



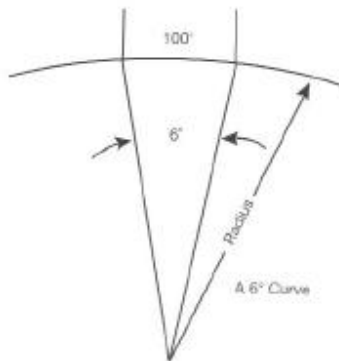
Ch. 3 – *The Track*

■ Alignment

- Tangents
- Curves
- Spiral
- Cross Level
- Superelevation



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The degree or sharpness of a railroad curve is the angle through which the track curves in 100 ft.

$$\text{Radius in ft} = \frac{5,729}{\text{Degrees}/100 \text{ ft}}$$

Degree of Curve	Radius Feet	Typical Max. Speed	Extra Curve Resistance, lb/ton	Equivalent Increase in Grade, %
1°	5,729	100 mph	0.8	0.04
5°	1,146	50 mph	4.0	0.20
10°	573	30 mph	8.0	0.40
15°	383	25 mph	12.0	0.60

■ Gauge (Gage)

□ 56.5"

□ 4'8.5"

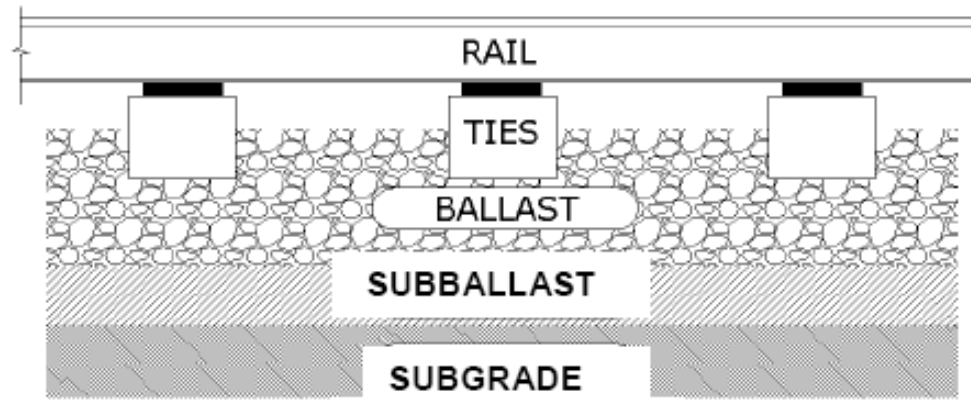


■ Track Structure

- Subgrade
- Subballast
- Ballast
- Ties
- Rail
- Fasteners
- OTM

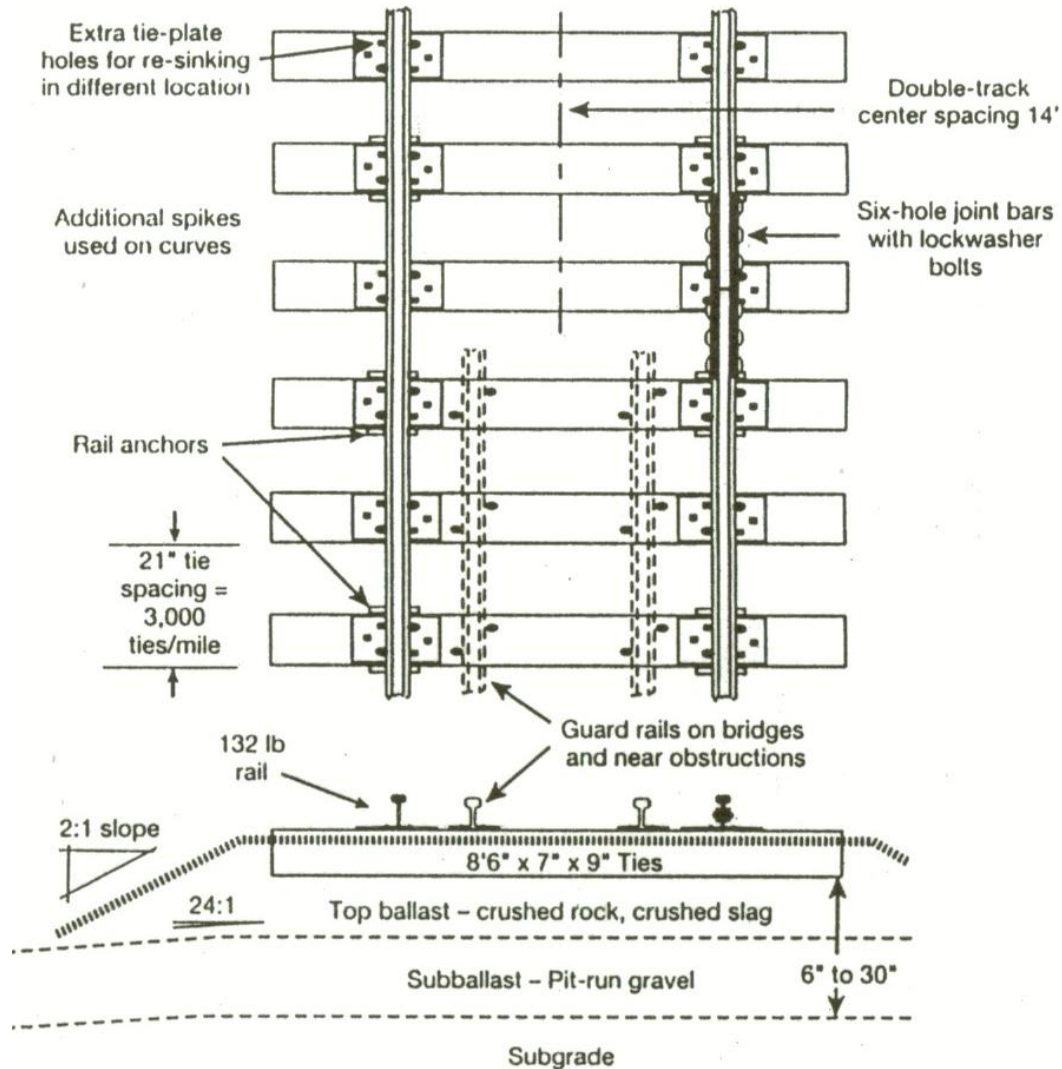


Components and Functions



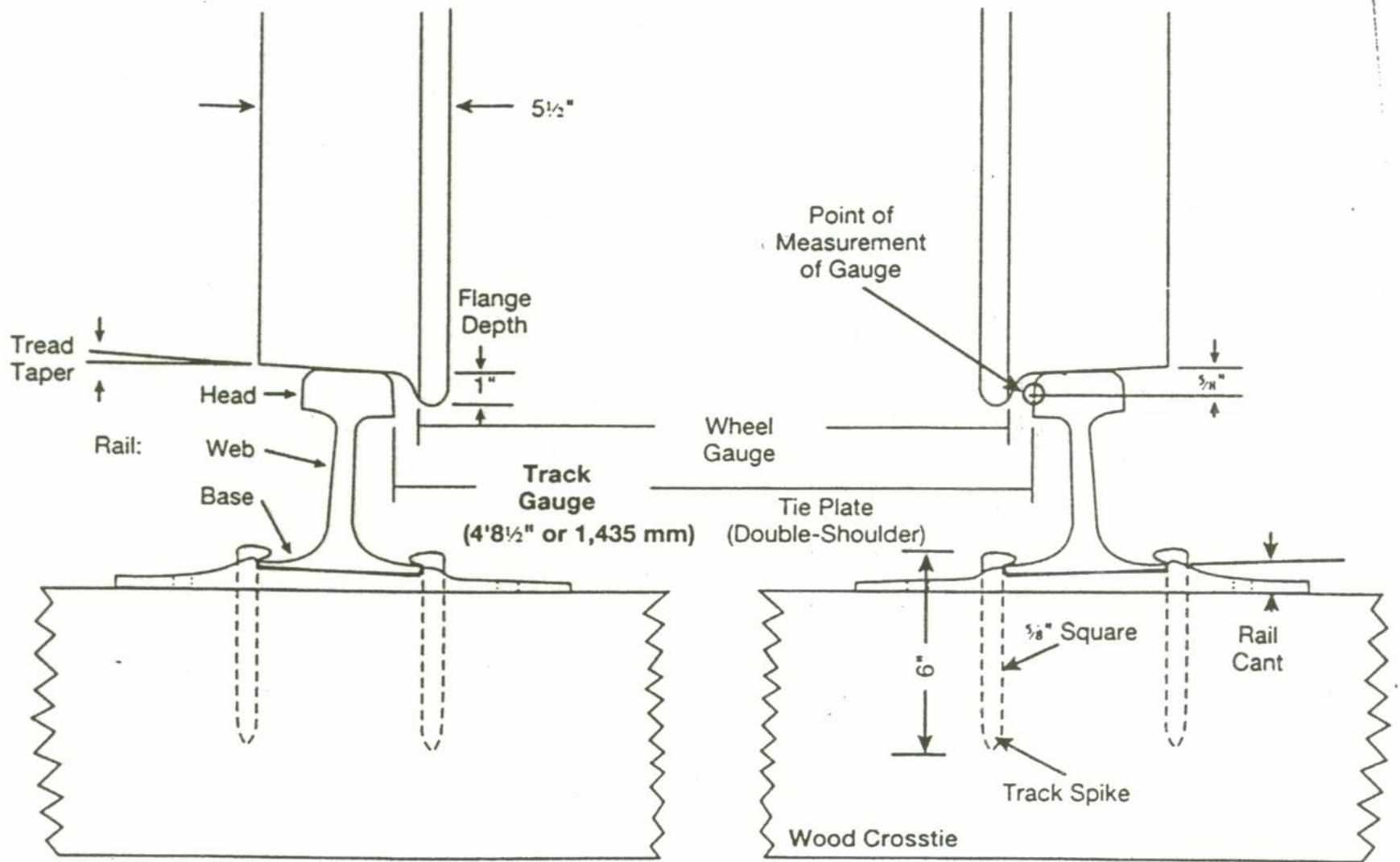
Track Structure

Typical main-line track



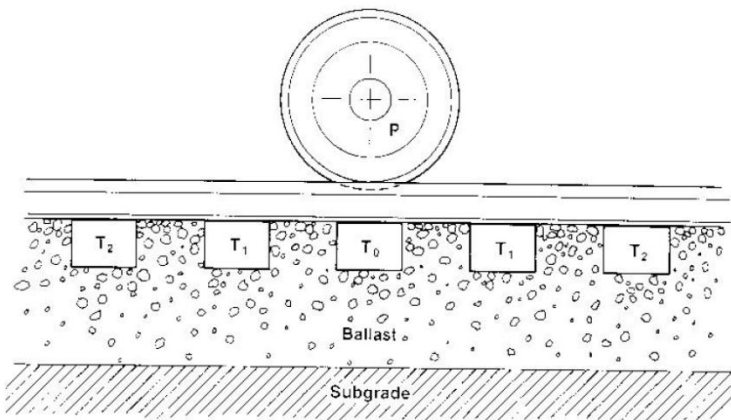
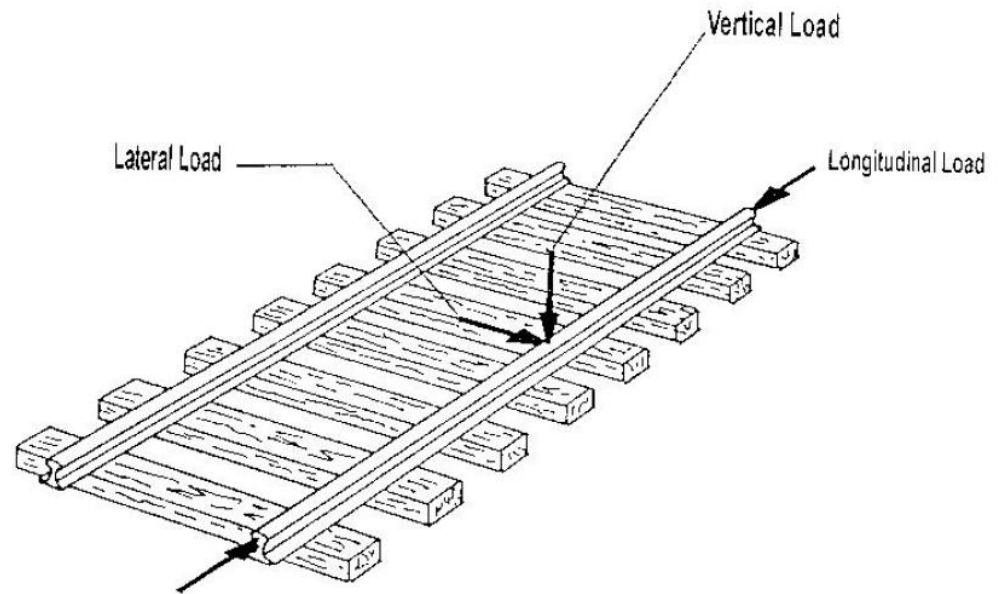
Track-Wheel Relationships

- (Dimensions shown are nominal)



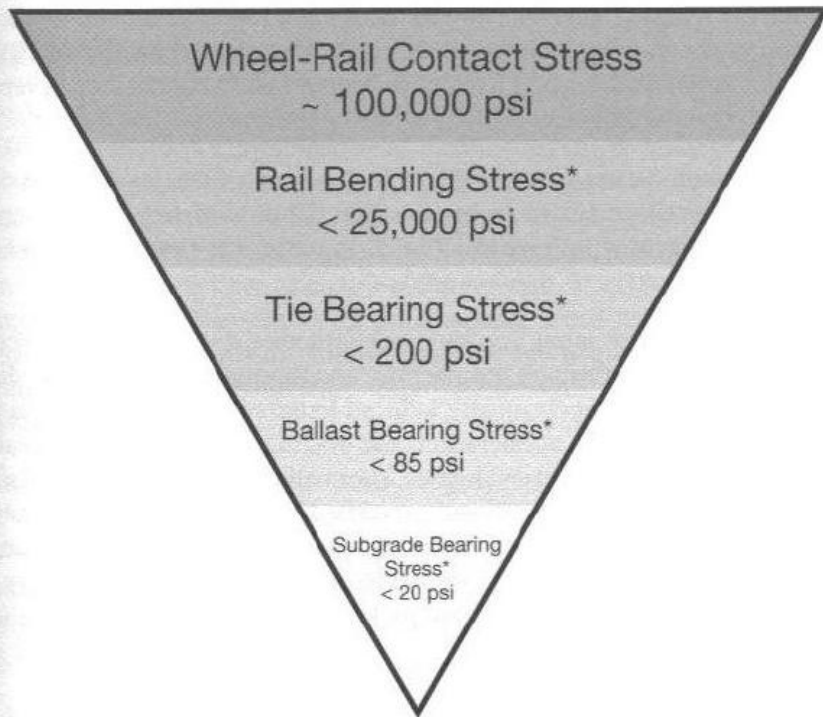
■ Loading of Track Structure

- 3 Types of Loading
- Vertical
- Axial
- Longitudinal



■ Static Wheel Loads

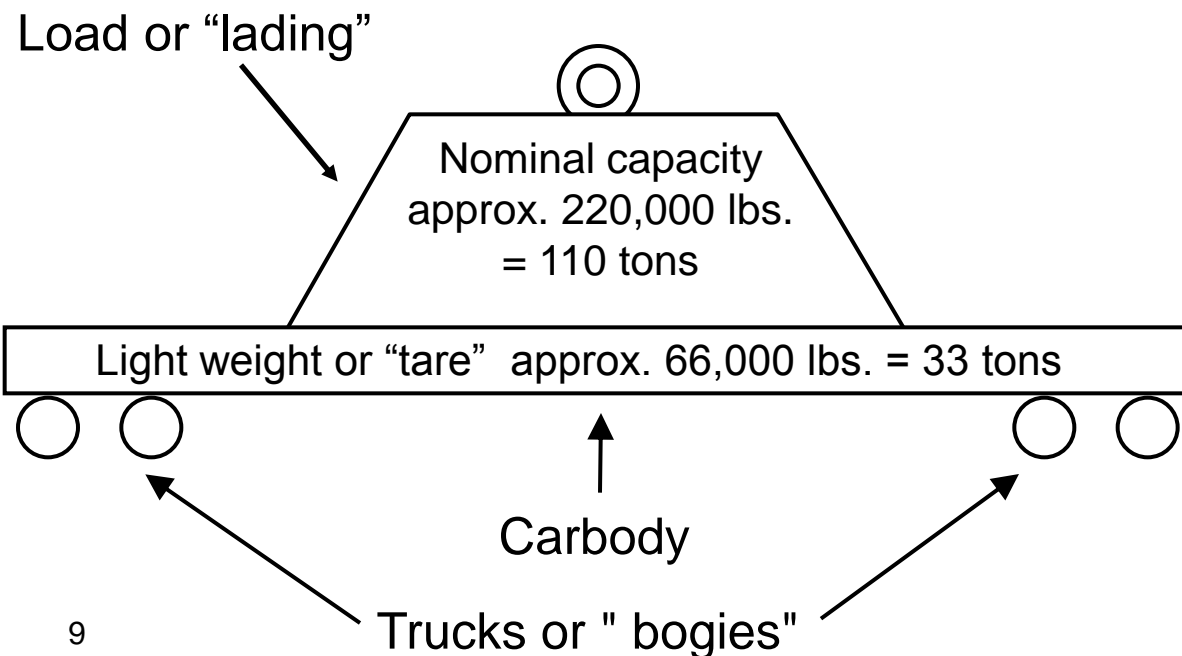
□ (Wheel Load)(# of wheels) = Gross Weight of Car



Axle Load		Gross Weight of Cars	
Axle load (tons)	Gross weight of cars (lbs)	Type	
10	80,000	Light rail transit	
15	120,000	Heavy rail transit	
25	200,000	Passenger Cars	
25	200,000	Common European freight limit	
27.5	220,000	U.K. and Select European limit	
33	263,000	North American free interchange limit	
36	286,000	Current Heavy Axle load weight for North American Class 1	
39	315,000	Very limited use; research phase	

Basics of freight railcar weight and capacity

- The nominal capacity of a typical, 4-axle railcar today is 110 tons (formerly was 100 ton)
- Maximum Gross Rail Load (GRL) of a 110 ton, 4-axle railcar is 286,000 lbs. (weight of car + contents or “lading”)
- Nominal capacity = 220,000 lbs. or 110 tons
- Often referred to as a “110 ton” car or a “286K” car



220,000 lbs.

+ 66,000 lbs.

286,000 lbs.

Gross Rail Load (GRL)

(actual light weight will vary somewhat depending on car size, consequently the weight-carrying capacity will vary inversely, i.e lighter car larger capacity)

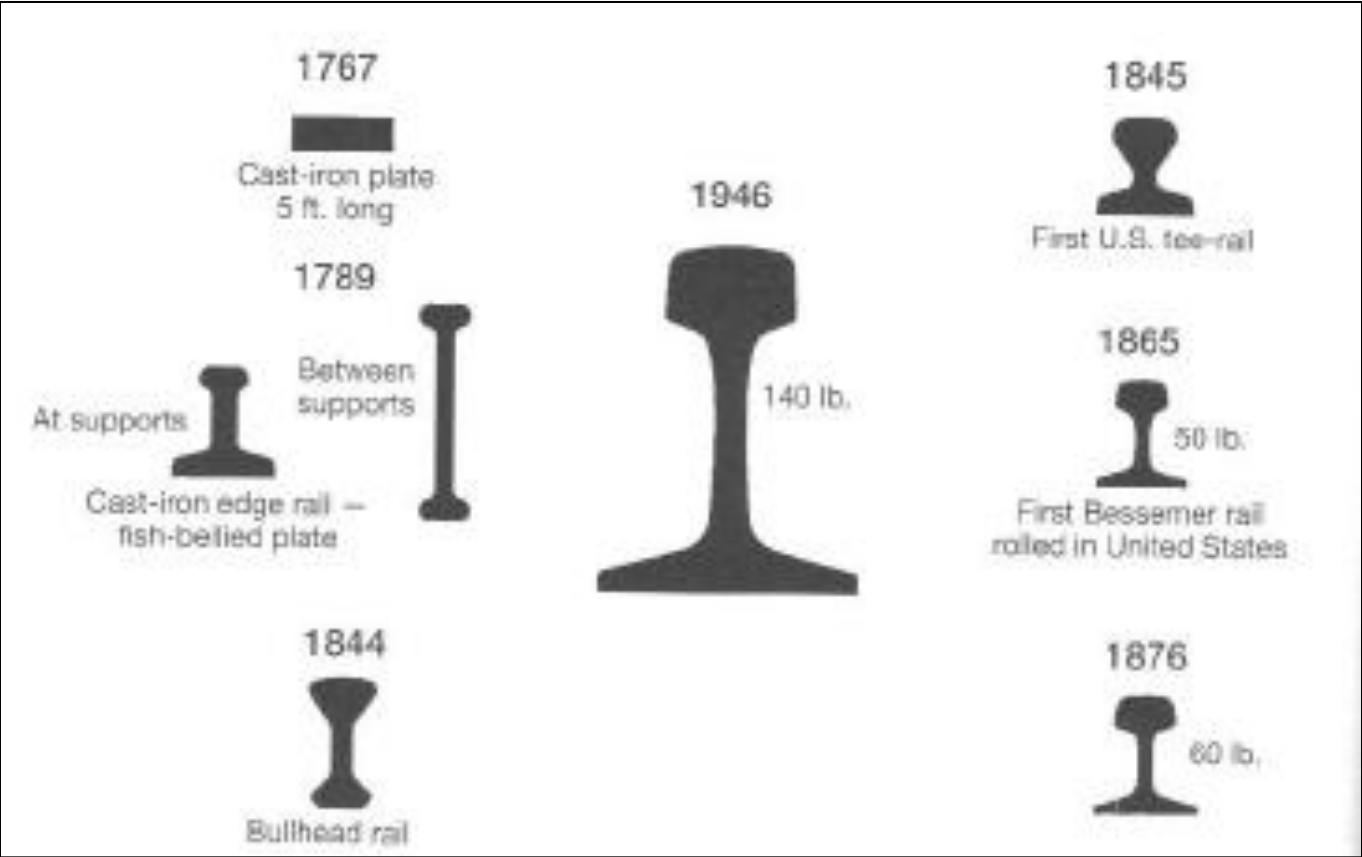
Freight train size & gross tonnage

- Typical freight train is about 100 cars (generally range from 50 to 150 cars)
- $100 \times 110 = \mathbf{11,000 \text{ tons of lading}}$
- GRL = 286,000 lbs.
- $100 \times 286,000 \text{ lbs.} = 28,600,000 \text{ lbs} = 14,300 \text{ gross tons}$
- Plus the weight of two locomotives, ca. 300,000 lbs each = 150 tons each
 $= 14,300 + 2 \times 150 = \mathbf{14,600 \text{ gross tons per train}}$
- One train per day for a year = $\mathbf{14,600 \text{ tons} \times 365 = 5,329,000 \text{ tons}}$
 $= \mathbf{5.329 \text{ million gross tons (MGT)}}$
- One train moving 100 miles equals = $14,600 \text{ tons} \times 100 \text{ miles}$
 $= \mathbf{1,460,000 \text{ gross ton-miles (GTM)}}$

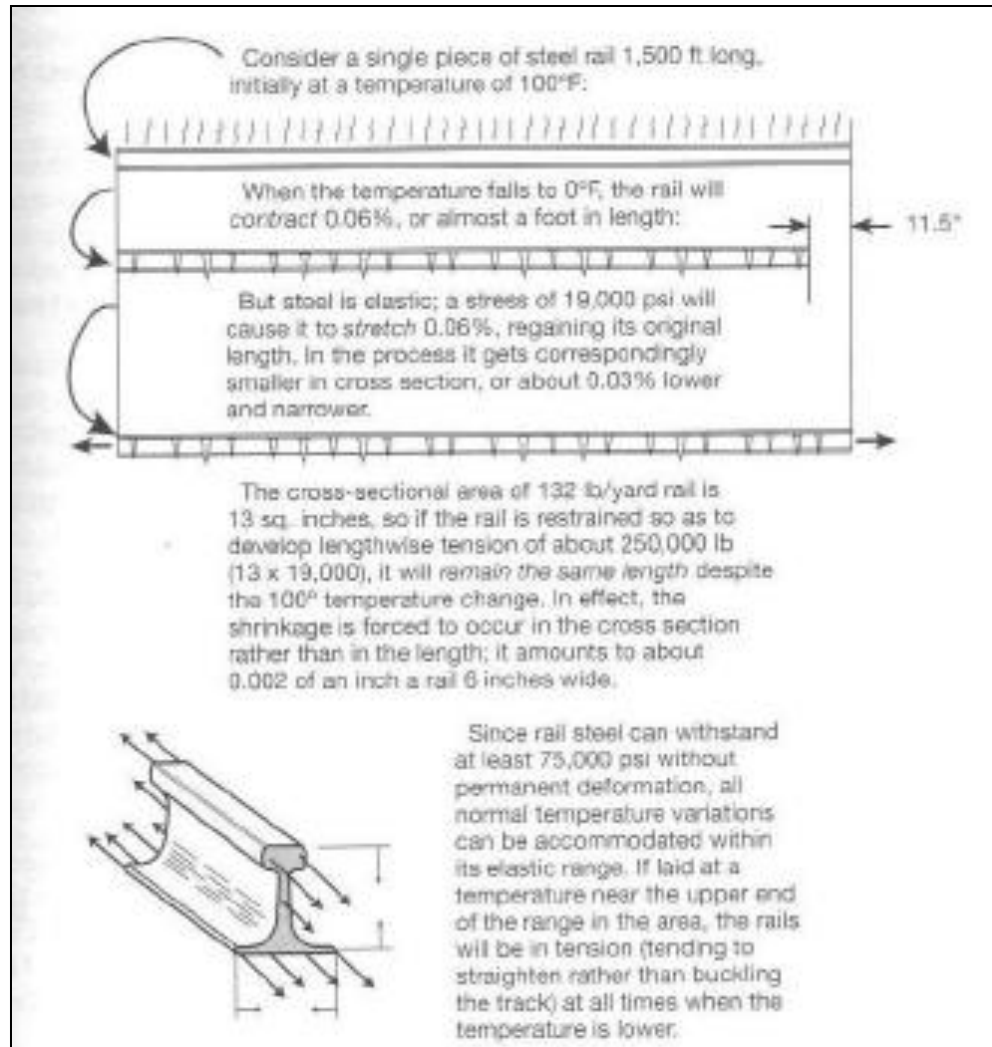
■ Rail

- Inverted “T”
- Life
- Defects
- Lubricators
- Grinding
- Bolted/CWR



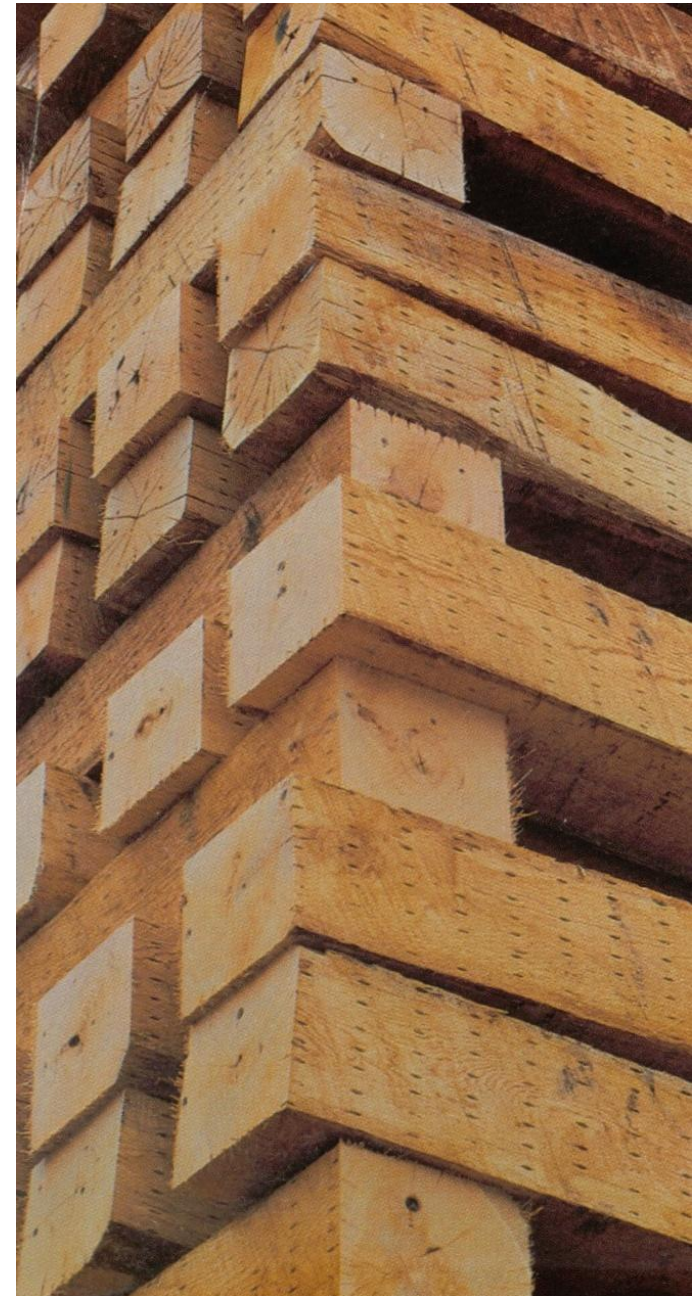


CWR Installation

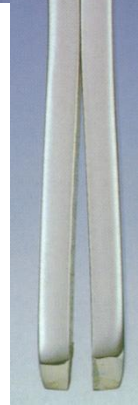
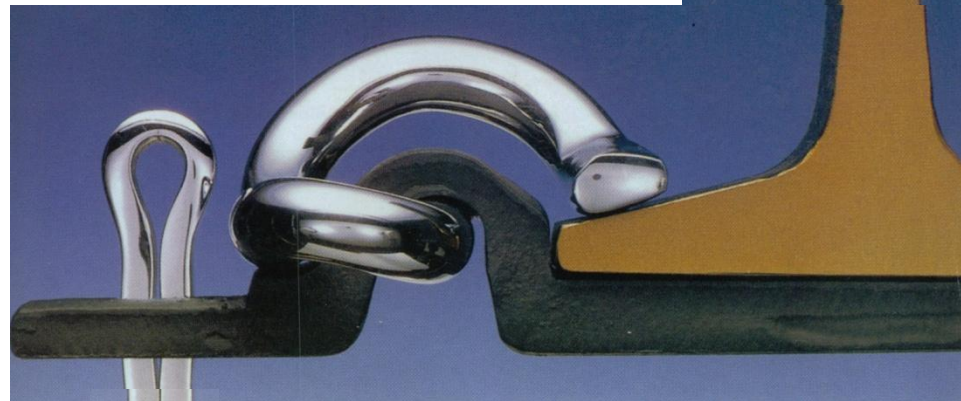


■ Crossties

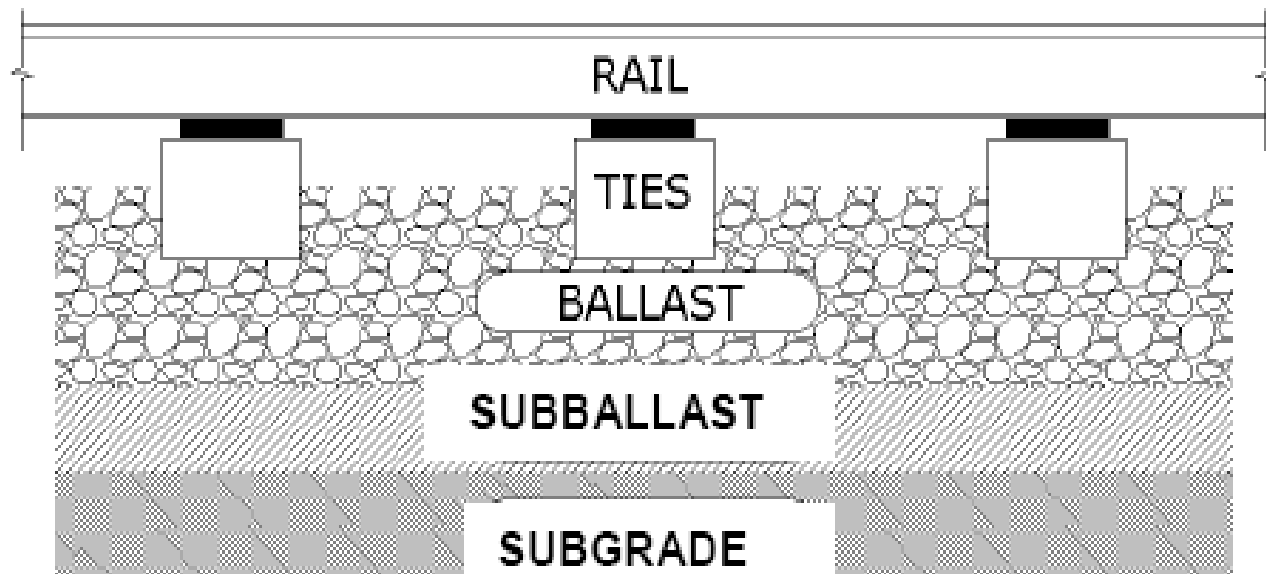
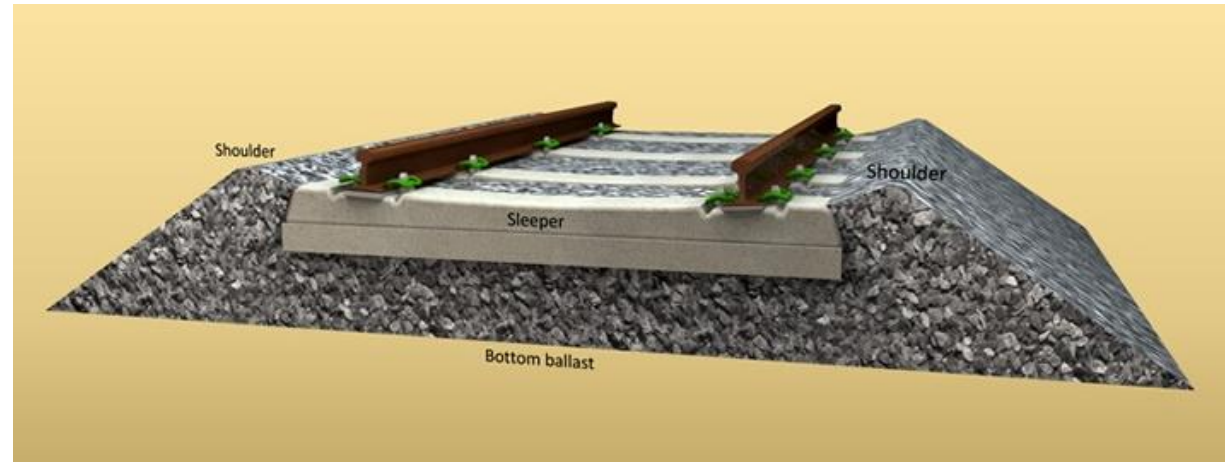
- Wood
- Concrete
- Others



■ Fasteners

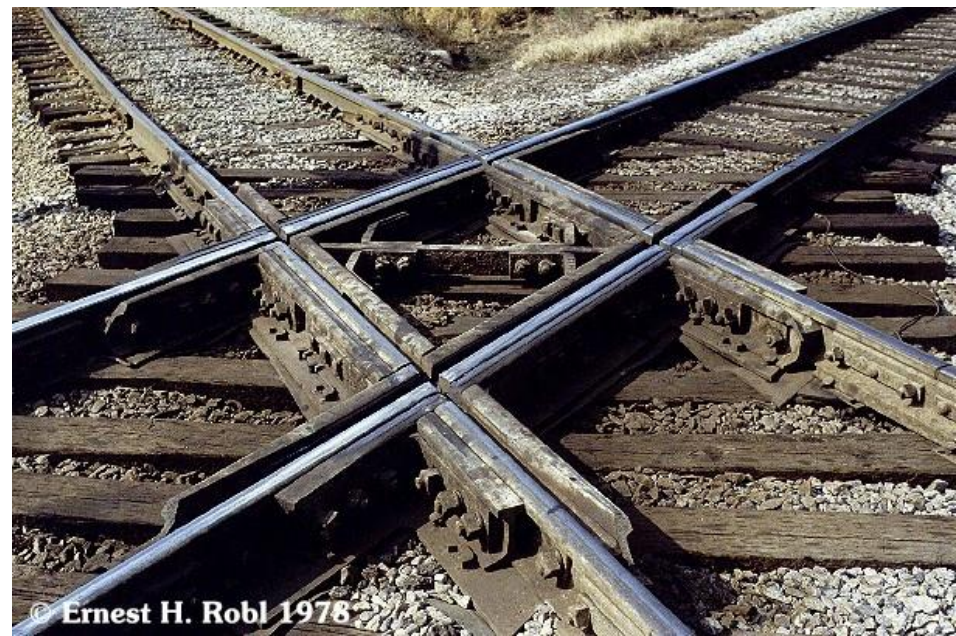
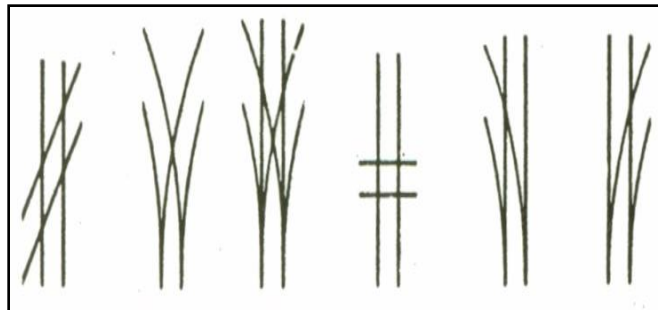


- Ballast
- Subballast
- Subgrade



■ Special Trackworks

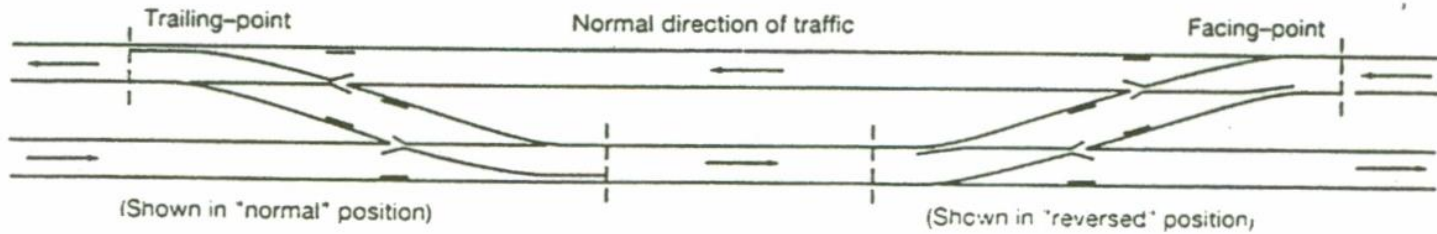
- Turnouts
- Crossings
- Crossovers



Trackwork

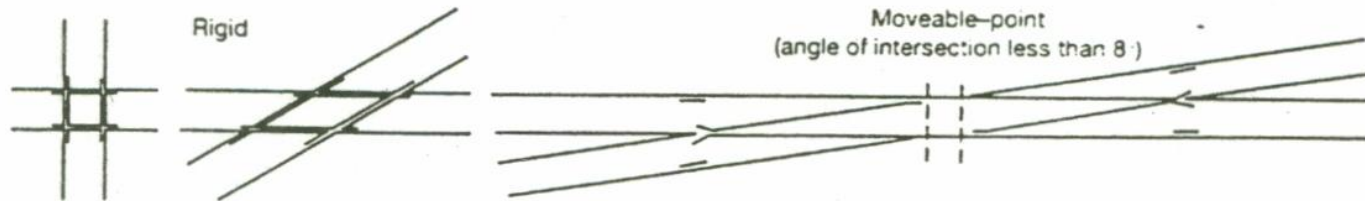
Crossovers

A crossover is a pair of turnouts connecting two parallel tracks.



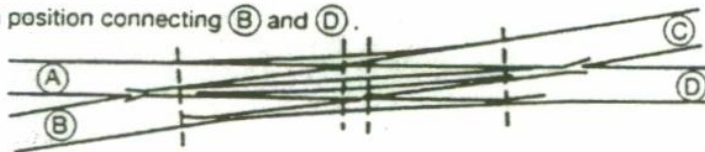
Crossings

A crossing carries one track across another.

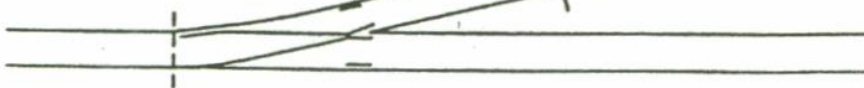


Double Slip Switch

Shown in position connecting (B) and (D).

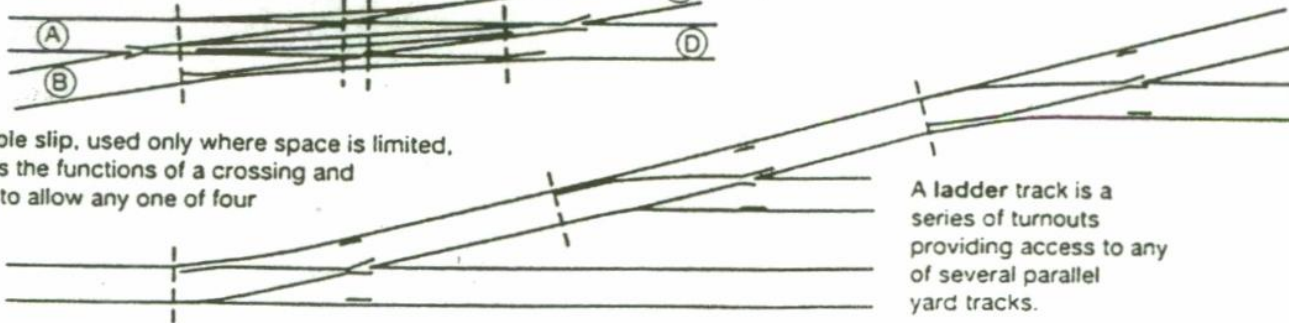


The double slip, used only where space is limited, combines the functions of a crossing and turnouts to allow any one of four routings.

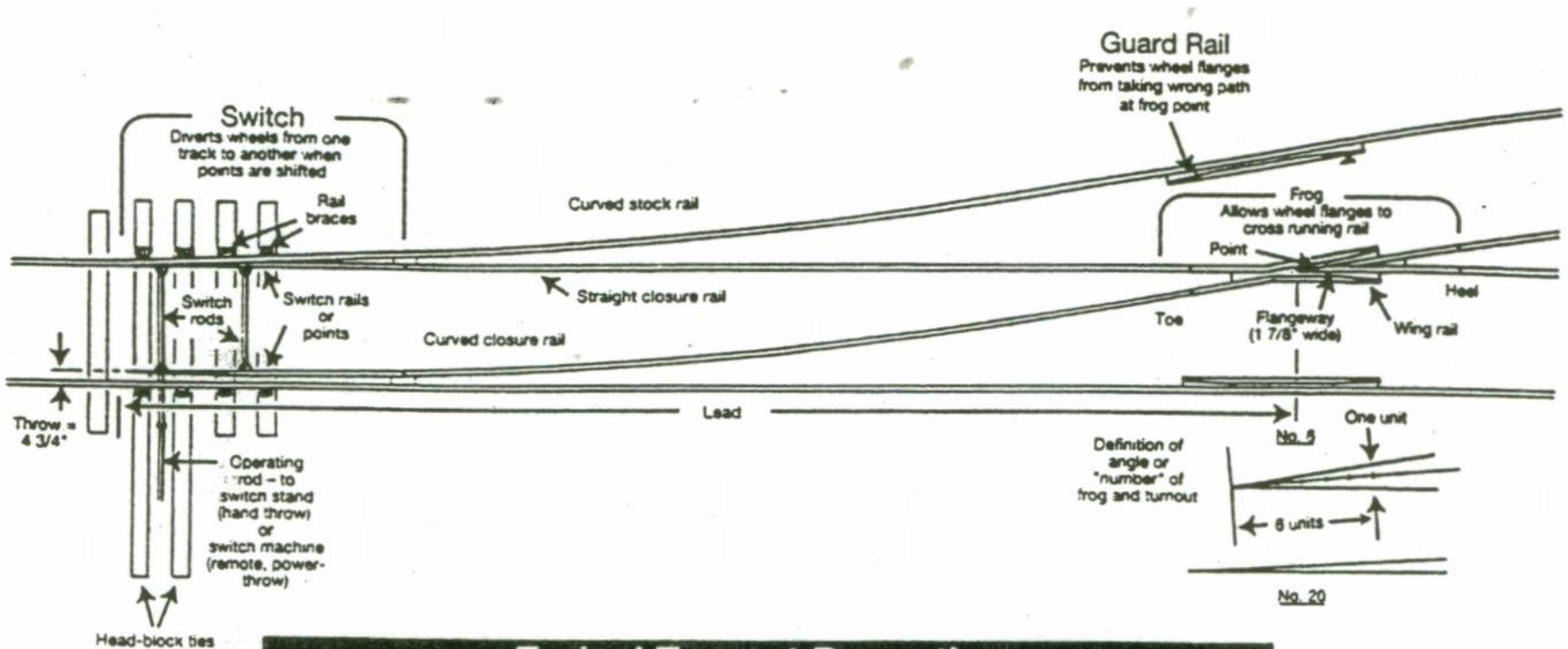


Ladder

A ladder track is a series of turnouts providing access to any of several parallel yard tracks.



The Turnout (Left-Handed)



Typical Turnout Proportions

Frog No.	Turnout Lead, Ft	Sharpness of Curve	Max. speed on Diverging Route	Typical Locations
6	48	21°	10 mph	Industry tracks
8	67	12°	15	Yards
12	97	5°	25	Low-speed crossovers
16	131	3°	30	Passing tracks
20	152	1½°	45	Junctions, end of double track

■ Track Maintenance Standards

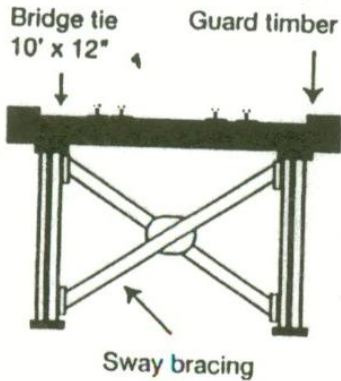
- Tie
- Rail
- Surface
- Drainage



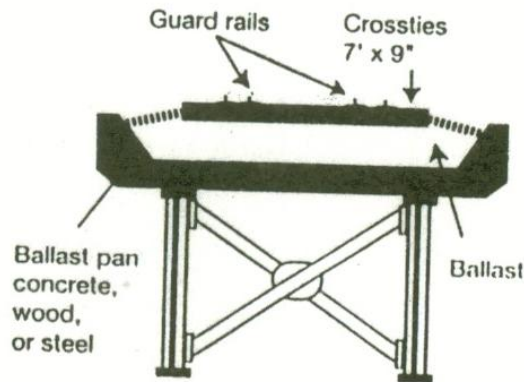
■ Bridges

- Open or ballast deck
- Deck or through

Plate girder



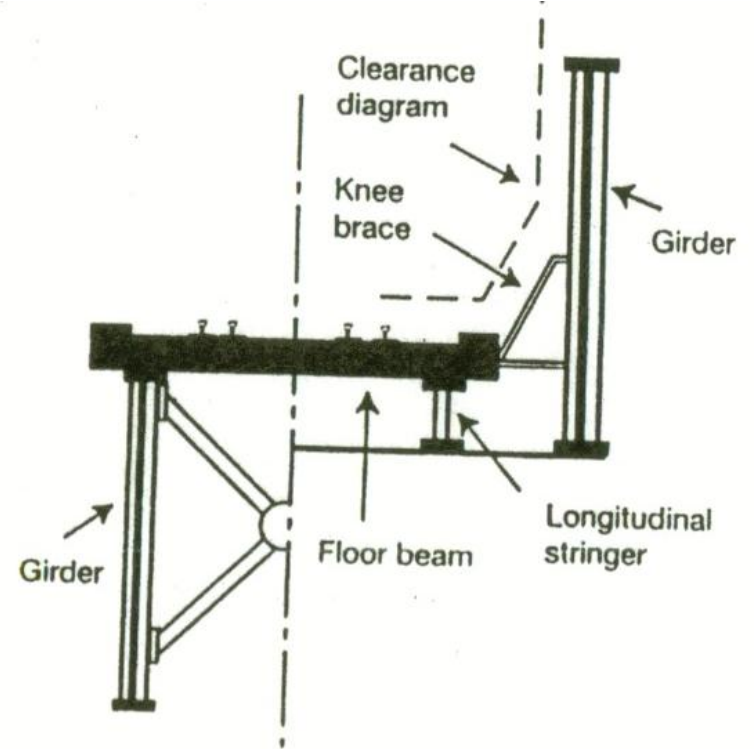
Open-deck

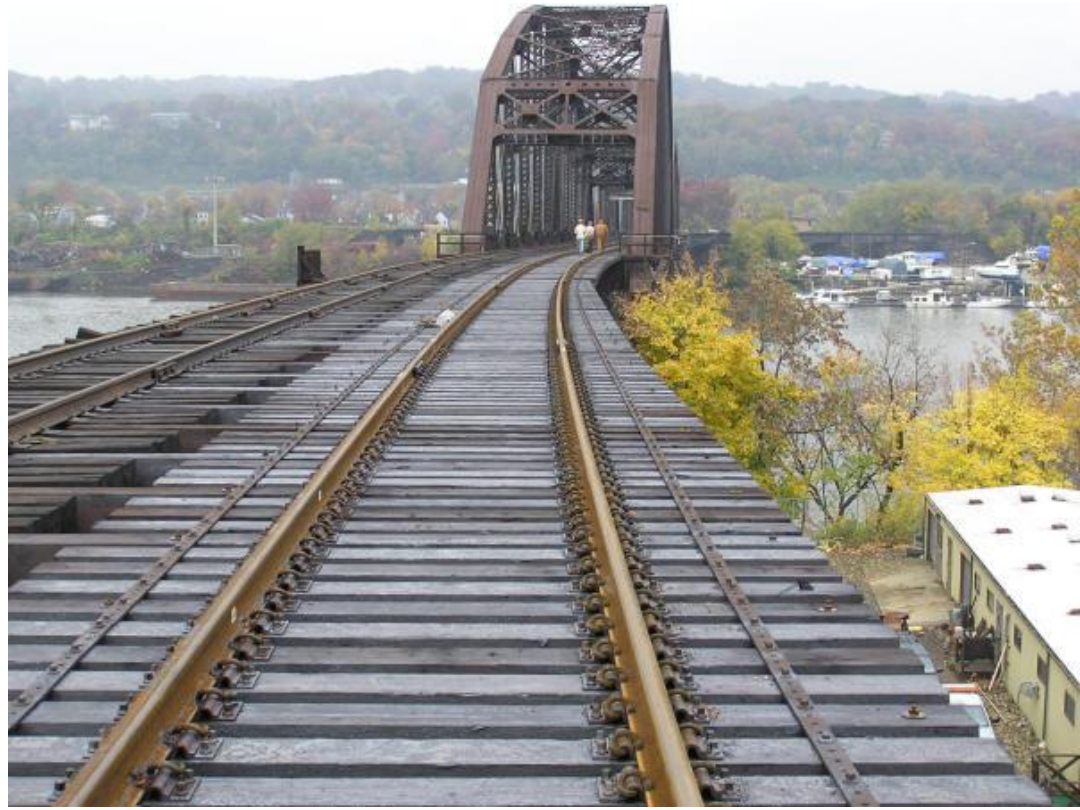


Ballast-deck

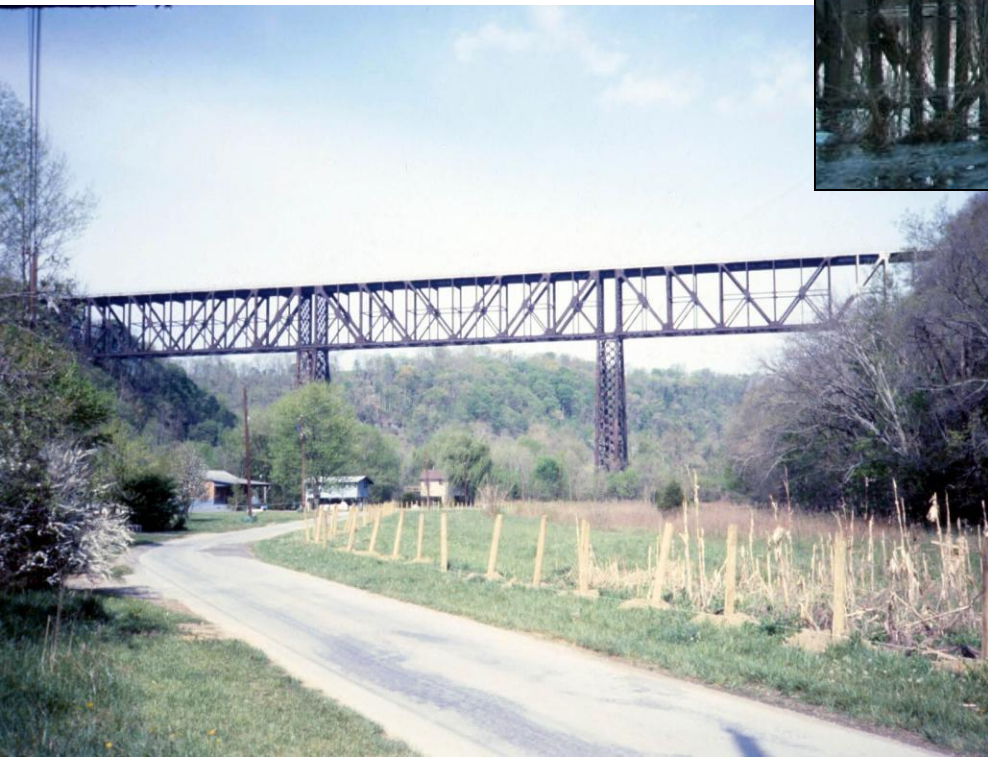
Deck

Through











FRA Standards

Track Safety Standards Part 213



Department of Transportation
Federal Railroad Administration –
Office of Safety

§ 213.9 Classes of track: operating speed limits.

- (a) Except as provided in paragraph (b) of this section and §§ 213.57(b), 213.59(a), 213.113(a), and 213.137(b) and (c), the following maximum allowable operating speeds apply—

Subpart A

[In miles per hour]

Over track that meets all of the requirements prescribed in this part for—	The maximum allowable operating speed for freight trains is—	The maximum allowable operating speed for passenger-trains is—
Excepted track.....	10	N/A
Class 1 track.....	10	15
Class 2 track.....	25	30
Class 3 track.....	40	60
Class 4 track.....	60	80
Class 5 track.....	80	90

- (b) If a segment of track does not meet all of the requirements for its intended class, it is reclassified to the next lowest class of track for which it does meet all of the requirements of this part. However, if the segment of track does not at least meet the requirements for Class 1 track, operations may continue at Class 1 speeds for a period of not more than 30 days without bringing the track into compliance, under the authority of a person designated under § 213.7(a), who has at least one year of supervisory experience in railroad track maintenance, after that person determines that operations may safely continue and subject to any limiting conditions specified by such person.

§ 213.307 Class of track: operating speed limits.

- (a) Except as provided in paragraph (b) of this section and §§. 213.329, 213.337(a) and 213.345(c), the following maximum allowable operating speeds apply:

Subpart C

Over track that meets all of the requirements prescribed in this subpart for—	The maximum allowable operating speed for trains ¹ is—
Class 6 track	110 m.p.h.
Class 7 track	125 m.p.h.
Class 8 track	160 m.p.h. ²
Class 9 track	200 m.p.h.

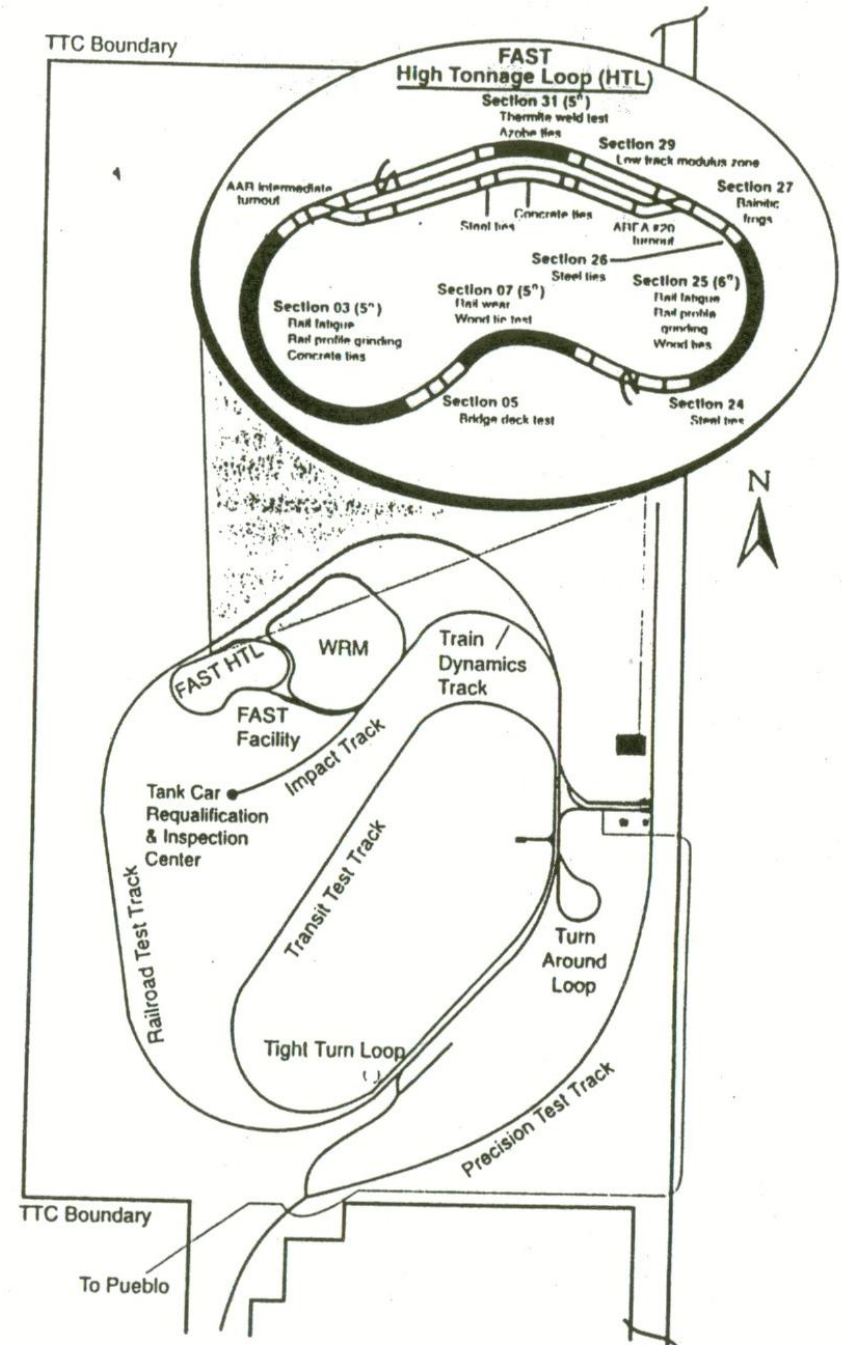
¹Freight may be transported at passenger train speeds if the following conditions are met:

- (1) The vehicles utilized to carry such freight are of equal dynamic performance and have been qualified in accordance with Sections 213.345 and 213.329(d) of this subpart.
- (2) The load distribution and securement in the freight vehicle will not adversely affect the dynamic performance of the vehicle. The axle loading pattern is uniform and does not exceed the passenger locomotive axle loadings utilized in passenger service operating at the same maximum speed.
- (3) No carrier may accept or transport a hazardous material, as defined at 49 CFR 171.8, except as provided in Column 9A of the Hazardous Materials Table (49 CFR 172.101) for movement in the same train as a passenger-carrying vehicle or in Column 9B of the Table for movement in a train with no passenger-carrying vehicles.

²Operating speeds in excess of 150 m.p.h. are authorized by this part only in conjunction with a rule of particular applicability addressing other safety issues presented by the system.

- (b) If a segment of track does not meet all of the requirements for its intended class, it is to be reclassified to the next lower class of track for which it does meet all of the requirements of this

■ Testing (FAST)





■ New Developments...

- Improve turnouts to reduce maintenance costs
- Develop new inspection devices
- Continuous-action track machines