Engineering

Red Book of Structures Requirements

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RED BOOK OF STRUCTURES REQUIREMENTS

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SECTION 1 – DEFINITIONS

1.1.0 Definitions

a. **Aboveground Storage Tank**
A storage tank with more than 90% of the storage tank volume above surface grade and that operates at atmospheric pressure plus or minus 10 kPa.

b. **Aboveground Storage Tank System**
One or more aboveground storage tanks connected by piping, both aboveground and underground, including pumps and product transfer equipment, diking, overfill protection, and associated spill containment and collection equipment.

c. **Bank Protection (Revetments)**
Sloping structures placed on banks in such a way as to absorb the energy of water and built to preserve the existing shoreline and protect the slope, as defense against erosion.

d. **Bridge**
Any structure with a deck which supports one or more railway tracks, or any other under grade structure with an individual span length of 10 feet (3 m) or more located at such a depth that it is affected by live loads.

e. **Bridge Inspector**
A bridge inspector is a person qualified and authorized to perform the task of bridge inspection.

f. **Chief Engineer**
The Chief Engineer of the company or his/her designated representative.

g. **Culvert**
A culvert is defined as any structure having a span less than 3 metres (10 feet) with loads applied to it through fill between the railway track structure and the top of culvert.

h. **Drainage**
The removal of water through a system of watercourses, ditches, culverts or drains.

i. **Employee**
An employee or employee of a contractor who is responsible for the inspection, repair, construction or maintenance of a structure.

j. **Excavation**
Any man-made cut, cavity, trench, or depression in an earth surface.

k. **Fall Arrest System**
An assembly of components that will arrest a worker’s fall when properly assembled and used together and when connected to a suitable anchorage.

l. **Fall Protection System**
Any secondary system that prevents workers from falling or, if a fall occurs, arrests the fall.

Examples include guardrails, fall restraint systems, fall arrest systems, control zones, and safety nets.

m. **Fall Restraint System**
A system that prevents one or more workers from reaching an unprotected edge or opening.

n. **Guardrail**
A barrier secured upright and erected along the exposed sides and ends of platforms to prevent falls as a component of a guarded structure.

o. **Guarded Structure**
Is one with a walkway and/or handrail installed on both sides in a manner, which prevents, falling with no openings in the deck, or surface through which a person could fall.

p. **Lead**
Means metallic lead and all inorganic lead compounds.

q. **Maintenance**
The process of performing work to extend the life of a track or structures asset.

r. **Qualified**
Qualified means a status attained by an employee who has successfully completed any required training for, has demonstrated proficiency in, and has been authorized by the employer to perform the duties of a particular position or function or means one who by possession of a recognized degree, certificate, or professional standing, or who by extensive knowledge, training, and experience, has successfully demonstrated his/her ability to solve or resolve problems relating to the subject matter, the work or the project.

s. **Qualified (specific to Lead Exposure)**
Means either registration by the Canadian Registration Board of Occupational Hygienists (CRBOH) or certification by the American Board of Industrial Hygiene (ABIH).

t. **Qualified Inspector/Technician/Employee (specific to Railroad Fuel Tank Inspection)**
An individual who has qualifications as described in API 653 and who have taken training on the application of this policy and who have experience in the operation and maintenance of storage tanks and/or are otherwise qualified to do a specific job.

u. **Regulations**
Applicable Federal, Provincial, State and/or Municipal by-laws, legislation and codes of practices.

v. **Rehabilitation**
The restoration of a track or structures asset to satisfactory state that ensures its integrity.

w. **Repair**
The action of fixing the damaged portion of a track or structures asset.

x. **Replacement**
The installation of a new or used component or system of components to ensure its integrity.

y. **Retaining Wall**
A retaining wall is defined as a structure providing lateral support for a mass of soil or rock and may be located at elevations above or below the track. Bridge substructure walls located outside the envelope of a 2(H):1(V) slope from the end of track ties are not considered as retaining walls.

z. **Safety Net**
An engineered “netting” system installed under a structure designed to arrest the fall of a person.

aa. **Scaffold (Scaffolding)**
Any temporary elevated platform (supported or suspended) and its supporting structure (including points of anchorage) used for supporting employees, materials, and equipment.

bb. **Scour**
Localized lowering of a water course by the erosive action of flowing water.

cc. **Shoring (Shoring System)**
A structure such as a metal, hydraulic, mechanical or timber support system that supports the sides of an excavation and which is designed to prevent cave-ins. Timber shoring systems usually consist of sheathings, uprights, wales/walers and struts (cross braces).

dd. **Storage Tank**
Any closed container with a capacity of more than 230 L (60 U.S. gal) that is installed at a fixed location.

ee. **Structure**
Bridges, culverts, retaining walls, tunnels and other equipment that will be used, maintained, or constructed by employees.

ff. **Structural Integrity**
The ability of a structure to perform its designed function, during reasonable use, for its designed life.

gg. **Trench (Trench Excavation)**
A narrow excavation (in relation to its length) made below the surface of the ground. In general, the depth is greater than the width, but the width of a trench (measured at the bottom) is not greater than 12 ft. (3.6 m) in Canada or 15 ft. in USA.

hh. **Tunnel**
A horizontal passageway through or under an obstruction that is open at both ends and used to carry rail traffic.

ii. **Underground Storage Tank**
A storage tank that has 10% or more of its volume below adjacent ground level or a storage tank that is completely buried by or covered with soil, backfill or concrete.

jj. **Underground Storage Tank System**
One or more completely buried and/or partially buried (manifolded) storage tank(s), including all underground and aboveground.

kk. **Water Course**
A natural or artificial channel in which a flow of water occurs either continuously or intermittently.

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SECTION 2 – STRUCTURES REQUIREMENTS

2.1.0 Requirements and Qualifications

a. Requirements are standards, practices and procedures which MUST be followed to ensure safety and/or comply with regulations.

b. This rule book contains the Requirements for ensuring safe inspection, maintenance and construction work procedures and practices for bridges, culverts and other structures owned and operated by CP. Inspection, maintenance, repair and construction work procedures must equal or exceed the minimum requirements laid out in this document, plus

- Canada Labour Code Part II Canadian Occupational Health and Safety (COHS) Regulations (Canada),
- Occupational Safety and Health Administration (OSHA) Regulations (USA),
- Federal Railroad Administration (FRA) Code of Federal Regulations (CFR) Title 49 Railroad Workplace Safety Part 214 (USA),
- Transport Canada Guideline for Bridge Safety Management (Canada), and
- Federal Railroad Administration (FRA) Code of Federal Regulations (CFR) Title 49 Bridge Safety Standards Part 237 (USA).

c. Each employee responsible for the inspection, maintenance and construction of bridges, culverts and other structures owned and operated by Canadian Pacific must perform the work in strict accordance with these Requirements and be qualified as Bridge Inspectors, Bridge Supervisors and/or Railroad Bridge Engineers in accordance with the CP Bridge Management Program (BMP). The CP BMP and Structures Handbook of Best Practices (SHBP) should be consulted for further information or instructions relating to these Requirements.

2.2.0 Railroad Bridge Inspection

2.2.1 General Requirements

a. In any and all cases where an inspection of a bridge reveals a condition that, in the opinion of the Bridge Inspector, Bridge Supervisor or Railroad Bridge Engineer, may render the bridge unsuitable for carrying railway traffic at time table speeds, the necessary steps must be taken to immediately safeguard train operations at that location through placement of a speed restriction or stopping traffic as necessary. The Bridge Inspector must inform the territory Engineering Manager of the event and outline conditions found, speed restrictions placed and, if necessary, repairs to be considered necessary to restore timetable train speeds.

Further details concerning Bridge Inspection provisions may be found in *Section 3.2* of the *CP Bridge Management Program (BMP)*.

2.2.2 Qualification as a Bridge Inspector

a. Bridge Inspectors must have a minimum of:

i. 3 years of relevant experience in railway bridge maintenance and/or inspection (supplemented with technical training in railway bridge inspection if qualified after July 15, 2010); or

ii. Registration as a licensed Professional Engineers; or

iii. Bridge Supervisor qualification.

c. All conditions noted during annual bridge inspections must be recorded on a new, unique bridge inspection report and entered into the CP SAP application. The bridge inspection form for each bridge indicates all superstructure and substructure inventory items that must be inspected for each bridge. Conditions for each bridge inventory component above are to be recorded as shown below.

Component Condition Rating	Description of Condition
0	Not Applicable
1	Very Good
2	Good
3	Fair
4	Poor (additional text description required)
5	Very Poor (additional text description required)
9	Needs Immediate Attention (additional text description required)

Figure 2-1

d. The Bridge Inspector must record conditions on the annual bridge inspection form in the electronic database within 120 days of the inspection.

e. Following an annual bridge inspection, Bridge Inspectors must verify the bridge inventory items in the CP SAP application.

f. In addition to Condition Ratings, Bridge Inspectors must record bridge maintenance recommendations, if any, that are required to ensure safety of operations until the next Annual Bridge Inspection. The Bridge Inspector must forward all annual bridge inspection reports with recommendations for maintenance work for review by the territory Engineering Manager or designated Professional Engineer.

g. For conditions reported with a rating of 9, the territory Engineering Manager will determine the measures required to safeguard traffic.

h. Based on conditions, the territory Engineering manager may request additional periodic inspections or a detailed inspection to further assess the need for additional work in accordance with the CP BMP.

2.3.0 Railroad Culvert Inspection

2.3.1 General Requirements

a. In any and all cases where an inspection of a culvert reveals a condition that, in the opinion of the Track or Bridge Inspector, Bridge Supervisor or Railroad Bridge Engineer, may render the culvert unsuitable for carrying railway traffic at time table speeds, the necessary steps must be taken to immediately safeguard train operations at that location through placement of a speed restriction or stopping traffic as necessary. The Track or Bridge Inspector must inform the territory Engineering Manager of the event and outline conditions found, speed restrictions placed and, if necessary, repairs to be considered necessary to restore timetable train speeds.

b. Culvert Inspections are for the purpose of ensuring;

   i. Hydraulic flow can be observed without obstruction upstream and downstream of the inlet and outlet;

   ii. Site conditions have not changed in a manner that impacts drainage through assessment of land use and ditch conditions;

   iii. The structural integrity of the culvert is sufficient to support track, ballast and embankment material and no voids are observed in the ballast or embankment; and

   iv. Identification of maintenance that may be required prior to the next inspection.

2.3.2 Inspection of Railroad Culverts Less Than or Equal to 36” in Diameter

a. All culverts 36” in diameter or less must be inspected annually with no more than 540 days between successive inspections by Track Inspectors in accordance with Section 14.12.0 (Culverts and Drainage) of the Red Book of Track Requirements (RBTR). These inspections are to be recorded in DTN.

b. All culverts 36” in diameter or less must be inspected every 5 years with no more than 2000 days between successive inspections by Bridge Inspectors. These inspections are to be recorded in DTN.

2.3.3 Inspection of Railroad Culverts Greater Than 36” in Diameter

a. All culverts greater than 36” in diameter must be inspected once every three years with no more than 1250 days between successive inspections by Bridge Inspectors. These inspections are to be recorded as a new culvert inspection report and entered into the CP SAP application.

b. Culverts greater than 36” in diameter where the “once every three years” inspection reveals poor hydraulic or structural conditions, must be inspected at least annually with no more than

540 days between successive inspections by Bridge Inspectors until implementation of work that improves conditions such that the once every three years inspection frequency may be resumed. These inspections are to be recorded as a new culvert inspection report and entered into the CP SAP application.

2.4.0 Inspection of Drainage Hazards

a. In any and all cases where an inspection is being conducted for drainage in accordance with *Red Book of Track Requirements Section 14 – Track Inspection Figure 14-4.* and the inspection reveals a condition that, in the opinion of the Track or Bridge Inspector, Bridge Supervisor or Railroad Bridge Engineer, may render the track unsuitable for carrying railway traffic at time table speeds, the necessary steps must be taken to immediately safeguard train operations at that location through placement of a speed restriction or stopping traffic as necessary. The Track or Bridge Inspector must inform the territory Engineering Manager of the event and outline conditions found, speed restrictions placed and, if necessary, repairs to be considered necessary to restore timetable train speeds.

b. When special inspections of drainage hazards are required, the following must be used to evaluate conditions:

   i. Culvert obstruction – Record the percentage blocked culvert by describing if it is ¼, ½, ¾ or completely blocked as shown in Figure 2-2.

   ii. Ditch obstruction - Record the percentage obstructed width of ditch by describing if it is ¼, ½, ¾ or completely blocked as shown in Figure 2-3.

   iii. Height of embankment – Record the height of embankment over which the potential observed blocked culvert if it is a low, medium or high fill as shown in Figure 2-4.

   Hazardous condition created by water seepage under tracks can occur when unusually high differential water level is observed on high side of the embankment. Always look for potential blocked culverts or ditches that may impede drainage flow followed with careful observation in the area of concern of potential sinkholes or voids through ballast or side slope, tension cracks along embankment shoulder, leaning trees on side slope, seepage coming out of slope, bulging and any sign of small sand fan at the toe of embankment. Record the height of water surface above the upstream end of culvert invert (A), the height measuring from the base of rail to the upstream water surface (B) and the differential water height between upstream and downstream water surface (C) along with the probability of water overtopping rail as shown Figure 2-5.

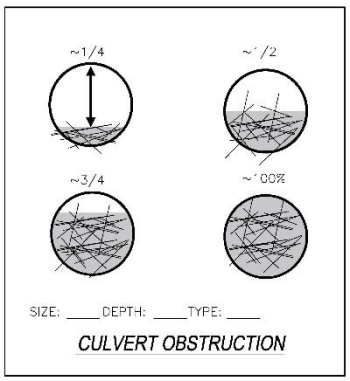

Figure 2-2

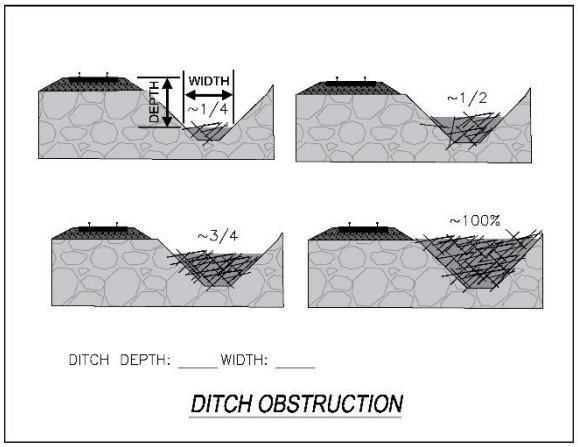

Figure 2-3

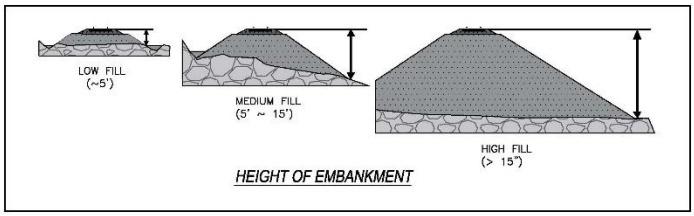

Figure 2-4

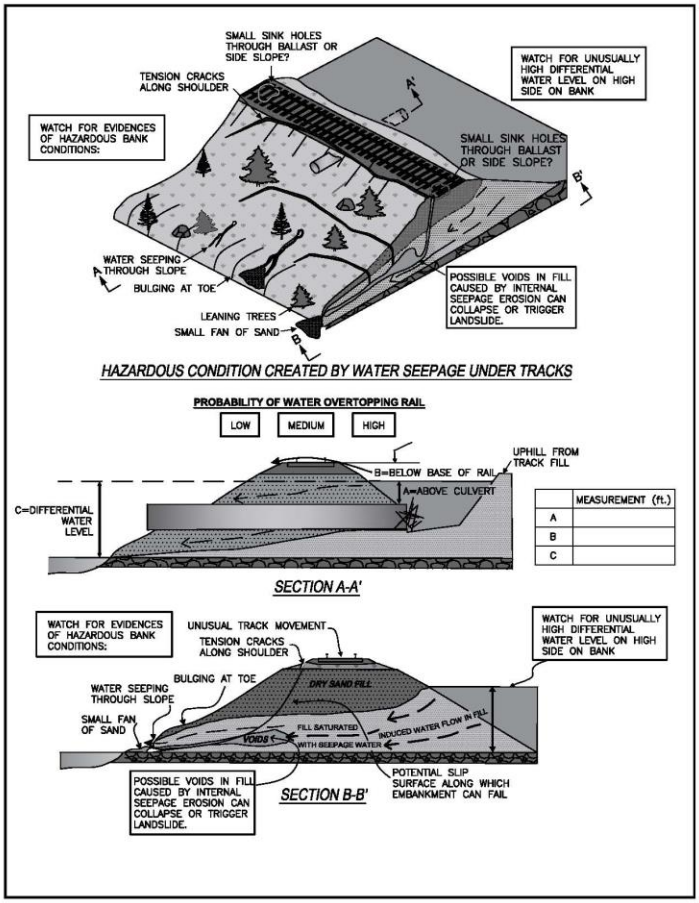
SMALL SINK HOLES THROUGH BALLAST OR SIDE SLOPE?
TENSION CRACKS ALONG SHOULDER
WATCH FOR UNUSUALLY HIGH DIFFERENTIAL WATER LEVEL ON HIGH SIDE ON BANK
WATCH FOR EVIDENCES OF HAZARDOUS BANK CONDITIONS:
SMALL SINK HOLES THROUGH BALLAST OR SIDE SLOPE?
WATER SEEPING THROUGH SLOPE
BULGING AT TOE
POSSIBLE VOIDS IN FILL CAUSED BY INTERNAL SEEPAGE EROSION CAN COLLAPSE OR TRIGGER LANDSLIDE.
LEANING TREES
SMALL FAN OF SAND
HAZARDOUS CONDITION CREATED BY WATER SEEPAGE UNDER TRACKS
PROBABILITY OF WATER OVERTOPPING RAIL
LOW
MEDIUM
HIGH
UPHILL FROM TRACK FILL
B=BELOW BASE OF RAIL
A=ABOVE CULVERT
C=DIFFERENTIAL WATER LEVEL
MEASUREMENT (ft.)
A
B
C
SECTION A-A'
WATCH FOR EVIDENCES OF HAZARDOUS BANK CONDITIONS:
UNUSUAL TRACK MOVEMENT
TENSION CRACKS ALONG SHOULDER
WATCH FOR UNUSUALLY HIGH DIFFERENTIAL WATER LEVEL ON HIGH SIDE ON BANK
BULGING AT TOE
WATER SEEPING THROUGH SLOPE
DRY SAND FILL
SMALL FAN OF SAND
FILL SATURATED WITH SEEPAGE WATER
VOIDS
INDUCED WATER FLOW IN FILL
POSSIBLE VOIDS IN FILL CAUSED BY INTERNAL SEEPAGE EROSION CAN COLLAPSE OR TRIGGER LANDSLIDE.
SECTION B-B'
POTENTIAL SLIP SURFACE ALONG WHICH EMBANKMENT CAN FAIL

Figure 2-5