ज्ञान ज्योति से मार्गदर्शन
To Beam As A Beacon of Knowledge

Mechanised Track Laying

November 2021

Indian Railways Institute of Civil Engineering
Pune 411001

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Preface

Indian Railway has already shifted to mechanized system of track laying and maintenance. Many new machines depending on the changing requirement from time to time is being inducted. In future also other machines will continue to be inducted. IRICEN published a book on "Quality Control in Mechanised Track Laying" written by Shri N.R.Kale, Assistant Professor/Works/IRICEN. However, it did not discuss the working mechanism of renewal machines working on Indian Railways in detail but only emphasized on quality control.

This new book has included working of existing track renewal machines and also working of New Track Construction (NTC) machine which is currently being used for laying Dedicated Freight Corridor (DFC) track and in future may be deployed for Indian Railway track laying also. The book also has included some other machines which may be required in future for improving working system over Indian Railways. Book has been written by Shri Anil Choudhary, Sr Professor/Track Machine/IRICEN.

I hope this book will be useful to field engineers. The suggestion for improvement is welcome.

Pune
November 2021

Ashok Kumar
Director General
IRICEN, Pune

Acknowledgement

Increasing axle load of goods traffic and speed of both goods and passenger train, compounded with need to add new lines for meeting ever increasing demand of carrying more passengers requires upgradation of existing track and laying new track at fast pace. For meeting these requirements, mechanized system of renewal of existing track and laying of new track has therefore become a necessity . Indian Railways is already using few machines for renewal of existing track. Laying of new track in DFC is being done using a different machines. The book primarily describes working of these existing machines. Other on track machines including small track machines, which are required at these sites are also described in brief. New type of machines may also be added in future. Some of other good machines working in other railways has also been covered in the book.

I would like to convey my sincere thanks to faculties at IRICEN for giving their technical input during various discussion. I would also like to convey my thanks to my wife and children for their support by allowing me spare time for writing this book.

Pune
November 2021

Anil Choudhary
Sr Professor/Track Machine
IRICEN

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CHAPTER 1

INTRODUCTION

1.1 General:

Indian Railways have come long way from light weight wooden sleeper track structure with 90R or lighter rails to heavier, 60 Kg concrete sleeper track structure with 60 Kg rails. In future, it will be shifting to even heavier wider sleepers with 68 Kg or even heavier rails. The Turnouts which were earlier laid on wooden and steel sleepers are now laid on PSC sleeper. Moreover, these turnouts are to be prefabricated and to be laid as one unit for better quality. This means, handling around 60 t and heavier weight.

Manually handling of these heavy track structures is not possible. Indian Railways has therefore gone for full-fledged mechanized system of laying of new track or relaying of existing track. This has not only made working comfortable but has also increased the speed of laying and renewal.

This book describes different system of mechanized laying and renewal used over Indian Railways at present. It also deals with the preparatory work, works required during and after block, the quality check etc. for ensuring good standard of laid track.

1.2 Track Components:

Railway Track comprises of following components

a. Formation
b. Ballast
c. Sleeper
d. Rail
e. Fittings (Elastic Rail Clip, Liner & Rubber Pad)

The formation including Blanketing is constructed as per standard given in RDSO instruction GE- G-1 .

Ballast specification and its system of supply and measurement is described in RDSO's IRS:G-1

The track components in use over Indian Railways are detailed as under:

A. Sleeper :

As per IRPWM para 705(2), all renewals shall be done with 60 Kg PSC sleepers only. Following different sleepers are in use in IR.

ii. PSC Sleeper for Plain Track :

Rail Section	RDSO Drg.	Remark
52 Kg	T-2495	Designed for 22.5 axle load
60 Kg	T-2496	Designed for 22.5 t axle load Declared fit for 25 t axle load upto limited speed
60 Kg & 136RE	T-7008	Design for 25 t axle load (for DFC) with same section as of T-2496
60 Kg & 136RE	T-8527	Design for 25 t axle load. Wider sleeper.

ii. PSC Sleeper for curves :

RDSO Drg.	Remark
RDSO/ T-3670	Gauge upto 1681 mm using different liners
RDSO/ T-4170-73	For 60 kg/m rail, sleepers with 1675,1677, 1679, 1681 mm gauge with normal liners.

RDSO Drg.	Remark
RDSO/ T-4183-86	60 kg/m rail with 52 kg/m Check Rail, with 75 mm check rail clearance, specially designed for KK line
RDSO/ T-6896-99	60kg/m rail with 52 kg/m Check rail, with 65 mm check rail clearance

iii. Special location Sleeper :

RDSO Drg.	Remark
RDSO/T-4852	Shallow Sleeper (60 Kg) (for location with restricted headways)
RDSO/T-8326	Shallow Sleeper (60 Kg) (for location with restricted headways with Guard Rails for tunnels)
RDSO/T-4148-4148A	Level Crossing Sleeper (52 Kg/60 Kg)
RDSO/T-4149 (With 120 mm gap)	SEJ Sleeper (52 Kg/60 Kg)
RDSO/T-6253 (With 300 mm gap)	SEJ Sleeper (60 Kg)
RDSO/T-4088 to 4097	Ballasted deck bridges with 52 Kg & 60 Kg M/L with 52 Kg Guard rail.

iv. Sleepers for Points and Crossing/Derailing Switch (PSC):

Type of T/O	RDSO Drg.	Remark
52 Kg & 60 Kg 1 in 12 with 10125 mm ORS and CMS Crossing (Layout-RDSO/T-4732 & 4218)	RDSO/T-4786-4790	Approach Sleepers
	RDSO/T-4512-4594	SL-1 to SL-83
	RDSO/T-5471-5474	Exit Sleepers
52 Kg & 60 Kg 1 in 8.5 with 6400 mm ORS and CMS Crossing (Layout-RDSO/T-4865)	RDSO/T-4786-4790	Approach Sleepers
	RDSO/T-4791-4844	SL-1 to SL-54
	RDSO/T-5471-5474	Exit Sleepers
60 Kg 1 in 16 with 11200 mm ORS and CMS Crossing (Layout-RDSO/T-5691)	RDSO/T-4786-4790	Approach Sleepers
	RDSO/T-4513-4517	SL-1 to SL-5
	RDSO/T 5595-5690	SL-6 to SL-101
	RDSO/T-5471-5474	Exit Sleepers
60 Kg 1 in 20 with 12460 mm ORS and CMS Crossing (Layout-RDSO/T-5858)	RDSO/T-4786-4790	Approach Sleepers
	RDSO/T-4517-4517	SL-1 to SL-5
	RDSO/T-4921-6035	SL-6 to SL-120

Type of T/O	RDSO Drg.	Remark
	RDSO/T-5471-5474	Exit Sleepers
Derailing switch 60 Kg 1 in 8.5 with 6400 mm ORS (Layout-RDSO/T-5836 & T-6068)	RDSO/T-4512,	SL-1,2
	RDSO/T-4793 to 4803,	SL-3 to SL-13
	RDSO/T-4804-4806	SL-14 to SL-16
	RDSO/T-6770-6775(RH),	SL-17 to SL-22
	RDSO/T-6776-6781(LH)	SL-17 to 22

v. Layout DRG for Diamond Crossing

T/O Type	Rail	Brief Description	Layout Drg.
1in8.5	52Kg	Without Slip	RT-5362
		Single Slip	RT-5363
		Double Slip	RT-5364
1 in10	60Kg	Without Slip	RT-6644
		Single Slip	RT-6877
		Double Slip	RT-6889

vi. Layout DRG for Scissor Crossover:

T/O Type	Rail	Layout Drg.
1in 8.5	60 Kg	RT-6092
1 in 10	60 Kg	RT-8109

B. Rail :

Different Rail sections used on IR are

Rail Section	Strength	Remark
IRS 52 kg/m	72 and 90 UTS	Normal Rail section used for Track and ORS switch
UIC 60kg/m	90 UTS	
ZU1-60 Profile (73kg/m)	90 UTS	Used for Thick web switch
136 RE 14 (68kg/m)	90 UTS	Proposed for future utilisation
R260	90 UTS	Normal Rail section used for Track and ORS switch.
1175HT	120 UTS	Proposed for future use.

C. Elastic Rail Clips:

Following ERC's are in use on IR.

Type	Drg. No.	Remark
Round Toe	RDSO/T-1892	52 Kg Rail on 52 Kg Sleeper
Flat Toe ERC	RDSO/T-3700	52 Kg Rail on 52 Kg Sleeper
ERC Mark-II Flat Toe	RDSO/T-3722	For MG PSC track
ERC Mark-III Flat Toe	RDSO/T-3701	52 Kg rail on 52 Kg Sleeper and 52 Kg and 60 Kg rail on 60 Kg Sleeper.

Type	Drg. No.	Remark
Flat Toe Mark-V	RDSO/T-5919	60 Kg & 136RE rail on DFC 60 Kg (T-7008) and wider sleeper (T-8527)
GJ-Clip	RDSO/T-8258	At Fish plated, Insulated and Glued Joint (60 Kg)
Anti-Theft	RDSO/T-6254-6255	52 Kg rail and 60 Kg rail respectively

D. Liners :

Rail	Sleepers	Types of Liners (RDSO Drg No)	
		GFN	Metal
52 Kg	52 Kg (RDSO T-2495)	T-3702	T-3738
52 Kg	60 Kg (RDSO T-2496)	T-3707(G) (yellow)	T-3741(G)
		T-3708(NG) (Green)	T-3742(NG)
60 Kg	60 Kg (RDSO T-2496)	T-3706	T-3704
60 Kg	60 Kg & 136RE (RDSO T-7008)	T-6938 T-6939	- -

Rail	Sleepers	Types of Liners (RDSO Drg No)	
		GFN	Metal
136RE (1673 mm gauge)	60 Kg & 136RE (RDSO T-7008)	T-6937	T-8256
60 Kg (1676 mm gauge)	60 Kg & 136RE (RDSO T-7008)	T-8222 (G)	T-8254 (G)
		T-8223 (NG)	T-8255 (NG)
60 Kg (1673 mm Gauge)	60 Kg & 136RE Wider (RDSO T-8527)	T-6938 (G) T-6939 (NG)	T-8616 (G) T-8617 (NG)
136RE (1673 mm Gauge)	60 Kg & 136RE Wider (RDSO T-8527)	T-6937	T-8618

E. Rubber Pad :

Sleepers	RDSO Drg No.	Remark
52 Kg (RDSO T-2495)	RDSO/T-3703	6 mm thick GRSP
60 Kg (RDSO T-2496)	RDSO/T-3711	6 mm thick GRSP
	RDSO/T-6618	6.2 mm thick Composite GRSP
60 Kg/136RE (RDSO T-7008)	RDSO/T-7010	10 mm thick Composite GRSP
60 Kg-Wider (RDSO T-8527)	RDSO/T-8528	10 mm Composite GRSP

1.3 Track Renewals:

Track structure and its components are subjected to different forces causing wear and tear and fatigue, and therefore have a life span after which it should be renewed. Different types of Track Renewals activities taken on IR are given below:-

S.No.	Renewal	Type	Abbreviated
1	Complete Track Renewal	Primary	CTR(P)
2	Complete Track Renewal	Secondary	CTR(S)
3	Through Rail Renewal	Primary	TRR(P)
4	Through Rail Renewal	Secondary	TRR(S)
5	Through Sleeper Renewal	Primary	TSR(P)
6	Through Sleeper Renewal	Secondary	TSR(s)
7	Casual Renewals		
8	Through Turnout Renewal	-	TTR
9	Through Fitting renewal	-	TFR
10	Through Fitting renewal (R)	-	TFR (R)
11	Through Weld Renewal	-	TWR
12	Through Bridge Timber Renewal	-	TBTR
13	Scattered Renewals	-	
14	Through Ballast Renewal		TBR

While primary renewal are with new materials, the secondary renewal are with released material from high GMT or axle load or high speed or main line track to be used in unimportant lines. Criteria of renewal of Rail and other components are given in Para- 702 of IRPWM and also discussed in brief in chapter-3 of this book..

1.4 Machines used for Track Renewal and New Track Laying:

When CST-9/Steel/Wooden sleepers were used all these renewal were done manually. However with the advent of PSC

sleepers both for plain track and Points and crossing, their manual handling was not possible. We have now shifted to mechanized renewal using On Track Machines.

The different Track Renewal and New Track Laying machines being used over Indian Railways and some of the Small Track Machines/Equipment used for assisting at sites are given below:

a. On Track Renewal Machines:

These are used for renewal of existing sleepers. Track Machines being used over Indian Railways are:

S.No.	Track to be Renewed	Machines
1	Plain Track	Track Laying Equipment (TLE) and includes PQRS and Simplex Make Machines etc.
		Track Relaying Train (TRT) and included Harsco and Russian TRT
2	Points and Crossing	AMECA make T-28 M/c

b. New Track Laying Machines:

S.No.	Track to be Renewed	Machines
1	Plain Track	New Track Construction Machines (NTC) by M/s Plasser and Theurer and Harsco make. Being used over DFC.
2	Points and Crossing	AMECA make T-28

c. Small Track Machines/Equipment's commonly used at Track Renewal/New Track Lying sites are:

S.No.	Function	Machines
1	Rail Renewal	Rail Threader
2	Rail Cutting	Abrassive Rail Cutting Machines
3	Rail Drilling	Rail Drilling Machine
4	Track lifting and slewing	Track Lifting Jack Track Lifting Cum Slewing Jack (TRALIS)
5	Welding	AT welding Equipment Mobile Flash Butt Welding Equipment

At Track Renewal and New Track Laying sites, other On Track Machines like Tamping Machines (DUOMATIC,UNIMAT etc), Dynamic Track Stabilizer (DTS), Ballast Regulating Machines (BRM) and Ballast Cleaning Machines (BCM), Utility Vehicle (UTV) are also used for handling of material and to make the track fit for movement of train at sectional speed.

In this book, working mechanism of Track Renewal/Laying machines working over Indian Railways will primarily be covered including some relevant small Track Machines. Works required to be executed at site by other On Track Machines will only be covered to the extent of function to be performed by them at site.

In the Last chapter, information on some of the other machines being used on World Railways for renewal and Laying of Track which can be useful for IR has been given.

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CHAPTER 2

TRACK STRUCTURE AND TRACK TOLERANCES FOR NEW WORK

2.1 Pre-Requisites for Ensuring Quality:

Quality of initial laying of track decides the maintenance effort required in future. A well laid track with stable formation and proper designed alignment etc. will have better track parameter retentivity and will require less maintenance. A badly laid track will be maintenance staff nightmare. It is therefore important to make all effort to lay good track with proper geometry.

To ensure good quality, some of the important pre-requisites are

a. Knowledge of standards
   i. Prescribed and
   ii. Accepted
b. Use of standard materials
c. Use of standard equipment and tools
d. Avoidance of short cut methods, and above all
e. Quality control at each stage execution

2.2 Indian Railway Track Standard:

Track is a composite structure consisting of rails, sleepers and their fastenings with ballast under and around the sleepers laid on a well prepared formation. The track standard specified for Indian Railways are:

A. Minimum Sleeper density (Ref: IRPWM para 209(2)) .

For LWR and CWR track, this is expressed as number of sleepers per Km.

Location	Minimum Sleeper density Nos/Km
Complete track renewal and through sleeper renewal. (doubling, gauge conversion, new line construction works for main lines)	1660
For loop lines & sidings (permissible speed upto 50kmph)	1540
For sidings with permissible speed more than 50 kmph	1660

Higher sleeper density may be provided with the approval of Principal Chief Engineer.

Where concrete sleepers are required to be laid in unavoidable circumstances, in SWR track, the sleeper spacing including at fish-plated joint, shall be kept uniform. In addition, 1 m long fishplates, be provided at fish plated joints.

B. Rail section (Ref: IRPWM Para 205):-

Rail sections are normally selected to suit the standard of loading and the speeds.

Recommended Rail section:

Location	Section
Track Renewals, Doubling, New Lines and Gauge conversions.	60kg rails with minimum 90UTS

Location	Section
Gauge conversion works & new line works having projected traffic of less than 5GMT	60kg (SH) rails, if available with Railways, can be used depending upon future projected extension of lines etc
Renewal of loop lines	60Kg (SH) or 52Kg (SH) Rails. New rails may be used for these rail renewals with prior approval of Railway Board.

For Private and other sidings:

Location	Section
Sidings taking off from DFC or feeder routes to DFC or 25t axle load routes.	60 Kg
Sidings other than (i) above with permissible speed up to 50 kmph.	52kg (SH) or 52 kg (IU)
Sidings other than (i) above with permissible speed more than 50 kmph	60 Kg

Anticorrosive paints to be applied before laying of Rails as per instruction in IRPWM Para-613. For new line/gauge conversion projects, corrosion prone areas shall be identified by CAO(C)/Chief Engineer(C) in consultation with Principal Chief Engineer.

C. Ballast Cushion (IRPWM para 212):

Depths of Ballast Cushion – The minimum depth of the ballast below the bottom of the sleepers at the rail seat for BG should be as under-

Location	Cushion
Track renewals	300 mm
(Complete track renewals and through sleeper renewals)	(Where possible a depth of 350 mm may be provided)
All doubling, gauge conversion and New Line construction works.	350 mm
Loop Lines	250 mm

For Private and other sidings, the cushion shall be as given below:

Sidings with permissible speed up to 50kmph	300 mm
For sidings with permissible more than to 50kmph	350 mm

The ballast profile and quantity of Ballast required for new construction for maintaining the above cushion is given in IRPWM as Annexure 2/2A,2/2B,2/2C of Para 212.

D. Track fittings for different track structure:

Fittings required for different Rail and sleeper combination are given below-

i. 52 Kg Rail on 52 Kg Sleeper (RDSO T-2495)

ERC	GRSP	Liner	
		GFN	Metal
Mark-III (RDSO/ T-3701)	6 mm (RDSO/ T-3703)	(RDSO/ T-3702)	(RDSO/ T-3738)

ii. 52 Kg Rail on 60 Kg Sleeper (RDSO T-2496)

ERC	GRSP	Liner	
		GFN	Metal
Mark-III (RDSO/ T-3701)	6 mm (RDSO/ T-3711)	GS - RDSO/ T-3707	GS - RDSO/ T-3741
		NGS- RDSO/ T-3708	RDSO/ T-3742

iii. 60 Kg Rail on 60 Kg Sleeper (RDSO T-2496)

ERC	GRSP	Liner	
		GFN	Metal
Mark-III (RDSO/ T-3701)	6 mm (RDSO/ T-3711)	RDSO/ T-3706	RDSO/ T-3740

iv. 60 Kg Rail on Sleeper -RDSO T-7008 (1673 mm Gauge)

ERC	CGRSP	Liner	
		GFN	
Mark-V (RDSO/ T-5919)	10 mm (RDSO/ T-7010)	(RDSO/ T-6938)	G
		(RDSO/ T-6939)	NG

v. 60 Kg Rail on 60KG/138RE Sleeper -RDSO T-7008 (1676 mm Gauge)

ERC	CGRSP	Liner	
		GFN	Metal
Mark-V (RDSO/ T-5919)	10 mm (RDSO/ T-7010)	GS - RDSO/ T-8222	GS - RDSO/ T-8254
		NGS- (RDSO/ T-8223	RDSO/ T-8255

vi. 136RE Rail on 60KG/138RE Sleeper -RDSO T-7008 (1673 mm Gauge)

ERC	CGRSP	Liner
		GFN
Mark-V (RDSO/ T-5919)	10 mm (RDSO/ T-7010)	RDSO/T-6937

vii. 136RE Rail on 60KG/138RE Sleeper -RDSO T-7008 (1676 mm Gauge)

ERC	CGRSP	Liner
		Metal
Mark-V (RDSO/ T-5919)	10 mm (RDSO/ T-7010)	RDSO/T-8256

viii. 60 Kg Rail on Wider Sleeper -RDSO T-8527 (1673 mm Gauge)

ERC	GRSP	Liner	
		GFN	Metal
Mark-V (RDSO/ T-5919)	10 mm (RDSO/ T-8528)	GS - RDSO/ T-6938	GS - RDSO/ T-8616
		NGS- RDSO/ T-6939	RDSO/ T-8617

ix. 136RE Rail on Wider Sleeper -RDSO T-8527 (1673 mm Gauge)

ERC	GRSP	Liner	
		GFN	Metal
Mark-V (RDSO/ T-5919)	10 mm (RDSO/ T-8528)	GS - RDSO/ T-6937	GS - RDSO/ T-8618

2.3 The track structure for operation of Passenger **train for speeds beyond 110 Kmph and up to 160 Kmph on** Indian Railway routes is given as under (Para 202 of IRPWM)

Speed	**Speed above 110 Kmph and up to 130 Kmph**	**Speed above 130 Kmph and up to 160 Kmph**
Rails	60 kg 90 UTS	60 kg 90 UTS
Sleeper/ Sleeper Density	PSC at 1660	PSC at 1660*
Note - * Wider and Heavier PSC sleeper shall be used during renewals		

Ballast Cushion in mm	Total 300 clean 150	Total 350 clean 150
Turnouts		
Switch	Thick Web Switches on all turnouts	Thick Web Switches on all turnouts
Crossing	CMS	Weldable CMS
SEJ	Improved Type	Improved Type
Bridge Sleepers	H – Beam Sleepers/Composite sleepers	
Level Crossings	Interlocked	No Level crossing
Fencing	All along the track	All along the track
Curves	All the curves shall be suitably realigned and proper transition lengths shall be provided. Maximum permissible cant of 165 mm can be provided in the section so that speed potential on curves is fully exploited, however, this shall be subject to the consideration of maximum cant excess for the slowest moving train. This will require survey of each curve including the fixed installation and thereafter realignment should be undertaken keeping all the constraints in view. With a cant deficiency of 100 mm, the maximum permissible speed on 1 degree curve and 2 degree curve works out to be 160 Kmph and 130 Kmph respectively for 165 mm cant.	

Note -
In case track structure does not fulfill the above requirement, relevant instructions of Railway Board would be referred.

2.4 Prescribed Track Laying Tolerances for Plain Track:

2.4.1 Variation in Track Geometry:

The acceptable variations in track geometry measured in floating condition for track linked using new materials are . (As per IRPWM Para 520(3).

Gauge	Sleeper to sleeper variation	2 mm
Expansion gap	Over average gap worked out by recording 20 successive gaps	+/- 2 mm
Joints	Low joints not permitted High joints not more than	2 mm
	Squareness of joints in mm with straight line.	+/-10mm
Spacing of Sleepers	With respect to theoretical Spacing	+/-20mm
Cross level	To be recorded on every 4th sleeper	+/- 3 mm
Alignment	In straight on 10 m chord	+/- 2 mm
	On curves of radius more than 600 m on 20 M chord Variation over theoretical versines.	5 mm
	On curve of radius less than 600 m on 20 m chord Variation over theoretical versines	10 mm
Longitudinal Level	Variation in longitudinal level with reference to approved longitudinal section	50 mm

The track geometry will to be recorded three months after the speed is raised to normal by TRC in loaded condition and the result should be within limits specified in IRPWM .

1. SD Based

S. No.	Parameter	Speed up to 100 Kmph	Speed above 100 Kmph and up to 160 Kmph
1	UN-1	2.0 mm	1.4 mm
2	UN-2	-	1.9 mm
3	AL-1	1.4 mm	1.1 mm
4	AL-2	-	1.3 mm

The limits for alignment are variation from the design versine of curves

2. Peak Based

S. No.	Parameter	Speed up to 100 Kmph	Speed above 100 Kmph and up to 160 Kmph
1	UN-1	6.0 mm	4.0 mm
2	UN-2	-	6.0 mm
3	AL-1	4.0 mm	3.0 mm
4	AL-2	-	4.0 mm

For this Chord length taken as

S. No.	Parameter	Short Chord/Base	Long Chord/Base
1	Unevenness	9.0 m (UN-1)	18.0 (UN-2)
2	Alignment	9.0 m (AL-1)	15.0 (AL-2)
3	Twist	3.0 m (TW-1)	15.0 m (TW-20

2.4.2 Gauge on Straight and Curved Track:

The Nominal gauge on Indian Railway Track in 1676 mm. The limits specified for new construction vide para 403 of IRPWM are:

S.No.	Radius in m	Gauge
1	Straight including curve of radius up to 350 m and more*	-5 mm to +3 mm
2	For curves of radius 350 m or less**	Upto +10 mm

* Ordinary sleeper to be used.
**Specially designed sleepers to be used.

Each component of track has permissible dimensional tolerances in their manufacture/laying. Even though adequate care is taken while specifying these tolerances, any adverse combination of such tolerance in two or more components can affect the final result and therefore it is very necessary to avoid such situations.

To appreciate the situation, let us take a case of 52 Kg rail on 52 Kg sleeper.

- 52 Kg Rail Flange width = 136 MM
- Liner thickness = 5.5 MM
- Tolerances in distance between outer insert is +1.5 mm to 0

  Implies tight gauge on this account is not possible, but slack gauge is possible.

- Distance between inserts at rail seats = 148 mm (Tolerance = +1.5 mm, - 0.0 mm).

  Implies, if distance between Rail seat is correct and equal to 148 mm, tight and slack gauge contribution individually by each rail is:

148-136-(5.5+5.5) =1 mm

i.e. Tight/slack gauge possible is 2*1=2 mm.

Maximum tight Gauge possible:

- If concrete sleeper is manufactured at insert distance tolerance of +1.5 mm i.e. inner inserts at both rail seat is further inside by 1.5 mm, tight gauge can further increase by 1.5*2=3 mm.

  Maximum tight Gauge possible will thus be- 2+3 = 5 mm

Maximum wide Gauge possible :

Wide gauge will be decided based on distance between outer inserts. If the same is taken as at +1.5 mm at both insert location.

Wide gauge on this account will be 1.5
Inbuilt wide gauge possibility as discussed above
= 2*1=2 mm
Implies Maxm wide gauge possible is 3.5 mm

So the gauge variation possible in the below combination of rail and sleepers will be

Sleeper	Distance between inserts (mm)	Rail	Rail Bottom width (mm)	Liner thickness (mm)	Gauge Variation due to tolerance (mm)
52 Kg (T-2495)	148	52 Kg	136	5.5	+5 to -3.5
60 Kg (T-2496)	162	52 Kg	136	9 (GS) & 15 mm (NGS)	+7 to -5.5
60 Kg (T-2496)	162	60 Kg	150	5.5	+5 to -3.5

2.5 Special Track Structures:

2.5.1 Points and Crossing: Different points and crossing layout used on IR are given below

S.No	T/O Type	Switch	RDSO Drawing
1 in 8.5	F/s	ORS	RDSO/T-4865 - 4866
1 in 12 (52 Kg)	F/s	ORS	RDSO/T-4732-4734
1 in 12 (60 Kg)	F/s	ORS	RDSO/T-4218-4220
1 in 12 (52 Kg)	F/s	Thick web	RDSO/T-5268-5268
1 in 12 (60 Kg)	F/s	Thick web	RDSO/T-6154-6155
1 in 16 (60 Kg)	F/s	ORS	RDSO/T-5691-5693
1 in 16 (60 Kg)	F/s	Thick web	RDSO/T-7075-7076
1 in 20 (60 Kg)	F/s	ORS	RDSO/T-5858-5860

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CHAPTER 3

TRACK RENEWAL SANCTION AND PLANNING

3.1 Introduction:

Track renewal work is to be got sanctioned from Railway Board . Its execution then requires lot of planning at all level right from arranging materials, arranging machines, awarding contract, arranging traffic block etc. This chapter deals with the planning involved from getting the work sanctioned to its execution.

3.2 Track Renewal Programme:

1. The track renewal proposal is initiated by Division based on the condition of track and its components.
2. The proposal should be initiated well in advance, keeping in mind that two years may elapse before the actual execution way start a site.
3. It shall include an abstract estimate of the cost of work and detailed narrative justification covering technical and financial aspects.
4. All such proposals sent by division is scrutinized at chief engineers office and then sent to Railway board for sanction.
5. On receipt of Railway Board's sanction to the track renewal program, detail estimate of work is prepared.
6. The estimate to have provision of staff and supervisors as per requirement.
7. Arrangements will be made by the Headquarters for supply of track materials to the Divisions and for co- ordinated execution and control over the works.
8. Sidings and yards close to worksite to be chosen for

stabling of machine and for constructing base depots.

9. All traffic facilities including block planning should be made in advance.
10. A proper project report to be made for systematic and time bound execution of work.

3.3 Codal Life of Railway Asset:

Codal life of all railway assets have been also specified in Indian Railway Finance Code Vol-I and circulated vide Railway Board letter no .20022/AC-II/1/10 dated 24.05.06. Life of some of the track components specified are produced below:

S.No.	Asset	Average life in years Routes			
		A&B	C(Sub)	D	E*
1	Rail	20	15	30	30
2	Concrete sleepers	35	35	40	40
3	ERC	5-8	5-8	8-10	8-10
4	Rubber Pads/Liners	2-4	2-4	4	4-6
5	Switches	4	2/3	5	5
6	Crossing	5	4/5	8	8

The service life or criteria for renewal, if specified in IRPWM or through railway board letter is to be taken for planning renewal.

3.4 Criteria for Rail Renewal (Ref Para 702 of IRPWM):

i. Incidence of Rail fracture / failures.
ii. Wear on rail.

iii. Maintainability of track to prescribe standards.

iv. Expected service life in terms of Gross Million Tonnescarried.

v. Plan based renewals.

i. Incidence of Rail fracture / failures:

Section having number of rail renewal due to rail fracture and/or due to IMR defects are 5 per 10 km shall be given priority while deciding rail renewal. Through Rail renewal is also allowed if numbers of defective welds existing are more than 30 per kilometer.

ii. Wear on Rail:

a. Limiting loss of Section: if loss in section is 6% in case of 52Kg rail and 7% for 60 Kg. This can be known by taking actual weighment or by taking the rail profile of existing rail at rail end with special type of gadgets

b. Wear due to corrosion: Corrosion beyond 1.5 mm on web and foot of rail may be taken as criteria for rail renewal. Localized corrosion such as corrosion pit specially under rail foot and liner biting on rail foot acts as stress riser from origin of fatigue crakes and would necessitate renewal.

c. Vertical wear: If the vertical wear exceeds prescribed limiting wear of 13 mm for 60 kg and 8 mm for 52 kg rail. Wear should be measured at centre of rail head by measuring height of the rail by calipers or by taking profile of worn out rail.

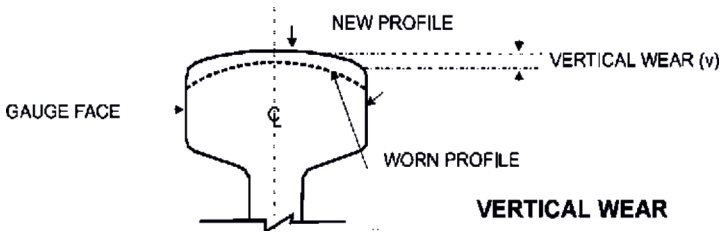

Fig. 3.1 Vertical Wear

d. Lateral Wear : Limits of lateral wear from relaying considerations are as under

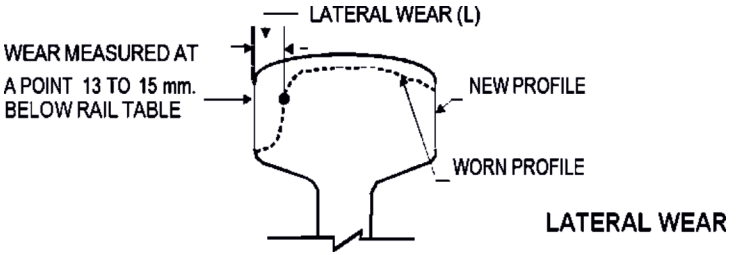

Fig. 3.2 Vertical Wear

Section	Gaug	Category of track	Lateral wear
Curves	B.G.	Group 'A' & 'B' Routes..	8 mm.
		Group 'C' & 'D' Routes ..	10 mm.
Straight	B.G.	Group 'A' & 'B' Routes..	6 mm.
		Group 'C' & 'D' Routes	8 mm.

iii. Maintainability of track to prescribed standards: In case of poor running quality of track in spite of extra maintenance efforts is also a criterion for TRR. This may be in case of excessive battering / hogging, wheel burn or scabbing on rail top.

iv. Expected service life in terms of total G.M.T. of traffic carried (ACS-2 of IRPWM) – The rail shall be planned for through renewal after it has carried the minimum total traffic is given below. For tunnel and 100 m approaches and major & important bridges on high embankment (>4m) including 100 m approaches the life will be half of the GMT shown below.

	Service life in terms of G.M.T. carried	
Rail Section	72 UTS	90 UTS rails
52 Kg/ m	350	525
60 Kg/ m	550	800
60 Kg/m		1000 (On routes covered by Rail Grinding)

v. **Plan based Renewals –** Renewals to pre-determined plan with the objective of modernising the track structure on selected routes in the quickest possible time may be planned even if it involves premature renewals.

3.5 Criteria for Sleeper renewal (ACS-2 of IRPWM):

Generally a sleeper is serviceable if it can hold gauge, provide satisfactory rail seat and permit rail fastenings being maintained in tight condition, and retain the packing underneath the sleepers. Sleepers will be considered for replacement when

a. They have developed a notch of 3mm and are unable to perform the said function.

b. Through renewal to be considered where such sleeper exceeds 20% in the stretch

c. In girder bridge if several sleepers are defective, full span sleeper to be replaced.

1.	PSC Sleeperss	For Plain Track 2000 GMT or 35 years whichever is earlier or on condition basis as decided by CTE

3.6 Criteria for Fitting Renewal (ACS-2 of IRPWM):

Sr.No.	Item	Service Life
1.	GFN-66	LinersFor Plain Track 200 GMT of 4 years whichever is earlier or on condition basis as decided by CTE
2.	Metal Liner	For Plain Track400 GMT of 8 years whichever is earlier or on condition basis as decided by CTE
3.	ERC	For Plain Track 400 GMT of 8 years whichever is earlier or on condition basis as decided by CTE
4.	GRSP	For Plain Track 200 GMT of 4 years whichever is earlier or on condition basis as decided by CTE
5.	CGRSP	For Plain Track 400 GMT of 8 years whichever is earlier or on condition basis as decided by CTE
Note: The service life of P. way components at special locations like turnout ,CC apron, curves sharper than 5*,5EJ gradient sharper than 1 in 100,coastal areas ,station yards including approaches etc.is 50% of that of plain or on condition basis as decided byCTE.		

3.7 Criteria for Switch and Crossing Renewal:

Para 424 of IRPWM specifies that, Tongue rail and stock rails should be replaced/ reconditioned when vertical/lateral wear exceeds the values laid down.

AS per para 429 of IRPWM, maximum permissible vertical wear on wing rails or nose of crossing shall be 10 mm. However, on Rajdhani/ Shatabdi routes, as a good maintenance practice, crossing and the wing rails should be planned for reconditioning/resurfacing by welding on reaching the following wear limits:

a. Built up/Welded Crossing– 6 mm

b. CMS crossings– 8 mm

In terms of GMT, the life of switch and crossing are

Item	Life in GMT	
	52 Kg	**60 Kg**
Fabricated ORS switch	250	300
Thick web switch	500	800
CMS crossing- After carrying out three rounds of in-situ reconditioning using robotic welding machine	350	350
CMS Crossing- After carrying out three rounds of in-situ reconditioning using H3B/H3C IRS electrodes.	300	300

3.8 Project Report for Track Renewal Works:

(Ref: Para 709 of IRPWM)

For every sanctioned track work e.g. CTR, TSR, TRR, deep screening, bridge timber renewal, etc. a detailed project report should be prepared. The report should cover the following aspects:

a. Details of work – Name of the work, scope of work, cost of work, estimate details, exact location, reference of pink book to be given..

b. Existing track structure – Details of existing track component with deficiency if any, ballast deficiency in track, width of formation and other details should be taken as prescribed in P.Way diagram, details of level crossings, bridges, curves, height of

bank/cuttings, details of yard if work to be done in yard, sidings, etc. should be given.

c. **Classification of track materials -** During taking inventory of the existing track structure by foot to foot survey, identification, classification and colour making of existing track materials as second hand and scrap would be done.The classification should be approved by the competent authority. Action plan for stacking/ storage and disposal of the released materials should be clearly indicated. Inventory of existing track materials would normally be prepared jointly by the PWI of the section and the PWI (Spl) for the renewal.

d. **Proposed track structure -** The proposed P.Way diagram of the affected length should be prepared in the same format as done for the existing track structure and incorporated in the project report.

e. **Existing/proposed gradient profile -** The levels of existing track should be taken at every 20 metres and a gradient diagram prepared. Introduction of vertical curves should be critically examined and the proposed profile of track shown in red line indicating the proposed grades.

Lowering of track should be avoided. Precise lift of track at girder bridges should be worked out and a separate scheme developed for lifting of girders on each of the affected bridges. Similarly, the magnitude of lifting at level crossing should be worked out and indicated in the report. Care should be exercised to keep the road surface in one level on level crossings spanning to across multiple tracks. This may require regrading of adjacent lines too.

f. **Realignment of curves -** All curves should measured and slew to be calculated for realignment if any considering the obligatory points.

g. **Method of execution –** The sequence of work should be indicated. Generally the work should be executed "bottom upwards" i.e. formation, ballast, sleepers then rails. In case of mechanized renewal, this sequence may not be followed exactly.

h. **Formation:** The project report should indicate the plan for widening of formation in both banks and cuttings wherever necessary. Provision of proper drains in cuttings should also be planned.

Formation treatment: Areas needing formation rehabilitation should be identified and a study for possible solutions and method of execution of the rehabilitation scheme should form part of the project report.

i. **Ballast:** The requirement indicating bifurcation of cess supply and depot supply and the source and means of each should be indicated. Mode of providing ballast cushion i.e. deep screening or raising should be identified along with sketches of cross sections present and proposed.

j. **Transportation of P. Way materials:** The mode of transportation for various tracks components and unloading of rails and sleepers in particular, at the work sites / depot should be indicated in the project report.

k. **Welding:** The complete details of welding requirements, and arrangements need to be made for its execution whether departmentally or through contract should be clearly indicated in the report.

l. **Renewal of turnouts, bridge timbers, etc:** Complete details of turnouts, bridge timbers, level crossings, etc. where renewal is to be carried out should be indicated. Whether turnouts are to be laid manually or by mechanized means, with arrangements made. The report should also

include the mode and agency for overhauling and relaying and making up of road surface at the level crossings

m. **Use of machines:** The machines that would be deployed for renewal, deep screening, and stabilization and tamping should be identified with staff nominated. The planning for repair and fueling of machines at the works site. The requirement of additional lines in the existing yards for making base depot and arrangements made for the same should be indicated in the report.

n. **Contracts:** The contracts required for various activities of works and planning for deployment of staff/supervisors for execution at various activities should be indicated.

o. **Material planning:** The material requirement should indicate the materials to be arranged by the headquarters and by the Divisions. Rails with length, sleepers (including special type of sleepers), fastenings, switches and crossings, bridge sleepers and fittings, etc. should be fully covered.

p. **Manpower planning:** The requirement of manpower including the officers, supervisors, and other staff should be worked out with minute details. The arrangements made for camping of these officials and mobilization should be reflected in the report

q. **LWR/CWR plans:** The LWR plan should be got approved by the competent authority in advance which should be a part of the project reports.

r. **Requirement of speed restrictions:** The report should indicate requirement of speed restrictions and traffic blocks with duration. The corridor for blocks is required to be planned in consultation with the Operating Department and accordingly reflected in the report after obtaining the approval of

DRM. Arrangements made for various types of wagons for transportation of ballast, sleepers, etc. together with requirement of locomotives should be indicated in the report in consultation with Sr. DOM and with the approval of DRM.

s. **Monitoring mechanism:** The list of all activities involved and the time estimation for each activity should be worked out. These activities should be sequenced and co-related in logical manner and network diagram prepared using CPM (Critical Path Method) method. The critical activities should thus be identified. These should form part of the project report.

The detailed project report covering the various points as mentioned above should be prepared as soon as the approval of Board is received for inclusion of that work in FWP. These reports should be submitted to headquarters for scrutiny and approval.

3.9 Preliminary Survey before Execution:

Requisite survey shall be carried out deciding final rail level. Longitudinal section showing the existing rail levels should be plotted showing the location of permanent structures like girder bridges, level crossings etc. Decide the proposed rail level taking into consideration the following points and as per relevant provision in the IRPWM and Schedule of Dimensions 2004:

i. Minimum 350mm ballast cushion is available below the concrete sleepers.

ii. Elimination of sags and humps.

iii. Clearances between structures is not infringed. Wherelifting of track is not possible at places like-below ROB, FOB, on girder bridges and in yards, etc., suitable ramp should be decided.

iv. On electrified section, clearance from OHE staff shouldalso be taken before deciding final rail level.

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CHAPTER 4

TRACK RELAYING MACHINE (TLE)-FOR SEMI-MECHANIZED PLAIN TRACK RELAYING

4.1 Introduction:

Mechanized Relaying is "Replacement/ renewal of complete track or one or more of it's components namely rail, sleepers or turn outs etc. with the help of machines"

Earlier, most of the track relaying was done manually but now mechanized track relaying is preferred due to following reasons.

I. Due to Heavy track structure, manual renewal is very difficult.
II. Due to increased traffic, availability of traffic blocks is limited.
III. In manual relaying, output was very less, whereas mechanized renewal gives better productivity.
IV. Manual relaying was interrupted frequently due to change in season whereas in mechanized relaying, progress is independent of seasonal variation.
V. Better quality in mechanized relaying which was very difficult in manual relaying.
VI. Due to slow progress manual relaying was not economical whereas mechanized renewal is economical in long run.
VII. Most importantly, work site is more safe in case of mechanized renewal. Mechanized renewal is done in traffic Block whereas sleeper changing in manual was being done under speed restriction which inherently had safety issues.

4.2 Mechanized Renewal of Plain Track:

There are two machines working on Indian Railways of Mechanized Relaying of Plain Track :-

i. **Track Laying Equipment (TLE):** Panel wise renewal is done by this machine i.e a prefabricated new panel of one rail length replaces existing panel of similar length one by one.

ii. **Track Relaying Train (TRT):** Component wise replacement is done by this machine i.e sleepers and Rails are replaced one by one in a continuous process. In this system only sleepers or rail can be replaced or both can be replaced together. Track Relaying Train (TRT) is used for this type of replacement.

Note: T-28 Machines with Indian Railways used for points and crossing renewal can also be used for Panel wise plain

4.3 Track Laying Equipment (TLE):

It is a semi-mechanised system of track renewal consisting of self-propelled portal cranes capable of moving on a Auxiliary Track of 3400 mm gauge. Normally two such portal cranes as a set are used. Both portal cranes and pre-assembled panels are taken to the site. Portal cranes are unloaded on auxiliary track of 3400mm gauge track and taken to the work location , where it lifts the old track and places the new pre-assembled panels. For this Old track is cut in 13 M (approx.) length. Two empty BFRs are also taken to the site in which old dismantled track is loaded. The portal crane with lifted prefabricated panel is shown below:

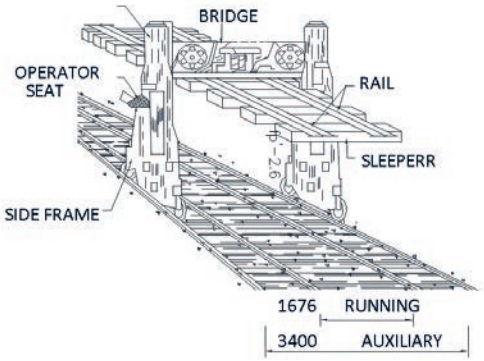


Fig. 4.1 PQRS Portal

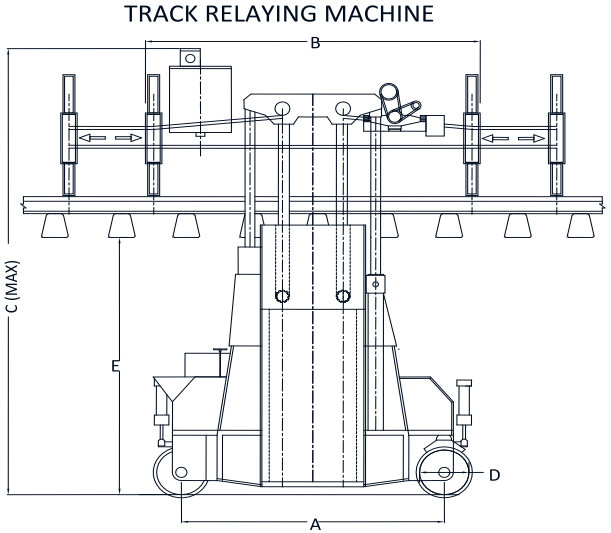
The fabrication of new panel and dismantling and disposal of released materials is done at Base depot.

4.4 Types of Track Laying Equipment:

TLE's with lifting capacity of 9 t and 12 t are in use on Indian Railways

Lifting Capacity	Manufacturers
9 tonnes	• Plasser India (PQRS) • BEML and • Simplex
12 tonnes	• Simplex

The dimension of different TLE's on Indian Railways are tabulated below.



MACHINE MODEL	A	B	C	D	E	OVER ALL WIDTH	AUXILARY TRACK GAUGE	LIFTING CAPACITY
12T CAPACITY	2400	3150	4450	450	2725	3850	3400	12T
9T CAPACITY	2400	3050	4390	450	2665	3860	3400	9T

ALL DIMENSIONS ARE IN MM.

Fig. 4.2 Dimensions of TLE

In the latest machine (12 T) capacity provision has been kept to increase the distance between holding points, i.e dimension B in above Fig 4.2.

The working mechanism of all the above models is similar.

The portal crane consists of following major components:

1. Side vertical main frames
2. Bridge which is the horizontal cross frame.
3. Sleeper Gripper to hold the sleepers from end.
4. Rail Clamps for holding rails for lifting fabricated and dismantled panel.
5. Turn Table for rotation of portal required during loading and unloading of portal.
6. Double flanged powered wheels for movement of portals on auxillary track.

4.5 Sequence of Track Laying with TLE.

The sequence of laying followed are:

1. Panels are fabricated with new sleepers & service rails in a Base Depot. These panels are loaded on BFRs in 2 or 3 layers.

Fig. 4.3 TLE (Plasser Make) Working in Base Depot

2. Speed restriction of 30 Kmph is imposed at site. The existing rails in track are cut in length of 12.6/13m, if rail is also to be replaced i.e. CTR(P) is planned. If TSR is planned, then existing rail is replaced by service rail of 12.6/13m.

3. New 20 RP for CTR(P) is unloaded at site and is used in making AT. Auxiliary track in case TSR(P) is planned with the existing rail released by replacing it with service rail. Auxiliary track is laid to proper line & level.

4. TLE rake is then brought to site of relaying in a train formation after getting proper traffic & OHE block.

5. Following three methods of laying of new panels are used depending upon site conditions:
   - Pulling the rake formation
   - Pushing the rake formation
   - Parting the rake formation

   In the pulling mode, the rake is standing on the existing track and is pulled away from the work site. This has an advantage that newly laid track is available for post laying work. This is the most commonly used method for renewal by TLE.

   In the pushing mode, the rake is pushed towards the work site and moves on the newly laid track. While approaching a bridge or yard, where auxiliary track cannot be continued, this method of laying is used.

   In parting mode, the rake is divided into two parts and work is performed in between. In jumbo traffic blocks, by dividing the rake into two parts, of new panel wagons and empty wagons, and using the portals, one for removing old panels and other for laying new panels, travelling time of portals can be reduced.

6. Portals are unloaded on Auxiliary track.

7. Old panels (12.6/13 m) are removed & loaded on TLE rake.

8. Ballast bed is scarified manually.

9. New Prefabricated panels are laid at site by using portal cranes.

10. Proper ramp provided at the beginning & at the end of the day's work.

11. Rail renewal for replacing service rail with rail in auxiliary track i.e. new 20 RP or released rail from previous track.

12. Welding these rails , correction of track alignment and packing under sleepers are subsequently done.

4.6 Base Depot:

4.6.1 Activities at Base Depot:

- Unloading & stacking of New PRC Sleepers
- New panel fabrication
- Loading of fabricated panel into BFR
- TLE Rake formation. The rake composition shall be as given below.
- Unloading of released panels brought from site.
- Dismantling released panels
- Segregating & stacking released material
- Paint marking on released rails
- Dispatch of released materials
- Machine maintenance

4.6.2 Base Depot-Location, Layout and Facilities:

Selection & development of proper base depot is very crucial for proper and efficient working with TLE.

Following care should be taken while deciding the location of base depot:

1. The Relaying site should be within 30-40 Km of Base Depot.
2. It should also be accessible by road and should have electric power supply and watering facilities.
3. It should preferably have facility of entry and exit on both sides from the running line.
4. There should be enough space for:
   - Laying at least three lines of about 500 meters each connected to a shunting neck of minimum 350 meters. Out of three lines, at least two lines should be provided with auxiliary track (AT) for movement of portal cranes.
   - For stacking, storing, loading and unloading of new and old materials.
   - For providing site office and resting facilities for workers.

A typical layout of Base depot is given below:

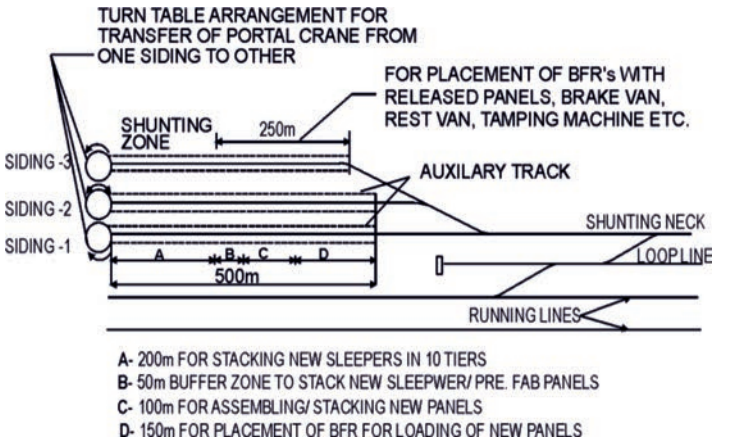


Fig. 4.4 Typical Layout of TLE Depot

In a typical depot, three siding around 500 m is provided. While siding 1 and 2 are used for fabrication of new panels and its loading in TLE rake, siding 3 is used for unloading of released panels.

All the three sidings are normally provided with turn table for shifting of TLE portal from one siding to another as per requirement. The typical track layout at the turn table location is given in Fig:4.6.

For limited work, we can have base depot with two sidings only as given below

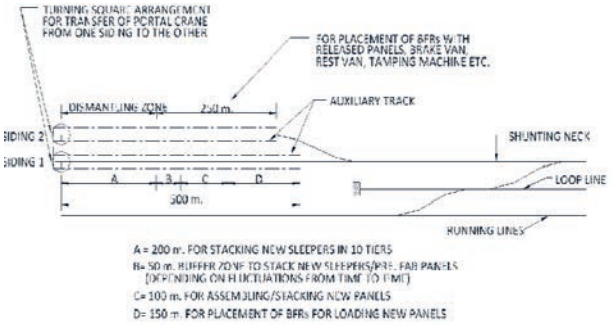


Fig. 4.5 Layout for Limited Output

However now the Base depot work is to be done with contractors' portal. These portals cannot rotate about Turn Table and are simple gantry cranes which moves on auxiliary track with provision to Loads and unloads Panels, unloads and loads the sleepers from Flat wagons. Thus, these cannot be shifted to other siding lines through turn table. Shifting is possible only by dismantling and refabricating it over other siding line.
Therefore, normally separate portals are provided on each siding line and turn table arrangement is not required.

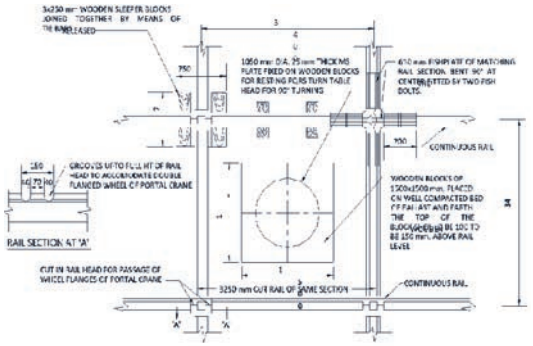


Fig. 4.6 Typical Layout of Turn Table

Following facilities to be provided at Base Depot:

(1) Lighting: It is desirable to illuminate the base depot so that the depot activities can be undertaken safely at night and to have enough plug points with 3 phase electric supply to facilitate welding/repairs required to the relaying equipment/machines.

(2) Communication: The base yard depot shall be well connected with Engg. Control of division, ZMD control as well as H.Q. and also the site of work for communication.

(3) Accommodation: The base depot shall have adequate camping facilities for staff, water supply arrangement and washroom facility apart from storage space for new as well as released material.

(4) Non-Electrified: It should not have Live OHE.

4.6.3 Quality Control at Base Depot:

The panel fabricated at Base depot is with Service rails on new sleepers and new fittings. The sleeper spacing at Base depot is retained at site. It is therefore important that quality of fabrication at Base depot is good. If proper care is not taken at base depot, end result at site will also not be upto the standards.

I. Service rails should be of same section by which TRR is to be done afterwards so that fittings are not required to be changed later.

II. Service rails should be of good quality and USFD tested. Rails having severe corrosion, liner bite should not be used as few trains will be passing over it before rail renewal is done.

III. All service rails to be exactly measured and length should be written by paint. For linking service rails, rails of equal measurement should be selected so that joint will be square at site. This will also ensure correct squaring of sleepers at site.

IV. While linking the service rails, it should be ensured that sleepers are placed squared.

V. For maintaining correct spacing, template should be used. In addition to this, paint marking should also be done on service rail.

VI. ERC and Inserts eye should be thoroughly cleaned. Grease confirmed to IS: 08-1981(Specification for Grease No. 'O' Graphited) should then be applied on the central leg of the E.R.C. and eye of the insert and then the clip should be driven at the time of assembly of the service panel.

VII. In the fabricated panel, all fittings i.e. rubber pad and liners should be new and should be the same as to be provided finally at site. Rubber pad may even be glued to the sleepers, to avoid its falling while changing rail at site.

VIII. Sufficient new panel should be taken to block depending on tentative traffic block planned. The progress expected in block is discussed later.

IX. Sufficient number of buffer stock of new panel for next two blocks normally should be kept in readiness so that work at site is not hampered due to base working.

X. Proper rake formation should be ensured, depending on laying procedure to be followed at site on that day. The typical composition consisting of 2-empty BFR, 16-20 loaded BFR, 1-Crew rest van, 1- Brake Van is shown below. Renewal of track in this case is on rear empty BFR side.

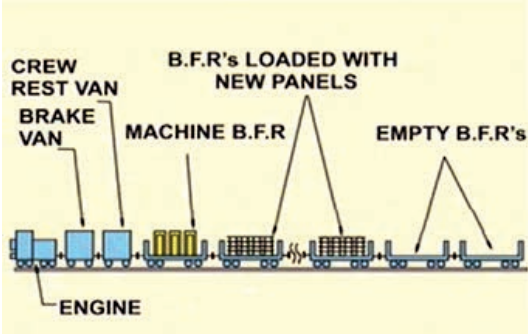


Fig. 4.7 Formation of PQRS Rake

4.7 Pre Block Activities at Site:

(a) Deep Screening: As far as possible deep screening if due should be completed prior to PQRS as the preparing bed is very easy on screened track.

(b) Alignment and Level marking : To maintain the alignment and level, take the measurement of existing track from fixed references at every 30 Meter. After laying the track with PQRS, same should be checked and corrected if required.

(c) If section is electrified, proposed rail level and Alignment can be written by paint on each OHE mast.

(d) Auxiliary track (AT) should be laid at 3,400 mm gauge keeping the center line same as that of main line track, as shown in Fig 4.8. CST-9 plates or wooden blocks of size 560 × 250 × 125mm should be used at 1.5 to 2.0 metres distance for laying the auxiliary track. The supports should not be extended beyond 250 mm inside of the track . The length of auxiliary track should match with the daily progress of work.

(e) Special care shall be taken while preparing Auxiliary track (AT) in curves such that any major alignment of curve & adjustment of SE can be avoided, especially in the summer months.

(f) Centerline of main track and auxiliary track should be same so that clamps of the portal will grip the both rails of the main track.

(g) Rail level of main track and auxiliary track should be same or maximum 50 mm above the existing track level, otherwise clamps of portal will not be able to grip the rails of main track. Lower AT adversely affects the clearance available over the Flat Wagons and hence it is undesirable.

(h) Rail head of auxiliary track should be clear from ballastjam otherwise movement of portal will be obstructed.

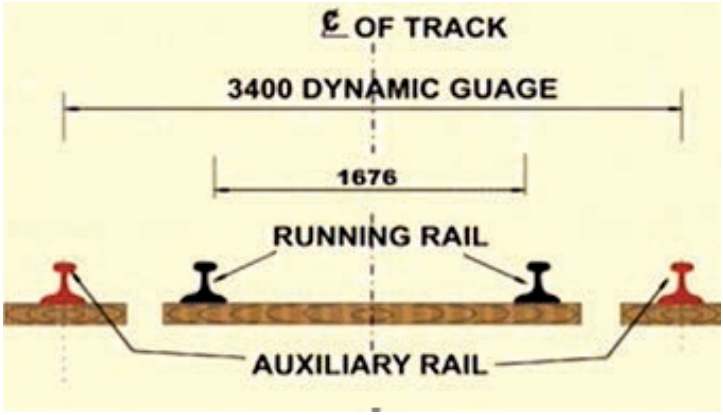


Fig. 4.8 Layout of Auxiliary Track

(i) AT may be prepared by using 20 RP new rail if TRR is also planned. If only TSR is planned, existing rail should be replaced with service rail of single rail length and the released existing rail to be used for AT.

(j) If TRR is planned, cutting of LWR/SWR to single rails is sufficient length should be done in advance for lifting released panels.

(k) If only TSR is planned, replace the existing running rail by service rails for the stretches, which are to be re-laid during the next day.

(l) Full fittings of the old sleepers should be ensured to avoid it's falling off while lifting released panels.

(m) Sleepers must be in single piece. All Broken sleepers should be removed or replaced in advance with released good sleepers preferably.

(n) On girder bridges, the guardrails at the approaches on both ends should be removed temporarily.

(o) In case a level crossing is to be encountered, it should be opened in advance and renewed along with approach track.

(p) Proper planning and insertion of Switch Expansion Joints at correct locations should be ensured.

(q) Temporally disconnect or remove any other permanent obstructions such as cables, signalling rods, axle counters and any other installations like embedded rail pieces, tie bars, OHE connectors etc. to allow unhindered progress of work.

(r) Presence of S & T and OHE staff shall be ensured and jumpers should be provided where required.

(s) Availability of under noted equipment should be ensured at site

- One set each of rail cutting and gas cutting equipment in good working condition.
- Two sets of rail closures of the each rail section being laid, in various sizes from 0.5m to 3m lengths.
- 4 sets of junction fishplates with bolts and clamps, in case existing rail section is different from the one being laid.

(t) Portable walkie-talkie sets should be provided at each relaying site for effective communication between the site of work and the adjoining stations.

(u) Wherever AT cannot be provided (e.g. on girder bridge, near P & C, i.e. in station yards), working direction of TLE shall be planned well in advance.

(v) Fabrication of panels involving special sleepers like LC, Bridge etc., shall be fabricated and loaded according to requirement.

(w) Power and crew arrangements should be done in advance.

(x) Sequence, arrangement of rake formation and position of machines shall be planned and conveyed to ASM on duty.

(y) Before entering into the block it must be tested and ensured that emergency back-up system of machine equipment is in working order. The Duplex and simplex chains should also be tested and made fit.

4.8 Activities During TLE Block:

(1) The block requirement for laying 20 panels by TLE is as below:

S.No.	Activity	Time (min)
1.0	Movement of relaying train to reach site of work, after block is permitted	10
2.0	Portal crane to start work after obtaining OHE block, unloading of portals from BFR	10
3.0	Total time required for relaying 0.26 km. of track (20 panels) at the rate of 2 panels per 8 min. with 2 nos. of portal.	75
4.0	Fixing of closure rails, loading of portals in BFR's and clearance of OHE block.	15
5.0	Relaying train to clear the block section after the work	10
Total Block Time		120 min (2 hrs)

accordingly, enough block to be planned.

(2) After ensuring attachment of discharge rods (jumpers) on either side of the working place, portals should be unloaded.

(3) Firstly, required numbers of existing track panels shall be removed to create working space.

(4) Thereafter, sequence of portals shall be so arranged that maximum output can be achieved.

(5) Sufficient labour shall be kept for alignment and linking of track, filling of ballast and packing the sleepers for passing the trains safely after clearing the block. If, TRR is also planned, separate labour with supervisor shall be deputed.

(6) While laying of the fabricated panels, due care shall be taken to keep required gaps at joints, keeping in mind the rail temperature and working season, particularly in curved track. Square-ness of joints & sleeper squaring should also be taken care of.

(7) One 12.60m track panel of 60 Kg rail and PSC sleeper weighs about 7.5 t. Thus unlike 9t portal, 12 t portal can carry two 12.60m released service rails also with the released panels. This saves the effort to separately carry the released service rails from the work site to the depot

The released service rails of previous day TRR work should therefore be loaded on the cut panels to be lifted and taken to base depot.

(8) At the end of the day's work, gap between the old track and new track shall be made up with the help of rail closure on both the rails, giving ramp not steeper than of 25 mm / rail length of 12.6 m.

(9) If there is level difference between new and old track, joints shall be fish plated and clamped/bolted tightly to pass the traffic.

(10) Fill up crib ballast during block period otherwise sleepers will get out of square.

(11) All the four bolts should be provided and tightened before clearing the block.

(12) If the existing and renewed rail section are different, Junction Fish Plate to be provided. At the junction joint, there should be no gap. Also provide wooden block at the junction joint.

(13) During block, continuous watch shall be kept on AT on which portals ply for its stability and continuity.

(14) The output shall be reviewed judiciously in the context of quality and quantity, both. The output expected with a set of portals are:

1st hour	–	20 Panels
2nd hour	–	17 panels

3rd hour	–	14 panels
4th hour	–	11 panels

(15) Clearance of track from any obstructions, infringement to SOD, for FOB/ROB/any other fixed structure/signal post etc. and implantation distance in case of electrified sections, before cancellation of the traffic block.

4.9 Activities after TLE Block:

(1) Picking up of left-over released materials.

(2) Dismantling of auxiliary track and relaying the same in advance for the next day's work or use it for TRR as the case may be.

(3) Rail Changing: This activity is normally carried in the shadow of TLE block

(4) Before taking the block, ensure that rails are painted with anticorrosive paint as per specification.

(5) At the closer of TRR work, provide a piece of new rail of around 6m between new rail panel and old rail otherwise joint will be battered and afterwards, weld may be defective.

(6) Rail welding: Mobile flash butt welding should preferably be done to convert the track into LWR. Proper destressing after welding should be done at Td.

(7) Ballasting: Training out of adequate quantity of ballast over the newly relayed track to full ballast section. Ballast recoupment activity should be properly synchronized with the relaying as to enable raising of speed to normal in three cycles of tamping by on-track tampers.

(8) Aligning, Levelling and Packing: Tamping machines with DTS for Lining, Levelling, Packing of Ballast and compaction/stabilization of track to

raise the speed of the different stretches as discussed in para 8.6 of this book. The reference marks provided on OHE mast should be used for the purpose.

(9) Restoration of cables, OHE connectors, axle counters and other fixtures e.g. checkrails on level crossing, which were removed temporarily.

(10) Provision of SEJ as per approved plan. In-situ welding of panels and de-stressing of LWR should be done after welding of panels.

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CHAPTER 5

TRACK RELAYING TRAIN (TRT) – FOR FULLY MECHANIZED PLAIN TRACK LAYING

5.1 Introduction:

As discussed in last chapter, track renewal with TLE are subject to following limitations:

- It is Semi mechanized process and activities like Rail renewal (TRR) is done manually or by using other machine.
- Laying is not continuous and panel by panel laying is done
- Auxiliary Track laying is tedious activity.
- Requires rear Rail renewal (once/twice). If CTR(P) is done it is once, if TSR(P) it is to be done twice.
- Requires free Rails (service rails) for auxiliary Track linking.
- Base depot activities and arrangements involves multiple handling of materials like unloading of new sleepers, fabrication of panel with these sleepers, loading of the new fabricated panels with these sleepers and finally laying at site.

Track Relaying Train (TRT) on the other hand is a complete mechanized track renewal system which removes old Rails and sleepers and inserts the new sleepers which are loaded in trains and then inserts the new rails which are already unloaded at site.

TRT can therefore perform following types of renewal:

- Complete Track Renewal (CTR)
- Thorough Sleeper Renewal (TSR)
- Thorough Rail Renewal (TRR)

Indian Railways started with Russian made TRT, however at present only model in use over Indian Railways is M/s Harsco Track Technologies, USA, Model No P 811-S. It does following work:

It does following jobs:

- Threads out existing rails from track.
- Removes old sleepers.
- Levels and compacts ballast bed.
- Places new sleepers.
- Threads in existing/new rails into track.

5.2 TRT M/s Harsco Track Technologies, USA, Model No P 811-S:

The model consists of three parts:

- **Beam Car(22.34m long)**

  The beam car is hinged with handling car and has one common bogie and one independent bogie. It carries the sledge used for supporting common bogie. Below this car, all the working units like old sleeper pickup, dynamic plough, sleeper flipper, indexing wheel (for sleeper spacing), self-guiding roller (for guiding in and guiding out rails), etc. are provided. If sleeper spacing is to be changed, this can be achieved by changing the indexing wheel. Sled is hung from this car when not in use.

- **Handling Car (21.05m long)**

  This car has one independent bogie and one common bogie with beam car. All the conveyors including New Tie conveyor are provided on this car.

- **Power Car(14.81m long)**

  This is a two bogie vehicle. TRT power unit is provided on half the length of this car and remaining half is utilized for loading of sleepers.

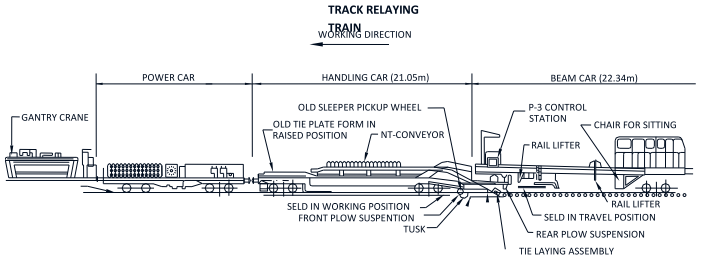

Fig. 5.1 Layout of TRT

5.3 Sequence of Working by TRT:

1) The TRT rake comprising of modified flat wagons with a flat type rail attached by the side for gantry movement and a bridge rail for connecting gap between wagons , loaded with sleepers, fittings etc and with TRT machine is brought to site by a separate locomotive.

Fig. 5.2 Bridge Rail between Two Wagons

2) At site, the locomotive is detached and TRT machine works with its own power.
3) At site if TRR along with sleeper renewal is planned, then 20 RP in unloaded and kept by the side of track.
4) One joint is created at location from where renewal is to start if TRR is not planned. If TRR also to be done then, a 7.0 m rail is cut at the start of work location.
5) The TRT is stopped at site of work in a position such that side plough is on first sleeper of cut rail.
6) Shoulder / Side plough is lowered and ballast from shoulder at the cut location is cleared.
7) Remove 7.0-meter-long rails closure. In case of TSR where single cut in rail is provided, the ERC of track to be renewed is removed in sufficient length and both the rail is slewed out.
8) Sled (3.4 m) from beam car is lowered on to the rail seats of sleepers at the location where rail closure removed or on space generated by slewing of rail.

9) This sled is fixed via chain to the rail on beam car side i.e where renewal has already taken place .

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Fig. 5.3 Sled being Connected to Rail.

10) Idle bogie of handling car is brought on to the sled and is locked with sled (by bringing back the machine). The chain fixing the sled with rail is removed.

Fig. 5.4 Bogie Placed over the Sled

11) Open some more fittings of rail on old track to be renewed i.e in front of working location and slew out both side rail using hydraulic system available in the machine.

Fig. 5.5 The Rail being Slewed Out

12) Similarly open the fittings of track already renewed on previous day i.e. in rear of working direction and connect this to the new rail laid by the side of track if TRR is planned. If only TSR is planned, connect this rail to the rail slewed in front of working location. Some closure rail piece will have to be inserted in between due to increased length.Thus, rail on both side of working area gets connected as shown below:

Fig. 5.6 Rail on One Side being Connected

13) Move TRT forward i.e. towards track to be renewed so that sled clears rail closure portion of around 7 m length.

14) Remove the old sleepers from this 7 m length manually and level the ballast bed.

15) Old sleeper pick up plough and dynamic plough are lowered in place cleared by removal of old sleepers.

Fig. 5.7 The Lowered Old Sleeper Pickup Plough

16) As the work starts and the machine moves forward, ERC of old track is removed the old rail is pushed out. Sled moved on the old sleepers. Old sleepers are picked up by the sleeper pickup plough. The levelling plough, levels the ballast bed.

Fig. 5.8 Work in Progress

17) After levelling of ballast sleeper feeding is done.

Fig. 5.9 Sleeper Feeding during Working

18) Index wheel of perimeter equal to sleeper spacing is used for ensuring equal spacing in an automatic mode.

Fig. 5.10 Index Wheel for Maintaining Sleeper Spacing

19) As TRT moves ahead old rails are threaded out and new rails or exiting rail are threaded in with the help of 5 no of guiding rollers provided all along the length of TRT.

Fig. 5.11 Threading in Rail

20) Rubber pad is placed on the laid sleeper before rail is threaded in and ERC's are provided after Rail are threaded in over the sleeper. Both these activities are done manually.

21) At close of work, cut in the old track at the closing of work site should be so planned that it matches with the rail end of new rail panel. Some extra gap is preferable, as the new rail while threading in is likely to straighten and extend.

5.4 Depot Activities:

1. The depot activities for TRT are:
   - Unloading and stacking of old/new sleepers
   - Loading of new PRC sleepers on the modified BRHs with proper spacer
   - Loading of fastenings such as liners pandrol clips etc.
   - Despatch of old sleepers
   - Daily maintenance of machine

- P.Way store, store for machine spare parts and consumables
- Yard layout for base depot to carry out above mentioned activities

2. The base depot for TRT should be centrally located (30-40 kms lead) in the area of working. It should have water, electricity and communication set up, accommodation for machine and P. way staff should, Sufficient space for loading and unloading of materials and connectivity via road.

3. Enough stock of new sleepers, elastic rail clips, liners and rail pads should be maintained.

4. Ensure proper line and level of auxiliary track for 3400/3700 mm gauge for portal working, if required for loading and unloading of sleepers.

5. If sufficient set of modified Flat wagons is available, the same can be circulated between sleeper plant and site with instruction to properly load the sleeper as per requirement and as shown below and these can be directly used in TRT rake. Normally 30 BFR's should be modified for one set of TRT. Rakes of 15 BFR or more depending on block availability should be formed.

Fig. 5.12 Sleeper loaded on TRT Wagon with Spacers.

Spacers (75 mmx 75 mm) are provided at rail seat location between layers for creating a gap for proper lifting of sleepers by gantry during working.

6. TRT Rake formation:

- Sleepers-loaded in modified BRHs with layer separation by wooden batten of size 75mmx75mm.
- Pandrol clips and Liners – Loaded on modified BRH attached in rear of TRT
- Rubber pads – loaded in racks specially provided on machine
- RDSO speed certificate No TM/HM/11 dated 11.9.98 should be referred for deciding on composition of rake and permissible speed for bringing to it to site. The composition should normally be such that Beam car is the last vehicle.

5.5 Pre-Block Activities at Site:

(a) **Deep screening** should be carried out in advance wherever feasible. Excess ballast should be removed and shoulders should be brought down wherever feasible to sleeper level. It should be ensured that the ballast bed is fully consolidated.

(b) **Alignment and Level marking:** To maintain the alignment, take the measurement of existing track from fixed references at every 30 Meter. OHE mast can be used for the purpose in electrified section. If alignment and level correction is planned the corrected level and alignment should be marked. After laying the track, same should be checked and corrected if required.

(c) There should be no infringement within one meter of sleeper ends. All obstructions like creep posts, alignment posts etc. within 1 meter of sleeper end should be removed.

(d) Adequate ballast should be available before relaying operations start so that tamping and raising of speed is not delayed.

(e) Check-rails of the level crossings falling in the range of work should be removed in advance.

(f) All longer fish bolts and joggled fish-plates should be removed from the range of work.

(g) New rails (20RP) should be unloaded if TRR is also planned, paired, fish plated or welded in one piece (as required for a day's work) and placed on both sides at about 1.5 meters from track center. Rails should be kept on foot with adequate support so that they do not get shifted during working of the TRT.

(h) All jammed fittings to be loosened in advance.

(i) Ballast from sleepers to be removed for creating space for starting TRT work should be removed in advance for easy placement of plough during start of work.

(j) At location where relaying is to start, two rail pieces of 7.0 meters length one on either side are cut and re-connected to track using well-greased fish-bolts to enable quick opening during block.

(k) Walkie-talkie sets for communication should be available with engine driver, Junior/Sr. Section Engineer (P. way), machine staff and adjoining stations.

(l) Ensure availability of S & T staff to connect- any wire/rodding disturbed during the block.

(m) Ensure removal of OHE bonds before the block. Temporary bonding of the OHE masts should be done by OHE staff while removing these bonds and providing these bonds after completion of work.

(n) Ensure earth bonding of new rail panels. There should be minimum 3 bonds in each panel length of 300 meters.

(o) Existing PSC sleepers of about 2 rail lengths can be replaced with wooden sleepers to avoid loss of time while working.

(p) De-stressing, at high temperature, of the old tack should be carried out as provided in Manual of Instructions on Long welded Rails.

5.6 Operation during Block:

a) Impose speed restriction on the adjacent line of not more than 50 kmph to ensure safety of men working at site.

b) Ensure proper track protection at the site of work, look-out men and hooter in good working order to give warning for train approaching on the other line.

c) OHE block should invariably be taken, as staff may be required to climb on top of the machine for repairs etc. in case of any break down.

d) Traffic Block and Progress: Traffic block of more than 4 Hours be taken. The rated output of machine is about 350m per effective hour of working and therefore in a total block of 4 hrs about 1 km track renewal will be done.

e) Out of total block granted, about 90 minutes of block period is consumed for following activities:-

Bringing TRT to site of work	15 min
Initial setting Time	30 min
Closing Time	30 min
Clearing Block Section	15 min
Total	90 min

5.7 Post Block Activities:

(1) Rail welding: Mobile flash butt welding should preferably be done to convert the track into LWR. Proper destressing after welding should be done at Td.

(2) Ballasting: Training out of adequate quantity of ballast over the newly relayed track to full ballast section. Ballast recoupment activity should be properly synchronized with the relaying as to enable raising of speed to normal in three cycles of tamping by on-track tampers.

(3) Aligning, Levelling and Packing: Tamping machines with DTS for Lining, Levelling, Packing of Ballast and compaction/stabilization of track to raise the speed of the different stretches as discussed in para 8.6 of this book. The reference marks provided on OHE mast should be used for the purpose.

(4) Restoration of cables, OHE connectors, axle counters and other fixtures e.g. checkrails on level crossing, which were removed temporarily.

(5) Provision of SEJ as per approved plan. In-situ welding of panels and de-stressing of LWR should be done after welding of panels.

(6) Check rails should be provided at level crossing after final tamping of the track.

(7) De-stressing of LWR should be done immediately after welding the rail panels to form long welded rails.

(8) Picking up of released materials (Rails when TRR has been done) left at site if any. UTV is used for the purpose.

5.8 Advantages of TRT:

i. Prefabricated panels not required, concrete sleepers loaded on modified BRHs are directly taken to site and relayed one by one.

ii. Auxiliary track not required.

iii. New rails unloaded at site and placed on sleeper shoulder are exchanged with old rails along with sleeper renewal.

iv. Separate block for TRR is not required as rails are also replaced along with the sleepers.

v. Only TSR can also be done without replacing the rails.

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CHAPTER 6

POINTS AND CROSSING RELAYING (T-28) – FOR FULLY MECHANIZED POINTS AND CROSSING RENEWAL.

6.1 Introduction:

Earlier points and crossing replacement were done manually as they were on wooden or steel sleepers and individual sleepers were easy to handle. Individual sleepers were changed manually without taking traffic block and under speed restriction. Limited block was taken for changing rails and switch portion and switch sleepers. However, with the Concrete sleepers and fan shaped layout, sleeper weight has increased and manual handling in Block time is not possible. Also for good quality of layout, it is important that Layout is pre-fabricated outside as per design, and the complete fabricated panel is lifted and laid at site in a traffic block. This will ensure good quality layout at site and also ensure safety.

Indian Railway is using M/s AMECA made T-28 machine for the purpose. A 60 Kg fanshaped T/o has a total weight of around 54 t. The machine comprises of two portals cranes cranes which works together, each with a lifting capacity of around 30 t for handling this T/o.

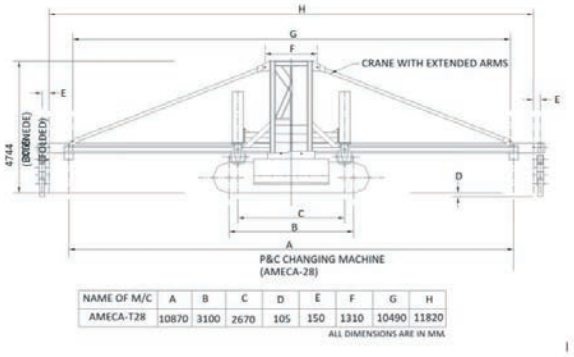
6.2 M/s AMECA Make T-28 Machine:

The machine comprises of

a. **Set of portal cranes:** 2 nos of portal cranes are used for lifting a fabricated panel.

Fig. 6.1 Set of T-28 Portal Crane

The dimensional details of T-28 are as given below:



NAME OF M/C	A	B	C	D	E	F	G	H
AMECA-T28	10870	3100	2670	105	150	1310	10490	11820

ALL DIMENSIONS ARE IN MM.

Fig. 6.2 Dimensions of T-28 Portal

Other important parameters are:

Parameter	**Value**
Load capacity (max.)	30 tonnes
Speed with full load (max.)	0.8 km/h
Speed with no load	10 km/h
Max. lift with full load	2300 mm
Height in closed position	3065 mm
Height in lifted position	4744 mm
Crawler width	360 mm
Crawler lateral clearance	2066 mm (min.) 6116mm (max.)
Moving width	3060mm (min.) 7110mm (max.)
Max. axle load	6.0 tonnes
Total weight	24.0 tonnes

These portals are provided with rail wheel and with crawler. It can thus move on rail as well as on ground. Facility of movement on rail is used for shifting of this machine and for toing of fabricated panel loaded on trolleys to the site of laying.

Fig. 6.3 T-28 Portal Crane on Rail

Facility to move on ground is used for small shifting on ground and final laying of fabricated panel at location of laying on ballast bed prepared for laying of fabricated panel.

The portal has the facility to lift and laterally shift with or without fabricated panel. Also Portal cranes of T-28 are self-loading/un-loading type and can load /off load itself from the road truck or railway wagon. This is required for long distance transportation from one yard to another.

Some of another salient feature of portal are:

- Maximum lateral shifting of switch side machine is 1.5 m per shift, and on crossing side is 0.75 m per shift.
- Each lateral shifting takes about 3 minutes (rotation ± 5°)
- The Portal crane can negotiate a level difference of 1679 mm while moving on the ground as shown below:

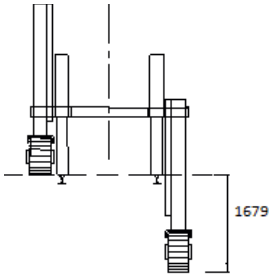


Fig. 6.4 Negotiating Level Difference

- Each machine is provided with 2 aligning chains for aligning of turn out after laying
- Equipped with lighting arrangements for night working.
- The two portals while working are connected via fabricated panel. The synchronized working is ensured by men standing to guide the two operators.

b. Four trolleys.

Fig. 6.5 Trolleys

These are used for carrying panels from fabrication site to location of laying on running track.

There are two motorized trolleys which has arrangement to lift and to shift the loaded panel. These trolleys are therefore provided at front (switch portion) and at end (crossing portion) where length of sleeper is more. For clearing obstruction like signal post, other posts and signal junction post where slewing and lifting of panel will be required for clearing these obstruction, this facility is used.

The dimensional detail of portal is given below:

Parameter	Value
Height	510 mm
Lateral Shift	+(-) 300 mm
Upper table rotation	+ 10o
Vertical lift	+ 300 mm
Capacity	25 tonnes

The upper table where fabricated panel rests can rotate by 10 degree and helps in negotiating curves when trolley is moving with fabricated panel.

c. Jib Crane:

This was used for handling PSC sleeper,rails and switches during fabrication of T/o. However, the same is no more used.

6.3 Sequence of Renewal of Points and Crossing using T-28:

1. The Turnout is fabricated at a suitable location so that it can be picked up by T-28 portal.

2. Dismantling of existing T/O:
   The existing T/o to be replaced can be dismantled manually or can be lifted with machine and shifted outside track to suitable location where it is dismantled manually. The procedure to be followed is:

   Manual dismantling:
   - During traffic block the existing T/o is dismantled manually and ballast bed is levelled.
   - The gangs should scarify the ballast from the location, where the turnout has been removed. The ballast bed is lowered to accommodate extra height in case of concrete sleepers.

Fig. 6. 6 Dismantling of Existing T/o

Dismantling by Machine:

- Immediately after getting traffic block, the fish bolts of existing turnouts should be opened.
- Both T-28 cranes should be traversed and brought in position for handling the existing turnout at the demarcated position.
- Old turnout should be lifted by cranes and traversed to suitable location for further dismantling after the block.
- The cranes should be traversed to the pre-assembled concrete sleeper turnout

3. The two portals brought by rail/road wagon off load itself from the wagon along with four trolleys. The trolleys are placed on track and the T-28 cranes positions itself over fabricated panel in advance of Block if the existing T/o is planned to be dismantled manually.
4. If the existing T/o is planned to be dismantled by machine, the cranes are parked at a nearby location in advance and moved over the panel to be dismantled during traffic block.
5. The points and crossing renewal can be done by longitudinal/forward launching and by transverse/side launching or a combination of both depending on site condition.

(A) Longitudinal/Forward Launching

i. The fabricated panel is lifted by the portal cranes and shifted laterally to place it on four trolleys on adjacent Railway track. If the fabricated panel is assembled over track, the trolleys are pushed underneath after portal cranes lift the panel.
ii. The loaded panel is then towed by one of the portal crane moving on its rail wheel to the site of laying. The other portal crane follows.

Fig. 6.7 Fabricated Panel on Trolleys being Toed

iii. Both the portal cranes are brought on crawlers by spreading their support legs and moved to the position over fabricated panel on trolleys to lift the panel and releasing trolleys. The trolleys are shifted by pushing them manually to siding.

Fig. 6.8 Trolleys being Released

iv. The fabricated panel is then longitudinally moved on crawler & placed on pre-prepared bed at correct position.

Joining of SRJ to running rail.

Placement of Back leg of crossing

Fig. 6.9 Final Laying and Fixing New Panel to Track.

v. The longitudinal and lateral shifting for proper joining with adjacent track and alignment of Panel is also carried out by the portal cranes. A hook at the centre of portal crane is used for correcting alignment of laid T/o.

vi. The portal cranes, after placement of turnout in position, load itself on the newly laid Turn out supported on its own rail wheels and moves to the siding line.

Fig. 6.10 Portal Crane on Rail Wheel after block.

vii. The siding can also be cleared by portal and trolleys, if required. For this, each portal can attach two trolleys with it and laterally shift to the ground or other line or even can self-upload on Flat wagons or Road vehicle as per requirement for clearing the siding.

(B) Transverse/Side Launching

When the fabricated panel is by the side of location where it is to be laid, the T-28 machine can lay the prefabricated panel without using the trolleys.

The fabricated panel can be lifted by using both portals and laterally shifted to position of laying using side shifting system of the machine as shown below:

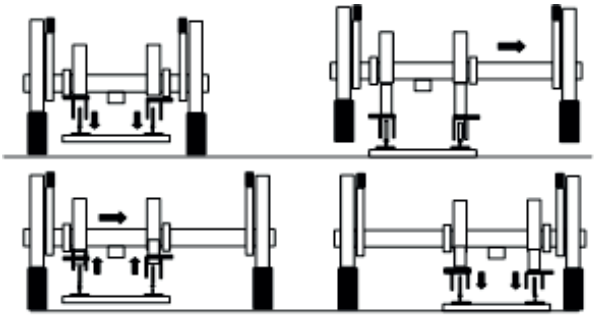


Fig. 6.11 Lateral Shifting Facility of Portal

The lifted panel can be longitudinally adjusted & positioned using crawler base.

viii. Emergency situation of Breakdown of one crane: In case of breakdown of one portal during traffic block, the fabricated panel can be laid by cutting the panel into two pieces (each panel to weigh less than 30 t) and using one portal for laying each half, one by one. The gripping position however will have to be adjusted according to panel being handled.

6.4 Laying of Pre-Assembled Diamond Crossing PSC Sleeper by T-28 Machine:

The Diamond assembly can also be laid by a set of AMECA T-28 Portal with following modifications:

(i) The weight of double slip diamond crossing on PSC sleeper is 62 t (approx.). Therefore 5 sleepers (no 50 to 54) will have to be removed to keep the total weight as 54 t.

(ii) Since Diamond crossing layout has crossing at both ends, the gripping location should be adjusted accordingly.

Position of Portals should be adjusted so that both share almost equal load.

6.5 Pre-Block Activities:

A. Checking of layout: The existing layout to be checked and changes because of new turnout to be calculated. It should be ensured that error in layout is rectified. SRJ position to be checked and Rail and another item requirement to be finalized.

B. Alignment and Level: For this, Enough length on either side of Turnout is surveyed and plotted for both Main Line and Turnout. Level should also be measured. Final Alignment and Level to be marked on fixed references.

C. Arrangement of Materials: Foot by foot survey of yard by AEN, ASTE, PWI & SI. Prepare Checklist of materials required for each turnout. All materials should be made available well in advance.

D. Location for fabrication of T/o:
This is one of the most important activity as this can save lot of problem that may other wise creep during Block working.

- Assembly site should be as near as possible to the existing turn out
- Place should be Level and be consolidated ground
- Earth work, if required, should be done in advance
- Site should be free from signaling rod and equipment as far as possible
- Path for movement or shifting should be decided and feasibility checked of any non-negotiable obstruction.

Some of the location for fabrication of point are:

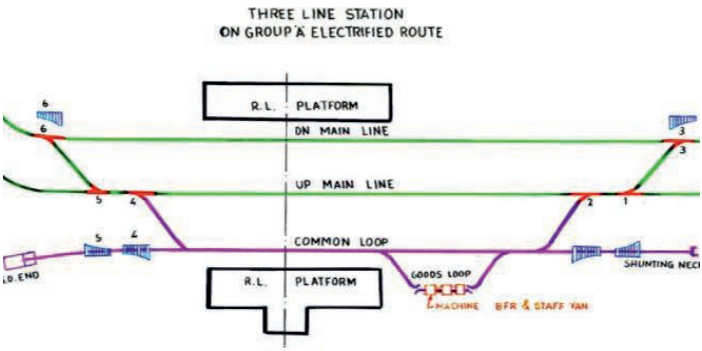


Fig. 6.12 Fabrication Location for Different T/O

Normally Sand Hump and siding should not be used for fabrication of T/o. The same should be fabricated by its side. If in case it is to be fabricated on the track, the same should be duly blocked so that operation system is modified as it effects safety.

E. Other activities/arrangement:

- Deep screening to be done well in advance, including approach track. Level shoulder ballast and build up cess for ease in crawler movement
- Sufficient ballast cushion to be maintained.
- Approach Special sleeper should be inserted.

- 60 kg new rails should be kept ready on both ends for replacing mismatch rails, if any.
- In case SRJ shifting, new foundation for signaling gear should be made well in advance if required.
- Lubricate nut and bolts for easy removal during block
- Maximum possible ballast should be removed out of turn out. Remove ballast from Crib/Shoulders up-to sleeper bottom
- About one hour before the block, one line of the turn out should be dismantled by clamping the turn out to the running line.

Fig. 6.13 Advance Dismantling of T/O Side Rails.

- Signalling equipment i.e., facing point lock and electrical point detector should be removed.
- Clamping stock rail and tongue rail of new Prefabricated T/o before lifting.
- Mark location for crane clamp holding in new panel.

F. Arrangement of materials during block working:

- 60 wooden blocks, each approx. 60 cm long should be kept ready for facilitating passage of crawler on the obstacles.
- 8 nos. of rail pieces , each 70cm long (welded block at extremes) should be kept ready for housing below the rail wheels of the crane.

- Availability of Two sets of gas cutting equipment should be ensured.
- Ensure Prompt communication facility.

6.6 Activates During Block:

(1) Disconnection of point by S & T staff

(2) The fish bolts of existing turnouts should be opened. OHE connectors shall be disconnected.

(3) If existing T/o is to be dismantled by machine, both cranes should be traversed and brought in position for handling the existing turnout at the demarcated position. L

(4) If the dismantling is to be done manually sufficient labour should be arranged in advance and dismantling to start immediately after obtaining Block.

(5) Old turnout should be lifted by cranes and traversed to suitable location for further dismantling after the block.

(6) The crane should be traversed to the pre-assembled concrete sleeper turnout and both the cranes should be taken to demarcated position on turnout.

(7) If Dismantling is to be done manually, the T-28 machine should be ready for Transporting the fabricated panel to the site before block.

(8) Simultaneously, the gangs should scarify the ballast from the location where the turnout has been removed. The ballast bed is lowered to accommodate extra height in case of concrete sleepers. If any hindrance is encountered, it shall be removed immediately to allow the turnout sleeper to rests at its place and level.

(9) Pre-fabricated turnout should be held by the crane. The cranes with the turnout be traversed in stages and brought to the location of laying. The turnout is laid in position and fishplates are bolted to the existing track.

(10) One crane is traversed on the track and the second is utilized for final alignment of turnout. After placing the turnout, gangs should fill back the ballast manually.

6.7 Activities after Block:

(1) Ballast deficiency should be made good by putting additional ballast. Profiling and boxing of ballast should be done.
(2) The turnout should be tamped with the help of UNIMAT machine. Both alignment and levels should be corrected while tamping the turnout.
(3) The turnout may be interlocked and point machine engaged immediately after laying the turnout. OHE connectors shall be put into place.
(4) Damage to the cess during block operation should be made good.
(5) Provision of proper earthing points should be ensured by the Electrical staff.

6.8 Important Points for Quality Control:

i. Use correct switch according to RH/LH T/Out.
ii. The T/o to be fabricated as per RDSO Drawings. Welding and machined joints to be provided as given in drawing.
iii. In case of LWR territory, three normal rail length shall be provided between stock rail Joint (SRJ) and SEJ as well as between heel of crossing and SEJ. Three normal rail length shall be provided with elastic rail clip / creep anchor to arrest the creep. However, where concrete sleeper turn out are laid, instead of three normal length one three rail panel shall be provided between SRJ and SEJ as well as between heel of crossing and SEJ.
iv. Ensure full crib ballast to maintain proper sleeper spacing.

6.9 Limitations of T-28 Machine:

The Lifting capacity of T-28 Cranes of 30 t each is just sufficient for laying 1 in 12 fan shaped layout. It cannot lay completely fabricated 1 in 16 or above T/O. They will have to laid in pieces with this machine.

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CHAPTER 7

NEW TRACK CONSTRUCTION MACHINE

7.1 Introduction:

New Track Construction (NTC) machine is used for laying new track using the continuous-action, assembly-line method. The machine is deployed after the formation is ready and ballast bed is prepared for laying of new track. The entire supply of new sleepers and rails within the track being laid is by mechanised operation. Accuracy and high working speed are the outstanding features of this technique. There is a very careful handling of the material, particularly the rails, and better preparation of the sleeper bed.

The laying of new track over Indian Railways is still being done manually. The handling of rail and sleepers are not proper, and quality of track is therefore compromised. DFC has however shifted to mechanized laying of new track using NTC machines. Indian Railway also should find ways for mechanized laying of new track.

7.2 Types of NTC Machine used in DFC:

Following two types of machines are being used in DFC:

1. SVM 1000 by M/s Plasser and Theurer, Austria
2. NTC by M/s Harsco Pvt. Ltd, USA.

The working mechanism of both these machines are same however their layout and structure are different. For track laying with these machines following machineries are required

- NTC Machine.
- Sleeper Loading Gantry crane at base depot.
- BLCA Flat wagons for carrying Rail Panels & PSC Sleeper and transporting them to site.
- UTV or Locomotive for pulling above material train.
- Tractor Dozer for pulling Rail panels of 260m.

- Rail Rollers for supporting rail during pulling from rake.
- Clip Applicator for ERC fixing after sleeper and rail laying.

7.3 BLCA Flat Wagon for Carrying Rail and Sleepers:

44 wagons will be used with the NTC for laying of the track. These will be the standard 40' container wagons (BLC). A sub frame consisting of a roller in the bottom layer, sleeper loading platform with end bolsters and rails for movement of the gantries shall be mounted on these wagons. Corner Castings for Twist locks as used for the containers will be there on these sub-frames for easy installation and removal. During work the NTC will use 22 wagons while the other 22 will be used at the depot for loading of rails & sleepers. Shunting movement of the wagon train will be done with the help of synchronized UTVs or locomotive.

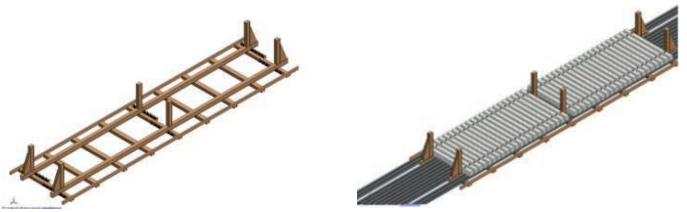
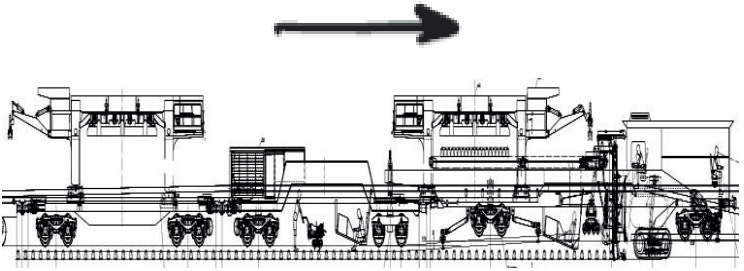


Fig. 7.1 Subframe consisting of Roller at Bottom for Rails and Sleepers on Support over it.

7.4 Working of NTC:

The working of the machine is described with respect to SVM 1000. However any major change in working of NTC by M/s Harsco is highlighted.
NTC Machine (SVM1000) consists 3 wagons.

- Sleeper laying machine
- Power Wagon
- Transition wagon



Transmission wagon Power Wagon Sleeper Laying M/c

Fig. 7.2 SVM 1000 Layout

Transmission wagon (BLCA) is for transporting rail and sleepers to site and for feeding sleepers to sleeper laying M/c . Power wagon is having generator for power supply to the machine for working. Sleeper Laying unit is for laying of sleepers. As can be seen the sleeper laying is in forward direction.

Fig. 7.3 SVM 1000

7.3.1 Laying of track using SVM 1000:

a. Base depot :

Track materials to be taken to site are loaded in material train in base depot and this train is taken to work site using UTV/locomotive for laying of new track. For performing these functions base depot to have following facilities:

i) To be accessible from Indian Railway's existing track .

ii) A temporary connection should be established with existing track to enable the 260 meter long rail panels to reach inside the staging area.

iii) The staging area is also accessible by Road.

iv) The base depot to have 3-5 nos. parallel tracks with connections to allow for smooth loading, shunting, stabling, and maintenance of machines and wagons sets with sufficient storage space between the tracks.

v) Turn table for turning NTC

vi) Proper surface for stacking rails as per RDSO drawing and space marked on plan,

vii) A set of 21 synchronized gantries with hoists for loading, unloading and stacking of 260 meter panels at Rail panel stacking area.

viii) Stabling yard for the NTC, wagons, UTV's, Locomotive, Surfacing Equipment's.

ix) Spare parts and Track material store.

x) Proper illumination for working at night,

xi) Proper service roads,

xii) Proper space for stacking sleepers with enough space in between two sleeper stacks to allow Hydra crane/Forklifts to move as to facilitate loading,

xiii) Office & Rest space for Managers, Staff, Operators, Mechanics and labour.

The activities to be performed in base depot are:

i) Material train consisting of 20-22 BLCA Flat wagons for loading of Rail Panels & PSC Sleeper is placed.

ii) Loading of 260m long welded rails on material rake with the help of synchronised Rail gantries erected at Base depot without causing stresses in rails or damages while loading into wagons. Each Gantry has a capacity of 2MT. Operation of gantries are

carried out from a centralized cabin. In case of any Gantry failure at any time, the same can be bypassed and remaining gantries will be operated.

Fig. 7.4 Arrangement of Gantry for Unloading and Loading of 20RP.

iii) Once the loading of Panels completed, Loading of sleepers with the help of Sleeper gantry/Hydra is done. Sleeper gantry can load 20 sleepers at a time. Sleepers are separated by 100mmX100mm dimensioned long wooden batten between two sleeper layers.

Fig. 7.5 Loading of Sleepers on BLCA Wagon.

iv) Once the rails and sleepers loaded into the wagons, the material train will be attached to SVM 1000 and shifted to track laying location by a locomotive in pushing. The Works Train shall travel

to railhead in accordance with the Travel Authority issued by the train controller and shall stop at the defined location.

Fig. 7.6 SVM 2000 Formation ready for despatch at Base Depot.

v) While locomotive in pushing mode is used for taking the NTC rake to site of work in SVM-1000, the NTC of M/s Harsco is shifted using two or more synchronized UTV . The UTV in front is so modified that the gantry can cross over it during working.

Fig. 7.7 NTC of M/s Harsco Pulled to Site by UTV

b. Site activity:

i) Pre Block activities at Site

- Prior to the commencement of Track-laying at a specified location, it is ensured that the formation is complete in all respect.

Fig. 7.8 Ready Formation for Laying of Ballast

- A visual survey is carried out and repairs taken up if any unsuitable patches found.
- Fixing of alignment for track-laying shall be marked by a surveyor with Total Station as per designed centre line of the horizontal alignment at 20m (for straight) & 10m (for curved) intervals as per approved track co-ordinates by using wooden pegs. Reference pegs at 2.6 m from centre of track is fixed.

Fig. 7.9 Reference Peg for Alignment

- A ballast bed of 200 mm thickness to be laid in two layers of 100 mm each duly graded by graders & compacted by a minimum 4 passes of a smooth vibrating Roller having a minimum static load of 4KN per 100mm width. and Centre line of track is marked.

Fig. 7.10 The Ballast Bed is Laid in Advance.

Fig. 7.11 Centre Line of Alignment Marked.

ii) Activities during Block:

- On arrival at site the SVM 1000 will be placed on already laid Ballast bed with support by Crawler.

Fig. 7.12 NTC on Crawler for Working

- Pulling of rails will be done in two stages, i.e. rail will be pulled from material rake to front of NTC machine by Gantry with the help of Arm Grabbers provided on it.

Fig. 7.13 Pulling of Rails from BLCA Wagon

In M/s Harsco machine, the pulling of rail is not through gantry but using puller.

- In M/s Harsco machine, the pulling of rail is not through gantry but using puller.

Fig. 7.14 Puller in M/s Harsco NTC Machine

- Consecutive Rails will be connected by Web clamps while pulling, which will later be replaced by fishplates while track linking. The

Fig. 7.15 Connecting Rails During Unloading.

- Later, Loader/Dozer will pull the rails by guiding over the rollers which were placed for free movement of rails when pulled.

Fig. 7.16 Connected Rail Panel Pulled by Dozer

- Rail panels will be placed on Rollers at regular intervals (around 2.6 m) to ensure no damages to the rails while handling the panels.

Fig. 7.17 Unloaded Rails on Rollers

- Once the Rail ends are joined by fishplate, then sleeper dropping will be initiated.
- Feeding of sleepers on conveyor belt will be done by sleeper gantry that runs on auxiliary guide rail pathway provided on material rake.
- There are two sleeper gantries, one for feeding to conveyor belt and other for filling the empty slots by shifting the sleepers from back end. Each time gantry can feed 20 nos of sleepers.

Fig. 7.18 Gantry for Feeding Sleepers.

- Laying of sleepers is done at equal spacing by NTC machine.

Fig. 7.19 Laying of Sleepers at Equal Spacing

- CGRSP put on sleepers rail seat manually before placing rail panels over Sleepers.
- Rail panels are threaded inside the sleeper seat with the help of Lining arrangement

Fig. 7.20 Threading in of Rails behind NTC

- With the help of Clip applicator, ERC driven at every 8th sleeper for holding rails in position with sleepers to allow movement of Material Train.
- The complete system of working is shown in fig below.

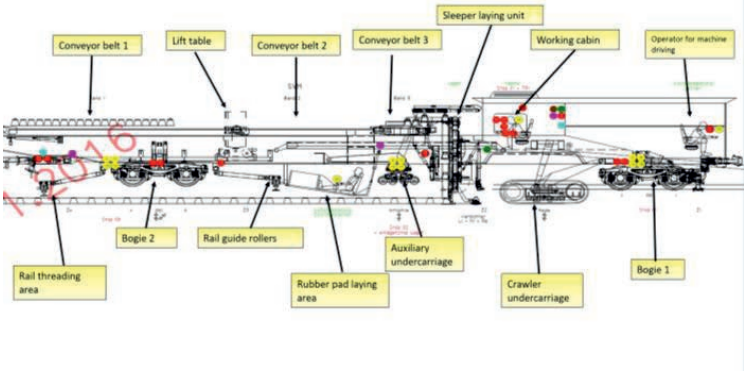


Fig. 7.21 SVM 1000 Position at Working Location.

NTC is now moving on crawler on prepared bed. Bogie-1 and 2 are lifted, while bogie -1 is in lifted to allow for movement over ballast bed on

crawler, Bogie-2 is lifted for creating space for placing rubber pad over newly laid sleeper and threading in of rail. The rake from Bogie-3 moves on this newly laid track and ERC fixing is done behind it as shown below:

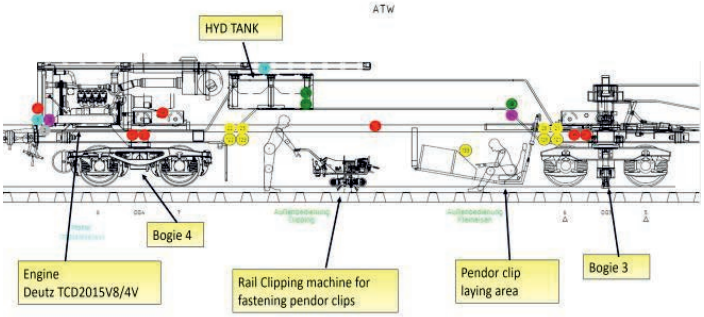
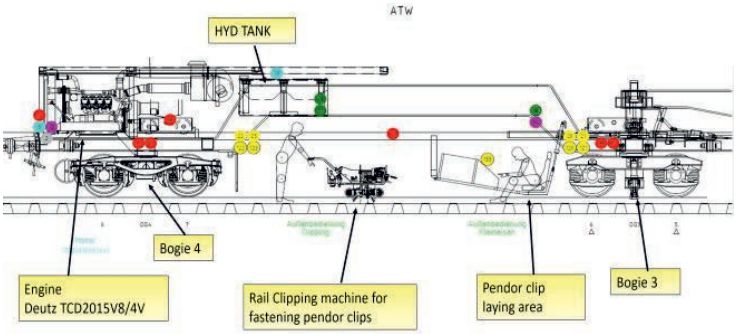


Fig. 7.22 SVM 1000 Fixing of Rail behind Working Position.

- The worksite of M/s Harsco NTC as it actuall looks is as below



iii) **Activities after Block**

- Checking of skeleton track: The alignment levels and sleeper spacing of newly laid track are then checked. Minor corrections, if required are attended by nominated gangs with

competent supervisor before clipping of sleepers.

- Thereafter rear works like ballasting and first round of tamping with double insertion is done.

- A survey trolley is then run to find the coordinates of existing alignment, which is compared with the design alignment and design feed for the tamper is generated. The tamper then does the required correction to the alignment and levels, while working in design mode.

- Subsequently one or more round of tamping brings the alignment of track within prescribed tolerance limits. Thereafter ballast regulator followed by DGS is run to stabilize the track.

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CHAPTER 8

OTHER ON TRACK MACHINES AT TRACK RENEWAL SITE

8.1 Introduction:

Deep screening of track should be done before track renewal. Ballast cleaning machine (BCM) is used for deep screening of track and in addition, Tamping machine, Dynamic Track stabilizer and Ballast regulator are used at deep screening and renewal site for restoring track to normal and relaxation of speed restriction.

In this chapter, working of these machines is discussed in brief. For detail working, IRTMM should be referred.

8.2 Deep Screening by Ballast Cleaning Machine (BCM):

Deep Screening of plain track and points and crossing should be done preferably sufficiently in advance of renewal so that, speed restriction at site is relaxed to normal before renewal work starts. Deep Screening simultaneously behind renewal can also be done, but this would increase the speed restriction length. Also, if done long time after the speed at renewal site is relaxed, track would inherit the history of existing defect and complete correction of track would be difficult.

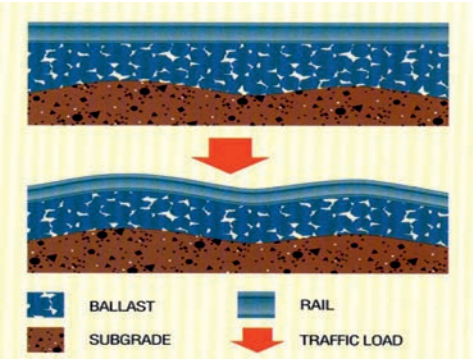

Fig. 8.1 Formation and its Behaviour

Deep screening by BCM creates a new smooth formation and uniform cushion and formation defect is not reflected in newly laid track.

8.2.1 Working of BCM

The process of deep screening involves

- Excavation of ballast;
- Picking up ballast by cutter chain;
- Carrying ballast to a set of vibrating screens;
- Separation of muck by screening;
- Throwing muck out by a chute; and
- Transfer of clean ballast back to the track

Fig. 8.2 BCM Machine

Track should be surveyed in advance and following works to be done before starting BCM working:

- Foot by foot survey of the section to check condition of track components, ballast, cess width and availability of land for muck disposal.
- Survey for longitudinal profile and alignment finalization as per the relevant codal/manual provisions (SOD/IRPWM)
- The longitudinal section showing formation level, existing and proposed rail levels should be plotted

and existing & final rail level shall be transferred on pegs or traction masts.

- Depth of cutting/magnitude of lifting should be decided on the basis of proposed rail level.
- Damaged/broken fittings/sleepers be replaced.
- The pockets of the ballast beyond the reach of cutter chain shall be transferred in its cutting width before commencement of work.
- Pucca drain walls, be dismantled or track slewed temporarily.
- Level crossings should be opened in advance.
- OHE mast foundation location to be checked.
- Signal rodding/cable may be temporarily removed.
- Approaches to bridges that cannot be screened should be screened manually in advance.
- Removal of rail lubricators/guard rails etc.
- The cutting width of BCM is 4280 mm. Ensure no obstruction within a width of 4500 mm exist, infringing cutter chain.

During working following should be taken care off:

- 20 Kmph speed restriction to be imposed at worksite on deep screened track.
- Speed restriction of 50 Kmph or at least look out cation to be imposed on adjacent line . All safety precautions for train and men working at site to be taken
- If the availability of cushion is less, the track can be temporarily lifted up to 100 mm by BCM itself during working.
- Also During working it is important that proper slope of cutting is maintained. For this cutting depth to be maintained should be as given below:

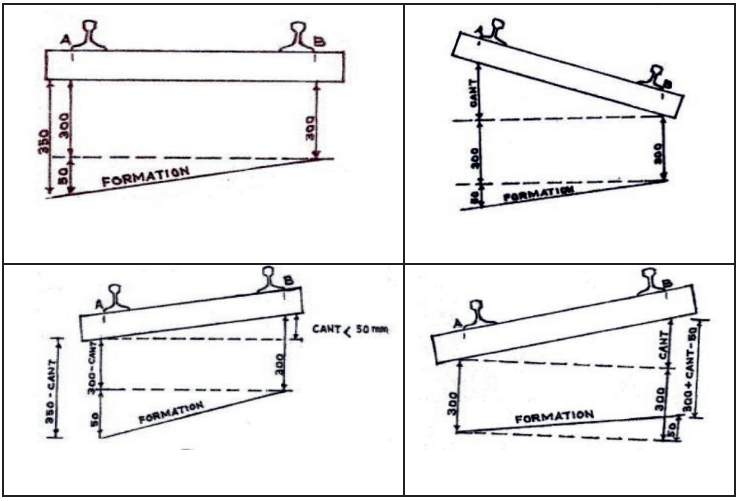

Fig. 8.3 Slope in Formation by BCM

- The ballast left unscreened due to limited cutting width of cutter bar should be separately screened after BCM work else it will leave a channel for water logging.

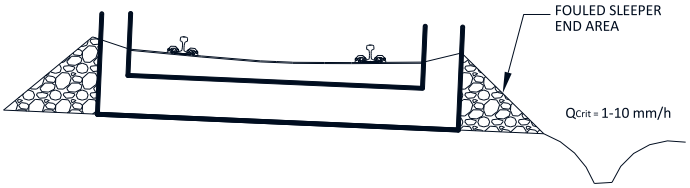

Fig. 8.4 Unscreened Left-Over Portion

- Cess accordingly should be brought to same slope of formation.

Deep screening of points and crossing requires adding extension pieces of 500 mm each to cutter bar. This extension of cutter bar is possible only on right side. Total 7 no of additional pieces are required to be added for covering the longest sleeper.

Sine extension is possible on right side, the movement of machine during working shall be as shown below:

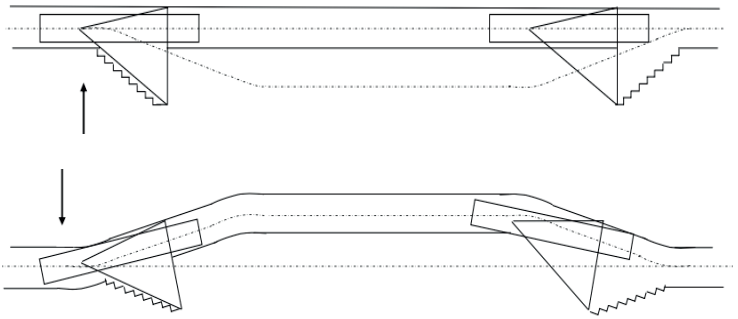

Fig. 8.5 Movement of Machine during Deep Screening of Points and Crossing.

Deep screening of complete crossover however cannot be done without taking additional block of adjacent line which should be planned accordingly.

8.3 Tamping Machines for Lining, Levelling and Track:

Normally Duomatic or Work site tamper (WST) to be used behind BCM or track renewal machine for plain track and UNIMAT for points and crossing for lining and levelling of track. Both types of machine works in following modes of Lining .

a. 3-Point Lining
   - Elementary mode
   - Design Mode

b. 4-Point Lining
   - Smoothening mode
   - Design mode

Levelling can also be done in
   - Smoothening mode
   - Design Mode

In smoothening mode of working , track defect size is reduced and track is smoothened but defect is not eliminated.

For complete elimination of all defects, lining and levelling to be done in design mode. For Design mode Lining and Levelling, existing alignment and level of track is measured and slew & lift required to achieve desired alignment and level is calculated. This slew and lift value can be calculated from fixed references also. In machines provided with ALC, correction can be done using ALC working principle, both in design mode and measuring run mode. Accordingly, data for tamping is fed using instructions in manufacturers manual and IRTMM. For detail understanding of tamping, lining and levelling, IRICEN publication “Mechanized Tamping and Stabilization” may be referred.

While working with UNIMAT, correction of mainline track with Tamping, lining and levelling be done. The machine to be brought back and only tamping of T/o side should be done with no lining and levelling.

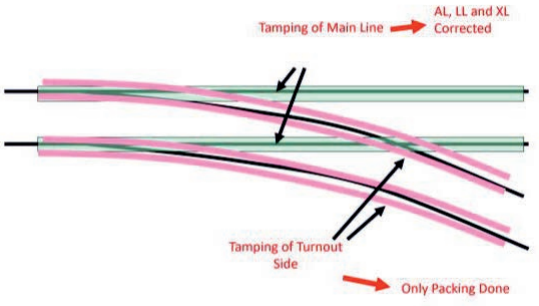

Fig. 8.6 Tamping Sequence of Points and Crossing

8.4 Track Stabilization using Dynamic Track Stabilizer (DTS).

While tamping machines achieves the desired track parameters, the stabilizer is used to consolidate the track ballast. DTS works in following two modes

i. Maximum Settlement mode (with constant vertical pre-load, Levelling system off)

ii. Controlled settlement mode (with regulated vertical pre-load, Levelling system on)

In maximum settlement mode, the intension is to achieve maximum consolidation, while in controlled settlement mode, intention is to go for consolidation ,simultaneously retaining the parameter achieved by tamping machines. For working in controlled settlement mode, levelling system provided in machine is to be switched ON.
For detail understanding of tamping, lining and levelling, IRICEN publication "Mechanized Tamping and Stabilisation" may be referred.

8.5 Ballast regulation by Ballast Regulating Machine (BRM):

Ballast unloading behind BCM, to recoup the deficiency of ballast created during deep screening . Also after track renewal, ballast is recouped to achieve LWR profile. BRM is used to pull the unloaded ballast into track and regulate it to LWR profile.

8.6 Speed Relaxation behind Deep Screening and Track Renewal:

The stages of speed relaxation behind Deep Screening with machine tamping shall be as per procedure laid down in Para 238(2)(g)(iii) of IRPWM and reproduced below

Details of Work	Day	SR
Deep screening of Track by BCM, Ballast equalization followed by initial packing and initial stabilization by DTS	1st day	40 km/h
First round of Tamping followed by stabilization of Track by DTS	2nd day (1st Tamping)	40 km/h
Survey of Track for Design Tamping mode as per Annexure 5.3 of IRTMM-2000, boxing of Ballast section and tiding	3rd day	40 km/h

Details of Work	Day	SR
Second round of Tamping followed by stabilization of Track by DTS	4th day (2nd Tamping)	40 km/h
Survey of Track for Design tamping mode as per Annexure 5.3 of IRTMM-2000, boxing of Ballast section and tiding	5th day	40 km/h
Third round of Tamping in design mode followed by third round of stabilization by DTS	6th day (3rd Tamping)	75 km/h
Inspection of Track, boxing of Ballast section and tidy-up.	8th day (3rd Tamping)	Normal speed

The proper description and sequence should be as given below:

Details of Work	Day	SR
Deep screening of Track by BCM, Ballast equalization followed by initial packing (in 4-Point smoothening mode) and initial stabilization by DTS (Levelling system "OFF")	1st day	40 km/h
First round of Tamping (in 4-Point smoothening mode) followed by stabilization of Track by DTS (Levelling system "OFF")	2nd day (1st Tamping)	40 km/h
Second round of Tamping (in 4-Point smoothening mode) followed by stabilization of Track by DTS (Levelling system "OFF")	4th day (2nd Tamping)	40 km/h

Details of Work	Day	SR
Survey of Track for Design tamping mode ,boxing of Ballast section and tiding	5th day	40 km/h
Third round of Tamping in design mode (3-point design mode) followed by third round of stabilization by DTS (Levelling system "ON")	6th day (3rd Tamping)	75 Km/h

It is important to note that relaxation of speed to 40 Kmph after initial tamping will be possible only if cutter bar and chain after closing of BCM work is removed and track is filled with ballast even at closing location and is tamped and stabilized.

At track renewal site IRPWM para 308, Table-II gives the schedule of speed relaxation after machine tamping on 10th day. This is without DTS. Since at all renewal site, the bed is already consolidated, the relaxation of speed to normal can be done faster than at BCM work site i.e. before 8 days. A tentative schedule should be:

Details of Work	Day of Work	Speed Restriction
Initial Packing in 4-Point		40 km/h
smoothening mode and stabilization in maximum settlement mode by DTS		1st day
First round of tamping in 4-Point smoothening mode followed by stabilization of track by DTS in maximum settlement mode	2nd day (1st Tamping)	60 km/h
Survey of track for design tamping mode as per IRTMM, boxing of ballast section and tiding.	3rd day and 4th day	60 km/h

Details of Work	Day of Work	Speed Restriction
Second round of tamping in design mode followed by third round of stabilization by DTS in controlled settlement mode.	5th day (2nd Tamping)	75 Km/h
Inspection of track, boxing of ballast section and tiding	6th day	Normal speed of the section.

■ ■ ■

CHAPTER 9

OTHER ANCILLARY ACTIVITIES AT TRACK RENEWAL SITE (Rail handling, welding and conversion to LWR)

9.1 Introduction:

At renewal site, single rails and 20 rail panels are to be unloaded and after renewal is to be welded. 90 UTS and higher UTS rails require proper handling to avoid creation of notches which as per study is the measure cause of rail fracture. For Rail handling, LWR and welding, IRICEN publications on these may be referred, however here they are covered in brief.

9.2 Precautions During Handling of 90 UTS Rails:

Proper handling of 90 UTS rail is important for preventing its premature failure due to dents and notches created during improper rail handling. It is found that, metal to Metal Rubbing/Dent/Depression during transportation accounts for 31% of total Rail failures. RDSO has issued guidelines vide No.CT-35 of October 2014 duly incorporated in IRPWM in para 234 as CS 137.

The handling in that is covered under following sub heads

- Stacking and Handling of rails in rail manufacturing plants, Flash Butt Welding plants and other Bulk Storage locations
- Loading and Unloading of Single/Three Rail Panels
- Loading and Unloading of long rail panels in EUR rakes
- Placement of single rails and welded rail panels on cess
- Handling of rails in electrified areas
- Handling of rails at port

- Precautions for preventing damage to rail e.g. straightness, rail surface, metallurgical damages etc.
- Safety of personnel

The instructions are given in detail, however following important instructions are reiterated here:

During handling of rail, the location of lifting should be such that, the distance between lifting point and over hang should be within limits given below:

Rail length (m)	No. of lifting points	Distance between two adjacent lifting points (m)	Max. rail end overhang (m)
12-13	2	6-6.5	3-3.25
26	4	6.5	3.25
39	6	6.5	3.25
130	20	6.5	3.25
260	40	6.5	3.25

9.2.1 Unloading of Single Rail Panel:

When planning unloading of single rail from BFR, following precautions to be taken:

- Unload in exact quantity and at location (to avoid double handling).
- Two or more ramps should be made in the middle of BFR (max dist. 6.5 m).
- Proper greasing on top surface of ramps for lubrication and easy sliding of rails downwards.
- Use gunny bags at bottom to reduce impact.
- Rail should be placed on ramp with both ends tied by manila rope. To be slid slowly by releasing rope.

9.2.2 Unloading of 20 RP from EUR Rake:

Three Specially designed wagons are provided at the unloading end in the sequence of Threader wagon followed by Ramp wagon followed by Chute wagon as shown below.

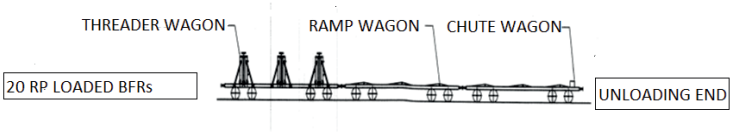

Fig. 9.1 Unloading Wagons of EUR Rakes

In old design Ramp wagon is provided in place of Threader wagon.

Some of the important instructions for unloading of 20 RP given are:

- Unloading to be done only in Traffic Block.
- Unloading Shall be started from top layer panels.
- The protective rail and flap door of bulk head should be opened during block only for the layer to be tackled.
- Rail panel should be tied with manila rope/wire rope with the help of HTS bolts through the holes provided at the end of rail.
- Only tested sling should be used.
- Speed of unloading should not exceed 15 kmph.
- Rail panels at equal distance from centre line should be unloaded.
- Eccentric unloading or unloading from only one side of BFR is STRICTLY PROHIBITED.
- The EUR rake shall never be moved backward during unloading.
- The EUR rake shall not run either backward or forward with open door of bulk head in any circumstance except during unloading.
- Unloading shall not be undertaken in PF area, Ballast less open web girder bridges and at locations having vertical clearance less than 4500 mm from rail level.
- Unloading in turnouts and cross overs should be avoided.
- Just before complete unloading of first pair the rake should be stopped and next panel to be tied with partially unloaded first panel.

9.2.2.1 Auto Rail Panel Linker:

The existing system of unloading 20RP has some inherent limitations:

- Proper co-ordination is required between Loco pilot and PWI to stop the Rake within a limited margin of chain length after every pair of rail is unloaded so that next rail is connected easily.
- The chain length is therefore kept large; 3 m(approx), thus gap between unloaded rail is very large.
- If the Rake could not be stopped in the chain length margin, additional chain is to be provided, increasing the gap between unloaded rails and making pairing and butting after unloading difficult.
- Men are standing on rake and in any case are in unsafe position.
- Any stoppage of rake is waste of traffic block period particularly with limited traffic block availability.

As a solution to above problem, RDSO has designed an Auto rail panel linker designed to automatically connect two 20 Rail Panels during unloading without any human involvement.

- It consist of two components:

(1) Linking Blocks: This is to be fixed at the both end of rail panels except first rail.

Fig. 9.2 Linking Block

2) Linking U-clamps: This consist of two U-clamps with neck provided at end for sliding over Rail head, connected by a chain through connector.

Fig. 9.3 Linking U-Clamp

- First rail as in existing system is unloaded by connecting the rail to track by wire rope. The Auto Rail Panel Linker is placed in advance (in yard) as shown below.

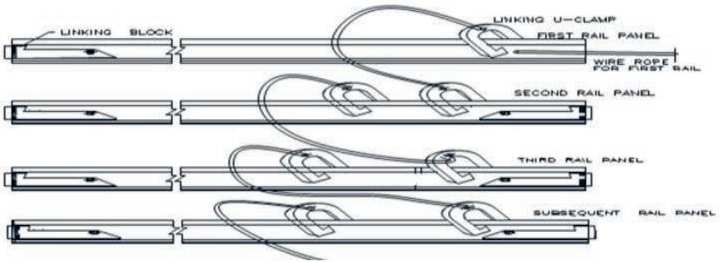

Fig. 9.4 Linking of Rails before Unloading

- As the rake moves, the unloading of first rail starts.
- The U-Clamp slides over the rail head getting unloaded.
- As the first rail end crosses the next rail to be unloaded, the U-clamp connects the two linking blocks of unloading rail and next rail as shown below:

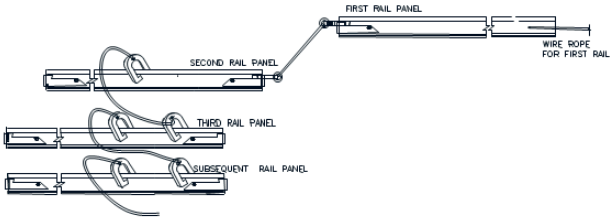

Fig. 9.4 Linking of First Rail

- On further movement of the rake subsequent linkage of rails automatically takes place as shown below:

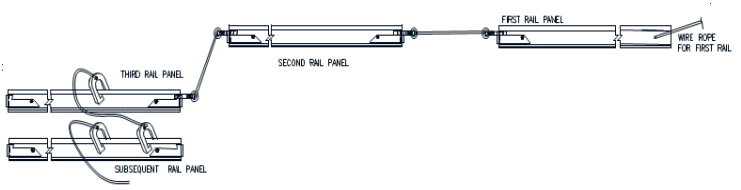

Fig. 9.5 Linking of Subsequent Rails

- Arrangement for automatic linkage of Rail during unloading will ensure:

  a) Safety to men as they need not stand on wagon.
  b) Fast unloading of Rail.
  c) Lesser Gap (less then 1 m) between unloaded Rails thus less effort in subsequent pairing and butting.
  d) Lesser requirement of Traffic Block.

9.3 Welding of Rails:

Welding is done to join two rails. There are two methods of welding

a. Thermit welding
b. Flash Butt welding

For proper understanding, IRICEN publication and RDSO manual for Thermit and Flash Butt welding should be referred. However some relevant issues have been discussed in brief:

9.3.1 Thermit Welding:

The detail procedure has been given in “Manual for fusion welding of rails by the Alumino-Thermic process “ issued by RDSO and incorporated in Chapter 3 Part A of IRPWM. The theory may be understood from IRICEN Publication book

"welding technique". The extract of the same is reproduced below:

a. Only trained welder with valid competency certificate should do welding.

b. If welding is in-situ, then ensure adequate block.

c. Check condition of portion. Portion containing moisture should not be used.

d. Portion of same UTS and section should be used. If both rails are of different UTS then portion of higher UTS should be used.

e. Ensure that rail ends are cleaned properly as the improper cleaning of rail end can lead to lack of fusion.

f. Ensure proper gap with gap gauge before fixing the mould.

g. Ensure proper alignment with 1 M straight edge. (Should be within +/- 0.5 mm)

h. Ensure that rail ends are kept higher by providing wedges.

(3-4 mm for 72 UTS rails and 2-2.4 mm for 90 UTS rails)

i. Ensure proper position of moulds. (Only 3-piece moulds manufactured by A.T. portion manufacturer should be used)

j. Ensure proper sealing by luting sand to avoid leakage.

k. Ensure adequate pressure in fuel tank. (In case of Air-Petrol tank :- 7+/- 0.7kg/cm2, In case of compressed AirPetrol pre-heating technique :– 2.0 -2.50 kg/cm2 and for preheating by Oxy-LPG process pressure of oxygen and LPG cylinders should be 7.0-8.0 kg/cm2, 2.0-2.50 kg/ cm2 respectively)

l. Ensure proper pre-heating time i.e. 10 - 12 minutes, 4.0 to 4.5 minutes and 2.0-2.5 minutes for Air-Petrol, Compressed Air-Petrol and Oxy-LPG preheating technique respectively.

m. Ensure proper reaction time as the premature tapping can cause slag inclusion.

n. Before tapping the molten metal, check the condition of lutin to avoid chances of leakage.

o. After tapping, proper waiting time should be given(mould waiting time) which is 6 minutes for 25 mm gap joint and 12 minutes for 75 mm gap joints.

p. Trimming should be done only by hydraulic weld trimmer, No chisel cutting should be permitted.

q. The wedges provided for aligning should not be removed up to 20 minutes from trimming.

r. Runners and risers also should not be removed until cold and that too knocking towards the rail.

s. Don't pass any train up to 30 minutes after pouring molten metal into mould as the inadequate cooling may result in cupped joint or even joint may fail.

t. Provide wooden block and joggled fish plate with clamps till joint is tested by USFD.

9.3.2 Flash Butt welding:

The detail procedure has been given in "Manual for Flash Butt Welding of Rails " issued by RDSO and incorporated in Chapter 3 Part B of IRPWM. The theory may be understood from IRICEN Publication book "welding technique". The extract of the same is reproduced below:

Flash butt welding are preferred due to less defects and better fatigue strength as compare to AT welds. Earlier, these welds were carried out in static plant only but now it has become possible to carry out this job on field with mobile flash butt weld plant. This plant is mainly deployed where number of welds are to be carried out in mass like construction site, through weld renewal work and conversion of SWR into LWR.This machine can weld rail in the centre of track, on the shoulder, cess and in the track on which it is standing.

Fig. 9.6 Mobile Flash Butt Plant

In this process, rail ends are clamped and brought towards each other till flash starts. The flash will lead to heat generation and which will soften the steel. Current of about 5 volts and 35000 Amperes is passed between interfaces of two rails. Lot of flashing takes place and considerable heat is generated. The rail ends are moved to and fro automatically by the machine till the temperature rises to fusion limit of 10000C to 15000C. The rail ends are hydraulically pressed so that the soften rail ends are fuse together and form weld. The time taken for one weld is about 6 minutes.

9.3.2.1 Steps to Ensure Good Quality FB Weld with Mobile Flash Butt Welding Plant:

a. Ensure that rail ends are straight.(tolerance is +0.7mm /-0 mm for vertical plane and +/- 0.7 mm for horizontal plane with straight edge of 1.5m)

b. Rail ends should be cleaned by grinding to get cleansurface.

c. In case of second hand rails like TWR work, height difference in both rail ends should not be more than 1.2 mm and Individual height should not be less than 164/ 150 mm for 60kg/52kg rails.

d. When weld is carried out in situ, train should not bepassed up to 20 minutes after trimming operation.

e. Excess butting pressure is strictly prohibited as it leadsto high joints.

f. To avoid buckling of track, a gap should be left at every 500-meter interval which will be utilized for distressing.

g. Welding work during nighttime and rainy season should be avoided.

9.4 LWR and permissible locations:

Provisions of Chapter 3 Part D of IRPWM deals with LWR and should be strictly followed. All new construction /Doubling /Gauge conversion shall be opened with LWR/CWR. Theory can be understood from IRICEN Book- “Long Welded Rails”

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CHAPTER 10

OTHER USEFUL MACHINES FOR TRACK LAYING WORK

10.1 Introduction:

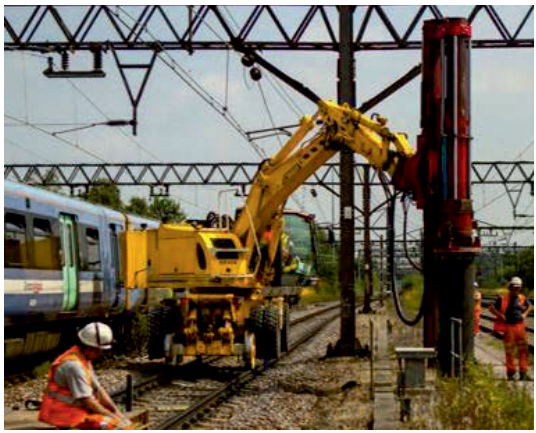
The renewal machines like Track Laying Equipment (TLE) and points and crossing laying machine i.e T-28 are having inherent limitations of its lifting capacity. As we induct wider sleeper, the weight of track is going to increase structure in future, these machines will only be able to handle the track till their lifting capacity is increased. In addition, as we shift to higher speed Turn outs like 1 in 16 or 1 in 20, T-28 machine will have difficulty in handling T/o due to increased length which will increase the sag. Also some of the machines which can perform multiple function should be inducted to reduce the number of machines and maintenance thereof.

In view of these limitations, different other types of machines which can be useful are given below:

10.2 Cranes with Multiple Functions:

A crane with multiple attachment for performing different function shall be useful in both construction and maintenance of track:

(a) With Tree cutting arrangement



(b) With Drilling Attachment

(c) With Sleeper Handling Arrangement

(d) With Lifting Attachment

(e) With Slab Laying Attachment

(F) With Tamping Attachment

Fig. 10.1 Cranes with Multi Utility Attachment

10.3 Other Machines for Plain Track and Points and Crossing Laying:

This machine consists of portals and any number of portals depending on length and weight to be handled can be used. This is useful for both plain track and points and crossing laying.

Fig. 10.2 (a) Giesmar Make Portal PEM and LEM used for Laying T/O and Plain Track also

Fig. 10.2 (b) Giesmar Portal Carrying Prefabricated Panel

In addition we have small machines which does not require even auxillary track for laying of new track and can be useful in many ways including at accident site. Some o such machines are given blow

Fig. 10.3. Dessec Make Portal for Laying Fabricated Panel
It does not require Auxillary track and moves on crawler.

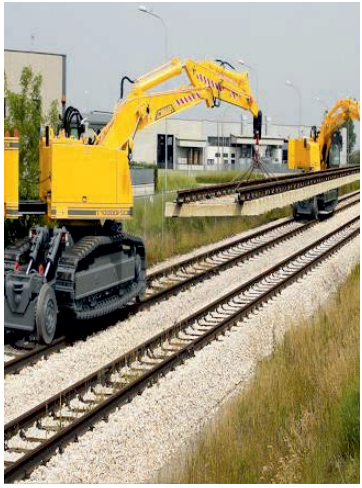


Fig. 10.4 Set of Coolmar Make Crane for Laying Points and Crossing and Track.
Can move on both rail and crawler, hence very useful.

10.4 Machines for Post Laying Work:

There are few machines which can be very useful for initial measurement and correction of level and alignment.

Fig. 10.5 Track Parameter Measuring Trolley.

Fig. 10.6 Giesmar Make Lifting cum Lining Unit for Lifting and Slewing of Running track.

Similarly there are many On Track and Small Machines which can be inducted into Indian Railways system for improving working condition, quality of work and for meeting future requirement arising out of change in track structure..

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For any suggestions, errors etc, please contact
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