Chapter 3

Basic Track

The engineer will frequently work from a set of standardized railway or transit standards when making his or her selection of track components for any given design project. However, a basic understanding of elementary track componentry, geometry and maintenance operations is necessary if intelligent decisions are to be made within the options that are typically available.

3.1 Track Components

We begin our study with the prime component of the track – the rail.

3.1.1 Rail

Rail is the most expensive material in the track.[2] Rail is steel that has been rolled into an inverted "T" shape. The purpose of the rail is to:

- Transfer a train's weight to cross ties.
- Provide a smooth running surface.
- Guide wheel flanges.

[2] Canadian National Railway Track Maintainer's Course

Switch Ties

Switch ties (Figure 3-3) are commonly hardwood species, usually provided in either 6" or 12" increments beginning at 9'-0" up to 23'-0" in length. Nominal cross-section dimensions are 7" x 9", although larger ties are specified by some railways. The primary use for switch ties is relegated to turnouts (thus their name). However, they are also used in bridge approaches, crossovers, at hot box detectors and as transition ties. Some railways use switch ties in heavily traveled road crossings and at insulated rail joints. Switch ties ranging in length from 9'-0" to 12'-0" can also be used as "swamp" ties. The extra length provides additional support for the track in swampy or poor-drained areas. Some railways have utilized Azobe switch ties (an extremely dense African wood) for high-speed turnouts. The benefits associated with reduced plate cutting and fastener retention may be offset by the high import costs of this timber.

Figure 3-3 Switch Timber – Photo by Craig Kerner

Softwood Ties

Softwood timber (Figure 3-4) is more rot resistant than hardwoods, but does not offer the resistance of a hardwood tie to tie plate cutting, gauge spreading and spike hole enlargement (spike killing). Softwood ties also are not as effective in transmitting the loads to the ballast section as the hardwood tie. Softwood and hardwood ties must not be mixed on the main track except when changing from one category to another. Softwood ties are typically used in open deck bridges.

Figure 3-4 Softwood Timber - Photo by J. E. Riley

Concrete Ties

Figure 3-5 Concrete Ties – Photo by Kevin Keefe

Concrete ties (Figure 3-5) are rapidly gaining acceptance for heavy haul mainline use, (both track and turnouts), as well as for curvature greater than 2°. They can be supplied as crossties (i.e. track ties) or as switch ties. They are made of pre-stressed concrete containing reinforcing steel wires. The concrete crosstie weighs about 600 lbs. vs. the 200 lb. timber track tie. The concrete tie utilizes a specialized pad between the base of the rail and the plate to cushion and absorb the load, as well as to better fasten the rail to the tie. Failure to use this pad will cause the impact load to be transmitted directly to the ballast section, which may cause rail and track surface defects to develop quickly. An insulator is installed between the edge of the rail base and the shoulder of the plate to isolate the tie (electrically). An insulator clip is also placed between the contact point of the elastic fastener used to secure the rail to the tie and the contact point on the base of the rail.

Steel Ties

Figure 3-6 Steel Ties

Steel ties (Figure 3-6) are often relegated to specialized plant locations or areas not favorable to the use of either timber or concrete, such as tunnels with limited headway clearance. They have also been utilized in heavy curvature prone to gage widening. However, they have not gained wide acceptance due to problems associated with shunting of signal current flow to ground. Some lighter models have also experienced problems with fatigue cracking.

3.1.4 Rail Joints

The purposes of the rail joint (made up of two joint bars or more commonly called angle bars) are to hold the two ends of the rail in place and act as a bridge or girder between the rail ends.[6] The joint bars prevent lateral or vertical movement of the rail ends and permit the longitudinal movement of the rails for expanding or contracting. The joint is considered to be the weakest part of the track structure and should be eliminated wherever possible. Joint bars are matched to the appropriate rail section. Each rail section has a designated drilling pattern (spacing of holes from the end of the rail as well as dimension above the base) that must be matched by the joint bars. Although many sections utilize the same hole spacing and are even close with regard to web height, it is essential that the right bars are used so that fishing angles and radii are matched. Failure to do so will result in an inadequately supported joint and will promote rail defects such as head and web separations and bolt hole breaks.

There are three basic types of rail joints (Figure 3-8):

- Standard
- Compromise
- Insulated

Figure 3-8 Conventional Bar, Compromise Bar & Insulated Joint Bar – Photo by J. E. Riley

[6] Canadian National Railway, Track Maintainer's Course

Standard Joints

Standard joint bars connect two rails of the same weight and section. (See Figure 3-9) They are typically 24" in length with 4-bolt holes for the smaller rail sections or 36" in length with 6-bolt holes for the larger rail sections. Alternate holes are elliptical in punching to accommodate the oval necked track bolt. Temporary joints in CWR require the use of the 36" bars in order to permit drilling of only the two outside holes and to comply with the FRA Track Safety Standard's requirement of maintaining a minimum of two bolts in each end of any joint in CWR.

Figure 3-9 Standard Head-Free Joint Bar – Photo by J. E. Riley

Compromise Joints

Compromise bars connect two rails of different weights or sections together. (See Figure 3-10) They are constructed such that the bars align the running surface and gage sides of different rails sections. There are two kinds of compromise joints:

Figure 3-10 Compromise Joint Bar – Photo by J. E. Riley

- Directional (Right or Left hand) compromise bars are used where a difference in the width of the head between two sections requires the offsetting of the rail to align the gage side of the rail.
- Non-directional (Gage or Field Side) are used where the difference between sections is only in the heights of the head or where the difference in width of rail head is not more than 1/8" at the gage point. Gauge point is the spot on the gauge side of the rail exactly 5/8" below the top of the rail.

To determine a left or right hand compromise joint:

- Stand between the rails at the taller rail section.
- Face the lower rail section.

- The joint on your right is a "right hand".
- The joint on your left is a "left hand".

Insulated Joints

Insulated joints are used in tracks having track circuits. They prevent the electrical current from flowing between the ends of two adjoining rails, thereby creating a track circuit section. Insulated joints use an insulated end post between rail ends to prevent the rail ends from shorting out.

There are three types of insulated joints:

- Continuous
- Non-continuous
- Bonded

Continuous insulated joints (Figure 3-11) are called continuous because they continuously support the rail base. No metal contact exists between the joint bars and the rails. Insulated fiber bushings and washer plates are used to isolate the bolts from the bars. The joint bars are shaped to fit over the base of the rail. This type of insulated joint requires a special tie plate called an "abrasion plates" to properly support the joint.

Figure 3-11 Continuous Insulated Joint – Photo by J. E. Riley

Non-continuous insulated rail joints are called non-continuous because these joints don't continuously support the rail base. A special insulating tie plate is required on the center tie of a supported, non-continuous insulated joint. Metal washer plates are placed on the outside of the joint bar to prevent the bolts from damaging the bar.

There are two common kinds of non-continuous insulated joints:

- Glass fiber.
- Polyurethane encapsulated bar.