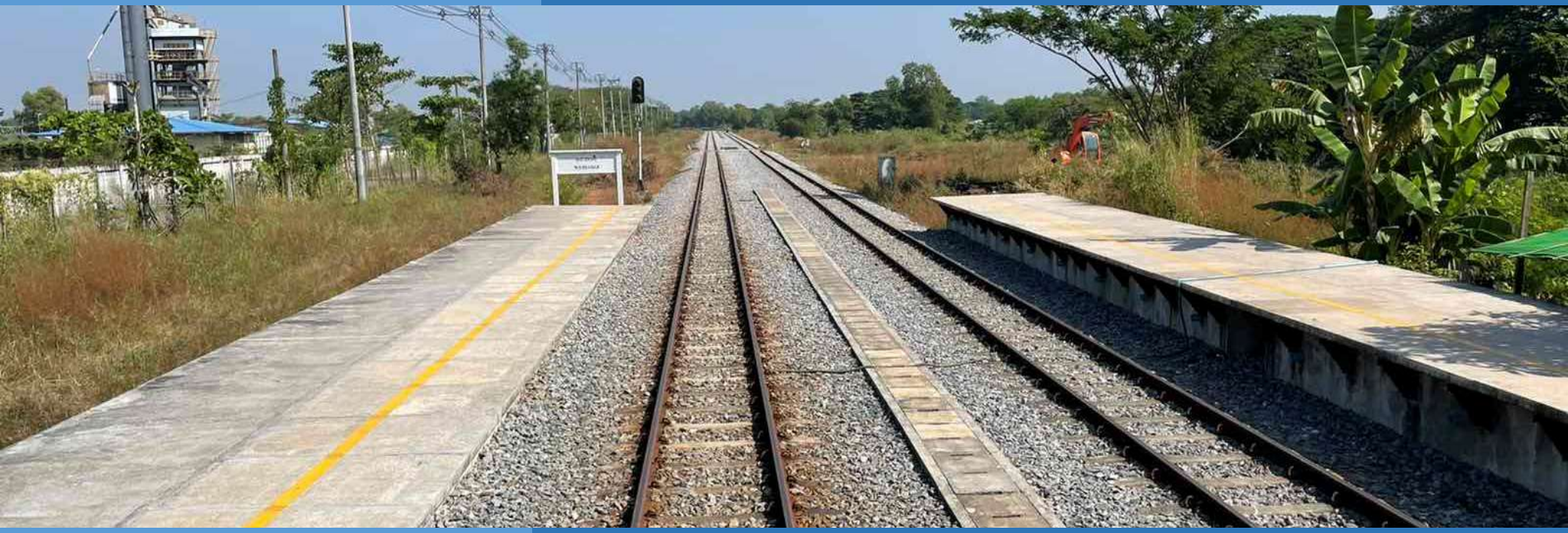


Presented By

U Tin Soe (BE Civil 1981)
General Manager
(Retired, Myanma Railway)
Head of Civil Engineering Dept
PE Construction
ACPE

Experiences on Myanma Railway Track Maintenance and towards the Better Riding Comfort

AUTOMATIC LEVELLING, LINING AND TAMPING MACHINE
(08-16M)

Brief History of Rail Transportation

- Railways originates in England in 1784, mail coaches for carrying mails were introduced.
- The first ever railway in the world was opened for traffic on 27 September 1825.
- In America, the first railway was started in 1833 and in India, the first railway line was opened for traffic in 1853 and in Japan in 1872.

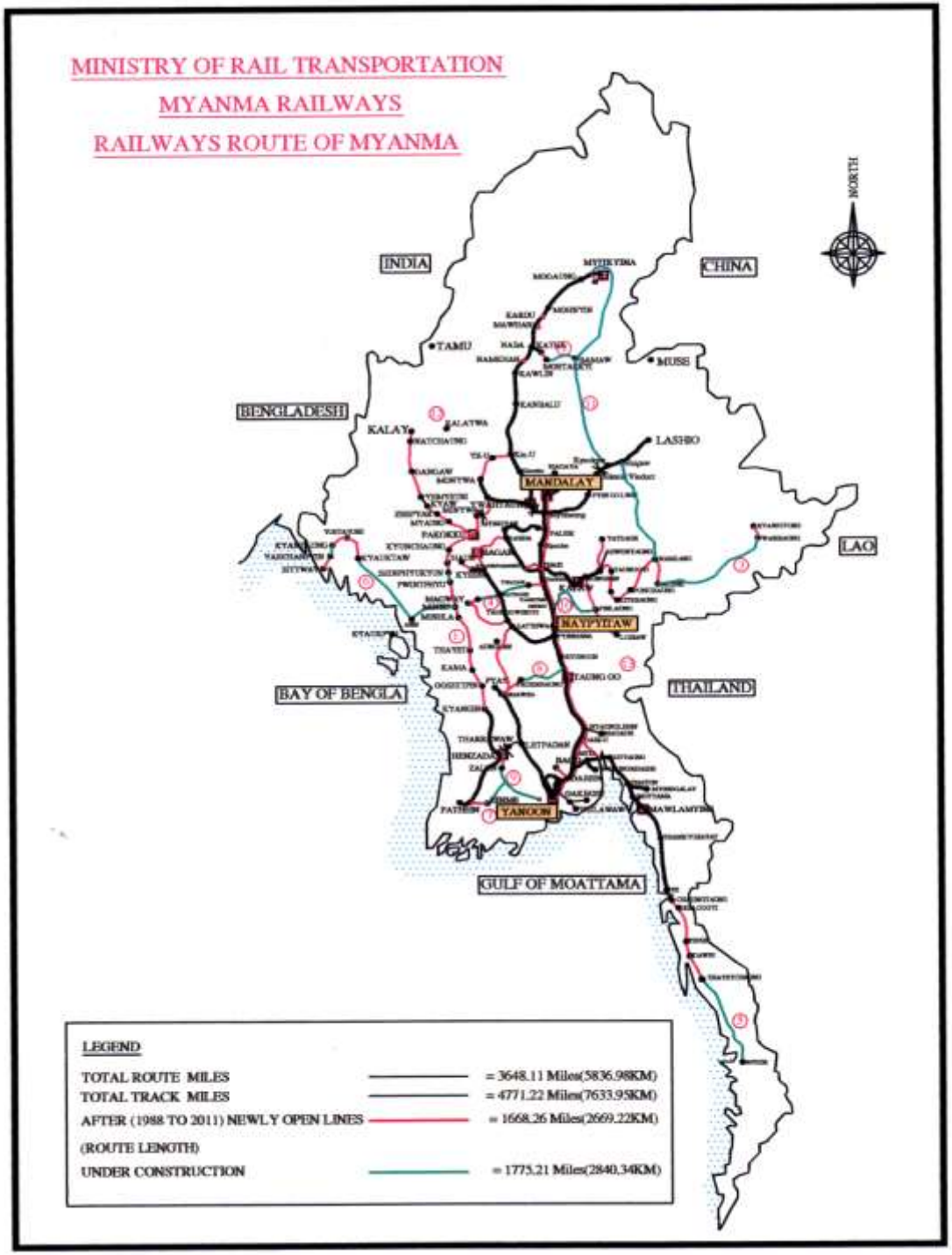
Brief History of Myanma Railways

- On 1st May, 1877, first railway was opened by Irrawaddy Valley State Railway between Yangon and Pyay, 161 miles apart, in 1884 Sittaung Valley State Railway and in 1891 Mu Valley State Railway opened the rail line in Myanmar.
- In 1896, Irrawaddy Valley state Railway, Sittaung Valley State Railway and Mu Valley State Railway were combined into Burma Railway Company.
- In 1928, Burma Railways was place under the Indian Railway Board.
- In 1937, Myanmar and India were separated and the Government of Myanmar formed the Burma Railway Board.
- In 1972, Burma Railways changed into Burma Railways Corporation.
- In 1989, BRC changed into Myanma Railways (MR).

Components of Railways System

1. Permanent way (Track + Bridge)
2. Signaling
3. Locomotive and wagons
4. Operating and Commercial

Railway Map

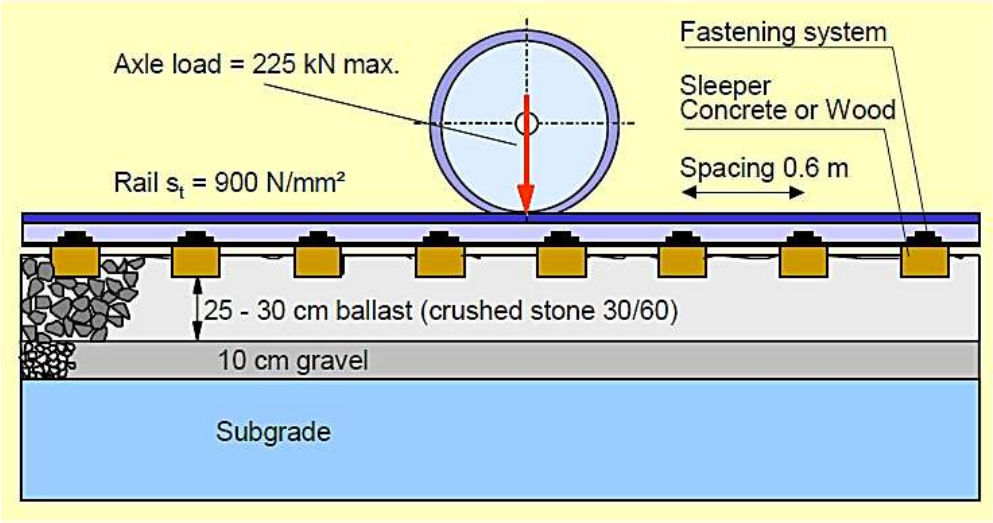

MINISTRY OF RAIL TRANSPORTATION
MYANMA RAILWAYS
RAILWAYS ROUTE OF MYANMA
NORTH
INDIA
CHINA
BENGLADESH
LAO
THAILAND
BAY OF BENGLA
GULF OF MOATTAMA
MANDALAY
NAYPYITAW
YANGON
TAMU
MUSE
KALAY
LASHIO
LEGEND
TOTAL ROUTE MILES = 3648.11 Miles(5836.98KM)
TOTAL TRACK MILES = 4771.22 Miles(7633.95KM)
AFTER (1988 TO 2011) NEWLY OPEN LINES = 1668.26 Miles(2669.22KM)
(ROUTE LENGTH)
UNDER CONSTRUCTION = 1775.21 Miles(2840.34KM)

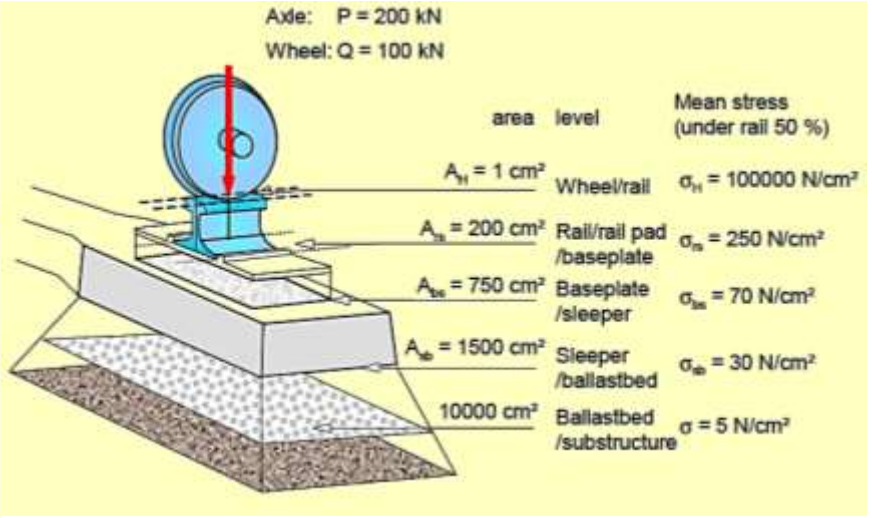
Route Mile, Track Mile in M.R

- Total Route Mile - 3393.33 miles
- Total Track Mile - 3798.83 miles
- Trunk Line-
  a) Yangon-Mandalay (Double Line) = 385.5 Miles
  b) Yangon-Pyay (Single Line) = 161 Miles
  c) Mandalay-MyitKyiNa (Single Line) = 340 Miles
  d) Bago-Mawlamying (Single Line) = 173 Miles
  e) Yangon Circular Railway (Double Line) = 29.5 Miles

Component of Railway Track

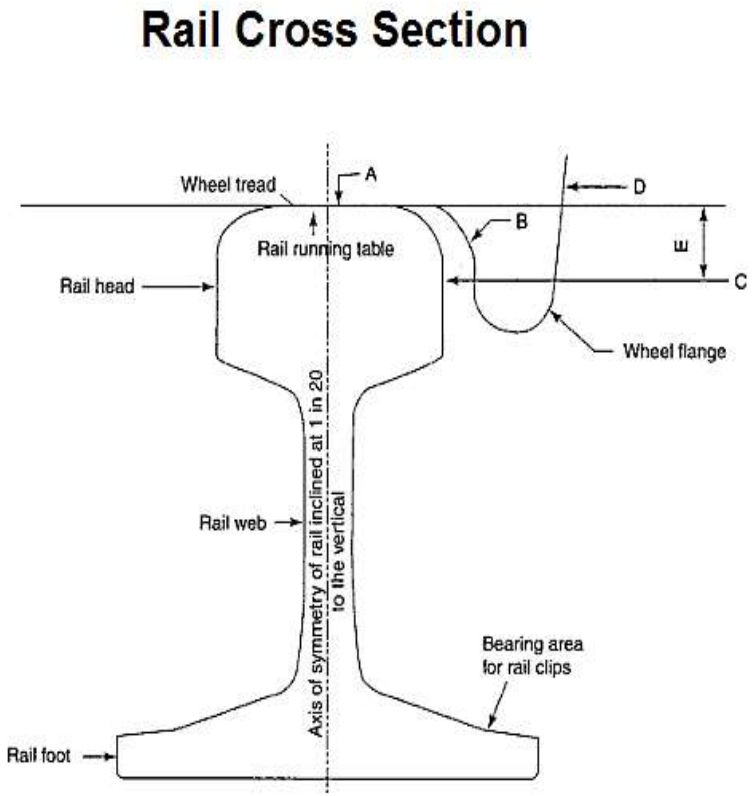
The track structure is made up of sub-grade, sub-ballast, ballast, ties and rails as illustrated in figure. Each of these contributes to the primary function of the track structure, which is to conduct the applied load from train traffic across the sub-grade safely.





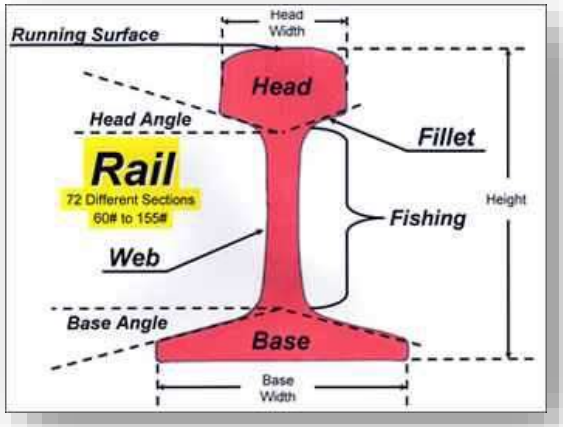
Rail

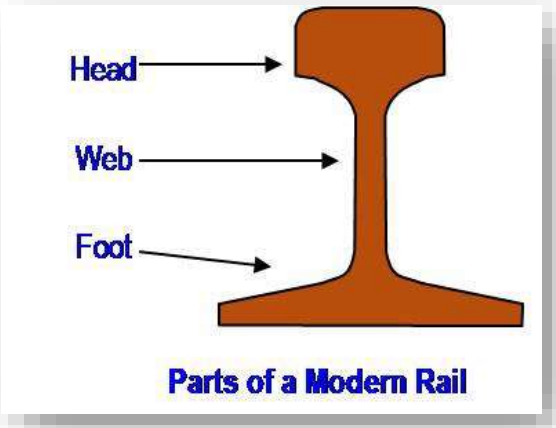
- Rail is an iron beam.
- Main function
  - Rails are similar to steel girders.
  - To guide for the running of the wheel.
  - The rails provide continuous and level surface for movement of trains.
  - The rails carry out the function of transmitting the load to a large area of formation through sleepers and ballast.

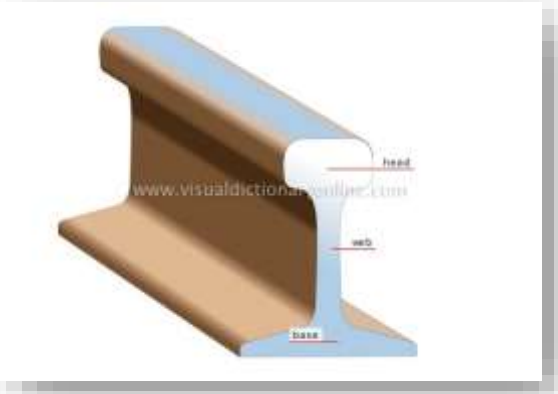


Rail Section

- The rail is designated by its weight per unit length.
- In FPS units, it is the weight in lbs per yard and in metric units , it is kg per meter.
- A 75 lb/yd rail denotes that it has a weight of 75 pound per yard.
- **The weight of rail and its section is decided after consideration such as the following;**
  - Heaviest axle load
  - Maximum permissible speed
  - Depth of ballast cushion
  - Type and spacing of sleepers
  - Other miscellaneous factors
- Rail section used in MR- 41 ¼ lb, 50lb, 60lb R.B.S, 7lb R.B.S







Sleepers

Sleepers

- transverse ties
- Functions
  1. transmit the wheel load
  2. Holding rails to correct gauge and alignment
  3. acting as an elastic medium between the rails and ballast and absorb the blows and vibrations.
  4. Providing longitudinal and lateral stability to permanent way

Sleeper density

- the number of sleepers per rail length.
- It is specified as **M+x** , where **M** is length of rail in yard and **x** is variable according to the following factors;
  - Axle load and speed
  - Type and Section of rail
  - Type and Strength of sleepers
  - Type of ballast and ballast cushion
  - Nature of formation

Types of Track Fittings

Purpose and type	*Details of fittings and fastenings*
Joining rail to rail	Fish plates, combination fish plates, bolts, and nuts
Joining rail to wooden sleepers	Dog spikes, fang bolts, screw spikes, and bearing plates
Joining rail to steel trough sleepers	Loose jaws, keys, and liners
Joining rail to cast iron sleepers	Tie bars and cotters
Elastic fastenings to be used with concrete, steel, and wooden sleepers	Elastic or Pandrol clip, IRN 202 clip, HM fastening, MSI insert, rubber pads, and nylon liners

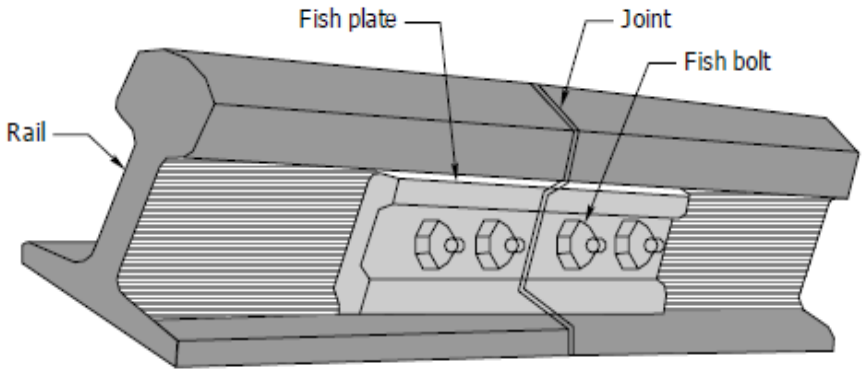


Fig. 10.1 Fish plate

Ballast

- Ballast
  - layer of broken stones, gravel, or any other granular material
  - for distributing load from the sleepers to the formation.
  - For providing drainage as well as longitudinal and lateral stability to the track.

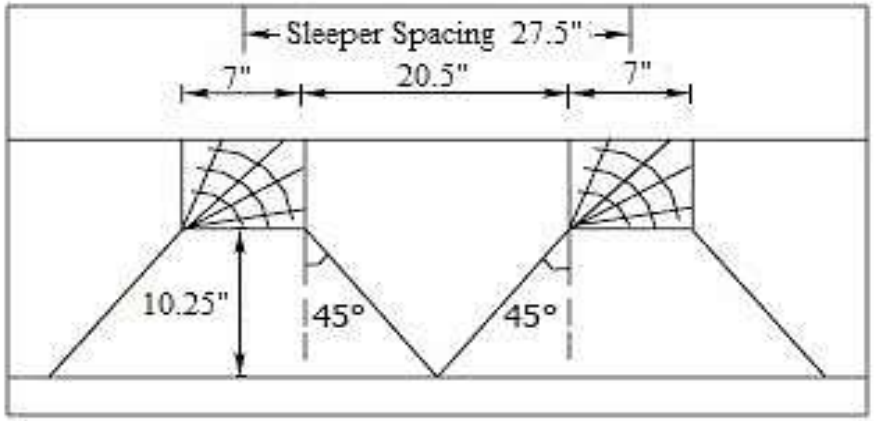
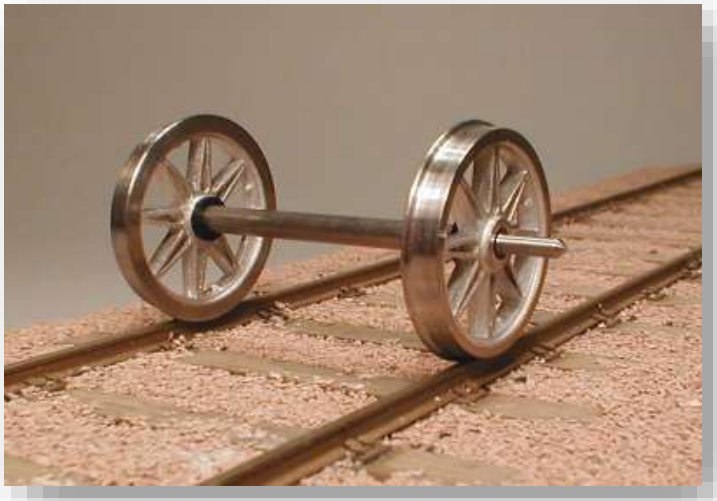


Fig. 8.1 Minimum depth of ballast cushion (dimensions in in)

Gauge

- Gauge
  - The minimum perpendicular distance between the inner face of the two rails.
- Types of Gauge
  - Broad Gauge
    - 1676 mm 5’-6’ (India, Pakistan)
    - 1524 mm 5’-0” (Russia)
  - Standard Gauge
    - 1435 mm 4’-8 1/2” (Japan, Korea)
  - Meter Gauge
    - 1000 mm 3’ – 3 3/8” (Myanmar, Thailand)
  - Cape Gauge
    - 1067 mm 3’ – 6” (Japan, Indo, Africa)
  - Narrow Gauge



Key Design Criteria Of Myanma Railway Track

(a) Track Gauge	- 1000 mm (Meter gauge)
(b) Axle load	- 12.5 tons
(c) Design speed	- 72 kmph max. for passenger train
	- 48 kmph max. for freight train
(d) Gradient	- 1:200 (0.5%) max. on main line
	- 1:25 max. on ghat section (Mountaneous Area)
	- 1:400(0.25%) max. on station yard
(e) Radius of Curvature (17 Degree)	- 291 meter. Max on main line , 103 meter on ghat section
(f) Cant	- 100 mm. max
(g) Section of Rails	- 75 lb/yard (37Kg/m) on main line
	- 60 lb/yard (29.76 kg/m) on siding
(h) Spacing of the track	- 4.42 m on main line
	- 3.81 m on station yard for good train
(i) Depth of Ballast	- 200 mm
(j) Spacing of sleeper	- 750.88 mm
(k) Type of Turn out	- 1:12 (main line)
	- 1:8½ (siding)

Geometric Design of Track

1. Gradient
2. Grade Compensation
3. Radius and Degree of Curve
4. Super Elevation or Cant
5. Safe Speed of Train
6. Curve (Horizontal and Vertical)
7. Widening of Gauge on Curves

Classification of Gradients

1. Ruling Gradient

The gradient which permit the maximum weight if a train to be pulled by a locomotive along a particular section of the track.

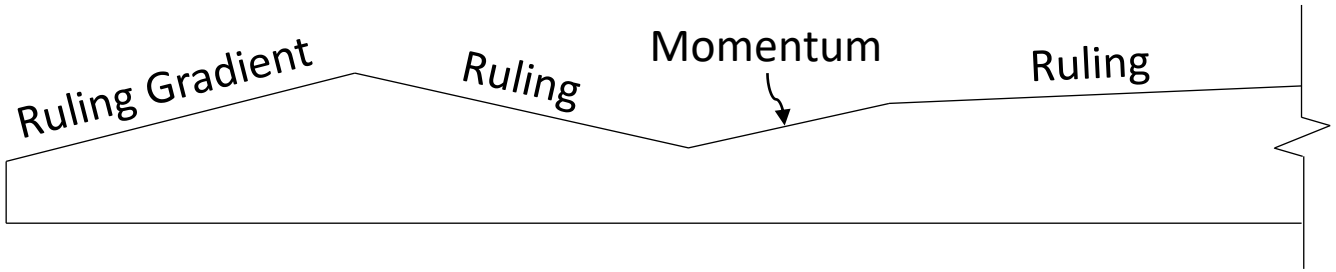
(or)

Maximum gradient which may be permitted on the section of track.

On Steeper Gradients, more powerful locomotives are employed.

2. Momentum Gradient

The up gradient which exceeds the ruling gradient along which an increased load of the train may be hauled by the locomotives after gaining momentum during descending a falling gradient, is called a Momentum Gradient



- There is no obstacle such as signal sign and station on the momentum gradient
- The train should not stop at the momentum gradient

Grade Compensation

In order to avoid the total resistance(due to gradient, and curves) beyond to permissible ruling gradient, the gradients are reduced on curves. This reduction is known as Grade Compensation on the Curve.

In M.G Line = 0.03% per Degree

Effect of Curves on Track

Bad effect of providing curve

- The length of the train to be restricted
- The maximum permissible speed is to be restricted on curves
- The use of Heavy locomotives is to be restricted on curves
- The chance of accidents and derailment increase
- Due to unequal distribution of load, running of trains on curve is not smooth
- The rail get bent due to rigid wheel base
- The operation and maintenance cost increase due to heavy wear and tear of rails


KhinMg Htay Htay Htay
More
Edit

Deciding factor of Radius of Curve

- Wheel Base of Vehicles
- Sharpness of the Curve
- Amount of Super Elevation
- Permissible Degree of curves – 17˚ in M.R

  18˚ in Indian

Curves and Super Elevation

- Cant

Super Elevation or Cant is the difference in height between the outer and the inner rail on a curve.

The main function of super Elevation are:

(1) To have a better distribution of load on both rails

(2) To reduce the wear and tear of rails and rolling stock

(3) To neutralize the effect of lateral forces

(4) To provide comfort to passengers

Radius or degree of curve

A curve is defined either by radius or its degree. The degree of a curve (D) is the subtended at its center by a chord of 30.5 meter or 100ft.

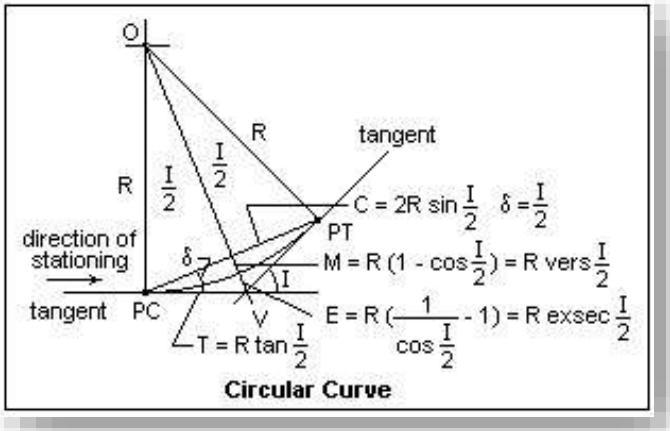
$$D = \frac{5730}{R}$$ R = radius in ft

$$D = \frac{1750}{R1}$$ R1 = in meter

Determination of Degree of curve in the field

11.8 meter Chord → Degree of curve

62 feet Chord → Degree of curve



Circular Curve

Transition Curve

- As soon as a vehicle enters a circular curve taking off from a straight, it is subjected to a sudden centrifugal force, which not only causes discomfort to passengers but distorts track alignment and affects the stability of rolling stock.

Length of transition curves

The length of transition curve prescribed on Indian Railways is maximum of the following three values:

(a) L= 0.008 Ca X Vm or L = $\frac{Ca\ X\ Vm}{125}$

(b) L=0.008 Cd X Vm or L =$\frac{Cd\ X\ Vm}{125}$

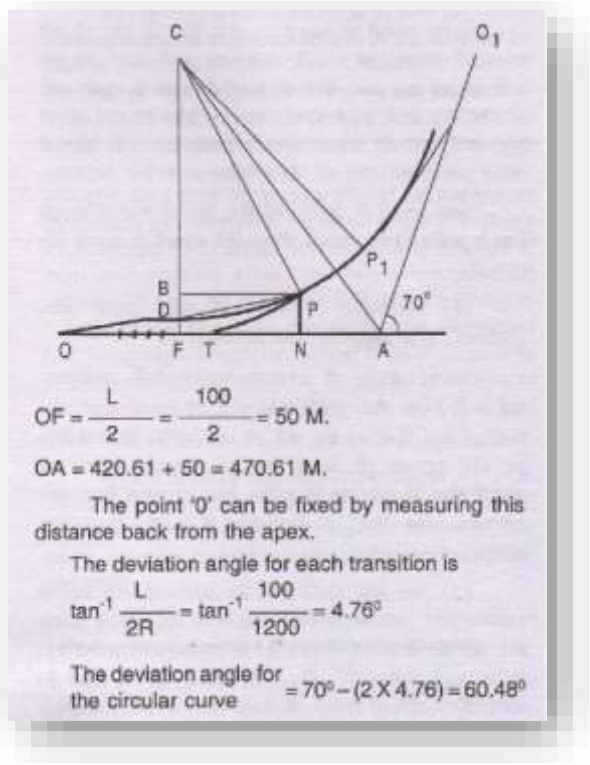
(c) L= 0.72 Ca

Where, L=Length of the curve in metres

Vm= maximum permissible speed in kmph.

Ca= actual cant or superelevation in mm

Cd= Cant deficiency in mm



Cant Deficiency

Difference between the cant necessary for the maximum permissible speed on a curve and actual cant provided.

50 mm in M.G

Cant Excess

Difference between the equilibrium cant and the theoretical cant reqd for the given lower speed

65 mm in M.G

Weighted Average Speed

As trains of different speeds generally use the curve with the same amount of super elevation it should be designed in such a way that it accommodate the trains of various speeds.

On the basis of weighted average speed or equilibrium speed is called equilibrium super elevation or cant.

$$\text{W.A Speed} = \frac{v_1 n_1 + v_2 n_2 + v_3 n_3 + \ldots}{n_1 + n_2 + n_3 + \ldots}$$

In Indian Railway

If $V_{max} \geq 50$ kmph

Average Speed = ¾ V_{max}

Average Speed = Safe speed of the curve obtained by Martin's formula

The lesser of the two values is accepted for this section.

If $V_{max} \leq 50$ kmph

Average Speed = Avg Sanction Speed

Average Speed = Safe Speed of the curve obtained by Martin's formula

The lesser of two accepted

Maximum permissible Super Elevation and Cant Deficiency

Due to 1. Frictional Resistance

2. Coning of Wheels

3. Body of Vehicles

4. Weighted Average of Speed of the moving vehicles

India Broad Gauge – 165 mm

Meter Gauge – 102 mm

Narrow Gauge – 76 mm

As a rule – $^{1}/_{10}$ th of Gauge

<u>Maximum Sanctioned Speed</u>

Maximum permissible speed authorized by the commissioner of railway safety

Determined after an analysis of track condition, interlocking, type of locomotives and rolling stock

Safe Speed on Curves

Depend on the maximum speed of trains based on the type of gauge, amount of S.E, presence or absence of transition curves at the ends and the weight of train is called safe speed on curve

1. Martin's formula for Safe Speed

   $V = 4.4\sqrt{R - 70}$ with transition curve

   V= ⅘th of the Speed without transition curve

2. Safe Speed based on S.E

   $e = \frac{Gv^2}{127}R$

   $V = \sqrt{\frac{127Re}{G}}$ e and R in meter

3. Safe Speed based on the length of transition curve

   a) Up to 100 kmph

   $V = \frac{134L}{d}$ d = cant deficiency

   b) V ≥ 100 kmph

   $V = \frac{198L}{d}$

Railway loading

- Branch line loading (10 tons axle load)
- Main line loading (12.5 tons axle load)
- Heavy mineral loading (17 tons axle load)

Track Maintenance

- Necessity of track maintenance -
  - ➢ Track settles slowly under moving train load
  - ➢ Packing under sleeper gets loose and thus the geometry of track gets disturbed. (Gauge, alignment & Cross Level)
  - ➢ Track fittings get loose and heavy wear and tear
  - ➢ Replacing of track components (Sleeper, Rail, Fittings & Ballast)
  - ➢ Regular Track Maintenance will prolong the life of an old Track and Rolling stock, reduce fuel consumption and avoid costly delays.

Advantages of Proper Track Maintenance

- Safe and Comfortable Journey to Passengers
- Increase the life of track as well as that of rolling stocks
- Ignore the track maintenance for a long time may result in heavy track renewals, costing a huge expenditures
- Maintenance of track fittings at proper time avoids the loss of items. (economy)

Methods of Track Maintenance

- By means of Manual Labor and Hand Tools
    1) Daily Maintenance
    2) Periodic Maintenance
- Mechanized Maintenance

Daily Maintenance

- Full time skill labor employed throughout the year
- Maintenance sections 4 miles per gang (gang mate)(5 km-6 km in India)
- Gang mate duties
  - ➢Allots specific duties to each of gang men and check their work
  - ➢For emergency, he stops the train by showing the emergency signals
  - ➢Keep an eye for the unauthorized construction in the right of way of track
  - ➢Work under the guidance of A.P.W.I and P.W.I
  - ➢General up keep of the section
  - ➢Check point and crossing

Daily Maintenance

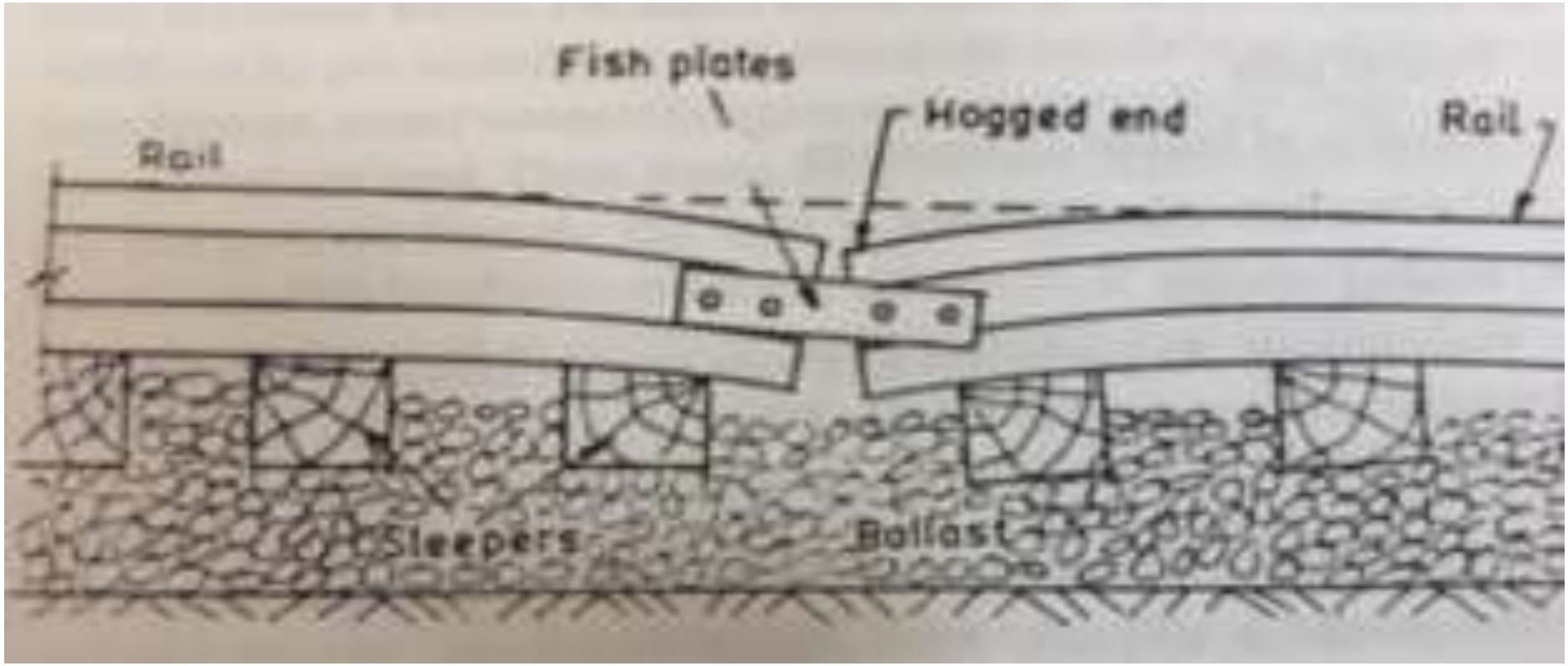
- Keyman Duties
  - ➢ Perform the gangmate duties whenever the gangmate absent
  - ➢ Up keep all the fastenings and rail joints
  - ➢ Walk over the his whole section to inspect the abnormal of track
  - ➢ Carry a spiking hammer, wrench, red flag and detonators while inspecting the track
  - Tighten the loose fittings (Bolts, Spikes, Sleeper, etc.)
  - Grease the fish bolt & fish plates

Periodic Maintenance

- Carry out an internal of two to three years
- The defects are rectified and cause of their occurrence are ascertained and remedial measures are taken
- Check
  - The surface of rail
  - Gauge
  - Proper Drainage
  - Track Alignment
  - Track components
  - Points and Crossing

Surface of the Rail

- Hogged Joint Repair
- High Joint Repair
- Blowing Joint Repair
- Battered Ends
- Expansion Gaps Adjustment
- Pumping Joint


Fish plates
Hogged end
Rail
Rail
Sleepers
Ballast

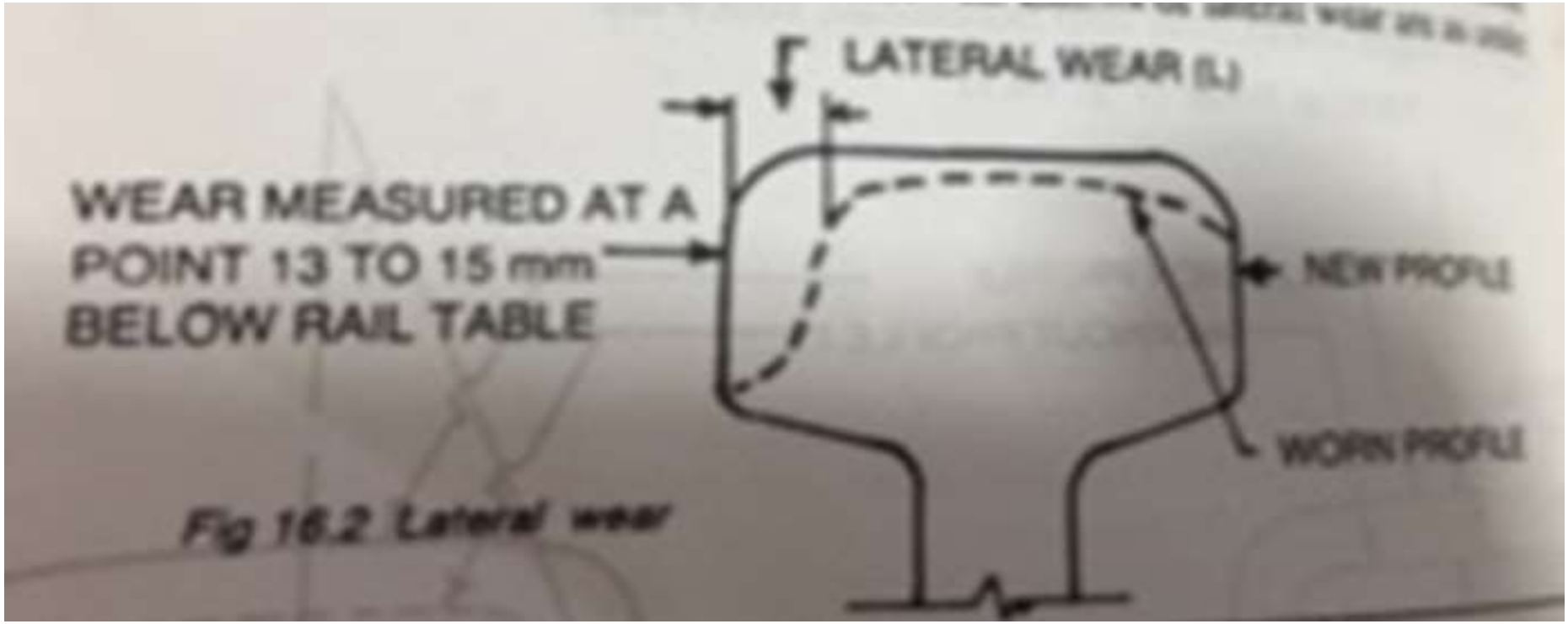


Fig 16.2 Lateral wear

(c) Vertical Wear (Fig. 16.1)

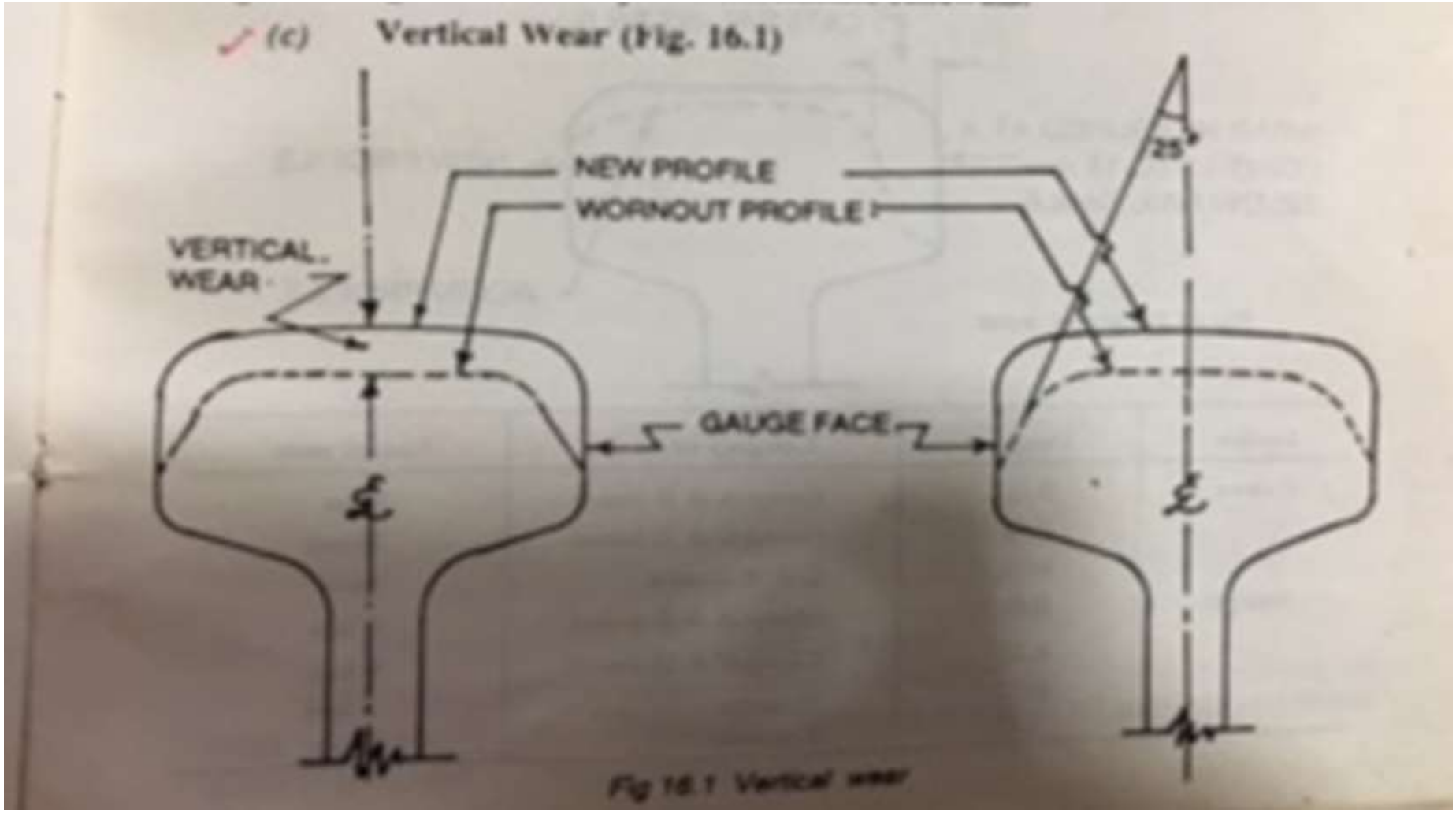


Fig 16.1 Vertical wear

Maintenance of Gauge

- Uniformity of Gauge is very important
- Loosening of track fittings
- Loosening of sleepers

Proper Drainage

- Proper drainage of the track ensures better riding qualities and long life to its components

  - Cleaning of Ballast
  - Cleaning of Cess
  - Surface drainage (Side Drain, Catch Drainage)

Track Alignment

If the track shifts sideway on straight or at curves due to any causes. (Distortion of track)

- Hammering action of wheels (Cross-level, non-unity of gauges. Improper packing of ballast, poor subgrade). Inadequate super elevation on curves, improper fittings with fishplate, absence of expansion joints.
- Variation of superelevation, fitting of rails, widening of gauge on curve
- Excessive atmospheric temperature

Realignment of Track

- Straight Track
- Curved Track
- Method of Realignment -
    a) With the help of Crow-Bars (By Labors)
    b) With the help of track-liner
    c) By eye judgement
    d) Using theodolite
    e) String Lining Method
    f) Hand Calculation Method
    g) By Computer Software
    h) By Matisa Calculator

Track Components

- Tracks Components are Rails, Sleepers and Fittings.
- Maintenance and Renewal of Rails
- Broken or Cracked Rails
- Development of kinks
- Excessive wear of check rail or inner rail on Curves
- Due to corrosion (Station yard, Costal area, Siding)
- Points and crossings

Types of Track

- Jointed track
  - Standard Rail connected with Fish Plate, Bolt & Nut.
- Short Welded Rail (S.W.R)
  - 3 to 9 Standard Rail Length welded (used in circular rail line ; Bago-Mawlamyaing Rail Line, Some portion of Mandalay-MyitKyiNa)
- Long Welded Rail (L.W.R)
  - Up to 1 km Length Rail Length Welded
- Continuous Welded Rail (C.W.R)
  - Greater than 1 Km Rail Length welded under operation on Yangon-Mandalay Rail Line upgrading project
- Ballasted Track
- Ballast Less Track

Welding of Rail

(A) Disadvantages of Jointed Track

- Standard Rail length-12 meter (or) 25 meter
- Use Fish Plate and Bolt & Nut
- The weakest point of the rail track is the Joint
- For Example ; 39 ft Rail Length in M.R
  - One Mile Length ➡ No. of Rail Joint 136 Joints
  - For Yangon to Mandalay (385.5 Miles) ➡ 52428 Joints
  - If we use S.W.R (9 rail length), No. of Joint will be 5799 Joints
- Maintenance Cost increase in Jointed Track
- Riding Comfort is not good in Jointed Track
- The more the joints in track, the more the worn out rails & Fish Plate and Bolt & Nut.

Welding of Rail

(B) Advantages of Welded Rail

- Welded rail increases the life of rail and Rolling stocks
- Welded rail provides the riding comfort
- Welded rail reduces the creep
- Welded rail reduces and eliminates the hammering effort of rail joints, displacement of joints, disturbance in alignment and running surface
- Welded rail reduces the efforts of impact on Large Span Bridges.
- The use of L.W.R, affords better longitudinal, lateral and vertical stability to the track
- Welding of rail reduces the risk of accidents
- Welding of rail reduces the maintenance cost by about 20% to 40%.

Flash Butt Welding Machine
(APT 500 C)

Methods of welding a Rail Joint

(i) Gas pressure welding

(ii) Electric arc welding or metal arc welding

(iii) Flash butt welding

(iv) Thermit welding

Thermit Welding of Rails

The underlying principle behind the working is that when a mixture of finely divided Aluminium and Iron Oxide called “Thermit mixture’ is ignited, a chemical reaction takes place with evolution of heat producing iron and aluminium oxide:

Iron oxide + Aluminium = Aluminium Oxide + Iron + heat

(159 grams) (54 grams) (102 grams) (112 grams)

Modern methods of Railway Track Maintenance

(A) Mechanized maintenance of track with the help of track machines (Off Track Tampers and On Track Tampers)

(B) Measured Shovel Packing (MSP)

(C) Directed Track Maintenance (DTM) (Based on Need)

Mechanized Maintenance Machines in M.R

- ALLTM (Automatic Levelling, Lining Tamping Machine) - 5 Nos
- Ballast Cleaning Machine - 2 Nos
- Ballast Regulator - 1 No
- Flash-Butt Welding Machine - 1 No
- Track Measuring Trolley - 4 Nos
- Trolley Type Tamper - 41 Nos

AUTOMATIC LEVELLING, LINING AND TAMPING MACHINE (DUOMATIC 09-32 CAT)

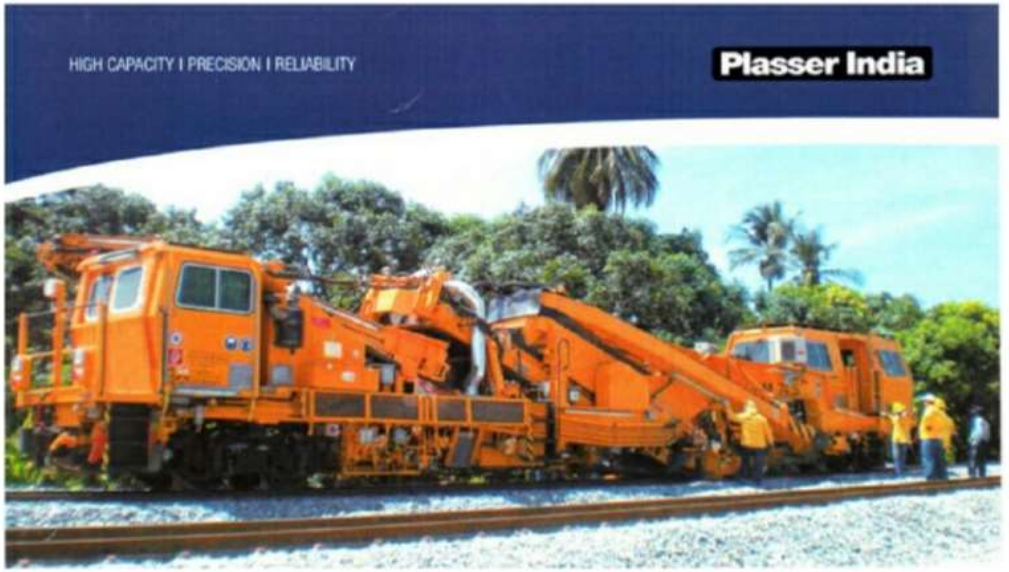
AUTOMATIC LEVELLING, LINING AND TAMPING MACHINE (DUOMATIC 09-32 CAT)

AUTOMATIC LEVELLING, LINING AND TAMPING MACHINE
(08-16M)

AUTOMATIC LEVELLING, LINING AND TAMPING MACHINE
(08-16M)

PROFILE BALLAST REGULATING MACHINE
(PBR - 400 R)

BALLAST CLEANING MACHINE
(RM-74 S)



TRACK MEASURING CAR

Flash Butt Welding Machine
(APT 500 C)

Pre–stressed Concrete Sleeper

• Myit Ngel Factory (China)	200000 nos/yrs	Long Bench
• Pakokhu Factory (China)	200000 nos/yrs	Long Bench
• Ohnshitpin Factory (China)	200000 nos/yrs	Long Bench
• KhinOo Factory (China)	200000 nos/yrs	Long Bench
• Shwe Nyaung Factory (China)	200000 nos/yrs	Long Bench
• MinBu Factory (China)	200000 nos/yrs	Long Bench
• ThiBaw Factory (China)	200000 nos/yrs	Long Bench
• PyunTazar (India)	100000 nos/yrs	Short Bench
• Mottama (India)	150000 nos/yrs	Short Bench

Present Situation of Track Maintenance in Myanma Railway

- M.R adopted the Indian Railway Maintenance practice as manual of Track
- Previous track maintenance gang strength,1:1:8 = 10 gang men per 4 mile Rail length
- Since 1993, Reduced the gang strength, 1:1:3 = 5 gang men
- Actual track labour strength in MR 1833 numbers
- According to present organization = 4875 numbers
- According to previous organization= 2x4875 = 9750 numbers
- For the time-being, we haven't increased the gang strength as well as haven't changed from manual maintenance into mechanized maintenance
- Shortage of skill labours, qualified permanent way inspectors, qualified engineer for track maintenance
- Need to learn and study modern track maintenance technique
- Insufficient budget for track maintenance
- Although M.R has the small quantities of mechanized machines, it needs to train the knowledge of these equipment to railway persons.

Yangon–Mandalay Railway Upgrading Project (Phrase–I)

- Phase I - Yangon–Taungoo
- Project Period – 2018 to 2023 (Under Operation)
- Route mile – 166 miles (Double Track)
- Maximum Running Speed (After project) – 100 km/hr
- Type of Track – Continuous Welded Rail
- LOAN O.D.A Loan (JICA)
- AXLE LOAD – 20 Tons

Yangon Circular Railway Upgrading Project

- Project period – 2017 to Up to now
- Speed – 30 miles/hr
- Route Length – 30 miles (Double Track)
- Type of Track (Welded 9 nos-12 meter Rail – S.W.R)
- Loan O.D.A (JICA Loan – 207 millions U.S)

  (Only for Signalling and D.M.U)
- Earth work, Bridge, Station and Track were allocated by Government Fund

Video

Bago Mawlamyaing Railway Upgrading

- Starting – 2015
- Finished – 2022
- Budget – Nearly 12 Billion Kyat
- Type of Track – S.W.R (9 rail length welded)
- Present Running Time for Yangon – Mawlamyaing Express train (10) Hours
- Average speed – 18 mile per hour
- After increase the average speed 30 miles per hour running time will be (5.9+1=6.9) Hour

Video

Video

Video


2021/1/23 17:43

In order to develop the Myanmar Railway Track Maintenance

My Suggestion

1. Provide sufficient maintenance budget
2. Need to train mechanized track maintenance to Myanmar railway persons
3. Fulfill the required track labors according to present organization strength
4. Need to interest the merchandised track maintenance in order to develop the railway track and better railway comfort

THANK YOU

References:

Railway Track Engineering (R-AGOR)
Indian Railway Track
Myanma Railway Manuals

hich in turn made the journey discomfortable
nent of kinks on the head on rails due to impacts

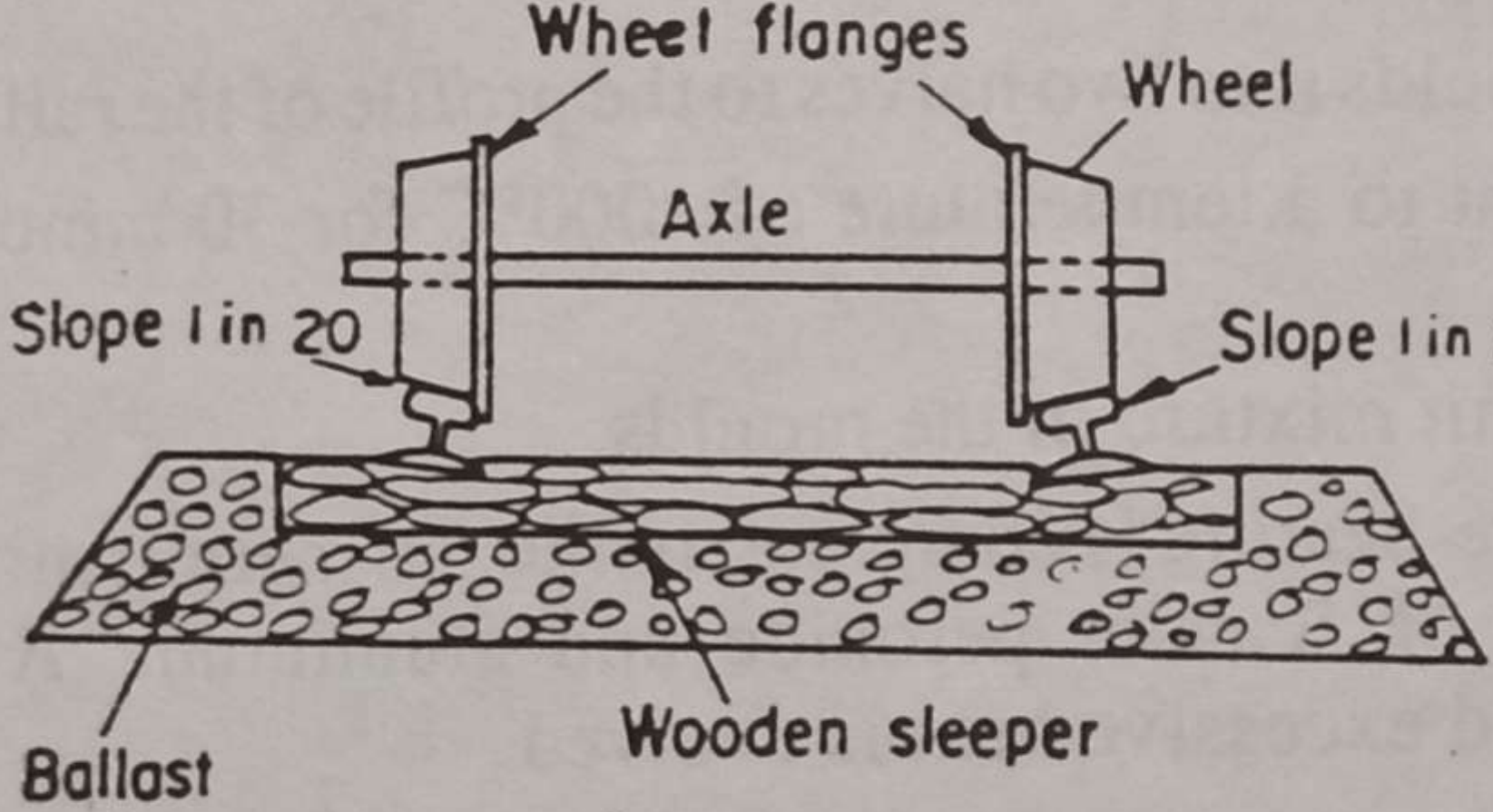


Fig. 7·10. Coning of wheels.

overcome these defects, the modern design

video

video