

TRACK STRUCTURE

CHAPTER – III

RAIL FASTENINGS

Rails have to be properly fixed over sleeper to ensure following:

- (i) To maintain the gauge
- (ii) To transmit the loads
- (iii) To withstand lateral forces
- (iv) To reduce impact on the joints
- (v) To have least disturbance during movement of wheels over it.

Bearing the above facts the following fittings are in vogue for different rail sections.

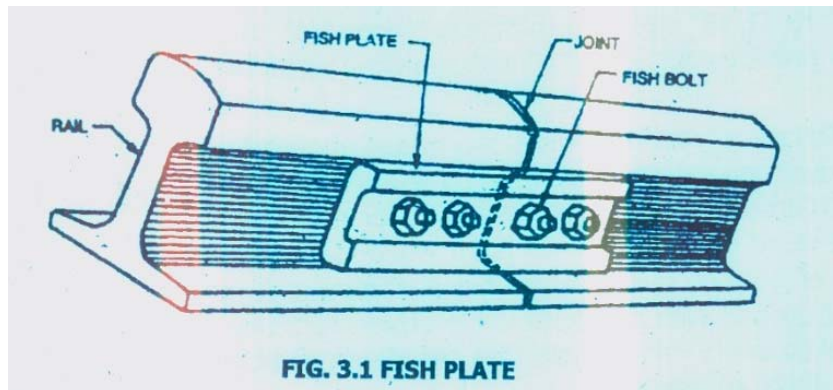
2.0 KEYS FOR DOUBLE HEADED AND BULL HEADED RAILS

Cast iron sleepers known as pot sleepers over which rail is placed is shown in Fig. 2.4 in chapter II. Rails are secured with fittings called as keys either rolled or plate bent or wooden wedges. These are fitted on outside the rail in between the jaw and rail web. During service either due to vibrations or movement of rail the fittings are loosened or can be thrown out resulting the rail to tilt inside or outside the jaw and will cause derailments. These types are not sturdy for present day loading as well as routes used for passenger trains.

2.1 FISH PLATES FOR DOUBLE AND BULL HEADED RAILS (fig.3.1)

The fish plates are required for continuity of the rail and maintain the line and level of top table and gauge face, are with five holes. Hence rail ends will be with circular hole. Also the fish plates bolt head are of pan headed type and protruded fillet is provided in the bolt (between head and thread). Hence while tightening the bolts the shank will not turn and nut can be tightened.

The disadvantage in this type of fish plates are –



- (a) Holes are to be drilled and again 'V' recess is to be formed.
- (b) The length of suspension becomes more.
- (c) Central bolts may shear off in between when rail contracts.
- (d) The joints pot sleepers needs to be elliptical shape whereas other central sleepers will be circular shape.

(e) The distance of over hang from end is more causing rails and fish plates bend and heaving up resulting in failures.

3. FITTINGS FOR FLAT FOOTED RAILS

These rails are flat footed. Number of different types of fixtures and fastening are available on to Indian Railways according, to the type of sleepers i.e. cast iron, steel sleepers, wooden sleepers or concrete sleepers.

3.1 The following are the fittings used on wooden sleepers

Wooden sleeper, these sleepers are available in two varieties: (i) Softwood (ii) Hard wood.

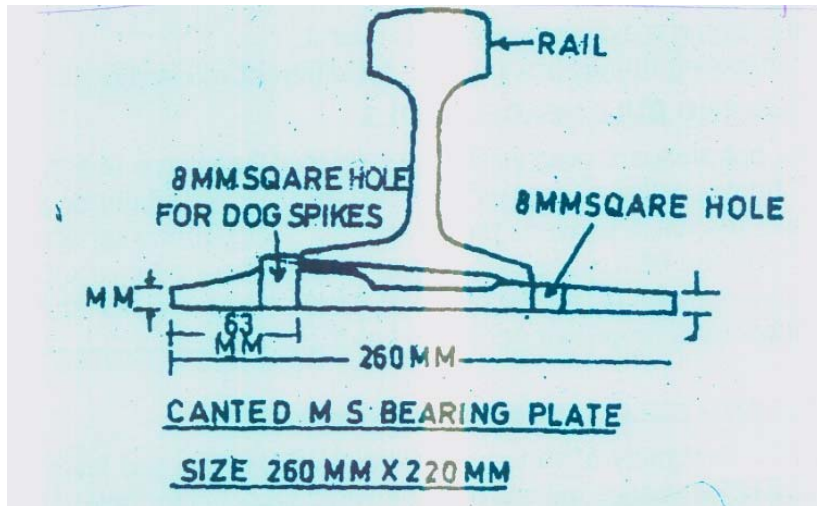


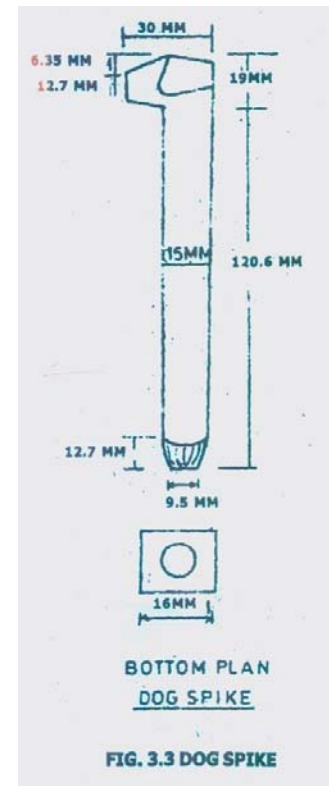
Fig 3.2 M.S. canted bearing plate & Dog Spikes.

Rails are placed over sleeper with provision of M. S canted bearing plate (fig.3.2). The plates are of size 260 mm having four square holes 5/8" to 11/16" size with thickness 5/8" to 7/6". Top surface sloping to provide cant of 1 to 20 with a groove at center 2 to 3 mm deep.

To arrest lateral thrust raised shoulder is provided at outside. The rail is placed over bearing plate and dog spikes are driven. The dog spikes (fig.3.3) are fixed by drilling holes by auger in wooden sleepers. (for soft wood dia of hole to be 2mm less and for hard wood correct dia of hole of spike) before fixing dog spike it is dipped in hot coal tar and with sledge hammer driven vertically, care should be taken while drilling hole that the depth of hole shall be up to full depth of sleeper.

Number of dog spikes should be as under:

- (1) On girder bridges, joints, level crossings and points and crossings. Four dog spikes per rail seat.
- (2) In curves out side two number and inside one number per rail seat.
- (3) In case of straight two diagonally driven (one inside and one outside) per rail seat.



The important points to be observed for driving spike.

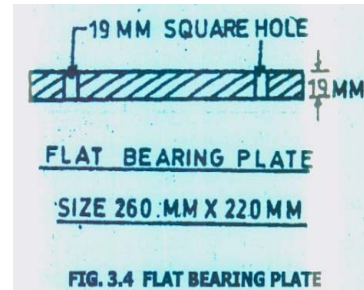
- (i) A template to be made and holes predrilled before fixing plate. This is essential to make square hole.
- (ii) Exact size of hole to be drilled as per the type of sleepers (soft or hard)
- (iii) Coal tarring of spike
- (iv) Vertically while driving.

3.1.2 Demerits of Dog Spikes

- (i) Due to side thrust and snubbing inside head wears out
- (ii) Shank getting corroded.
- (iii) Re-gauging becomes difficult.
- (iv) To keep gauge within tolerance greater skill is required.

On some unimportant lines dog spikes are provided without MS bearing plates. When M. S bearing plates are not used, top of sleeper is provided with 1 in 20 cant by adzing. In case of guard rails over Girder Bridge, direct fixing is done. However when cant of rail is not required, rail has to be fixed on MS plain bearing plate, e.g. on points and crossing sleepers. Flat bearing plates are of size 260mm x 220mm and $\frac{3}{4}$ " thick as in fig.3.4. These are thicker plates compared to canted bearing plates.

In practice it will be found that during the passage of wheels rattling noise of bearing plates is a nuisance. To stop this while laying plate, a coat of coal tar with sprinkling of sand at bottom will make the bed even and works as a adhesive on the top of wooden sleeper.

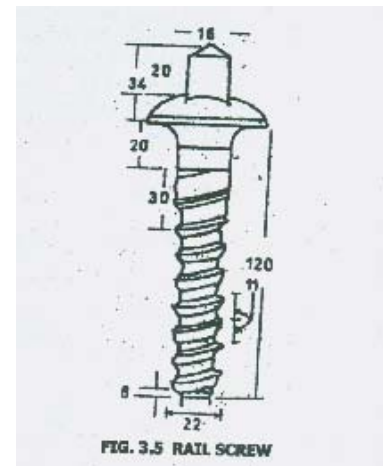


RAIL SCREWS (FIG.3.5)

Holes are made circular and rail screws can be provided instead of dog spikes. This is modified fixture and salient feature are as under:

- (1) This is not driven but screwed.
- (2) Screw size is thicker and screw thread makes the plate snug fit.
- (3) Cannot be easily removed.
- (4) There is a cant of a 1 in 20 circular head where it comes in contact with rail which will ensure more area of contact.
- (5) Replacement will be easy.

Before fixing, this should be greased instead of coal tarring so that fixing and extraction will be easy at later stage



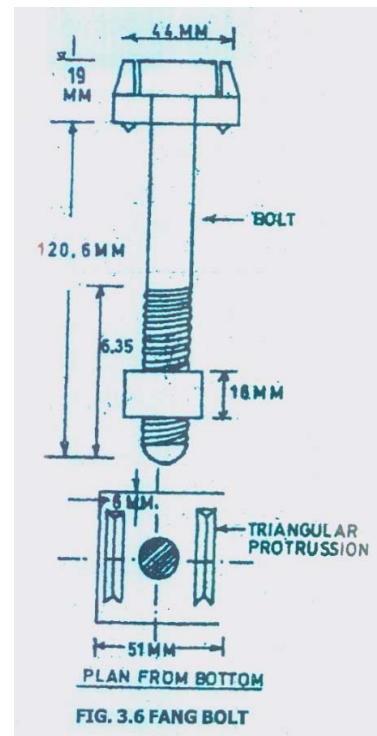
3.2 Fang Bolt (fig.3.6)

Rails with special bearing plates are provided as in case of points and crossings where slide chairs are used, the fang bolt is useful. This will give sturdiness and constant attention shall not be required.

The bolt head and nut are square with a recessed washer with protruding head in a triangular shape. Hole is pre-driven and from bottom the bolt inserted with washer. Top bearing plates are provided with single or double washer and nut tightened from top. As nut is tightened the protrusion on the washer comes and gets set on the sleepers. This will not allow the bolt to turn while tightening of the nut from top.

Minimum 50% holes in bearing plate are to be provided with fang bolts in the special bearing plates. Disadvantages in this method is that if any replacement is required, the ballast bed will have to be disturbed for the removal of bolts and new bolts fixed from bottom and again sleeper to be packed up.

These are also to be coal tarred below thread and greased on the threads. The holes are driven to the correct dia of the fang bolt shank to keep it fit.

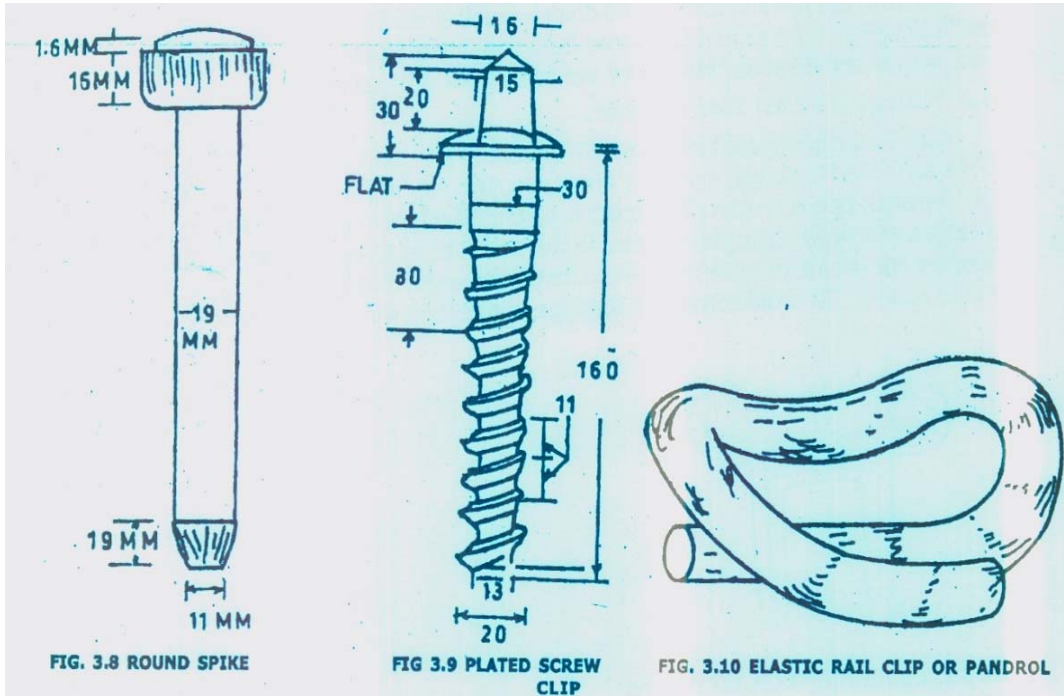


3.3 Anti-creep bearing plates (fig.3.7)

ACB plates are called as anti-creep bearings plates made of cast iron either with four holes for BG or three holes for MG on either side of plates to hold it in its position with round spikes or plate screws (Fig.3.8 & 3.9). For fixing the plates proper templates are to be used. Keys are to be driven to hold the rail which passes between the jaw and foot of the rail. The plates are manufactured either single key type in which key is driven inside or double key type wherein keys can be provided on both sides.

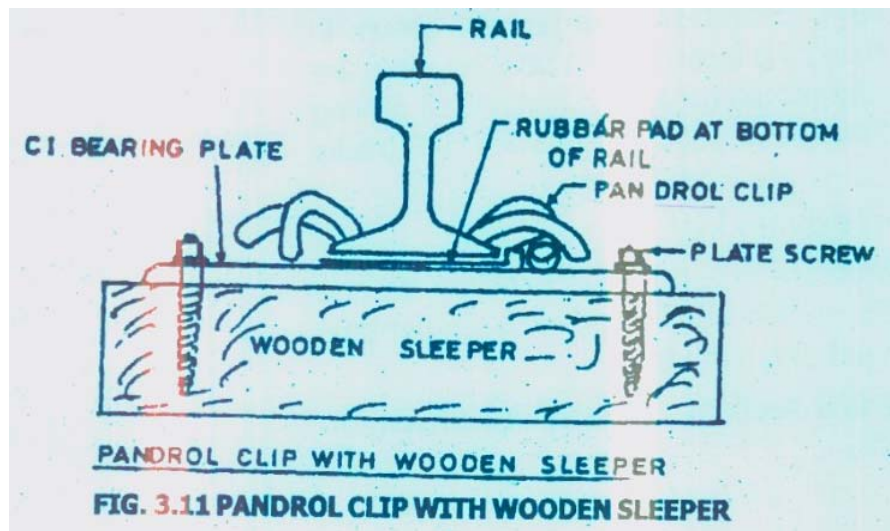


In double key ACB plates slight gauge adjustment is possible by adjusting the keys on either side of rail. These plates are restraining the rails from longitudinal movement. The rail creeps constantly due to running of train, on steep gradients, sharp curves, ACB plates can be used. To arrest creep effect on points and crossing, these plates are provided before and after the turn out, so that there should not be any relative movement of rail which will result in the geometry of points and crossing getting disturbed.



4. Elastic Fasteners

In recent years some of new fixtures which are very sturdy and of fit and forget type have been developed. Fig.3.10 & Fig.3.11 show details of one such fastening, known as Elastic Rail Clip (ERC) for fixing the clip to rail on wooden sleeper. ERC was earlier known as PANDROL clip.

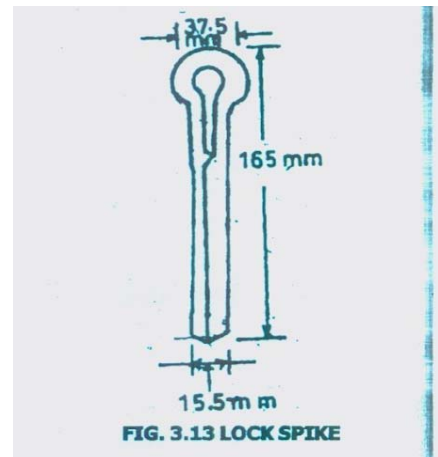


4.1 These clips (ERC) are made up of high silicon spring steel. These are manufactured to a special bent shape so that one leg of clip will press on foot of the rail and other leg is fixed in eye of insert. This will provide toe load on rail foot. The special bearing plates for this purpose are screwed down to the wooden sleeper. It is necessary to provide grooved rubber pad on the top of bearing plate (at rail seat). Each sleeper requires four clips and clips should be greased once in 2 years to avoid corrosion.

Some of the modern fixtures are double shank elastics spikes shown at Fig.3.12. There is also one lock spike, Fig.3.13 and these two fastenings have replaced dog spikes. They are very sturdy and provide sufficient toe load. They are to be fixed with special equipment.

4.2 Fittings for Cast Iron Sleepers.

Cast iron sleeper are called as CST or central standard trial sleepers. To use these sleepers loose parts like MS tie bar, 4 cotters, and 2 nos., two way keys are required. There are two types of CST-9 plates; one is ordinary and other is reverse jaw type which is utilized for anti-sabotage. Rail is seated with keys inside jaw. In reverse jaw type the key is from outside of rail. Such reverse jaws sleepers are minimum three for one ordinary rails length to prevent sabotage. Keys may fall down due to rocking. To avoid spreading of gauge, the cotters should be in tight condition.



4.3 Fittings for Steel Trough Sleeper.

These sleepers are with 4 holes two on either side of rail to hold the rail by means of four loose jaws and four two way keys. Details of loose jaw are shown in Fig.3.14. After fixing the loose jaws in position, keys are driven to keep the required gauge. Direction of driving keys depends on single or double line tracks, LWR tracks etc.

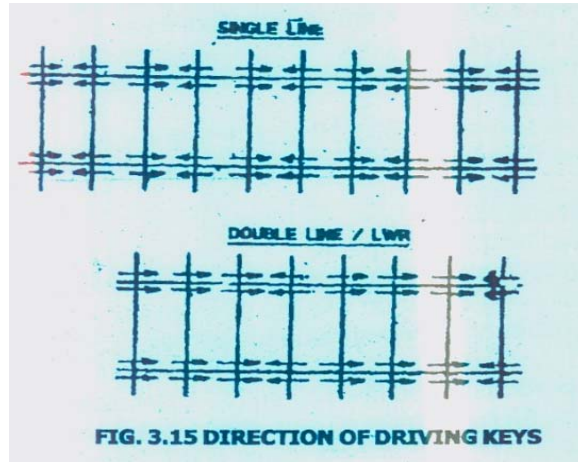
Pattern of driving keys:

In single line keys are driven in one direction on one sleeper and opposite direction on adjoining sleeper thus position is changed alternatively.

On double line sections, all keys are driven in direction of traffic.



On LWR sections 75% keys driven in direction of traffic and 25% in opposite direction.(Fig. 3.15).



4.3.1 ST sleepers with modified loose jaws and pandrol clip

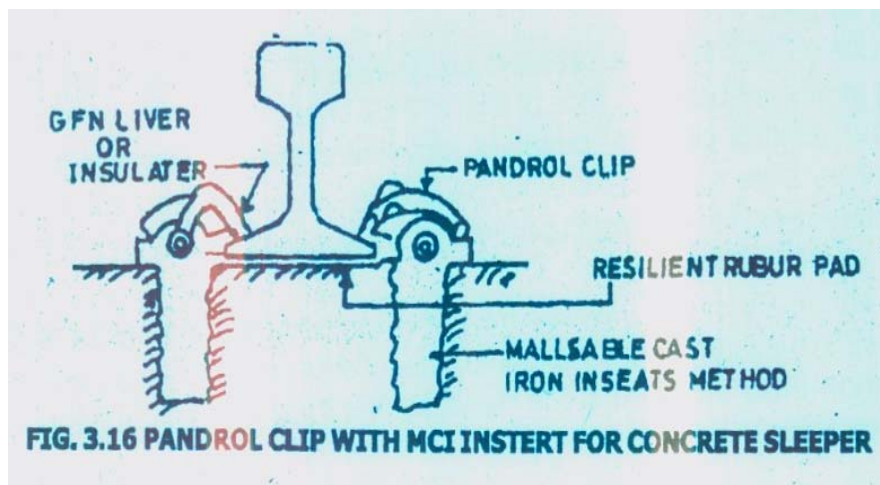
Instead of ordinary loose jaw and keys the replacement can be done with modified loose jaw (Fig.2.9 of chapter II) which has got two clips on top holding the sleeper tight out side, one open clip through which the ERC is fixed. However for this arrangements rubber pad provision is a must above sleeper and bottom of rail foot. In case sleeper holes get elongated and sleepers are worn out at rail seat pad plates are welded and the ERC can be provided.

4.3.2 Also with bolt and nut arrangement spring steel clip can be provided. This arrangement has more loose parts. For replacement ballast bed has to be disturbed. Sleepers are to be packed well. Such arrangements are not sturdy as compared to modified loose jaw and pandrol clip with rubber pad.

4.4 Fittings for concrete sleepers

4.4.1 M.C.I Insert

In the mono-block sleepers (Fig.3.16), malleable cast iron insert is fixed in position. C.I. inserts fully grip in due to the corrugations on the shank when embedded in concrete.

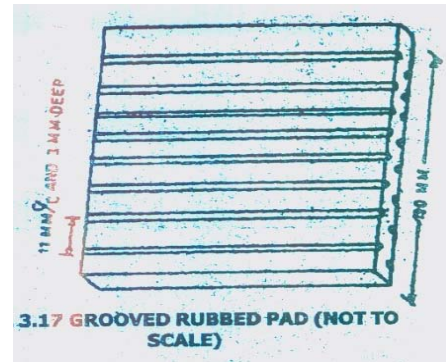


4.42 Rubber Pad

The rail seat is provided with the rubber pad (Fig. 3.17) which is of size 130 mm x 125mm x 6mm with grooves at 11 mm centre to centre and 3mm deep on either side alternatively at top and bottom. The placing of pad has to be done with grooves parallel to the rail.

The rubber pad as shown in fig. 3.17 is an integral part of an elastic fastening. The functions of the rubber pad are as under:

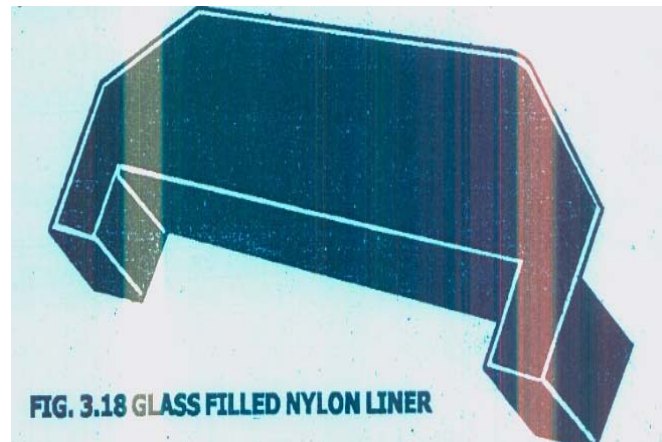
- (i) It absorbs the shocks.
- (ii) It dampens and absorbs vibration,
- (iii) It resists longitudinal movement of rail.
- (iv) It prevents abrasion of rail on the top of sleeper.
- (v) It acts as an insulator between rail and sleeper.



4.4.3 Liners:

In track circuited portions, glass filled nylon (GFN) insulated liner are inserted between foot of the rail and pandrol clip. Metal liners are used in non-track circuited area.

RDSO has developed glass filled nylon liners (GFN-66) of 4 mm thickness particularly for track circuited areas and sections, subject to severe corrosion. These glass filled nylon liners are considered to be technically superior because these are in single piece, have longer life and are free from corrosion. These liners are on extensive use on Indian Railways particularly with ERC clip assembly on 60 kg



and 52 kg rails and PRC sleepers. It has also been decided that in saline atmosphere of coastal belts and areas subjected to industrial fumes etc., where corrosion is prominent, only GFN-66 liners should be used.

4.4.4 Driving of ERC

The eye piece of MCI insert is greased properly and then pandrol clip is driven in such a manner that leg of clip is flush with face of eye of MCI insert.

When all four pandrol clips are provided with liners correctly, the gauge of track becomes uniform, It is not possible to adjust the gauge & cross level with above type elastic fastenings therefore, necessary care is to be taken to manufacture the concrete sleepers with tight tolerances.

5. Rail Joints

To keep the continuity of rail, the rails are to be fastened by some means so that the rails are kept in position while withstand imposed loads. The location where it happens is called joint.

It is a well known fact that joint is the weakest link in track due to following reasons:

- (1) Sudden impact
- (2) Extra stresses of bending.

(3) The ballast get disturbed leaving voids.

Therefore, maintenance of joints is very important for P. Way engineers.

6. Fish Plates

These are used to connect two rails together with fish bolts. Since these are fishing the rails to provide continuity and rigidity to the joint, the name is given as fish plate. Standard IRS fishplates are provided with four holes.

To accommodate the bolts, it is quite necessary to drill holes in rails at pre-specified locations and spacing keeping in view the thermal movements of rails, i.e. expansion or contraction and to slide without disturbing the geometry of rail or track structure.

6.1 Lubrication of Rail Joints

The fish plates are to be examined periodically. This is carried out at the time of lubrication of rail joint. Wherein fishing planes are lubricated using PLUMBAGO (Graphite powder mixed with K-oil). In case any cracks are noticed the fishplate is be replaced. Lubrication of joints is done during the months of November to March of each year. The bolts are thoroughly cleaned, examined for cracks and wear and oiled. After this, fish plates are put back in their position. To check the cracks of fish plates, rails, etc., magnifying glasses are used by the maintenance staff, after cleaning the rail ends and fish plates.

The fish plates are of six varieties.

- (a) Normal or ordinary fish plate.
- (b) Junction or combination fish plate.
- (c) Insulated fish plate.
- (d) Special fish plates for rail expansion joints on bridges.
- (e) One meter long fish plates for using in case of emergency and while installation of LWR.
- (f) Joggled fish plate.

6.2 Ordinary or plain fish plates

These fish plates are used for joining rails of similar section with four fish bolts. (Details in para 2.1)

6.3 Junction or combination fish plates (Fig 3.18)

When two different sections of rails are to be joined, junction or combination fish plate is used. Details shown in Fig 3.19

The construction features of combination fish plate are as under:

- (1) The thickness at centre is increased.
- (2) The clips of bigger and smaller section are either raised or lowered to make the top level of rail even.
- (3) The holes are drilled on either side corresponding to the rail section.
- (4) Pairs are made and inscribed on fish plate as outside right as OR, inside right as (IR), outside left as OL and inside left as IL.
- (5) Longer fish bolts are to be used near the joints and ordinary bolts on ends of fish plate.

While providing junction fish plates following care should be taken:

- (1) Higher section of rails to be faced while fishing these fish plate:

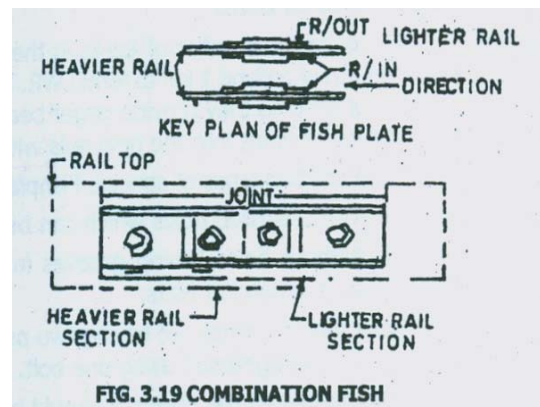


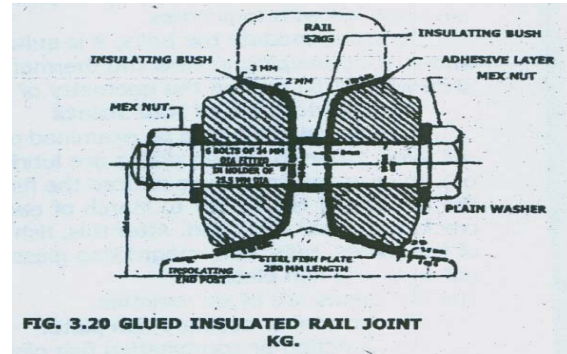
FIG. 3.19 COMBINATION FISH

- (2) There should not be any expansion gap and rails should butt each other (Gapless Joint)
- (3) Rail ends should be made perfectly vertical by saw cut.
- (4) When old rail sections are joined, their ends should be cropped and new holes drilled.
- (5) The spacing and pitch of holes should be such that a gapless joint is formed.
- (6) Proper size of bolts to be used. No washers are used on any side.

The above requirement is a must to avoid rails acting independently. Joint should be rigid and firm and act as one unit to withstand stresses of rails including the impact of wheels.

6.4 Insulated Joints (Fig 3.20)

These are used in track circuited area to provide electrical insulation between the two rails at a joint. Special insulation material in the form of ferrules, and post channel plates, etc. made up of fibre/nylon is used to make the joint electrically insulated.



6.4.1 Insulated joints are of 2 types.

- (1) Insulation provided by nylon insulator and installed at site as per the requirement.
- (2) Glued joint (prefabricated in workshop)

In the first type, insulation is provided by hard nylon liner with ferrules for fish plates and bolts. End post is provided between the two rails.

Glued joints are prefabricated in workshop with two rails of 3.125m or 3.37m length on either side of joint so that there is no wastage since free rail is 13 m of length. The entire joint is fabricated in workshop, inserted into the track and welded to existing track at site. There are two types of glued joints, i.e. (G3)S for use in SWR and G3 (L) for use in LWR track. Now glued joints are made at site also duly taking traffic block and making only one cut in the rail.

6.5 1m long special, fish plates for using in case of emergency and during the installations of LWR:

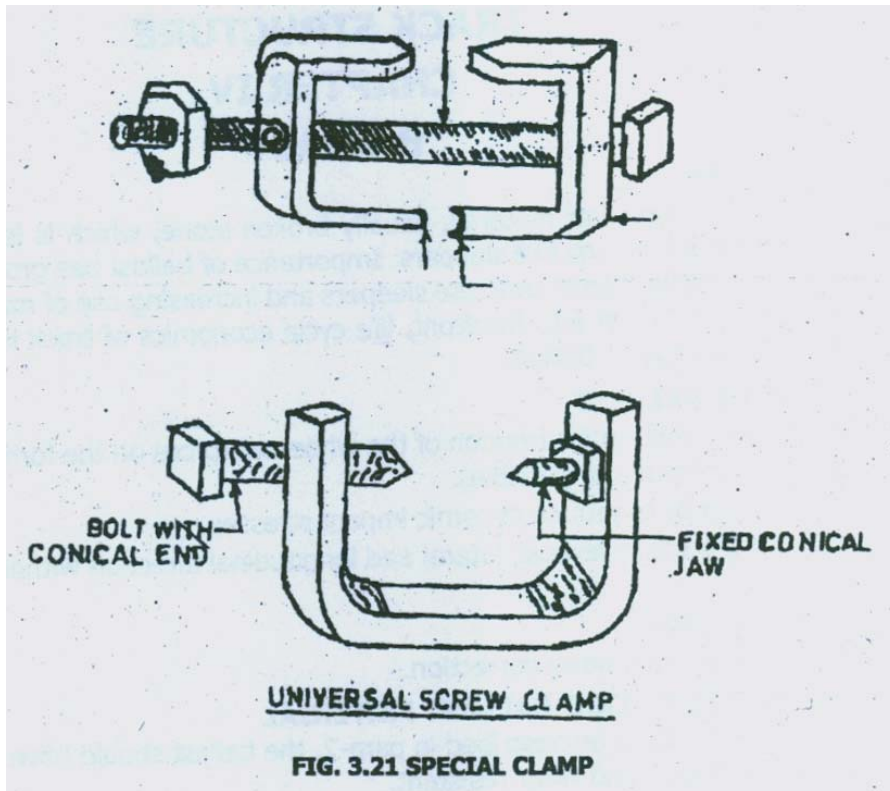
To reduce the number of joints in the track, the standard rails are welded into a longer length of around 1 km to form LWR. While doing the work of welding, 1 m spl. Fishplates are used temporarily as they provide larger bearing area for longer gaps encountered. It is possible to avoid drilling of holes into the new rails with the use of 1 m long fishplates and special clamps. 1 m fish plates are also used on rail joints on major bridges and behind backlog of xings.

There are two types of special. Fishplates:

- (1) With predrilled holes which can be fixed with fish bolts.
- (2) Without holes having grooves in place of holes in the fishplate to accommodate the special clamps instead of bolts.

These special clamps are having two parts, one is male part, and the other is female part and these clamps are tightened using one bolt.

While tightening the clamp, it should be ensured that top portion of male and female part is fixed in groove of fish plate and bottom portion of male & female parts are fixed with each other, such clamp is shown in Fig. 3.21



6.6 Joggled fishplates (Fig.3.21)

These are the fishplates used for providing temporary security to defective welds. These fishplates are made out of hard steel or medium hard steel plates. The length of fishplates is not less than 450mm. The central portion of fishplates is having semi-circular projection of 3 inch radius to accommodate the protruding centre portion collar of welds. These fishplate have grooves on either side, so that it can be tightened by the clamps. When these fishplates are used, minimum 4 clamps should be provided before passing any train. Joggled fish plates are exclusively used whenever Alumino Thermit weld is found to be defective/fractured. Till the time, weld are tested by USFD and found sound or defective weld exists, such welds should be protected with joggled fishplates and clamps. Recently joggled fish plates with elongated holes have been developed which can be fixed with fish bolt duly driving the holes in the rails.

