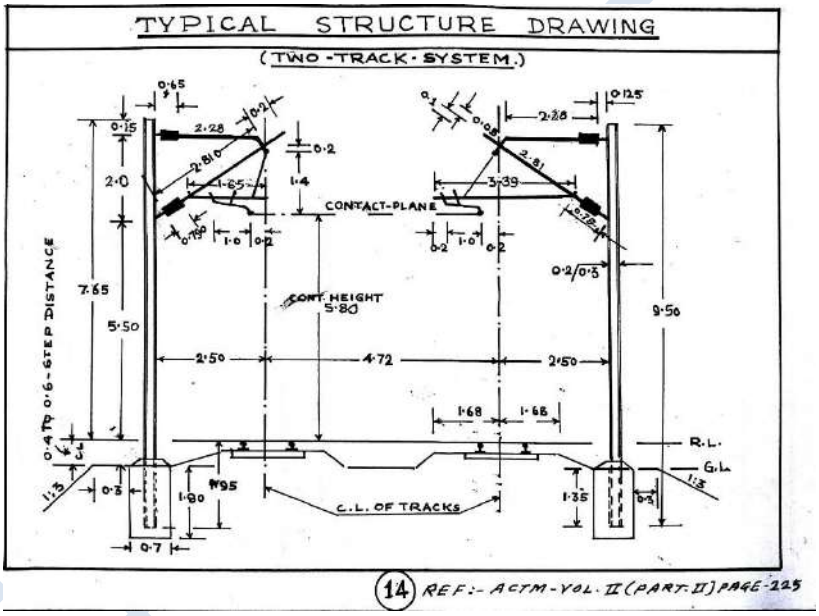
OHE STRUCUTRES

Different types of structures used to support OHE are: -

1. Broad Flanged Beam (BFB) mast
2. Rolled Steel Joist (RSJ) mast
3. Fabricated mast (K-series, B-series etc.)
4. Two/Three Track Cantilever (TTC)
5. Portal (N, O, R, P, G and BFB 6X12)
   - OHE conductors are suspended from swiveling cantilever assembly generally erected on individual mast.
   - The masts for standard applications viz. masts for single OHE, anti-creep and overlaps should be selected from the mast employment schedules.



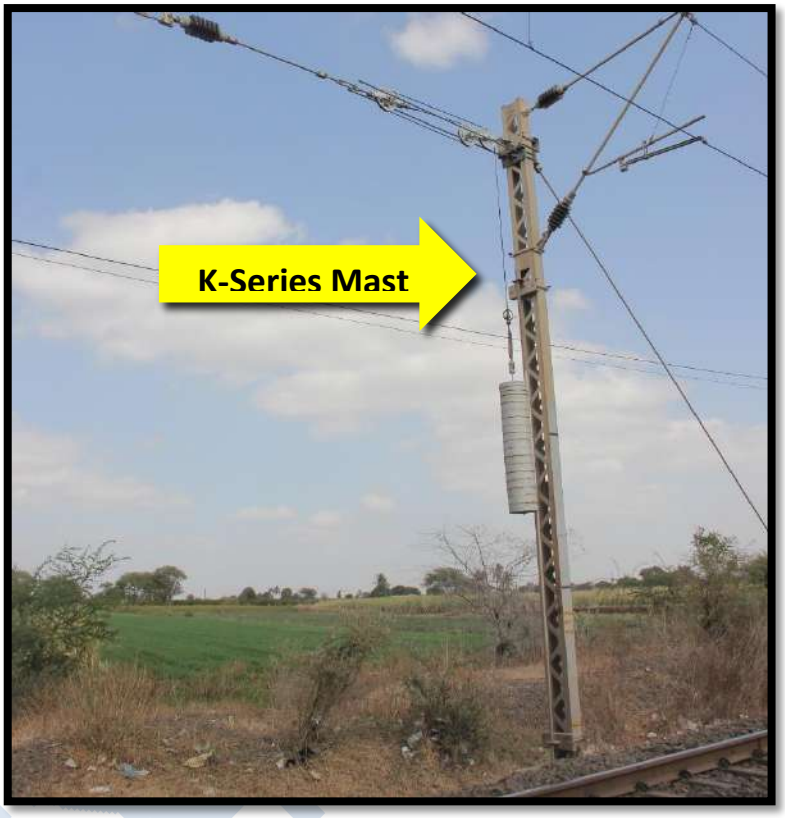
Type of MAST

(Rolled Steel Joist Mast) that is RSJ Mast

RSJ of size 203x152 mm (8"x 6") is suitable for supporting Double OHE. This type of mast is suitable for resisting both bending moment and twisting moment. The approximately weight of mast is 53.30Kg/meter.

➢ **BFB Mast (Broad Flanged Beam Mast)**

Its Size is 152x 152 mm, suitable for single OHE 200x200 mm is suitable for supporting Double OHE. Good for resisting bending moment but weak in arresting twisting moment.



Mast arrangement on Bridge

DROP ARMS (BFB & RSJ)

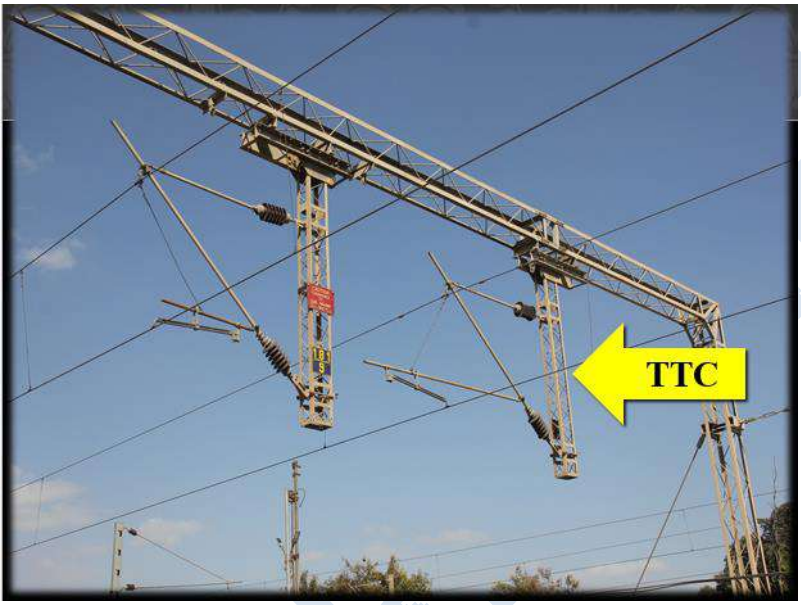
6”x 6” BFB drop arm is suitable for single Back to Back bracket .
8”x 6” RSJ drop arm is suitable for multiple back to back brackets.
The above style of drop arms of rolled section
helps in avoiding bird nesting.

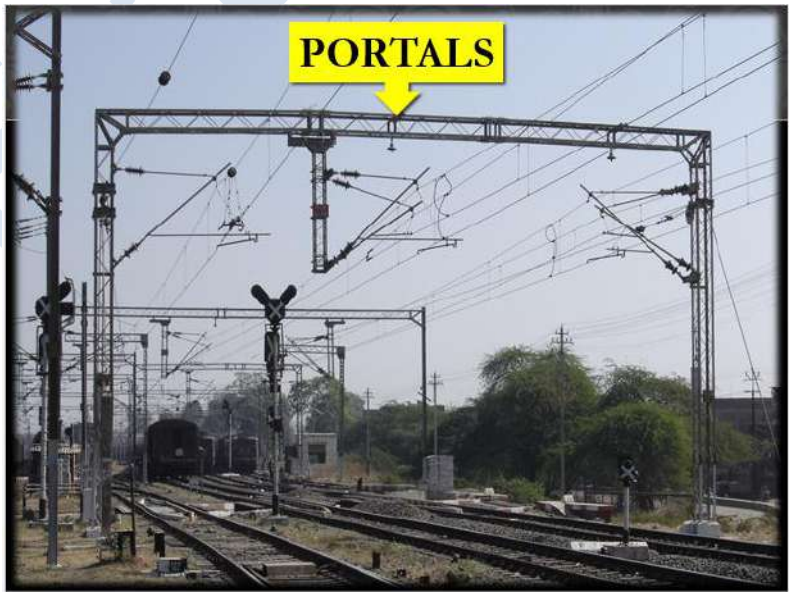
SECTIONS OF MASTS

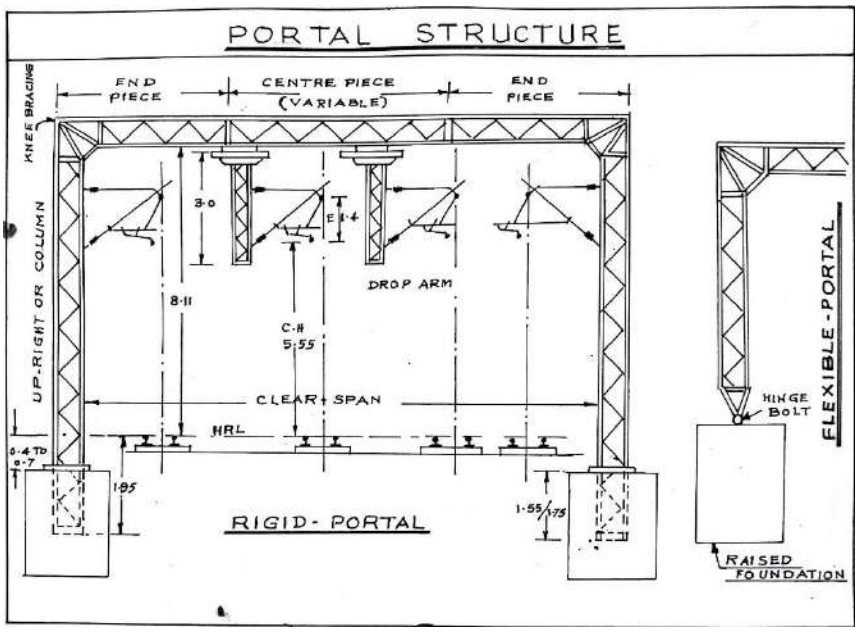
A SINGAL VERTICAL POST, EMBEDDED IN THE FOUNDATION OR OTHER-WISE RIGIDILY FIXED IN VERTICAL POSITION TO SUPPORT THE OVER-HEAD EQUIPMENT WITH ITS ASSOCIATED FITTINGS, IS CALLED MAST. IT MAY BE ROLLED STEEL SECTION OR FABRICATED. THE UP-RIGHTS OF PORTALS AND T.T.C. ARE ALSO CALLED MASTS.

BROAD-FLANGE BEAM.	ROLLED STEEL JOIST.	'B' SERIES	T.T.C.	R-15.	R-16.
BFB-6x6 W-369.286 Kg 152 152 9.50M LONG	W-502.205 Kg 203 152 9.50M. LONG	B-150 = 371.165 B-175 = 423.795 B-200 = 482.220 V 300 V = 100 TO 250 (IN STEPS OF 25) 9.50M LONG B-250 = 671.840	5m Boom - 977.291 Kg ANGLE 65X65X6 225 300 CHANEL 225X80 10.665M. LONG 8m Boom - 1078 Kg	R.S.J. 6"X8" 200 12.4M. LONG.	200 300 R.S.J 8"X6" 148 12.4M. LONG
N PORTAL.	'O' PORTAL.	'P' PORTAL	'G' PORTAL	'R' PORTAL	SPL. BFB PORTAL
ROD-LACING 16φ 450 450 HEIGHT-10.51 ANGLES:- 65X65X5 - N TYPE	ROD-LACING 20φ 550 550 ANGLES 75X75X8 HEIGHT 10.61	CHANEL 300X90 BRACE PLATE 90 120 90 300 300	BRACE PLATE CHANEL 400 X 100 400 250	ANGLES 80X80X8 LACE ROD 20φ 600 600	152 155 WELDING 152 152
max - 1542 Kg min - 1165 Kg	max - 2956 min - 2379				

(10) REF: R.D.S.O. DRG.NO. ETI/C/0018 & 0071/ 004/ 0009 / 0017/ 0006-







DROP ARMS *(BFB & RSJ)*

Separate mast employment schedules have been made for each wind pressure zone as under:

a) Conventional OHE (65 sq.mm Cd-Cu catenary and 107sq.mm copper contact wire):	
Light wind pressure (75 kgf/sq.m)	Drg. No. ET1/C/0702, Sheet 1 to 5.
Medium wind pressure (112.5 kgf/W)	Drg.No.ETI/OHE/G/00153 and 00154, Sheet 1 to 4.
Heavy wind pressure (150 kgf/sq.m)	Drg. No. ETI/C/0726, Sheets 1 to 4. ETI/C/0727, 0728 and 0729.

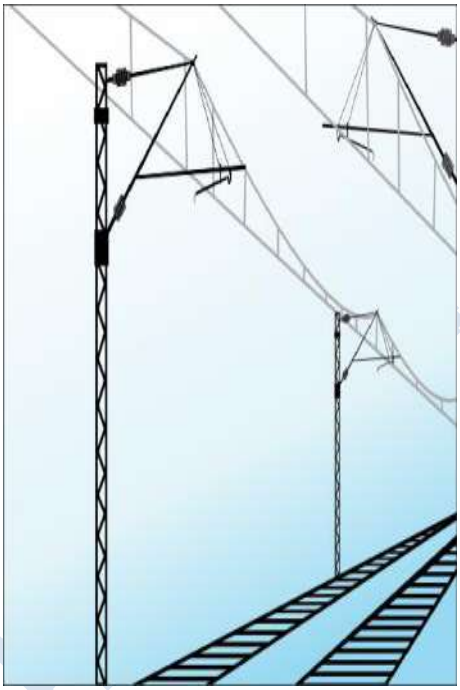
b) Composite OHE (comprising of aluminium alloy catenary and 107 sq.mm copper contact wire with 1000 kgf tension in each conductor).	
Light wind pressure (75 kgf/sqm)	Drg.No.ETI/C/0721 Sheet 1 to 4 & ETI/C/0722,0723, & 0724.
Medium wind pressure (112.5 kgf/sq.m)	Drg No.ETI/C/0717Sheet 1 to 4 & ETI/C/0713,0719 & 0720.

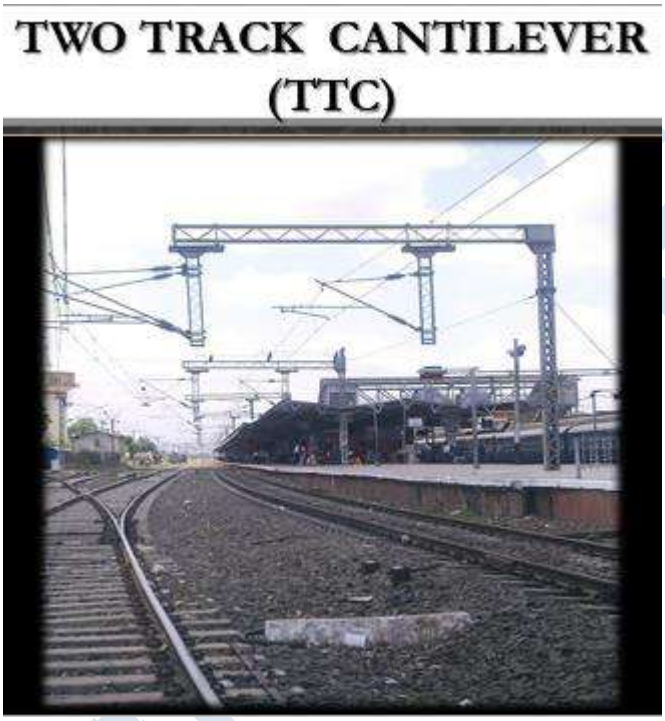
- The mast employment schedules are prepared only for standard setting distance as shown on the screen. (given in Drg. No.ETI/OHE/ G/00111 Sh. 1.)
- For higher implantation's and other locations like masts for turnouts, diamond crossings, umbrella type OHE etc., the load on the mast should be calculated separately for every location and safety of the mast checked in accordance with Drg. No. shown on the screen. (TI/OHE/G/00141 Sheet 3.)
- The permissible bending moments of the masts are given in Drg. No. ETI/SK/C/122.
- On long (more than 150 m) bridges and within 100 m from their abutments on either side and on banks where the height of the catenary above surrounding mean retarding surface is more than 30 m, 25% reduction in wind pressure should not be taken into consideration. These masts should be designed for full wind pressure i.e.

1. Heavy (red) wind pressure zone - 200 kgf/m^2
2. Medium (yellow) wind pressure zone - 150 kgf/m^2

3. Light (green) wind pressure zone - 100 kgf/m^2

- The maximum span should be restricted to 54 m for heavy wind pressure zone and 63 m for medium wind pressure zone.
- In case of curves on the banks of such bridges, the span should be 4.5 m less than the max. span permitted by relevant span and stagger chart, but should not exceed 54 m for heavy (red) wind pressure zone and 63 m for medium (yellow) pressure zone.

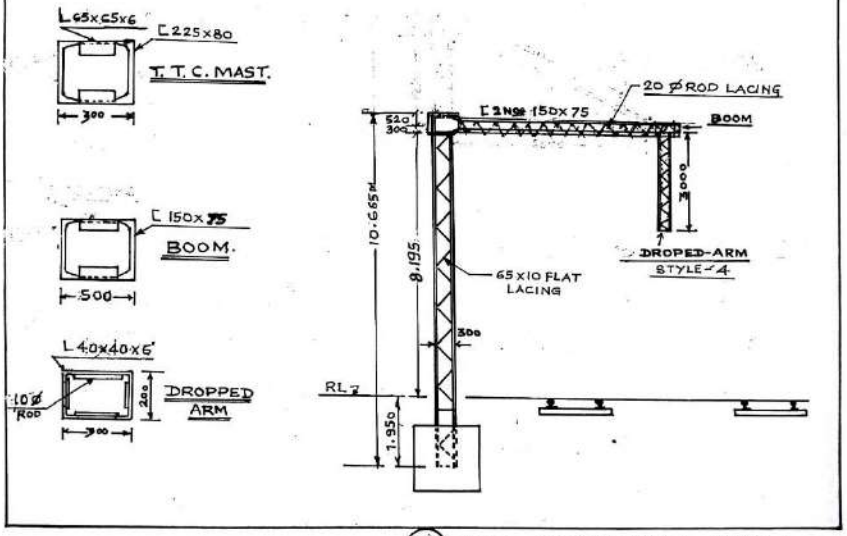




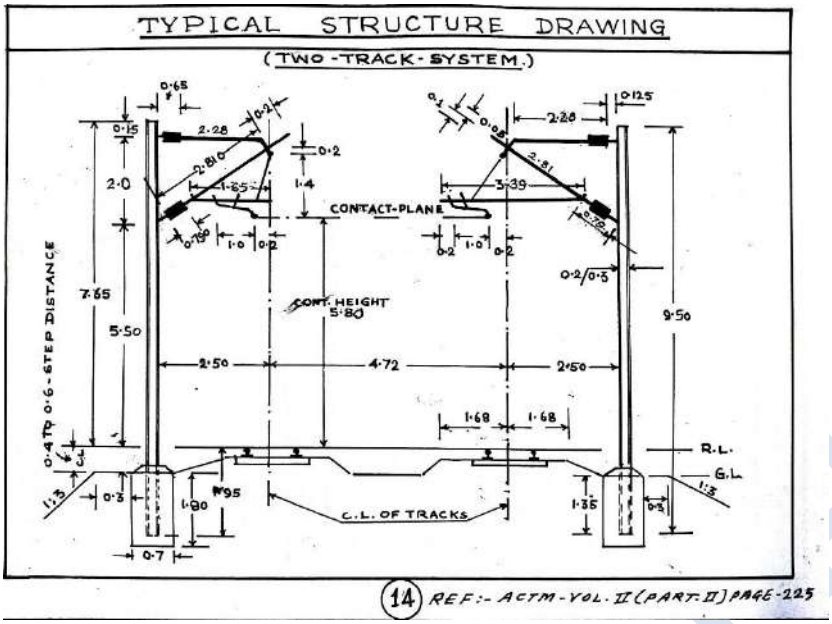
Two Track Cantilever

- In the yards and sidings when the mast cannot be erected near the track to be equipped, it may be erected spanning one or two tracks using a two-track cantilever.
- This is generally used for supporting OHE near turnouts and cross-overs.
- This arrangement should not be used for supporting OHE of two main lines. The OHE can be supported upto a distance of 10.5 m from the upright with this arrangement.

GENERAL ARRANGEMENT OF T.T.C. MAST.

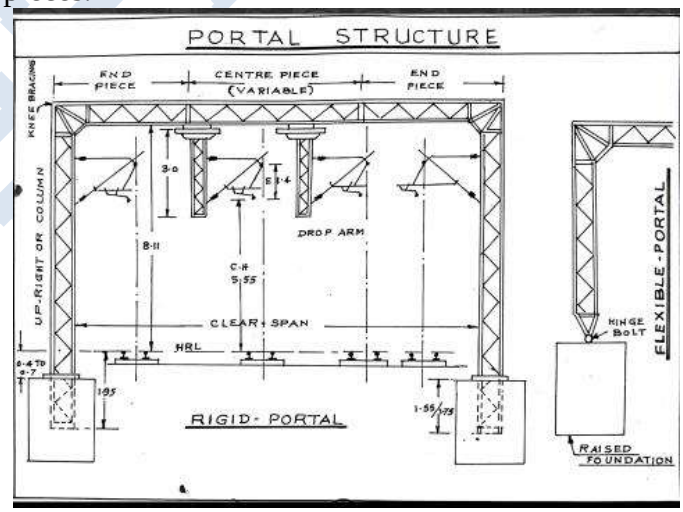


(13) REF:- ETI/C/0009/69 SHEET-1



PORTALS

- On multiple track sections, where adequate track centres are not available and tracks cannot be slewed, portals are used.
- Each portal consists of two fabricated uprights and one fabricated boom consisting of with or without one central piece and two end pieces.



Three types of portals have been standardized.

1. 'N' type portal for clear spans of 10m – 20 m (4 tracks max.)
2. '0' type portal for clear spans of 20 m -30 m (for 6 tracks max.) and
3. 'R' type portal for clear spans of 30 m -40 m (for 8 tracks max.)

Different Types of Portals

Type	Size	Used for	Angle size	Clear span	Lacing Rod Diameter
"N" Type	450 x 450mm	Four Track	65 x 65 x 6mm	10 to 20 meter	16mm

“O” Type	550 x 550mm	Six Track	75 x 75 x 8mm	20 to 30 meter	16mm
“R” Type	600 x 600mm	Eight Track	80 x 80 x 8mm	30 to 40 meter	20mm
“P” Type	300 x 300mm	Four Track	65 x 65 x 6mm	10 to 20 meter	16mm
“G” Type	250 x 400mm	Six Track	75 x 75 x 8mm	20 to 30 meter	16mm

1. Where the upright of standard portals cannot be erected, due to limited track centres, 'P' type portal may be used in place of 'N' type and 'G' type may be used in place of ‘O' type.
2. The width of upright of these portals is 300 mm for P-Type and 250 mm for G-Type, as against 450 mm of 'N' type and 550 mm of ‘O' type respectively.
3. In exceptional cases, BFB uprights of 152 mm width (Drg. No. ETI/C/0026, Sheet 1) may also be used with 'N' type portal boom.
4. Special BFB portals with 3 legs (Drg. No. ETI/C/0027. Sheet 1) may also be used in exceptional cases where normal portals cannot be used.
5. The cantilevers for the extreme tracks are provided on the uprights of the portals. The cantilevers for the intermediate tracks are provided on the drop-arms suspended from the boom.

‘N’ Type portal

This is used to cover a maximum of 4 tracks with their multiple overhead equipment’s, say 8 overhead equipment’s and return conductors for up and Down main lines. This is also capable of carrying anchors on uprights. The maximum permissible clear span shall not exceed 20.4 m. This portal can with stand a maximum bending moment of 8000 kgm at the base.

‘P’ Type portal

This portal is used for covering 4 tracks with their multiple overhead equipment’s say 8 overhead equipment’s. The maximum clear span permissible is 20.4 m. This is used where the track centers are very tight. This can be used in combination with ‘N’ type portal. This portal can withstand a maximum bending moments of 8,000 kgm at the base.

‘O’ Type portal

This will cover 6 tracks with their multiple overhead equipment’s (say 12 overhead equipment’s) and return conductors for Up and Down main lines. This is designed to carry anchors on their uprights. The clear span for this portal shall not exceed 30.50 m. This portal can withstand a maximum bending moments of 17,000 kgm at the base.

BFB portal

This is designed to cover 5 tracks, but can carry 6 overhead equipment’s only. The clear span shall not exceed 24.6 m. This is a special type of portal and can be used where the track centres are very minimum and un-avoidable. For this portal more than one central piece shall not be used. This is not designed to carry anchor loads on uprights. This can be used in combination with ‘N’ portal. This can withstand a maximum bending moment of 8000 kgm at the base.

‘G’ Type portal

This portal is used for covering 6 tracks with their multiple overhead equipment’s say 12 overhead equipment’s.

The maximum clear span permissible is 30.5 m. This is used where the track centers are very tight. This can be used in combination with ‘O’ type portal. This portal can withstand a maximum bending moments of 17,000 kgm at the base.

‘R’ Type portal

This portal is designed to carry multiple overhead equipment’s covering 8 tracks with 2 return conductors and can carry anchors on the uprights.

The clear span shall not exceed 36.00 m. This portal can withstand a maximum bending moments of 20,000 kgm at the base.

Three upright portal is a non-standard portal and may be used in yards with tight track centers only, where the use of standard `N' `O' & `R' type portals is not possible.

Sr. No	Item	Weight in kg		Upright length in Mtrs.	Remarks
		(Min.)	(Max.)		
1	K - 100	225.150		9.50	
2	B - 100	263.245		9.50	
3	K - 125	287.305		9.50	
4	B - 125	308.465		9.50	
5	BFB 6 x 6 x 25 l b	361.285		9.50	
6	T-150	362.514		9.50	
7	K - 150	362.710		9.50	
8	B - 150	371.165		9.50	
9	K - 175	415.340		9.50	
10	B - 175	423.795		9.50	
11	K - 200	473.765		9.50	
12	B - 200	482.220		9.50	
13	BFB 200 x 200 x 49.90 kg	486.400		9.50	
14	RSJ 8 x 6 x 35 l b	502.205		9.50	
15	K - 225	546.250		9.50	
16	B - 225	584.258		9.50	
17	K - 250	633.840		9.50	
18	B - 250	671.840		9.50	
19	TTC upright	616.635		10.135	
20	TTC Boom 5.50 m.	263.312		5.50	
21	TTC Boom 8 m.	362.829		8.00	
22	TTC K.B.	43.834			
23	TTC complete with Boom 5.50 m.	977.291		10.135	
24	TTC complete with Boom 8 m.	1078.00		10.135	
25	N-Type Portal	1165	1542	10.51	Clear Span 9.91m (Min) 20.36m (Max)
26	O-Type Portal	2379	2956	10.61	Clear Span 20m (Min) 30.5m (Max)
27	DA-I for R Type portal. (Single cant.)			121.78	
28	DA-I for TTC. (Single cant.)			115.414	
29	DA-I including channels (N type portal)			118.00	
30	DA-I including channels (O type portal)			121.00	
31	DA-II for R Type portal. With MCC			129.103	
32	DA-II for O / G Type portal.			128.427	
33	DA-II for N / BFB Type portal. With MCC			124.73	

HEAD SPANS

In yards where un-regulated-regulated OHE is used head span may also be used to cover more than 6 tracks. Standard head span arrangement is given in Drg. No. ETI/OHE/G/03201. The head span arrangements are not used normally.

OUT-OF-PLUMB MASTS

Inspite of the care taken in design and erection, OHE masts do sometimes get out of plumb.

This occurs largely on embankments, due to erosion of earthwork on the outer side of the mast on account of poor drainage or excavations in the vicinity or due to sinking of foundations on new embankments.

OUT-OF-PLUMB MASTS

OHE maintenance staff should, during patrolling and inspection, make a particular check of the condition of earthwork around foundations of masts on embankments.

If the earthwork has been or is likely to be eroded away, the engineering department should be approached to strengthen the embankment.

Arrangement of MASTS

Location of MASTS

Masts are arranged as far as possible in the same line parallel to the track and transverse to the track. Normally, no structure is to be located between any of the running tracks.

Umbrella type

Masts may be fitted with bracket assemblies on both sides to serve adjacent tracks, if the overhead equipment's belong to the same elementary section.

Restrictions

- Masts serving track of different elementary sections should not normally be located between them and in the same line. If two masts serve tracks belonging to two different elementary sections and are located between them, the masts should normally be staggered by 9 m, though a minimum stagger of 4.5 m is permissible in exceptional cases.
- If one of the masts mentioned is an anchor mast, and the anchor falls between the two masts, they should be staggered by 13.5 m minimum.
- If both the masts mentioned are anchor masts and both anchors fall between the masts, they should be staggered by 18 m
- If one of the masts is an anchor mast and the anchor falls away from the masts and the out-of run equipment runs close to the second mast, the spacing of masts should be such that sufficient working clearance is available between the overhead equipment and the second mast. Cut in insulators or special anchor arrangements may be adopted in special cases
- If one of the masts is an anchor mast and the anchor falls away from the masts and the out-of run equipment runs close to the second mast, the spacing of masts should be such that sufficient working clearance is available between the overhead equipment and the second mast. Cut in insulators or special anchor arrangements may be adopted in special cases
- If masts are located on both sides of a track, they shall be staggered by 4.5 m
- Masts for turnouts and diamond crossing should be located at the theoretical centre.
- If unavoidable, 2 metres is the permissible displacement on either side of the theoretical centre of turnout.

Wiring of Loops in Future

- Masts should generally be located and designed to permit wiring of unwired loops and extension of electrification in yards and sidings, in future, conveniently.
- Wherever such provisions is made, future wire-runs should be shown in dotted lines on the layout plans to ensure selection of correct type of masts and foundations.
- Masts with counterweights should be avoided on platforms.

- Masts shall not be located opposite to trolley refuges, close to culverts, subways and on bridges of length less than 50 m.
- Masts shall not be located in front of station entrances.
- No masts shall be located beyond a signal post at a distance less than 10 m. In case the OHE mast is located In the front of the signal the distance between the OHE mast and signal post should not be less than 30m.
- Sections having more than two tracks – Independent structures shall be provided if adequate track centers are available or if tracks can be slewed to obtain adequate track centre.
- Where adequate track centre is not available, portals will normally be used and they must be located in such a way as to facilitate provision of drop arms and bracket assemblies.
- Masts must be located sufficiently far away from level crossings and back of abutments of bridges. The distance between the structure and the border of the level crossings/abutment should not be less than 10 m.
- In case of bad formations, if it is possible to locate the structures on either side of a track, preference must be given to the side with better stability.
- In the case of lined tunnels stubs for supporting overhead equipment cantilever assembly should be provided on both sides of the tunnel, opposite to each other. This would facilitate restoration of overhead equipment in the event of damage to stubs on one side.

Masts on Bridges

Core holes for erecting structures on bridges must be provided on both sides of all piers. Holes on piers which are not used for foundation must be filled with dry sand and covered by a slab.

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