



CHAPTER 1

Basic Terms of Railway Operation

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Introduction

- A railway system consists of three essential elements.
 - ◆ The first is the **infrastructure** with the **track work**, the signaling equipment, the stations and on electrified lines the **catenary** or third system with **power supply**.
 - ◆ Second, there is the **rolling stock** with **cars** and **locomotives**. Infrastructure and rolling stock represent the “hardware” of a railway system.
 - ◆ A third element of every railway is a system of operating rules and procedures for a safe and efficient **operation**.
- These rules and procedures may be regarded as the “software” of a railway system.
 - ◆ Although it is not be seen, this element of a railway system is as same importance as infrastructure and rolling stock.
 - ◆ To understand how railway operation is controlled requires a basic understanding of how the procedures for **movements** of railway vehicles are connected with the conditions of the **track layout** and the signaling system.
- This first chapter explains basic terms of track layouts, signal **arrangements**.

Unit 1 Basic Track Arrangements

- **Tracks**
- **Turnouts**
- **Crossing**
- **Derails**
- **Junction, Crossovers, Ladder Tracks and Wyes**
- **Yards**
- **Terminals**

1.1 Tracks

- Tracks are the roadways of a railway system.



- ◆ A track consists of the **rails**, the **ties** (wooden, concrete or steel), the tie plate between rails and ties, the rail **fasteners** (**screws**, **spikes** or **clamps**) and the **ballast** (Fig.1.1), the surface of the **subgrade** under the ballast is constructed with a small slope (to one or both sides of the track) to enable a sufficient **drainage** of the **track bed**.

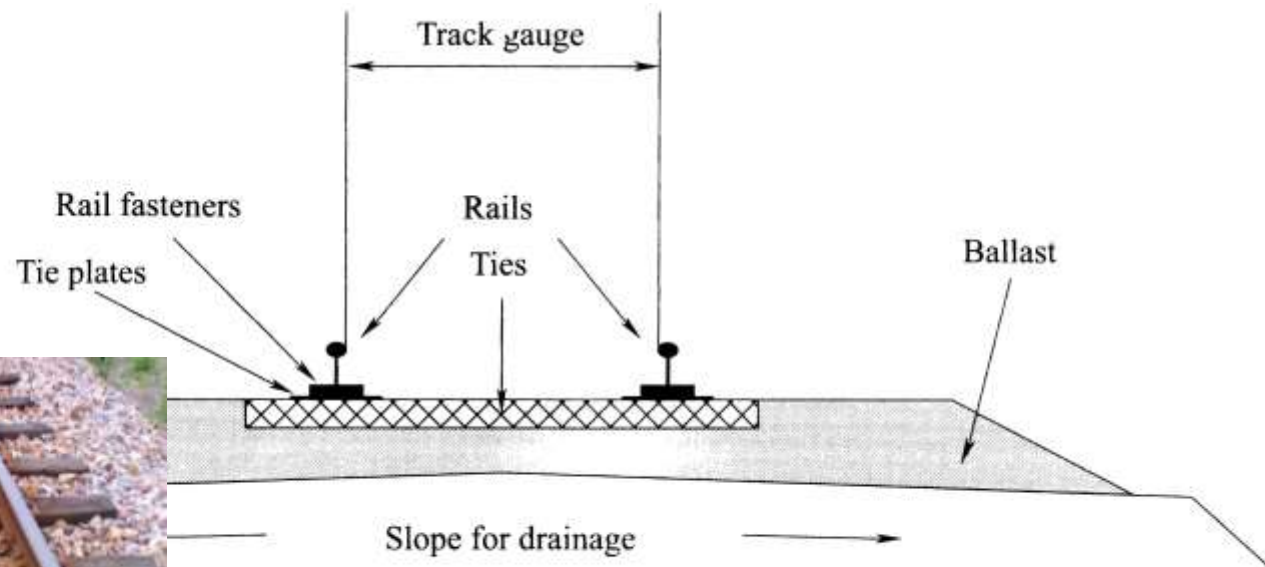


Fig. 1. 1 Cross-section of a track

1.1 Tracks

- Tracks are the roadways of a railway system.
 - ◆ The **track gauge** is the distance between the inner sides of the rail heads of a track. The most common track gauge is 1435mm (4'-8 $\frac{1}{2}$ "). This track gauge is used on about 2/3 of all railway lines in the world. That is why it is called “standard gauge”.

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1.1 Tracks

- For operational purposes track are divided into **main track** and **sidings**.
 - ◆ Main tracks are all tracks, which can be used for regular **train movements**.
 - ◆ Main tracks used for passing and **overtaking train** are called loops (Fig.1.2).

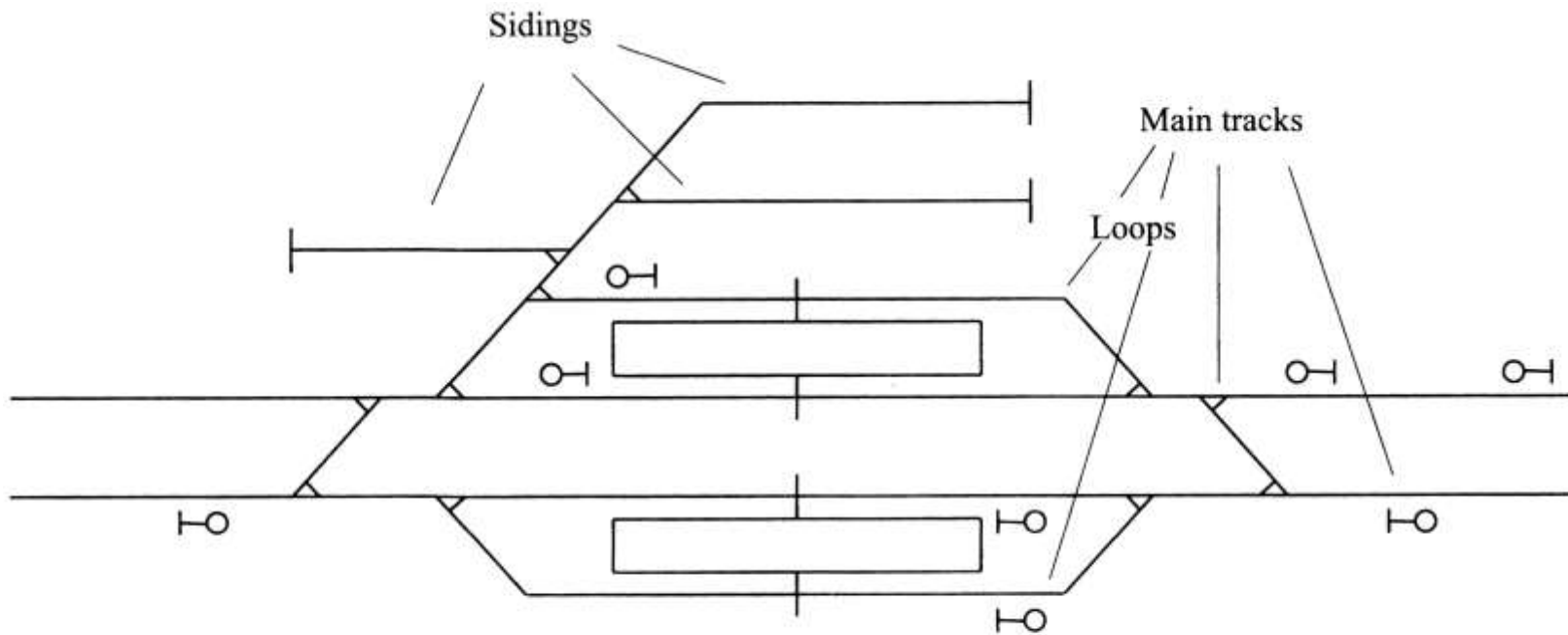


Fig. 1.2 Classifications of tracks

1.2 Turnouts

- A **turnout** is an **assembly of rails, movable points and a frog**,
 - ◆ which effect the **tangential branching** of tracks and allows trains or vehicles to run over one track or another (Fig.1.3).

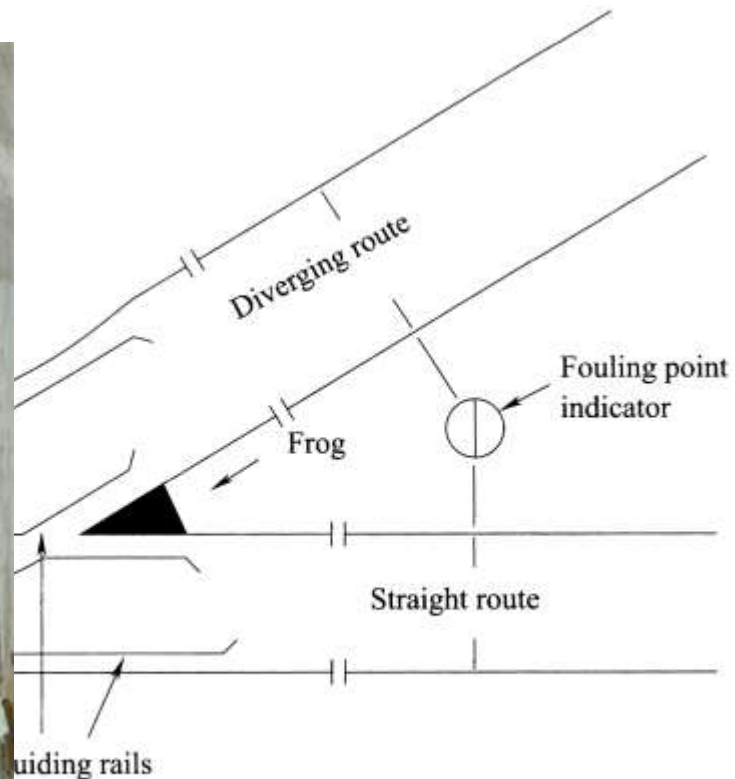


Fig. 1.3 Components of a turnout

1.2 Turnouts

- The points may be operated manually or by a **point machine**.
 - ◆ Movements on a turnout where the points face approaching traffic are called “**facing point movements**” where the frog faces approaching traffic are called “**trailing point movements**” (Fig.1.4).

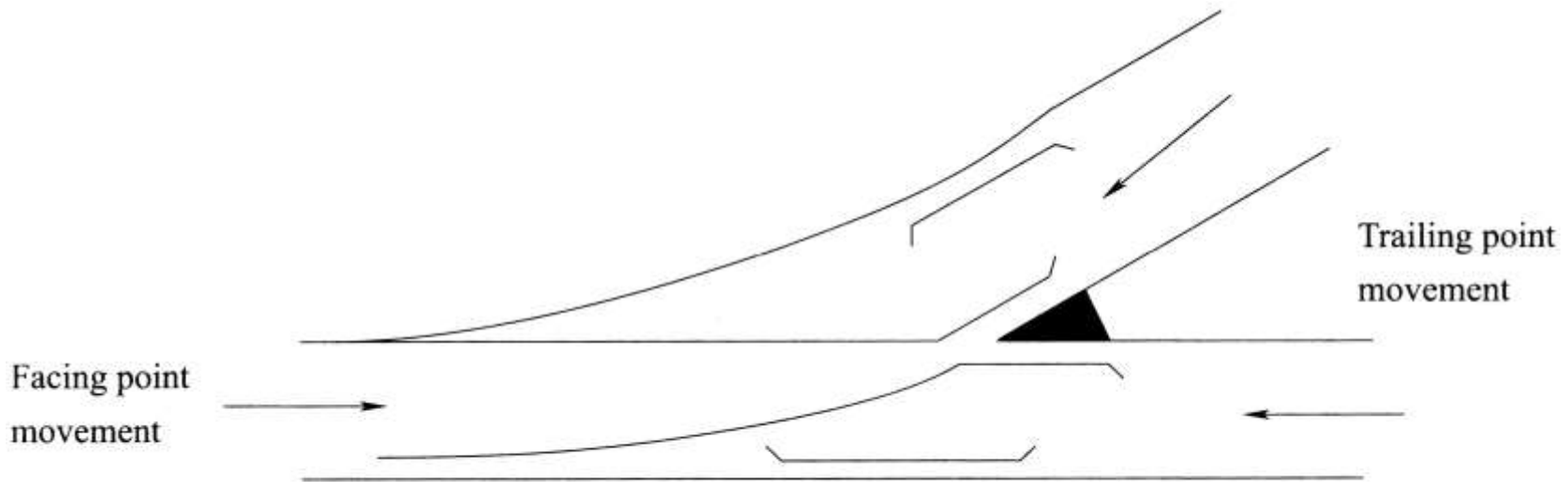


Fig. 1.4 Movements on points

1.2 Turnouts

■ Note:

- ◆ The term turnout is mostly used in **civil engineering**.
- ◆ In railway operation and signaling, the turnout is usually referred to as a pair of points or shortly points, although this term in its original meaning only applies to the part of a turnout where the points are located.
- ◆ On North American Railways this part of a turnout is called a **switch** and the point machine is called a **switch machine**.
- ◆ In North American railway operation and signaling turnouts are usually referred to as switches.
- ◆ The limit of occupation of the converging tracks is called “**the fouling point limit**”.
- ◆ Many railways mark this limit with a **trackside (wayside) fouling point indicator**.



1.3 Crossing

- A **crossing** is an assembly of rails, which affect two tracks, to cross **at grade**.
 - ◆ Like points, crossings are equipped with fouling point indicators.
 - ◆ The inner part of a crossing is called a “**diamond**”.
 - ◆ Crossing with a **large angle of intersection** are constructed rigidly.
 - ◆ In case of a small angle of intersection (usually less than 1:9) a crossing may have movable points instead of frogs (Fig.1.5).

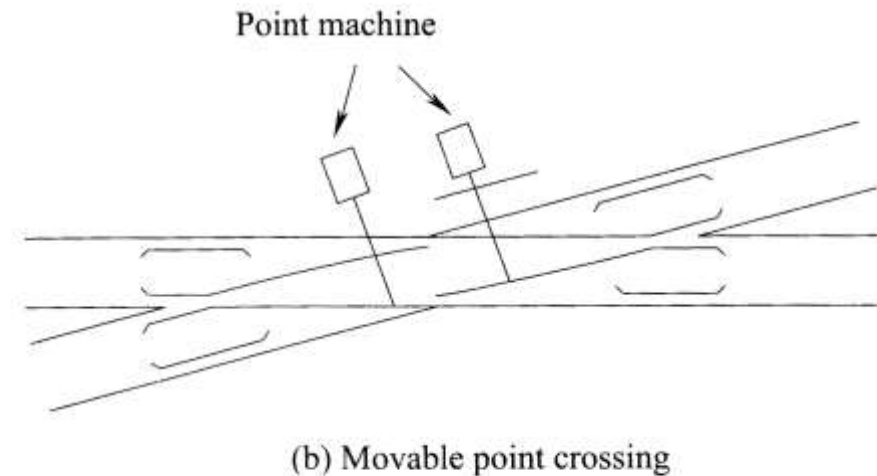
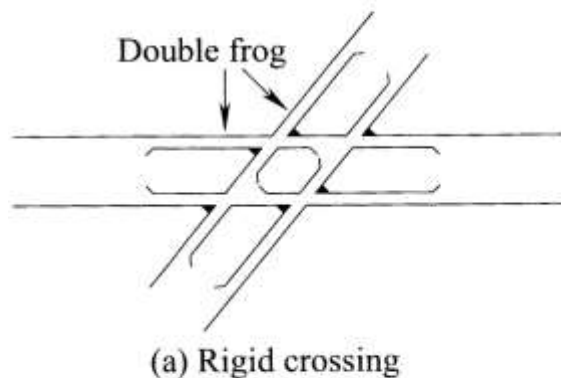


Fig. 1.5 Crossings

1.3 Crossing

- A crossing is an assembly of rails, which affect two tracks, to cross at grade.
 - ◆ Small angle crossings may be equipped with additional points providing a **slip** connection to **permit movements** from one line to another.
 - ◆ A crossing with a slip connection at one side is called a “single slip” and a crossing with slip connections at both sides is called a “double slip” (Fig.1.6). On North American, railways slip crossing are called **slip switches**.

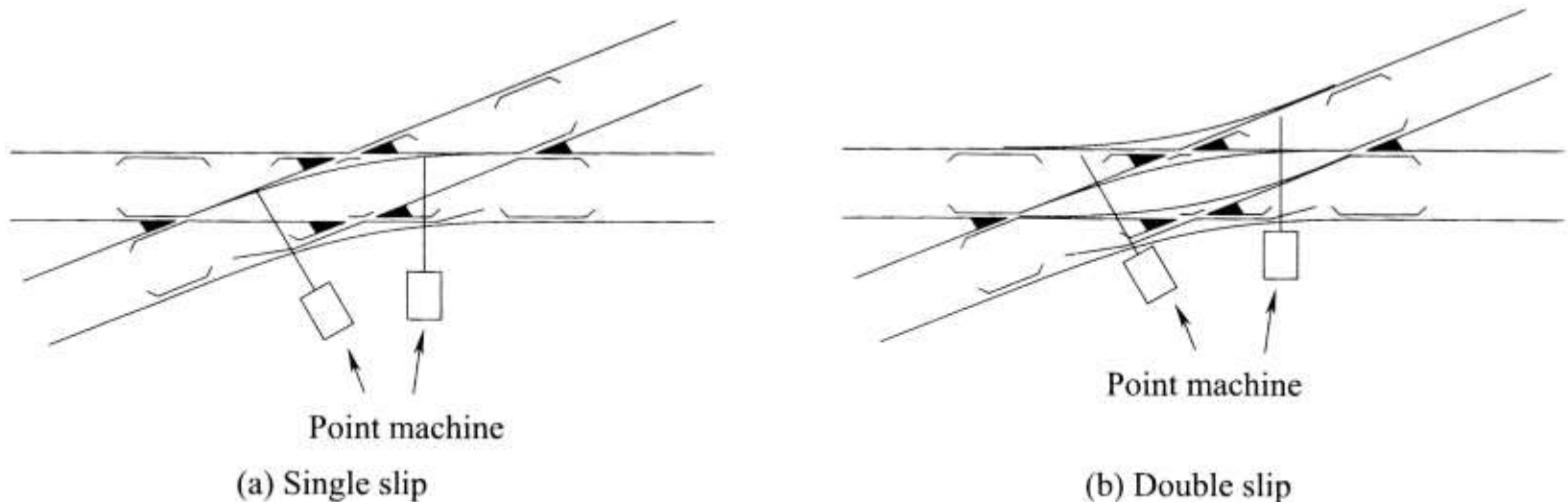


Fig. 1.6 Slip crossings

1.3 Crossing

■ Note (Exercise):

- ◆ In signal layout diagrams of many railways turnouts and crossings are drawn in form of their tangent diagrams in which the single lines that represent the converging tracks meet at the intersection of the tangents.
- ◆ Some railways use special symbols to mark how the points are operated, e.g. by filling the triangle between the tangents with different patterns.

1.4 Derails

■ Derails are trackside devices

- ◆ which are used to protect train movements against **unattended** movement of vehicles on converging tracks.
- ◆ An unsafe movement is **derailed** before it could join the protected **route**. Like points, derails can be hand or power operated.
- ◆ On most railways, derails must not be installed in main tracks.



1.5 Junction, Crossover, Ladder Track and Wye

■ Junction

- ◆ A **junction** is an arrangement of tracks and turnouts in which a line is joined by another one.

■ Crossover

- ◆ A **crossover** is an arrangement of corresponding turnouts providing a connection between two **parallel tracks**.

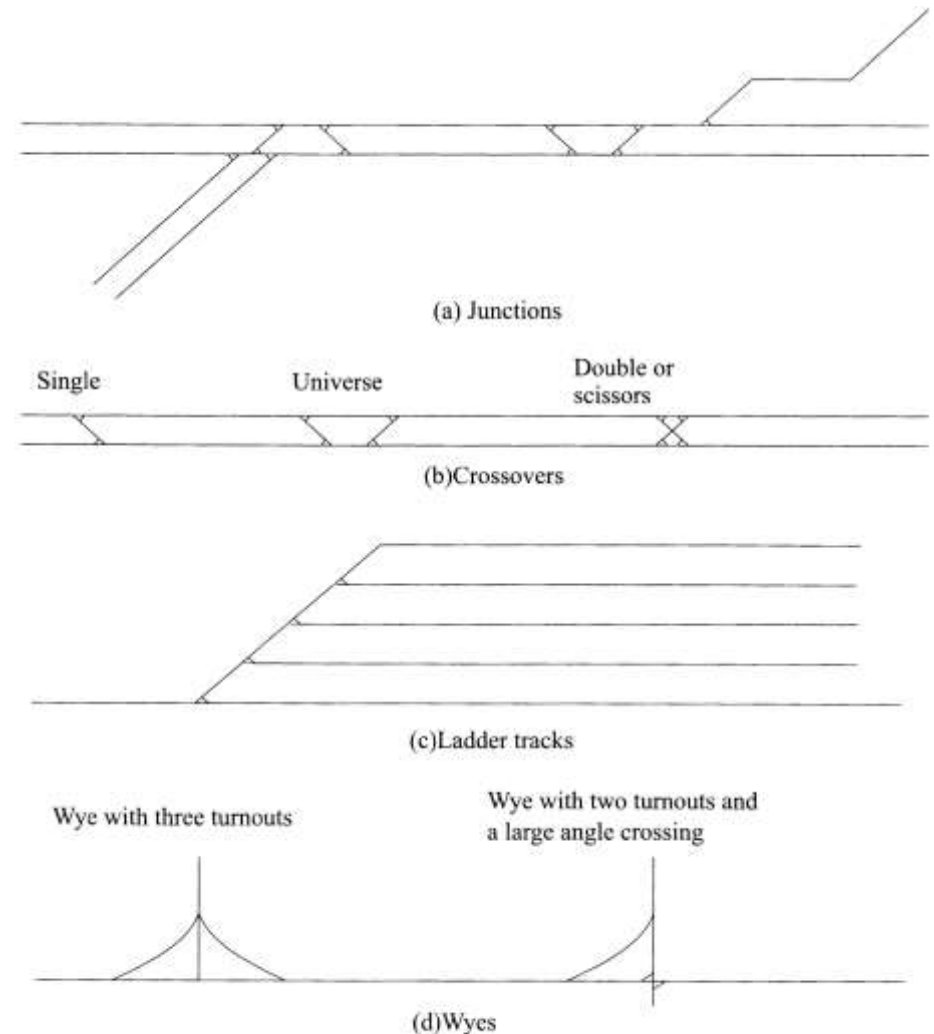


Fig. 1.7 Basic turnout arrangements

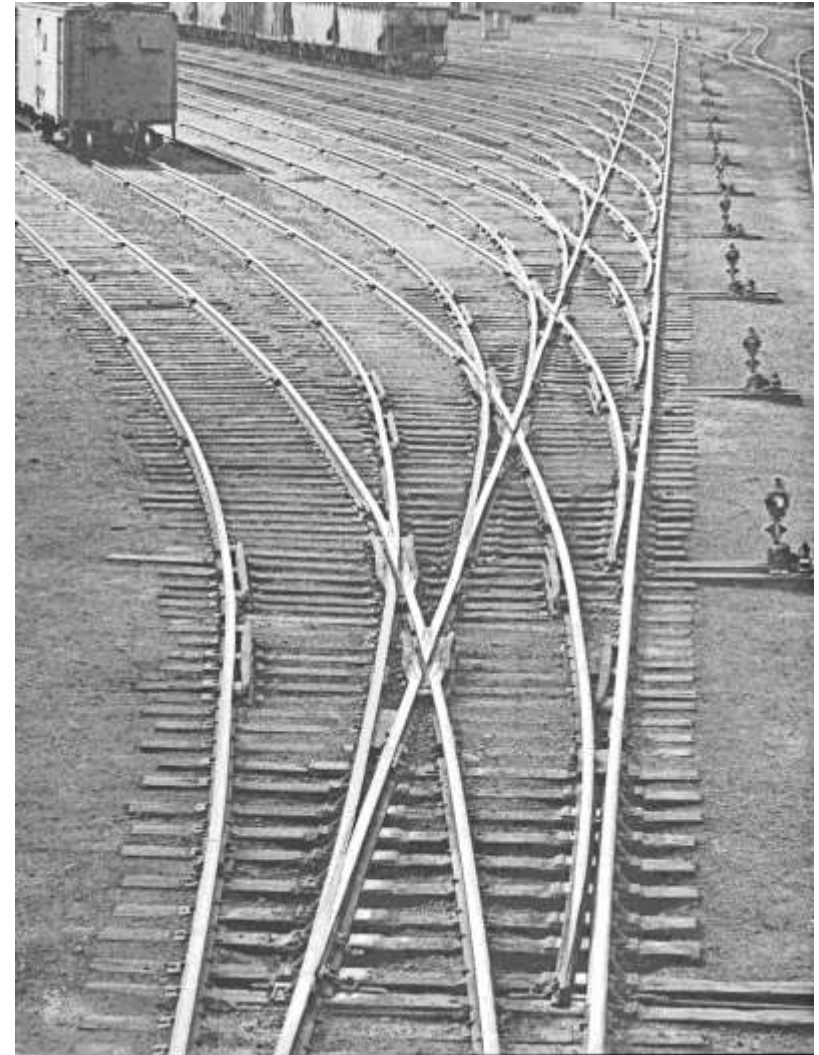
1.5 Junction, Crossover, Ladder Track and Wye

■ Ladder track

- ◆ **Ladder track** is a track with a series of turnouts that provides access to any of several parallel tracks (Fig.1.7).
- ◆ Ladder track is typical for **yard** and **terminal** layouts.



(c)Ladder tracks



1.5 Junction, Crossover, Ladder Track and Wye

■ Wye

- ◆ A **wye** is an arrangement of three turnouts or of two turnout and one large angle crossing forming a triangle of tracks.

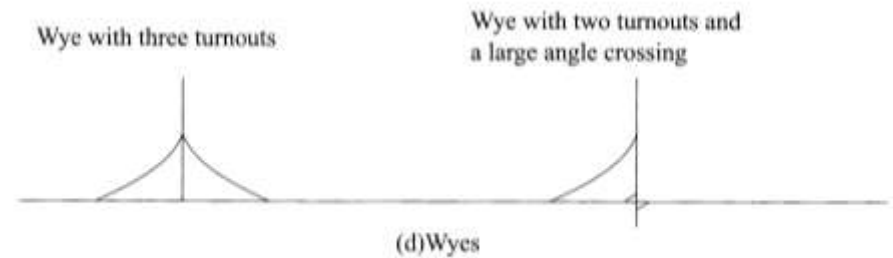


Fig. 1.7 Basic turnout arrangements



1.6 Yards

Yards are arrangements of sidings used for **making up trains**, storing cars and trains and similar purposes (Fig.1.8).

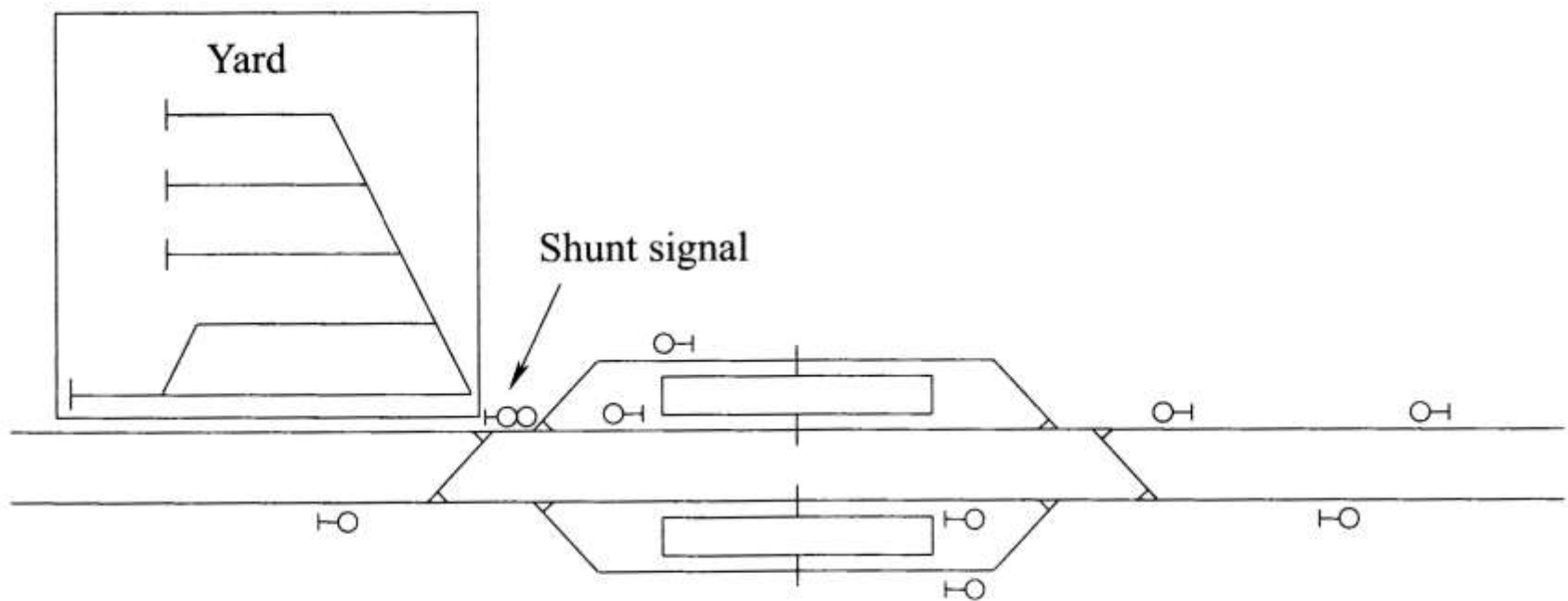


Fig. 1. 8 Yard layout

1.7 Terminals

■ Terminal

- ◆ A terminal is an **assemblage** of **facilities** provided at a **terminus** or **intermediate point** of a line for the purpose of **assembling**, **assorting**, **classifying** and **relaying** trains.

■ Freight Terminal

- ◆ A typical **freight terminal** consists of track groups for **arrival** and **departure** of trains, a **shunting** district with yard facilities for sorting and storing of cars and connecting tracks to industrial sidings.

■ Passenger Terminal (五分钟测验)

- ◆ A typical **passenger terminal** consists of a group of **platform tracks** and some yard facilities for storing passenger cars.
- ◆ In large terminals there are also often service facilities for the rolling stock.
- ◆ Large terminals are often located at the intersection or junction of different lines.

Homework

■ Pages 7~8

- ◆ 1
- ◆ 2
- ◆ 3: (1), (2)
- ◆ 4: (1)