METRO RAILWAY

SCHEDULE OF DIMENSIONS - 1676 mm GAUGE
RECTANGULAR BOXTUNNEL, CIRCULAR TUNNEL
SURFACE & ELEVATED STRUCTURE

Approved by Rly. Board under
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1994

DEN/SPL

METRO RAILWAY

SCHEDULE OF DIMENSIONS - 1676mm GAUGE RECTANGULAR BOX TUNNEL, CIRCULAR TUNNEL, SURFACE & ELEVATED STRUCTURES.

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The dimensions given in this are to be observed in all new Metro Railway works or alterations to Metro Railway works on 1676mm gauge, unless prior sanction has been obtained from the Railway Board through the Commissioner of Railway Safety to execute works which infringe the schedule.

CHAPTER - I GENERAL

(See Diagram No: 1, 1A, 1B & 2)

Spacing of tracks :

1. Minimum distance centre to centre of tracks. ... 3500mm
   Note: See Appendix I for clearance required on curves.

Curves:

2. Minimum radius for curves
   a) On main running lines generally 300metres
   b) On main running lines at difficult locations. ... 200metres

Note: For relation of speed to curvatures, See Appendix - I. In case there is difficulty in providing the full super elevation as shown in Appendix I, the same may be reduced subject to the condition that the cant deficiency should not exceed 75mm.

Bridges:

3. Bridges must conform to requirements of Chapter VII of the Rules for the opening of a Railway or section of a Railway for the public carriage of passengers with appropriate standard of loading for Rapid Transit System (RTS) traffic.(See appendix III for loading standard and Design criteria for elevated structure carrying RTS track).

Buildings and Structures:

4. Minimum horizontal distance from centre of track to any structure except a passenger platform for heights above rail level in straight track(See Diagram No: 1)

i) Upto 25mm	...	1005mm
ii) 25 to 50mm	...	1235mm increasing to 1240mm
iii) 50 to 600mm	...	1661mm
iv) 600 to 2460mm	...	1661mm increasing to 1720mm
v) 2460 to 3250mm	...	1720mm decreasing to 1705mm
vi) 3250 to 3412mm	...	1705mm decreasing to 1618mm
vii) 3412 to 3510mm	...	1618mm decreasing to 1436mm
viii) 3510 to 3875mm	...	1436mm decreasing to 435mm
ix) 3875 to 3895mm	...	435mm

Note: (a) The fixed structure line for curves should be as shown in Diagram No: 1A or 1B.

(b) The term 'structure' covers any item including light ones like ladders, isolated posts, cables etc. erected alongside the track.

(c) The term 'structure' however excludes the Third Rail and its shroud alongwith supporting arrangements, which are governed by items 1 to 5 of Chapter II.

Platform:-

5. (a) Maximum horizontal distance from centre of track to face of passenger platform coping ... 1475mm.

(b) Minimum horizontal distance from centre of track to face of passenger platform coping 1465mm

Note:-(a) Platform faces shall be flared away smoothly from the centre line of the track at either and for a distance of 1500mm so as to give a dimension of 1490mm ± 5mm(1485mm minimum & 1495mm maximum).

(b) See Appendix II for extra clearance on curves.

6. (a) Maximum height above rail level for passenger platform. 1035mm

(b) Minimum height above rail level for passenger platform. 1025mm

Note:- The height of platform serving super elevated track should be in relation to the plane passing through the top of both the rails.

7. Minimum horizontal distance of any structure on a passenger platform from the edge of coping. 1850mm

Note:- a) See diagram no: 2 for item nos: 5 to 7.
b) The structures on the platform include only staircase and columns(referred to in item 7).

Interlocking and Signal Gear:-

8. Maximum height above rail level of any part of interlocking or signal gear for a width of 1235mm on either side of centre of track subject to the restriction embodied in note(a) below. .. 25mm

Note:- a) Except for check rails of ordinary and diamond crossings, or wing rails and point rails of crossings leading to snag dead ends, or such parts of signalling gear as are required to be actuated by the wheels, no gear or track fittings shall project above rail level for a distance of 167mm outside and 100mm inside the gauge face of the rails.

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Points & Crossings :

9. Maximum clearance of check rail opposite nose of crossing. ... 48 mm

10. Minimum clearance of check rail opposite nose of crossing and at heel of switch rail. ... 44 mm

Note: In case of turnouts laid with 1673 mm gauge, the clearance shall be 41 mm instead of 44 mm.

11. Maximum clearance of wing rail at nose of crossing. ... 48 mm

Note: In case of turnouts laid with 1673 mm gauge, the clearance shall be 45 mm instead of 48 mm.

12. Minimum clearance of wing rail at nose of crossings. ... 44 mm

Note: In case of turnouts laid with 1673 mm gauge, the clearance shall be 41 mm instead of 44 mm.

13. Minimum clearance between toe of open switch and stock rail. ... 95 mm

14. Minimum radius of curvature for slip points, turnouts or crossover roads. ... 219 Metr

Note: In special cases mentioned below this may be reduced to not less than the minimum of (i) 213 metres radius in case of 1 in 8½ B.G. turnout with 6.4 metres over-riding switch and (ii) 175 metres radius in case of 1 in 8½ scissors crossing to allow for sufficient straight over the diamond crossing between crossovers.

15. Minimum angle of crossing(ordinary) ... 1 in 16

Note: Crossing as flat as 1 in 20 will usually be sanctioned if recommended by the Commissioner of Railway Safety.

16. Diamond crossings not to be flatter than ... 1 in 8½

Note: The above restrictions shall not apply to switch diamonds.

17. Minimum length of tongue rail. ... 3660 mm

18. Minimum length of train protection point locking or fouling treadle bar. ...12800 mm

Note: There must be no change of superelevation (of outer over inner rail) between points 18 metres outside toe of switch rail and nose of crossings respectively, except in the case of special crossing leading to snag dead-ends or under circumstances as provided for in item 19.

19. Superelevation and speed in stations on curves with turnouts of contrary and similar flexure.

Contd

Main line:

Subject to the permissible run through speed based on the standard of interlocking, the equilibrium super elevation, calculated for the speed of the faster train may be reduced by a maximum amount of 75mm without reducing speed on the main line.

Turnouts:

Curves of contrary flexure :

The equilibrium superelevation in millimetres should be calculated by the formula below :

$$C = \frac{11860}{R}$$

Where R = radius of turnout in metres.

The permissible negative superelevation on the turnout (which is also the actual superelevation of the main line) may then be made ... 75 - Cmm.

The question of reduction or otherwise of superelevation on the main line must necessarily be determined by the Administration concerned. In the case of a reverse curve close behind the crossing of a turnout the superelevation may be run out at the maximum of 1mm in 333.33mm.

Guard Rails:

20. Maximum height above rail level of any part of guard rail or guard rail fixture/part wherever provided within the track subject to the restictions embodied in item 8 note (a) 25mm

Note on clearance for fixed structures on straight track and on curves.

A. The fixed structures line has been arrived at taking into account the following factors :

1. Track :

a) Track alignment tolerance - laying ... 12mm
b) Track alignment tolerance -in service 6mm
c) Max. rail wear - lateral ... 10mm
d) Max. rail wear - vertical... 10mm
e) Track unevenness - laying ... 12mm
f) Track unevenness - maintenance 6mm
g) Gauge tolerance (i) on straight ... 10mm
(ii) on curves sharper than 500M radius ... 19mm
(iii) On curves of 500M radius and flatter...13mm
h) Superelevation - As indicated in Appendix I
i) Radius of vertical curves(for calculation of vertical throw). ... 1500M

2. Rolling Stock:

a)	Clearance between wheel flange & rail ...	... 9mm
b)	Maximum flange wear ...	... 12mm
c)	Coach manufacturing tolerance ...	... 5mm
d)	Bolster sway ...	... 35mm
e)	Length of coach ...	...19500mm
f)	Distance between bogies ...	13515mm
g)	Profile of coach ...	As in diagram no:1
h)	i) Max. secondary spring deflection	51mm from tare
	ii) Max. secondary spring off loading	25mm from tare
i)	i) Max. primary spring deflection	20mm from tare
	ii) Max. primary spring off loading	20mm from tare
j)	i) Bolster spring base ...	... 1600mm
	ii) Primary spring base ...	... 2210mm
k)	Tyre wear - Restricted ...	... 10mm
	- Unrestricted	... 40mm

3. Dynamic characteristics:

a) Nosing of coach due to lateral displacement of track and coach.

b) Tilting of coach due to dynamic off loading and onloading of secondary and primary springs. The angle for 'Roll & Tilt' has been taken as 3° - 45'.

c) Deflection due to pay load: (taken as 70mm for floor beam and 35mm for undergear).

d) Pitching of the coach due to track unevenness as well as relative off loading and onloading of springs at either end.

B. Extra allowance on curves:

The following are the extra allowances considered for curves.

i) Allowance for curvature:

The allowance for curvature consists of:

a) Middle throw at the centre of the vehicle

$$V = \frac{(13.515)^2}{8R} \times 1000 = \frac{22832}{R} \text{ mm}$$

b) End throw at the end of the

Vehicle = $V_o = \frac{(19.50)^2}{8R} \times 1000 - \frac{22832}{R} = .\frac{24699}{R}$ mm

ii) Allowance for superelevation:

A) Rectangular box tunnel, surface and elevated structure

The lean L due to super elevation at any point at height 'h' above rail level is given by $L = \frac{h}{g} \times s$

where s = super elevation
g = distance between centres of rails

b) Circular tunnel :

The lean 'L_1' due to super elevation at any point at vertical distance 'h_1' from the centre of circular tunnel is given by $L_1 = \frac{h_1 \times s}{g}$

where s = superelevation
g = distance between centres of rails.

Note:- In circular tunnel, the super elevation is provided by rotating the track and coach profile about the central axis of the circular tunnel. The track centre line gets shifted due to this.

iii) Allowance for additional sway on curves

Additional sway is kept at 10mm.

iv) Extra due to gauge widening on curves (as in item (g) of para A).

a) On curves sharper than 500 M radius ... 9mm

b) On curves of 500 M radius and flatter ... 3mm

v) Additional nosing due to extra gauge tolerances and additional sway on curves.

Additional nosing to be calculated is say 'N'.

C. Fixed Structures Lines on inside of a curve :

For obtaining fixed structure line, extra allowance to be added is =(i) V + L+10mm+ 9mm for curves sharper than 500 M radius.

ii) V + L + 10mm + 3mm for curves of 500 M radius and flatter.

D. Fixed structure line at the outside of a curve:

For obtaining the fixed structure line, extra allowance to be added:

i) Vo + 10mm + N + 9mm for curves sharper than 500 M radius.

ii) Vo + 10mm + N + 3mm for curves of 500 M radius and flatter.

Note: Relief due to lean on the outside of the curve is not considered to cater for eventual non provision of superelevation or reduction in superelevation.

E. Extra clearance between adjacent tracks:

The worst case will be when the end of a bogie carriage on the inner track is opposite the centre of a similar carriage on the outer track. Extra clearance = V + Vo + L + 2 x 10mm + N.

Note: Lean due to superelevation is taken because the inner track may have a different superelevation or, in exceptional case, none at all.

F. Platforms:

The additional clearance for platforms on curves is to be provided as follows: -

On inside of curve = V + L + 10mm

On outside of curve = Vo + 10mm

Note:- Relief due to lean on the outside of the curve is not considered as in 'D' above.

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METRO RAILWAY

SCHEDULE OF DIMENSIONS - 1676 mm GAUGE

APPENDIX-I

Permissible speed and track centres on curves.

Radius of curvature	Maximum permissible speed (kmph)	Superelevation (mm)	Minimum distance between two adjacent tracks (mm)
2000 M	80	40	3615
1500 M	80	55	3650
1000 M	80	80	3710
700 M	80	120	3800
500 M	80	150	3880
400 M	70	150	3905
300 M	60	150	3945
200 M	45	130	3990

Note: Figures for any intermediate radius of curvature may be obtained by interpolating between two adjacent radii. For higher radii, values may be extrapolated. For greater accuracy, values may be independently calculated.

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APPENDIX - II

Extra clearance for platforms on curves

Extra clearance over the dimensions as shown in item 5 when the adjacent track is on a curve.

Radius (in metres)	Extra clearance (in mm)	
	For platform on inside of curve	For platform on outside of curve
400	156	72
500	144	60
700	114	45
1000	80	35
1500	58	27
2000	45	22

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Chapter II - Electrical Traction (Direct Current) with Conductor Rail.

1.	(a) Maximum height from rail level to the top (current collecting surface) of the conductor rail.	... 164 mm
	(b) Minimum height from rail level to the top (current collecting surface) of the conductor rail.	
	(i) New installation.	... 156 mm
	(ii) Wornout condition.	... 126 mm
2.	(a) Maximum distance of centre line of the conductor rail from the track centre.	... 1500 mm
	(b) Minimum distance of centre line of the conductor rail from the track centre.	... 1480 mm
3.	Minimum distance between the bottom of the shroud and top of the conductor rail.	... 90 mm
4.	Minimum distance between the centre line of the conductor rail and the shroud structure.	... 171 mm
5.	(a) Maximum distance between the centre line of the track and tip of the shroud.	... 1420 mm
	(b) Minimum distance between the centre line of the track and tip of the shroud.	... 1400 mm

Chapter III - Metro Coaching Stock (Electrical Multiple Unit)

1.	Wheel and axle.	
	(a) Maximum wheel gauge distance	... 1602 mm
	(b) Minimum wheel gauge distance	... 1599 mm
2.	(a) Maximum diameter on the tread of carriage measured at 63.5 mm from wheel gauge face.	... 860 mm
	(b) Minimum diameter on the tread of carriage measured at 63.5 mm from wheel gauge face.	... 780 mm
3.	(a) Minimum projection for flange of new tyre measured from tread at 63.5 mm from wheel gauge face.	... 28.5 mm
	(b) Maximum projection for flange of worn type, measured from tread at 63.5 mm from wheel gauge face.	... 35.0 mm

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4.	(a) Maximum thickness of flange of tyre measured from wheel gauge face at 13 mm from outer edge of flange.	... 28.5 mm
	(b) Minimum thickness of flange of tyre measured from wheel gauge face at 13 mm from outer gauge of flange.	... 16 mm
5.	Minimum width of tyre.	... 127 mm
6.	Incline of tread.	...1 in 20
7.	Height of floor.	
	(a) Maximum height above rail level for floor of any unloaded vehicle.	... 1160 mm
	(b) Minimum height above rail level for floor of any loaded vehicle.	... 1080 mm
8.	Buffer and Couplings.	
	(a) Maximum height of centre buffers above rail level for unloaded vehicle.	... 860 mm
	(b) Minimum height of centre buffers above rail level for loaded vehicle.	... 780 mm
	Wheel base and length of vehicle.	
9.	Distance apart of bogie centres.	...13515 mm
10.	Length of underframe overhead stock.	...19500 mm
11.	Length over buffers.	...20400 mm
12.	Maximum distance apart between any two adjacent axles.	...11065 mm
13.	Length of rigid wheel base for single bogie.	... 2450 mm

Note: As there is only one design of vehicle, only one dimension is given in this Chapter for each item.

CHAPTER IV - SPECIAL ROLLING STOCK (NON TRAFFIC)

(A) WAGON STOCK (NON TRAFFIC)

All special wagon stock (non traffic) will be

(1) within the standard static and dynamic profile of Metro Railway Rolling Stock.

(2) In accordance with the dimensions indicated in Chapter III - for Metro Coaching Stock(Electrical Multiple Unit) except for the following : -

(1) WHEEL & AXLE

a) Maximum diameter on the tread of new wagon wheel measured at 63.5mm from wheel gauge face. 1092mm

b) Minimum diameter on the tread of new wagon wheel measured at 63.5mm from wheel gauge face. 860mm

(2) HEIGHT OF FLOORS

a) Maximum height above rail level for floor of any unloaded wagon 1345mm

b) Minimum height above rail level for floor of fully loaded wagon 1080mm

(3) BUFFERS & COUPLINGS

Same as Chapter III i.e. Metro Coaching Stock

(4) WHEEL BASE & LENGTH OF VEHICLE

a) Maximum rigid wheel base for wheeled wagon. 6000mm

b) Minimum distance apart of bogie centres for bogie wagons. ... 2/3rd of length of b of vehicle.

c) Maximum distance apart of bogie centres for bogie wagons. ... 12000mm

d) Minimum rigid wheel base for bogie 1830mm

e) Maximum length of body or roof or underframe overhead stock. ...

i) 4 wheeler vehicles. ... 8540mm

ii) Bogie vehicle. 18000mm

f) Maximum length over buffers

i) 4 wheeler wagon 9440mm

ii) Bogie vehicle. 18900mm

g) Maximum distance apart between any two adjacent axle. 10170mm

Note:- This does not apply to Crocodile(Well Type) wagons.

(B) BATTERY LOCOMOTIVE(NON TRAFFIC).

All dimensions shown in Chapter III for Metro Coaching Stock will equally apply to Battery Locomotive.

APPENDIX-III

LOADING STANDARDS AND DESIGN CRITERIA FOR ELEVATED STRUCTURE.

1. Scope - For the design of elevated structures carrying rapid transit track, the following loading standard is specified. Wherever expressly not provided for, the relevant provisions under Bridge rules shall be adopted.

2. Loads: - For the purpose of computing stresses the following items shall where applicable, be taken into account.

a) Dead Load
b) Live Load
c) Impact effect
d) Forces due to curvature and eccentricity of track
e) Temperature effect
f) Frictional resistance of expansion bearings
g) Longitudinal force
h) Racking force
i) Forces on parapets
j) Wind pressure effect
k) Forces and effect due to earthquake
l) Erection forces and effects

3. Dead Load: Dead load is weight of structure itself together with permanent load carried thereon. For the purpose of calculations, the dead load for various materials shall be adopted from IS-1911-1967.

4- Live Load:- a) The live load due to RTS rolling stock shall be taken as per the axle load diagram as enclosed.

b) For footpaths the live load with impact shall be taken as $490/kgm^2$ of the footpath area.

c) The load on footpath for the purpose of designing the main girders shall be as per para 2.3.2.2 of Bridge Rules.

5. Impact Effect:- The impact effect shall be as per clause 2.4 of Bridge Rules.

6. Forces due to curvature and eccentricity of track:- Shall be as per clause 2.5 of Bridge Rules.

7. Temperature Effect: Shall be as per clause 2.6 Bridge Rules.

8. Frictional resistance of expansion bearing:-Shall be as per clause 2.7 of Bridge Rules.

9. Longitudinal Forces:- Longitudinal forces shall be considered as per clause 2.8 of Bridge Rules except that in regard to clause 2.8.2 the tractive effort or braking force for loaded length L shall be as under : -

a) Tractive effort : - 20% of the axle loads on the loaded length L.

b) Bracking force: - 15% of the axle loads on the loaded length L.

Further, in addition to the longitudinal forces covered by clausex 2.8 of Bridge Rules, the longitudinal force due to one rail fracture shall also be considered in the design of the structures. In such an event, the allowable stresses may be increased by 33.1/3%

10. Racking Forces: Horizontal lateral loading from racking forces shall be taken in the form of a uniformly distributed load of 400kg/metre per track acting at the top of rail head. No impact effect need be considered for this loading.

11. Forces on parapets:- Shall be as per clause 2.10 of Bridge Rules.

12. Wind pressure effect:- Shall be as per clause 2.11 of Bridge Rules.

13. Forces and effects due to earthquake: Shall be as per clause 2.12 of Bridge Rules.

14. Forces due to derailment:- The structure shall be designe for derailment conditions of one or more wheels assuming that one set of derailed wheels will be confined within the guard rails. No increase in impact effect need be considered provided permissible stresses are not increased.

15. Live load for platform: Platforms shall be ~~daxing~~ designed for a crowed load of 750kg/m^2 or a point load of 1.5 tonnes placed anywhere on the platform. No impact ~~xfxxx~~ effort for live load need be considered.

16. Design criteria:-

16.1 Each track shall be supported on beam and slab arrangement. The beam shall be simply supported over supports and shall be designed as T. Beam.

16.2 Steel bearing shall be used for each beam at support points

16.3 All beams and slab shall be of RCC with M.200 grade concrete.

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16.4 Design of RCC beam shall conform to I.R.S. Concrete Bridge Code.

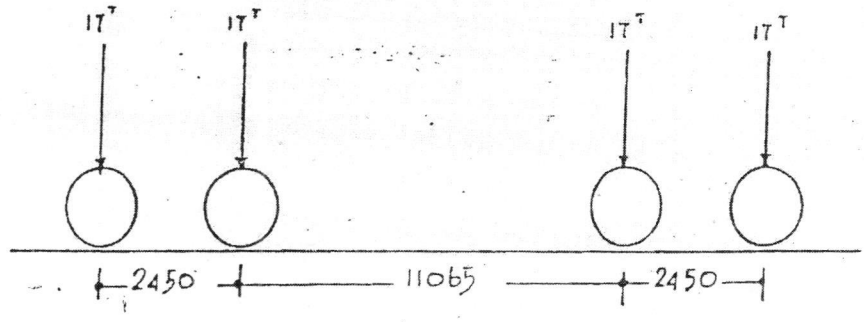
16.5 Supports of beam shall be of R.C. portal with two columns and a cross beam (Caping beam).

16.6 R. C. portals shall be fixed at base on pile caps.

16.7 Foundation of portals shall comprise of Driven, cast in situ R. C. C. pile.

16.8 Design of portals and pile foundation shall conform to I.R.S. Sub-structure code and IS: 2911(Part-1)-64.

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LOADING DIAGRAM SHOWING AXLE LOADS OF METRO RTS COACH

METRO RAILWAY

FIXED STRUCTURE LINE ON STRAIGHT TRACK

CHAPTER-I ITEM NO. 4

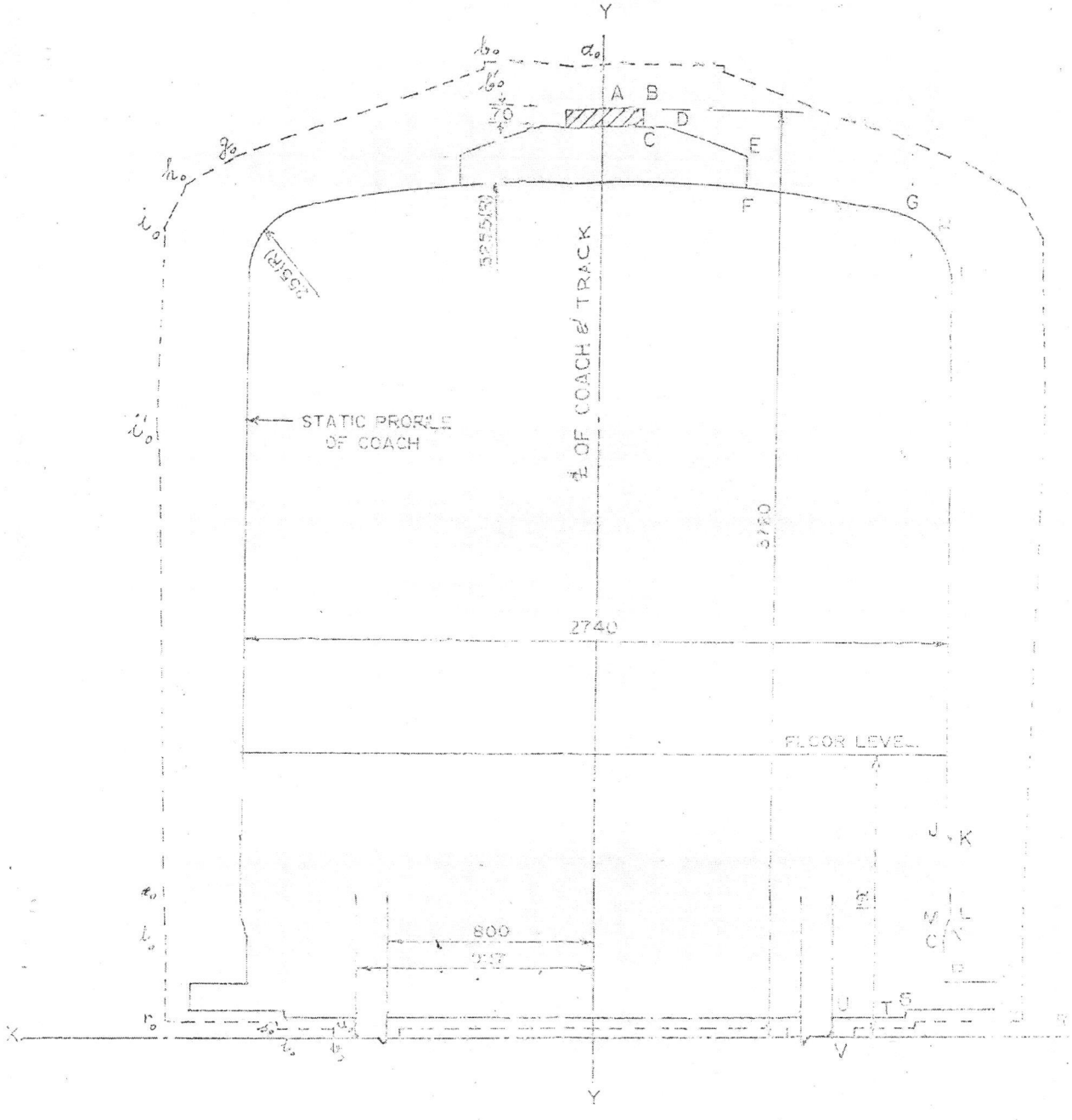


DIAGRAM NO. 1
1676 GAUGE

NOTE:-

ALL DIMENSIONS ARE IN MILLIMETRES.

STATIC PROFILE OF COACH			FIXED STRUCTURE LINE		
	X	Y		X	Y
A	0	3720	a_0	0	3895
B	150	3720	b_0	435	3895
			b'_0	435	3875
C	150	3650			
D	250	3650			
E	560	3540.			
F	560	3425			
G	1160.	3332	g_0	1438	3510
H	1305	3265	h_0	1618	3412
I	1370	3085	i_0	1705	3250
			i'_0	1720	2460
J	1370	860			
K	1375	850			
			k_0	1661	600
L	1375	420			
M	1351	441			
N	1351	408			
O	1245	398			
P	1345	210			
Q	1363	210			
R	1363	184	r_0	1661	50
S	1204	104	s_0	1240	50
T	1200	63	t_0	1230	25
U	927	63	u_0	1005	25
V	927	0	v_0	1005	0

SKETCH NO. MRC/W/SK/ - 94