

**Basic Features of Shed Layout**

1. A uni-directional movement of locomotives in shed is preferable.
2. Separate entrance and exit points should be provided to avoid bottlenecks.
3. The layout should permit a locomotive to skip stage servicing without hampering the flow of other locomotive.
4. The shed should have covered accommodation in its repair area for about 25-30% of the fleet homed. The yard of the maintenance shed should be able to hold at a time about 50% of the total holding of the shed.
5. Each line in the covered repair area of the shed should be able to hold 3 locomotives. The layout should provide for possibility of expansion widthwise i.e. by providing more lines side by side. Expansion along the length of the running lines should not be adopted.
6. The work area in the shed should be devided into two distinct portions, one dealing with servicing and light maintenance and the other with heavy repairs. Facilities should be provided in the same sequence in which an incoming locomotive is to be attended to.
Sequence of Repair Operation

1. The recommended sequence of operations for servicing is
   - Cleaning and washing of under-gearing and body.
   - Sanding
   - Fueling
   - Inspection and topping of lube oil and cooling water.
   - Repairs
   - Departure

2. Lines earmarked for normal servicing attention should be through lines so that minimum time is taken. In the repair areas, separate lines should be earmarked for scheduled repairs and for locos needing out-of-course repairs.
**Servicing Facilities**

1. **Washing and Cleaning**

   (a) A washing apron and pit laid with concrete and provided with good drainage, suitable hydrant points and adequate supply of water should be located well away from the shed building to clean the under-gearing and body of the locomotives.

   (b) Manual washing with brushes (fitted with long handles) is recommended for small sheds. Automatic washers with mechanized sprays, brushes etc. can be justified only for very big running sheds scaling with a large number of Locomotives.

   (c) Hose and nozzle arrangement for spraying the under-gearing with water under pressure will ensure proper removal of grease and oil from the Chassis. Provision of a boiler to give a steam jet will be an additional help.

2. **Sanding**

   (a) Sand should be stored under cover to keep it dry. Sand drying arrangements may be necessary in areas having heavy rainfall.

   (b) Sand should be properly sieved before being field to prevent the sanding apparatus on the locomotives getting choked.

   (c) For small sheds, manual filling of sand boxes is adequate. Mechanised sanding facilities are recommended for large running sheds.

   (d) The sanding point should be at an adequate distance away from the fueling Installation and the running shed building.

Shed Construction

1. A 3-level working floor arrangement should be provided. The rail level in the repair area is the same as the general shed floor level. The depressed floor area outside the rails is kept lower than the shed floor level so as to be able to attend effectively to the bogies and under-gear. The pit level between the rails is kept still lower to enable proper examination of under-gearing. Above the depressed floor level, a platform level is provided, which is at the same height as the locomotive floor, to attend to all underframe. Ramps or steps should be provided to conveniently connect the three working levels with the general floor level in the shed.

2. Flooring should be easily washable so that split oil can be effectively removed. All flooring should be finished with a hard top to withstand abrasion resulting from handling of heavy parts and movements of material trollies etc. Wooden flooring is not recommended. Concrete flooring is acceptable.

3. Flooring in the heavy lifting bays of the shed should be adequately strengthened. Special reinforcement is required in the location where heavy duty high lift jacks are installed.

4. To minimize cracking and to facilitate repairs flooring should be divided into rectangular panels, with sides not exceeding 2 metres, using dividing strips.

5. The platforms, and ramps as also steps should be protected with steel or cast iron edging of non-skidding type.
**Lifting and Material Handling Facilities**

1. Overhead cranes of suitable capacity should be provided to serve heavy repairs area, free floor space, a part of the machine shop and stores. Crane capacity should be sufficient to lift the heaviest single repairable component or assembly. Overhead crane is not intended to lift complete locomotive singly; however it should be capable of lifting a complete locomotive from one end so as to enable a bogie to be run out from under it.

2. Heavy duty high lift electrically operated jacks may be provided at suitable locations in the heavy repair area for lifting the locomotive. It should be possible to alter spacing of the jacks to suit locomotives having different spacing of lifting pads.

3. Tram beam cranes operated from the floor level and hoists should be provided at all suitable work locations. Whenever it is possible to provide these facilities and dispense with overhead cranes, the shed structure can be made lighter.

4. Hand carts and trolleys should be used for movement of components. Fork lift trucks should also be provided in large maintenance sheds.
Illumination

1. Good illumination is necessary for efficient repair work. In the repair area fluorescent light or mercury vapour lamps giving an even illumination of atleast 200 lux at platform and floor levels should be provided.

2. Pits should be provided with bulk head fittings for direct lighting of the under-gear of the locomotive. Here also minimum illumination level of 200lux is necessary.

3. At fueling, sanding and washing points and turn tables etc. illumination level of 100 lux is sufficient.

4. At the area where relief train is stabled, an illumination level of approximately 60 lux should be available. The general level of illumination in the yard in the maintenance shed should also be of the same order.

5. Low voltage plug points should be provided at all work areas, including the pits, for use of portable hand lamps with flexible leads.
**Shed Building**

The shed building, besides providing for the repair area, machine shop etc., should accommodate the following:

1. Battery charging and storage room.
2. Instrument repair and testing room.
3. Fuel injection repair and testing room.
4. Engine governor repair and testing room.
5. Brake testing room.
6. Flaw detector room (magnetic and zyglo etc.)
7. Filter storage.
8. Tool room.
9. Lockers and washing room.
10. Laboratory.
11. Driver’s lobby and lockers.
13. Supervisors' office room.
15. Office room and record room.
16. Library.
17. Lecture or Meeting room.
Battery charging.

1. The battery charging room should be located preferably at one end of the shed building, where fumes and gases can be easily exhausted to the atmosphere.

2. The floors and the walls in the battery room should be of acid resistant construction.

3. Plug-points for mobile battery charging plant should be provided near the pits to provide direct charging of locomotive batteries without the necessity of taking them off.

4. Adequate distilled water should be available for topping up the batteries. Distillation or demineralization plant of adequate capacity should, therefore, be provided.
Shed stores.

1. The shed store should have approach by both rail as well as road. The approaches should not interfere with other movements in the maintenance shed.

2. Proper pins and racks should be provided for storage and handling of components to avoid damage during handling and in storage.

3. Adequate lifting facilities should be provided for handling heavy components. Use of fork lift truck for this purpose preferable.

4. Special provision should be made for storage of rubber components since these subject to deformation if not properly stacked and to ageing in the presence of air and due to effect of temperature.

5. While designing, store building, due regard should be paid to the fire fighting precautions.

6. To reduce material handling to a minimum and same time, small components frequently require should be stocked at platform level near work areas. Heavier components such as brake-shoes etc. can be conveniently stored at the depressed floor level.
**Auxiliary Buildings**

1. A small shed should be provided in the vicinity of the main shed building for stabilizing spare wheels and bogies. A 3-tonne gantry should serve the line and the next to it for proper loading and unloading of the wheels.

2. Under floor type of wheel lathe should be provided in a large maintenance shed for in-situ re-profiling of worn locomotive wheels. A separate shed for the under floor wheel lathe is preferable.

3. A load-box for testing a locomotive under power should be provided in every home shed. This applies to shed handling only diesel-electric locomotives.
Compressed air

1. Air compressor should be installed in a place where minimum disturbance due to vibrations and noise is caused to the surroundings. A separate compressor room is recommended outside the main shed building.

2. Compressed air pipe lines should be laid so as to reach all working areas and adequate number of points should be provided to tap the air supply. The layout should permit provision of additional tapping points at a later date near locations such as machine shop, fitter repair benches, block smith shop, etc. Compressed air is also required for blowing out dirt, to operate hand tools.

3. Air receivers should be provided in the compressed air line at suitable locations to minimize pressure drop.

4. For small sheds to home up to 10 locos, a portable mobile compressor should be provided which can be moved to any point required. This will save the installation of long compressed air pipe lines and air receivers to safeguard against pressure drop.
Repair Area

1. In the general repair area, separate areas should be demarcated for specialized repair groups such as
   - Diesel engines.
   - Electric rotating machines.
   - Hydraulic transmission.
   - Cooling equipment and radiators.
   - Brake equipment and valves.
   - Final drives, gears cardan shafts.
   - Under-greasing components.

2. Fitters benches should be suitably provided in each of the demarcated areas.

3. For ease of handling during repairs, suitable hoists and chain pulley blocks etc. should be provided.

4. Special stands and carries, etc. for different components should be provided in the different repairs areas. For example, connecting rod and piston assemblies and after removal from the engine should be stacked on a rack with the connecting rods suspended from the gudgeon pins. Special holding trays etc. should similarly be provided for bearing shells, fuel injection nozzles etc.
Fuel Injection Room

1. As indicated in para 4.8, a separate room for repair and testing of fuel injection equipment should be in every maintenance shed, this room is required to be absolutely dust free. It is preferable to wholly air-conditioned this area.

2. Suitable arrangements for expelling fumes from this room should be provided.

3. Non-skid oil proof flooring should be provided in the fuel injection room.

4. The type of testing equipment to be provided in the fuel injection room depends on the make of the diesel engine. However, the minimum repair facilities provided in this room should consist of:
   - Test stands for checking nozzle spray and pressure.
   - Fuel pump calibration stand.
   - Nozzle valve lapping tools and machine.

5. Spare parts required for repairing injection equipment should be stocked in the injection room itself.
Governor, Instruments And Brake Valve Repair Rooms

1. Separate rooms should be provided for repair and testing of engine governor, instruments and brake valves.

2. All these rooms should be made dust free. Air conditioning is not necessary but arrangements for supply of filtered air are required.
Laboratories

1. In every diesel locomotives maintenance shed, it is essential to have a well equipped laboratory to exercise control on lubricating oils, fuel oil and cooling water. The laboratory is also helpful in carrying out metallurgical and chemical inspection parts and supplies received in the shed.

2. Appendix 4.2 gives the general equipment that should be available in the shed laboratory.

3. The essential tests required to be carried out on fuel oil and lubricating oil are described in chapters 8 and 9 respectively. Some of these tests as also tests on cooling water are required to be carried out during every trip schedule. For such tests, the laboratory should function round the clock.
Filter cleaning

1. All diesel locomotives are fitted with air-filters. Most locomotives have the first stage air-filter in the form of impingement type filters and the second stage as oil bath type filters. Whatever be the type of filters, their periodical cleaning is absolutely necessary. Choked filters lead to high thermal loading, low engine power and high specific fuel consumption.

2. In every large shed, mechanized filter cleaning equipment should be provided to the extent possible. Where the workload does not justify mechanization, a separate area for manual cleaning of filters should be provided.
Cleaning and Washing

1. Keeping the equipment clean goes a long way in ensuring trouble free operation and long equipment life. Suitable cleaning and washing facilities are, therefore, absolutely necessary in every shed.

2. Cleaning of components immediately after their disassembly is necessary, before any inspection or repair can be undertaken. Degreasing and cleaning facilities whether of the vapour type or hot bath or spray-jet type are required in every shed. Wherever justified, mechanized cleaning equipment should be provided.

3. Special cleaning devices with circulating pumps etc. are required for turbocharger after coolers, oil heat exchangers etc.
Shed Offices

1. The offices for supervisors should be located near their place of work. This ensures effective and constant supervision of the repair work.
2. The drivers booking office and lobby should be located near the point where the locomotives are inspected and prepared for dispatch.
3. The general administration and other offices should provide for a meeting room.
**Plant and Equipment**

1. A list of machinery and plant required at maintenance shed of different sizes is given at Appendix 4.3 to this chapter. This list is generally applicable to sheds homing WDM2 type of locomotives. Suitable adjustments can be made for locomotives of other types. This list does not include ordinary tools such as spanners, chisels, files, hammers etc.

2. Every shed should be provided with equipment required for testing and calibrating various tools, machines and fixtures used in repair work.

**Fire Fighting**

1. Adequate safety measures must be adopted against fire hazards in the shed. Since large volumes of petroleum products are handled, special precautions are necessary.

2. Fire fighting equipment such as hydrants, hoses, extinguishers and alarm alarm boxes etc. should be conspicuously visible both at day and at night.

3. The above arrangements shall be planned and provided by security department.
Training School

1. For proper maintenance of the sophisticated equipments on diesel locomotives, the work force has to be adequately trained. Each large shed should, therefore, include a training school for imparting theoretical and practical training for various categories of staff.

2. Provision of a hostel attached to the training school is necessary.

3. The training school should be provided with a library with sufficient books and technical literature and audio visual aid for training.

4. Model room in the training school should display cut-way models and working models of as many components as possible.

Staff Amenities

1. Toilet and washing facilities and water coolers should be available both inside building and for the use of office staff.

2. Adequate precaution are necessary against dermatitis amongst workers handling fuel oil, lubricants, chromates, etc. Suitable cleaning agents and ample washing facilities in the vicinity of areas where these products are handled, are necessary. Use of hand protection cream before starting work and non-irritant cleaning soap after completion of work should be enforced.

3. Staff lockers rooms, cycle and scooter stand, canteen and other essential amenities should be provided in the shed.
Terminal Maintenance Shed

1. From operating considerations it becomes necessary sometimes to provide terminal running sheds. Whereas the homing sheds are provided for all facilities described above, in the terminal shed only the minimum facilities enough to ensure satisfactory completion of the return trip to the homing shed are necessary. Facilities should also provide for minor repair work.

2. The basic facilities required in a terminal shed are sanding, fueling, inspection pit, 3 level working, platform, topping of lubricating oil and treated water, checking and charging of batteries.

3. Following minimum accommodation should be provided in the terminal shed.
   - Store room.
   - Foreman and Supervisors room.
   - Repair benches.
   - Sand House.
   - Fuel installation.
   - Mobile lubricating oil dispensing arrangement.
   - Drivers lobby.

4. Enough covered area should be provided for berthing of locomotives under going inspection and repairs.