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CHAPTER 6

Ballast

6.1 BALLAST

Ballast is the granular material usually broken stone or any other suitable material which is spread on the top of railway formation and around the sleepers.

6.2 FUNCTIONS OF BALLAST

Ballast in railway track performs the following functions :

(i) To hold the sleepers in position and preventing the lateral and longitudinal movement.

(ii) To distribute the axle load uniformly from sleepers to a large area of formation.

(iii) To provide elasticity to the track. It acts as an elastic mat between subgrade and sleepers.

(iv) To provide easy means of maintaining the correct levels of the two rails in a track.

(v) To drain rain water from the track.

(vi) To prevent the growth of weeds inside the track.

6.3 CHARACTERISTICS OF GOOD BALLAST

(i) It should have sufficient strength to resist crushing under heavy loads of moving trains.

(ii) It should be durable enough to resist abrasion and weathering action.

(iii) It should have rough and angular surface so as to provide good lateral and longitudinal stability to the sleepers.

(iv) It should have good workability so that it can be easily spread on formation.

(v) It should be cheaply available in sufficient quantity near and along the track.

(vi) It should not make the track dusty or muddy due to its crushing to power under wheel loads.

(vii) It should allow for easy and quick drainage of the track.

(viii) It should not have any chemical action on metal sleepers and rails.

6.4 TYPES OF BALLAST

In India, the following materials are used as ballast :

(i) Broken strong
(ii) Gravel
(iii) Sand
(iv) Ashes or cinders
(v) Kankar
(vi) Moorum
(vii) Blast furnace slag
(viii) Brick ballast
(ix) Selected earth

(i) **Broken Stone :** This is the best type of ballast as it possesses all the characteristics of a good ballast. It holds the track to correct alignment and gradient due to its high interlocking action. The stones which are non porous, hard and do not flake on breaking should be used. Igneous rocks such as granite, quartzite and trap make execllent ballast. This type of ballast is used for high speed tracks.

Advantages

(a) It is hard and resist crushing under heavy loads.
(b) It has angular and rough surface and hence gives more stability to the sleepers.
(c) Its drainage property is excellent.

Disadvantages

(a) It is expensive.
(b) It is not so easily available.

(ii) **Gravel :** Gravel is the second best material for ballast. This is obtained either from river beds or from gravel pits and has smooth rounded fragments. Gravel obtained from pits usually contains earth which should be removed by washing. Gravel obtained from river beds is screened and required size gravel is used. Larger size gravels are broken into required size. Round edges gravels are broken to increase their interlocking action.

Advantages

(a) Gravel is cheaper than stone ballast.
(b) The drainage property of gravel is excellent.
(c) It holds the track to correct alignment and gradient.
(d) It is easy to use gravel ballast than stone ballast at certain places where formation is unstable.

Disadvantages

(a) It requires screening before use due to large variation in size.
(b) Gravel obtained from pits requires washing.
(c) Due to round faces the packing under sleepers is loose.
(d) Gravel easily roll down due to vibrations.

(iii) **Sand :** Sand is reasonably a good material for the ballast. Coarse sand is generally preferred to fine sand for ballast. This type of ballast is suitable for packing pot sleepers. It is used only on unimportant tracks.

Advantages

(a) It is a cheap material.
(b) It is available in large quantities.
(c) It has good drainage properties.
(d) Sand ballast produces a silent track.

Disadvantages

(a) It has no stability and gets disturbed by the vibrations caused by moving train.
(b) It causes wear of rail, seats and keys.

(iv) **Ashes or Cinders :** These are waste products obtained from steam locomotives.

Advantages

(a) It is cheaper ballast material.
(b) It has very good drainage quality.
(c) It is available in large quantities and hence can be used in emergency.
(d) The handling and transportation are easy.

Disadvantages

(a) It is very sott and gets crumbled to powder under heavy loads.
(b) It has got corrosive quality and corrode steel sleepers and foot of the rails.

(v) **Kankar :** It is a natural material in the form of nodules from which lime is prepared.

Advantages

(a) It is cheaper.
(b) It has good drainage property.

Disadvantages

(a) It is soft and crumbles to powder under traffic load.
(b) The track laid on kankar ballast are difficult to maintain.

(vi) **Moorum :** It is a soft aggregate and is obtained by the decompositon of laterite. It has red or yellow colour. It is used in unimportant lines and sidings.

Advantages

(a) It is easily available in most parts of India.
(b) It has good drainage properties.
(c) It is used as blanket for new embankment.

Disadvantages

(a) It is soft and easily crumbles to powder under heavy loads.
(b) Maintenance of track laid on moorum ballast is very difficult.

(vii) **Blast Furnance Slag :** It is a waste product obtained from the blast furnance of steel industry. High grade slag fulfils all the characteristics of good ballast.

Advantages

(a) It is a cheap material.

(b) It has good drainage properties.

(c) It is a strong material.

(d) In holds the tracks in correct alignment and gradient.

Disadvantages

(a) It is not available in large quantity.

(b) Spreading of this material on the formation is difficult.

(c) Maintenance of track laid on slag ballast is difficult.

(viii) **Brick Ballast :** At places where good ballast material is not available over-burnt bricks are broken into suitable size to be used as ballast.

Advantages

(a) It is a cheap material.

(b) It prevents growth of vegetation

(c) It has good drainage properties.

Disadvatages

(a) It is soft and easily crumbles to powder under heavy loads.

(b) The rails laid over such ballast get corrugated.

(ix) **Selected Earth :** Hardened clay and decomposed rock are suitable for use as ballast. When tracks are laid on new formation, then sleepers are packed with earth for a few months. When the formation is consolidated and surface becomes hard, good type of ballast is laid. The use of earth ballast in the beginning is to prevent the loss of good ballast by sinking into soft formation.

6.5 SIZE AND SECTION OF BALLAST

The size of ballast used in railway track varies from 19 mm to 51 mm. Stones of size larger than 51 mm are not preferred because these do not provide good interlocking. The best size of ballast is that which contains equal proportions of different sizes of stones and varies between 19 mm to 51 mm.

The size of ballast mainly depends upon the type of sleeper used and location of the track. The following sizes of ballast are used in Indian Railways.

(i) For Wooden Sleepers - 51 mm

(ii) For steel sleepers - 38 mm

(iii) For point and crossing - 25.4 mm

The depth of ballast section under the sleepers is an important factor as the load carrying capacity and uniformity of distribution of traffic load on formation depends much on it. The more the depth of ballast below the sleeper more will be the load carrying capacity of the track. The depth of ballast remains uniform throughout on straight tracks as shown in Fig. 6.1, but on curves additional ballast is required to make up the super-elevation. The depth of ballast under the outer rail on the curves is increased so as to give the required superelevation. Extra shoulder of 150 mm is provided on the outside of curves to counteract the increased lateral thrust.

The lateral stability of the track depends partly on the quantity of ballast at the

end of sleepers. The lateral stability increases with the increase in width of ballast section upto a certain limit. This limit is 380 to 430 mm from the end of sleeper.

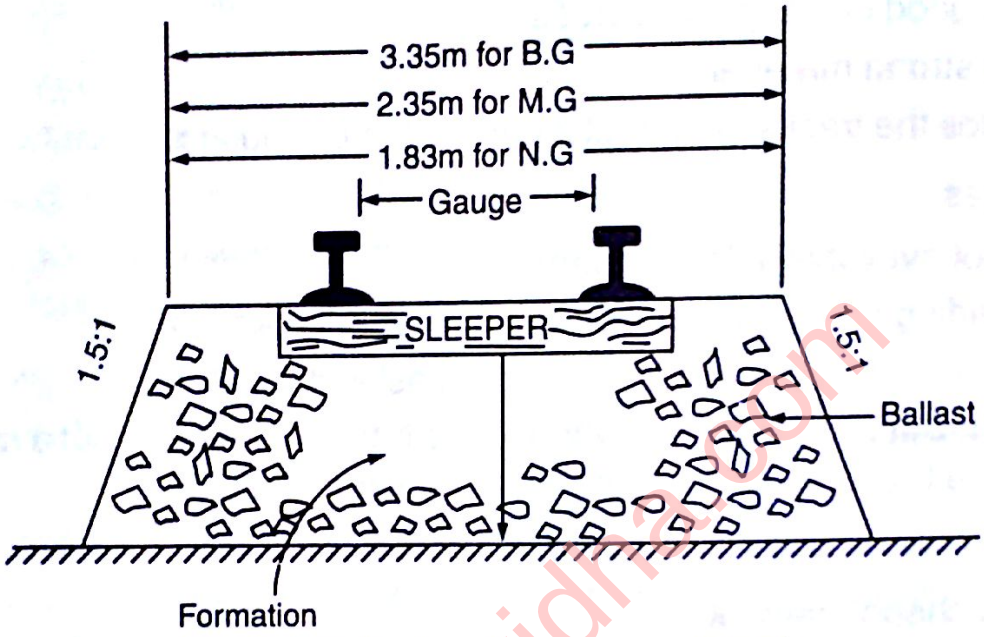

Fig. 6.1 Ballast section on curved track

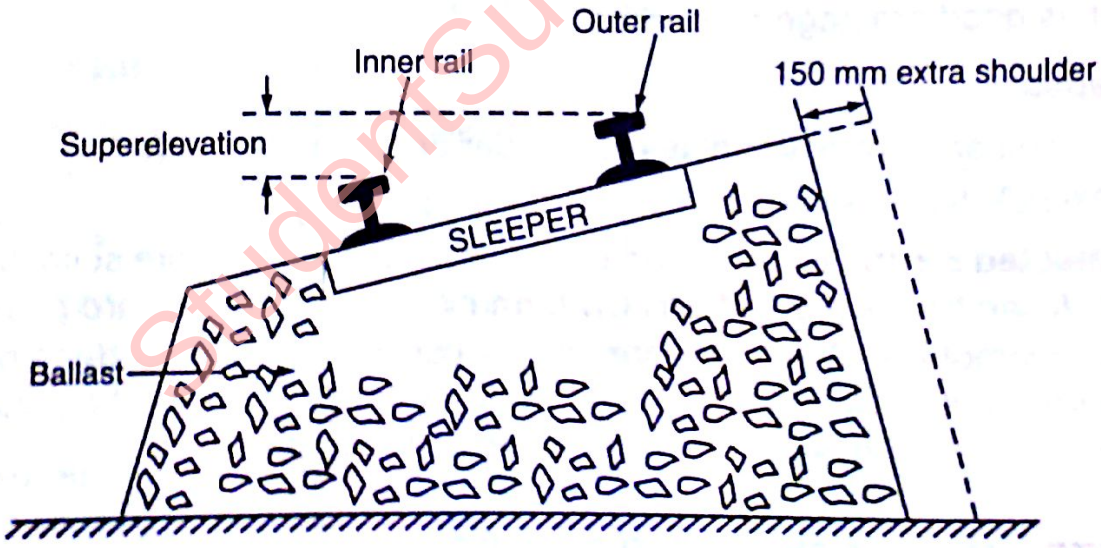

Fig. 6.2 Ballast section on curved track

6.6 QUANTITY OF BALLAST

The quantity of ballast per metre tangent length is 1.036 cu m for B.G. 0.071 cum for M.G. and 0.053 cum for N.G.