

Railway Track Elements

1- RAILS:

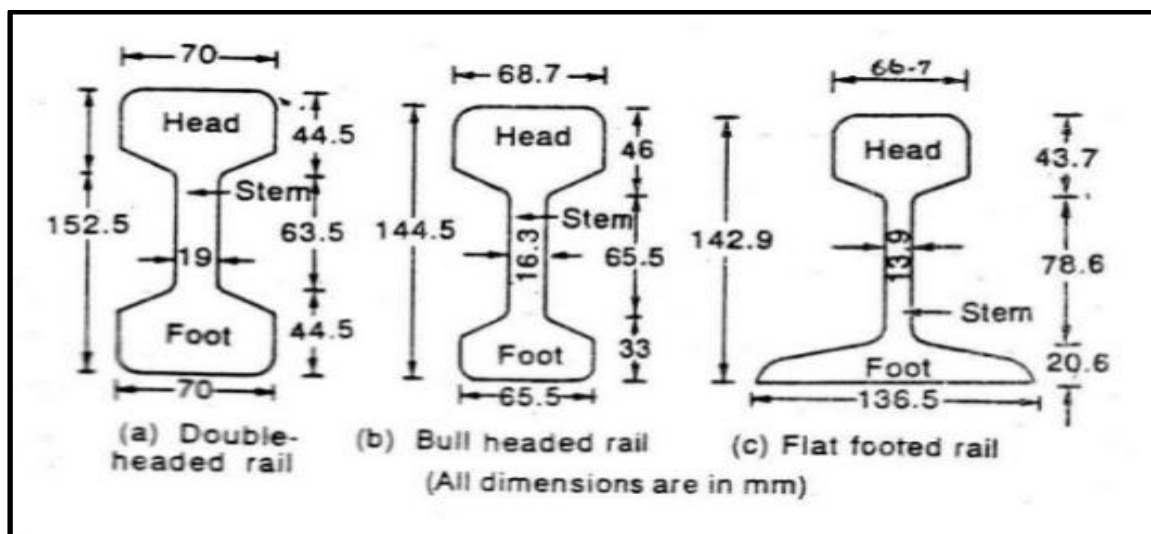
a- General

Rails are steel girders which provide the hard and smooth surface for movement of wheels of a locomotive and railway vehicles. They are made of high carbon steel to withstand wear and tear. Flat – footed rails are mostly used in railway track.

b- Functions

- 1- Rails provide a hard smooth and unchanging surface for passage of heavy moving loads with a minimum friction between the steel rails and steel wheels.
- 2- Rails bear the stresses developed due to heavy vertical loads, lateral and braking forces and thermal stresses.
- 3- The rail material is such that it gives minimum wear to avoid replacement charges and failures of rails due to wear.
- 4- Rails transmit load to sleepers and consequently reduce pressure on ballast and formation.

c- Types of rail sections:



- 1- Double headed rails (D.H. Rails).
- 2- Bull headed rails (B.H. Rails).
- 3- Flat footed rails (F.F. Rails).

d- Selection of rails.

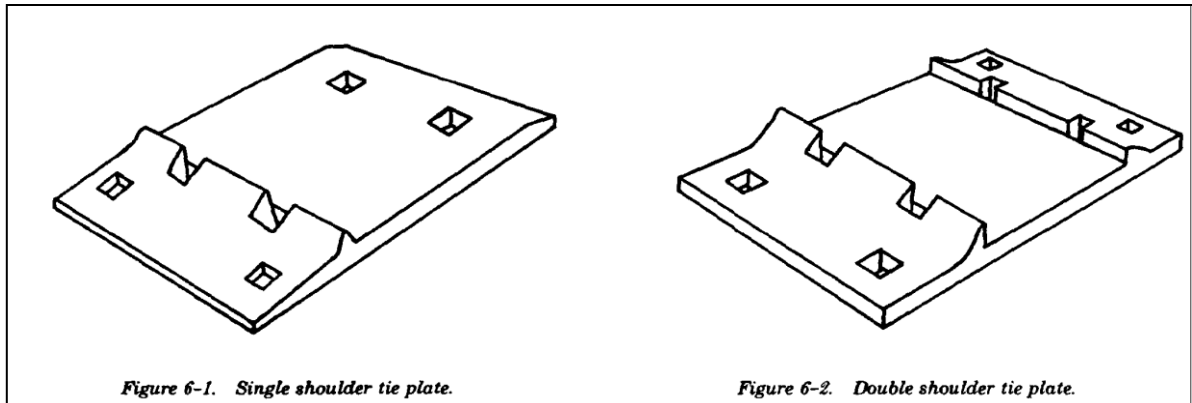
A rail is designated by its weight per unit length. The various important factors to be considered in deciding the weight of rails to be used are the following:

- 1- Speed of train.
- 2- The gauge of the track.
- 3- The axle load and nature of traffic.
- 4- Type of rails whether D.H. or B.H. or F.F. rails.
- 5- Spacing of sleepers or sleeper density.
- 6- Maximum permissible wear on top of rails. (5 percent of the weight of rail is allowed).

** In Iraq use rail 132 RE = 132 lb/yard = 60 kg/m.

e- Length of rails.

The rails of larger length are preferred to smaller length of rails, because they give more strength and economy for a railway track. The weakest point of track is the joint between two rails. Lesser the number of joints, lesser would be the number of fish plates and this would lead to less maintenance cost, smooth running of trains and comfort to the passengers. Length of rail jointed shall not be less than 15 m long and desirable length is 36m.

2- Tie Plates (Bearing Plates):**a- General.**

Bearing plates are rectangular plates are used below rails to distribute the load on a larger area of sleepers.

b- Functions.

- 1- Provide a large bearing surface on the tie (sleeper) reducing the intensity of bearing pressure.
- 2- Protect the rail from the longitudinal defects and lateral movement of the rail base.
- 3- Make spike more effective in holding the rail gauge.
- 4- Better maintenance of gauge, is possible, if bearing plates are used.

3- BALLAST:**a- General.**

Ballast is the granular material packed under the sleepers to transport load from sleepers to subgrade. It helps in providing elasticity to the track. (crashed gravel, crashed limestone).

b- Function of Ballast.

- 1- Distribute loads uniformly over the subgrade.
- 2- To hold track structure to line and grade, (prevent or reduce possibility of buckling).
- 3- To reduce the excess pore water pressure developed in clay subgrade.
- 4- To provide good drainage of track structure.
- 5- To reduce dust.
- 6- To prevent growth of brash and weeds.
- 7- Reduce frost heave.
- 8- Simplify the maintenance operations.

c- Selection criteria.

- 1- Size and gradation.
- 2- Shape (angularity).
- 3- Weight.
- 4- Strength.
- 5- Durability.
- 6- Cleanliness.
- 7- Economics.

d- Types of ballast.

- 1- Crushed stone.
- 2- Prepared gravel.
- 3- Sand.
- 4- Other material.

Ballast subgrade system:-

According to Talbot's formula:

$$h_{min.} = \left[\frac{16.8 P_a}{P_c} \right]^{4/5}$$

Where:

h_{min} = Minimum depth of ballast (and sub ballast if any below the bottom of the tie and over the subgrade (in).

P_a = Allowable bearing pressure over the bearing area of the tie beneath the centerline at the depth h (psi).

P_c = Average bearing capacity of subgrade .

Assume:

P_c = 20 psi (average allowable bearing capacity of a normally firm subgrade soil).

P_a = 65 psi (maximum desirable unit tie pressure especially for ballast at less than top quality)

P_a = 85 psi for concrete ties is allowable

$$\text{For } P_a = 65 \text{ psi, } P_c = 20 \text{ psi then } h_{min.} = \left[\frac{16.8 \times 65}{20} \right]^{4/5} = 24.5 \text{ in}$$

$$\text{For } P_a = 85 \text{ psi, } P_c = 20 \text{ psi then } h_{min.} = \left[\frac{16.8 \times 85}{20} \right]^{4/5} = 30.41 \text{ in}$$

$$P_a = \frac{P \text{ (wheel load)}}{\text{Tie bearing area}}$$

5- Ties (Sleepers):**a- General**

Sleepers are members generally laid transverse to the rail, on which the rails are supported and fixed, to transfer the loads from rails to the ballast and subgrade below.

b- Functions

- 1- To hold the rails to proper gauge.
- 2- To hold the rails in proper level or transverse tilt.
- 3- To interpose an elastic medium between the ballast and rails.
- 4- To distribute the load from rails to the ballast underlying it or to the girders in case of bridges.
- 5- To support the rails at a proper level in straight tracks and at proper superelevation on curves.
- 6- Sleepers also add to the general stability of the permanent track on the whole.

c- Classification of sleepers:

Sleepers can be classified according to the material uses in their construction, in the following:

- 1- Wooden sleepers.
- 2- Metal sleepers.
 - a- Cast-iron sleepers.
 - b- Steel sleepers.
- 3- Concrete sleepers.
 - a- Reinforced concrete sleepers.
 - b- Prestressed concrete sleepers.