

SUB :-TRACK MACHINE & WORKING PRINCIPLE

Duration- 36 Sessions = 72 Periods

Sub discipline-Track Machine (Lessons-01 Sessions-01)

Lesson-I: History of Track Machine and their Types

Session-1:History of Mechanization on Indian Railways introduction of Track Machines in chronological order.

Historical Development of Track Maintenance:

1950-80: From manual methods to full mechanization - From the very beginning the railways were aware of the importance of track maintenance. Nevertheless, it was not until 1950s that machines were developed to do the work. Initially, between 1950 and 1980, efforts were concentrated on mechanizing heavy manual, and on reducing construction costs.

1950-1960: Mechanization of the heavy duty works - Tamping and Cleaning of ballast.

1960: Development of multi-functional machines - Several work processes combined in one machine, starting with the first leveling and tamping machine and followed by the combined leveling, tamping and lining machine for plain track, switches and crossings.

1965: Increased working speeds - Introduction of the first double sleeper tamping machine and the hydraulic high performance ballast cleaning machine

1967 Introduction of complete machine systems - The mechanized maintenance train MDZ and the high speed track relaying train SUZ, the first track renewal using the assembly line method (not working on Indian Railways).

Since **1971:** Further improvements in performance and quality - By designing on-track machines as standard railway vehicles followed by further improvements in the quality of work resulting from the use of electronics, laser technology, computers and automatic work sequences.

Brief History of introduction of Track Machines Worldwide:

World over first mechanical off-track tamper was tried out around 1920, which was doing packing only. First On-Track Tamper was produced by Matissa of Switzerland which was founded in the year 1945. It produced and marketed only one type of tamper, model B-60. Plasser and Theurer established their works at Linz Austria in the year 1953 and produced their first hydraulic tamping machine HGL for use on Austrian Federal Railways. They came into regular production line for the first tamping machine VKR 01 in Cantilever design from 1955 onwards. Further, evolution of track machines is given below:

First leveling & tamping machine VKR 04

- 1962: First switch tamping machine with tilting tamping tools WE 75
- 1963: First automatic lining machine with two chord measuring technique
- 1964: First hydraulic ballast cleaning machine RM 62
- 1965: First two sleeper tamping machine Duomatic
- 1970: First leveling & tamping machine in 07 series
- 1972: First leveling, lining & tamping machine for switches 07-275
- 1973: First welding machine K355APT
- 1975: Dynamic Track Stabilizer - a new technology for stabilization of tracks
- 1983: First continuous action tamping machine 09 CSM
- 1996: First continuous action 3 - sleeper tamping machine came into existence

TION TO ON-TRACK MACHINES ON INDIAN RAILWAYS:

TYPE OF M/C	MODEL NO.	YEAR OF INTRODUCTION ON IR	MANUFACTURER	NO. OF WHEELS	MAX. DRIVING SPEED KMPH	RATE OF PROGRESS / EFFECTIVE HOUR	SALIENT FEATURES
1	2	3	4	5	6	7	8
Tie Tamping Machines – Plain Track Tamping Machine							
Super Lining Control Tamper	06-16-SLC	1968	Plasser & Theurer, Austria	4	40	400 to 500 sleepers	Double chord lining. Obsolete.
Universal Tamper	06-16-USLC	1972	-do-	4	40	500 to 600 sleepers	-do-
Tamper single sleeper	08-16-Unomatic	1985	-do-	8	60	800 to 1000 Sleepers	Single chord lining. One end driving due to Mechanical Gear Box.
Tamper Double Sleepers	08-32-Duomatic	1986	-do-	8	60	1400 to 1600 Sleepers	-do-
Continuous Tamping Machine	09-32-CSM	1989	-do-	8+2	60	2200 to 2400 Sleepers	ZF Gear Box. Satellite unit. Both end driving.
Tamping Express Three Sleepers	09-3X-CSM	2000	-do-	8 + 4	60	2800 to 3500 Sleepers	Two Engines. ALC & Laser.
Tamper Double Sleepers	08-32-New Duomatic	2003	-do-	8	60	1800 Sleepers	ZF gear Box, ALC. Both end driving.
Tamper Double Sleepers	08-32C Fully Imported	2008	-do-	-do-	-do-	-do-	No ALC, PCB 819, Fast Locking and unlocking.
Russian Tamper Double Sleepers	VPR-02M-18	2004	Metex, Russia	8	60	2000 Sleepers	Computer in Front Cabin.
Tie Tamping Machines – Points & Crossing Tamping Machine							
Points & Crossing Tamper	07-275-Unimat	1984	-do-	4	40	1 Turnout in 90 min.	Tool tilting 85 ⁰ outside & 5 ⁰ inside. Obsolete

Crossing Tamper	2S Unimat	1990	-do-	8	60	1 Turnout	Third (Working) cabin in the middle.
Points & Crossing Tamper	08-275-3S Unimat	1993	-do-	8	60	1 Turnout	Cantilever for 3 rd rail lifting. T/Unit can be turned up to 8½°.
Points & Crossing Tamper	08-475-4S Unimat	2009	-do-	10	60	1 Turnout	4 Tamping unit with 2 split head tools & 2 telescopic arms that can be slewed out to L.H or R.H side up to 3300 mm from track centre. Synchronous 3-rail lifting and 4-rail tamping.

TYPE OF M/C	MODEL NO.	YEAR OF INTRODUCTION ON IR	MANUFACTURER	NO. OF WHEELS	MAX. DRIVING SPEED KMPH	RATE OF PROGRESS / EFFECTIVE HOUR	SALIENT FEATURES
1	2	3	4	5	6	7	8
Tie Tamping Machines – Multi Purpose Tamper							
Multi Purpose tamper	Unimat Compact - M	1998	-do-	8	60	1 Turnout or 600 sleepers on Straight	Provision of Jib Crane. For Spot Attention. No Lifting Rollers.
Dynamic Track Stabilizer							
Dynamic Track Stabilizer	DGS-62N/62-PLS	1990	-do-	8	60	1 to 2 Km.	To consolidate track by Controlled Settlement 1Pass = 0.1 Million T.
Ballast Handling Machines							
Ballast Cleaning Machine	BCM	1970	Matissa, Switzerland	8	40	-	Obsolete.

Cleaning Machine	KBC-600	1989	Plasser & Theurer, Austria Kershaw, USA	8	40	650 Cum.	Deep screening of plain track. New M/cs also for Points & Crossings. 2 Engines. Hydrostatic drive.
Ballast Cleaning Machine for Points & Crossing	RM-76	1992	Plasser & Theurer, Austria	8	40	550 Cum.	Deep screening of T/Out as well as plain track. Hydrostatic drive
Shoulder Ballast Cleaning Machine	FRM-80 KSC-600	1992 1986	Plasser & Theurer, Austria Kershaw, USA	12 (8 Dr. + 4 Run.)	40	550 Cum.	Hydrostatic drive.
Shoulder Ballast Cleaning Machine	FRM-85	2004	Plasser & Theurer, Austria	12	40	550 Cum.	Waste Conveyor provided at front side. Engine shifted to rear side. Centre Plough provided.

TYPE OF M/C	MODEL NO.	YEAR OF INTRODUCTION ON IR	MANUFACTURER	NO. OF WHEELS	MAX. DRIVING SPEED KMPH	RATE OF PROGRESS / EFFECTIVE HOUR	SALIENT FEATURES
1	2	3	4	5	6	7	8
Ballast Regulating Machine	BRM 66-4 BRM C56-3	1989	Kershaw, USA	4	50 60	1 Km.	Profiling & Dressing of Track.

							Hydrostatic drive.
	PBR-40-R	2008	Plasser & Theurer, Austria	4	60	2 km	Front/Shoulder Plough and sweeper unit
Track Relaying Machines							
Track Relaying Machine	PQRS 2000-I (5T) & 201(9T)	1972	Plasser & Theurer, Austria	4	5	1 st hr = 20P 2 nd hrs. = 17P 3 rd hrs = 14P	5T load - 9m panel. 9T load - 13m panel.
Track Relaying Train	TRT P-811S	1989-90	Tamper Corporation, USA	Train	5	1 Km. in 2 Hr. 40 Mts.	For CTR/TSR.
Machine for Turn out Renewal	T-28	1992	Ameca. Italy	4	10	Depends on site conditions.	For complete renewal of turnout.
Special Purpose Machine							
Mobile Flash Butt Welding Plant	K-355 APT	1987	Plasser & Theurer, Austria	8	60	-	Welded with gap 3mm, rail are shorted by 32-35mm.
Rail Grinding Machine	SX-11	1990	Loram, USA	8	60	-	8 Grinding stones on each rail. Micro-processor controlled hydraulic system. Removes corrugation
Air & Vacuum Excavation Machine	RAIL VAC 10000/4800	-	Plasser & Theurer Austria	-	-	25m ³ /Hr	Installation or repair of cable drainage pipes & other underground equipment

								excavatio n for same

LINE- TAMPING MACHINES (LESSIONS-06 SESSIONS-08)

Lesson-1: 08-Unomatic / Duomatic **Session-2:** Main features, Main assemblies and components, Working Principle and Power Transmission

08 UNO –DUOMATIC:

MAIN FEATURES:

- Ø 2 Bogies Of 2 - 2 Axles
- Ø Main Gear Box – Mechanical (6 Speed Gear Box)
- Ø Fully Electronics Control M/C
- Ø Tamping Unit Up/Down Proportional Control
- Ø Single Chord Lining System.
- Ø Maximum Permissible Speed 60kmph
- Ø Output Uno -800 – 100 Slipper/ Hour Duo 1400 – 1600 Slipper/ Hour

TECHNICAL DATA:

Ø Gauge	-	1676 mm
Ø Over All Length	-	18710 mm
Ø Height Above Rail Level		3285 mm
Ø Width	-	3050 mm
Ø Wheel Dia	-	710 mm
Ø Weight		40 Ton

VARIOUS ASSEMBLIES:

CHASIS: It is welded construction out of steel girders, channel and sheets etc.

UNDER CARRIAGE: M/C is equipped with two-2 axles bogies with axles.

ENGINE: Kirloskar Cummins Diesels Engine, Six Cylinder Vertical Water Cooled, Turbo Charger Modern N .T. 743 C. Output: 243 HP At 2000 RPM.

TAMPING UNITS: Unomatic Model Have 16 Tools And Duomatic –Model Has 32 Tools.

HYDRAULIC SYSTEM: DUOMATIC :

PUMP: - : - **3 DOUBLE PUMPS**

(1) **38 × 17 GPM** COMBINED DELIVER TO SYSTEM PRESSURE OF 120 TO 140 BAR.

(2) **38 × 17 GPM**
38 GPM = VIBRATION (ONE SIDE) PRESSURE 150 BAR
17 GPM = COUNTER PRESSURE 35 BAR

(3) **38 × 22 GPM**
38GPM = VIBRATION ANOTHER SIDE PRESSURE 150 BAR
22 GPM = HYDRAULIC COOLER MOTOR PRESSURE – 50BAR

UNOMATIC: - **3 DOUBLE PUMPS**

(1). **38 × 17 GPM** =DELIVER TO SYSTEM PRESSURE ADJUSTED 120 -140 BARS

(2) **20 × 17 GPM**
20 GPM = VIBRATION (ONE SIDE) PRESSURE 150 BAR
17 GPM = HYDRAULIC OIL COOLER PRESSURE 50 BAR

(3). **20 × 22 GPM or 20 × 17 GPM**
20 GPM = VIBRATION ANOTHER SIDE PRESSURE 150 BAR
17 GPM = HYDRAULIC OIL COOLER PRESSURE 50 BAR.

HYD MOTOR = 5 NOS

Position Motor	=	2 Nos
Driving Motor	=	1 Nos
Hydraulic Oil Cooler Motor	=	2 Nos

ACCUMULATOR: - 32 liters capacities, N2 pressure 85 bars for system pressure are produce on both Uno and Duo. Two 1.6 liter capacity N2 pressure 20 bar for counter pressure are provided on Duo only.

PROPORTIONAL VALVE: - 2NOS FOR TAMPING UNIT UP/DOWN CONTROL

SOLENOID VALVE: - UNO - 16 NOS DUO - 18 NOS

HAND OPERATED VALVE: - 01 NO

CYLINDERS : UNO -30 NOS DUO = 38 NOS

HYDRAULIC OIL COOLERS: - 02 NOS

SUCTION FILTERS: - 03 NOS

RETURN FILTERS: - 02 NOS

PRESSURE FILTERS: - 01 NO

PRESSURE CONTROL VALVE: - 09 NOS

PRESSURE REDUCING FILTER: - 03 NOS

FLOW CONTROL VALVES:- 08 NOS

PNEUMATIC SYSTEM:

COMPRESSOR	=	01 NO 500 LITER/MINUTE
UNLOADER VALVE	=	01 NO PRESSURE ADJUSTED 7 BAR
AIR TANK	=	02 NOS CAPACITY 100 LITER EACH
BRAKE CYLINDER	=	02 NOS DIA 12 INCH EACH
CYLINDER	=	43 NOS OFF SIZES.

DRIVING SYSTEM:

1. Run Drive - 6 Speed Gear Box Is Provided For Driving Station To Station.

2. Work Drive - Hydraulic motor is provided for work drive at constant speed.

2. Tamping Unit: This is first tamping machine on which proportional valves are provided for smooth and jerk less up and down.

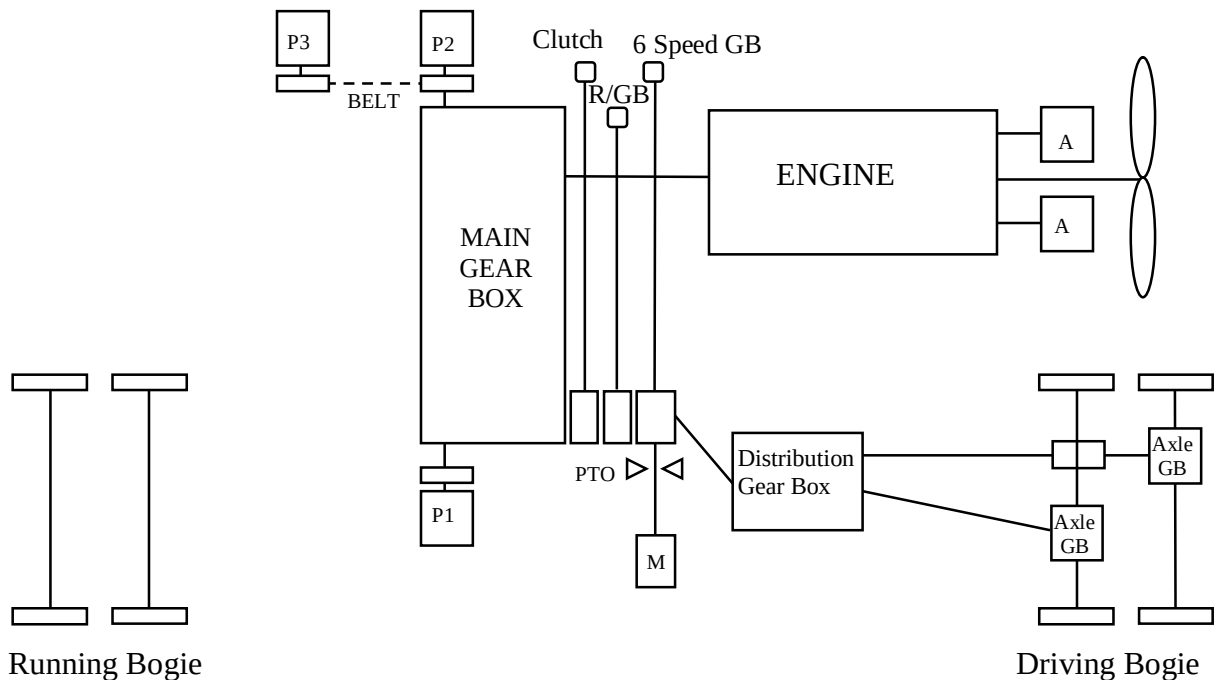
3. Lining : This is first tamping machine on which single chord lining (4 point and 3 point lining) systems are provided. 4 point lining is called smoothening mode and 3 point is called precision mode.

design lining is possible in every mode for which offset value is feeded.

4. Levelling : Double chord follow up systems are provided on this series machine. In this method one rail is kept base line and other line is cant line. Cant side chord follow up base line to maintain the level of the chord with the help of front pendulum. This machine is design for cross-level correction.

the leveling may be done by proportional mode or design mode.

SSION :



ELECTRONIC PCBs :

SR.NO.	PART NO.	FUNCTION	QUANTITY
1	EK813SV00	DC-DC CONVETER	4 NOS.
2	EK255LV00	FRONT AUTO LEVELLING	1 NOS.
3	EK708/715A00	M MOTOR DRIVE	2 NOS.
4	EK217LV00	FRONT PENDULUM CONTROL	1 NO
5	EK275LV00	DESIGN LINING	1 NO
6	EK 16V00	TEMP UNIT UP-DOWN CONTROL.	2 NOS.
7	ELT1116	SEMI AUTO WORK	1 NO
8	EK335LV00	LINING	1 NO
9	EK290LV00	OVER SLEW	1 NO
10	EK80V00	3 STAGE LINING	1 NO
11	EK229LV00	TRACK LIFTING	2 NOS.
12	EK277LV00	MIDDLE PENDULUM CONTROL	1 NO
13	EK79V00	3 STAGE LIFTING	1 NO
14	ELT631.00	INTERCOM	1 NO

ELECTRICAL SYSTEM

1	BATTERY 12 V/180 AH	= 2 NOS. Combined In Series
2	ALTERNATOR 53 A/27 V	= 2 NOS.TVS Lucas Make
3	SELF STATER	=2 NOS.
4	MARRELLY MOTOR(WIPER MOTOR)	= 2 NOS.
5	PENDULUM(MECHANICAL+ ELECT)	= 2 NOS.
6	HEIGHT TRANSDUCER	= 2 NOS.
7	LINING TRANSDUCER	=2 NOS

Lesson-II: 09-32-CSM

Session-3: Main features, Main assemblies &

components.

09 -32 CSM

MAIN FEATURES:

- Ø MACHINE HAVE TWO PARTS I.E. MAIN FRAME & FRAME SATELLITE
- Ø MAIN GEAR BOX—ZF -- (4 SPEED GEAR BOX).
- Ø PROGRAMMABLE LOGIC CONTROL (PLC) MACHINE.
- Ø AUTOMATIC DATA DEEDING BY COMPUTEC (GVA) ONLY FIVE MACHINE.
- Ø LASER LINING (ONLY ON 5 MACHINE)
- Ø LINING & LIFTING SERVO CONTROL.
- Ø FULLY AUTO WORKING.
- Ø DATA RECORDER, (AFTER WORK) 3- CHANNELS.
- Ø TWIST CORRECTION.
- Ø MAXIMUM PERMISSIBLE SPEED 60 KMPH (BY RDSO)
- Ø OUTPUT ---- 2200 TO 2400 SLEEPER / HR.
- Ø MULTICHECK SYSTEM.

GENERAL DATA:

Ø OVERALL LENGTH	--	27640 MM
Ø HEIGHT ABOVE RAIL LEVEL	--	3600 MM
Ø WIDTH	--	3040 MM
Ø WHEEL DIA	--	730 MM
Ø TOTAL WEIGHT	--	64 TON
Ø MINIMUM RADIUS WORKING	--	100 M

MAIN UNITS:

1. SATELLITE --	WEIGHT 14 TON
2. MAIN FRAME	WEIGHT 50 TON
3. ENGINE	MWM 232 TBD 12 V @ 473 BHP
4. TAMPING UNITS (DUO TYPE)	32 TOOLS
5. LIFTING & LINING UNITS	
6. Z. F GEAR BOX.	4 SPEED GEAR BOX.

HYDRAULIC SYSTEM:

PUMP 5 PUMP (4 DOUBLE PUMPS + 1 VARIABLE PUMP)

1. **DOUBLE PUMP** = 38×22 GPM COMBINED FOR SYSTEM PRESSURE ADJUST **120-140 BAR**
2. **DOUBLE PUMP** = 38 × 17 GPM
 - 38 GPM** = VIBRATION (ONE SIDE) PRESSURE **150 BAR**.
 - 17 GPM** = HIGH PRESSURE **150 BAR**
3. **DOUBLE PUMP** = 38× 17 GPM
 - 38 GPM** = VIBRATION (ANOTHER SIDE) PRESSURE **150 BAR**;
 - 17 GPM** = COUNTER PRESSURE **35 BAR**.
4. **DOUBLE PUMP** = 20 × 17 GPM OR 20 × 114 GPM
 - 20 GPM** = 2 HYDRAULIC COOLERS MOTOR PRESSURE **50BAR**
 - 17 GPM** = RADIATOR + Z. F.OIL COOLER PRESSURE **50 BAR**.
5. **VARIABLE PUMP.** = **90 LPM** DRIVING PRESSURE **210 BAR**
CHARGING PRESSURE **30 BAR**.

8 NOS

VIBRATION MOTOR	= 2 NOS
DRIVING MOTOR	= 2 NOS
HYDRAULIC OIL COOLER MOTOR	= 2 NOS
Z. F. + RADIATOR MOTOR	= 2 NOS

ACCUMULATOR: - 4 NOS

1. 32 LITRE CAPACITY N2 PRESSURE 85 LITER FOR SYSTEM PRESSURE -1NO
2. 20 LTS CAPACITY N2 PRESSURE 100 LITER FOR HIGH PRESSURE -1NO
3. 1.5 LTS CAPACITY N2 PRESSURE 20 LITER FOR COUNTER PRESSURE- 2NOS

PROPORTIONAL VALVES: -	3 NOS
TAMPING UNITS UP/DOWN CONTROL	= 2 NOS
SATELLITE MOVEMENT	= 1 NO

SERVO - VALVE	-	3 NOS
LIFTING	=	2 NOS
LINING	=	1 NO

SOLENOIDS: -	22 NOS	SOLENOID VALVE
CYLENDRS: -	50 NOS	
SUCTION FILTER	= 3 NOS	
RETURN FILTER	= 2 NOS	
PRESSURE FILTER	= 3 NOS	

PNEUMATIC SYSTEM:

TWIN CYLINDER COMPRESSOR CAPACITY 600 CM/MINUTE	
UNLOADER VALVE	= 1 NO PRESSURE ADJUST 7 BAR
AIR TANK	= 2 NOS CAPACITY 100 LITER EACH
BRAKE CYLINDER FOR MAIN MACHINE	= 2 NOS DIA 12 INCH.
BRAKE CYLINDER FOR SATELLITE	= 2 NOS DIA 8 INCH.
PRESSURE CYLINDER	= 56 NOS OFF SIZES.

WORKING PRINCIPLE

DRIVING SYSTEM: -

WORK DRIVE: - During work machine is driven by variable pump with variable speed 0 to 2 kmph. but satellite drive is proportional drive. the speed of satellite varies with the main frame speed.

RUN DRIVE: - Hydro dynamics gear box (zf) is provided on the machine.

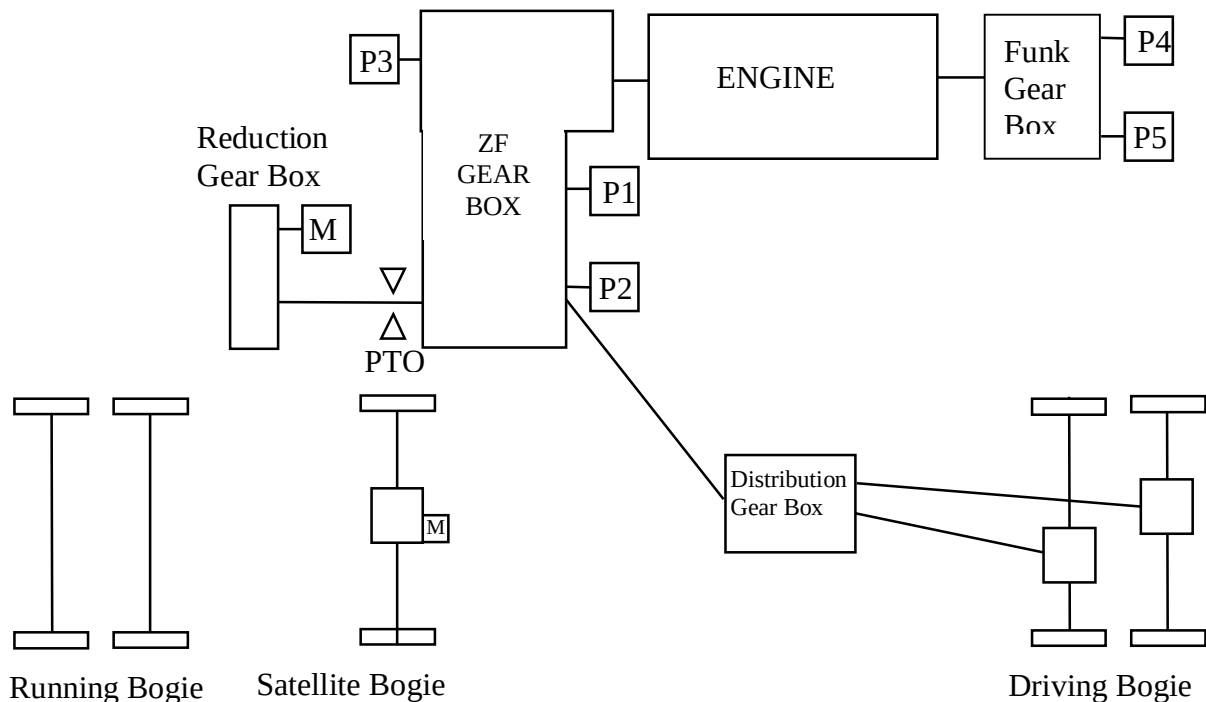
LINING: - Single chord lining system is provided on CSM .on few machine (only 5 machines) laser lining systems are provided.

LEVELING: - On this machine fixed chord double chord leveling system is provided. This machine is designed for the twist correction for that rear pendulum is given.

RECORDER: - 3 channel recorders are provided on each machine to record the parameters i.e. versine, cross level and lift value after work.

GVA: - Geometrical value assessment computer is provided on only first five CSM. computer feeds the required data to the machine automatically with respect distance. Linear feeding is only possible in this method.

POWER TRANSMISSION:



ELECTRICAL & ELECTRONICS

Ø BATTERY 12 V/ 180 AH	= 2 NOS COMBINED IN SERIES
Ø ALTERNATOR 28V/55A	= 2 NOS BOSH MAKE
Ø SELF STARTOR	= 1 NO
Ø PENDULUM	= 3 NO.
Ø HIEGHT TRANSDUGER	= 2NOS
Ø LINING TRANSDUCER	= 2NOS
Ø TAMPING DEPTH TRANSDUCER	= 2 NOS
Ø DISTANCE ENCODER	= 2 NOS

NAME OF PCB:

Sr. NO.	PART NO.	FUNCTION	QUANTITY
1	EK813SV00	DC to DC Converter	5 Nos
2	EK812SV00	DC to DC Converter	1 No
3	EK851SV00	DC to DC Converter	1 No
4	EK345LV00	Front Input	1 No
5	EK24V00	Satellite Drive	1 No
6	EK28V00	Multiplexer	1 No
7	EK16V00	Tamping Unit UP/DOWN Control	2 Nos
8	EK347LV00	Track Lifting	2 Nos
9	EK346LV00	Pendulum Control	1 No
10	EK348LV00	Satellite Compensation	1 No
11	EK349LV00	Lining Control	1No
12	EK290LV00	Overslew	1 No
13	EK319LV00	Work Drive Control	1 No
14	EK99V00	Distance Simulator	1 No
15	EK110LV00	Pendulum Compensation	1 No
16	EK501P00	Programmer	1 No
17	EK552P00	Delayed Output	1 No
18	EK553P00	Input/Output	9 Nos
19	ELT631	Intercom	1 No

08 – 275 UNIMAT

MAIN FEATURES: -

- Ø THIS MACHINE HAS GOT 16 TAMPING TOOLS .WHICH CAN BE TILTED.
- Ø MAIN GEAR BOX -- ZF
- Ø THREE CABINS I.E FRONT , REAR & WORKING
- Ø PLC CONTROL
- Ø MULTICHECK SYSTEM
- Ø TWO OPERATORS REQUIRED IN WORKING CABIN.
- Ø DOUBLE CHORD FIXED LEVELING SYSTEM.
- Ø HOOK BLOCK FOR LIFTING
- Ø MAXIMUM PERMISSIBLE SPEED 60 KMPH
- Ø MAXIMUM OUTPUT 90 MINUTE/ T.O.

GENERAL DATA

Ø OVERALL LENGTH	--	19170 MM
Ø HEIGHT ABOVE RAIL LEVEL	--	3500 MM
Ø WIDTH	--	3020 MM
Ø WHEEL DIAMETER	--	730 MM
Ø TOTAL LOAD	--	44000 KG
Ø LINING BASE	--	20600 MM
Ø LEVELING BASE	--	12210 MM

MAIN ASSEMBLY:-

- ENGINE -- CUMMINS NT 855 L 320 HP @ 2000 RPM
- Ø CHASSIS --
- Ø MAIN GEAR BOX -- Z F GEAR BOX
- Ø TAMPING UNITS - WITH TILTING ARRANGEMENT
- Ø LINING AND LIFTING - MONOBLOCK WITH SEPARATE LIFT-ARRANGEMENT.
- Ø DISTRIBUTION GEAR BOX
- Ø REDUCTION GEAR BOX.

HYDRAULIC SYSTEM

PUMPS - 3 DOUBLE PUMPS ARE PROVIDED

1. **D/PUMP 38×22 GPM** COMBINED FOR THE SYSTEM PRESSURE.120- 140 BAR.
2. **DOUBLE PUMP - 20 × 17 GPM**
 - 20 GPM** = VIBRATION (ONE SIDE) PRESSURE 150 BAR
 - 17 GPM** = 3 HYDRAULIC COOLERS MOTOR PRESSURE 150 BAR
3. **DOUBLE PUMP 20×22 GPM**
 - 20 GPM** = VIBRATION (ANOTHER SIDE) PRESSURE 150 BAR.
 - 22 GPM** = HIGH PRESSURE. 150 BAR.

MOTOR: - 7 MOTORS ARE USED ON THIS MACHINE.

VIBRATION MOTOR	-	2 NOS
DRIVING MOTOR	-	2 NOS
HYDRAULIC OIL COOLER	-	2 NOS
Z F COOLER MOTOR	-	1 NO

ACCUMULATOR:-

TWO ACCUMULATORS BLADDER TYPE.

1. 32 LITERS CAPACITY NITROGEN PRESSURE 85 BAR FOR SYSTEM PRESSURE.
2. 20 LITERS CAPACITY NITROGEN PRESSURE 100 BAR FOR HIGH PRESSURE.

PROPORTIONAL VALVE:-

TWO NOS FOR TAMPING UNIT UP/DOWN CONTROL.

SOLENOIDS: - 43 SOLENOIDS.

CYLINDERS: - 57 CYLINDERS OFF SIZES.

PNEUMATIC SYSTEM.

- | | | |
|-------------------|---|--------------------------------|
| 1. COMPRESSOR | = | 1 NO CAPACITY 500 CUM/MINUTE |
| 2. PRESSURE TANK | = | 2 NOS CAPACITY 100 LITER/ INCH |
| 3. BRAKE CYLINDER | = | 2 NOS. DIA. = 12 INCH. |
| 4. CYLINDER | = | 48 NOS OF SIZES |
| 5. SOLENOID | = | 12 NOS |

WORKING PRINCIPLE

DRIVING:

RUN DRIVE: - BY HYDRODYNAMICS (ZF) IV SPEED GEAR BOX.

WORK DRIVE: - BY HYDRAULICS MOTOR WITH CONSTANT SPEED.

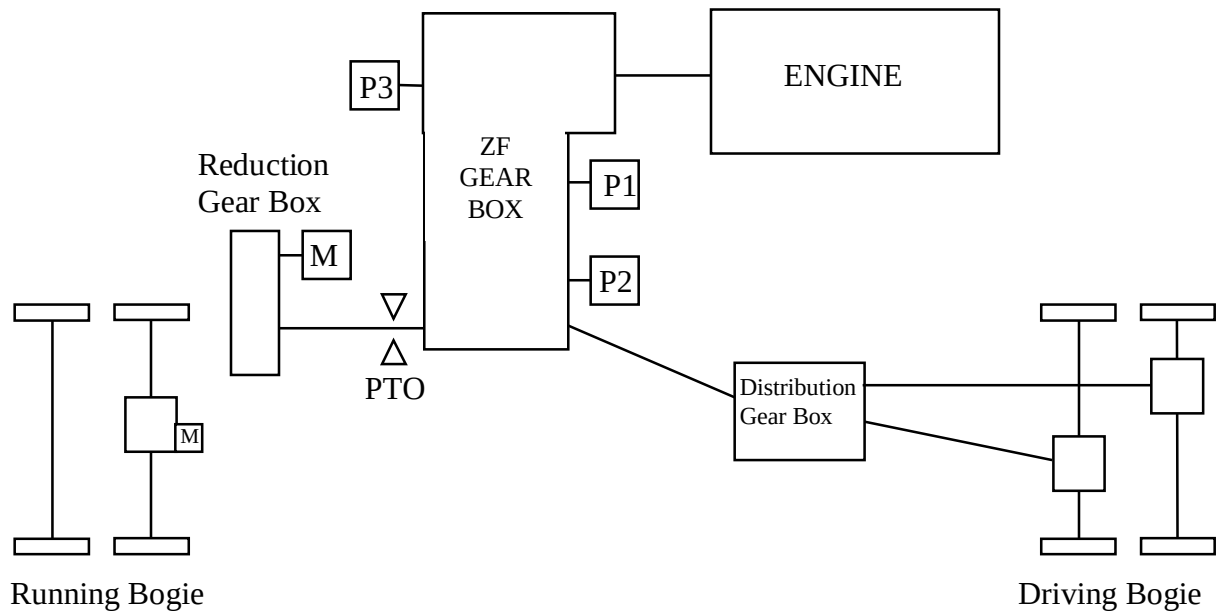
LINING: SINGLE CHORD LINING SYSTEM.

LEVELLING:- DOUBLE CHORD FIXED TYPE SYSTEM AND CROSS-LEVEL
RECORDING

REAR PENDULUM IS PROVIDED.

RECORDER 2- CHANNEL RECORDER IS USED TO RECORD CROSS LEVEL AND
VERSINE AFTER THE WORK.

POWER TRANSMISSION:



ELECTRIC SYSTEM.

1. BATTERY 12 V/ 180 AH = 2 NOS COMBINED IN SERIES.
2. ALTERNATOR 28 V/55A = 2 NOS BOSCH MAKE.
3. SELF STARTER = ONE
4. PENDULUM = 3 NOS
5. HEIGHT TRANSDUCER = 2 NOS
6. VERSINE TRANSDUCER = 2 NOS
7. TAMPING DEPTH TRANSDUCER = 2 NOS
- 8 LINING CHORD FOLLOW UP COMPENSATION = 1 NO
TRANSDUCER

PCB 15 DIFFERENT TYPE PCB (MAIN)

Sr. NO.	PART NO.	FUNCTION	QUANTITY
1	EK813SV00	DC to DC Converter	4 Nos
2	EK2072LV00	Front Input	1 No
3	EK28V00	MULTIPLEXER	1 No
4	EK132V00	Tamping Unit UP/DOWN Control	2 Nos
5	EK144V00	Hook + Three Stage Regulator	1 No
6	EK2041LV00	Track Lifting	2 Nos
7	EK2042LV00	Pendulum Control	1 No
8	EK2038LV00	Lining Control	1 No
9	EK290LV00	Overslew	1 No
10	EK719A00	Lining Chord Follow up	1 No
11	EK502P00	Programmer	1 No
12	EK552P00	Delayed Output	1 No
13	EK553P00	Input/Output	11 Nos
14	EK554P00	QL Plate	5 Nos
15	ELT631.00	Intercom	1 No

Lesson -IV : 08-275-3S UNIMAT

Session-7: Main features, Main assemblies & components, Working Principle and Power Transmission, Difference between 2S & 3S Unimat.

08 – 275 – 3S UNIMAT - 3S

MAIN FEATURES

- Ø ALL FOUR BOGIES ARE POWERED.
- Ø TAMPING UNIT CAN BE RUNNING 8 EACH SIDE.
- Ø 3RD RAIL LIFTING ARRANGED ALSO.
- Ø LINING AND LIFTING: - SERVO VALVE
- Ø SQUEEZING: - PROPORTIONAL VALVE
- Ø MAX. PERMISSIBLE SPEED: - 60 KMPH.
- Ø OUTPUT: - 60 MINUTE/T.O.

GENERAL DATA

- Ø OVER ALL LENGTH = 22305 MM
- Ø WIDTH = 3550 MM
- Ø WHEEL DIA = 730 MM
- Ø L. CHORD LENGTH = 22.60 M
- Ø LEVELING CHORD = 15.58 M
- Ø WEIGHT = 64 TONNES

MPT-2000

MAIN FEATURE

- i. It can tamp plain track as well as point and crossing.
- ii. It has a small 1 tonne capacity crane for loading and unloading 4 No. Rail pieces of about 6.5 metres long.
- iii. It can carry 20 workers to site of work.

GENERAL DATA

LENGTH	:	20.270 M
WIDTH	:	3.100 M
HEIGHT	:	3.700 M
DISTANCE BETWEEN BOGIE PIVOTS	:	12.000 M
WHEEL DIA	:	0.730 M
WEIGHT	:	46 TONNES
ENGINE CUMMINS	:	KT 855
SPEED POTENTIAL	:	80 KMPH

WORKING PRINCIPLE

DRIVING:

RUN DRIVE: - BY HYDRODYNAMICS (ZF) IV SPEED GEAR BOX.

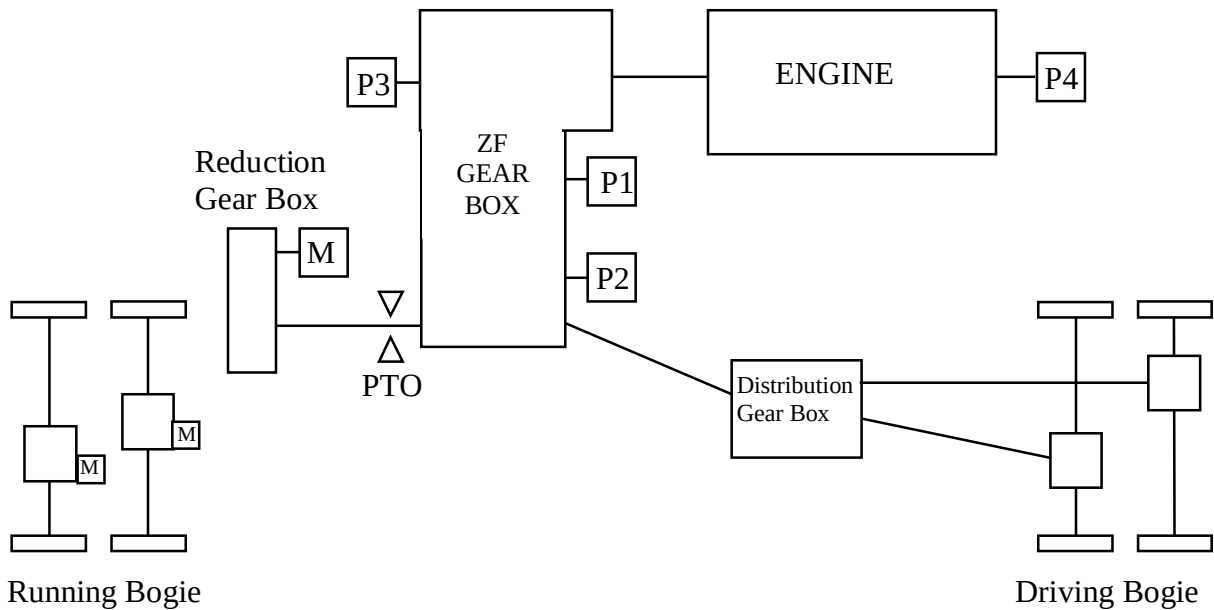
WORK DRIVE: - BY HYDRAULICS MOTOR WITH CONSTANT SPEED.

NORMALLY TWO MOTORS ARE WORKING BUT ON GRADIENT THIRD MOTOR IS APPLIED

LINING: SINGLE CHORD LINING SYSTEM WITH PNEUMATIC FOLLOW UP SYSTEM LEFT OVER ERROR IS VERY LESS ($FR = FD/7.6$) .

LEVELLING:- DOUBLE CHORD FIXED TYPE SYSTEM THIRD RAIL LIFTING ARRANGEMENT IS GIVEN WHICH CAN LIFT ADJACENT RAIL AND PACKED MANUALLY .

POWER TRANSMISSION:



NAME OF PCBs & THEIR FUNCTIONS: 08-275-3S:

S. No.	PCB Part No.	Function	Qty.
1.	EK 813 SV 00	DC to DC Convertor 24V→ ± 15 V and ± 10V	4 Nos.
2.	EK 812 SV00	DC to DC Convertor 24V→ +24V and + 12V	1 No.
3.	EK2072 LV00	Front input	1 No.
4.	EK2173 LV00	Lining Inputs control	1 No.
5.	EK2140 LV00	Lining Output& Over Slew control	1 No.
6.	EK2041 LV00	Track lifting	2 Nos.
7.	EK2042 LV00	Pendulum control	1 No.
8.	EK 120 V00	Hook Control	1 No.
9.	EK 140 A00	Proportional squeezing	1 No.
10.	EK 132 V02	Tamping Unit UP/DN control	2 Nos.
11.	EK 28 V02	Multiplexer	1 No.
12.	EK 502 P00	Programmer PCB	1 No.
13.	EK 552 P00	Time Delay	1 No.
14.	EK 553 P00	Programmer Input/output	13 Nos.
15.	EK 554 P00	QL-relay	5 Nos.
16.	EL-T 631.00	Inter com.	1 No.

TEMS:FOR UNIMAT-3S:

- | | |
|-----------------------------|---|
| 1. BATTERY | =4 NOS. (12V/180AH-2 NOS, 12V/40AH 2 NOS) |
| 2. ALTERNATOR 28 V/55A | = 2 NOS BOSCH MAKE. |
| 3. SELF STARTER | = ONE |
| 4. PENDULUM | = 2 NOS |
| 5. HEIGHT TRANSDUCER | = 2 NOS |
| 6. VERSINE TRANSDUCER | = 2 NOS |
| 7. TAMPING DEPTH TRANSDUCER | = 2 NOS |

Differences between unimat 2S & 3S	
UNIMAT -08-275-2S	UNIMATE -08-275-3S
- Cummins engine water cooled , model NTA-855 L six cylinder with 320 H.P at 2000 rpm - One turbocharger - One radiator and one water pump - Two batteries of 12 v / 180 AH - Inter communication system is not provided in the driving cabin - Automatic chord follow up system by electrical power. - Two hydraulic motors for work drive - Two separate valves are used each for slow & fast movement of lifting & lining operations - Three hydraulic pumps of 38/22 GPM, 20/22 GPM and 20/17 GPM Are provided. - Pump 38-22 GPM : used for system at 135-150 bar - Pump 20-22 GPM : 20 GPM pump vibration at 150 bar and 22 GPM high pressure system of 150 bar - Pump 20-17 : 20GPM pump for vibration at 150 bar 17 GPM for cooling circuit - Two return & One pressure filter - Tamping units moves laterally only - Fail safe brake arrangement is not provided - No emergency brake-up is provided for locking tamping unit. Lifting unit etc. in case of shut-down or hydraulic pump failure - Recorder is provided to record track parameters - There are three electrical pendulums one each on front tower. Working cabin and recorder - Lining unit frame work is in piece - Cannot lift third rail. Jacking has to be done with kutch packing	- MWM engine water cooled , model TBD-232 v-12 with 473 H.P at 2000 rpm - Two turbochargers - Two radiators and two water pumps - Two batteries of 12 v / 20AH in additions 2 no.s 12 v 220 AH - Inter communication system is provided in all the three cabin - Automatic chord follow up system by pneumatic power. - Three hydraulic motors for work drive - Servo valves are used for lifting and lining operations - Three double pumps of 38/17 GPM. 25/25 GPM. And 20/14 GPM are provided and one axial piston pump - Pump 38-17 GPM : used for system at 135-150bar - Pump 25-25 GPM : for vibration motors LH & RH at 150bar vibration motors are of 22 GPM capacity - Pump 20-14 for drive of cooler and engine radiator fans - Two return & three pressure filters - The t/units can be rotated through 8.5 degrees on both the sides. - Fail safe- brakes are provided. - Back-up system is provided. - Recorder is not provided. - Only two pendulums have been provided. - Lining unit frame work is in two pieces - Can lift third line synchronous with main line but cannot tamp. Manual katcha packing has to be done.

NIMAT:

Main Features:

- 2 bogies of 2-2 Axles & one idle axle.
- Z.F. Gear box.
- Fully automatic tamping cycle (plain track).
- (Adjustment automatic system) SJA systems.
- ALC system.
- Maximum permissible speed 60 km/hrs..
- Toeing speed 100kg/hrs.
- 3rd Rail Lifting & 4th Rail tamping arrangement.
- Out put one turn out/hrs.
- Intercom in all cabins

General Data:

Overall length – 28370mm
Width – 3000mm
Height – 3743mm
Axle – 5Nos.
Wheel diameter – 920mm
Total Weight – 84100 Kg.

Main Units:

Tamping Unit – In 4 parts & each contains 4 tilt able tools.

Lining & Lifting Unit – 4T tool

ZF Gear Box – 4 speed

Engine – 2 Nos.

(1) Cummins KTA-1150L 350W at 2100RPM

(2) Additional Engine Kirloskar 6.8KW

Tamping Unit: Tamping Unit in 4 parts & each contains 4 tilt able tamping tools. The two outer tamping unit parts can be slewed laterally 200mm to the inside & 1500mm to the outer side.

- The two tamping unit parts can be slewed on guide columns 200mm to inside & 640mm to the out side of the machine.
- Each tamping unit parts can tilt 8½° in either side.
- Each tamping tool can tilt 15° inside & 85° out side.

Proportional valves are provided for smooth and jerk less up and down movement of tamping units .

Lining : In this machine single chord lining (4 point and 3 point lining) systems are provided. 4 point lining is called smoothening mode and 3 point is called precision mode. design lining is possible in every mode for which offset value is feeded.

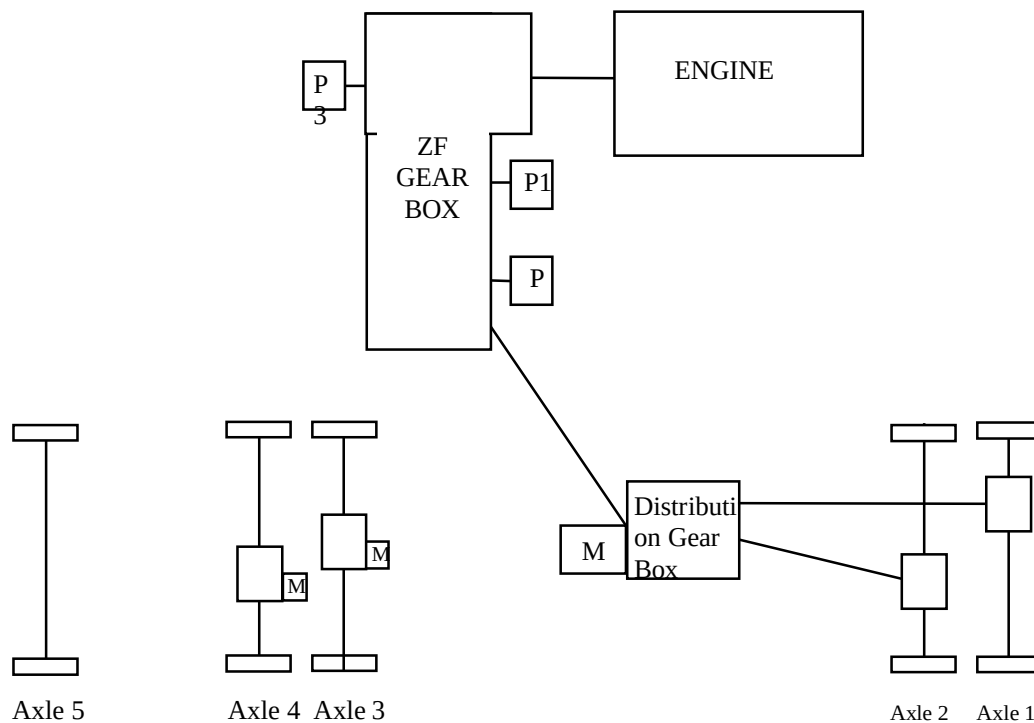
Levelling : Double chord levelling systems are provided on this series machine. In this method one rail is kept base line and other line is cant line. Cross level is maintained with the help of pendulums. This machine is design for cross-level and longitudinal level correction. the leveling may be done by proportional mode or design mode.

Driving:

Run Drive – By Hydrodynamics (ZF) IV Speed Gear Box.

– Three Hydraulic Motors are provided. Machine work in constant speed.
 Fuel Tank Capacity – 3000 ltr. + 1 additional tank of 900 ltr. Capacity.

POWER TRANSMISSION :



Engine KT-1150L 350KW 2100RPM
 ZG ZF Gear Box Model – 4WG 65II
 Distribution Gear Box WN-75 200/1800
 MX – Hydraulic Motor – Hy 916N800
 P1 = Hydraulic Triple Pump Hy 832 x 24-14-14L
 P2 = Hydraulic Triple Pump Hy 832 x 20-14-14L
 P3 = Hydraulic Triple Pump Hy 832 x 38-22-14RE

Hydraulic System:

1. Hydraulic Pumps Hy 832 x 24 x 14 x 144 – 1 No.
2. Hydraulic Pumps Hy 832 x 38 x 22 x 14RE – 1 No.
3. Hydraulic Pumps Hy 832 x 38 x 14 x 14Li – 1 No.
4. Gear Pumps Hy 711 x 08 RE – 1 No.

Hydraulic Motors:

1. For Driving – 3 Nos.

- Nos.
3. For AC = 2 Nos.
 4. Engine Radiator – 1 No.
 5. With Small Engine – 1 No.
 6. Cooler + ZF Cooler - 3

Hydraulic Filter:

Suction filter	Hys-501-460-150H – 3 Nos.
Return flow filter	Hys-501-330-10A/H – 1 Nos.
Filter Elements	Hyd-501-32-10ES – 2 Nos.
Filter	Hyr-508-05-01 – 3 Nos.
Filter	DL-40-60E – 2 Nos.
Filter	Hyd-501-225-25 – 1 No.
Filter (Diesel)	Hyd-506-10-30 – 1 No.

Accumulator:

- | | |
|-----------|--------------------------|
| 1. 85 bar | 32 ltr capacity – 2 Nos. |
| 1. 85 bar | 20 ltr capacity – 1 No. |

Special Valve:

- | | |
|--------------------|----------|
| Servo Valve | 3 Nos. |
| Proportional Valve | – 4 Nos. |

Hydraulic Pressure

- | | |
|--------------------|--------------|
| Vibration Pressure | – 185bar |
| Squeezing Pressure | – 130-140bar |
| Big Squeezing | – 150bar |
| AC | - 10bar |

Cardon Shaft – 5 Nos.

Pneumatic System:

- Two cylinder compressor
- Use (i) For Brake System
- (ii) Lifting & Lowering of Trolleys
- (iii) For locking of trolleys
- (iv) For warming device.

Lesson-V:09-3x Tamping Express Session-8: Main features, Main assemblies & components Working Principle.

09 - 3X TAMPING EXPRESS

MAIN FEATURES:

- Ø LATEST VERSION OF CSM
- Ø PROGRAMMABLE LOGIC CONTROL (PLC) MECHANISM.
- Ø COMPUTER
- Ø ALC: - FOR AUTOMATIC DATA FEEDING
- Ø 3.BOGIES OF 2 – 2 AXLES (INCLUDING SATELLITE BOGIE)
- Ø 2 – ENGINES OF CUMMINS NT 855 & KTA 1150
- Ø MAXIMUM PERMISSIBLE SPEED 60 KMPH (BY RDSO)
- Ø OUTPUT 2700 SLIPPER/HOUR

GENERAL DATA:

Ø OVERALL LENGTH	--	22940 MM
Ø WEIGHT	--	4090 MM
Ø WIDTH	--	2900 MM
Ø DISTANCE BETWEEN BOGIE PIVOTS	--	15700 MM
Ø WHEEL DIA	--	730 MM
Ø TOTAL WEIGHT	--	830 TONNES

MAIN UNITS:

- Ø FOUR TAMPING UNITS
- Ø ENGINE: TWO ENGINES ARE PROVIDED KTA 1150L AND NT 855
- Ø SATELLITE HAVING TWO AXLES WITH HYDRAULIC BRAKES
- Ø ZF GEAR BOX WITH FOUR SPEED
- Ø DIFFERENTIAL GEAR BOX

HYDRAULIC SYSTEM:-

PUMP 6 DOUBLE PUMP AND ONE VARIABLE PUMP.

1. Double pump 38×22 GPM Combined for system pressure adjust 130 bar.
2. D/ Pump 35×25 GPM = 01 No.
35 GPM = Vibration + 2nd tam/ v Pressure 150 bar
17 GPM = ZF Cooler motor + Radiator of KTA 1150 L
3. D/Pump 35 ×17 GPM = 01 No
35 GPM = Vibration (another side) pressure 150
17 GPM = Counter pressure for big cylinder and small Cylinder.
4. D/Pump 35 X 17 GPM
35 GPM = Vibration of tamping unit
17 GPM = Hydraulic coolers
- 5 D/Pump 38 X 25 GPM Combined for the system pressure 130 bar
- 6 D/Pump 35 X 17 GPM
35 GPM = Vibration of tamping unit
17 GPM = Hydraulic cooler motor drive
7. Variable Pump: Capacity 125 LPM for continuous drive

WORKING PRINCIPLE

DRIVING SYSTEM: -

WORK DRIVE: During work machine is driven by variable pump with variable speed 0 to 2 kmph. but satellite drive is proportional drive. the speed of satellite varies with the main frame speed.

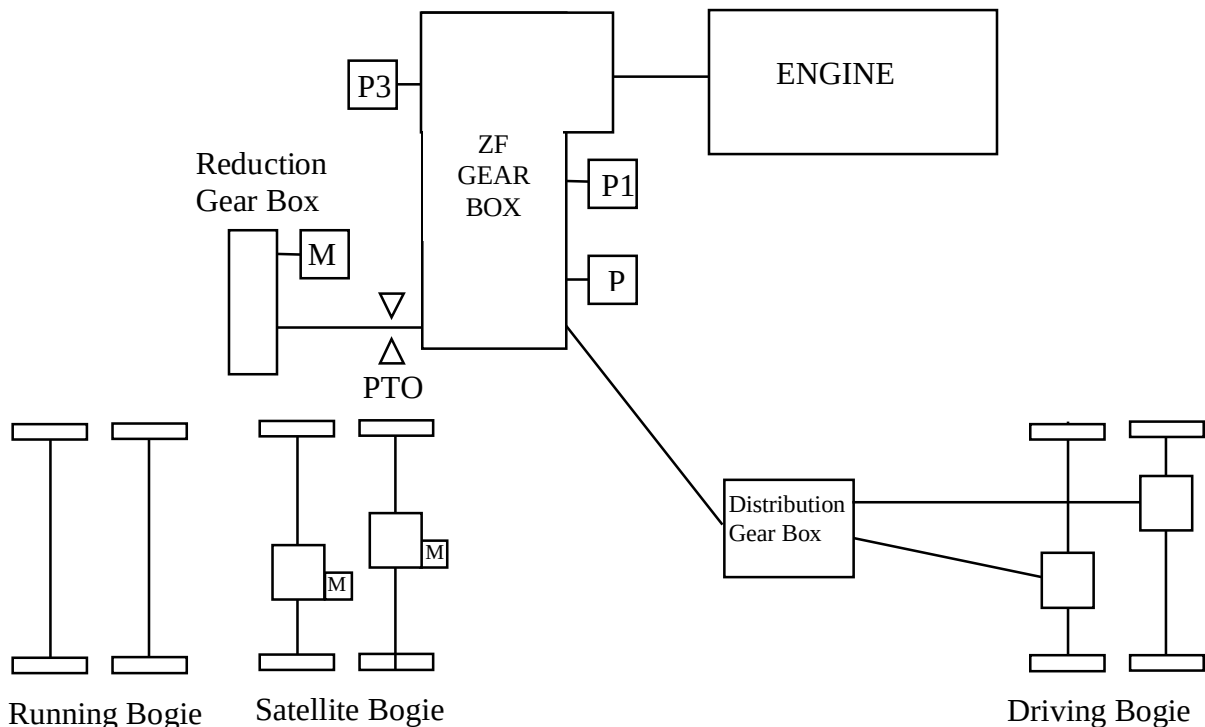
RUN DRIVE: - Hydro dynamics gear box (ZF) is provided on the machine.

LINING: - Single chord lining system is provided on 3x. alc is provided on this machine for measuring run and automatic data feeding .

LEVELING: - On this machine double chord fixed type leveling system is provided. this machine is designed for the twist correction for that rear pendulum is given.

RECORDER: - ALC is provided for recording the datas during the measuring run mode.

POWER TRANSMISSION:



Sr. NO.	PART NO.	FUNCTION	QUANTITY
1	EK813SV00	DC to DC Converter	2 Nos
2	EK816SV00	DC to DC Converter	4 Nos
3	EK812SV00	DC to DC Converter	1 No
4	EK805SV00	DC to DC Converter	1 No
5	EK2343LV00	Front Input	1 No
6	EK2361LV00	Lining Control	1 No
7	EK2140LV00	Auxiliary Lining	1 No
8	EK526MC	Satellite Compensation	1 No
9	EK3069LV00	Track Lifting	2 Nos
10	EK2361LV00	Pendulum Control	1 No
11	EK1AP7-02	Tamping Unit UP/DOWN	4 No
12	EK2360LV00	Drive Pump Control	1 No
13	EK140V00	Squeezing Control	1 No
14	EK650P00	Programmer	1 No
15	EK651P00	Subroutine	5 Nos
16	EK652P00	Time Delay	6 Nos
17	EK653P00	Input/Output	28 Nos
18	EK654P00	Load Relay PCB	2 Nos
19	EK2324LV00	Satellite Control	1 No

ELECTRICAL SYSTEM:

BATTERY: FOUR BATTERIES ARE PROVIDED

TWO BATTERIES OF 12V/200AH

TWO BATTERIES OF 12V/70AH FOR ALC AND PROGRAMMER

ALTERNATOR: THREE ALTERNATORS

TWO ALTERNATORS ARE MOUNTED ON ENGINE I. CURRENT RATING 120A, BOSCH MAKE

ONE ALTERNATOR IS MOUNTED ON ENGINE II. CURRENT RATING 40A, LUCAS MAKE

SELF STARTER: TWO SELF STARTERS ARE PROVIDED ONE ON EACH

DEPTH TRANSDUCER: FOUR NUMBERS

HEIGHT TRANSDUCER: TWO NUMBERS

LINING TRANSDUCER: TWO NUMBERS

PENDULUM: THREE NUMBERS

Lesson-VI: WST Session-9: Main features, Main assemblies & components, Working Principle and Power Transmission..

MAIN FEATURES:

- Ø ZF HYDRODYNAMIC GEAR BOX IS PROVIDED INSTEAD OF MAIN GEAR BOX, DRIVE CLUTCH, REVERSING GEAR BOX, 6-SPEED GEAR BOX, PTO ASSEMBLY.
- Ø TWO TRIPLE HYDRAULIC PUMP & ONE DOUBLE PUMP PROVIDED.
- Ø ONE EMERGENCY PUMP PROVIDED FOR BACK-UP SYSTEM.
- Ø TWO HYDRAULIC MOTORS ARE PROVIDED FOR WORK DRIVE.
- Ø CENTRAL LUBRICATION SYSTEM IS PROVIDED.
- Ø SERVO VALVES ARE PROVIDED OR LINING & LIFTING
- Ø THE PROGRESS IS RELATIVELY MORE.
- Ø AIR DRYER IS PROVIDED IN PNEUMATIC SYSTEM.
- Ø CUMMINS ENGINE NTA855-L 380HP (280 KW) IS PROVIDED INSTEAD OF NT-743C IN OLD MODEL.

GENERAL DATA:

- | | |
|---|-------------|
| Ø OVERALL LENGTH | = 18940MM |
| Ø GAUGE | = 1676 MM |
| Ø HEIGHT FROM RAIL LEVEL | = 3350MM |
| Ø WIDTH | = 2900MM |
| Ø WHEEL DIA (NEW) | = 730MM |
| Ø WHEEL DIA (WORNOUT) | = 680MM |
| Ø MAXIMUM PERMISSIBLE SPEED (OWN POWER) | = 75 KM PH. |
| (TRAIN FORMATION) | = 80 KMPH. |

MAIN UNITS:

ENGINE: CUMMINS NTA 855L HP: 380 HP @ 2100 RPM

CHASIS: Sturdy welded construction of welded steel girders and sheet provide utmost stability.

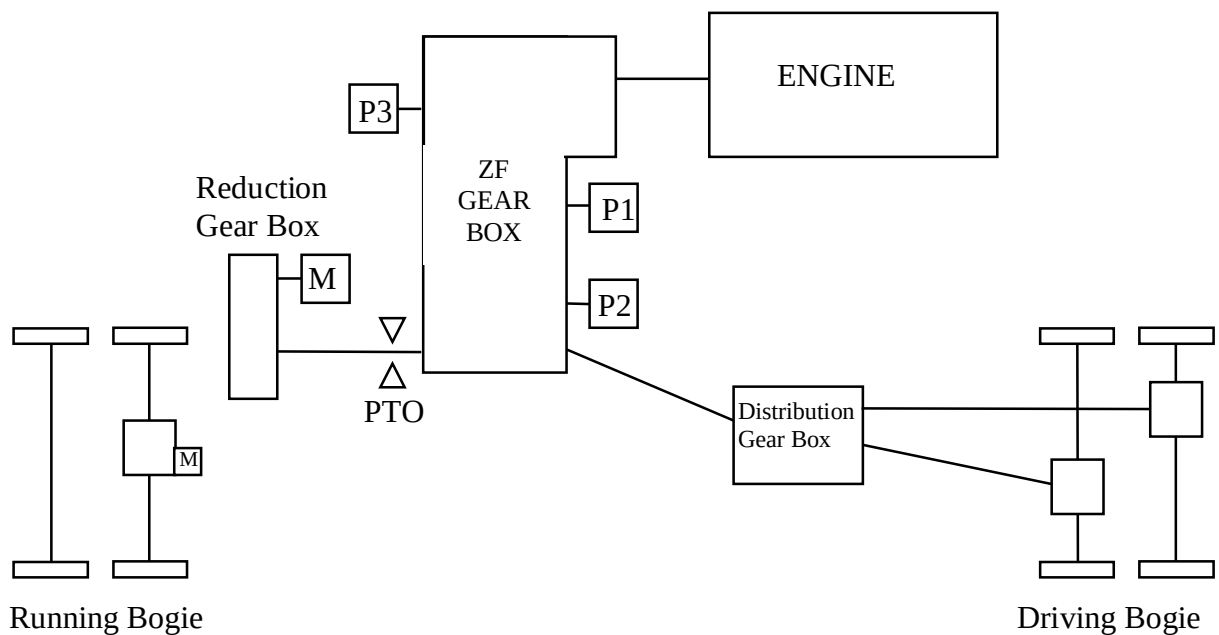
UNDER CARRIAGE: The machine is equipped with 2 axle bogies with rigid axles i.e. front & rear bogie.

SUSPENSION: It is done by bonded metal-rubber springs between axles & bogie frame and two rubber spring disc between bogies and machine frame, provides sufficient absorption of vibrations and smooth running of the vehicle.

AXLE BEARINGS: Axles are supported by means of cylindrical roller bearings (02 Nos. on each side) (NJ 2224 & NJP 2224) outside the wheels in separate bearing housing.

BRAKES: Pneumatic operated block brakes are applied on all wheels. During travel drive, brakes are operated by hand controlled valve i.e. brake valve. During work drive hydraulic operated brakes are operated automatically by working control.

DRIVE POWER TRANSMISSION: ZF hydrodynamic gear box model No. 4WG 65 II WK is provided to drive the machine in traveling mode



ELECTRONIC PCBs:

Sr. NO.	PART NO.	FUNCTION	QUANTITY
1	EK813SV00	DC to DC Converter	4 Nos
2	EK2039LV00	Front Input	1 No
3	EK28V00	MULTIPLEXER	1 No
4	EK176V00	Tamping Unit UP/DOWN Control	2 Nos
5	EK2041LV00	Track Lifting	2 Nos
6	EK2042LV00	Pendulum Control	1 No
7	EK2286LV00	Lining Control	1 No
8	EK2195LV00	Overslew	1 No
9	EK600P00	Programmer	1 No
10	EK652P00	Delayed Output	1 No
11	EK653P00	Input/Output	11 Nos
12	EK554P00	QL Plate	5 Nos
13	ELT631.00	Intercom	1 No
14	EK805SV00	DC to DC Converter	1 No

ELECTRIC SYSTEM.

1. BATTERY (12 V/ 180 AH) = 2 NOS COMBINED IN SERIES.
2. ALTERNATOR (28 V/55A) = 2 NOS BOSCH MAKE.
3. SELF STARTER = 1 NO
4. PENDULUM = 2 NOS
5. HEIGHT TRANSDUCER = 2 NOS
6. VERSINE TRANSDUCER = 2 NOS
7. TAMPING DEPTH TRANSDUCER= 2 NOS

Lesson-I: BCM: RM-76

Session-10: Main features main units and their functions,
Working Principle.

INTRODUCTION:

Ballast cleaning machine is to carry out cleaning of ballast by removing muck ,thereby improving drainage of track and elasticity of the ballast bed. basically the machine its excavates and picks up ballast by means of cutter chain and carries it to a set of vibrating screens where muck is separated and thrown out.

three types of ballast cleaning machines are available on indian railways

1. Plain Track Ballast Cleaning Machine – RM80
2. Point And Crossing Ballast Cleaning Machine – RM76
3. Shoulder Ballast Cleaning Machine – SBCM (FRM80)

RM76 - MAIN UNITS:

EXCAVATION UNIT

It consists of a excavating chain of 82 scraper shovels and 82 intermediate links. scraper shovel is fixed with 2 scraping fingers.

DISTRIBUTING UNIT

It consists of two ballast distributor belts on both sides of track to distribute clean ballast at desired locations.

MUCK DISPOSAL UNIT

This throws away the muck outside track through waste conveyor belt.

SCREENING UNIT

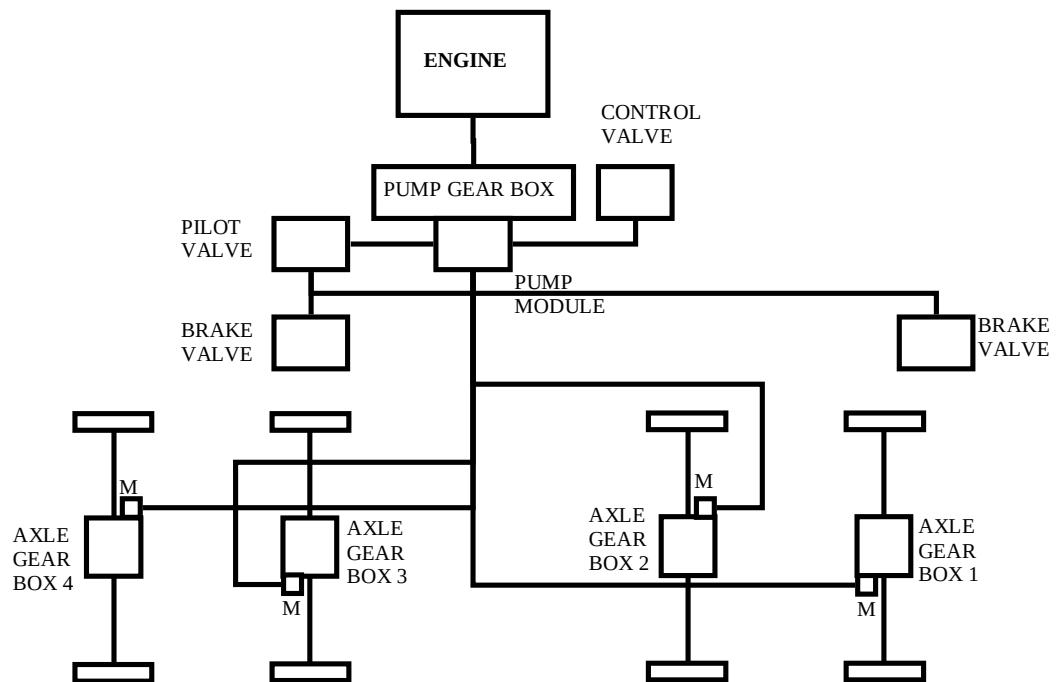
This consists of three sets of screens and the total screen area is 21 m^2 . the unit has three square meshes of size 80 mm, 50 mm and 36 mm. the screens vibrate with hydraulic power.

GENERAL DATA:

ENGINES	DEUTZ-BF12L 513C 396 HP AND 221 HP
LENGTH OVER BUFFERS	24730 MM
WIDTH	3130 MM
HEIGHT ABOVE RAIL TOP	4015 MM
BOGIE PIVOTS SPACING	19500 MM
WHEEL DIA	900 MM
TOTAL WEIGHT	71 TONNES
SPEED	40 KMPH

POWER TRANSMISSION:

BLOCK DIAGRAM OF POWER TRANSMISSION IN RM76



WORKING PRINCIPLE:

The excavating chain designed in pentagon shape cuts the ballast bed and carries the ballast and muck through the chain guides to the screening unit. The freely vibrating screen with linear vibration effects separation of ballast and muck. Underneath the vibrating screen, the muck falls on a conveyor belt which then carries this muck to a slewable conveyor belt (which can be folded also during travel). This slewable belt is called waste conveyor and it throws the muck outside the track. The cleaned ballast is led directly on to the distributor conveyor belts and from there, it is distributed over the entire ballast profile.

CAPABILITY OF MACHINE:

It is capable of disposing off muck along cess at a distance of more than seven metres from the centre of track. Lifting of track upto 100 mm and slewing upto ± 300 mm can be achieved.

The machine can deep screen 1 in 12 turnout in 1 hour, 30 minutes and can deep screen plain track upto 140-150 metres per effective working hour.

PRECAUTIONS DURING WORKING:

- i. When the machine reaches site, the cutter bar should be lowered in the trench, both ends of cutter bar shall be connected to guides through links. For subsequent work, cutter bar is left under the track.
- ii. When the machine starts working, cutter bar scarifies the ballast. Links of rotating chain push ballast in the inclined guides and lead the ballast to screening unit. One person on either side should move with the machine to watch for any obstruction to cutter chain, so as to arrange for stoppage of the machine immediately. Thereafter, the necessary corrective action should be taken.
- iii. Screening should be stopped well before expiry of traffic block to permit proper closing of the work and packing before resumption of traffic.
- iv. If the machine stops moving during work, it should be ensured that gates for clean ballast below screen are instantly closed. otherwise, the screened ballast will get heaped up at one place.
- v. Utmost caution should be observed while manipulating movement of waste conveyor to avoid hitting against electrical mast/signal post. Safety switch provided to sense the mast should, therefore, be kept 'ON'.
- vi. All the staff working with the machine should wear safety helmets and masks to avoid inhaling dust.

SUB DISCIPLINE - BALLAST HANDLING MACHINE (LESSONS -04 SESSIONS -04)

Lesson-II: BCM: RM-80 **Session-11:** Main features main units and their functions, Working Principle.

BCM: RM-80 : MAIN FEATURE:

1. This machine is for plain track ballast cleaning.
2. Machine is powered by two independent power units
3. Front engine powers for all conveyor belt drives, lifting movement and driving.
4. Rear engine powers for excavations, chain drive and screen drive.
5. The chain speed is variable between 2.4 to 4 m/sec.

MAIN UNITS & THEIR FUNCTIONS

EXCAVATING UNIT

The excavation chain is guided in two slanted lateral channels and one horizontal channel. The top of the lateral guides are pivoted to the machine frame and hydraulically adjusted. The lower part of the chain guide is parallel to the machine body and is made of wear resistant steel. For protection against dust, noise and for safety reasons, the lateral guides are covered with solid rubber sheets which open by hinges.

At the beginning of work at a site, the cutter bar is inserted underneath the sleepers and connected to the lateral guides by quick action locks. Hydraulic hoists are provided for easy handling of the cutter bar. At the end of work at a particular site, the cutter bar is removed.

SCREENING UNIT

The screening unit consists of three vibrating sieves of the following square mesh sizes:

Upper screen: 80 mm

Middle screen: 50 mm

Lower screen: 36 mm

The vibrations are provided by the hydraulically driven rotating fly weights. In super-elevated curves, the entire unit is hydraulically adjusted by the operator to keep it horizontal.

CONVEYER SYSTEM FOR DISTRIBUTION OF BALLAST AND DISPOSAL OF MUCK

The distributing conveyors receive the cleaned ballast and distribute it evenly across the entire surface of track right behind the excavating chain.

From underneath the screening unit, the waste drops to the conveyor belt which carries it to a hydraulically adjustable belt controlled from the cabin. The waste can be discharged outside the track by means of the tilting waste conveyor.

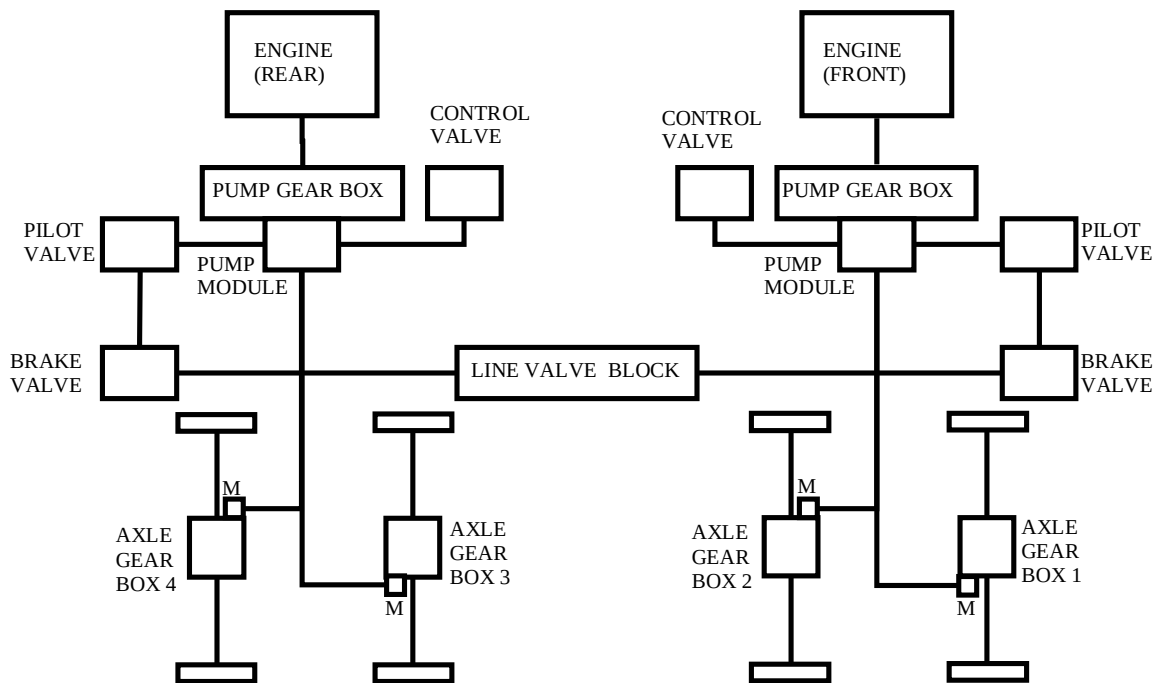
TRACK LIFTING AND SLEWING UNIT

A track lifting and slewing unit is located next to the cutter bar for adjusting the excavation depth and for avoiding the obstacles.

RECORDING UNIT

This is for recording the track parameter after the work.

POWER TRANSMISSION:



TECHNICAL DATA:

ENGINES	DEUTZ-BF 12L 513C, 453 HP, 2 NOS
LENGTH OVER BUFFERS	30600 MM
WIDTH	3050 MM
HEIGHT ABOVE RAIL TOP	4015 MM
BOGIE PIVOT SPACING	22200 MM
BOGIE WHEEL BASE	1830 MM
DIAMETER OF WHEELS:	
A) POWER	900 MM
B) IDLE	700 MM
SPEED:	
A) SELF PROPELLED	40 KMPH
B) IN TRAIN FORMATION	30 KMPH
TOTAL WEIGHT	91 TONNES
MAXIMUM AXLE LOAD	18.5 TONNES

WORKING PRINCIPLE:

The excavating chain designed in pentagon shape cuts the ballast bed and carries the ballast and muck through the chain guides to the screening unit. The freely vibrating screen with linear vibration effects separation of ballast and muck. Underneath the vibrating screen, the muck falls on a conveyor belt which then carries this muck to a slewable conveyor belt (which can be folded also during travel). This slewable belt is called waste conveyor and it throws the muck outside the track. The cleaned ballast is led directly on to the distributor conveyor belts and from there, it is distributed over the entire ballast profile.

PRECAUTIONS DURING WORKING:

- i. When the machine reaches site, the cutter bar should be lowered in the trench, both ends of cutter bar shall be connected to guides through links. For subsequent work, cutter bar is left under the track.
- ii. When the machine starts working, cutter bar scarifies the ballast. Links of rotating chain push ballast in the inclined guides and lead the ballast to screening unit. One person on either side should move with the machine to watch for any obstruction to cutter chain, so as to arrange for stoppage of the machine immediately. Thereafter, the necessary corrective action should be taken.
- iii. Screening should be stopped well before expiry of traffic block to permit proper closing of the work and packing before resumption of traffic.
- iv. If the machine stops moving during work, it should be ensured that gates for clean ballast below screen are instantly closed. Otherwise, the screened ballast will get heaped up at one place.
- v. Utmost caution should be observed while manipulating movement of waste conveyor to avoid hitting against electrical mast/signal post. Safety switch provided to sense the mast should, therefore, be kept 'ON'.
- vi. All the staff working with the machine should wear safety helmets and masks to avoid inhaling dust.

Lesson-III: FRM-80 Session-12: Main features main units and their functions, Working Principle

FRM-80 : MAIN FEATURES:

This machine is for cleaning of shoulder ballast to improve the drainage of track. This machine is similar to RM80. This machine is provided with two excavating cutter chain, one on each side. Each chain excavates and picks up the shoulder ballast and directs it to a set of vibrating screening.

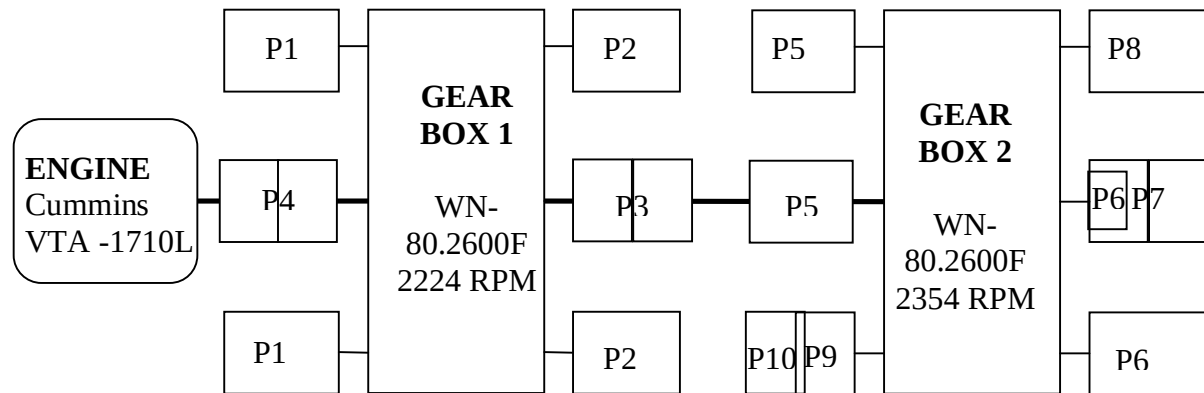
MAIN UNITS:

- Ø Excavating wheel and scarifier
- Ø Hopper assembly/bucket
- Ø Screen drive assembly
- Ø Broom assembly
- Ø Conveyor system

Heavy duty scarifier breaks up the mud pockets underneath the sleeper ends to allow the track to drain. The ballast is transferred to the screening unit by the excavating wheel having hoppers/buckets. The reclaimed ballast is distributed back to the shoulder area of the ballast profile. The machine completes the job by shaping the reclaimed ballast with the built-in shoulder regulator wings and then finally sweeps the sleepers by broom.

TECHNICAL DATA:

ENGINE	DEUTZ TBD-234V-12, 470 HP CUMMINS VTA-1710L, 515 KW
LENGTH OVER BUFFERS	39470 MM
WIDTH	3135 MM
HEIGHT ABOVE RAIL TOP	4260 MM
BOGIE PIVOTS SPACINGS:	
A) FRONT AND MIDDLE BOGIES	15000 MM
B) MIDDLE AND REAR BOGIES	16000 MM
BOGIE WHEEL BASE	1830 MM
WHEEL DIAMETER	900 MM
MAX. AXLE LOAD	20.0 TONNES
TOTAL WEIGHT	80 TONNES
SPEED:	
A) SELF PROPELLED	40 KMPH
B) IN TRAIN FORMATION	30 KMPH



- P1-Cutter chain Pump (Axial Piston Type)-HY704X90R/EL/A350BAR=02 NO.
- P2-Drive Pump (Axial Piston Type)-HY704X180L/EL/A380BAR=02 NO.
- P3-Water Cooler + Two Oil Cooler Pump (Double Vane Pump)-HY830X08.05 L1=01 NO.
- P4-Clutch Pump (Double Vane Pump)-HY830X06.06 RE=01 NO.
- P5-Excavating Belt Pump (Axial Piston Type)-HY709X28 R=02 NO.
- P6-Distributor Belt Pump (Axial Piston Type)-HY709X28 L=02 NO.
- P7-Brush Box + General System Pump (Double Vane Pump)-HY830X7.06 RE=01 NO.
- P8-Screen Drive Pump-HY712X60 L=01 NO.
- P9 & P10-Main Conveyor + Waste Conveyor Pump-HY709X71 (65) R/FED=01+01=02 NO.
(Axial Piston Type)

- BALLAST HANDLING MACHINE (LESSONS -04 SESSIONS -04)

Lesson – IV: BRM Session-13: Main features main units and their functions, Working Principle.

MAIN FEATURES:

1. Regulation of ballast to proper profile
2. Transfer of ballast from center to outwards either on both sides or on the desired side
3. Transfer of ballast from one side to the other or to the center.
4. Sweeping the sleepers and cribs
5. Cleaning the fasteners after ballast regulation
6. Transfer of surplus ballast from the place it is excess to the place it is deficient (optional)
7. The machine operates in either direction

MAIN UNITS AND THEIR FUNCTIONS:

1. ENGINE:

MODEL-CUMMINS- NT 743, 232 HP @ 1800 RPM

NO. OF CYLINDERS-6, FIRING ORDER 1-5-3-6-2-4

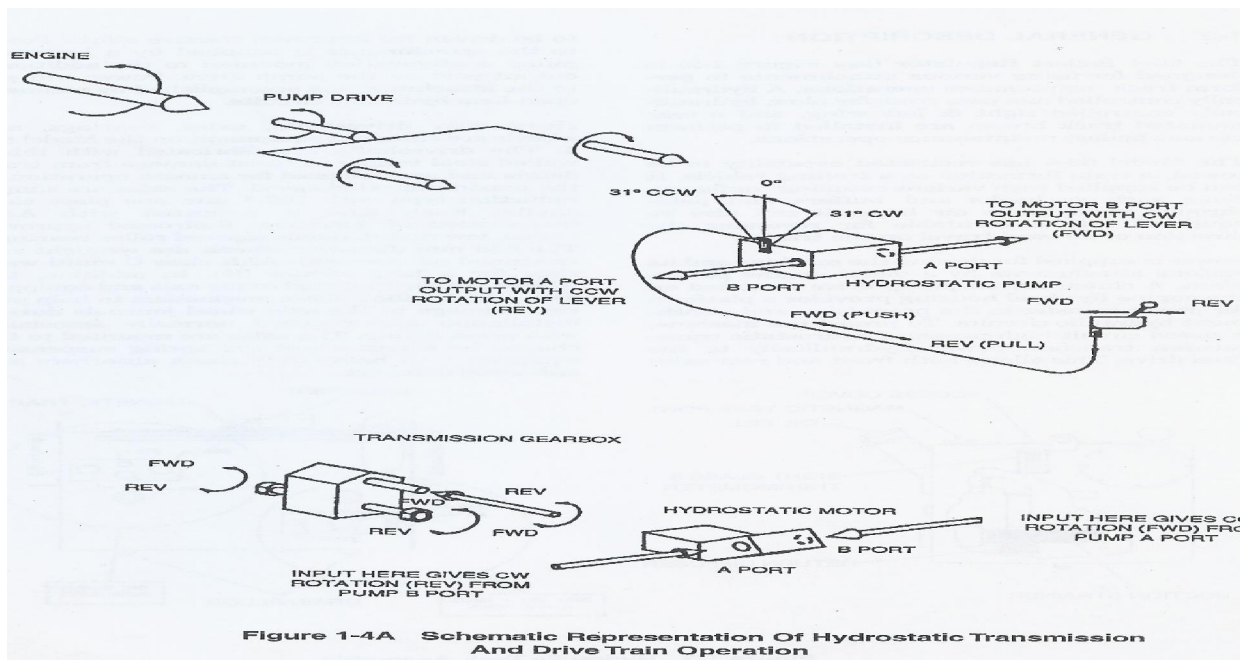
BORE-130 MM, STROKE-152 MM

2. Wings-LHS & RHS (shoulder plough) these are made of wear resistant steel assembled with pieces and fully operated hydraulically. These ploughs are provided one on each side. These are pressed down keeping margin for ballast profile and held firmly against the shoulder for achieving the desired ballast profile in new paces. The plough blades can be adjusted along with the plane of the shoulder angle in conjunction with the centre plough. Large heaps of ballasts at sides are raked up to the track. Shoulder plough angle varied from about 70° to 0° from the cabin as desired. On Kershaw ballast regulating machine the shoulder plough is in trough shape. It can be locked up side down to the top frame of the machine. This trough shaped plough is lowered sideways and activated with hydraulic cylinder.

To pull ballast from bank slopes, this plough can be bend to suit the site.

3. **CENTRE PLOUGH** :On Kershaw machine the plough has been provided in the front of the machine there are two templates operated independently by hydraulic cylinder. A number of shifting operations may be executed with the centre plough.

4. **BROOM (SWEEPER CONVEYOR SYSTEM)** :The sweeper unit consists of rotating drum fitted with flexible hyd. Hose pieces of designated length and mounted inside a steel plate housing. While rotating it throws surplus ballast via a guiding duct on to two lateral conveyors. These takes to a steep conveyor belt which takes it to a Hooper for collection. Broom is rotated



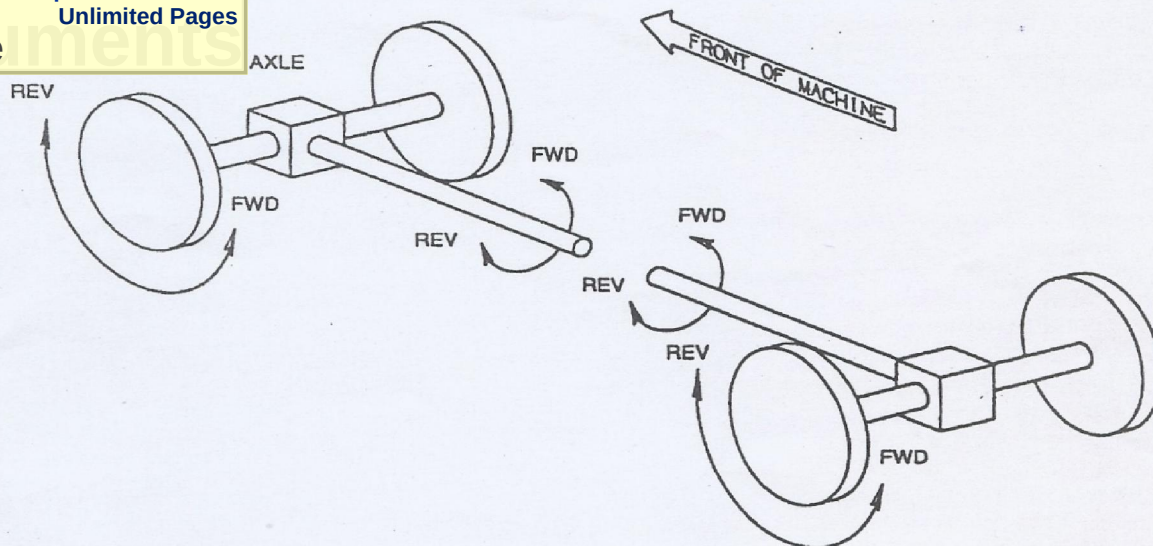


Figure 1-4B Schematic Representation Of Hydrostatic Transmission And Drive Train Operation

TECHNICAL DATA:

MODEL 66-4

ENGINE	CUNNINS MODEL, NTA 743P DIESEL ENGINE, 265 HP @ 1800 RPM
LENGTH OVER BUFFERS	10389 MM
WIDTH	3166 MM
HEIGHT ABOVE RAIL TOP	3617 MM
WHEEL BASE	4725 MM
WHEEL DIA	838.2 MM
AXLE LOAD	10.66 TONNES
SPEED:	
A) SELF PROPELLED	50 KMPH
B) IN TRAIN FORMATION	40 KMPH

MODEL 56-3

ENGINE	CUNNINS MODEL, NTA 743P DIESEL ENGINE, 250 HP @ 1800 RPM
LENGTH OVER BUFFERS	12344 MM
WIDTH	3122 MM
HEIGHT ABOVE RAIL TOP	3810 MM
WHEEL BASE	5791 MM
WHEEL DIA	832.0 MM
AXLE LOAD	12.97 TONNES
SPEED:	
A) SELF PROPELLED	60 KMPH
B) IN TRAIN FORMATION	40 KMPH

TOPIC : TRACK LAYING MACHINES (LESSONS -04 SESSIONS -04)

Lesson-I: PQRS

Session-14: Main features main units and their functions, Yard Activities, Fabrication of Panels, Rake Formation, Amenities at Base Depot..

MAIN FEATURES:

- i. The damage to the concrete sleepers is avoided because of mechanized handling of the sleepers by PQRS equipment.
- ii. The work done is of better quality, as the track obtained has better alignment and the sleepers are laid to correct spacing.
- iii. The concrete sleepers can be laid radially on curves with the help of PQRS equipment, which is not possible in manual relaying.
- iv. No pre-fabrication of panels is necessary as the work of laying the sleepers at the correct spacing and linking of track is done directly at site.
- v. The double handling of the concrete sleepers is avoided as the BFRs loaded with concrete sleepers are taken directly to the site.
- vi. Deep screening can be done ahead of relaying with the help of ballast cleaning machine in shadow blocks, thereby giving clean ballast cushion below the track.
- vii. The track can be packed with heavy 'on track' tie tampers immediately following the track relaying equipment, thereby giving better quality of track and restoring the speed to normal in a lesser time.
- viii. The requirement of labour is very much less, thereby not affecting the progress of work due to seasonal shortage of labour.
- ix. The method may work out to be economical on a long term basis, particularly if long blocks are available and there is shortage of labour.

MAIN UNITS AND THEIR FUNCTIONS:

1. SIDE FRAMES: The machine contains two vertical side frames that house two vertical sliding frames.

2. BRIDGE: Sliding frames are joined together with horizontal cross frame known as bridge. The motive power, hydraulic and electrical assemblies are installed over the bridge. The whole bridge is raised/lowered to facilitate lifting of panels.

3. SLEEPER GRIPPER: On the underside of the bridge, gripper to pick up sleepers is provided. Gripping of sleepers by its end is done by two angles welded to the gripper.

4. RAIL CLAMPS: On the end side of the frame, scissors type clamps are provided to hold the rails/panels.

5. TURN TABLES: To facilitate turning of portal crane for placing it on the BFR and off tracking in mid section, a turn table is provided. On the BFR, a wooden platform is provided to support the turn table.

YARD ACTIVITIES:

- i. Unloading of PSC sleepers from the rake and stacking.
- ii. Fabrication of new panels.
- iii. Unloading of released panels from PQRS rake.
- iv. Dismantling of released panels.
- v. Loading of pre-fabricated new panels.
- vi. Formation of PQRS rake.
- vii. Maintenance of machines.
- viii. Dispatch of released material.
- ix. Loading/unloading of ballast, if the Base Depot is also to be used as ballast depot.

PANNELS:

- i. Concrete sleepers are laid by portal cranes almost at correct spacing and minor adjustment about spacing is done manually.
- ii. The rails in suitable lengths are then placed in position and fixed to sleepers with proper fittings and fastenings.
- iii. For the sake of easy handling the Pre-assembled panels are of 9.1 metre length so that one portal crane of 5 tonnes capacity can handle one panel conveniently.
- iv. These fabricated panels are loaded in 3 to 4 tier to form a PQRS Rake including empty BFRs.

RAKE FORMATION: A complete material train having the following rake is taken to site along with one loco motive:

1. Engine
2. Camping coach
3. BFR carrying the portal cranes
4. BFR (As required) loaded with new fabricated panel
5. 2 empty BFRs for released panel.

AMENITIES AT BASE DEPOT:

- i. For smooth working, the Base Depot should have at least three sidings of 500 metres each connected to a shunting neck of 350 metres.
- ii. Of these, at least two sidings should be provided with auxiliary track for movement of portal cranes.
- iii. It is desirable to illuminate the Base Depot so that the activities listed in item (i) above can be undertaken safely at night.
- iv. To strengthen depot working, it is desirable to install a few hand-operated/motorized gantry cranes moving on auxiliary tracks in addition to the third portal crane in the depot.
- v. Some of these gantry cranes can be of 6.5 metres height from rail level to facilitate repair of portal cranes.

WORKING PRINCIPLE:

1. Panels are fabricated with new sleepers and service rails in a Base Depot. These panels are loaded on BFRs in 3 or 4 layers.
2. The existing rails in track are cut in lengths of 13 m.
3. Auxiliary track is laid to proper line and level with the new rail panels, if rail renewal is also to be carried out as part of track renewal. Otherwise, service rails are used for making auxiliary track.
4. PQRS rake is brought to site of relaying after getting proper traffic and OHE block.
5. Following three methods of laying of new panels are used depending upon site conditions:
 - Ø Pulling the PQRS rake
 - Ø Pushing the PQRS rake
 - Ø Parting the PQRS rake
6. Portals are unloaded on the auxiliary track.
7. Old panels are removed and loaded on PQRS rake, ballast bed is scarified manually and new panels are laid at site by using portal cranes.
8. Proper ramp is provided at the beginning and at the end of the day's work.

AUXILIARY TRACK:

- i. Auxiliary track should be laid at 3400 mm gauge keeping the centre line same as that of main line track.
- ii. CST-9 plates or wooden blocks of size 560 X 250 X 125 mm should be used at 1.5 to 2.0 metres distance for laying the auxiliary track.
- iii. The length of the auxiliary track should match with the daily progress of work.
- iv. The level of auxiliary track should be same as that of existing main line track and must have proper longitudinal and cross levels to avoid derailment of portal cranes.
- v. In no case, the auxiliary track should be more than 50 mm higher than the existing track.

MODE OF WORKING:

PULLING METHOD: When engine leads in the direction of work and the work is done in the leading direction, it is called pulling.

PUSHING METHOD: When engine is opposite to the direction of work and the work is done in trailing direction, it is called pushing.

TRAIN PARTING METHOD: In case of non availability of proper length of auxiliary track PQRS rake is parted in two portions at site, and it is called 'Train Parting.' In this case, lot of time is wasted for parting and coupling and therefore this method is not very economical.

Lesson – II: TRT

Session-16: Main features main units and their functions, Yard activities, Modified BRHs & Rake Formation, Working Principle & SRs after relaying.

MAIN FEATURES:

- There is no need to prefabricate panels.
- No auxiliary track is to be laid.
- Concrete sleepers loaded on BRHs are directly taken to site and relayed one by one.
- New rails unloaded at site on shoulders and duly paired or fishplated are exchanged with old rails along with sleeper renewals.

MAIN UNITS & THEIR FUNCTIONS: TRT consists of the following:

BEAM CAR (22.34m Length): The beam car is hinged with handling car and has one common bogie and one independent bogie. Below this car, all the working units like old sleeper pickup, dynamic plow, sleeper, flipper, indexing wheel, new tie conveyor, self guiding roller for guiding in and guiding out rails, 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 Length): This car has one independent bogie and one common bogie with beam car. All the conveyors are provided on this car.

POWER CAR (14.81m length): This is a four axle vehicle. TRT power unit is provided on half the length of this car and remaining half is utilized for loading of sleepers. Power unit is Cummins NTA-855 turbo-charged, 6 cylinder diesel engine, maximum rating 360 hp at 2100 rpm, continuous rating 295 hp at 1800 rpm.

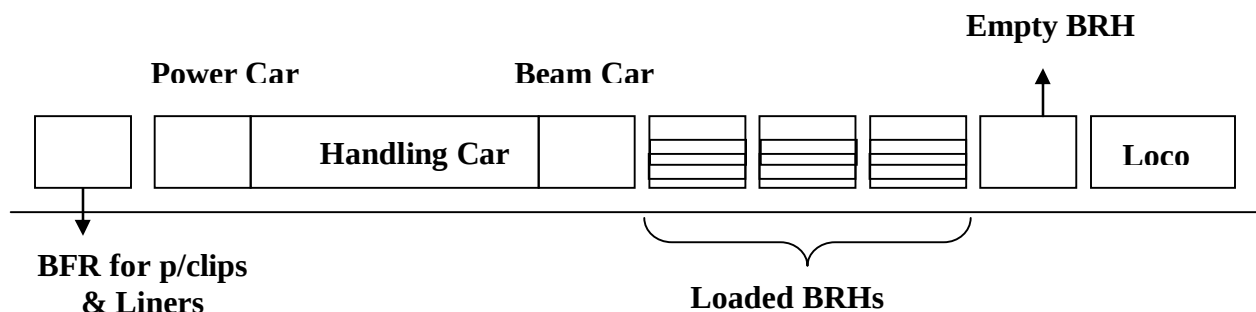
YARD ACTIVITIES:

- Ensure proper selection of Base Depot site. The Base Depot for TRT should be centrally located (30-40 kms. Lead) in the area of working.
- Provide sufficient stock of new sleepers, elastic rail clips/fastenings, liners and rail pads in the Base Depot.
- Ensure proper line and level of auxiliary track for 3400/3700 mm gauge for portal working.
- 30 nos. BFRs should be modified for one set of TRT. 160 sleepers are loaded in one BFR and about 1500-2000 sleepers should be loaded as required during block.
- Load rail fastening like elastic rail clips, liners and rail pads as required during block.

MODIFIED BRHs:

On both side of BFR, for running of gantries, plates are welded, which makes gantry track. The gauge of this track is kept 3050 mm. Due to this modification these BFRs are called modified BRH.

RAKE FORMATION:



first vehicle is locomotive which is used to take the TRT rake, then we provide 1 or 2 empty BRH & then loaded BRH, on which new PRC sleepers are loaded. The number of loaded BRH depends on the traffic block.

As we know it very well that the progress of TRT is app. 10 sleepers per effective minute. Hence we can calculate the number of sleepers required for the block. 80 minutes is deducted for total block time for reaching at site, clearing section and setting & closing of diff. units. Remaining time is effective time. On one BRH 160 sleepers (20X4X2) are loaded.

WORKING PRINCIPLE:

- i. Removal of fastening: the fastenings of old rails to sleepers are removed in advance of track renewal work.
- ii. Placement of new rails: the new rails are placed in advance on either side of the track duly welded or fish plated at a distance of 1.5 metres from the track.
- iii. Positioning of the track: the main vehicle is now positioned on the track to be renewed. The design of the machine is such that with the help of 'guidance sled', the machine is located in the track at three points: the front and rear bogies and the sled at the centre. The guidance sled rests on the old sleepers at the point made free by the removal of the old rails. This design ensures an accurate reproduction of the old track layout without the need for an external machine guidance system.
- iv. Lifting of old rails: the old rails which are already free from fastenings, are lifted and properly guided, with the help of 'Rail lifting and guidance frame.' The machine continuously lifts the old rails and deposits them on either side of the track.
- v. Picking up of old sleepers: the old sleepers are picked up with the help of sleeper pick up system and these are placed upright on the conveyor system. With the help of chain conveyor belts, the old sleepers are carried and stored on the train in stacks of 4 layers separated by Dunn age with the help of handling gantry.
- vi. Leveling & Compaction of ballast bed: Following the old sleeper pick up position is a vibratory plough and compactor. This plough levels the ballast ready to accept the new sleepers.
- vii. Laying of new sleepers: The new sleepers are already stacked on the train in wagons. New sleepers are now placed automatically at a specified distance by using a wheel of specific circumference. The wheel send a signal after each revolution to the sleeper spacing mechanisms giving accurate sleeper positioning. Because of the unique geometry of this mechanism, the system ensures that sleepers are laid square and at specified distance.
- viii. Laying of new rails: The new rails, which are already lying along the track, are then lifted and put in the position on the sleepers.
- ix. Fixing of insulators & elastic rail clips: Attached behind the P811 S machine is a wagon containing elastic rail clips and insulators. Two labours place these adjacent to each sleeper. Two additional labours then position the rail clips and insulators in the correct position on the sleeper. Following this wagon is a clip applicator which fits the elastic rail clip into position, thereby, capturing the rail.
- x. Picking up of old rails: the final operation is to remove the old rails. It is necessary prior to rail pick up to cut the rail into 39m lengths for proper handling. There wagons towed by utility vehicle (UTV), containing a mobile crane then pick up the old rails and place them onto the wagons for transporting to the depot.

SRs AFTER RELAYING:

First day relaying & tamping	: 40 kmph
Second day, second tamping & welding	: 60 kmph
Third day, third & final tamping	: 80 kmph
Fourth day	: Full Speed

Lesson – III: T-28 **Session-17:** Main features main units and their functions, Working Principle

MAIN FEATURES:

- i. These are special bridge trains with adjustable span and height.
- ii. These are equipped with crawlers and rail beams.
- iii. These can lift and handle turn-outs as well as plain tracks.

MAIN UNITS & THEIR FUNCTIONS:

The important assemblies of T-28 are



I. Portal Cranes:

The portal crane permits adjustment of span and height and is equipped with both circular and flanged wheels. A set of two cranes can lift and handle a complete turnout. It can also be used to handle normal track. When working with a set of two portal cranes, the connection is provided by the turnout or track portion which is being handled.

II. Trolleys:

The trolleys are used to transport the turnout assembly on track. The motorized trolleys have the facility to move laterally by 300 mm on either side and lift vertically by 300 mm. one such trolley is placed below each of the crossing portion and switch portion and is used for shifting the turnout laterally or vertically for clearing any obstructions e.g. signal post, OHE mast, platform etc while transporting the turnout.

III. Jib Crane:

Pre-stressed concrete (PSC) sleepers for turnouts require careful handling to avoid damages during loading/unloading, assembling and laying. The sleepers loaded on BFRs are unloaded either at assembly depot or in yards near to the site of laying. Thereafter the PSC sleepers have to be spread at proper spacing for linking of turnout assembly. The jib crane is used for unloading and placement of PSC sleepers.

Lesson – I: DTS/DGS Session-18: Main features main units and their functions, Power Transmission

MAIN FEATURES:

- Ø Elimination of initial differential settlements which are caused by the impact of passing trains.
- Ø The track geometry achieved by tamping machines is retained for a longer duration.
- Ø Homogenous structure of ballast bed is built up.
- Ø Lateral track resistance increases resulting in enhanced safety against track buckling.
- Ø Speed restrictions are relaxed faster.

MAIN UNITS & THEIR WORKING:

STABILIZER UNITS:

The machine has two dynamic stabilizer units which run on the track beneath the main frame, make contact with the rail heads through eight flange rollers on the inside and four roller discs on the outside. The two synchronized vibration units cause the track to vibrate horizontally. The frequency is adjustable from 0 to 45 Hz from the cabin. Two centrifugal force, independent of the frequency, can be up to 320 kN.

RECORDING AND MONITORING SYSTEM:

A proportional chord-leveling device enables controlled settlement of the track. A steel chord is spread over each rail between the sensor rods which are jointed to the inside axles of the bogies. They form the reference base of the recording system of the longitudinal level. By means of a sensor rod between the stabilization units, on which a recording value transmitter is attached to the left and right hand side, the settlement is recorded and monitored.

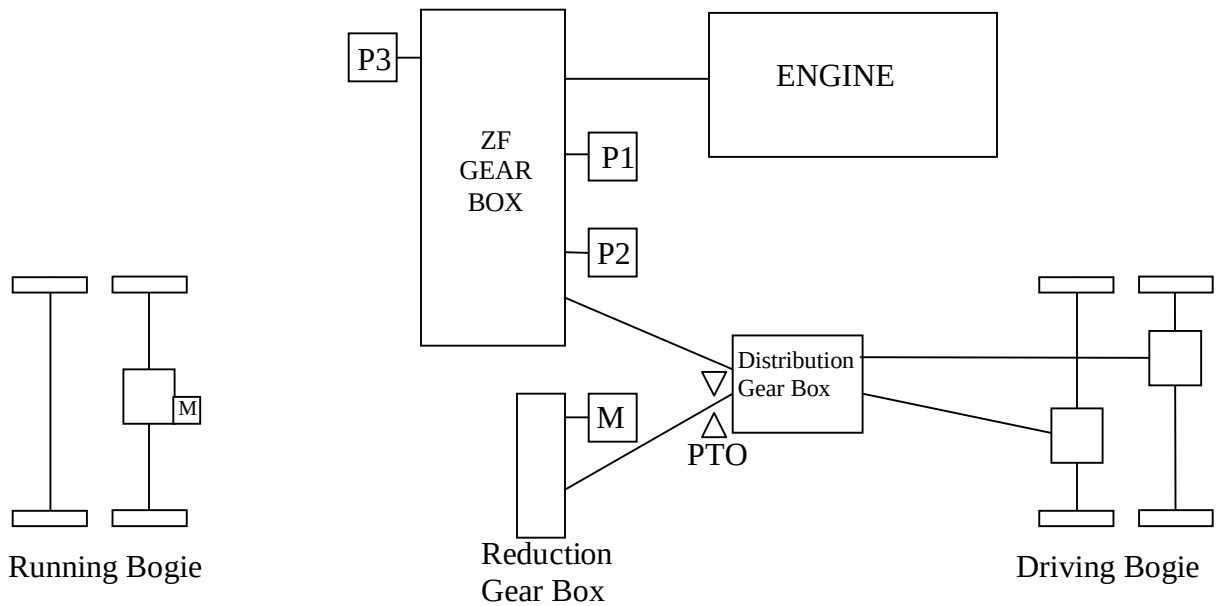
TECHNICAL DATA:

ENGINE:

(OLD STOCK)	DEUTZ-BF-12L-513C
	460 BHP (AIR COOLED)
(NEW STOCK)	KTA-1150L FROM KCL
	473 BHP AT 2200 RPM

LENGTH OVER BUFFER	17250 MM
WIDTH	2800 MM
HEIGHT ABOVE RAIL	3790 MM
BOGIE PIVOTS SPACING	12000 MM
BOGIE WHEEL BASE	1500 MM
WHEEL DIAMETER	730 MM
WEIGHT	57 TONNES
AXLE LOAD:	
(I) FRONT AXLE LOAD	14.5 TONNES
(II) REAR AXLE LOAD	14.0 TONNES
SPEED:	
(I) SELF PROPELLED	60 KMPH
(II) IN TRAIN FORMATION	50 KMPH

SSION:



NAME OF PCB'S AND THEIR FUNCTION:

PCBs used in DGS (New)			PCBs used in DGS (Old)	
1.	Levelling Control (L&R)	EK 2186LV	Levelling Control (L)	EK 2031LV
2.	Peak Value measuring control	EK2155LV	Levelling Control (R)	EK2032LV
3.	Servo control vibration	EK 2683LV	Amplitude control	EK 2033LV
4.	Servo control working drive	EK2684LV	Pendulum compensation	EK97V
5.	Safety drive circuit	EK182LV	Power supply	EK813SV
6.	Relay circuit	EK603E	Encoder PCB	ELT5034
7.	Processor PCB	EK650PX	Processor	EK501P
8.	Input-Output	EK653P	Input-Output	EK553P
9.	QL	EK654P	QL	EK554P
10.	Time delay	EK657P	Measurement Display PCB	ELT 5144
11.	Power supply	EK813SV		
12.	Power supply	EK805SV		
13.	Servo adjustment	VT3005		
14.	Encoder PCB	ELT 5348		
15.	Distance delayed Analogue value	EK152.00		
16.	Measurement Display PCB	ELTEL5353 & ELT5354		
17.	Servo Adjustment	VT3005G-5032-A822		

PRE-REQUISITES:

- i. A minimum cushion of 150 mm of clean ballast is recommended for the proper functioning of the machine. Adequate ballast should be available in shoulders and cribs to allow for required lift (about 20 mm in each tamping operation) and retention of packing after tamping.
For this purpose, planning and execution of deep screening of ballast as well as training out of ballast should be done well in advance.
- ii. Sanction of Commissioner of Railway Safety for working of the concerned tamping machine shall be available.
- iii. Traffic blocks of adequate duration shall be planned.
- iv. The sleepers shall be uniformly spaced.

PRE-TAMPING OPERATIONS:

- i. Field survey should be carried out to determine existing profile of track and to decide the general lift. In case of design mode working, the survey should be done as per guidelines.
- ii. The beginning and the end of curves/ transition curves should be marked on sleepers. Super-elevation and slew should be marked on alternate sleepers to act as guide for the operator.
- iii. Ballast shall be heaped up in the tamping zone to ensure effective packing. However, sleeper top should be visible to the operator and the ballast should not obstruct the lifting rollers.
- iv. Hogged, battered and low joints shall be attended.
- v. Low cess should be made-up.
- vi. Track drainage should be improved for better retentivity of packing. Pumping locations should be attended. Rounded ballast should be replaced with clean and angular ballast.
- vii. Deficient fittings and fastenings should be made good and all fittings and fastenings like fishbolts, keys, cotters, loose jaws, elastic rail clips, pads etc should be properly tightened. Worn out fittings should be replaced.
- viii. Broken and damaged sleepers shall be replaced.
- ix. Sleepers should be squared, correctly spaced and gauge corrected.
- x. Destressing of rails, adjustment of creep, expansion gaps in joints, buffer rails and SEJs etc, if necessary, shall be carried out.
- xi. Guard rails at the approach of bridges and check rails shall be removed temporarily.
- xii. All obstructions such as rail lubricators, signal rods and cable pipes which are likely to obstruct the tamping tools should be clearly marked and made known to the operator before the start of work.
- xiii. Wooden blocks and joggled fishplates shall be removed temporarily ahead of tamping.
- xiv. In electrified sections, the earthing bond should either be removed or properly adjusted for tamping.

OPERATIONS DURING TAMPING:

- i. The gap between top edge of the tamping blade and the bottom edge of the sleeper in closed position of the tamping tool should be adjusted depending upon the type of rail and sleepers. The gap for different types of sleepers will be as under:
 - a. Metal sleeper : 22-25 mm
 - b. Flat bottom sleeper : 10-12 mm

- (squeezing) pressure should be adjusted according to the type of sleeper as under:
- a. CST-9 sleeper : 90-100 kg/sq.cm.
 - b. ST or wooden sleeper : 100-110 kg/sq.cm.
 - c. PSC sleeper : 110-120 kg/sq.cm.
- iii. Care should be taken to ensure that tamping tools are inserted centrally between the sleepers into the ballast to avoid damage to sleepers. The number of insertions of the tamping tool per sleeper varies with the type of sleeper and the amount of track lift to be given. While tamping, following guidelines should be adopted:-
 - a. CST-9 sleepers and steel trough sleepers may require double insertion before passing on to the next sleeper.
 - b. Wooden sleepers require one insertion upto 20 mm lift and two insertions for lifts above 20 mm.
 - c. One additional insertion for joint sleepers will also be required.
 - d. Concrete sleepers require one insertion upto 30 mm lift. Two insertions may be required for lifts above 30 mm.
 - iv. For maintenance packing, squeezing time of 0.4 second to 0.6 second should normally be adequate. Higher squeezing time may be required for track with caked up ballast.
 - v. The machine should have full complement of tamping tools. The tamping tools should not be loose or worn out. The wear on the tool blade should not be more than 20% of its sectional area.
 - vi. A ramp of 1 in 1000 shall be given before closing the day's work and obligatory point. The next day's work shall begin from the point of commencement of previous day's ramp.
 - vii. If work is to be done during night, sufficient lighting at work site should be ensured.
 - viii. Care shall be taken to provide for slew and lift compensation as necessary. Heavy slewing or lifting should normally be done in steps of not more than 50 mm. for LWR/CWR track, the relevant provisions of LWR manual shall be adhered to.
 - ix. During tamping, the parameters of tamped track should be checked immediately after tamping for cross level and alignment, and necessary corrective action should be taken.

POST TAMPING OPERATIONS:

- i. Checking and tightening of loose fittings.
- ii. Replacement of broken fittings.
- iii. The ballast shall be dressed neatly. Proper consolidation of ballast between the sleepers shall be done.
- iv. Final track parameters should be recorded with the help of recorders provided on the tamping machine. A copy of this record should be kept with the Section Engineer (P.Way) and the recorded values should not exceed the following limits:-

Parameter	Not more than 10 peaks per km to exceed this value	Any peak exceeding this value
Alignment	± 4 mm	± 6 mm
Cross level	± 6 mm	-
Unevenness	6 mm	10 mm

If the recorder is not available, then track parameters of at least four stretches of 25 sleepers each per kilometer of tamped track should be recorded. In addition, the versines and super-elevation of curves shall be recorded for atleast ten stations at a specified chord length.

- v. While working in LWR territory, the provisions of Manual of Instructions on Long Welded Rails – 1996 should be followed.
- vi. The fixtures like check rails removed during pre-tamping operation should be restored.

FOR BCM & SBCM:PRE-REQUISITES:

- i. The cutter bar will cut the formation and form channel under the track if minimum 250 mm ballast cushion (caked and clean) is not available. If the availability of cushion is less, the track can be temporarily lifted up to 100 mm by BCM itself during working. If this temporary lifting is inadequate, the track shall be lifted up to desired level in consultation with Traction Distribution branch in electrified areas.
- ii. Since the cutter bar moves continuously below the track, the machine can not work if there is any lateral or vertical infringement. For such locations, either some special preparations are required or work has to be done manually.
- iii. Since the setting and closing time of the machine is longer, a block of at least four hours is necessary to effectively utilize the machine.
- iv. Adequate arrangements for supply and training out of ballast shall be ensured.
- v. While working in LWR territory, provisions of Manual of Instructions on Long Welded Rails-1996 should be followed.

OPERATIONS PRIOR TO DEPLOYMENT:

- i. Foot by foot survey of the section shall be conducted to see the condition of track components, ballast, cess width and availability of land for waste disposal.
- ii. Requisite survey shall be carried out and the longitudinal profile and alignment shall be finalized as per the relevant provisions in the Indian Railways Permanent Way Manual-1996 and Schedule of Dimensions-1939.
- iii. Depth of cutting/magnitude of lifting of track should be decided on the basis of proposed rail level. The longitudinal section showing formation level, existing and proposed rail levels should be plotted on a graph sheet. Otherwise, aid of computer along with suitable software may be taken. The final rail level shall be transferred on pegs or traction masts.
- iv. The pockets of ballast beyond the reach of cutter chain shall be transferred in its cutting width before commencement of deep screening.
- v. It should be ensured that there is no obstruction in the width of 4100 mm to avoid infringement to cutter chain. Rail pegs of LWR, creep posts etc should be removed. Pucca drain wall, if infringing, should be dismantled, alternatively the track can be slewed temporarily.
- vi. In electrified section, distance of mast foundation from track centre will have to be accurately measured to ensure free movement of cutting chain.
- vii. Any signal rodding or cable which is likely to interrupt the work should be temporarily removed.
- viii. Approaches to bridges which can not be screened by the machine should be screened manually in advance of the machine working.
- ix. Level crossings should be opened in advance so as to enable machine to work.
- x. Sleepers should have all the fittings intact so that no sleeper becomes loose and come in the way of cutter chain while the ballast is being excavated. The broken tie bar and ST sleepers should be replaced.
- xi. Gas cutting equipment should be available at site to cut any obstruction like rail pieces, pipes etc, which might get entangled with cutting chain.
- xii. Spoil disposal units should be attached with the machine while working in station yards, cuttings or multiple lines section where dumping of the spoil along the cess is not feasible. If waste is to be disposed off across any adjacent track, the adjacent track shall also be blocked for traffic.
- xiii. A trench of 30 cm depth and one metre width should be made for lowering cutter-bar by removing one sleeper or re-spacing of sleepers.

OPERATIONS DURING TRAFFIC BLOCK

- i. When machine reaches site, the cutter bar should be lowered in the trench, both ends of cutter bar shall be connected to guides through links. For subsequent work, cutter bar is left under the track.
- ii. When the machine starts working, cutter bar scarifies the ballast. Links of rotating chain push ballast in the inclined guides and lead the ballast to screening unit. One person on either side should move with the machine to watch for any obstruction to cutter chain, so as to arrange for stoppage of the machine immediately. Thereafter, the necessary corrective action should be taken.
- iii. Screening should be stopped well before expiry of traffic block to permit proper closing of the work and packing before resumption of traffic.
- iv. If the machine stops moving during work, it should be ensured that gates for clean ballast below screen are instantly closed. Otherwise, the screened ballast will get heaped up at one place.
- v. Utmost caution should be observed while manipulating movement of waste conveyor to avoid hitting against electrical mast/signal post. Safety switch provided to sense the mast should, therefore, be kept 'ON'.
- vi. All the staff working with the machine should wear safety helmets and masks to avoid inhaling dust.

POST BLOCK OPERATIONS:

- i. At the end of work, about five sleeper spaces are left without ballast. These should be filled manually with the clean ballast.
- ii. The vertical and lateral clearances for OHE, signal post and any other structure should be checked and adjusted before clearing the BCM block.
- iii. Ballast recoupment activity should synchronize with deep screening activity so as to enable raising speed to normal after necessary packing.
- iv. One watchman should be posted at the location where cutter bar and chain are left whenever considered necessary.
- v. It is desirable that one round of tamping along with DTS should be carried out immediately after deep screening to resume traffic at a speed of 40 kmph.

The combining of BCMs, training out of ballast and DTS in the same block should be considered for opening of track at 40 kmph while clearing the block.

Lesson-III: PQRS, TRT & T-28 **Session-21:** Pre-requisites, Operations prior to deployment, Operations during Traffic Block and Post Block Operations.

PRE-REQUISITES:

- i. A well organized and properly laid out Base Depot is the back bone of relaying by portal cranes. Smooth functioning of the Base Depot will ultimately reflect in efficiency and productivity of the relaying work. The Base Depot is required to cater to the following activities:-
 - a. Unloading of PSC sleepers from the rake and stacking.
 - b. Fabrication of new panels.
 - c. Unloading of released panels from PQRS rake.
 - d. Dismantling of released panels.
 - e. Loading of pre-fabricated new panels.
 - f. Formation of PQRS rake.
 - g. Maintenance of machines.
 - h. Dispatch of released material.
 - i. Loading/unloading of ballast, if the Base Depot is also to be used as ballast depot.
- ii. It is desirable to locate the Base Depot at a central place such that the distance of remotest work site on either side does not exceed 60-70 kilometers. At the same time, the site selected should be accessible by road, there should be electric power supply and watering facilities. The Base Depot may have facility of entry and exit on both sides from the running line.
- iii. For smooth working, the Base Depot should have at least three sidings of 500 meters each connected to a shunting neck of 350 meters. Of these, at least two sidings should be provided with auxiliary track for movement of portal cranes.
- iv. It is desirable to illuminate the Base Depot so that the activities listed in item (i) above can be undertaken safely at night.
- v. To strengthen depot working, it is desirable to install a few hand-operated/motorized gantry cranes moving on auxiliary tracks in addition to the third portal crane in the depot. Some of these gantry cranes can be of 6.5 meters height from rail level to facilitate repair of portal cranes.

OPERATIONS PRIOR TO DEPLOYMENT

- i. The requisite survey shall be carried out and the longitudinal profile and alignment shall be finalized as per relevant provisions in the Indian Railways Permanent Way Manual 1986 and Schedule of Dimensions-1939.
- ii. Track may be deep screened one or two days in advance of relaying.
- iii. Auxiliary track should be laid at 3400 mm gauge keeping the centre line same as that of main line track.
- iv. The level of auxiliary track should be same as that of existing main line track and must have proper longitudinal and cross levels to avoid derailment of portal cranes. In no case, the auxiliary track should be more than 50 mm higher than the existing track.
- v. Removal of ballast from the crib and shoulders up to the bottom level of the sleepers should be ensured.
- vi. Full fittings of the old sleepers should be ensured to avoid their falling off while lifting released panels.
- vii. All broken sleepers should be removed or replaced.
- viii. In case a level crossing is to be encountered, it should be opened in advance.
- ix. Proper planning and insertion of Switch Expansion Joints at correct locations should be ensured.

- WR/SWR to single rails should be ensured for lifting released panels. Otherwise, replace the existing running rail by service rails for the stretches which are to be relaid during the next day.
- xi. Temporarily disconnect or remove any other permanent obstructions.
 - xii. The following equipments should be available during working:
 - a. One set each of rail cutting and gas cutting equipment.
 - b. Two sets of rail closures of the each rail section being laid, in various sizes from 0.5 m to 3 m lengths.
 - c. 4 sets of junction fish plates with bolts.

OPERATIONS DURING TRAFFIC BLOCK

- i. After the train has reached the site, first of all the portals are unloaded from BFR on the auxiliary track.
- ii. Both the portals have to go to that point from where the work has to be started.
- iii. Both portal cranes will lift the released panel and keep them on empty BFR.
- iv. After the old track is removed, the ballast section is leveled up manually and brought to the required level.
- v. In second round, both the portal cranes will come without new panel and pick up old panels.
- vi. In third round, both the portal cranes will bring pre-fabricated panels and lay these panels on working place.
- vii. These operations are repeated until the last panel is laid.
- viii. At the end of block, proper ramp is provided.
- ix. Block is then cleared as the thus the track is already linked.

POST BLOCK OPERATIONS:

- i. Clearance of track from any obstructions before removal of traffic block.
- ii. Complete track fittings including their correct positioning and tightness.
- iii. Proper lifting, packing, ballast regulating and compaction/stabilization of track to raise the speed of the different stretches.
- iv. Training out of adequate quantity of ballast over the newly relaid track to full ballast section.
- v. Picking up of left over released materials.
- vi. Dismantling of auxiliary track and relaying the same in advance for the next day's work.
- vii. Restoration of cables and other fixtures e.g. guard rails on bridges and check rails on level crossings which were removed temporarily.
- viii. Tie tamping machines, BRM and Dynamic Track Stabilizer should be deployed to enable raising of speed to normal.
- ix. Provision of SEJs as per approved plan, in-situ welding of panels and distressing of LWR should be done after welding of panels.

CTIONS PRIOR TO DEPLOYMENT:

- i. Base Depot
 - a. Ensure proper selection of Base Depot site. The Base Depot for TRT should be centrally located (30-40 kms. Lead) in the area of working.
 - b. Provide sufficient stock of new sleepers, elastic rail clips/fastenings, liners and rail pads in the Base Depot.
 - c. Ensure proper line and level of auxiliary track for 3400/3700 mm gauge for portal working.
 - d. 30 nos. BFRs should be modified for one set of TRT. 160 sleepers are loaded in one BFR and about 1500-2000 sleepers should be loaded as required during block.
 - e. Load rail fastening like elastic rail clips, liners and rail pads as required during block.
- ii. All corroded and broken steel/CST-9 sleepers should be marked.
- iii. There should be no infringement within one metre of sleeper ends.
- iv. Adequate ballast should be available before relaying operations start.
- v. Deep screening should be carried out in advance wherever feasible.
- vi. Check-rails of level crossings falling in the range of work should be removed in advance.
- vii. New rails should be unloaded, paired, fishplated or welded in one piece and set at about 1.5 metres from track centre.
- viii. All longer wooden sleepers from joints be either removed or cut to size in advance.
- ix. Interlaced sleepers of height different from remaining sleepers should be removed.
- x. In case of CST-9 sleepers, gauging should be done in advance to avoid hitting of sleepers by sled assembly during lifting of CST-9 sleepers.
- xi. Seven wooden sleepers should be laid in track at a location five sleepers behind the rail cut and ballast around them removed for easy placement of plow.
- xii. The new location should be planned that it matches with the new rail end for threading at the start of work.
- xiii. At location where relaying is to start, two rail pieces of 7.3 metres length are cut and connected together using well greased fishbolts to enable quick opening during block.
- xiv. Plan the location of cut in the old track at the closing of work site so that it matches with the rail end of new rail panel.
- xv. Ensure availability of S&T staff to connect any wire/rodding disturbed during the block, and OHE staff for opening of temporary bonds and bonding back after the work.
- xvi. Ensure earth bonding of new rail panels.
- xvii. Ensure removal of alternate keys in case of CST-9 sleepers and inside alternate keys in case of ST sleepers.
- xviii. Existing small nos. of PSC sleepers should be replaced with wooden sleepers to avoid loss of time while working.
- xix. High temperature distressing of the old track should be carried out as provided in Manual of Instructions on Long Welded Rails-1996.

OPERATIONS DURING TRAFFIC BLOCK

- i. Shield hydraulic pipes and other moving parts of the TRT so that in case of any mishap, these do not hit OHE mast.
- ii. Take OHE block, if staff is required to climb on top of the machine for repairs etc, in case of any breakdown.
- iii. 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.
- iv. Utmost caution should be taken while lowering and raising Clamp in order to avoid infringement to the adjacent line.

OPERATIONS:

- i. Ballasting of the track should be done immediately after track relaying operation.
- ii. Then, Ballast Regulator, Tie Tamping machine and Dynamic Track Stabilizer should be deployed to enable raising of speed to normal in shortest possible time.
- iii. In-situ welding of isolated joints should be done before restoration of speed to normal.
- iv. Switch Expansion Joints should be provided at locations as per approved LWR/CWR plans.
- v. Check rails should be provided at Level Crossings after final tamping of the track.
- vi. Destressing of LWR should be done immediately after welding the rail panels to long welded rails.

FOR T-28:

PRE-REQUISITES:

PRE-BLOCK OPERATIONS:

- i. New turnout should be assembled using Jib Crane near the site of turnout to be replaced. The fittings of assembled turnout should be complete and properly tightened. If suitable location is not available nearby, assembly may be done away from site and then transportation can be done with the help of trolleys. Infringements on the way should be checked and movement with slewing accordingly may be planned.
- ii. The assembled turnout should be loaded on trolleys for transportation.
- iii. Rails on either side of existing turnout should be of the same section as that of new turnout.
- iv. Deep screening of turnout portion should be done. Ensure required cushion and proper drainage. Rail levels should be taken for sufficient length on either side of turnout. Proposed rail profile should be plotted both for main line and loop line.
- v. Point machines should be disengaged and turnout should be non-interlocked before taking up its replacement.
- vi. Ballast from crib and shoulder of sleepers should be removed up to sleeper bottom for full turnout length.
- vii. 60 wooden blocks, each approximately 60 cm long, should be kept ready for facilitating passage of crawler on the obstacles.
- viii. 4 nos. of rail pieces, each 70 cm long, should be kept ready for housing below the rail wheels of the crane.
- ix. Jumpering of both ends of the turnout should be done by electrical staff before lifting and removing of existing turnout.
- x. Adequate arrangements should be made for protection of the line involved and adjacent lines while the machine is working.
- xi. Fishbolts should be lubricated and worked to facilitate easy removal during block.
- xii. Location where clamp of each crane will hold the crossing and switch portions for lifting should be marked on the assembled turnout.

ERING TRAFFIC BLOCK

- i. Immediately after getting traffic block, the fishbolts of existing turnouts should be opened.
- ii. Both cranes should be traversed and brought in position for handling the existing turnout at the demarcated position.
- iii. Old turnout should be lifted by cranes and traversed to suitable location for further dismantling after the block.
- iv. The cranes should be traversed to the pre-assembled concrete sleeper turnout and both the cranes should be taken to demarcated positions on turnout.
- v. 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.
- vi. The crawler side frame of the cranes should be spread suitably in stages to accommodate the length of the turnout sleepers on their demarcated locations for each crane.
- vii. Pre-fabricated turnout should be held by the cranes. The cranes with the turnout be traversed across in stages and brought to the location of laying. The turnout is laid in position and fishplates are bolted to the existing track.
- viii. 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.

POST BLOCK OPERATIONS:

- i. Ballast deficiency should be made good by putting additional ballast. Profiling and boxing of ballast should be done.
- ii. The turnout should be tamped with the help of UNIMAT machine. Both alignment and levels should be corrected while tamping the turnout.
- iii. The turnout may be interlocked and point machine engaged immediately after laying the turnout.
- iv. Damage to the cess during machine operation should be made good.
- v. Provision of proper earthing points should be ensured by the electrical staff.

MAINTENANCE SCHEDULES OF TAMPING MACHINES:

**SCHEDULE-I
(TO BE DONE DAILY)
DURATION-ONE HOUR**

- i. Check and top up the hydraulic oil tank, if required.
- ii. Check the level of tanks for lubrication of guide columns and top up with hydraulic oil, if required.
- iii. Lubricate eye and fork end of every squeezing cylinder with grease.
- iv. Change the worn out tamping tools.
- v. Check the tightness and infringement of tamping tools with one another.
- vi. Check locking device of all units.
- vii. Lubricate all the lining roller pins with grease.
- viii. Check leakages from hydraulic hose connections.
- ix. Check for any air leakage from the system.
- x. Check the air brake pressure.
- xi. Check for any unusual sound from machine.
- xii. Record the maximum hydraulic temperature of the day's work.
- xiii. Observe the leakage from all gear boxes.
- xiv. Check the level of tank for lubrication of tamping arm and main bearings.
- xv. Check the level of main gear box.
- xvi. Lubricate the vibration shaft bearing with grease.
- xvii. Check the tightness of cardon shaft bolts.
- xviii. Check the brake application.

**SCHEDULE-II
(TO BE DONE AFTER 50 HOURS OF ENGINE RUNNING)
DURATION-TWO HOURS**

- i. Check the condition of brake shoes.
- ii. Check the oil level of all gear boxes and top up, if required.
- iii. Lubricate the axle gear box flange cover with grease.
- iv. Lubricate the guide bushing of front and rear feeler with engine oil
- v. Grease all cardon shaft.
- vi. Grease flange of driving axle.
- vii. Lubricate all link rods, pivots and rocker bearing of all assemblies.
- viii. Grease lifting/lining unit assembly.
- ix. Check the tightness of 55 mm and 35 mm pin.
- x. Check bolts/welding of holding brackets of tamping units.
- xi. Check nuts and bolts of suspension block of tamping units.
- xii. Check/clean air breather of tamping units and gear boxes.
- xiii. Lubricate the feeler rods with grease.
- xiv. Clean and lubricate the guide rods of lining trolley with engine oil.
- xv. Lubricate all other moving parts except above with oil or grease.
- xvi. Check and clean the air oiler and fill up with new hydraulic oil.
- xvii. Check air leakage from pneumatic system.
- xviii. Check all lights for proper functioning.
- xix. Check the bolts of cover plate of squeezing cylinders for tightness.

SCHEDULE-III

(TO BE DONE AFTER 100 HOURS OF ENGINE RUNNING)

DURATION-ONE DAY

- i. Inspect the hydraulic pumps for any abnormal sound.
- ii. Inspect the hydraulic motor for any abnormal sound.
- iii. Inspect the water separator for proper functioning.
- iv. Lubricate the tamping unit lateral adjusting cylinder guide rod with grease.
- v. Examine the expiry date of the fire extinguisher.
- vi. Check tightness of tamping unit lifting/lowering cylinder piston rod.
- vii. Inspect main gear box cover through inspection window.
- viii. Check hydraulic system pressure.
- ix. Check vibration pressure.
- x. Check squeezing pressure.

SCHEDULE-IV

(TO BE DONE AFTER 200, 400, 600 & 800 HOURS OF ENGINE RUNNING)

DURATION-TWO DAYS

- i. Replace the hydraulic oil of reservoir for lubrication of vibration shaft main bearing.
- ii. Lubricate the pre load cylinder of front tightening, lining and measuring trolley with grease.
- iii. Lubricate the lifting cylinder of lining and measuring trolley with grease.
- iv. Replace the proportional valve filter element.
- v. Replace the return line filter element.
- vi. Change the oil of distributor gear box.
- vii. Change the oil of drive intermediate shaft and main gear box.
- viii. Change the oil of six speed gear box.
- ix. Change the oil of reversing gear box.
- x. Change the oil of axle gear boxes.
- xi. Change suction filter.

SCHEDULE-V

(IOH)

(TO BE DONE AFTER 1000, 3000 & 5000 HOURS OF ENGINE RUNNING)

DURATION-7 DAYS

- i. Send the hydraulic oil for chemical testing.
- ii. Clean the hydraulic oil tank.
- iii. Clean the hydraulic oil through 10 μ if found OK in chemical testing otherwise fill new oil.
- iv. Check the bearings of all the axles and lubricate with grease.
- v. Check the condition of megg springs and replace them if required.
- vi. Recondition the worn out wheels of all trolleys, if required.
- vii. Check bearing of trolley wheels and lubricate them with grease.
- viii. Clean and check the air reservoir for rated air pressure.
- ix. Overhaul/Replace the tamping units, if required.
- x. Overhaul/Replace the lifting units, if required.
- xi. Replace the hydraulic hoses, which are damaged.
- xii. Replace the seals of leaking hydraulic cylinders.
- xiii. Overhaul all the transducers.
- xiv. replace the defective transducer fork.
- xv. Thoroughly clean all the panel boxes with pressurized air.
- xvi. Check the wire connections in panel boxes.
- xvii. Replace the missing or defective lights.
- xviii. Calibrate the sensing trolleys.
- xix. Strengthen the machine frame where cracks have been developed.

line on track for all functions.

xxi. Replace the brake shoes.

SCHEDULE-VI
(IOH)
(TO BE DONE AFTER 2000 & 4000 HOURS OF ENGINE RUNNING)
DURATION-45 DAYS

Replace the seal of brake cylinders.

Clean and repair the hydraulic oil cooler, if it is blocked more than 20% or badly leaking.

Check the hydraulic motors for rated delivery and replace if required.

Replace the damaged and choked pneumatic pipes.

Overhaul all the pneumatic valves and change unserviceable ones.

Replace the seals of all pneumatic cylinders.

Check the machine wheels for tyre defects. Reprofile or replace if required.

Replace the defective switches and potentiometer.

Calibrate the machine on track for all functions.

SCHEDULE-VII
(POH)
(TO BE DONE AFTER 6000 HOURS OF ENGINE RUNNING)
DURATION-90 DAYS

i. Replace all hydraulic pumps.

ii. Replace all the hydraulic motors.

iii. Check and recharge the hydraulic accumulators.

iv. Replace the hydraulic cylinders on condition basis otherwise replace all the seals.

v. Replace all the D.C. and pilot operated valves.

vi. Get calibrated the proportional valve, if possible, otherwise replace it with new ones.

vii. Replace all pressure control valves.

viii. Check the functioning of all stopcock and flow control valves, if anyone found defective then replace it with new ones.

ix. Replace all hydraulic hoses along with crimped fittings.

x. Clean the hydraulic tank. Inside to be painted with approved quality paint.

xi. Flush the complete hydraulic system.

xii. Replace all pneumatic hoses.

xiii. Test the air tank for rated air pressure.

xiv. Replace all pneumatic valves.

xv. Replace the pneumatic cylinders on condition basis, which were creating the frequent trouble during work. Otherwise replace seals only

xvi. Overhaul the brake cylinders and replace the seals if cylinder is o.k.

xvii. Overhaul the sensing trolleys.

xviii. Re-profile all the trolley wheels.

xix. Replace the axle bearings.

xx. Overhaul all the gear boxes.

xxi. Overhaul the cardon shafts.

xxii. Repair or replace the defective PCB's.

xxiii. Check the limit switches and replace on condition basis.

xxiv. Overhaul the pendulums.

xxv. Overhaul the panel boxes and provide thimbles as required.

xxvi. Replace the defective switches and indicator lights.

xxvii. Check and replace the defective LED's of solenoids if required.

xxviii. Calibrate all the potentiometers for zero correction.

xxix. Calibrate the machine in all respects.

xxx. Paint the complete machine with approved quality paint.

SUB DISCIPLINE – MAINTENANCE SCHEDULE (LESSONS –0 4 SESSIONS - 04)
Lesson – II: BCM & FRM Session-23: Maintenance schedules of RM-76, RM-80, FRM-80 and FRM-85.

SCHEDULE-I
TO BE DONE DAILY
(DURATION-ONE AND HALF HOURS)

- i. Check hydraulic oil level in tank and top up if required.
- ii. Check oil level in vibration screen drum.
- iii. Check proper locking of all units.
- iv. Check the function and condition of conveyor belt, belt tension, scrapers of conveyors and look out for damages.
- v. Check anti collision device of waste conveyor and cutting unit.
- vi. Screening mesh should be checked in order to have proper size of ballast.
- vii. Check for any unusual sound from machine.
- viii. Check air brake pressure.
- ix. Check and lubricate corner rollers of excavating chain.
- x. Check the safety screw, scraper fingers and safety bolts of the excavating chain.
- xi. Check the connection between connecting elbow and cutter bar.
- xii. Check brake parts of idling bogie and powered bogie.
- xiii. Check for any air leakage.
- xiv. Check leakage in hydraulic circuit and do needful.
- xv. Check tightness of cardon shaft bolts.
- xvi. Record the max. hydraulic oil temperature of the day.
- xvii. Check for proper axle clutch pressure.
- xviii. Lubricate the cutting chain and excavating conveyor bearing.
- xix. Check for any rubbing of hoses and loose clamping etc.
- xx. Check and top up bottle for lubricating conveyor chain and ensure that lubrication system is working properly.
- xxi. Check the safety items, emergency tools and spares.
- xxii. Check the filter indicators of axle gear box clutch.
- xxiii. Check the filter indicator of suction filters.
- xxiv. Check the ballast distributing chutes.
- xxv. Clean the slots next to the joint of the hydraulic cylinders.
- xxvi. Check oil level of pneumatic lubricator.

SCHEDULE-II
TO BE DONE AFTER 50 ENGINE HOURS
(DURATION-TWO HOURS)

- i. Check brake linkage and lubricate the pivots and gear teeth of hand brake with grease.
- ii. Check guide rollers of conveyor belts.
- iii. Check the condition of the cutter chain and replace worn-out parts.
- iv. Lubricate axle gear box flange cover of driving bogie with grease.
- v. Lubricate screen guide plates with grease.
- vi. Lubricate all cardon shaft with grease.
- vii. Lubricate bearing for main and distributing conveyor chain and adjust if required.
- viii. Clean complete machine.
- ix. Check wear on ballast distribution chutes.
- x. Inspect wear plates of chain trough.

- xi. Top up the bottle for lubrication of king pin pivot.
- xii. Clean excavating conveyor sliding frame.
- xiii. Check the tension of excavating conveyor chain and adjust if required.
- xiv. Grease guide columns, plow pivots broom units and sliding planes of cutter unit.
- xv. Check rubber bearing fitted under screen meshes and change if broken.
- xvi. Check all working lights and do needful.
- xvii. Check brake shoe clearance and adjust if required.
- xviii. Check the oil level and top up both main gear boxes, if required.
- xix. Check oil level of axle gear boxes and top up, if required.
- xx. Lubricate the chain guide of excavating chain.
- xxi. Check the oil level of conveyor belt gear box A1 and B1.
- xxii. Check oil level of main gear box.

SCHEDULE-III
TO BE DONE AFTER 100 ENGINE HOURS
(DURATION-ONE DAY)

- i. Check all the idler rollers of conveyor for free rotation.
- ii. Check guide rollers and bushes of cutter chain.
- iii. Check bushes, pressure separating rings and grooves of axle clutch shaft.
- iv. Check the functioning of back up system.
- v. Check the condition of torque arm bearing.
- vi. Lubricate all cardon shaft.
- vii. Check brake lining and brake block play

SCHEDULE-IV
TO BE DONE 200 ENGINE HOURS
(DURATION-TWO DAYS)

- i. Check function of all limits switches.
- ii. Check up rubber element of torque plate suspension and do needful.
- iii. Check the excavation chain sprocket and change if required.
- iv. Clean breather filter of hydraulic oil tank.
- v. Change the filter s of axle gear box clutch.
- vi. Repair ballast screens.
- vii. Replace scraper shovel and intermediate links, if required.
- viii. Lubricate hand brake gear with grease.
- ix. Change oil in the axle gear boxes and replace clutch filter.
- x. Change oil in the main gear boxes.
- xi. Change oil in the waste conveyor gear box.
- xii. Check the clutch pressure and adjust if required.
- xiii. Clean the hydraulic oil with the help of hydraulic pump for about one hour.
- xiv. Change hydraulic suction and return filters.
- xv. Check and lubricate the sleeper scraper.
- xvi. Check filter of hydraulic tank.
- xvii. Check the function of the lifting device, Clean and lubricate.
- xviii. Check the support rollers of the conveyor belts and lubricate them.
- xix. Check draw bars and lubricate it.
- xx. Check and lubricate pivot and side bearing of bogie.
- xxi. Replace the filter cartridge and granule element of air dryer.
- xxii. Change oil of conveyor belt A1 and B1.
- xxiii. Check the main supply cable.

SCHEDULE-V
TO BE DONE AFTER 1000, 3000 & 5000 HOURS
(DURATION-7 DAYS)

- i. Check meggi spring and change oil required.
- ii. Lubricate the axle bearings of the bogies with grease.
- iii. Clean and lubricate sliding surfaces and bolts of torque supports with oil.
- iv. Change oil in screen drive drum and replace filter element.
- v. Change hydraulic oil on condition basis through lab test.
- vi. Change the chute wear plates.
- vii. Check shock absorber for proper functioning and do needful.
- viii. Check universal joints for play and replace if required.
- ix. Replace all conveyor belts on condition basis and overhaul the driving stations.
- x. Overhaul the complete plow.
- xi. Replace the worn out broom sticks, if required.
- xii. Repair the missing and defective hand tools.
- xiii. Clean water separator.
- xiv. Check tappet clearances and adjust if required.
- xv. Check the cover plate bolts of all hydraulic cylinders.
- xvi. Lubricate the turn table with grease.
- xvii. Check foundation bolts of brake cylinders.
- xviii. Check all pressure settings.
- xix. Check wear of brake shoes.
- xx. Check condition of trough plates and replace if required.
- xxi. Change the chute wear plates.
- xxii. Check condition of hydraulic and pneumatic hoses and replace as required.
- xxiii. Check the functioning of pressure switch of axle clutch and adjust if required.
- xxiv. Check wheel and axle cracks by magnifying glass.
- xxv. Replace the defective lights.
- xxvi. Paint the screen area and chain trough.
- xxvii. Replace excavating belts, supports pipes and chains of excavating units & acrylic strip.
- xxviii. Replace distributing conveyors and waste conveyor.
- xxix. Replace main conveyor, support pipes and chains. And replace acrylic strip.

SCHEDULE-VI
TO BE DONE AFTER 2000 & 4000 ENGINE HOURS
(DURATION-45 DAYS)

- i. Check wheel tyre defects and do needful.

SCHEDULE-VII
TO BE DONE AFTER 6000 ENGINE HOURS
(DURATION-90 DAYS)

- i. Check hydraulic pumps, valves, motors in the test bench for rated output and replace if necessary.
- ii. Clean the hydraulic oil tank. Paint the surface of tank with approved quality of paint and fill new oil.
- iii. Change scraper rubber plates of excavating unit.
- iv. Change the rear frame, chute box and wing frame.
- v. Overhaul the gearboxes.

- vi. Check the bogie pivot for wear and attend as necessary.
- vii. Change the scraper pads and skirt rubbers of all conveyors.
- viii. Check all the direct acting and pilot operated direction valves and change if necessary.
- ix. Check all the pressure control valves and change if necessary.
- x. Check all the stopcocks and flow control valves and change if required.
- xi. Check shock absorber and replace/repair as necessary.
- xii. Replace defective switches and potentiometers.
- xiii. Repair/replace screen frame.
- xiv. Overhaul screen vibration drum and replace bearings.
- xv. Replace bearing of cutting chain drive gearbox.
- xvi. Replace bearing of excavating unit.
- xvii. Check the wheel tyre profile.
- xviii. Check the brake system.
- xix. Replace pneumatic cylinder seals or cylinders as required.
- xx. Replace all the hydraulic hoses along with clamps.
- xxi. Check all hydraulic cylinders, change if necessary.
- xxii. Clean hydraulic oil cooler.
- xxiii. Replace air unloader.
- xxiv. Test air tank.
- xxv. Check all pneumatic valves and change if necessary.
- xxvi. Check all the pneumatic cylinders and do needful.
- xxvii. Change all the brake shoes.
- xxviii. Check the axle bearing and grease them. Change if required.
- xxix. Change mounting pad of all gearboxes.
- xxx. Overhaul the bogies.
- xxxi. Check the calibration of all the indicative instruments and replace the defective ones.
- xxxii. Replace all the limit switches on condition basis.
- xxxiii. Check the LED of all solenoids.
- xxxiv. Overhaul all the panel boxes.
- xxxv. Arrange insulation test of main cables and replace the defective ones.
- xxxvi. Provide missing thimbles.
- xxxvii. Replace the defective PCBs.
- xxxviii. Strengthen the machine frame where cracks have developed.
- xxxix. Flush the complete system.
 - xl. Fill new oil after replacing return line and suction filters.
 - xli. Check the function of all assemblies.
 - xl.ii. Test the machine for one week before it is put for actual working in section on regular basis.
 - xl.iii. Overhaul the cutting unit.
 - xl.iv. Replace excavating belts, supports pipe and chains of excavating units & acrylic strip.
 - xl.v. Replace distributing conveyors and waste conveyor.
 - xl.vi. Replace main conveyor, support pipes and chains. And replace acrylic strip.

SUB DISCIPLINE – MAINTENANCE SCHEDULE (LESSONS – 04 SESSIONS - 04)
Lesson – II:DTS & BRM **Session-24: Maintenance schedules of DTS & BRM.**

MAINTENANCE SCHEDULES OF DTS:

**SCHEDULE-I
TO BE DONE DAILY
(DURATION-ONE HOUR)**

- i. Check tightness of cardon shaft bolts.
- ii. Check leakage from all gear boxes and do the needful.
- iii. Check vibration frequency and adjust it if necessary.
- iv. Drain water separator.
- v. Check air-brake pressure on locking position.
- vi. Check for any air leakage and do the needful.
- vii. Check brake system before going into section for its effectiveness.
- viii. Check leakage in hoses, valves and joints. Rectify if required.
- ix. Check hydraulic oil level in tank and do the needful.
- x. Record the max. hydraulic temperature of the day.
- xi. Check for any rubbing of hoses, loose clamping etc. and do the needful.
- xii. Check for any unusual sound from any section of machine.
- xiii. Ensure proper functioning of parking brakes.
- xiv. Clean complete machine.
- xv. Check all hydraulic and pneumatic pressures.

**SCHEDULE-II
TO BE AFTER 50 ENGINE HOURS
(DURATION-TWO HOURS)**

- i. Lubricate the king pin pivots of driving and idle bogies with grease.
- ii. Check and top up oil of axle gear box, Drive intermediate shaft, ZF gear box, distribution gear box and vibration gear box
- iii. Lubricate both axle guides/Stabilizing unit rollers with grease.
- iv. Lubricate clamp pivot pins with grease.
- v. Lubricate link rod bearings with grease.
- vi. Lubricate roller clamp housing with grease.
- vii. Lubricate front, middle and rear feeler roller guide bushes and guide pulleys.
- viii. Check bolts and nuts of all hydraulic cylinders.
- ix. Check wear on brake shoes and do needful.
- x. Adjust the gap between brake shoes and wheels, if required.
- xi. Check horizontal swing of the unit.
- xii. Lubricate the stabilizing unit guide column.
- xiii. Lubricate axle gear box flange cover with grease.
- xiv. Lubricate guide pulleys.
- xv. Lubricate front and rear tightening trolley lifting cylinder pivot.
- xvi. Lubricate front and rear tightening trolley preload cylinder pivot.
- xvii. Check working of stabilizing unit derailment protection mechanism.
- xviii. Lubricate the guide rod sleeve of vibration unit.
- xix. Check all locking device for proper functioning.

SCHEDULE-III
TO BE DONE AFTER 100 ENGINE HOURS
(DURATION-ONE DAY)

- i. Grease all cardon shafts.
- ii. Lubricate both brake linkage and torque arm pivot.
- iii. Clean hydraulic oil cooler by blowing air from opposite direction.
- iv. Check all working lights, push buttons, switches etc. and do needful.

SCHEDULE-IV
TO BE DONE AFTER 200 ENGINE HOURS
(DURATION-TWO DAYS)

- i. Change suction and return line filter elements.
- ii. Change proportional filter element.
- iii. Check pneumatic valves for proper functioning and change if required.
- iv. Grease sliding surfaces, guide column surface and bolts of torque supports.
- v. Check foundation bolts of brake cylinders. Tighten them if required.
- vi. Replace the oil of ZF-gear box.
- vii. Replace the oil filter of ZF-gear box.
- viii. Change the oil of working drive clutch.
- ix. Change oil of distributor gear box.
- x. Change oil of axle gear box.
- xi. Change the oil of drive intermediate shaft.
- xii. Change the oil of vibration gear box.
- xiii. Check all the spares and tools for emergency.
- xiv. Check for safety items.

SCHEDULE-V
TO BE DONE AFTER 1000 ENGINE HOURS
(DURATION-7 DAYS)

- i. Change grease of hand brake gear.
- ii. Grease the axle bearings of the bogies.
- iii. Change hydraulic oil. (Before replacement, check quality through lab test).
- iv. Check leakage from all hydraulic cylinders and replace the seals on condition basis.
- v. Check condition of roller clamps and do the needful.
- vi. Check function of opening and closing cylinder for roller clamps.
- vii. Check function of lifting cylinders of vibration unit.
- viii. Replace defective lights.
- ix. Check meggy springs and replace if required.
- x. Check wheel tyre defects and do needful.
- xi. Inspect all electrical connections and do the needful.
- xii. Check meggy flexi washer of axle gear box, torque plate for damage. Replace if required.
- xiii. Lubricate hand brake gear with grease.
- xiv. Repair the defective hand tools or replace them.

**SCHEDULE-VI
TO BE 2000 HOURS
(DURATION-45 DAYS)**

- i. Replace damaged hoses along with clamps.
- ii. Clean the hydraulic oil tank. Paint the surface of tank with approved quality of paint.
- iii. Thoroughly clean all panel boxes.
- iv. Provide missing thimbles.
- v. Replace defective switches and potentiometers.
- vi. Replace defective indicative instruments.
- vii. Check the function of all assemblies after maintenance.
- viii. Test the machine for one week near the workshop before it is put for normal working in section on regular basis.

**SCHEDULE-VII
TO BE DONE AFTER 6000 ENGINE HOURS
(DURATION-90 DAYS)**

- i. Replace all the hydraulic hoses along with clamps.
- ii. Check all hydraulic pumps and motors on the test bench for rated output. Replace if necessary.
- iii. Check all hydraulic cylinders change if necessary.
- iv. Clean hydraulic tank, inside surface is to be painted with approved type of paints.
- v. Fill new oil after replacing all the hydraulic filters.
- vi. Clean hydraulic oil cooler. If it is blocked more than 20% during service or badly leaking, it should be replaced.
- vii. Check all the direct acting and pilot operated direction valves and change if necessary.
- viii. Check all the pressure control valves and change if necessary.
- ix. Check all the stop cocks and flow control valves and change if required.
- x. Flush the complete system.
- xi. Change all pneumatic valves.
- xii. Check all the pneumatic cylinders and change on condition basis.
- xiii. Check brake cylinder bore for corrosion. If corroded, the inner bore should be chrome-plated and ground to standard size.
- xiv. Change all the brake shoes.
- xv. Strengthen the machine frame where cracks have developed.
- xvi. Check the wheels for any tyre defects. Reprofile or change if required.
- xvii. Check the axle bearing and grease them. Change if required.
- xviii. Change mounting pad of all gear boxes.
- xix. Overhaul all the gear boxes except ZF-gear box.
- xx. Replace the cardon shaft or these may be overhauled.
- xxi. Replace the shaft coupling and holding nuts & bolts on condition basis.
- xxii. Overhaul the driving and idle bogies. Replace the defective parts.
- xxiii. Replace the defective PCBs.
- xxiv. Check the calibration of all the indicative instruments.
- xxv. Arrange insulation test of main cables and replace the defective ones.
- xxvi. Overhaul the panel boxes.
- xxvii. Change all the defective switches and lights.
- xxviii. Check the LED of all solenoids and replace if required.
- xxix. Replace all the limit switches.
- xxx. Check tightness of the frame of stabilizing unit.

- xxxi. Change stabilizing unit roller.
- xxxii. Check stabilizing unit guide column. Change if required.
- xxxiii. Change clamp pivot pins.
- xxxiv. Change link rods with their bearings.
- xxxv. Overhaul derailment protection mechanism.
- xxxvi. Check chassis side members, cross frames, buffer beams and welded joints etc. if damaged, it should be repaired.
- xxxvii. Check bogie side frame, springs, shock absorbers, wheel's torque supports, shackles, brakes and rod linkage. If any damage is noticed, it should be changed.
- xxxviii. Check all electrical and emergency switches and do the needful.
- xxxix. Attend complete painting of the machine.

MAINTENANCE SCHEDULES OF BRM:

SCHEDULE-I TO BE DONE DAILY (DURATION-ONE HOUR)

- i. Check oil leakage from both the main gear boxes.
- ii. Check tightness of cardon shaft bolts.
- iii. Check oil level of axles gear boxes and top up, if required.
- iv. Check air brake pressure.
- v. Check for air leaks, after shutdown the engine and do the needful.
- vi. Check leakage in Hydraulic circuit and do the needful.
- vii. Check hydraulic oil level in tank and top up if required.
- viii. Record the maximum hydraulic temperature of the day.
- ix. Check for any rubbing of hoses, loose clamping etc. and do the needful.
- x. Check all hydraulic pressure for rated settings and adjust if necessary.
- xi. Check functioning of power pack/emergency backup pump.
- xii. Check the tightness of sweeping elements on broom.
- xiii. Check chain for proper deflection.
- xiv. Check for any unusual sound from machine section.
- xv. Check all the spares and tools for emergency.
- xvi. Check safety items.
- xvii. Ensure proper functioning of parking brakes.
- xviii. Check all locking devices for proper functioning.
- xix. Grease rollers, universal joints and propeller shaft coupler.
- xx. Check level of two-speed transmission fluid. Drain/flush/clean magnetic drain plug and refill with recommended oil.
- xxi. Clean complete machine.
- xxii. Check all the functions of machine before block working.

SCHEDULE-II TO BE DONE AFTER 50 HOURS OF ENGINE RUNNING (DURATION-TWO HOUR)

- i. Grease axle gear box flange cover of bogies.
- ii. Check gear oil of transmission gear box.
- iii. Lubricate all cardon shafts with grease.
- iv. Check all pressure control valves for rated setting.
- v. Check bolts and nuts of all hydraulic cylinders.

- vi. Lubricate the wing ballast box pivot pins with grease.
- vii. Lubricate the wing lift frame, brake arm and wing pivot with grease.
- viii. Lubricate wing mounting with grease.
- ix. Lubricate the broom reel bearing with grease.
- x. Check conditions of room wheel bearing, bushes and grease it.
- xi. Check broom drive chain housing for oil level. Fill up if required.
- xii. Check for water in oil. If water is present, check cover seal and repair. Drain and refill with new oil.
- xiii. Check wear on brake shoes. Adjust gap between brake shoe and wheels.
- xiv. Check all grader blade for proper tightness and replace if required.
- xv. Lubricate the hopper door hinges with grease.
- xvi. Lubricate the lift frame locks front and rear.
- xvii. Lubricate the brake arms with grease.

SCHEDULE-III
TO BE DONE AFTER 100 HOURS OF ENGINE RUNNING
(DURATION-ONE DAY)

- i. Lubricate hand brake gear with grease.
- ii. Lubricate all cardon shafts.
- iii. Clean filters of axle gear box clutch.
- iv. Lubricate bogie pivot bearing and clutch lever shaft.
- v. Lubricate guide column surface and bolts of torque supports.
- vi. Check foundation bolts of brake cylinders.
- vii. Lubricate the broom chain and plough rollers with grease.
- viii. Check condition of broom sticks and do needful.
- ix. Check tightness of chains fitted with broom unit.
- x. Check working of the manual lever arrangement for disconnecting engine to gear box working.
- xi. Check hinges of wing assembly for cracks and do needful.

SCHEDULE-IV
TO BE DONE AFTER 200, 400, 600 & 800 HOURS OF ENGINE RUNNING
(DURATION-TWO DAYS)

- i. Check function of shock absorber.
- ii. Lubricate hand brake linkage.
- iii. Change oil in the axle gear boxes. Replace clutch filter.
- iv. Check condition of hydraulic and pneumatic hoses. Replace if required.
- v. Check effectiveness of the brake both manually and pneumatically.
- vi. Change pump drive oil.
- vii. Check all working lights, push buttons, switches etc. replace the defective/missing ones.
- viii. Check working of water separator.
- ix. Check all pressure gauges for proper working.
- x. Check foundation and bracket bolts of compressor.
- xi. Lubricate the bearing of sweeping element with grease.
- xii. Check broken/crack brake shoes and do the needful.
- xiii. Check universal joint for play and replace if required.
- xiv. Check hydraulic pressures.
- xv. Change oil in the axle gear boxes. Replace clutch filter.
- xvi. Change oil of main gear box.

- xvii. Change return line filter element.
- xviii. Change Suction filter element.
- xix. Replace the oil of transmission gear box.

SCHEDULE-V
TO BE DONE AFTER 1000, 3000 & 5000 HOURS OF ENGINE RUNNING
(DURATION-7 DAYS)

- i. Grease axle bearing of the bogies.
- ii. Flush and drain entire hydraulic oil from the system.
- iii. Grease sliding surfaces.
- iv. Change air cleaner filter above the hydraulic tank.
- v. Send the hydraulic oil for chemical testing and refill it after filtering it by 10µm porta filter if found O.K. otherwise, replace with new oil.
- vi. Clean breather and magnetic drain plug.
- vii. Clean the hydraulic tank.
- viii. Check function of shock absorber.
- ix. Grease the bogie pivot.
- x. Replace defective lights.
- xi. Change sensors if required.
- xii. Replace defective seals of pneumatic cylinder, pipe joints and hoses, if required.
- xiii. Check pneumatic cylinders for their proper working.
- xiv. Check revolution of the sweeping unit. It should be 244 rpm.
- xv. Check condition of idler sprocket for its correct revolution and proper functioning of broom.
- xvi. Check wheel tyre defects and do needful.

SCHEDULE-VI
(IOH)
TO BE DONE AFTER 2000 & 4000 HOURS OF ENGINE RUNNING
(DURATION-45 DAYS)

- i. Check all gear boxes and repair, if required.
- ii. Check the wheel tyre profile and do the needful.
- iii. Replace old hoses along with clamps on condition basis.
- iv. Clean the hydraulic oil tank. Paint the surface of tank with approved quality of paint and fill new oil.
- v. Thoroughly clean all panel boxes.
- vi. Replace defective switches and potentiometers.
- vii. Replace defective indicative instruments.
- viii. Replace defective pneumatic cylinders.
- ix. Replace damaged hoses.
- x. Replace pneumatic valves, if required.
- xi. Overhaul broom reel bearing and bushes.
- xii. Overhaul broom chain.
- xiii. Change all fittings of rubber elements if found defective.
- xiv. Change worn out rubber pads provided at broom.
- xv. Repair/replace missing and defective hand tools.
- xvi. Check function of all assemblies after IOH.

SCHEDULE-VII
TO BE DONE AFTER 6000 HOURS OF ENGINE RUNNING

(DURATION-90 DAYS)

- i. Strengthen the machine frame where cracks have developed.
- ii. Check the wheels for any tyre defects. Re-profile or change if required.
- iii. Check the axle bearing and grease them. Change, if required.
- iv. Change mounting pad of all gear boxes.
- v. Overhaul all the gear boxes.
- vi. Replace/overhaul the propeller shafts.
- vii. Overhaul the bogies.
- viii. Dismantle the clutch assembly. Inspect all parts for wear/damage etc. and replace defective parts.
- ix. Replace all the hydraulic hoses along with clamps.
- x. Replace all hydraulic pumps and motors.
- xi. Check all hydraulic cylinders. Change, if required.
- xii. Clean hydraulic tank, inside surface is to be painted with approved type of paints.
- xiii. Replace the hydraulic oil.
- xiv. Check all the pressure control valves and change, if required.
- xv. Check all the stopcocks and flow control valves and change, if required.
- xvi. Flush complete hydraulic system.
- xvii. Test air tank for rated pressure.
- xviii. Check all pneumatic valves and change, if required.
- xix. Check all the pneumatic cylinders and do the needful.
- xx. Check brake cylinder bore and do the needful.
- xxi. Change all the brake shoes.
- xxii. Check calibration of all the indicative instruments.
- xxiii. Arrange insulation test of main cables and replace the defective ones.
- xxiv. Overhaul the panel boxes.
- xxv. Change all the defective switches and lights.
- xxvi. Change sensors, if required.
- xxvii. Change worn out sweeping element.
- xxviii. Change bearing of the broom unit.
- xxix. Replace blade graders.
- xxx. Replace chains fitted for broom unit in order to correct revolution of unit.
- xxxi. Check the bogie pivot for wear and attend as necessary.
- xxxii. Change oil pump of drive gear box.
- xxxiii. Paint complete machine with approved paint.
- xxxiv. Test the machine working for one week near POH Workshop, before it is put for actual working in the section on regular basis.

SUB DISCIPLINE – MAINTENANCE SCHEDULE (LESSONS –0 4 SESSIONS - 04)
Lesson – IV:UNIMAT **Session-25:**Maintenance schedule of 2S & 3S-Unimat.

MAINTENANCE SCHEDULES OF 08-275 2S & 3S:

SCHEDULE-I
TO BE DONE DAILY
(DURATION-ONE HOUR)

POWER TRANSMISSION:

- Ø Check in running condition (at 1000 rpm), the oil level of ZF gear box (Servo-Ultra 10-W) and top if required, after stopping.
- Ø Check oil level of axle gear boxes through sight glasses & top up. (G.OIL SAE90).

TAMPING BANKS:

- Ø Check & top up oil level of tank for lubrication of main pin bearing of 55 mm dia and monitor while working. (Oil same as hydraulic oil used on the machine).
- Ø Check & top up oil level of tank for lubrication of guide columns.

LIFTING & LINING UNIT:

- Ø Check locking and unlocking of lifting and lining unit.
- Ø Grease all lining rollers.
- Ø Check for oil leakage from pipes.

MEASURING DEVICES:

- Ø Apply lube oil on bush bearing.
- Ø Lubricate all ball & socket, pivot joints.
- Ø Lubricate all ball & socket, pivot joints of trolleys.

ELECTRICAL:

- Ø Check all lights, to be in working order.
- Ø Check battery charging from ammeter. It should be positive.
- Ø Check all PCB's. They should be properly housed in sockets.

HYDRAULIC:

- Ø Check hydraulic hoses and valves for leakage.
- Ø Check hydraulic oil level in tank and top up if required.
- Ø Check all system pressure.

PNEUMATIC:

- Ø Drain air reservoirs after the day's work.
- Ø Top up air oiler.
- Ø Check pressure on Dual Air Pressure Gauge.

GENERAL:

- Ø Clean complete machine.
- Ø Check for any unusual sound from tamping units, gear boxes, engine & hydraulic pumps.

SCHEDULE-II
TO BE DONE AT 50 P & C OF WORK DONE OR APPROX. 50 ENGINE HOURS
(WHICHEVER IS EARLIER)

TAMPING UNIT:

- Ø Check and tighten shoe plate bolts of guide column.
- Ø Check and tighten squeezing cylinder cover plate bolts.
- Ø Lubricate radial tilting guide plates and rollers.

TRACK LIFTING & LINING UNIT:

- Ø Grease lining cylinder pivots.
- Ø Grease rail clamp pivot pins.
- Ø Check and tighten clamp roller locking bracket bolts.
- Ø Grease the following points of the 3rd rail lifting unit (UNIMAT-3S)
 - a. Cylinder pivot pins
 - b. Rope pulley
 - c. Sliding plate
 - d. Rollers
 - e. Telescopic slide

MEASURING DEVICES:

- Ø Grease pendulum bridge pivots.
- Ø Check for play in feeler rollers of middle trolley.
- Ø Check lifting transducer carrier rod, for excessive wear or damage.
- Ø Check tension of wire cord for leveling & lining.

PNEUMATIC:

- Ø Check foundation bolts of brake cylinders.
- Ø Clean water separator filter.
- Ø Check function of water oiler.

HYDRAULIC:

- Ø Check all hoses for twisting, rubbing and replace leaking hoses.
- Ø Check functioning of tank level indicator, tank breather and temperature sensor.
- Ø Clean the fins of ZF Gear Box and System Oil Coolers, by blowing air in opposite direction.

DRIVING AND IDLE BOGIE:

- Ø Grease king pin pivot of drive & idle bogies.
- Ø Grease axle gear box flange cover of driving bogie.
- Ø Grease torque arm pivots of driving bogie.
- Ø Grease link rods.

POWER TRANSMISSION:

- Ø Check and tighten bolts of cardon shafts.
- Ø Check for oil leakage of other gear boxes.
- Ø Check oil level of working drive reduction gear box and top up.
- Ø Grease all cardon shafts.

ELECTRICAL:

- Ø Clean battery plugs.
- Ø Clean battery terminals and apply petroleum jelly.

SCHEDULE-III

**TO BE DONE AFTER 100 P & C OF WORK DONE OR APPROX. 100 ENGINE HOURS
(WHICHEVER IS EARLIER)**

MISCELLANEOUS:

- Ø Change proportional valve filter element.
- Ø Change servo valve filter element.
- Ø Check calibration of cross level.
- Ø Check calibration of lining.
- Ø Check calibration of tamping unit depth.
- Ø Check universal joints of Cardon Shaft for play and replace in case of excessive play.
Visually examine for fracture, distortion & twist of splines of Cardon Shaft.
- Ø Grease hand brake gear.

SCHEDULE-IV

**TO BE DONE AFTER 250 P & C OF WORK DONE OR APPROX. 250 ENGINE HOURS
(WHICHEVER IS EARLIER)**

MISCELLANEOUS:

- Ø Change gear oil of hydraulic drive reduction gear box.
- Ø Check oil of intermediate drive shaft.
- Ø Change Z-F Gear Box filter.
- Ø Change oil of axle gear boxes.
- Ø Inspect all cardon shafts.
- Ø Change vibration shaft housing oil
- Ø Change suction filter (after 500 hours during alternative Schedule)
- Ø Change inner and outer elements of air cleaner filter.
- Ø Grease water pump bearing and pulley bearings.
- Ø Clean diesel tank.
- Ø Check RPM of the engine radiator fan.

SCHEDULE-V

**TO BE DONE AFTER 625 P & C OF WORK DONE OR APPROX. ONE YEAR
(WHICHEVER IS EARLIER)**

MISCELLANEOUS:

- Ø Check bearings of all axles and grease them.
- Ø Check meggy springs and replace, if required.
- Ø Check wheel discs tyre defects and take necessary remedial action.
- Ø Check backlash of drive axle pinions.
- Ø Recondition worn-out wheels of all trolleys.
- Ø Check bearings of trolley wheel and grease them.
- Ø K and clean air reservoir.
- Ø Inspect wires of all transducers.
- Ø Replace/overhaul taming unit, if required.
- Ø Change batteries.
- Ø Overhaul water pumps.
- Ø Recondition roller clamps and lining rollers.
- Ø Check hooks vertical/horizontal guide bushes and replace if necessary.

SCHEDULE-VI

IOH AFTER

A) 1250 P & C OR 2 YEARS WHICHEVER IS EARLIER

B) 2500 P & C OR 4 YEARS WHICHEVER IS EARLIER

HYDRAULIC:

- Ø Check the hydraulic pumps for rated delivery on the test bench and replace if it is less than the demand of circuit.
- Ø Check the hydraulic motors for rated torque and replace, if required.

HOSES:

- Ø Replace the Hydraulic hoses which are damaged by external abrasion & corrosion.
- Ø Replace the hoses which have developed cracks in external and internal plies.

PNEUMATIC

- Ø Clean cooling coils.
- Ø Replace/overhaul air unloader.

MECHANICAL:

- Ø Replace/overhaul the tamping units if required.
- Ø Overhaul the lifting units.
- Ø Overhaul the trolleys and wheels of all the feeler rollers.
- Ø Strengthen the machine frame, where cracks have developed.

ELECTRICAL:

- Ø Thoroughly clean all panel boxes.
- Ø Provide missing thimbles.
- Ø Replace defective switches and potentiometers.
- Ø Replace defective indicative instruments.
- Ø Replace the batteries.

GENERAL:

- Ø Check the function of all assemblies after IOH.
- Ø Calibrate the sensing equipments.
- Ø Test the machine for one week near the workshop, before it is put for work in regular section.
- Ø Update lo book entries indicating all the works done till on date.
- Ø Update the Machine history book.

SCHEDULE-VII

POH AFTER 3750 P & C OR APPROX. 6 YEARS WHICHEVER IS EARLIER

(OR)

**ON CONDITION BASIS WITH SPECIAL PERMISSION FROM COMPETENT
AUTHORITY**

HYDRAULICS:

- Ø Change all Hydraulic pumps, motors and cylinders.
- Ø Replace all hydraulic hoses.
- Ø Clean hydraulic tank, inside to be painted with approved quality of paint.
- Ø Fill new oil after replacing return line and suction filters.

PNEUMATIC:

- Ø Replace cooling coil, air unloader.
- Ø Test air tanks.
- Ø Replace water separator and air oiler.
- Ø Change all pneumatic hoses & valves.
- Ø Change pneumatic cylinders, brake cylinders and clapper cylinders.
- Ø Overhaul the air compressor.
- Ø Change all the brake shoes.

MECHANICAL:

- Ø Replace tamping units.
- Ø Overhaul the lifting units.
- Ø Overhaul the trolleys, wheels & feeler rollers.
- Ø Strengthen machine frame where cracks have developed.
- Ø Axles may be replaced if the bearings are loose on the journal.
- Ø Replace the propeller shaft or these may be overhauled.

GENERAL:

- Ø A diesel driven portable filter should be installed on the machine.
- Ø Through the above power pack, emergency back up system should be provided on the machine.
- Ø Update all log books entries, recording all the works done till on date.

ELECTRICAL:

- Ø Replace the defective PCBs.
- Ø Replace the limit switches.
- Ø Calibrate all the indicative instruments.
- Ø Overhaul the pendulums.
- Ø Overhaul all the transducers.
- Ø Calibrate the machine for lifting and alignment on zero setting for leveling and alignment.

SUB DISCIPLINE – IRTMM (LESSONS – 01 SESSIONS - 03)

Lesson-I: Introduction to IRTMM and RDSO TM Reports

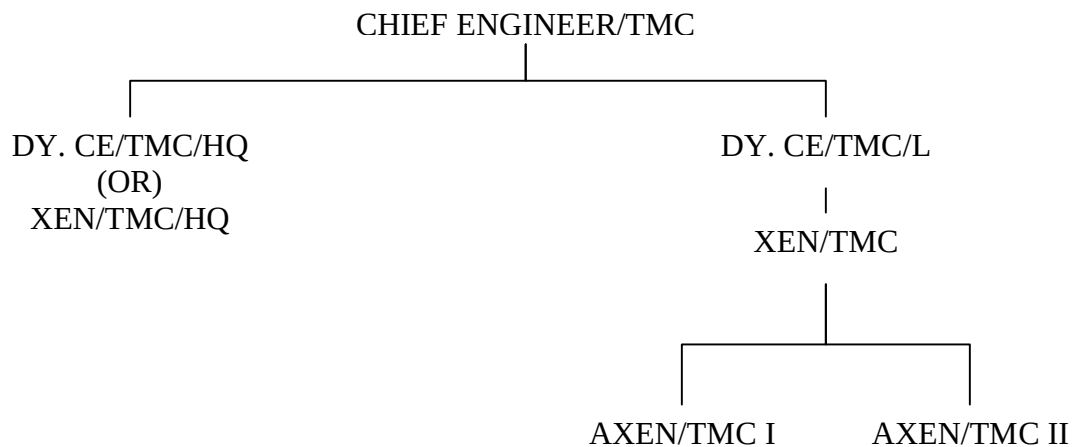
Session-26: Ch1: Track Machine Organisation & Duties of AEN, SSE, Operator & Technician..

TRACK MACHINE ORGANISATION:

The organization shall be under the overall charge of Chief Track Engineer (Machines) of the Railway who shall be reporting to the Chief Engineer through Chief Track Engineer. The organization shall be responsible for the following functions:

- i. Field operation of track machines,
- ii. Repair and maintenance of machines,
- iii. Supervision and technical services including training, and
- iv. Planning and deployment of machines.

To carry out each of the above functions, chief Track Engineer (Machine) shall be assisted by one or more Deputy CE (Machine). As given below:



DUTIES OF AEN:

GENERAL:

The Assistant Engineer is responsible for maintenance and efficient working of all the track machines in his charge.

IMPORTANT DUTIES:

- Ø Inspection and maintenance of all machines.
- Ø Ensure adherence to stipulated maintenance schedules.
- Ø Ensure availability of necessary staff for operation.
- Ø Ensure achievement of stipulated target.
- Ø Ensure adequate availability of consumables and spares.
- Ø Initiate proposals and plans for major schedule of work.
- Ø Ensure co-ordination with other units of engineering department.
- Ø Verification of store.
- Ø Ensure maintenance of various records.
- Ø Ensure availability of tools.

TRAINING OF PROBATIONERS

STAFF MATTERS

All the section engineers and other staff working under him receive proper training in maintenance practice.

SERVICE AND LEAVE RECORDS

WITNESSING PAYMENTS TO STAFFS

KNOWLEDGE OF RULE & REGULATION

INSPECTION BY HIGHER OFFICERS

INSPECTION OF MACHINE BY ASSISTANT ENGINEER

- Ø Inspection of machines by the Assistant Engineer shall be carried out in detail covering necessarily the following aspects and keep in view the Check List Maintenance Schedule issued by RDSO:
- Ø Health of engine.
- Ø Condition of hydraulic, pneumatic, electrical and electronic systems.
- Ø Condition of transmission/brake system.
- Ø Performance of the machine.
- Ø Staff accommodation.
- Ø Availability of the spares with the machine.

EXECUTION OF WORKS

DUTIES OF (SENIOR) SECTION ENGINEER/TMC:

- i. The (Senior) Section Engineer/Track Machines shall be responsible for the satisfactory operation, maintenance and productivity of the machines under his charge and quality of work.
- ii. He shall be well acquainted with the working systems, operating instructions, maintenance schedules, specifications of the oils/lubricants to be used, critical components etc of machines under his charge.
- iii. He shall have thorough knowledge of the rules and regulations and procedures concerning his work and duties as laid down in this Manual, G&S Rules, IRPWM, Engineering Code and other departmental codes, extant orders and circulars issued from time to time.
- iv. He shall have in his possession up-to-date copies of the rule books/documents/manuals pertaining to the safe, efficient and trouble-free working of the machines and also other codes and books applicable and needed for the day-to-day working.
- v. He shall maintain the records pertaining to the machines under his charge and submit the prescribed returns regularly.
- vi. He shall ensure discipline among the staff working under his within the framework of rules and endeavour to keep their moral high and look after their welfare.
- vii. He shall ensure proper handing over/taking over of the charge when transfer/change of portfolio is effected.
- viii. He shall plan and ensure timely execution of the maintenance schedules of the machines within the specified time.
- ix. He shall keep himself abreast of the various methods and techniques of reconditioning of components and availability status of spares at the Base Depot for efficient recommissioning of the machine during breakdowns.
- x. He shall investigate major failure of the machine critically for corrective actions/remedial measures and for fixing responsibilities in case of failures occurring due to lapses of staff.

- xi. He shall be conversant with the provisions in various Service Agreement/Contracts and organize the visits of Service Engineers (scheduled or breakdown).

DUTIES OF MACHINE OPERATORS:

Each machine shall be under the direct charge of Section Engineer/Junior Engineer hereinafter called the operator. He shall ensure the following:

- i. Operation and maintenance of the machine.
- ii. Carrying out pre-block maintenance and making the machine fit for working.
- iii. Initial setting out for the block working and closing the work of the machine including ramping in/ramping out of general lift to the track as in case of tie-tamping machine.
- iv. Proper functioning of all the systems and components and keeping a watch on the controls/indicators/gauges.
- v. Taking precautions for special Design Mode operations such as curve slewing etc in case of tamping machine.
- vi. Posting of fitters/khalasis at respective places around the machine for monitoring the work of various systems, carrying out during block maintenance (greasing, oiling, tightening of bolts etc.) and also to attract attention of the main cabin Operator and assist him in the event of any problem of malfunctioning of the machine or due to track obstructions.
- vii. He shall ensure safe working of the machine and staff.

When there are more than one Operators on the machine, the senior-most Operator shall be the Machine Incharge. In addition to his normal work as an Operator he shall be responsible for the following functions in which he will be assisted by other Operators/staffs:

- i. Carrying out the prescribed schedule of maintenance and keeping proper records of the same.
- ii. Safe custody, accountal and replacement of the spares, Tools & Plants and consumables issued for the machine and returning of released spares to base depot for reclamation/condemnation.
- iii. Keeping systems of the machine in working condition and ensuring the target output, duly maintaining quality.
- iv. Maintaining log books and other records, sending daily and other periodical reports/statements using appropriate fastest mode of communication.
- v. Liaisoning with the Divisional Officials for efficient working of his unit, coordination with the Permanent Way staff and planning daily programme of machine work and interacting with the Permanent Way staff for working in design mode, slewing of curve etc.
- vi. Actively associating during visit of firm's Service Engineer, furnishing of such information as may be needed for proper examination of the machine and taking necessary follow up action.

DUTIES OF TECHNICIAN:

The main functions of Track Machine Fitters/Mechanics are:

- i. To attend to the daily and weekly maintenance schedules of machine and record the compliance in log book.
- ii. To extend help during other maintenance schedules/service checks by the Service Engineers.
- iii. To keep in his custody the various tools and equipment necessary to attend repairs and ensure their working condition.
- iv. To remain vigilant during movement and working of machine and to inform the operator of any abnormalities.
- v. To guide and supervise the semi-skilled/unskilled staff in attending to the maintenance/repairs.
- vi. To ensure safety of the machine and men from approaching trains on adjacent lines.
- vii. Any other work assigned to him by the machine incharge.

DISCIPLINE – IRTMM (LESSONS – 01 SESSIONS - 03)

Lesson – I: Introduction TO IRTMM And RDSO TM reports **Session-27:** Ch 4 & 5: Rules for Movement & Working of Track Machines and Planning, Operation & Monitoring of Track Machines.

RULES FOR MOVEMENT:

GENERAL:

- Ø Track machines are self propelled machines. These machines shall be worked as a train except when attached in the rear of a train, they will be treated as part of that train. However, when self propelled, there is no need of guard or breakevan.
- Ø When more than one machines are required to work within the same block section, they may be allowed under one authority. In such situation, all the track machines must leave and enter the section simultaneously one after another keeping adequate distance among them and with proper authority.
- Ø In case of run through movement from one station to another, upto three machines may be allowed under one authority to enter in a section with ruling gradient not steeper than 1 in 100. For gradients steeper than this only one machine shall be allowed at a time.
- Ø Whenever the track machines are working in an integrated traffic block where other railway agencies are also working, the relevant instructions for integrated block working should be followed.

INCHARGE OF MACHINE:

- Ø Each machine shall be under the direct charge of Section Engineer/Junior Engineer (Machine) hereinafter called the ‘Operator’. Number of railway staff on driving cab of each machine shall not exceed five. The operator shall have valid competency certificate.
- Ø The track machine shall work under the direct supervision of an Engineering official, not below the rank of Section Engineer/Junior Engineer (P.Way), who will be responsible for taking the traffic block and for protection of the line while working and also timely clearance of block after completion of work.

COMPETENCY OF OPERATOR:

- Ø The operator shall be fit in A-3 medical category. If wearing spectacles, he shall carry and extra pair while on duty.
- Ø The operator shall undergo training in train working rules at the Zonal Training Centre/IRTMTC, Allahabad. On successful completion of training, he shall be examined and if found competent, shall be issued with the competency certificate by Dy. Chief Engineer incharge of the machines which shall be valid for three years and shall be kept in the personal custody of the operator. The certificate shall be produced promptly when required.
- Ø The operator shall apply to the Dy. Chief Engineer incharge of machines well in advance of the date of expiry for renewal of the competency certificate. The officer shall renew the certificate for further period of three years at a time after holding a test. The operator shall, however, be required to go for a Refresher Course in Zonal Training Centre/IRTMTC, Allahabad, within a period of 6 years.

SAFETY EQUIPMENTS:

The following safety equipments must be available in good working condition in the machine:

- i. Two red and one green hand signal flags,
- ii. Two tri-colour hand signal lamps,
- iii. Two chains with padlocks,
- iv. Two clamps with padlocks,
- v. Twelve fog signals (detonators) in a tin case,
- vi. A copy of the working time table of the section where the machine is working,

- book with upto date amendment slips,
- viii. One 4 cell flasher light,
 - ix. One portable field telephone,
 - x. Two banner flags,
 - xi. One first aid box,
 - xii. Two skids,
 - xiii. Petromax/LPG lamps,
 - xiv. Safety helmets for all machine staff,
 - xv. Protective clothings, safety shoes and safety gloves,
 - xvi. Track Machine Manual, and
 - xvii. Accident Manual

HEAD & TAIL LIGHTS:

Each track machine must be equipped with prescribed head and tail lights, marker lights and flasher lights as per GR 4.14, 4.15 & 4.16 and SRs thereof.

The following equipments should be available on the machine during block working to meet the exigencies:

- | | | | |
|-------|---|----|----------|
| i. | Fire extinguisher | - | one |
| ii. | Hooter (manual) | - | two |
| iii. | Jack 50 t | - | two |
| iv. | Wooden blocks | - | four |
| v. | Crow bars | - | four |
| vi. | Trifor (3t) | - | four |
| vii. | Hydraulic hand pump | - | one |
| viii. | Emergency pneumatic/hydraulic hose of sizes suiting different machines (complete with end fittings) | - | one |
| ix. | Wire rope with close loops at both ends 2 metres & 9 metres for BCM | -- | one each |

RULES FOR OPERATION:

GENERAL:

- Ø When the track machines are stabled at a station, necessary precautions against rolling down such as pinning down hand brakes, chaining and provision of skids, shall be taken.
- Ø No track machine shall be moved between a running line and the siding/stabling line without the written permission of Station Master on duty in the form of shunting order/shunt signals.
- Ø When the track machine is required to move from one block station to another block station, the operators shall run the machine only with proper authority to proceed.

SINGLE LINE SECTION-WORK AND PROCEED:

- Ø Station master will obtain line clear, take off dispatch signals and issue special caution order indicating the number of machines permitted and the work in block section, Junior/Section Engineer (P.Way) shall move thereafter with token if any, shunting key, OPT form etc, ensuring piloting if due. He shall travel in the last machine, in case proceeding ahead.
- Ø One completion of the work, the machines will be received by lowering reception signals.
- Ø Station porter shall display green signal at the foot of first stop signal till the last machine enters the station.

in advance, the token and the key etc, if any, shall be handed over after the last machine has cleared the block section. The Junior/Section Engineer (P.Way) shall certify the fitness of track, then only the Station Master will clear the line for normal trains.

SINGLE LINE SECTION-WORK AND RETURN:

WITH TOKEN TABLET INSTRUMENTS:

- Ø Station Master will obtain line clear from station in advance, lower last stop signal, issue special caution order indicating the number of track machines permitted to work within the block section, the station where they will return etc.
- Ø On completion of the work, the machines will be received by lowering reception signals.
- Ø Station porter shall display green signal at the foot of first stop signal till the last machine enters the station.
- Ø At the station, the token and the special caution order etc, shall be handed over after the last machine has cleared the block section. The Junior/Section Engineer (P.Way) shall certify the fitness of track, then only the Station Master will clear the line for normal trains.

WITH TOKENLESS BLOCK INSTRUMENTS:

- Ø Station Master will block back the section, take out the shunting key, issue a special caution order indicating the number of track machines permitted to work within the block section to Junior/Section Engineer (P.Way).
- Ø On completion of the work, the machines will be received by lowering reception signals.
- Ø Station porter shall display green signal at the foot of first stop signal till the last machine enters the station.
- Ø At the station, the shunt key and the special caution order etc, shall be handed over after the last machine has cleared the block section. The Junior/Section Engineer (P.Way) shall certify the fitness of track, then only the Station Master will clear the line for normal trains.

DOUBLE LINE SECTION-WORK AND PROCEED:

VIA RIGHT DIRECTION:

- Ø Station Master will obtain line clear from station in advance, lower last stop signal, issue special caution order indicating the number of track machines permitted to work within the block section, the station where they will return etc.
- Ø On completion of the work, the machines will be received by lowering reception signals.
- Ø Station porter shall display green signal at the foot of first stop signal till the last machine enters the station.
- Ø At the station, the special caution order etc, shall be handed over after the last machine has cleared the block section. The Junior/Section Engineer (P.Way) shall certify the fitness of track, then only the Station Master will clear the line for normal trains.

VIA WRONG DIRECTION:

- Ø Station Master will take the line clear from station in rear on block telephone indicating the number of track machines which will work from that station upto the next station, prepare paper line clear ticket, issue special caution order. Both will be handed over to Junior/Section Engineer (P.Way) who shall travel on the last machine.
- Ø The machine shall be piloted out of the station with a written authority by the Station Master after all the facing points are correctly set and locked and trailing points are set correctly.

- ion of work, the operator will stop the machine at the first stop signal of the right line or last stop signal of the wrong line (which they are running) at the next station.
- Ø The Station Master will send a railway staff in uniform to pilot them into the station on a written authority.
 - Ø After all the machines reaches the other end of the block section, Junior/Section Engineer (P.Way) will return the paper line clear ticket, special caution order to Station Master. He will also certify that the track is fit and then only the Station Master will close the line and normal train running can be resumed.

DOUBLE LINE SECTION-WORK AND RETURN:

VIA RIGHT DIRECTION:

- Ø Station Master will block forward the section. He will take out the shunt key if available and issue special caution order to the Junior/Section Engineer (P.Way) along with the shunt key.
- Ø In addition , requisite written authority will be issued for passing the last stop signal at danger.
- Ø After completion of work, the operator will stop the machine at the first stop signal of the right line or last stop signal of the wrong line (which they are running) at the next station.
- Ø The Station Master will send a railway staff in uniform to pilot them into the station on a written authority.
- Ø After all the machines reaches the station, Junior/Section Engineer (P.Way) will return the paper line clear ticket, special caution order to Station Master. He will also certify that the track is fit and then only the Station Master will close the line and normal train running can be resumed.

VIA WRONG DIRECTION:

- Ø Station Master will block back the section. He will take out the shunt key if available and issue special caution order to the Junior/Section Engineer (P.Way) along with the shunt key.
- Ø The machine shall be piloted out of the station with a written authority issued by the Station Master.
- Ø On completion of the work, the machines will be received by lowering reception signals.
- Ø Station porter shall display green signal at the foot of first stop signal till the last machine enters the station.
- Ø At the station, the special caution order and shunt key, shall be handed over after the last machine has cleared the block section. The Junior/Section Engineer (P.Way) shall certify the fitness of track, then only the Station Master will clear the line for normal trains.

PLANNING:

GENERAL:

- i. Working of all track machines in a zonal railway shall be centrally controlled and managed by the Chief Track Engineer in-charge of track machines hereinafter called CTE (MC).
- ii. In drawing the programme, the following aspects shall be taken into consideration:
 - Ø Base depot locations,
 - Ø Loco requirements and loco power availability,
 - Ø Block requirements and block availability,
 - Ø Ballast needs and supply prospects,
 - Ø Speed restrictions,
 - Ø Working season,

- t of individual machines,
- Ø Effective availability of machines, taking into account slots for POH/IOH, on line repairs, etc,
 - Ø Priorities/targets for completion of projects/works,
 - Ø Coordination with and requirements of S&T and TRD branches, and
 - Ø Any other factor having a bearing on machine utilization.
- iii. The divisions and construction units on receipt of the draft deployment plan shall initiate all preliminary works such as development of base depots, execution of contracts, arranging blocks, ballast collection, procurement of consumables like diesel oil etc. so that no time is wasted once the machines reach site.
- iv. The machines on arrival in the divisions/construction units shall be deployed as per the approved deployment programme, their progress closely monitored, works completed in time and machines handed over to the next worksite as per programme.
- v. The concerned Sr. DEN/DEN shall arrange for expeditious movement of machines as per the approved programme. Timely completion of preparatory works in the section/division where the machine is due to arrive, shall be ensured.

PROJECT WORKS:

- i. The quality of relaying will be better by using PQRS cranes.
- ii. Keep “Panel assembling locations” or base depot as close as possible to the work site.
- iii. Adequate availability of service rails and labour for allied activities shall be ensured for uninterrupted working of machines.
- iv. The initial standards of ballast cushioning, track linking and packing shall be such as to ensure safe and efficient working of on-track machines.
- v. The availability of a gang to work along with tampers, spot calculation of versines for design lining and advance work for design mode of tamping for longitudinal surface with a knowledgeable supervisor are essential for the working of machines.
- vi. Adequate availability of critical spares and consumables and a mobile workshop with a welding plant and gas cutting equipment shall be ensured.
- vii. A separate “Imprest” for urgent requirement of spares and undertaking on the spot repairs shall be kept handy to help intensive utilization of machines.
- viii. An SEN/AEN exclusively nominated may monitor the working of machines and coordinate with Construction branch for safe, efficient and uninterrupted working of machines.

INTER RAILWAYS DEPLOYMENT:

- i. Inter-Railways transfer of machines will be done with the approval of Railway Board only.
- ii. When machines are deployed to work in other railways for short duration, the “Owning Railway” shall send the machine staff required for their working.
- iii. The Railway receiving the machine shall associate its staff to pilot the machine movement in its jurisdiction.
- iv. The requirements of oils and consumables shall be supplied by the railway using the machines.
- v. The user railway shall be responsible for the optimum utilization of the machines and keep appropriate records for future use.
- vi. Output of the machine shall however be reported by the “Owning Railway” only in its performance report.

- i. The machine staff and P.Way staff shall work as a team towards the common goal of ensuring optimum utilization of the machine and manpower.
- ii. The machine staff shall ensure adequate attention to the machine in time as prescribed in RDSO manuals and manufacturer's manuals in respect of their machines and keep the machines ready for availing stipulated blocks.
- iii. The machine shall be berthed in the sidings safely as stipulated in the G&SR and the P.Way staff shall arrange for watchman for the machine during the non-working shift.
- iv. The machine incharge on arrival shall check up the condition of the machine and report any unusual features observed by him such as disturbance to the machine at the berthing place, missing of parts etc and initiate appropriate action as per extant rules.
- v. The machine incharge and Junior Engineer/Section Engineer (P.Way) shall jointly inspect and finalize the week's work in advance and discuss the day's programme and share with each other all information required for the working.
- vi. The Junior/Senior Engineer (P.Way) of the section shall be responsible for the block working of the machine.
- vii. The Junior/Senior Engineer (P.Way) of the section shall be responsible for all the machine related track works.
- viii. The Junior/Senior Engineer (P.Way) of the section shall be responsible for arranging necessary lighting etc for night works with the association/involvement of other divisional staff such as Signal/OHE etc.
- ix. It should be ensured by the machine incharge that no person climbs to the top of any machine without OHE block in electrified sections.
- x. The machine incharge shall ensure that all precautionary measures are taken for safety of the staff while working on double/multiple line block section against the danger of trains moving on adjacent lines. The Junior/Section Engineer (P.Way) should provide Lookout-men at the site of machine working as per requirements.
- xi. SM will liaison with Section Controller/Controller to ensure that at the end of work, the machine is brought to the base station and placed in the nominated berthing line at the earliest to enable post block maintenance of the machine being undertaken.

MONITORING OF TRACK MACHINES:

TRACK MACHINE CONTROL:

A Track Machine Control office shall function in the headquarter of railway under control of JA Grade/Sr. Scale officer of the Track Machine Organization to co-ordinate between the divisions and headquarter, as also between field units and the base depot/zonal workshops.

FUNCTIONS OF TRACK MACHINE CONTROL:

- i. Contacting the Divisional Engineering Controls for obtaining and recording the daily progress details, to co-ordinate between the divisions and headquarter, as also between field units and the base depot/zonal workshops.
- ii. Recording details of failures.
- iii. Recording assistance required.
- iv. Obtaining next day's programme etc.
- v. Communicating essential instructions from HQ to division/field units.

REPORTS AND DOCUMENTS:

I. T.M. ORGANIZATION'S REPORTS:

- performance report compiled by the Track Machine Control based on the information collected from all divisional engineering controllers/field staff. A register shall be maintained by Track Machine Control for serving as a “Master Record” for all relevant data.
- ii. A daily report from the machine incharge to SEN incharge of field incorporating block details, performance, schedules done/overdue, consumables/spares used, repair and failure, shall be made out and submitted every ten days.
 - iii. The machine incharge will submit a report to Dy. CE/SEN incharge on every breakdown of the machine resulting in failures exceeding half an hour on the proforma.
 - iv. Monthly Appreciation reports from the machine incharge on performance furnishing:
 - a. Number of days worked
 - b. Number of days not worked with reasons
 - c. Blocks availed
 - d. Target
 - e. Output
 - f. Reasons for less output
 - g. Other remarks
 - h. Consumables/spares used and cost thereof
 - i. Failures/repairs with spares and cost particulars
 - v. A summarized monthly performance report from SEN/AEN/MC (line) showing schedules of inspections done, health of machine, failure analysis, adequacy of allied track works etc of the machines under their control to Headquarter/Dy. CE/CE (Machines).
 - vi. A summary of availability of each machine for a period of 3 years shall be maintained at the machine and Zonal Depot showing at a glance the availability, breakdowns, schedule repairs and POH of machine.

II. DIVISIONAL REPORTS:

- i. A daily report from the P.Way incharge to the Divisional Engineering Control giving the following details:
 - a. Block details
 - b. Output kms
 - c. Ineffective time
 - d. Remarks on quality of work
- ii. A monthly report giving
 - a. Details of blocks availed
 - b. Output
 - c. Reasons for deficiencies etc.shall be prepared by the Divisional Engineer incharge of the section.
- iii. A monthly joint report from the Section Engineer incharge of the section and the machine incharge furnishing the details of work done by the respective machine shall be sent to SEN/MC and Sr. DENs concerned.
- iv. A monthly joint report signed by Sr. DEN and Sr. DOM should be submitted to CTE (Machines) giving position of blocks demanded, the blocks actually made available and the blocks actually utilized.

MONITORING SYSTEMS:

Monitoring of machine work involves the aspects of the following:

- Ø Performance
- Ø Failure
- Ø Consumption of oils and consumables
- Ø Consumption of spares
- Ø Cost of machine working and financial control
- Ø Tamping cycle

Lesson-I: Introduction to IRTMM and RDSO TM Reports. **Session-28:** Brief on other Chapters of IRTMM and RDSO TM Reports.

BRIEF ON OTHER CHAPTERS OF IRTMM:

Chapter-6: Periodical Repair And Maintenance Of Machines: This chapter deals with types of maintenance schedules, types of workshops, central periodical over hauling workshop (CPOH), intermediate overhauling workshops/zonal base depot, satellite depot, mobile workshop-cum-transport van and camp coach workshop.

Chapter-7: Duties Of Divisional Officers And Staff Incharge Of P.Way: This chapter deals with the duties of incharge SSE/SE/JE (P.Way), duties of Assistant Engineer (Open Line) and duties of Sr. DEN/DEN.

Chapter-8: Staff Requirement And Other Infrastructural Facilities: This chapter deals with the requirement of staff for machine working, training of track machine personnel and other infrastructural facilities such as storage & carriage facilities for fuel and oil, transport of spare parts, communication facilities, etc.

Chapter-9: Stores: This chapter deals with store depot, inventory control, procedure for procurement of materials, procedure regarding approved suppliers of indigenous spares, procedure for inspection and acceptance of materials, cash imprest, emergency purchase, purchase of items for which DG S&D rate contract exists, purchase of items through running rate contract, annual maintenance contracts, other modes of repairs through contracts and inventory management.

LIST OF TM REPORTS ISSUED BY RDSO UPTO 30.06.2009

S. No.	Name of Machines	Maintenance Schedule		Inspection Check List		Trouble Shooting	
		Report No.	Date of issue	Report No.	Date of issue	Report No.	Date of issue
1	09-CSM	TM-69(F)	22/27.07.04	TM-74(F)	10.12.04	TM-62(F)	10.03.04
2.	Unimat	TM-80(F)	01.03.05	TM-71(F)	2/6.09.04	TM-99(F)	31.03.2006
3	BCM	TM-77(F)	18.01.05	TM-73(F)	4/8.11.04	TM-42(F)	30/31.01.02
4.	FRM-80	TM-79(F)	22.02.05	TM-91(F)	21.09.05	TM-47(P)	30.7/2.8.02
5.	DGS	TM-90(F)	31.08.05	TM-92(F)	28.10/14.11.05	TM-41(P)	22.01.02
6.	BRM	TM-87(F)	20/28.06.05	TM-96(F)	01.02.06	TM-70(F)	29.7/5.8.04
7.	T-28	TM-102(F)	23/31.08.06	TM-103(F)	11.10.06	TM-110(F)	26.04.07
8.	PQRS	TM-101(F)	28.07.06	TM-108(F)	March-07	TM-128(P)	12/13.03.09
9.	MP	TM-100(F)	30.06.06	TM-105(F)	06.12.06/ 27/28.12.06	Not issued	
10.	DUO	TM-84(F)	13/17.05.05	TM-111(F)	29.06.07	TM-89(F)	18.7/30.8.05
11.	UNO	TM-83(F)	06.05.05	TM-76(F)	22.12.04	TM-88(F)	14.07.05
12.	TRT	TM-104(F)	31-10/ 13.11.06	TM-107(F)	23/27.02.07	TM-93(P)	Nov.-2005
13.	09-3X	TM-85(F)	27/1-5/6.05	TM-106(F)	19/25.01.07	Not issued	
14.	WST (08-32)	TM-130(P)	31/03 - 02/04.09	TM-129(F)	March-2009	TM-117(F)	29-02/ 05.03.08
15.	FRM-85	TM-119(P)	25.03/ 01.04.08	Draft	25/26.03.08	Not issued	
16.	UTV	TM-121(F)	21.07.08	TM-127(P)	6/12.02.09		

Note: F = FINAL P = PROVISIONAL

LINING – WORKING PRINCIPLE (LESSONS – 02 SESSIONS - 08)

Lesson-I : Lining **Session-29:** Principle of Lining, Single chord system, Type of lining i.e. 4 Point & 3 Point lining.

PRINCIPLE OF LINING:

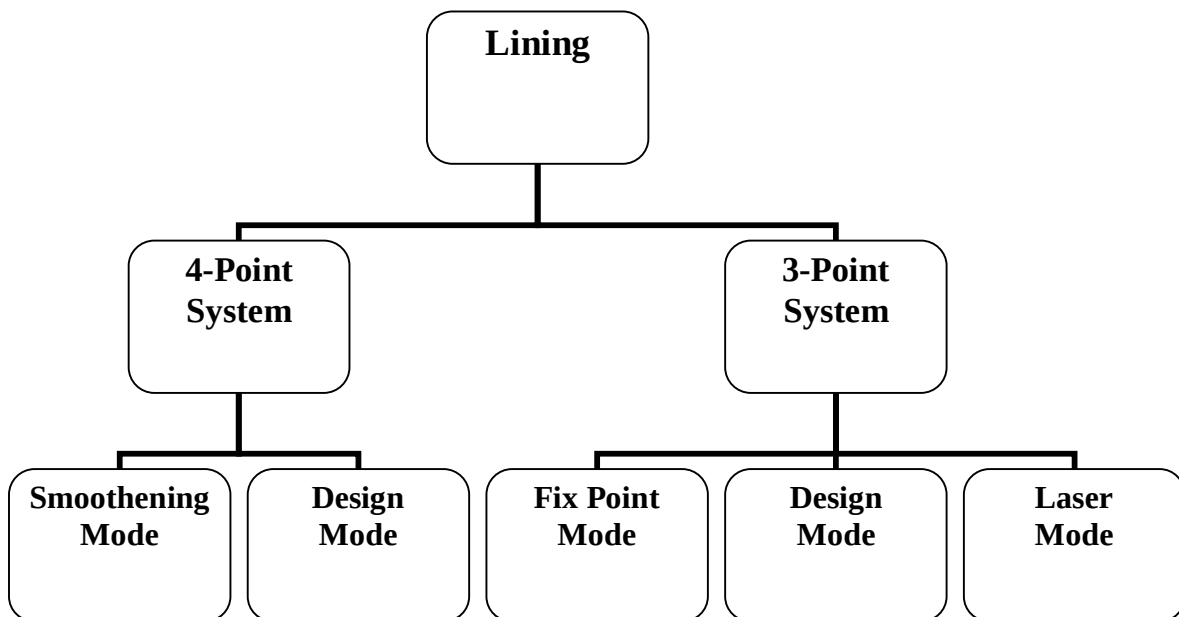
- Ø Machine measures only one rail and rectify that rail i.e. datum rail.
- Ø Other rail is fixed with the sleeper hence that is also rectified.
- Ø If there is a gauge problem that will remain there.
- Ø During alignment machine corrects versine.
- Ø The versine of straight track is zero and
- Ø Versine on curved track depends on radius of curves, measuring chord length and measurement method.

SINGLE CHORD SYSTEM:

On UT machine double chord lining system was used. In this system, two chords i.e. long chords and short chords was used for measuring the versine. But in single chord lining system, one chord is used to measure the versine. This system is used in all machine except UT.

TYPE OF LINING:

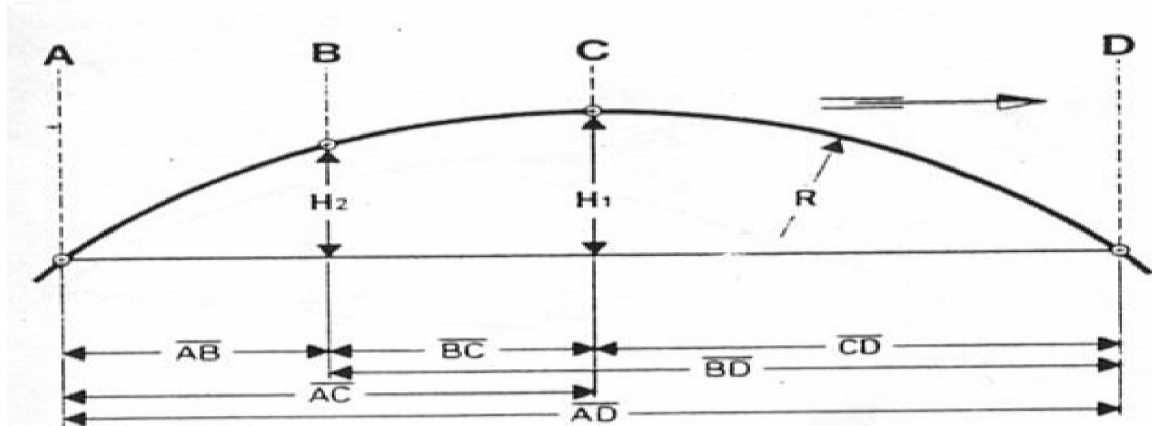
In single chord system there are two methods of lining.



FOUR POINT LINING SYSTEM:

- GEOMETRICAL PRINCIPLE OF 4 - POINT LINING SYSTEM:**

- In a circular curve, two Versines of a chord are related in a ratio, depending on the measuring point distance. This Versine ratio is independent of the radius of the circular curve and is always constant. It is also valid for a straight, which may be considered as a curve with infinite radius. In 4 - point lining system, the track is measured at 4 points (A, B, C & D) and Versines at two points are compared (B & C) to control the lining. The existing errors are reduced or eliminated by means of the Hydraulic Lining System.



From the above figure,

$$\text{Existing Versine } H_1 = \frac{AC \times CD}{2R}$$

$$\text{Theoretical Versine } H_2 = \frac{AB \times BD}{2R}$$

$$\text{Versine Ratio } i = \frac{H_1}{H_2} = \frac{AC \times CD}{AB \times BD}$$

$$H_1 = i \times H_2$$

- Hence, lining is done at Point C until Versine H_1 is in the correct ratio to H_2 ($H_1 = i \times H_2$) at Point B. **Versine Ratio 'i value' for different machines, is as under:**

Machine

i Value

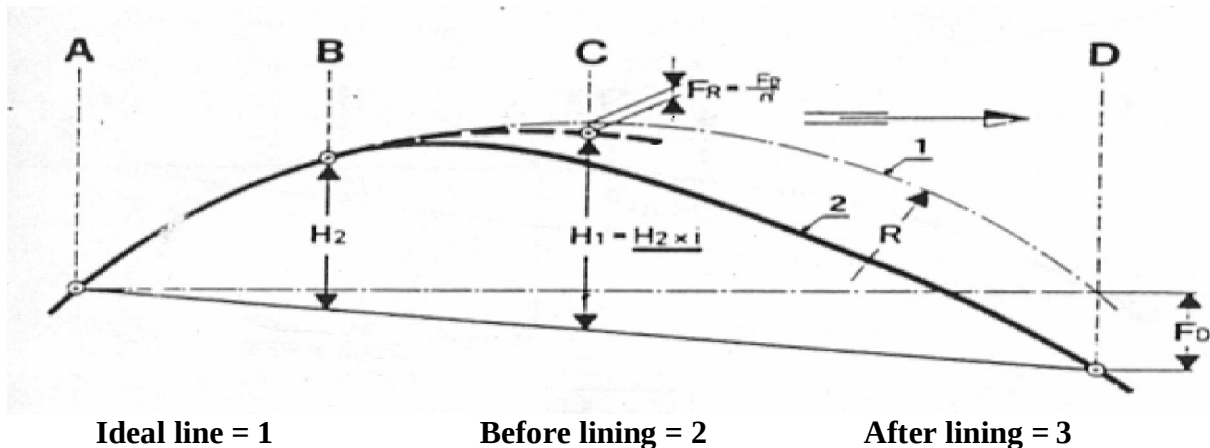
• 08-UNO-DUO	= 1.33
• 08-275 UNIMAT	= 1.35897
• 08-275-3S	= 1.62241
• MP-2000	= 1.395122
• WST	= 1.3292
• 09-32 CSM	= 1.2157
• 09-3X TAMPING EXPRESS	= 1.507

- The points A & B always remain on the corrected track and the Versine H_2 at Point B represents the measuring base. Point D always remains on the disturbed track. Lining is done at Point C. H_2 and H_1 are separately measured by measuring and lining bogies of the machine, respectively. H_2 is fed in PCB where it is multiplied with constant i and becomes " $H_2 \times i$ ". Thus $H_2 \times i$ and H_1 are then fed in difference amplifier and if the alignment is OK both will be equal and reading on the dial will indicate zero. If alignment is not OK, the difference of the two will be indicated on the dial as well as the current will flow to lining solenoids, the alignment will be corrected till both $H_2 \times i$ and H_1 are equal or the ratio $H_1/H_2 = i$, is maintained. **The schematic diagram is as under:**

$$\text{ERROR} = \text{THEORATICAL VERSINE } (H_2) \sim \text{EXISTING VERSINE } (H_1)$$

↑
CALCULATED BY PCB
↑
MEASURING TRANSDUCER
↑
LINING TRANSDUCER

• **ERROR REDUCTION ACCORDING TO THE 4 - POINT LINING SYSTEM:**



- In the above figure, Points A & B are on the already lined track behind the machine. The front end of the chord, Point D is on the disturbed position with lining error F_D , resulting in new Versine H_2 . Point C is now lined until H_1 is in the correct ratio to H_2 . Depending on the measuring point distances (**Error reduction ratio 'n'**), an error remains at lining Point C, which is called **Left over error or Residual error 'F_R'**.

$$\text{Error reducing ratio, } n = \frac{AD \times BD}{AC \times BC}$$

$$\text{Left over error } F_R = \frac{F_D}{n}$$

$$\text{For 08-Machine } F_R = \frac{F_D}{6} \quad n = (20 \times 15) / (10 \times 5) = 6$$

- n depends on Bogie distances, which is as under for different machines:**

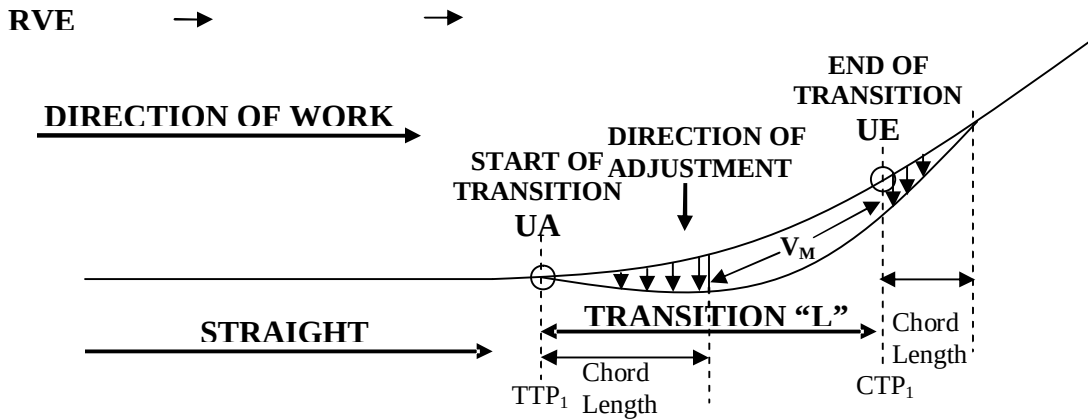
<u>Machine</u>	<u>n - value</u>
08-UNO/DUO	= 6
08-275 UNIMAT	= 6.42720
08-275 UNIMAT	= 7.61997
08-32 WST	= 5.7411
9-32 CSM	= 6.27692
09-3X TAMPING EXPRESS	= 6.47

- This error reduction ratio is valid under the presumption that the Points A and B are on the perfect alignment. Proceeding with further lining, points A and B are positioned at the remaining errors and determine therefore a new base for the following measuring and lining operation. These errors are reduced and adapted to another which results in a considerable improvement of the alignment.

SUB DISCIPLINE – WORKING PRINCIPLE (LESSONS – 02 SESSIONS - 08)

Lesson-I :Lining

Session-31: Calculation of V_m value on Transition & Reverse Curve, Toggle switch Direction, Non-suitability of 4 Point lining on Straight, V_m value feeding at Reverse & Compound curve.



CALCULATION OF V_M VALUE ON TRANSITION CURVE:

The constant versine ratio (i) applied only to tracks with the constant curvature (Straight or circular curve). But when there is change in curvature, the constant versine ratio remains no more applicable. As an example, let us consider a case of the machine entering from straight to transition.

Machine measure the versine H_2 at the measuring bogie and the versine H_1 at the lining bogie. Had the machine been on a regular curve the relationship

$$H_1 = 1.33 \times H_2 \text{ would have been true.}$$

For the changing curvature, we actually have

$$H_1 = 1.33 \times H_2 + V$$

Therefore, even though the curvature of the transition is true the machine still experiences an “Error” V . Therefore, we have to apply some adjustment at the lining bogie to compensate versine for V . Maximum versine compensation is called V_m value.

$$V_m \text{ value} = \frac{\text{Constant}}{R \times L}$$

$$R = \text{Radius of curve } L = \text{Length of Transition.}$$

The procedure of applying V for the different situations is calculated by above formula and distributed in the machine cord length. The tables are also available with each machine. V value is feeded when machine enters from straight to transition, transition to curve, curve to transition and transition to straight. The direction of versine compensation is decided by toggle switch as per following rule:

DIRECTION OF TOGGLE SWITCH:

IF MACHINE IS INTERING:

- (i) High radius to low radius = outside
- (ii) Low radius to high radius = inside

CALCULATION OF V_M VALUE ON REVERSE CURVE:

For the reverse curve or compound curve the value of V is decided as under:

Say R_1 & R_2 are the radius of the two curves and V_1 & V_2 are the corresponding adjustment for the individual curve (page no. 4 & 5)

1. If the R_1 is bigger than R_2 , the net adjustment, V_0 will be $V_0 = V_2 - V_1$ or $V_{0m} = V_{2m} - V_{1m}$,
2. The applicable of adjustment will start as soon as the front tightening starts entering the transition.

This during working 1/6 of the error will be left and therefore it is called smoothing lining of some procedure is available with which it is possible to give exact location of various points like beginning & end of transition and amount of fault at a particular location established with some permanent works these, by shifting front and find the chord by the amount of fault. We can achieve exact alignment.

But in the field it is difficult to obtain correct reference marks as such generally smoothing system is adopted which is fairly accurate for smooth running of trains.

If we are tamping constructed line we can always, lay a parallel reference line from which difference can be calculated for feeding into the machine to achieve exact alignment.

NON-SUITABILITY OF 4-POINT LINING ON STRAIGHT:

On Straight Track H_2 is zero hence machine corrects versine at C with respect to H_2 as

$$H_1 = 1.33 \times 0 = 0$$

If at any point $F_D = 12\text{mm}$

then $FR = F_D/6$ i.e. $12/6 = 2\text{mm}$.

On next sleepers $H_2 = 2\text{mm}$

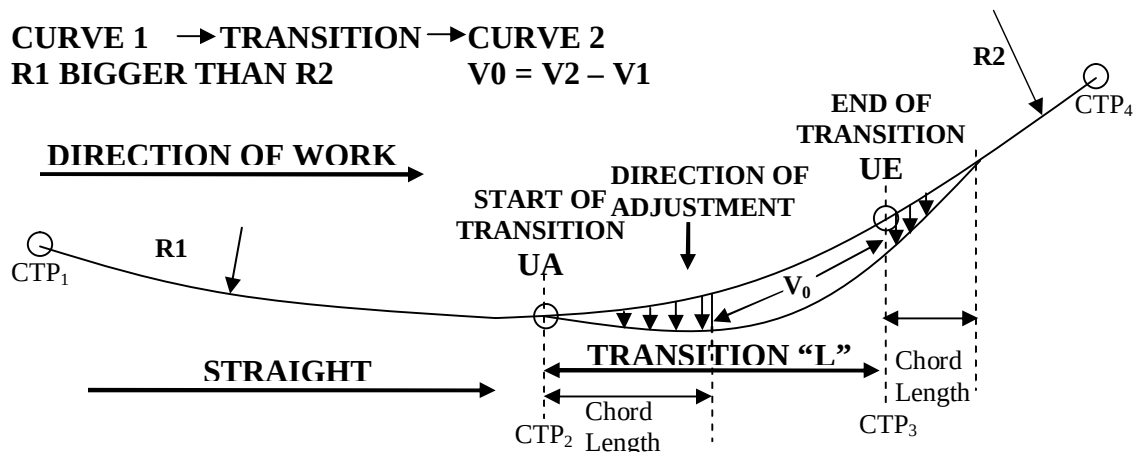
$$H_1 = 1.33 \times 2 = 2.66\text{mm}$$

again $H_2 = 2.66\text{mm}$

$$\text{then } H_1 = 1.33 \times 2.66 = 3.53$$

As per above calculation if machine is leaving any error that will again accumulates. Hence machine forms a false curve. Therefore 4 point is not suitable for straight track.

FEEDING METHOD OF V_M VALUE AT REVERSE AND COMPOUND CURVE:

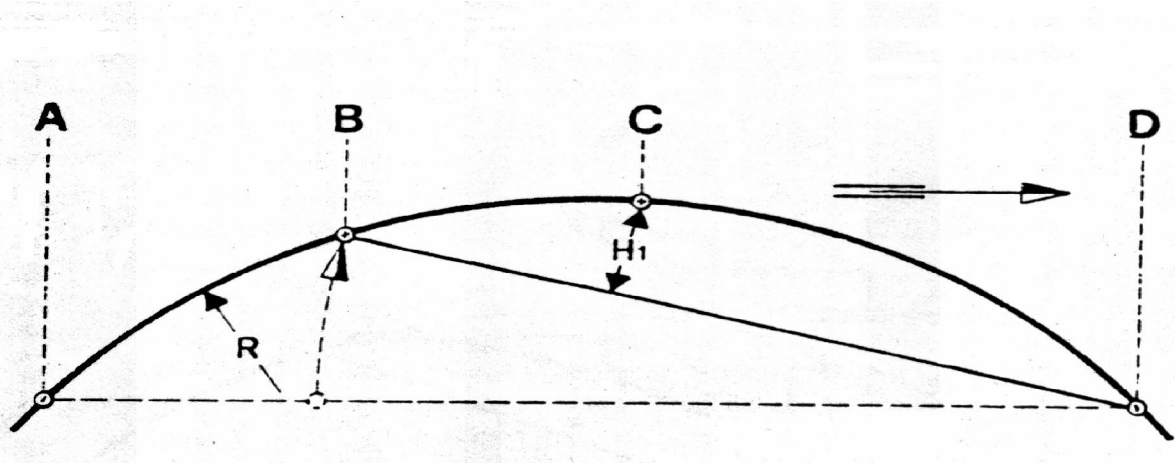


SUB DISCIPLINE – WORKING PRINCIPLE (LESSONS – 02 SESSIONS - 08)

Lesson-I :Lining **Session-32:** 3 Point lining & Left over error, Calculation of 'V' value,
 Method of feeding 'V' value. 3 POINT LINING:

THREE POINT LINING SYSTEM:

- GEOMETRICAL PRINCIPLE OF 3 - POINT LINING SYSTEM:



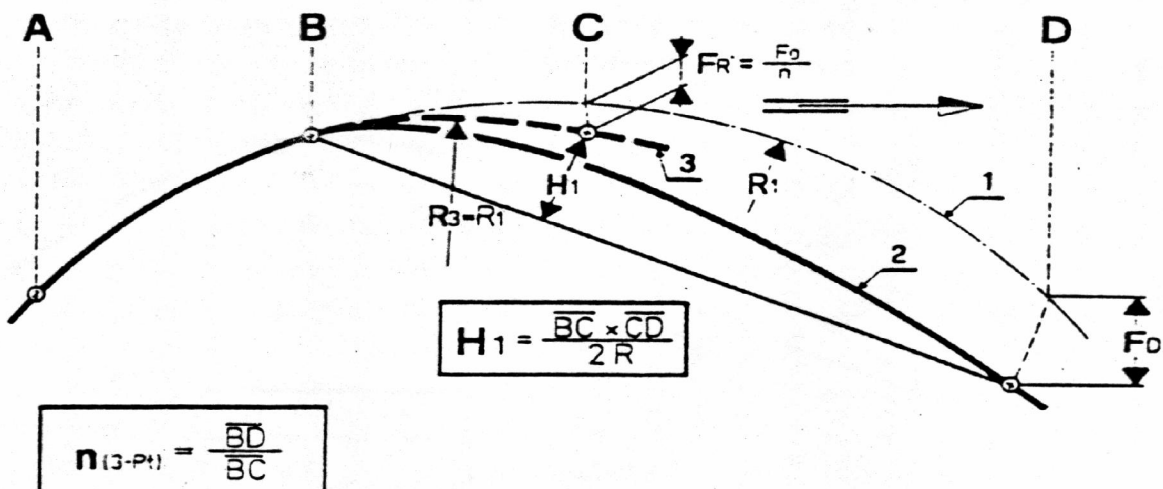
$$H_1 = (BC \times CD) / 2R$$

- The Versine H_2 at Point B is not measured. The track is measured at three points. The lining Versine H_1 at point C is specified according to the curvature. Lining commences until the Theoretical Versine H_1 is achieved. Using the 3-point system, the chord is generally fixed at point B, which results in a reduction of the distance A-B.

$$\text{ERROR} = \text{THEORETICAL VERSINE} - \text{EXISTING VERSINE}$$



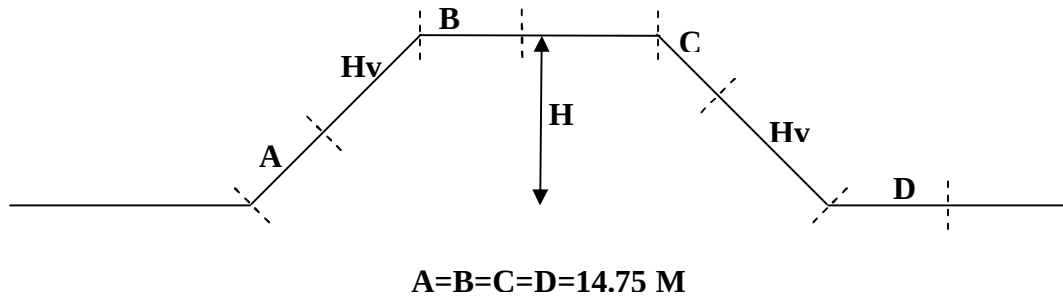
- ERROR REDUCTION ACCORDING TO THE 3 - POINT LINING SYSTEM



- Point B is on the already lined track behind the machine. The front end of the chord, point D is at the lining error F_D . Point C is lined until H_1 corresponds with the specified Theoretical Versine. Specifying the Theoretical Versine, H_1 shifts Point C in a position which corresponds with the required radius R. The remaining error $F_R = F_D / n$, is a result of the ratio of the measuring point distances. Proceeding with the lining, Point B is at the remaining error and influences therefore the next measurement.
- $n_{(3-Pt)}$ - value for different machines is as under:

Machine	$n_{(3-Pt)}$ - value
8-UNO/DUO	= 3
08-275 UNIMAT	= 3.12
08-275 UNIMAT -3S	= 3.297
08-32 WST	= 2.91
09-32 CSM	= 3.138
9-3X TAMPING EXPRESS	= 3.04

FOR CSM IN 3-POINT LINING VERSINE FOR SECTIONS A, B, C AND D IN TRANSITION CURVES WITH STRAIGHT CURVATURE								HV = $\frac{23617}{R \times L}$	
								HV = $\frac{23617}{R}$	
Constant sections A & C	0	425	3399	11417	27191	53107	90534	135455	153120
R = XL =									
Meter after OA/OE	TP/CTP UA/UE	2	4	6	8	10	12	14	14.75
Versine in curve H = $\frac{BC \times CD}{2R}$									
Versine section A = $\frac{\text{Constant}}{R \times L}$									
Versine section C = H - A									
Constant sections B & D	195238	148428	104167	65004	33489	12170	2362	48	0
R = XL =									
Meter after OA/OE	TP/CTP UA/UE	2	4	6	8	10	12	14	14.75
Versine in curve H = $\frac{BC \times CD}{2R}$									
Versine section A = $\frac{\text{Constant}}{R \times L}$									
Versine section C = H - A									



Step 1: Calculate the value of H (as above chart).

Step 2: Calculate versine value of sections A, B, C & D (as above chart).

Step 3: For the calculation of 'Hv' value there are two methods:

Method 1: $HV = \frac{\text{CONSTANT}}{R \times L}$ mm/metre

Method 2: $\frac{\text{Versine at starting of B} - \text{Versine at the end of A}}{\text{Transition length} - \text{machine chord length}}$ mm/metre

Step 4: The calculation of versine is for two metres interval as above. This may be divided for alternate sleeper.

LINE – WORKING PRINCIPLE (LESSONS – 02 SESSIONS - 08)

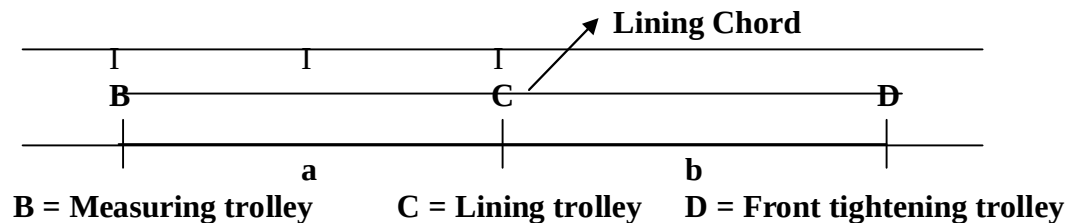
Lesson-I :Lining

Session-33: Design lining, Laser lining and measuring run method, Potentiometers & their calibration.

- Maintenance of track geometry to desired parameter is very important for the safe and smooth running of trains. Track machines have facilities of measurement and rectification of track defects for achieving design geometry. 5 CSMs & all 3x machines are also equipped with Automatic Guide Computer (ALC) for track geometry measurement and LASER Sighting System (LSS) for lining besides other features for design tamping. However, only few machines are working in design mode mainly due to the inadequate knowledge of field staff. On NCR, there is not much problem of leveling due to stable formation and good initial laying. Hence, this Circular is to enrich knowledge of Design lining among field staff. Smoothing mode lining details are also given in **Annexure-I**.

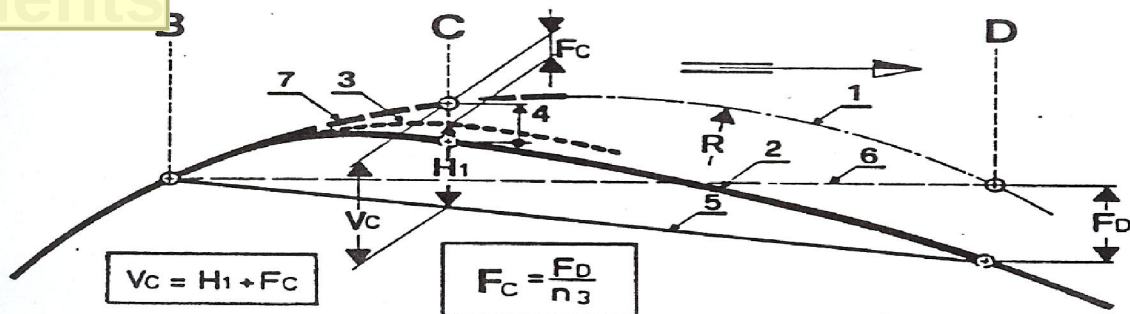
DESIGN LINING

- Modern Track Machine always corrects Versine during Alignment correction using single chord. Machine measures only one rail i.e. Datum rail and rectify it. Other rail is fixed with the sleeper, hence that is also rectified. Four trolleys are provided for alignment measurement. In design lining, only three trolleys are used. The trolleys are pneumatically pressed against Datum rail and transducer provided on lining trolley measures offset of alignment at C i.e. distance between lining chord and center of lining trolley. After measuring the offset, track is slewed so much that specified Versine is achieved at lining trolley, which is zero for straight track and certain value on curved track.



- In the lining process Front trolley always remains on disturbed track and Measuring trolley always remains on corrected track. Because of misalignment in track at front trolley, front end of the chord will be out of its correct position equal to the alignment defect at that point. Due to incorrect position of the front end proportional alignment error will remain after lining. **Left over error at C, $F_R = F_D/n_{(3-P)}$, where F_D = Lining offset at front trolley and $n_{(3-P)} = BD/BC = (a+b)/a$.**
- GEOMETRICAL PRINCIPLE OF 3 - POINT DESIGN LINING SYSTEM:**

1 = Perfect alignment	2 = Before lining	3 = After lining without error input
4 = Lining Value	5 = Actual position of the lining chord	
6 = Theoretical position of the lining chord	7 = After lining with error input	



- For a perfect alignment of the track according to fixed points, the existing error F_D , which is measured at the front end of the chord, is adjusted to the opposite direction, and is automatically and in the right proportion transmitted to the lining Versine by means of the lining control. Thus, the lining error is transmitted, relatively reduced, to the cut off point on the lining trolley C. Therefore radius and angular position are corrected perfectly. In design lining this error is eliminated by shifting front end of the chord equal to alignment defect at that point. In Modern Track Machine, proportional electric signals are relayed through Lining PCB to lining unit and track is lined accordingly.

Slew at C = Specified Theoretical Versine at C ~ (Lining offset measured by transducer at C + Proportional signals corresponding to lining offset at D)
 $= H \sim (H_1 + F_C)$ where $F_C = F_D / n_{(3-P_t)}$ and Left over error $F_R = \text{Zero}$

DETERMINATION AND ADJUSTMENT OF LINING ERRORS:

MANUAL SYSTEM:

Surveying Design Lining Offset By Long Chord:

- In terms of Guidelines on 'Survey for Alignment Correction' as contained in Item No. 6.0 of Ann 5.3 to IRTMM, the lining errors are to be determined by measuring offsets at every 5 m intervals on 40 m chord on straight track and at every 10 m intervals on 20 m chord on curves track and marked on the track. The required slew at every alternate sleeper is worked out by interpolating the offsets, taking note of the obligatory points and ensuring that there are no infringements to moving dimensions. The slews are then marked on alternate sleepers. During the lining operation these values are transmitted to the lining value adjustment. **An example on Field measurement for design lining offset by long chord is given in Annexure-II.**

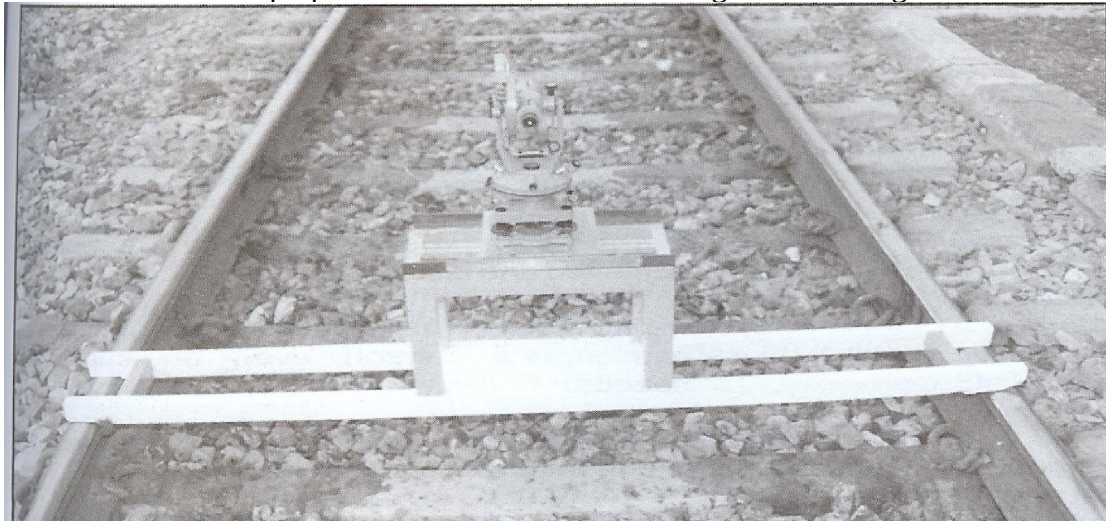
Surveying Design Lining Offset By Theodolite:

- The long-wave track geometry faults become significant with the increase in speed of trains. Assuming the typical natural frequency of vehicular oscillation to be 1 Hz, the critical track geometry fault wavelength even in speed range upto 160km/h is upward of 40 m. While working on straight track, the most preferable chord length for alignment correction is in the order of 60 – 80 m.
- For achieving such chord length, if the Theodolite with the standard tripod stand is used it takes about 10-12 minutes for centering, leveling and measurements. In the saturated high density routes, so much time is not available and whenever a train

The Theodolite is required to be removed and reset. It is even difficult to ensure verticality of Ranging rod at target.

- For making it more practicable, fast and efficient, some specially designed gadgets, as given below may be developed, which makes the direct slew measurement with Theodolite quite easy. Using these gadgets, a chord of upto 1 km may be taken between 2 good points, which is the line of collimation of Theodolite at a fixed lateral distance from gauge face of reference rail of existing track and the slew measurements at every 5 m intervals are directly measured on specially designed Satellite with reference to the line of collimation. The equipments and specially designed gadgets used are as under:

- **Theodolite:** Normal Theodolite.
- **Scaled Sliding Table:** It may be made of wood or metal with 1.85 m Length and 0.45 m Height. On upper side, one horizontal graduated table is fixed in which a plate is mounted on which Theodolite slides laterally to keep it at any required lateral distance from the reference rail. A lug is provided similar to that provided in gauge-cum-level. Touching Hook is on left side of the sliding table stand to bypass the burr on rail. SST will be perpendicular to rail, when both lugs are touching reference rail.



- **Satellite:** It may be prepared from existing gauge-cum-level. In middle portion of the vertical face towards Theodolite, a teathed scale made of luminous red strip is pasted for a length 20 cm either side of zero (centre) point. The height of triangular teeth is 10 mm and distance between the two apexes of teeth is 10mm. This is further divided into 5 equal parts by 4 nos. of black horizontal lines to give a least count of 1 mm. *Alternatively, the Satellite may be made like the Target described below with a movable vertical arm of length 30 cm and height 45 cm in 'reverse T shape' $\perp$, painted white with a black vertical central line pointer towards Theodolite and a Satellite scale (30 cm Steel scale with Least Count – 1mm) on the upper side at either ends starting at 15 cm distance from the centre point on which the vertical arm slides laterally. During survey, this movable vertical arm is sighted and brought in line with the alignment of line of collimation of Theodolite and Target. The shifting of movable vertical arm from centre point is read from Satellite scale and deviation is directly recorded as slew at that point.*
- **Target:** It may be made of wood. One end of its horizontal board ensures reference rail contact and zero point has a **fixed vertical pointer** of 0.75 m height

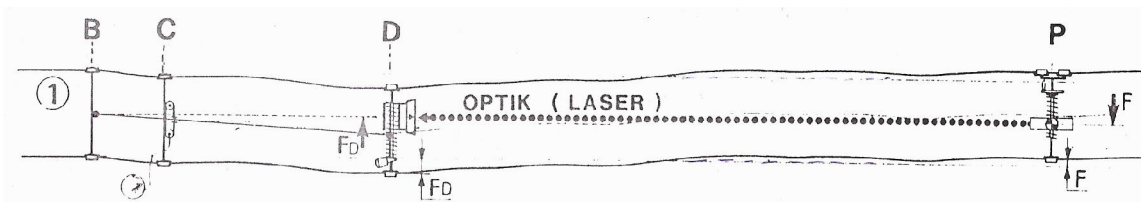
hite and has got a red vertical central line passing through zero point towards Theodolite.



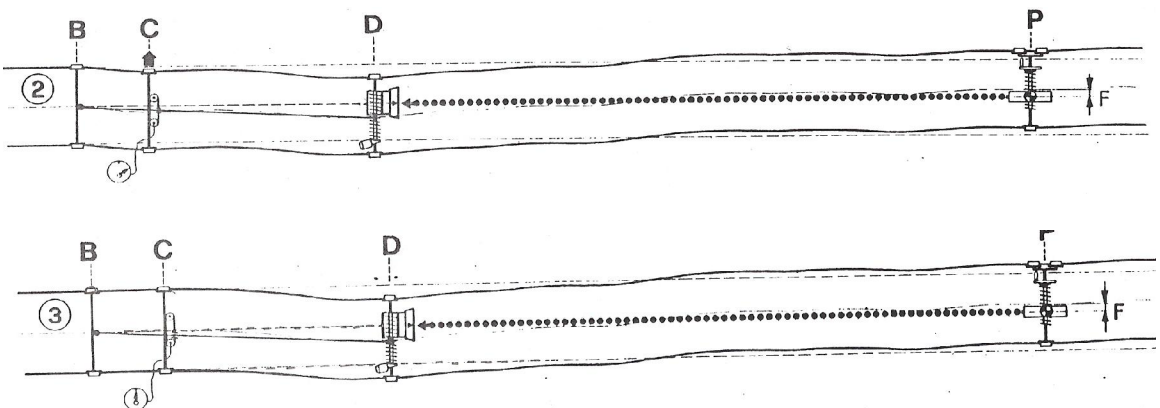
- **VHP Sets:** One each at Theodolite, Satellite and Target i.e. total 3 Nos.
- **Method of Working:**
 - **Preliminary Works:**
 - a) Marking of stations at 5 m apart at the centre of track.
 - b) Selecting good point at about $\frac{1}{2}$ to 1 km apart. These good points should have their position in the mean alignment of the existing track.
 - **Slew Recording:**
 - **Step 1** – Check squaring of SST with reference rail by touching it's both the notches on gauge face.
 - **Step 2** – Set the Sliding table at zero point, place Theodolite and level it.
 - **Step 3** – Sight the Target and fix the line of collimation.
 - **Step 4** – With the alignment of line of collimation, read deviation at Satellite scale by seeing through telescope of Theodolite.
 - **Step 5** – Take and record deviations of subsequent stations till the readings are visible with the telescope of Theodolite.
 - **Step 6** – Leaving satellite on last recorded station, SST is shifted on second last recorded station.
 - **Step 7** – Slide SST as per slew reading of the station on which it is shifted, place Theodolite, level it at site the target again so that initial line of collimation is maintained for further measurement of slews. Repeat the steps till Slews of each stations at 5 m apart are recorded for full length.
 - **An example on Field measurement for design lining offset by Theodolite is given in Annexure-II.**
- **LASER SIGHTING SYSTEM:**
 - 5 CSMs and all 3x machines are provided with a LASER Sighting System (LSS) that can be used to extend the measuring system on straight track. LASER lining is used on straight track in 3-point mode to remove long misalignment or false curve. The LASER system consists of LASER gun (transmitter) and LASER receiver. The LASER trolley

s of laser gun is placed in front of the machine up to 300 m away. The receiver mounted on the front tightening trolley is adjustable so that it follows the LASER beam and the position is detected by a transducer that provides an input to the lining system equivalent to the offset of the front of the chord. As the machine is working it moves up to the LASER trolley until the distance is a minimum of 20 m away. LASER system operates fully automatically and is able to cope with distances of up to 300 m. But LASER lining is only applicable for straight track. Important details are given below:

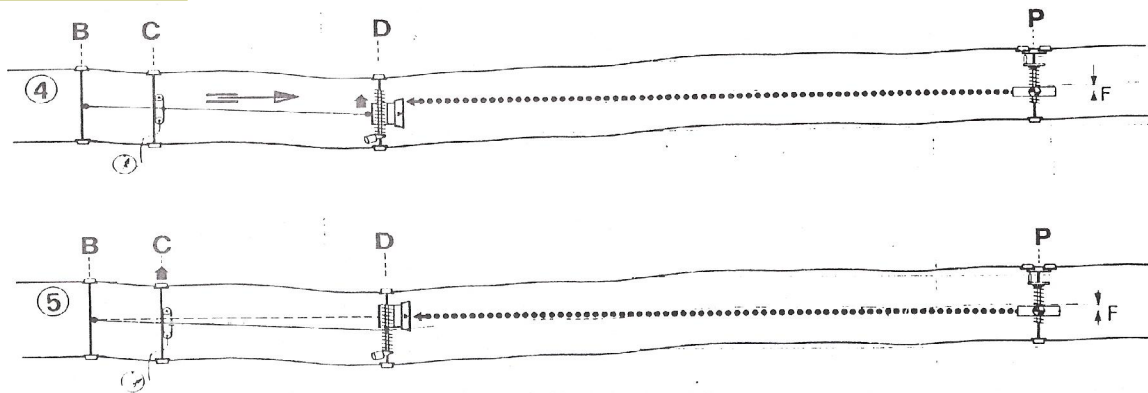
- By means of a special device, the LASER beam is fanned vertically in such a way that, the eventual change in track height has no influence on the system.
- By means of an automatic follow up control, the LASER receiver is always positioned at the centre of the LASER beam and therefore determines the input of the slewing values.
- The distance of the LASER gun from the machine is also dependent on the ambient conditions (rain, snow, fog, high ambient temperature). In good ambient conditions (clear, dry air) the lining distance can be extended considerably.
- **Working Sequence of Design Lining with the Laser Sighting System:**
 - **Phase 1:** When the design lining commences the front end of the chord with the LASER receiver is shifted by the amount of the error F_D in the direction of the THEORETICAL alignment, whereby the follow up control is switched off. If the lining errors exceed certain amount, a transition is necessary for the new alignment. LASER transmitter is positioned as far as possible from the machine, adjusted laterally over the amount of the lining error F , aimed at the LASER receiver and fixed in this position.



- **Phase 2 and 3:** The design is set; the follow-up control is switched on. The track is lined at point C and matches exactly with the line of sight.



- **Phase 4 and 5:** The machine drives forward and the front end of the chord is matched up again with the line of sight. The machine is ready for the next lining operation.

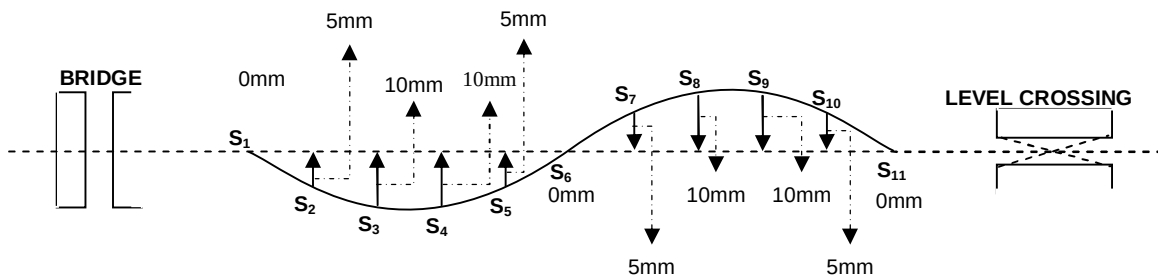


ANNEXURE-II

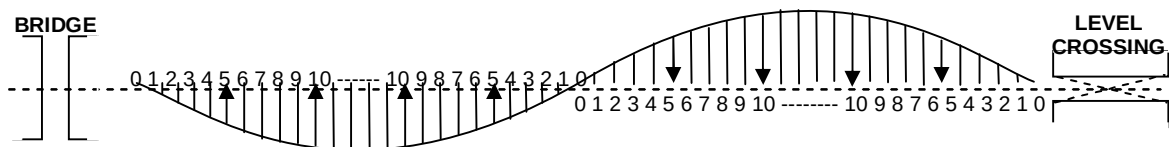
A. FIELD MEASUREMENT FOR DESIGN LINING OFFSET BY LONG CHORD

• Surveying and Marking of Slews without any Infringement to SOD:

- Ø Surveying should be done between two good points, which may be on well maintained obligatory points i.e. girder bridges, level crossings, points & crossings, permanent structure etc, with the centre line of track on the design or original theoretical position.
- Ø In case of any shift in alignment of the centre line at obligatory points from the design or original position, the centre line must be brought to design or original theoretical position, manually for a minimum track length of 50m before surveying.
- Ø The lining errors are to be determined by measuring offsets at every 5 m intervals on 40 m chord on straight track and at every 10 m intervals on 20 m chord on curves track and marked on the track.

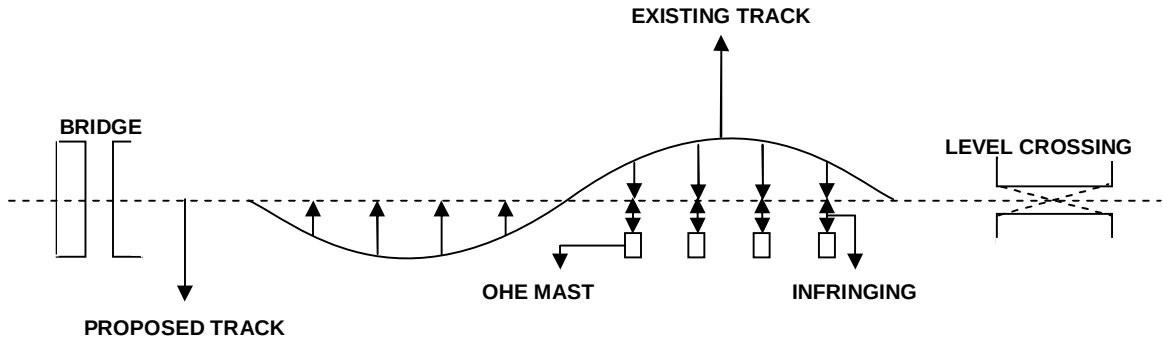


- Ø The required slew at every alternate sleeper is worked out by interpolating the offsets. The slews are then marked on alternate sleepers and Design tamping done by feeding the slew values to Slew Potentiometer in the Front tower.

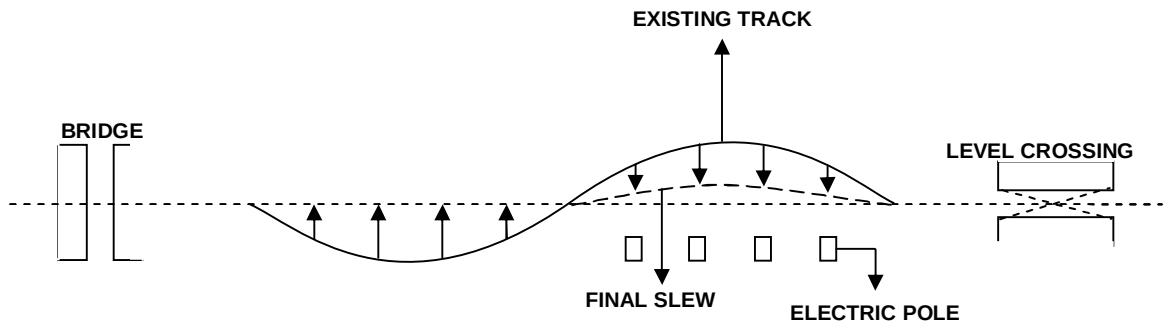


• Surveying and Marking of Slews in case of Infringement to SOD:

If a slew is infringing the SOD viz OHE Mast etc, the slew has to be worked out taking note of the obligatory points and ensuring that there are no infringements to moving dimensions as shown below.



Required Slew Values Infringing SOD



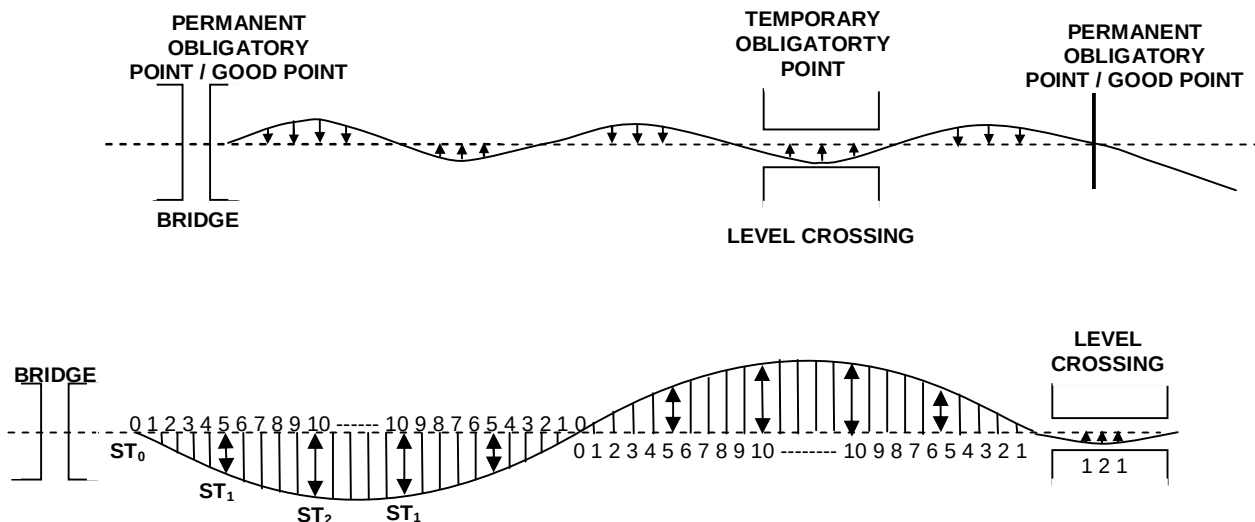
Final Slew Values With No SOD Infringement

Ø The final worked out slews are then marked on alternate sleepers and Design tamping done by feeding the slew values to Slew Potentiometer in the Front tower.

B. FIELD MEASUREMENT FOR DESIGN LINING OFFSET BY THEODOLITE

• Surveying and Marking of Slews without any Infringement to SOD:

- Ø Preliminary Works and Slew Recording Steps are already given in the Circular. However, the following procedure may be followed for Permanent (Girder Bridges, Fixed Structure etc.) and Temporary Obligatory points (Level crossings etc):
 - Ø In case of any shift in alignment of the centre line at Permanent obligatory points (Girder Bridges, Fixed Structure etc.) from the design or original theoretical position, the centre line must be brought to design or original theoretical position, manually for a minimum track length of 50m before selection of good points.
 - Ø Either the Permanent obligatory points or any other points at about $\frac{1}{2}$ and 1 km apart having their position in the mean alignment of the existing track are taken as good points. Thereafter, the Working Method as given in the Circular is followed.
 - Ø Temporary Obligatory points (Level crossings etc) should be opened out and may be shifted to the extent possible after ensuring that there are no infringements to moving dimensions as shown below.
 - Ø Any shifting of Temporary Obligatory points should be approved by the ADEN.



MEASURING RUN METHOD: ALC MEASURING METHOD:

The measuring method is used where the track data is not known. The data for the track is obtained via measurement run using the machine's measuring system prior to working. During or after the measurement any data that is known can be entered e.g. fixed points, cant, radius, etc. After computation by the "ALC" computer the tamper is set to work with the "ALC" automatically entering the computed lift and line data.

SEQUENCE OF OPERATION: The machine can either measure in the working direction or the reverse. If the track is measured in the working direction, the tamping machine must reverse back to the start of the work site before commencing tamping. There is a "fast measuring drive" key switch on the front and rear driving desks. These enable the machine to use the second gear of the main drive to make the measuring run.

PERFORMING A MEASURING RUN: Set up the machine for normal working, although there is not necessary to have the tamping banks running. The tamping banks slew switch on the B2 panel should be set to automatic. If it is on manual the fast measuring function will be disabled. It is advisable to drive the machine for a short distance using the normal working drive. Thus checking that the lifting and lining system is in working order before the start of the measuring run by avoiding errors at the start of the measuring run, due to poor bogie alignment or incorrect pre-loading. It is important to select the correct float rail. If the wrong rail is selected, the design for the lift will not be correct. It is also a good idea to mark the position of the machine on the rail before the start of the measuring run, so that the machine can be repositioned accurately at the start position after the measuring run has been completed (Forward measuring run). The lining system has to be set to 3-point. Use the can switch to select the datum rail for the longitudinal height recording. The reference rail for the versine recording is selected by turning on the lining system and selecting the required pre-load.

END OF MEASURING RUN: At the end of the measuring run return the key switch to the normal position. The computer will automatically produce a "run in from" the old track geometry to the new target geometry at the beginning and end of the measuring run. The measuring run should therefore only cover the length of rail on which the work has to be carried out.

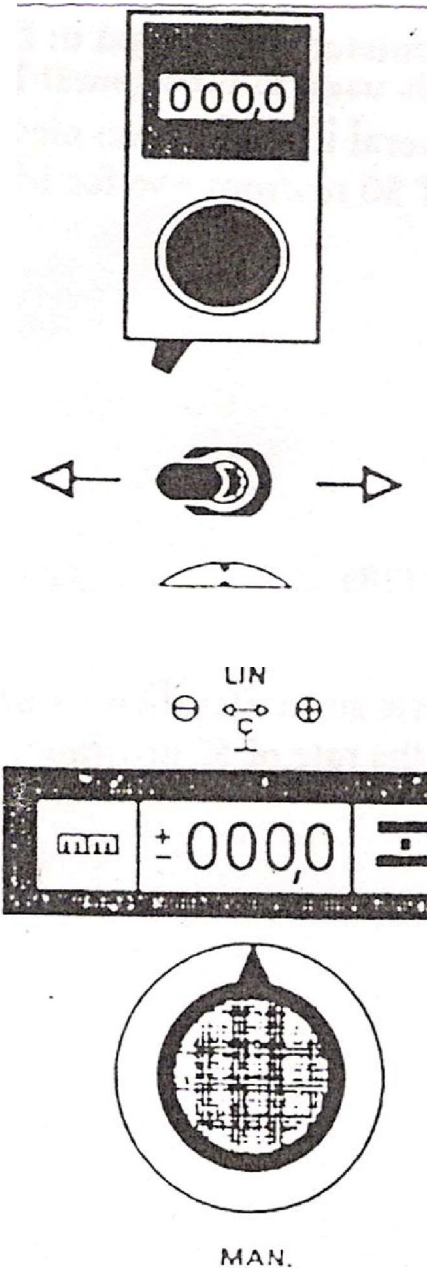
POTENTIOMETER(4f1):

This potentiometer converts versine value to electrical signal at the rate of **50mv/mm +ve for RH side and -ve for LH side**. For calibration of versine potentiometer select Multicheck address **F00**. Select "0" value in versine potentiometer then output voltage of versine potentiometer should be zero on display. If not, loose the screw of digital counter and take out the counter and now rotate shaft of potentiometer to get zero volt on display. Now set all digits to zero of counter then fit counter on shaft of potentiometer. When voltage of versine potentiometer is checked at multicheck address F00 then polarity will be -ve for RH and +ve for LH side.

Before starting calibration +10V & -10V to this potentiometer should be checked and adjusted by potentiometer P1 & P2 in EK 813SV of front input.

CALIBRATION OF SLEW POTENTIOMETER(4f4):

This potentiometer is provided in front cabin on panel B4. This potentiometer converts slew value to electrical signal at the rate of **50mv/mm +ve for RH side and -ve for LH side**. For calibration of this potentiometer, keep slew potentiometer at zero position then output voltage should be zero, if not then take out the knob of potentiometer then rotate the shaft of potentiometer to get zero volt. Then by matching the knob at zero position fit on shaft of potentiometer. When voltage of slew potentiometer is checked at multicheck address **F06** then polarity will be -ve for RH and +ve for LH side. Before starting calibration +10V and -10V should be checked. If there is any variation then adjust by P1 & P2 in EK813SV of front input.



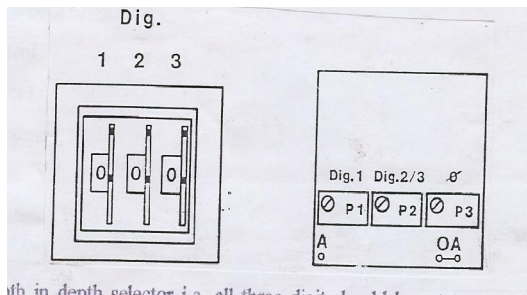
GENERAL LIFT POTENTIOMETER (4f3): This potentiometer is provided in panel no. B4 in front cabin. This potentiometer converts given general lift value to electrical signal at the rate of 50mv/mm output of this potentiometer can be checked at multicheck address **F22**.

For calibration of this potentiometer keep general lift potentiometer on zero and check output of this potentiometer with the help of multi meter it should be 0V. If there is some signal on zero position first take out knob of potentiometer now rotate shaft of potentiometer to get zero volt. Now fit knob on shaft by matching zero position.

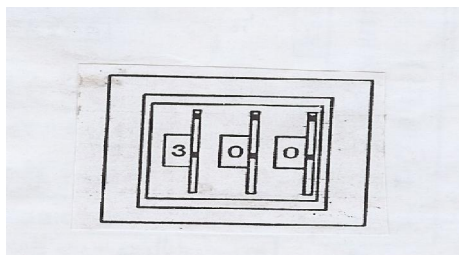
SUPER ELEVATION POTENTIOMETER(2f08): This potentiometer is provided in B2 panel in working cabin this potentiometer is used to feed super elevation or cant values on curves. This converts cant values to electrical signal at the rate of 50mv/mm. output of this potentiometer can be checked at multicheck address **F08**. For calibration of this potentiometer. Set zero value in

Select multichex address F08 then check voltage on display. It should be 0V if there is some voltage then remove digital counter set it to zero and also set shaft of potentiometer to get zero volt on display then refit digital counter on shaft.

DEPTH SELECTOR CALIBRATION:

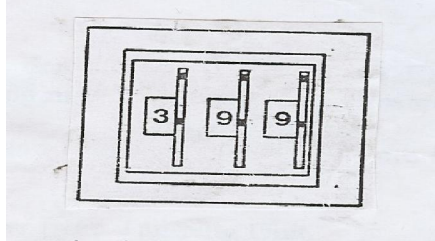


- (1) Select Zero depth in depth selector i.e. all three digit should be set to zero. Now select multichex address F13 in multiplex PCB and keep selector switch in 2nd position Now display should read 0V. If it is showing some value then adjust potentiometer P3 to get zero volt.



- (2) Now select 300 MM depth in depth selector then. Output of selector will be -7.5V if it is not showing -7.5V, then adjust P1.

showing -7.5V, then adjust P1.



- (3) Now select 399m depth in depth selector output of depth selector in display should be -9.975V if it is not, adjust potentiometer P2.

SUB DISCIPLINE – WORKING PRINCIPLE (LESSONS – 02 SESSIONS - 08)

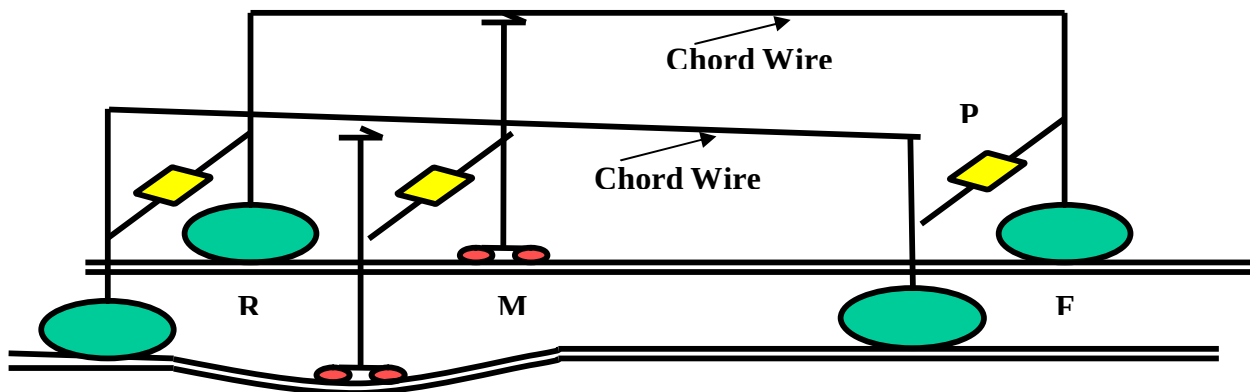
Lesson-II: Leveling

Session-34: Types of leveling system, Double chord system, General lift, ramp in & ramp out, Criteria for selection of Base line

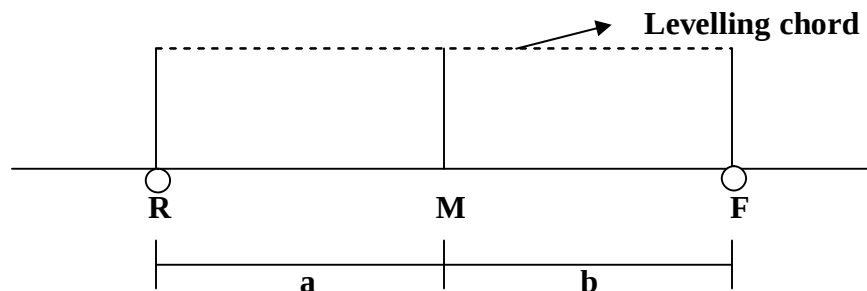
- Tamping Machine corrects the leveling error in the following two modes:

- § **Proportional or Compensation mode-** In this mode, General lift over the Base rail is generally fixed and smoothening action takes place. Longitudinal level and Cross-level are not completely corrected and the Machine leaves some error. Only short wave defects are removed. **Details are given in Annexure-I.**
- § **Design or Precision mode-** In this mode instead of General lift, the target heights are fed over the Base Rail to rectify 100% error. All long wave and short wave defects are fully removed. **This PCE Circular is to enrich knowledge of Design Levelling.**

- Levelling and Lifting System** consists of two chord wires one for each rail, stretched tightly from Front tower (F) to Rear tower (R). Tamping machines rectify level defects in track by lifting it with reference to these levelling chords. Height Transducers are mounted on Middle feeler rods (M), which rest on track at the place where tamping is actually done and these are also lifted when the track is lifted. Both rails are controlled separately. For Cross-level/Super-elevation correction, Pendulums (P) are provided. Only CSM & 3x are designed for twist correction also. Schematic diagram is given below:



- Height transducers provided on Middle feeler rod measures the gap between its zero level and chord wire. Base rail is lifted to eliminate this gap and other rail is lifted to bring specified cant between two rails, which is kept zero in straight track and a certain value on curved track. Values of unevenness and cant are fed through potentiometers.



R = Rear measuring point M = Measuring & correction point F = Front measuring point

- In levelling process, front tower always remains on unlevelled track and rear tower on levelled track. Because of level defects in track at front trolley, front end of the chord goes out

of its correct position equal to level offset at that point. Due to incorrect position of the front end of chord proportional level error remains after levelling.

- Thus, the leveled track at M is having
Level error = $LF \cdot a / (a+b) = LF / r$, where **LF = Level offset at front tower &**
r = Reduction Ratio = $(a+b)/a$

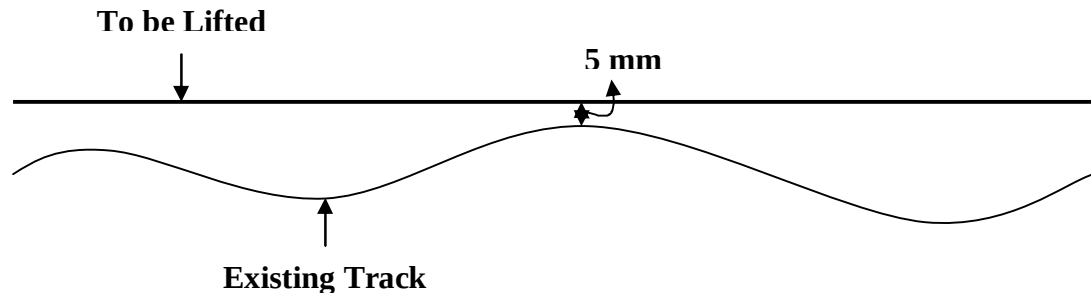
- Bogie Distances and Reduction Ratio for different machines are as under:**

Bogie Distance (m)	UNO/DUO	UNI-2S	UNI-3S	O9-CSM	MP-2000	09-3X
RM (a)	4.04	3.32	4.85	3.90	5.10	4.56
MF (b)	9.64	8.89	10.73	8.90	9.05	10.67
RF (a+b)	13.68	12.21	15.58	12.80	14.15	15.23
Reduction Ratio (r)	3.326	3.678	3.212	3.232	2.775	3.333

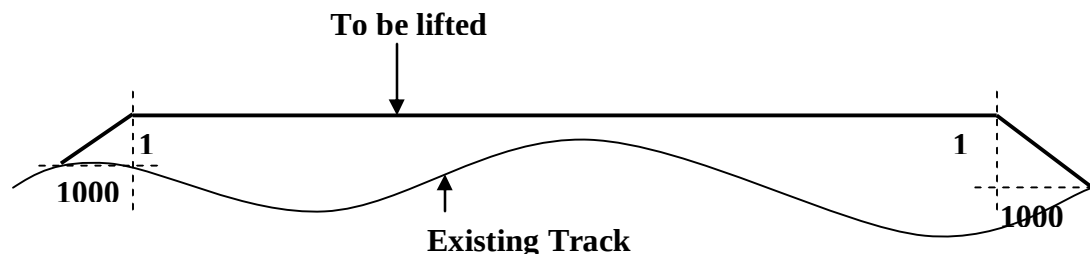
- In Design levelling, this error is eliminated by raising or lowering front end of the chord equal to level offset at that point. In CSM, UNIMAT and 3x, chord wire is not physically shifted but electronic signals are relayed through microprocessor to leveling unit and track is lifted accordingly.**

General Lift: The amount of lift, which is given to track while tamping to cover all undulations over the Base Rail, is called General Lift. It is decided on the magnitude of the dips/peaks generally available in the track. General Lift should always be more than the largest of dips which shall be ascertained by P.Way supervisor in advance.

- § It is given to the Base Rail. **General Lift is the algebraic difference of higher and lower point of Base rail + 5mm. At one time, General Lift value should not exceed 50 mm. If more than 50 mm lift is required, it can be achieved by lifting two times.**



- § While giving the General Lift, ramp in of 1:1000 and also while closing the work ramp out of 1:1000 should be given to the track for smooth transition.

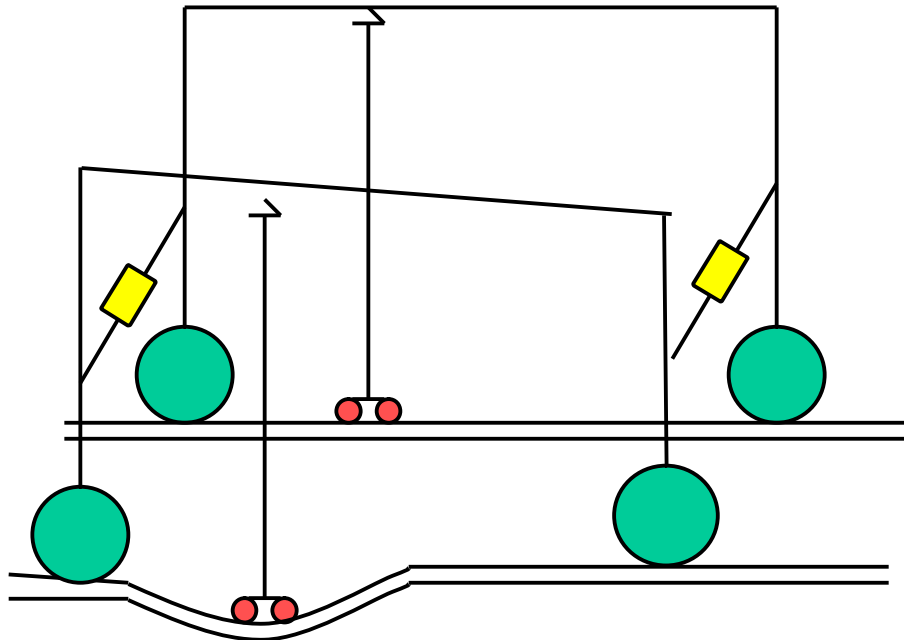


- § For Curves, when the existing Super-elevation (SE) is less than equilibrium SE, General Lift will be equal to track irregularities over the Base Rail (Inner Rail + 5mm) and when the existing SE is more than equilibrium SE, General Lift will be the track irregularities in the Base Rail + max difference between existing and equilibrium SE.

Base Rail: For carrying out attention to longitudinal profile, one rail is kept as Base or Datum Rail. Machine corrects Cross-level w.r.t. Base Rail, which should be selected as under:

- § On straight track in single line and middle track in multiple lines, **higher/less disturbed rail** is kept as Base Rail.
- § On straight track in double line, **non-cess rail** is kept as Base Rail.
- § On curves, **inner-rail** is kept as Base Rail.
- § In Plasser Tamper, direction of Cant Selector Switch is to be always kept opposite to the Base Rail.

In Russian Tamper, Base Selector Switch is provided for selecting Base Rail.

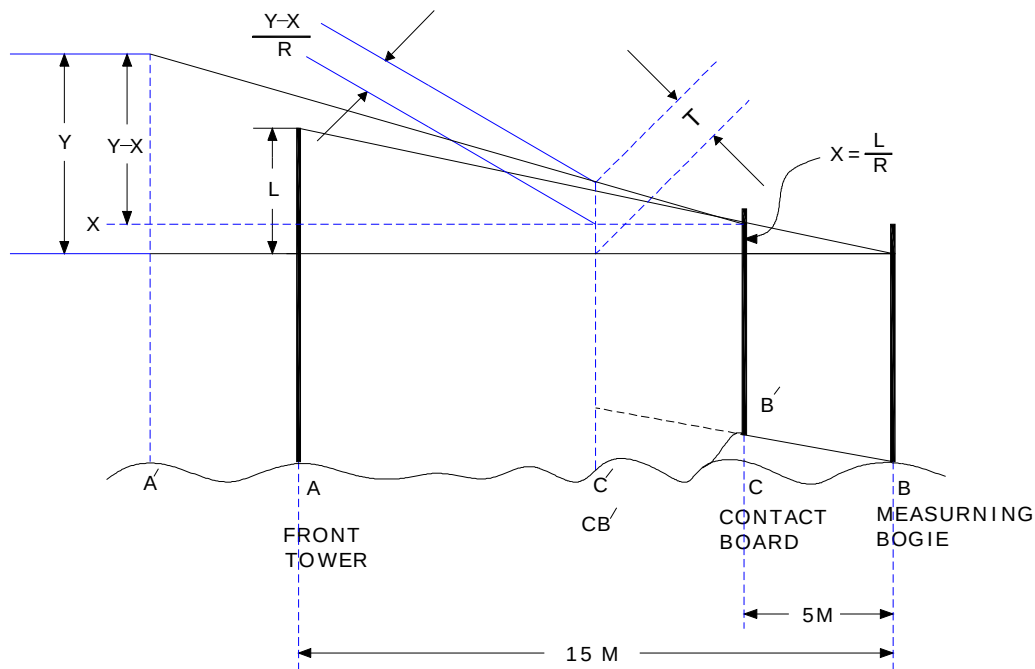


SUB DISCIPLINE – WORKING PRINCIPLE (LESSONS – 02 SESSIONS - 08)

Lesson-II: Leveling

Session-35: Double chord follow up system & fixed chord system, Proportional leveling, Error reduction ratio, Method of feeding of Cant on CSM, Method of feeding of Cant on other machines

RUN IN RAMP



(DIMENSIONS HAVE BEEN ASSUMED IN THIS EXAMPLE)

$$\frac{AB}{CB} = R$$

$$\frac{L}{X} = \frac{AB}{CB} = R$$

$$X = \frac{L}{R}$$

AS THIS MACHINE MAX. AHEAD TO NEXT POSITION
AND SUPPOSE A TOTAL LIFT OF 'Y'
HAS BEEN GIVEN ON FRONT TOWER,
TOTAL ACTUAL LIFT AT C.B. OR T.U. CAN BE WRITTEN.

$$T = X + \frac{Y-X}{R}$$

T = TOTAL LIFT AT A PARTICULAR SLEEPER

X = ACTUAL LIFT ACHIVED ON PREVIOUS SLEEPER

Y = LIFT GIVEN TO FRONT TOWER AT THAT POINT

R = RATIO OF DISTANCE

PROPORTIONAL LEVELLING SYSTEM

The tamping machines with non-displaceable front end of the leveling chords are equipped with a proportional levelling and lifting system for measuring and correcting the track geometry.

1. Measuring of the Longitudinal Profile:

1.1 The track is measured at three locations per rail:

- At the front of the machine (location “F”) for determination of the actual level and the front measuring reference point.
- In the area of the tamping units (location “M”) for the proportional control of the hydraulic track lifting system.
- At the rear of the tamping units (location “R”) on the already corrected track for determination of the rear measuring reference point.

1.2 A chord is stretched above each rail between the reference points “F” and “R” which forms two, independent from each other, measuring references for the longitudinal level.

1.3 Measuring transducers are mounted on the feeler rod of the centre measuring device. The control arms of the transducer are connected with the leveling chord. Proportional to the level of the track at point “M” the measuring transducers send electronic signals for the automatic control of the track lifting servo hydraulic system.

2. Measuring of the Cross Level:

At the measuring points “F” and “M” the cross level is measured by means of pendulums.

2.1 The difference between the THEORETICAL and the measured ACTUAL cross level at the front measuring point “F” is automatically transmitted to the lifting adjustment, corresponding to the side.

2.2 During the lifting and tamping operation the cross level is checked at the centre measuring point “M” (in the area of the tamping units).

2.3 The measuring of the cross level at the rear measuring point “R” (optional) serves several functions:

- a) Checking the cross level of the track which has been lifted and tamped immediately beforehand.
- b) Recording of the cross level by means of an electronic recorder.

3. Input of the Lifting Values: The adjustment of the track lifting takes place at the front reference point “F” and is automatically and in the right proportion transmitted to the cut off points of the measuring transducer mounted on the centre measuring device “M”. The leveling system may be used for the following methods:

3.1 Compensating method:

Without having the track surveyed, a required lifting value is selected. Existing longitudinal errors are reduced and the cross level errors are eliminated.

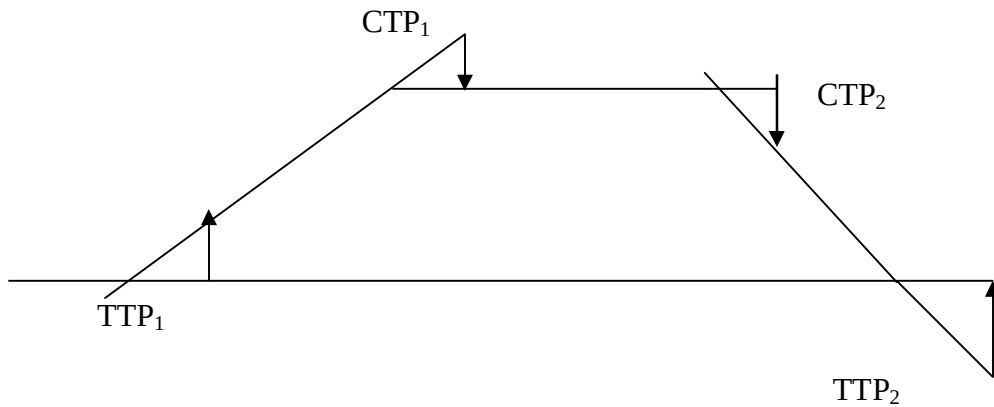
3.2 Precision method:

The track has to be surveyed beforehand and the lifting values of one rail are marked on the sleepers. During work the lifting values are set manually.

ERROR REDUCITON:

S. No.	Dist	08 DUO/UNO	08 UNI-2S	08 UNI-3S	09 CSM	MP-2000
1	Reduction Ratio	3.326	3.678	3.212	3.232	2.775

METHOD OF FEEDING OF CANT ON CSM: FEEDING OF CANT. VALUE IN CURVE:

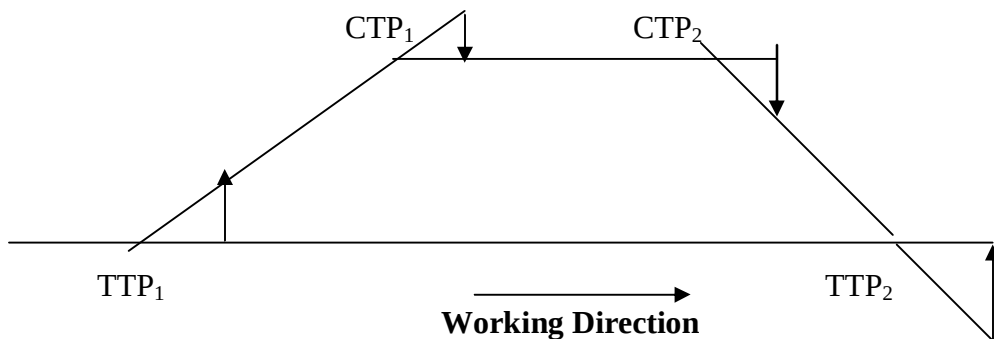


- JE/P.Way will write down cant value of curve on the sleeper near inside rail seat of outer rail.
- Total cant value should be distributed through out the transition length in such a way that it is Zero at TP & Max. at CTP.
- Generally when the tamping machine enters into the transition position, the machine operator start feeding cant value according to the value written on the sleeper.
- In front cabin cant potentiometer is not provided, hence operator will not feed the value.
- Once machine completed entered into transition, the cant value which is written on the sleeper at measuring bogie is feeded.
- Similarly when front cabin reached at CTP1 the remaining bogie is stile in transition portion i.e. working has not reached at full cant value.
- Similarly when machine reached at CTP2 suddenly the cant value will be reduced to the value till TTP2 as per written on the sleeper when the front tower reached at TTP2 then although the reaching of cant value digital reached at zero but reduced it in ergative till measuring bogie reached at TTP2. no raise the cant value equal to zero.

.METHOD OF FEEDING OF CANT ON OTHER MACHINES:

METHOD OF FEEDING OF CANT ON OTHER MACHINES:

Feeding of Cant Value in Curve:



- In all tamping machines, generally there are two digital potentiometers for feeding the Cant value, one at front tower and another at working cabin except CSM in which there is only one potentiometer in working cabin.
- Cant value is written by JE/P.way on the sleeper near inside rail seat of outer rail.

- Total cant value should be distributed through out the transition length in such a way that it is Zero at TTP and Max. at CTP.
- ***There is incorrect practice of feeding of Cant value wrongly in the field i.e. when tamping machine enters into the transition portion, the operator in the front cabin starts feeding cant value according to the value written on the sleeper. As soon as cant value is fed in front cabin when it is at TTP, the lifting starts and cant rail is also lifted. Since, lifting is not required till measuring trolley reaches over TTP, it creates hump.***
- So the operator of front cabin should not feed any cant value till the working cabin reaches over TTP. Thereafter, whatever value is written on the sleeper in front of the front cabin should be fed by the operator in the front cabin.
- When front cabin reaches at CTP₁, the working cabin is still in transition portion i.e. it has not reached at full cant value. The operator in the front cabin should keep on feeding the Cant value at the same rate till the working cabin reaches at CTP₁. Thereafter, the operator in the front cabin should instantaneously reduce the Cant value to Max. Cant written on the sleeper.
- Similarly when the front cabin reaches at CTP₂, the cant value should be kept as Max. Cant till the working cabin reaches at CTP₂, when suddenly the cant value is reduced to the value as written on the sleeper in front of the front cabin.
- When the front cabin reaches at TTP₂, although the cant value becomes zero at TTP₂, but the cant value should be fed at the same rate by changing the direction of the toggle switch i.e. negative cant value is fed, till working cabin reaches at TTP₂, when suddenly the cant value is brought to zero.

LINE – WORKING PRINCIPLE (LESSONS – 02 SESSIONS - 08)

Lesson-II: Leveling **Session-36:** Function of Pendulum- Front, Middle, Rear Pendulum & Twist correction, Method of data feeding on Tamping Machines - Manually and by Computer (GVA&ALC)

There are three pendulums used in CSM and CSM -3X , in other tamping machines only two pendulums are used .

Front Pendulum: This pendulum is mounted on front trolley . It measures cross level of front area before tamping.

Middle Pendulum : This pendulum is mounted on middle feeler rod . It measures cross level of tamping area .

Rear Pendulum : This pendulum is mounted on measuring trolley . It measures cross level after tamping . This pendulum participates in twist correction.

METHOD OF DATA FEEDING ON TAMPING MACHINES(MANUALLY):

GENERAL LIFT: The value of general lift is decided by survey i.e. peak value plus 5 mm. This value is fed in general lift potentiometer in one to thousand ratio. In case of design mode target height is feeded in place of general lift.

SUPER ELEVATION: The value of cant is zero for the straight track. But cant value is feeded in super elevation potentiometer whatever retain on the track on the circular curve this is constant but in case of transition this value varies. The cant value is retain on the sleeper of the track on the outer side.

GEOMETRY VALUE ASSESSMENT (GVA):

It is a small computer which eliminates the feeding of adjustment values from tables and marking on sleepers. The locations of main points of curve i.e. starting of transition, end of transition, transition length, radius, super elevation and vertical curve data etc are fed into the computer.

The attention of the Operator is not distracted by adjustment operation, mistake in calculation is avoided and therefore, the higher progress is achieved with improved quality.

AUTOMATIC GUIDING COMPUTER (ALC): The system have two modes, (i) geometry mode and (ii) measuring mode

In geometry mode parameter of curve is feed in computer ALC. WinALC software draw the curve as per parameters on screen then curve is corrected accordingly.

In measuring mode the parameters are measured first then mean value of each parameters i.e. versine, longitudinal level are taken and displayed by the computer. The correction is done by the computer as percentage of correction is fed by operator by seeing the position of the track after the correction. This is almost same to the design mode.

SUB: P.WAY, ESTABLISHMENT, ACCOUNTS, STORES & RAJBHASHA

Duration: 36 Sessions = 72 Periods

Sub Discipline -Track Technology (Lessons: 13 Sessions: 26)

Lesson-I: Introduction to Railway Organization **Session-1:** History of Railways, Zonal Railways Divisions, Production Units

History of Railways and General Features :

History of Railways:

Development of railways is closely linked with the growth of civilization of mankind. In 15th century stone slabs or wooden baulks were laid flush with the road surface for carriage of heavy goods loaded on carts and drawn by animal. These were called “Tram ways”. These Tram ways were extensively used in 16th century in mines in central Europe for carriage of coal and other minerals.

The timber bulks were replaced by iron plates to reduce wear and these were called ‘Plate ways’. These iron plates were also substituted in course of time by angle irons to give lateral support or better safety. The present railway track is a gradual evolution from these ‘Plate ways.’

The first public railway in the world was opened to traffic on 27th September, 1825, when the first train made its maiden journey between Stockton and Darlington in U.K.

The maiden trip on Indian Soil of the first train consisting of one steam engine and 4 coaches was made on 16th April 1853, when it traversed a 21 mile stretch between Bombay and Thana in 1.25 hours time. Starting from this humble beginning, the Indian Railways system has grown up today into a giant net work consisting of 63221 route Kms.

The Indian Railways run about 13.000 trains every day, serving about 7.031 railway stations and carry about 5112 million passengers and about 581 million tonnes of goods traffic in a year. For moving this traffic, the Indian Railways deploy about 1441.000 (14.41lakh) employees and maintain 7,817 locomotives consisting.

Railway Board:

The responsibility of the administration and management of the Indian Railways rests with the Railway Board under the overall supervision of the minister for railways. The Railway Board consists of Chairman, financial commissioner for railways and five other functional members.

The other members of the railway Board are separately incharge of matters relating to staff, Civil Engg., Traffic, Mechanical Engg. & Electrical Engg. They function as ex-officio secretaries to the Government of India. The board members are assisted by additional members, executive directors & directors.

Zonal Railways:

The entire railway system has been divided into 16 zones. Zonal headquarters of each railway are given as below:

S. No.	Railway	Zonal Headquarters.
1	Central Railway	Mumbai V.T.
2	Eastern Railway	Colcutta
3	East Central Railway	Hazipur
4	East Coast Railway	Bhubneshwar
5	Northern Railway	New Delhi
6	North Central Railway	Allahabad
7	North Eastern Railway	Gorakhpur
8	North Frontier Railway	Maligaon (Guwahati)
9	North Western Railway	Jaipur
10	Southern Railway	Chennai
11	South Central Railway	Secunderabad
12	South Eastern Railway	Colcutta
13	South East Central Railway	Bilaspur
14	South Western Railway	Banglore (Hubli)

	Western Railway	Mumbai Churchgate
16	West Central Railway	Jabalpur

Production Units:

Apart from Zonal Railways there are six production units as given below:

S. No.	Name of Unit	Headquarters	Functions
1.	Chittranjan Locomotive Works (CLW)	Chittranjan	Manufacture of Electric Locomotives
2.	Diesel Locomotive Works (DLW)	Varanasi	Manufacture of Diesel Locomotives.
3.	Integral Coach Factory (ICF)	Parambur	Manufacture of Coaches
4	Diesel Component Works (DCW)	Patiala	Manufacture of Diesel components
5	Rail Coach Factory (RCF)	Kapurthala	Manufacture of Coaches
6.	Wheel& Axle Plant (W&AP)	Bangalore	Manufacture of Wheel & Axles

Divisions:

Zonal Railways work on divisional system. Each division has around 800 to 1500kms of track. There are 67 divisions on Indian railways. Each division works under the overall Control of Divisional Railway Manager (DRM) who is assisted by ADRM. In Engineering the division is headed by Sr. Divisional Engineer(C) and he is assisted by Sr.DEN/DENs. Each Sr. DEN/DEN is incharge of around 1100 ITKM & has 2-3 ADENS to assist him in maintenance of P. Way & Works. Zonewise break up of divisions over Indian Railways is listed as below:

S. No.	Railway	Division	S. No.	Railway	Division
1.	Central Railway	Mumbai Bhusaval Nagpur Pune Solapur	2.	Eastern Railway	Howrah Asansol Malda Sealdah
3.	East Central Railway	Danapur Dhanbad Mugalsarai Sanastupur Sonpur	4.	East Coast Railway	Khurda Road Sambalpur Waltair
5.	Northern Railway	Delhi Ferozpur Ambala Moradabad Lucknow	6	North Central Railway	Allahabad Agra Jhansi
7	North Eastern Railway	Izzatnagar Lucknow City Varanasi	8	North Frontier Railway	Alipurduar Katihar Lumding Rangia

					Tinsukia
9	North Western Railway	Jaipur Ajmer Bikaner Jodhpur	10	Southern Railway	Chennai Madurai Palghat Truchechirapalli Trivendrum
11	South Central Railway	Secunderabad Hyderabad Guntkal Guntur Nanded Vijayawada	12	South Eastern Railway	Adra Chakradharpur Kharagpur Ranchi
13	South East Central Railway	Bilaspur Nagpur Raipur	14	South Western Railway	Hubli Bangalore Mysore
15	Western Railway	Mumbai Vadodara Ratlam Ahamedabad Rajkot Bhavnagar	16	West Central Railway	Jabalpur Bhopal Kota