



Unit

# 1

## Station, Line and Turnout

### Learning Objectives

After learning this unit, you'll be able to:

- understand the features of main facilities at the intermediate station, district station and marshalling station
- master the classification of station lines and the numbering of station lines and turnouts
- know the components of the single turnout and types of turnouts



## Part One : Lead-in

**Directions:** Have you ever seen the railway stations in the pictures below? Look at the pictures and describe the main functions of them.



Main functions:



Main functions:



Main functions:

## Part Two : Reading Materials

### Material A

#### Railway Station

The railway station, as a basic production part of the railway system, is a railway facility where trains regularly stop to load or unload passengers or freight. Apart from passenger and freight transportation, the railway station

also performs such tasks as trains receiving and dispatching, crossing, overtaking, break-up, sorting of trains, changing and servicing of locomotives and vehicles, as well as inspection and maintenance of trains. To fulfill the above tasks, railway stations are generally equipped with passenger and freight transportation facilities and various equipment and devices required for train operation. Besides, staff specialized in relevant industries are assigned to stations for managing the train and station operation.

Railway stations can be categorized into different types by the type of technical operation, function, handling volume and location.

By the type of technical operation, the railway station can be categorized into three types, the intermediate station, district station and marshalling station. The district station and the marshalling station are collectively called the technical station. By function, the railway station can be categorized into three types, the passenger station, freight station, and passenger and freight station. In terms of handling volume and location of the station, there are six types, the top-class station, the first-class station, the second-class station, the third-class station, the fourth-class station and the fifth-class station.

### 1 Intermediate station

The intermediate station is relatively of small scale but its number is the largest in the railway network. It is mainly established to serve urban and rural residents living along the railway route, facilitate transportation of industrial and agricultural products, improve carrying capacity of the section and enhance the safety of train operation.

The intermediate station often carries out the following tasks: trains receiving and dispatching, crossing, overtaking, passing through, loading and unloading of passengers and goods as well as shunting for operation of pulling the unloaded car into the intermediate station for detachment, loading and attaching, and pulling the loaded car out of the intermediate



station. In order to complete the above-mentioned tasks, there are different tracks and devices shall be equipped at the intermediate station, for example, the receiving-departure track, head shunt and rail freight track, passenger transportation facilities like the station building, passenger platform, train shed and crossing equipment, as well as freight transportation facilities like the warehouse, freight platform, loading and unloading machinery. The intermediate station is shown in Fig.1-1 (a), (b).

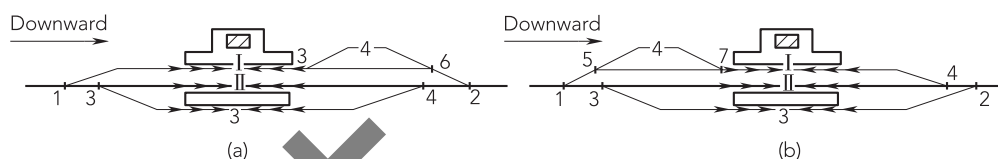


Fig. 1-1 Intermediate station

## 2 District station

Most district stations are found in medium-sized cities or at the start or end of locomotive working districts (routing of passenger or freight locomotives). At the district station, some or all the locomotives of trains running through adjacent sections are changed and locomotive crew is shifted. Furthermore, the district station may be tasked with certain technical operations, a certain volume of break-up and marshalling of freight trains, and passenger and freight transportation for transit trains without resorting.

In order to complete the above-mentioned tasks, the following facilities shall be equipped at the district station:

- (1) passenger transportation facilities: station building, passenger platform, train shed and crossing facility.
- (2) freight transportation facilities: freight yard and relevant facilities.
- (3) transportation facilities: receiving-departure track, shunting track, head shunt, locomotive running track and entrance and exit depot line for rolling stock depot.
- (4) locomotive facilities: motive power depot or locomotive turnaround depot.
- (5) vehicle facilities: rolling stock depot, freight car inspection and repair workshop at station.

The volume of the district station and the technical operations carried out at the district station are not the largest. However, the district station is equipped with relatively complete facilities capable of carrying out various technical operations. The district station can be classified into the transversal layout district station, the longitudinal layout district station, and the passenger and freight longitudinal type district station according to the configuration of the receiving-departure yard. They are shown in Fig.1-2, 1-3, 1-4.

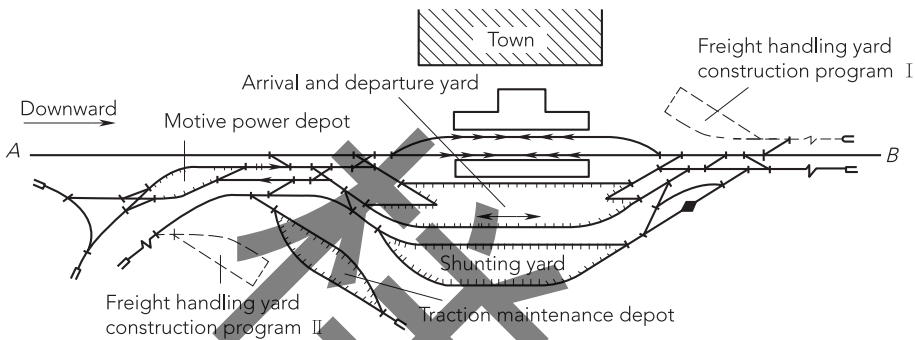


Fig. 1-2 Diagram for lateral layout district station of single-track railway

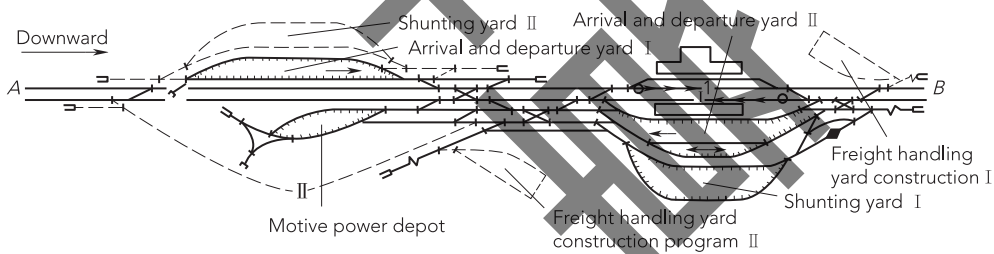


Fig. 1-3 Diagram for longitudinal layout district station of double-track railway

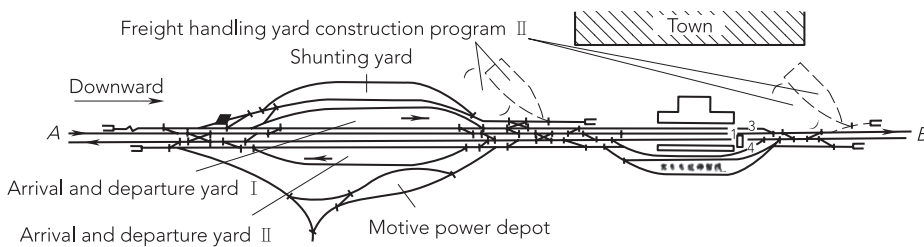


Fig. 1-4 Diagram for passenger and freight longitudinal layout district station of double-track railway

### 3 Marshaling station

The marshaling station is often built at the junctions of several main



lines in the railway network and equipped with a complete set of shunting facilities to break up and resort a large number of freight trains. According to the marshalling plan, resorting tasks for the solid train, through the service train, district train and coupling and uncoupling of trains are performed at marshalling stations to facilitate the wagon flow. Generally speaking, a very limited volume of passenger and freight transportation service is provided at the marshalling station. At the marshalling yard, in addition to the receiving-departure track for the freight train (the receiving-departure yard, receiving yard, departure yard and passing-through yard), numerous shunting facilities such as the hump, shunting yard, head shunt and auxiliary shunting yard are set up to sort freight trains. Furthermore, locomotive facilities and vehicle facilities are also established for inspection and maintenance. According to the location of the marshalling station, its role and workload in the railway network, the marshalling station can be categorized into the railway network marshalling station, the regional marshalling station and the local marshalling station. The marshalling station is shown in Fig. 1-5.

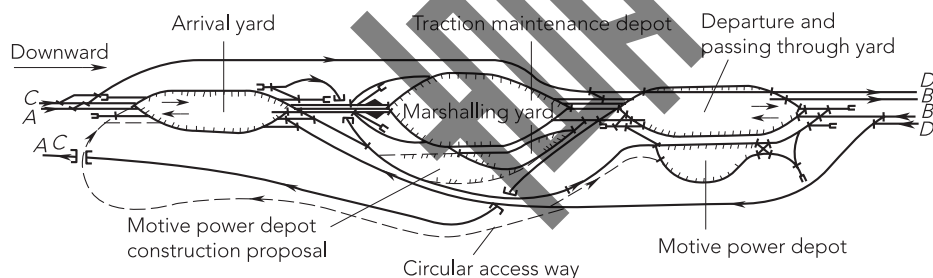


Fig. 1-5 Diagram for one-way longitudinal three-layer layout marshalling station with three yards

#### 4 Passenger station

Passenger stations are often found at political or economic centers and tourist attractions with a great number of passengers. The main function of the passenger station is to provide passenger-related services, passenger transportation services and carry out technical operations for trains. The passenger station shall include station buildings, railway station square and platforms. The passenger station is shown in Fig. 1-6.



Fig. 1-6 Passenger station

## 5 Freight station

Freight stations, tailored for loading and unloading of goods, freight traffic and transshipment, or mainly designed for intermodal freight transportation or transshipment, are mainly constructed in big cities or at places with a large quantity of goods requiring loading and unloading, such as industrial production, mining sites, forest zones and ports. The freight station shall be equipped with rail transportation facilities and freight transportation facilities so that its main functions can be fulfilled. The freight station is shown in Fig. 1-7.



Fig. 1-7 Freight station

## Exercise A

**Directions:** Fill in the blanks.

1. The intermediate station is mainly composed of \_\_\_\_\_, \_\_\_\_\_, \_\_\_\_\_, and \_\_\_\_\_.



2. At the district station, \_\_\_\_\_  
\_\_\_\_\_ are changed, and \_\_\_\_\_ is shifted.
3. The marshalling station is often built at \_\_\_\_\_  
\_\_\_\_\_ and equipped with \_\_\_\_\_  
to break up and resort a large number of freight trains.

### Mini-project A

1. **Directions:** Look at Fig. 1-1 and draw a sketch of the intermediate station.
2. **Directions:** Look at Fig. 1-2 and Fig. 1-3 and describe the “lateral layout” station and the “longitudinal layout” station respectively.
3. **Directions:** Explain the following terms.
  - (1) Technical station;
  - (2) Passenger transportation facility;
  - (3) Freight transportation facility;
  - (4) Shunting facility.

### Material B

#### Numbering of Lines and Turnouts

Station lines include main lines and sidings. The main line is the line that connects and runs through stations or directly extends into stations. The siding can be categorized into the following types according to its applications:

- (1) the receiving-departure track for receiving and dispatching of passenger trains or freight trains;
- (2) the shunting track and head shunt for break-up and resorting of freight trains;
- (3) the freight track for loading and unloading of goods;
- (4) other tracks designed to carry out various operations, say, the locomotive running track, the stabling siding for standby trains and the



inspection and maintenance track.

In order to make the operation, management and maintenance of facilities easier, lines and turnouts shall be numbered in accordance with the uniform numbering standard. Lines and turnouts at the same station or yard shall not bear the same number.

## 1 Numbering of lines

In terms of the numbering of station tracks, the main lines shall be numbered with Roman numerals while other tracks Arabic numerals.

(1) Tracks at a single-track section, including the main lines, shall be numbered consecutively from the one nearest the station building to the opposite side of the station building. Tracks at the left or right side and in the rear of station building shall be consecutively numbered from the main line to the one which is far away from the main tracks.

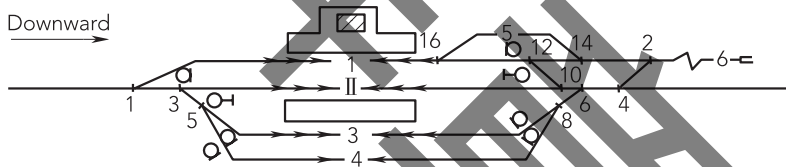


Fig. 1-8 Diagram for the numbering of lines and turnouts at a single-track railway station

(2) Tracks at a double-track section shall be numbered from the main line to the ones outside with tracks in the upward direction of the train running even-numbered and those in the downward direction odd-numbered. Refer to Fig. 1-9.

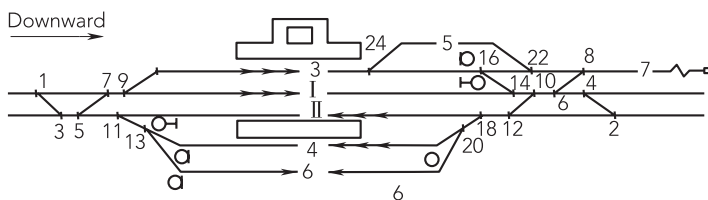


Fig. 1-9 Diagram for the numbering of lines and turnouts at a double-track railway station

(3) For tracks at a stub-end station, (a) if the station building is found at one side of the main track, the tracks shall be numbered consecutively from the one nearest the station building to the one on the opposite side of the



station building. Refer to the Fig. 1-10 (a), (b). If the station building is located at the end of the line, tracks shall be numbered consecutively from left to right with the farthest one from the end of the line numbered the smallest. Refer to the Fig. 1-10 (b).

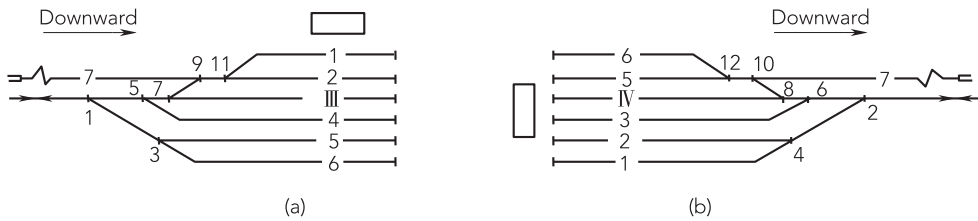


Fig. 1-10 Diagram for the numbering of lines and turnouts at a stub-end station

(4) If a large station has several yards, tracks in different yards shall be numbered respectively from the track nearest the station building (signal tower) to the one on the opposite side of the station building. The numbering of tracks shall follow the format of Roman numerals and Arabic numerals with Roman numerals signifying the number of the yard, e.g., track III5. In case no station building (signal tower) is identified in the yard, tracks are numbered towards the larger kilometer signs from left to right.

## 2 Numbering of turnouts

(1) From the main route to the secondary one, turnouts are numbered with Arabic numerals from two ends of the station to its center. Turnouts located at where the upward train comes in shall be even-numbered while those located at where the downward train comes in shall be odd-numbered. The center line of the station building divides all turnouts in stations into two types, turnouts in the upward section and turnouts in the downward section. Refer to Fig. 1-9 and Fig.1-10.

(2) Turnouts on the same crossover or ladder track shall be either odd-numbered or even-numbered consecutively.

(3) Turnouts at a stub-end station are numbered in the ascending order from the farthest to the nearest of the end of tracks. Refer to Fig. 1-10.

In case the tracks extend in two or more directions at the end of a station and there are both upward and downward trains, turnouts shall be numbered in the light of the main direction.

(4) If there are several yards at a large station, turnouts of different yards shall be numbered separately. In order to distinguish them, the turnouts in the yards are numbered with a three-digit number with the digit in the hundred's place representing the number of the yard, for example, turnout #101, #199, #201 and #299. The turnouts which are not installed in the yards are numbered with a two-digit or one-digit number, i.e. #1 to #99.

In case there are over 100 turnouts in a yard, the numbering shall proceed by using three-digit numbers. For example, #1100 represents the hundredth turnout in the yard I, #1101 indicates the hundred-and-first turnout in the yard I while #3101 the hundred-and-first turnout in the yard III. Under such a circumstance, the digit in the thousand's place signifies the number for the yard.

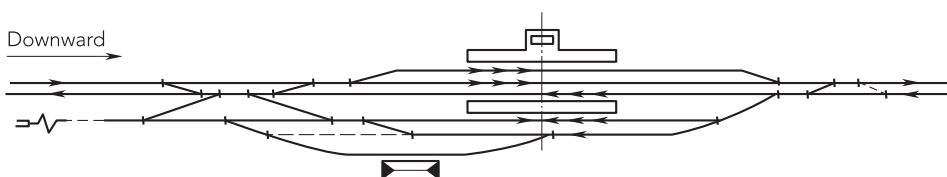
## Exercise B

**Directions:** Fill in the blanks.

1. Tracks at the double-track section shall be numbered from \_\_\_\_\_ to the ones outside with tracks in the upward direction of the train running \_\_\_\_\_ and those in the downward direction \_\_\_\_\_.
2. Turnouts at the stub-end station are numbered in \_\_\_\_\_ from the farthest to the nearest of the end of tracks.

## Mini-project B

**Directions:** Number the tracks and turnouts in the picture below.



## Part Three : Further Development

### Material C

#### Turnout

The turnout is a mechanical connection enabling the locomotive to move from one track to another or cross a track. It appears in abundance in stations to serve various operations. The most common type is the single turnout.

#### 1 Single turnout

The single turnout consists of the point, frog, guard rail and connection part. See the Fig.1-11 below.

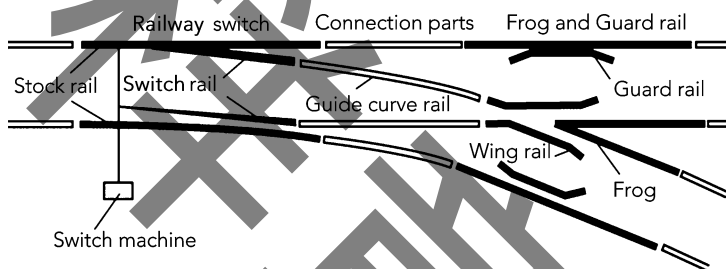


Fig. 1-11 Diagram of a single turnout

##### (1) Railway switch

One set of railway switch includes two stock rails, two switch rails and a switch machine. Switch rails, the main components of the railway switch, are attached to the switch machine by the pipe link. Through controlling the switch machine, one can change the position of the switch rail to direct trains towards either the straight or the diverging track.

Frequently-used switch machines include two types: the electrical switch machine and the manual operating switch machine. Manual operating switch machines are mainly employed for non-centralized operation of turnouts while electric switch machines centralized operation of turnouts.

##### (2) Frog and guard rail

This part is made up of the frog, wing rail and guard rail to ensure the

safety of the train when it passing through the junction of two routes.

There is a gap between the narrowest part between the two wing rails and the actual point of the switch rail. The gap can seriously violate the railway safety since the train wheels may roll into the wrong flange-way when passing through the gap. Therefore, to eliminate the risks, at the inner side of the stock rail, wing rails are often symmetrically placed at both sides of the frog.

The gap in the frog can seriously limit the passing speed of the train at a turnout. To eliminate the gap and ease the impact of wheels on the wing rail and point rail and meet the demands, various movable point frogs are developed at home and abroad to meet the demands of high-speed trains.



Fig. 1-12 Movable point frog

### (3) Connecting part

The connection part consists of two straight stock rails and two curved stock rails, which help connect the railway switch with the frog and guard rail, thus a complete railway turnout is formed. The curved stock rail often takes the shape of circular curve, the radius of which determines the scale number of the turnouts and the lateral passing speed through a turnout.

## 2 Size number of the turnout

Turnouts are designated with different size numbers according to the size of the frog angle. The size number of the turnout is determined by the cot of the angle at which the rails cross at the frog. Refer to Fig. 1-13.

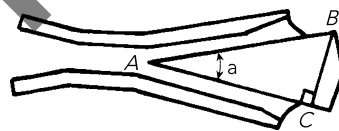


Fig. 1-13 Frog angle

$$N = \frac{AC}{BC} = \cot \alpha$$

The smaller the frog angle is, the larger the number of the turnout becomes; the bigger the radius of the lead curve is and the longer the length of the turnout is, the faster the train can pass through the turnout. In practice, employment of a certain number of the turnout is determined by the



purpose of the line. Chinese railways often use #9, #12, #18 and #30 single turnouts for main lines, and the maximum safe speed of passing those turnouts is 30 km/h, 45 km/h, 80 km/h and 140 km/h respectively.

### 3 Other turnouts

Besides the single turnout, turnouts can be divided into the symmetrical turnout, three-way turnout, diamond crossing turnout and dual-gauge slip switch turnout in respect of the structures and the number of lines they connect.

The symmetrical turnout is a special form of the single turnout and it is almost the same as the single turnout in terms of its structure. Different from the single turnout, the connection part of the symmetrical turnout is composed of curved stock rails only.

The three-way turnout connects with three lines at the same time with two switch rails controlling two point machines.

The diamond crossing turnout, composed of two sets of frogs with an acute angle and two sets of frogs with an obtuse angle, enables the train to pass and cross when two tracks in one plane join with an acute cross angle.

A double dual-gauge slip switch turnout equals to two single turnouts laid oppositely, providing eight routes in four directions. The dual-gauge slip switch turnout is a complex one with a relatively short length of land covering, and is often installed at the bustling throat section of a station where space is limited.



Fig. 1-14 Symmetrical turnout



Fig. 1-15 Dual-gauge slip switch turnout

### Exercise C

**Directions:** Fill in the blanks.

1. Turnouts are designated with different size numbers according to \_\_\_\_\_.
2. Besides the single turnout, turnouts can be divided into the \_\_\_\_\_, \_\_\_\_\_, \_\_\_\_\_ and \_\_\_\_\_ in respect of the structures and the number of lines they connect.

### Part Four

### Workshop

- 1. Directions:** Draw a diagram for a left-hand track turnout with the point indicator pointing in the straight direction; write down the names for all the parts of the turnout and the components of each part at their corresponding places in the diagram.
- 2. Directions:** Visit a railway vocational training base and finish the following tasks:
  - (1) determine the size number of turnouts through heel-assisted measurement; observe and know all parts of turnouts;
  - (2) draw a track (station) layout plan for the railway vocational training base (by using centerlines of the track);



### 3. Notes:

(1) Heel-assisted measurement:

- ① Identify at the top of a frog a spot with a width of a heel in length;
- ② Move away from the spot towards the theoretical point;
- ③ The number of steps one needs to take to finish the course is the size number for the turnout.

(2) The spatial location of each track is established by its distance away from the centerline of the track. The center line refers to the vertical line passing through the intersection point (i.e. Point O in the diagram) which is formed by the plumb line half-gauge in length away from the outer rail (i.e. Line AB) and the horizontal line formed by two points at the edge of each shoulder (i.e. Line CD).

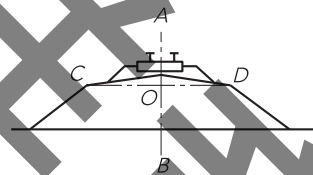


Diagram of a center line

## Self-assessment

**Directions:** Check the box (☺, ☹ and 😞) given for each learning objective and tick the one that best matches your performance.

Learning objectives	My Performance		
	☺	☹	😞
understand the features of main facilities at the intermediate station, district station and marshalling station			
master the classification of station lines and the numbering of station lines and turnouts			
know the components of the single turnout and types of turnouts			