PART TITLE	**STANDARDS**
PART No	**1**
DATE	**Sept 2017**

PART UPDATE INFORMATION

DATE Sept-2017

Part 1- Standards completely revised for inclusion in 'Standards and Guidance Manual'.

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1. Standards

1) Summary

The fundamental standards on any railway are those relating particularly to the wheels and track, especially if interchangeability of rolling stock is required. The track gauge is necessarily a constant so long as the two wheels on each axle are mutually dependent on each other for guidance. Similarly, if rolling stock from different sources is to run successfully on the same track, then the critical dimensions of the wheelsets have also to conform to a determined standard. This becomes essential, not just for good running, but for guidance through the points and crossings that are an intrinsic feature of any working railway. Unlike the prototype, wheels are components that are generally bought in, since making wheels is a task for which many modellers lack either the skill, facilities and/or time. That makes it essential that the wheels available commercially, either individually or as part of ready to run stock, are both to a consistent standard and matched to the dimensions of the track.

Within 0 gauge, there are three basic standards of track and wheelset dimensions (however for Finescale there are now two further track standards compatible with the Finescale wheel standard, which can be characterised as:-

1) Finescale (0-F or Fine) wheels and track standard,

0-MF/0-SF (0-Medium Fine/0-Super Fine) track standard.

Finescale is the most commonly used standard, with a strong trade support and many layouts and test tracks built to this standard. The wheels do not represent an exact scaling of the prototype. The track gauge (in common with Coarsescale) is based on the traditional 32mm standard. However, to improve the smooth running characteristics of Finescale vehicles particularly through pointwork, a growing number of modellers have adopted track gauges slightly narrower than this to achieve better running and appearance, whilst retaining use of the commercially available Finescale wheels. This has resulted in the creation of two additional variants of Finescale, 0-MF [0-Medium Fine] and 0-SF [0-Super Fine], with track gauges of 31.50mm and 31.25mm respectively. 0-F, 0-MF and 0-SF are compatible with wheels to the Guild Finescale standards, and require no alterations to vehicles.

2) ScaleSeven

ScaleSeven was created in the 1970s out of the same frustrations with the errors inherent in the original Finescale standards, but sought to overcome the problems by starting again, using wheelset and track dimensions scaled directly from the prototype. As a consequence, although sharing the same modelling scale, rolling stock built to ScaleSeven standards will run only on track built to the same standards; there is no interchangeability with Finescale 0.

3) Coarsescale

Coarsescale was once considered the usual standard for 0 gauge modelling and dates back to the days when track was laid in sections on the floor, or as garden layouts. In both instances, the necessity for rolling stock to cope with poor quality track regarding alignment and level, meant that wheels had to have deep flanges and wide treads simply to stay on the track. Although once popular, it is now becoming a minority standard, having been eclipsed by Finescale. It is also the area of 0 gauge modelling that is the least standardised, with several manufacturers having entered the market in recent years with retro style models, using wheels that differ significantly from, and are not compatible with, the Guild Coarsescale standard.

In summing up, it should be noted that the Finescale, ScaleSeven and Coarsescale standards are completely incompatible with each other for satisfactory running.

1.2 Determining Standard Dimensions

The defining factors in setting the dimensions of both the track and the wheelsets are:

- the need for the gauge of the wheelsets, i.e. the distance between the flange fronts, to be sufficiently well matched to the track gauge to ensure that the wheelsets do not slop about between the rails
- the need for the wheels to be able to be guided through crossings, where one rail is necessarily gapped and cannot provide guidance

Although the latter may concern only a tiny proportion of any railway's trackwork, in both model and prototype form, it is actually the most critical part, as any failure to guide the wheels through crossings will result in derailments.

The consequence of this is that for the wheels and track to function as a system, there are three key dimensions:

- track gauge - the distance between the inside faces of the rails.
- wheelset gauge - the distance between the flange fronts.
- the check gauge - for the wheels, the distance between the front of one flange and the back of the opposite flange, and for the track, the distance from the guiding face of the check rail to the gauge face of the opposite rail.

For the wheel and rail system to work, these dimensions are interdependent.

1.2.1 Check Gauge

On plain track, the wheelsets are guided by the fact that the flanges fit between the rails. However, wherever tracks diverge or cross, it is necessary to create gaps in the rails to let the flanges of the wheels on one route pass through the rails of the other route. This leaves the wheels momentarily unguided, with the risk that they may take the wrong route and become derailed.

To prevent this happening, an additional rail, the check rail, is provided at crossings, located adjacent to the rail opposite the gap. The wheel on that side of the track is now prevented from moving out of line by virtue of its flange being trapped between the running rail and the check rail, as shown in Figure 1 below.

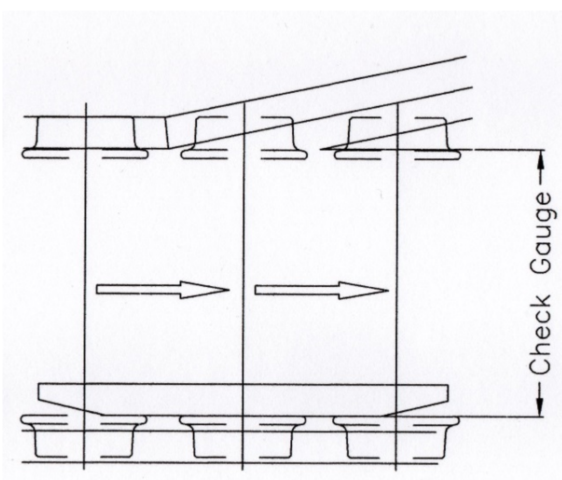

Figure 1 - The correct functioning of the check rail, showing how the wheels are prevented from deviating into the crossing gap

The check rail is gauged from the face of the gapped rail, in practice the crossing nose, such that the wheelset is prevented from moving sideways and striking the rail at the end of the gap. Ideally, the flange that is in the gap remains aligned with the face of the rail so that the wheelset runs past the gap with minimal disturbance. For this to happen, the wheelset check gauge has to be equal to the track check gauge.

For convenience, we can refer to the wheelset check gauge as ’c’ and the track check gauge as ’C’. (It is a convention in full size practice to give wheelset dimensions lower case letters and track dimensions upper case.)

There is a critical relationship between c and C, in that c must not be greater than C; if it is, then the check rail can no longer ensure that the opposite flange remains clear of the crossing nose. The same will happen if the check rail is incorrectly set too near to the crossing nose, as illustrated by Figure 2 below.

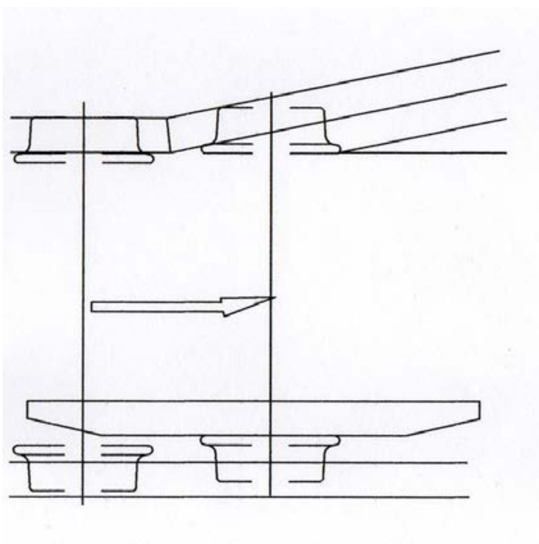

Figure 2 - The effect of the check rail being under-gauge (or the wheelset being over-gauge). The check rail can no longer hold the opposite wheel flange clear of the crossing gap, resulting in the crossing nose being struck and the wheel derailed.

Technically, it does not matter if the check rail is over-gauged, i.e. set too far from the crossing nose, in that the flange on that side will be kept clear of the nose. However, what will happen is that the wheel on the opposite side will strike the flare at the end of the check rail, causing it to be jerked sideways. The ideal situation is where the back of the flange just touches the check rail as it enters the flangeway.

For the wheelset, under-gauging is tolerable only up to a point. If the wheels are under-gauge by too much, the distance between the flange backs (the 'back to back') can be less than the width between the wing and check rail faces. When this occurs, whilst the wheels will still be guided correctly, the flange of the wheel next to the crossing will either become jammed against the wing rail, impeding free running, or *in extremis*, ride up onto the top of the wing rail, as illustrated in Figure 3 below.

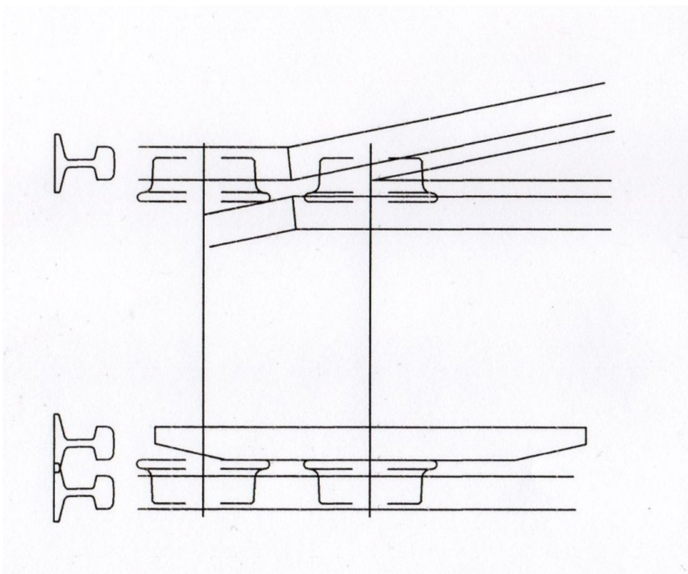

Figure 3 - The effect of the wheelset being excessively under-gauge (or the check rail being excessively over-gauge). Instead of passing through the crossing flangeway, the flange rides up the wing rail.

Because of the critical nature of the check gauge dimensions in determining whether or not wheels will successfully negotiate crossings, they are the defining dimension for any wheelset and track combination, from which all of the other dimensions are determined.

1.2.2 Flange Width (see Figure 4)

In terms of guidance, the width of the flange (e) is relatively unimportant. However, both it and the crossing flangeway width (W) are inseparably linked with the width of the wheel tread by the need for the latter to provide, and be provided with, continuous support through the gap in the crossing required for the intersecting route.

As the flange width is increased, so too does the width of the flangeway between the crossing rails and the wing rails. In turn, as the flangeway increases, so does the width of the wheel tread, otherwise it will run off the edge of the wing rail before reaching the crossing nose, thus dropping into the crossing gap. That is best seen on the 'steamroller' wheels found on early 0 gauge trains and still retained by the 0 Coarsescale standard. There is no true algebraic relationship between these dimensions as the ability of any given width of tread to support the wheel through a crossing is limited by the crossing angle. In practice, a compromise set of dimensions is chosen that will provide adequate support to the wheels for the range of crossing angles normally encountered. In modelling, this is also influenced by the desire towards maintaining a reasonably prototypical appearance. For 0 Finescale, the flange width has become a *de facto* 0.75mm as a result of its near universal adoption by the trade in preference to the older 1.00mm standard.

1.2.3 Back to Back (r)/Width over Checks (R) (see Figure 4)

These are another two consequential dimensions, in that they are defined from the check gauge and the flange width/flangeway width. Clearly, the width over the wing and check rails at the crossing must not exceed the distance between the backs of the flanges on the wheelset, i.e. the wheel 'back to back'.

1.3 Track and Wheel Standards Defined

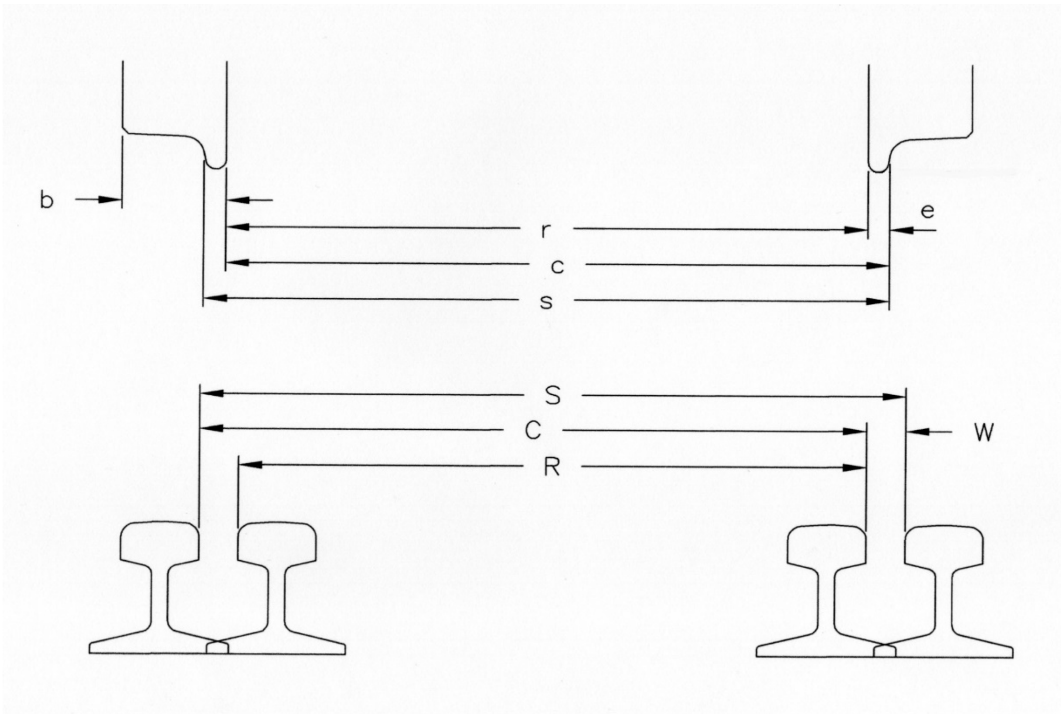

Figure 4 - Critical dimensions for track and wheelsets

Referring to Figure 4, the various dimensions interrelate with each other as follows:-

Dimension		Dimension code	Calculation formula
Wheelset Check Gauge	**max**	**c**	r + e
Flange Width	**max**	**e**	
Back to back (min)		*r*	*c - e*
Wheelset gauge		*s*	*c + e*
Wheel width (min)		*b*	
Flange height		*h*	
Track Check Gauge	**min**	**C**	C ≥ c
Track gauge	*min*	*S*	*C + W* *S ≥ s*
Flangeway		*W*	*S - C*
Width over check/wing rails (max)		*R*	*S - 2W* *≤ r*
Switch throw (min)		*PT*	*S-c*

Notes: Entries in **bold text** are the defining values for that standard's set; all other dimensions, shown in *italic text* are derived values.

1.3.1 Guild Wheel And Track Standards

These are applicable to 4ft 8½in prototype gauge models and 7mm = 1ft scale. For other gauges, the principles set out in sections 1.2 and 1.3 above should be applied to generate the standard dimensions for that combination of gauge and wheelset dimensions.

Dimension		Exact Scale	Finescale			Coarse-scale	Scale-Seven	Notes
			0-F	0-MF	0-SF			
Wheelset Check Gauge	c	31.95	29.95			29.5	31.96	Maximum
Flange Width [1]	e	0.64	0.75			1.5	0.63	Nominal
Back to back (max) [2]	c-e	31.26	*29.20*			*28.0*	*31.33*	*Maximum*
Wheelset gauge	c+e	32.59	*30.70*			*31.0*	*32.59*	*Maximum*
Wheel width (min)		3.35 2.92	*3.50*			*4.4*	*3.16* *3.26*	*Maximum* *Minimum*
Flange height [3]		0.69	1.00			1.5	0.66	
Track Check Gauge	C	31.98	30.00			29.8	31.98	Minimum
Track gauge [4]	S	32.96	32.00	31.50	31.25	32.0 32.4	33.00 33.45	Minimum Maximum
Crossing flangeway	*W (S-C)*	*1.01*	*1.75*	*1.50*	*1.25*	*2.2*	*1.02* *1.08*	*Minimum* *Maximum*
Width over check / wing rails (max)	*R (C-W)*	*30.91*	*28.25*	*28.50*	*28.75*	*27.6*	*30.96*	*Maximum*

Switch throw (min) [5]	*PT (G-c)*	*2.48*	*2.05*	*1.55*	*1.30*	*2.50*	*1.04*	*Minimum*

Notes:

[1] 0.75mm is given as the nominal flange width, as this has been the accepted industry standard for many years, together with a 29.20mm back to back dimension. Flange widths greater than 0.75mm are permissible provided that the back to back dimension is reduced accordingly so as to maintain the maximum check gauge value. The table below gives the variation required for various common flange thicknesses found on wheels manufactured to other than the Guild Standard.

Nominal flange thickness, mm	Resultant back to back for 29.95mm check gauge, mm	
0.63	29.32	S7 wheels regauged
0.75	29.20	Nominal standard
0.87	29.08	
1.00	28.95	Typical cast iron wheels

[2] For the prototype, the actual back to back value varies according to various design factors, such as the bearings being inside or outside the wheels, as this affects the way on which the axle bends under load. These effects are negligible in the model.

[3] Flange height can be reduced to scale limits (0.70mm) if desired. However some form of suspension is essential if this is done.

[4] The need for gauge widening depends on the radius and the difference between the wheelset and track gauge dimensions, becoming more necessary as the difference reduces. For practical purposes, in 0-F, 0-MF, 0-SF, gauge widening is not generally considered to be necessary other than for very small curve radii, such as would be found in industrial environments. For ScaleSeven (S7), reference should be made to prototype practice.

[5] The values given are the minimum required to ensure that the flange will clear the back of the open switch rail. In practice, the switch throw is greater than this to allow for narrowing of the flangeway towards the heel end of the planed section of the switch rail. Modellers may wish to adopt a smaller than prototype throw for reasons of improved

appearance. However, where the switch rails are not electrically bonded to their parent stock rails, minimal clearance may result in flange back contact and consequent short circuiting.

1.4 Gauge Widening

The need to sometimes get stock round tighter than average curve radii creates two additional problems.

Because any railway vehicle has a finite, i.e. non-zero, rigid wheelbase, the wheels cannot adopt a position that is radial to the curve. This results in the wheel being at an angle to the rail (the 'angle of attack'). As the angle between the wheel and the rail increases, so does the effective width of the flange, measured perpendicularly to the rail. In effect, the gauge of the wheelset increases. On normal curve radii, this is not an issue, but as the radius decreases to small values, such as might be found on industrial layouts and in constrained sidings, the effective gauge of the wheelset starts to increase at a disproportionate rate. Eventually a point is reached where the wheels are wedged between the rails and, apart from the increased rolling resistance, are quite likely to derail as a result of the outer wheel's flange climbing the rail.

To avoid this problem, it is usual to widen the track gauge by a small amount, so that the track gauge is maintained greater than the effective gauge of the wheels. Where the curvature is particularly tight, a check rail is provided to prevent the outer wheels from climbing the rail. As with check rails on pointwork, this is set to the same check gauge dimension *from the outer rail of the curve*. The effect is that the flangeway width is increased by the same amount as the gauge is widened.

Tight curves can also present problems for vehicles, typically locomotives, that have a rigid wheelbase with more than two axles. Normally, to enable these to cope with curves, sideplay is provided in one or more of the axles. The minimum curve that can be negotiated is limited by the amount of sideplay available before the wheels bind against the chassis. Widening the gauge relieves the situation by providing, in effect, additional sideplay between the wheels and rails, as illustrated in Figure 5 below.

On the prototype, since the late 1960s, check rails on some diamond crossings and slips have been raised above the level of the running rail by a small amount which gives earlier back of flange contact when the gaps in both rails are opposite each other, thus reducing the risk of pony wheels in particular going the wrong way at the gap. This has been found useful in some model configurations, and a height of 1.5 mm above running rail level is suggested. On BR, locos with flangeless wheels (9F) were banned as a result, but this is unlikely to be a problem on the model.

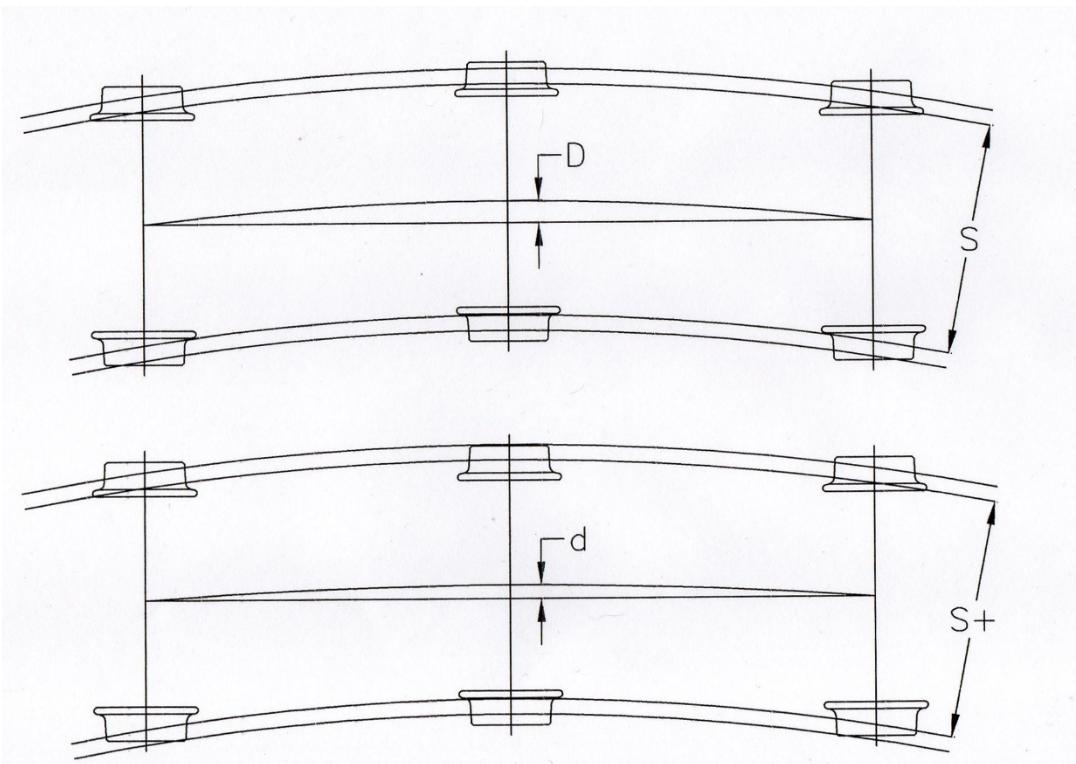

Figure 5 - The effect of gauge widening in easing the passage of multi-axle vehicles through curves. As the track gauge (S) is increased, the extent to which the centre wheelset needs to be displaced (D, d) reduces as a result of the additional sideplay between the wheels and rails.

1.5 Flange Depth And Profile

The depth of the flange is largely immaterial to the lateral dimensions of the track, unless it is unusually deep, in which case the considerations described above can apply to curved track. For the same reasons, the flanges of full size tramway wheels are much shallower than on railway wheels, essentially to cope with curve radii that are very much smaller (as tight as 50ft/15m). In the model, the flange depth is determined more by the need for rolling stock that is unsprung to cope with track that is twisted, intentionally or otherwise. Thus, the generally adopted depth is the product of experience.

In addition to having width and depth, the flange is tapered from top to bottom and provided with a rounded tip. Apart from providing clearance on curved track, this also facilitates the design of the switch rails in turnouts by avoiding unwanted contact between the flange and the tips of the switch rails, particularly the undercut type. Like the prototype, a flange angle of 68° serves well, having been found thus by long experience. The root radius joining the flange to the tread of the wheel must be greater than the shoulder radius linking the top to the flank of the rail head, otherwise two point contact will result, which will increase the rolling resistance under some circumstances.

1.6 Limiting Dimensions Of Structures And Rolling Stock

Because lineside structures are often not exact scale models of prototypes, their limiting dimensions are usually of more value to modellers than are those of rolling stock. Various structure dimension diagrams for 0 gauge , differing only in minor detail and probably originating from the same source, have been published over the years. Figure 6 shows the nominal size of lineside structures based on these working practices. Note that this model structure gauge is not a 7mm scale version of the prototype structure gauge.

A variable offset for curvature, E, is included in the structure gauge. E is the amount by which the lineside structures must be further from the track to avoid being hit by rolling stock on curves. E varies from zero for straight track (in which case the top of the structure gauge is circular) up to 30mm for long wheelbase vehicles on 2ft 6in (800mm) radius curves, where the top of the structure gauge is a straight line 105mm from rail height. The vehicle profile diagram shows overall dimensions so that modellers can check whether models of unusual or overseas prototypes will clear ‘standard’ structures. Again this is not an exact scaling of a prototype vehicle profile diagram, which varies between railways and also between sections of the same system which may originally have been independent companies, but models built to scale will automatically take account of these variations. Figure 6 includes limits for the clearance to the under-side of vehicles, including clearance to gearwheels, etc. A prototype vehicle profile diagram makes allowance for spring deflection and wheel wear, but this will not concern the modeller except to note that prototype wheels can wear by as much as 75mm (3in) in diameter. This reduction may be useful if a wheel of 'as new' diameter is not available for a particular model or if it is necessary to provide additional clearance because of sharp curves or over-scale flanges.

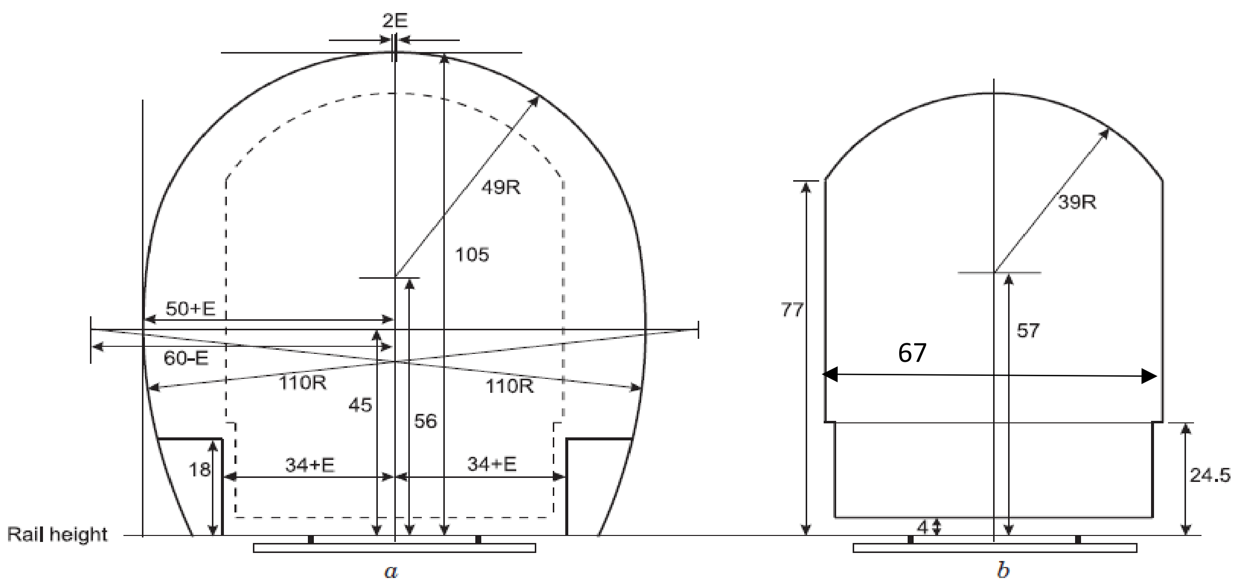

Figure 6 **Limiting Dimensions of Structures and Rolling Stock**