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MAINTENANCE FACILITIES FOR TRAIN SET DEPOT

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PED/CAMTECH

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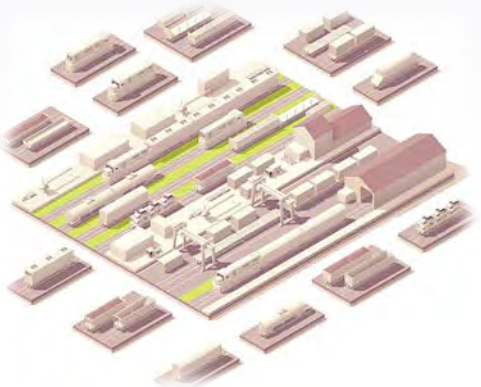
Introduction

- IR has planned to proliferate Semi High Speed Self Propelled trains sets on IR.

- The inherently world class design of the train sets requires state of the art maintenance facilities.



- CAMTECH was advised to prepare a standard LAYOUT for Train set maintenance depot and workshop along with standard list of M&P and Tools.

Train Maintrenance requirments

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Train Maintenance

- An essential ingredient in the successful running of a railway is a well maintained And Reliable system.

- Train maintenance is very important. The methods and systems used in modern train maintenance are outlined in this presentation.

Train Maintrenance requirments

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Background

- Railways are made up of complex mechanical and electrical systems.
- There are hundreds of thousands of moving parts.
- If a railway service is to be reliable and safe, the equipment must be kept in good working order and regular maintenance is the essential ingredient to achieve this.

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Background

- A railway will not survive for long as a viable operation if it is allowed to deteriorate and become unsafe because of lack of maintenance.

- Although maintenance is expensive, it will become more expensive to replace the failing equipment early in its life because maintenance has been neglected.

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Background

- Reliability is the key to successful railway operation and maintenance should be the number one priority to ensure safety and reliability is on-going.
- Line failure of a train adversely affect entire train operation with unmanageable delays.
- A major out of course repair will adversely affect train scheduling.

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Maintenance Facilities

- Trainsets require dedicated facilities for stabling, cleaning, maintenance and testing.
- The basic design of these facilities have changed little in the last 100 or more years and, in many cases, the original sites and buildings are still in daily use.
- Old layouts have made adapting to modern maintenance systems very difficult.

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Maintenance Facilities

- The layout of a maintenance facility or depot will consist of a stabling yard, a train cleaning area, an inspection and light maintenance shed, a heavy maintenance shop and, possibly, a separate locomotive shop or at least an area for locomotives if EMUs are the main service providers.

- A typical facility with space for EMUs, works trains and locomotives might look like Figure as shown below

Train Maintrenance requirments

Maintenance Facilities

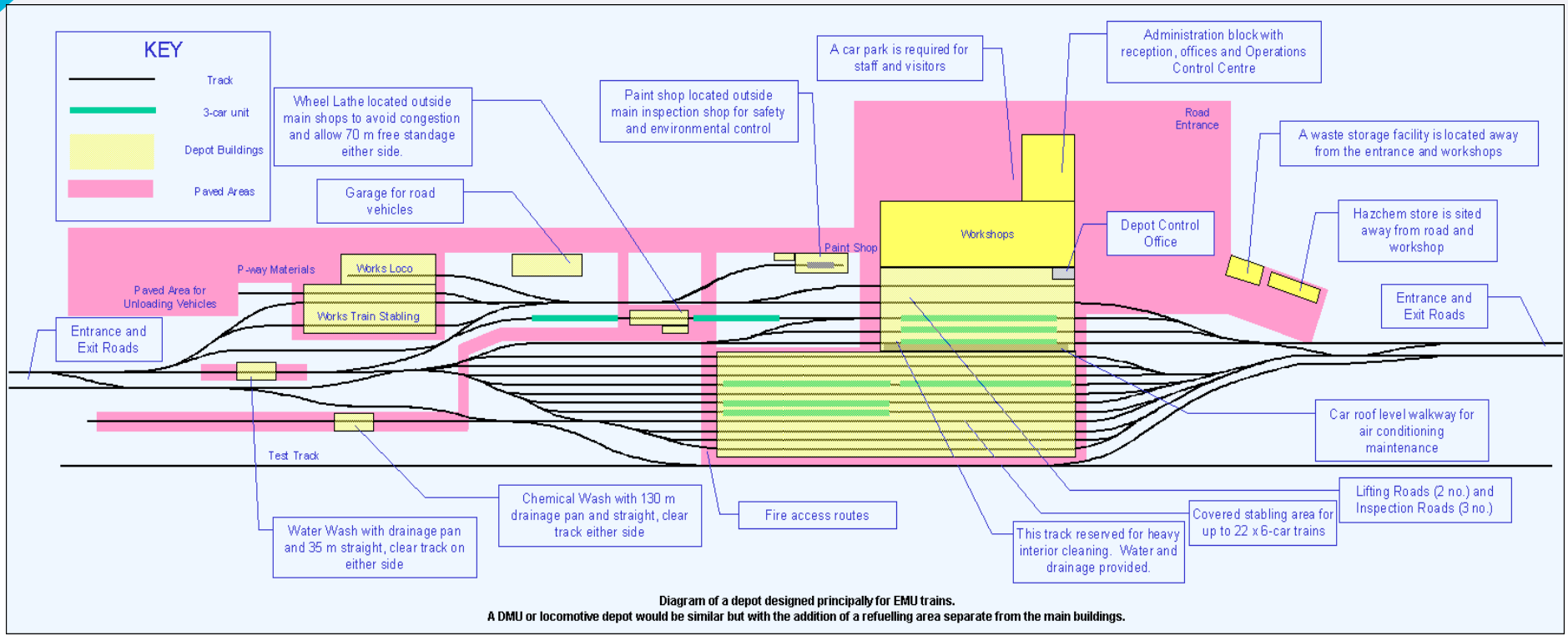

Diagram of a depot designed principally for EMU trains.
A DMU or locomotive depot would be similar but with the addition of a refuelling area separate from the main buildings.

Sample layout for a depot (not based on anywhere in particular) but using best practice and with Trainset/EMU operation in mind.

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Accessibility to Maintenance Depot

- An essential feature of any depot is good access, for both road and rail.
- So that trains can get in and out of the depot without delaying trains on the main line and without upsetting operations within the depot.
- Usually a long access track into (and out of) a depot is required, if space is available.
- With ATP (Automatic Train Protection) equipped system, the changeover between ATP and manual operation will probably have to take place on this track. This must be carefully incorporated into the depot track design.

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Accessibility to Maintenance Depot

- Road access is equally important. Large items of equipment may be needed to be delivered to the depot (transformers, pre-assembled traction units, Bogies) and space to allow heavy trucks to get into the depot.

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Cleaning and Stabling

- Regular exterior water wash and interior sweeping and dusting or vacuuming.
- Exterior washing by Automatic Train Washing Plant to wash the sides and the roof.
- At longer intervals, seating upholstery and carpets must be shampooed.
- Watering, power charging and toilet cleaning facility.
- Floor height walkways alongside or at least up to the first car.

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Cleaning and Stabling

- A train stabling area where a level access is provided for train crew and to allow equipment to be taken inside the train for interior cleaning.

- A sloping ramp is provided to allow access for the cleaning equipment cart.

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Cleaning and Stabling

- Train stabling areas are traditionally outdoors largely because of the expense of constructing large sheds.

- Covering the stabling areas with weather proof structure is always preferable. It protects the trains and the staff working on or around them and reduces contamination by pollutants, frost, snow and wind damage.

- Covered area in hot conditions=reduce air conditioning cost.

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Wheel Lathe

- Removing the wheels requires the train to be lifted - an expensive and very time-consuming. So, underfloor wheel lathe is essentially required.

- Modern wheel lathes can also reprofile a loose wheelset.

- Cutting has been the most common method of reprofiling but, recently milling machines, can offer a longer tool life and better tolerance control on diameters.
- Although it might seem obvious, the roundness of wheels is important, especially at very high speeds. An eccentric wheel can cause extreme loads on the wheel, axle, bearing and suspension, leading to failures.

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Underfloor Wheel Lathe

Some modern wheels lathes are designed to turn both wheelsets on a bogie at the same time.
These "double-headed" lathes have been developed as a result of electronically controlled AC motors.

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Wheel Lathe

- Removing the wheels requires the train to be lifted and this is an expensive business and very time-consuming.

- To avoid this, underfloor wheel lathe is essentially required.

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Inspection Shed

The rails are raised above floor level on posts to allow underfloor access with good light and air circulation.

Walkways are provided at floor level and, on the far side, at roof level to allow access to air conditioning and pantograph equipment.

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Lifting facilities

The traditional method for accessing bogies was to lift the coach body off the bogies by use of an overhead crane or cranes.

Useful in a factory environment where equipment manufactured in one shop has to be moved to another shop for completion or testing.

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Lifting facilities

- Jacks are the usual method of lifting nowadays. Vehicles can be lifted individually or, if a fixed formation is used for normal service, more recent practice has been to lift the whole train set. This is done by synchronised jacks.

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Lifting facilities

- To exchange a underslung equipment a fork lift truck can be used if there is enough room at the sides of the trains for it to manoeuvre.
- Otherwise a small scissors lift table can be used. In all cases, it is essential to ensure that the floor will take the weight of the train raised on jacks.

- Most modern rolling stock is designed to be lifted with bogies to exchange any underslung equipment on a lifted train without disturbing any other coaches.

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Lifting facilities

- Another system used is the bogie drop pit. The train is positioned so that the bogie to be removed is located over a special section of track. The bogie is disconnected from the train, using the pit for access. The section of track where the bogie is located is lowered into a basement area and the bogie removed and replaced by a fresh one.
- A variation -The train lifted by raising the sections of track under the bogies. The car bodies are supported by stands placed under them and the bogies to be changed are disconnected.

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Lifting facilities

Bogie drop table. The train is positioned over the table, the bogie is disconnected from the train, the vehicle having the bogie removed is supported and then the table is lowered, taking the bogie down.
The table design is basically a large scissors lift.

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Maintenance Scheduling

Rolling stock maintenance can be programmed in one of three ways;

- by mileage,
- by time or
- by conditioning monitoring.

Despite the use of computer-based data management systems, it is useful to provide a real-time wall mounted display to show the currently planned train maintenance programme. A wall mounted display allows rapid changes to the program to be made by the maintenance controller and for the information to be available as an immediate visual indication of the current position.

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Failures

- Reliability is the key to running a successful railway.
- If the equipment, especially the rolling stock, is not reliable, the railway is not workable.
- Keep track of performance and failures and ensure that problems are eliminated before they become endemic.

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Prediction of Failures

- Modern asset maintenance management should examine the potential risks of failures occurring in rolling stock using a failure mode, effects and criticality analysis (FMECA) approach.
- The most critical failure modes in the system with respect to both reliability and economic criteria need to reviewed, the levels of failure criticality determined and possible methods for mitigation provided.

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Prediction of Failures

- There is a useful paper, **"Risk Evaluation of Railway Rolling Stock Failures Using FMECA Technique: A Case Study of Passenger Door System"** by Dinmohammadi et al (2016), looks at the door system on the Class 380 trains operating on Scotland's railway network.
- The authors suggest that the results of this study can be used not only for assessing the performance of current maintenance practices but also to plan a cost- effective preventive maintenance (PM) programme for different components of rolling stock.

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Performance Measures

- Rolling stock performance in respect of failures can be measured by MTBF (Mean Time Between Failures) or MDBF (Mean Distance Between Failures).
- It is sometimes measured by numbers of failures/year, month or week but this may not represent an accurate rate consistent with mileage.
- Another measure applied to equipment is the MTTR (Mean Time To Repair).
- Short MTTR is another important part of good rolling stock performance.

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The Development of Train Maintenance regime

- The regular inspection of motive power, coaches and wagons and visual inspections was based on the need to ensure the good condition of the structure of the largely wooden bodies of the coaches and wagons and the integrity of the wheels, axles and braking systems.
- Wheels and axles were vulnerable to fracture and they were checked daily for visual signs of damage including Wheel tapping with a hammer to ensure a "ring" was heard.

Train Maintrenance requirments

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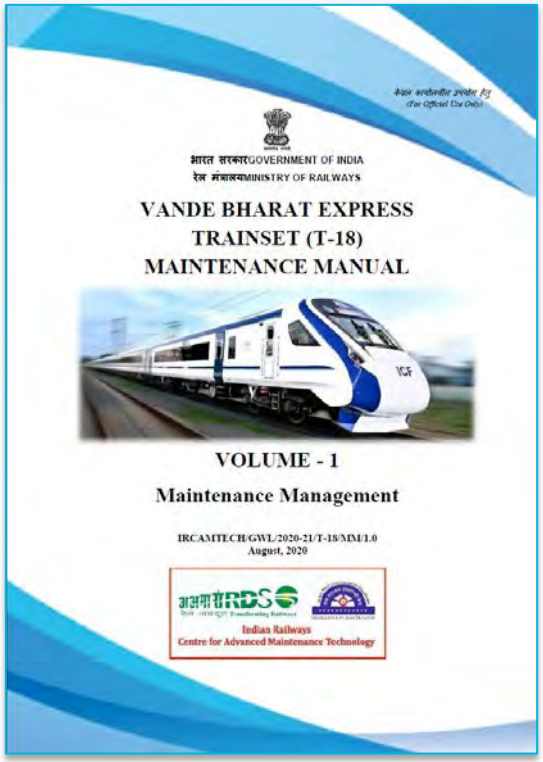
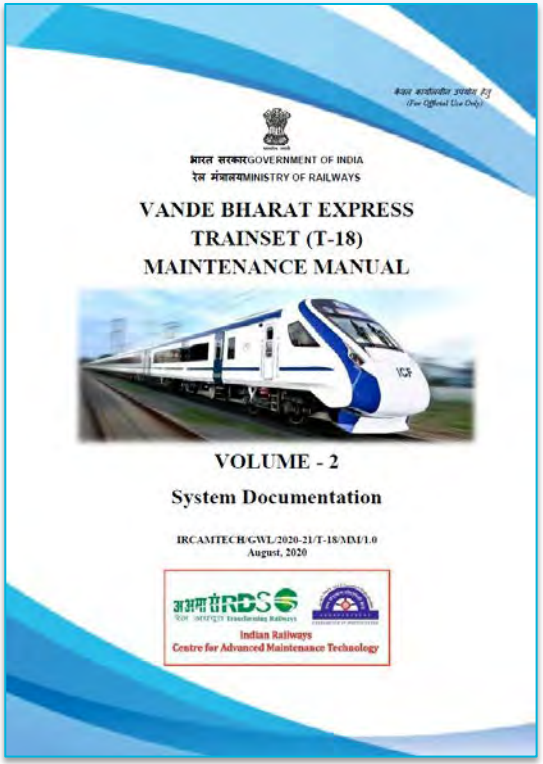
The Development of Train Maintenance regime

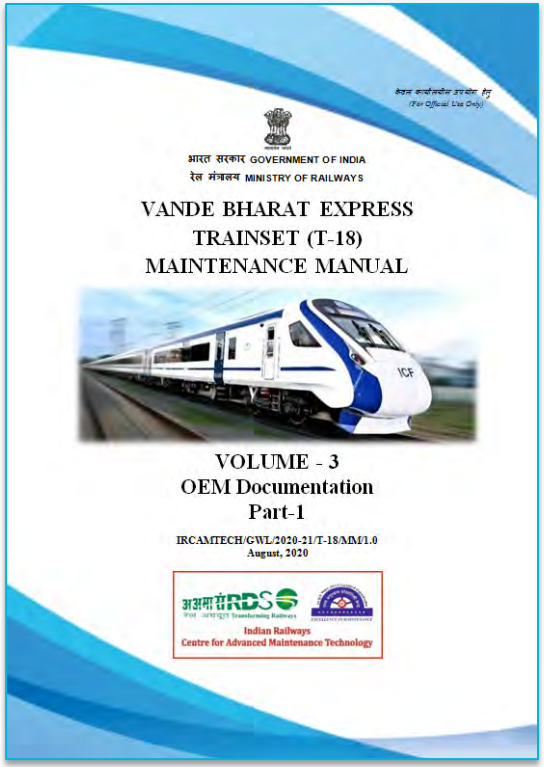
- Traditional visual inspections and manual checking with gauges world wide is now being replaced by automatic inspection systems that compare wheel profiles of vehicles passing through an inspection building with computer based data profiles.
- Trackside systems are used to monitor wheel behaviour, for bakes pads, discs and pantographs for current collection.
- On-board systems provide train system performance checks and report to the maintenance centre via wifi downloads at regular intervals.

Trainset Maintenance Manual

IRCAMTECH/Gwalior has prepared Maintenance Manual on Trainset, in association with, RDSO, Northern Railway and respective OEMs.







Trainset Maintenance Manual

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Documentation structure has been made modular.

- For the ease of understanding
- To explain the complex maintenance related information to the end user effectively.
- Documentation divided into three volumes.

- Volume -1 : Maintenance Management
- Volume -2 : System Documentation
- Volume -3 : Original Equip Manufacturers Documentation.
- Link : https://rdso.indianrailways.gov.in/view_section.jsp?lang=0&id=0,2,17,6313,6321,6322

Coach Parameters

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Designation	DTC	TC	NDTC	MC
Length of car-body (Over Coupler)	24000 mm	24000 mm	24000 mm	24000 mm
Width of car-body	3240 mm	3240 mm	3240 mm	3240 mm
Car height above top of rail	4140 mm	4140 mm	4140 mm	4140 mm
Distance between center pivots	14900 mm	14900 mm	14900 mm	14900 mm
Tare Weight	50.53 t	55.58 t	50.89 t	57.61 t
Gross Weight	55.95 t	64.06 t	59.37 t	66.09 t

Maintenance schedules

Train - 18	
Schedule	**Periodicity**
Daily	Every Day
Trip	Every 3 Days or 5000 kms (Whichever is earlier)
Monthly	30 Days ± 2 Days
Quarterly	90 Days ± 3 Days
Nine Monthly	270 Days ± 3 Days
Shop Schedule-1 (SS-1)	18 Months ± 5 Days
Shop Schedule-2 (SS-2)	36 Months ± 5 Days
Shop Schedule-3 (SS-3)	72 Months ± 5 Days

	Conventional EMU / MEMU	3 Phase EMU / MEMU
Schedule	**Periodicity**	**Periodicity**
Trip	15 (+0 /- 3) Days	15 (+0 /- 3) Days
IA	60 (+0 /- 5) Days	60 (+0 /- 5) Days
IC	240 (+ 0/-10) Days	240 (+ 0/-10) Days
POH	18 Months	24 (+0 -1) Months

Mileage Assumptions

- Average daily distance travelled by each unit is approximately 1500 km.
- The maintenance schedule similar to LHB coach .

Rolling Stock Maintenance Needs

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Washing Needs

- To maintain high degree of cleanliness, following schedules are proposed for cleaning of rakes.

S.No	Description	Location
1	Outside Cleaning (wet washing on automatic washing plant)	Automatic washing plant of Depot Single Pass
2	Internal Cleaning (Vestibule, Floor, walls inside, laboratory, and all interior area etc)	Mechanized cleaning on washing line
3	Under Gear Cleaning	Advance Mechanized Cleaning

Advanced Mechanized Cleaning

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Why cleaning of Under gear is required

a) To reduce Under-gear examination time & Improve safety in Washing line

a)To improve accuracy of Inspection : Cracks detection of welding joints of hanging parts during daily schedule.

b)To prepare surfaces for lubrication: lubrication of all pins & bushes including break calipers pins is required.

c)To prepare surface for DPT test : Rm web area of wheels and bio toilet hanging brackets.

2.To improve visual of sensitive safety components of Rolling stock during rolling in and Rolling out examination at station & precise collection of data by sensors/ cameras of automated monitoring systems.

Advanced Mechanized Cleaning

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EFFECTS OF ADVANCED MECHANIZED CLEANING ON MAINTENANCE SCHEDULES

- Better heat dissipation from brake disks which leads to better braking efficiency & improvements in life of disks and brake pads
- Cleaned brake callipers move more freely which may reduce cases of wheel shelling
- Improved mechanical efficiency & enhanced rust prevention, thereby service life of all cleaned components
- Improves rolling in & rolling out examination visual & camera/sensor data collection.

Why Under gear cleaning reqd?

- ***TO REDUCE UNDERGEAR EXAMINATION TIME & IMPROVE SAFETY IN WASHING LINE***

a) ***TO IMPROVE ACCURACY OF INSPECTION : CRACKS CAN BE DETECTED EASILY IN WELDING JOINTS OF HANGING PARTS DURING D1/DAILY SCHEDULE.***

b) ***TO PREPARE SURFACES FOR LUBRICATION : IN D2 SCHEDULE, LUBRICATION OF ALL PINS & BUSHES INCLUDING BREAK CALIPERS PINS IS REQUIRED.***

c) ***TO PREPARE SURFACE FOR DPT TEST: IN D3 SCHEDULE, DPT TEST OF RIM WEB AREA OF WHEELS AND BIO TOILET HANGING BRACKETS IS***

ADVANCED MECHANIZED CLEANING

D1 schedule

CRACKS easily DETECTED IN WELDING Joints of hanging parts

D2 schedule

Pins and bushes including brake callipers ready for lubrication

D3 schedule

rim web area of wheels and hanging j bracket of bio toilets ready for DPT test,

- Better heat dissipation from brake disks which leads to better braking efficiency & improvements in life of disks and brake pads
- Cleaned brake callipers move more freely which may reduce cases of *wheel shelling*
- Improved mechanical efficiency & enhanced rust prevention, thereby service life of all cleaned components
- Improves *rolling in & rolling out examination* visuality & camera/sensor data collection.

ADVANCED MECHANIZED CLEANING

BEFORE AFTER

BEFORE AND AFTER IMAGES OF BOGIE FRAME

ADVANCED MECHANIZED CLEANING

BEFORE AND AFTER IMAGES OF RIM WEB AREA OF WHEEL

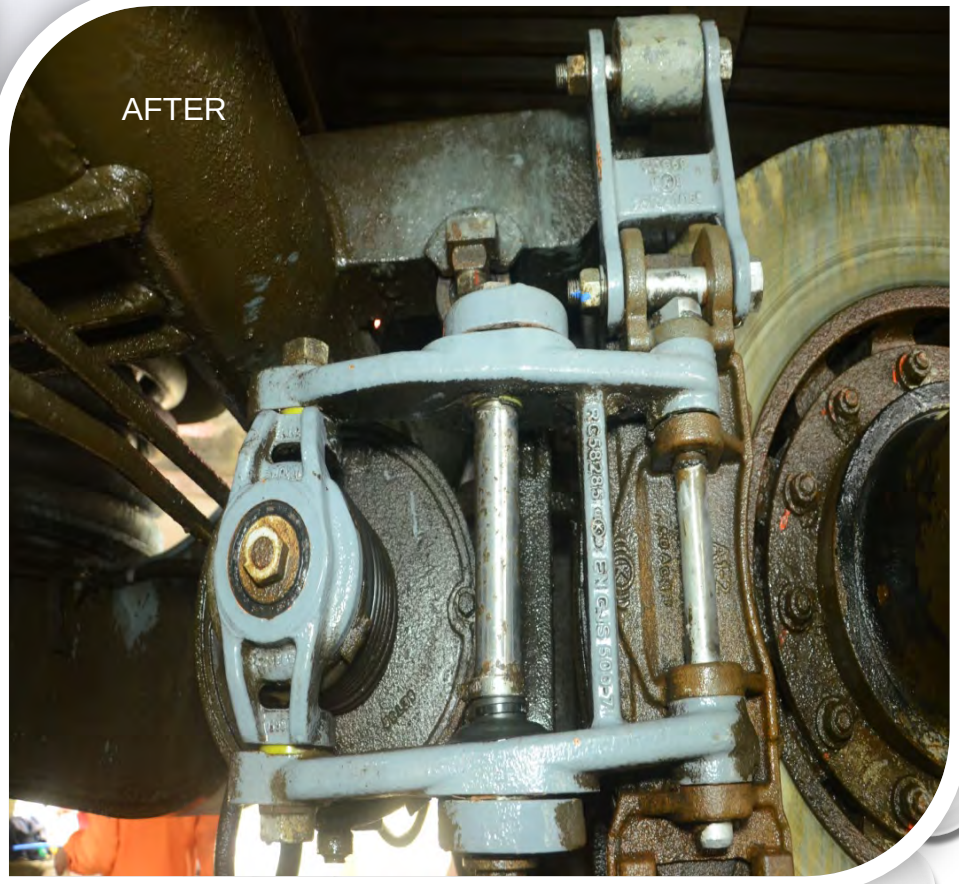
ADVANCED MECHANIZED CLEANING

BEFORE AND AFTER IMAGES OF BIO TANK

ADVANCED MECHANIZED CLEANING

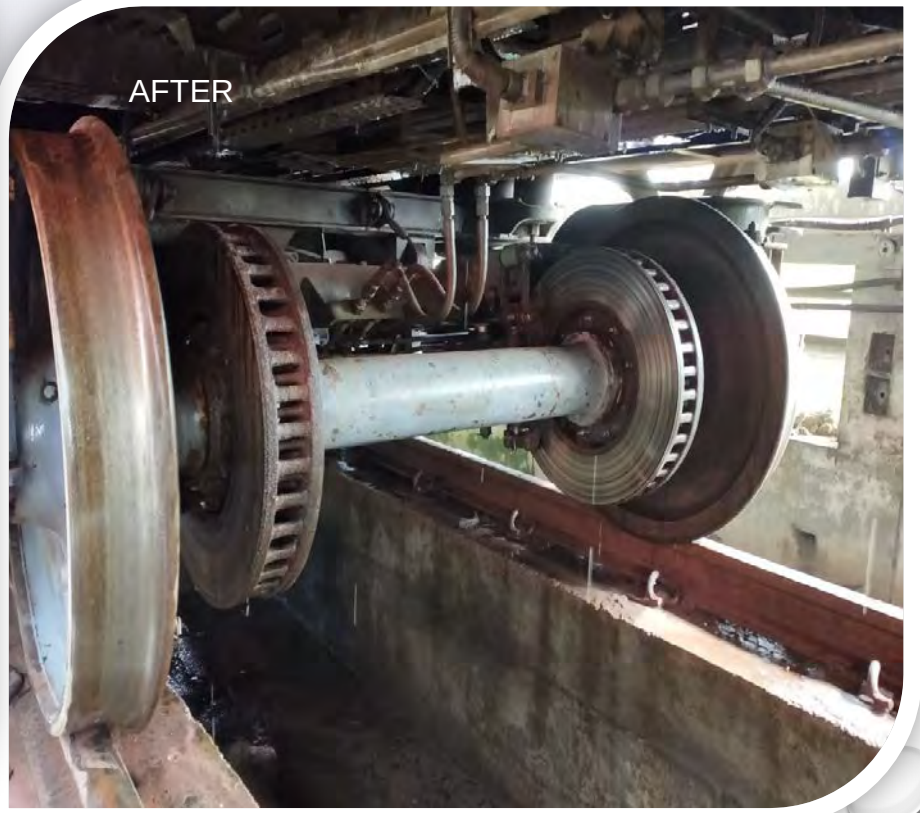
BEFORE AND AFTER IMAGES OF DV PANEL

ADVANCED MECHANIZED CLEANING



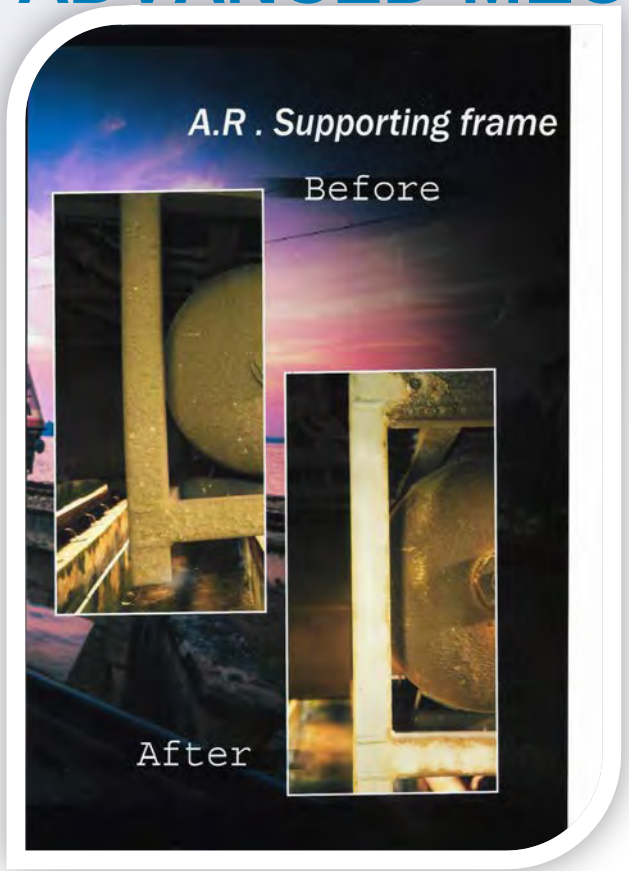
BEFORE AND AFTER IMAGES OF BRAKE CALLIPER

ADVANCED MECHANIZED CLEANING

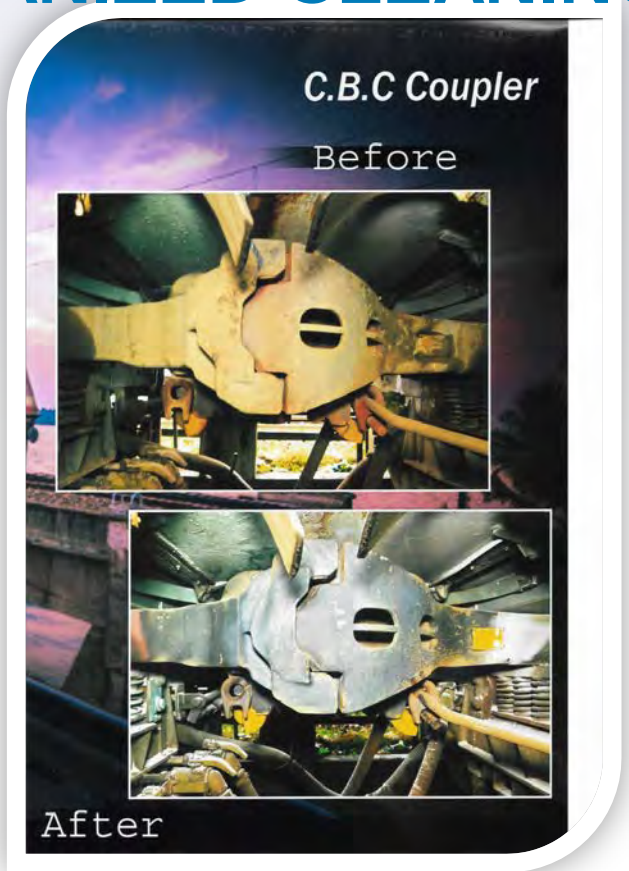


BEFORE AND AFTER IMAGES OF AXLE & BRAKE DISC

ADVANCED MECHANIZED CLEANING



BEFORE AND AFTER IMAGES OF A.R SUPPORTING FRAME



BEFORE AND AFTER IMAGES OF C.B.C.COUPLER

ADVANCED MECHANIZED CLEANING

CBC SUPPORT SPRINGS

Before

After

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Maintenance Facility Planning for Trainset

1

Line holding capacity requirements

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Rake Holding	No. of Washing Line	No of Stabling Line	No of Inspection Lines
Upto -10	1	2	2
11 - 20	1	3	3
21-30	2	4	4
31 - 40	3	5	6

Considerations for Maintenance Facility

A Rolling Stock maintenance Depot needs to comply with :

Both System and Infrastructure external interfaces

- Integration of System specificities in signaling, power supply, control-command, operating rules...
- Connection to the track alignment, geotechnical constraints, environmental and local guidelines
- The yard own dimensions and geometry

All types of internal interfaces

- Civil works rules and architectural program
- Subsystems and equipment, as well as local components (CCTV…)
- Infrastructure maintenance devices to fit within the depot
- Rolling Stock characteristics and maintenance requirements

Local regulations and standard rules

- Labour regulation for staff safety
- Technical standards

Considerations for Maintenance Facility

The Smart Depot concept

Green Depots

- Sustainable building design (reduce Operating & Maintenance Costs, …)

- Eco-friendly Solution (Photovoltaic solution to convert Solar energy into electricity, natural/recycled material finishes, Greenery, Saving Energy solution)

- Good Ambience design and monitoring
  - Natural Light in the Workplace – skylights, shading.. (added value in providing staff with access to a sunroom / outdoor patio area for breaks and lunches…)
  - Sound (Acoustic is critical for safety – clearly heard announcements/signals, noise protection…)
  - Indoor Air Quality (ventilation, air quality control…)

Considerations for Maintenance Facility

The Smart Depot concept

Green Rolling stock

- RS traction trends (Hybrid train, Hydrogen, fuel cell, Batteries/Supercaps)

- Depot equipment and layout impacts : charging facilities, operating procedures, personal safety

Rolling Stock Optimized maintenance

- Real-Time Asset Management

- OCC / Depot / Fleet Management

- CBM - Condition-based maintenance

Rolling Stock – Infrastructure Maintenance Synergy

- Sensors fixed to the Rolling Stock for P-Way side monitoring

- Sensors installed on the line/in the depot for RS scanning

Desigining modern Maintenance Depot

Smart Depot

- **Green Depots**
  - **Sustainable** building **design** (reduce Operating & Maintenance Costs, …)
  - **Eco-friendly Solution** (Solar /PV electricity, natural/recycled materials, Greenery, Energy Saving solutions)
  - **Good Ambience** design and monitoring

  - **Natural Light** in the Works place – skylights, shading, outdoor patio area for breaks and lunches
  - **Sound** (clearly heard announcements/signals, noise protection…)
  - **Indoor Air Quality** (ventilation, air quality control…)

- **Green Rolling stock**
  - **RS traction trends** (Hybrid train, Hydrogen, fuel cell, Batteries/Super caps)
  - **Depot equipment and layout impacts :** charging facilities, operating procedures, personal safety.

- **Rolling Stock Optimized maintenance**
  - **Real-Time Asset Management**
  - **OCC / Depot / Fleet Management**
  - **CBM** - Condition-based maintenance
- **Rolling Stock – Infrastructure Maintenance Synergy**
  - **Sensors** fixed to the Rolling Stock **for P-Way side monitoring**
  - **Sensors** installed on the line/in the depot **for RS scanning**

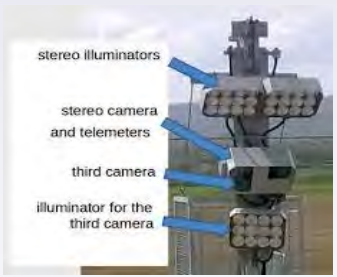
CBM & Asset Management

Optimized maintenance

- Train Integrated diagnostic + real-time remote monitoring : *reduce interventions on train*
- Predictive Maintenance Models (CBM) : *prevent failures and focus maintenance tasks*
- New Tools (3D pantograph monitoring system, Train scanning, inspection Drones…) *: use infrastructure as a train lab*

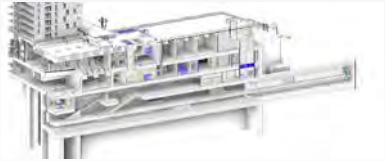
Optimized logistics & data management

- Tag Data Standard - Electronic Product Code
- BIM -digital, real-time, maintenance connected database -added value



BIM methodology

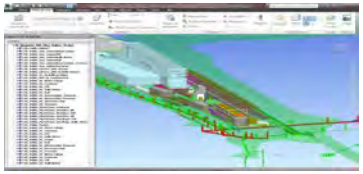
- 3D mock-up of the entire depot
- Details added along the design phases, civil works oriented
- Very efficient support for interfaces management
- Support for as-build documentation + configuration/asset management



3D mock-up for clash detection, interfaces management, scheduling…

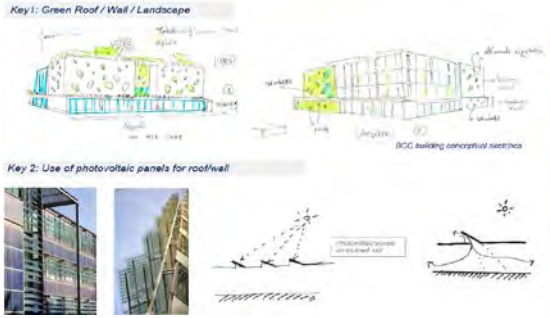
Depot specificities

- Define characteristics and interfaces, unusual devices with high stakes civil works constraints (wheel lathe, washing machines, lifting jacks…)
- Help optimize rolling stock / infrastructure interfaces (accesses, location)
- Manage the design flow by a progressive design freeze approach

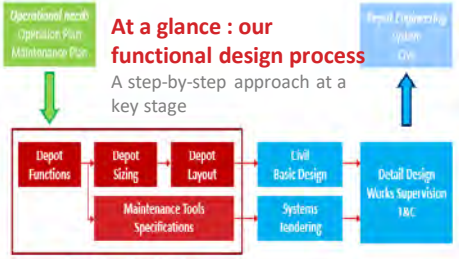


BIM : also a mega database, shared and located

Eco Design



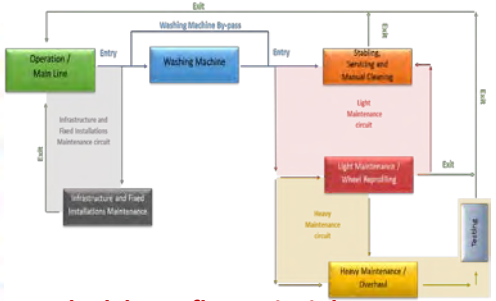
Depot Design Process



At a glance : our functional design process

A step-by-step approach at a key stage

Depot Functional Design



Ideal depot flow principles

Considerations for Maintenance Facility

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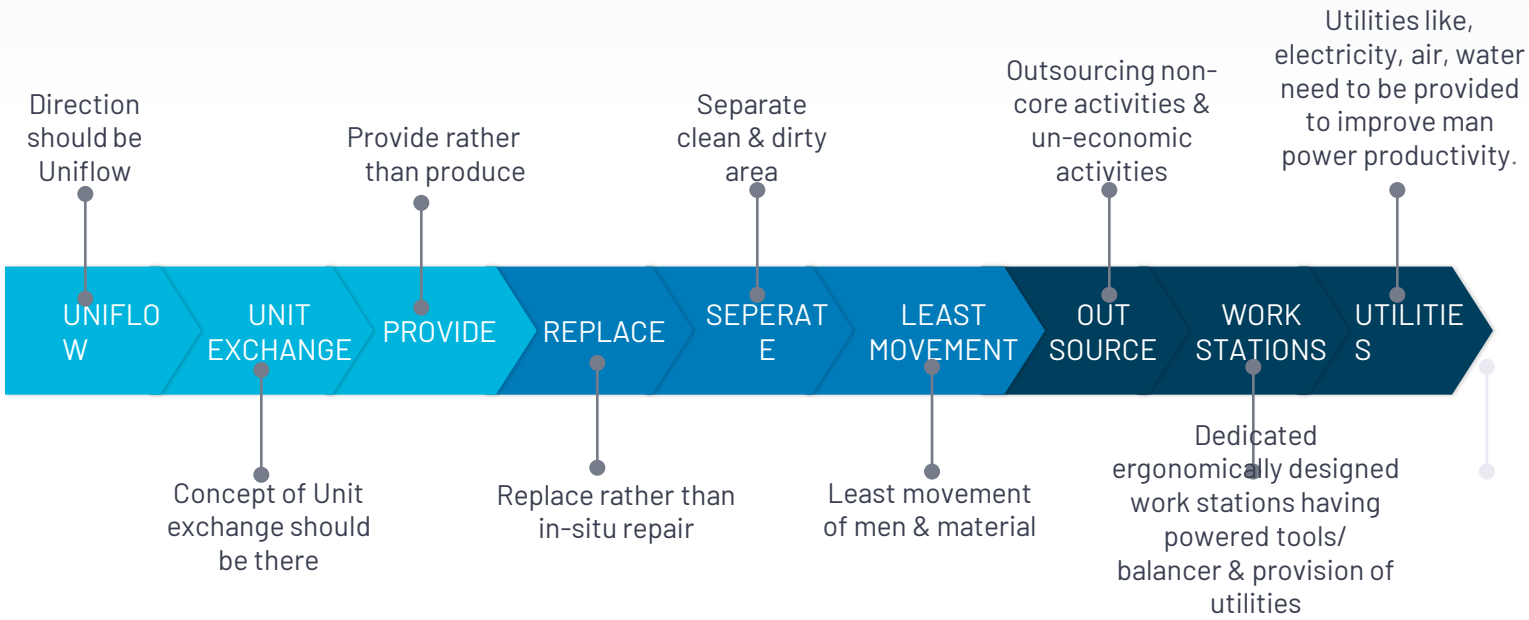
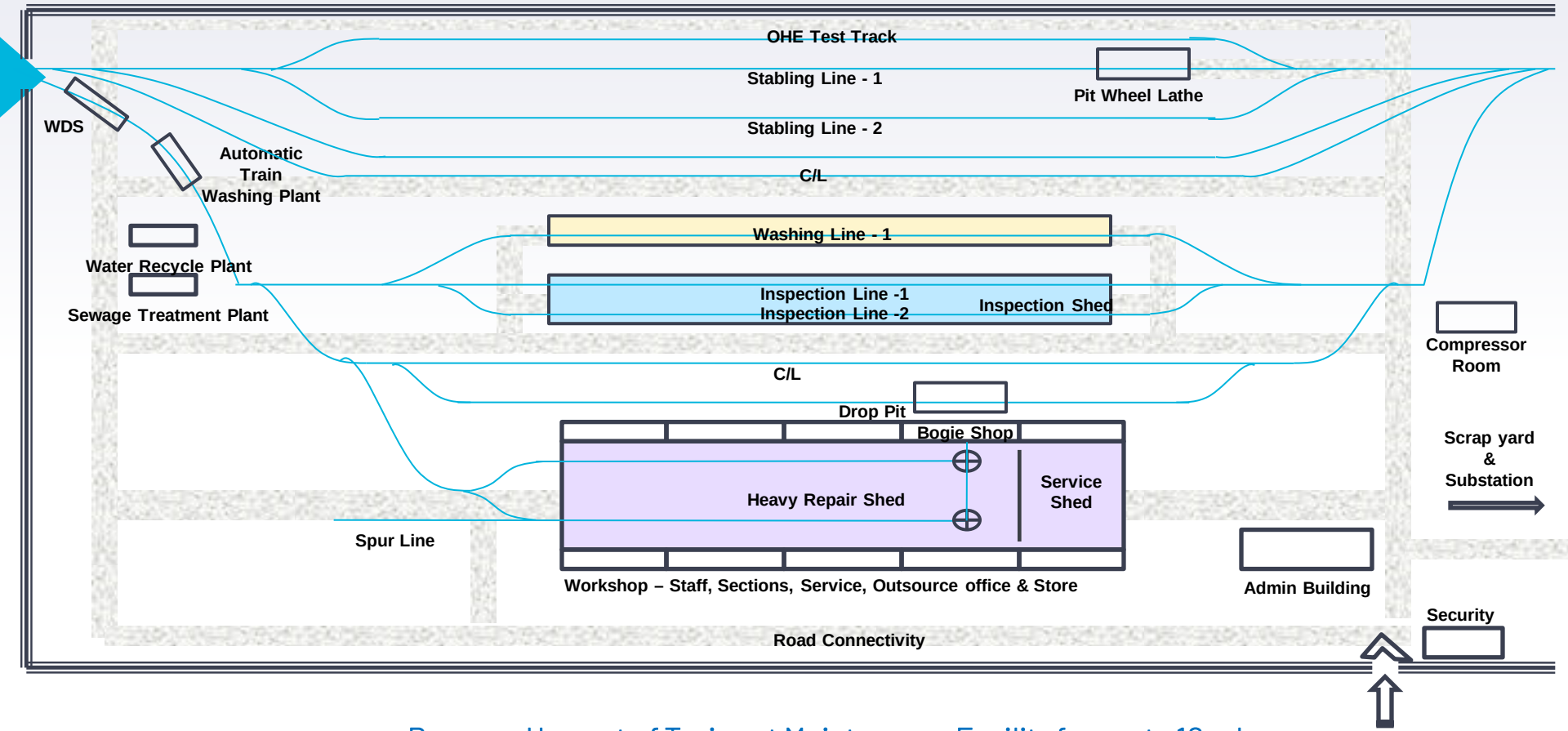
Following factors to be considered while planning for a maintenance facility

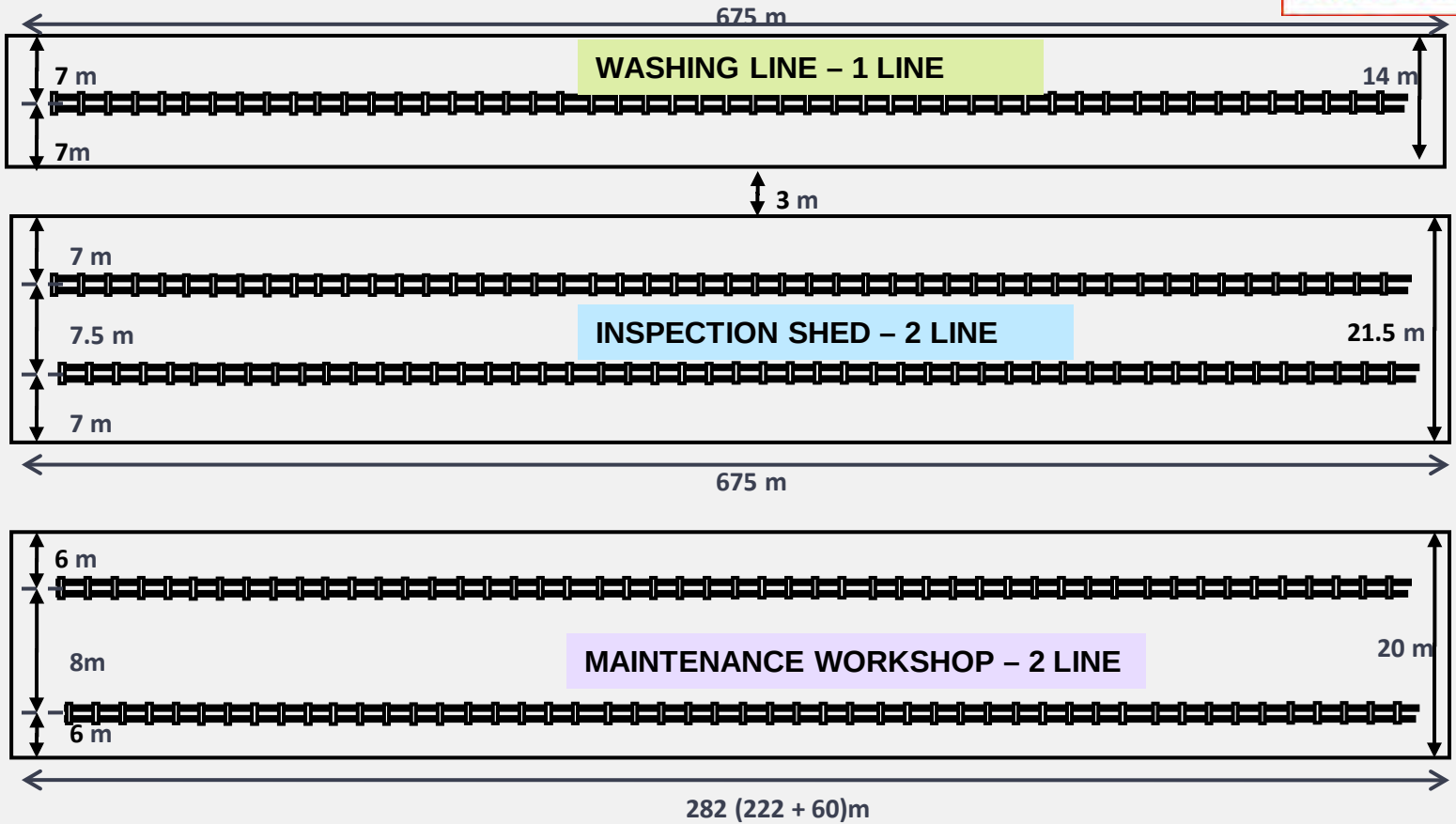




Proposed Layout of Train set Maintenance Facility for up-to 10 rakes

Inspection Line, Washing Line & Workshop Details

Indian Railways
Centre for Advanced Maintenance Technology



Maintenance Facilities

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Stabling Lines

Stabling lines with length 675 m should be provided for stabling of full-length train set rakes for 24 coaches.

The stabling line should have the following features :

- Washable apron
- Good drainage
- Carriage watering system
- High pressure water jet cleaning system
- Adequate supply of water watering rakes of trainset.

Maintenance Facilities

Indian Railways
Centre for Advanced Maintenance Technology

Washing Line

Washing line should be of length 675 m . The washing line will accommodate full-length train set rakes for 24 coaches.

The washing line should have the following features :

- Washable apron
- Good drainage
- Carriage watering system
- High pressure water jet cleaning system
- Adequate supply of water for interior cleaning and watering of rakes of train set.
- Bio-tank discharge facility
- Algae and leakage proof light weight pipelines to be used.

- Here mechanized cleaning to be adopted. First sign of corrosion to be attended. Protective measures to be taken. Further on older rolling stock welded portion has to be closely monitored for development of any welding defect.

Maintenance Facilities

Indian Railways
Centre for Advanced Maintenance Technology

Inspection Lines

- Inspection Shed with dimension 675 m X 21.5 m with two inspection lines could remain open at night and would cater for receipt & dispatch of train set.

- Troubleshooting and inspection, night inspection can also be undertaken (if necessary).

- The inspection shed shall be fully covered. Transparent sheets on the roof at suitable locations to have maximum utilization of day light for general purpose lighting. In this shed, there shall be provision for pneumatic lines, welding points and at Inspection line.

- Electric sockets, compressed air outlets and lighting shall be installed along and on each side of the pits. Running tables "in pit" will also be provided for under-floor component removal.

- ***System of 4 - Tier inspections system should be adopted***

4- Tier Inspection System

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Component of 4 – Tier inspection system

Maintenance Facilities

Indian Railways
Centre for Advanced Maintenance Technology

Inspection Lines

Four Tier Inspection Shed–

1. Central Pits for under gear inspection :

Pits all along the length of the rake is made 1.5 m deep, to facilitate working on the under frame equipment by shed staff. Working pits are equipped with stairs at each end to allow access. Moving trolleys “in pit” should be provided for under floor component transportation.

2. Floor level – for lateral side inspection

Tracks in the Inspection Shed are supported on steel columns, spaced 1.2 m apart. This depth of 1.2 m allows easy crossing from the pit to the trainset rake side (and inversely) at any place of the tracks.

Sunken floor is constructed 1 m below rail level. This sunken floor helps eye level inspection of wheel-set, axle box and other under-gear equipments, on lateral side of the rake.

Maintenance Facilities

Inspection Lines

Four Tier Inspection Shed–

3. Coach Interior access platforms

Platforms at coach floor level is provided so that maintenance staff can easily access the coach interior as well as the driving cabs.

4. Roof working platforms

Walking roof platforms for on-roof components maintenance all along the trainset rake length has been provided. Roof gangway helps in

- Easy access to roof equipment like pantograph, RMPU etc.
- Ease in replacement of roof equipments.
- In situ attention to equipment.

They have safety devices inter-locked with (Overhead Equipment) OHE isolation, to switch off electrical power supply whenever on roof activities have to be performed, thus ensuring safety of the staff working on roof.

Maintenance Facilities

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Heavy Repair Shed

- The shed with dimension 222 m X 20 m is provided with two 25 ton overhead electrical cranes.
- This shed shall not be provided with overhead lines.
- The trainset body will be lifted and put on special tressels leaving the bogies on the pits.
- The bogies can be separately lifted and sent to the bogie repair shop.

Maintenance Facilities

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Heavy Repair Shed

Attached to the Heavy Repair Shed, there shall be the following repair sections

- Pantograph & VCB
- Traction transformer & traction converter
- traction motors
- Train control & management system
- Driver desk equipment
- Passenger information system equipment
- Control panels & Inter-vehicular couplers
- RMPU
- Isolation (pantry) transformer
- Brake System etc.

Maintenance Facilities

Indian Railways
Centre for Advanced Maintenance Technology

Heavy Repair Shed

- Rooms for above section will be sized in such a way so that they will not be required to be changed when holding increases and shed is augmented.
- Similar type of activities initially may be carried out in one room and later on, after expansion, some activities may be shifted to new rooms constructed during expansion.

Service Shed

- Service shed with dimension 60 m X 20 m will have one EOT crane of capacity 5 ton
- It shall be provided in this bay for lifting equipment for repairs, overhauling & testing of equipment
  - Switch Groups.
  - Rectifiers.
  - Circuit Breakers.
  - Pantographs.
  - Resistors. etc

Maintenance Facilities

Shunting Neck

- They are required to facilitate the shunting of trainset. To take the rake from stabling line to inspection line or heavy repair shed or washing line or Vice-Versa
- They should be provided at both end of the maintenance facility

Spur Lines

- Spur lines to be provided so as to accommodate the loose coaches and spare/defective wheel sets.
- Preferred location to be near the heavy repair shed.

Maintenance Facilities

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Test Track

- This line is used for internal testing of train and other systems.
- Test track is equipped with signaling equipment.
- The boundary of the track shall be completely fenced to prevent unauthorized trespassing across or along the track.
- Upto 4 Coach length – (one unit of train set) covered shed may be provided.

2

Major Plants & Machinery

Maintenance Facilities

Indian Railways
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Under floor Wheel Lathe

- A separate building is planned for housing under floor wheel lathe measuring 35 m x 15 m along with a clear space for storing the turnings
- Suitable arrangements for compressing of wheel turnings and their collection shall be made.
- A clear space of 80m should be left on both sides of the shed to accommodate up to four coaches so that unit could be moved on its own power under the overhead line.

- This facility should be set up on a separate line i.e. free on both ends.

Maintenance Facilities

Drop Pit

- With dimension 60 m X 15 m will have bogie drop table equipment consists of a large lifting table capable of accommodating a bogie.
- It moves transverse inside a pit. Bogie can be lower for maintenance without having to uncouple the rake.
- Bogie drop table should be preferably located on a separate line near the heavy repair shed. Location for drop table may be finalized by the Zonal Railway as per availability of space.

Maintenance Facilities

Indian Railways
Centre for Advanced Maintenance Technology

Automatic Train Washing Plants

- The car wash facility shall be located with direct access from the main line.
- The automatic train washing plant shall be installed on a dedicated track with concrete floor.
- The car wash shall permit operating the vehicles automatically at a slow recommended speed, under their own power, through a series of water and detergent sprays, rotary brushes and plain water spray jets for rinsing.

Maintenance Facilities

Automatic Train Washing Plants

- The water used for washing with detergent shall be directed to the Treatment Plant.
- The usual length required for a car wash facility location is about 100 m.
- Straight line alignments of 25 m are also required at the entry and exit ends to prevent car sweeping due to curves.
- Total washing machine width is about 10 m excluding technical rooms.

Maintenance Facilities

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Centre for Advanced Maintenance Technology

Wayside Diagnostic Equipment

- Detection equipment will enable the maintainers to get the condition of rolling stocks well in advance in respect of critical safety components and other defects which are normally being observed during the rolling in examination for effective planning of yard examination /maintenance of rake supposed to be received by yard. Wayside diagnostic equipment are :

- Wheel Diagnostic System
- Wheel Impact Load Detector (WILD)
- Acoustic Bearing Detector (ABD)
- Hot Box Detectors

Maintenance Facilities

Indian Railways
Centre for Advanced Maintenance Technology

Machine Vision Equipment

The basic principle of the machine vision equipment is that it takes photographs of the vehicles from sides and bottom, and software compares these photos with the standard photos of that type of vehicle. This way it is able to detect loose / hanging parts, worn brake blocks, wheel dia. Etc
Some of the machine vision devices are :

- Wheel Profile Recording System
- Brake Equipment Monitor
- Hanging Parts Detectors
- Broken Spring & Bogie performance detector
- Body Inspection system for body defects/ hanging part

Maintenance Facilities

Indian Railways
Centre for Advanced Maintenance Technology

IT and Communication Facilities.

The facilities pertaining to S&T infrastructure

- Signal Interlocking setup for movement of rakes from Main line to trainset depot and vice-versa.
- Railway Telephone facility for internal as well as communication with Zonal Railways/Headquarters through railway telephone exchange.
- Railnet connection for e-office working and other official online communication.
- Announcement System for broadcast communication among admin building, control office and maintenance staff.

Depot Control Centre

- Movement of trains inside depot shall be controlled from Depot Control Centre (DCC) suitably located inside the depot.

Maintenance Facilities

Indian Railways
Centre for Advanced Maintenance Technology

Power Supply and Lighting

ELECTRIC SUB-STATION

- A separate 33 kV/415 or 11 kV /415 Volt sub-station of adequate capacity for power supply arrangement complete with transformers, HT VCB panel and LT panel board etc. shall be provided for electrical services.

- D.G Sets of adequate capacity shall be provided to take care of emergency loads.

LIGHTING

- LED light fittings should be provided to obtain appropriate illumination as per latest guidelines or industry norms for illumination in service buildings, sheds, under-pits, below catwalk area, above catwalk area, approach roads etc.

Maintenance Facilities

Indian Railways
Centre for Advanced Maintenance Technology

Power Supply and Lighting

LIGHTING

- To obtain high illumination level at work spots, inspection of under gear equipment directed LED lights may be used as per requirement.

- For directed maintenance, staff may use helmet based LED lights or portable LED hand lamps for precision work.

- High mast with LED flood lights should be provided for external illumination of circulating area and yard as per as per latest guidelines or industry norms.

Maintenance Facilities

Indian Railways
Centre for Advanced Maintenance Technology

Power Supply and Lighting

POWER INSTALLATIONS

- Internal/External Electrification of service buildings and offices with earthing arrangement.
- A/C units, desert coolers, water coolers etc. for service buildings.
- Electrical pump for water supply and coach cleaning facility.
- TL/AC maintenance infrastructure like charging points, welding supply points etc.
- Provision of Power supply arrangements to facilitate power supply for Mechanical, Electrical and other Maintenance equipment.

Maintenance Facilities

Indian Railways
Centre for Advanced Maintenance Technology

Power Supply and Lighting

EMERGENCY SUPPLY FROM OHE

- Auxiliary Transformers of adequate capacity maybe installed for emergency lighting of service buildings, sheds, roads, yard etc.

SOLAR PLANT

- Provision of Grid Connected Solar Panel of adequate Capacity complete with all arrangement may be planned.

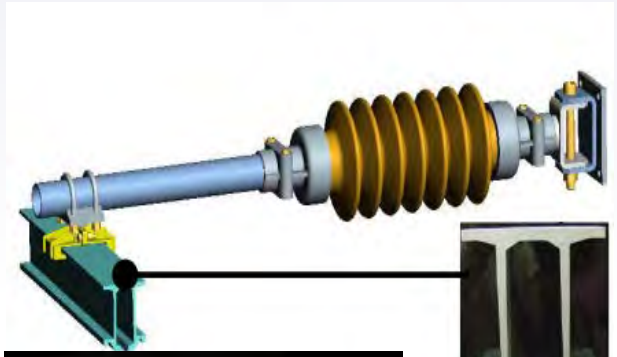
Maintenance Facilities

Indian Railways
Centre for Advanced Maintenance Technology

Power Supply and Lighting

25 kV OHE ARRANGEMENT

- The tracks in the depot should be equipped with 25 kV overhead equipment (OHE).
- Provision of both ends sectioning arrangement with interlocking facility should be made in the inspection line/ washing line for the purpose of testing of traction equipment and movement of train sets.
- The provision of retractable OHE in inspection bay is optional and can be included in the proposal based on requirement.



Maintenance Facilities

Compressed Air Supply

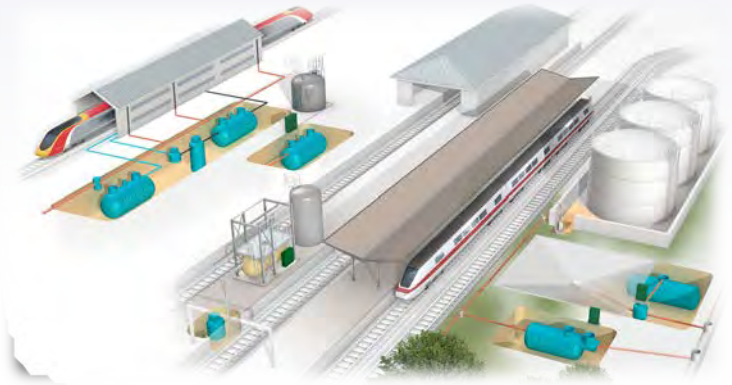
- Two Screw type air compressors of capacity 500 cfm & 10 kg/cm2, to be provided in the compressor room.
- The compressors should be screw compressor to minimize noise and vibration inside the shed.
- Air reservoirs of adequate capacity should be provided and compressed air distribution mains with isolating facilities, filters and dryer should be run along the main column in the shed, and tappings provided so as to reach the working areas.
- The compressed air pipeline shall be leak free lightweight aluminum .Push-together connectors make it even easier to fit and provide any additional tapping.

Maintenance Facilities

Indian Railways
Centre for Advanced Maintenance Technology

Water Supply, Sewerage and Drainage Works

- In house facilities shall be developed for the water supply of the entire depot.
- Past records of Municipal Corporation shall be used to design the drainage system.
- Rainwater harvesting would be given due emphasis to charge the underground reserves.
- STP to treat the sewage by extended aeration process to limit the level of pollution.



Maintenance Facilities

Indian Railways
Centre for Advanced Maintenance Technology

Stores

- Covered area with dimension 60 m X 8 m for general stores with provision for future expansion.
- Store will be served by road. An unloading platform should be provided for unloading from road vehicle.
- Adequate space should be provided for operation of battery operated pallet trucks and lift truck inside the depot.
- Open area should be provided in the stores enclosure for storage of steel bars, channels, angle iron, castings, empty drums etc.
- A separate room should be provided for storing costly items by the side of the Stores Depot Clerk's Office.
- A small separate room should be made for storing petrol/kerosene, solvents and other inflammable things.

Maintenance Facilities

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Admin Building

- An administrative building close to the main entrance should be planned.
- This block will contain technical & drawing office, planning office, conference room, computer room and library and the rooms of controlling and assisting officers .
- It can be suitably sized and architecturally designed at the detailed design stage.
- A time and security office is also provided close to main entrance. It shall be equipped with suitable Access control system for all the staff working in the complex.

Ancillary Buildings

Garage , Sewage Treatment Plant & Water Recycle Plant, Watch Towers, Scrap yard, Compressor Room

Maintenance Facilities

Indian Railways
Centre for Advanced Maintenance Technology

Ancillary Buildings

- Garage
- Sewage Treatment Plant & Water Recycle Plant
- Watch Towers
- Scrap yard
- Compressor Room

Maintenance Facilities

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Centre for Advanced Maintenance Technology

LIST OF MECHANICAL M&P FOR TRAINSET DEPOT

S.N	EQUIPMENT	QUANTITY
1	EOT crane 25/5 Ton	2
2	CNC Under Floor Wheel Lathe with Industry 4.0	1
3	Tandem Under Floor Wheel Lathe with industry 4.0 (Optional)	1
4	Automatic Train Washing Plant	1
5	Wheel Diagnostic System	1
6	Drop Pit Table	1
7	Rail Cum Road Shunting Vehicle (135t)(Optional)	1

S.N	EQUIPMENT	QUANTITY
8	Set of (4+1) Synchronized Lifting Jacks (25 t)	4
9	Compressed air system for 8 drop points including 2 Nos. of Compressor (500cfm), 10 kg/cm^2, piping, dryer etc	1
10	Rake brake test stand (RTR) with SCADA	1
11	Brake Panel Test Rig (SCTR)	1
12	Jib crane 5 ton capacity 4m reach	1
13	Center Lathe	1
14	Portable Digital Ultrasonic Flaw Detector	2

Maintenance Facilities

Indian Railways
Centre for Advanced Maintenance Technology

LIST OF MECHANICAL M & P FOR TRAINSET DEPOT

S.N	EQUIPMENT	QUANTITY
15	Hand held Spectro Analyser (Hand held XRF)	1
16	Road mobile crane with earth moving attachment 15 ton	1
17	Fork lift electric 3 tons	2
18	*Fork lift diesel 3 tons (Optional)*	1
19	Platform Trucks 3 ton	2
20	Inverter Based MIG/MAG Synergic pulse portable welding plant 400 Amp	2
21	Air Plasma Cutting Machine	1

S.N	EQUIPMENT	QUANTITY
22	Airless Spray Painting Machine	1
23	High pressure Jet cleaning machine	2
24	*Pipe Bending Machine(Optional)*	*1*
25	Welding Machine 200A(Single Phase) Rectifier Inverter Based (IGBT) Double Bridge Type	2
26	Small M&Ps and T&Ps, Gauges, Measuring Instruments etc.	Lump sum
27	Storage and Racking System	Lump sum
28	Hand pallets 3 ton	2

Maintenance Facilities

Indian Railways
Centre for Advanced Maintenance Technology

LIST OF MECHANICAL M & P FOR TRAINSET DEPOT

S.N	EQUIPMENT	QUANTITY
29	Wheel Barrow (140 liters)	5
30	Office Equipment & Furniture	Lump sum
31	Water Recycling Plant & STP	1
32	Truck (10T)	1
33	Utility Vehicle	2
34	Heavy duty floor scrubber & mopper - ride on types	2
35	Floor sweeper push type	2

S.N	EQUIPMENT	QUANTITY
36	Dry vacuum cleaner for coaches	2
37	LAB equipment	Lumpsum
38	Design work station with 3D printer and accessories	1
39	Trolley Mounted Mobile Sewage Evacuation Machine	1

Maintenance Facilities

Indian Railways
Centre for Advanced Maintenance Technology

LIST OF ELECTRICAL M & P FOR TRAINSET DEPOT

S.N	EQUIPMENT	QUANTITY
1	Industrial vacuum cleaner wet and Dry Duty Cleaning	1
2	Air velocity measuring meter	4
3	Constant voltage constant current battery charger	2
4	LCR meter	2
5	Oil BDV testing kit	2
6	DGA facilities	1
7	Transformer oil filtration plant (oil centrifugal plant)	1
8	Oil filling plant with flow control for transformer	1
9	Light load run test facilities for traction motor (Auto transformer 3 phase)	1

S.N	EQUIPMENT	QUANTITY
10	Electrical and Electronics testing lab facility unit for PCB testing and handling , Oscilloscope with probe, multimeter (AC/DC), ammeter (clamp on), server grade laptop for data analysis	1
11	Integrated charge discharge regenerative type unit	1
12	Tool Kits in set	4
13	DG set with suitable capacity	1
14	Thermal Imaging Camera with Software	2
15	Induction Heater	1
16	Pressure jet cleaner	1

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Thank You