TRACK STRUCTURE

Lesson 2

SLEEPERS

1.0 FUNCTION OF SLEEPERS

Sleeper is a component of track structure transversely placed, on which the rails are laid. The primary functions of sleepers are as under:

(1) To transmit the load to the formation below ballast.
(2) To hold the rails at the correct specified distance.
(3) To enable the rails to be seated at a cant of 1 in 20 either directly or over a bearing plate in case of wooden sleepers.
(4) To maintain the desired cross level between the two rails in the track with the help of ballast.
(5) To provide lateral and longitudinal resistance to the track with the help of ballast.
(6) To provide torsion resistance to the track frame with the help of rail/sleeper fastenings.
(7) To absorb the vibrations set up by the moving loads.

1.1 Requirements of an ideal sleeper

(1) Should be able to perform all the functions as indicated above.
(2) Assembly, installation, removal and renewal should be possible with ease.
(3) Should permit adjustment of gauge.
(4) Should have sufficient bearing area to avoid crushing of ballast.
(5) Packing should be possible with ease.
(6) Handling should be easy.
(7) Should have insulating properties for use in track circuited areas.
(8) Should be economical and durable.

2.0 DENSITY AND SPACING OF SLEEPERS

Number of spacing of sleepers in the track is indirectly described as sleeper density. The sleeper density is designated in two forms.

(1) Number of sleepers per rail of standard length, or
(2) Number of sleepers per kilometer.

Sleeper density in the form of number of sleepers per rail of standard length is defined as (M+K) where M is the length of the rail in meters and (K) is a constant varying from 2 to 9 depending on the importance of the line.

From the number of sleepers as defined above, sleeper density can also be designated as number of sleepers per kilometer.

For a standard rail length of 13M on B.G a sleeper density of (M+4) would mean 17 sleepers per rail of 13m length or 1308 sleepers per KM.

Depending upon the density of the sleepers, the number of sleepers in a rail length is decided and their spacing is kept as uniform as possible.

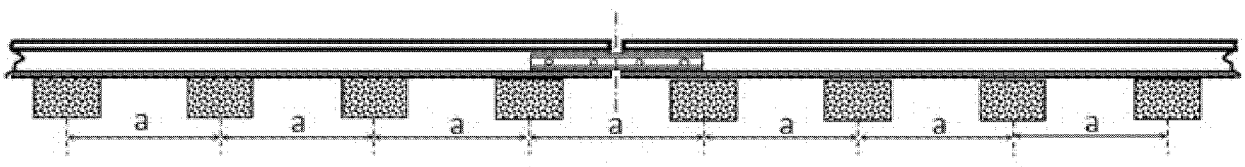


Fig. 2.1 SPACING OF SLEEPERS

For long welded rails a uniform spacing of 65 cm. and 60 cm. are adopted for sleeper density of 1540 per km and 1660 km respectively. For short welded rails, sleeper spacing are arrived at based on the above principles, taking into consideration the increase or decrease of the length of short welded rails paved depended upon the System of welding, i.e. thermit or flash butt.

3.0 DIFFERENT TYPES OF SLEEPERS

The sleepers, which were in use on Indian Railways-

(1) Wooden Sleepers
(2) Cast Iron sleepers
(3) Steel Trough sleepers
(4) Steel Sleeper on Bridges

Presently in all over Indian Railways only Concrete sleepers (PSC/PRC) are being used.

3.1 Concrete Sleepers (Fig 2.2)

The primary function of the sleepers is to transmit the axle load of rolling stock to the formation through the ballast and to maintain the gauge level and alignment parameters of the track. Another important requirement is to generate adequate longitudinal and lateral resistance of track for LWR. Due to increase in the axle load of the moving vehicles accompanied with the need for high speed trains, necessity of heavier track structure was felt. Further, due to reduction in availability of wooden sleepers need arose to develop of a sleeper design, having adequate electrical resistance from the point of view of track circuiting. Concrete sleepers are considered as the only alternative as these are expected to satisfy all the requirements.

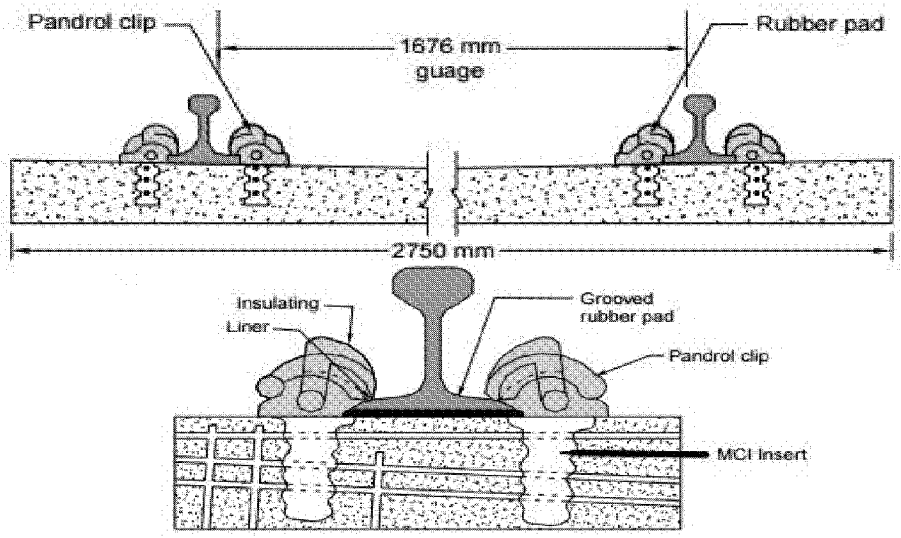


FIG. 2.2 DETAILS OF CONCRETE SLEEPER

3.1.1 Advantages & disadvantages of concrete sleepers

Advantages

(1) Concrete sleeper being heavier than other types of sleepers provide longitudinal and lateral stability to the track and thus are suitable for LWRs.

(2) Concrete sleepers with elastic fastening provide a good maintainability of track with good packing retentivity.

(3) Because of their flat bottom these sleepers are ideally suited for mechanised maintenance.

(4) Due to their adequate electric resistance, concrete sleepers can be used in track circuited areas.

(5) They are not liable to damage by fire, pests attack or corrosion.

(6) The life of concrete sleepers is about 40 to 50 years.

Disadvantages

(1) Due to their heavy weight, handling and laying of concrete sleepers is difficult. Normally mechanised method has to be adopted for handling, which involves heavy initial expenditure.

(2) At the time of derailments, the damage to concrete sleepers is very heavy.

(3) Scrap value of these sleepers is very low.

(4) These sleepers are not suitable for manual maintenance.

3.1.2 Location where concrete sleepers are used

Concrete sleepers should normally be used only with LWR/CWR track. Hence the condition for laying LWR/CWR should equally apply for laying concrete sleepers. When concrete sleepers are used with fish plated track, provision of wooden sleepers at the joints and first shoulder is desirable.

3.1.3 Maintenance of concrete sleepers

(1) Heavy on duty track tampers should be used for maintaining track laid on concrete sleepers. For spot attention off-track tampers may be used.

(2) Central binding of mono-block concrete sleepers would be avoided and to ensure this the central portion of the sleepers should not be hard packed.

(3) Both the ends of the concrete sleepers should be painted with an approved type of anti-corrosive paint periodically to prevent corrosion of the exposed ends of pre-stressing wires.

(4) The laying of concrete sleepers should be done by mechainsed means as for as possible.

(5) The elastic rail clip should be driven properly so that the leg of the clip is flush with the end face of the insert. Over-driving and under-driving should be guarded against by observations of the clips in position. Over-driving/under-driving of the clips causes eccentric load on the insulators and results in their displacement and variation of toe load.

(6) A vigilant watch should be kept to ascertain that no creep is taking place in any of the portion of the concrete sleepers track or excessive movement near SEJs.

(7) Rubber pads: It must be ensured that the rubber pads are in correct positions. Whenever it is found that the rubber pads developed a permanent set, these should be replaced by new ones. Such examinations can be done at the time of distressing. Loss of toe load should be occasionally checked particularly, if any creep is noticed resulting in excessive movements of the SEJs.

(8) Insulating liners**:** Nylon/composite insulating liners used with pandrol clips should be examined periodically for sign of cracking and breakage. Adequate care should be exercised while driving the clip at the time of installation to prevent damage.

(9) Measures to prevent corrosion and seizure of ERC with SGCI (Spheroidal Graphite Cast Iron) inserts:

(a) Initial treatment

At the base depot, all the elastic rail clip and inserts should be thoroughly cleaned. Grease to IS:408-1981 (specification for grease No. 'O' graphite) should then be applied on the central leg of the ERC and eye of the SGCI insert and then the clip should be driven at the time of assembly.

(b) In service maintenance

All the elastic rail clips are to be taken out from the inserts and are to be cleaned specially on the central leg. The eyes of the inserts are also to be cleaned for any debris or rusted material. Cleaning of elastic rails clips may be undertaken by wire brush and emery paper and the surface cleaned before the grease is applied. The central leg of the ERC should then be applied with grease of approved quality. The eye of the inserts should also be smeared with the same grease before the treated ERCs are driven back. This should be repeated every one year in corrosion prone areas. In other locations the frequency should be 2 years, and one half length in each gang should be greased annually.

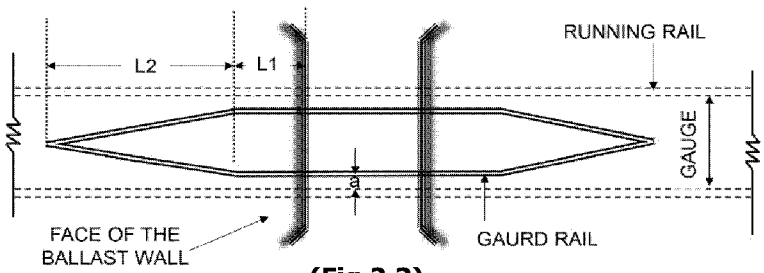
3.1.4 Sleepers on approaches of Bridges and Tunnels (for fixing Guard Rails) (Fig 2.3)

Guard rail should be provided on all girder bridges (including pre-stressed Concrete girder bridges without deck slab) whether major or minor. Guardrails should also be provided on all major and important

ballasted bridges and also on such other minor bridges where derailment may cause serious damages. On all flat top, arch and pre-stressed concrete girder bridges with deck slab, where guardrails are not provided the whole width of the bridge between the Parapet walls shall be filled with ballast up to the top of sleeper level. The provision of guardrails along the inner rail can be dispensed with, in case of ballasted deck bridges located on sharp curves where the maximum permitted speed is not more than 30 Kmph and track is laid with PSC sleepers having arrangement for provision of checkrail due to which guardrail cannot be provided. Total 11 nos. PSC sleepers are provided on each approach of Bridge/ Tunnel. Details of approach sleepers are given below:

Sr. No.	PARTICULARS	Length of Guard Rail	RDSO Drawing No. of Sleeper	No of Sleepers
1.	Straight Length of Guard Rail	1825 mm (L1)	RT-4089	03 Nos.
2.	Tapered Length of Guard Rail	4875 mm (L2)	RT -4090 to 4097	08 Nos.
3.	On Ballasted Deck Bridges	Abutment to Abutment	RT-4088	As per requirement

In case of ROB/FOBs, the guard rail shall be provided on the track adjacent to a column/pier/abutment which is located within a distance of 8m from centre of track. The top table of the guardrail should not be lower than that of the running rail, by more than 25 mm. In the case of bridges on curves with canted track, the difference should be measured with reference to a straight line connecting the running tables of inner and outer rails.



(Fig 2.3)

Sr.No.	PARTICULARS	SKETCH REF	DIMENSIONS
1	Clearance between Guard Rail & Running Rail	a	250 ± 50 mm
2	Straight length of Guard Rail outside the Ballast Wall	L1	1825 mm
3	Tapered length of Guard Rail to be bent so as to be brought together at the middle of the track	L2	4875 mm

3.2 Steel sleepers on Bridges

Steel Sleepers on bridges refer to both Steel Channel Sleepers and Steel H Beam Sleepers as shown in FIG. 2.4 Steel sleepers to be used on girder bridges should be fabricated as per approved drawings. For girder bridges on curved track, and track on skewed alignments, steel sleepers should be designed to suit the specific locations.

3.2.1 Sleeper spacing

Maximum centre-to-centre sleeper spacing should be 600 mm at all locations on the bridge except at the cross girder in open web girders, where the spacing may be suitably increased depending upon the top flange width of the cross girder. However, in case of width of top flange of cross girder exceeds 450 mm. then special channel sleeper to be provided as per applicable RDSO drawing for such situations. The clear distance between joint sleepers should not be more than 200 mm.

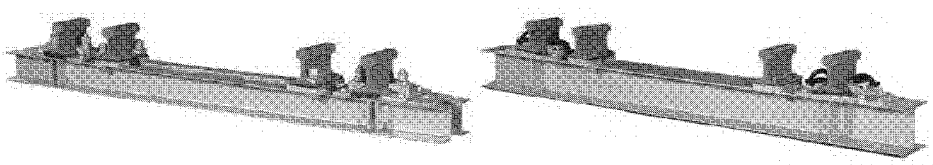


FIG. 2.4 STEEL CHANNEL SLEEPER