	Stub & Cleats	302.08	
3	Stub Setting Templates	1100.07	
4	+ 3 meters extensions	1148.88	
5	+ 6 meters extensions	1954.92	
6	+ 9 meters extensions	3552.20	
7	+ 12 meters extensions		
8	Spl Members for DE Towers	461.14	

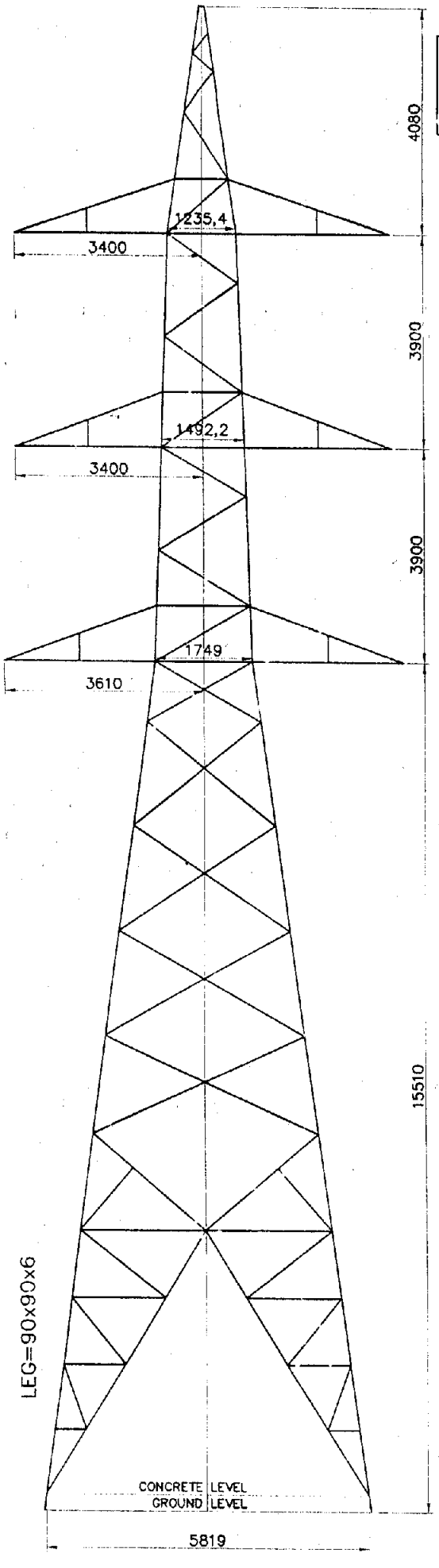
APCERP 132 kV DC

Foundation details Spec.No.APT 7/90

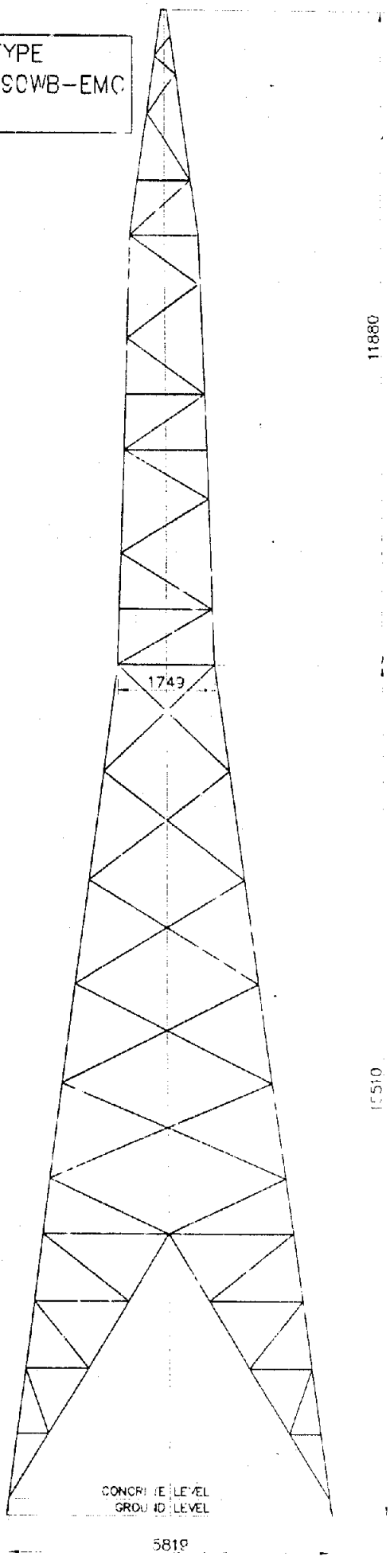
Design - A&B - EMC; C&D - KEC

Sl. No.	Types	Type of foundation	Stub size	Depth of foundation	Vol. of Concrete (Cum)	Vol. of Excavation (Cum)	Reinforcement steel (MT) (width)
I)	**Type of Tower : A**						
1	Dry	Frustrum	90 x 90 x 6				
2	Wet	-do-	-do-				
3	PS	-do-	-do-	3000	5.1684	46.0992	
4	FS	-do-	-do-	3000	8.1163	66.84	
5	Rocky			2.850	3.2972		0.80
II)	**Type of Tower : B**						
1	Dry	Frustrun	100 x 100 x 3	2900	2.4888	27.5106	
2	Wet	-do-	-do-	3000	6.5598	56.5068	
3	PS	-do-	-do-				
4	FS	-do-	-do-				
5	Rocky			2.850	4.5536		0.90
III)	**Type of Tower : C**						
1	Dry	Frustrum	110 x 110 x 10	2950	3.3148	35.3162	
2	Wet	- do -	- do -	3000	6.868	78.03	204
3	PS	- do -	- do -	3000	9.055	109.44	312
4	FS	- do -	- do -	3000	12.366	147.84	458
5	Rocky			2.900	5.1892		0.90
IV)	**Type of Tower : D**						
1	Dry	Frustrum	130 x 130 x 10				
2	Wet	- do -	- do -	3000	16.806	193.00	750
3	PS	- do -	- do -	3000	9.392	108	326
4	FS	- do -	- do -	3000	12.602	145.32	474
5	Rocky			2.900	9.7192		1.10

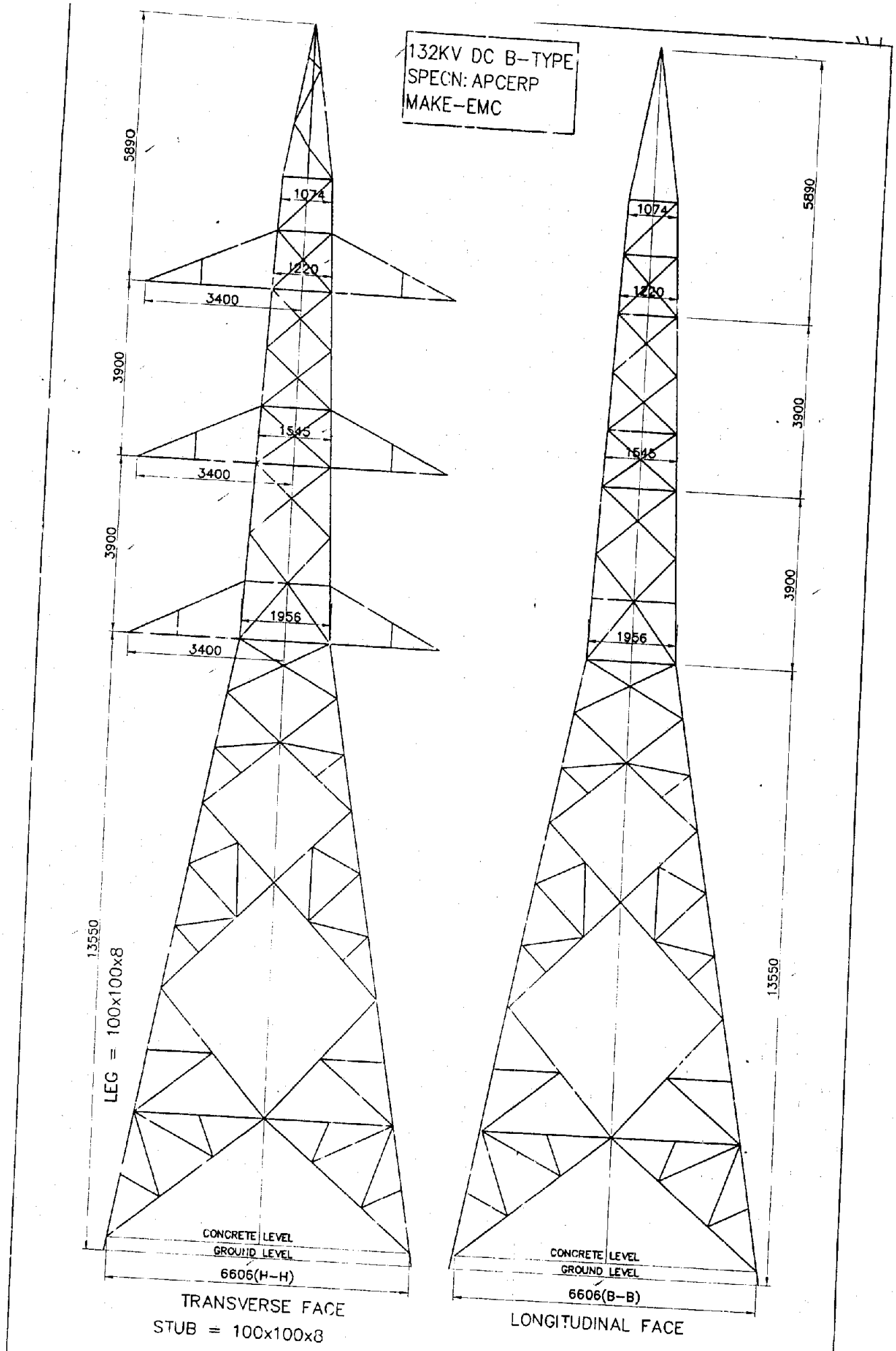
132KV DC. A-TYPE
SPECN: APT-7-SCWB-EMC
MAKE-APCERP

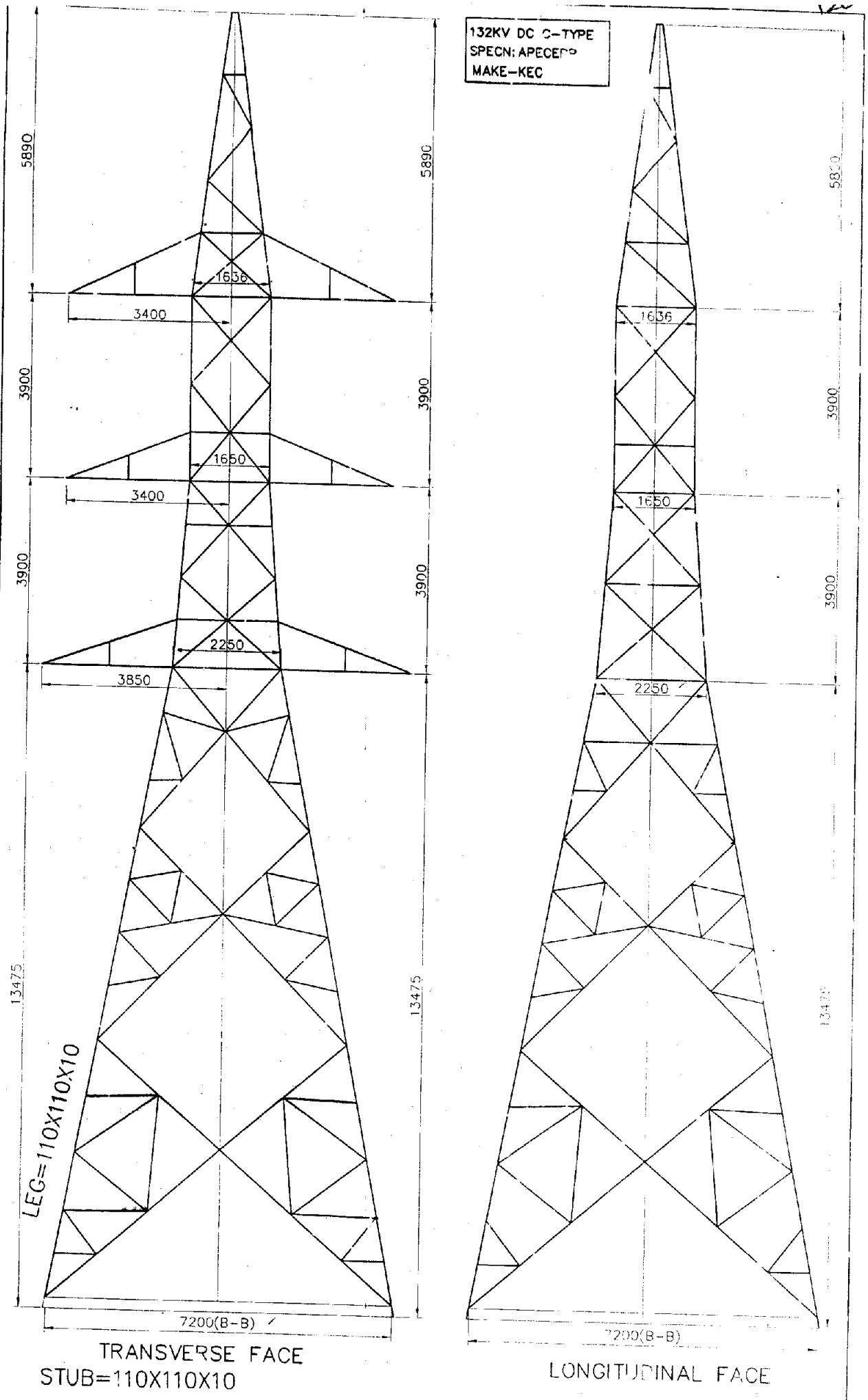


TRANSVERSE FACE

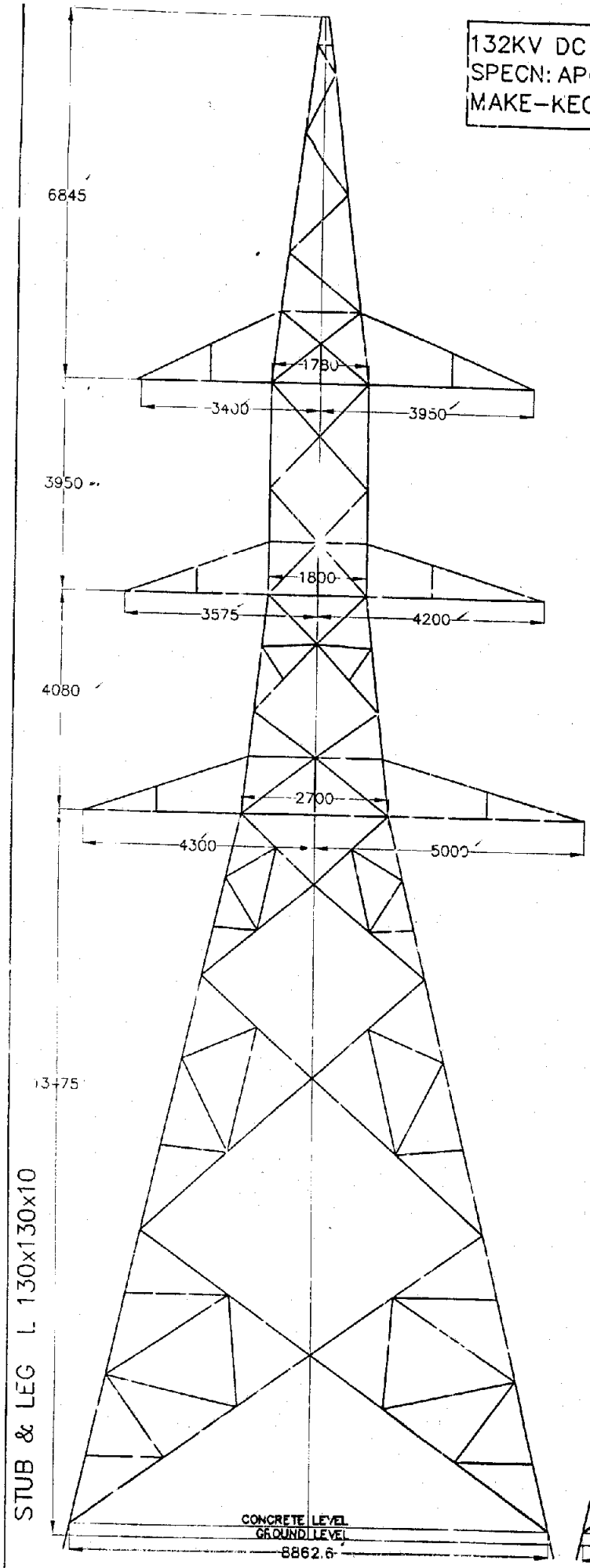


LONGITUDINAL FACE

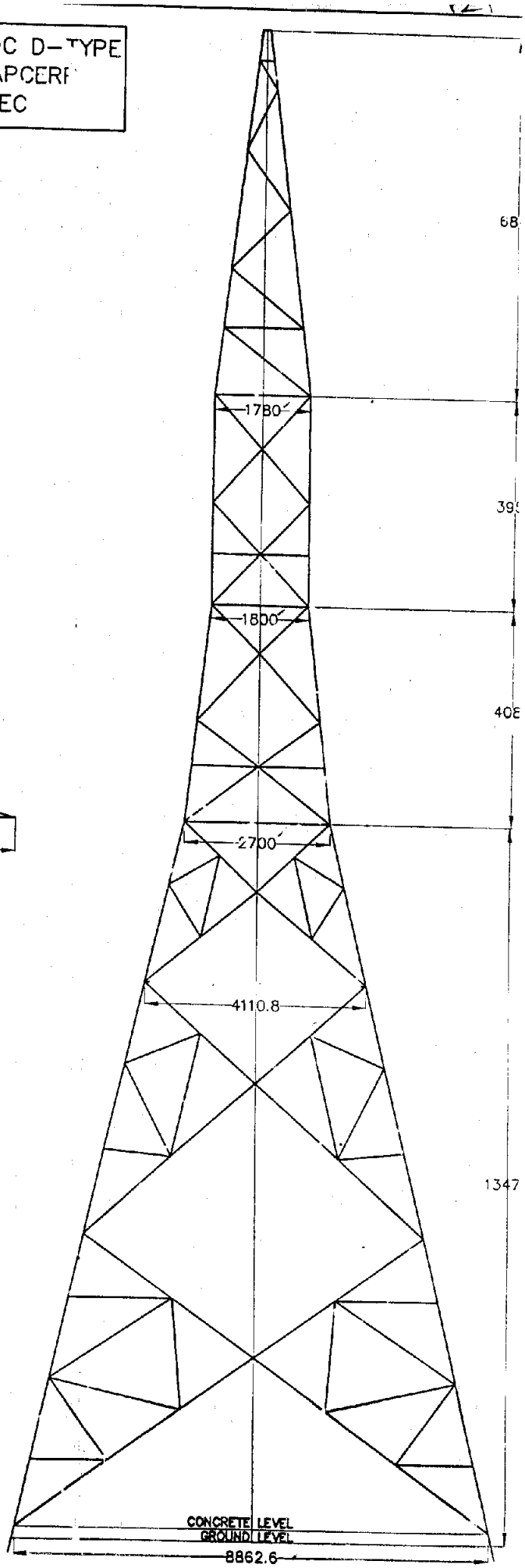

132KV DC B-TYPE
SPECN: APCERP
MAKE-EMC
5890
1074
1220
3400
3900
1545
3400
3900
1956
3400
13550
LEG = 100x100x8
CONCRETE LEVEL
GROUND LEVEL
6606(H-H)
TRANSVERSE FACE
STUB = 100x100x8
5890
1074
1220
3900
1545
3900
1956
13550
CONCRETE LEVEL
GROUND LEVEL
6606(B-B)
LONGITUDINAL FACE


132KV DC C-TYPE
SPECN: APECEP
MAKE-KEC
5890
1636
3400
3900
1650
3400
3900
2250
3850
13475
LEG=110X110X10
7200(B-B)
TRANSVERSE FACE
STUB=110X110X10
5890
1636
3900
1650
3900
2250
7200(B-B)
LONGITUDINAL FACE

132KV DC D-TYPE
SPECN: APCERI
MAKE-KEC



TRANSVERSE FACE



LONGITUDINAL FACE

132 kV Multi Circuit Tower Weights

Specn. - APT - 32/88
Make - SAE

Sl. No.	Structure Type	Approx. Unit Weight in Kgs.	Weight of Bolts & Nuts Kgs.	
	I) Type of Tower : K			
1	Stub & Cleats	260.36	3.58	
2	Stub Setting Templates	873.2	21.35	
3	Normal Tower	6235.75	241.72	
4	+ 3 meters extensions	1101.81	31.13	
5	+ 6 meters extensions	1803.99	45.96	
6	+ 9 meters extensions			
7	+ 12 meters extensions			
	II) Type of Tower : L			
1	Stub & Cleats	658.4	3.93	
2	Stub Setting Templates	1084.88	24.06	
3	Normal Tower	10207.76	366.11	(1)
4	+ 3 meters extensions	1579.61	37.31	
5	+ 6 meters extensions	2708.68	69.65	
6	+ 9 meters extensions			
7	+ 12 meters extensions			
	III) Type of Tower : M			
1	Stub & Cleats	1012.88	7.92	
2	Stub Setting Templates	1776.36	37.45	
3	Normal Tower	14355.89	484.28	(2)
4	+ 3 meters extensions	2685.1	60.85	
5	+ 6 meters extensions	4127	82.87	
6	+ 9 meters extensions			
7	+ 12 meters extensions			

(1) Including step bolts.
(2) Including step bolts & D-shackle

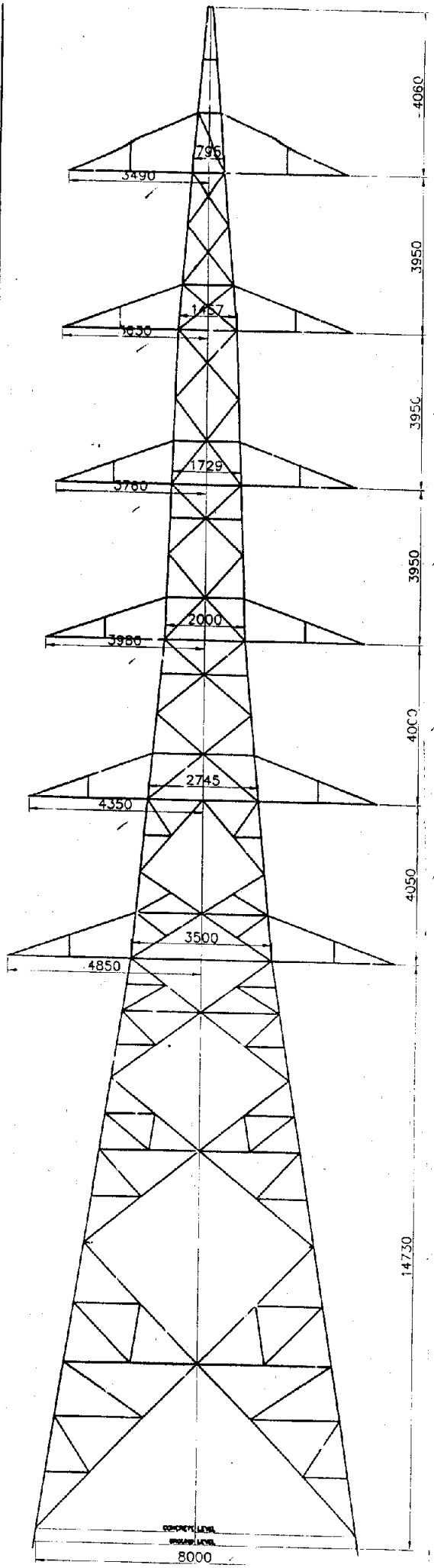
132 kV Multi Circuit Tower Foundations

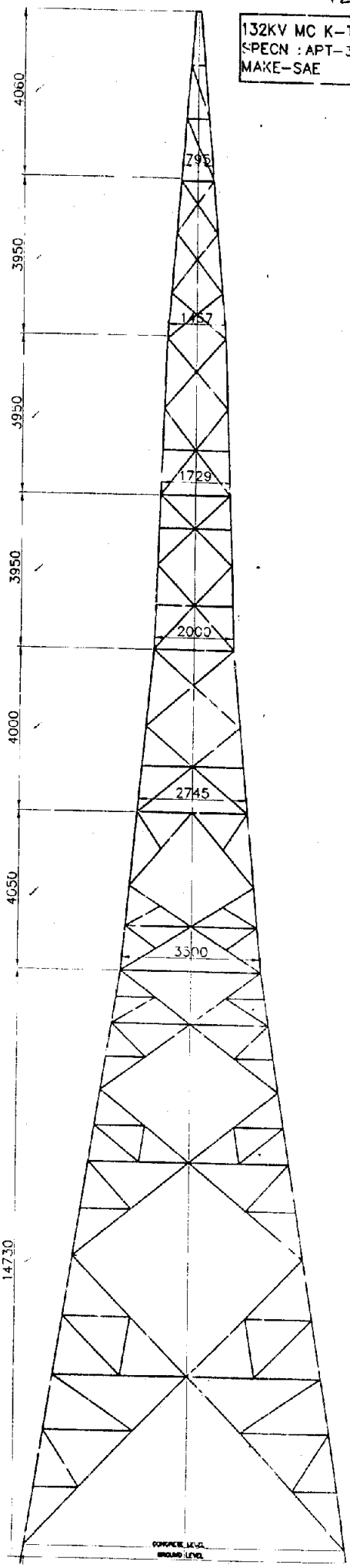
Spec.No.APT32/88

Make - SAE

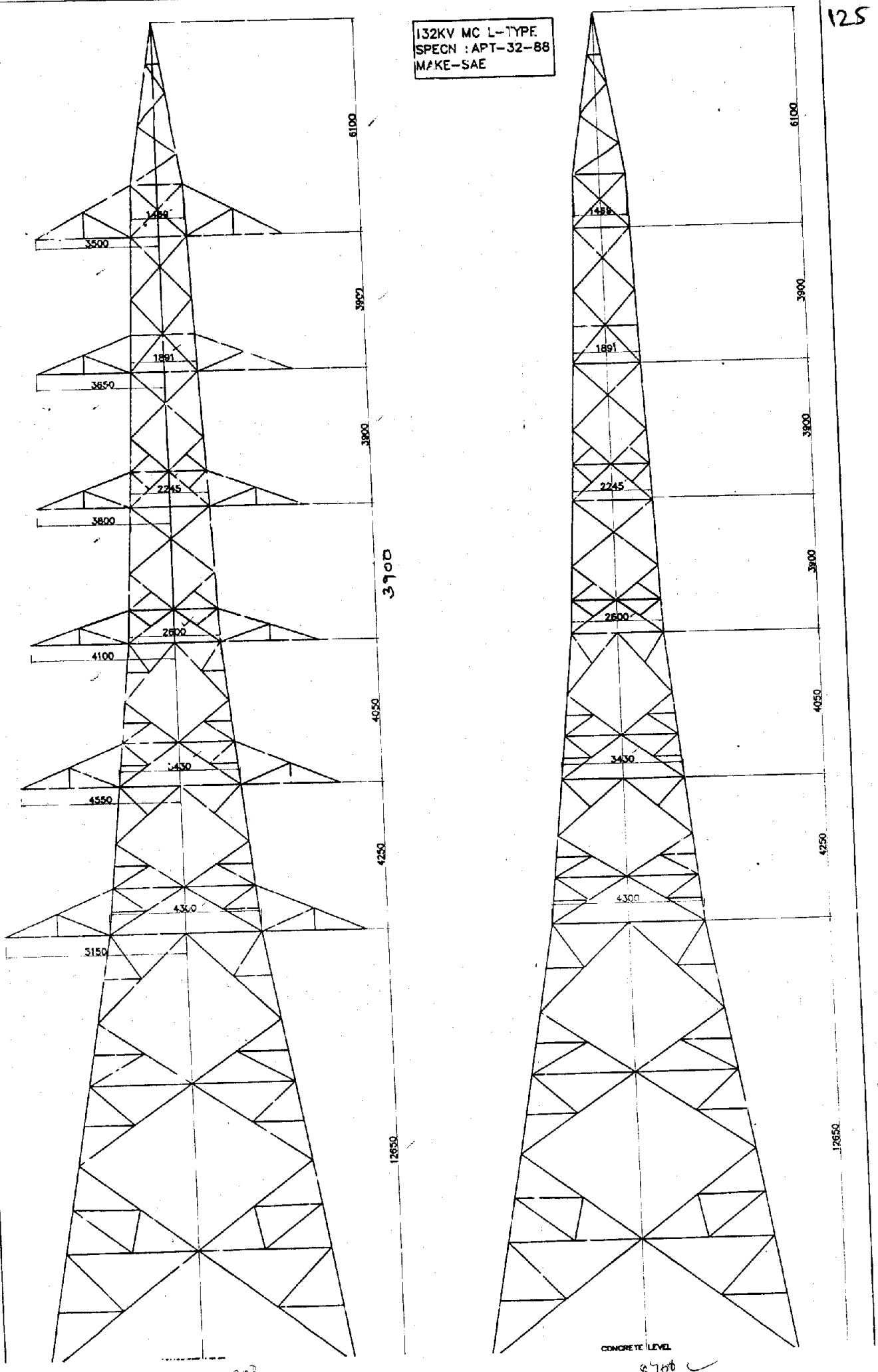
Sl. No.	Types	Type of foundation	Stub size	Depth of foundation	Vol. of Concrete (Cum)	Vol. of Excavation (Cum)	Reinforcement steel (MT)
I)	**Type of Tower : K**						
1	Dry	Pad & Chimney	110 x 110 x 10	2650	2.77	26.67	--
2	Wet	Stepped	- do -	- do -	6.85	62.96	0.274
3	PS	- do -	- do -	- do -	9.00	87.47	0.344
4	FS	- do -	- do -	- do -	11.47	112.40	0.416
II)	**Type of Tower : L**						
1	Dry	Pad & Chimney	150 x 150 x 16	3550	9.50	91.25	0
2	Wet	Stepped	- do -	- do -	16.91	195.45	1.149
3	PS	- do -	- do -	- do -	20.41	244.56	1.403
4	FS	- do -	- do -	- do -	26.13	293.98	1.545
III)	**Type of Tower : M**						
1	Dry	Pad & Chimney	200 x 200 x 16	3500	14.82	122.79	0.00
2	Wet	Stepped	- do -	- do -	25.97	282.63	1.630
3	PS	- do -	- do -	- do -	31.59	343.84	2.036
4	FS	- do -	- do -	- do -	37.90	409.48	2.418

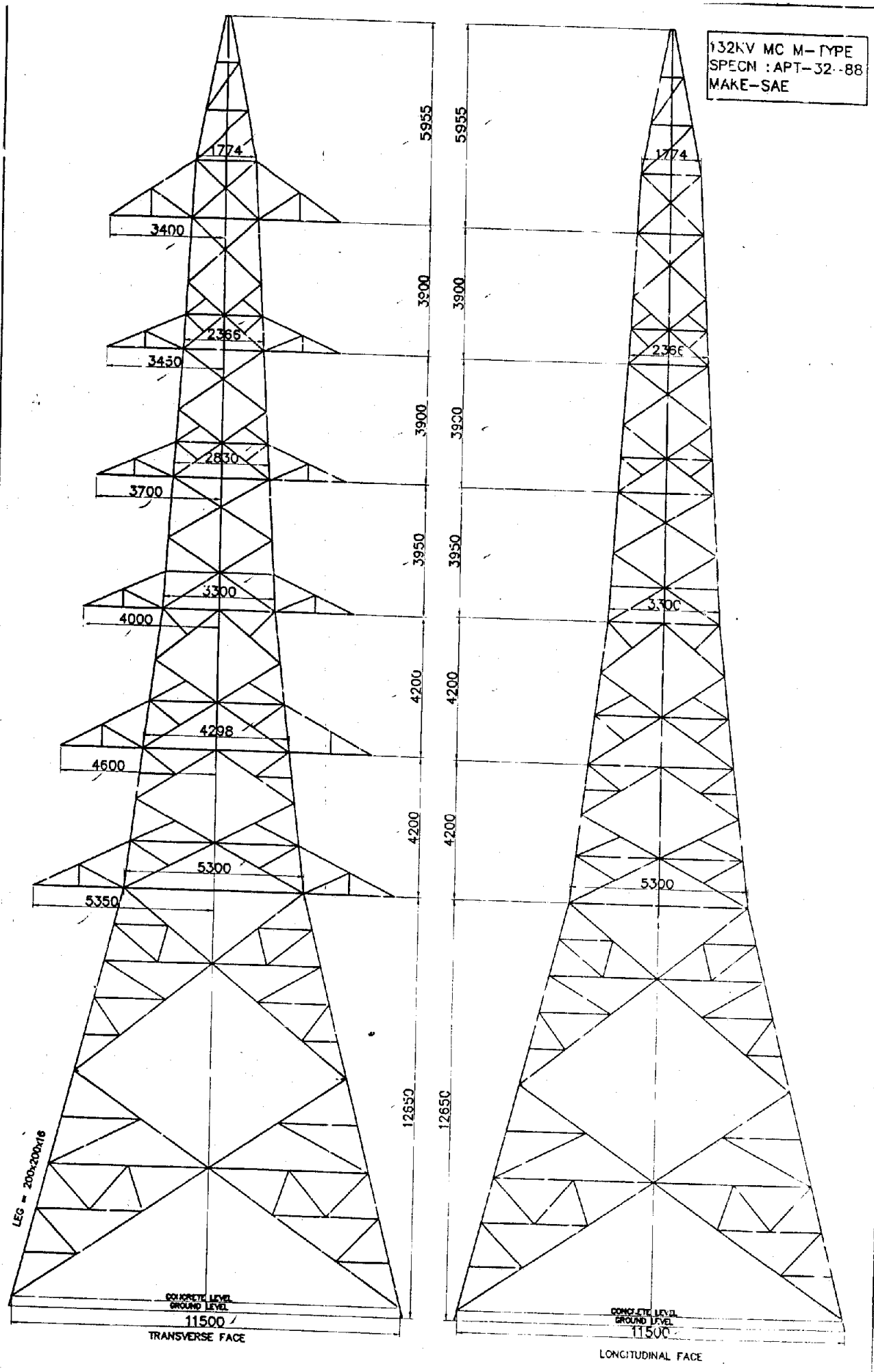
132KV MC K-TYPE
SPECN : APT-32-88
MAKE-SAE





132KV MC L-TYPE
SPECN : APT-32-88
MAKE-SAE




132KV MC M-TYPE
SPECN : APT-32-88
MAKE-SAE
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3400
2366
3450
2830
3700
3300
4000
4298
4600
5300
5350
5955
3900
3900
3950
4200
4200
12650
LEG = 200x200x16
CONCRETE LEVEL
GROUND LEVEL
11500
TRANSVERSE FACE
1774
2366
3300
5300
5955
3900
3900
3950
4200
4200
12650
CONCRETE LEVEL
GROUND LEVEL
11500
LONGITUDINAL FACE

132 kV DC Narrow Based tower

Spec.No.
Make -

Sl. No.	Structure Type	Approx. Unit Weight in MT	Weight of Bolts & Nuts
I)	**Type of Tower : 0^0**		
1	Super Structure	3362.145	279.817
2	Stub & Cleats	424.32	
3	Stub Setting Ternplates		
4	Normal Tower		
5	+ 3 meters extensions		
6	+ 6 meters extensions		
7	+ 9 meters extensions		
8	+ 12 meters extensions		
II)	**Type of Tower : 30^0**		
1	Super Structure		
2	Stub & Cleats 150 x 150 x 12	533.12	
3	Stub Setting Templates	489.66	
4	Normal Tower		
5	+ 3 meters extensions		
6	+ 6 meters extensions		
7	+ 9 meters extensions		
8	+ 12 meters extensions		
III)	**Type of Tower : 60^0**		
1	Super Structure	7934.20	291.44
2	Stub & Cleats 150 x 150 x 20	918.84	
3	Stub Setting Templates	531.64	
4	Normal Tower		
5	+ 3 meters extensions		
6	+ 6 meters extensions		
7	+ 9 meters extensions		
8	+ 12 meters extensions		

132 kV DC Narrow Based tower

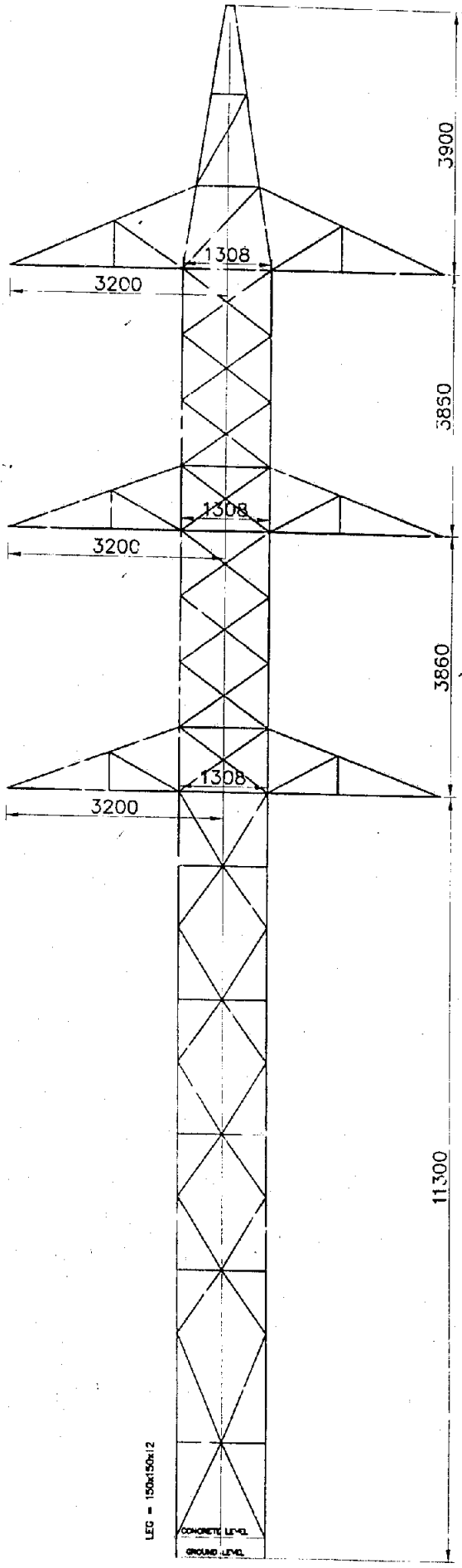
Foundation details

Spec.No.

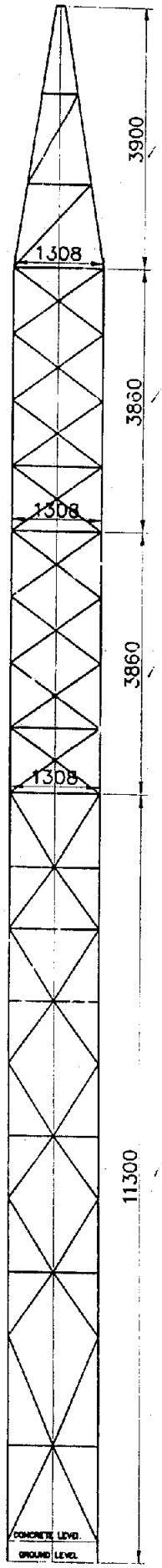
Make :-

Sl. No.	Types	Type of foundation	Stub size	Depth of foundation	Vol. of Concrete (Cum)	Vol. of Excavation (Cum)	Reinforcement steel (MT)	Width of Foundations
III)	**Type of Tower : 0^0**							
1	Dry							
2	Wet							
3	PS							
4	FS							
II)	**Type of Tower : 30^0**							
1	Dry	Stepped	150 x 150 x 12	3700	16.632	89.2480		2200
2	Wet							
3	PS							
4	FS							
I)	**Type of Tower : 60^0**							
1	Dry	Stepped	150 x 150 x 20	4270	19.85	98.38		2400
2	Wet							
3	PS							
4	FS							

132KV DC
SPECN: NBT-PN
MAKE-

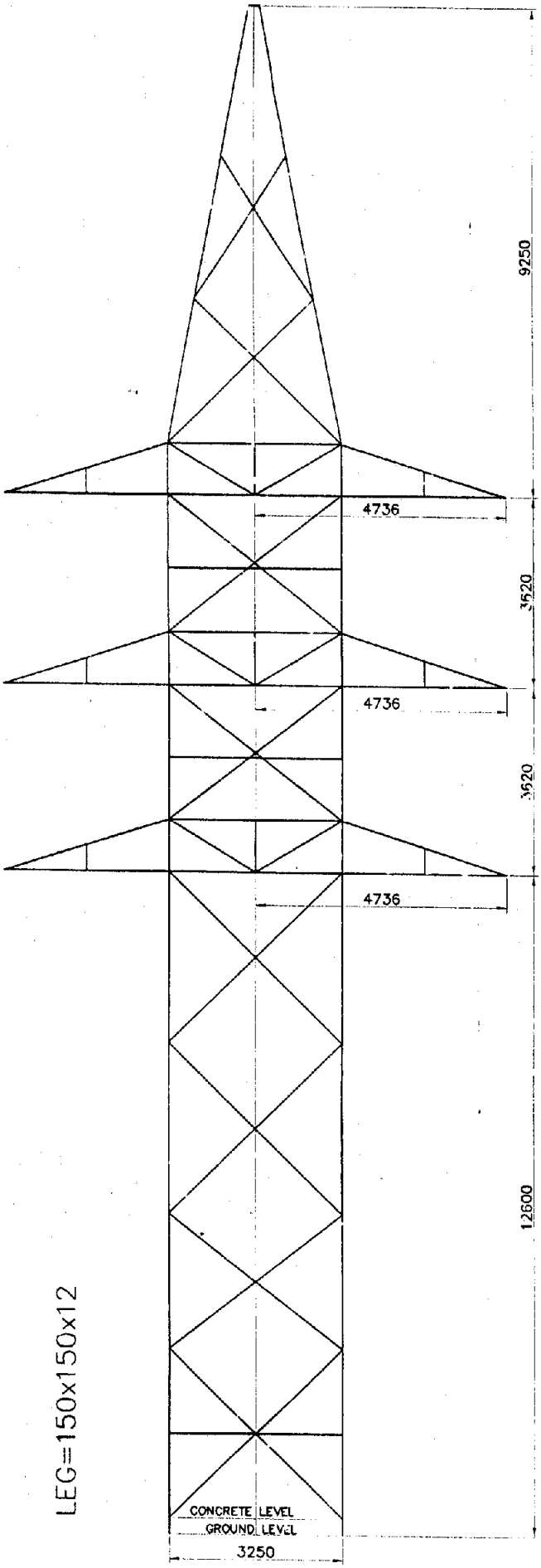


TRANSVERSE FACE



LONGITUDINAL FACE

132KV DC. R-TYPE
SPECN: NB(30°)
MAKE-



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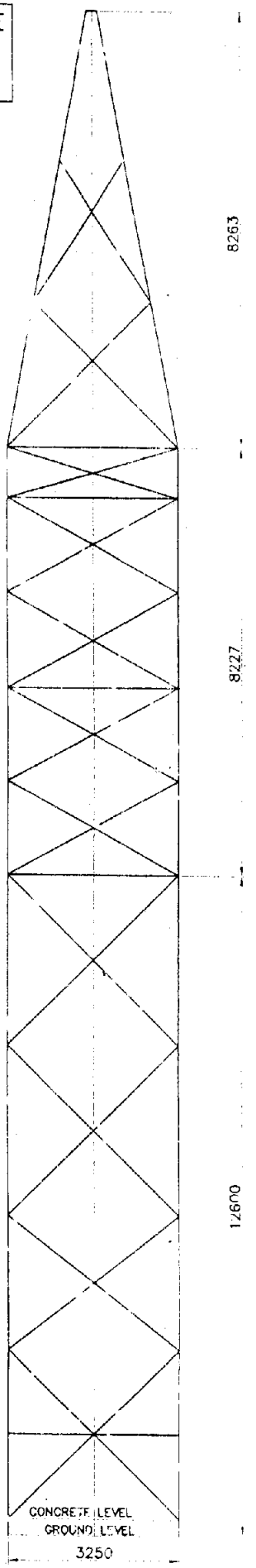
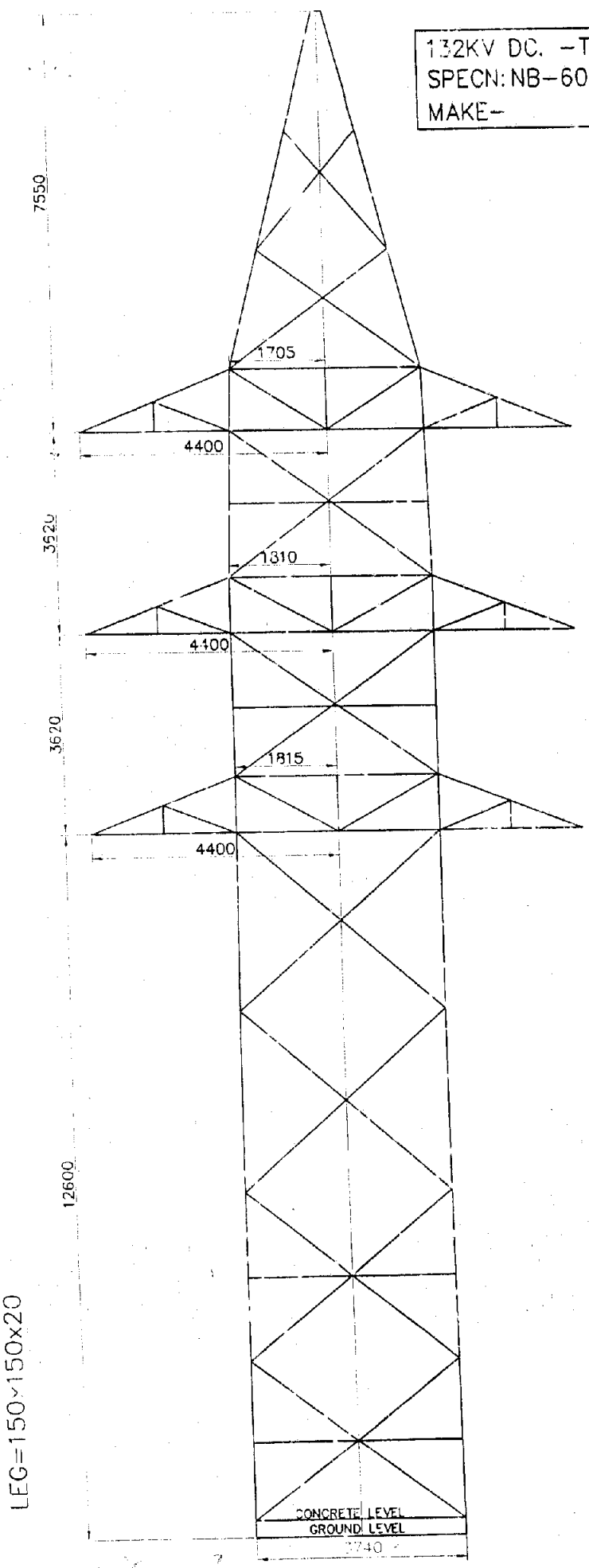
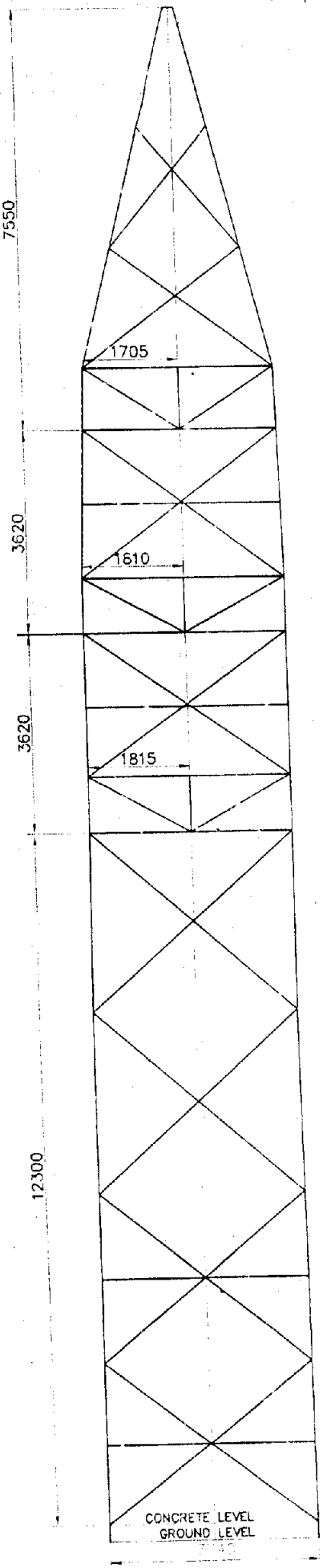
TRANSVERSE FACE



LONGITUDINAL FACE

132KV DC. -TYPE
SPECN: NB-60°
MAKE-





LEG=150×150×20

132 kV DC MPEB - 'D' towers

Spec.No.
Make - MPEB

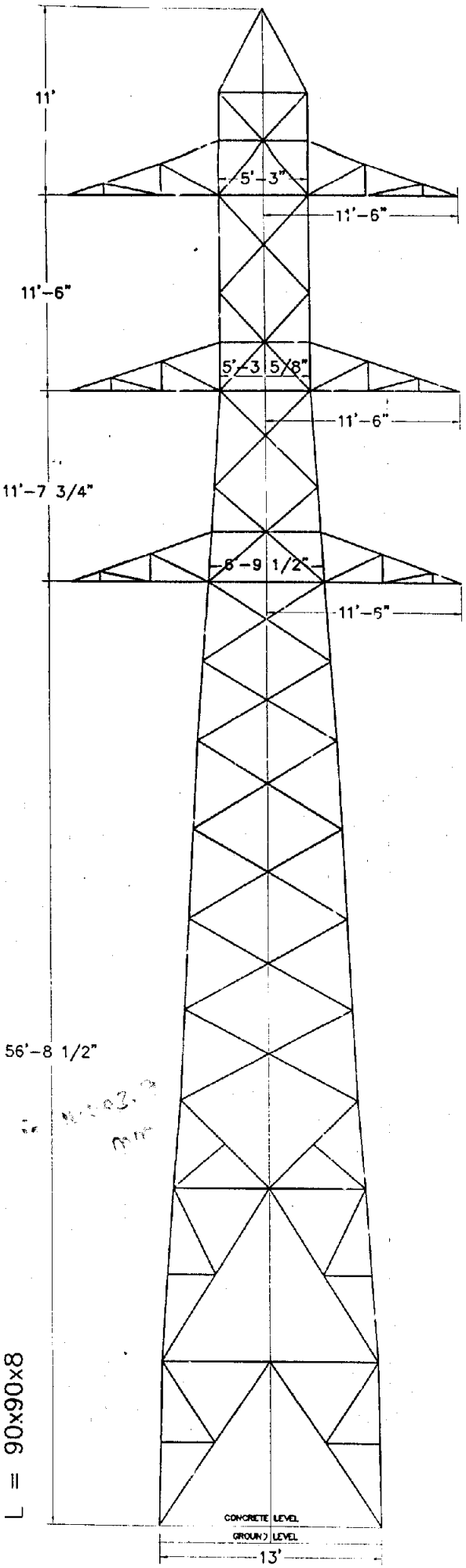
Sl. No.	Structure Type	Approx. Unit Weight in MT	Weight of Bolts & Nuts
	I) Type of Tower : D-Type suspension tower		
1	Super Structure	3226.60	145.74
2	Stub & Cleats L90 x 90 x 8	715.92	5.28
3	Stub Setting Templates	354.44	
4	+ 10 ft extensions	453.370	
5	+ 6 meters extensions		
6	+ 9 meters extensions		
7	+ 12 meters extensions		

132 kV MPEB -D FOUNDATION DETAILS

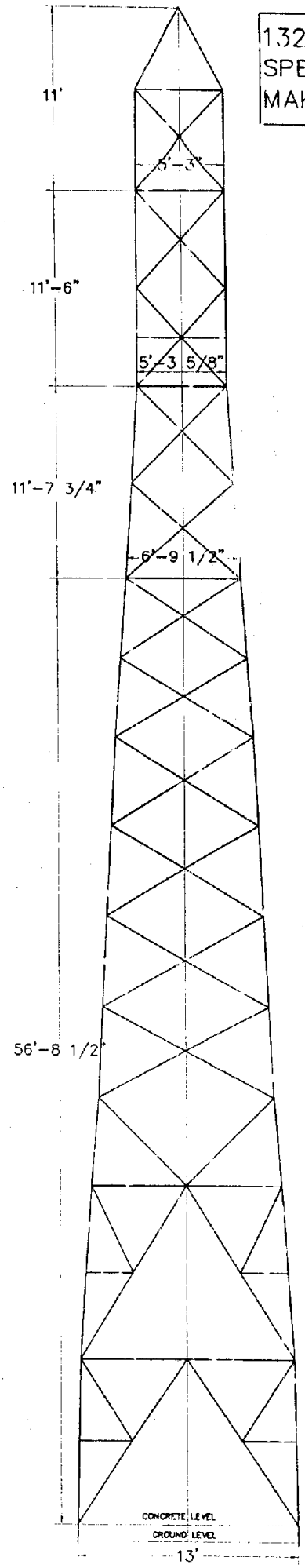
Spec.No.
Make - MPEB

Sl. No.	Types	Type of foundation	Stub size	Depth of foundation	Vol. of Concrete (Cum)	Vol. of Excavation (Cum)	Reinforcement steel
I)	**Type of Tower :**						
1	Dry	Frustrum	90 x 90 x 8	2286	2.6559	23.70	
2	Wet	- do -	- do -	2286	6.2857	48.40	
3	Submergible	- do -	- do -	2286	17.775	89.00	

132KV DC D-TYPE
SPECN:
MAKE-MPEB



TRANSVERSE FACE



LONGITUDINAL FACE

132 kV SC Transmission Line

Spec.No. IDA 20
Make: - SAE

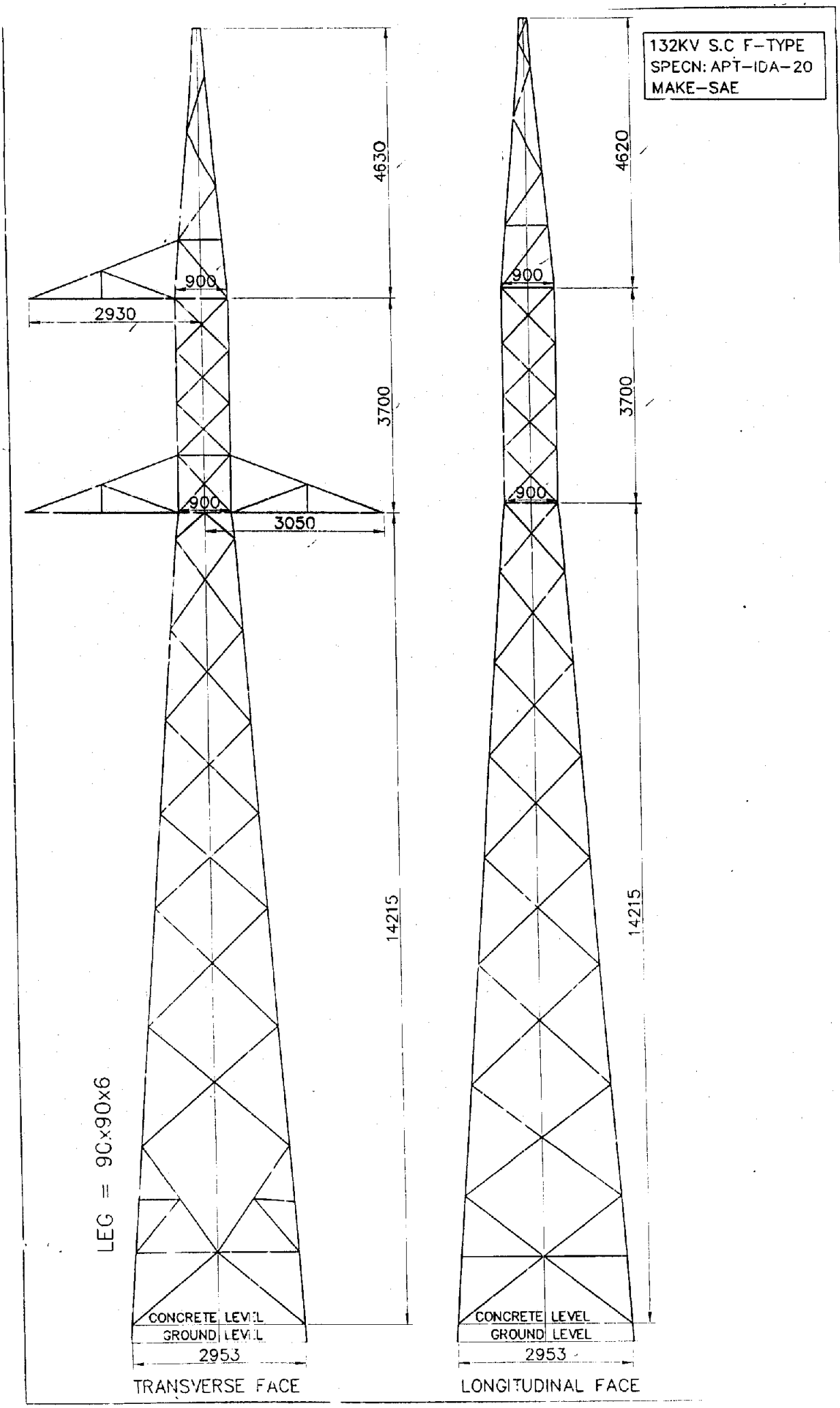
Sl. No.	Structure Type	Approx. Unit Weight in MT	Weight of Bolts & Nuts	
	I) Type of Tower : F			
1	Super Structure	1626.59	143.07	
2	Stub & Cleats L90x90x8	136.44	2.54	
3	Stub Setting Templates	260.48	9.27	
4	Normal Tower			
5	+ 3 meters extensions	292.94	19.21	
6	+ 6 meters extensions	596.26	39.42	(+3mtr extension)
7	+ 9 meters extensions			
8	+ 12 meters extensions			
	I) Type of Tower : G			
1	Super Structure	2244.71	153.81	
2	Stub & Cleats L90x90x10	182.32	2.54	
3	Stub Setting Templates	428.68	15.46	
4	Normal Tower			
5	+ 3 meters extensions	622.64	20.70	
6	+ 6 meters extensions	1314.16	62.10	(+3mtr extension)
7	+ 9 meters extensions			
8	+ 12 meters extensions			
	I) Type of Tower : H			
1	Super Structure	3079.81	166.39	
2	Stub & Cleats L110x110x1	239.68	7.63	
3	Stub Setting Templates	712.32	15.50	
4	Normal Tower			
5	+ 3 meters extensions	893.68	20.97	
6	+ 6 meters extensions	2092.28	42.92	(+3mtr extension)
7	+ 9 meters extensions			
8	+ 12 meters extensions			

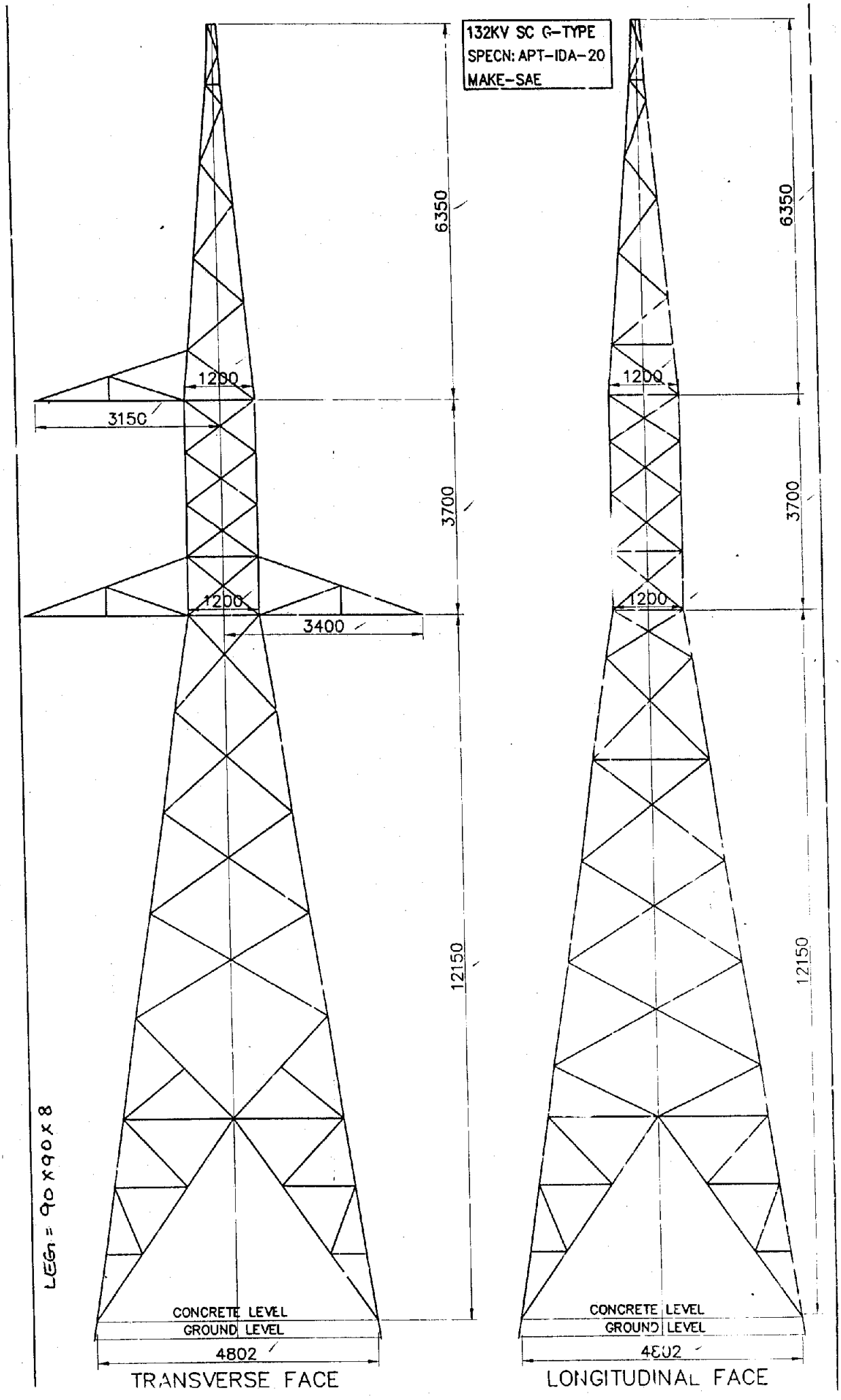
U' - Bolt =
Hanger (16mm dia Red) = 2.20

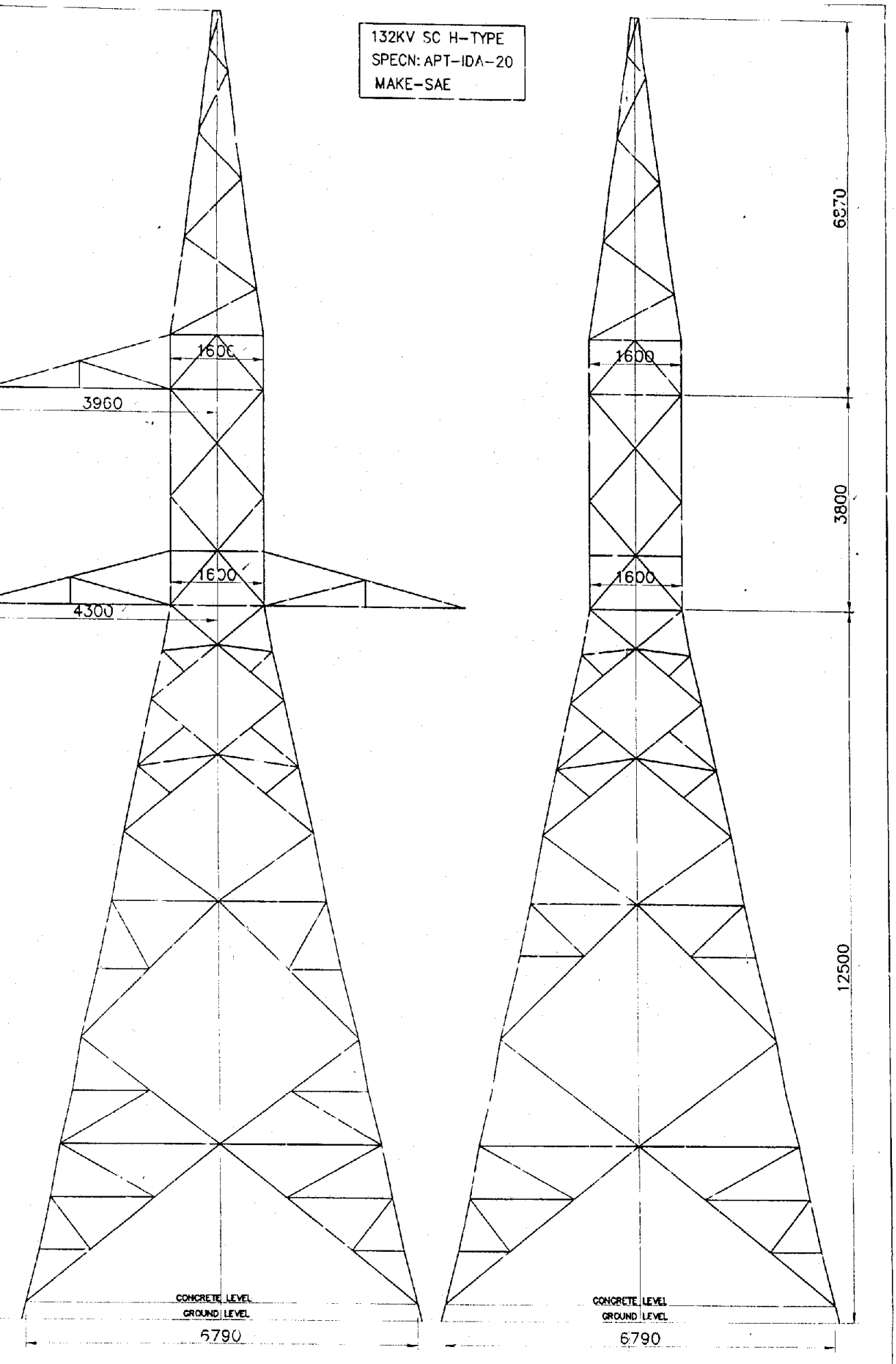
FOUNDATION DETAILS IDA 20

Make - SAE Spec.No. APT - IDA 20

Sl. No.	Types	Type of foundation	Stub size	Depth of foundtion	Vol. of Concrete (Cum)	Vol. of Excavation (Cum)	Reinforcement steel (Kgs)
I)	**Type of Tower : F**						
1	Dry	Pad & Chimney	90 x 90 x 8	2.41	1.5432	16.2916	
2	Wet	Pad & Chimney			4.90	48.80	
3	PS	Pad & Chimney			11.7048	55.528	
4	FS	Pad & Chimney			13.05	66.17	140.8 (214)
II)	**Type of Tower : G**						
1	Dry	Pad & Chimney	90 x 90 x 10	2.55	1.92 92	19.9920	
2	Wet	Pad & Chimney			5. 30	54.00	
3	PS	Pad & Chimney			13.29 92	63.7500	
4	FS	Pad & Chimney			14.50	75.46	192.0 (267)
III)	**Type of Tower : H**						
1	Dry	Pad & Chimney	110 x 110 x 10	2.65	2.4488	25.4665	
2	Wet	Pad & Chimney			7.60	66.00	
3	PS	Pad & Chimney			20.172	77.274	
4	FS	Pad & Chimney			23.48	95.44	218.4 (306)


132KV S.C F-TYPE
SPECN: APT-IDA-20
MAKE-SAE
4630
900
2930
3700
900
3050
14215
LEG = 90x90x6
CONCRETE LEVEL
GROUND LEVEL
2953
TRANSVERSE FACE
4620
900
3700
900
14215
CONCRETE LEVEL
GROUND LEVEL
2953
LONGITUDINAL FACE


132KV SC G-TYPE
SPECN: APT-IDA-20
MAKE-SAE
6350
1200
3150
3700
1200
3400
12150
CONCRETE LEVEL
GROUND LEVEL
4802
TRANSVERSE FACE
LEG = 90 X 90 X 8
6350
1200
3700
1200
12150
CONCRETE LEVEL
GROUND LEVEL
4802
LONGITUDINAL FACE



TRANSVERSE FACE

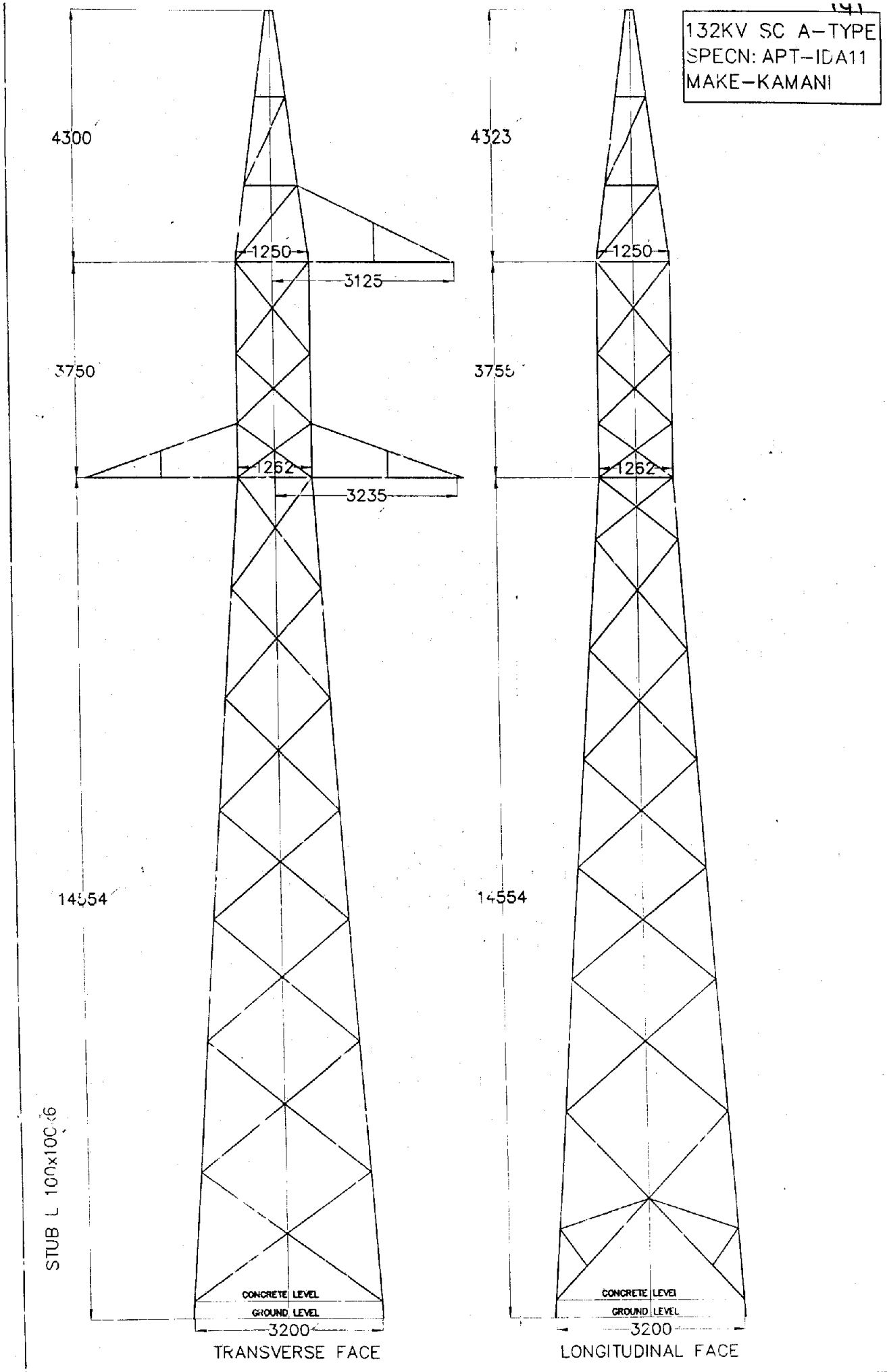
LONGITUDINAL FACE

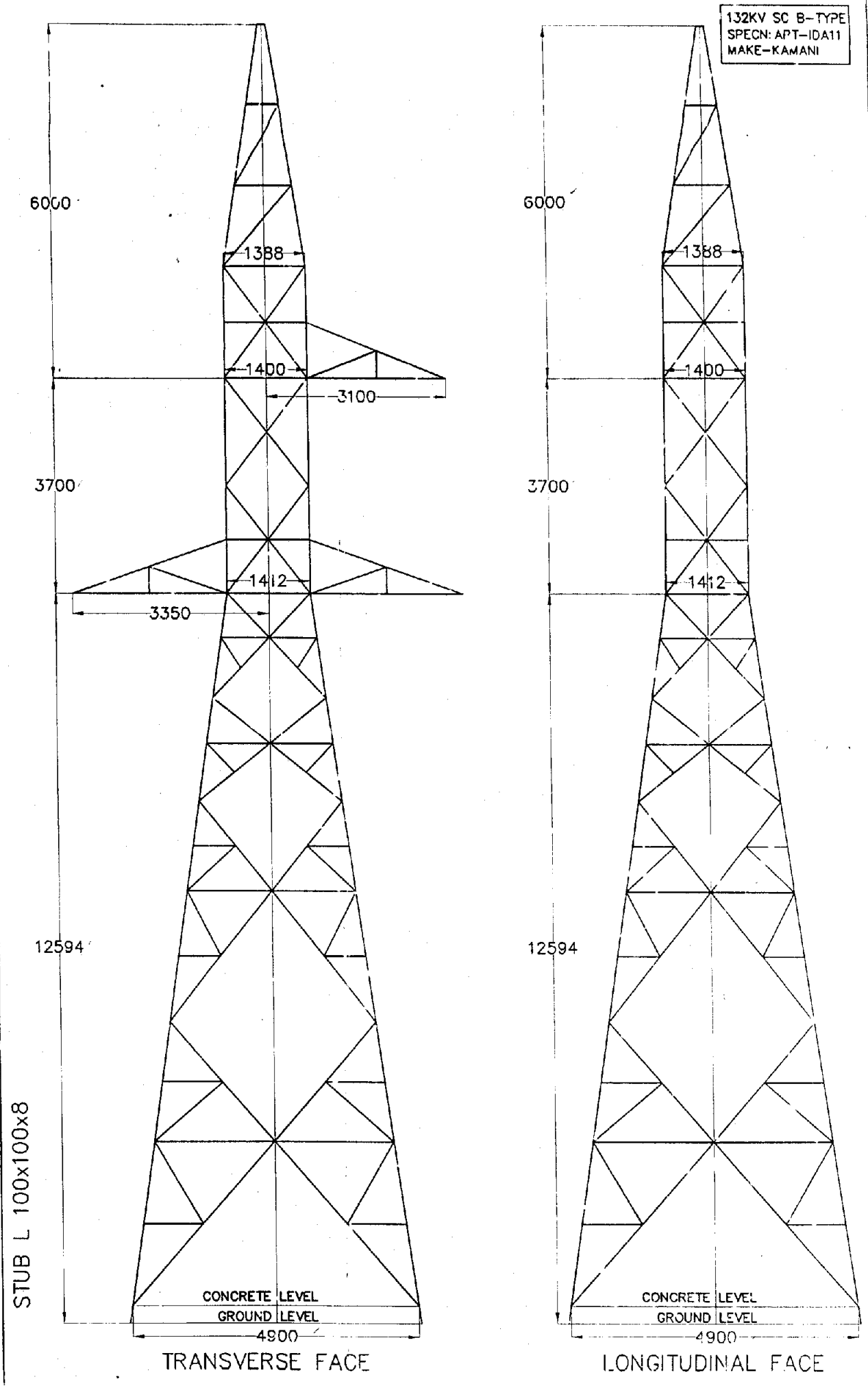
132 kV SC Transmission Line **IDA - 11**

NELLORE - SULLURPETA - RENIGUNTA

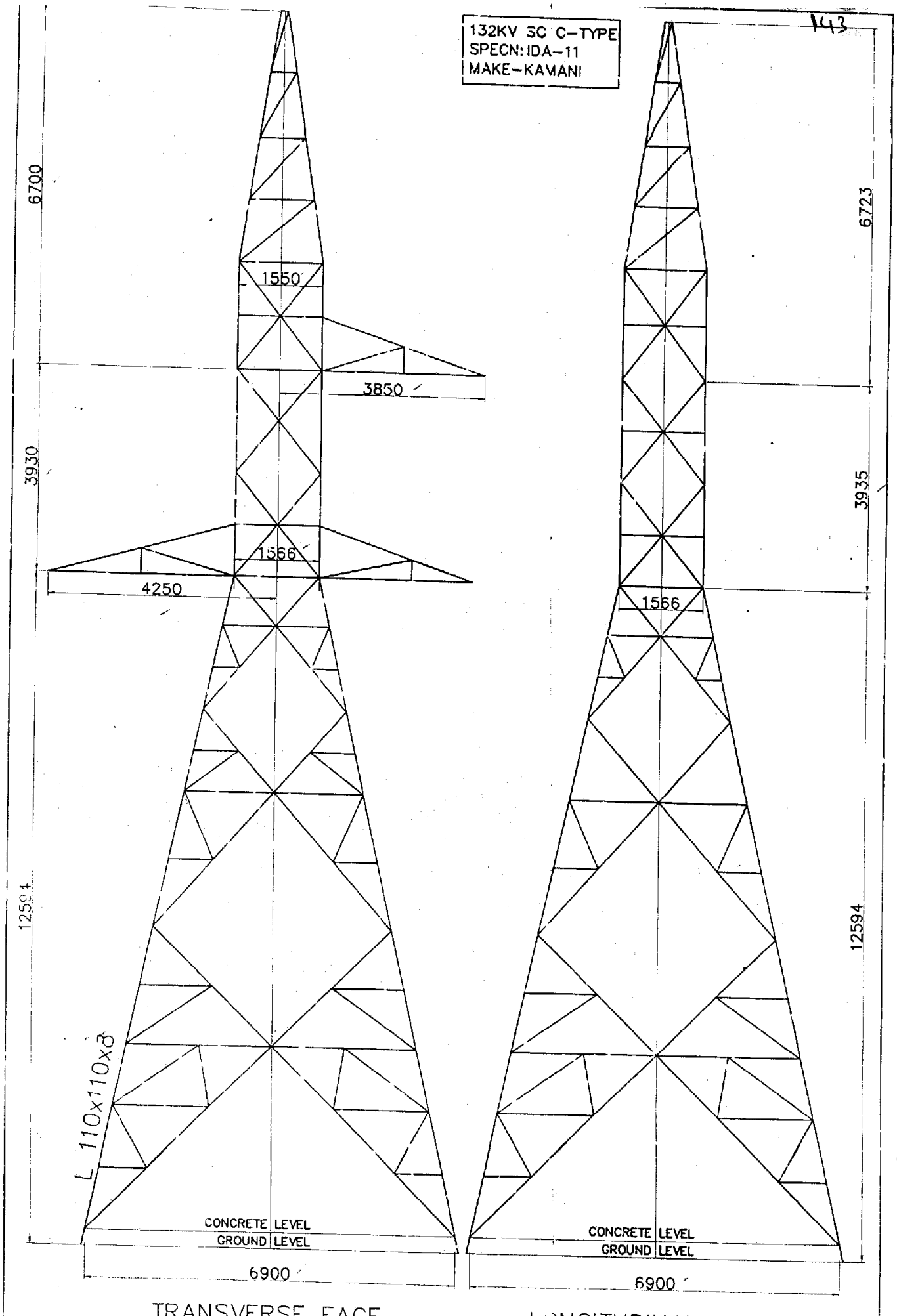
Make: - KAMANI

Sl. No.	Structure Type	Approx. Unit Weight in MT	Weight of Bolts & Nuts	
I)	**Type of Tower : A**			
1	Super Structure			
2	Stub & Cleats (100 x 100 x 6)	136.28	1.26	
3	Stub Setting Templates	417.12	15.82	
4	Normal Tower			
5	+ 3 meters extensions	374.20	35.46	Add 3.5% for galvanizing
6	+ 6 meters extensions	908.00	66.04	Add 3.5% for galvanizing
7	+ 9 meters extensions			
8	+ 12 meters extensions			
II)	**Type of Tower : B**			
1	Super Structure	2467.83	165.33	
2	Stub & Cleats (100 x 100 x 8)	182.40	1.26	
3	Stub Setting Templates	610.40	26.49	
4	Normal Tower			
5	+ 3 meters extensions	635.96	38.61	
6	+ 6 meters extensions	1373.36	71.01	Add 3.5% for galvanizing
7	+ 9 meters extensions			
8	+ 12 meters extensions			
III)	**Type of Tower : C**			
1	Super Structure	3454.02	217.37	Add 3.5% for galvanizing
2	Stub & Cleats	252.34	1.34	
3	Stub Setting Templates			
4	Deadend Tower	3582.52	217.37	Add 3.5% for galvanizing
5	+ 3 meters extensions	1010.16	49.82	(")
6	+ 6 meters extensions	2224.92	95.40	(")
7	+ 9 meters extensions			
8	+ 12 meters extensions			


132KV SC A-TYPE
SPECN: APT-IDA11
MAKE-KAMANI
4300
1250
3125
3750
1262
3235
14554
STUB L 100x100x6
CONCRETE LEVEL
GROUND LEVEL
3200
TRANSVERSE FACE
4323
1250
3755
1262
14554
CONCRETE LEVEL
GROUND LEVEL
3200
LONGITUDINAL FACE

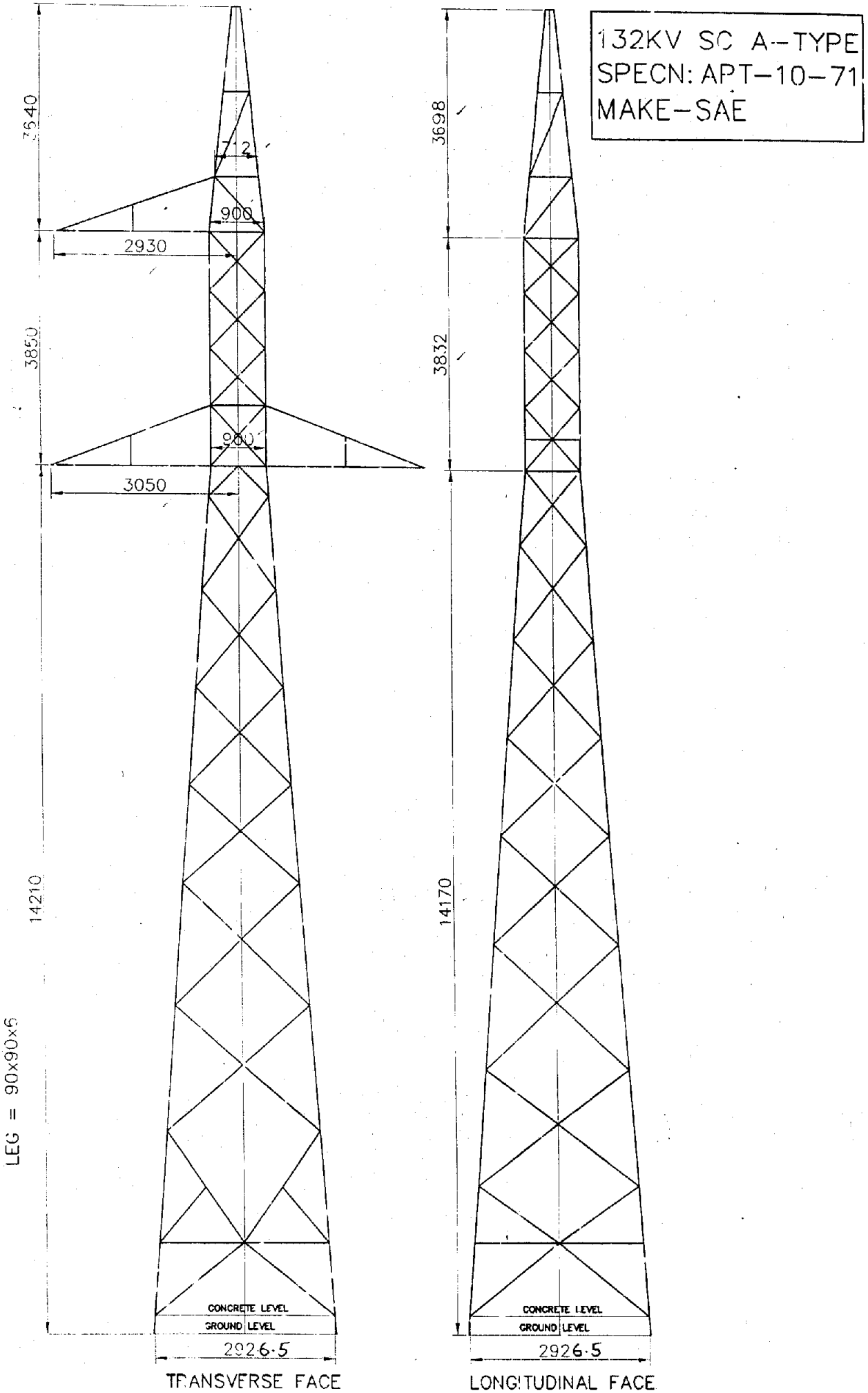

132KV SC B-TYPE
SPECN: APT-IDA11
MAKE-KAMANI
6000
1388
1400
3100
3700
1412
3350
12594
STUB L 100x100x8
CONCRETE LEVEL
GROUND LEVEL
4900
TRANSVERSE FACE
6000
1388
1400
3700
1412
12594
CONCRETE LEVEL
GROUND LEVEL
4900
LONGITUDINAL FACE

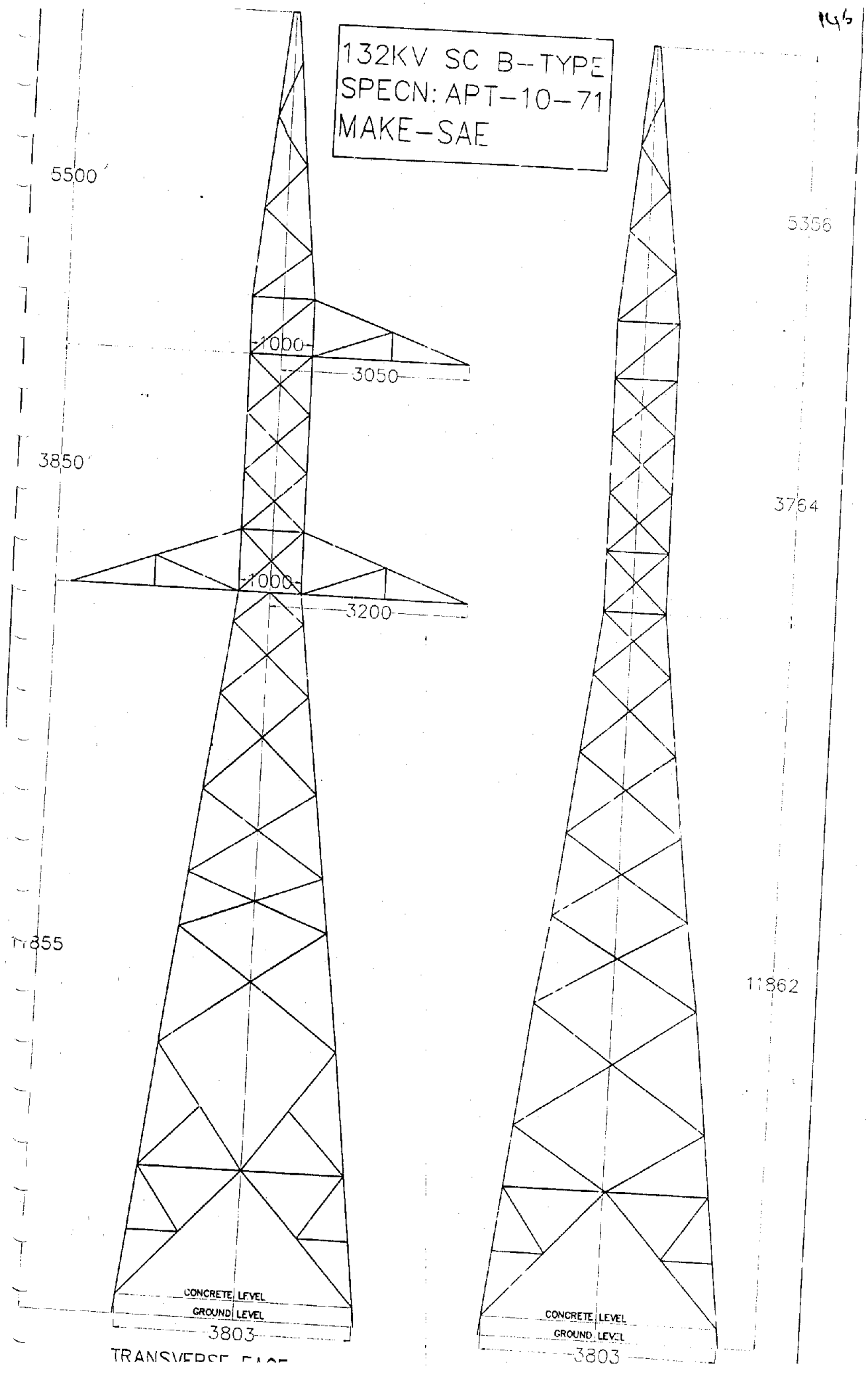
132KV SC C-TYPE
SPECN: IDA-11
MAKE-KAMANI



132 kV SC Transmission Line Spec.No.APT 10/71
Make: - SAE

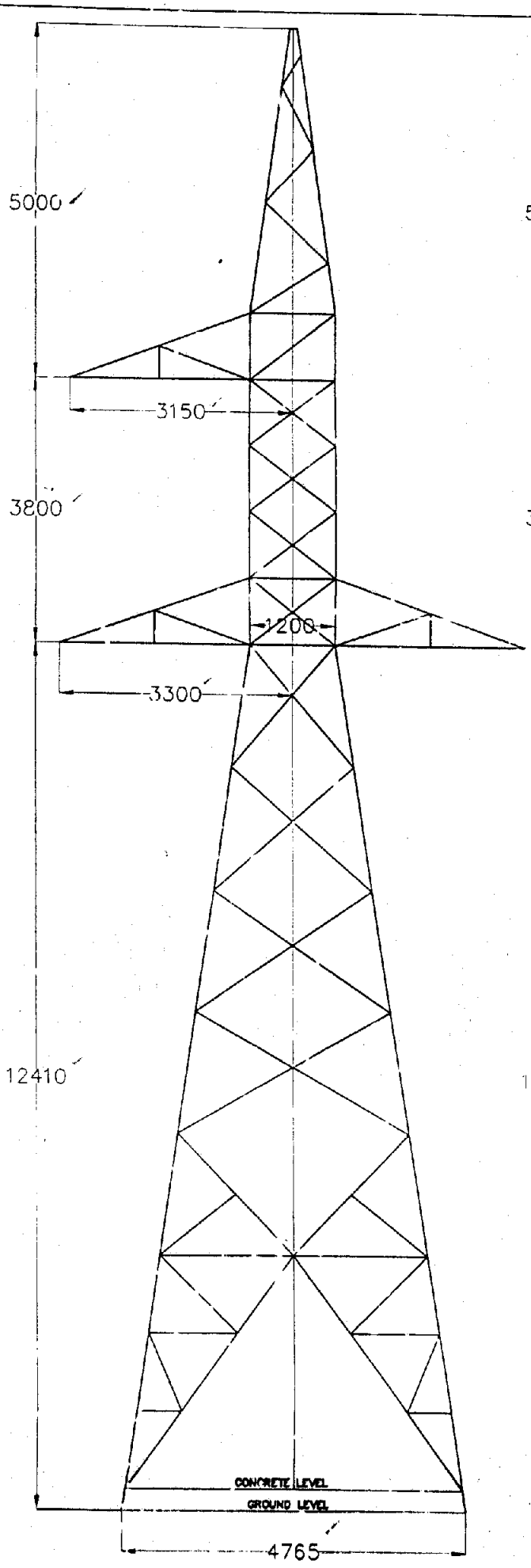
Sl. No.	Structure Type	Approx. Unit Weight in MT	Weight of Bolts & Nuts	
	I) Type of Tower : A			
1	Super Structure	1705.25	101.62	
2	Stub & Cleats L90x90x6	109.28	2.62	
3	Stub Setting Templates	241.00	8.69	
4	Normal Tower			
5	+ 3 meters extensions	334.33	11.00	
6	+ 6 meters extensions	680.97	12.15	+3 mtr externsion with bolts & nuts
7	+ 9 meters extensions			
8	+ 12 meters extensions			
	II) Type of Tower : B			
1	Super Structure	2014.67	122.81	
2	Stub & Cleats L100x100x6	136.00	2.62	
3	Stub Setting Templates	330.40		
4	Normal Tower			
5	+ 3 meters extensions	408.54	14.83	
6	+ 6 meters extensions	850.43	15.93	+3 mtr externsion with bolts & nuts
7	+ 9 meters extensions			
8	+ 12 meters extensions			
	III) Type of Tower : C			
1	Super Structure	2451.13	125.07	
2	Stub & Cleats L110x110x8	196.72	5.59	
3	Stub Setting Templates	439.64		
4	Normal Tower			
5	+ 3 meters extensions	621.95	21.99	
6	+ 6 meters extensions	1299.81	21.81	+3 mtr externsion with bolts & nuts
7	+ 9 meters extensions			
8	+ 12 meters extensions			
	IV) Type of Tower : D			
1	Super Structure	3702.00	156.24	
2	Stub & Cleats	278.32		
3	Stub Setting Templates	680.92		
4	Normal Tower			
5	+ 3 meters extensions	960.85	26.63	
6	+ 6 meters extensions	2031.32	27.05	+3 mtr externsion with bolts & nuts
7	+ 9 meters extensions			
8	+ 12 meters extensions			


132KV SC A-TYPE
SPECN: APT-10-71
MAKE-SAE
3640
772
900
2930
3850
900
3050
14210
LEG = 90x90x6
CONCRETE LEVEL
GROUND LEVEL
2926·5
TRANSVERSE FACE
3698
3832
14170
CONCRETE LEVEL
GROUND LEVEL
2926·5
LONGITUDINAL FACE

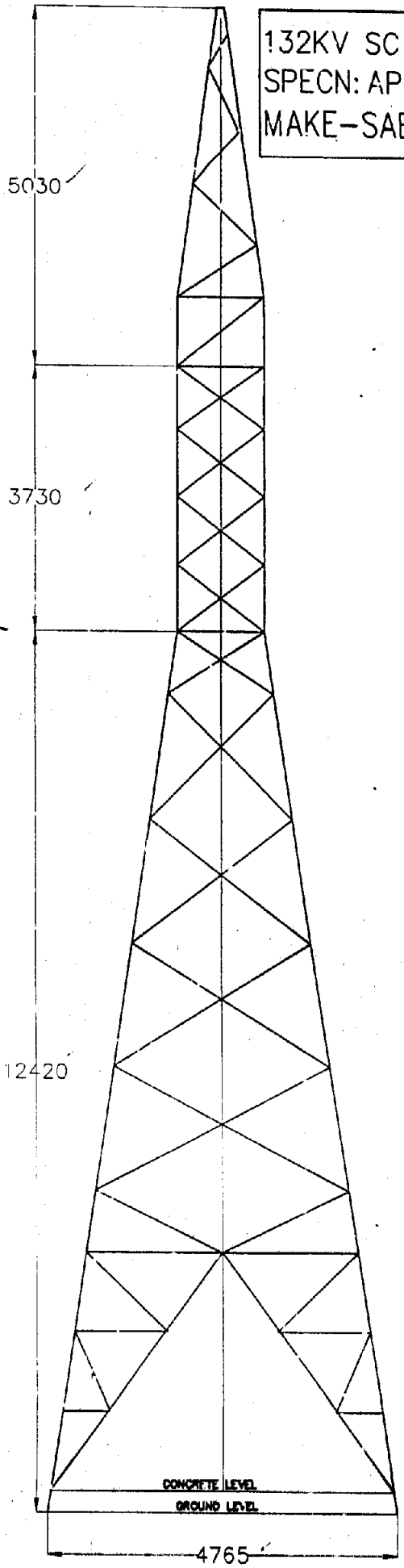


TRANSVERSE FACE

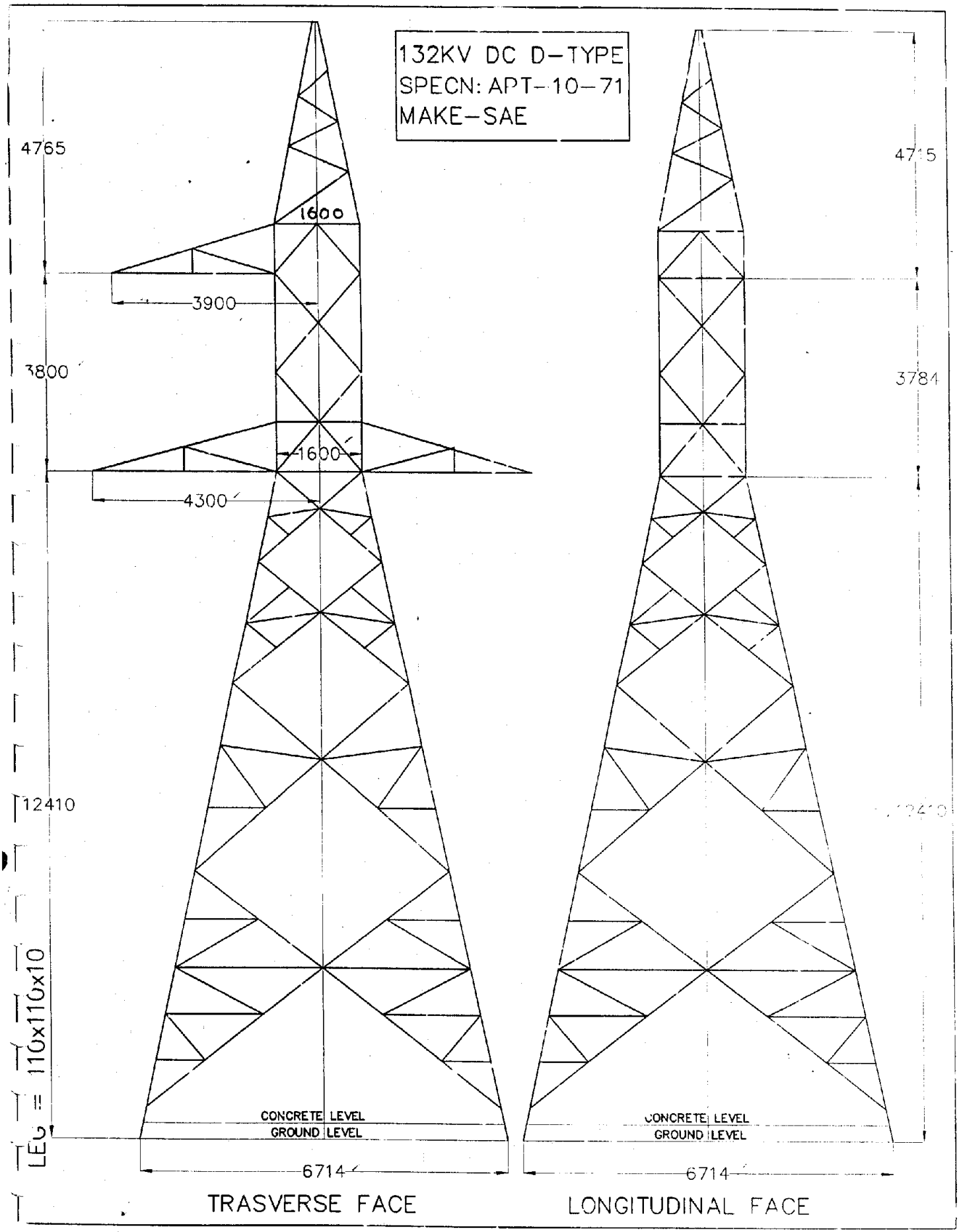
132KV SC C-TYPE
SPECN: AP-10-71
MAKE-SAE



TRANSVERSE FACE



LONGITUDINAL FACE


132KV DC D-TYPE
SPECN: APT-10-71
MAKE-SAE
4765
1600
3900
3800
1600
4300
12410
LEG = 110x110x10
CONCRETE LEVEL
GROUND LEVEL
6714
TRASVERSE FACE
4715
3784
CONCRETE LEVEL
GROUND LEVEL
6714
LONGITUDINAL FACE

132 kV S/C Transmission Line

Spec.No.16/64
Make: - SAE

Sl. No.	Structure Type	Approx. Unit Weight in MT	Weight of Bolts & Nuts
	I) Type of Tower : A		
1	Super Structure	1903.32	
2	Stub & Cleats	105.92	
3	Stub Setting Templates	205.76	11.51
4	+ 3 meters extensions	401.00	16.53
	II) Type of Tower : B		
1	Super Structure	2277.27	
2	Stub & Cleats	127.04	
3	Stub Setting Templates	397.72	
4	+ 3 meters extensions	537.92	
5	20 feet extensions	599.520	
	III) Type of Tower : C		
1	Super Structure	2528.40	
2	Stub & Cleats	201.68	
3	Stub Setting Templates	146.12	
4	+ 3 meters extensions	635.36	
5	20 feet extensions	742.800	
6	30 feet extensions	917.92	
	IV) Type of Tower : D		
1	Super Structure	3745.61	
2	Stub & Cleats	272.52	
3	Stub Setting Templates	795.32	
4	+ 3 meters extensions	1032.32	
5	20 feet extensions	1193.000	
6	30 feet extensions	1542.52	
	V) Type of Tower : JCP		
1	Super Structure	15241.85	
2	Stub & Cleats	996.64	
3	Stub Setting Templates	1602.50	

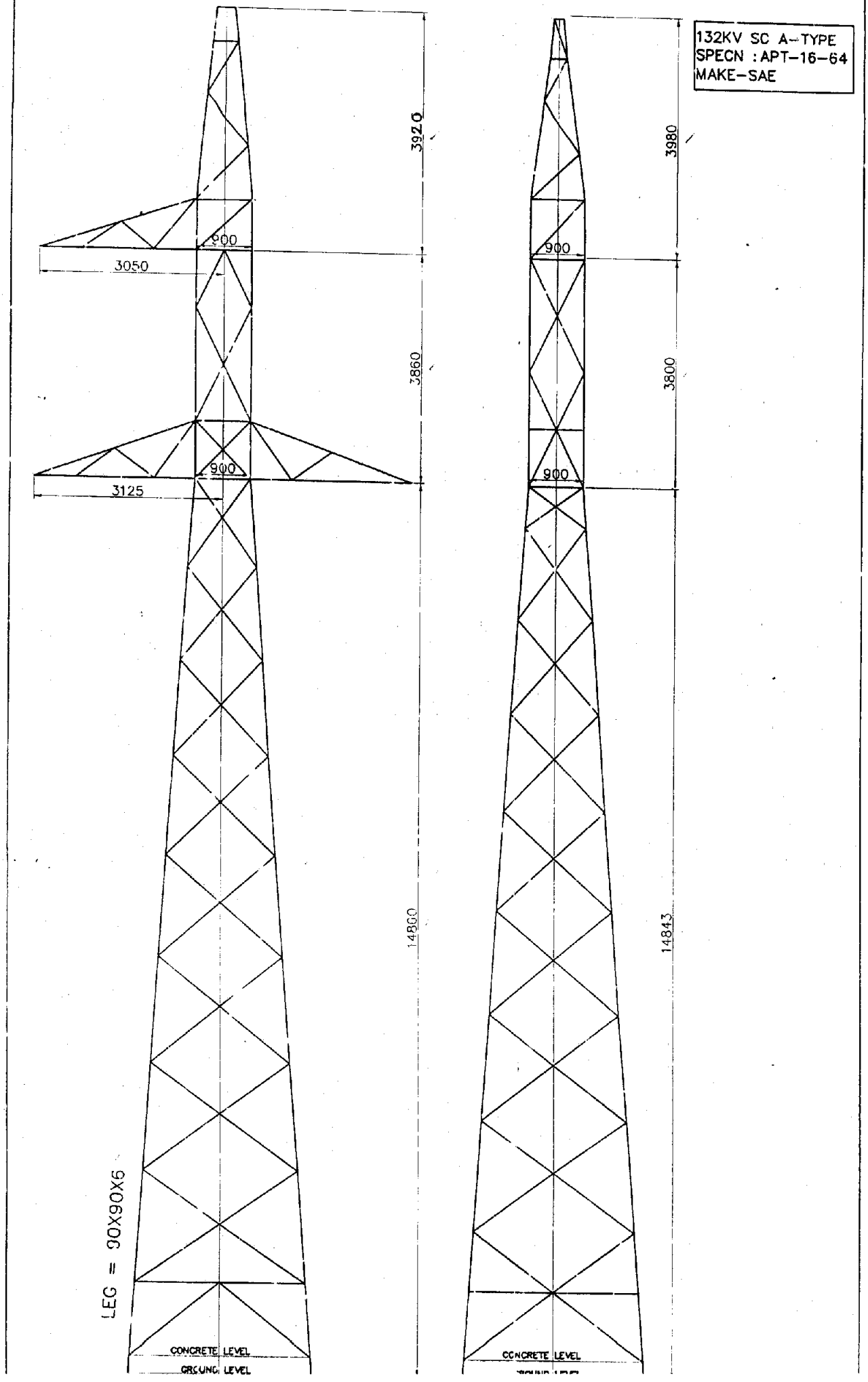
Super structure weight having 2 components painted + Galv

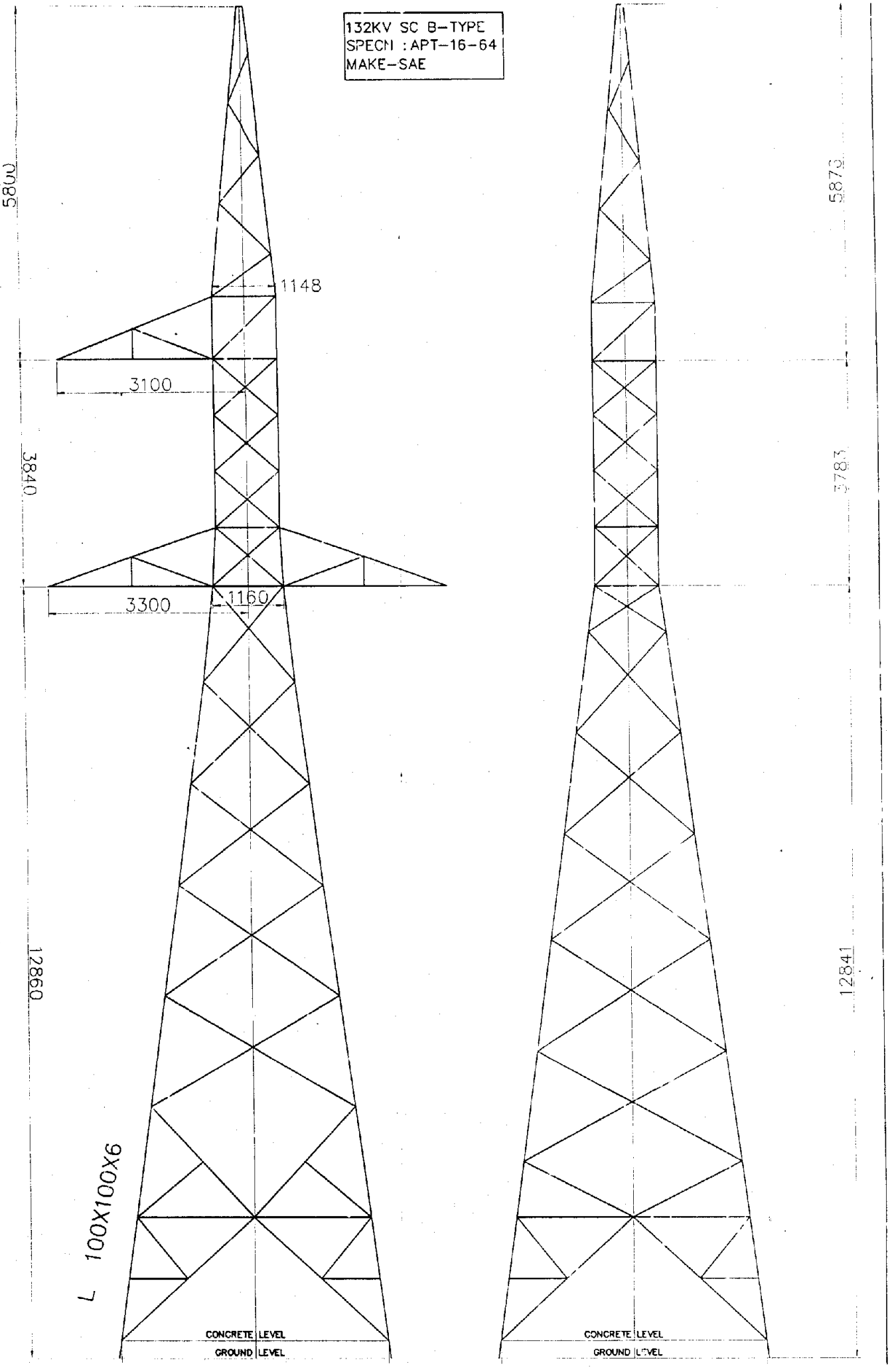
FOUNDATION DETAILS APT 16/64

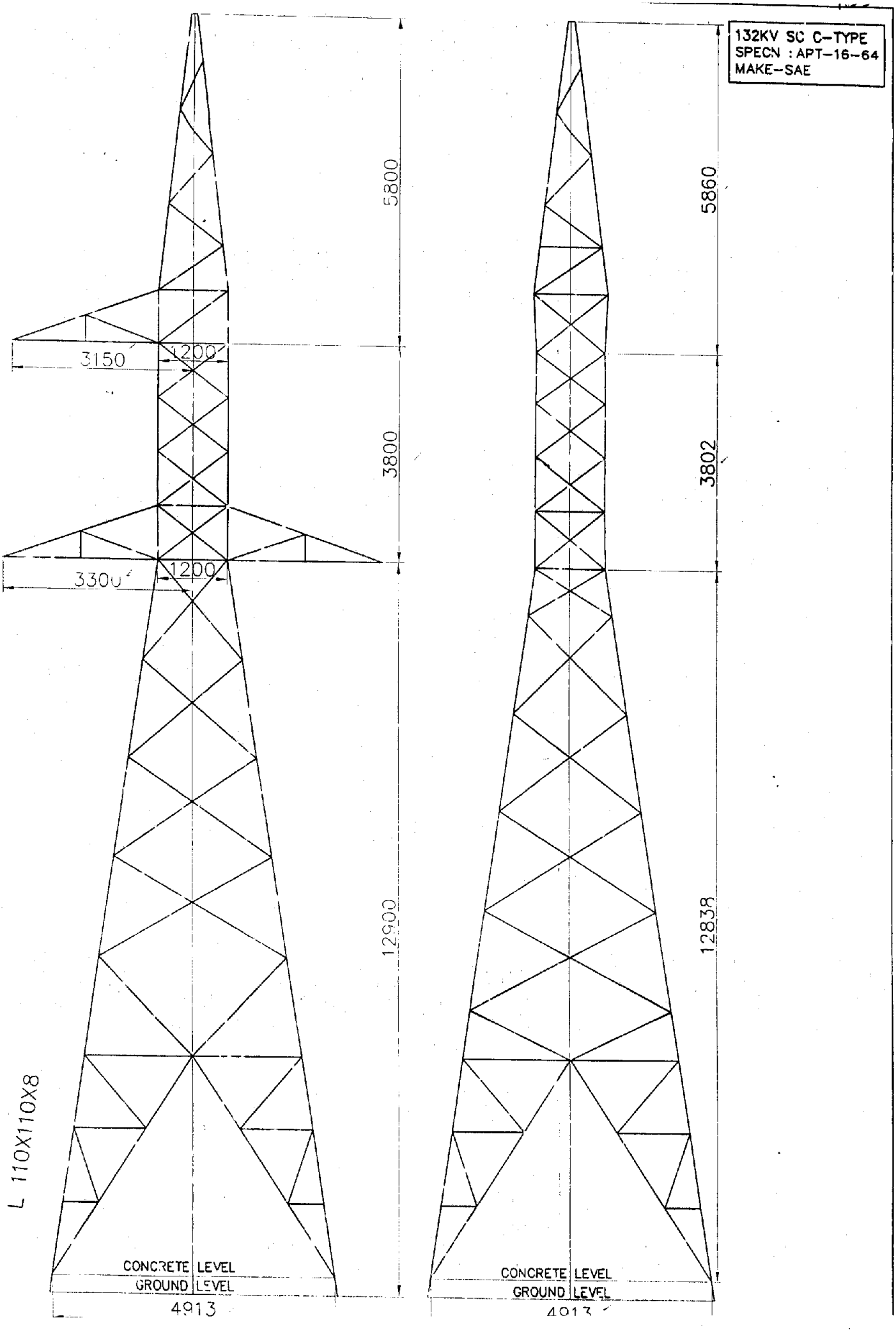
132 kV SC Transmission Line

Sl. No.	Types	Type of foundation	Stub size	Depth of foundation	Vol. of Concrete (Cum)	Vol. of Excavation (Cum)	Reinforcement steel (MT)
I)	**Type of Tower : D**						
1	Wet				11.032	55.25	*
2	Dry				5.389	33.00	
3	PS						
4	FS						

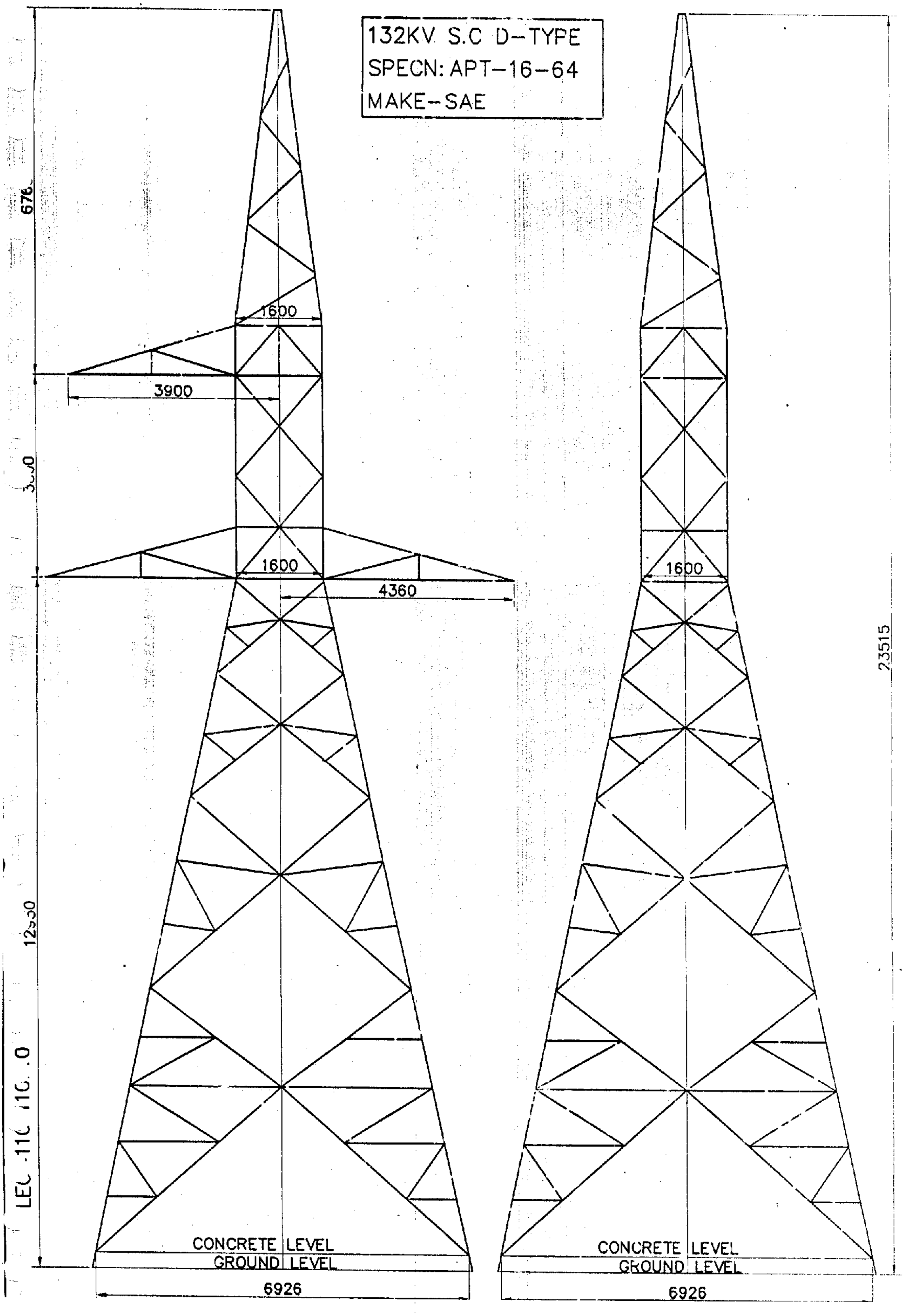
* Stepped

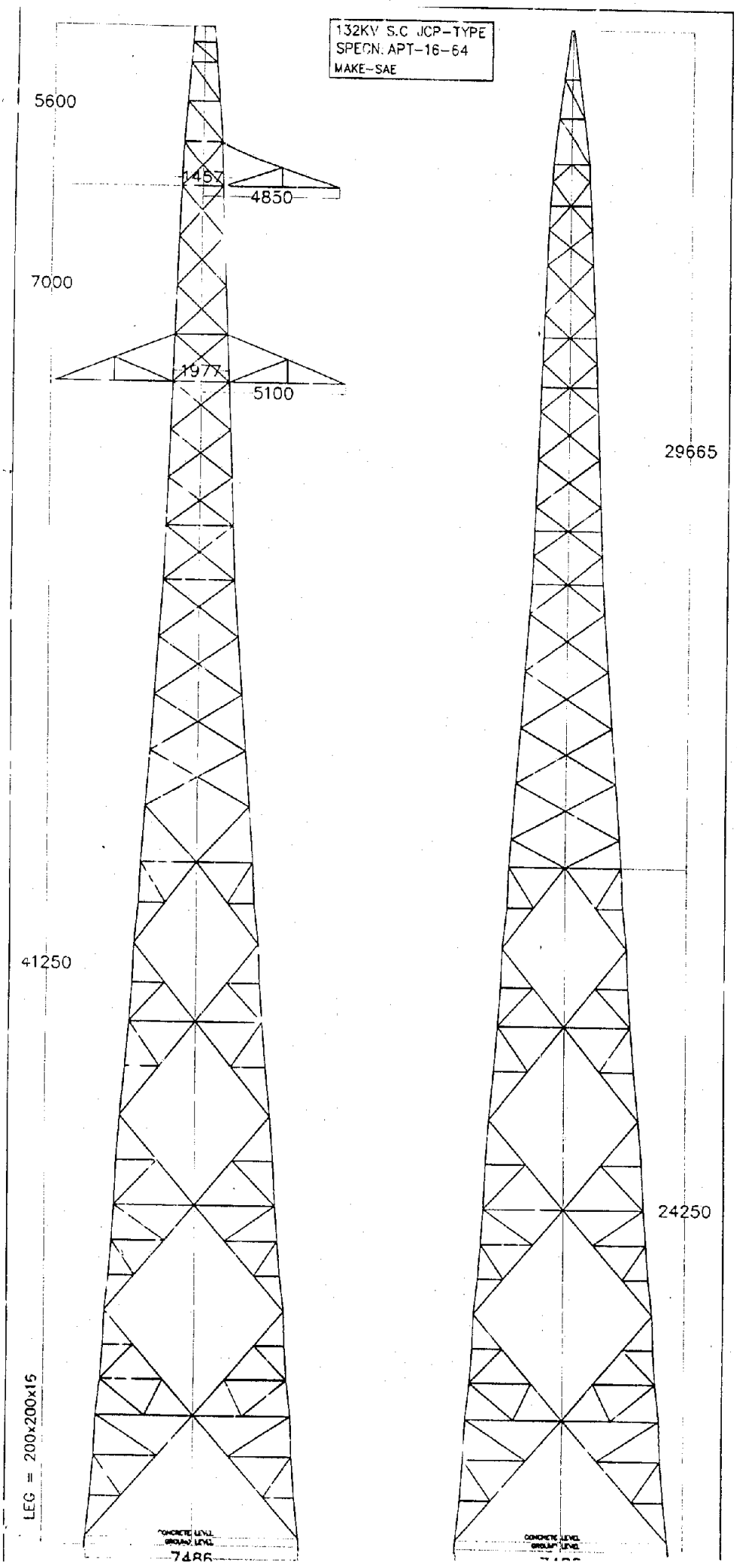

132KV SC A-TYPE
SPECN : APT-16-64
MAKE-SAE
3920
3860
14800
900
3050
900
3125
LEG = 90X90X6
CONCRETE LEVEL
GROUND LEVEL
3980
3800
14843
900
900
CONCRETE LEVEL


132KV SC B-TYPE
SPECN : APT-16-64
MAKE-SAE
1148
3100
3840
3300
1160
12860
L 100X100X6
CONCRETE LEVEL
GROUND LEVEL
5873
3783
12841
CONCRETE LEVEL
GROUND LEVEL


132KV SC C-TYPE
SPECN : APT-16-64
MAKE-SAE
5800
3800
12900
3150
1200
3300
1200
L 110X110X8
CONCRETE LEVEL
GROUND LEVEL
4913
5860
3802
12838
CONCRETE LEVEL
GROUND LEVEL
4913

154


132KV S.C D-TYPE
SPECN: APT-16-64
MAKE-SAE
1600
3900
1600
4360
1600
23515
CONCRETE LEVEL
GROUND LEVEL
6926
CONCRETE LEVEL
GROUND LEVEL
6926

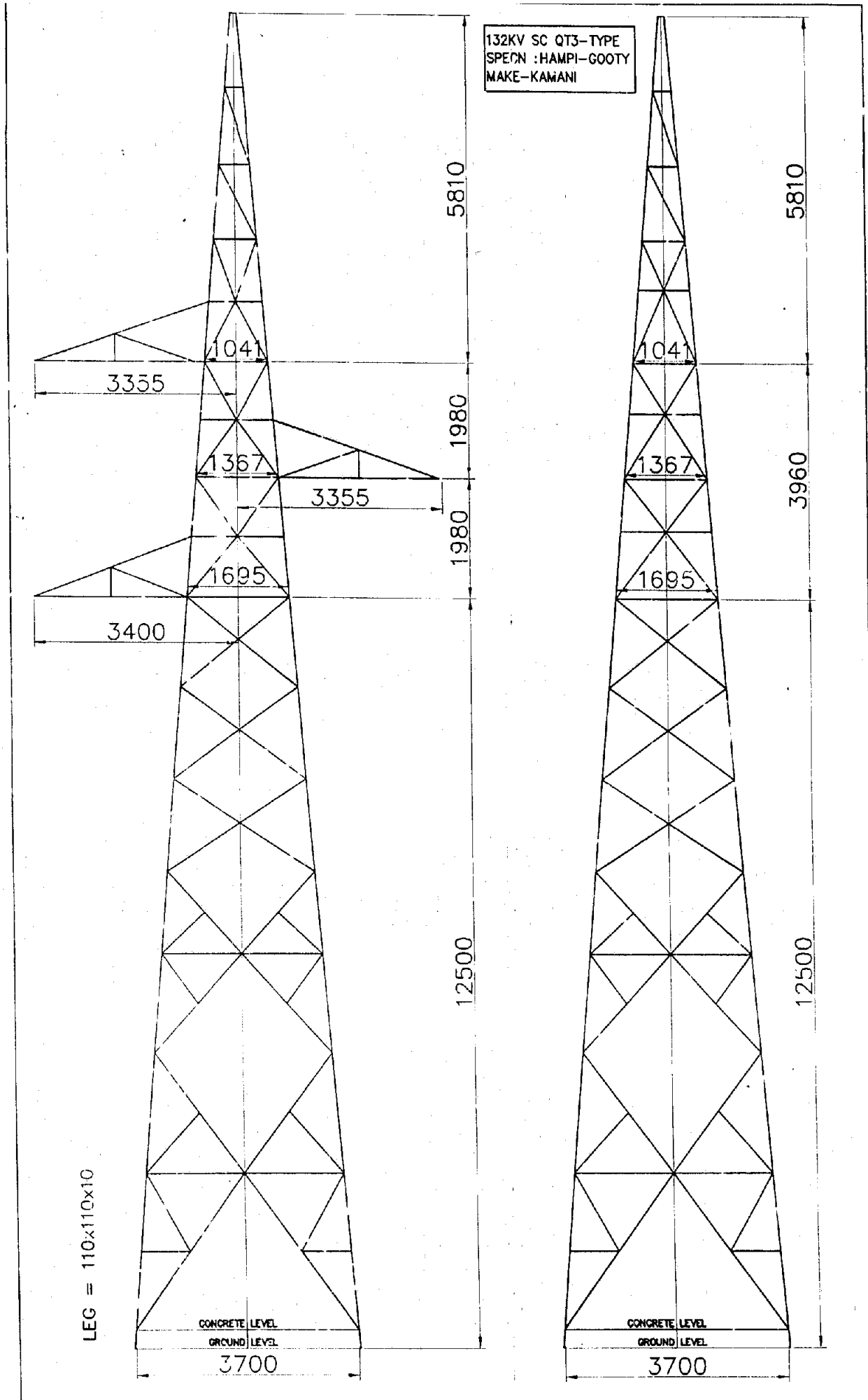

132KV S.C JCP-TYPE
SPECN. APT-16-64
MAKE-SAE
5600
1457
4850
7000
1977
5100
29665
41250
24250
LEG = 200x200x16
7486

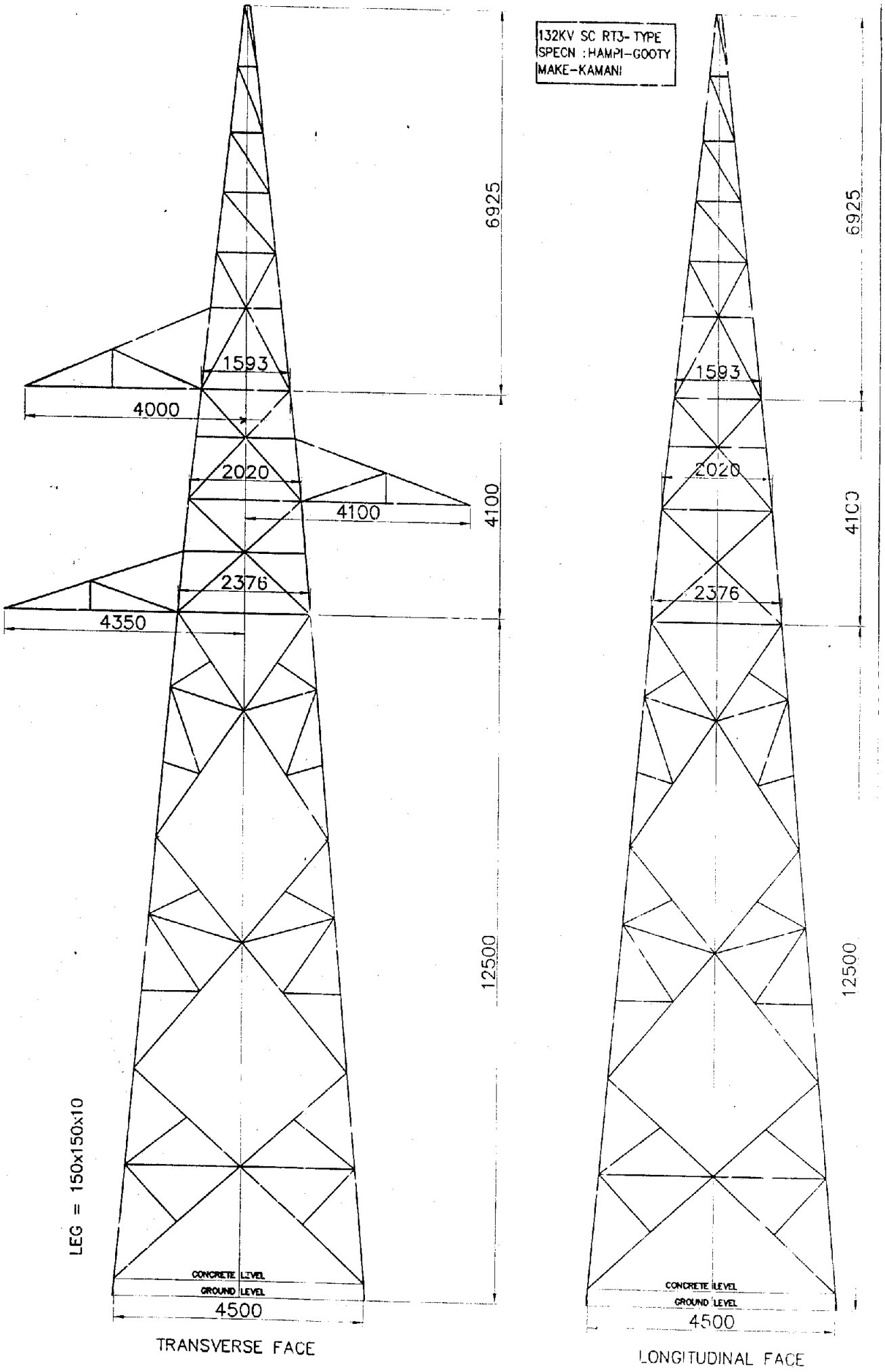
132 kV SC Transmission Line Spec.No.APT 12/61

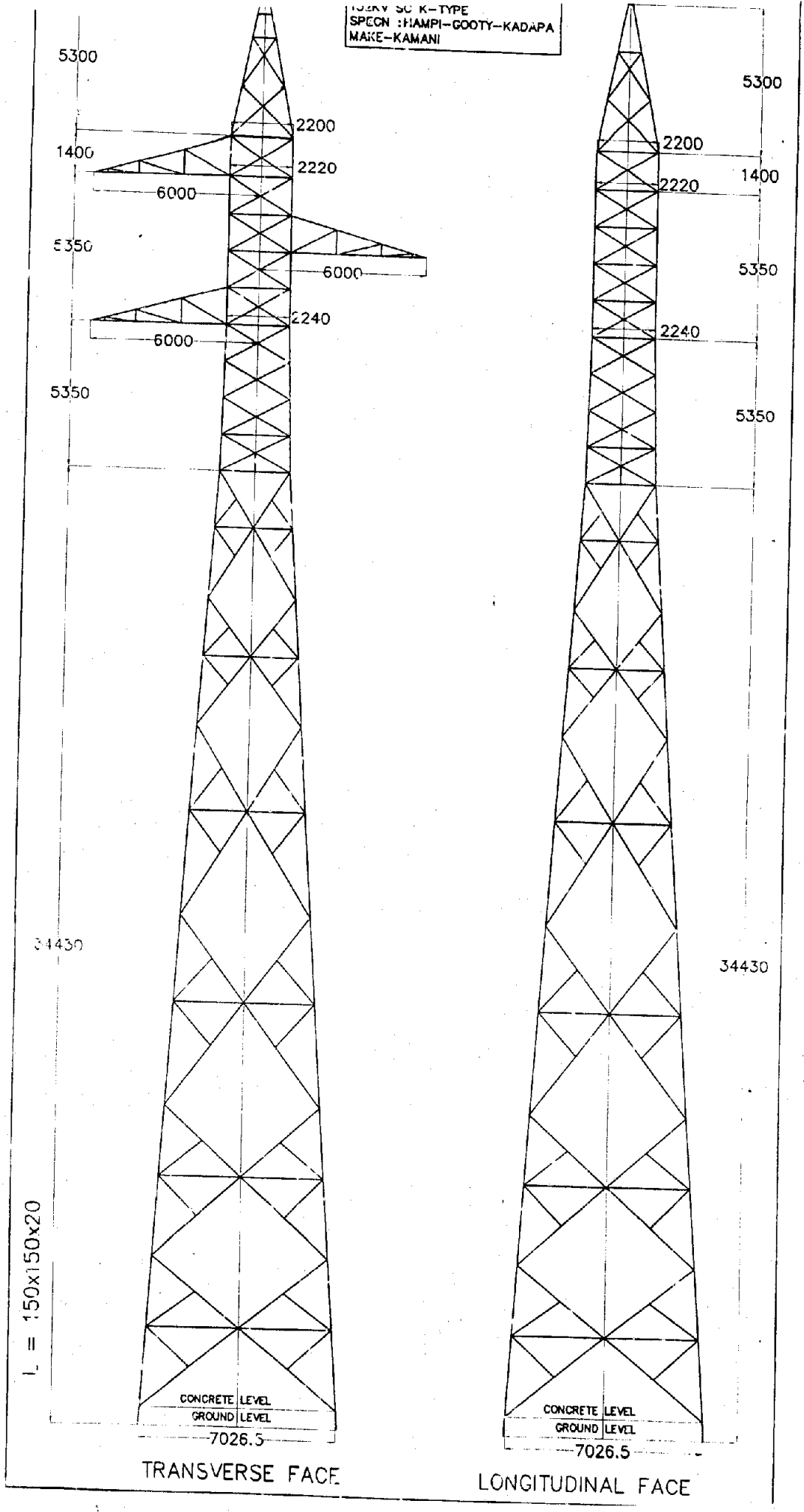
HAMPI - GOOTY - CUDDAPPAH

Make: - KAMANI

Sl. No.	Structure Type	Approx. Unit Weight in MT	Weight of Bolts & Nuts	
	I) Type of Tower : PT3			
1	Super Structure	1792.98	177.79	inclusive of 2.5% extra
2	Stub & Cleats L80 x 80 x 6	91.84	1.26	4.5 mm galvanising
3	Stub Setting Templates			
4	+ 1.525 meters extensions	209.28	19.26	inclusive of 2.5% extra
5	+ 3.050 meters extensions	333.07	24.66	inclusive of 2.5% extra
6	+ 6 meters extensions	708.04	53.26	
7	+ 9 meters extensions			
8	+ 12 meters extensions			
	I) Type of Tower : QT3			
1	Super Structure	2522.68	159.32	inclusive of 2.5% extra
2	Stub & Cleats L110x110x10	244.12	1.34	inclusive of 2.5% extra
3	Stub Setting Templates			
4	+ 1.525 meters extensions	402.95	25.89	inclusive of 2.5% extra
5	+ 3.050 meters extensions	608.56	29.34	inclusive of 2.5% extra
6	+ 6 meters extensions			
7	+ 9 meters extensions			
8	+ 12 meters extensions			
	I) Type of Tower : QT3 S			
1	Super Structure	2611.39	180.99	inclusive of 2.5% extra
2	Stub & Cleats L110x110x10	244.12	1.34	inclusive of 2.5% extra
3	Stub Setting Templates			
4	+ 1.525 meters extensions			
5	+ 3.050 meters extensions			
6	+ 6 meters extensions			
7	+ 9 meters extensions			
8	+ 12 meters extensions			
	I) Type of Tower : RT3			
1	Super Structure	3734.82	193.47	
2	Stub & Cleats L150x150x10	368.20	1.34	inclusive of 2.5% extra
3	Stub Setting Templates			
4	+ 1.525 meters extensions	498.10	29.83	inclusive of 2.5% extra
5	+ 3.050 meters extensions	770.07	33.12	inclusive of 2.5% extra
6	+ 6 meters extensions	1640.04	69.66	Add 2.5 % for galv.
7	+ 9 meters extensions			
8	+ 12 meters extensions			
9	Additional members			


132KV SC QT3-TYPE
SPECN :HAMPI-GOOTY
MAKE-KAMANI
5810
1980
1980
12500
1041
3355
1367
3355
1695
3400
LEG = 110x110x10
CONCRETE LEVEL
GROUND LEVEL
3700
TRANSVERSE FACE
5810
3960
12500
1041
1367
1695
CONCRETE LEVEL
GROUND LEVEL
3700
LONGITUDINAL FACE


132KV SC RT3- TYPE
SPECN : HAMPI-GOOTY
MAKE-KAMANI
6925
1593
4000
2020
4100
4100
2376
4350
12500
LEG = 150x150x10
CONCRETE LEVEL
GROUND LEVEL
4500
TRANSVERSE FACE
6925
1593
2020
4100
2376
12500
CONCRETE LEVEL
GROUND LEVEL
4500
LONGITUDINAL FACE


SPECN :HAMPI-GOOTY-KADAPA
MAKE-KAMANI
5300
2200
1400
2220
6000
5350
6000
2240
6000
5350
34430
L = 150x150x20
CONCRETE LEVEL
GROUND LEVEL
7026.5
TRANSVERSE FACE
5300
2200
2220
1400
5350
2240
5350
34430
CONCRETE LEVEL
GROUND LEVEL
7026.5
LONGITUDINAL FACE

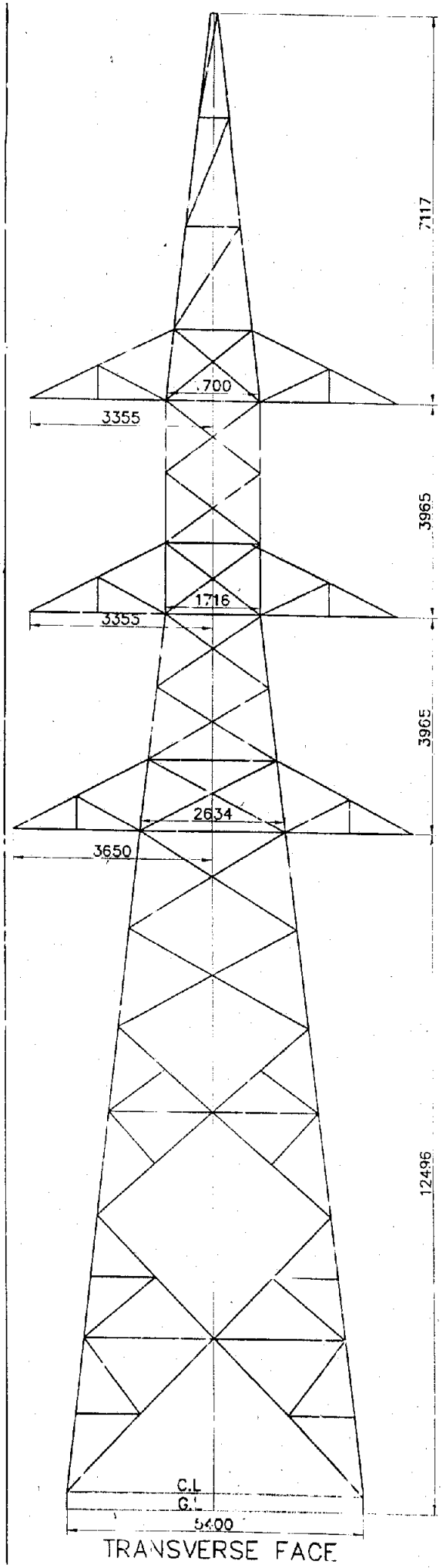
132 kV DC Transmission Line **APT-11/61**

KOTHAGUDEM - WARANGAL, RAMAGUNDAM - WARANGAL, WARANGAL - HYDERABAD

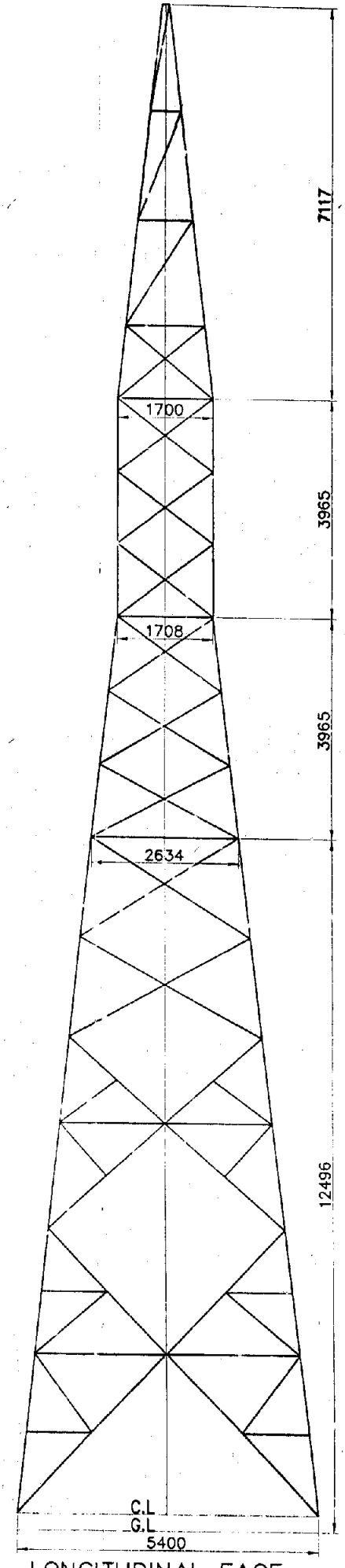
Make: - KAMANI

Sl. No.	Structure Type	Approx. Unit Weight in MT	Weight of Bolts & Nuts	
	I) Type of Tower : A			
1	Super Structure			
2	Stub & Cleats			
3	Stub Setting Templates			
4	+ 3 meters extensions	469.840	23.23	
5	+ 6 meters extensions			
6	Adj stub template			
	II) Type of Tower : B			
1	Super Structure	3749.54	223.31	Add 2.5% for galvanising
2	Stub & CleatsL110x110x10	273.12	1.34	
3	Stub Setting Templates			
4	+ 3 meters extensions	756.72	37.07	
5	+ 6 meters extensions			
6	Adj stub template			
	III) Type of Tower : C			
1	Super Structure	4403.08	244.87	Add 2.5% for galvanising
2	Stub & Cleats L150x150x10	377.56	1.34	
3	Stub Setting Templates			
4	+ 3 meters extensions	840.520	34.43	
5	+ 6 meters extensions			
	IV) Type of Tower : D			
1	Super Structure	6218.65	307.28	
2	Stub & Cleats L150x150x15	643.16	1.34	
3	Stub Setting Templates			
4	+ 3 meters extensions	1182.840	45.84	
5	+ 6 meters extensions			
	V) Type of Tower : M			
1	Super Structure	13170.52	694.54	
2	Stub & Cleats L200x200x20	1184.20	4.57	3 ft galvanising from top
3	Stub Setting Templates			
4	+ 3 meters extensions			
5	+ 6 meters extensions			
	VI) Type of Tower : L			
1	Super Structure	23715.66		
2	Base Assembly members	1085.72	800.05	
3	Anchor bolts	771.48		
4	Anchor flats	102.20		

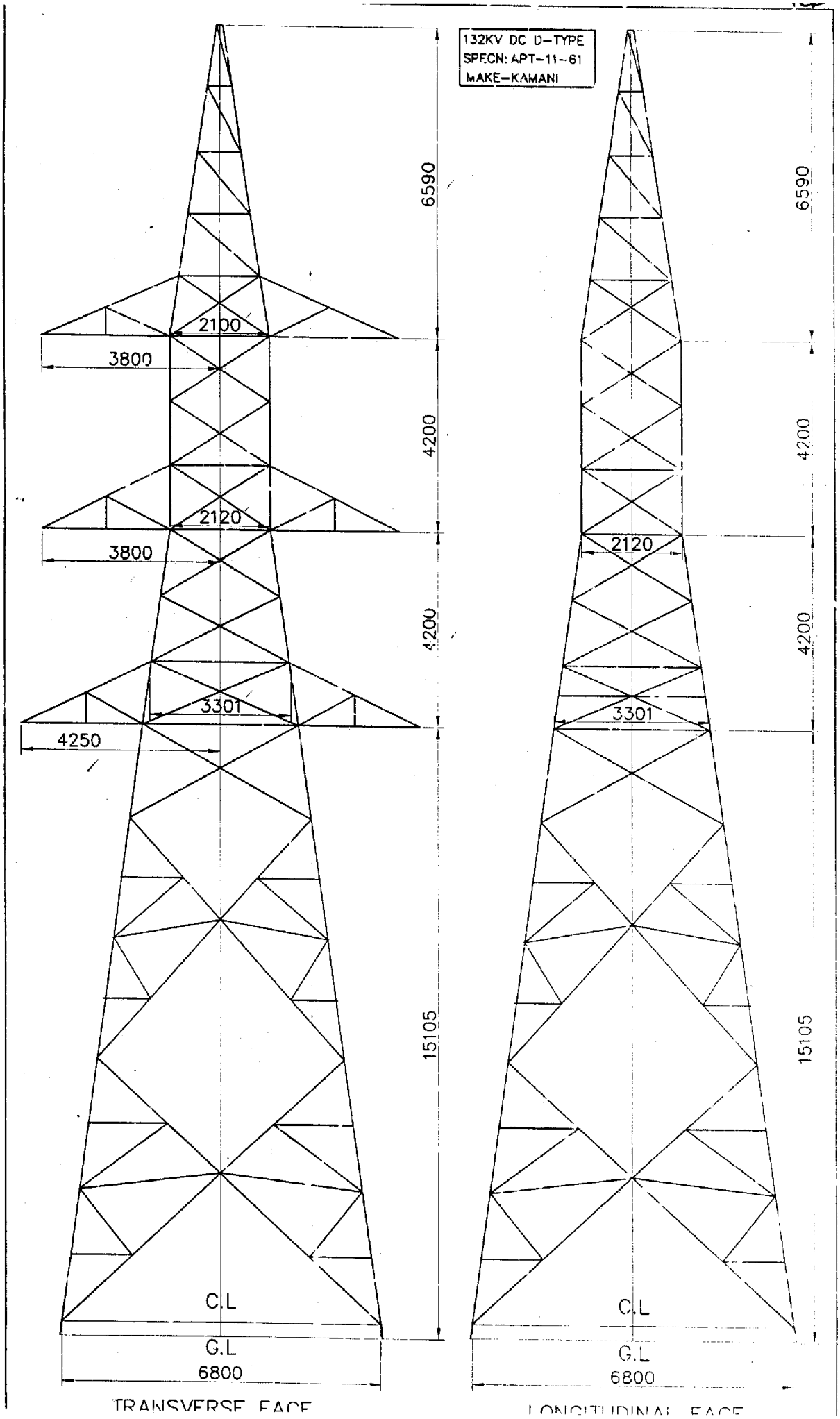
132KV DC B-TYPE
SPECN: APT-11-61
MAKE-KAMANI



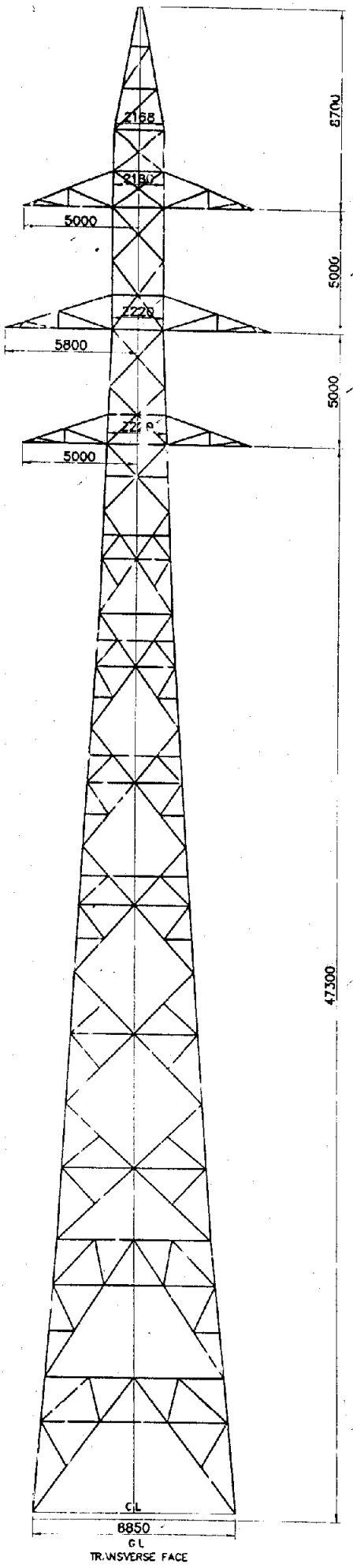
TRANSVERSE FACE



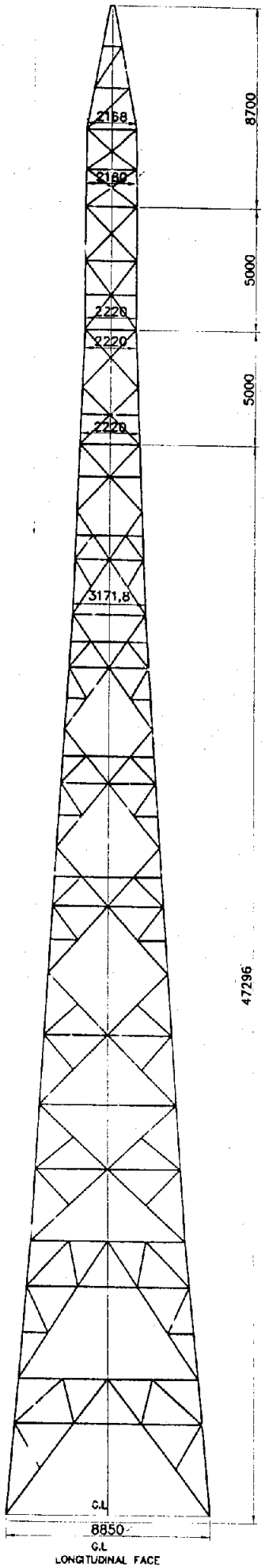
LONGITUDINAL FACE


132KV DC D-TYPE
SPECN: APT-11-61
MAKE-KAMANI
6590
4200
4200
15105
2100
3800
2120
3800
3301
4250
C.L
G.L
6800
TRANSVERSE FACE
6590
4200
4200
15105
2120
3301
C.L
G.L
6800
LONGITUDINAL FACE

132KV SC L-TYPE
SPECN: APT-11-61
MAKE-KAMANI

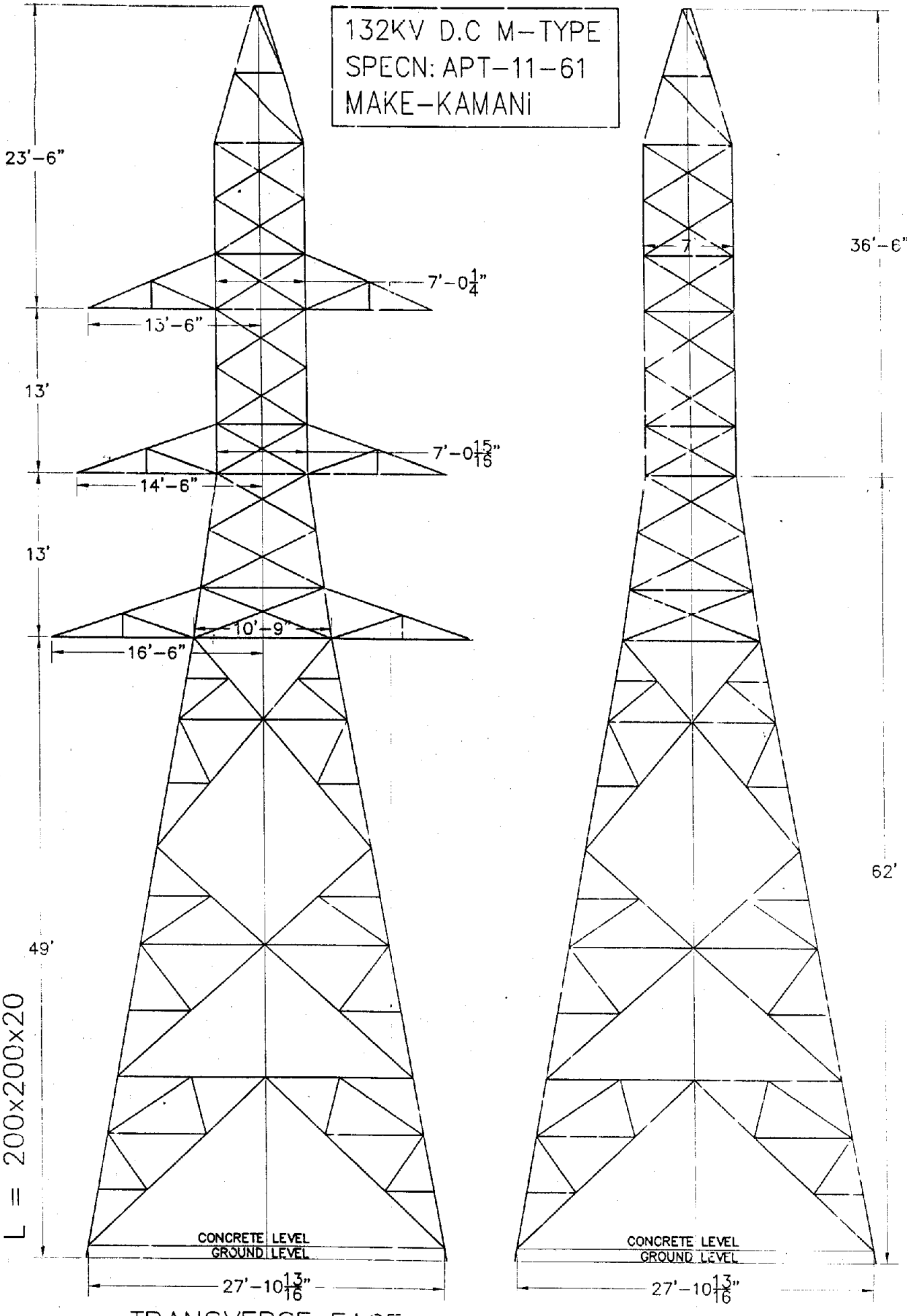


TRANSVERSE FACE



LONGITUDINAL FACE

132KV D.C M-TYPE
SPECN: APT-11-61
MAKE-KAMANI



TRANSVERSE FACE

LONGITUDINAL FACE

132 kV SC Transmission Line Spec.No.APT 5 /60

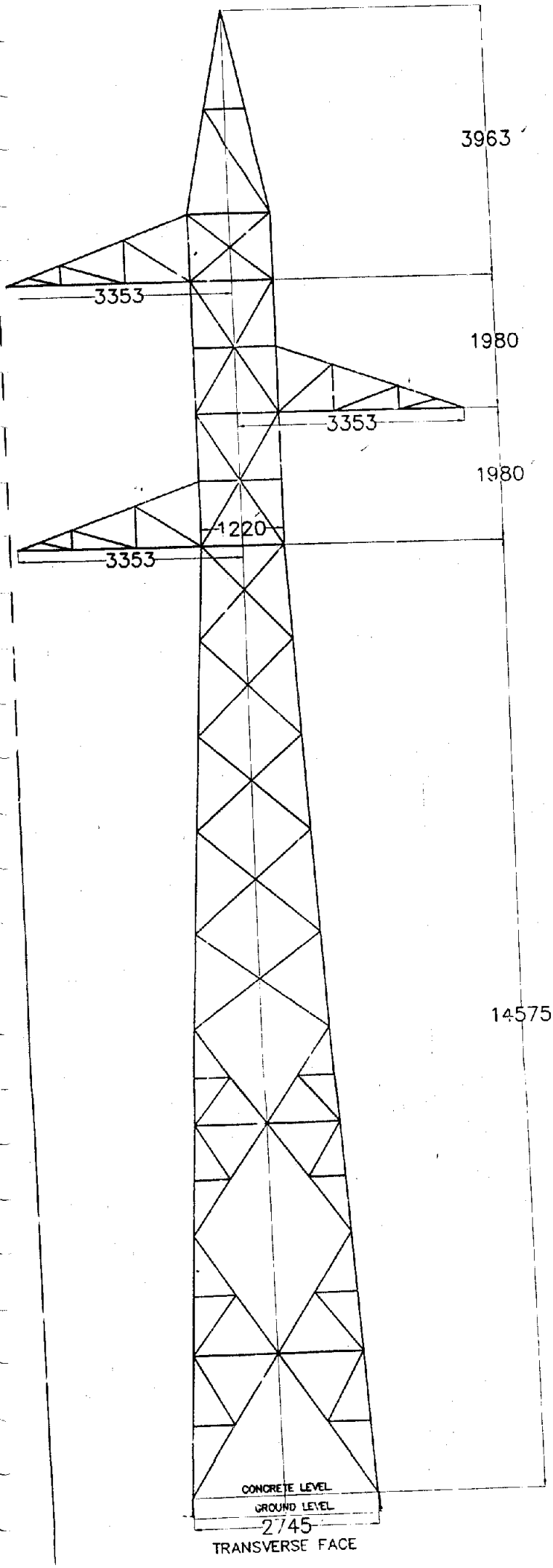
TADEPALLI - NAGARJUNASAGAR - HYDERABAD

Make: - KAMANI Type of tower : - ZA

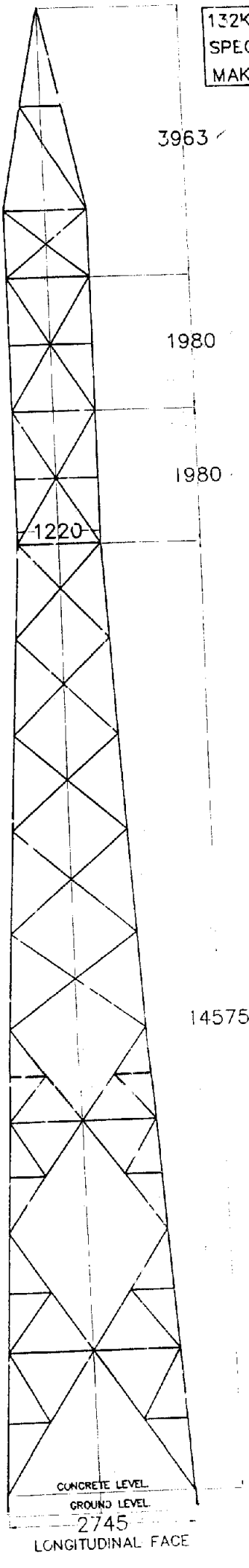
Sl. No.	Structure Type	Approx. Unit Weight in MT	Weight of Bolts & Nuts
	I) Type of Tower : XA		
1	Super Structure		
2	Stub & Cleats		
3	Stub Setting Templates		
4	Normal Tower		
5	+ 3 meters extensions		
6	+ 6 meters extensions		
7	+ 9 meters extensions		
8	+ 12 meters extensions		
	I) Type of Tower : YA		
1	Super Structure		
2	Stub & Cleats		
3	Stub Setting Templates		
4	Normal Tower		
5	+ 3 meters extensions		
6	+ 6 meters extensions		
7	+ 9 meters extensions		
8	+ 12 meters extensions		
	I) Type of Tower : ZA		
1	Super Structure	4325.73	260.23
2	Stub & Cleats	465.70	
3	Stub Setting Templates		
4	Normal Tower		
5	+ 3 meters extensions		
6	+ 6 meters extensions		
7	+ 9 meters extensions		
8	+ 12 meters extensions		

inclusive of 2.5% extra

132KV SC XA-TYPE
SPECN. APT-5-60
MAKE-KAMANI

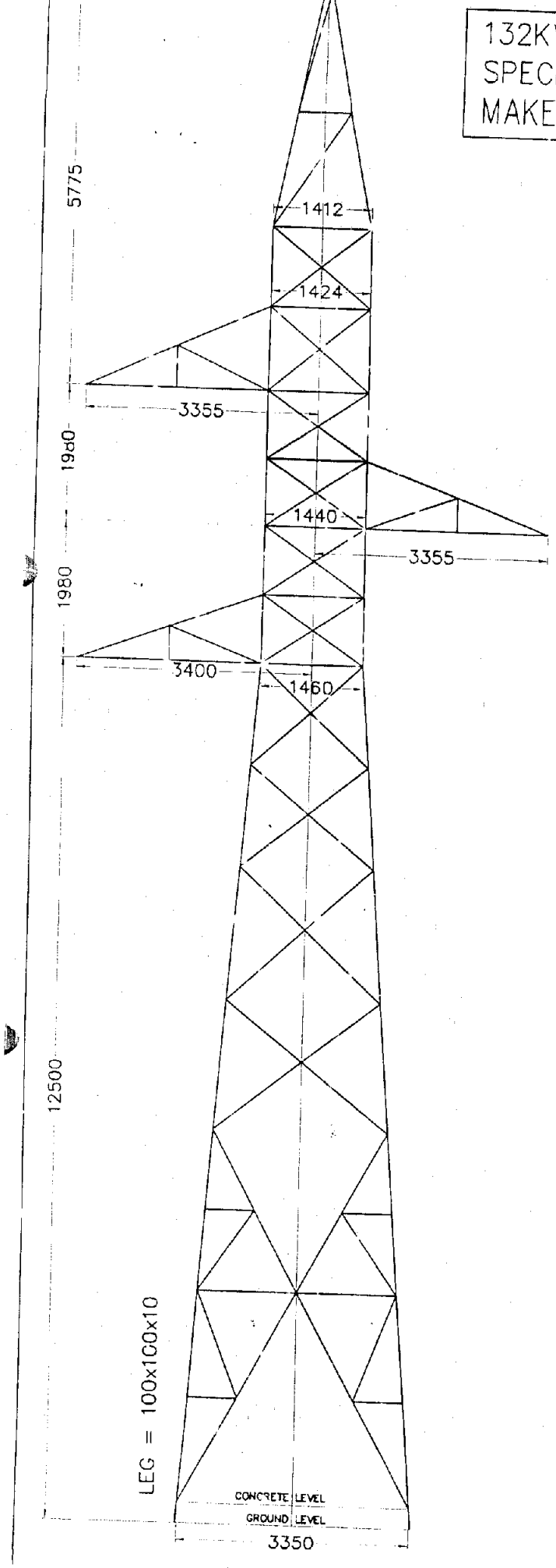


TRANSVERSE FACE

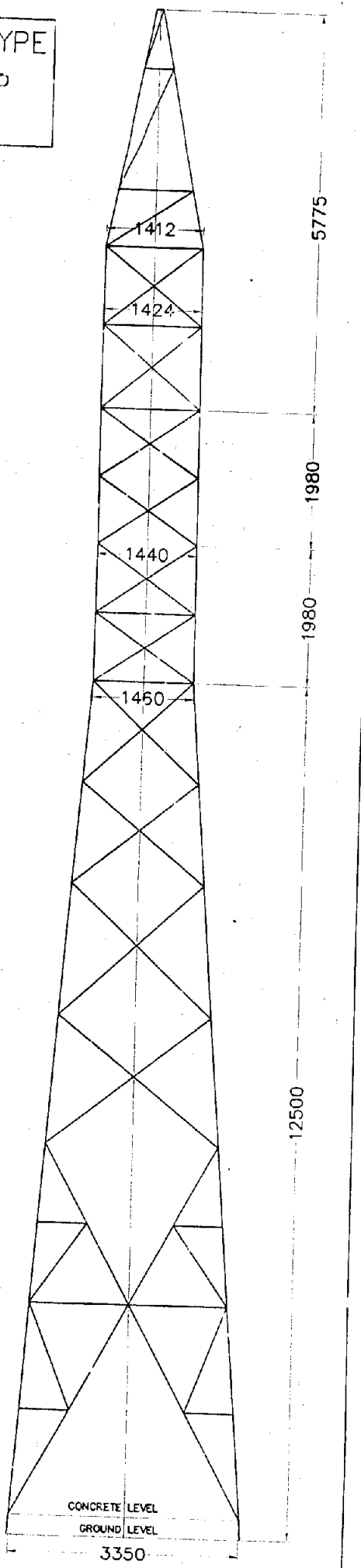


LONGITUDINAL FACE

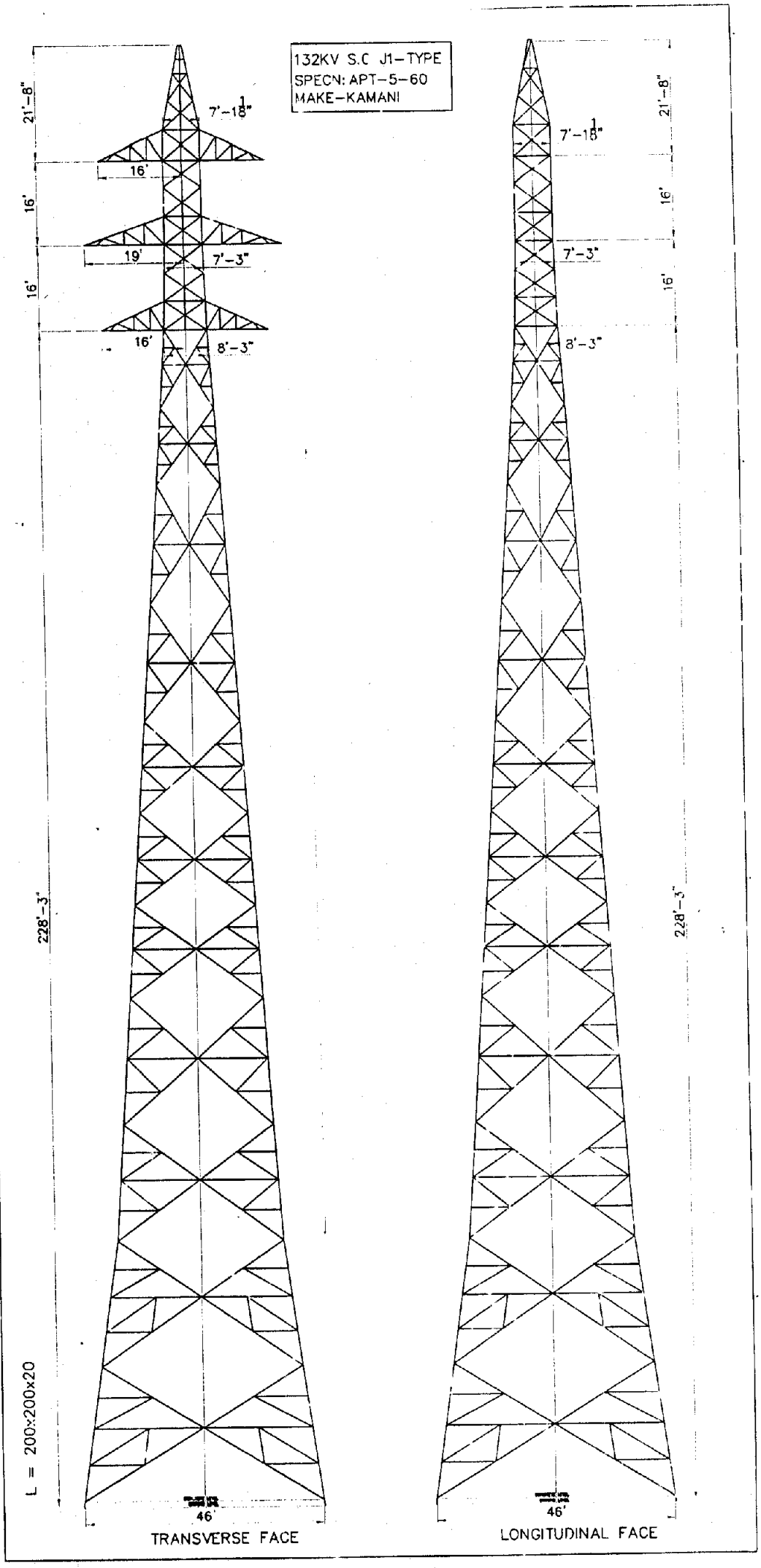
132KV S.C YA-TYPE
SPECN. APT-5-60
MAKE-KAMANI

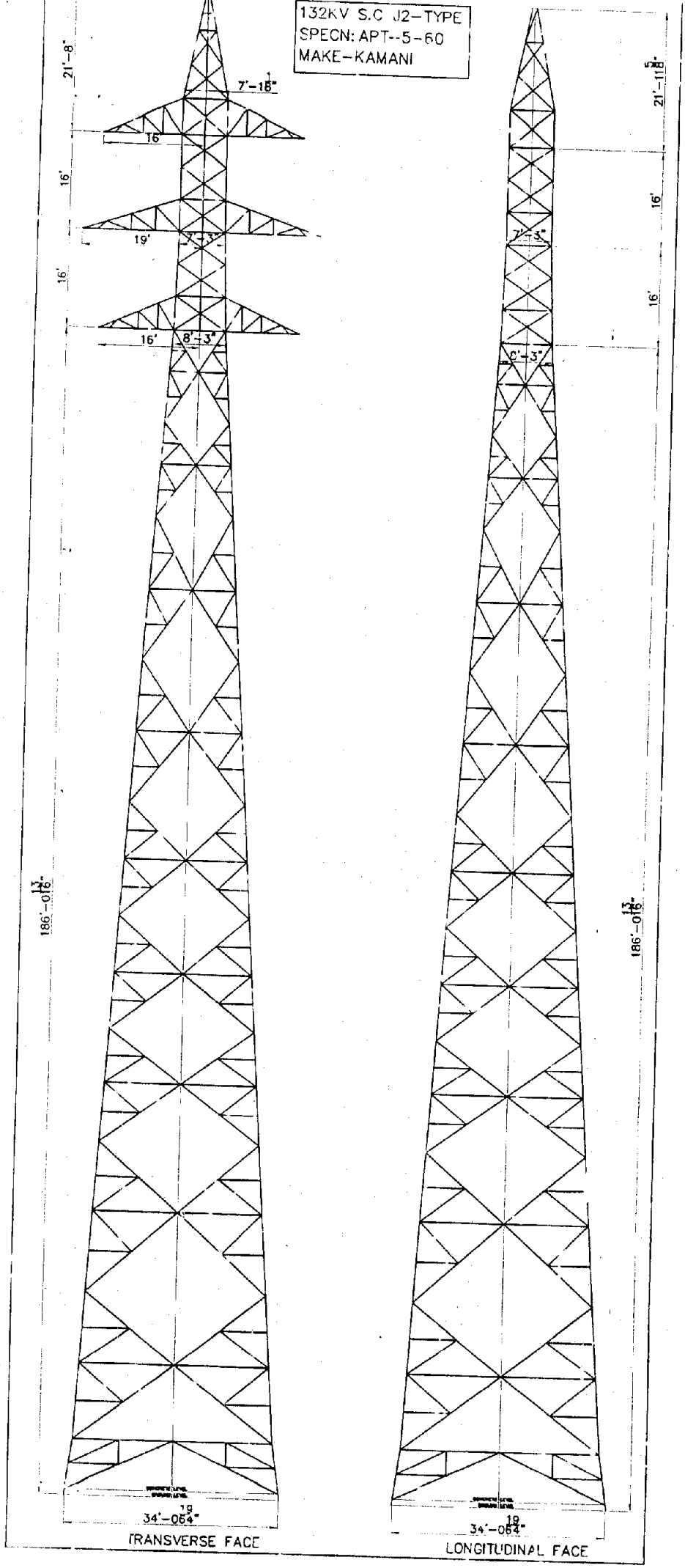


TRANSVERSE FACE

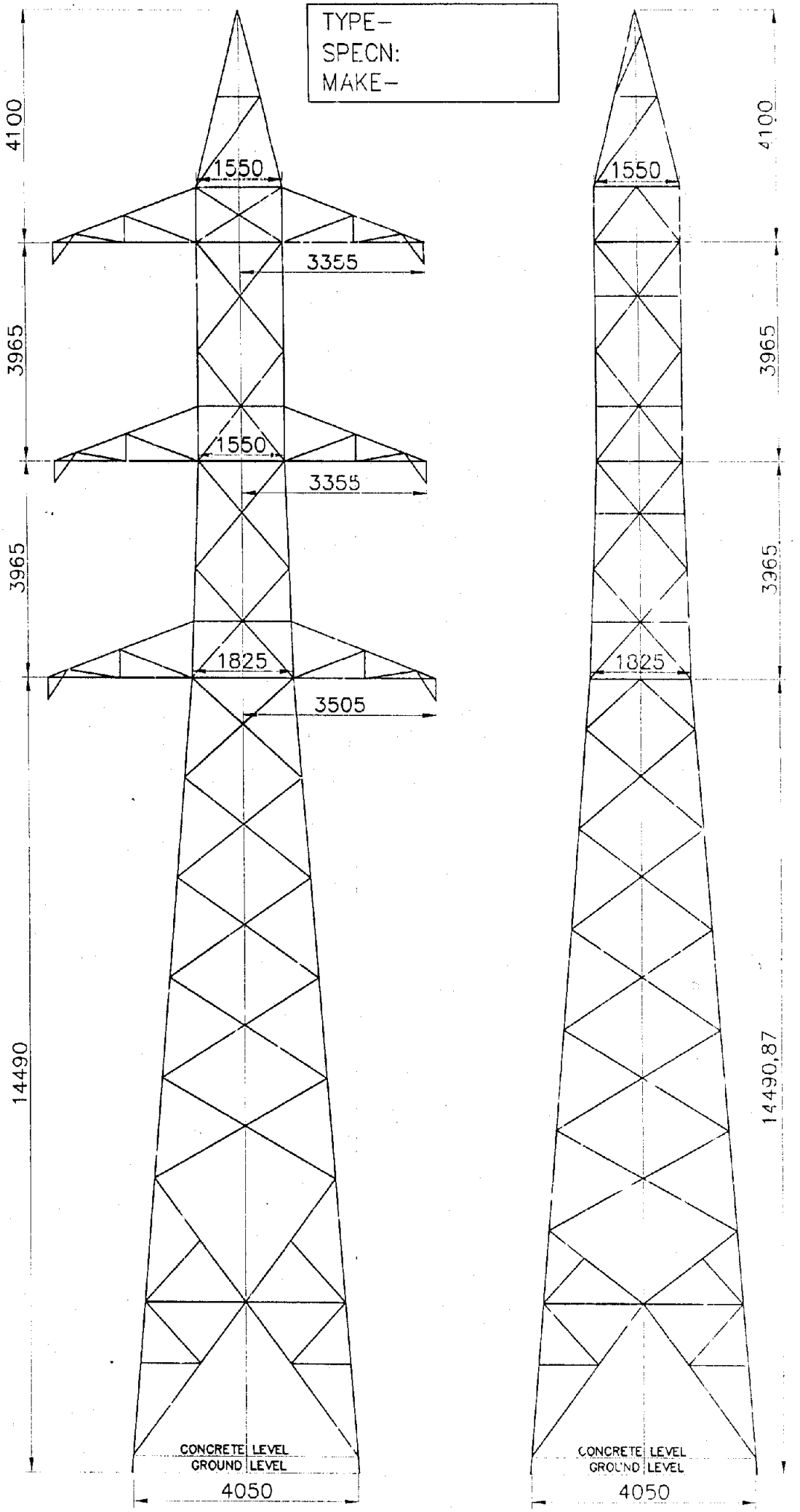


LONGITUDINAL FACE


132KV S.C J1-TYPE
SPECN: APT-5-60
MAKE-KAMANI
21'-8"
16'
16'
228'-3"
7'-1 1/8"
16'
19'
7'-3"
16'
8'-3"
46'
TRANSVERSE FACE
21'-8"
16'
16'
228'-3"
7'-1 1/8"
7'-3"
8'-3"
46'
LONGITUDINAL FACE
L = 200x200x20


132KV S.C J2-TYPE
SPECN: APT--5-60
MAKE-KAMANI
21'-8"
7'-18"
16'
16'
19'
7'-3"
16'
16'
8'-3"
186'-0 13/16"
34'-0 19/64"
TRANSVERSE FACE
21'-11 5/8"
16'
16'
7'-3"
16'
6'-3"
186'-0 13/16"
34'-0 19/64"
LONGITUDINAL FACE

TYPE–
SPECN:
MAKE–



ANNEXURE -2

Sl. No.	Standard Indian / Internationally Recognized	Title
A. Structural Steel Cement Concrete and Reinforced Concrete, Soil classification and Tests.		
1	IS : 2062 ISO/R/660 IS:226-1973 (fifth revision)	Structural Steel (for tower members and cross arms) standard quality.
2	IS:432 BS: 785 CSA - 630	Mild steel and medium tensile bars and hard drawn solid wires for concrete reinforcement.
3	IS: 802 Part – I 1995	Code of Practice for use of structural steel in O.H. Transmission lines – Loads and permissible stresses.
4	IS:802 Part – II 1995	Code of Practice for use of structural steel in O.H. Transmission lines: Fabrication, Galvansing, Inspection and Packing.
5	IS:802 Part – III 1995	Design, Fabrication and Testing of Towers.
6	IS:1893 - 1975	Criteria to earthquake resistant design of structures.
7	IS:1367 Part – 1	Threaded fasteners (First revision)
8	IS:1367 Part – 2	Product grades and Tolerances.
9	IS:1367 Part – III	Mechanical proportion and test methods for bolts screws and studs with full load abilities. Hexagonal head bolts screws and nuts of product grade "C" Hexagon nuts M5- M64
10	IS:2016 ISO/R-75 ISO/R-78	Plain Washers Testing of washers
11	IS 3063 DIN - 127	Single coil rectangular section Spring lock washers for bolts and nuts; screws.
12	IS:6639-1972	Hexagonal bolts for steel structures.
13	IS:6735	Fasteners – Spring Lock Washers for screws with cylindrical heads.
14	IS:8500	Structural Steel micro alloyed (Medium and High Strength quality)
15	IS:6610	Specification for heavy washers for steel structures.
16	IS: 5369	General requirements of plain washers and lock washers
17	IS: 2614	Methods of sampling of fasteners
18	IS:5624 - 1970 IS: 1755 - 1983	Foundation Bolts Method for wrapping test for metallic wire.
19	IS : 1367 part 6	Mechanical Properties and test methods for nuts with specified proof loads.
20	IS : 4072	High quality spring steel
21	IS:209 ISO/R-752	Specification for Zinc: prescribed requirements of virgin zinc (It does not cover requirements of reclaimed zinc)
22	IS: 1563	Electro galvanization: Electrc plated Coating of Zinc on Iron and Steel.
23	BS : 3436 IS : 406	Method for chemical analysis of slab zinc
24	IS:4826	Spn. for galvanized coating
25	IS.6821 IS: 2629	Recommended Practice for Hot Dip Galvanizing of iron and steel.

Sl. No.	Standard Indian / Internationally Recognized	Title
26	IS:2633	Method for testing uniformity of coating of zinc coated articles
27	IS:5358	Hot dip galvanized coating on fasteners
28	IS:6745	Methods of determination of weights of zinc coating of zinc coated iron and steel articles
29	IS:4759 - 1984 / 1989 Service Grade 4	Hot dip zinc coating on structural steel and other allied products, plain and heavy washers, spring washers Electro galvanisation.
30	IS : 4826 – 1979	Hot dip galvanized coatings on round steel wires
31	IS : 1892	Procedures for collection of soil data (Code of practice for subsurface investigation for foundation).
32	IS: 21331 - 1961	Method of standard penetration test of soils.
33	IS : 1888 - 1982	Method of load tests on soils
34	IS:1786-1966	Reinforcement steel to be used for foundations: Cold twisted steel rods.
35	280 – 1972	Binding wires (for the reinforcement rods)
36	IS:2502 – 1963	Code of Practice for bending and fixing bars for concrete reinforcement.
37	IS: 491	Safe loads for under deemed files
38	IS : 456 - 1978	Bond stresses between concrete and reinforcement steel deformed bars intention of grade Fe:415 conforming to IS:1786- 1985 and IS:1139-1986.
39	IS:456 – 1978	Spn. for concrete aggregates
40	IS:383 – 1978	Fine and course aggregates for use in concrete.
41	IS:269: 1969	Ordinary Portland Cement
42	IS : 2911	Capacity of piles
43	IS : 456 - 1978	Code of practice for plain and reinforced concrete
	B. Insulators and Insulation Co-ordination	
1	IS:731-1971	Porcelain Insulations for O.H. Power lines with a normal voltage greater than 1000 volts (Second revision) String Insulators included.
2	IS:2544	Porcelain Post Insulators for Systems with nominal voltage greater than 1000V.
3	IS:5350 (Part II)	Dimensions of indoor and outdoor porcelain post insulators and post insulator units for systems with nominal voltage greater than 1000 V – Out door cylindrical post insulators.
4	IS:3188 IEC 305	Characteristics of String Insulator Units.
5	IS:1570 Part – I	Schedules for wrought steels for general engineering purposes - steel specified by tensile and / or yield properties
6	IS:2004	Carbon Steel forgings for general engineering purposes.
7	IS:6603	Stainless steal bars and flats.
8	IS : 2108	Blackheart malleable iron castings.
9	IS:2486 (Part II) 1971/89	Insulator Fitting for OH Power Lines: General requirements and dimensional requirements.
10	10136-1982	Code of Practice for selection of disc insulator fittings for highest system voltages 72.5 kV and above.

Sl. No.	Standard Indian / Internationally Recognized	Title
11	2486	Specification for insulator fittings for OH Power Lines of nominal voltage greater than 100V General Requirements and Tests.
	Part - I	Please also refer to specifications under structural steel
12	IS: 2071 Parts (I, II & III)	Methods of High Voltage Testing.
13	IS.8267	Methods of Switching Impulse Tests on High Voltage Insulators.
14	IEC : 383	Impulse Withstand and flash over Test. Electrical Routine Test.
15	IS:8269-76	Switching surge wet withstand Tests.
	IEC-506	
16	IEC:575	Thermal Mechanical Performance Test.
17	IS:2108	Metallurgical Test
	2004	
18	IEC:372	Test on Locking device for Ball and Socket coupling.
19	ASTN / CIS-PR	Autoclave Expansion Test to evaluate cement aging.
	CSA C411-1	
20	IS:2165 (Part 1) 1977	Insulation Coordination Part – II
		Phase-to-Phase Insulation
21	IS:2165 (Part 2) 1983	Insulation Coordination Part 2 phase-to-phase insulation.
22	IS:2165	Insulation Coordination principles and rules: Insulation Coordination for equipment for 100 kV and above.
23	IEC – ITI	Insulation Coordination
24	IS:3716-1978	Application guide for Insulation Coordination
26	IS:8437	Guide on effects of currents passing through the human body.
	C - Conductors & Cables	
1	398 (Part I) – 1976	Aluminium conductors for O.H. Transmission purposes (Second Revision)
	I to V (As relevant)	
	IEC:209, BS:215 (Part II)	
	IEC-208	
2	IS:398 – Part IV 1994	AAA Conductor.
3	IS:2121 (Part I to3) --	Conductors and earth wire accessories for overhead power lines.
	1981/91/92	Armour rods repair sleeves for AAA conductors, binding wire and tapes for conductors mid span joints and repair splices, accessories for earth wire, non-tension joints.
4	A NSIC – 119	- Connectors for O.H. lines AAAC. Spring
	0.4-1991	loaded jointing splices.
5.	IS:1621	Tests for earthwire.
	IS:3908 Part II 1976 IS:2141-1979	
	IS: 1755 , IS:4759 – 1984	
6	IS:1997 IEC-104	Aluminium alloy redraw rods for electrical purposes.
7	IS:5484	EC Grade Aluminium rod produced by continuous casting and rolling.
8.	IS:1841	EC Grade Aluminium rod produced by rolling.
9.	IS:1778	Reels and drums for bear conductors.
10.	IS : 1788	Dimensionod dravvings of the drum.
11	IS:214172	Specification for galvanized stay strain.

Sl. No.	Standard Indian / Internationally Recognized	Title
D – Other Specifications Codes of Practice for Transmission Lines & Sub-stations		
1	IS:5613 Part I&II	Code of Practice for design installation and maintenance of OH power lines.
2	IS:5613 (Part 2 / Section I 1985	Codes of Practice for Design,
3	IS 5613 (Part 2/Section II 1985	Installation and Maintenance of O.H Powerlines (lines above 11kv and upto and including 220 kV).
4	IS: 3043 – 1987	Code of Practice for Earthing.
5	IS: 802 Part I 1995	Code of Practice for use of structural steel in O.H. Transmission lines.: Loads and permissible stresses.
6	IS: 802 Part II 1995	Fabrication, Galvanising, Inspection and Packing.
7	IS: 802 Part III 1995	Design, Fabrication and Testing of Towers.
8	IS:456	Code of Practice for Plain and Reinforced concert.
9	IS: 1888 – 1988	Code of Practice for Site Investigation for foundations.
10	IS : 4091 – 1979	Code of practice for design and construction of foundations for Transmission Line Towers.
11	IS: 5613 – 1976	Code of Practice for design, installation and maintenance of E.H.T. Lines.
12	IEC: 826 – 1991	Technical Report on strength of O.H.Lines.
13	IEE Std. 524 1980 published by the Institute of Electrical and Electronic Engineers Inc. 345 East Street. New York – 10017 Dec. 18/1980	IEEE Guide to the installation of O.H. Transmission Line conductors
15	IS :10136 - 1982	Codes of Practice for selection of disc insulator fittings for highest system voltages, 72.5 kV and above.
16	IS. 800 – 641/1962	Code of practice for use of structural steel in building construction.
17	IS :875 1964	Code of Practice for structural safety of buildings, loading standards.
18	IS :1255 – 1967	Codes of Practice for installation and maintenance of power cable.
19	IS: 5613 – 1985 Part Section I	Pipe Earthing materials
20	IS : 5613 Part II Section 1/1976	Phase plated and Anti – Climbing devices.
21	IS:2851	Danger Boards
E - Publications for Reference		
1	CBIP Publication No. 268	Transmission line Manual
2	CBIP Publication	Upgrading / Uprating of Transmission Lines
3	CBIP Publication No. 239	Guide for New code for design of Transmission Lines in India
4	CBIP Publication No. 290	Design of towers for long span river crossings
5	Shanta Kumar	Transmission line structures
ADDITIONAL		
1	IS: 2 -1960	Rules for rounding off numerical values.
2	IS: 278 - 1978	Specification for Galvanized steel barbed wire for fencing
3	IS: 808 - 1989 (Part V - VI)	Dimensions for hot rolled steel beams, column channels & Angle sections. Equal leg angles. Unequal leg angles.
4	IS: 1573-1986	Specification for Electroplated coatings for zinc on iron and steel.
5	IS: 2062-1992	Specification for steel for gneral purpose.
6	IS: 2551-1982	Danger notice plates.
7	IS: 3757-1985	High strength structural bolts.

Sl. No.	Standard Indian / Internationally Recognized	Title
8	IS. 7215-1991	Specfication for tolerance for fabrication of steel structures.
9	IS: 10238-1982	Step bolts for steel structures.
10	IS: 12427-1988	Transmission tower bolts.
11	IS: 1080	Codes of practice for design for construction of simple spread foundations.
12	IS: 1498	Classification and identification of soils for general Engineering purposes.
13	IS: 1904	Code of practice for desing and construction of foundation in soils general requirements.
14	IS: 2131	Method of standard penecration test for soil.
15	IS: 2132	Code of practice for thin walled tube sampling of soils.
15	IS: 2720	Method of test for soils (relevant parts).
16	IS: 2809	Glossary of terms and symbols relating to soil Engineering.
17	IS: 2810	Glossary of terms and symbols relating to soil dynamics.
18	IS: 3025	Methods of sampling and testing (Physical and Chemical) for water used in industry.
19	IS: 4078	Code of practice for indesing and storage of Drill cores.
20	IS: 4434	Code of practice for in-situ vane shear test for soils.
21	IS: 4453	Code of practice for Exploration by Trenches, Drifts and Shafts.
22	IS: 4464	Code fo practice for presentation of drilling information and core description in foundation investigation.
23	IS: 4968 (Part-II)	Method for subsurface sounding for soils, Dynamic method using cone and bentonive starry.
24	IS: 5313	Guide for core drilling observation.
25	IS: 6403	Code of practice for determination of allowable bearing pressure on shallow foundation.
26	IS: 6920	Code of practice for diamond core drilling for site investigation for river vailey projects.
27	IS: 6935	Method of determination of water level in a bore hole.
28	IS: 7422	Symbols and abbreviations for use in geological maps. Sctions and subsurface exploratory logs (relevant parts).
29	IS: 8009 (Part-I)	Code of practice for calculation of settlements of foundations (shallow foundations subjected to symmetrical vertical loads).
30	IS: 8764	Method of determination of point load strength index of rocks.
31	IS: 9143	Method of determination of unconfined compressive strength of rock materials.
32	IS: 9179	Method of preparation of rock specimen for laboratory testing.
33	IS: 9259	Specification for liquid limit apparatus.
34	IS: 9640	Specification for split spoon sampler.
35	IS: 10050	Method of determination of stake durability index of rocks.
36	IS: 11315	Description of discontinuities in rock mass - core recovery and rock quality.
	CBIP Manual on transmission line towers chapter 10 : foundation.	

ANDHRA PRADESH STATE ELECTRICITY BOARD

* * * * *

From
The Superintending Engineer,
Technical/Elecl (Projects)
Vidyut Soudha,
Hyderabad - 4

To
The Superintending Engineer,
Transmission Line Construction,
Hyderabad

Letter No.T1241/APT 35/70-65/71, Dt. 30-6-'71

Sir,

Sub: Single line sketches of Tangent towers to be used on Kothagudem-Hyderabad and Lower Sileru-Bommur 220kV lines and tower spotting requirements – Reg.

* * *

As requested by Assistant Engineer/Technical of your office over phone, I enclose herewith two single line sketches of Tangent towers (furnished by the company with their tender) proposed to be used on Kothagudem – Hyderabad and Lower Sileru – Bommur 220kV lines. The tower spotting requirements for various types of towers are furnished in the enclosed statement.

The angle towers proposed for use on the above lines will be designed for a normal span of 320 metres, but the tower spotting requirements shown above will be applicable to these towers also. Only the height of towers is reduced by 3 metres. This shall be taken into account while fixing angle towers on profiles.

Please acknowledge the receipt of this letter.

Encl: As above.

sd/-
for SUPERINTENDING ENGINEER
TECHNICAL ELECTRICAL (PROJECTS)

Copy to Executive Engineer/T.L.C./Hyderabad.
Copy to Executive Engineer/T.L.C./Visakhapatnam – 2.
Despatched on 02.07.1971.

(True copy extracted from Vol-1 of the files pertaining to APT-35/1970 under EME-1 Division)

Tower spotting requirements

Sl. No.	Description	Kothagudem - Hyderabad line			Lower Sileru - Bommur line		
		A	B	C	AA	BB	CC
1	Deviation not to exceed	2^0	30^0	60^0	2^0	30^0	60^0
2	Individual span not to exceed (meters)	400	450	500	400	450	500
3	Weight span of conductor:						
	i) Effect of single span (metres)	291	285	285	291	285	285
	ii) Effect of both spans(metres)	475	475	475	475	475	475
4	Weight span of Ground wire:						
	i) Effect of single span (metres)	273	265	265	273	265	265
	ii) Effect of both spans	475	475	475	475	475	475
5	Design tension 50^0F and full wind pressure (Kg)						
	i) Power Conductor	------ 4520 ------			------ 5325 ------		
	ii) Ground wire	------ 1920 ------			------ 2213 ------		
6	Permissible sum of adjacent spans (Metres)						
		2^0-760	30^0-760	60^0-760	2^0-760	30^0-760	60^0-760
		1^0-871	29^0-866	59^0-856	1^0-847	29^0-843	59^0-836
		0^0-981	28^0-973	58^0-952	0^0-937	28^0-928	58^0-911
		-----	27^0-1081	57^0-1048	-----	27^0-1012	57^0-986
		-----	-----	56^0-1145	-----	-----	56^0-1058
7	Configuration	---------- Triangular (Isosceles) ----------					
8	Normal span or Wind span	A & AA Type ---------- 380 m ----------					
		B & BB Type ---------- 320 m ----------					
		C & CC Type ---------- 320 m ----------					
9	Minimum weight span	75% of wind span with suspension insulators.					
	Assumptions:						
	i) Weight of two men with tools = 150 Kg.						
	ii) Weight of one set of suspension Insulator string = 80 Kg.						
	iii) Weight of one set of Tension Insulator string = 120 Kg.						

NOTE: When checking up the angle towers, its ground level shall be marked 3 metres below the actual ground level and check up the clearances in spans adjacent to it.

E:\Vikram\tower-spoting\[statement-TS.xls]Sheet1

TOWER SPOTTING REQUIREMENTS

220 kV Lines Kothagudem - Hyderabad & Lower Sileru - Bommuru

I Lower Sileru - Bommuru line (for 112.5 Kg/m^2 wind)

I Tangent Towers

Wind load on conductor (A)
= 2/3 x 112.5 x 28.62/1000 x 380
= 815.670 Kg

Transverse load due to deviation (B) at $\theta = 2^0$

2T Sin $\delta/2$
= 2 x 5325 x Sin1 = 2 x 5325 x 0.0175
= 186.375 Kg

Total Transverse load (A+B) = 815.670 + 186.375
= 1002.045 Kg

1) When Deviation = 1^0

Transverse load due to deviation 1^0 = 2 x 5325 x Sin 30^1
= 2 x 5325 x 0.0087
= 92.655 Kg

:.Wind load on conductor = 1002.045 - 92.655
= 909.390 Kg

:. Span = 909.39/112.5 x 3/2 x 1000/28.62
= 423.6618 Meters

:. Sum of Adj Spans = 2 x 423.6
= 847.3235
Or say = 847 Meters

2) When Deviation = 0

:.Wind load on conductor = 1002.045

:. Span = 1002.045/112.5 x 3/2 x 1000/28.62
= 466.8274 Meters

:. Sum of Adj Spans = 2 x 466.8
= 933.6548
Or say = 934 Meters

II For 30^0 angle (B-Type) towers

Wind load on conductor (A)
= 2/3 x 112.5 x 28.62/1000 x 380
= 815.670 Kg

Transverse load due to deviation (30^0) = 2T Sin θ/2

2T Sin θ/2
= 2 x 5325 x Sin15 = 2 x 5325 x 0.2588
= 2756.22 Kg

Total Transverse load (A+B) = 815.670 + 2756.22
= 3571.890 Kg

1) For a deviation = 29^0

Transverse load due to deviation 29^0 = 2 x 5325 x Sin 14.5
= 2 x 5325 x 0.2504
= 2666.76 Kg

:. Hence allowable load due to wind = 3571.89 - 2666.76
= 905.130 Kg

:. Allowable Span = 905.13 / 2.1465
= 421.6771 Meters

:. Sum of Adj Spans = 2 x 421.6
= 843.3543
Or say = 843 Meters

2) For a deviation = 28^0

Transverse load due to deviation 28^0 = 2 x 5325 x Sin 14
= 2 x 5325 x 0.2419
= 2576.235

:. Allowable load due to wind = 3571.890 - 2576.235
= 995.655 Kg

:. Allowable Span = 995.655 / 2.1465
= 463.8505 Meters

:. Sum of Adj Spans = 2 x 463.850
= 927.7009
Or say = 928 Meters

3) For a deviation = 27^0

Transverse load due to deviation 27^0 = 2 x 5325 x Sin 13.5
= 2 x 5325 x 0.2334
= 2485.71

∴ Allowable load due to wind = 3571.890 - 2485.71
= 1086.180 Kg

∴ Allowable Span = 1086.18 / 2.1465
= 506.0238 Meters

∴ Sum of Adj Spans = 2 x 506.0238
= 1012.048
Or say = 1012 Meters

III For 60^0 angle (C-Type) towers

Wind load on conductor (A)
= 2/3 x 112.5 x 28.62/1000 x 380
= 815.670 Kg

Transverse load due to deviation (60^0) = 2T Sin θ/2

2T Sin θ/2
= 2 x 5325 x Sin30 = 2 x 5325 x 0.5
= 5325 Kg

Total Transverse load (A+B) = 815.670 + 5325
= 6140.670 Kg

1) For a deviation = 59^0

Transverse load due to deviation 59^0 = 2 x 5325 x Sin 29.5
= 2 x 5325 x 0.4924
= 5244.06 Kg

∴ Hence allowable load due to wind = 6140.67 - 5244.06
= 896.610 Kg

∴ Allowable Span = 896.610 / 2.1465
= 417.7079 Meters

∴ Sum of Adj Spans = 2 x 417.70
= 835.4158
Or say = 835 Meters

2) For a deviation = 58^0

Transverse load due to deviation 58^0 = 2 x 5325 x Sin 29
= 2 x 5325 x 0.4848
= 5163.12

:. Allowable load due to wind = 6140.67 - 5163.12
= 977.550 Kg

:. Allowable Span = 977.55 / 2.1465
= 455.4158 Meters

:. Sum of Adj Spans = 2 x 455.4158
= 910.8316
Or say = 911 Meters

3) For a deviation = 57^0

Transverse load due to deviation 57^0 = 2 x 5325 x Sin 28.5
= 2 x 5325 x 0.4772
= 5082.18

:. Allowable load due to wind = 6140.67 - 5082.18
= 1058.490 Kg

:. Allowable Span = 1058.49 / 2.1465
= 493.1237 Meters

:. Sum of Adj Spans = 2 x 493.1237
= 986.2474
Or say = 986 Meters

4) For a deviation = 56^0

Transverse load due to deviation 56^0 = 2 x 5325 x Sin 28
= 2 x 5325 x 0.4695
= 5000.175

:. Allowable load due to wind = 6140.67 - 5000.175
= 1140.495 Kg

:. Allowable Span = 1140.49 / 2.1465
= 531.3277 Meters

:. Sum of Adj Spans = 2 x 531.3277
= 1062.655
Or say = 1063 Meters

Note: - In the tower spotting sheet normal span is mentioned as 380 m for tangent and 320 Mts. for angle tower for both wind zones. However it can be seen in the design sheets, the same 380 m is specified in both. Please note that the above calculation sheets are also made for 380 m span.

TOWER SPOTTING REQUIREMENTS

220 kV Lines Kothagudem - Hyderabad & Lower Sileru - Bommuru

I **Kothagudem - Hyderabad line (for 75 Kg/m^2 wind)**

T = 4520

For Tangent towers at $\theta = 2^0$

I **Tangent Towers**

Wind load on conductor (A) = 2/3 x 75 x 28.62/1000 x 380
= 543.780 Kg

Transverse load due to deviation = 2T Sin 1^0

= 2 x 4520 x Sin1^0 = 2 x 4520 x 0.0175
= 158.2 Kg

Total Transverse load (A+B) = 543.780 + 158.20
= 701.980 Kg

1) When Deviation = 1^0

Transverse load due to deviation 1^0 = 2 x 4520 x Sin 30
= 2 x 4520 x 0.0087
= 78.648 Kg

:. Allowable Wind load = 701.980 - 78.648
= 623.332 Kg

:. Allowable Span = 623.332/1.431
= 435.5919 Meters

:. Sum of Adj Spans = 2 x 435.5919
= 871.1838
Or say = 871 Meters

2) When Deviation = 0

Transverse load due to deviation = 0

:. Allowable Wind load = 701.98

:. Allowable Span = 701.980/1.431
= 490.5521 Meters

:. Sum of Adj Spans = 2 x 490.5521
= 981.1041
Or say = 981 Meters

II **For 30^0 angle (B-Type) towers**

Wind load on conductor (A) = 543.78

$\theta/2$ = 15^0

Transverse load due to deviation (30^0) = 2T Sin $\theta/2$

2T Sin $\theta/2$ = 2 x 4520 x Sin15 = 2 x 4520 x 0.2588

= 2339.552 Kg

Total Transverse load (A+B) = 815.670 + 2339.552

= 2883.332 Kg

1) For a deviation = 29^0 = $\theta/2$ = 14.5

Transverse load due to deviation 29^0 = 2 x 4520 x Sin 14.5

= 2 x 4520 x 0.2504

= 2263.616 Kg

:. Hence allowable load due to wind = 2883.332 - 2263.616

= 619.716 Kg

:. Allowable Span = 619.716/1.431

= 433.065 Meters

:. Sum of Adj Spans = 2 x 433.065

= 866.13

Or say = 866 Meters

2) For a deviation = 28^0 = $\theta/2$ = 14

Transverse load due to deviation 28^0 = 2 x 4520 x Sin 14

= 2 x 4520 x 0.2419

= 2186.776

:. Allowable load due to wind = 2883.332 - 2186.776

= 696.556 Kg

:. Allowable Span = 696.556/1.431

= 486.7617 Meters

:. Span of Adj Span = 2 x 486.7617

= 973.5234

Or say = 973 Meters

3) For a deviation = 27^0 = $\theta/2 = 13.5$

Transverse load due to deviation 27^0 = 2 x 4520 x Sin 13.5
= 2 x 4520 x 0.2334
= 2109.936

:. Allowable load due to wind = 2883.332 - 2109.936
= 773.396 Kgs

:. Allowable Span = 773.396/1.431
= 540.4584 Meters

:. Sum of Adj Spans = 2 x 540.4584
= 1080.917
Or say = 1081 Meters

III For 60^0 angle (C-Type) towers

Wind load on conductor (A) = 543.78

Transverse load due to deviation (60^0) = 2T Sin $\theta/2$

2T Sin $\theta/2$ = 2 x 4520 x Sin15 = 2 x 4520 x 0.5

= 4520 Kg

Total Transverse load (A+B) = 4520 + 543.78
= 5063.780 Kg

1) For a deviation = 59^0 = $\theta/2 = 29.5$

Transverse load due to deviation 59^0 = 2 x 4520 x Sin 29.5
= 2 x 4520 x 0.4924
= 4451.296 Kg

:. Hence allowable load due to wind = 5063.780 - 4451.296
= 612.484 Kg

:. Allowable Span = 612.484 / 1.431
= 428.0112 Meters

:. Sum of Adj Spans = 2 x 428.0112
= 856.0224
Or say = 856 Meters

2) For a deviation = 58^0 = $\theta/2 = 29$

Transverse load due to deviation 58^0 = 2 x 4520 x Sin 29
= 2 x 4520 x 0.4848
= 4382.592

:. Allowable load due to wind = 5063.780-4382.592
= 681.188 Kgs

:. Allowable Span = 681.188/1.431
= 476.0224 Meters

:. Sum of Adj Spans = 2 x 476.0224
= 952.0447
Or say = 952 Meters

3) For a deviation = 57^0 = $\theta/2 = 28.5$

Transverse load due to deviation 57^0 = 2 x 4520 x Sin 28.5
= 2 x 4520 x 0.4772
= 4313.888

:. Allowable load due to wind = 5063.780 - 4313.888
= 749.892 Kgs

:. Allowable Span = 749.892/1.431
= 524.0335 Meters

:. Sum of Adj Spans = 2 x 524.0335
= 1048.067
Or say = 1048 Meters

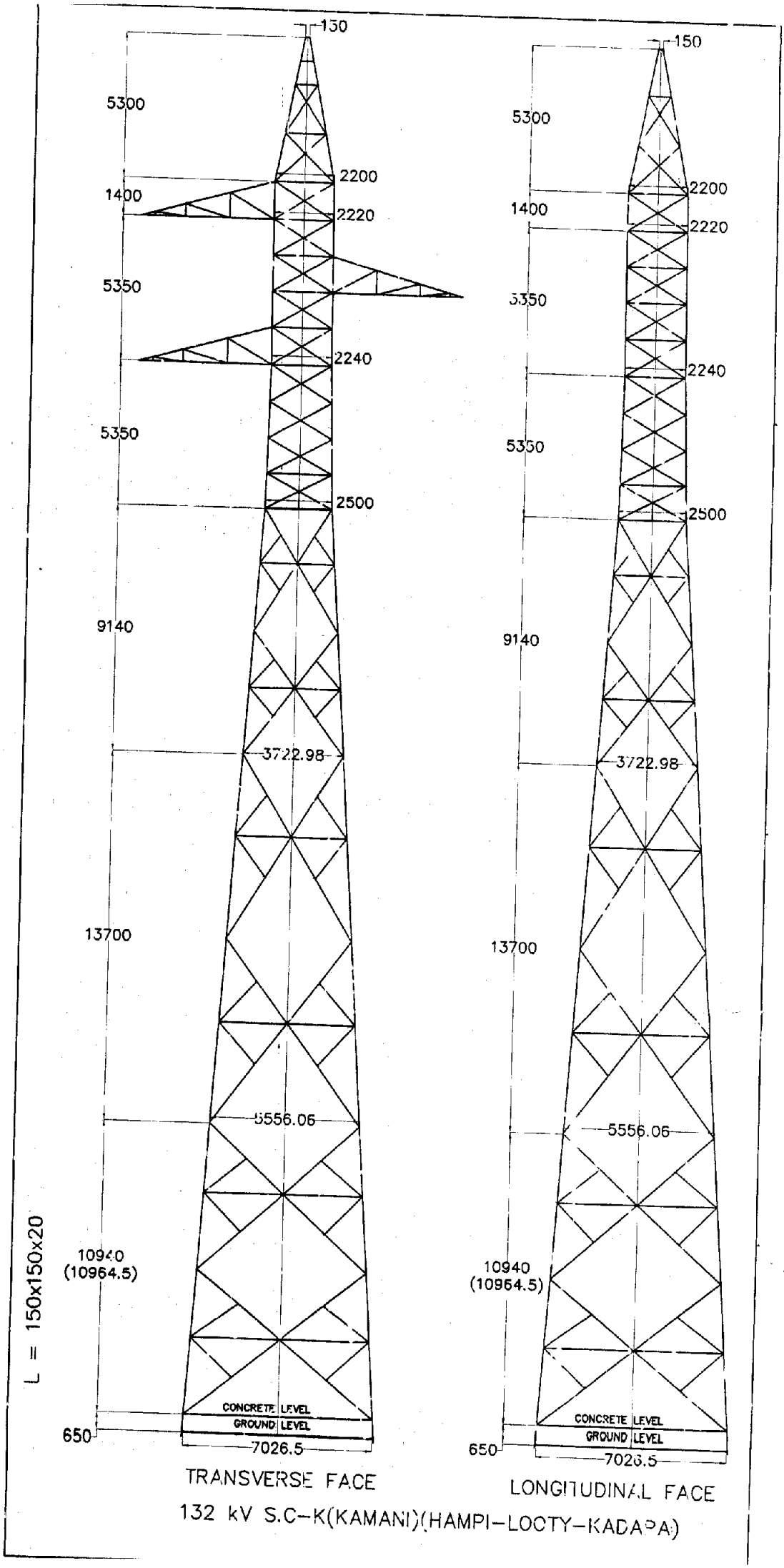
4) For a deviation = 56^0 = $\theta/2 = 28$

Transverse load due to deviation 56^0 = 2 x 4520 x Sin 28
= 2 x 4520 x 0.4695
= 4244.28

:. Allowable load due to wind = 5063.780 - 4244.28
= 819.500 Kgs

:. Allowable Span = 819.500/1.431
= 572.6765 Meters

:. Sum of Adj Spans = 2 x 572.6765
= 1145.353
Or say = 1145 Meters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2200
1400
2220
5350
2240
5350
2500
9140
3722.98
13700
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10940
(10964.5)
650
CONCRETE LEVEL
GROUND LEVEL
7026.5
TRANSVERSE FACE
150
5300
2200
1400
2220
5350
2240
5350
2500
9140
3722.98
13700
5556.06
10940
(10964.5)
650
CONCRETE LEVEL
GROUND LEVEL
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LONGITUDINAL FACE
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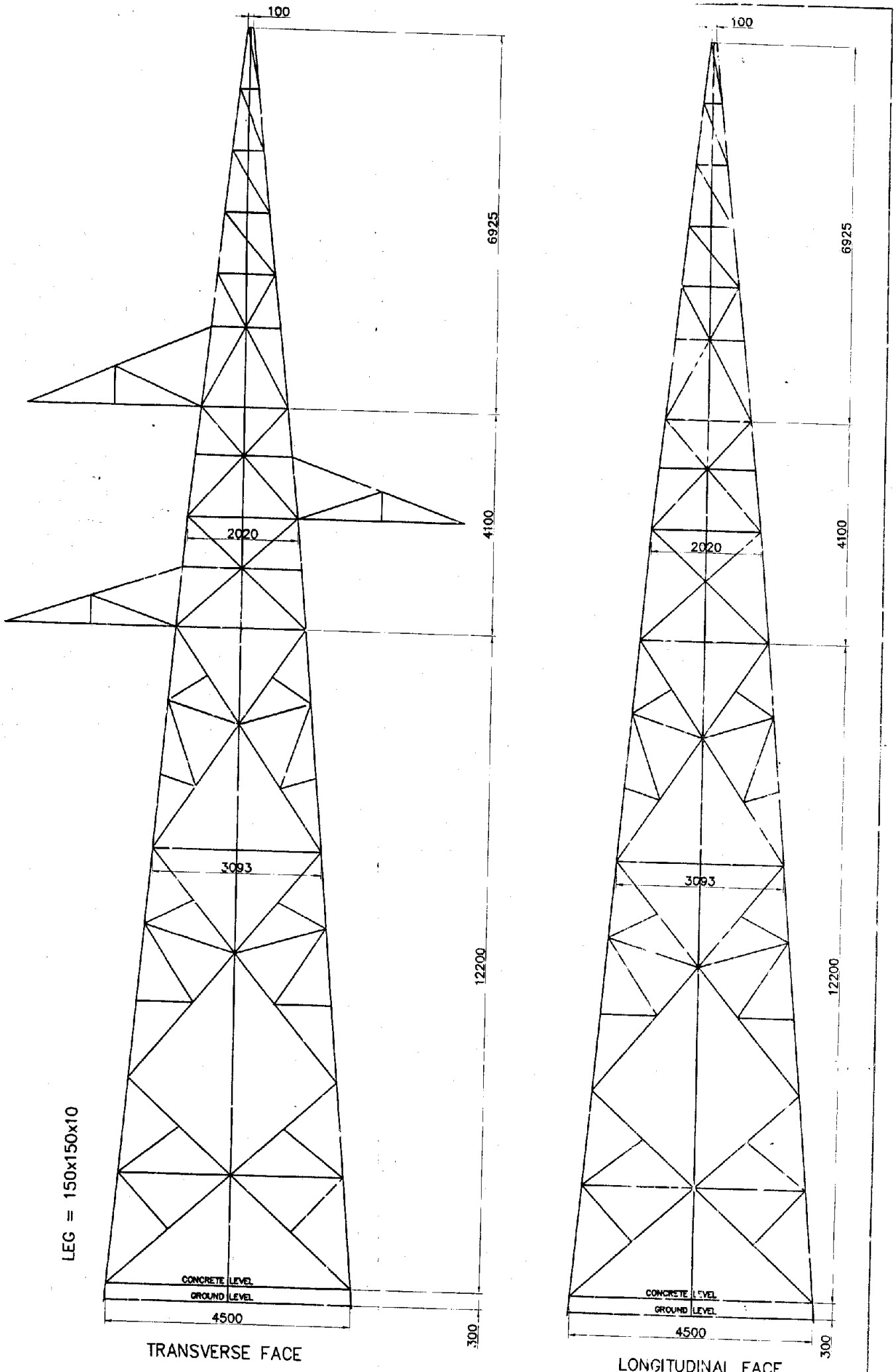
132 kV S.C-K(KAMANI)(HAMPI-LOCTY-KADAPA)



132 KV S.C–RT3(KAMANI)

(1) S/B.

Vertical Load Limitations

i) a) weight span of conductor

1) 'A' - type tower = $\frac{702 - 230}{1.619} = \frac{472}{1.619}$ = 291.538

Or say = 292 Meters

2) 'B' - type tower = $\frac{812 - 390}{1.619} = \frac{422}{1.619}$ = 260.6547

Or say = 261 Meters

3) 'C' - type tower = 261 Meters

ii) Effect of two spans (for weight span of conductor)

475 meters for all types of towers

Effect one span

Tangent = $\frac{702 - 230}{1.619} = \frac{472}{1.619}$ = 291.538 Meters

Angle = $\frac{812 - (200+150)}{1.619}$ = 285.3613 Meters

b) Weight span of ground wire

(i) Effect of single span (for all types of towers)

Tangent = $\frac{313 - (150+5)}{0.578} = \frac{158}{0.578}$ = 273.3564 Meters

Angle = $\frac{313 - (150+10)}{0.578} = \frac{153}{0.578}$ = 264.7059 Meters

(ii) Effect of two spans = 475 meters for all types of towers

c) 1) Weight of conductor

i) Both Spans = 768 Kg for all types of towers

ii) Effect of single span (A-type) = 472 Kg

Effect of single span (B&C-type) = 462 Kg

d) Weight of ground wire

i) Both Spans = 275 Kg for all types of towers

ii) Effect of single span = 160.5 Kg

Max individual span -- 400 mts for A

450 mts for B

500 mts for C