



DEPARTMENT OF TRANSPORT

**RAILWAY CONSTRUCTION
AND OPERATION
REQUIREMENTS**

STRUCTURAL AND ELECTRICAL
CLEARANCES

LONDON

HER MAJESTY'S STATIONERY OFFICE

85p NET

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1. INTRODUCTION

1.1 These Requirements specify the structural clearances that are to be provided on new lines, and on existing railways where new structures are built or where existing structures are modified or where clearances are otherwise altered. They also deal with clearances between trains, intervals between lines, electrical clearances on electrified railways, and lineside refuges.

1.2 These new sections represent the first stage of a complete revision and metrication of the 'Railway Construction and Operation Requirements for Passenger Lines and Recommendations for Goods Lines of the Minister of Transport', 1950 (Reprinted 1970). They are published separately in advance of the complete revision because of the urgent need for an up-to-date metric guide to the Department's requirements for clearances, both structural and electrical. They supersede Paragraphs 51-56 (inclusive) and Appendix III of the 1950 edition of the Requirements, and also the separately published 'Ministry of Transport, *Railway Electrification on the Overhead System, Requirements for Clearances*', 1966.

1.3 Where the unrevised sections of the 1950 edition of the Requirements refer to standard dimensions and clearances, eg in the section dealing with stations, and in the reference to direct current systems of electrification in the Notes preceding paragraph 61, the dimensions and clearances specified in these new Requirements are to apply.

1.4 Where, in these revised Requirements, speeds of 160 km/h and 200 km/h are quoted they may be taken as equivalent to 100 mile/h and 125 mile/h respectively, even though the equivalence is not exact.

2. STANDARD DIMENSIONS AND STRUCTURAL CLEARANCES

2.1 Definitions

2.1.1 *Static Load Gauge*

The maximum permitted cross-sectional dimensions of vehicles and, where applicable, their loads when at rest and located centrally on straight and level track.

2.1.2 *Kinematic Load Gauge*

The static load gauge enlarged to allow for the maximum possible displacement of the vehicles, when at rest or in motion, with respect to the rails, taking account of their suspension characteristics, including arrangements for body tilting if provided, and making allowance for maximum permitted tolerances in the manufacture and maintenance of the vehicles, including wear. The effects of end-throw and centre-throw of stock, resulting from both horizontal and vertical curvature of track, are disregarded in the development of the kinematic load gauge but must be taken into account when determining clearances.

It should be noted that certain vehicle displacements, other than those due to end-throw and centre-throw, are greater on curved track than on straight track. These must be taken into account when developing the kinematic envelope for the determination of clearances on curved track.

2.1.3 *Kinematic Envelope*

The kinematic load gauge enlarged to take account of the maximum permitted tolerances in the gauge, alignment, top, and cross-level of the track including the effects of wear. The kinematic envelope thus contains the full cross-section of vehicles and, where applicable, their loads under any permissible condition of operation and maintenance both of the vehicles and of the track.

2.1.4 *Structure Gauge*

The boundary enclosing the clear spaces required to be provided with respect to the designed position of the track(s) to allow the railway to be operated in safety.

2.2 Clearance Requirements

2.2.1 The Requirements regarding clearances apply to lines carrying trains at speeds up to 200 km/h. The clearances are shown on the diagram at Annexure A. This diagram is based, for the purposes of illustration, on the kinematic envelope applicable to British Railways' vehicles (having a maximum static load gauge

width of 2820 mm) running on straight and level track having a nominal standard gauge of 1432 mm. The diagram also shows, for standard (1432 mm) gauge railways, a standard structure gauge which should be adopted for all new lines and for new or reconstructed works on existing railways. This comprises a rectangle, 4640 mm high (measured above designed rail level) and 8080 mm wide for double tracks (4680 mm for a single track), which may only be infringed by railway operational equipment and structures, and to the extent indicated in paragraphs 2.3.2. and 2.3.3. below. Where the railway is electrified at 25 kV AC on the overhead system, or is likely to be so electrified, the minimum vertical distance between the designed rail level and the underside of structures should be increased, preferably to 4780 mm or more, if this can be achieved with reasonable economy. In a few cases such increased clearance may be essential: see paragraph 3.2.13.

2.2.2 Where other track gauge and/or kinematic envelope dimensions apply, the appropriate adjustments may be made to the standard structure gauge. The mandatory minimum clearances defined below and shown in red on the diagram must however be respected.

2.2.3 The clearances given relate to straight and level track; additional allowance must be made for the effects of horizontal and vertical curvature, including superelevation.

2.2.4 When drawings of new or altered structures are submitted for approval the actual kinematic envelope adopted for the location concerned must be indicated and the relevant clearances dimensioned therefrom.

2.2.5 On existing railways, at places where clearances are equal to or less than those specified in these Requirements, the present clearances must not be reduced nor must the extent or number of such places be increased, by new or altered works, by track alterations affecting line or level, or by the introduction of new rolling stock, without the approval of the Railway Inspectorate.

2.2.6 Where the minimum clearances specified in paragraph 2.3.2. are not achieved, warning signs are to be provided at an appropriate height wherever staff, either on foot or in trains and in the normal execution of their duties, may be placed at risk by reason of the restricted clearances.

2.2.7 The clearance requirements may be varied, with the prior agreement of the Railway Inspectorate, in particular cases, for example on underground railways where rolling stock of a special type is used and where suitable arrangements are made for the safety of staff employed on maintenance and inspection work.

2.3 Structural Clearances—New Construction

2.3.1 Infringement of the standard structure gauge must be avoided so far as possible. It must, in any case, be limited to railway operational structures and be such as will ensure that a clear separation, as specified below, is maintained at all times between such structures and the kinematic envelope.

2.3.2 After allowing for the effects of curvature, including superelevation, the lateral clearance between the widest portion of the kinematic envelope and any fixed structure between rail level and the cantrail level of rolling stock (taken as 3415 mm above rail level on standard gauge railways) shall not be less than 675 mm, save only:

- (a) Below platform level (915 mm above rail level on standard gauge railways) where station platform copings, bridge girders, ground signals, and similar railway operational structures may encroach to give a minimum lateral clearance of 50 mm outside the kinematic envelope. Such encroachment may be permitted between adjacent tracks.
- (b) In the case of signal posts and other isolated structures or items of fixed railway equipment not exceeding 2000 mm in length (but excluding masts carrying overhead line equipment on electrified railways), where the lateral clearances outside the kinematic envelope must not be less than 570 mm.

2.3.3 On lines not electrified on the overhead system and unlikely to be so electrified, the overhead and cornice clearances between the kinematic envelope above cantrail level and railway operational structures must not normally be less than 250 mm; in cases of special difficulty this dimension may be reduced to 100 mm. On lines with overhead electrification the required electrical clearances will normally exceed these figures: where they do not, for example near cantrail level, the dimensions of 250 mm and 100 mm will apply.

2.3.4 Overhead telegraph, telephone, and stay wires, and electric cables and conductors (other than overhead line equipment on electrified railways), where these cross the railway in the open, must be at least 6000 mm above rail level after allowing for temperature and wind effects. In the case of electric cables and conductors additional height may be necessary to ensure adequate electrical clearance.

2.4 Structural Clearances—Existing Railways

2.4.1 Where any structure adjacent to an existing railway is replaced or significantly modified, the new works should conform to the standard structure gauge wherever practicable. The same standards should also apply wherever permanent alterations affecting the lateral or overhead clearances are to be carried out to an existing railway as a result of:

- (a) Track alterations
- (b) Electrification
- (c) The introduction of higher or wider rolling stock.

2.4.2 If such provision gives rise to undue difficulty or excessive costs, clearances to railway operational structures may be reduced to the minima specified in paragraph 2.3. The application of reduced clearances to other structures will require the prior approval of the Railway Inspectorate. Any reduced clearances must comply with the provisions of paragraph 2.2.5.

2.5 Clearances between Trains

2.5.1 On new lines the lateral clearance between the kinematic envelopes for adjacent tracks shall normally be at least 380 mm and shall nowhere be less than 200 mm. The distance between tracks may need to be increased on curves to ensure that the minimum clearance of 200 mm is not infringed.

2.5.2 When existing lines are reconstructed or altered, the same minimum clearance of 380 mm shall be provided wherever possible. If such provision is not practicable the maximum clearance possible shall be achieved, provided that in no case shall the clearance between the adjacent kinematic envelopes be less than 100 mm.

2.6 Intervals between Lines

2.6.1 In all new construction where there are only two tracks, they must be at such spacing as will provide the required clearances, as specified in paragraph 2.5.1. For British Railways' stock of 2820 mm maximum width, the standard spacing between track centre lines on the straight is 3400 mm.

2.6.2 Where there are more than two running lines an extra clearance of 1200 mm shall be provided between each pair of running lines or additional single running lines. In reconstruction on existing railways this extra clearance may be reduced to 900 mm.

2.6.3 In new works and also in reconstruction of existing railways (except where otherwise approved in cases of special difficulty) the spacing between the centre lines of a siding and the nearest running line shall not be less than 4300 mm. Where rolling stock examination or shunting operations are likely to be regularly performed in the siding, this dimension shall be not less than 4600 mm.

3. ELECTRICAL CLEARANCES

3.1 Application

3.1.1 These requirements apply to construction or reconstruction of and alterations or additions to all electrified lines, including goods lines and sidings.

3.1.2 They relate to overhead conductor systems having nominal voltages between 500V and 1500V DC, at 6.25kV 50Hz AC, at 25kV 50Hz AC, and to conductor rail systems between 500 and 750V DC. Where different systems or special conditions exist the requirements may be modified at the discretion of the Railway Inspectorate having regard to the circumstances as may be submitted for consideration in each case. Whenever practicable, such submissions are to be made well before the works are commenced.

3.1.3 Plans for new sections of overhead electrification are to be submitted to the Department of Transport in sufficient time to allow for approval of the design before work commences, and for inspection and approval of the works before energisation.

3.2 Overhead Systems

Construction Clearances

3.2.1 The clearances to a structure must include provision for the following:

- (a) The electrical clearance between the earthed material of the structure and overhead equipment, and the live parts of the equipment and pantograph.
- (b) The electrical clearance between the live parts of the overhead equipment and the kinematic load gauge.
- (c) The uplift of the live overhead equipment and pantograph when the two are in contact, taking account of the design of the equipment and the speed of traffic.
- (d) Lateral movement (sway) of the pantograph.
- (e) The construction depth of the live parts of the overhead equipment.
- (f) The tolerance in the installation and maintenance of the overhead equipment.
- (g) The tolerance in installation and maintenance of the alignment, height, and cross-level of the track.
- (h) The effects of horizontal and vertical curvature, including superelevation.
- (j) The kinematic load gauge for the line concerned.

In the following paragraphs dimensions are given for these items, as appropriate.

Electrical Clearances

3.2.2 The clearances required in paragraph 3.2.1(a) and (b) are divided into two categories:

Static clearance, defined as the minimum distance required between the live parts of the overhead equipment (under any permissible conditions of maintenance and when not subject to uplift from a pantograph) and a structure or the earthed parts of the overhead equipment.

Passing clearance, defined as the minimum distance required between live parts of the overhead equipment and any earthed material or rail vehicle, or between the pantograph and any earthed material, under any permissible conditions of operation and maintenance of vehicles, track, and overhead equipment.

3.2.3 Values for the Static and Passing clearances are dependent on which of three categories of clearance is used. These categories are NORMAL, REDUCED, and (for 25kV AC systems only) SPECIAL REDUCED. The corresponding values are:

(a) for 25kV 50Hz AC

	<i>Normal</i>	<i>Reduced</i>	<i>Special Reduced</i>
Static clearance	270 mm	200 mm	150 mm
Passing clearance	200 mm	150 mm*	125 mm*

*With the prior approval of the Railway Inspectorate the Passing clearance between a pantograph and a brick or masonry bridge or tunnel may be reduced to 80 mm.

(b) For 500V to 1500V DC, and 6.25kV 50Hz AC

	<i>Normal</i>	<i>Reduced</i>
Static clearance	100 mm	100 mm
Passing clearance	100 mm	80 mm

3.2.4 At structures crossing the line where the overhead equipment is neither attached to the structure nor supported immediately adjacent thereto, not less than Normal clearances are to be provided. At structures to which the overhead equipment is attached, clearances at least to Normal standard, with full tolerances, should be provided wherever practicable. Where such provision is unduly difficult or costly, Normal clearances with close tolerances should be used. Where this is insufficient further reductions in clearance, down to the level quoted for Reduced clearances, may be made at the Railways' own discretion. Further reductions, on 25kV AC systems, to the level quoted for Special Reduced clearances, may only be made in cases of exceptional difficulty or expense, and with the prior approval of the Railway Inspectorate in each case. Details of the various restrictions on construction depth, tolerances, and uplift are given in the following paragraphs.

3.2.5 *Uplift* of the overhead equipment during the passage of a pantograph where less than Normal clearances apply, shall not exceed:

Under Reduced clearance conditions	50 mm
Under Special Reduced clearance conditions	25 mm

3.2.6 The allowance for the *lateral movement (sway) of the pantograph* on British Railways' rolling stock is as follows:

Lateral (each way) sway of pantograph at a height of 4300 mm above rail	± 130 mm
Extra per metre additional height	40 mm

Where dynamic movements differ from the foregoing, appropriate adjustments shall be made.

3.2.7 Where less than Normal clearances are used, the *construction depth* of the live parts of the overhead equipment shall not exceed:

Under Reduced clearance conditions	120 mm
Under Special Reduced clearance conditions	115 mm at supports 25 mm between supports

Any allowance for sag in the contact wire between supports shall be included in the construction depth.

3.2.8 The track and the live parts of the overhead equipment shall be installed and maintained within the following *tolerances* on their designed position:

(a) In any place where:

the vertical distance between an overhead structure and the kinematic load gauge is less than 765 mm in the case of 25kV AC systems and 565 mm in the case of 500–1500V DC and 6.25kV AC systems or where Normal Passing clearance cannot be achieved with the tolerances laid down in (b) below

the live overhead equipment and the track shall be installed and maintained within the following tolerances on designed position:

Live overhead equipment height	± 10 mm
Track height	+15 mm
Track cross-level	± 15 mm
Track alignment	± 15 mm

(b) Elsewhere the tolerances shall be:

Live overhead equipment height	± 75 mm
Track height	+25 mm
Track cross-level	± 20 mm
Track alignment	± 25 mm

At structures where the rail level tolerances given in sub-paragraph (a) apply, rail level datum marks are to be provided on or adjacent to the structure.

3.2.9 A definition of the *kinematic load gauge* is given in paragraph 2.1.2 of these Requirements. For the purpose of determining vertical electrical clearances its height may be taken as the sum of the height of the static load gauge plus vehicle bounce. The normal maximum static load gauge height on lines electrified on the overhead system on British Railways is 3990 mm and the allowance for vehicle bounce is 25 mm. Where these values differ an appropriate adjustment should be made.

3.2.10 Limiting values of the *vertical clearance* for Normal, Reduced, and Special Reduced clearance conditions between the underside of a structure and the kinematic load gauge, based on the preceding paragraphs, are shown diagrammatically in Annexure B (for 25kV AC) and Annexure C (for 500V to 1500V DC and 6.25kV AC). Also shown are the corresponding clearances between the undersides of structures and the designed rail level, based on the normal British Railways static load gauge. These diagrams show vertical clearances only. At arched structures, pockets may be required for the accommodation of supports and the height of the contact wire may be governed by the requirement to obtain sufficient lateral clearance to the structure from moving pantographs, in accordance with paragraph 3.2.11. Clearance diagrams in these cases can be constructed on the basis of the preceding paragraphs.

3.2.11 The *pantograph clearance* is to be sufficient to provide a Passing electrical clearance in accordance with paragraph 3.2.3 between the horn of the pantograph moving within the limits defined in paragraphs 3.2.5 and 3.2.6 and the side or haunch of a structure after allowing for:

- (a) the contact wire height at its upper limit of tolerance as permitted in paragraph 3.2.8
- (b) wear of the contact wire and the collecting strips in the centre of the pantograph totalling 25 mm
- (c) variations in height, cross-level, and alignment of the track as allowed in paragraph 3.2.8

3.2.12 Any *additional clearance* available above the minimum required for the category of clearance concerned is to be used to increase electrical clearances towards the next higher category of clearance before the construction depth, uplift, or tolerance is increased.

Headroom at New or Reconstructed Overline Structures

3.2.13 When new structures are built, or existing ones are significantly modified, over a line which in the foreseeable future might have overhead electrification, the vertical clearance between the underside of the structure and the kinematic load gauge should not be less than:

For 25kV 50Hz AC	625 mm
For 500–1500V DC and 6.25kV 50Hz AC	425 mm

The corresponding minimum structure height above designed rail level in the case of the normal British Railways static load gauge height of 3990 mm, and on

lines electrified at 25kV AC is 4640 mm. Greater clearance than this, preferably to 4780 mm or more, is desirable where it can be achieved with reasonable economy in order to permit greater flexibility in the design of the overhead equipment; it may be essential to provide such increased clearances in some places, for example where the overhead equipment is complicated by the presence of switches and crossings or on the approach to level crossings.

Headroom at Level Crossings

3.2.14 The minimum height at public level crossings between road level and the lowest portion of the overhead equipment under the worst conditions of temperature and loading is to be:

for 25kV AC	5600 mm
between 500 and 1500V DC and for 6-25kV AC	5500 mm

Any reduction in this headroom will require the prior approval of the Railway Inspectorate. The headroom at a private level crossing will be as agreed between the railway authorities and the occupier, subject to the final approval of the Railway Inspectorate. Height gauges may be required where wire heights are substandard.

Special Clearances at Stations, Depots etc.

3.2.15 An increased wire height and/or an offset wire alignment or registration from the remote side may be required at stations, depots, and other places where work is carried out under energised equipment.

3.3 Conductor Rail Systems

3.3.1 Except where permitted in paragraph 3.3.2 the distance between any exposed conductor rail, including all metalwork connected thereto, and any other fixed metalwork shall be at least 75 mm.

3.3.2 Metal parts of protective boarding supports may infringe the 75 mm dimension referred to in 3.3.1 where the protective board is located between such metal parts and the conductor rail.

3.3.3 Except where permitted in paragraph 3.3.4 the minimum vertical clearance between the lowest part of any collector shoe and the running rails shall be 40 mm.

3.3.4 On fourth rail systems where the potential of a set of collector shoes does not, except under fault conditions, exceed 250 V the minimum vertical clearance referred to in paragraph 3.3.3 may be reduced to 10 mm for those shoes.

4. REFUGES

Provision

4.1 Refuges are to be provided in all tunnels, unless the circumstances are such that staff can stand in safety during the passage of trains in which case the need for refuges may be waived by agreement with the Railway Inspectorate. Refuges will also be required on long bridges and viaducts, and where the railway is enclosed by bridge substructures, buildings, retaining walls or cuttings, wherever the lineside clearances, up to a height of 2000 mm above rail level and over a continuous length of 40m or more, are less than the dimensions quoted below:

<i>Maximum speed of train in km/hour</i>	<i>Minimum lateral clearance from kinematic envelope at its widest point</i>
160	830mm
Between 161 and 200	1700mm

4.2 On embankments and in cuttings, wherever the lineside walkways fail to extend to the lateral distance from the kinematic envelope quoted in paragraph 4.1 over a length of 40m or more and where a man cannot stand in safety on the slopes of the embankment or cutting during the passage of trains, special measures are to be taken to provide refuge spaces.

4.3 Where the criteria of paragraphs 4.1 and 4.2 are met on one side of the line but not on the other, refuges will not normally be required unless more than two running lines may need to be crossed in order to reach a place of safety.

Spacing of Refuges

4.4 Where a railway having two or more running tracks needs to be provided with refuges, these are to be located on both sides of the line at a spacing not exceeding 40 m. Refuges should be staggered equally to give an effective spacing of 20 m or less.

4.5 On single lines the arrangement of refuges may be as in paragraph 4.4, or on one side only at a maximum spacing of 20 m.

4.6 If for any reason the required spacing cannot be achieved, the warning time available to men on the line must be sufficient to enable them to reach a place of safety before the arrival of a train.

Dimensions and Construction

4.7 The minimum dimensions of refuges are to be:

Height	2000 mm
Width	1400 mm
Depth	700 mm

4.8 The floor level of refuges should not differ substantially from the level of the lineside walkway unless special means of access are provided. The whole refuge must be kept clear of cables, pipes or other obstructions.

4.9 Refuges are to be provided with handholds to assist men in keeping their balance during the passage of a train. Handholds should also be provided, at the same spacing as refuges, in situations where the lateral clearances are only marginally greater than those quoted in paragraph 4.1.

4.10 In tunnels, the position of refuges, and of handholds where there are no refuges, must be marked by lights, marker plates, paint, or other means.

Application of Refuge Requirements to Existing Situations

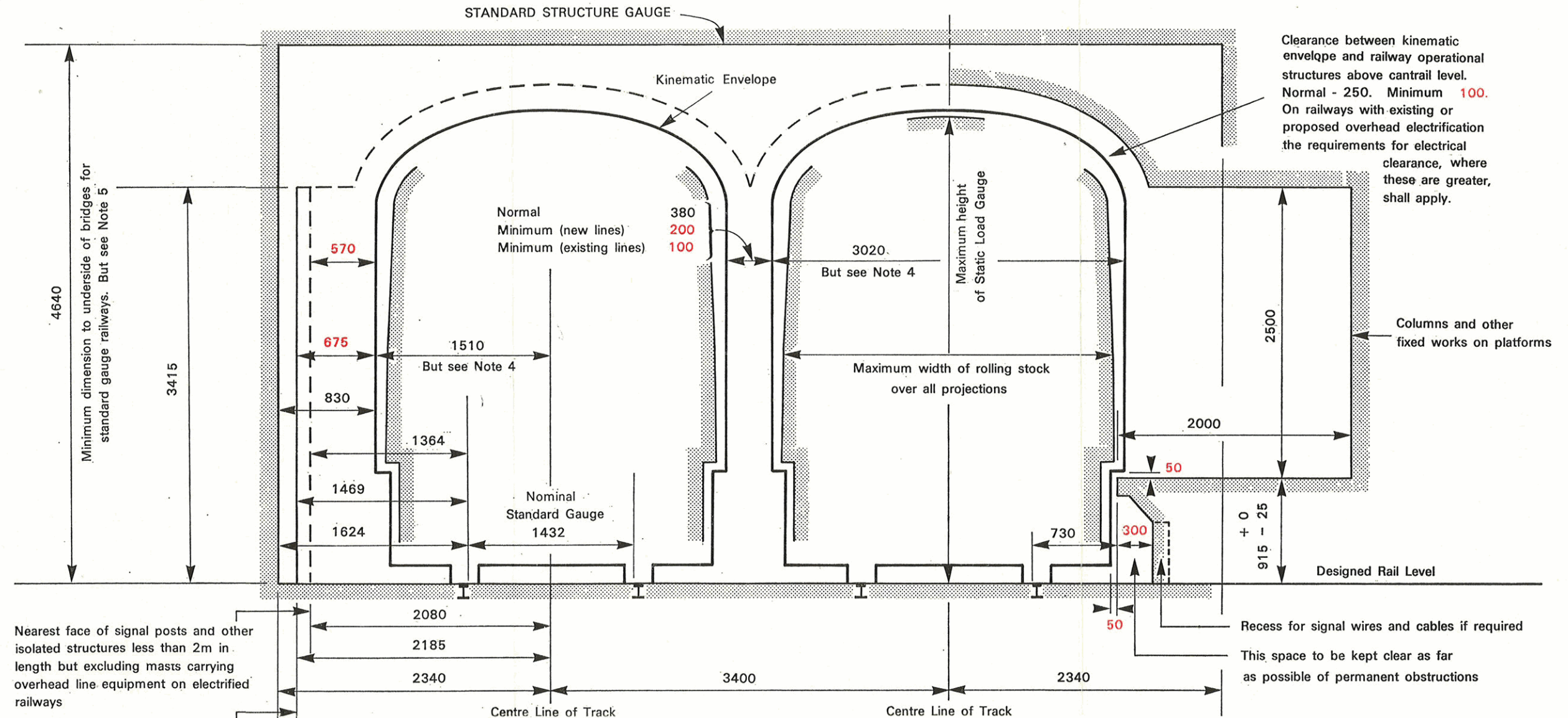
4.11 The requirements for new construction are to be applied to existing lines whenever the operational speed of trains using them is increased above 160 km/h or when new structures are built, or existing ones are reconstructed.

4.12 Existing refuges will not need modification under the terms of paragraph 4.11 if the deficiency in any of the minimum dimensions listed in paragraph 4.7 does not exceed 200 mm. Such refuges should however be provided with handholds.

STANDARD STRUCTURE GAUGE

Diagram illustrating lateral and overhead clearances to be adopted in construction or reconstruction and for alterations or additions to existing track and structures

All dimensions in millimetres



Clearance between kinematic envelope and railway operational structures above cantrail level. Normal - 250. Minimum 100. On railways with existing or proposed overhead electrification the requirements for electrical clearance, where these are greater, shall apply.

Columns and other fixed works on platforms

Recess for signal wires and cables if required
This space to be kept clear as far as possible of permanent obstructions

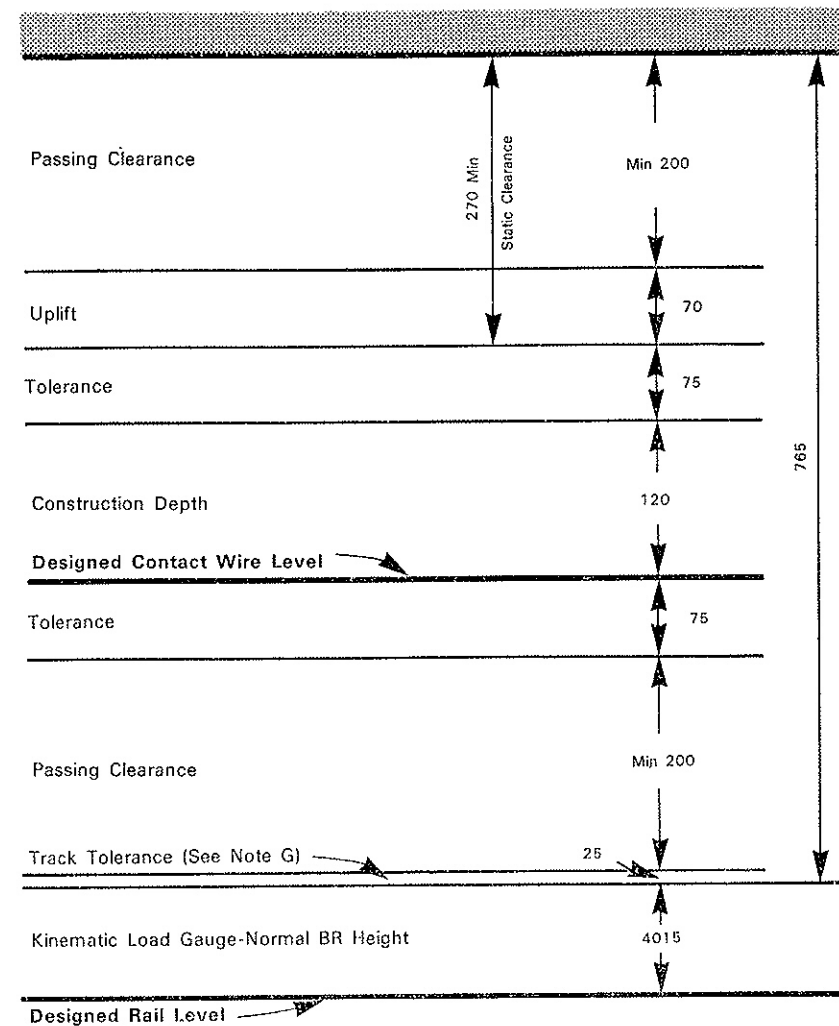
NOTES

1. The kinematic envelope is defined in paragraph 2.1.3 of the Requirements.
2. The dimensions shown in red are mandatory. Dimensions shown in black are dependent on the load gauge and the kinematic envelope derived therefrom, and may vary.
3. The kinematic envelope shown is that applicable to British Railways vehicles (having a maximum static load gauge width of 2820mm) running on track with a nominal standard gauge of 1432 mm and maintained to full normal tolerances.
4. The clearance dimensions given are valid for straight and level track only. Due allowance must be made for the effects of horizontal and vertical curvature, including superelevation, and for possible increments in the dimensions of the kinematic envelope (see paragraph 2.1.2).
5. The Standard Structure Gauge allows for overhead electrification at voltages up to 25kV. However, to permit some flexibility in the design of the overhead equipment, the minimum dimension between rail level and the underside of structures should be increased, preferably to 4780 mm, or more, if this can be achieved with reasonable economy. In a few cases such increased clearance may be essential: see paragraph 3.2.13 of the Requirements.
6. Clearances given are applicable for speeds not exceeding 200 km/h.
7. Permissible infringements, above rail level, in respect of conductor rail equipment, guard and check rails, trainstops, and structures in the space between adjacent tracks, are not shown.
8. The track spacing is to be increased for additional running lines or between running lines and sidings: see paragraph 2.6 of the Requirements for details.
9. Where lineside structures are more than 40m in length, refuges may be required: see section 4 of the Requirements for details.

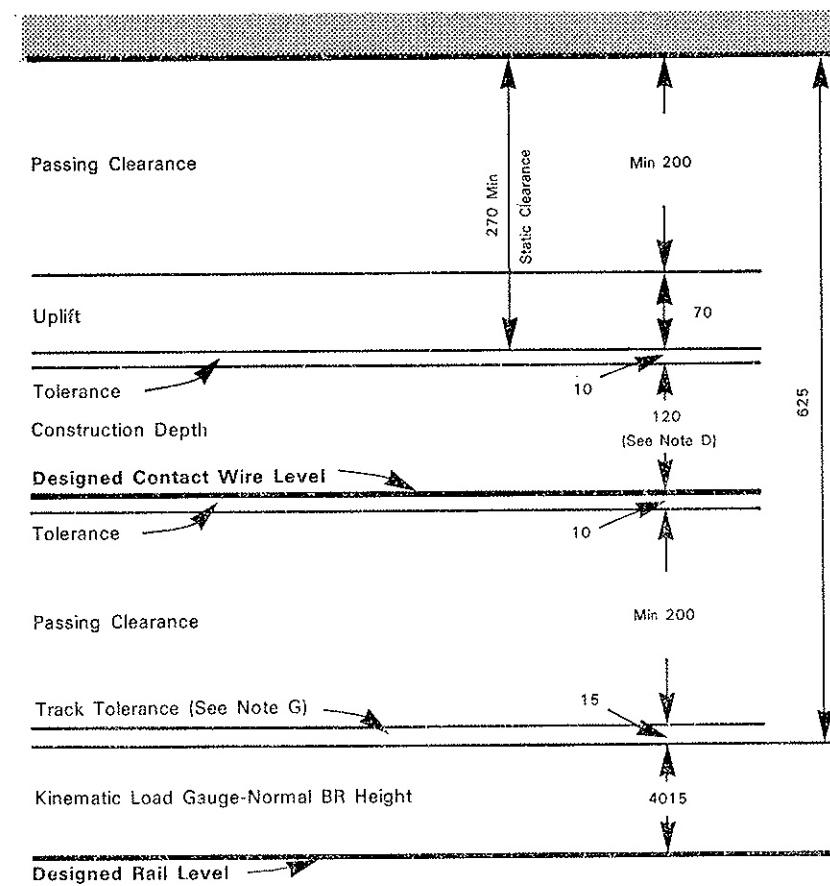
LIMITING VALUES OF DESIGN CONSTRUCTION & MAINTENANCE 25kV AC

Annexure 'B'

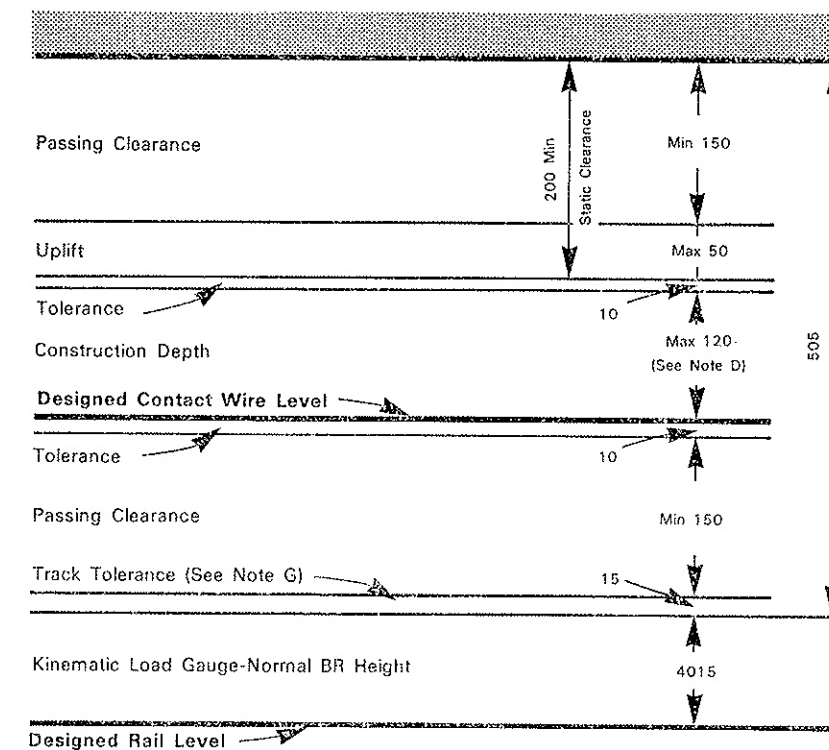
1. NORMAL CLEARANCES WITH FULL TOLERANCES



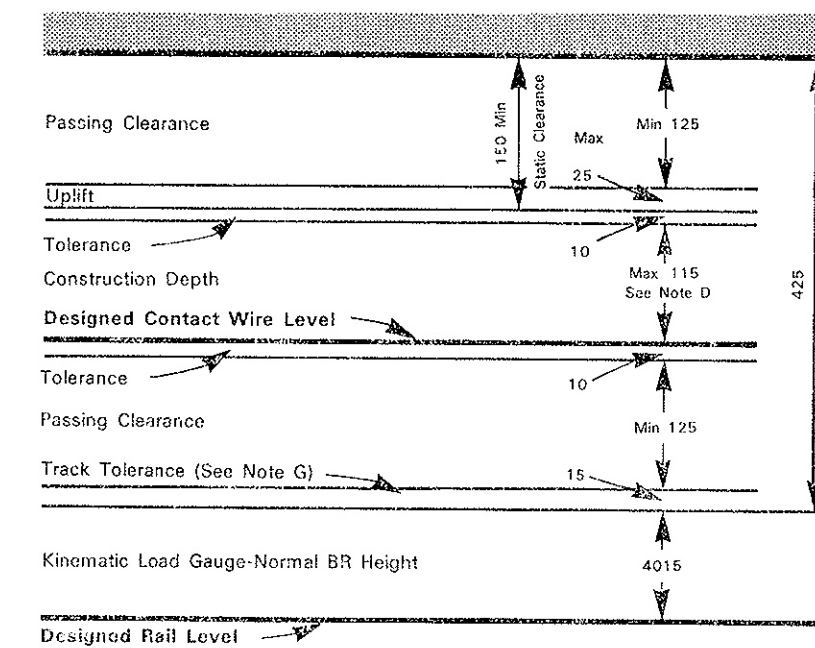
2. NORMAL CLEARANCES WITH CLOSE TOLERANCES



3. REDUCED CLEARANCES

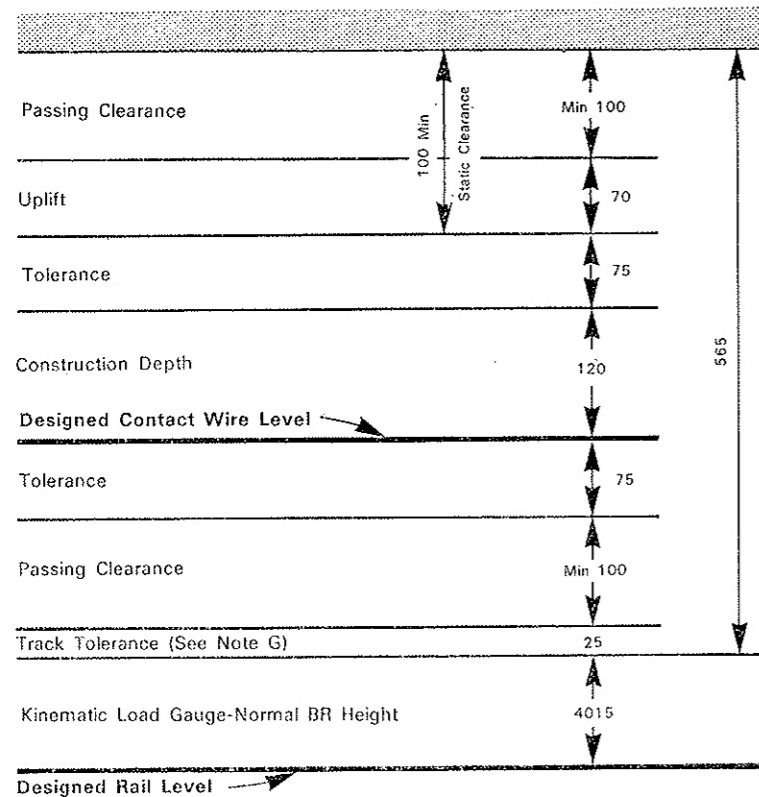


4. SPECIAL REDUCED CLEARANCES

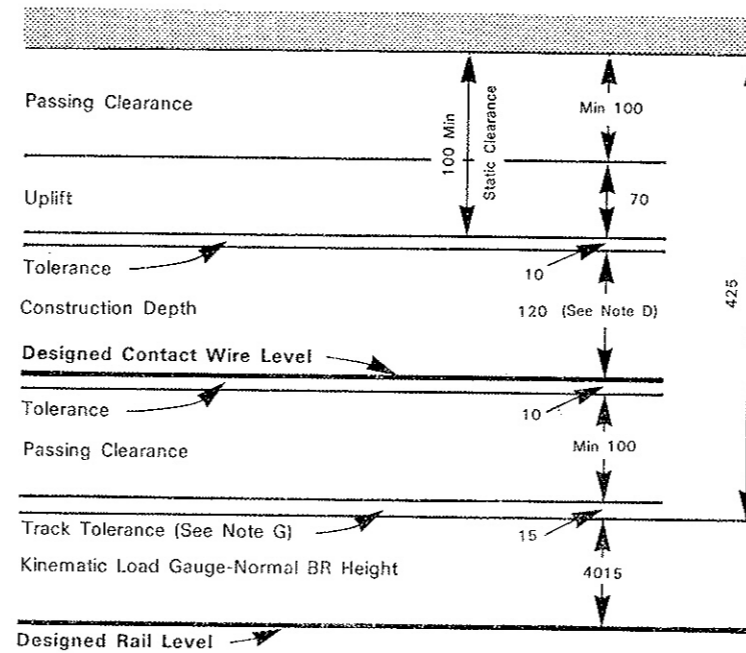


	At Supports	4780	4640	4520	4440
Height of Structure above Designed Rail Level					

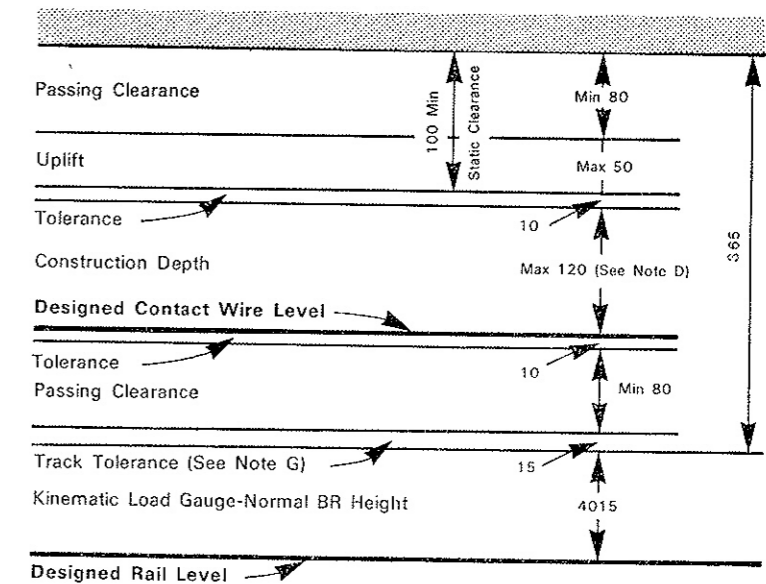
1. NORMAL CLEARANCES WITH FULL TOLERANCES



2. NORMAL CLEARANCES WITH CLOSE TOLERANCES



3. REDUCED CLEARANCES



Height of Structure above Designed Rail Level	At Supports	4580	4440	4380
	Between Supports (See Note D)	4580	4345	4285