AREMA
AMERICAN RAILWAY ENGINEERING AND
MAINTENANCE-OF-WAY ASSOCIATION

Part 4

Design Criteria for Locomotive Repair Facilities[1]

— 2024 —

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TOC will be updated after balloting

[1] References Vol. 75, 1974, p. 209; Vol. 89, 1988, p. 84. Rewritten 1988.

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SECTION 4.1 INTRODUCTION

4.1.1 SCOPE (R2024)

The material presented herein is intended to familiarize the engineer and designer with the problems they will encounter and should consider in the design of a locomotive facility.

a. It is not intended to imply that other practices may not be equally acceptable.

b. Definition of Light, Medium and Heavy Repair may vary among railroads but should not affect the concepts being presented.

c. A check list of the facilities and processes necessary for the efficient operation of the locomotive repair shop is presented in Table 6-4-1 as a design guide.

4.1.2 DEFINITION (R2024)

A locomotive repair facility constitutes a "facility" designed to arrange an orderly progression of locomotives for repairs, maintenance, servicing and cleaning as required, and to meet inspection requirements of the manufacturer and governmental authorities. This section is focused on locomotives powered by diesel fuel. The facility should be designed to accommodate locomotives of a variety of power sources/fuels as needed by the Owner.

4.1.3 CLASSIFICATION (R2024)

Locomotive repair facilities are generally classified as "Heavy Repair," "Medium Running Repair" and "Light Running Repair and Servicing." For typical site plans and flow diagrams refer to Figure 6-4-1, Figure 6-4-2, Figure 6-4-3, Figure 6-4-4, Figure 6- 4-5 and Figure 6-4-6.

4.1.3.1 Heavy Repair

Consists of any work involving truck repair and maintenance, traction motor assembly, dynamic brake grids, etc.

4.1.3.2 Medium Running Repair

Consists of any work involving repair, air reservoir test, brake change outs, repairs to motive power components (injector, governors, turbos, etc).

4.1.3.3 Light Running Repair and Service

Consists of any work involving oiling, lubricating, testing, minor adjustments and repairs, etc.

Table 6-4-1. Locomotive Shop Preliminary Design Check List

This checklist is a tool for the facilitation of discussions between the Designer, Owner and Stakeholders to define the facility at the early stage and ensure the desired goals are achieved.

Location/Site Criteria		
1.	City: State:	
2.	Yard:	
3.	Zoning Classification:	
4.	Building Codes and Regulations:	
Departmental Contacts		
1.	Administration	
2.	Engineering	
3.	Locomotive Maintenance	
4.	Communications	
5.	Supply (materials handling)	
6.	Maintenance of Way	
Site Considerations/Constraints		
1.	Soil Conditions:	
	a.	Bearing Capacity:
	b.	Water Table:
2.	Utility Availability	
	a.	Potable Water
	b.	Fire Protection
	c.	Sanitary Sewer
	d.	Industrial Sewer/Treatment
	e.	Electrical
	f.	Natural Gas
	g.	Storm Water
	h.	Communications
3.	Adjacent Tracks	
4.	Adjacent Buildings	
5.	Site Access - Surface Roads	
6.	Noise/Air/Lighting Restrictions	
7.	Utility Easements/Locations	
8.	Subsurface conditions (fill material, old foundations, etc.)	
9	Future Expansion Considerations (reserve space)	
10.	Stormwater Run-off/Run-on (Flooding)	
Building/Facility Information		
1.	Preferred Exterior Finishes (Materials/type of construction)	
	a.	Office area

	b.	Shop
	c.	Auxilliary Buildings
2.	Number of Occupants	
	a.	Office Personnel: male female:

Table 6-4-1. Locomotive Shop Check List (Continued)

	b.	Shop Personnel male: female:
	c.	Other (visitors, training groups) male: female:
3.	Space Requirements - Administration	
	a.	Offices: Sizes:
	b.	Conference Room(s)
	c.	Training/Class Room(s)
	d.	Locker Rooms No. of lockers: M: F: Locker Size:
	e.	Lunch Room
	f.	Mechanical Room
	g.	Communications/Computer Room
	h.	File/Storage Room
	i.	Toilet Rooms No. Male: No. Female:
	j.	Janitors Closet
	k.	Space Programming (Adjacencies, Spatial Relationship, ADA Access)
4.	Warehouse/Material Storage	
	a.	Enclosed Size (S.F.)
		Receiving Office (S.F.)
	b.	Outside Storage Area (S.F.)
	c.	Loading Dock Spaces
	d.	Conveyance (fork lift, conveyor, totes, cranes)
	e.	Shelf/Rack Space
	f.	Material segregation for Hazardous Materials (batteries, soap, etc.)
	g.	Spill Containment
5.	Shop:	
	a.	Supervisors Office
	b.	Remote Toilet Room(s)
		Hand Wash Station(s)
	c.	Number of Tracks:
		1. Raised Rail (reference inspection pit section of check list) Number of Spots:
		a. Depth - top of rail top of floor
		b. Access - ramp/stair
		c. Track Support
		2. Flat Track
		a. With Centerline Pit Number of Spots:
		b. Without Centerline Pit Number of Spots:
	d.	Elevated Platforms with Elevated Rail (reference platform section of check list) Number of Spots:
		1. Fork Lift Ramps
		2. Stairs
		3. Lifts
	e.	Overhead Cranes

		1. Spanning Tracks:
		2. Capacities:
		3. Hook Height:
		4. Fall Protection:

f Special Equipment

		1. Drop Table:	Size:	Drop Track	Release Track:
		Wheel Storage Location(s):			
		2. Wheel True Machine:			
		a. Tool change jib crane			
		b. Progression System			
		3. Shim Table:			
		Note that special equipment may be in a separate building			
	g.	Tool Crib			
	h.	Nurses Station/Office			

Table 6-4-1. Locomotive Shop Check List (Continued)

6.	Auxiliary Buildings/Facilities	
	a.	Pump/Compressor/Boiler House
	b.	Tank Farm
	c.	Wheel True Building
	d.	Industrial Wastewater Treatment Facilities
	e.	Turn Table/Transfer Table
	f.	Load Test Area
	g.	Wash Rack
	h.	Service Track
	i.	Paint Booth/Building
	j.	Component Rebuild
7.	Support and Miscellaneous Functions	
	a.	Parking Lot
		1. Pavement Type: Curbing:
		2. No. employee No. visitor No. company vehicles
	b.	Exterior Lighting:
	c.	Landscaping
	d.	Filter/Trash Compactors
	e.	Servicing Facility (reference Parts 4 and 16 of this chapter)
		1. Fueling
		2. Sanding
8.	Trackage	
	a.	Yard Access
	b.	Storage/Parking for inbound and outbound power
	c.	Movements to and from shop
	d.	Test
	e.	Material Storage
	f.	Run-around
	g.	Track pans
		1. Location Length
		2. Type of Pan (Steel, Fiberglass, HDPE, Concrete)
	h.	Blue Flag/Derails
		1. Location Type
	i.	Automatic Equipment Identification (AEI) reader: location:
Locomotive Movement		
1.	–Locomotive Operation (Engine power): Yes/No	
2.	Traction Motor Movement using Locomotive Batteries: Yes/No	
3.	Hy-Rail Tractor (Car Mover): Yes/No	
4.	Progression System: Yes/No	

	a.	Type (cable, rabbit, capstan)
	b.	Size/Capacity
	c.	Number
	d	1 or 2 Directions of travel
	e.	Type of Control

Table 6-4-1. Locomotive Shop Check List (Continued)

Special Equipment		
1.	Cranes	
	a.	Type (bridge, mono, underslung, jib, straddle)
	b.	Size/Capacity (Component weights)
	c.	Number
	d.	Type of Control
	e.	Hook Height
	f.	Span
2.	Drop Table	
	a.	Size/Capacity (Single axle, truck or combination)
	b.	Number of active tracks Location:
	c.	Release Tracks Location:
	d.	Storage & Racking Requirements Location:
3.	Jacks (Permanent or Portable utilized in same location)	
	a.	Type: fixed (in-floor) portable:
	b.	Size/Capacity
	c.	Number (Cable troughs for Jack syncronization Location:
	d.	Power supply:
	e.	Jacking Pad Reinforcement
4.	Parts Washer/Cleaning	
	a.	Type (pressure, chemical, water recirculating)
	b.	Capacity
	c.	Number and Locations
	d.	Hot water Soap
5.	Wheel Truing	
	a.	Lathe or Mill
	b.	Location
	c.	Chip Conveyor/Receptable location
	d.	Manufacturer/Installation Pit
6.	Progression System - see equipment mover section	
7.	Paint Booth/Building	
	a.	Location
	b.	Size
	c.	Type

Table 6-4-1. Locomotive Shop Check List (Continued)

Material Handling					
1.	Conveyance				
	a.	Fork Lift	Capacity	Fuel/Power Supply	
	b.	Conveyor			
2.	Storage - Parts				
	a.	Warehousing	Square Footage	Height	
	b.	Work Stations			
	c.	Racking (Bulk/High Density)	Size	Type	
3.	Storage - Tools				
	a.	Location	Area Requirement		
	b.	Security/Access			
4.	Storage - Hazardous				
	a.	Location			
	b.	Material			
	c.	Quantity			
5.	– Material Core Storage				
	a.	Location			
	b.	Material (Hazardous/Non-hazardous)			
	c.	Quantity			
6.	Shipping Packaging Disposal				
	a.	Location			
	b.	Material (Hazardous/Non-hazardous)			
	c.	Quantity			
Pits					
1.	Depth				
2.	Type (centerline, raised rail)				
3.	Drainage				
4.	Services and Utilities				
5.	Lighting				
6.	Access				
	a.	End Ramp			
	b.	End Stair			
	c.	Side entry			
7.	Track Supports				

Platforms

1.	Height (above top of rail)		Working Width:	
2.	Clearance from centerline of track			
3.	Services required			
	a.	Above the platform	Spacing	

	b.	Below the platform	Spacing
4.	Access		
	a.	Ramp	
	b.	Stair	
	c.	Material Lift	
5.	Storage Items		Square Foot Loading
6.	Material Movement/Special Loading Requirements		Square Foot Loading
7.	Railing and Protection (Permanent or Removable)		

Table 6-4-1. Locomotive Shop Check List (Continued)

	Mechanical Services (Piped) List for each equipment and work station item. Identify pressure, flow, storage location and valving.
1.	Oxygen
2.	Acetylene/MAPP
3.	Natural Gas
4.	Compressed Air
5.	Soap
6.	Journal/Bearing Oil
7.	Compressor Oil
8.	Lube Oil
9.	Diesel Fuel
	Diesel Exhaust Fluid (DEF)
10.	Used Oil Collection System
11.	Radiator Water (borate mixture)
	Antifreeze
12.	Radiator Water Reclaim
	Toilet Chemical
	Toilet Dump
13.	Raw Water (potable, non-potable)
14.	Hot Water (potable, non-potable)
	Traction Sand
	Electrical Services List for each equipment and work station items. Identify voltage, amps, and light levels.
1.	Welding receptacles Voltage: Amps:
2.	Convenience receptacles (tools) Voltage: Amps:
3.	Battery Charger receptacle Voltage: Amps:
4.	Special/Task Lighting
5.	Blue Flag/Light system inside shop
6.	Special Equipment (Cab Signal Testers, Head End Power Receptacle (HEP))
7.	Lighting
8.	Back-Up Power Generation
9.	Renewable Energy Sources (Solar, Wind)
10.	Facility Grounding/Bonding & Lightning Protection (Electric Traction Requirements)

Building(s) Interior Finishes
Identify by Each Space/Room

1.	Offices (identify various spaces/needs)	
	a.	Floors
	b.	Walls
	c.	Ceilings

2.	Warehouse (identify various spaces/needs)	
	a.	Floors
	b.	Walls
	c.	Ceilings
3.	Shop (identify various spaces/needs)'	
	a.	Floors
	b.	Walls
	c.	Ceilings

Table 6-4-1. Locomotive Shop Check List (Continued)

4.	Auxiliary Buildings (identify various spaces/needs)	
	a.	Floors
	b.	Walls
	c.	Ceilings
Other Building Requirements		
1.	Security	
2.	Visual Control from Offices	
3.	Communications/Data needs	
4.	Bulletin Boards/Display Cases	
5.	Fire Monitoring and Suppression/First Aide Cabinets/Emergency Communication (BDA)	
6.	Emergency Eye Wash/Showers	
7.	CCTV/BTV to include cable conduits	
8.		
Building Environment Identify for each space.		
1.	Lighting levels (varies by need/use)	
2.	Ventilation (varies by need/use)	
3.	Air Conditioning (temperature/humidity requirements)	
4.	Heating	
	a.	System type
	b.	Fuel availability
	c.	Heat source
	d.	Distribution system
5.	Special operations/equipment & operational exhaust requirements	
Wastewater Treatment Facility		
1.	New or Existing	
	a.	Location
	b.	Effluent limits
	c.	If existing - adequate capacity
	d.	Permit limits - if any
Drainage		
1.	Storm water surface run off	
	a.	Drainage ditch or other surface structure (off or on site)
	b.	Municipal system
	c.	Other
2.	Sanitary	
	a.	Municipal system
	b.	On-site treatment
3.	Industrial	

Table 6-4-1. Locomotive Shop Check List (Continued)

	a.	Municipal discharge point
	b.	On-site treatment or retention
	c.	Permit
4.		
5.	Collection System	
	a.	Track Pans, Truck Pads, Containment areas for Industrial Activity, Dumpsters, etc.
		Inbound/Outbound Service Area
1.	Type of containment	
	a.	See drip pan type - trackage section this schedule
	b.	Track slab
2.	Services required (indicate inbound or outbound)	
	a.	Used oil collection
	b.	Washing
	c.	Inspection
	d.	Radiator water
	e.	Lube oil
	f.	Platforms
	g.	Canopy
	h.	Lighting (General/Task)
	I	Traction Sanding
		Miscellaneous
1.	Air Quality Considerations	
	a.	Non-attainment area
	b.	Discharge Limits
	c.	Polluting Emitters (tanks, cleaning equipment, heating equipment, welding, painting, etc.)
2.	Hazardous Materials	
	a.	Review Material SDS Considerations
	b.	Quantities
	c.	Storage Location, Containment, Protected from elements
	d.	Disposal
3.	Washing Operation	
	a.	Cleaner/Soap SDS
	b.	Type of dispensing equipment
	c.	Location(s)
	d.	Hot/Cold/Mix Water
4.	Parts Cleaner	
	a.	Type/model
	b.	Heating Required/Heating Source
	c.	Ventilation requirements

	d.	Drainage requirements
	e.	Power requirements

Table 6-4-1. Locomotive Shop Check List (Continued)

	f.	Cleaner MSDS
	g.	Location
	h.	Water requirements
5.	AEI Reader - inbound and outbound track	

SECTION 4.2 SITE CONSIDERATIONS

When selecting a site for a locomotive repair shop a number of factors will need to be considered.

At a minimum these factors are: traffic flow, sufficient area for the proposed facility and the attendant trackage into and out of the facility, availability of utilities, site roadway access, relationship to existing (if any) servicing facilities, material storage, bulk fluid storage facilities, ready tracks and administrative or crew buildings. Other factors may be the proximity to non-railroad buildings that may be impacted by the construction of a facility such as road crossings, wetlands or other habitat areas and air quality and noise level issues for adjacent properties.

In many instances the location of the locomotive shop may require the need to perform, at a minimum, a Phase 1 environmental investigation, possibly soil borings and soils analysis will be required.

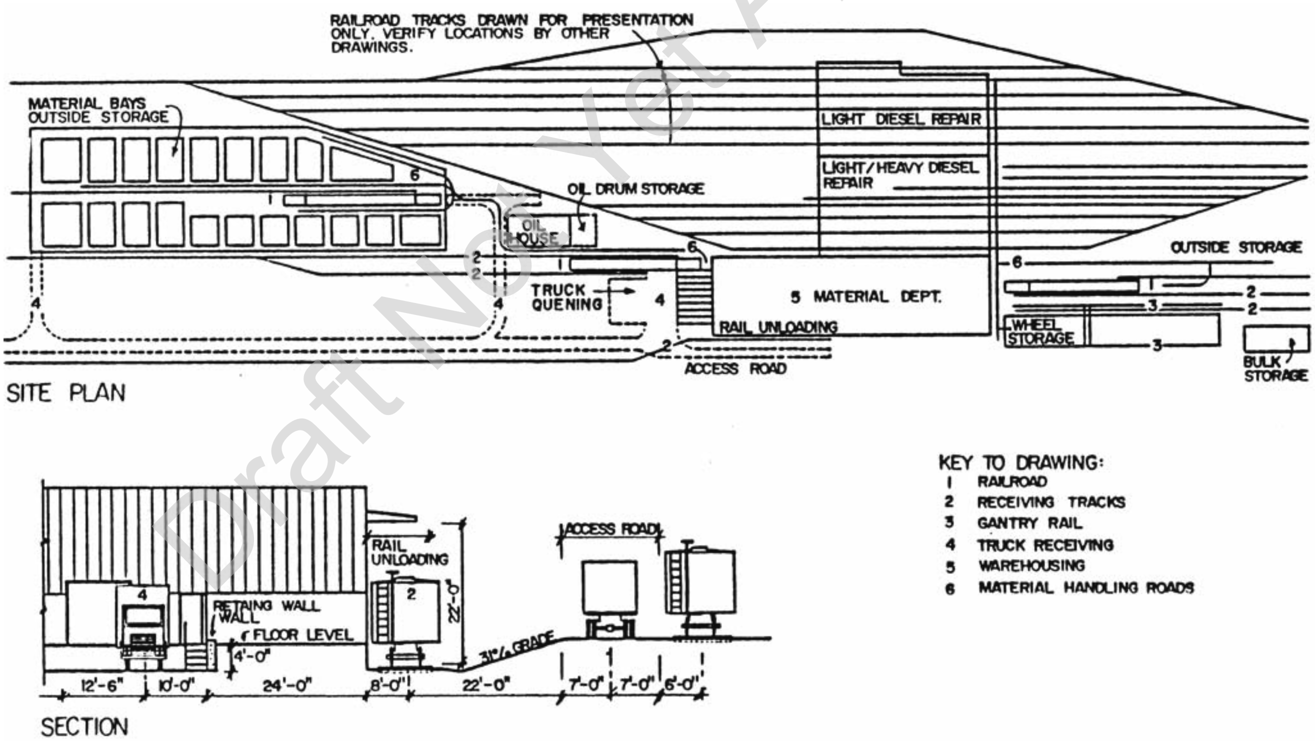

Figure 6-4-1. Typical Site Plan

SECTION 4.3 BUILDING ARRANGEMENT

4.3.1 GENERAL R(2012)

a. The design professional should be aware that the design requirements may present problems with the building code and fire officials having jurisdiction in that the size and classification of the building may exceed that allowed under the building codes they use for granting permits. Early discussions with the authorities concerning the project and what issues they want addressed by the design can reduce possible delays or redesigns for obtaining building permits.

b. The designer should consider OSHA, NFPA, local building codes and federal regulations when undertaking the design of the facilities.

c. In designing and planning a locomotive repair shop tracks through the shop should be parallel and run through the shop where the service requirements and the site facilitate this option.

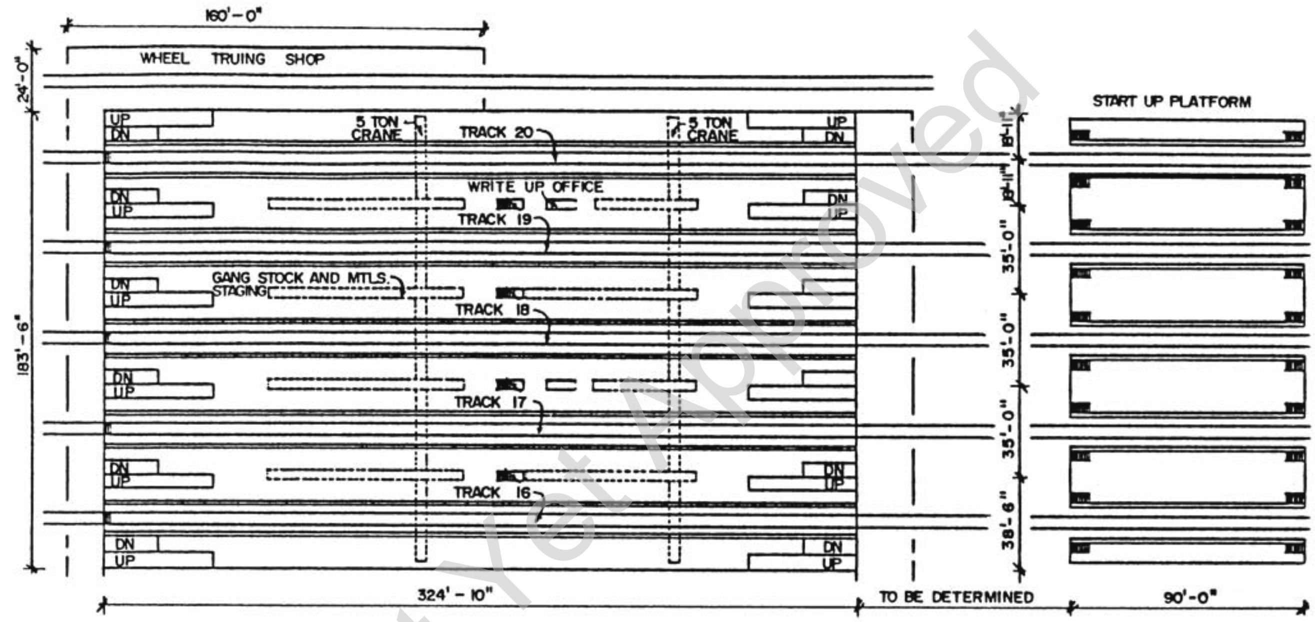

Figure 6-4-2. Typical Light Repair Facility

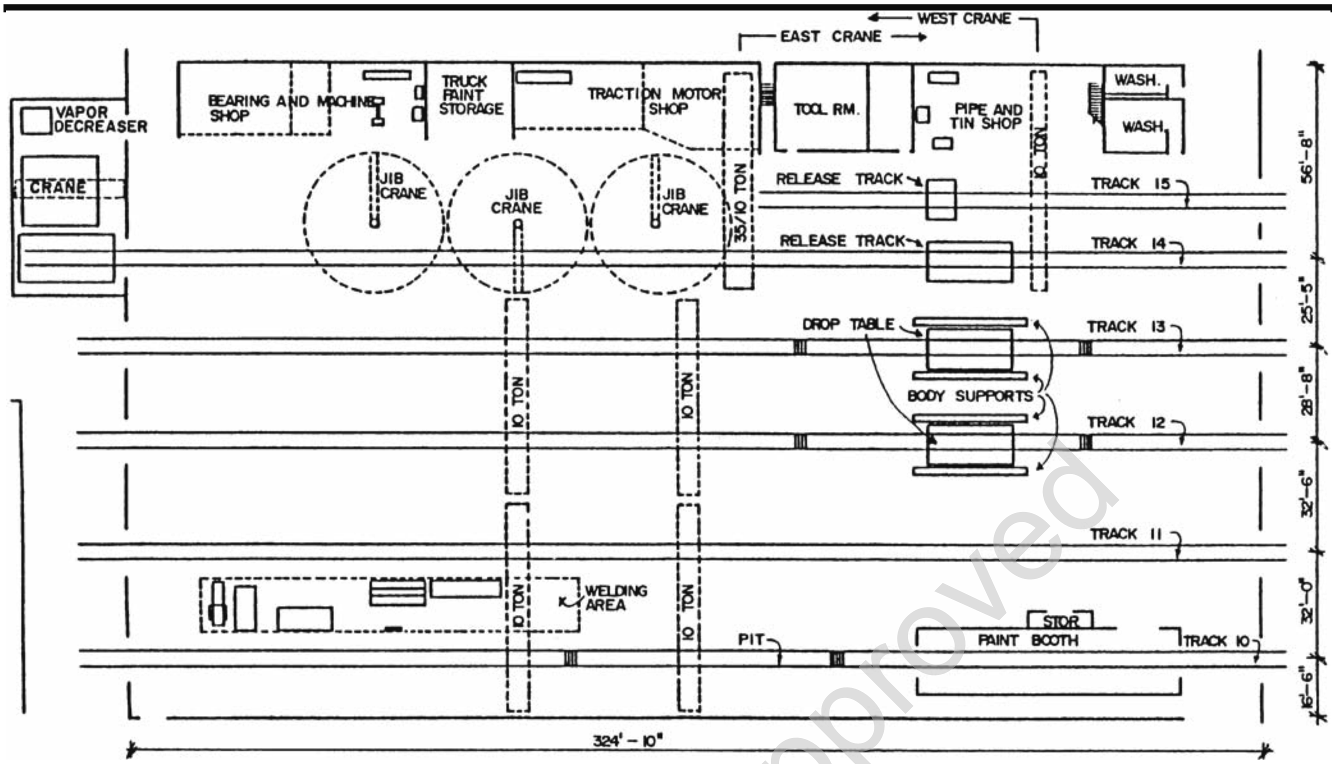

Figure 6-4-3. Typical Heavy Repair Facility

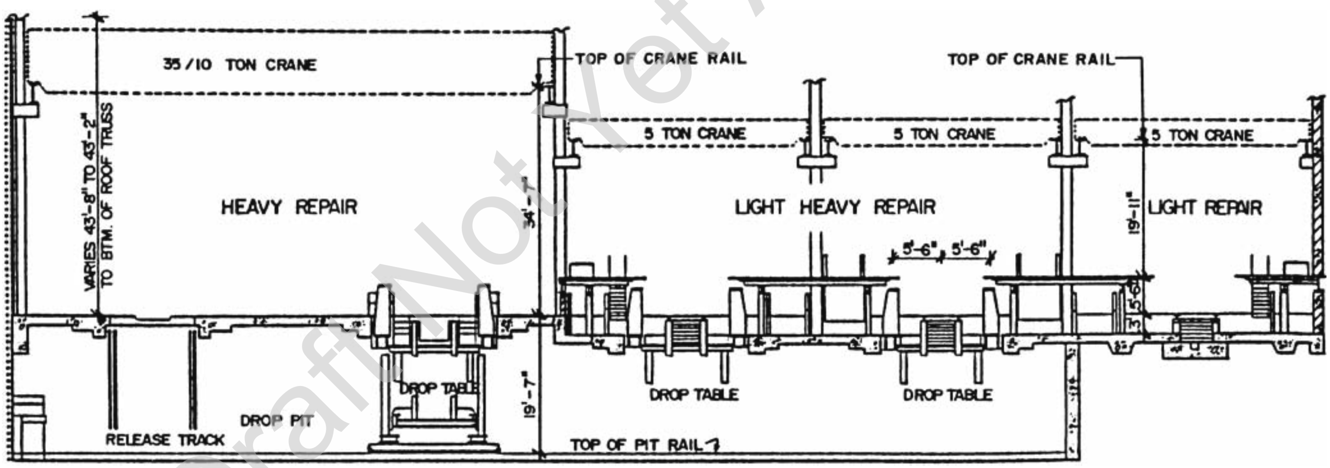

Figure 6-4-4. Typical Cross Section

d. For greater efficiency of operation, the locomotive shop should be designed on a production line concept. Where possible there should be separate tracks inside the facility providing options for the various repair requirements of a locomotive. Ideally locomotives requiring heavy repairs, heavy component replacement or wheel work would not be in “consist” with those requiring only light or medium repairs. The owner should be able to provide information as to their typical production rate for the required operations if they requested that the designer determine the size of the shop.

e. If a heavy repair track is part of the design, it may be acceptable to use a stub end track due to the time element required for heavy repair work.

f. The size and arrangement of the shop will be dependent on the type of repairs to be done and the number of units to be serviced (released) per day. The type of work being performed on each track will dictate the rail configuration and equipment requirements for that track and shop.

g. The design and layout of the shop should incorporate all of the equipment and other functions to support the repair, servicing and inspection of locomotives. These items may include: overhead cranes, drop tables, wheel true machines, forklift access, elevated platforms, exhaust systems, personnel access, material movement to the work areas, material storage space, waste removal and fluid dispensing stations and drainage.

h. Because of the nature of the work being performed on a heavy repair track the designer will have to work closely with the user to determine the desired means of accomplishing the work. Typically a heavy repair track will use a 250 ton overhead crane for lifting an entire locomotive to replace trucks, fuel tanks or other items. However, this requires a heavy building structure and in a seismic area may represent a significant design and cost challenge. It may be appropriate to evaluate fixed or portable floor mounted lift equipment for some functions with lighter overhead cranes (35 ton) to support the heavy repair operation. The user will also need to decide on the type of drop table they need, either a full truck with or without a single axle auxiliary or a single axle drop table

i. Selection of the overhead crane size(s) will depend upon the work being performed and the size of the components involved. This will need to be confirmed with the user. Most work done on a light and medium repair track can be done using a 3 to 5 ton capacity crane, work involving generators possibly a 15 to 20 ton crane, single traction motor combos require a 10 to 12 ton crane, full truck assemblies require a minimum capacity of 35 tons and locomotive lifting requires a minimum of a 250 ton crane or tandem 125 ton cranes. A wheel truing operation requires either a small overhead crane or jib crane for cutter head replacement. The use of auxiliary hoists and type of controls is also an item for discussion with the user.

j. Light and medium repairs are usually performed either on an elevated rail with elevated platforms or with a centerline pit. An elevated rail has a depressed floor on the outside of the rails and a centerline pit has the floor on the outside of the rails typically at the top of rail elevation. Reference Articles 4.4.1, 4.4.2 and 4.4.3 for additional information.

k. Heavy repairs are usually done on flat tracks or possibly with a centerline pit. The pit may or may not need removable covers. The centerline pit allows access to the underside of a locomotive to permit the personnel to reach components that must be disconnected prior to lifting a unit off a truck. The heavy repair track may also require in-floor tie downs for frame straightening or other work in conjunction with a jack. Reference Article 4.4.4 for additional information.

l. Wheel truing operations should be done on a dedicated track. The wheel true machine has unique requirements.. Reference Article 4.4.7.1 for additional information.

m. Track centers will vary depending on the classification of the work being done on the tracks, width of any possible platforms and service equipment access requirements. Typically dimensions vary from 18 feet to 34 feet with most needs satisfied in the 26 foot to 30 foot range. Drop table and wheel true track have special needs that may not be consistent with this generality.

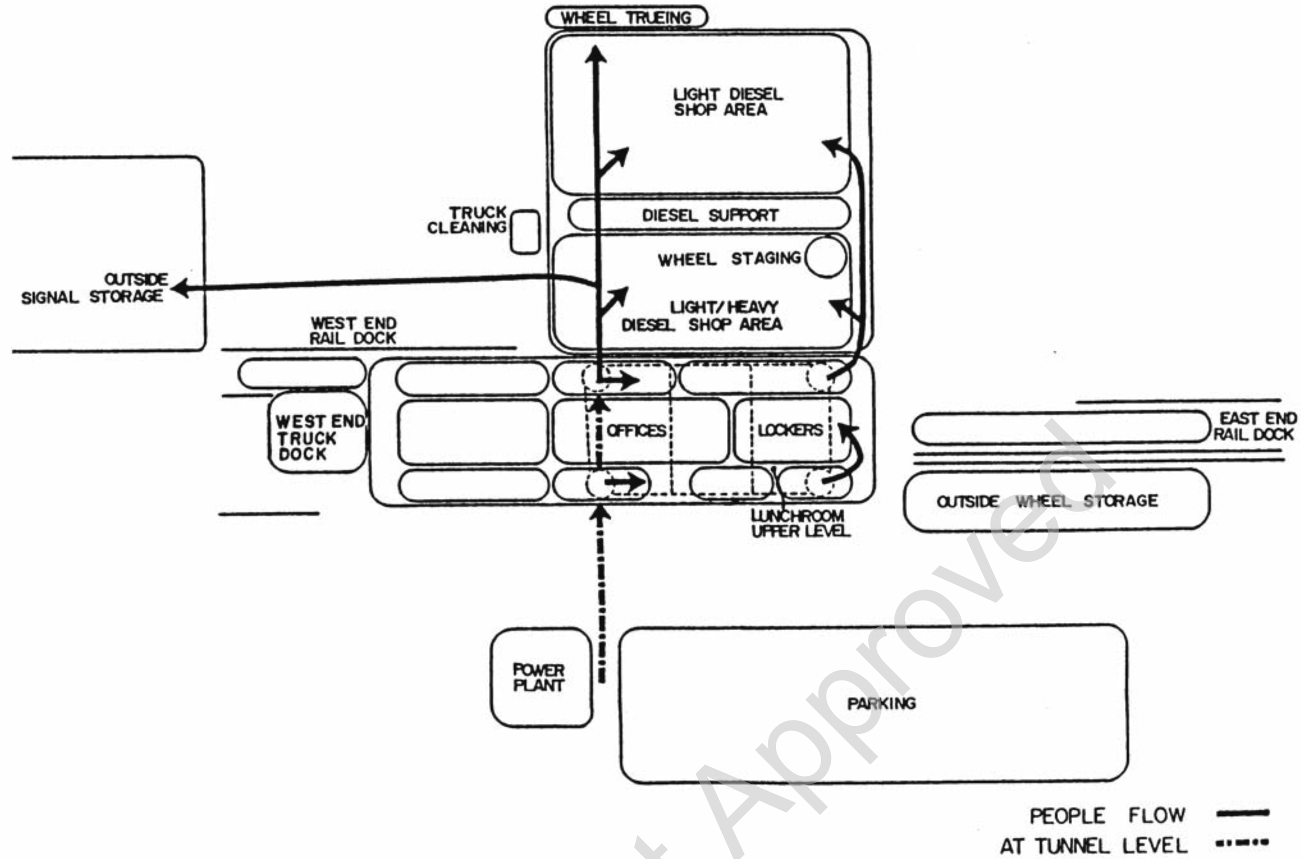

Figure 6-4-5. Typical Flow Diagram

n. The shop may also require rooms or spaces allocated for: machine shop, combo rebuild, metal shop, battery shop, tool crib, electrical shop, truck repairs, production supervisor, etc.

o. In locations subject to heavy snow fall, provide adequate areas to deposit plowed snow or provide the means to remove snow from areas that must be traversed or accessed by service employees.

SECTION 4.4 EQUIPMENT AND RELATED FACILITIES

4.4.1 PITS R(2012)

Inspection pits, maybe either centerline or raised rail types. The correct depth is usually an item of preference. As a general rule the top of rail elevation above the pit floor should be between 4'-6" and 4'-8". This elevation can be varied to suit the users requirements. The length of the pit should be greater than the overall length of the locomotive or consist being serviced to allow for personnel access at each end, a minimum of 10 feet is suggested. It is also desirable to have intermediate points of access for those longer than one locomotive length.

a. The pit rail support system may either be cast in place concrete or structural steel. There are a number of design options available for the engineer's consideration and each option, of course, has its advantages. Stem or stub walls provide

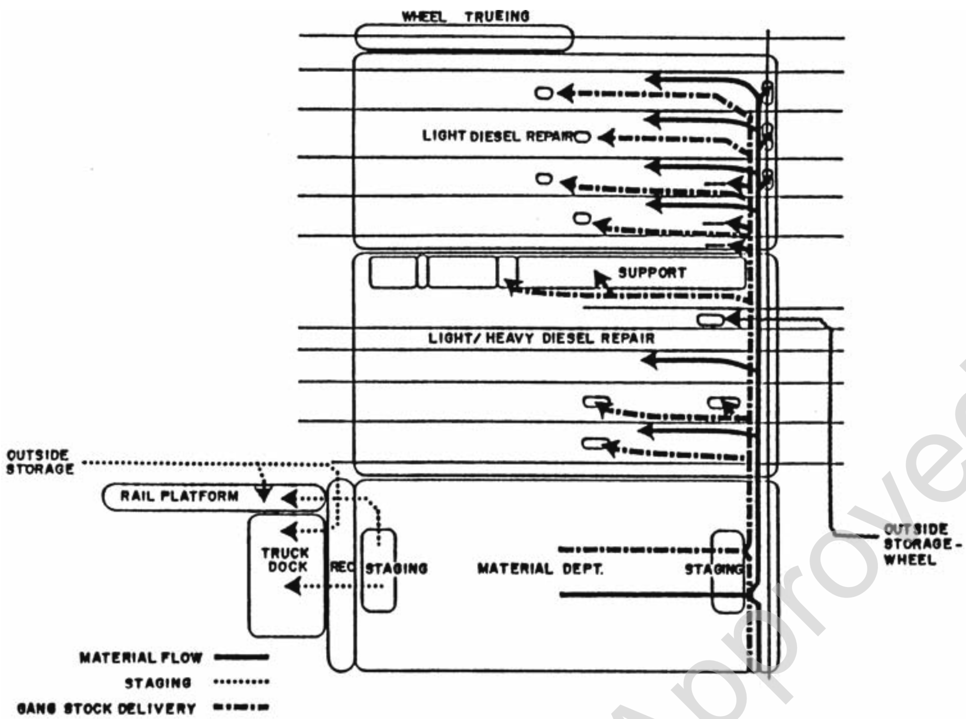

Figure 6-4-6. Typical Material Flow Diagram

stability, better rail support and facilitate the support of auxiliary services equipment such as lighting and piping and can be configured for any reasonable number of side access openings.

b. Pedestals may present stability and long term maintenance issues. These issues can be overcome by the engineer through proper design. The pedestal design is perceived by the service personnel as providing better air circulation and a less confined feeling. However, support of lighting and service piping can reduce the access options and require additional detailing to support and locate these items. The maximum unsupported span of the rail should not exceed 4 feet 6 inches. This span is dependent on the rail weight (section), pedestal design and calculated locomotive loading and should be verified by the design engineer.

c. The inspection pits can be designed with a number of services. The primary items required in the pit are adequate lighting followed by convenience power receptacles. In addition a traction motor oil dispensing system and possibly a crankcase dump system as well as a sliding tray may be desired. The sliding tray is a simple device that provides a moving tray suspended between the rails that holds traction motor cell packs (lubricant) in a position that reduces the effort required by the service technician.

4.4.2 DEPRESSED FLOOR - RAISED RAIL (2012)

The depressed floor for the raised rail places the service personnel in an ergonomic position with respect to the locomotive for inspection, making a repair to the trucks, brake shoe change out, brake work and other outside the rail work. The elevation of the floor may vary between 2 feet 6 inches (30 inches) and 3 feet (36 inches) below top of rail of the inspection pit. The floor should be sloped to drain and it is recommended that a floor sealer be used to facilitate the cleaning of the area as it will frequently be subjected to spilled petroleum products. The recommended slope is one eighth (1/8) inch per foot. It is also recommended that means to get parts to the lower section to be considered.

4.4.3 ELEVATED PLATFORMS (2012)(R2024)

a. Elevated service platforms provide a means for service personnel to access the locomotive at or near running board height. These platforms are typically provided between and adjacent to light and medium service and repair tracks to provide access to both sides of a locomotive.

b. The elevation of the platform above top of rail needs to take into consideration key maintenance aspects. The elevation impacts the relationship between the servicing personnel and running board height but also the below platform clearance for personnel working in the raised rail (depressed floor) area. The elevation from top of rail to top of running board varies between the types and models of locomotives. Running board height can vary between five (5) feet and to more than six (6) feet with the newer models being taller (5 ft. 9in seeming to be average). It is suggested that the designer determine the predominant model being serviced by the user prior to setting this dimension. It is preferable for the elevation of the platform to be slightly lower than that of the locomotive because this facilitates access by service personnel under the locomotive hand rail. If car body style locomotives (locomotives with no external running board) are serviced, the platform must be lower than the car body side doors.

c. The platform clearance from center line of track should be a minimum of 5 feet 6 inches. Because the dimensions of locomotives can change with new models this dimension should be verified to allow a nominal distance of 6 inches of clearance between the drip line of a locomotive and the edge of the platform.

d. Platforms should be constructed of steel and/or reinforced concrete structure with a grating or concrete top. The design factors which should be considered are: amount and density of the material stored on the platform, if any, and the size and capacity of the forklift working the platform. The surface should be a grating or solid but consideration should be taken into account to prevent debris from dropping on personnel working below the platform. Signage should be posted at each platform denoting the design capacity (PSF) of the platform.

e. Platforms should be designed to facilitate distribution of maintenance parts and personnel access.

f. Platforms should include provisions for removable or gated guard rails along the servicing side of the platform. All railings along the track as well as other areas of the platform are to be provided with OSHA standard guard rail system.

g. For platforms requiring access for forklifts a ramp should be provided with a maximum of a 12% slope for access up to the platform and below the platform if there is a depressed floor.

h. Where space is at a premium, material movement may be accomplished by mechanical movers such as cranes, conveyors or hydraulic lifts.

4.4.3.1 Other Elevated Platforms

a. High level platforms and/or fall prevention devices to allow access to the top of locomotives may be requested. Because of the probable presence of overhead cranes these types of platforms offer a challenge for the designer and a trade off between crane coverage, side clearance and high level access may need to be evaluated and the impacts discussed with the user.

b. Portable/ movable platforms may be used in flat track areas where fixed platforms and depressed floors are not present or on the service platforms. These platforms may require drop down man ways with guardrails for accessing the top of the locomotive.

4.4.4 JACKING OPERATIONS R(2012)

Where the user prefers to use jacks instead of overhead cranes or for operations where a jack is a more feasible solution to a maintenance operation, the designer will need to provide adequate structural support for this operation. Because the jacking points on the locomotives vary between the manufacturers and models of locomotives it is recommended that the track slab be designed for the maximum size locomotive and capacity of the portable jacks. Typically, the rail will be embedded in the track slab to place the top of rail at the top of floor elevation. The jacking points being located opposite of each other on one end of the locomotive. The minimum width of the track slab should be 10 ft. 6 inches. Often tie downs will be used in conjunction with locomotive jacks. These tie downs should be recessed below the floor level in the track slab with a removable cover. The tie downs should be rated for the load they will be subject to during the jacking operation. Power for the jacks (pneumatic or electric) should be located convenient to the point of use to minimize trip hazards when deployed. The limits of the jacking pad and maximum design capacity should be permanently marked.

4.4.5 DROP TABLES R(2012)

Drop tables are used to change out single axle traction motor combos (wheels and motor) or complete trucks. Because the need to change out full trucks is not frequent the most common drop table is the single axle type. There are two predominant styles of drop tables and these are mechanical and hydraulic. Table capacity refers to the table tops strength to support a locomotive moving across the top. Drop tables come in several configurations as follows:

a. Single axle, minimum capacity 50 tons. Requires a drop table pit and a centerline pit to allow maintenance personnel to access the traction motor power leads. Typically an under the floor passageway is provided for the motor dolly with a release track. The release position is usually provided with a combo storage area and a 10 ton overhead crane for moving the removed traction motor combo and its replacement. The table "top" is typically 6 ft. 6 in. long measured parallel to the track.

b. Two axle truck drop table, minimum capacity 100 tons with a minimum 18 foot long "top". The release point will require a heavier crane or other means for moving replacement components. Full truck drop tables may or may not have an under the floor passage way.

c. Three axle truck drop table, minimum capacity 125 tons, with a minimum 26 foot long "top". The release point will require a crane or other means for moving replacement components. Full truck drop tables may or may not have an under the floor passage way.

d. Combination full truck and single axle drop table, minimum capacity 125 tons, with a minimum 26-foot full truck "top" and 6 foot 6 inch single axle auxiliary "top" on one end.

e. Full truck drop tables described in b, c and d above must be equipped with locomotive body supports. These must be of the type that permits the support bar to be moved parallel to the running rail the full length of the drop table top and extend beyond one end of the top approximately 7 feet 8 inches.

f. Drop table pits may open or closed with an automatic elevating cover at the release point. If there are two active drop spots the release point should be between the drop tracks. If there are more than two, there is no advantageous position for the release point. Drop table pits are typically considered a confined space entry.

g. A consolidated drop table combines the drop table and the hoisting mechanism, resulting in a considerable savings in pit depth. Available only in long top type for dropping complete trucks, they do not lend themselves well to either multiple track operations or closed pit installations. Capacities are available from 50 tons to 150 tons, and top lengths from 15 feet to 26 feet.

h. Access in and around the drop point for the workers in critical. The workers need access to the under the locomotive power leads and connections as well as the traction motor rotating ram. At a minimum they will need a one truck length centerline pit on each side of the drop location.

4.4.6 LOCOMOTIVE PROGRESSION SYSTEMS R(2024)

a. Where a large number of units must be progressed daily through a shop, it may be desirable to incorporate a mechanized progression system. There are several methods for providing a progression system. Typical systems employ a cabled winch type system or an in-floor rabbit system. The progression system should be capable of moving a locomotive from an inbound position (outside of the building) through the shop to an outbound position (outside of the building).

As an alternative to the progression system some railroads may modify their locomotives to move using the locomotive battery to energize the traction motors, they may use a mobile car mover (tired vehicle) piece of equipment or use a switch engine to move the locomotives to and through the shop. Possibly the user may use a combination of methods. For a winch type system, the use of a rope as opposed to a steel cable will reduce any safety concerns in the event of the cable breaking. The designer should ascertain what methods will be used in order to accommodate the selected method in the facility design. The following advantages are inherent in a mechanized progression system:

b. Eliminates the need to dedicate a locomotive and operator.

c. Eliminates the need to remove a unit from train service to work at the shop.

d. Units can be moved in uncoupled progression.

e. Reduces noise and air pollution.

f. Reduces heating and ventilation costs.

The disadvantages are:

a. Greater first cost.

b. There is some difficulty in the installation of the system on raised rail.

c. If a cable system is used there are winch position issues and cable maintenance and safety issues.

4.4.7 TRUCK AND TRACTION MOTOR REPAIR AND OVERHAUL R(2012)

Because of the nature of the work repairs and overhauls to locomotive trucks and/or traction motors are typically made in an area somewhat removed from the locomotive service and maintenance areas.

This area should be provided with adequate overhead cranes for parts movement, a washing area with steam or hot water and detergents, compressed air and possibly lubricant dispensing as well as parts washer units for journals. The cleaning area will be subject to a significant amount of oily waste and mixed solids. The drainage in this area should be designed to intercept the solids and be treated as an industrial waste. Refer to Section 4.9, Pollution (Noise-Air-Water) for pollution control considerations. Embedded floor rails for wheel/ motor assemblies should also be provided. The area will need to be designed to allow fork lifts access and possible heavy trucks for movement of the components into and out of the shop.

Provision should be made to accept shipment and delivery and storage of traction motors and truck components by either rail or truck and possibly both.

4.4.7.1 Wheel Truing (2024)

Wheel truing machines are lathe units or milling machines for turning locomotive wheels without removal from the locomotive. It is recommended that where possible this operation be made a separate function from the service and repair operation on a dedicated track(s). Because of the machine cutter head position movement of locomotives over the machine should be uni-directional and limited to those locomotives being machined.

A wheel true machine typically requires: an installation pit with personnel access, a progression system capable of movement in both directions, compressed air, an overhead or jib crane for cutter head manipulation and a chip removal system. Due to of the amount of metal shavings generated by the wheel truing machine a large storage container is required. This can be a dumpster or rail car. These metal shavings will be very hot when discharged into the holding container. Access for movement of the container must be provided. In addition the storage area where the container is positioned should be provided with containment and industrial drainage. If at all possible the chip container should be located external to the building. Due to the potential collection of metal shavings in the industrial drains, consideration for removal should be reviewed to prevent from settling in the drainage piping. Metals content of effluent industrial water could potentially be elevated and need to be reviewed for the treatment plant design.Consideration of noise from the wheel machine area should be reviewed and possibly located away from other maintenance areas if possible. Ventilation of the pit and wheel truing area should be considered to allow for proper air turnover as well as maintaining ambient conditions for employee comfort and wheel true machine functionality.

As an auxiliary function the user may request a shim table installation to supplement the wheel truing operation. This shim table provides a means to insert shims in single axle springs for cross leveling purposes. The shim table should have a minimum capacity of 50 tons and be installed in an in-floor pit with personnel access and compressed air outlets.

4.4.8 MATERIAL HANDLING PLATFORM R(2024)

A materials handling platform is often associated with a store or warehouse function supporting the locomotive service and repair operation. Reference Section 7 for additional information concerning the storage or warehouse space. A platform to unload trucks and possibly rail cars should be provided adjacent to the locomotive shop. This platform should be designed for forklifts.

For rail car receiving of materials the recommended dock height above top of rail is 3'-7" (high side) and the edge is 5'-9" from the centerline of the rail. The rail car unloading spot may need a means to restrain movement of the car during the loading/unloading process.

For truck docks the height may be between 3'-8" and 4'-4". The dock should be equipped with levelers, locks and lighting.

4.4.9 STORE ROOM R(2024)

Repair parts must be readily available. The needs of the store room or warehouse as well as an outside material storage area should be established early in the design as this is an integral part of the locomotive shop operation. The purchasing and/or stores department should be consulted for their area requirements for material storage, dock space, employee provisions, office requirements, inventory management, security, forklift maintenance, tool storage and forklift movement. Reference Part 6 for additional information.

4.4.10 OFFICE R(2012)

An office area for the locomotive shop supervisory and clerical staff should be located adjacent to the shop area. Space requirements for this area may include toilet facilities separate from the shop personnel which should be American with Disabilities Act (ADA) and Accessible Canada Act (ACA) compliant, meeting rooms, training rooms, and file storage room. The designer will need to obtain user requirements for office spaces and finishes and the occupancy capacity to determine the area.

There may be a preference for an elevated space with windows overlooking the shop area. This area will need to be provided with ADA access. Due to fire separation code requirements there may be some difficulty in meeting this performance. An ancillary in-shop office space for supervisory personnel may satisfy this need. This space will have to be ADA accessible.

4.4.11 LOCKER AND TOILET FACILITIES (2024)

Locker, break, toilet and wash facilities are needed for the shop personnel. These facilities should be located so as to be easily accessible from the shop and from the employee parking area. It is preferable that the shop personnel not be moving through the office space to access the break, locker, toilet rooms or the parking lot.

The primary toilet and wash facilities should be adjacent to the locker rooms. The minimum number of toilet fixtures will be determined by the building codes and the local authority having jurisdiction. All areas will require ADA and ACA compliant toilet facilities.

If the facility is significant in size auxiliary toilet and wash facilities may be located in remote areas of the shop.

Finishes need to be very durable and easy to clean. It should be noted there is the possibility of petroleum coated foot wear and clothing.

The break room will need adequate space for seating, vending machines, counter tops, possible reach in coolers for lunch storage, double bowl sink and storage cabinets. Consideration should be given for the use of the break room for safety meetings and training.

The plan should incorporate space for bulletin boards, electronic displays, first aid kits, and display cases. Auxiliary drinking and wash fountains may be located in the shop for use by the employees.

4.4.12 OTHER FACILITIES R(2012)

The shop may require allocating space for securing tools and tool boxes. This space will normally be portioned off with limited access and security measures. This area may be located outside the materials storage area.

Depending on the smoking policy of the owner a smokers space, or area, either in the shop facility or external to the facility may be required.

SECTION 4.5 SERVICE FACILITIES

4.5.1 SERVICES REQUIRED (2012)

There are a number of services that may be required in a servicing or repair shop. These are: diesel fuel, diesel exhaust fluid (DEF), lubricating oil, oil drainage, traction motor oil, compressor oil, oil changing, anti-freeze, radiator water, soap, compressed air, electrical welding receptacles, battery charger receptacles, locomotive washing, welding gases, etc. The user should provide a list of services required and the areas where the services are needed.

4.5.2 LUBRICATING OIL SUPPLY (2012)

a. Lubricating oil is an important feature of a locomotive servicing and repair facility. "Topping off" or oil changes are a common practice at these shops. Proper design using modern equipment will contribute to keeping the premises clean and minimize fire hazards.

b. Oil dispensing is usually accomplished using hose reels at hose reel stations. These stations consist of a hose reels for each dispensing fluid used in the shop. The lube oil hose reels are typically located on the elevated platform and are spring return type with approximately 50 feet of hose and an automatic dispensing nozzle. Dispensing stations should generally be located on approximately 60 foot centers. Meters may or may not be provided for each hose reel for measuring the amount of oil dispensed to each locomotive. A mechanism for collecting hose drips should be included at the dispensing station.

c. The character of the lubricating oils will need to be determined to properly design the pump and piping systems. For viscous oils in cold climates it may be necessary to provide heat to the dispensing and storage system. The heating system may be by electrical heat tracing, recirculation, or some other method. Typically a positive displacement pump would be used in this type of service. In determining the size and design of the pump system the designer will need to select a pump rate for each dispensing location and probable maximum number of dispensing locations calling for oil at one time (diversity). Suggested design parameters are 25 gallons per minute (GPM) per station with a demand for one hose reel per track calling for oil (i.e. 2 tracks = 50 GPM). If there are a large number of locomotive spots on each track (more than three per track), it is recommended that the demand be increased to two (2) per track.

d. Selection of the means to control the oil dispensing system will depend upon the dispensing system design. Generally a push button pump start controller or a pressure controller/switch/tank will work for a limited number of dispensing locations. For larger demand systems a circulating system may provide the better option as this will eliminate the short cycling of pump on-off demands.

e. Reference Section 4.13 concerning storage tank requirements.

4.5.3 LUBRICATING OIL DRAINAGE/RECOVERY (2012)R2024

a. Locomotive shops need a means of draining the locomotive crankcase. There are several methods for accomplishing this work.

(1) Using a gravity drain system, a collection tank, or other means of containment must be provided that is lower than the locomotive. Where possible an underground tank should be avoided due to environmental regulations regarding underground tanks. Depending on the size and location of the tank, a pump system may be needed to transfer the collected drained oil to a primary storage tank.

(2) Using a pump system with a piping system below the locomotive to transfer the drained oil directly from the locomotive to a primary storage tank.

(3) Portable tanks that are moved to the locomotive being serviced.

b. The primary drained oil storage tank may be a fixed tank or possibly rail tank cars. Typically, the drained oil is of good quality and may be recycled, usually to a contracted recycler. For a rail car operation, a top loading arm assembly will probably be needed with a means of safe access for operating personnel provided. For a fixed tank, provisions will need to be made for truck connections. Most recycler trucks have their own truck mounted pump equipment and the drained oil system may not require a truck loading system. Reference the Section 4.13 for storage tank information.

4.5.4 LOCOMOTIVE TRUCK OIL (2012)R2024

a. Journal oil or bearing lubricant is dispensed in small quantities to the traction motor bearing housing located on each end of the axle. The dispensing equipment should be located low along the inside and outside of an elevated rail or centerline pit. Typically the outlets can be spaced at approximately 30 foot intervals with a short section of small diameter hose and a valved spigot on the end. The user should be consulted as to the preferred equipment. As an option, hose reels below the elevated platform or along the service track may be provided. Lubricant is available in tote containers that could be housed in a heated container with dispensing equipment suited to the application.

b. Traction motor oil is typically a heavy oil and due to the low flow rate that is required, one to three GPM, and location of the dispensing pipe the system design should be evaluated and sized to dispense at ambient temperatures, if the location is inside of a building. For locations outside of a building the same considerations as those for the lube oil system will govern the pump and piping design as well as the method of heating. Additionally small 1-liter bags of high viscosity grease are available for individual addition to traction motors.

c. Reference Section 4.13 for information on storage tanks.

4.5.5 COMPRESSOR OIL (2012) R2024

a. Although not typical, some users may want a piped compressor oil dispensing system. If this is required, the system will be similar to the lube oil system. However, the nature of the lubricants may be very different and the designer must determine the characteristics of the compressor oil used before determining the system design parameters. The dispensing rate will be similar to the lube oil system but the total quantity dispensed will be less.

b. Compressor oil dispensing is usually accomplished using hose reels at hose reel stations. These stations consist of a hose reel for each dispensing fluid used in the shop. The compressor oil hose reels are located on the elevated platform and typically are spring return type with approximately 50 feet of hose and an automatic dispensing nozzle. Dispensing stations may be located on approximately 60 foot centers.

c. Reference Section 4.13 for information on storage tanks.

4.5.6 USED OIL FILTERS (2012) R2024

a. Due to the number of oil changes occurring in the shop and the necessary oil filter replacement a means of draining and disposing of the filter should be considered. Disposal should be accomplished with a minimum of handling. Typically, service personnel will remove the filter and drop it into a portable liquid tight container. The container will have a means to draw off oil that will leak from the filter elements. This drained oil may be disposed of into the drained oil capture system or possibly to an industrial sewer. The preference is to the drained oil recovery system.

b. To reduce the solids volume the user may employ a filter crusher. This equipment usually requires: a solid base/foundation with drainage to an industrial waste system, electrical power and access for fork lifts and dumpster trucks.

c. The filter elements are considered a regulated waste requiring compliance with regulations concerning toxic or hazardous materials. In some instances, the user may have a recycler or user for this waste product.

4.5.7 WATER SUPPLY SYSTEMS (SERVICE AND TREATED) R(2012)

a. Treated radiator water is water that may be softened and/or treated with chemicals to reduce corrosion in the engine prior to adding it to a locomotive cooling system.

b. Treated water may be considered toxic in nature, detrimental to streams and/or municipal sewage plants and may require a separate drainage system or means of retrieval or recycling. The designer should discuss this issue with the user and obtain an MSDS sheet on the material from the user to assist in determining regulatory requirements.

c. Some users use a prepackaged radiator water chemical tablet that is dropped into the cooling system manually. This does not normally represent a hazard to be dealt with.

d. The softener capacity (if required) should be selected to provide a minimum of 12 GPM per track. The need for a softener will have to be determined on a site-specific basis.

e. Radiator water dispensing is usually accomplished using hose reels at hose reel stations. These stations consist of hose reels for each dispensing fluid used in the shop. The hose reels are located on the elevated platform and typically are spring return type with approximately 50 feet of hose and an automatic dispensing nozzle. Dispensing stations may be located on approximately 60 foot centers.

f. The radiator water system will require a back flow preventer to prevent contamination of the potable water system.

g. Raw (service) water may be either hot or cold and is used for general washing or rinsing, but not drinking.

h. Hose reels or spigots for the raw water system should be located at convenient and numerous locations to accommodate the general cleaning of the shop floors and locomotive washing.

i. The raw water system may include a soap injection/ proportioning/mixing system and/or hose reel to facilitate the cleaning operations.

j. The raw (service) water system should also have a back flow preventer providing isolation from the potable water system.

k. Potable water is supplied to the shop for use for the emergency eye washes and showers, drinking fountains and sanitary facilities such as wash basins or lavatories.

4.5.8 RADIATOR WATER RECLAIM SYSTEM (2012) R2024

The system for collecting used radiator water may be similar to that used to collect drained oil from a locomotive. The used radiator water is typically collected and then pumped to a surge or holding tank. The water then may go to a skimming basin for the removal of contaminants such as oil. After skimming, the water either goes directly to a mixing tank for addition of chemicals or is pumped through a filters system and then to the mixing tank. The mixing tank is necessary in order to bring the reclaimed water chemical concentration back to recommended levels. The reclaimed reconditioned water is then sent to a storage tank for future use in locomotives.

4.5.9 COMPRESSED AIR (2012) R2024

Compressed air outlets and hose reels should be provided at convenient intervals about the shop, above and below the elevated platform, in the drop table pit and wheel true pit.

In sizing the air compressors, piping and air reservoir system, the designer should as a minimum assume 20 cubic feet per minute (CFM) per locomotive spot inside the shop plus the air requirements of any air operated equipment and air dryer requirements. Air requirements for locomotive maintenance typically requires 90 psi. Some freight car repair facilities require a higher air pressure. The compressed air design should incorporate pressure regulating as needed.

The compressed air system should be provided with an air dryer and each air tool station should have an oiler and a one way venting quick connection coupling. The selection of the air dryer will be dependent on several criteria: ambient conditions at the shop location, exposure of piping to ambient conditions and energy costs. Consideration for condensate in the system and r

The compressor(s) will typically be located away from the shop in a compressor building, pump house or as an out of doors installation.

It may be desirable to investigate the use of the rejected heat from the compressors for use in space heating.

4.5.10 LOCOMOTIVE WASHING (2012) R2024

There are generally two types of locomotive washing operations that may be performed at a locomotive shop. They are: full wash of the locomotive body (exterior) and truck and spot washing of running boards and engine compartments.

a. Locomotive washing of the exterior body and truck is usually performed in a separate building with automated equipment. Reference Part 12, Design Criteria for a Locomotive Washing Facility for a description of this operation. In cold climates, it may be necessary to provide a heated facility or a location and equipment inside the repair shop for manual washing operations.

b. Spot washing of the running boards and engine compartment may be performed at the repair shop. Provisions to perform this operation on each track in the facility will require water, either hot or cold or possibly both, cleaner/ soap dispensing and an adequate collection and drainage system.

   Due to the potential for petroleum products and grit associated with the cleaning operation the drainage may have to be routed to the industrial treatment plant. The cleaners/ soap may present a challenge for the treatment plant, therefore it should be determined if the treatment plant has the ability to accept the cleaners/ soaps used. If grit is captured this may require the construction of a settling basin, grit trap or interceptor on the drain line prior to the treatment plant.

   The designer should determine if the owner has preferences for: type of wash system, manufacturer or soaps to be used.

   The system may simply consist of totes or drums of cleaner manually dispensed and applied or the system may include dedicated tanks, pumps, dispensing/ mixing equipment, foamers, water, hose reels and possibly a recycling option.

4.5.11 GENERAL WASHING SYSTEM R(2012)

Provision should be made for general cleaning of the facility using water and cleaners/soaps for the floor, pits and platforms. The designer should determine whether or not the owner wants cleanser/ soap dispensers or hot water for the general cleaning operations and design to these requirements.

Connections for the water and possibly cleaner/soap dispensers should be located in several convenient places to reduce the use of long hoses or snagging problems.

4.5.12 PARTS CLEANER R(2012)

Parts cleaning equipment may be used in the traction motor repair operation, as well as for other repair operations. The designer should determine the need for these cleaning areas, the types of equipment the owner will specify, location(s) and the connection needs of the equipment. Typically, the use of a parts cleaner will generate a significant amount of oily waste and water with extreme pH levels that will need to be considered in the design of the installation.

The type of equipment, water or solvent based, will need to be determined to properly design the installation needs. This design should take into consideration: floor coatings, industrial drainage, possible curbing of the area and ventilation.

4.5.13 ELECTRICAL CLEANING SOLVENT R(2012)

If a combustible product is used, ensure that the area is enclosed, well ventilated with explosion proof electrical and mechanical equipment. Depending on the quantities of solvent involved a fire rated storage space may be required for the cleaner material. If a vapor degreasing system is used, provide adequate ventilation in accordance with the manufacturers recommendations. The ventilation of the solvent based cleaner may require special permits or equipment to satisfy the air quality. The disposal of the solvent may be a regulated as a hazardous material. A careful review of the local code requirements should be made for this type of activity.

4.5.14 WELDING & TORCHING GASES (2024)

A typical requirement at a repair shop is the ability to torch and weld on a locomotive.

The decision to install a central piped welding gas distribution system may have a significant impact upon the occupancy and fire rating of the building. An evaluation of the building codes pertaining to the site of the locomotive repair shop and an opinion from the permitting authority is recommended.

The design of a welding gas distribution system will depend on several items: gases being used, quantities and method of storage. Typical welding gas systems consist of oxygen in combination with acetylene, methylacetylene-propadiene gas (MAPP) or MAPP substitute or natural gas. Acetylene burns at a higher temperature than either MAPP or natural gas thereby using less fuel and being faster but has a higher cost.
Acetylene can be provided by manifolding a number of tanks together for a central system or a dual tank portable system may be used. MAPP gas requires provision for a larger storage vessel. Natural gas is typically piped off the local supply.

If a central location is provided for a manifold of gas bottles, the area should be well ventilated, have a roof, security fence and a rigid frame with safety chains for holding the bottles upright and in place. Proper signage must be provided warning of the hazardous nature of the storage area.

4.5.15 ELECTRICAL WELDING R(2012)

Locomotive repair shops need a large number of electrical welding outlets located about the shop. The location of welding receptacles will typically coincide with the locations of the hose reel racks and be spaced along heavy repair tracks at frequent intervals to reduce the distance from the receptacle to the work spot. Verify the type of connection coincides with the type of electrical welder to be use.

4.5.16 BATTERY CHARGING (2012)

Battery charging receptacles are usually located on the elevated platform and mounted on or adjacent to the hose reel racks.

The use of a centralized battery charging station or individual portable battery chargers will need to be determined.

4.5.17 LOCOMOTIVE TOILET SERVICING R(2012)

Although it is not typical to service the locomotive toilets at the repair shop, one of the operations that may be performed is the "dumping" of the locomotive toilet and refilling the toilet chemical tank. There are several methods for accomplishing the "dumping" task: the use of a "honey wagon", a wheeled container with appropriate fittings, an in-floor system with appropriate fittings for the drain hose and a vacuum system. All of these systems are discharged to a sanitary sewer. It is recommended that the designer obtain the safety data sheet for the toilet chemical to verify that the chemical may be discharged to the local municipal system.

In addition to dumping the toilet the means to add a toilet chemical to the holding tank may be required. This can be done using a pump system with its attendant hose reel or a dispensing location for filling a container for the employee to fill the holding tank. A locomotive may only require 3 to 5 gallons of toilet chemical.

4.5.18 LOCOMOTIVE DEICING R(2012)

In extremely cold weather conditions icing or freeze up of locomotives may occur. Provision for thawing out the locomotive may be desirable.

Deicing the locomotive may be accomplished by using steam, fixed or portable infrared heating units, hot water, raw (service) water or by the shops heating system. Proper ventilation of the water vapor generated by the deicing operation should be considered. When considering the design parameters of a deicing system the thermal mass of the locomotive will need to be considered.

A frozen locomotive may have "dumped" its cooling water. Warming the engine block up should be done gradually to prevent cracking. This can be accomplished using hot or tepid water or raw (service) water that is passed through the radiator cooling system until the engine block temperature is raised to an above the freezing temperature. Provisions will have to be made for collection and disposal of the water passing through the system as well as any heater for the water provided. The decision of using hot/warm water versus a raw (service) at ambient temperature water will depend on the required time demand.

SECTION 4.6 BUILDING SUPERSTRUCTURE DETAILS

4.6.1 GENERAL R(2012)

Early in the design stage of a locomotive repair shop, the engineer/architect should consult with the environmental, building and fire officials having jurisdiction to obtain information on their requirements and classification of the facility. There will be differences in the requirements between jurisdictions. What involvement each jurisdiction requires will be an important point to determine.

Due to the size and nature of the repair facility the codes officials may have demands that need to be addressed early on in the design. A code analysis should be performed at the earliest stage of design in order to determine any special requirements that may affect the building design. Once an analysis has been completed it is recommended that a meeting be held with local officials to determine what if any additional requirements will be imposed upon the work.

4.6.2 FLOORS R(2012)

The design of the floor should consider the operation and equipment loading on the floor as well as equipment described above. Items to consider are:

- Heavy forklift and/or mobile car mover equipment may traverse the floor.
- Progression equipment provisions, anchor points and foundations.
- The floors should be sloped to provide positive drainage for washing and spill collection.
- The floors should have a sealer that is resistant to floor cleaners and petroleum products.
- Provide an anti-slip treatment.
- Provide safety striping for walking aisles, trip hazards, fall hazards and equipment clearances.
- Provide chemically resistant waterstop and joint sealants at construction joints.
- Spaces attached to the shop should have flooring similar to the shop floor requirements for compatibility of cleaners, petroleum, etc.

4.6.3 WALLS AND ROOF (2024)

The building structure should be constructed of non-combustible materials.

It is recommended that the lower portion of a building wall be constructed of durable material, such as concrete to protect the building from forklifts, material handling, etc. The height of this lower portion should not be less than four (4) feet high with a metal liner or other durable material above that to at least a height of eight (8) feet to ten (10) feet above the floor.

The interior of the building structure should be painted a light reflective color to enhance the lighting in the shop.

Interior surfaces should be selected for ease in maintenance and cleaning and if possible materials with sound deadening properties is also recommended.

A sloping roof is recommended. Although flat roofs are an option, they may represent a possible increase in maintenance. The roof should be provided with a means of access for roof mounted equipment servicing, preferably without the need to use ladders or lift equipment. Roof access as well as means to provide walkways to major equipment with fall protection should be considered. Refer to Part 14: Roofing Systems.

Consideration should be given to providing skylights or wall translucent panels/windows to enhance day lighting of the shop.

Sound deadening for the walls of the welfare spaces (administrative, lunch, locker areas) should be considered to reduce the noise in these areas from locomotives idling or passing by the facility on exterior tracks.

Bird Netting or other means to deter birds from nesting up in the wall and roof structure may be considered in the design.

4.6.4 DOORS R(2012)

Locomotive entrance doors should be a minimum of 14 feet wide by 18 feet high. Owner clearance regulations should be reviewed to verify their requirements. Locomotive entrance doors should be provided with power operators. Consideration for the use of high speed and/or impact resistant doors is recommended.

Overhead doors for forklifts or delivery trucks may be of a smaller size and located to provide access to the shop and the warehouse or material storage space and are separate from the locomotive access doors.

All personnel doors should have a sidelight or door window for safety reasons, where feasible, and be configured to prevent exiting personnel from walking onto a track or traffic way. The door may need a stoop and/or provided with guard railing to provide this protection.

The fire rating of the wall that a door is installed in must be considered in door selection. The codes will provide information on the required fire rating of the door and glass as well as opening size for emergency exiting.

SECTION 4.7 HEATING AND VENTILATION

4.7.1 GENERAL R(2012)

For the welfare (administrative, lunch and locker spaces) area standard practices are acceptable. Local energy codes should be reviewed and complied with to the extent that they address the buildings particular needs. Attention to the location for outside air intakes is recommended due to the possibility of capturing locomotive exhaust fumes from nearby idling or passing locomotives.

Heating and ventilation of locomotive repair shops pose a significant challenge to the designer. Shops maintenance areas typically do not require air-conditioning. The administrative and locker areas will likely require heating and air conditioning. The welfare areas should be on separate systems from the shop maintenance area(s).

It is strongly recommended that locomotive engines not be operated in the shop. The owner will have to be consulted on this issue to determine if this is anticipated and the probable locations, durations and types of locomotives that may be operated in the building. If locomotives are allowed to run in the building the owner needs to understand that this represents a significant first cost and long term operating cost to the facility. The exhaust fumes represent a health hazard, a fire hazard with residue build up and a cleaning/ maintenance issue as it coats the underside of the roof, light fixtures, and exhaust fan blades.

If engines are allowed to operate inside the shop facility at large, this situation will require ventilation and make-up air systems. This issue can be addressed by use of some type of progression or mover system.

Aside from the air quality issues an operating locomotive engine will generate a large amount of heat that will possibly be a discomfort to the work force, especially in warmer climates or during summer months.

4.7.2 VENTILATING R(2012)

Prior to designing the heating and ventilation system for the shop area the operating practices the owner intends to use for the shop must be determined. This should include considerations for shop equipment like wheel true and drop table pits. This will permit the designer to calculate the impacts the operation of a locomotive engine may have on the capacity requirements of the systems.

There are two currently accepted methods for handling emissions in a repair shop. These are dilution and local capture by hoods. There are other emerging and maturing technologies that may provide additional design options. These other options include demand controlled local systems and direct capture methods.

a. Dilution ventilation is usually employed when high ceilings, overhead cranes or other obstructions preclude the use of hoods. With dilution ventilating, the total volume of space to be exchanged should be as small as possible. Normally six (6) air changes per hour will provide adequate dilution for locomotives that are idled in the shop at less than 350 rpm. This ventilation rate will permit recovery if a short run at a higher speed is done on individual or multi-unit consists. The temperature stratification is a very important consideration because most diesel engine emissions are denser than the ambient air and drop towards the floor once they lose a 40 degree differential from the ambient air temperature. With the introduction of dilution air, the dilution air must be either tempered or introduced into the shop at a low elevation to ensure the emissions are not cooled before they can be captured and removed by high sidewall or roof mounted ventilation equipment. In cold climates, this poses a comfort problem for the work force that must work around and under the locomotive unless the make-up air is tempered prior to distribution in the building. Tempered low level dilution air discharged into the work area will help alleviate some worker discomfort. In warm climates, the differential in temperature is quickly lost, hence dilution ventilation is a less desirable solution unless prevailing winds are reasonably strong and frequent. The use of a low discharge point for make-up air with a high sidewall or roof mounted exhaust system will also facilitate removal of the emissions. When exhaust emissions cool, they tend to curl over and around the top of the locomotive and be ingested through the radiator cooling intakes, further compounding the problem of capture and removal. Generally dilution systems are less sensitive to locomotive placement and offer more flexibility when accommodating overhead cranes or other obstructions. However, they require large volumes of make-up air and have a high energy cost of operation.

b. Capture hoods are more difficult to position and represent an interference with overhead cranes or other structures but they can reduce the exhaust volume, the make-up air requirement and operating costs.

(1) In the design of capture hoods for emissions at or near the point of generation, care must be taken to ascertain the physical location of the stacks of the different types of locomotives and their location on the shop floor to co-ordinate clearances and operations with other services and equipment. The radiator cooling fans can cause turbulence and disrupt the capture of emissions when operating. The exhaust capacity of the hood should also consider: exhaust velocity, exhaust volume (at anticipated engine operating rates) and radiator fan impact on the air volume entering the hood. The hood entrance velocity should be at least twice the locomotive exhaust discharge velocity, which becomes impractical at higher throttle settings. If the hood is located some distance from the locomotive stack, the system takes on the characteristics of a dilution ventilation system Locomotives cannot be subjected to any significant increase in backpressure imposed by hoods or dust collection systems, hence any hood configuration should have large, unrestricted cross sections that duplicates a free air discharge. In the design of capture and containment hoods, occupational safety and railroad clearance regulations should be reviewed.

(2) In the design of mechanical ventilation systems, long duct runs and numerous turns should be avoided since they become collection surfaces for the oily carbon residues from emissions that eventually increase the risk of fire. In the design of the duct work and ventilation fans, adequate provision should be made for access panels and doors at any in-duct installations for ease of cleaning this carbon residue. In specifying fan drives, every effort should be made to keep the fan motor out of the contaminated air stream. Typically this is accomplished using a belt drive system. Fan bearings should also be checked for suitability with the higher temperatures and chemical composition of the contaminated air stream that it will experience in this service.

For those "no smoking" shops (locomotive engines are not allowed to run) the need for ventilation is greatly reduced to that needed for ventilation for summer cooling and worker comfort. For both the shop and the welfare areas the minimum ventilation rate should be determined by using recommendations in the latest version of ASHRAE 62.

It is also suggested that the designer should reference the latest version of the ASHRAE Applications Handbook and ASHRAE Industrial Ventilation Handbook for additional information.

4.7.3 HEATING R(2012)

a. The selection of the heating source for the building will depend upon several factors. These factors are: availability, cost and size of the shop and heating load. The use of fixed or portable heating equipment will depend upon the size of the shop and the climate the shop is located in. In some instances the use of recovered oils as a fuel source may be feasible for all or part of the heating requirement.

b. In addition to the fresh air introduced into the building to replace that for locomotive exhaust ventilation, make-up air may also be used for space heating when large volumes of make-up air are continuously required. Where the make-up air units need not be operated continuously, it may be economically justifiable to provide supplemental space heating to offset natural building

c. heat losses. A supplemental system may be a single or composite system which might include: under floor warm air, in-floor hydronic, fin tube or coils, unit heaters, infra-red, furnaces or other systems. The fuel source should be selected on cost of fuel and availability. Air to air heat exchangers to recover heat from the exhausted air may be feasible provided the exhausted air is not heavily laden with contaminants that may foul the heat exchanger.

d. In shops with operating locomotive engines the use of direct -fired gas equipment may present a problem with contaminated combustion air. A piped or ducted outside combustion air in-take may be needed.

e. Besides direct-fired equipment (gas or oil) other options include steam, hot water or electric.

f. Due to large door openings in the shop there can be significant heat loss during the movement of locomotives into and out of the facility. This condition will have to be considered in sizing the heating system and determining a recovery time for the movement of locomotives in severe weather.

g. In cold climates where the locomotive is brought in at ambient temperature, the effect of the large cold mass of the locomotive should be considered in sizing the heating capacity of the equipment.

SECTION 4.8 ELECTRICAL LIGHTING AND POWER SUPPLY

4.8.1 GENERAL (2024)

a. Specific requirements are usually dictated by the local code, availability, equipment requirements and other project specific needs. The user may also have internal electrical design standards that may govern, if they meet or exceed code requirements.

b. Specific requirements for outlet locations, lighting types and location are user related and vary between facilities and users. These requirements may not be less than the building codes minimum requirements.

c. For lighting of inspection pits various types and configurations may be used. It is recommended that the designer consult with the user to determine if there are preferences or specific input into the type of lighting and configuration to be used. Due to washing operations and the fluids dispensed the lighting units should be rated for the materials and conditions it will be subject to.

d. Inspection pit lighting is provided for safety purposes in addition to task lighting while convenience receptacles (waterproof) should also be provided inside the pit. The selection and placement of receptacles may be dictated by client requirements or local code interpretations.

e. For exterior lighting requirements the designer is referred to AREMA Chapter 33, Part 10 for information.

f. The various areas of a locomotive repair facility have differing light level requirements. The best source of information for the design of the lighting is the Illuminating Engineering Society (IES) Handbook. There are a number of factors to be considered in the determination of the light levels and lighting selection. Several of these considerations are: type of activity, characteristics of the space, light loss factors and dirt depreciation.

SECTION 4.9 POLLUTION (NOISE-AIR-WATER)

4.9.1 NOISE R(2012)

If a new shop is constructed in a location where a shop was not previously located the designer may have to consider impacts on adjoining property and possibly design a method to reduce noise pollution as it impacts the adjacent property owners. A particular shop function that may create discomfort or raise the objections of the adjacent property owners is if a load test area is to be provided. If a load test facility is to be provided a means to buffer or diminish the sound will probably be required.

The factors associated with noise are:

a. Frequency of the sound

b. Sound level or decibels

c. Duration time (per hour/day)

d. When does the exposure occur during a working day

e. Distance for noise source

4.9.2 AIR EMISSIONS (2024)

Quantitative data on emissions from locomotive engines, chemical cleaners, welding operations, product storage tank throughput (lube oil, traction motor oil, diesel fuel, boilers, traction sand etc.), heating equipment and all other sources of possible air pollution must be collected and evaluated to determine compliance with local allowable limits.

4.9.3 W A S T E WATER R(2012)

Industrial wastes generated by locomotive shop operations such as oils, corrosion inhibitor, detergents, etc., as well as run off from locomotive parking areas must be considered for (pre) treatment facilities whether discharging to a stream, municipal sewer, landfill or incinerator. The engineer must consult with Federal, State and Local regulators to determine the permitting requirements or limitations so that these requirements or limitations may be incorporated into the design.

SECTION 4.10 COMMUNICATIONS AND DATA

4.10.1 GENERAL (2024)

Users are automating and computerizing operations with a need for flexibility to alter or replace systems and cabling as new technology or other capabilities become available and are adopted by the user. The engineer should consult with the user and determine what provision needs to be made in the design for their communications and data requirements as well as who will be responsible for the design and installation of the equipment and cabling. Items for consideration:

- PA Systems
- CCTV

- Data Connections (Ethernet)
- Door Security Access
- WiFi

SECTION 4.11 FIRE PROTECTION

There are essentially two separate fire systems associated with the repair shop, the exterior and the interior systems. Typically the local fire official will provide information concerning what criteria they require to provide acceptable fire protection.

The current building codes require that all buildings, with few and minor exceptions, will have sprinkler systems. An unheated building in a cold climate will need a dry system. In warm climate areas or in a heated building a wet system is recommended. The National Fire Protection Association (NFPA) provides the design guidelines for sprinkler systems, however it is suggested that the local fire official be consulted concerning this item to determine if they have adopted local changes or requirements not in the NFPA manual.

The exterior fire protection system usually consists of a series of hydrants and fire department connections. The required design flow is usually dictated by the local fire authority and the NFPA manuals. A determination of the local conditions and location of existing water supplies will be needed prior to designing and sizing the water distribution system. Depending on the site the existing water supply distribution system may be municipal or owned by the railroad. If the system is being connected to a municipal water supply the location of connection points, metering, back flow prevention and flow requirements will have to be coordinated with the water authority or municipality.

It is desirable for the water supply to be "looped" as opposed to a "dead end" single pipe system. The "looping" of the system typically allows for the use of smaller diameter pipe sizes, has less pressure drop, greater flow and is less susceptible to total failure than a single pipe "dead end" system. The distribution system will have to comply with the performance parameters provided by the local fire official.

One other area that will have to be addressed in connection with the fire protection component is in the development of the site plan. The site plan must provide for access by fire and rescue personnel and equipment. A means of access to the facility that is not obstructed by locomotives or other equipment is desirable. In addition the emergency personnel and equipment must be able to get to the fire hydrant and have access around the building(s).

SECTION 4.12 BLUE SIGNAL/FLAG PROTECTION

Regulations governing locomotive worker protection can be found in the Code of Federal Regulations (CFR) Title 49 part 218 "blue signal protection of workers".

It is typical for the various railroads to adopt a company standard or method of instituting these regulations. The designer should request information from the owner as to what their company standard/method or policy is in regard to worker protection.

Generally speaking the blue signal system provides protection to the worker. The blue signals control the movement of railway equipment. If the blue signal is shown, a piece of equipment may not be moved. If there is an amber or other colored signal the locomotive may be moved and workers should not be on, over or below the locomotive. The removal of the blue signal may be accompanied by an audible signal as well. The signals must be located in places that are easily observed by the workers and easily associated with the track it is controlling. It is typical for the blue signal system may be interlinked with de-rails and/or track switches to provide the required worker protection.

SECTION 4.13 STORAGE TANKS

The sizing of storage tanks depends on a number of factors among these are: anticipated daily consumption or collection, company standards for inventory "capacity", availability of the material, method of delivery and transportation cost.

It is generally recommended that the size of the storage tank accommodate the size (capacity) of the means of delivery (truck, tank car, etc.) plus a safety factor to account for the delay between ordering the material and delivery. The typical tank truck will have an approximate capacity of 6,000 to 7,000 gallons and a tank car of 12,000 to 19,000 gallons. It is not unusual to be assessed a surcharge for not taking an entire load from a truck if it is not compartmented. Some trucks have as many as 3 internal compartments that separate the products being transported.

If the products are reasonably available a capacity equal to a 10 to 14 day supply and/or a tank capacity of at least 8000 to 10,000 gallons is recommended.

Tanks are fabricated to several standards. Factory fabricated tanks are normally constructed per UL142 and field erected tanks are constructed according to API 650. Installation of all tankage must conform to NFPA 30 and local ordinances.

API 650 and UL 142 tanks can be constructed as double walled tanks and as such it may be possible, with proper design, to eliminate the constructed secondary containment requirements.

NFPA provides information on the requirements for overfill prevention and set point conditions. API and UL tank standards provide information on the sizing and location of the inlets, outlets and vent sizing for their tanks.

The designer should check local ordinances and building codes for requirements that must be met in order to install storage tanks in the involved jurisdiction.

The design of the tank site must include a method for containment, storm water segregation, industrial waste disposal and tank truck and/or tank car facilities for loading and unloading. The owner and designer must determine whether or not to use the truck mounted equipment for loading and unloading of tank trucks or provide pumps and piping systems for the various fluids. Tank cars will need a pump and piping system as well as access platform(s) and a dedicated track for this use.

SECTION 4.14 TRACK DRIP COLLECTION

In areas where locomotives are typically parked for servicing and storage outside of the shop provision for drip collection should be provided. The drip collection system can be of either a pan, monolithic, or track mat type systems. There are pros and cons to be considered with each type.

The pan systems can be either a top of tie or under rail type. The top of tie systems material of construction can be steel, HDPE, fiberglass or concrete. These systems usually use an under track drainage pipe to collect the dripped or spilled products. The top of tie type of system needs to be reviewed for the consequence of a plugged drain if the plugged drain will result in leakage into the ballast structure. If so, secondary containment with a french drain system may be required. These top of tie pan systems should be provided with poured concrete walk ways with edge flashing and non-slip cross walks.

With an under the rail monolithic type system, which is usually constructed of reinforced concrete, secondary containment may not be required but attention must be paid to the design of water stopped joints with fuel resistant material and fuel resistant caulks as well as concrete coatings to seal the surface. The monolithic type collection system can also be constructed, if desired, with the top surface equal to the top of rail. The top of rail design allows for non-restricted movement of vehicles and personnel across the area but it has minimum spill containment capacity and requires additional drainage inlets outside and between the rails. With both the under the rail and top of rail monolithic systems a tie structure is not needed.

For all collection systems the drainage piping should be provided with a sand/grit interceptor(s) to capture the dirt and locomotive sand that finds its way into the drains..

Track mats typically are designed for minimal drips and spills and could be considered for areas where minimal work or no work takes place.