1 PERMANENT WAY, EARTHWORKS AND STRUCTURES

1.1. THE TRACK

Principle 1.1 The track

The track should provide for the safe guidance and support for the trains allowed to run on it.

1.1.1. General Guidance

1.1.1.1. This section provides guidance on the track which supports and guides the trains. It may consist of a ballasted track with a well-consolidated, well-drained formation, a rigid formation, or special structure.

1.1.1.2. It should be designed, installed and maintained to a standard suitable for the axle loads, tonnage and speeds of the traffic it has to carry and the dynamic forces generated.

1.1.1.3. Adequate measures should be taken to ensure the stability, line and level of the track under all conditions of applied load, plus temperature generated stresses, by giving due consideration to the design of the formation and all track components.

1.1.1.4. The formation should be designed to provide adequate support to the track. Cross falls and drainage should be provided as required. On weak or unstable ground additional measures may be required to ensure stability.

1.1.1.5. The depth, type and quality of ballast, where provided, should be related to the loadings and the nature of the formation. A depth of not less than 150mm below the bottom of the sleepers for jointed track and not less than 220mm for continuously welded rail is recommended.

1.1.1.6. Ballast shoulders should be provided to ensure the stability of the track, particularly on curves.

1.1.1.7. Precautions may be required to minimise vibration in adjacent buildings, particularly if the track is supported on concrete or other solid foundation.

1.1.1.8. Where staff and/or public are exposed to potentially health damaging effects from wheel/rail interface noise, measures to reduce this noise should be applied. However, additional noise reducing measures may be required at specific locations.

1.1.1.9. The design should accommodate the electrical and mechanical requirements of the signalling, control and electric traction systems that are to be used on that line. See section 3 Electric traction systems and section 4 Signalling.

1.1.2. Running rails

1.1.2.1. The appropriate European Standard or an equivalent standard acceptable to the RSC should be complied with. The use of bolted rail joints on running lines should be minimised and continuous welded rail should normally be provided.

1.1.2.2. If jointed track is to be used on running lines, rails should be as long as practicable and permanent closure rails should be at least 4.5m long. Shorter closure rails may be permitted under special circumstances, but these should have the agreement of the RSC.

1.1.2.3. Fastenings should comply with the relevant European Standards or an equivalent standard acceptable to the RSC.

1.1.3. Wheel/Rail Interface

1.1.3.1. The wheel and rail profiles should be sufficiently compatible to optimise wear, damage and safe vehicle ride performance.

1.1.4. Check rails

1.1.4.1. Check rails should be provided on curves of sharp radius. For nominal 1602mm gauge track check rails should be provided on curves of 200m radius or less.

1.1.4.2. The bearing edge of a check rail should be placed at a distance from the running edge of the high (outer) rail, equal to the distance between the backs of a pair of wheels plus the effective thickness of one flange; any gauge-widening on the curve should be added to the flangeway.

1.1.5. Points and crossings

1.1.5.1. All moving parts should be positively located and should be locked in the correct position during the passage of passenger trains in the facing direction.

1.1.5.2. At least two stretcher bars and a stock rail gauge tie should be provided for points.

1.1.6. Trap points

1.1.6.1. Where sidings or freight only running lines converge on passenger running lines, and any overrun from such lines might foul a passenger line, trap points should be provided to derail vehicles. Trap points should be located and means provided to guide and arrest derailed vehicles away from the passenger lines, structures and any other hazards.

1.1.6.2. Trap points with an arresting system may be necessary on passenger lines at:

(a) the entrance to, and on passing loops within, single lines where the overlap beyond the protecting signal is substandard;

(b) the approach to swing or moveable bridges; and

(c) stations and passing loops on gradients steeper than 1 in 500 where vehicles are left unattended.

1.1.7. Catch points

1.1.7.1. Catch points should be provided to derail vehicles running away backwards, and located so that vehicles are not directed towards another railway or another danger. They are not required if all trains using the line are fully-fitted with an automatic brake, or if only a few trains are not so fitted and special arrangements can be made to hold a following train in a place of safety until a preceding unfitted train has cleared the gradient.

1.2. EARTHWORKS, EMBANKMENTS AND CUTTINGS

Principle 1.2 Earthworks, embankments and cuttings.

Earthworks should be stable under all foreseeable loads imposed on them to prevent risk from collapse of the works.

1.2.1. General Guidance

1.2.1.1. Embankments should be constructed using suitable materials to provide adequate support to the formation and long-term stability.

1.2.1.2. Cutting slopes should be suitably graded to ensure long-term stability. In steep-sided cuttings, precautions should be taken to prevent materials falling onto the line.

1.2.1.3. Protection should be provided to prevent scour or erosion of the toe of embankments and cuttings.

1.2.1.4. Appropriate measures should be taken to prevent erosion of embankments, cutting slopes and the track formation during heavy water flows. Adequate arrangements should be made to intercept and direct any cross-flow of ground or surface water that may be affected by any railway works.

1.2.1.5. The discharge of drainage water should conform with the requirements of all relevant statutory authorities.

1.2.1.6. Embankments and cuttings should have sufficient width at track level to provide lineside walkways or places of safety, see sections 1.5.10 and 1.5.11.

1.2.1.7. Retaining walls should be designed to ensure long-term stability. Where there is a steep or vertical drop and staff are required to gain access on a regular basis to the top of the wall, a handrail or parapet should be provided.

1.2.1.8. The possible effects of a train being derailed on an embankment should be evaluated, particularly where it is high or the face steep. Measures to contain a derailed train may be required.

1.3. BRIDGES

Principle 1.3 Bridges

Bridges should be capable of carrying all foreseeable loads on them and minimise risks from intrusion onto the railway from above or the fall of trains from the railway.

1.3.1. General guidance

1.3.1.1. For the purposes of this section 'bridges' includes viaducts.

1.3.1.2. Bridges should be durable and provide for ease of inspection and maintenance.

1.3.1.3. Consideration should be given to the safety of railway staff and others, including those carrying out inspection and maintenance see sections 1.5.10, 1.5.11 and 1.5.13.

1.3.1.4. Adequate arrangements should be made to drain water from bridges and other structures on the railway.

1.3.2. Bridges carrying the railway

1.3.2.1. The design criteria to be applied to new or reconstructed bridges carrying the railway, together with the associated design loads and specification of materials and workmanship, should be in accordance with the appropriate European Standards, Codes of Practice and the requirements of the relevant road and rail authorities. Where no appropriate European standard or other document is available an alternative should be applied such as British Standards or National Roads Authority standards with the agreement of the RSC.

1.3.2.2. The headroom over public roads beneath newly constructed railway bridges should be at least 5300mm. It should be maintained thereafter to not less than 5030mm. The headroom should be provided over the full width of the carriageway including hard shoulders etc.

1.3.2.3. Where a bridge over a public road is reconstructed and the existing headroom is less than 5300mm, the headroom provided when the bridge is reconstructed should not be reduced and where practicable should be increased to, or towards, 5300mm.

1.3.2.4. Where the headroom over a public road is less than 5300mm, warning signposting should be displayed at the bridge and on its approaches. In such cases the relevant road authority, emergency services and the RSC should be consulted. The height restriction signposting along the road with a reduced clearance bridge should be erected by the road authority. Further measures may be necessary to protect the bridge from road vehicle strikes.

1.3.2.5. Consideration should be given in the design of a bridge carrying the railway for the possible effects of a train being derailed on it, or on the immediate approaches to it. This should include the consequences for people both in the train and outside the train who may be affected by a derailed train.

1.3.2.6. Suitable means should be provided to contain the wheels of derailed vehicles. These may be an integral part of the bridge structure or additional features such as guard rails.

1.3.2.7. Derailment protection measures should extend clear of the bridge on the approach side where reasonably practicable.

1.3.2.8. Measures may be necessary to protect the supports of bridges carrying the railway from damage by road or rail vehicles. Where the railway crosses a waterway, measures may be necessary to protect the bridge from damage by vessels and from the effects of scour.

1.3.2.9. Bridges should incorporate a safe lineside walkway with a substantial parapet or railings not less than 1250mm above the walkway. Consideration should be given to containment of ballast and other materials or items that may fall from the bridge on to people below. Where railings are provided, at least 150mm above walkway level should have a solid infill. Lateral clearances to the walkway and parapet should be in accordance with section 1.5. Walkways on top of longitudinal girders, above track level, should have adequate access from the track at each end and at any suitable intermediate points.

1.3.2.10. Bridges near stations or stop signals on the approach to stations, where a passenger might inadvertently alight onto a girder or parapet, may require a fence above the parapet, unless the

structure itself affords protection. Illuminated signs warning passengers not to alight may be necessary.

1.3.3. Bridges over the railway

1.3.3.1. The supports of bridges and similar structures, including supports to buildings, built over the railway may need to be protected from the consequences of being struck by derailed railway vehicles. Supports should be located as far from the railway tracks as practicable and be designed to minimise the effects of contact by a derailed vehicle. Supports should be positioned and designed in accordance with UIC Code 777-2 (Structures built over railway lines, Construction requirements in the track zone) or an alternative with the agreement of the RSC.

1.3.3.2. Bridges should be designed to deter people from climbing along the structure, climbing onto and along the top of any parapet, dropping, hanging and throwing objects on the railway and to keep people at a safe distance from live conductors.

1.3.3.3. On electrified railways, bonding of exposed metalwork may be required. It may be necessary to guard against electrolytic corrosion (see section 3 Electric traction systems).

1.3.3.4. The parapets of road bridges should have the strength, containment and design characteristics specified by the requirements of EN1317, 'Vehicle containment systems', which should be supplemented by those of the National Roads Authority or any other relevant authority. An equivalent standard of protection may be provided on the approach to the bridge and parapets for a distance commensurate with the risk of intrusion onto the track by errant road vehicles.

1.3.3.5. 'High containment' parapets should be provided where the likelihood of impact with the parapet and consequential damage outweigh the hazards resulting from the containment and redirection of errant road vehicles. Parapets should be designed so that any foreseeable vehicle impact cannot dislodge any part of the structure onto the railway. In the event of disagreement between the road authority and the railway on the need for 'high containment' parapets, the matter should be referred to the RSC for resolution.

1.3.3.6. A parapet, with a traffic face which is imperforate, should be provided for bridges carrying all-purpose roads and for footbridges. Where the deck is not enclosed the parapet should not provide hand or footholds. There may be locations where a parapet that prevents visibility due to its imperforate nature would introduce greater hazards than those the imperforate nature seeks to avoid. Where this is the case, means of providing adequate visibility while maintaining the imperforate function should be employed in the first instance prior to introducing a degree of perforation to allow visibility.

1.3.3.7. The height of the parapet above the adjoining paved surface should be maintained at not less than 1800mm in the following situations:

(a) in urban areas;

(b) where the bridge is used frequently by equestrian traffic;

(c) bridges carrying national roads;

(d) bridges over an automatic railway;

(e) where the railway is electrified with an overhead line electrification system.

1.3.3.8. In other locations the parapet should be maintained at least 1500mm above the adjoining paved surface.

1.3.3.9. Where vandalism may be a problem, parapets at least 1800mm high or a totally enclosed structure may be necessary.

1.3.3.10. All coping stones and components attached to the parapet should be adequately secured to deter removal.

1.3.3.11. Bridges over railways which are electrified on the overhead system should have a parapet which extends at least 3000mm beyond any uninsulated overhead electrical equipment. If the parapet has a plinth or ledge on the outside face more than 50mm wide, access should be denied to the plinth or ledge from each end of the bridge. This may be achieved by the provision, over a 2000mm length, of a 45° chamfer to the plinth top, or by fitting panelling on the

outer face of the parapet to cover any ledge, or other similar measures. See section 3 Electric Traction Systems for additional guidance about parapets on bridges over electrified railways.

1.3.3.12. On all new bridges which have parapets more than 100mm thick, the top of the parapet should be finished to deter climbing and walking. Such measures should be provided on existing bridges over lines which are to be electrified with an overhead system.

1.3.4. Pipe bridges

1.3.4.1. Pipelines carrying liquids or gases over the railway, where the pipes are not incorporated in a bridge structure, should be supported by a purpose-designed beam or service bridge. Such a bridge should span the railway without intermediate supports. Where supports are necessary, they should comply with section 1.3.3. In the case of low-pressure water mains or similar pipes conveying non-hazardous materials, and where significant savings in cost would result, consideration may be given to a free-standing design, subject to agreement by the RSC.

1.3.4.2. Appropriate measures should be taken to deter trespass onto pipe bridges in particular where it could offer a short cut across the railway.

1.3.4.3. Adequate measures should be taken to contain and limit the extent of any spillage of hazardous substances from pipe bridges and to direct them away from the railway, watercourses or any other location where serious harm may result.

1.3.5. Services under and alongside the track

1.3.5.1 Services such as pipes and cables that are required to cross beneath or run alongside the track should be installed at a depth which ensures consideration of the need to avoid damage to the service from:

(a) the loads imposed by the passage of rail traffic;

(b) any foreseeable future track maintenance work.

1.3.5.2 The services may require protection from damage or loading if they are not installed at an adequate depth to avoid those hazards.

1.3.5.3 Consideration should be given to the future access arrangements for maintenance of the service.

1.3.6. Safety fences

1.3.6.1. Safety fences may be required on the road approaches to bridges over the railway, especially if the road curves or is on a falling gradient. These should comply with EN1317 'Vehicle containment systems' and where applicable be supplemented by the relevant National Roads Authority standards subject to the approval of the RSC.

1.3.6.2. Other additional measures should be considered to reduce the likelihood of a road vehicle striking any safety fence. These may include road speed limit reduction, road marking or surface treatment and signposting to alert road vehicle drivers of the hazard. These should be undertaken in consultation with the relevant road authority.

1.3.6.3. Where there is a high risk of a road vehicle penetrating a safety fence, special arrangements may be required on high-speed or automatic railways to replace signals to stop or otherwise to stop trains.

1.4. TUNNELS

Principle 1.4 Tunnels

Enclosed spaces such as tunnels should provide a safe environment for people and safe means of evacuation in emergency.

1.4.1. General Guidance

1.4.1.1. This section provides guidance on tunnels for underground and sub-surface railways. It should also be taken into consideration for longer tunnels on other railway systems. The method of construction for a tunnel will normally have been by excavating the ground without removing the surface of the ground above or alternatively by cut and cover techniques. There is no specific defining length of the structure to designate a tunnel. This guidance for tunnels should be applied to all structures constructed over the railway including buildings and bridges, which could be deemed to be tunnels either by virtue of their design and construction, and or by virtue of the risks they import to the safe operation of the railway e.g. evacuation of people.

1.4.1.2. The configuration of the tunnel will be dependent on the type of rolling stock to be used, the operational requirements for vehicle movements within the tunnel, the means of evacuation to be employed and on whether the tunnel is an extension of an existing railway.

1.4.1.3. Twin single-track tunnels equipped with modern signalling systems may have advantages for railway safety compared with double-track tunnels in that the risks of collisions and secondary collisions resulting from a train derailment between trains travelling in opposite directions are minimised. This safety environment may also be achieved by a single bore tunnel partitioned between the two tracks. Where twin single-track tunnels are provided, they will normally aid emergency evacuation and ventilation arrangements with the non-incident tunnel providing a safe refuge.

1.4.1.4. The normal arrangement for a sub-surface (underground) railway shall be twin single-track tunnels. Twin tunnels created by the internal division of a larger tunnel will be acceptable. Special arrangements may be required for single-line sections of railway or where there are cross-overs between twin running tunnels.

1.4.1.5. In the case of an extension to an existing railway, the means of evacuation should not change in principle between the existing and the new parts, but may require enhancing.

1.4.1.6. In deciding on the appropriate form of tunnel construction and the emergency evacuation facilities to be provided, consideration should be given to:

(a) keeping the train running to the next station, either below or above ground, or clear of the tunnel to enable evacuation to take place;

(b) the distance and running time through the tunnel or between stations; and

(c) the method of evacuation from the train.

1.4.1.7. The stability of tunnels should not be endangered by any reasonably foreseeable fire. Materials used in their construction should be chosen to:

(a) resist the spread of flame;

(b) reduce the rate of heat release; and

(c) reduce the products of combustion.

1.4.1.8. Tunnels should be designed and constructed using suitable materials and techniques taking into consideration:

(a) the nature of the surrounding ground and/or water;

(b) the need to contain movement of the tunnel to within operational limits of the track, signalling, trains and other systems;

(c) the need to maintain pressure variations within the tunnel to acceptable limits particularly when trains are running at high speeds;

(d) the need to prevent the ingress of ground water;

(e) the need to inspect and maintain the tunnel structure and equipment within it.

1.4.1.9. Derailment containment measures should be provided in all tunnels. Where a side walkway is provided to allow passenger evacuation, the walkway may be designed to provide derailment containment on that side.

1.4.1.10. All tunnel equipment including cable routes should be positioned to minimise damage from any derailed train and should not obstruct people from using the walkways or access spaces.

1.4.1.11. No projections which might cause serious damage to a train should be extended into the swept envelope (see section 1.5.2.5) of a derailed train.

1.4.1.12. In double- or multi-tracked tunnels, measures should be taken to prevent a derailed train obstructing the passage of a train on an adjacent line.

1.4.1.13. The internal design of the tunnels should avoid creating traps for accumulation of rubbish and debris which could act as a fire hazard or an attraction for vermin or other animals.

1.4.1.14. The location of signalling sections should take account of the location and spacing of any access points and cross-passages to ensure that passengers can be safely evacuated. It should also enable trains to be stopped from entering a tunnel where a fire alarm has been advised.

1.4.1.15. An assessment of the risk of fire, and the measures that may be taken to minimise the risk, should be made at an early stage.

1.4.1.16. The methods proposed for controlling the products of combustion and the measures to be employed for evacuation and emergency fire fighting should be discussed with the RSC and the appropriate Fire Authority.

1.4.2. Access points

1.4.2.1. Emergency access points to a tunnel should be provided at distances determined by the ability of the fire brigade to penetrate effectively into the fire zone. The emergency access points may be tunnel portals, stations or intermediate shafts with stairways.

1.4.2.2. Current practice indicates that distances between access points should be in the order of 1 km where there are twin single-bore tunnels with adequate intermediate cross-passages. In other circumstances this distance may need to be reduced. A full risk assessment would be required to determine the appropriate spacing. Where the emergency access is to be used as an evacuation route as well, these needs should be included in the determination of the spacing required.

1.4.2.3. Stairways in intermediate shafts should be separated from the running tunnels by fire-resisting smoke stop doors in such a way as to form a lobby between the tunnels and the foot of the stairway. The lobby should be ventilated to keep it free of smoke and designed in accordance with BS 5588 (Part 5) Code of practice for fire-fighting stairs and lifts or alternative relevant European standard with the approval of the RSC.

1.4.2.4. Where the depth of an intermediate shaft is greater than 9m, a fire-fighting lift should be provided in addition to stairs.

1.4.2.5. Passengers may be evacuated through emergency access shafts. Where this is proposed, additional provisions may be necessary to separate conflicting movements of passengers and emergency services.

1.4.2.6. Emergency access provided at the tunnel portals and other access points should include adequate:

(a) access from the roadway for vehicles and pedestrians; and

(b) hard standing for emergency vehicles.

1.4.2.7. Signs should be provided at regular intervals in the tunnels indicating the direction and distance to the nearest exit.

1.4.3. Cross-passages

1.4.3.1. Cross-passages between single-track running tunnels or to a service tunnel should be provided on the basis of safety assessments. They should be provided at a spacing determined on the basis of train length, the method of evacuation and the needs of the emergency services.

1.4.3.2. If cross-passages are provided between the running tunnels, consideration should be given to:

(a) the passage of smoke and heat;

(b) the opening and closing of doors if provided; and

(c) risk to people from trains in any parallel tunnel, including any aerodynamic effects.

1.4.3.3. Signs should be provided at regular intervals indicating the direction and distance to the nearest cross-passage.

1.4.4. Track surface and side walkways

1.4.4.1. Where the design of the trains using the tunnel permits evacuation throughout the length of the train and from the end of the train to the tunnel floor, the track construction should provide an adequate anti-slip surface and be free from obstruction. Except for the rails, any unavoidable obstructions should be suitably bridged with an anti-slip material with ramped approaches. Special arrangements may be necessary if points or crossings lie on the evacuation route.

1.4.4.2. Where the train design does not permit longitudinal evacuation throughout the length of the train, a side walkway to permit evacuation through the normal passenger side doors of the train should be provided. The side walkway should take into account the floor height and stepping distance from all types of train using the tunnel.

1.4.4.3. The side walkway should be free of obstruction, at least 850mm wide with 2000mm headroom above the centreline of the walkway and have an even, anti-slip surface. Any change in level should be achieved by ramps with a gradient not steeper than 1 in 12.

1.4.4.4. A means of guiding people along the side walkway, such as a continuous handrail against the tunnel wall, should be provided between access points.

1.4.4.5. Suitable steps should be provided between the track and side walkway for use by the emergency services.

1.4.4.6. There should be an access space at approximately rail level on the side opposite to the side walkway, or on both sides if no side walkway is provided. The access should be free of obstruction, at least 450mm wide at foot level, 800mm wide at shoulder level and 2000mm high and have an adequate anti-slip surface. This access space enables people to pass between the tunnel wall and a stationary train and provides emergency services with access past a train and access beneath a train.

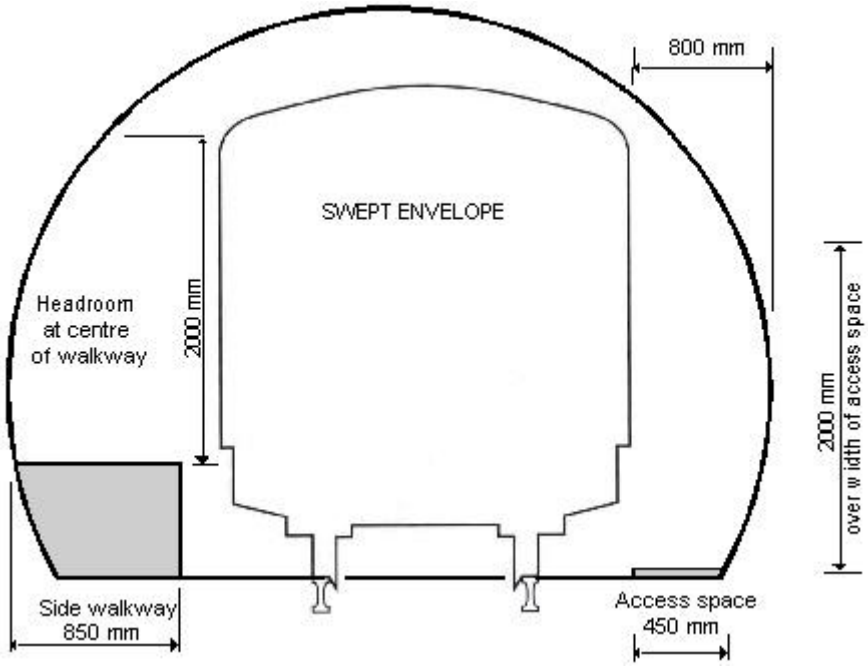


Figure 1: Tunnel side walkway and access space

1.4.5. Electric traction power supplies

1.4.5.1. Guidance relating to Electric Traction Systems is described in section 3. The principal additional concern within a tunnel environment is that means should be provided throughout the tunnel and on underground platforms for the disconnection of traction current. This may be on request at the control room by use of tunnel telephone system. The same system of discharging the current should be used throughout.

1.4.6. Fire-fighting facilities

1.4.6.1. A fire-fighting main should be installed with hydrant points at least at each end of cross-passages and the lobbies of intermediate shafts where provided, and at such additional locations and intervals as may be determined in consultation with the local Fire Authority.

1.4.6.2. The fire-fighting main should be charged and provide an adequate flow at an adequate pressure on operation for the fire conditions likely to be encountered. A system of leak prevention and early warning in case of leaks should be provided as appropriate. Provision of appropriate equipment for use with the particular fire-fighting main should be agreed with the local Fire Authority.

1.4.6.3. Adequate and reliable means of draining any reasonably foreseeable leakage of water should be provided. The drainage capacity should also take into account the amount of water likely to be used in fire fighting.

1.4.7. Ventilation

1.4.7.1. A ventilation system capable of providing an acceptable environment in normal operation and controlling the movement of smoke in any emergency should be provided.

1.4.7.2. When more than one train is permitted to be in the tunnel, due regard should be given to engulfment of any other trains by smoke and to evacuation procedures.

1.4.8. Lighting

1.4.8.1. Running tunnels, cross-passages and access shafts should be permanently equipped with adequate lighting. The lighting need not normally be illuminated but should be capable of being switched on remotely from adjacent stations, the railway control room, manually from within the tunnel, and automatically on the interruption of the electric traction supply.

1.4.8.2. The electrical supply to the lighting should be arranged to prevent total loss through disruption

of power supplies, electrical faults or damage. The lighting should provide adequate illumination for passenger evacuation. In the event of a total power failure, it should be possible to sustain emergency lighting at not less than 5 Lux for at least the time required for evacuation and not less than 3 hours.

1.4.8.3. The position of any cross-passage, access shaft and tunnel telephone should be indicated by permanently illuminated marker lights connected to the emergency lighting system and be provided with unique identification.

1.4.9. Communications

1.4.9.1. A radio communication network should be provided incorporating the following features:

(a) discrete radio between train drivers and the railway train movement control;

(b) discrete radio between the railway train movement control and the public address to passengers on a train;

(c) an 'open' radio between the railway train movement control and all trains simultaneously, including public address to passengers in them; and

(d) provision for each of the emergency services and railway personnel to use their own portable radios within their own command structure. This facility should be functional throughout the running tunnels, and within any access shafts and cross-passages.

1.4.9.2. Telephones connected directly to the railway control should be provided at appropriate intervals and in suitable locations including at any cross-passages and access points.

1.5. CLEARANCES

Principle 1.5 Clearances

There should be safe passing clearances between trains and to adjacent structures and, where such access is permitted, safe clearances for people while trains are running.

1.5.1. General Guidance

1.5.1.1. This section gives guidance on passing clearances between trains and structures and between trains. It also includes the definitions and methods of calculating the dynamic shape of the trains (see 'Definitions' below), and typical structure gauges for existing routes and for extensions to existing routes (see section 1.5.18). Guidance on clearances to electric traction power supply systems can be found in section 3 Electric Traction Systems.

1.5.1.2. The guidance has been structured to make a clear distinction between passing clearances for the safe passage of a train on the railway where people have no access to the line when trains are running, and safety clearances and provisions that should be made if people may work on or adjacent to the line when trains are running.

1.5.1.3. The passing clearances for staff safety given in this section recognise two speed bands for train operation:

(a) train speed 165 km/h (100 mph) or less;

(b) train speed over 165 km/h but less than 200 km/h (over 100 mph up to and including 125 mph).

1.5.1.4. The boundaries of the above speed bands are based on existing railway safety rules and practices. Additional guidance for railways where the train speed may exceed 200 km/h is given in section 1.9 High Speed Lines

1.5.2. Definitions

1.5.2.1. The passing clearance is the space between the swept envelopes of vehicles of one train passing another and is the space between the swept envelopes of vehicles and a given structure.

1.5.2.2. The static vehicle profile is the profile formed by the maximum permitted cross-sectional dimensions of vehicles and, where applicable, their loads when at rest on straight and level track. It should take into account allowances for tolerances in the manufacture of the vehicles and the effects of vehicle loading on the suspension.

1.5.2.3. The dynamic vehicle profile is the static vehicle profile enlarged to allow for the maximum possible displacement of the vehicle at rest or in motion, with respect to the rails on straight track. It should take into account vehicle suspension characteristics including arrangements for body tilting if provided, and allowances for tolerances in the maintenance of vehicles including wear to components, wheels and flanges. The effects of end-throw and centre-throw of vehicles on curved track are not included, and are disregarded in the development of the dynamic vehicle profile.

1.5.2.4. The kinematic envelope is the dynamic vehicle profile enlarged to allow for the permitted tolerances in track gauge, alignment, level and cross level and the dynamic and static effects generated in response to track roughness. The effects of end-throw and centre-throw of vehicles on curved track are not included, and are disregarded in the development of the kinematic envelope.

1.5.2.5. The swept envelope is the kinematic envelope enlarged to allow for the effects of vertical and horizontal curvature, including centre and end throw of vehicles, and the cant (super-elevation) applied to the track. This represents the bounds that a vehicle can sweep through when traversing a particular section of track. The swept envelope may be defined separately for each structure or for sections of the route and should take account of all railway vehicles using the line.

1.5.2.6. The structure gauge (also referred to as the construction gauge) is the boundary enclosing the passing clearances required outside the swept envelope to enable the railway to be operated in safety. The structure gauge should include provision for staff safety, where staff are permitted

on the railway while trains are running.

1.5.3. All clearances

1.5.3.1. The clearances to be used in determining a structure gauge should ensure the safety of the trains, people on-board and any people permitted on the lineside. These clearances should be increased where vehicles have windows through which passengers or staff may lean out.

1.5.3.2. Where the normal clearance dimensions specified below are not achieved consideration should be given to aerodynamic effects resulting from the passage or passing of trains, on structures, on trains and on people inside or outside trains.

1.5.3.3. The structure gauge derived from the above considerations should be used to determine dimensions from a fixed datum, preferably the running edge of the nearest running rail.

1.5.3.4. On existing railways, at places where clearances are equal to or less than those specified in this guidance, the present clearances should not be reduced, nor should 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 different rolling stock, without the agreement of the RSC.

1.5.3.5. On existing lines where the practice has been to maintain minimum construction gauges of former constituent companies, for example GSWR, this may be permitted to continue.

1.5.3.6. Where any structure adjacent to an existing railway is replaced or significantly modified, the new or reconstructed works should conform to the clearances defined in this section wherever reasonably practicable. Other significant permanent alterations including:

(a) track alterations;
(b) electrification;
(c) the introduction of railway vehicles with different swept envelopes; and
(d) an increase of line speed;

should be treated in the same way.

1.5.4. Clearances between trains and structures

1.5.4.1. The lateral passing clearances given below are applicable when people are not permitted to be on or near the tracks while trains are running. Where people are permitted on the track, see sections 1.5.9 to 1.5.17 for the additional passing clearances required.

1.5.4.2. The passing clearances to be used in determining the structure gauge should ensure the safe passage of the trains, including additional passing clearance where vehicles have windows through which passengers or staff may lean out.

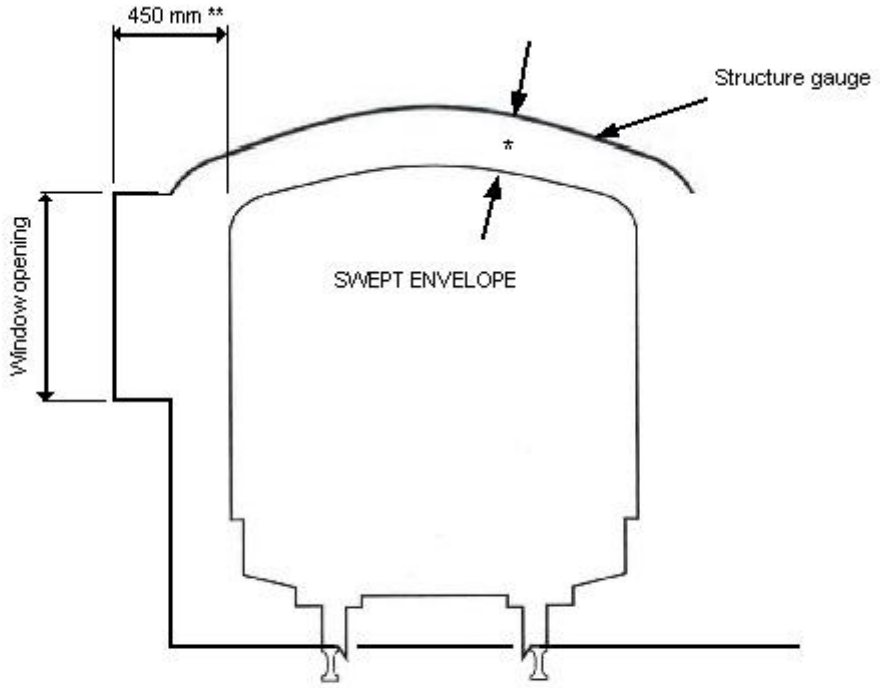
1.5.5. Lateral passing clearances

1.5.5.1. The lateral passing clearance between the structure gauge and the swept envelope, for line speeds up to 200 km/h, should be at least 450mm. This dimension is applicable between 1100mm above rail level and cantrail level (see Figure 2).

1.5.5.2. This dimension may be reduced to 250mm on lines on which the passenger windows of all rolling stock do not permit people to lean out.

1.5.5.3. The dimension may be further reduced to 150mm where there are no windows from which either passengers or staff can lean out and adequate measures are taken to sustain the position of the track in relation to the structure.

1.5.5.4. Where normal passing clearances are not achieved, due consideration should be given to aerodynamic effects.



* Clearance between kinematic envelope and railway operational structure. Normal 250 mm. May be reduced to 100 mm where the level of the track is sustained in relation to the structure.

** for line speeds up to 200 km/h; may be reduced to 250 mm [illegible] to 150 mm where there are no windows for staff or passengers to lean out.

Figure 2: Lateral and vertical passing clearances

1.5.5.5. Where lineside signals are provided, the passing clearance between track and structures should take into consideration the sighting of signals from trains.

1.5.5.6. Signal posts and their telephones should not be less than 570mm from the swept envelope. The passing clearance between the swept envelope and the masts supporting electrical overhead line equipment or isolated structures or items of fixed equipment, not exceeding 2000mm in length, should not be less than 675mm (see Figure 3).

1.5.5.7. Support structures for overhead electric traction systems and other items of lineside equipment may need to be positioned at a greater passing clearance so as not to adversely affect signal sighting.

1.5.5.8. Structures such as bridge girders, ground signals, similar railway operational equipment and platforms below 940mm above rail level may encroach within the structure gauge. There should be a minimum passing clearance of 50mm from the swept envelope. This clearance may be reduced to 25mm where the swept envelope includes the maximum displacements combined with an allowance for a serious rolling stock suspension fault.

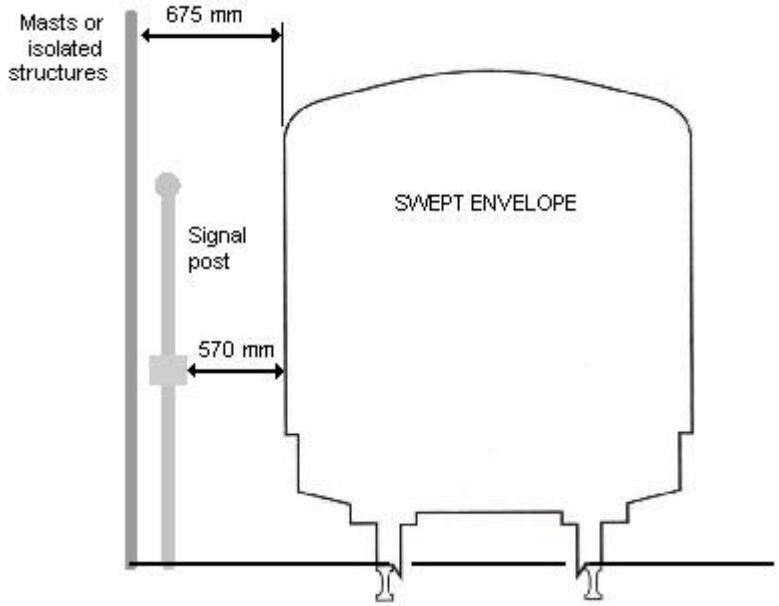


Figure 3: Lateral passing clearances to posts, masts and isolated structures

1.5.5.9. For clearances to platforms see section 2 Stations.

1.5.6. Vertical passing clearances

1.5.6.1. The passing clearance between the swept envelope and the structure gauge above rail level should be not less than 2700mm. This may be reduced to 1000mm where the level of the track position is sustained in relation to the structure. This dimension is applicable above carriage level (see Figure 2).

1.5.6.2. All wires, cables and conductors and any stay wires which cross over the railway in the open, other than the overhead line equipment on electrified railways, should be at least 6000mm above rail level after allowance for wind and temperature effects.

1.5.6.3. In the case of electric cables the height should ensure adequate electrical clearance. Markers should be provided in accordance with section 1.7.

1.5.6.4. Where the railway is electrified on the overhead line system or is likely to be so electrified, the height of the structure gauge should be increased in accordance with section 3 Electric traction systems.

1.5.7. Track datum marks

1.5.7.1. Track datum marks should be provided at all platforms and at other structures where reduced clearances have been permitted.

1.5.7.2. On railways electrified on the overhead line system, track datum marks should be provided at intervals along passenger platforms, at over bridges, tunnels and automatic level crossings.

1.5.8. Passing clearances between trains

1.5.8.1. The passing clearance between swept envelopes of trains should not be less than 380mm (see Figure 4).

1.5.8.2. Aerodynamic considerations may require an increase in the clearance between trains.

1.5.8.3. When existing railways are reconstructed or altered, the 380mm passing clearance should be provided wherever this can be achieved. Where this cannot be achieved in full, the maximum passing clearance practicable should be provided, but in no case should the passing clearance be less than 100mm.

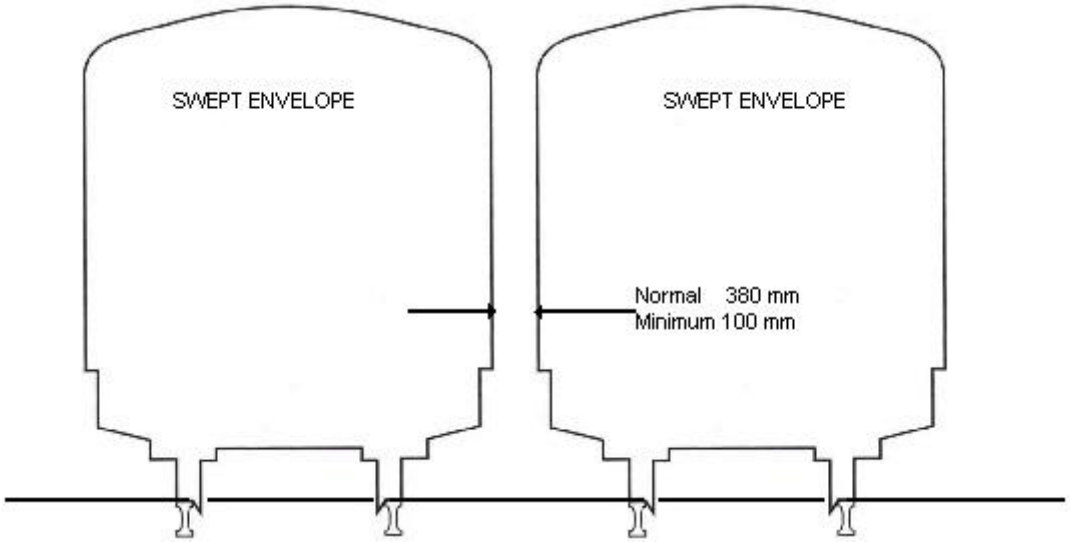


Figure 4: Passing clearances between trains

1.5.8.4. Where there are more than two running lines or there are sidings adjacent to running lines, wider track spacings may be necessary between pairs of running lines and between running lines and sidings to ensure the safety of trains and staff.

1.5.8.5. Where new railways are constructed 450mm passing clearance should be achieved. Where this cannot be achieved in full, the maximum passing clearance practicable should be provided, but in no case should the passing clearance be less than 380mm (see Figure 8).

1.5.9. Lineside premises and equipment

1.5.9.1. Lineside premises and equipment should be designed and located so that they can be reached, and planned maintenance carried out, without danger from trains. Waist high safety barriers may be required between equipment and the adjacent track where there is a danger of staff stepping foul of the line.

1.5.9.2. Signal masts and their telephones, masts supporting electrical overhead line equipment and other individual structures or items of fixed equipment not exceeding 2000mm in length should be positioned so they do not obstruct a lineside walkway. Where there is insufficient space to safely position the walkway between the track and the structure, the walkway should pass behind that structure.

1.5.9.3. Lineside equipment and structures to which staff need to gain access while trains are running should be located at a safe clearance from the passing trains. Where practicable access doors should not open towards the track. Where it is necessary to have doors that open towards the track consideration should be given to the provision of safety barriers or other means of preventing staff inadvertently moving to a position of danger.

1.5.9.4. Where train crew need to gain access to the track to use signal post telephones, provision should be made for their safety, including suitable hard standing. At other places where train crew regularly need to gain access to the track, similar provisions may be necessary.

1.5.10. Lineside walkways

1.5.10.1. There should be a walkway, with a minimum width of 700mm, on both sides of a railway along which staff can walk and stand in safety during the passage of trains.

1.5.10.2. Walkways should be accessible from the track and places of access to the railway. The walkway should be nominally at cess level. At places where this cannot be achieved consideration should be given to the provision of additional protective measures such as handrails.

1.5.10.3. Where cable troughing routes form part of any walkway they should be so designed that they do not introduce additional hazards. The top of troughing should be level with the walkway surface and have suitably secure lids.

1.5.10.4. Where a lineside walkway cannot be made continuous or crosses any track, appropriate provision should be made. The crossing point between places of safety should be sited where adequate sighting is available, or warning equipment should be provided. The location of all authorised crossing points should be suitably identified.

1.5.10.5. If adequate sighting is not available at the crossing point, a suitable means should be provided to warn of the approach of trains.

1.5.11. Places of safety

1.5.11.1. Where alterations are made to existing railways and where it is not reasonably practicable to provide a lineside walkway, a continuous place of safety not less than 450mm wide should be provided.

1.5.11.2. Where a place of safety is between two running lines or between a running line and a siding, its width should be 900mm to allow for the possible effects of staff disorientation and the aerodynamic effects of adjacent passing trains.

1.5.11.3. At any place from which the approach of trains cannot be seen in sufficient time for staff to stop work and reach a place of safety, automatic warning of the approach of trains should be available if any work is to be undertaken while trains are running.

1.5.11.4. In the case of lines with reversible signalling, where normally traffic is uni-directional but the signalling system provides for wrong direction running, a method of warning staff who have access to the line should be provided so that appropriate arrangements can be made for a safe system of work. The signalling system should be provided with a means of inhibiting change of direction (see section 4 Signalling).

1.5.12. Sign posting of restricted clearances

1.5.12.1. Where the lateral clearances specified in section 1.5 are not available, it is possible for staff with duties on the line to undertake their work safely by exercising special care or by the provision of refuges.

1.5.12.2. 'Limited clearance' warning signs or notices should be fixed at about eye level at each end of the restriction and at not less than 40m intervals.

1.5.12.3. Where the clearances at a location or locations on a section of line where staff have access during normal train running are so reduced as to make it unsafe for staff to enter when trains are running, a prohibition sign or notice should be erected at each end of the location or locations and at not less than 40m intervals.

1.5.12.4. Where clearances are adequate on one side of the line but not on the other, a prohibition sign or notice should be provided on the restricted side.

1.5.12.5. Where staff are not permitted on the track while trains are running, adequate prohibition signs or notices should be provided at both ends of such sections and at any potential access points including the ends of all platforms.

1.5.13. Provision of refuges

1.5.13.1. Where a place of safety is not available over a distance of more than 40m, or the warning time of an approaching train is inadequate for staff to reach a place where they can stand clear of trains in safety, refuges may provide a safe system of work.

1.5.13.2. Places where refuges may be necessary include:

(e) in tunnels;

(c) where clearances are constrained by retaining walls, buildings or over bridge abutments;

(d) on long bridges or viaducts; and

(e) on embankments and in cuttings unless it is possible to stand in safety on the slope during the passage of trains.

1.5.13.3. Where refuges do not provide for a safe system of work, an automatic warning should be provided to give all staff sufficient time to reach a place of safety, or access should be prohibited

when trains are running.

1.5.13.4. Refuges should be spaced so that there is adequate time from the moment staff working on the line become aware of the approach of a train for them to stop work, make their way to, and have entered the refuge with an adequate time margin before the arrival of the train.

1.5.13.5. Refuges should be located on each side of a line having two or more tracks at a spacing not exceeding 40m. They should be staggered equally to give an effective spacing of 20m, or less. On a single line the maximum spacing and arrangement of refuges should be as above or on one side of the line only at a maximum of 20m.

1.5.13.6. The minimum dimensions of refuges should be not less than: entrance height 2000mm; width 1400mm; and depth 700mm.

1.5.13.7. Refuges should be of adequate size to accommodate the maximum number of people required to use them, together with any equipment they may have. In determining the size of refuges consideration should be given to the type of work envisaged to be undertaken during normal train operation. The types of work for which the refuges have been designed should be documented.

1.5.13.8. The floor level of refuges should not differ substantially from the level of the lineside walkway unless easy access is provided. The whole refuge needs to be kept clear of cables, pipes or other obstructions.

1.5.13.9. The position of refuges should be marked by lights, reflective marker plates or other effective means. Consideration should be given to providing an indication to staff of the direction to the nearest refuge.

1.5.13.10. Handholds should be provided in refuges to help staff keep their balance during the passage of trains. Handholds may be required at other locations where clearances are adequate but where aerodynamic effects could be a hazard.

1.5.13.11. Consideration should be given to indicating to staff that a place of safety is not available between refuges, for example by means of signs, notices or paint markings.

1.5.13.12. For intervals between running lines and sidings where places of safety are provided, see section 1.5.

1.5.14. Additional passing clearances required for staff safety

1.5.14.1. Staff should not be allowed onto any automatic railway or any railway where the line speed exceeds 200 km/h while services are operating normally.

1.5.14.2. Where staff are permitted to be on or near the railway tracks while trains are running, additional passing clearances to those between trains and structures are required.

1.5.14.3. The guidance for staff safety given in this section should be applied whenever the works facilitate it, or operational changes necessitate it, such as when:

(a) new structures are built, or existing ones are reconstructed;

(b) the line speed is increased above 165 km/h;

(c) any line speed increase is introduced which renders insufficient the warning time available to staff;

(d) alterations to the track layout or signalling are carried out which introduce, or increase the extent of, bi-directional or reversible running;

(e) additional tracks are added or realignment results in significant changes in passing clearances; or

(f) new rolling stock with different characteristics is introduced.

1.5.15. Clearances to lineside walkways

1.5.15.1. Details of lineside walkways and places of safety for staff working on or near to the track are given in section 1.1. The passing clearance to the vertical plane through the edge of a lineside walkway or the edge of a place where staff may stand in safety during the passage of a train

should be at least 430mm clear of the adjacent swept envelope for line speeds not greater than 165 km/h. The passing clearance should not be less than 1285mm for line speeds greater than 165 km/h and not exceeding 200 km/h (see Figure 5).

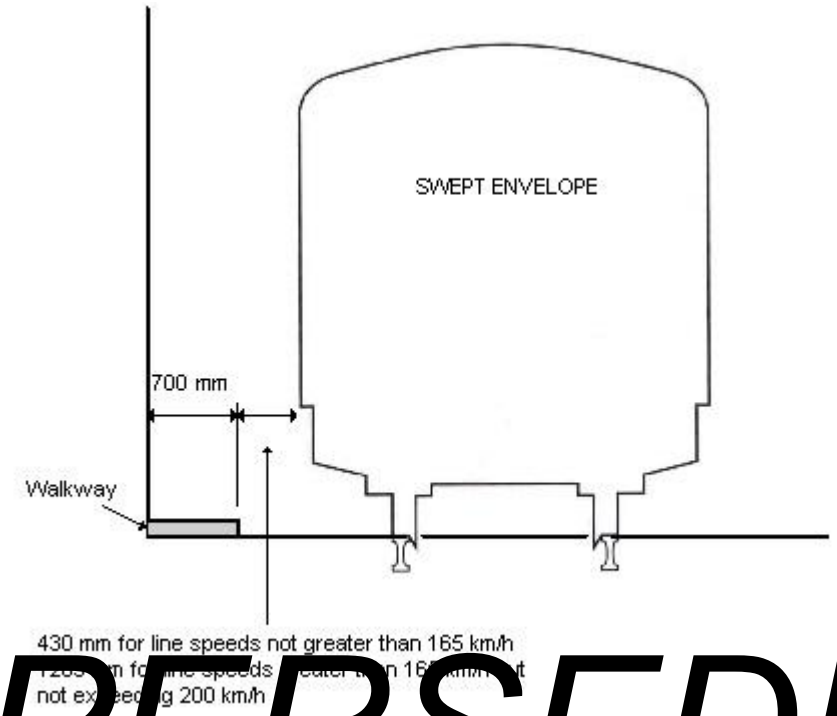


Figure 5: Additional passing clearances required for staff safety

1.5.16. Spacings between lines

1.5.16.1. The spacing between tracks should be not less than the 900mm place of safety plus the appropriate passing clearances to a place of safety for the line speed for each adjacent track (see Figure 6).

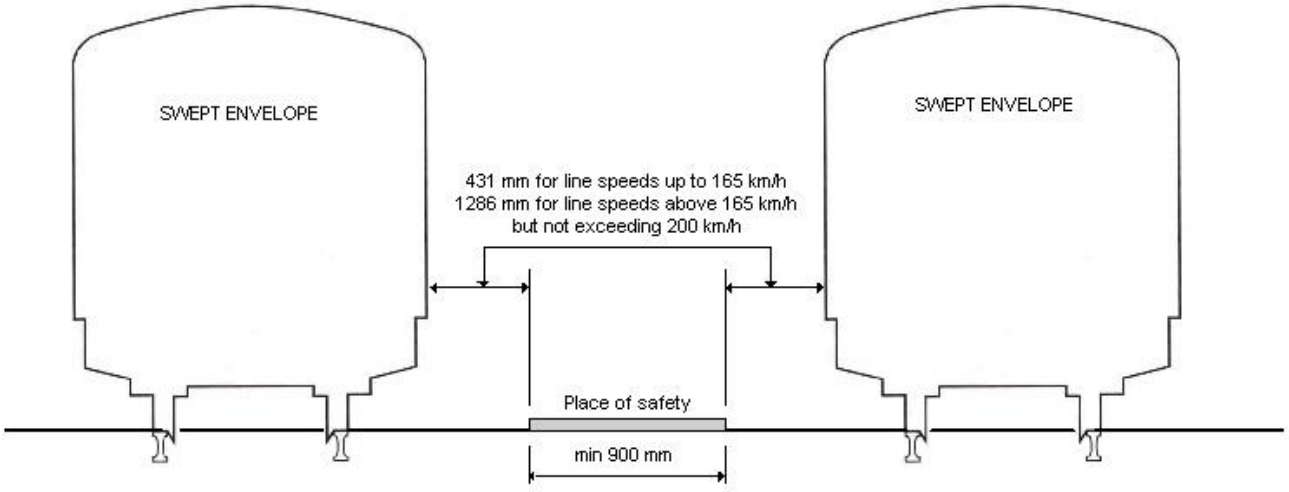


Figure 6: Place of safety between trains

1.5.16.2. Where the passing clearances from adjacent lines are different, the position of the place of safety should be clearly marked.

1.5.17. Spacings between sidings

1.5.17.1. Where the only work carried out involves side access for entry or for simple tasks such as examination of rolling stock, train preparation or coupling of vehicles the total passing clearance between swept envelopes of adjacent sidings may be reduced to 1130mm.

1.5.17.2. Where maintenance takes place or there is an authorised access route along the track, the spacing should be increased sufficiently to ensure that staff can remain in a place of safety clear of both sidings.

1.5.18. Typical structure gauges

1.5.18.1. The above clearances given in this section should be calculated and expressed in terms of distances to a fixed reference, preferably the running edge of the nearest rail. Typical structure gauges are given in Figure 7 and Figure 8.

1.5.18.2. Station canopies, signals, electrification and other operational equipment may encroach within the typical structure gauges provided that the guidance in 1.5.3 is adhered to.

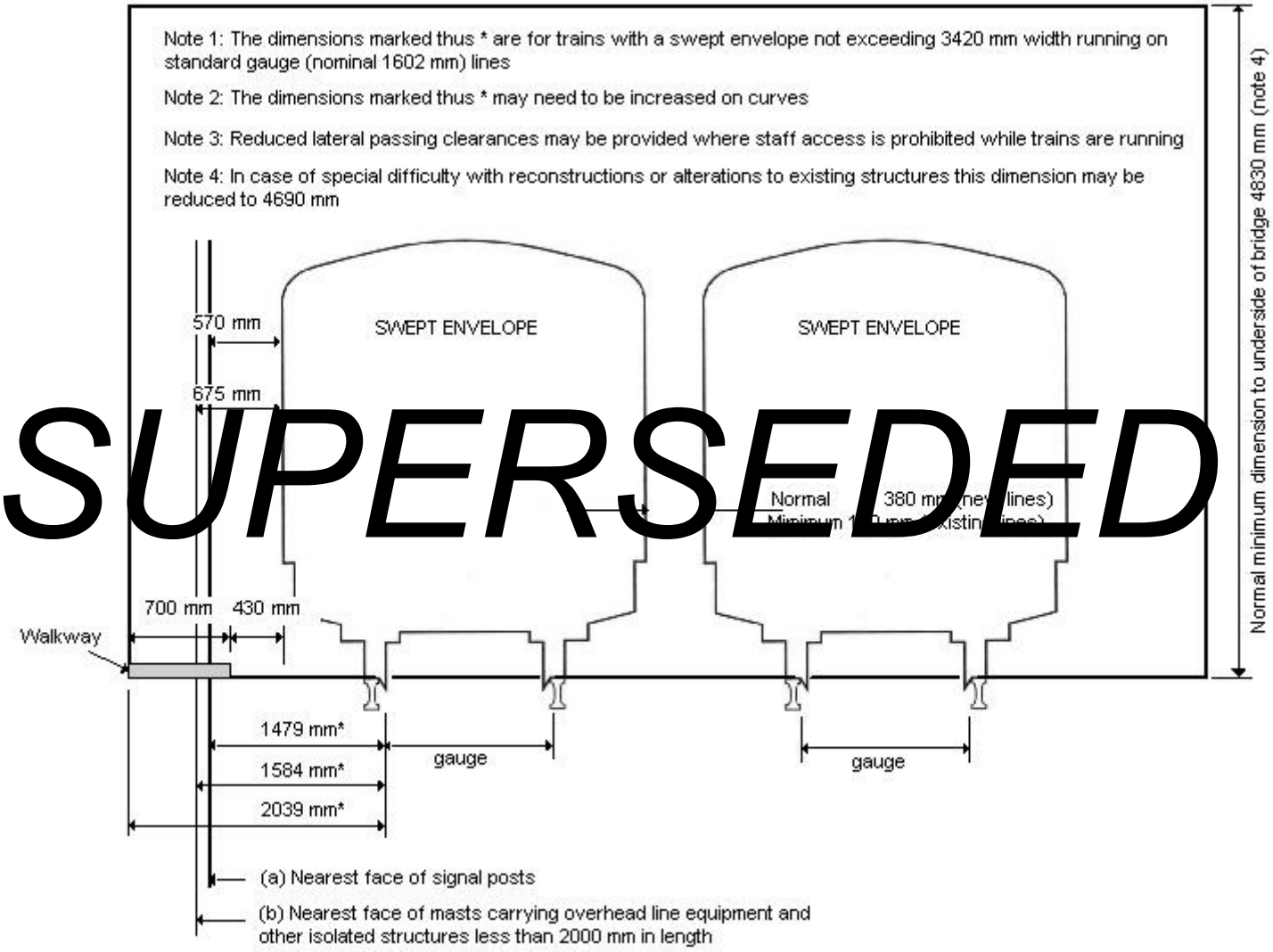


Figure 7: Typical structure gauge for linespeeds up to 165km/h

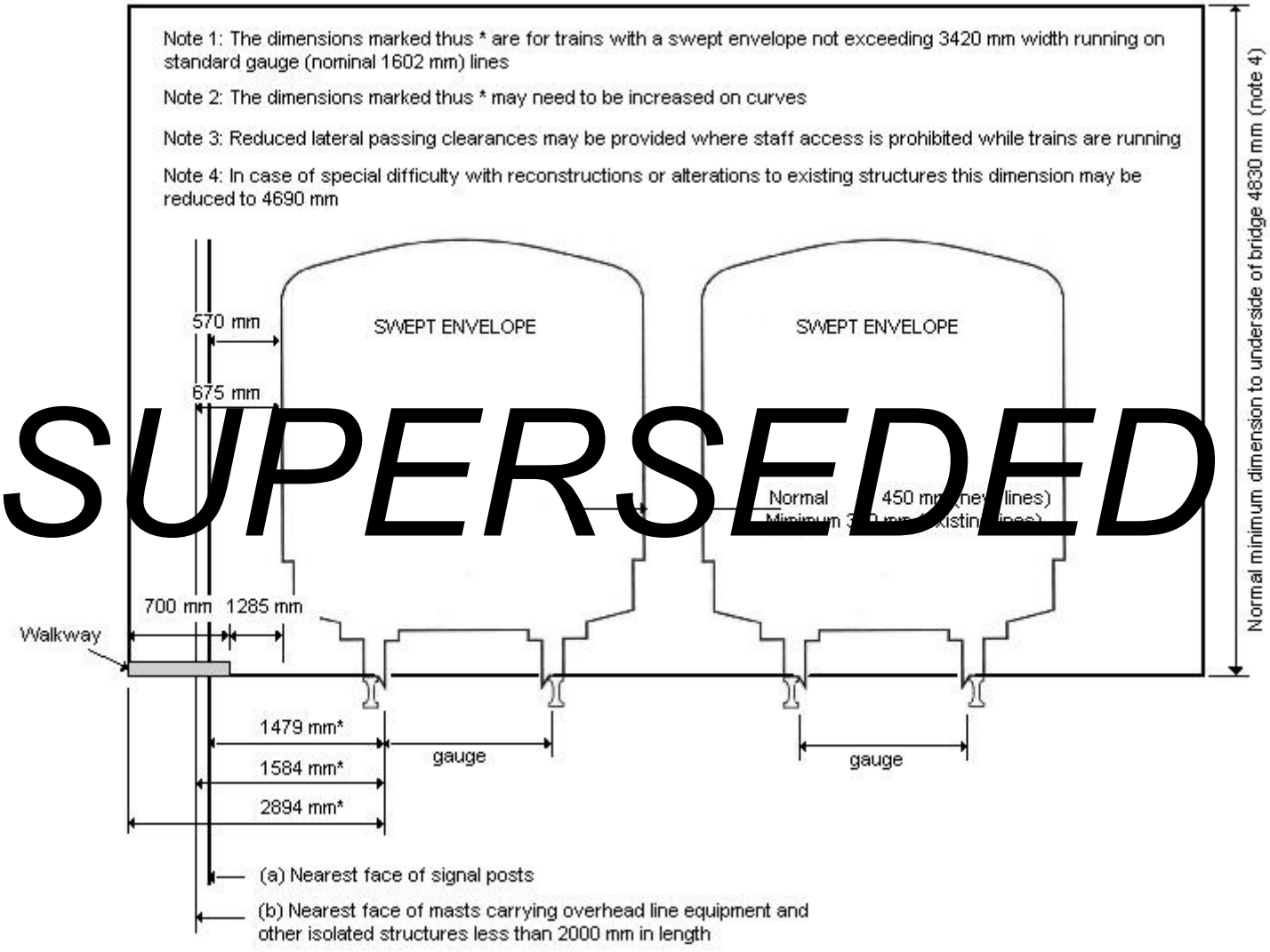


Figure 8: Typical structure gauge for linespeeds above 165km/h

1.6. CONTROL OF ACCESS

Principle 1.6 Control of Access

Provisions are needed to prevent unauthorised intrusion of people, animals, plant or vehicles but allow legitimate access to the railway in safety.

1.6.1. Fencing of the railway

1.6.1.1. Fencing should be continuous, clearly visible and of sturdy construction. Natural growth, ditches or mounds may provide suitable fencing in certain locations.

1.6.1.2. Fencing should be provided to at least the minimum standards set out in 1.6.1.3 and 1.6.1.4 and in accordance with relevant European Standards or equivalent standards acceptable to the RSC. There will be circumstances or locations where more stringent standards are required. Arrangements for fencing of lines where the line speed is greater than 200 km/h are given in section 1.9.

1.6.1.3. A fence of timber, steel or concrete posts with a minimum of seven wire strands and a top wire height of 1350mm should normally be provided.

1.6.1.4. Where there are areas subject to high vandalism, security type palisade steel fencing or open welded mesh steel panel fencing at least 1800mm high should be provided and the bottom buried or otherwise protected against burrowing as necessary to ensure the boundary is secure.

1.6.1.5. Additional fencing may be required at pedestrian, rights of way, vehicular and other crossings of the line (see section 5 Level crossings).

1.6.1.6. Adequate measures should be taken to ensure that stations, particularly those that are not staffed, do not provide an easy means of access to the line.

1.6.1.7. Suitable measures should be taken for the safety of trains in the vicinity of airport runways and where other hazards may impinge upon the railway. Trip wires may be used to alert the train signalling/control system (see section 4 Signalling).

1.6.1.8. In built up areas, welded mesh or chain-link fencing to a minimum height of 1800mm should be provided. In areas where a particular trespass problem exists, additional means to deter climbing should be provided.

1.6.1.9. In rural areas, to prevent animal ingress, timber, steel or concrete posts may be used as described in sections 1.6.1.3 and 1.6.1.4, with the addition of wire fencing at least 800mm high. The bottom of the fence may be buried or turned back to prevent burrowing. Alternatively fencing may be used with the addition of extra wires above to attain the minimum top wire height of 1350mm.

1.6.1.10. Where necessary, additional measures should be taken to prevent livestock and other animals gaining access to the railway, for example sheep wire or netting.

1.6.1.11. In deciding on the type of fencing to be used at any location, the risks at that location should be taken into account.

1.6.1.12. The statutory requirements are given in section 68 of the Railway Clauses Consolidation Act 1845.

1.6.2. Access to the railway

1.6.2.1. Gates should be capable of being kept locked. The locks, bolts, gate hinges and any warning notices should not afford footholds.

1.6.2.2. Special attention should be paid to the existence of structures, other fences etc that either abut or are close to the lineside fence and which may provide a possible means of climbing over or avoiding the fence.

1.6.2.3. Consideration should be given to the needs of emergency services to gain access to the line, particularly at tunnels, bridges and viaducts.

1.6.2.4. Where regular access to the lineside is required, it should be along defined access routes.

1.6.3. Maintenance access on foot

1.6.3.1. Access suitable for use by maintenance people on foot should be provided to the lineside of the railway.

1.6.3.2. A lockable gate should be located at the boundary of access.

1.6.3.3. Where steps and ramps lead directly to the lineside walkway, suitable, level hard standing should be provided at both ends of the steps and ramps.

1.6.3.4. A barrier may be necessary at the end of the access to the trackside or lineside walkway, to prevent accidental access onto the tracks.

1.6.4. Maintenance access for road vehicles

1.6.4.1. Access suitable for use by maintenance road vehicles should be provided for the maintenance of railway infrastructure, e.g. electrical substations, auto-transformers, signalling equipment etc.

1.6.4.2. A lockable gate should be located at the boundary of the access.

1.6.4.3. A suitable area should be provided at the end of the access routes for parking and turning.

1.6.4.4. Where access routes approach the line, suitable barriers should be provided to prevent accidental road vehicle overrun onto the track.

1.6.5. Barriers and fencing when the railway is adjacent to roadways

1.6.5.1. Where the lights from road vehicles or other roadway lighting may interfere with a train driver's view of railway signals, anti-dazzle fencing or other screening should be provided.

1.6.5.2. Where a roadway runs alongside or converges on a railway at such a distance and level that an errant vehicle could obstruct the railway, a means of containing the vehicle before it reaches the railway should be provided. The form of the barrier will depend on the type of road traffic and speeds and topographical features. It may consist of vehicle barriers, ditches, mounds, or reinforced walls.

1.6.5.3. The length of the barriers and safety fences described in clause 1.6.5.2 should be commensurate with the risk of intrusion onto the track by errant road vehicles.

1.6.5.4. On high-speed or automatic railways, where there is a high risk of a road vehicle penetrating onto the line, special arrangements may be required to stop trains.

1.7. LOCATION IDENTIFICATION

Principle 1.7 Location identification

Adequate means to identify any particular structure or location on the railway should be provided.

1.7.1. General Guidance

1.7.1.1. Conspicuous distance markers should be provided at suitable and regular intervals along the track.

1.7.1.2. Conspicuous track gradient markers should be provided at all significant changes in the degree or direction of slope.

1.7.1.3. Markers should be provided at the lineside indicating the location of all power lines which cross over the railway, and giving the maximum safe working height beneath them.

1.7.1.4. Markers should be provided at the lineside indicating the location and depth of all buried power cables and other buried services which cross under or pass along the railway.

1.7.1.5. All bridges and other fixed structures (including signal posts and OHLE masts) should be uniquely identified. The identification should be conspicuous from both roadway and rail, as appropriate to allow prompt and accurate identification of the structure and the location. To assist reporting of bridge strikes (normally of underbridges), a notice identifying the structure and location with a contact telephone number may be appropriate at roadway level.

1.7.1.6. The names of junctions, level crossings and other locations, which may be used as reference points by train crews and people working on or near the line, should be conspicuously displayed towards trains.

1.7.1.7. Point ends should be uniquely identified to assist staff when carrying out maintenance and implementing out of course operational procedures.

1.7.1.8. All staff refuges, track crossings, limited clearances and prohibited areas should be marked in accordance with section 1.5.1.

1.7.1.9. Track datum marks should be provided in accordance with section 1.5.

1.8. SIDINGS AND DEPOTS

Principle 1.8 Sidings and Depots

Sidings and depots should be installed and equipped to minimise risk to persons having work to do in or around the trains.

1.8.1. General Guidance

1.8.1.1. Much of the guidance contained within the rest of section 1 and within section 2-Stations is applicable to the design and construction of sidings and depots.

1.8.1.2. Due to the particular nature of working within depots and sidings, consideration should be given during design, to the safe systems of work that will be required to allow workers engaged in maintenance or other activities to carry out their tasks in a safe manner while trains move about the depot or sidings. Considerations will include:

(a) Systems for moving trains within the depot or siding and means of protecting against unsafe movement;

(b) Designated pedestrian and vehicle crossings to direct their respective movements when crossing tracks;

(c) Provision of designated walkways with appropriate surfacing, where necessary with barriers and/or handrailing to protect people from moving trains;

(d) Adequate space between adjacent tracks or other safety provisions to enable servicing, maintenance or loading/unloading tasks to be without risk from train movements;

(e) Provision of adequate lighting for workers carrying out operational or maintenance activities;

(f) Systems to allow isolation of electrical traction power supply when maintenance to vehicles is required.

1.8.1.3. Depots and sidings should be designed such that in the event of the braking system of a stationary train failing it will not result in any running lines that cause harm to people who may be affected by it such as staff or neighbours. Considerations in the design to achieve this should include:

(a) All sidings and stabling lines where rail vehicles may be left unattended being constructed on a level or gradient of no more than 1:500 at the steepest, falling towards a buffer stop;

(b) Adequate buffer stop provision or other means of arresting runaway vehicles;

(c) Trap points.

1.8.1.4. The guidance for determining the interval between sidings can be found in section 1.5.17

1.9. HIGH-SPEED LINES

1.9.1. General Guidance

1.9.1.1. This section gives guidance on the additional measures which may be necessary where the line speed exceeds 200 km/h but is not greater than 300 km/h. Provisions for line speeds in excess of 300 km/h should be discussed with the RSC. The structure gauge for line speeds up to 300 km/h is shown in Figure 12 at the end of this section.

1.9.1.2. On high-speed lines, additional measures should be provided to protect people from exposure to aerodynamic effects and the rapid approach of trains, and to protect trains from trackside hazards.

1.9.1.3. The design of railways where the line speed exceeds 200 km/h should take into account the increased aerodynamic effects when high-speed trains pass each other or slower moving freight trains. Similar consideration should be given to the design of tunnels or other enclosed structures.

1.9.1.4. The following guidance should be applied to all lines where the line speed exceeds 200 km/h and to any adjacent lines that are not suitably fenced from high-speed lines:

(a) no people should be permitted on or nearer to the line than 2750mm from the nearest rail, during normal running of trains;

(b) where staff are required to have access to or to work on the lineside, during normal running of trains, an additional fence or barrier should be provided at a distance greater than 2750mm from the nearest rail to prevent access nearer to the line;

(c) there should be no barrow, footpath or other level crossing on the line; and

(d) there should be no platforms adjacent to lines where the speed exceeds 200 km/h (for tracks adjacent to the platform unless there are platform barriers or similar devices to separate people on the platform from passing trains).

1.9.2. Passing clearances

1.9.2.1. Passing clearances between adjacent tracks should be increased to allow for the aerodynamic effects when trains pass in the open and for the effects of pressure transients in tunnels or enclosed structures. In all cases, an assessment should be made of the effects arising from and to all trains, including those which may not achieve high speed, running on the high-speed line or other adjacent line.

1.9.2.2. The passing clearance between swept envelopes should be not less than 910mm where all trains are designed for high-speed running. A reduced passing clearance may be permitted where line speeds are restricted and train speed suitably controlled (see Figure 9).

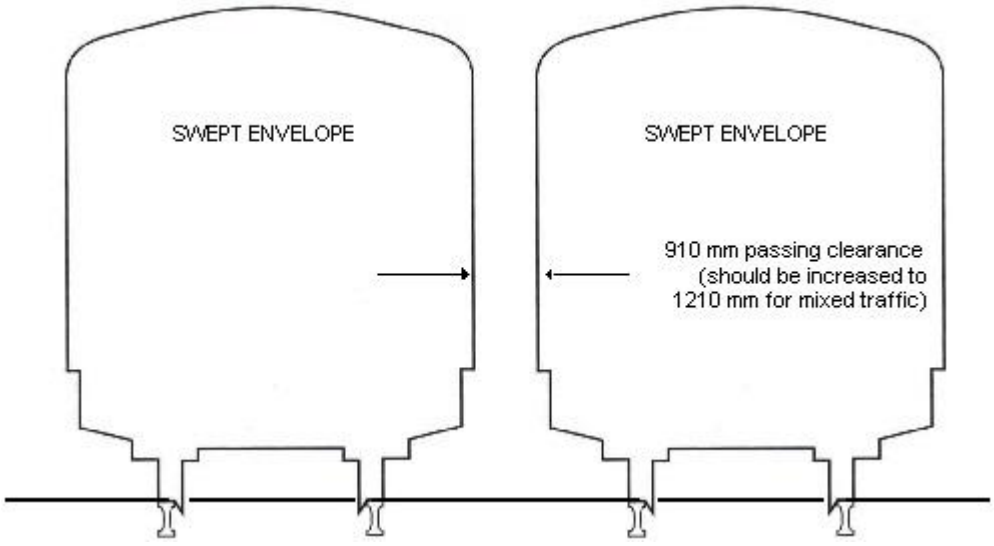


Figure 9: Passing clearance

1.9.2.3. Where mixed traffic can use the line, the passing clearance should be increased to at least 1210mm to allow for the different aerodynamic shapes and effects of the trains.

1.9.2.4. The passing clearance to all structures should be at least 570mm from the swept envelope (see Figure 10).

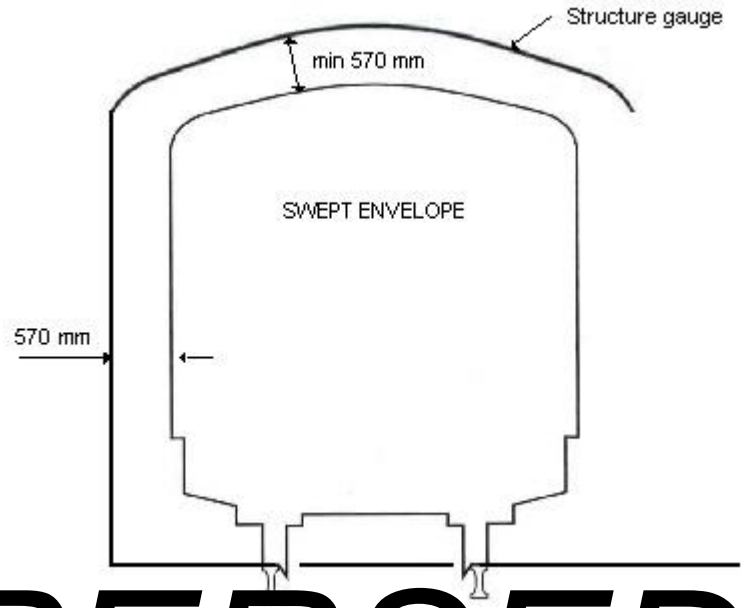


Figure 10: Clearances to structures

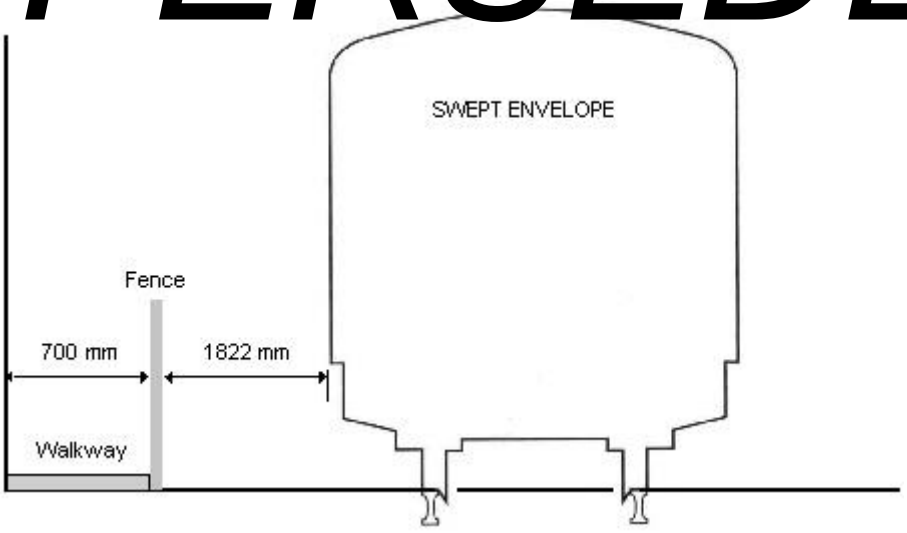


Figure 11: Lineside walkway clearance

1.9.2.5. If a lineside protected walkway is to be provided, the clearance between the lineside walkway and the swept path should be increased to at least 1822mm. See sections 1.5 for the provision of lineside walkways.

1.9.2.6. In tunnels, where reduced clearances are proposed, adequate free cross-sectional area should be provided to restrict pressure transients to within acceptable values.

1.9.2.7. An assessment for the aerodynamic effects on structures positioned adjacent to high-speed lines should be made.

1.9.2.8. Where circumstances necessitate the use of reduced clearances, a full aerodynamics study should be carried out.

1.9.3. Access to the railway

1.9.3.1. Where staff are required to gain access along the track to reach equipment etc, they should do so from a suitably protected walkway not less than 1822mm from the swept envelope if the nearest track is a high-speed line. The walkway should be at least 700mm wide, see sections 1.5.10 and 1.5.15.

1.9.4. Fencing of the high-speed line

1.9.4.1. A risk assessment should be carried out for all locations along any high-speed line to determine the likelihood of trespass or unauthorised access so that appropriate fencing and access can be determined, but subject to a minimum provision as set out in section 1.6.1.

1.9.4.2. Additional screens and fences should be provided at all bridges over the railway and locations above and close to the track to prevent objects from falling on the line. At some locations means may be required to detect the presence of any such objects. Any additional screens provided should not in themselves provide a means of, or encourage, trespass.

1.9.5. Typical structure gauge

1.9.5.1. The dimensions in Figure 12 and Figure 13 accommodate a full UIC GC kinematic envelope, having a maximum width of 3290mm and a height of 4700mm for line speeds up to 300 km/h.

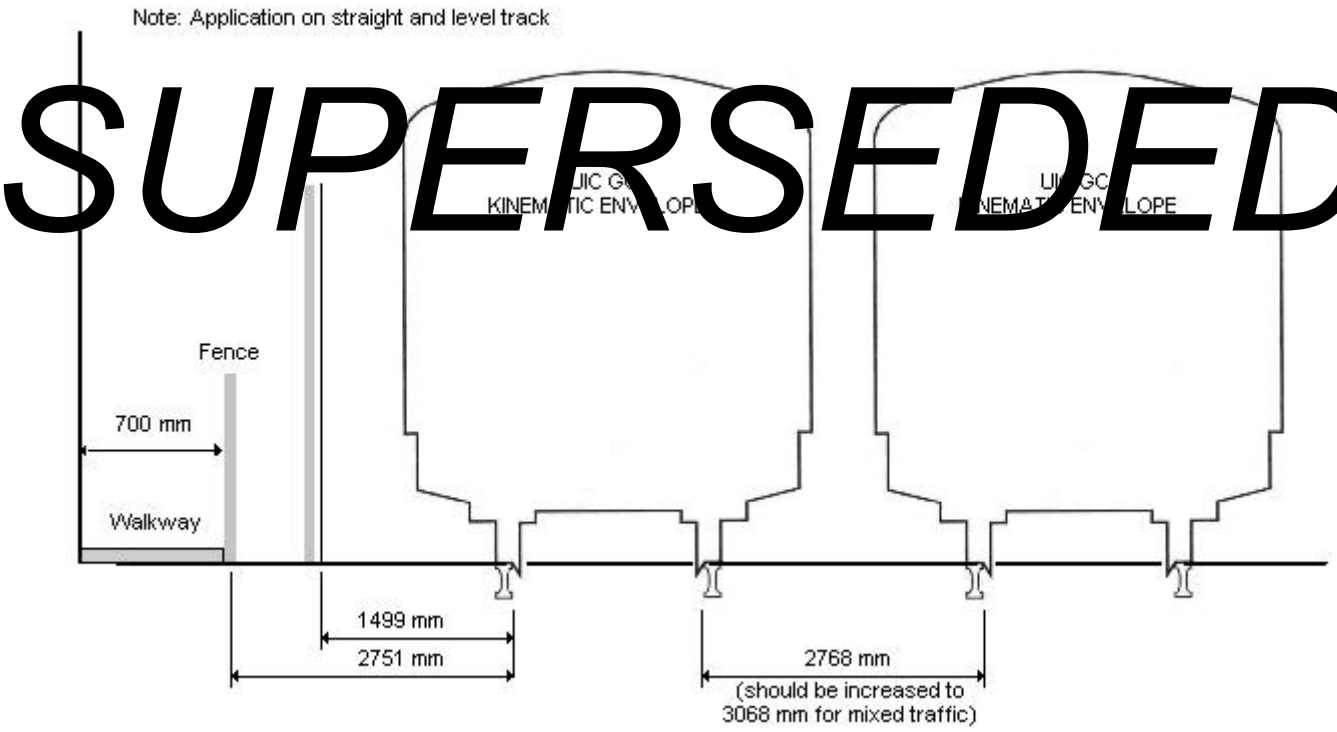


Figure 12: Typical structure gauge for 1435 mm gauge track for linespeeds greater than 200kph up to 300km/h

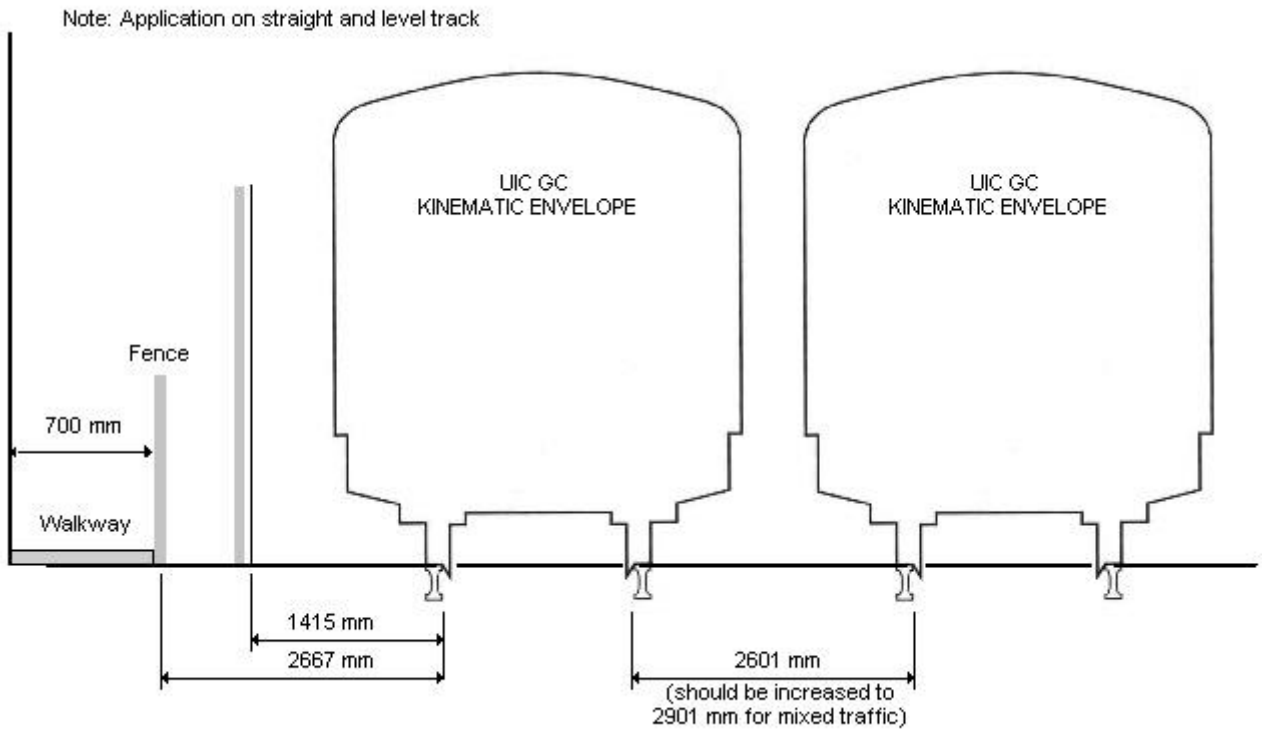


Figure 13: Typical structure gauge for 1602 mm gauge track for linespeeds greater than 200kph up to 00km/h