

7. MAINTENANCE DEPOT AND WORKSHOP

7.1 INTRODUCTION

The Panvel-Virar Suburban corridor would require a dedicated Depot cum workshop facility for the maintenance of the rakes. The total coach holding would increase to about 576 i.e. 48 Rakes of 12 car in the horizon year 2041 to meet the traffic demand. All the rakes will be serviced at main Depot cum workshop for the scheduled inspections, major schedules viz Periodical overhaul (POH) and major unscheduled repairs. The main depot will also house Operation Control Centre (OCC), Administrative Building, maintenance facilities for Civil – track, buildings, water supply; Electrical – traction, E&M; Signalling & Telecomm.; etc. apart from necessary facilities viz stabling lines, scheduled inspection lines, workshop for overhaul, unscheduled maintenance including major repairs, wheel profiling, heavy interior/under frame/roof cleaning etc. for the rolling stock operational on the corridor.

For starting the morning services, some rakes will have to be kept at terminal stations and stabling facilities for the remaining rakes will have to be provided at the depots.

All the systems at the depot would be designed to cater for 12 Car composition trains in order to serve the ultimate passenger traffic on Panvel-Virar suburban corridor.

This chapter covers following aspects of depot -

- Conceptual design of Stabling lines, Inspection Shed and Workshop to provide maintenance facilities and stabling facilities for the Rolling Stock.
- Operational and functional safety requirements.
- Ancillary buildings for other maintenance facilities.
- Electrical & Mechanical Services, power supply system etc.
- Location for Depot cum Workshop

This section provides conceptual design of the depot and will only work as a guide for the detailed design later.

7.2 MAINTENANCE PHILOSOPHY

The main outlines of the maintenance philosophy followed are:



- Monitoring of the performance of equipment by condition monitoring of key parameters. The concept is to progressively evolve the need based maintenance regime, which can be suitably configured in the form of minor & major schedules.
- Unit replacement and to get essential repairs done by the OEMs, will be preferred. Since the cost is a constraint, certain activities of the workshop can be outsourced.
- Labour intensive procedures be kept to the minimum & emphasis laid on more automation with state of the art machinery to ensure quality with reliability.
- Multi skilling of the Maintenance staff to ensure quality and productivity in their performance.
- Energy conservation shall be given due attention

7.3 PLANNING OF THE MAINTENANCE FACILITIES SETUP

The projected Rolling Stock requirements for the corridor are as follows:

Table 7.1

Year	2021	2026	2031	2041	Designed
Headway (minutes)	15	12	8	5	3
No of Cars/Train	12	12	12	12	12
Rakes Required	19	21	33	48	78
Coaches Required	228	252	396	576	936

The operation plan envisages 12-car rakes operation at 15 minutes headway in the inception year 2021, requiring total 228 coaches (19 Rakes of 12 car each). The services increase to 5 minutes headway in the horizon year 2041, requiring total 576 coaches (48 Rakes of 12 car each) as the traffic demand grows.

7.4 ROLLING STOCK MAINTENANCE NEEDS

The servicing requirement is to be determined from the Rolling Stock manufacturer. Depending upon manufacturer's requirements, servicing facilities may be provided to include the ability to carry out the inspection, maintenance, overhaul and repair of the rolling stock fleet, including the following components:

- Body;
- Bogies;
- Wheels;
- Traction motors;



- Electrical components;
- Electronics; PA/ PIS
- Mechanical components;
- Batteries;
- Rolling stock air conditioning;
- Brake modules;
- Vehicle doors, windows and internal fittings.

The modern, fully equipped facilities are proposed to be provided to meet these requirements efficiently and in full. In meeting these requirements, it is envisaged that the average daily distance travelled by each rolling stock unit is approximately **650 km**.

The following maintenance schedule recommended by RDSO in Para (k) of SMI no. RDSO/PE/SMI/EMU/0037-2007(rev.0) dated April-2007, has been followed for conceptual design -

Table 7.2: Periodicity of Maintenance Schedules for Rakes

Schedule	Periodicity	
	As per SMI	With 10 days frequency
Trip Schedule (TI)	10 days	10 days
IA Inspection	45 days	40-50 days
IC Inspection	180 days	180-190 days
POH	18 months	18 months (540 days)

7.5 WASHING NEEDS OF ROLLING STOCK

To maintain high degree of cleanliness, following schedules (**Table 7.2**) are proposed for cleaning of rakes.

Table 7.3: Schedule of Cleaning

S. No	Kind of Inspection	Maint. Cycle	Time	Maintenance Place
1.	Outside Cleaning (wet washing on automatic washing plant)	3 Days	10 mins	Automatic washing plant of Depot Single Pass
2.	Outside heavy Cleaning (wet washing on automatic washing	30 days	3 Hrs	Automatic washing Plant & heavy cleaning



	plant and Front Face, Vestibule/ Buffer area, Floor, walls inside/ outside and roof Manually)			on nominated stabling line
--	---	--	--	-------------------------------

7.6 DEPOT CUM WORKSHOP

The layout plans of proposed Main Depot cum Workshop will be evolved for maintenance & POH of 93 Rakes of 12 car length. The concept plan will include following operational features.

7.7 OPERATION FEATURES

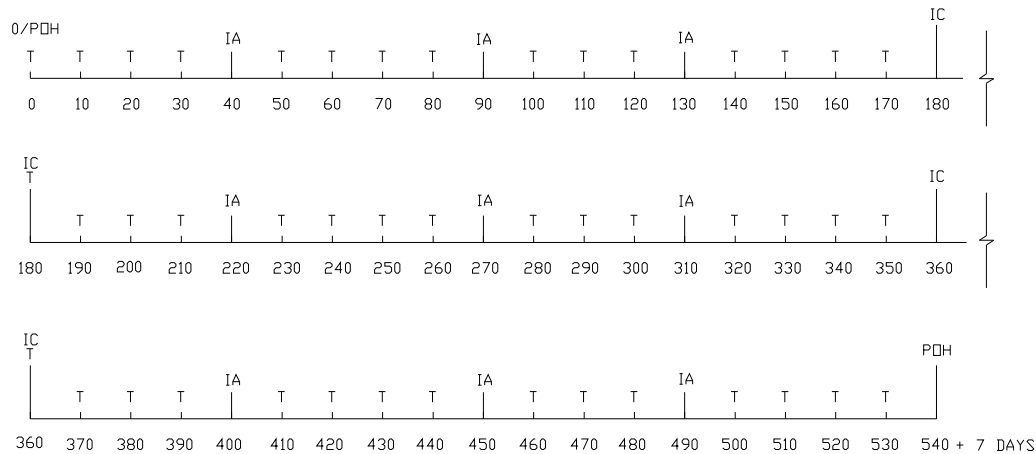
The rake induction and withdrawal from depot to the open line will have to be so planned that the headway of open line is not affected. For the purpose, facilities for simultaneous receipt and dispatch of trains from depot to open line should be created. The stabling area should be interlocked with the open line so that the induction of train from the stabling can be done without loss of time. The rake washing can be done at automatic coach washing plant provided at the entry of depot i.e before rake is placed on stabling lines.

The other movements in the depot, viz from the stabling to the inspection shed or workshop and vice versa may be non-interlocked. An ART line and 2 emergency re-railing lines will be provided from which emergency rescue vehicles can be dispatched to open line in the event of any emergency. To cater to the peak requirements, all trains except trains under maintenance would be in the service. However during the off-peak hour in daytime, approximately half of the trains will be withdrawn from the service. There would be pathways between the stabling lines, which are necessary for the “Safe to Run” examination and to facilitate the workers to move trolleys for the sweeping work. The scheduled inspections are envisaged to carry out during the day off-peak hours and night.

The stabling and the yard layout would be at grade level for least power requirements in shunting movements and to avoid accidental rolling of Rolling Stock resulting into accidents and damages to the property.

7.8 INFRASTRUCTURE FACILITIES PLANNED AT DEPOT

The schedule sequence for rakes with 10 days frequencies of inspection will be as given below:



As per the above frequency of inspections, the visits of rakes to car sheds are as given in **Table 7.4** below:

Table 7.4: Rake Visit periodicity for Depot

Rake visits to car shed/depot		
Schedule	Total visits in 18 months	Average visits per year
TI	43*	28.667
IA	9	6
IC	2	1.333
POH	1	0.667

*includes one additional inspection in car shed after POH in workshop

Assumptions: To assess the number of lines required to maintain the rakes, following assumptions are made:

For Washing of rakes, an automatic washing plant will be proposed. Hence no separate washing line is needed exclusively for washing. However, one line will be provided for heavy cleaning (Manual cleaning of Floor, walls inside/outside and roof).

In a day, two rakes are taken for Trip Inspection on a pit line.

In a day, one rake is taken for IA schedule on a pit line.

Pit line occupancy for IC schedule (Down time 16 hrs) is taken for two days.

Based on the number of holidays as given below, total number of working days is taken as 300 for calculating the requirement of lines.

- No. of days of Public holidays in a year : 13
- No. of Sundays in a year : 52
- No. of available working days in a year : 365 - 65 = 300 days

Table 7.5: Total requirement of Maintenance Lines in Depot

Schedule	Schedule per rake per Year	Total Arising per day for designed holding of 78 of 12 car	Rakes attended on a line / day	Number of lines needed	Lines required (roundoff)
Trip Insp.	28.67	7.45	2	3.73	3
IA	6	1.56	1	1.56	1
IC	1.33	0.35	0.5	0.69	1
Add for unscheduled shed attention & adjustment/shunting etc.					1
Total no of lines needed in Inspection shed					6
Similarly lines needed for Workshop Activities					
Schedule	Schedule per rake per Year	Total Arising per year for designed holding of 78 of 12 car	Time taken in over haul	Number of lines needed	Lines required (roundoff)
POH	0.667	52.03	24	2.17	2
Add for unscheduled major Repairs /Lifting & adjustment/shunting etc.					2
Total no of lines needed in Workshop					4
Total Lines needed in Depot for Maintenance					10

All lines in workshop to be provided with lifting facility

7.9 LINES FOR STABLING OF RAKES

There will be a holding of 48 rakes of 12-Car in year 2041, and elaborate arrangement for stabling of these rakes will have to be done in depot cum workshop, terminal stations and at few places enroute the section.

The train operation plan envisages operation with 12-Car composition in the inception year itself in year 2021. Accordingly, all the infra structure facilities has been provided for 12-Car length and stabling lines are also provided for 12 car length and accommodate trains as detailed in Table 7.6 below:

Table 7.6: Stabling Line Provisions of 12-car length

Year	2021	2031	2041
Stabling lines at the terminal station for morning & evening peak period services	4	4	4
En-route Stabling lines at convenient location such as Bhivandi Road or/and Taloje or/and Kalamboli	-----	9	20
Rakes to be stabled in the Depot	15	20	24



Total Stabling Lines of 12 car length	19	33	48
---------------------------------------	----	----	----

Twenty five (24) number of 12-car length-stabling lines, Five (5) number of inspection lines and Five (5) number of workshop lines will have to be provided in the main depot. For starting the morning services, it will be necessary to stable the rakes at the terminal station & suitable sidings enroute as indicated above.

Design of Stabling Lines

The length of 12 cars Rolling Stock is approx 252 m Stabling lines are designed for 278 m length or more to cater for provision of the friction buffer stops and the signaling/interlocking needs - assuming the speed of the Rolling Stock in the depot to be 15 kmph. The breakup is as follows:

252 m (length of 12 car Rolling Stock) + 15 m (length of the Buffer for 12 car Rolling Stock & signaling / interlocking needs) + 1m (clear distance between Rolling Stock & buffer) + 10 m (clearance between three 4 car trains running initially) = **278 m**.

Accordingly, stabling lines as well as inspection & workshop lines be designed for 280 m length. The track centre in stabling lines would be 4.9~5.3m and in inspection lines 6.25~8.5m. Thus, sufficient space shall be provided to construct pathway in stabling area and in inspection shed to provide easy access for internal train cleaning / attention to equipments in passenger area.

7.10 POWER SUPPLIES

An auxiliary substation of 2X3000 KVA capacities has been planned for catering to the power supply requirement of the main depot. Details of connected load, feeder may be worked out during detailed designing stage.

7.11 STANDBY POWER SUPPLY

The standby power supply will be proposed through silent DG set of 3X320 KVA capacities to supply all essential loads without over loading.

7.12 WATER SUPPLY, SEWERAGE AND DRAINAGE WORKS

In-house facilities should be developed for water supply for the entire depot cum workshop. Sewerage, storm water drainage may be given due care while designing the depot for efficient system functioning. Rainwater harvesting should be given due emphasis to charge the underground reserves.

7.13 ENGINEERING TRAIN UNIT WORKSHOP

Since the workshop cum depot is designed optimally, it would not be wise to waste its capacity in maintaining the other than passenger Rolling Stock vehicles. Carrying these vehicles to the inspection shed affects the RS maintenance as shunting is also involved. Therefore other vehicles like diesel locomotive, tower wagons, wagon for



material trains etc may be housed and given required inspection attention in a separate shed called ETU workshop, for which 2 lines shall be provided in the main depot. However for the heavy lifting needs, these vehicles may be taken to the area where such facilities are available.

7.14 PLANT AND MACHINERY

Requirement of major plants and machinery, which are vital for operational needs, is given in **Annexure-I**.

7.15 DEPOT LOCATIONS

The proposed Corridor would require a dedicated Depot cum Workshop (Main Depot) in the inception year 2021 itself. A plot of 34.8 hectare has been marked at Kalwar between Kalwar and Dunge station.

Car Depot Site requirements

The pre requisites of coach maintenance depot site are as under –

- i. A plot size of adequate area - about 34 Ha for main depot
- ii. Proximity to alignment: Site must be located as close to the alignment as possible so that no time is wasted in placement/retrieval of rakes from depot. In addition, it will save expenditure in constructing link from corridor to depot,
- iii. Ease of movement – there should not be any obstruction to movement of rakes in either direction so that defective rakes can be withdrawn from service & placed in depot for maintenance and healthy rakes can be retrieved from depot & pressed in service.
- iv. A store depot within car-depot premises is to be set up.

The conceptual layout plan of Depot with above infrastructure will be developed upon finalization of suitable location with adequate area for the depot.

Depending upon the type of rolling stock procured and recommendations of original equipment manufacturers of rolling stock and sub assemblies, exhaustive list of machinery and plants along with tool and tackles shall be prepared for procurement so as to develop healthy maintenance practices for reliable operation of the rolling stock. An indicative list of such items is given in **annexure I**.

For maintenance of OHE, PSI, signaling, Telecom, P-WAY, Works etc standard facilities as per practice in vogue shall be planned at the time of detailed project report. Special attention shall be however given for procurement of machinery and plants to introduce mechanized maintenance to reduce dependence on man power.

ANNEXURE-I

LIST OF MAJOR PLANT & MACHINERY FOR DEPOT

Sl no.	PLANT & MACHINERY	Qty.
A.	Material Handling	
1	Travelling over head EOT cranes for workshop 35/10T	2
2	Travelling over head EOT cranes for inspection bay 2.0T	2
3	Travelling over head EOT cranes for ETU shed 5T	1
4	Jib crane for workshop 3 T	2
5	Synchronized pit jacks system for lifting (3 cars as one set)	1
6	Car body stands for keeping car shells	32
7	Dummy bogies	6
8	Mobile lifting jacks-15T	2
9	Mobile lifting jacks 10T	2
10	Battery powered Electric locomotive	2
11	OHE Inspection car	2
12	Road mobile Crane 5T cap	1
13	Fork lift trucks 3T cap	2
14	Pallet trucks	4
15	Pick up van	1
16	TATA Truck	2
B.	Wheel shop	
17	500T Hydraulic wheel press	1
18	Vertical boring m/c / Turret Lathe for wheel machining	1
19	Multipurpose Wheel Lathe/CNC surface wheel lathe	1
20	CNC Axle turning lathe/Axle journal turning & burnishing lathe	1
21	Axle UST inspection machine	2
22	Induction Heater	2
23	Bearing Extractor	4
C.	Bogie shop	
24	Bosch Tank : Bogie wash/cleaning plant (manual)	1
25	Bogie static load testing m/c	1
26	Shock absorber testing m/c	1
27	Spring scragging & testing m/c	1



Sl no.	PLANT & MACHINERY	Qty.
28	Magnacheck crack detector	1
29	Glowcheck crack detector	1
D.	Rotating m/cs	
30	Air blow plant/Cleaning booth for Traction Motor	1
31	Baking Oven for traction motor drying	1
32	Dynamic balancing	1
E.	Other m/cs	
33	Under floor Pit wheel lathe, Chip crusher and conveyor, Electric tractor for movement over under floor wheel lathe	1
34	Bogie Drop Table	1
35	Automatic Washing plant for Metro cars.	1
36	High-pressure washing pump for front and rear end cleaning of cars	2
37	Turn table for one car	1
38	Turntable for bogies	6
39	Driving Cab Simulator	1
40	Water de-mineralizing plant (Distillation plant)	2
41	Painting booth for separate parts	1
42	Floor cleaning machine	5
43	Welding equipments (Mobile welding, oxyacettelene, fixed arc welding)	5
44	Compressor 500Cfm, 10 kg/sq.cm for depot air supply	2
45	DG set 320 KVA	3
46	EMU Battery charger	2
F.	Machine shop	
47	Guillotine Shearing m/c	1
48	Shearing, punching & cropping	1
49	Universal tool cutter & grinder	1
50	Vertical surface grinder	1
51	Centre lathe 2m bed	1
52	Centre lathe 1m bed	1
53	Radial drill m/c	1
G.	Test Benches/Instruments	
54	Traction motor test console	1



Sl no.	PLANT & MACHINERY	Qty.
55	Motor compressor test bench	1
56	Brake test bench	2
57	Speedometer test bench	2
58	Door test bench	2
59	Inverter test bench	1
60	Other test benches (MCB, RMPU etc.)	1
H.	Furniture/material storage/Small tools	
61	Vertical carousel storage system for DCOS store	1
62	Computer MMIS with LAN connectivity for depot	1
63	Storage racks	LS
64	Industrial furniture, work benches etc.	LS
65	Electric and pneumatic tools	LS
66	Measuring and testing equipments	LS
67	Tool kits	LS
68	Other small tools, machines & misc items etc	LS