



Track Handbook 14

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The Track Engineer's Department

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Understanding track design

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How to use this handbook

This handbook is one of a series intended to help Track Managers, Track Area Managers and Section Track Managers achieve standards and meet LUL corporate objectives. This handbook offers:

- practical advice on track activities**
- guidance on choices and alternatives**
- do s and don ts for use on site**
- technical data and illustrations**
- material to use in staff training.**

Before you first use this handbook, you should familiarise yourself with its contents. These are set out on the following page under the heading **What this handbook covers** .

The front pages also include a **quick reference guide** to topics and page numbers that tells you where you can find information directly on particular items.

You will find in this handbook notes and comments based on the day-to-day experience of staff, outlining methods they have found successful in particular conditions as well as points not to be overlooked in carrying out the work.

If you have any comments about the guidance contained in this handbook or suggestions for additions, improvements or amendments, please communicate them to the Standards Engineer (Track).

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1 Overview of track design

The purpose of this handbook is to give Track Managers an overview of track design, including junctionwork. This is to enable Track Managers to take into account how geometric design impacts on day-to-day maintenance activities and to give a better understanding of options for junctionwork renewal and configuration (how it all goes together). The text focuses on the factors that determine key track parameters:

- ◆ curves (section 2)
- ◆ cant (section 3)
- ◆ clearances (section 4).

Features of turnouts, crossovers and switches are discussed in section 5.

Track design and configuration are the outcome of a detailed process of analysis and calculation which has to take into consideration a broad range of factors:

- ◆ the route and its physical environment - whether open, sub-surface or tube sections
- ◆ local site conditions and constraints
- ◆ the type and volume of traffic that will use the track
- ◆ predicted train loadings and the dynamic forces and stresses at work on the track
- ◆ the resources and facilities likely to be available for track maintenance
- ◆ the materials employed to manufacture components of the track asset
- ◆ the required durability and service life of track components
- ◆ the cost constraints and value-for-money assessments that determine the options available for component design and installation.

Managers responsible for the track need to be aware of the thinking behind this process, so that they know the reasons for the minimum requirements defined in track standards and why the track asset has to perform at least to those standards. Often there will be scope for managers to make technical judgements on the applicability of particular design options in the track environments for which they are responsible. Familiarity with the basis on which the track and its components are designed will help them reach fully informed and consistent decisions, in the interests of safety, quality and improved track performance.



It is essential that track is designed to minimise risks to staff who maintain the track and to customers who may need to walk to safety in an emergency. The designer needs to take particular care to create designs that, as far as possible, avoid tripping hazards and which are simple to keep free of obstructions and litter.

Track Managers need to seek guidance from the Track Design Engineer when further information on aspects of track design is required.

2 Curves

Introduction

Most railways tend to follow a more or less sinuous course because of the need to avoid obstacles such as hills and deep valleys and to avoid excessively steep gradients. In the sub-surface and tube sections of LUL the horizontal alignments were often imposed by the need to follow the streets and roads above the railway to avoid the foundations of buildings and paying compensation to property owners.

In terms of design, railway horizontal alignment consists of a series of:

- ◆ straight lines
- ◆ circular curves
- ◆ transition curves which are used to join a curve to straight track or to another curve of different radius.

Hand of curves

Railway curves are said to be handed according to whether the curve goes towards the left (left hand) or right (right hand) in the direction of running.

Geometric elements of a curve

The geometric elements of a curve are:

- ◆ the radius; the larger the radius, the flatter the curve
- ◆ the tangent point; this is where:
 - ◇ a curve meets a straight
 - ◇ a curve meets another curve of different radius
 - ◇ a straight meets a transition curve
 - ◇ a transition curve meets another transition curve
- ◆ a chord which is a straight line joining two points in a curve
- ◆ a versine which is the offset from a chord at its midpoint to the curve.

See figure 1 below.

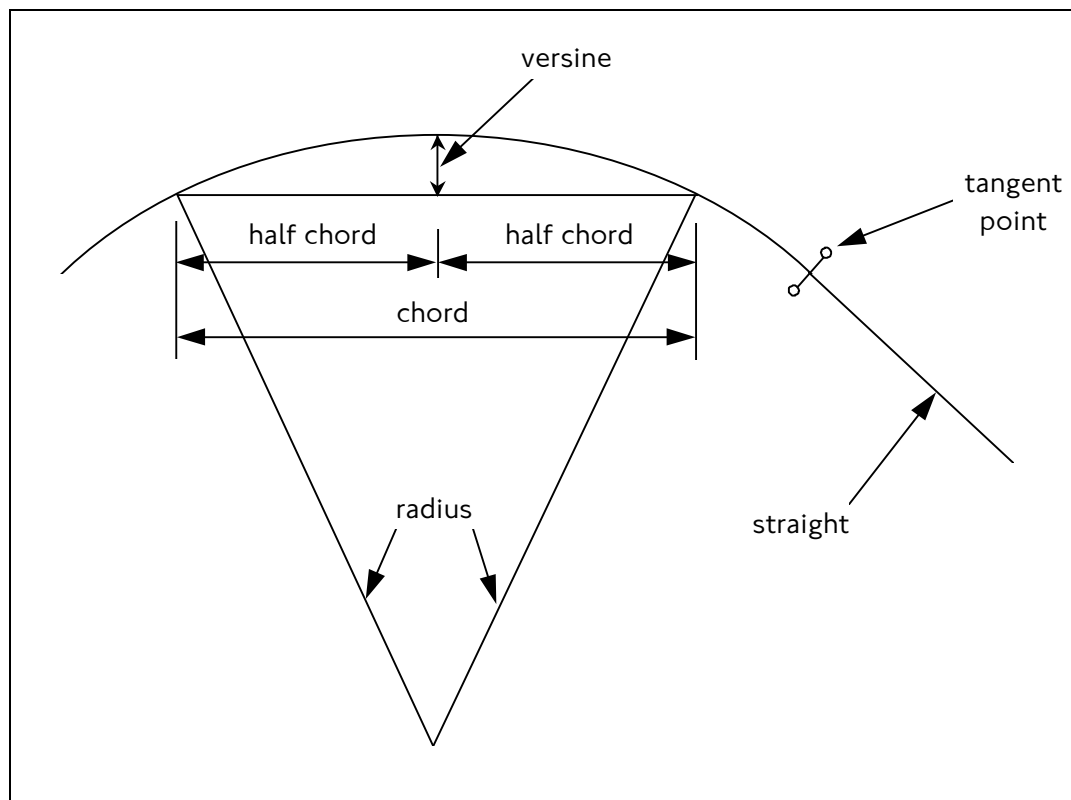


Fig. 1 Main elements of a railway curve

Types of curves

In terms of geometric design, there are four main types of horizontal (as opposed to vertical) curve:

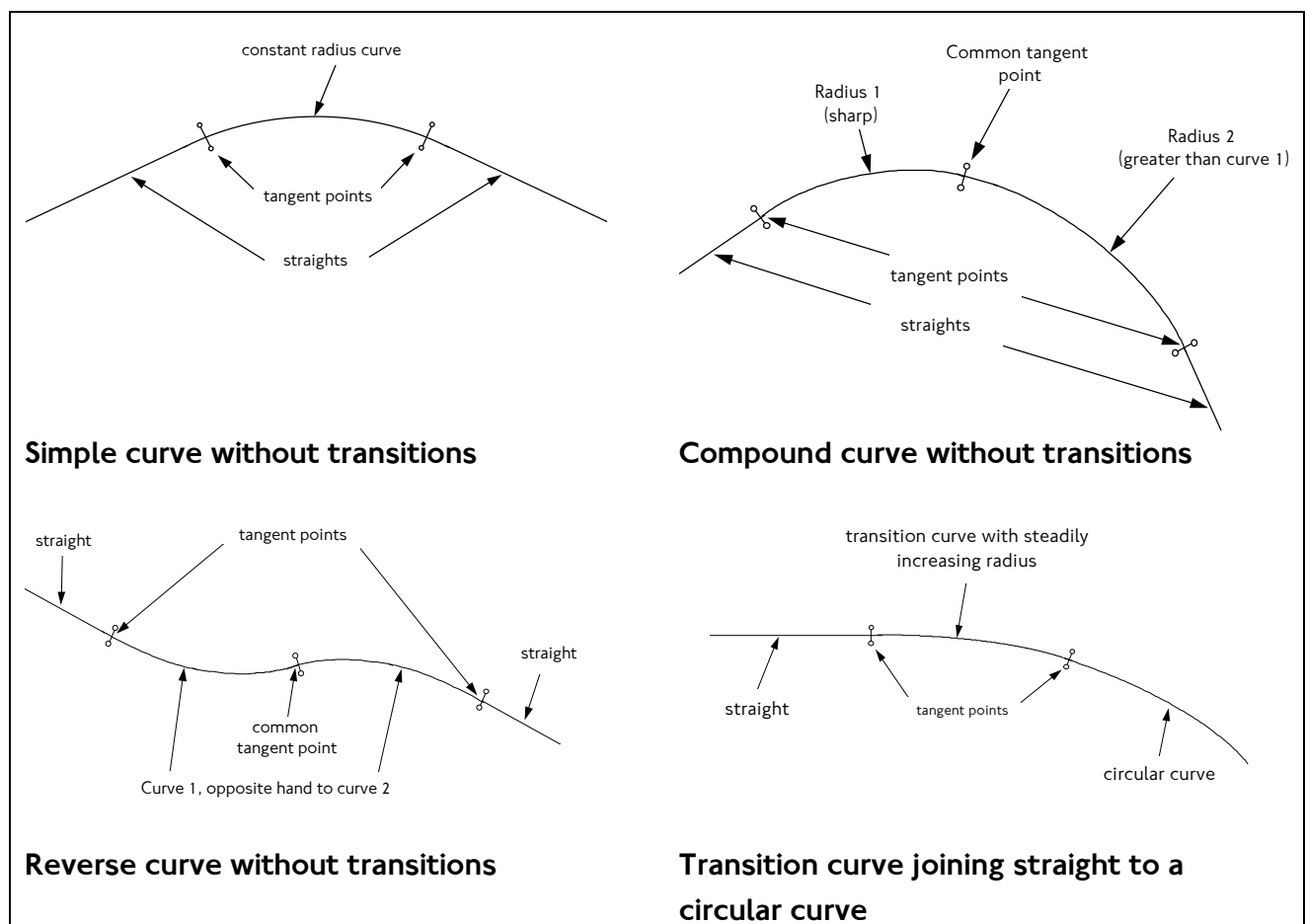
- ◆ simple curves in which two straights are joined by one curve of constant radius
- ◆ compound curves in which two or more curves of the same hand but different radius follow one another without any intervening straight track
- ◆ reverse curves in which two or more curves of differing hand follow one another without any intervening straight track
- ◆ transition curves in which the radius is constantly changing. See later in this section for further explanation of transition curves.

Table 1 summarises data for the geometric design of curves (from TE-DS-0105). The data shown are those for new work and upgrading existing tracks. Because of site constraints when carrying out upgrading work, it is often not possible to use the figures quoted in table 1. In these cases the figures used are those which would give the best possible design for the particular site.

Table 1: Curves: requirements for geometric design

Horizontal curves	Desirable	Absolute
On running lines		
Minimum length of straight or curved track	45m	25m
Curve minimum radius		
- where line speed exceeds 80 km/h	500m	
- elsewhere	400m	250m
- through station platforms	straight	1000m
Minimum length of straight track between tangent points	45m	25m
In depots		
Minimum curve radius		
- if only used by LUL rolling stock	210m	120m
- elsewhere	210m	140m
Minimum distance between tangent points		12m

Note that curves below 200m radius are to be fitted with running check rails. Figure 2 below shows the four main types of curves.

**Fig. 2 Railway curves**