
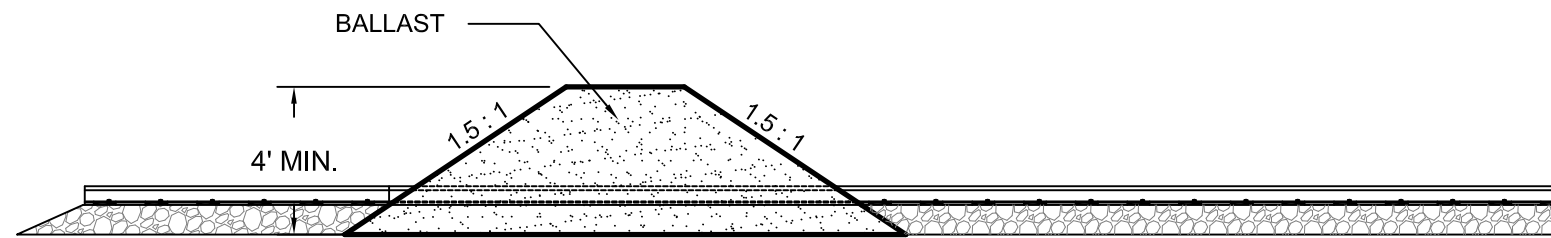
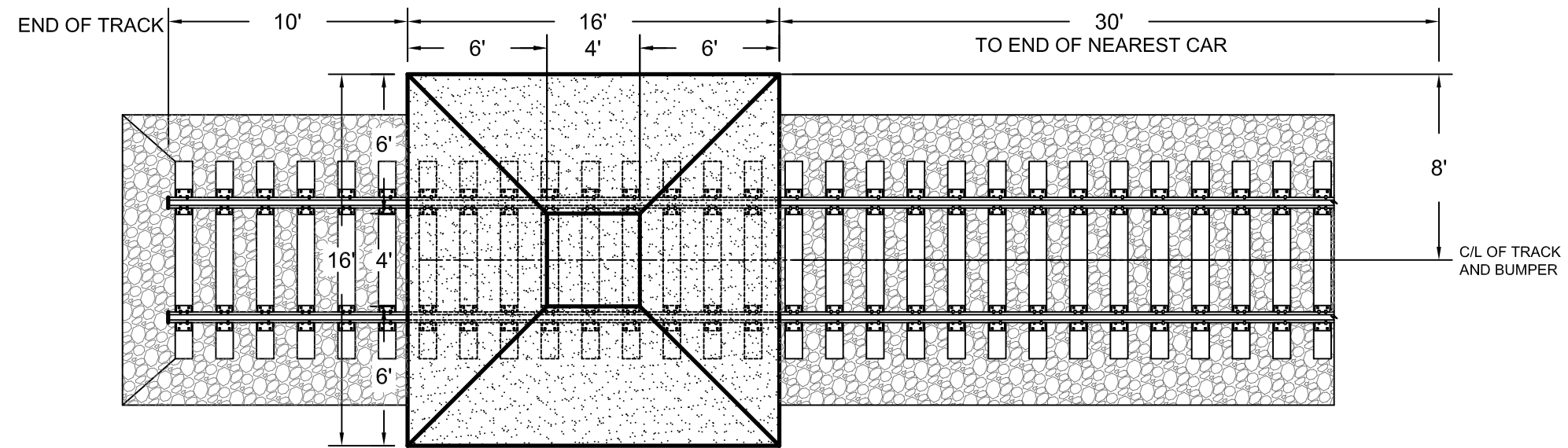


IF SIDE SLOPE CONTINUES ABOVE TOP OF SUB-BALLAST,  
AN INTERCEPTOR DITCH MAY BE REQUIRED ON TOP OF SLOPE

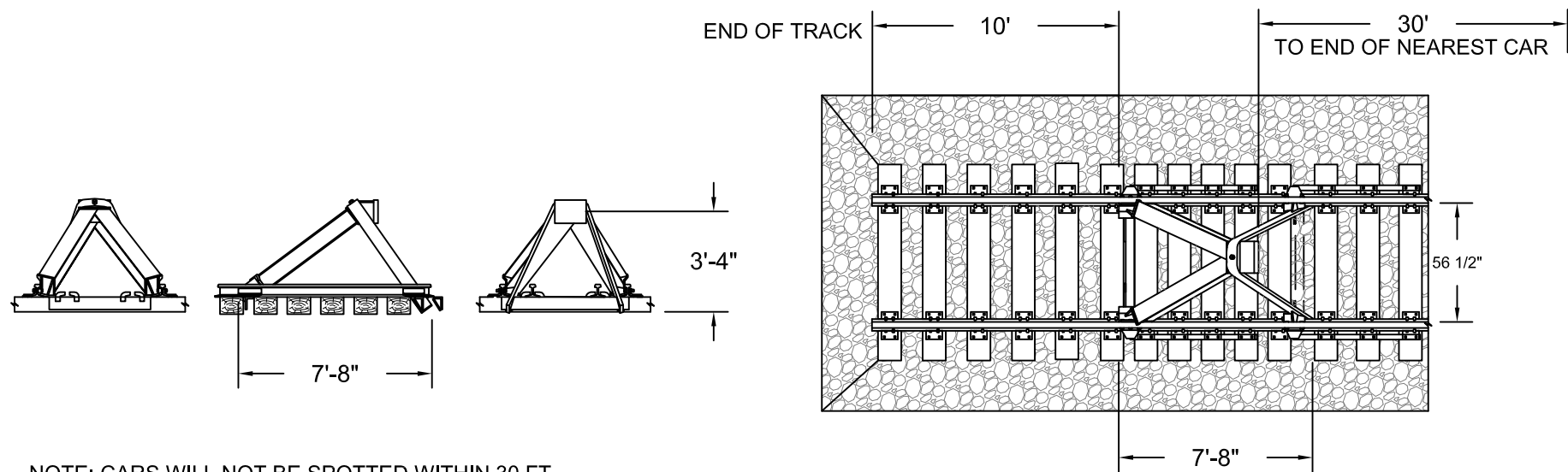
TYPICAL CROSS SECTION

A1

REVISIONS		DATE		BY	
					
<b>TYPICAL CROSS SECTION DETAIL</b>					
<small>OFFICE OF DESIGN &amp; CONSTRUCTION</small>					
<b>SHEET</b> 1 OF 1		<small>DRAWN BY:</small> DAP	<small>SCALE:</small> NONE	<small>DWG NO.:</small>	<small>FILE:</small>
<small>CHECKED BY:</small>		<small>DATE:</small> 15 NOV 15			



STANDARD EARTHEN BUMPER FOR END OF TRACK



NOTE: CARS WILL NOT BE SPOTTED WITHIN 30 FT. OF BUMPING POST OR EARTHEN BUMPER

STANDARD BUMP POST FOR END OF TRACK

A2

REVISIONS			
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APPROVALS			
OFFICE OF DESIGN & CONSTRUCTION			
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CHECKED BY:		DATE: 15 NOV 15	FILE:
SHEET 1 OF 1			

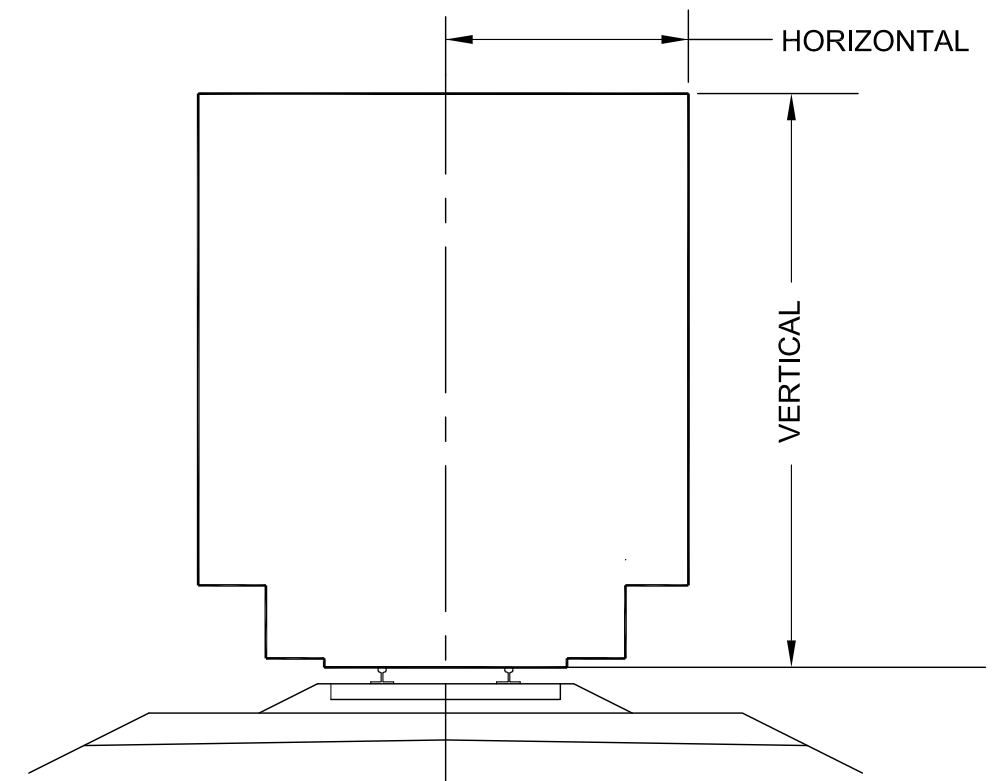


**EARTHEN BUMPER/BUMP POST  
DETAIL**

VERTICAL													
STATES	GENERAL STRUCTURES	THROUGH BRIDGES	HIGHWAY BRIDGES	TUNNELS	BUILDING DOORS	STRUCTURES IN BUILDINGS	ENGINE HOUSES (SHOPS, SHEDS ETC.)	TIPPLES, STONE CRUSHERS, ETC.	AWNINGS AND CANOPIES	POLES, POSTS AND SIGNS	FENCES (BETWEEN TRACKS)	TELLTALE REQUIRED FOR LESS THAN MINIMUM CLEARANCE	WARNING SIGNS REQUIRED FOR LESS THAN MINIMUM CLEARANCE
ALABAMA	--	--	23' 0"	--	--	--	--	--	--	--	--	--	--
ILLINOIS	21' 6"	21' 3"	21' 6"	21' 6"	H	--	H	H	21' 6"	15' 0"	4' 6"	--	YES
INDIANA	22' 0"	22' 0"	22' 0"	22' 0"	22' 0"	22' 0"	21' 0"	21' 0"	21' 0"	21' 0"	--	--	--
IOWA	--	--	--	--	--	--	H	H	22' 0"	17' 0"	4' 0"	--	YES
KENTUCKY	--	--	22' 0"	--	--	--	--	--	--	--	--	YES	--
LOUISIANA	--	--	--	--	--	--	--	--	--	--	--	YES	--
MICHIGAN	22' 6"	E	E	22' 6"	22' 6"	22' 6"	22' 6"	22' 6"	22' 6"	22' 6"	--	--	YES
MINNESOTA	22' 0"	22' 0"	22' 0"	22' 0"	22' 0"	22' 0"	17' 6"	22' 0"	22' 0"	--	--	YES	YES
MISSISSIPPI	--	--	--	--	--	--	--	--	--	--	--	YES	--
NEBRASKA	22' 6"	22' 6"	23' 0"	23' 0"	17' 0"	18' 0"	E	--	--	--	--	YES	YES
OHIO	21' 0"	21' 0"	21' 0"	21' 0"	21' 0"	21' 0"	21' 0"	21' 0"	21' 0"	21' 0"	--	--	--
PENNSYLVANIA	22' 0"	22' 0"	22' 0"	22' 0"	18' 0"	18' 0"	18' 0"	--	--	--	--	--	--
TENNESSEE	22' 0"	22' 0"	22' 0"	22' 0"	17' 0"	17' 0"	17' 0"	22' 0"	22' 0"	22' 0"	--	--	--
WISCONSIN	23' 0"	23' 0"	23' 0"	23' 0"	23' 0"	23' 0"	23' 0"	23' 0"	23' 0"	23' 0"	--	YES	--

HORIZONTAL													
STATES	GENERAL STRUCTURES	THROUGH BRIDGES	HIGHWAY BRIDGES	TUNNELS	BUILDING DOORS	STRUCTURES IN BUILDINGS	ENGINE HOUSES (SHOPS, SHEDS ETC.)	TIPPLES, STONE CRUSHERS, ETC.	AWNINGS AND CANOPIES	POLES, POSTS AND SIGNS	ORE AND COAL DOCKS	BUILDING MATERIAL AND SUPPLY STORAGE (LONG TERM)	WARNING SIGNS REQUIRED FOR LESS THAN MINIMUM CLEARANCE
ALABAMA	--	9' 0"	9' 0"	--	--	--	--	--	--	--	--	--	--
ILLINOIS	8' 0"	8' 0"	8' 0"	8' 0"	7' 0"	8' 0"	7' 0"	8' 0"	8' 0"	9' 0"	8' 0"	9' 0"	YES
INDIANA	8' 0"	8' 0"	8' 0"	8' 0"	8' 0"	8' 0"	6' 6"	7' 0"	8' 0"	8' 0"	8' 0"	9' 0"	YES
IOWA	--	--	--	--	--	--	--	--	--	--	--	--	--
KENTUCKY	--	--	--	--	--	--	--	--	--	--	--	--	--
LOUISIANA	--	--	--	--	--	--	--	--	--	--	--	--	--
MICHIGAN	8' 6"	E	E	8' 6"	8' 6"	8' 6"	8' 6"	8' 6"	8' 6"	8' 6"	E	8' 6"	YES
MINNESOTA	8' 6"	8' 6"	8' 6"	8' 6"	8' 6"	8' 6"	8' 6"	8' 6"	8' 6"	14' 6"	8' 6"	8' 6"	--
MISSISSIPPI	--	--	--	--	--	--	--	--	--	--	--	--	--
NEBRASKA	8' 6"	8' 0"	8' 6"	8' 0"	7' 0"	7' 0"	E	--	--	8' 6"	8' 6"	8' 6"	YES
OHIO	8' 0"	8' 0"	8' 0"	8' 0"	8' 0"	8' 0"	--	--	--	--	8' 0"	8' 0"	--
PENNSYLVANIA	12' 0"	8' 0"	12' 0"	8' 0"	8' 0"	8' 0"	--	--	--	12' 0"	E	--	--
TENNESSEE	8' 0"	8' 0"	8' 0"	8' 0"	8' 0"	8' 0"	8' 0"	8' 0"	8' 0"	8' 0"	8' 0"	8' 0"	--
WISCONSIN	8' 6"	E	8' 6"	8' 6"	8' 6"	8' 6"	--	--	--	12' 0"	8' 6"	--	--

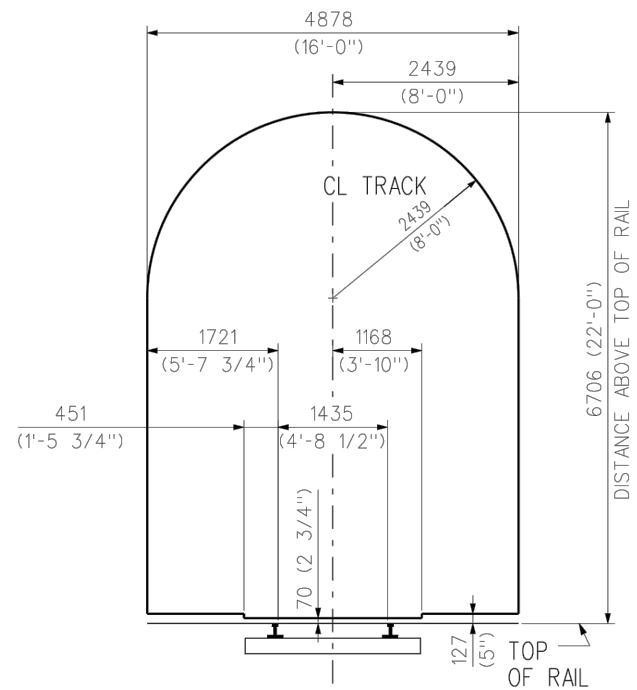
CHART IS FOR INFORMATION ONLY  
 FOLLOW CURRENT STATE REGULATORY CRITERIA  
 Source: Chapter 28, Table 3-3, AREMA Engineering Manual



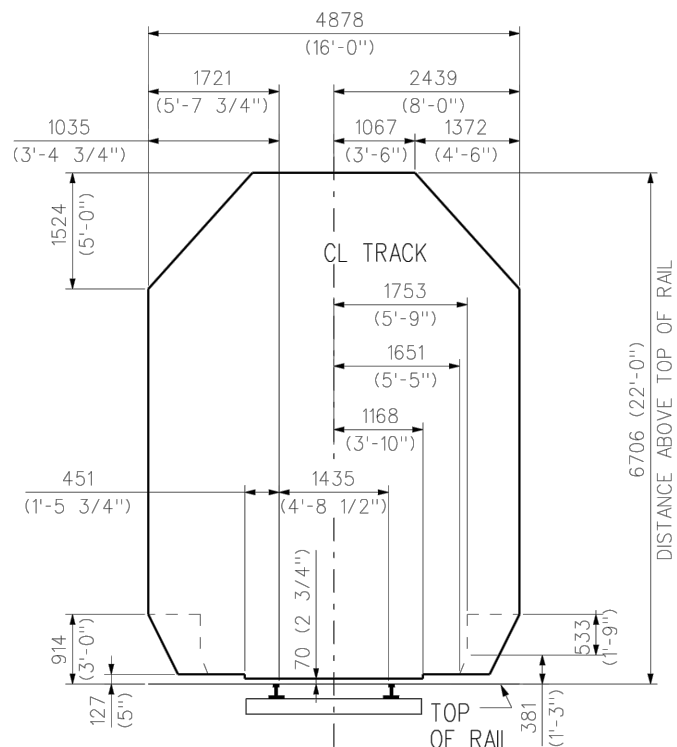
E= EXEMPT  
 H= HEIGHT OF CAR GOVERNS

A3

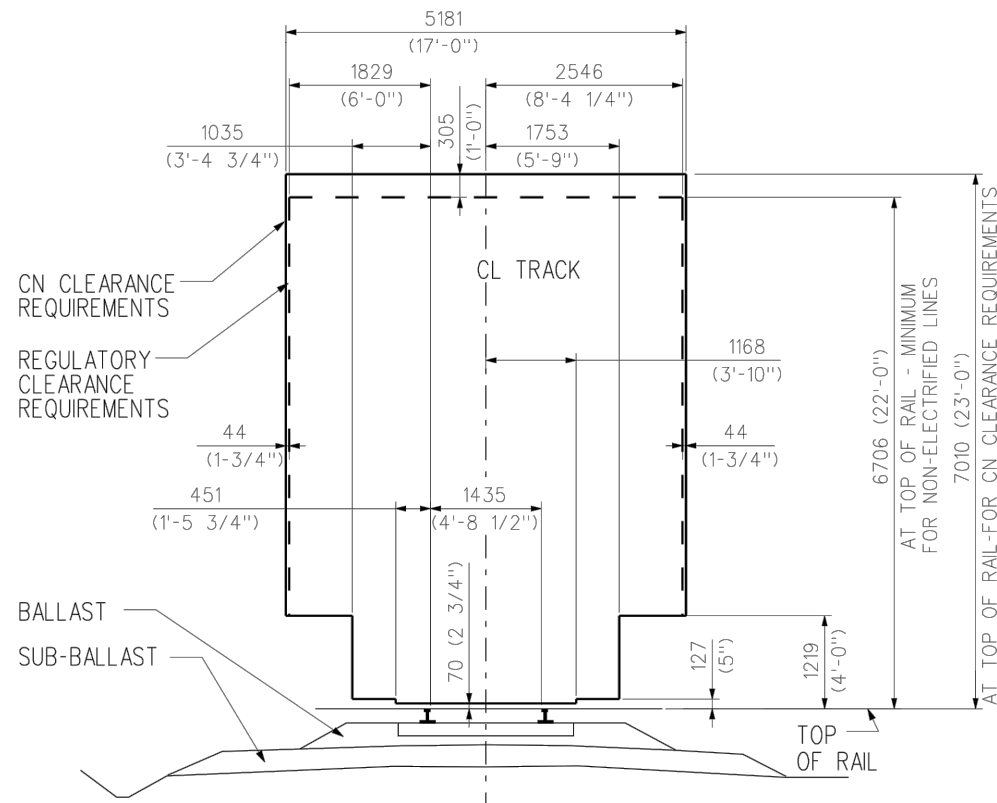
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DATE	BY			
APPROVALS		<b>HORIZONTAL AND VERTICAL CLEARANCES</b> <b>US ONLY</b>		
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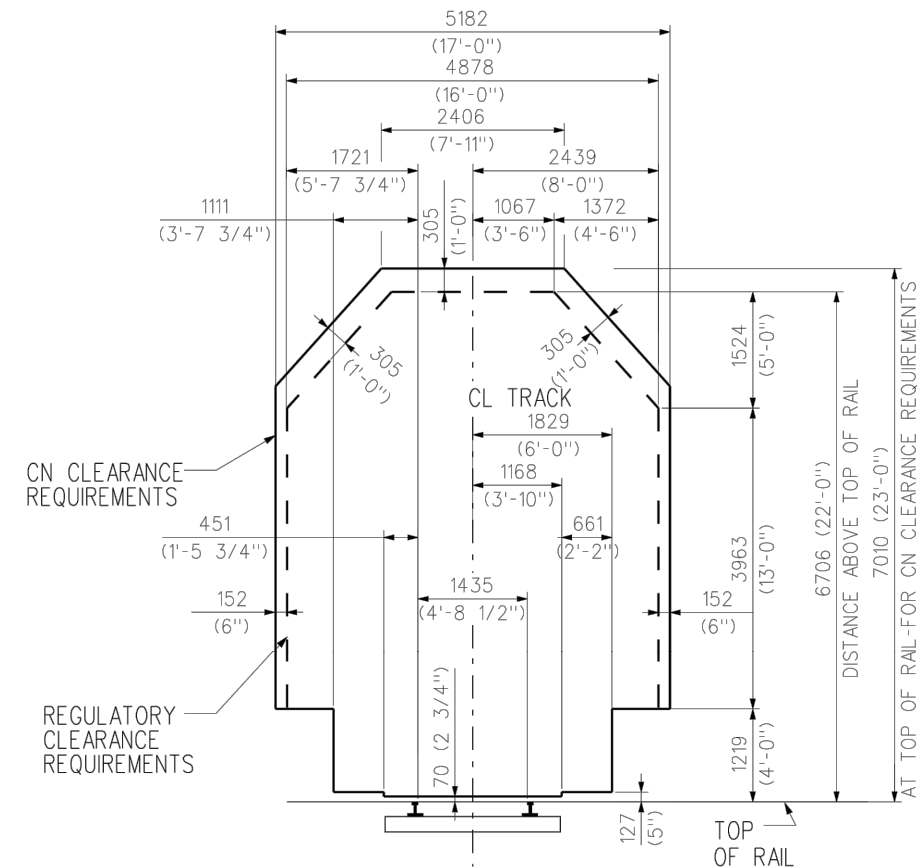
ALL RAILWAY TUNNELS  
CANADA ONLY



ALL RAILWAY BRIDGES, SNOWSHEDS,  
AND OVERHEAD TIMBER BRIDGES  
CANADA ONLY



ALL STRUCTURES OVER OR BESIDE THE RAILWAY TRACKS  
EXCEPT RAILWAY BRIDGES, SNOW SHEDS AND OVERHEAD TIMBER BRIDGES  
CANADA ONLY



INDUSTRIAL SIDINGS  
CANADA ONLY

NOTE:  
CLEARANCES INDICATED APPLY TO TANGENT TRACK. CLEARANCE REQUIREMENTS SHALL BE INCREASED BY 24.11MM (1 INCH) PER DEGREE IF THE RESTRICTION OCCURS ON CURVED TRACK OR LESS THAN ONE HALF A CAR LENGTH FROM CURVED TRACK.

A4

REVISIONS			
DATE	BY		
APPROVALS			
OFFICE OF DESIGN & CONSTRUCTION			
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**TS-3003 HORIZONTAL & VERTICAL  
CLEARANCE REQUIREMENTS  
CANADA ONLY**

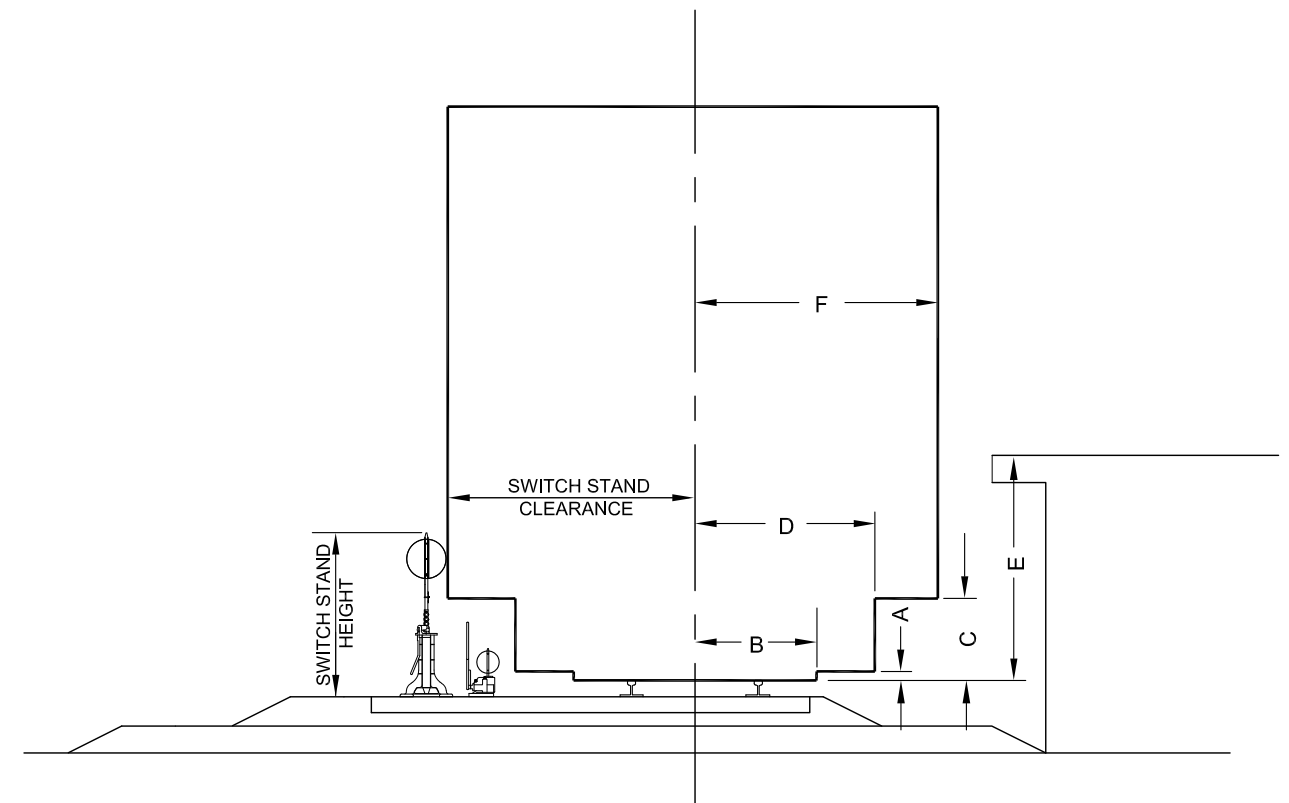


PLATFORMS						
STATES	DIAGRAM DIMENSIONS					
	A	B	C	D	E	F
ALABAMA	--	--	--	--	--	--
ILLINOIS	0' 4"	4' 6"	4' 8"	5' 1"	CFH	6' 2"
INDIANA	--	--	--	--	--	--
IOWA	--	--	--	--	--	--
KENTUCKY	--	--	--	--	--	--
LOUISIANA	--	--	--	--	--	--
MICHIGAN	--	--	--	--	--	--
MINNESOTA	--	--	--	--	--	--
MISSISSIPPI	--	--	--	--	--	--
NEBRASKA	0' 8"	5' 0"	4' 0"	5' 9"	4' 0"	8' 6"
OHIO	--	--	--	--	--	--
PENNSYLVANIA	0' 8"	5' 1"	4' 0"	5' 7"	4' 0"	8' 6"
TENNESSEE	0' 8"	4' 8"	4' 0"	5' 9"	4' 0"	7' 6"
WISCONSIN	0' 4"	4' 6"	1' 9"	6' 0"	5' 0"	6' 4"
	0' 8"	5' 1"				

E= EXEMPT  
CFH = CAR FLOOR HEIGHT

SIGNALS										
STATES	SWITCH STANDS						SWITCH BOXES ETC.		HIGH (SEMAPHORE & COLOR LIGHT)	
	MAIN		SECONDARY		LOW, BETWEEN OR ADJACENT TO TRACKS		HEIGHT ABOVE BASE OF RAIL	CLEARANCE		
	HEIGHT ABOVE BASE OF RAIL	CLEARANCE	HEIGHT ABOVE BASE OF RAIL	CLEARANCE	HEIGHT ABOVE BASE OF RAIL	CLEARANCE				
ALABAMA	--	--	--	--	--	--	--	--	--	
ILLINOIS	2' 10" to 4' 0" over 4' 0"	8' 0" 8' 3"	2' 10" to 4' 0" over 4' 0"	7' 6" 8' 0"	0 to 2' 10"	8' 0"	--	--	8' 6"	
INDIANA	--	--	--	--	--	--	--	--	8' 0"	
IOWA	2' 10" to 4' 0" over 4' 0"	8' 0" 8' 3"	2' 10" to 4' 0" over 4' 0"	7' 6" 8' 0"	--	--	--	--	--	
KENTUCKY	--	--	--	--	--	--	--	--	--	
LOUISIANA	--	--	--	--	--	--	--	--	--	
MICHIGAN	--	--	--	--	--	--	E	E	E	
MINNESOTA	--	--	--	--	--	--	--	--	8' 6"	
MISSISSIPPI	--	--	--	--	--	--	--	--	--	
NEBRASKA	3' 0" +	8' 3"	3' 0" +	8' 3"	3' 0"	6' 0"	0' 4"	3' 0"	8' 6"	
OHIO	--	--	--	--	--	--	--	--	8' 0"	
PENNSYLVANIA	--	--	--	--	3' 0"	6' 0"	0' 4"	3' 0"	12' 0"	
TENNESSEE	--	--	--	--	--	6' 6"	0' 4"	3' 0"	8' 0"	
WISCONSIN	--	--	--	--	E	E	E	E	8' 6"	

CHART IS FOR INFORMATION ONLY  
FOLLOW CURRENT STATE REGULATORY CRITERIA  
Source: Table 28-3-3, AREMA Engineering Manual



A5

REVISIONS	DATE	BY	
APPROVALS			<b>PLATFORM AND SIGNAL CLEARANCES</b> <b>US ONLY</b>
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Association of American Railroads

Circular OT-55-N Effective August 5, 2013

**Recommended Railroad Operating Practices For Transportation of Hazardous Materials**

**Road Operating Practices**

**I. "Key Trains"**

- A. Definition: A "Key Train" is any train with:
- One tank car load of Poison or Toxic Inhalation Hazard (PIH or TIH) (Hazard Zone A, B, C, or D), anhydrous ammonia (UN1005), or ammonia solutions (UN3318),
- 20 car loads or intermodal portable tank loads of any combination of hazardous material.
- One or more car loads of Spent Nuclear Fuel (SNF), High Level Radioactive Waste (HLRW)

Appendix 1 is a list of SNF and HLRW with 49 Hazmat Codes, Appendix 2 is a list of time sensitive materials and Appendix 3 is a form for requesting hazardous materials commodity flow information.

**B. Restrictions:**

- 1. Maximum speed -- "Key Train" - 50 MPH
2. Unless siding or auxiliary track meets FRA Class 2 standards, a Key Train will hold main track at meeting or passing points, when practicable.
3. Only cars equipped with roller bearings will be allowed in a Key Train.
4. If a defect in a "Key Train" bearing is reported by a wayside detector, but a visual inspection fails to confirm evidence of a defect, the train will not exceed 30 MPH until it has passed over the next wayside detector or delivered to a terminal for a mechanical inspection.

**II. Designation of "Key Routes"**

- A. Definition: Any track with a combination of 10,000 car loads or intermodal portable tank loads of hazardous materials, or a combination of 4,000 car loadings of PIH or TIH (Hazard zone A, B, C, or D), anhydrous ammonia, flammable gas, Class 1.1 or 1.2 explosives, environmentally sensitive chemicals, Spent Nuclear Fuel (SNF), and High Level Radioactive Waste (HLRW) over a period of one year.

**B. Requirements:**

<sup>1</sup> Poison Inhalation Hazard (PIH) and Toxic Inhalation Hazard (TIH) are used interchangeably and refer to the same list of chemicals.

- 1. Wayside defective bearing detectors shall be placed at a maximum of 40 miles apart on "Key Routes", or equivalent level of protection may be installed based on improvements in technology.
2. Main Track on "Key Routes" is inspected by rail defect detection and track geometry inspection cars or any equivalent level of inspection no less than two times each year; sidings are similarly inspected no less than one time each year; and main track and sidings will have periodic track inspections that will identify cracks or breaks in joint bars.
3. Any track used for meeting and passing "Key Trains" must be Class 2 or higher. If a meet or pass must occur on less than Class 2 track due to an emergency, one of the trains must be stopped before the other train passes.

**III. Yard Operating Practices**

- A. Maximum reasonable efforts will be made to achieve coupling of loaded placarded tank cars at speeds not to exceed 4 MPH.
B. Loaded placarded tank cars of PIH or TIH (Hazard zone A, B, C or D), anhydrous ammonia, or flammable gas which are cut off in motion for coupling must be handled in not more than 2-car cuts; and cars cut off in motion to be coupled directly to a loaded placarded tank car of PIH or TIH (Hazard zone A, B, C, or D), anhydrous ammonia, or flammable gas must also be handled in not more than 2-car cuts.

**IV. Storage**

**Separation Distance for New Facilities**

Loaded Tank Cars and Storage Tanks from Mainline Class 2 Track or Higher

Table with 3 columns: Activity, PIH (Zone A, B, C or D), Class 3, Division 2.1, Division 2.2 and all other Hazard Classes, Combustible Liquids, Class 8, and Class 9. Rows include Loading and Unloading, Storage of Loaded Tank Cars, and Storage in Tanks.

Note 1 - With regard to existing facilities, maximum reasonable effort should be made to conform to this standard taking into consideration cost, physical and legal constraints.

Note 2 - The proposals apply to storage on railroad property and on chemical company property located close to railroad mainline.

Note 3 - These separations are primarily intended to provide protection to new facilities from main line derailments. Separation distances were derived from AAR derailment data for distances that cars typically travel from the main line during derailments.

Note 4 - Distances above are measured from track centerline to track centerline or from track centerline to nearest edge of storage tanks.

**V. TRANSCAER® (Transportation Community Awareness and Emergency Response Implementation of Transcaer®)**

Railroads will assist in implementing TRANSCAER®, a system-wide community outreach program to improve community awareness, emergency planning and incident response for the transportation of hazardous materials.

- Demonstrate the continuing commitment of chemical manufacturers and transporters to the safe transportation of hazardous materials;
• Improve the relationship between manufacturers, carriers and local officials of communities through which hazardous materials are transported;
• When requested assist Local Emergency Planning Committees (LEPC's) in assessing the hazardous materials moving through their communities and the safeguards that are in place to protect against unintentional releases.

An important product of the TRANSCAER® program will be to overcome the widespread belief that every local firefighter and policeman must have the expert skills and equipment to respond personally to any hazardous materials emergency.

TRANSCAER® should be highly publicized to produce the maximum desirable enhancement of public awareness.

**VI. Criteria for Shipper Notification**

The railroads will initiate the shipper's emergency response system by calling CHEMTREC, or the appropriate contact telephone number as required by regulation on the shipping document, when an incident occurs involving any car (load or residue) containing a hazardous material regulated in transportation by the Department of Transportation.

An incident is defined as a rail car which is derailed and not upright, or which has sustained body or tank shell damage, or has sustained a release of any amount of product.

The shipper's emergency response system should also be initiated if the carrier believes there is reason to suspect any other potential for injury to people, property or the environment.

In the event of a major rail accident, a consist (to include shipper, consignee and commodity description for each hazardous material), waybill or equivalent document, should be provided upon request to CHEMTREC or the appropriate shipper contact as identified by the emergency response telephone number displayed on the shipping document.

Table with REVISIONS (DATE, BY), APPROVALS, SHEET 1 OF 3, and metadata including DRAWN BY: DAP, SCALE: NONE, DATE: 15 NOV 15, FILE: and the AAR logo.

A major rail accident is defined as one resulting in fire, explosion, the potential for an explosion, fatalities, evacuation of the general public, or multiple releases of hazardous materials.

Anytime a consist or other document is provided to CHEMTREC or the appropriate contact a follow-up call by the carrier should be made to confirm the receipt of the information as well as to provide other additional information pertaining to the incident not contained in the facsimile or electronically transmitted document.

This practice does not preclude any carrier from notifying CHEMTREC or the appropriate shipper contact of a rail incident involving hazardous materials that does not meet the criteria outlined above.

**VII Time Sensitive Materials**

Railroads and shippers will be responsible for monitoring the shipments (loads & residue) of products classified by the Department of Transportation as being time sensitive.

This monitoring process will, at a minimum, provide a means to ensure the movement of rail cars containing time sensitive materials (for list see Appendix 2) in order to achieve delivery of the product within the time specified by the Department of Transportation.

As warranted, railroads will implement an internal escalation process and communicate with shippers, receivers and other rail carriers concerning any rail car containing a time sensitive product that has been delayed in transit to the extent that it may not reach destination within the time specified by the Department of Transportation. In such cases, an expedited movement of the rail car, or other action as deemed appropriate by the carrier and shipper will be taken.

**VIII Special Provision for Spent Nuclear Fuel (SNF) and High Level Radioactive Waste (HLRW)**

When a train carrying SNF or HLRW meets another train carrying loaded tank cars of flammable gas, flammable liquids or combustible liquids in a single bore double track tunnel, one train shall stop outside the tunnel until the other train is completely through the tunnel.

**IX Applicability**

These recommendations apply to rail operations within the United States of America.

(Supersedes Circular No. OT-55-M dated October 1, 2012)

Issued by:

Robert C. VanderClute  
Senior VP Safety and Operations  
(202) 639 – 2200  
rvanderclute@aar.org


**Appendix 1  
Spent Nuclear Fuel (SNF) and High Level Radioactive Waste (HLRW)  
August 5, 2013**

HMRC	Proper Shipping Description
4929142	Radioactive Material, Type B(U) Package, Fissile
4929143	Radioactive Material, Type B(M) Package, Fissile
4929144	Radioactive Material, Transported Under Special Arrangement, Fissile
4929147	Radioactive Material, Transported Under Special Arrangement

**Appendix 2  
Time Sensitive Materials  
August 5, 2013**

Proper Shipping Name	Haz Mat STCC
<b>20 Day</b>	
Ethylene, refrigerated liquid	4905735
Hydrogen, refrigerated liquid	4905745
Vinyl Fluoride, stabilized	4905793
Chloroprene, stabilized	4907223
Flammable Liquid, n.o.s. (Methyl Methacrylate Monomer, uninhibited)	4907255
Hydrogen chloride, refrigerated liquid	4920504
<b>30 day</b>	
Styrene monomer, stabilized	4907265
Styrene monomer, stabilized	4907235

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<b>AAR CIRCULAR NO. OT-55-N</b>			
<b>APPROVALS</b>			
<b>OFFICE OF DESIGN &amp; CONSTRUCTION</b>			
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2 OF 3		CHECKED BY:	DATE: 15 NOV 15
		DWG NO: FILE:	

**Appendix 3**  
**Sample Request for Hazardous Materials Commodity Flow Information**  
**August 5, 2013**

[Company LOGO]

Request for Hazardous Materials COMMODITY FLOW INFORMATION

Organization Requesting Information: \_\_\_\_\_

Contact Person: \_\_\_\_\_

Phone Number: \_\_\_\_\_

Email Address: \_\_\_\_\_

Mailing Address: \_\_\_\_\_  
 (Street Address)  
 \_\_\_\_\_  
 (City, State, Zip)

Geographical Description of Area for study: \_\_\_\_\_

Preferred method to receive report:  Email  U.S. Mail (Mark One)

By signing below I acknowledge and agree to the terms set forth by [RAILROAD NAME] for use and dissemination of the [RAILROAD'S] Hazardous Materials Commodity Flow Information. [RAILROAD'S NAME] considers this information to be restricted information of a security sensitive nature. I thus affirm and agree that the information provided by [RAILROAD NAME] in this report will be used solely for and by bona fide emergency planning and response organizations for the expressed purpose of emergency and contingency planning. This information will not be distributed publicly in whole or in part without the expressed written permission of [RAILROAD NAME].

\_\_\_\_\_  
 (Signature of person requesting commodity flow information)

**Return Completed Form to: [INSERT RAILROAD NAME AND ADDRESS]**

-----  
 For [RAILROAD] Use Only

[PERSON RESPONSIBLE FOR APPROVAL]: \_\_\_ Yes \_\_\_ NO Date: \_\_\_\_\_

Hazardous Materials Service Support:

Date Request Received: \_\_\_\_\_

Time Period Covered: \_\_\_\_\_

Date Report Sent: \_\_\_\_\_

Report sent via:  Email  U.S. Mail

A6- 3

REVISIONS	
DATE	BY



**AAR CIRCULAR NO. OT-55-N**

APPROVALS

SHEET  
3 OF 3

OFFICE OF DESIGN & CONSTRUCTION

DRAWN BY: DAP SCALE: NONE DWG NO:

CHECKED BY: DATE: 15 NOV 15 FILE:

Design Criterion																		
Track Classification	Maximum (M)	Minimum (m)	Industry Lead Track								Industry Service Track							
			HAZMAT/Leads > 1/2 mi		Unit Train		Loop Track		General Service		HAZMAT		Unit Train		Loop Track		General Service	
			Switched by		Switched by		Switched by		Switched by		Switched by		Switched by		Switched by		Switched by	
Design Criterion			RR	Industry	RR	Industry	RR	Industry	RR	Industry	RR	Industry	RR	Industry	RR	Industry		
Degree of Curve (Chord)			7 deg 30 min		8 deg		9 deg		9 deg		7 deg 30 min		8 deg		9 deg		9 deg	
Radius of Curve			764.48		716.78		637.27		637.27		764.48		716.78		637.27		637.27	
Max Grade	Moving	M	0.50%				0.5% or 1.0% MAX.		1.00%		1.00%				0.5% or 1.0% MAX.		2.00%	
	Spotting		0% Optimum not to exceed 0.2%															
Vertical Curve Factor	Sag	m	0.60% per 100 ft															
	Summit		1.00% per 100 ft															
Tangent Between Curves			100'				70'											
Track Centers	Main	m	25' Track Centers - Minimum from Working Track to Main															
	Other		15'				14'											
Distance from T/O	To Curve	m	100'								70'							
	To Bridge-Xing		100'															

**Material Specifications**

Track Classification	Maximum (M)	Minimum (m)	Industry Lead Track (1)								Industry Service Track (1)							
			HAZMAT/Leads > 1/2 mi		Unit Train		Loop Track		General Service		HAZMAT		Unit Train		Loop Track		General Service	
			Switched by		Switched by		Switched by		Switched by		Switched by		Switched by		Switched by		Switched by	
Design Criterion			RR	Industry	RR	Industry	RR	Industry	RR	Industry	RR	Industry	RR	Industry	RR	Industry		
Operating Speed	M		25 MPH/ 15 MPH	10 MPH	25 MPH	15 MPH	≤ 10 MPH	15 MPH	≤ 10 MPH	15 MPH				≤ 10 MPH				
Turnout No/Wgt/Type (1)	m		#12 New/ #10 New	#10 New	#12 New	#10 New	#10 New/PW	#10 New	#8 New	#10 New				#10 New/PW	#10 New	#8 New/PW		
Type of Frog		Mainline	Jump or Rail Bound Manganese (RBM)															
		Other	Rail Bound Manganese (RBM) or Self Guarded Solid Manganese (SGSM)															
Rail Weight/Section			136# /115# RE New				115#		136# / 115# RE PW				112# (100# RA PW Canada Only)	115#		112# (100# RA PW Canada Only)		
Switch Tie - size			7" x 9" Hardwood															
Crosstie - size			7"x9"x8'-6" Grade HW				6"x8"x8'-6" Grade HW		7"x9"x8'-6" Ind Grade HW				6"x8"x8'-6" Grade HW					
Crosstie - spacing (2)	M		20" Timber				24" Concrete		24" Steel				22"		22"			
Ballast depth			12"				9"		12"				9"		9"			
Sub-ballast depth	m		12"															

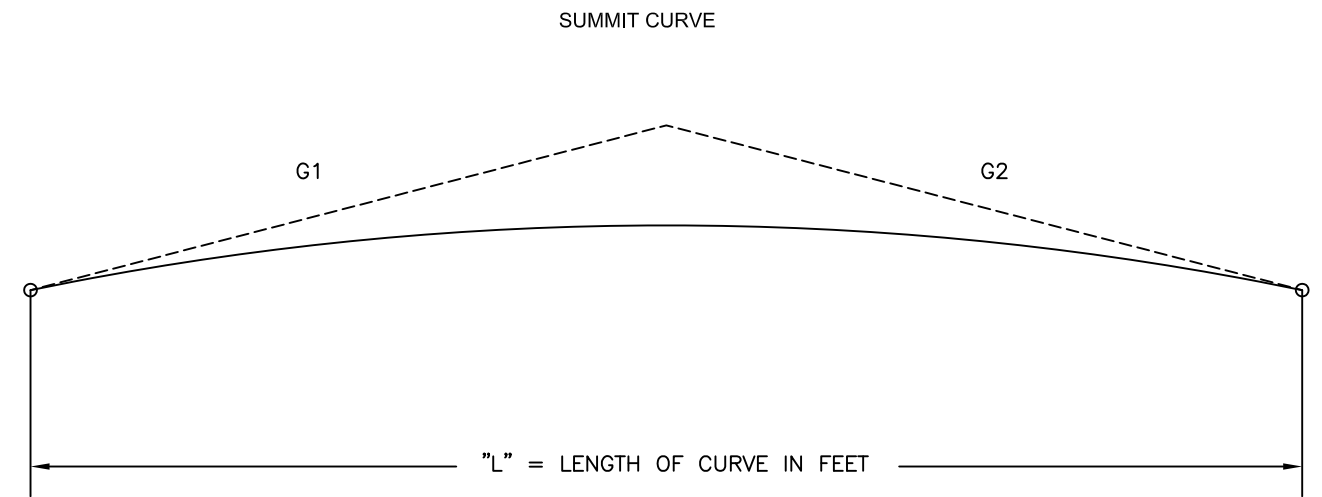
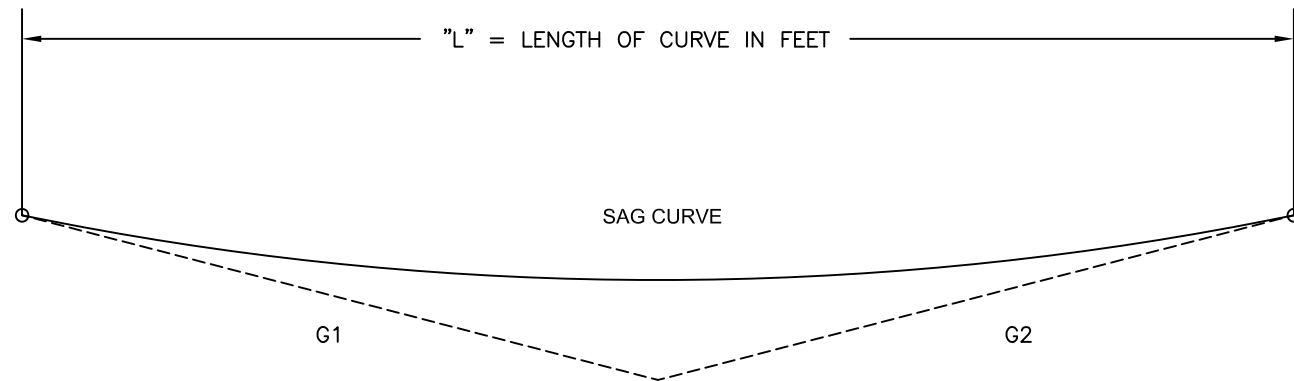
(1) - Mainline turnout weight to match or be higher than main line section (no less than #10 -115# New)

(2) - Tie spacing in xing areas are to match crossing surface specifications

A7

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**DESIGN AND MATERIAL TABLES**



$$L = D/R \times 100$$

EXAMPLE CALCULATIONS FOR FREIGHT OPERATIONS

G1 AND G2 DESIGNATE GRADES IN PERCENT

L= LENGTH OF CURVE IN FEET

D= (G1-G2) ALGEBRAIC DIFFERENCE IN RATES OF GRADES EXPRESSED AS A DECIMAL (EX. -1% AND +2%=3%)

R= RATE OF CHANGE SHOWN IN DESIGN CRITERION (EX. 1.2% PER 100 FT.)

EXAMPLE:

$$L = D/R \times 100$$

$$D = (-2\%) - (+2\%) = (-4\%) \quad D = 4\%$$

$$R = 1.2\% \text{ PER } 100 \text{ FT FOR SAG}$$

$$L = 4\% / 1.2\% \times 100 = 333.33 \Rightarrow 340 \text{ FT.}$$

G1 AND G2 DESIGNATE GRADES IN PERCENT

L= LENGTH OF CURVE IN FEET

D= (G1-G2) ALGEBRAIC DIFFERENCE IN RATES OF GRADES EXPRESSED AS A DECIMAL (EX. -1% AND +2%=3%)

R= RATE OF CHANGE SHOWN IN DESIGN CRITERION (EX. 1.5% PER 100 FT.)

EXAMPLE:

$$D = (+0.5\%) - (-0.2\%) = 0.7\%$$

$$R = 1.5\% \text{ PER } 100 \text{ FT FOR A SUMMIT}$$

$$L = 0.7\% / 1.5\% \times 100 = 46.66 \Rightarrow \text{Minimum } 100 \text{ FT.}$$

NOTES:

1.) VERTICAL CURVES SHALL NOT FALL WITHIN THE LIMITS OF HORIZONTAL CURVES OR TURNOUTS - UNLESS AUTHORIZED BY THE SENIOR MANAGER DESIGN & CONSTRUCTION.

2.) MINIMUM VERTICAL CURVE LENGTH SHALL NOT BE LESS THAN 100FT - UNLESS AUTHORIZED BY THE SENIOR MANAGER DESIGN & CONSTRUCTION

3.) MINIMUM DISTANCE BETWEEN VERTICAL CURVES SHALL NOT BE LESS THAN 100FT - UNLESS AUTHORIZED BY THE SENIOR MANAGER DESIGN & CONSTRUCTION

FOR MAIN LINE VERTICAL CURVES, USE AREMA FORMULA

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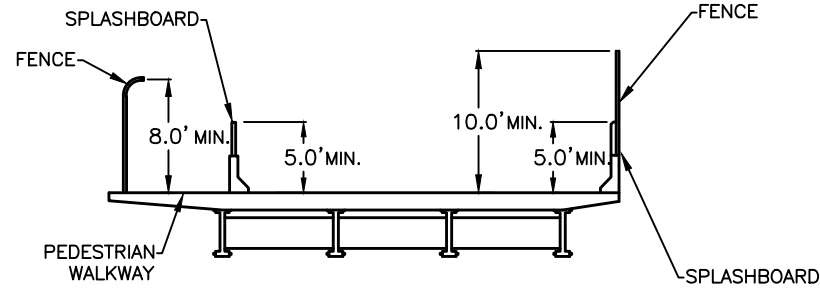


VERTICAL CURVES FOR INDUSTRIAL TRACKS

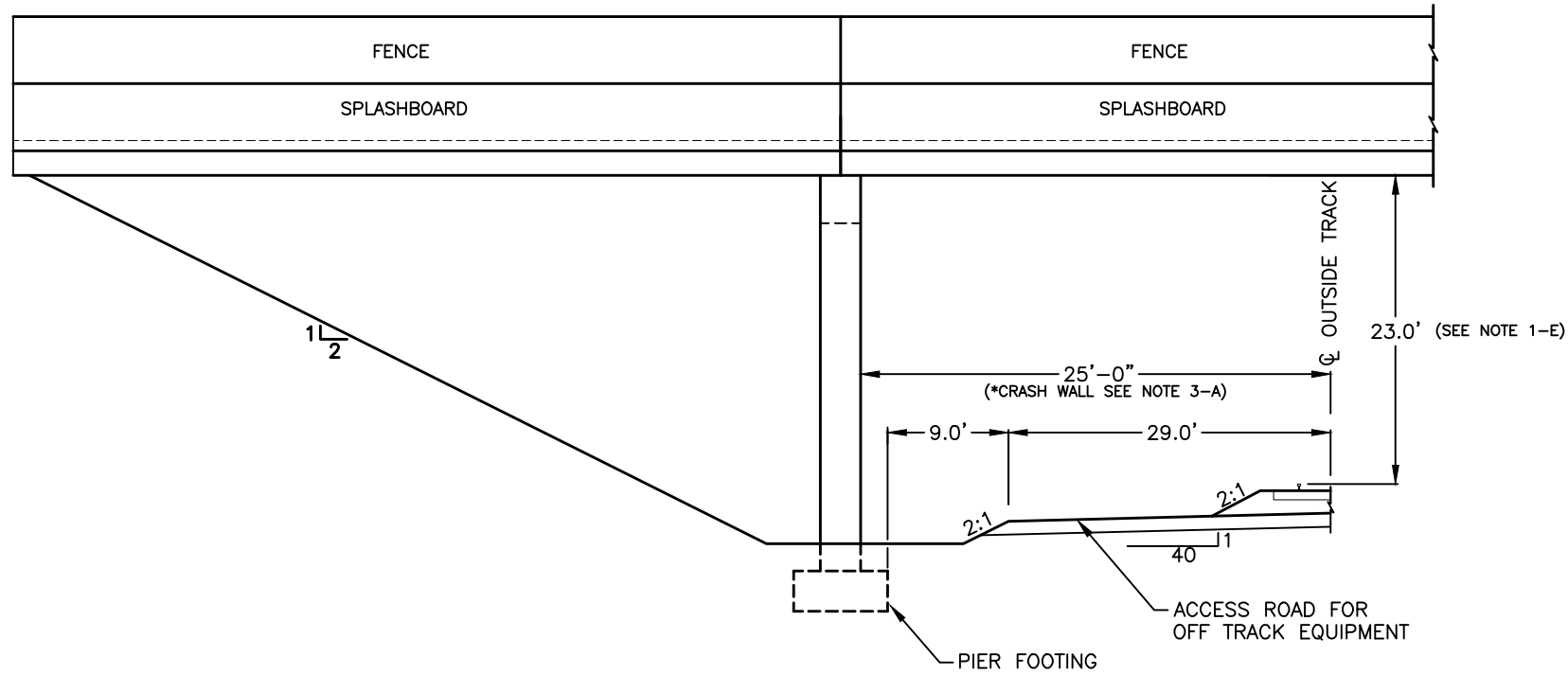
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OVERPASS CROSS SECTION



ELEVATION

GENERAL:

- FENCE SHALL BE PROVIDED AS INDICATED ON THE CROSS SECTION ON BOTH SIDES OF THE VIADUCT. THE FENCE SHALL EXTEND COMPLETELY ACROSS THE STRUCTURE OR CN RIGHT-OF-WAY, WHICHEVER IS SHORTER.
- SPLASH BOARDS SHALL BE PROVIDED ON BOTH SIDES OF THE VIADUCT IN LOCATIONS WHERE SWITCHING OR OTHER FREQUENT RAILROAD ACTIVITIES ARE PERFORMED, THE SPLASHBOARD SHALL EXTEND COMPLETELY ACROSS THE STRUCTURE OR CN RIGHT-OF-WAY, WHICHEVER IS SHORTER.
- LIGHTS ARE TO BE INSTALLED ON THE UNDERSIDE OF THE VIADUCT WHERE SHADOWS CAST BY THE STRUCTURE WOULD INTERFERE WITH THE RAILROAD OPERATIONS.
- SLOPE PAVING SHALL BE PROVIDED WHERE END SLOPES EXCEED 2 HORIZONTAL TO 1 VERTICAL.
- FALSEWORK, NETTING OR OTHER SUITABLE PROTECTION SHALL BE PROVIDED TO PREVENT DEBRIS FROM FALLING ON THE TRACK DURING DEMOLITION AND CONSTRUCTION OPERATIONS.
- APPLICANT SHALL BE RESPONSIBLE FOR IDENTIFICATION, LOCATION AND PROTECTION OF EXISTING UTILITIES.
- CONTACT CN'S PUBLIC WORKS ENGINEER FOR THE DESIGNATED PROJECT IN THE STATE IN WHICH IT IS LOCATED AT LEAST 1 WEEK PRIOR TO COMMENCEMENT OF WORK TO LOCATE CN UNDERGROUND SIGNAL INFRASTRUCTURE.
- 2 WEEKS PRIOR TO PROJECT START, FLAGGING PROTECTION TO BE PUT IN PLACE WITH DIRECTION OF CN'S NETWORK OPERATIONS ENGINEER.
- APPLICANT MUST CONTACT JOINT UTILITY LOCATION SERVICE TO DETERMINE LOCATION OF ALL UTILITIES.
- CERTAIN LOCATIONS MAY REQUIRE ADDITIONAL CLEARANCES OR FEATURES BEYOND THOSE SHOWN IN THIS DRAWING BASED ON LOCAL CONDITIONS.
- EXCEPTIONS TO THESE STANDARDS MUST BE APPROVED BY CN.

NOTES:

- CLEARANCES:
  - VERTICAL CLEARANCE SHALL BE 23' MINIMUM ABOVE THE PLANE OF TOP-OF-RAIL, ADDITIONAL CLEARANCE MAY BE REQUIRED IF SAG OF VERTICAL CURVE MUST BE ADJUSTED OR IF FUTURE TRACK RAISE FOR FLOOD CONSIDERATIONS OR MAINTENANCE IS PROBABLE.
  - MINIMUM HORIZONTAL CLEARANCES, MEASURED AT RIGHT ANGLE FROM THE CENTERLINE OF TRACK, SHALL BE AS SHOWN.
  - MINIMUM CONSTRUCTION CLEARANCES SHALL BE 22' VERTICAL ABOVE THE PLANE OF TOP-OF-RAIL AND 12' HORIZONTAL AT RIGHT ANGLE FROM CENTERLINE OF TRACK. DEPENDING ON THE TYPE OF STRUCTURE, CLEARANCES MAY BE INCREASED.
  - HORIZONTAL CLEARANCES ARE TO BE INCREASED 1/2" PER DEGREE OF CURVE WHERE THE STRUCTURE IS LOCATED ADJACENT TO OR WITHIN 80' OF THE CURVE LIMITS.
  - VERTICAL CLEARANCES FOR PIPE AND PEDESTRIAN BRIDGES ARE TO BE A 25' MINIMUM FROM TOP-OF-RAIL.
- FUTURE TRACKS:
  - SPACE IS TO BE PROVIDED FOR ONE OR MORE FUTURE TRACKS AS REQUIRED FOR LONG RANGE PLANNING OR OTHER OPERATING REQUIREMENTS, WHERE PROVISION IS MADE FOR MORE THAN TWO TRACKS, SPACE IS TO BE PROVIDED FOR ACCESS ROADS ON BOTH SIDES OF TRACK.
- PIERS:
  - PIER PROTECTION (CRASH WALLS) SHALL BE PROVIDED IN ACCORDANCE WITH AREMA CHAPTER 8, PART 2.1.5 FOR PIERS WITHIN 25 FEET OF THE CENTERLINE OF TRACK.
  - TOP OF FOOTING SHALL BE A MINIMUM OF 6' BELOW BASE OF RAIL AND A MINIMUM OF 1 FOOT BELOW FLOW LINE OF DITCH.
  - TEMPORARY OR PERMANENT SHORING SHALL BE DESIGNED AND SEALED BY A LICENSED ENGINEER OF THE STATE IN WHICH THE STRUCTURE IS BEING BUILT AND SUBMITTED TO CN'S STRUCTURES GROUP FOR REVIEW (SEE SPECIFICATION DRAWING)
- DRAINAGE:
  - DRAINAGE FROM THE OVERPASS SHALL BE DIVERTED AWAY FROM CN TRACKS AND NOT DISCHARGED ONTO THE TRACKS OR ROADBED.
  - A STANDARD FLAT-BOTTOM DITCH SHALL BE PROVIDED ON EACH SIDE OF TRACKS AS NECESSARY
  - CULVERTS MAY BE INSTALLED ON THE OPPOSITE SIDES OF COLUMN FROM TRACK IN LIEU OF STANDARD RAILROAD DITCHES WHEN APPROVED BY TECHNICAL SERVICE ENGINEER. MAINTENANCE OF CULVERTS IS TO BE AT APPLICANT'S EXPENSE.

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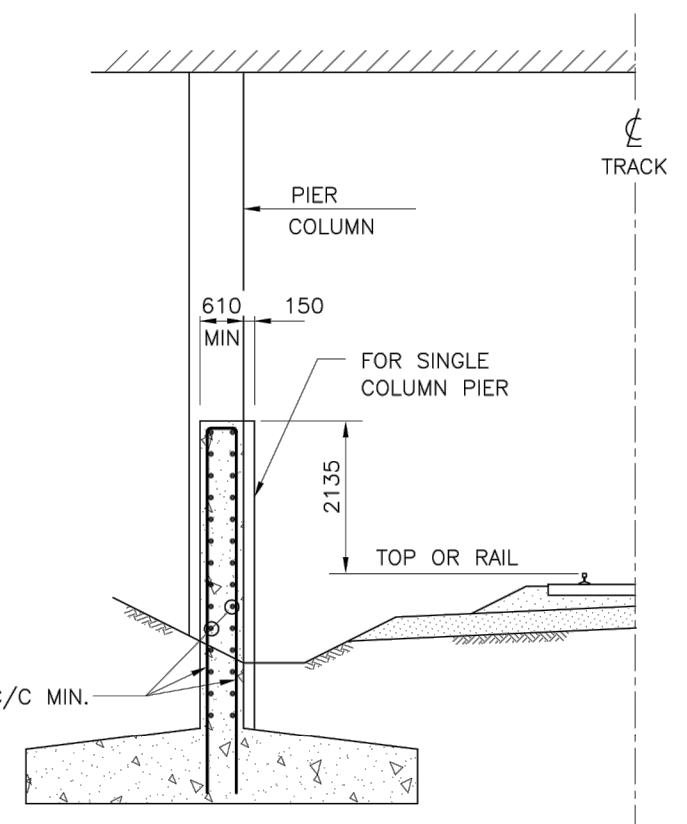
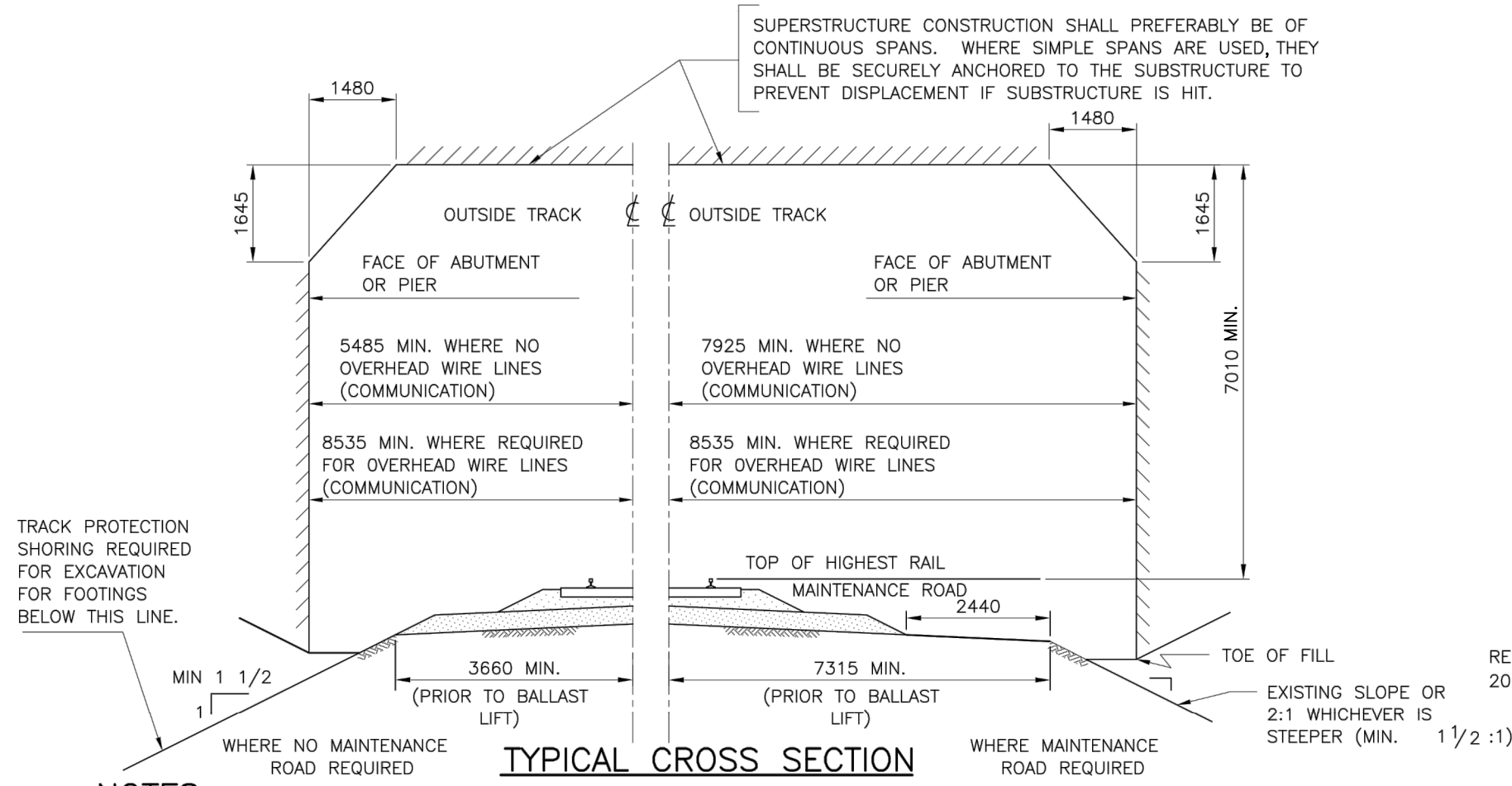
**US ONLY**  
**DESIGN CLEARANCES FOR**  
**HIGHWAY AND PEDESTRIAN**  
**OVERPASS**

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SUPERSTRUCTURE CONSTRUCTION SHALL PREFERABLY BE OF CONTINUOUS SPANS. WHERE SIMPLE SPANS ARE USED, THEY SHALL BE SECURELY ANCHORED TO THE SUBSTRUCTURE TO PREVENT DISPLACEMENT IF SUBSTRUCTURE IS HIT.



**NOTES**

- ALL HORIZONTAL DIMENSIONS ARE TO BE TAKEN PERPENDICULAR TO RAILWAY TRACKS.
- ALL VERTICAL DIMENSIONS ARE TO BE TAKEN FROM THE TOP OF RAIL.
- FOR TRACKS ON CURVE, CONSULT SYSTEM ENGINEER – CN DESIGN & CONSTRUCTION
- FOR RAILWAY REQUIREMENTS FOR ADDITIONAL FUTURE TRACK PROVISIONS AND FOR THE MINIMUM TEMPORARY CONSTRUCTION CLEARANCES CONSULT SYSTEM ENGINEER – CN DESIGN & CONSTRUCTION
- NO WATER FROM DECK OF STRUCTURE SHALL DRAIN ONTO RAILWAY TRACK BETWEEN TRACK DITCHES.
- NO WATER FROM ROAD APPROACH EMBANKMENT SHALL DRAIN INTO RAILWAY DITCHES WITHOUT PROPER PROTECTION AGAINST EROSION OF SLOPE OR FILLING WITH FINES OF DITCHES.
- APPROACH SLOPES IF ADJACENT TO TRACKS ARE TO BE PAVED OR OTHERWISE PROTECTED FROM EROSION.
- ANY DEVIATION FROM THIS STANDARD MUST RECEIVE PRIOR APPROVAL OF THE REGIONAL CHIEF ENGINEER

**PIER PROTECTION**

- PIERS WITHIN 7620 OF CENTER LINE OF ADJACENT TRACK SHALL BE OF SOLID HEAVY CONSTRUCTION OR SHALL BE PROTECTED BY REINFORCED CONCRETE PROTECTION WALL EXTENDING 2135 ABOVE TOP OF RAIL. WHERE 2 OR MORE COLUMNS COMPOSE A PIER, A PROTECTION WALL AT LEAST 610 THICK SHALL CONNECT THE COLUMNS. WHEN THE PIER CONSISTS OF A SINGLE COLUMN, THE PROTECTION WALL SHALL BE PARALLEL TO THE TRACK, 760 THICK, EXTEND AT LEAST 2135 BEYOND BOTH SIDES OF THE COLUMN, END PROJECT 150 BEYOND THE FACE OF THE COLUMN ON THE SIDE ADJACENT TO THE TRACK. PROTECTION WALL SHALL BE ANCHORED TO THE COLUMN AND FOOTINGS WITH ADEQUATE REINFORCING STEEL.
- DESIGN AND LOCATION OF PROTECTION WALLS SHALL BE VERIFIED WITH THE RAILWAY COMPANY.

**PROTECTION WALL DETAIL**

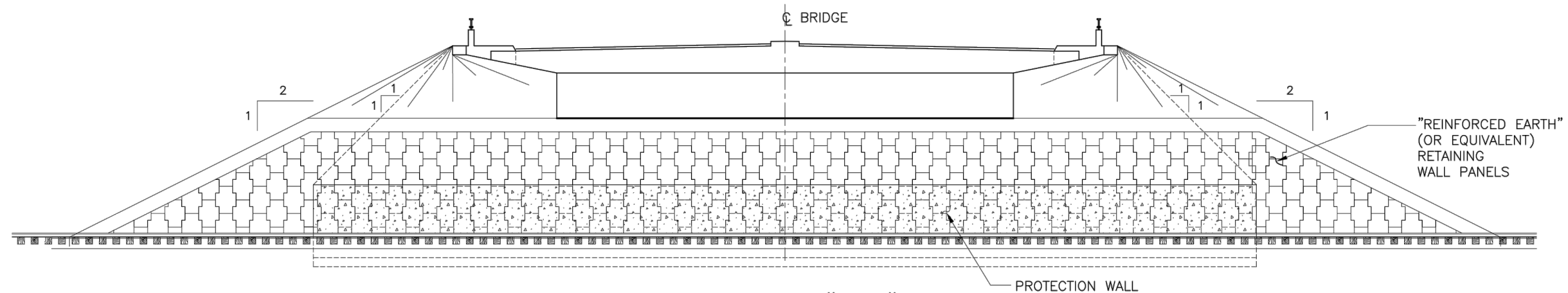
\*DOES NOT COVER THE EVENTUALITY OF ELECTRIFICATION  
ALL UNITS ARE IN MILLIMETERS

**A10-1**

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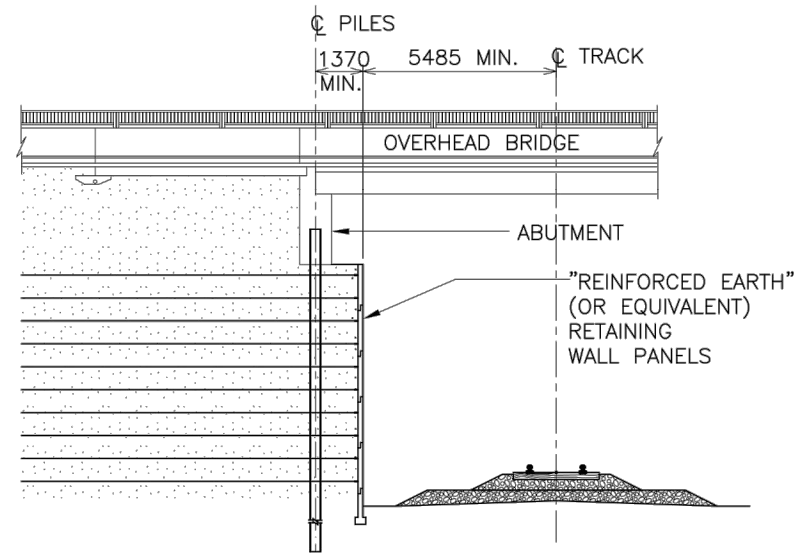
**K1U-10.2m DESIGN CLEARANCES FOR HIGHWAY AND PEDESTRIAN OVERPASS CANADA**



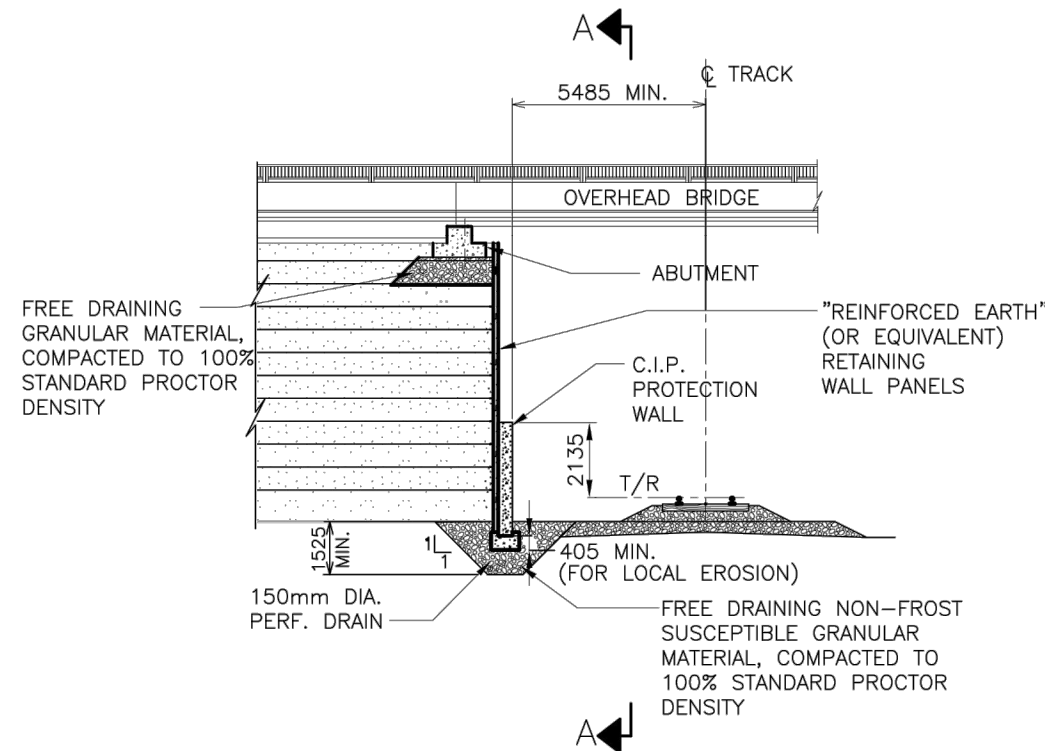
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NOTES:

- WHEN "REINFORCED EARTH" WALLS (OR EQUIVALENT) ARE TO BE CONSTRUCTED WITHIN 7.62m OF THE CENTER LINE OF TRACK, THEY SHALL BE IN ACCORDANCE WITH THE TYPICAL SECTIONS SHOWN ON THIS DRAWING FOR ABUTMENTS ON PILES OR ON A GRANULAR BASE.
- THE PROTECTION WALL SHALL BE PARALLEL TO THE TRACK 760mm (MIN.) THICKNESS AND EXTEND 2.135m ABOVE THE TOP OF RAIL.
- REFER TO DWG. K1U-10.2 FOR NOTES & PROTECTION WALL DETAILS.
- PRIOR TO CASTING OF THE C.I.P. PROTECTION WALL A TEMPORARY FACED REINFORCED EARTH WALL (OR EQUIVALENT) MUST BE CONSTRUCTED TO THE TOP OF THE C.I.P. WALL TO ENSURE THAT THE SOIL REINFORCEMENT HAS BEEN MOBILIZED EQUALLY.
- THE C.I.P. PROTECTION WALL MUST BE POSITIVELY CONNECTED TO THE M.S.E. WALL AND AN ALLOWANCE PROVIDED FOR VERTICAL DRAINAGE BETWEEN THE TWO WALLS.



TYPICAL SECTION FOR ABUTMENTS ON PILES



TYPICAL SECTION FOR ABUTMENTS ON GRANULAR BASE

ALL UNITS ARE IN MILLIMETERS UNLESS INDICATED OTHERWISE

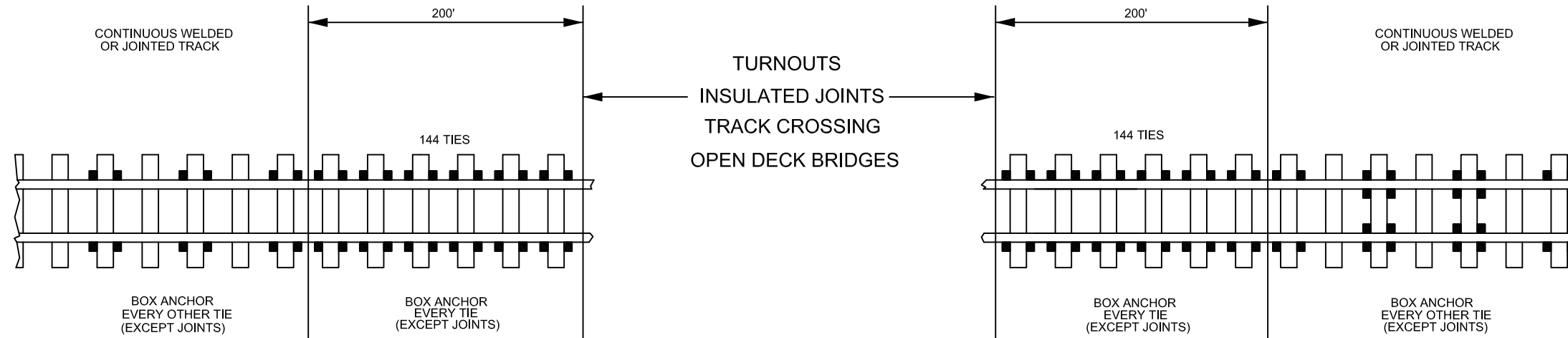
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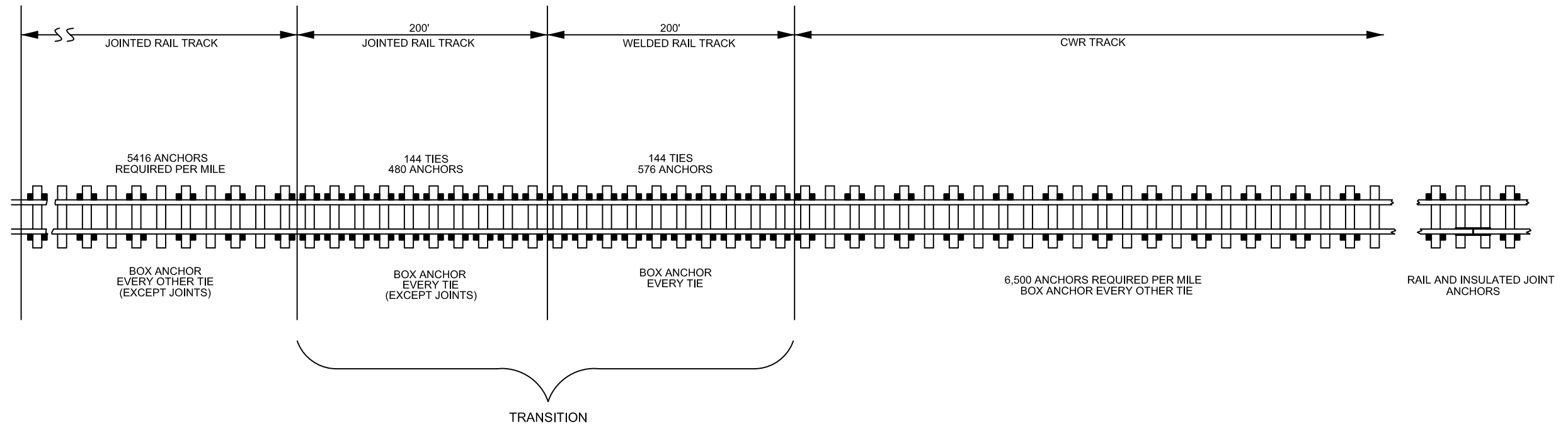


**K1U-10.3m DESIGN CLEARANCES FOR  
HIGHWAY AND PEDESTRIAN OVERPASS  
CANADA**

## ANCHOR PATTERN NEAR FIXED OBJECTS



## ANCHOR PATTERN OF TRACK



A11

**NOTE:**

ON JOINTED RAIL ABUTTING A COMPLETED LENGTH OF CONTINUOUS WELDED RAIL, THE FIRST 6 JOINTED RAILS (234') IN EACH DIRECTION MUST BE FULLY BOX ANCHORED ON ALL TIES BUT JOINT TIES AND THEREAFTER EVER OTHER TIE MUST BE BOX ANCHORED

ANCHORS WILL BE APPLIED TO BOTH SIDE OF TIE.

AT RAIL ON INSULATED JOINTS, RAIL ANCHORS WILL NOT BE APPLIED TO THE RAIL ACROSS FROM THE JOINT

ANCHORS NOT REQUIRED WHERE PREMIUM FASTENERS SUCH AS PANDROL OR SAFELOK CLIPS ARE USED

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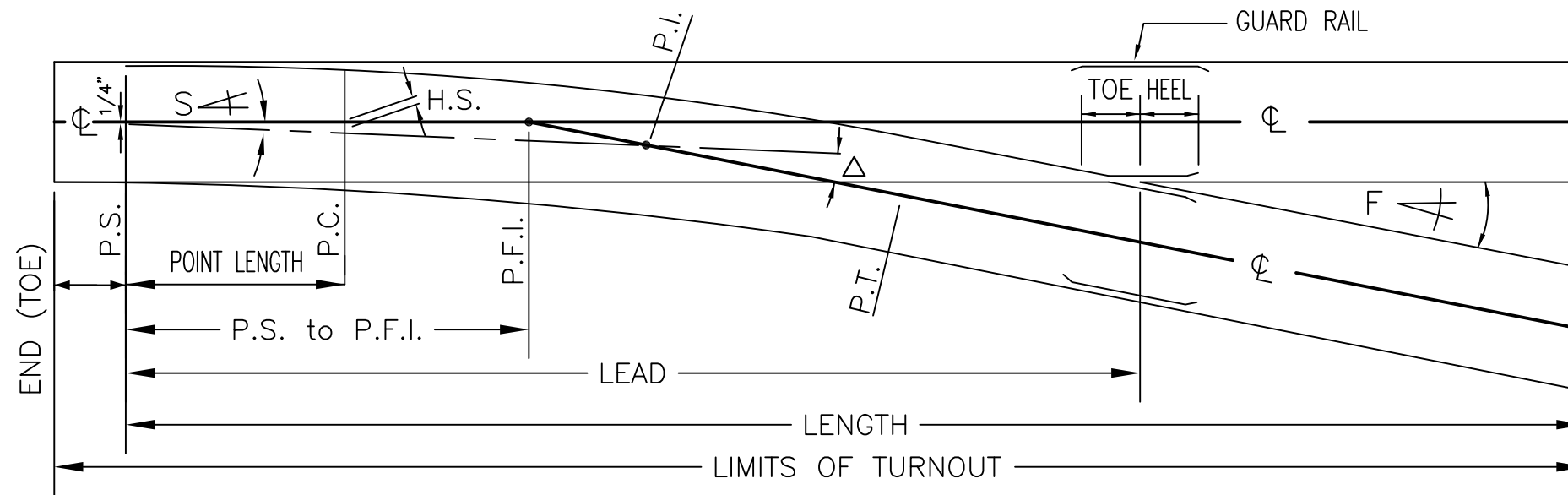
### ANCHOR PATTERN FOR (CWR) CONTINUOUS WELDED RAIL & JOINTED RAIL

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**PLAN OF RIGHT HAND TURNOUT**

	#8 - SPECIAL	#10	#12
END TO P.S.	3'- 5 5/8"	3'- 5 5/8"	3'- 5 5/8"
POINT LENGTH	16'- 6" OR 38'-5"	16'- 6" OR 38'-5"	22'- 0" OR 36'-7"
S $\sphericalangle$	1° 42' 01"	1° 42' 01"	1° 16' 31"
H.S. (HEEL SEPARATION)	5 5/8"	6 1/4"	6 1/4"
P.S. TO P.F.I.	29'- 10 3/4"	34' - 1/2"	41' - 1"
LEAD	67'- 10 3/4"	81' - 6"	98' - 1"
LENGTH	91'- 0 3/8"	110'- 8 7/8"	137'- 3 3/4"
$\Delta$ (F $\sphericalangle$ - S $\sphericalangle$ )	5° 27' 09"	4° 01' 28"	3° 29' 48"
TOE LENGTH (FROG)	5'- 0"	12'- 0"	14'- 3"
HEEL LENGTH (FROG)	8'- 0"	14'- 0"	17'- 3"
F $\sphericalangle$ (FROG)	7° 09' 10"	5° 43' 29"	4° 46' 19"
LIMITS OF TURNOUT	94'- 6"	114'- 2 1/2"	140'- 9 3/8"

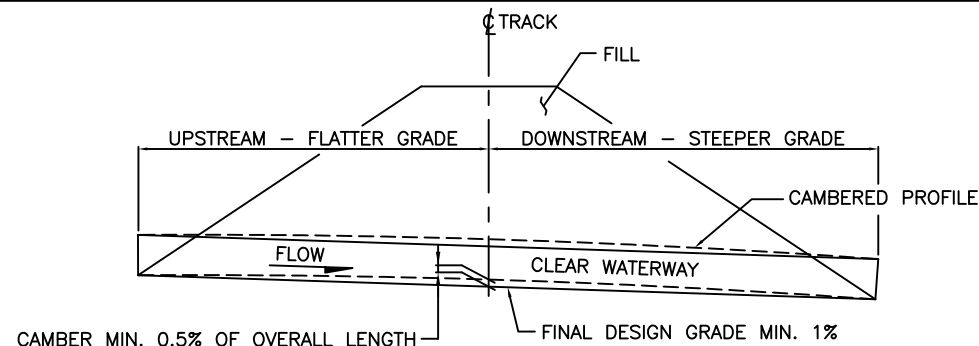
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**ABBREVIATIONS:**  
 P.S. POINT OF SWITCH  
 S  $\sphericalangle$  SWITCH ANGLE  
 H.S. HEEL SEPARATION  
 P.C. POINT OF CURVE  
 P.F.I. POINT OF FROG INTERSECTION  
 P.I. POINT OF CURVE INTERSECTION  
 P.T. POINT OF TANGENCY  
 F  $\sphericalangle$  FROG ANGLE

**NOTES:**  
 1. LEFT HAND TURNOUT IS OPPOSITE HAND.  
 2. LIGHTER LINES TO EACH SIDE OF CL REPRESENT TRACK GAUGE LINE

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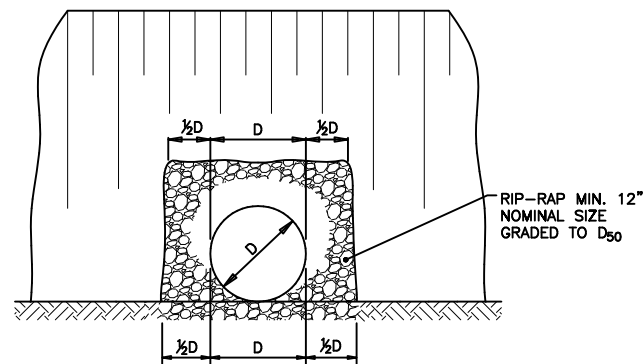




**MINIMUM GRADE AND CAMBERING REQUIREMENTS FOR CULVERT INSTALLATION**

TABLE 1: CAMBER TABLE

LENGTH (FT)	CAMBER (IN)
20	1.2
30	1.8
40	2.4
50	3.0
60	3.6
70	4.2
80	4.8
90	5.4
100	6.0



**RIP-RAP PROTECTION**

TABLE 3: STEEL ROUND CORRUGATED PIPE (CSP) MINIMUM AND MAXIMUM HEIGHT OF COVER ASSUMED NORMAL SITE CONDITION PH > 6-8, MINIMUM RESISTIVITY > 381000 ohm-in.

CULVERT SIZE ID (IN)	MIN COVER (FT)	MAXIMUM COVER (FT)									
		CORRUGATION PROFILE 2 1/2 x 1/2				5 x 1					
		16 ga	14 ga	12 ga	10 ga	14 ga	12 ga	10 ga	8 ga		
24	4	20	30	44							
30	4	18	24	36							
36	4	15	18	30	32						
42	4	12	16	25	28						
48	4		24	40		28	50	66			
54	6			30		26	45	58			
60	6					23	40	52	62		
66	8					20	36	48	56		
72	8					18	34	42	52		
78	8					16	30	40	48		
84	8						22	36	44		
90	8						20	34	40		
96	8							30	38		

NOTES: MINIMUM SIZE OF CSP CULVERTS TO BE 36 in. DIA. 24 in. AND 30 in. DIA. CSP CULVERTS ARE TO BE USED WHERE EXISTING COVER DOES NOT PERMIT A 36 in. DIA. SIZE CULVERT. SELECTION OF CULVERTS SHALL BE BASED ON MINIMUM GAUGE FOR ANY GIVEN DIAMETER. IN POOR GROUND CONDITIONS, IT IS RECOMMENDED THAT RIVETED PIPES BE USED.

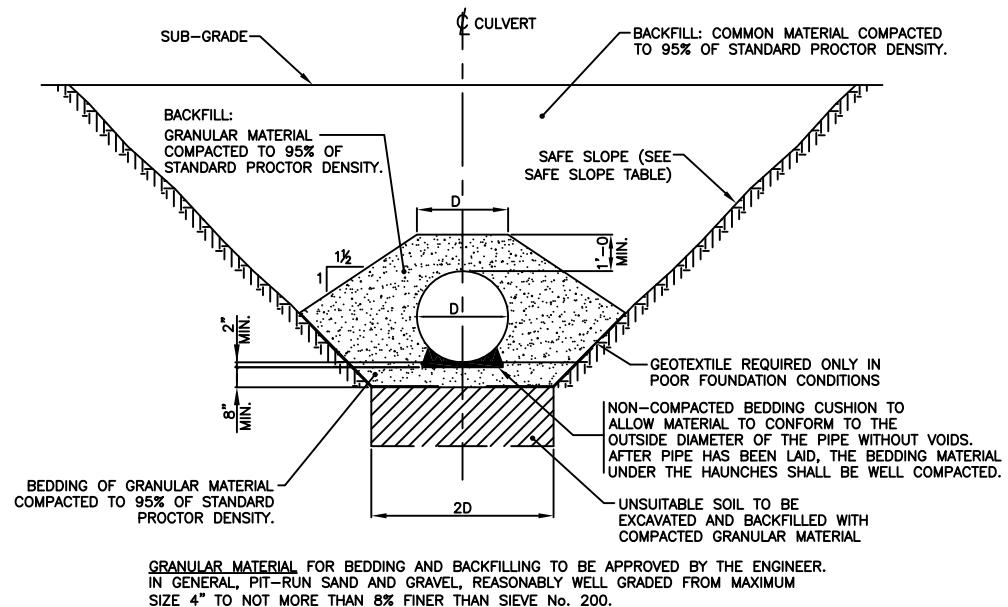
TABLE 4: STRUCTURAL PLATE PIPE (MULTI PLATE/SPCSP) MINIMUM AND MAXIMUM HEIGHT OF COVER ASSUMED NORMAL SITE CONDITION PH > 6-8, MINIMUM RESISTIVITY > 381000 ohm-in.

CULVERT SIZE ID (IN)	MIN COVER (FT)	CORRUGATION PROFILE 6 x 2						
		MAXIMUM COVER (FT)						
		12 ga	10 ga	8 ga	7 ga	5 ga	3 ga	
84	8	22	36	50	60	74	86	
96	8	18	32	44	52	65	78	
108	8	16	28	38	46	58	70	
120	8		25	35	42	52	62	
132	8		22	32	36	46	56	
144	8		20	28	34	42	52	
156	8			26	32	38	48	
168	8			24	28	36	45	
180	8				26	34	40	

TABLE 5: CULVERTS IN CORROSIVE CONDITIONS

SOIL TYPE	DESCRIPTION	DEGREE OF CORROSIVENESS	UPGRADES	
			WALL THICKNESS	COATINGS
1	SANDY SILT	LOW	NONE	NONE
2	CLAYEY SOIL	MODERATE	INCREASE IN GAUGE	ALUMINIZED/POLYMER/INCREASE GALVANIZING THICKNESS 0.186/0.25 lb/ft <sup>2</sup> (ONLY SPCSP)
3	MARSH AND PEATY SOIL	SEVERE	INCREASE IN GAUGE	ALUMINIZED/POLYMER/INCREASE GALVANIZING THICKNESS 0.25 lb/ft <sup>2</sup> (ONLY SPCSP)

- NOTE:
- RECOMMENDED ALTERNATIVE COATINGS ARE:
    - ALUMINIZED STEEL TYPE 2 IN ACCORDANCE WITH ASTM A929 AND AASHTO M-274 WITH 0.62 lb/ft<sup>2</sup>
    - POLYMER COATING SUCH AS TRENCHCOAT OR EQUIVALENT IN ACCORDANCE WITH ASTM A742 AND AASHTO M525 WITH 10/10 FINISH.
  - ABRASION IS A COMBINATION OF STREAM VELOCITY AND BED LOAD. IN GEOGRAPHIC AREAS WHERE HEAVY LOADS OF SAND AND SMALL GRAVEL POSE AN ABRASION PROBLEM, AND FLOW VELOCITY IS HIGH, INCREASE RECOMMENDED THICKNESS BY ONE GAUGE THICKNESS.
  - SELECTION OF UPGRADES OR COMBINATION OF UPGRADES SHALL BE DETERMINED BY THE SEVERITY OF SITE CONDITIONS.



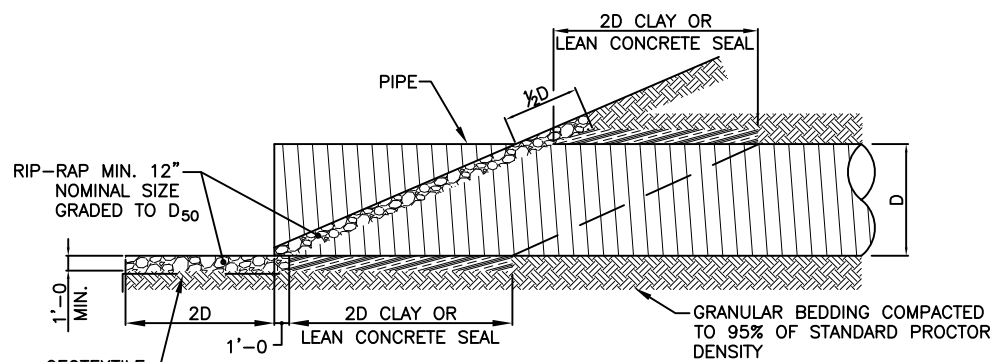
**CULVERT INSTALLATION**

TABLE 2: SAFE SLOPE TABLE

TYPE	SOIL CONDITION	SAFE SLOPE
A	HARD, DENSE AND STIFF SOILS WITH A LOW MOISTURE CONTENT	1 HORIZ: 1 VERT
B	MEDIUM DENSITY SOILS WHICH ARE OF LOOSE CONSISTENCY, HAVE BEEN PREVIOUSLY EXCAVATED OR EXHIBIT SIGNS OF WATER SEEPAGE	1.5 HORIZ: 1 VERT
C	SOFT, VERY LOOSE, WET AND MUDDY SOILS	3 HORIZ: 1 VERT

THE SAFE SLOPE SHALL BE REDUCED WHEN THE FOLLOWING CONDITIONS OCCUR:

- SIGNS OF DISTRESS APPEAR AT THE FACE OF THE CUT OR AT THE GROUND ADJACENT TO THE OPEN EXCAVATION
- SURCHARGE LOADS FROM STORED MATERIAL OR EQUIPMENT OPERATE AT TOP OF CUT
- HIGH WATER TABLE
- INADEQUATE OR UNCERTAIN SOIL PROPERTIES DATA.



INORGANIC CLAY OR LEAN CONCRETE SEAL TO BE PLACED AT BOTH ENDS OF CULVERTS FOR A LENGTH OF TWICE THE DIAMETER (2D). THE CLAY OR LEAN CONCRETE SEAL SHALL EXTEND FROM THE BOTTOM OF THE EXCAVATION TO 12" ABOVE THE CROWN OF THE PIPE AND FOR THE FULL WIDTH OF THE EXCAVATION.

**SEEPAGE CUT-OFF DETAIL**

**RCP NOTES:**

- REINFORCED CONCRETE PIPE (RCP) DESIGN, MATERIALS, AND FABRICATION TO BE IN ACCORDANCE WITH ASTM DESIGNATION C-76.
- CLASS WALL DESIGN TO BE AS NOTED.
- BEDDING TO BE CLASS B OR BETTER
- OTHER THAN ROUND SECTION TO BE APPROVED BY CN'S STRUCTURES DEPT.
- JOINTS AND LIFT HOLES TO BE MORTARED.
- RCP LESS THAN 24" TO BE AVOIDED.

**GENERAL NOTES:**

- A DEPTH OF COVER GREATER THAN 25'-0" NEEDS TO BE APPROVED BY THE CN'S STRUCTURES DEPARTMENT.
- 24" DIAMETER MINIMUM.

SCOPE: CULVERT SIZES IN TABLE 3 AND 4 HAVE BEEN DEVELOPED BASED ON STRENGTH AND DURABILITY REQUIREMENTS FOR NORMAL SITE CULVERT INSTALLATIONS.

DESIGN LOAD: E80 + IMPACT

DURABILITY BASED ON 75 YEAR SERVICE LIFE.

CULVERT DURABILITY: SITE SPECIFIC DESIGN IS REQUIRED WHERE WATER AND/OR SOIL IS CORROSIVE OR ABRASIVE. WATER AND/OR IN CLAY, CLAY LOAM, PEAT AND ORGANIC SOILS SHOULD BE TESTED FOR WATER AND SOIL CORROSIVENESS. TESTS TO BE CARRIED OUT ARE RESISTIVITY AND PH TESTING IN ACCORDANCE WITH CALIFORNIA TEST METHOD 6438 AND SHALL BE PERFORMED BY A QUALIFIED MATERIALS TESTING COMPANY.

INSTALLATION: PIPE SHALL BE INSTALLED IN ACCORDANCE WITH CN ENGINEERING RECOMMENDED METHOD OF INSTALLATION OF CULVERTS RM4402.

FOR MULTIPLE PIPE INSTALLATIONS, THE CLEARANCE BETWEEN CULVERTS SHALL NOT BE LESS THAN 1/2 THE PIPE DIAMETER, BUT NEED NOT BE GREATER THAN 3 FT UNLESS REQUIRED FOR SPECIFIC CONSTRUCTION COMPACTION METHODS AND EQUIPMENT.

FOR PIPES SIZES GREATER THAN 60", TEMPORARY STRUTTING SPACED AT MAX. 10' SPACING SHALL BE PROVIDED.

FOR VERTICAL FACE CUTS, SHORING TO BE PROVIDED AND SHALL BE ENGINEERED TO SUIT HEIGHT OF EMBANKMENT AND VERTICAL FACES.

COVER: THE MINIMUM HEIGHT AND MAXIMUM HEIGHT OF COVER FOR VARIOUS CULVERT SIZES AND SPECIFIED WALL THICKNESS ARE GIVEN IN TABLES 3 AND 4.

END TREATMENT: WHERE REQUIRED TO PREVENT, EROSION, UNDERMINING, DRIFT AND DEBRIS DETENTION AT THE INLET AND/OR OUTLET, OR WHERE REQUIRED TO INCREASE HYDRAULIC CAPACITY, THE ENGINEER SHALL SPECIFY AN APPROPRIATE CULVERT PIPE END TREATMENT. END TREATMENT MAY CONSIST OF SLOPE RIP-RAP, GABIONS, STANDARD STEEL CULVERT APRONS, BEVELLED PIPE ENDS OR CONCRETE HEADWALLS WITH RIP-RAP APRONS.

**SPECIFICATIONS:**

CULVERTS: CSP SHALL BE PLAIN GALVANIZED CORRUGATED STEEL PIPE IN ACCORDANCE WITH CSA STANDARD CAN3-G401, AASHTO M-218 OR ASTM A929.

SPCSP SHALL BE PLAIN GALVANIZED STRUCTURAL PLATE PIPE IN ACCORDANCE WITH CSA STANDARD CAN3-G401, AASHTO M-167 OR ASTM A761.


GALVANIZING SHALL BE NOT LESS THAN 0.125 lb/ft OF SURFACE (TOTAL BOTH SIDES)

ALTERNATIVE COATINGS: ALUMINIZE STEEL TYPE 2 - ASTM A929 AND AASHTO M-274 WITH 0.62 lb/ft COATING WEIGHT. POLYMER COATING SUCH AS TRENCHCOAT OR EQUIVALENT - ASTM A742 OR AASHTO M-525 WITH 10/10 GRADE FINISH.

GEOTEXTILE FILTER FABRIC: WHEN IN THE OPINION OF THE ENGINEER, FOUNDATION CONDITIONS ARE CONSIDERED SOFT AND UNSTABLE, WOVEN GEOTEXTILE FILTER FABRIC SHALL BE INSTALLED AT THE BASE OF THE EXCAVATION AND SHALL CONFORM WITH THE FOLLOWING:

- GRAB STRENGTH \_\_\_\_\_ 290 LBS
- ELONGATION (FAILURE) \_\_\_\_\_ 15%
- PUNCTURE STRENGTH \_\_\_\_\_ 60 LBS
- BURST STRENGTH \_\_\_\_\_ 525 PSI
- TRAPEZOIDAL TEAR \_\_\_\_\_ 105 LBS
- MINIMUM FABRIC LAP TO BE 3'

A13-1

REVISIONS		DATE		BY	
					
<b>R7A-80.2_1 CORRUGATED STEEL PIPE (CSP) CULVERT INSTALLATION GUIDELINES-US ONLY</b>					
OFFICE OF DESIGN & CONSTRUCTION					
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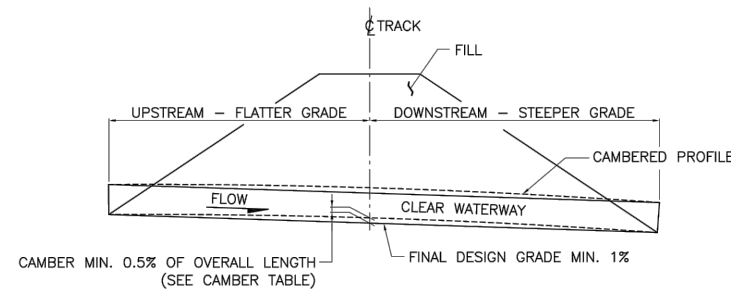
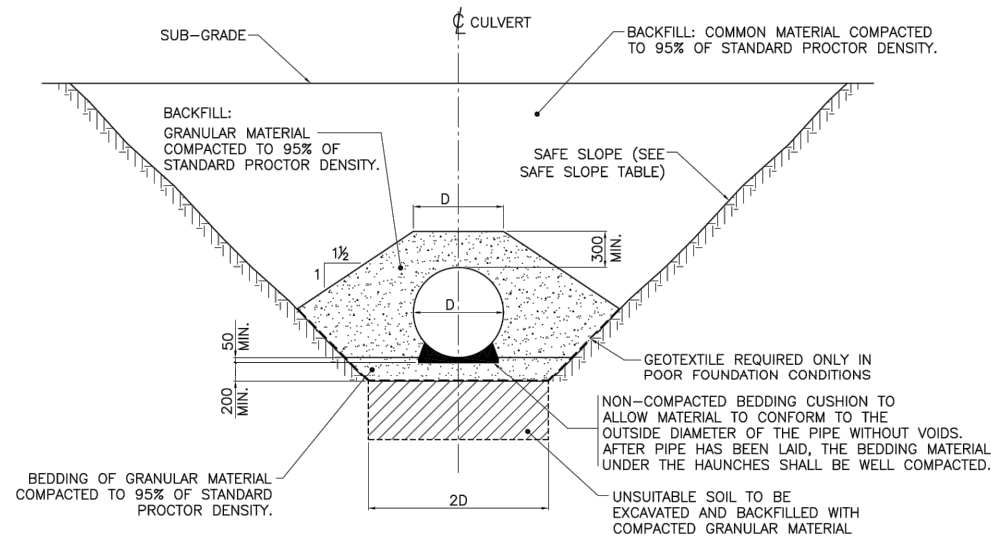


TABLE 1: CAMBER TABLE

LENGTH (m)	CAMBER (mm)
6.0	30
9.0	45
12.0	60
15.0	75
18.5	90
21.5	105
24.5	120
27.5	135
30.5	150

**MINIMUM GRADE AND CAMBERING REQUIREMENTS FOR CULVERT INSTALLATION**

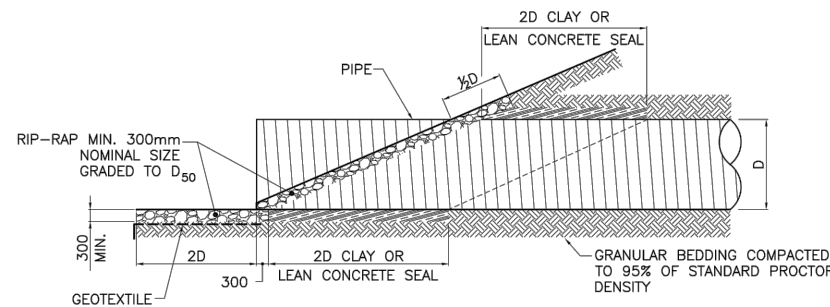


GRANULAR MATERIAL FOR BEDDING AND BACKFILLING TO BE APPROVED BY THE ENGINEER. IN GENERAL, PIT-RUN SAND AND GRAVEL, REASONABLY WELL GRADED FROM MAXIMUM SIZE 100mm TO NOT MORE THAN 8% FINER THAN SIEVE No. 200.

**CULVERT INSTALLATION**

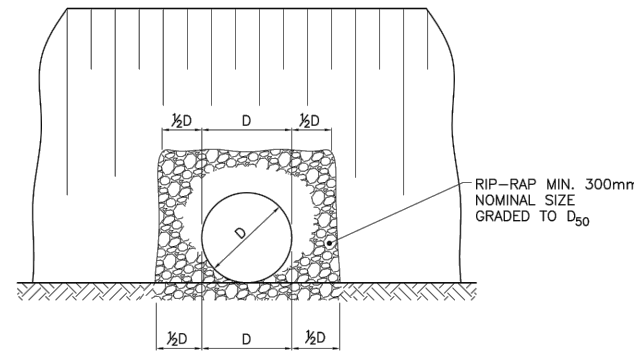
TYPE	SOIL CONDITION	SAFE SLOPE
A	HARD, DENSE AND STIFF SOILS WITH A LOW MOISTURE CONTENT	1 HORIZ: 1 VERT
B	MEDIUM DENSITY SOILS WHICH ARE OF LOOSECONSISTENCY, HAVE BEEN PREVIOUSLY EXCAVATED OR EXHIBIT SIGNS OF WATER SEEPAGE	1.5 HORIZ: 1 VERT
C	SOFT, VERY LOOSE, WET AND MUDDY SOILS	3 HORIZ: 1 VERT

THE SAFE SLOPE SHALL BE REDUCED WHEN THE FOLLOWING CONDITIONS OCCUR:  
 - SIGNS OF DISTRESS APPEAR AT THE FACE OF THE CUT OR AT THE GROUND ADJACENT TO THE OPEN EXCAVATION  
 - SURCHARGE LOADS FROM STORED MATERIAL OR EQUIPMENT OPERATE AT TOP OF CUT  
 - HIGH WATER TABLE  
 - INADEQUATE OR UNCERTAIN SOIL PROPERTIES DATA.



INORGANIC CLAY OR LEAN CONCRETE SEAL TO BE PLACED AT BOTH ENDS OF CULVERTS FOR A LENGTH OF TWICE THE DIAMETER (2D). THE CLAY OR LEAN CONCRETE SEAL SHALL EXTEND FROM THE BOTTOM OF THE EXCAVATION TO 300mm ABOVE THE CROWN OF THE PIPE AND FOR THE FULL WIDTH OF THE EXCAVATION.

**SEEPAGE CUT-OFF DETAIL**



**RIP-RAP PROTECTION**

TABLE 3: STEEL ROUND CORRUGATED PIPE (CSP) MINIMUM AND MAXIMUM HEIGHT OF COVER ASSUMED NORMAL SITE CONDITION PH > 6-8, MINIMUM RESISTIVITY > 2000 ohm-cm

CULVERT SIZE ID (mm)	MIN COVER (mm)	MAXIMUM COVER (m)									
		CORRUGATION PROFILE									
		68 x 12					125 x 25				
		1.6mm	2.0mm	2.8mm	3.5mm	1.6mm	2.0mm	2.8mm	3.5mm	4.2mm	
600	1200	7.0	9.0	14.0	15.0						
700	1200	5.5	7.0	12.0	13.0						
800	1200	5.0	6.5	10.0	11.0						
900	1200	4.0	6.0	9.0	10.0						
1000	1200		5.0	8.0	9.0						
1200	1200			13.0		5.5	8.0	16.0	20.0	23.0	
1400	1600			12.0		5.0	7.0	13.0	17.0	20.0	
1600	1600					4.0	6.0	11.0	15.0	17.0	
1800	2400						5.5	10.0	13.0	15.0	
2000	2400						5.0	9.0	12.0	14.0	
2200	2400							7.0	10.5	12.0	
2400	2400							5.5	10.0	11.0	

NOTES: MINIMUM SIZE OF CSP CULVERTS TO BE 900mm DIA. 60mm AND 750mm DIA. CSP CULVERTS ARE TO BE USED WHERE EXISTING COVER DOES NOT PERMIT A 900mm DIA. SIZE CULVERT. SELECTION OF CULVERTS SHALL BE BASED ON MINIMUM WALL THICKNESS FOR ANY GIVEN DIAMETER. IN POOR GROUND CONDITIONS, IT IS RECOMMENDED THAT RIVETED PIPES BE USED.

TABLE 4: STRUCTURAL PLATE PIPE (MULTI PLATE/SPCSP) MINIMUM AND MAXIMUM HEIGHT OF COVER ASSUMED NORMAL SITE CONDITION PH > 6-8, MINIMUM RESISTIVITY > 2000 ohm-cm

CULVERT SIZE ID (mm)	MIN COVER (mm)	CORRUGATION PROFILE 152x51			
		MAXIMUM COVER (m)			
		3mm	4mm	5mm	6mm
2120	2430	7.0	12.0	18.0	26.0
2280	2430	6.0	11.5	17.0	24.0
2430	2430	5.5	11.0	16.0	23.0
2590	2430	5.0	10.0	15.0	21.0
2740	2430		9.5	14.0	20.0
3050	2430		9.0	13.0	18.0
3360	2430		8.0	12.0	16.0
3670	2430		7.0	11.0	15.0
3990	2430			10.0	13.5
4300	2430			9.0	13.0
4610	2430			8.0	12.0

TABLE 5: CULVERTS IN CORROSIVE CONDITIONS

SOIL TYPE	DESCRIPTION	DEGREE OF CORROSIVENESS	WALL THICKNESS	UPGRADES
				COATINGS
1	SANDY SILT	LOW	NONE	NONE
2	CLAYEY SOIL	MODERATE	INCREASE IN WALL THICK.	ALUMINIZED/POLYMER/INCREASE GALVANIZING THICKNESS 910/1220 g/m <sup>2</sup> (ONLY SPCSP)
3	MARSH AND PEATY SOIL	SEVERE	INCREASE IN WALL THICK.	ALUMINIZED/POLYMER/INCREASE GALVANIZING THICKNESS 1220 g/m <sup>2</sup> (ONLY SPCSP)

- NOTE:
- RECOMMENDED ALTERNATIVE COATINGS ARE:
    - ALUMINIZED STEEL TYPE 2 IN ACCORDANCE WITH ASTM A929 AND AASHTO M-274 WITH 305 g/m<sup>2</sup>
    - POLYMER COATING SUCH AS TRENCHCOAT OR EQUIVALENT IN ACCORDANCE WITH ASTM A742 AND AASHTO M525 WITH 10/10 FINISH.
  - ABRASION IS A COMBINATION OF STREAM VELOCITY AND BED LOAD. IN GEOGRAPHIC AREAS WHERE HEAVY LOADS OF SAND AND SMALL GRAVEL POSE AN ABRASION PROBLEM, AND FLOW VELOCITY IS HIGH, INCREASE RECOMMENDED THICKNESS BY ONE SIZE WALL THICKNESS.
  - SELECTION OF UPGRADES OR COMBINATION OF UPGRADES SHALL BE DETERMINED BY THE SEVERITY OF SITE CONDITIONS.

**GENERAL NOTES:**

- SCOPE:  
 CULVERT SIZES IN TABLE 3 AND 4 HAVE BEEN DEVELOPED BASED ON STRENGTH AND DURABILITY REQUIREMENTS FOR NORMAL SITE CULVERT INSTALLATIONS.
- DESIGN LOAD: E80 + IMPACT
- DURABILITY BASED ON 75 YEAR SERVICE LIFE.
- CULVERT DURABILITY:  
 SITE SPECIFIC DESIGN IS REQUIRED WHERE WATER AND/OR SOIL IS CORROSIVE OR ABRASIVE.  
 WATER AND/OR IN CLAY, CLAY LOAM, PEAT AND ORGANIC SOILS SHOULD BE TESTED FOR WATER AND SOIL CORROSIVENESS. TESTS TO BE CARRIED OUT ARE RESISTIVITY AND PH TESTING IN ACCORDANCE WITH CALIFORNIA TEST METHOD 6438 AND SHALL BE PERFORMED BY A QUALIFIED MATERIALS TESTING COMPANY.
- INSTALLATION:  
 PIPE SHALL BE INSTALLED IN ACCORDANCE WITH CN ENGINEERING RECOMMENDED METHOD OF INSTALLATION OF CULVERTS RM4402.
- FOR MULTIPLE PIPE INSTALLATIONS, THE CLEARANCE BETWEEN CULVERTS SHALL NOT BE LESS THAN 1/2 THE PIPE DIAMETER, BUT NEED NOT BE GREATER THAN 1.0m UNLESS REQUIRED FOR SPECIFIC CONSTRUCTION COMPACTION METHODS AND EQUIPMENT.
- FOR PIPES SIZES GREATER THAN 1.5m, TEMPORARY STRUTTING SPACED AT MAX. 3.0m SPACING SHALL BE PROVIDED.
- FOR VERTICAL FACE CUTS, SHORING TO BE PROVIDED AND SHALL BE ENGINEERED TO SUIT HEIGHT OF EMBANKMENT AND VERTICAL FACES.

COVER:  
 THE MINIMUM HEIGHT AND MAXIMUM HEIGHT OF COVER FOR VARIOUS CULVERT SIZES AND SPECIFIED WALL THICKNESS ARE GIVEN IN TABLES 3 AND 4.

END TREATMENT:  
 WHERE REQUIRED TO PREVENT, EROSION, UNDERMINING, DRIFT AND DEBRIS DETENTION AT THE INLET AND/OR OUTLET, OR WHERE REQUIRED TO INCREASE HYDRAULIC CAPACITY, THE ENGINEER SHALL SPECIFY AN APPROPRIATE CULVERT PIPE END TREATMENT. END TREATMENT MAY CONSIST OF SLOPE RIP-RAP, GABIONS, STANDARD STEEL CULVERT APRONS, BEVELLED PIPE ENDS OR CONCRETE HEADWALLS WITH RIP-RAP APRONS.


**SPECIFICATIONS:**

- CULVERTS:  
 CSP SHALL BE PLAIN GALVANIZED CORRUGATED STEEL PIPE IN ACCORDANCE WITH CSA STANDARD CAN3-G401, AASHTO M-218 OR ASTM A929.
- SPCSP SHALL BE PLAIN GALVANIZED STRUCTURAL PLATE PIPE IN ACCORDANCE WITH CSA STANDARD CAN3-G401, AASHTO M-167 OR ASTM A761.
- GALVANIZING SHALL BE NOT LESS THAN 610 g/m<sup>2</sup> OF SURFACE (TOTAL BOTH SIDES)
- ALTERNATIVE COATINGS:  
 ALUMINIZE STEEL TYPE 2 - ASTM A929 AND AASHTO M-274 WITH 305 g/m<sup>2</sup> COATING WEIGHT.  
 POLYMER COATING SUCH AS TRENCHCOAT OR EQUIVALENT - ASTM A742 OR AASHTO M-525 WITH 10/10 GRADE FINISH.

- GEOTEXTILE FILTER FABRIC:  
 WHEN IN THE OPINION OF THE ENGINEER, FOUNDATION CONDITIONS ARE CONSIDERED SOFT AND UNSTABLE, WOVEN GEOTEXTILE FILTER FABRIC SHALL BE INSTALLED AT THE BASE OF THE EXCAVATION AND SHALL CONFORM WITH THE FOLLOWING:
- GRAB STRENGTH \_\_\_\_\_ 1275 N
  - ELONGATION (FAILURE) \_\_\_\_\_ 15%
  - PUNCTURE STRENGTH \_\_\_\_\_ 275 N
  - BURST STRENGTH \_\_\_\_\_ 3.6 MPa
  - TRAPEZOIDAL TEAR \_\_\_\_\_ 475 N
  - MINIMUM FABRIC LAP TO BE 1 m

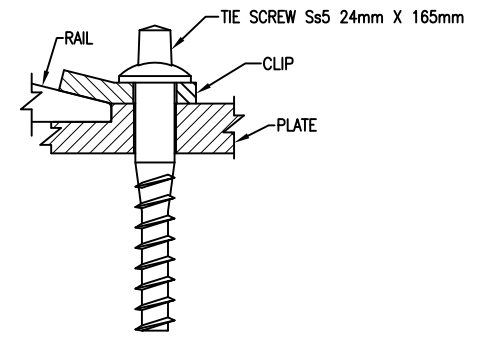
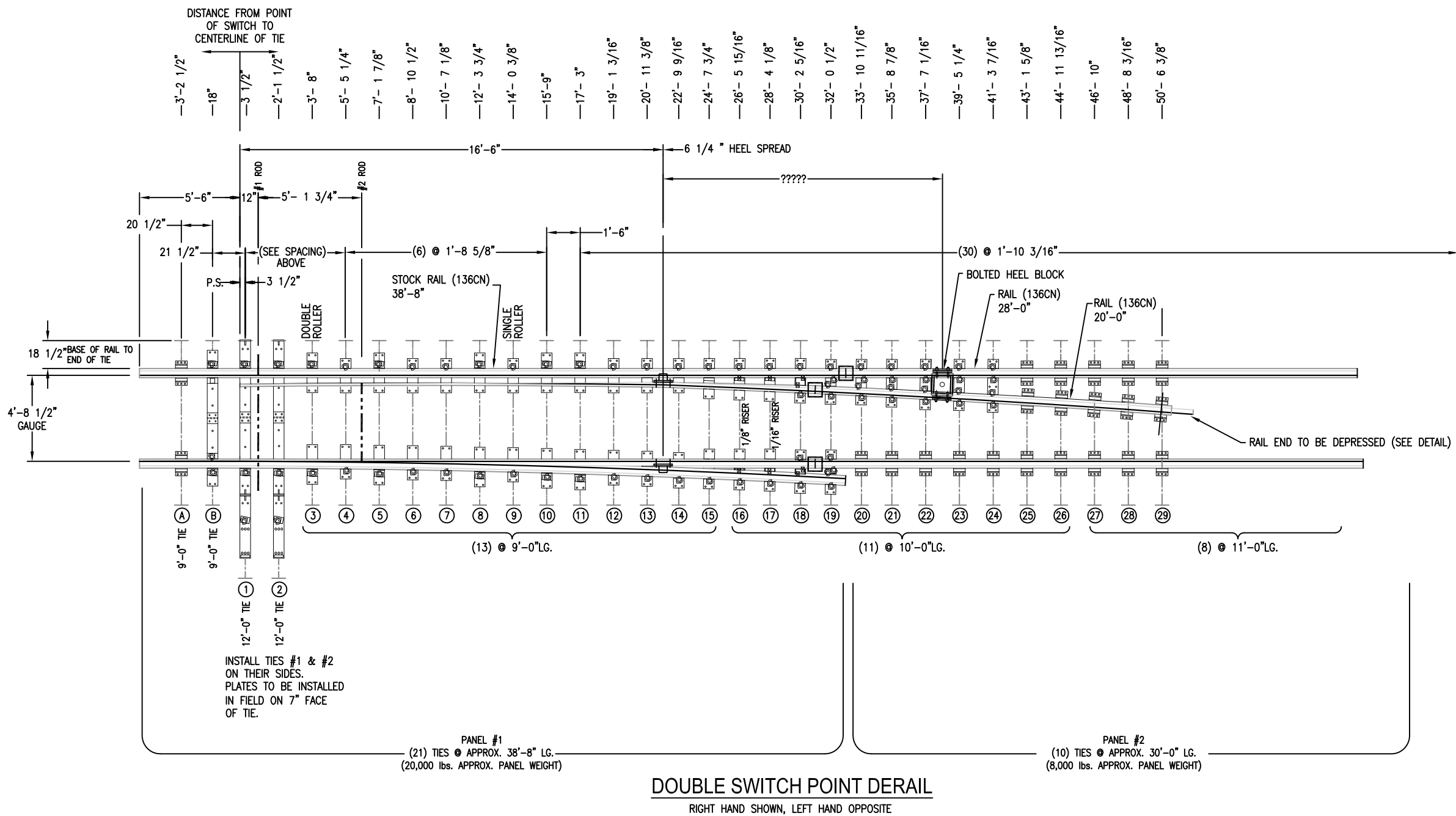
Original Drawing Signed by George Nowak Sept. 29/2003  
 SENIOR STRUCTURAL ENGINEER

REVISIONS		DATE	BY

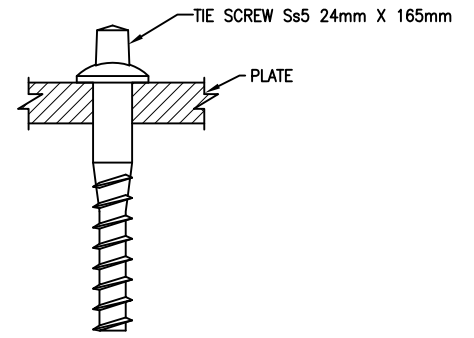


**R7A-80.2\_2 CORRUGATED STEEL PIPE (SPCSP) CULVERT INSTALLATION GUIDELINES-CANADA**

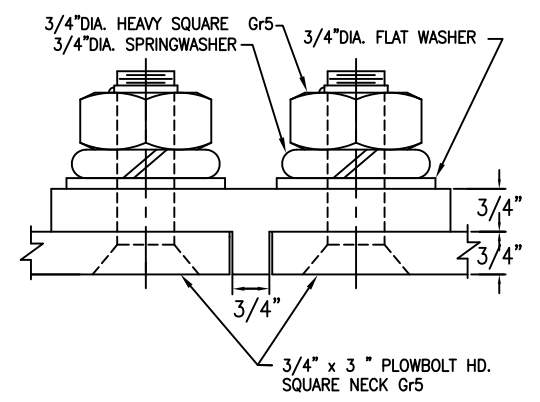
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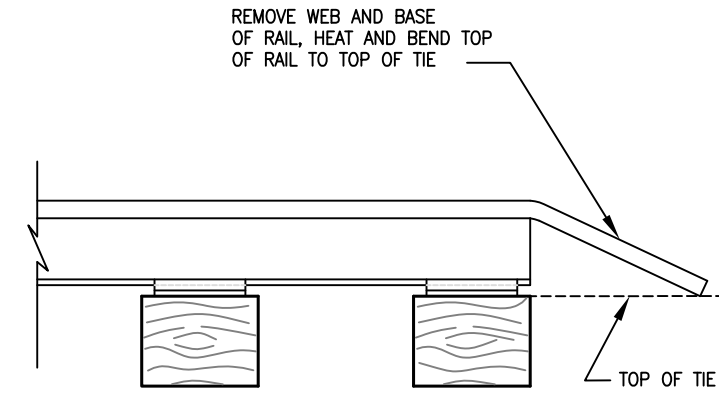
HOLD DOWN CLIP ASSEMBLY



TIE SCREW ASSEMBLY DETAIL



INSULATED PLATE JOINT ASSEMBLY



DEPRESS RAIL HEAD DETAIL

- NOTES:
- TIES TO BE PRE-DRILLED FOR SCREW SPIKES 21/32" DIA. 6" DEEP.
  - - INDICATES LOCATION OF FIELD WELDED JOINTS 0" OPENING.
  - ⊠ - INDICATES LOCATION OF RAIL HOLD DOWN CLIP ASSEMBLIES.
  - END DRILLING 9 1/2" x 6" ~ 1 5/16" DIA. 3 3/32" A.B.
  - BEFORE SHIPPING, THROW THE SWITCH, PLACE WOOD BLOCK BETWEEN OPEN SWITCH & STOCK RAIL TO HOLD THROW, THEN BAND BOTH SWITCH POINTS TO STOCK RAILS.

DERAIL DATA	
LENGTH OF POINT	16'-6" ON 31'-6"
HEEL SPREAD	6 1/4"
POINT THICKNESS	0"
RADIUS OF CVD. POINT	809.55'
SWITCH ANGLE	0°-27°-58"
CENTERLINE RADIUS	807.20'

TANGENT OFFSETS FROM HEEL OF SWITCH	
5'-0"	8 21/32"
10'-0"	11 13/32"
15'-0"	14 17/32"
20'-0"	18 1/32"
25'-0"	21 15/16"


TIE SCHEDULE	
29	7" x 9" x 9'-0"
2	7" x 9" x 12'-0" HEADBLOCK TIES

SWITCH POINT THROW	
● #1 ROD	5"
● #2 ROD	3 23/32"

A14

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**DOUBLE SWITCH POINT DERAIL**

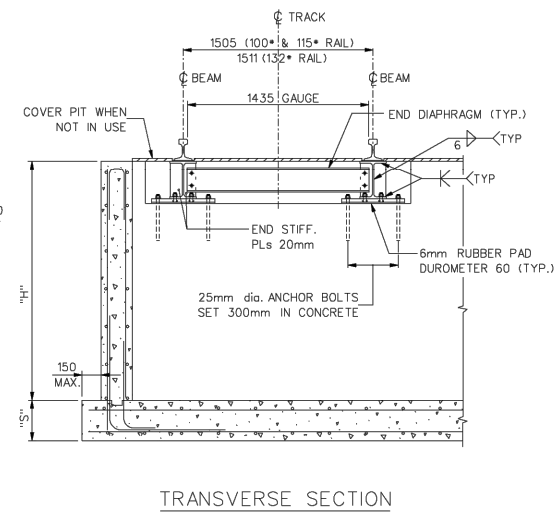
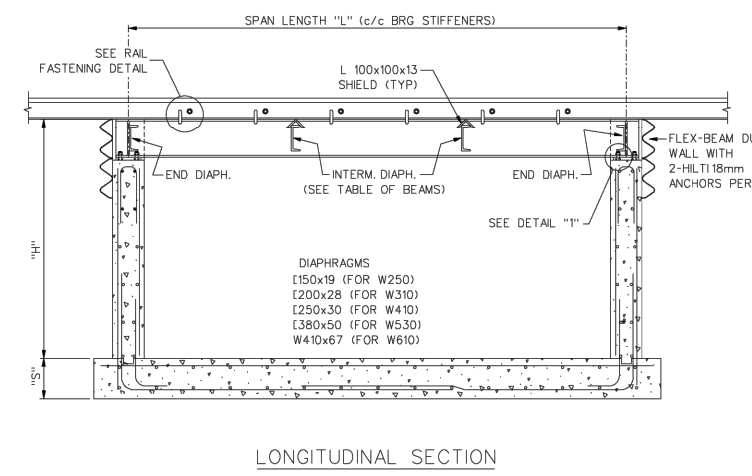
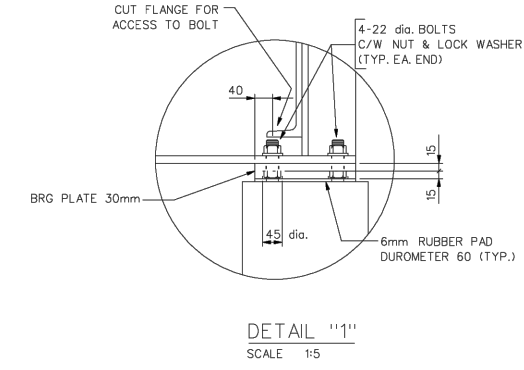
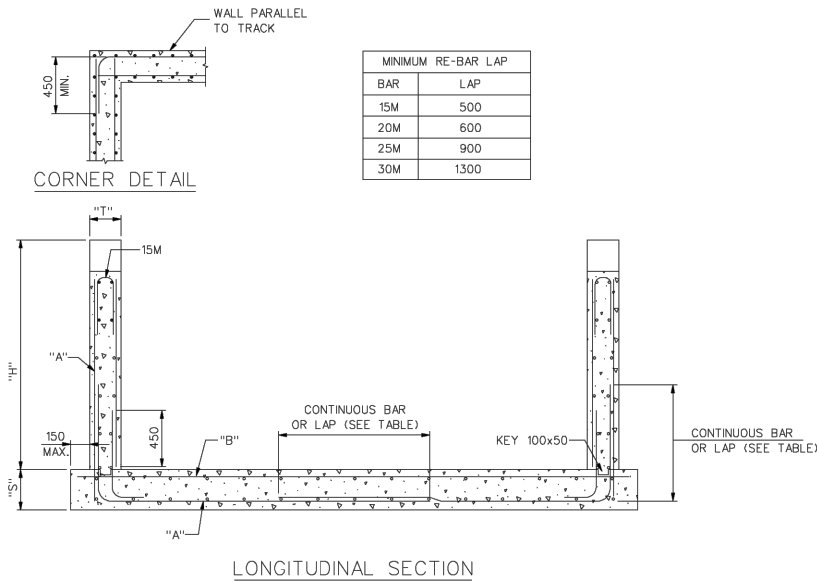
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		LENGTH "L" IN MILLIMETRES										
		1500	1800	2100	2400	2700	3000	3400	3700	4000	4300	4600
HEIGHT	1500	T 250 mm	250 mm	250 mm	250 mm	250 mm	250 mm	250 mm	250 mm	250 mm	250 mm	300 mm
		S 280 mm	280 mm	280 mm	280 mm	280 mm	320 mm	320 mm	350 mm	350 mm	350 mm	380 mm
		A 15M @ 150	15M @ 150	15M @ 150	15M @ 150	15M @ 150	15M @ 150	15M @ 150	15M @ 150	15M @ 150	15M @ 150	15M @ 150
H	1800	T 250 mm	250 mm	250 mm	250 mm	250 mm	250 mm	250 mm	250 mm	250 mm	250 mm	300 mm
		S 280 mm	280 mm	280 mm	280 mm	280 mm	330 mm	330 mm	350 mm	350 mm	350 mm	380 mm
		A 25M @ 300	25M @ 300	25M @ 300	25M @ 300	25M @ 300	25M @ 300	25M @ 300	25M @ 300	25M @ 300	25M @ 300	25M @ 300
I	2100	T 300 mm	300 mm	300 mm	300 mm	300 mm	300 mm	300 mm	300 mm	300 mm	300 mm	300 mm
		S 330 mm	330 mm	330 mm	330 mm	330 mm	330 mm	330 mm	350 mm	350 mm	350 mm	380 mm
		A 20M @ 150	20M @ 150	20M @ 150	20M @ 150	20M @ 150	20M @ 150	20M @ 150	20M @ 150	20M @ 150	20M @ 150	20M @ 150
M	2400	T 300 mm	300 mm	300 mm	300 mm	300 mm	300 mm	300 mm	300 mm	300 mm	300 mm	300 mm
		S 330 mm	330 mm	330 mm	330 mm	330 mm	350 mm	350 mm	350 mm	350 mm	350 mm	400 mm
		A 25M @ 150	25M @ 150	25M @ 150	25M @ 150	25M @ 150	25M @ 150	25M @ 150	25M @ 150	25M @ 150	25M @ 150	25M @ 150
L	2700	T 350 mm	350 mm	350 mm	350 mm	350 mm	350 mm	350 mm	350 mm	350 mm	350 mm	350 mm
		S 380 mm	380 mm	380 mm	380 mm	380 mm	380 mm	380 mm	380 mm	380 mm	380 mm	400 mm
		A 25M @ 150	25M @ 150	25M @ 150	25M @ 150	25M @ 150	25M @ 150	25M @ 150	25M @ 150	25M @ 150	25M @ 150	25M @ 150
E	3000	T 400 mm	400 mm	400 mm	400 mm	400 mm	400 mm	400 mm	400 mm	400 mm	400 mm	400 mm
		S 430 mm	430 mm	430 mm	430 mm	430 mm	430 mm	430 mm	430 mm	430 mm	430 mm	450 mm
		A 25M @ 150	25M @ 150	25M @ 150	25M @ 150	25M @ 150	25M @ 150	25M @ 150	25M @ 150	25M @ 150	25M @ 150	25M @ 150

NOTES:  
 - BARS "A" AND "B" ARE NOTED IN THE TABLE.  
 - ALL OTHER BARS SHALL BE 15M @ 300 c/c.  
 - END WALL BARS SHALL BE THE SAME AS SIDE WALL BARS.

TABLE OF BEAM REQUIREMENTS						
LENGTH mm	Aw REQ'D mm <sup>2</sup>	S REQ'D 10 <sup>3</sup> mm <sup>3</sup>	METRIC BEAMS	BRG PLATES 2-PLs 30mm THICK	STIFFENERS T=20mm WIDTH mm	INTERM. DIAPH. QUANT.
1500	2172	521	W310x97	510x150	125	-
1800	2534	625	W310x97	510x150	125	-
2100	2791	729	W310x107	510x150	125	1
2400	2981	833	W310x107	510x150	125	1
2700	3124	977	W310x118	510x150	125	1
3000	3258	1171	W310x118	510x150	125	1
3400	3553	1367	W310x129	510x150	125	1
3700	3800	1665	W310x143	510x150	125	1
4000	4000	1977	W310x158	510x150	125	2
4300	4181	2289	W610x155	520x150	125	2
4600	4400	2601	W610x155	525x150	150	2

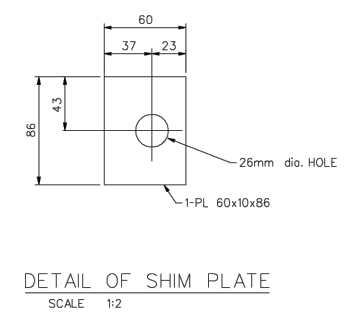
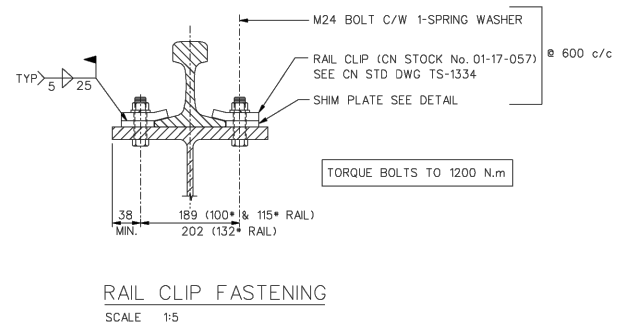
THE CRITERIA OF SELECTION FOR BEAMS IS GOVERNED BY THE WIDTH OF FLANGES IN ORDER TO HAVE AN EDGE DISTANCE OF 44mm TO THE BOLTS.




**GENERAL NOTES**

- DESIGN AND WORKMANSHIP SHALL BE IN ACCORDANCE WITH AREMA MANUAL (1999), CHAPTER 8, CONCRETE STRUCTURES AND FOUNDATIONS AND CHAPTER 15, STEEL STRUCTURES
- LIVE LOAD: COOPER E80 WITH 28% IMPACT
- MATERIAL SPECIFICATIONS:  
 - CONCRETE: CSA CAN3-A23.1, A23.2-M94  
 - REINFORCING STEEL: CSA G30.18-M92  
 - STRUCTURAL STEEL: CSA CAN3-G40.21-M92 GRADE 300W OR EQUAL
- CONCRETE SHALL BE 30 MPA @ 28 DAYS
- REINF. STEEL SHALL BE 400 MPA BILLET STEEL, DEFORMED BARS.
- CONCRETE COVER FOR REINFORCING STEEL SHALL BE 75MM WHERE CONCRETE IS POURED AGAINST GROUND, AND 50MM WHERE POURED AGAINST FORM WORK AND SURFACE
- ALL EXPOSED EDGES OF CONCRETE SHALL BE GIVEN A 20X20 CHAMFER.
- THIS DRAWING IS INTENDED AS A GUIDE IN PREPARING A CONSTRUCTION DRAWING. IF PIT IS TO BE CONSTRUCTED UNDER TRAFFIC, INCLUDE PLANS FOR SUPPORTING THE TRACK. IF PIT IS LOCATED ADJACENT TO AN OPERATING TRACK, INCLUDE SHEETING PLANS TO SUPPORT THE OPERATING TRACK. ALL PLANS SHALL BE SIGNED AND SEALED BY A PROFESSIONAL ENGINEER AND SUBMITTED TO THE RAILWAY ENGINEER FOR REVIEW.
- NO TRAFFIC WILL BE PERMITTED OVER PIT UNTIL CONCRETE HAS REACHED 25 MPa.
- PITS ARE TO BE LOCATED ON TRACKS HAVING A MAXIMUM SPEED OF 10 MPH.
- GROUND WATER PRESSURE WAS NOT CONSIDERED IN THE DESIGN AND PROVISIONS MUST BE MADE FOR DRAINAGE IF NECESSARY.
- BEARING CAPACITY OF FOUNDATION SHALL BE A MINIMUM OF 200 kPa. THIS CAPACITY SHALL BE CONFIRMED IN THE FIELD BY A GEOTECHNICAL ENGINEER.

Original Drawing Signed by George Nowak Dec. 13, 2011  
 SENIOR STRUCTURAL ENGINEER



**A15**

REVISIONS		DATE	BY
			
<b>JL3-5m UNLOADING PIT STANDARD</b>			
APPROVALS			
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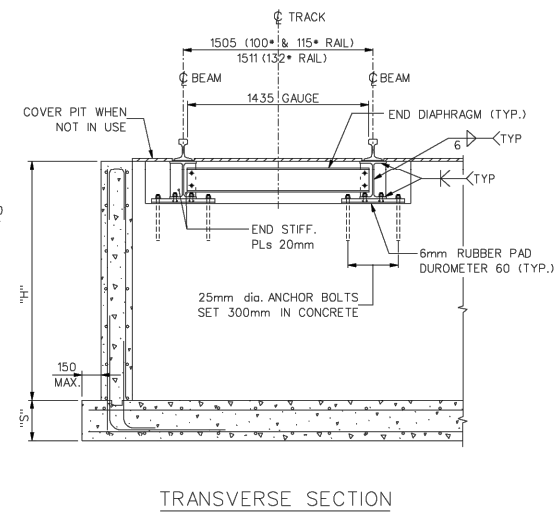
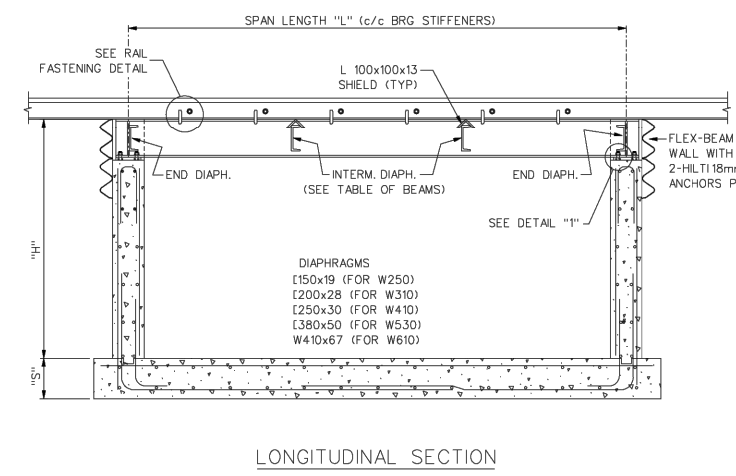
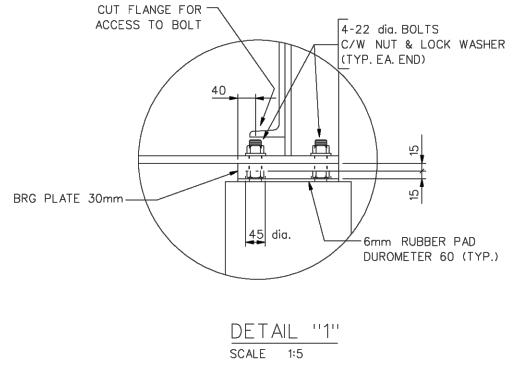
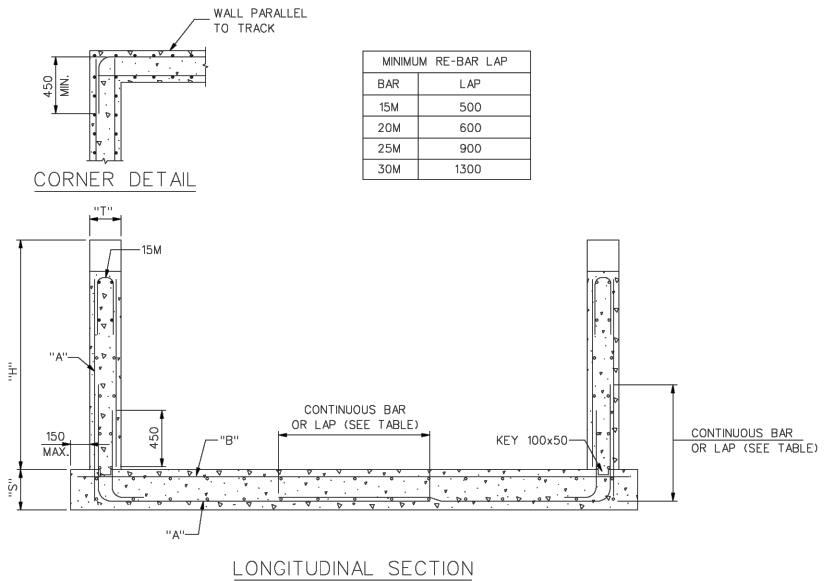


		LENGTH "L" IN MILLIMETRES										
		1500	1800	2100	2400	2700	3000	3400	3700	4000	4300	4600
HEIGHT	1500	T 250 mm	250 mm	250 mm	250 mm	250 mm	250 mm	250 mm	250 mm	250 mm	250 mm	300 mm
		S 280 mm	280 mm	280 mm	280 mm	280 mm	320 mm	320 mm	350 mm	350 mm	350 mm	380 mm
		A 15M @ 150	15M @ 150	15M @ 150	15M @ 150	15M @ 150	15M @ 150	15M @ 150	15M @ 150	15M @ 150	15M @ 150	15M @ 150
H	1800	T 250 mm	250 mm	250 mm	250 mm	250 mm	250 mm	250 mm	250 mm	250 mm	250 mm	300 mm
		S 280 mm	280 mm	280 mm	280 mm	280 mm	330 mm	330 mm	350 mm	350 mm	350 mm	380 mm
		A 25M @ 300	25M @ 300	25M @ 300	25M @ 300	25M @ 300	25M @ 300	25M @ 300	25M @ 300	25M @ 300	25M @ 300	25M @ 300
I	2100	T 300 mm	300 mm	300 mm	300 mm	300 mm	300 mm	300 mm	300 mm	300 mm	300 mm	300 mm
		S 330 mm	330 mm	330 mm	330 mm	330 mm	330 mm	330 mm	350 mm	350 mm	350 mm	380 mm
		A 20M @ 150	20M @ 150	20M @ 150	20M @ 150	20M @ 150	20M @ 150	20M @ 150	20M @ 150	20M @ 150	20M @ 150	20M @ 150
M	2400	T 300 mm	300 mm	300 mm	300 mm	300 mm	300 mm	300 mm	300 mm	300 mm	300 mm	300 mm
		S 330 mm	330 mm	330 mm	330 mm	330 mm	350 mm	350 mm	350 mm	350 mm	350 mm	400 mm
		A 25M @ 150	25M @ 150	25M @ 150	25M @ 150	25M @ 150	25M @ 150	25M @ 150	25M @ 150	25M @ 150	25M @ 150	25M @ 150
L	2700	T 350 mm	350 mm	350 mm	350 mm	350 mm	350 mm	350 mm	350 mm	350 mm	350 mm	350 mm
		S 380 mm	380 mm	380 mm	380 mm	380 mm	380 mm	380 mm	380 mm	380 mm	380 mm	400 mm
		A 25M @ 150	25M @ 150	25M @ 150	25M @ 150	25M @ 150	25M @ 150	25M @ 150	25M @ 150	25M @ 150	25M @ 150	25M @ 150
E	3000	T 400 mm	400 mm	400 mm	400 mm	400 mm	400 mm	400 mm	400 mm	400 mm	400 mm	400 mm
		S 430 mm	430 mm	430 mm	430 mm	430 mm	430 mm	430 mm	430 mm	430 mm	430 mm	450 mm
		A 25M @ 150	25M @ 150	25M @ 150	25M @ 150	25M @ 150	25M @ 150	25M @ 150	25M @ 150	25M @ 150	25M @ 150	25M @ 150

NOTES:  
 - BARS "A" AND "B" ARE NOTED IN THE TABLE.  
 - ALL OTHER BARS SHALL BE 15M @ 300 c/c.  
 - END WALL BARS SHALL BE THE SAME AS SIDE WALL BARS.

LENGTH mm	Aw REQ'D mm <sup>2</sup>	S REQ'D 10 <sup>3</sup> mm <sup>3</sup>	METRIC BEAMS	BRG PLATES 2-PLs 30mm THICK	STIFFENERS T=20mm WIDTH mm	INTERM. DIAPH. QUANT.
1500	2172	521	W310x97	510x150	125	-
1800	2534	625	W310x97	510x150	125	-
2100	2791	729	W310x107	510x150	125	1
2400	2981	833	W310x107	510x150	125	1
2700	3124	977	W310x118	510x150	125	1
3000	3258	1171	W310x118	510x150	125	1
3400	3553	1367	W310x129	510x150	125	1
3700	3800	1665	W310x143	510x150	125	1
4000	4000	1977	W310x158	510x150	125	2
4300	4181	2289	W610x155	520x150	125	2
4600	4400	2601	W610x155	525x150	150	2

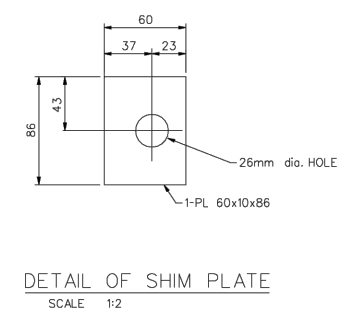
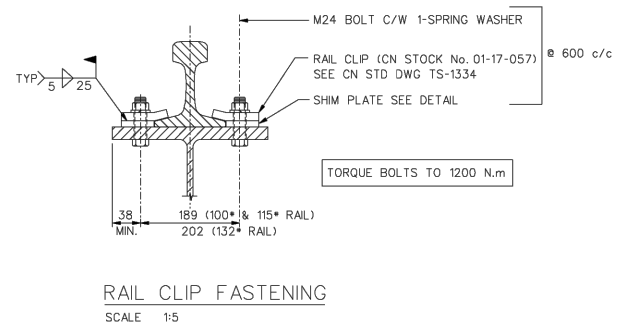
THE CRITERIA OF SELECTION FOR BEAMS IS GOVERNED BY THE WIDTH OF FLANGES IN ORDER TO HAVE AN EDGE DISTANCE OF 44mm TO THE BOLTS.



GENERAL NOTES

- DESIGN AND WORKMANSHIP SHALL BE IN ACCORDANCE WITH AREMA MANUAL (1999), CHAPTER 8, CONCRETE STRUCTURES AND FOUNDATIONS AND CHAPTER 15, STEEL STRUCTURES
- LIVE LOAD: COOPER E80 WITH 28% IMPACT
- MATERIAL SPECIFICATIONS:  
 - CONCRETE: CSA CAN3-A23.1, A23.2-M94  
 - REINFORCING STEEL: CSA G30.18-M92  
 - STRUCTURAL STEEL: CSA CAN3-G40.21-M92 GRADE 300W OR EQUAL
- CONCRETE SHALL BE 30 MPA @ 28 DAYS
- REINF. STEEL SHALL BE 400 MPA BILLET STEEL, DEFORMED BARS.
- CONCRETE COVER FOR REINFORCING STEEL SHALL BE 75MM WHERE CONCRETE IS POURED AGAINST GROUND, AND 50MM WHERE POURED AGAINST FORM WORK AND SURFACE
- ALL EXPOSED EDGES OF CONCRETE SHALL BE GIVEN A 20X20 CHAMFER.
- THIS DRAWING IS INTENDED AS A GUIDE IN PREPARING A CONSTRUCTION DRAWING. IF PIT IS TO BE CONSTRUCTED UNDER TRAFFIC, INCLUDE PLANS FOR SUPPORTING THE TRACK. IF PIT IS LOCATED ADJACENT TO AN OPERATING TRACK, INCLUDE SHEETING PLANS TO SUPPORT THE OPERATING TRACK. ALL PLANS SHALL BE SIGNED AND SEALED BY A PROFESSIONAL ENGINEER AND SUBMITTED TO THE RAILWAY ENGINEER FOR REVIEW.
- NO TRAFFIC WILL BE PERMITTED OVER PIT UNTIL CONCRETE HAS REACHED 25 MPa.
- PITS ARE TO BE LOCATED ON TRACKS HAVING A MAXIMUM SPEED OF 10 MPH.
- GROUND WATER PRESSURE WAS NOT CONSIDERED IN THE DESIGN AND PROVISIONS MUST BE MADE FOR DRAINAGE IF NECESSARY.
- BEARING CAPACITY OF FOUNDATION SHALL BE A MINIMUM OF 200 kPa. THIS CAPACITY SHALL BE CONFIRMED IN THE FIELD BY A GEOTECHNICAL ENGINEER.

Original Drawing Signed by George Nowak Dec. 13, 2011  
 SENIOR STRUCTURAL ENGINEER



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**JL3-5m UNLOADING PIT STANDARD**

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CRUSHED ROCK BALLAST

1 **SCOPE:** This specification covers two classes of crushed rock ballast and one class of trowelling stone.

Class 1 - Crushed rock ballast for use primarily on main line track.

Class 2 - Crushed rock ballast for use only on other than main line track.

Trowelling stone shall be supplied in one class only.

GENERAL REQUIREMENTS

2 **Material**

- 2.1 The ballast and trowelling stone shall be composed of hard, strong and durable particles, clean and free from clay and shale and from an excess of dust or elongated pieces.
- 2.2 Before crushed rock ballast is accepted from any new pit, or from a new seam, bed or formation in any existing pit that in the judgement of the Inspector is substantially different from material previously inspected and approved, the material shall be inspected by a qualified petrologist and approved by the Senior Geotechnical Engineer of the Railway.
- 2.3 The word "Inspector" occurring in this specification shall mean the duly authorized representative of the Railways' Chief Engineer.

DETAILED REQUIREMENTS

3 **Methods of Test**

All tests shall be carried out according to the latest revision of the standard test methods referred to in this specification.

4 **Fractured Faces**

The crushed rock ballast or trowelling stone shall have at least 75% of the particles by mass with two or more fractured faces and at least 98% of the particles by mass with one fractured face. The above percentages will be required within each sieve size coarser than 3/4-inch (19 mm).

5 **Flat Pieces**

The crushed rock ballast or trowelling stone shall contain less than 30% by mass of flat pieces. In cases of dispute the test method "Determination of Flakiness Index" contained in British Standard 812 shall be used.

6 **Absorption**

The absorption of the ballast or trowelling stone shall be less than 0.5%. ASTM C 127

**Note:** Vertical bar on left margin indicates location of latest revision.

CRUSHED ROCK BALLAST

7 **Soundness and Resistance to Abrasion**

Property	Requirement		Tested in Accordance with ASTM Method	Testing Remarks
Soundness	Class 1 Ballast & Trowelling Stone	Class 2 Ballast	C 88	Coarse aggregate only, magnesium sulphate solution.
	Less than 7.0% at 5 cycles.	Less than 10.0% at 5 cycles.		
Abrasion Loss	Less than 20%.	Less than 30%.	C 535	ASTM Grading "2".

8 **Grading**

The ballast and trowelling stone shall conform to the grading requirements shown below.

% Passing by Mass

Sieve Size	Class 1 & 2 Ballast	Trowelling Stone
2-1/2" (63 mm)	100	-
2" (50 mm)	70-90	-
1-1/2" (37.5 mm)	40-70	-
1" (25 mm)	0-25	100
3/4" (19 mm)	0-3	90-100
1/2" (12.5 mm)	-	15-55
No. 4 (4.75 mm)	-	0-5
No. 200 (0.75 mm)	0-1	0-1

ASTM C 136  
ASTM C 117 (for material passing the No. 200 sieve).

9 **Ballast Resistivity**

- 9.1 When tested as described in Appendix A, ballast resistivity shall not be less than 3000 ohm-meters.

10 **Frequency of Testing**

- 10.1 At the start of production the Producer shall carry out all tests described in Sections 4 to 9 inclusive to establish compliance with this specification.
- 10.2 During production the Producer shall carry out the grading test twice per day, the abrasion loss test once on each 10,000 metric tonnes of production, and all other tests once on each 30,000 metric tonnes of production thereafter. The ballast or trowelling stone shall be tested more frequently if there is any indication of a change in quality.

11 **Handling and Loading**

CRUSHED ROCK BALLAST

11.1 Ballast and trowelling stone shall be handled, stockpiled and/or loaded into cars in such a manner as to minimize the abrasion of particles and the segregation of sizes.

11.2 Under no circumstances shall rubber tired or crawler type vehicles be allowed to operate or traverse repeatedly over the stockpile of crushed material.

11.3 The handling and loading procedures shall have the prior approval of the Senior Geotechnical Engineer of the Railway.

12 **Weighing**

12.1 All ballast and trowelling stone delivered to the Railway shall be weighed by the Producer at his expense and proof of such weight shall be supplied to the Inspector.

12.2 All measurement shall be by actual weight in net tonnes (1000 kg).

12.3 The weighing device or method used must be approved by the Railway in writing. The Producer shall arrange for and obtain certification by the Weights and Measures Division of the Federal Department of Consumer and Corporate Affairs of any weighing device before it goes into service and thereafter as required by the Inspector. In no case shall calibration be done less than once after each 100,000 tonnes of production.

12.4 The accuracy of any weighing device may be checked by the Inspector at any time and should any discrepancies be found in the reading adjustments to the production quantities will be made by the Inspector.

QUALITY ASSURANCE

13 **Application**

Material ordered to this specification is subject to inspection by the Railway with respect to all the requirements of this specification.

14 **Plant Access**

The Inspector shall have, during working hours, free entry to all parts of the producer's plant and laboratory facilities used in the production or testing of material ordered to this specification.

15 **Quality Assurance Provisions**

It is the producer's responsibility to satisfy the Inspector that the ballast and trowelling stone conforms to this specification. This may be accomplished either by performing the tests (preferably on-site) prescribed in this specification or by demonstrating to the Inspector that the production, handling and stockpiling are so controlled that conformity to this specification is assured.

The Railway reserves the right to perform any of the tests set forth in the specification where such tests are deemed necessary to assure conformity to the prescribed requirements.

16 **Test Samples**

The incidence of sampling and the location at which samples are selected for testing by the Railway shall be at the discretion of the Inspector. The samples shall be taken in such a manner as to ensure

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that they truly represent the material being produced. The sample size for complete testing shall be not less than 50 kg.

17 Defective Material


Material which has been or is being produced which does not comply with this specification shall be rejected by the Inspector. The Producer shall stop further production until the fault has been corrected and shall dispose of all rejected material without cost to the Railway.

APPENDIX A

Ballast Resistivity Testing

1. Load ballast into the covered plexiglass resistivity box (see Diagram A below – minimum dimensions h=0.15m and L=0.2m). Ensure that the box is filled level. If necessary, shake the box to settle material.
2. Measure and record the resistance of the material as produced / received.
3. Record ambient temperature.
4. Using an atomizer, add de-ionized water 50 ml at a time waiting 3 minutes between applications until bottom of sample is wet. Water may not be allowed to accumulate at the base of the box. Record volume of water added and cover sample.
5. The resistivity of the material will decrease as water disperses through the sample. Record resistivity every hour for the first 6 hours and then take a minimum of three additional measurements over the next 36 hours.
6. Minimum resistivity will be calculated by multiplying the lowest recorded resistivity by the ballast box factor ( $h^2/L$  where h and L are the ballast box dimensions shown in Diagram A)
7. Replace sample and repeat test a minimum of 4 times. Ballast resistivity shall be the average of the minimum resistivity of all valid tests.

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PREVENTION OF ELECTRIC SPARKS AT FLAMMABLE LIQUID AND GAS TRANSFER FACILITIES

1. GENERAL

- 1.1 THIS PRACTICE COVERS PROCEDURES FOR THE PREVENTION OF ELECTRIC SPARKS THAT MAY CAUSE FIRE DURING THE TRANSFER OF FLAMMABLE LIQUIDS OR COMPRESSED FLAMMABLE GASES TO OR FROM RAIL EQUIPMENT AND STATIONARY BULK STORAGE FACILITIES.
- 1.2 STATIC ELECTRICITY IS GENERATED WHEN LIQUIDS MOVE IN CONTACT WITH OTHER MATERIALS. IF THE ACCUMULATION OF STATIC IS SUFFICIENT, A SPARK MAY OCCUR. IF THE SPARK OCCURS IN THE PRESENCE OF A FLAMMABLE VAPOR-AIR MIXTURE, AN IGNITION MAY RESULT. WHERE A STATIC SPARK AND FLAMMABLE MIXTURE MAY OCCUR SIMULTANEOUSLY, SUITABLE PREVENTIVE MEASURES ARE REQUIRED TO AVOID IGNITION.
- 1.3 THE ACCUMULATION OF STATIC CHARGES MAY BE PREVENTED BY BONDING AND GROUNDING. "BONDING" IS THE PROCESS OF CONNECTING TWO OR MORE CONDUCTIVE OBJECTS TOGETHER BY MEANS OF A CONDUCTOR. "GROUNDING" IS THE PROCESS OF CONNECTING ONE OR MORE CONDUCTIVE OBJECTS TO EARTH, AND IS SPECIFIC FORM OF BONDING. BONDING IS DONE TO MINIMIZE POTENTIAL DIFFERENCES BETWEEN METALLIC OBJECTS. LIKEWISE, GROUNDING IS DONE TO MINIMIZE POTENTIAL DIFFERENCES BETWEEN OBJECTS AND THE GROUND.

2. APPLICATION

- 2.1 THIS PRACTICE IS INTENDED TO APPLY TO ALL STATIONARY BULK STORAGE FACILITIES ON RAILWAY PROPERTY OR OTHER PROPERTY ADJACENT TO PRIVATE TRACKAGE SERVICED BY THE RAILWAY WHERE FLAMMABLE LIQUIDS OR COMPRESSED FLAMMABLE GASES ARE LOADED OR UNLOADED. (SEE SECTION 4.2)
- 2.2 IN THIS PRACTICE:
  - \*COMPRESSED FLAMMABLE GAS\* MEANS ANY PRODUCT, MATERIAL OR MIXTURE THAT HAS A CRITICAL TEMPERATURE LESS THAN 50°C, AN ABSOLUTE VAPOUR PRESSURE GREATER THAN 295 kPa AT 50°C OR AN ABSOLUTE PRESSURE IN A PRESSURE VESSEL GREATER THAN 275 kPa AT 21.1°C OR 716 kPa AT 54.4°C, AND IS FLAMMABLE WHEN IN A MIXTURE OF 13 PER CENT OR LESS BY VOLUME WITH AIR AT NORMAL ATMOSPHERIC TEMPERATURE AND PRESSURE OR HAS A FLAMMABLE RANGE † WITH AIR WIDER THAN 12 PER CENT REGARDLESS OF THE LOWER LIMIT.

(NOTE: TYPICAL COMPRESSED FLAMMABLE GASES INCLUDE LIQUIFIED PETROLEUM GASES (PROPANE, BUTANE) AND METHYL CHLORIDE.)

† \*FLAMMABLE RANGE\* MEANS THE DIFFERENCE BETWEEN THE MINIMUM AND MAXIMUM VOLUME PERCENTAGE OF PRODUCT, MATERIAL OR MIXTURE IN AIR THAT, WITH AIR, FORMS A FLAMMABLE MIXTURE.

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\*FLAMMABLE LIQUID\* MEANS ANY LIQUID HAVING A FLASH POINT BELOW 23 °C IN A CLOSED CUP TEST.

(NOTE: TYPICAL LIQUIDS INCLUDE: NAPHTHA GASOLENE, PETROLEUM SOLVENTS, CERTAIN PAINTS, AND COMMON ALCOHOLS.)

- 2.3 BONDING AND GROUNDING AS SPECIFIED IN SECTION 3 OF THIS PRACTICE SHALL BE PROVIDED WHERE FLAMMABLE LIQUIDS AND COMPRESSED FLAMMABLE GASES ARE TRANSFERRED TO OR FROM RAIL EQUIPMENT.
- 2.4 LIQUIDS HAVING A FLASH POINT AT OR ABOVE 23 C IN A CLOSED CUP TEST ARE KNOWN AS "COMBUSTIBLE LIQUIDS". TYPICAL COMBUSTIBLE LIQUIDS INCLUDE KEROSENE, STOVE OIL, DIESEL FUEL OIL, AND HEAVY FUEL OILS. BONDING AND GROUNDING IS NOT REQUIRED FOR COMBUSTIBLE LIQUIDS.
- 2.5 THIS PRACTICE APPLIES TO ALL NEW INSTALLATIONS, AND FOR REPLACEMENT ON EXISTING INSTALLATIONS WHERE GENERAL RENEWAL OR REPLACEMENT IS TO BE MADE.
- 2.6 THIS PRACTICE IS INTENDED TO BE COMPLEMENTARY TO C. T. C. REGULATION 1982-8 RAIL ENTITLED "RAILWAY PREVENTION OF ELECTRIC SPARKS REGULATIONS." SHOULD THERE BE ANY CONFLICT BETWEEN THIS PRACTICE AND C. T. C. 1982-8 RAIL, THE C. T. C. REGULATION SHALL GOVERN.
- 2.7 THIS PRACTICE DOES NOT APPLY TO LOADING AND UNLOADING TRACKS EQUIPPED FOR ELECTRIC TRAIN OPERATION. THIS APPLICATION REQUIRES SPECIAL CONSIDERATIONS.

3. PERMANENT BONDING AND GROUNDING CONNECTIONS.

- 3.1 THIS SECTION IS INTENDED TO COVER THE PERMANENT BONDING AND GROUNDING CONNECTIONS REQUIRED FOR THE PREVENTION OF ELECTRIC SPARKS AT TRANSFER FACILITIES. PORTABLE OR TEMPORARY CONNECTIONS WHICH MAY BE REQUIRED SUCH AS BETWEEN THE PIPING SYSTEM AND RAILWAY ROLLING STOCK ARE NOT COVERED AS THIS PROTECTION IS NOT INSTALLED, OPERATED OR MAINTAINED BY RAILWAY FORCES.
- 3.2 EACH SECTION OF TRACK ON WHICH ANY PART OF RAIL EQUIPMENT STANDS WHILE A FLAMMABLE LIQUID OR COMPRESSED FLAMMABLE GAS IS BEING LOADED OR UNLOADED SHALL BE PROTECTED IN ACCORDANCE WITH THE FOLLOWING REQUIREMENTS:
  - (a) THE SECTIONS OF TRACK SHALL BE BONDED AT EACH RAIL JOINT;

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- (b) TWO RAIL BOND CROSS-CONNECTIONS SHALL BE INSTALLED BETWEEN THE TWO RAILS OF EACH BONDED TRACK SECTION, ONE NEAR EACH END OF THE SECTION;
  - (c) THE BONDED TRACK SECTIONS SHALL BE GROUNDED WITH TWO GROUND RODS. EACH 10 FEET (3 METERS) LONG AND AT LEAST 1/4-INCHES (15.875mm) IN DIAMETER. GROUND RODS SHALL BE SEPARATED AT LEAST 10 FEET (3 METERS) FROM EACH OTHER AND FROM ANY GROUND ROD USED FOR ANY OTHER PURPOSE. GROUND RODS SHALL BE DRIVEN TO A DEPTH OF AT LEAST 10 FEET (3 METERS) EXCEPT THAT WHERE ROCK BOTTOM IS ENCOUNTERED AT A DEPTH OF 4 FEET (1.2 METERS) OR MORE, THEY SHALL BE DRIVEN TO ROCK BOTTOM. WHERE ROCK BOTTOM IS ENCOUNTERED AT A DEPTH OF LESS THAN 4 FEET (1.2 METERS) THEY SHALL BE BURIED IN A HORIZONTAL TRENCH.
  - (d) TWO No. 6 A. W. G. STRANDED COPPER CONDUCTORS SHALL BE INSTALLED BETWEEN THE BONDED TRACK SECTIONS AND THE PIPING SYSTEM THAT IS TO BE USED FOR THE TRANSFER. CONDUCTORS TO BE CONTINUOUS FROM RAIL CONNECTION TO THE PIPING SYSTEM; AND
  - (e) INSULATED RAIL JOINTS SHALL BE INSTALLED TO ELECTRICALLY SEPARATE EACH BONDED TRACK SECTION FROM ALL OTHER TRACK RAILS.
    - (NOTE: INSULATED RAIL JOINTS MUST BE LOCATED SO AS NOT TO BE BRIDGED BY RAIL EQUIPMENT OR BY OTHER MEANS DURING THE TRANSFER OPERATIONS.)
- 3.3 BONDING AND GROUNDING CONDUCTORS TO BE INSTALLED SO AS NOT TO BE SUBJECT TO MECHANICAL DAMAGE.
- 3.4 SEE FIGURES 1 AND 2, PAGES 4 AND 5, ENTITLED "TYPICAL BONDING AND GROUNDING CONNECTIONS" WHICH ILLUSTRATE THE PERMANENT BONDING AND GROUNDING SYSTEM DESCRIBED ABOVE.
- 3.5 OTHER PRECAUTIONS SUCH AS INSULATED JOINTS IN THE PERMANENT PIPING SYSTEM, ADDITIONAL GROUNDING, TEMPORARY BONDS BETWEEN THE PIPING SYSTEM AND THE RAIL EQUIPMENT TANK, AND OTHER SPECIAL MEASURES AS MAY BE REQUIRED UNDER SPECIFIC LOCAL CONDITIONS, SHALL BE TAKEN TO PROVIDE ADEQUATE PROTECTION.

4. INSPECTION AND MAINTENANCE

- 4.1 PERMANENT BONDING AND GROUNDING CONNECTIONS SHALL BE INSPECTED IN ACCORDANCE WITH RULE 332 (FORM 1199B) AND REPAIRS MADE WHERE NECESSARY.
- 4.2 SUCH FACILITIES OFF RAILWAY RIGHT-OF-WAY SHALL ONLY BE MAINTAINED IN ACCORDANCE WITH THE ABOVE, UNDER CONDITION OF AGREEMENT BETWEEN RAILWAY AND PRIVATE PARTY CONCERNED.

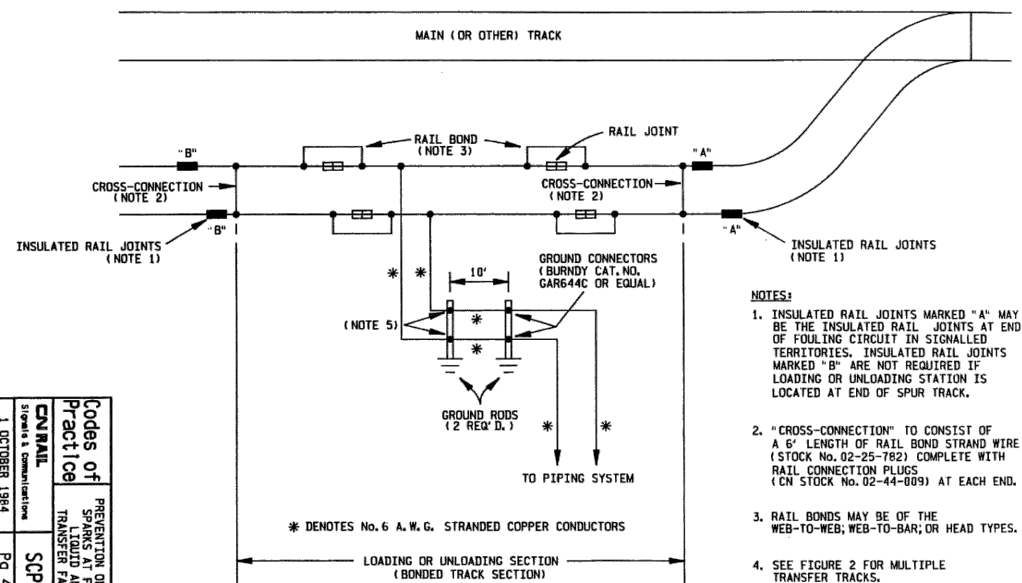
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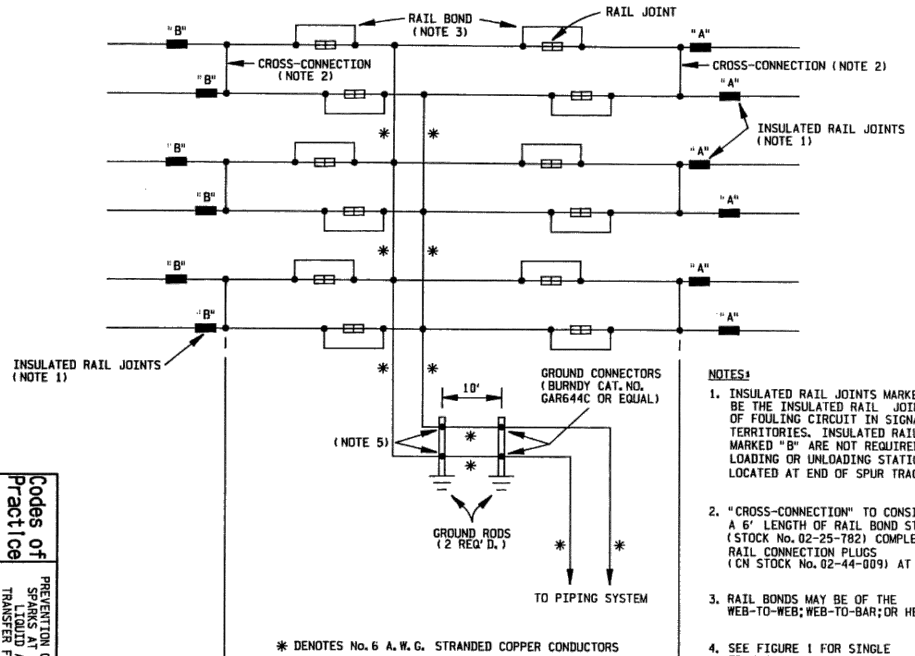


- NOTES:**
1. INSULATED RAIL JOINTS MARKED "A" MAY BE THE INSULATED RAIL JOINTS AT END OF FOULING CIRCUIT IN SIGNALLED TERRITORIES. INSULATED RAIL JOINTS MARKED "B" ARE NOT REQUIRED IF LOADING OR UNLOADING STATION IS LOCATED AT END OF SPUR TRACK.
  2. "CROSS-CONNECTION" TO CONSIST OF A 6' LENGTH OF RAIL BOND STRAND WIRE (STOCK No. 02-25-782) COMPLETE WITH RAIL CONNECTION PLUGS (CN STOCK No. 02-44-009) AT EACH END.
  3. RAIL BONDS MAY BE OF THE WEB-TO-WEB; WEB-TO-BAR; OR HEAD TYPES.
  4. SEE FIGURE 2 FOR MULTIPLE TRANSFER TRACKS.
  5. GROUNDING CONDUCTORS TO BE CONTINUOUS FROM RAIL CONNECTION TO PIPING SYSTEM. CONDUCTORS SHALL NOT BE CUT BUT SHALL "FEED-THROUGH" CONNECTOR AT GROUND ROD.

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**FIGURE 1**  
TYPICAL BONDING AND GROUNDING CONNECTIONS  
SINGLE TRANSFER TRACK

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- NOTES:**
1. INSULATED RAIL JOINTS MARKED "A" MAY BE THE INSULATED RAIL JOINTS AT END OF FOULING CIRCUIT IN SIGNALLED TERRITORIES. INSULATED RAIL JOINTS MARKED "B" ARE NOT REQUIRED IF LOADING OR UNLOADING STATION IS LOCATED AT END OF SPUR TRACK.
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  3. RAIL BONDS MAY BE OF THE WEB-TO-WEB; WEB-TO-BAR; OR HEAD TYPES.
  4. SEE FIGURE 1 FOR SINGLE TRANSFER TRACK.
  5. GROUNDING CONDUCTORS TO BE CONTINUOUS FROM RAIL CONNECTION TO PIPING SYSTEM. CONDUCTORS SHALL NOT BE CUT BUT SHALL "FEED-THROUGH" CONNECTOR AT GROUND ROD.

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**FIGURE 2**  
TYPICAL BONDING AND GROUNDING CONNECTIONS  
MULTIPLE TRANSFER TRACKS

A17-2

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**ISOLATION AND GROUNDING OF RAILWAY  
TRACKS SERVICING ELECTRICAL SUPPLY STATIONS**

**1. GENERAL**

- 1.1 THIS PRACTICE COVERS RECOMMENDED PROCEDURES FOR THE PREVENTION OF HAZARDOUS POTENTIALS ON RAILWAY TRACKS WHICH SERVICE ELECTRICAL SUPPLY STATIONS.
- 1.2 A SERIOUS HAZARD MAY RESULT TO PERSONNEL AND RAILWAY SIGNALLING AND COMMUNICATION SYSTEMS DURING A POWER SYSTEM GROUND FAULT, FROM THE TRANSFER OF POTENTIALS BETWEEN THE SUPPLY STATION GROUND-GRID AREA AND POINTS OUTSIDE THE STATION BY RAILWAY TRACKS. THE SERIOUSNESS OF THE PROBLEM RESULTS FROM THE VERY HIGH POTENTIAL DIFFERENCES THAT MAY OCCUR.
- 1.3 THE POTENTIAL RISE OF THE STATION GROUNDING SYSTEM ABOVE REMOTE EARTH IS USUALLY LIMITED TO A VALUE OF 3000-VOLTS. IN PARTICULARLY DIFFICULT GROUNDING CONDITIONS, STATION DESIGNERS MAY LIMIT THIS VALUE TO A MAXIMUM RISE OF 5000-VOLTS. THIS POTENTIAL RISE IS DUE TO THE FLOW OF GROUND CURRENT THROUGH THE STATION GROUND RESISTANCE. GROUND CURRENT RESULTS FROM GROUND FAULTS, AND IS LIMITED BY THE IMPEDANCES OF LINES, TRANSFORMERS, GROUNDING SYSTEMS AND OTHER ELECTRICAL COMPONENTS FROM THE SOURCE UP TO THE POINT OF FAULT.
- 1.4 THE TRANSFER OF HAZARDOUS POTENTIALS TO REMOTE POINTS BY RAILWAY TRACKS MAY BE PREVENTED BY ISOLATING THE RAILS OUTSIDE OF THE STATION GROUND-GRID AREA, AND BY GROUNDING THE RAILS INSIDE THE STATION TO THE MAIN GROUND BUS. GROUNDING OF THE RAILS WITHIN THE STATION FENCE ALSO ENSURES PROPER OPERATION OF THE STATION'S PROTECTIVE DEVICES IN THE EVENT OF UNINTENTIONAL RAIL CONTACT WITH HIGH VOLTAGE STATION CONDUCTORS.

**2. SCOPE AND APPLICATION**

- 2.1 THE PRACTICES OUTLINED ARE INTENDED TO BE REPRESENTATIVE AND ARE THEREFORE INDICATIVE OF THE TYPE OF PROTECTION WHICH MAY BE REQUIRED TO REDUCE THE EFFECTS OF HAZARDOUS POTENTIALS. BEFORE APPLICATION TO NEW INSTALLATIONS A SITE-SPECIFIC INSPECTION AND EVALUATION SHOULD BE MADE AND THE PROTECTION APPROVED BY THE ASSISTANT CHIEF ENGINEER SIGNALS AND COMMUNICATIONS. THE FACT THAT PARTICULAR METHODS ARE SPECIFIED HEREIN DOES NOT PRECLUDE THE USE OF OTHER METHODS MUTUALLY SATISFACTORY TO BOTH THE RAILWAY AND ELECTRIC POWER UTILITY.

Codes of Practice	ISOLATION AND GROUNDING OF RAILWAY TRACKS SERVICING ELECTRICAL SUPPLY STATIONS
	CN RAIL SIGNALS AND COMMUNICATIONS
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**3. PREVENTION OF HAZARDOUS POTENTIALS**

- 3.1 TRACK RAILS LOCATED INSIDE THE FENCED AREA OF AN ELECTRICAL SUPPLY STATION SHALL BE CONNECTED TO THE STATION MAIN GROUND BUS WITH NO. 2/0 A.W.G. (MINIMUM) STRANDED COPPER CONDUCTORS. THE SPACING BETWEEN TAPS TO THE STATION MAIN GROUND BUS SHALL NOT EXCEED THE SPACING ESTABLISHED FOR THE STATION GROUND GRID.
- 3.2 A NO. 2/0 A.W.G. (MINIMUM) COPPER GROUND GRID SHALL BE BURIED UNDER THE TRACK RAILS WHERE THE TRACK RAILS PASS THROUGH THE STATION GATE(S). THIS GROUND GRID SHALL CONSIST OF 2 METER BY 2 METER (6.5 FT. X 6.5 FT.) SQUARES AND COVER THE AREA OF THE GATE SWING. THIS GROUND GRID SHALL BE CONNECTED TO THE STATION MAIN GROUND BUS WITH A NO. 2/0 A.W.G. (MINIMUM) COPPER CONDUCTOR.
- 3.3 THE SECTIONS OF TRACK WITHIN THE FENCED AREA OF AN ELECTRICAL SUPPLY STATION SHALL BE BONDED AT EACH RAIL JOINT WITH A NO. 2/0 A.W.G. STRANDED COPPER CONDUCTOR.
- 3.4 TRACK RAILS LOCATED OUTSIDE THE STATION GROUND-GRID AREA SHALL BE ELECTRICALLY ISOLATED FROM THE STATION-GROUNDING ELECTRODE WITH A MINIMUM OF THREE (3) INSULATED RAIL JOINTS IN EACH RAIL. THE NUMBER OF INSULATED RAIL JOINTS DEPENDS ON THE EXPECTED STATION GROUND POTENTIAL RISE AND THE DIELECTRIC STRENGTH OF AN INSULATED RAIL JOINT.

**3.5 IMPORTANT NOTE**

THE REMOVAL OF A COMPLETE SECTION OF RAIL IS A PREFERRED PERMANENT SOLUTION AND SHOULD BE IMPLEMENTED WHERE OPERATIONS PERMIT. AS HIGH VOLTAGES MAY APPEAR ACROSS SOME OF THE INSULATED RAIL JOINTS DURING POWER SYSTEM GROUND FAULTS, THERE SHALL BE A MINIMUM OF 1.5 METERS (5'-0") CLEARANCE BETWEEN THE STATION GATE GRID AND THE NEAREST RAIL OUTSIDE OF THE STATION FENCE. THE REMOVED LENGTHS OF RAIL SHOULD BE LEFT OUT AND ONLY REPLACED WHEN THE STATION SPUR TRACK IS REQUIRED FOR IMMEDIATE USE. THE REMOVAL OF A COMPLETE SECTION OF RAIL DOES NOT ELIMINATE THE INSULATED RAIL JOINTS REQUIRED BY SECTION 3.4 UNLESS THE INSULATED RAIL JOINTS ARE INSTALLED EACH TIME THE RAILWAY TRACK IS MADE OPERATIONAL.

- 3.6 GROUNDING CONDUCTORS SHALL BE INSTALLED IN SUCH A WAY AS TO MINIMIZE MECHANICAL DAMAGE.

- 3.7 FIGURE 1 ON PAGE 4 ILLUSTRATES A TYPICAL RAILWAY TRACK PROTECTIVE SYSTEM.

Codes of Practice	ISOLATION AND GROUNDING OF RAILWAY TRACKS SERVICING ELECTRICAL SUPPLY STATIONS
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**4. INSPECTION AND MAINTENANCE**

- 4.1 RAIL GROUNDING CONNECTIONS, INSULATED JOINTS, ETC. SHALL BE INSPECTED IN ACCORDANCE WITH RULE 332 (FORM 1199B) AND REPAIRS MADE WHERE NECESSARY.

- 4.2 SUCH FACILITIES OFF RAILWAY RIGHT-OF-WAY SHALL ONLY BE MAINTAINED IN ACCORDANCE WITH THE ABOVE, UNDER CONDITION OF AGREEMENT BETWEEN RAILWAY AND PRIVATE PARTY CONCERNED.

**5. SAFETY**


- 5.1 HAZARDOUS VOLTAGES CAN OCCUR IF THE GROUNDING CONDUCTORS ARE DISCONNECTED, OR IF INSULATED RAIL JOINTS ARE REMOVED, WHILE THE POWER STATION IS ENERGIZED. IF MODIFICATIONS TO THE RAILWAY TRACK PROTECTIVE SYSTEM ARE NECESSARY, ALL WORK SHALL BE DONE IN ACCORDANCE WITH THE ELECTRIC POWER UTILITY'S SAFETY RULES AND APPROVED WORK PRACTICES, AND WITH THE FULL KNOWLEDGE OF THE SUPPLY STATION OPERATORS. MODIFICATIONS TO THE RAILWAY TRACK PROTECTIVE SYSTEM, HOWEVER, SHOULD PREFERABLY BE MADE WITH THE STATION DE-ENERGIZED.

- 5.2 TO PREVENT TRANSFER OF HAZARDOUS POTENTIALS, THE INSULATED RAIL JOINTS COVERED BY SECTION 3.4 MUST NOT BE BRIDGED BY STATIONARY RAIL EQUIPMENT OR BY OTHER MEANS. THIS IS PARTICULARLY IMPORTANT WHEN THE REMOVABLE RAIL SECTIONS HAVE BEEN INSTALLED TO PERMIT RAIL ACCESS TO THE SUPPLY STATION.

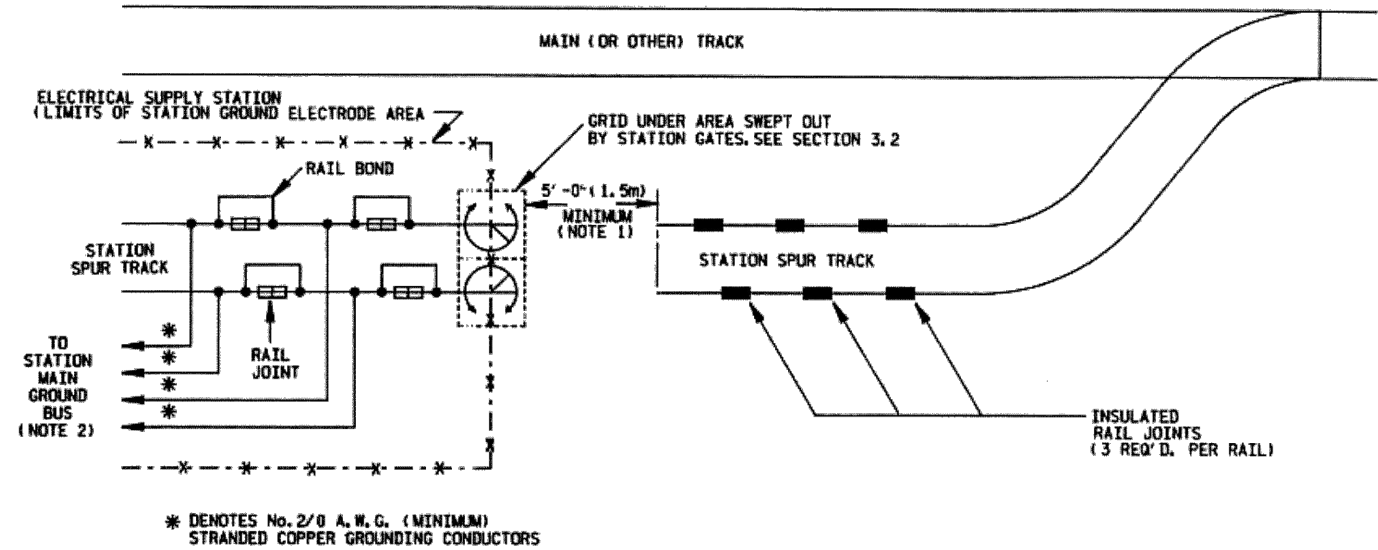
Codes of Practice	ISOLATION AND GROUNDING OF RAILWAY TRACKS SERVICING ELECTRICAL SUPPLY STATIONS
	CN RAIL SIGNALS AND COMMUNICATIONS
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**A18-1**

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- NOTES:**
1. RAIL SECTIONS SHOULD BE REMOVED WHERE OPERATIONS PERMIT. RAIL SECTIONS SHOULD BE TEMPORARILY REPLACED WHEN TRACK IS TO BE USED BY RAIL EQUIPMENT, (SEE SECTION 3.5)
  2. RAIL GROUNDING CONDUCTORS TO STATION MAIN GROUNDING GRID TO BE INSTALLED BY ELECTRIC POWER UTILITY.
  3. RAIL JOINTS WITHIN STATION TO BE BONDED BY ELECTRIC POWER UTILITY.

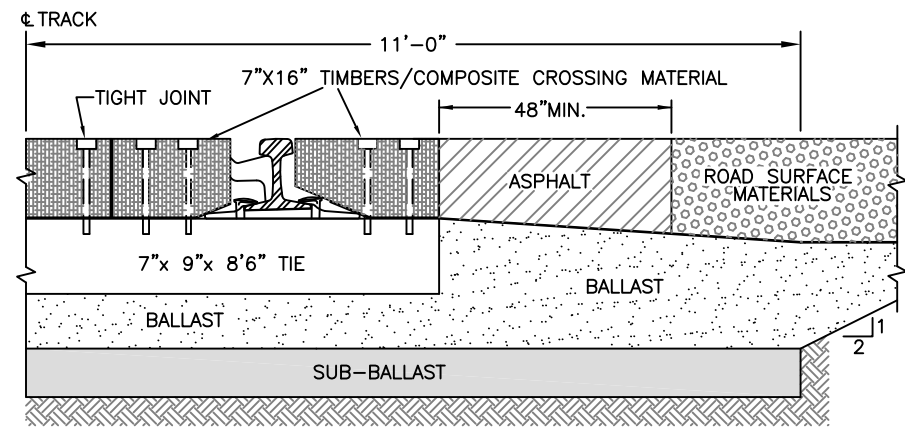
Codes of Practice CNRAIL STANDARDS AND CONVENTIONS 1 OCTOBER 1984	ISOLATION AND GROUNDING OF RAILWAY TRACKS SERVICING ELECTRIC POWER STATIONS
	SCP-1302 Pg 4 of 4

**FIGURE 1**  
 (SEE SECTION 2.1)  
 TYPICAL RAILWAY TRACK PROTECTIVE SYSTEM

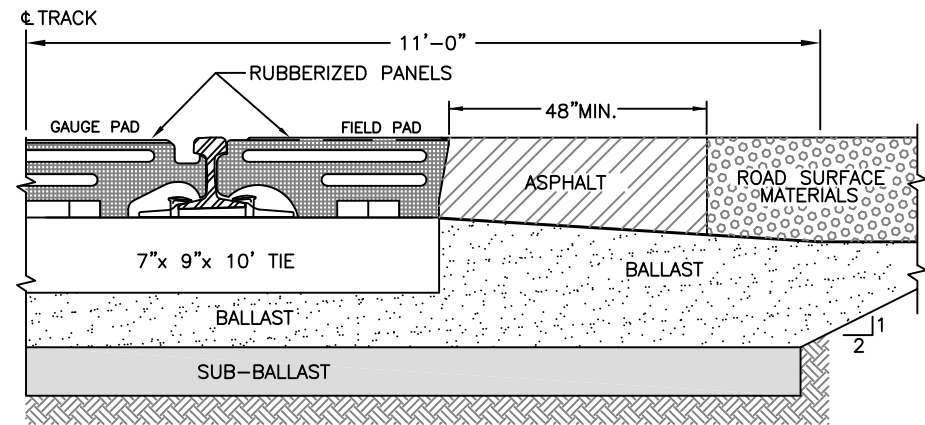
A18-2

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APPROVALS		<b>SCP 1302-ISOLATAION AND GROUNDING OF RAILWAY TRACKS SERVICING ELECTRICAL SUPPLY STATIONS</b>		
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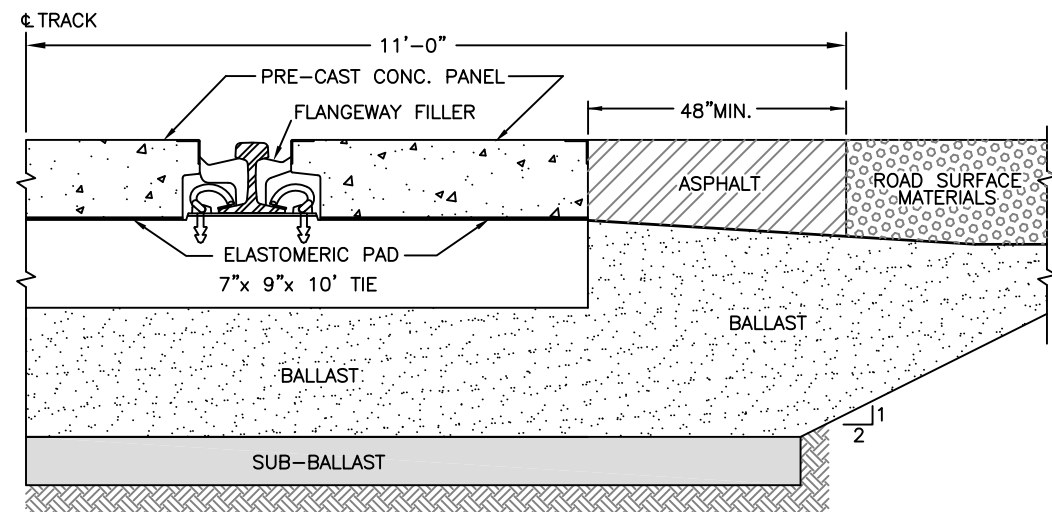




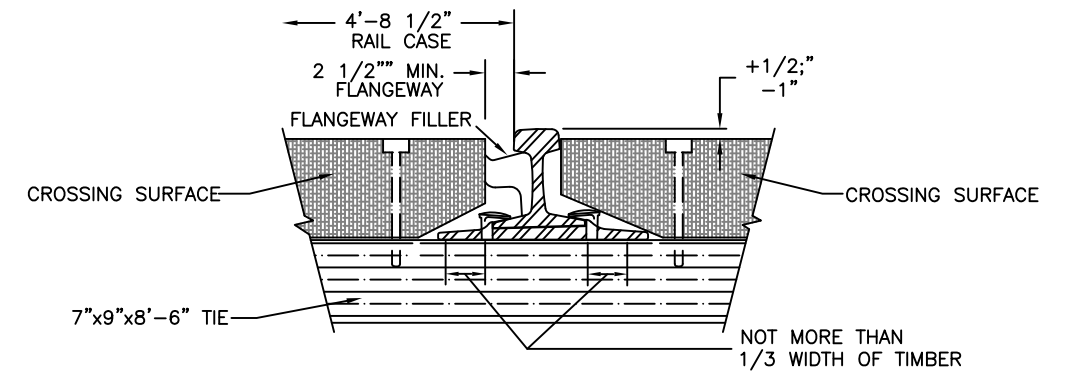
**HALF SECTION SOLID TIMBER OR COMPOSITE CROSSING**  
N.T.S.



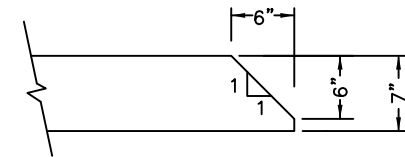
**HALF SECTION RUBBERIZED CROSSING**  
N.T.S.



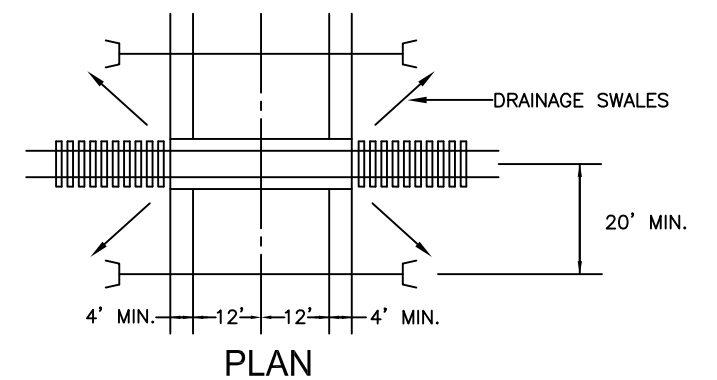
**HALF SECTION CONCRETE CROSSING**  
N.T.S.



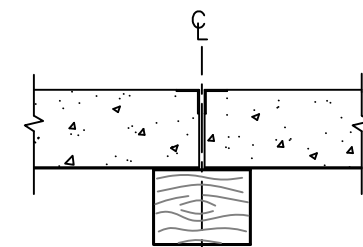
**TYPICAL DETAIL FLANGEWAY**  
N.T.S.



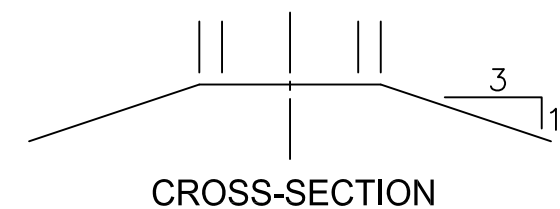
**END CHAMFER DETAIL**  
FOR WOOD CROSSING TIMBER ONLY  
N.T.S.



**PLAN**



**PANEL END DETAIL**  
CROSSING PANELS ARE TO BE BUTTED  
TOGETHER OVER THE  $\phi$  OF TIE  
N.T.S.




**CROSS-SECTION**

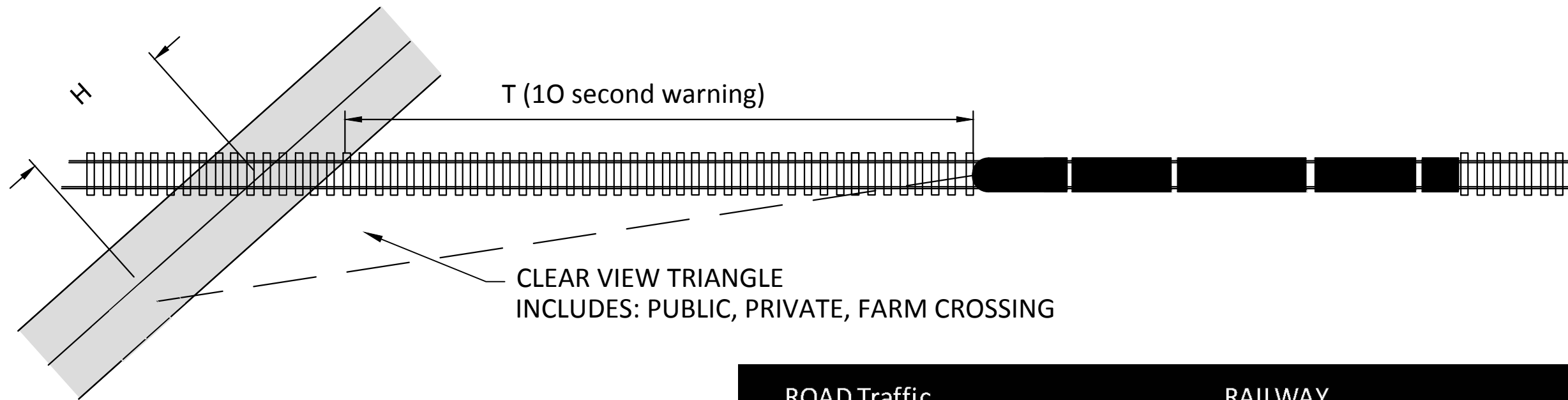
**NOTES:**

- CROSSING LENGTH SHOULD EXTEND ENTIRE WIDTH OF USABLE SHOULDERS.
- CROWN IN ROADWAY SHOULD BE ELIMINATED AT CROSSING SO AS TO MATCH GRADE AND PROFILE OF RAILROAD.
- DRAINAGE CULVERTS IN TRACKSIDE DITCHES SHOULD BE APPROPRIATELY SIZED (24" MINIMUM DIAMETER) AND INSTALLED AT AN ELEVATION WHICH PERMITS UNRESTRICTED FLOW. CULVERTS SHOULD ALSO BE OF SUFFICIENT LENGTH AND/OR EQUIPPED WITH FLARED ENDS OR HEADWALLS TO PRECLUDE COLLAPSE OF ROADWAY SHOULDER AT OR AROUND CULVERT ENDS.

**NOTE:**

- FASTENING TO BE WITH 5/8" DRIVE SPIKE OF A LENGTH TO PENETRATE CROSS TIE 3" OR MORE.
- USE ONE FASTENING PER TIMBER PER CROSS TIE, ALTERNATE POSITION BORE TIMBER 9/16" AND COUNTERSINK PILOT BORE CROSS TIE.
- FULLY ASPHALTED OR AGGREGATE CROSSINGS ARE NOT ALLOWED
- CROSSINGS IN CURVES WILL NEED TIES TO BE SPACED IN RADIAL FAN ARRANGEMENT
- CROSSINGS IN CURVES MAY NEED TO BE SPECIALLY ORDERED.

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<b>ROAD CROSSING DETAILS</b>					
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ROAD Traffic		RAILWAY	
Maximum Vehicle Speed km/hr (mph)	Minimum* Distance "H" Meters (Feet)	Maximum Train Speed (MPH)	Minimum * Distance "T" Meters (Feet)
STOP	*****	STOP	30 (100)
1-10 (0-6)	8 (26)	(1-10)	45 (150)
11-20 (7-12)	20 (66)	(11-20)	90 (300)
21-30 (13-19)	30 (100)	(21-30)	135 (450)
31-40 (20-24)	45 (150)	(31-40)	180 (600)
41-50 (25-31)	65 (215)	(41-50)	225 (750)
51-60 (32-37)	85 (280)	(51-60)	270 (900)
61-70 (38-43)	110 (360)	(61-70)	315 (1050)
71-80 (44-50)	140 (460)	(71-80)	360 (1200)
81-90 (51-56)	170 (560)	(81-90)	405 (1350)
91-100 (57-62)	210 (690)	(91-100)	450 (1500)

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**G4A - SIGHTLINE CROSSING REQUIREMENTS CANADA ONLY**

APPROVALS

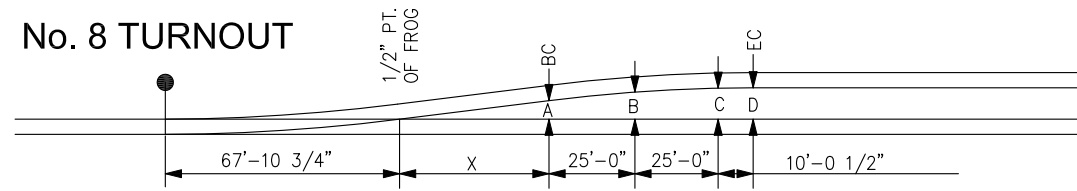
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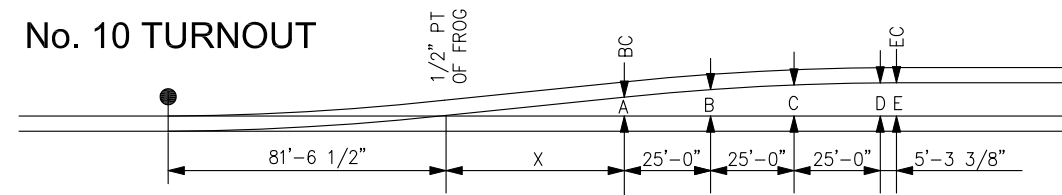
# TURNOUT RETURN CURVES

## No. 8 TURNOUT



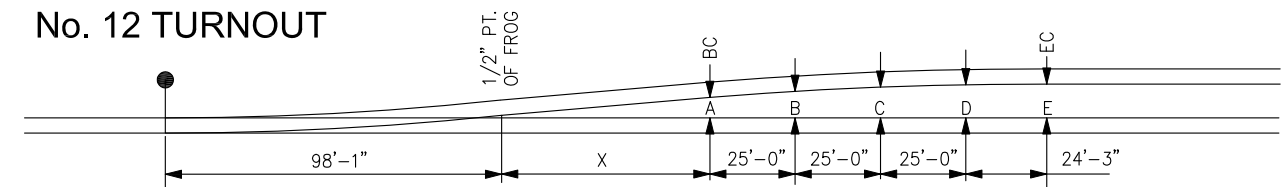
TRACK CENTERS	X	A	B	C	D
13'-0"	35'-10"	4'-6 1/2"	7'-0 1/4"	8'-2 1/4"	8'-3 1/2"
13'-6"	39'-9 13/16"	5'-0 1/2"	7'-6 1/4"	8'-8 1/4"	8'-9 1/2"
14'-0"	43'-9 5/8"	5'-6 1/2"	8'-0 1/4"	9'-2 1/4"	9'-3 1/2"
14'-6"	47'-9 7/16"	6'-0 1/2"	8'-6 1/4"	9'-8 1/4"	9'-9 1/2"
15'-0"	51'-9 1/4"	6'-6 1/2"	9'-0 1/4"	10'-2 1/4"	10'-3 1/2"

## No. 10 TURNOUT



TRACK CENTERS	X	A	B	C	D	E
13'-0"	42'-3 1/8"	4'-3 3/8"	6'-4 3/4"	7'-8 5/8"	8'-3 1/4"	8'-3 1/2"
13'-6"	47'-2 15/16"	4'-9 3/8"	6'-10 3/4"	8'-2 5/8"	8'-9 1/4"	8'-9 1/2"
14'-0"	52'-2 13/16"	5'-3 3/8"	7'-4 3/4"	8'-8 5/8"	9'-3 1/4"	9'-3 1/2"
14'-6"	57'-2 11/16"	5'-9 3/8"	7'-10 3/4"	9'-2 5/8"	9'-9 1/4"	9'-9 1/2"
15'-0"	62'-2 1/2"	6'-3 3/8"	8'-4 3/4"	9'-8 5/8"	10'-3 1/4"	10'-3 1/2"

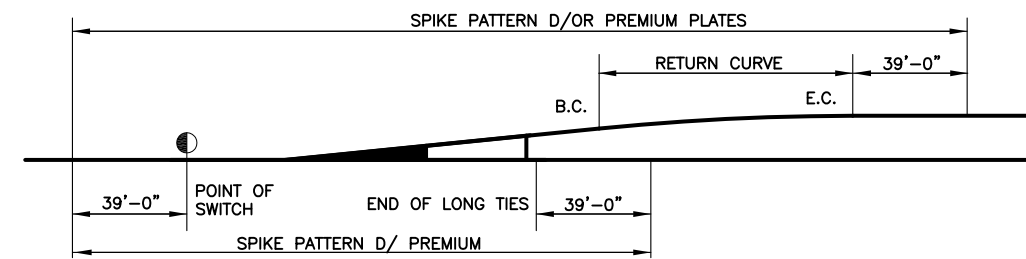
## No. 12 TURNOUT



TRACK CENTERS	X	A	B	C	D	E
13'-0"	49'-3 3/8"	4'-1 7/8"	5'-11 3/4"	7'-3 1/4"	8'-0 1/2"	8'-3 1/2"
13'-6"	55'-3 1/4"	4'-7 7/8"	6'-5 3/4"	7'-9 1/4"	8'-6 1/2"	8'-9 1/2"
14'-0"	61'-3 1/8"	5'-1 7/8"	6'-11 3/4"	8'-3 1/4"	9'-0 1/2"	9'-3 1/2"
14'-6"	67'-3"	5'-7 7/8"	7'-5 3/4"	8'-9 1/4"	9'-6 1/2"	9'-9 1/2"
15'-0"	73'-2 7/8"	6'-1 7/8"	7'-11 3/4"	9'-3 1/4"	10'-0 1/2"	10'-3 1/2"

NO.	SPIKING PATTERNS		YEARLY MGT	DEGREE OF CURVE			
	FIELD GAUGE	FIELD GAUGE		TANGENT UP TO 2'	2' TO 4'	4' TO 6'	GREATER THAN 6'
A			OTHER THAN MAIN 0-20	X	X	X	X
B		OR	0-20 GREATER THAN 20	X	X		
C			0-20 GREATER THAN 20		X	X	*X
D			GREATER THAN 20				*X
ALL TURNOUTS TO BE SPIKED PER PATTERN D							
E							*X
PLATES WILL BE APPLIED TO TURNOUTS AS PER TRACK DIAGRAM							
* EVERY OTHER TIE CAST PREMIUM PLATES							

TURNOUT SPIKE PATTERN

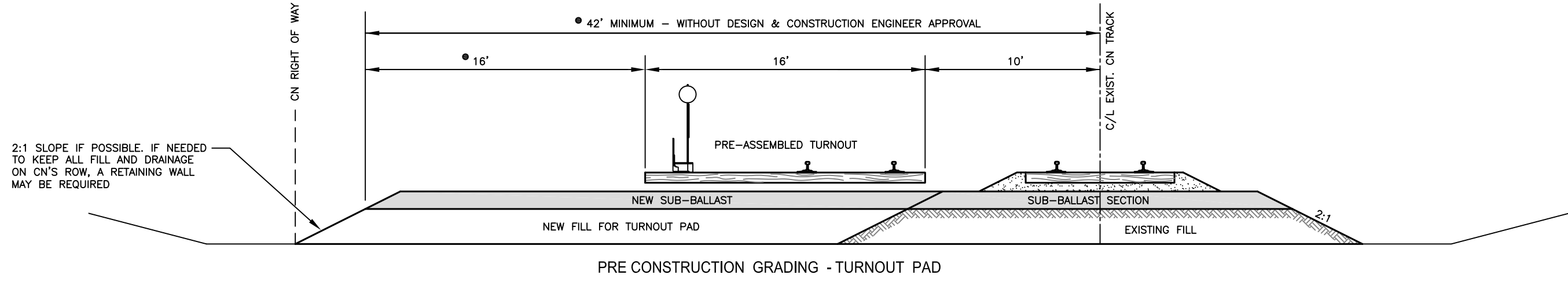


TRACK DIAGRAM

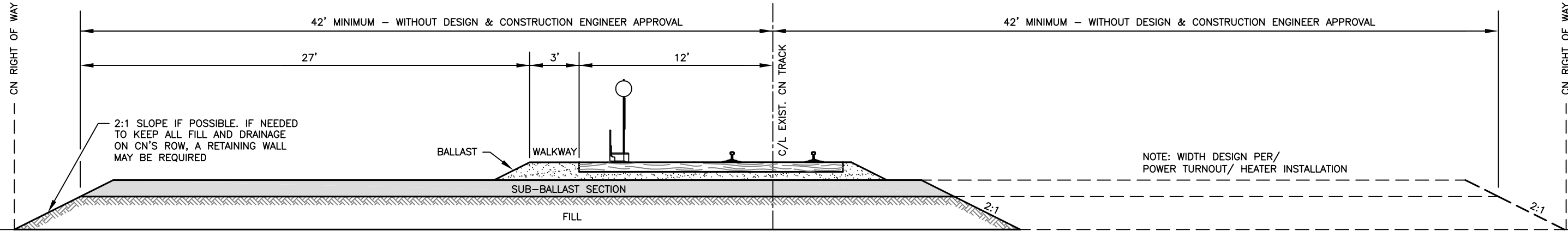
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**NOTE:**  
MEASUREMENTS ARE FROM THE GAUGE SIDE OF RAIL TO GAUGE SIDE OF RAIL

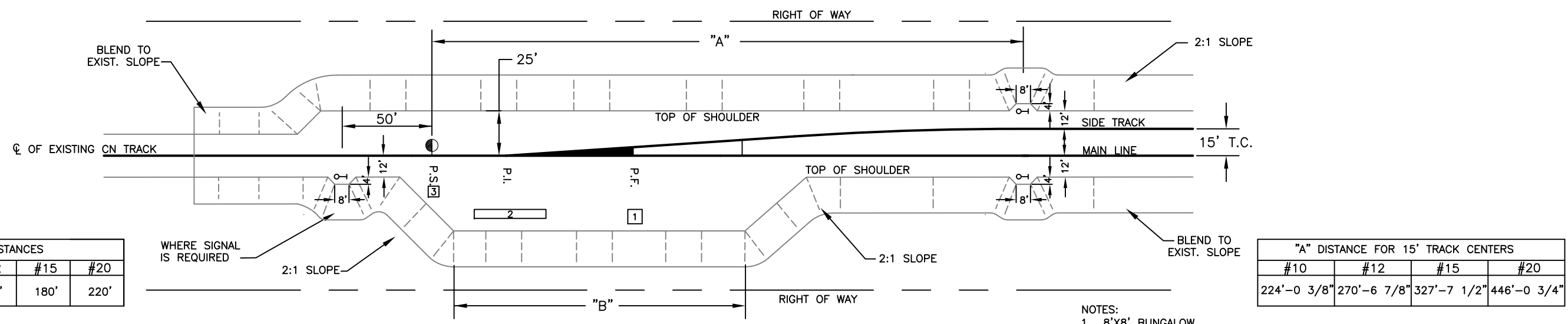
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<b>TURNOUT RETURN CURVES &amp; SPIKING PATTERNS FOR INDUSTRIAL TRACKS</b>		
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PRE CONSTRUCTION GRADING - TURNOUT PAD



POST CONSTRUCTION GRADING - TURNOUT PAD



PLAN VIEW

- NOTES:
1. 8'X8' BUNGALOW
  2. PROPANE TANK
  3. 6'X6' SWITCH HEATER HOUSING

LOCATION	TURNOUT DISTANCES				
	#8	#10	#12	#15	#20
"B"	102'	120'	140'	180'	220'

**NOTE:** CONSTRUCTION OF INDUSTRY TURNOUT PAD IS FOR THE PLACEMENT OF THE PROPOSED PACKAGE TURNOUT FOR ASSEMBLY AND INSTALLATION. TURNOUT PAD IS ALSO TO PROVIDE FOUNDATION FOR ANY REQUIRED SIGNAL EQUIPMENT.


TURNOUT PAD FILL MATERIAL SHALL BE PLACED BY THE INDUSTRY AS PART OF THE GRADING FOR THE NEW INDUSTRY SPUR. PAD IS TO BE CONSTRUCTED USING STANDARD COMPACTION AND FILL PLACEMENT PROCESSES AS PER THE CN INDUSTRY TRACK GUIDELINES. TOP OF PAD IS TO BE 2' BELOW THE EXISTING TOP OF RAIL.

CONTRACTOR SHALL COORDINATE WITH THE DESIGN & CONSTRUCTION FIELD ENGINEER AND ASSOCIATED PROJECT ENGINEER/MANAGER FOR ANY DEVIATION OF FILL AND FOR FLAGMAN PROTECTION.

**NOTE:** IF RIGHT OF WAY IS OVER 50' FROM C/L OF EXISTING CN TRACK, THIS DISTANCE SHALL BE INCREASED TO 25' AND 50' RESPECTIVELY

ROADWAY ACCESS SHALL BE PROVIDED

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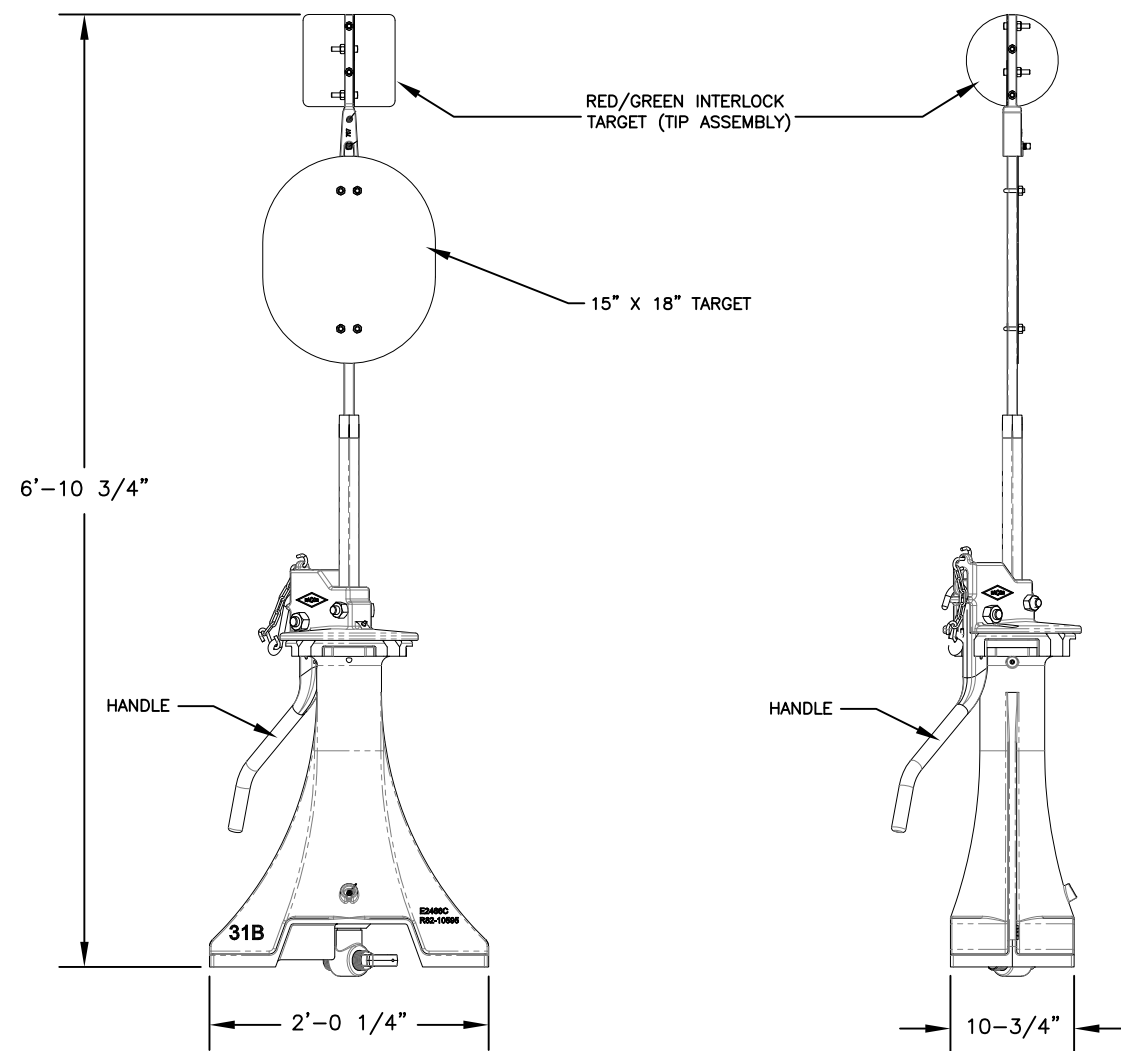


**TYPICAL GRADING  
AT MAINLINE TURNOUT LOCATIONS**

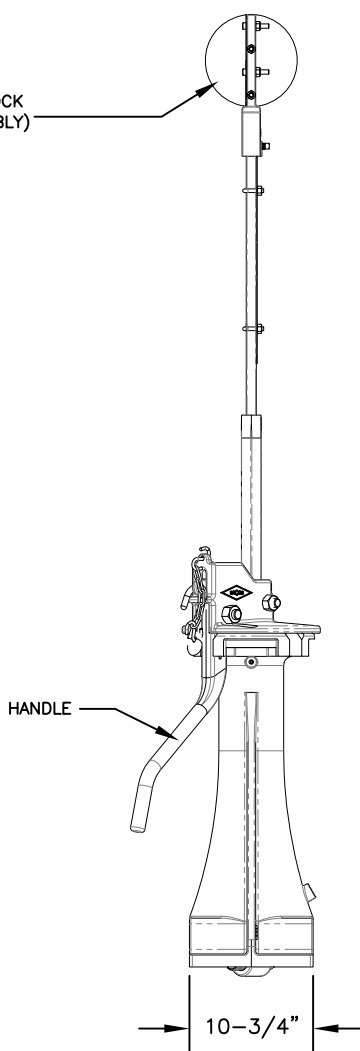
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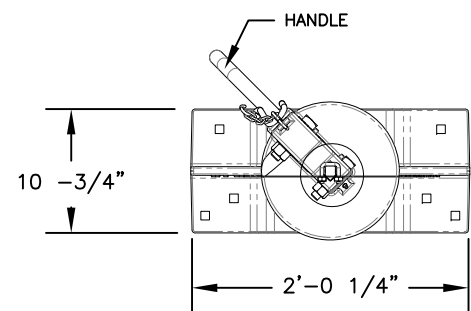
A22



ELEVATION VIEW

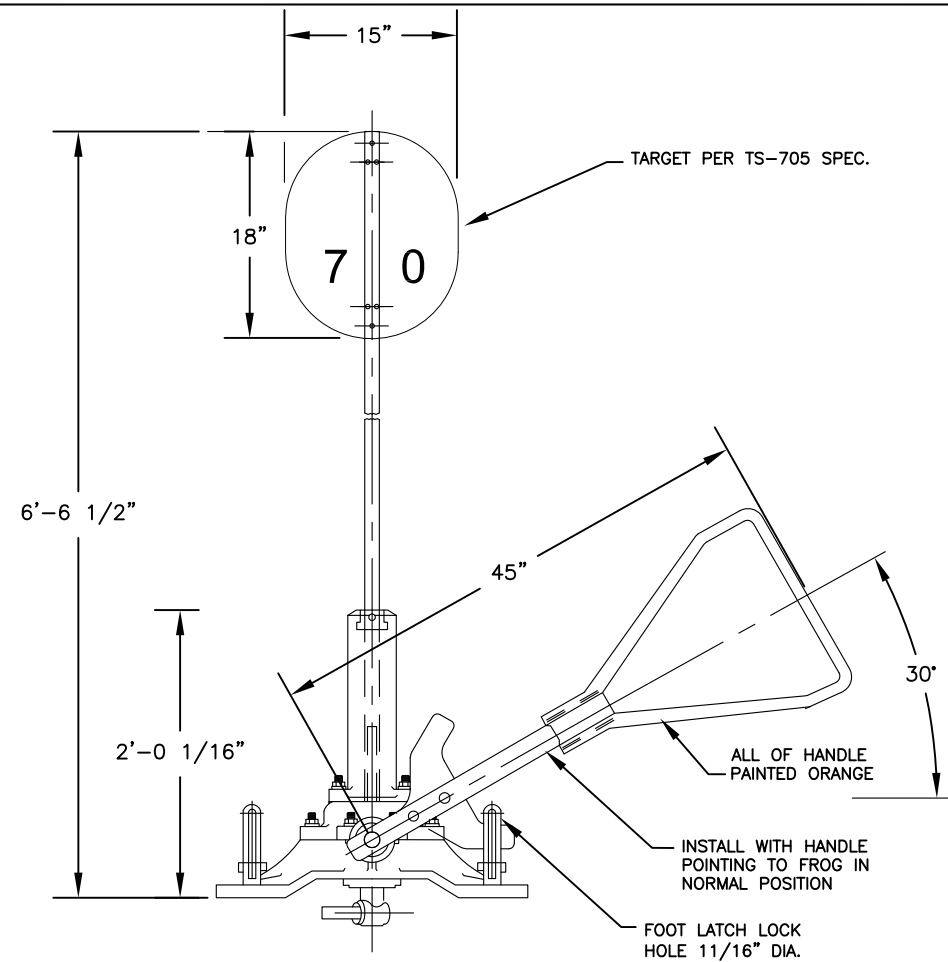


ELEVATION VIEW



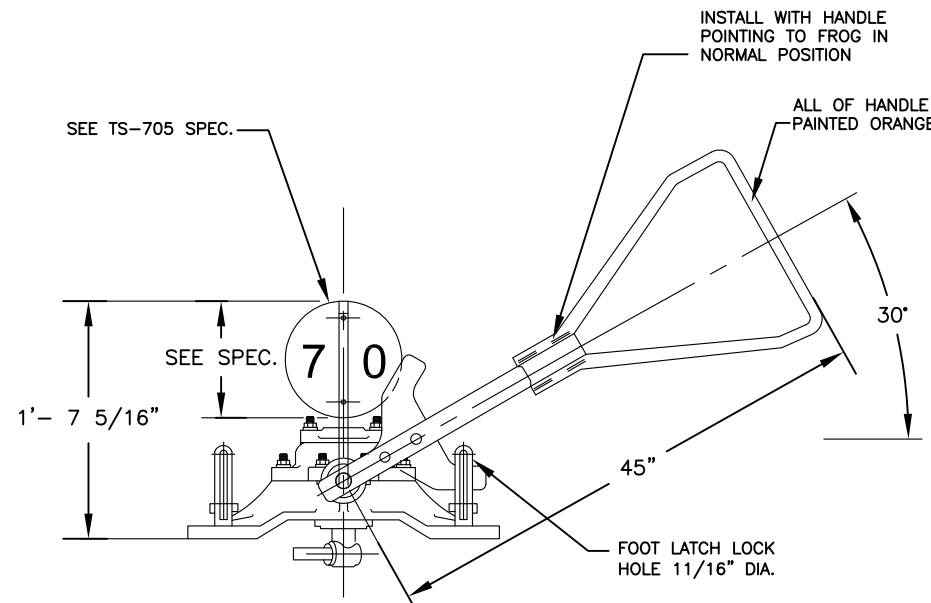
PLAN VIEW

SWITCH STAND  
31B



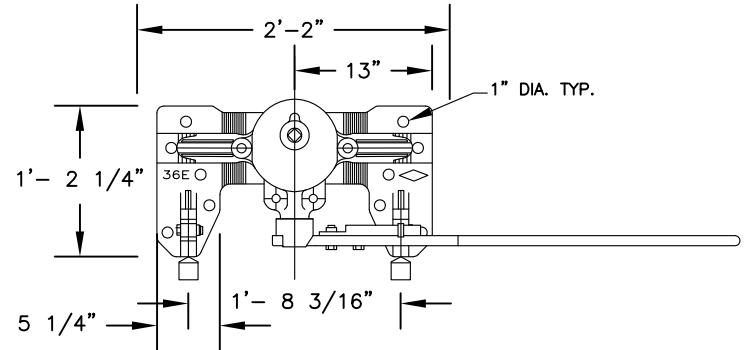
ELEVATION VIEW

36EH STANDS  
SHOWN WITH HIGH STAFF  
AND TRI-HANDLE



ELEVATION VIEW

36E STANDS  
SHOWN WITH LOW STAFF  
AND TRI-HANDLE



PLAN VIEW


36 E STANDS,  
SHOWN WITH LOW STAFF  
AND TRI-HANDLE

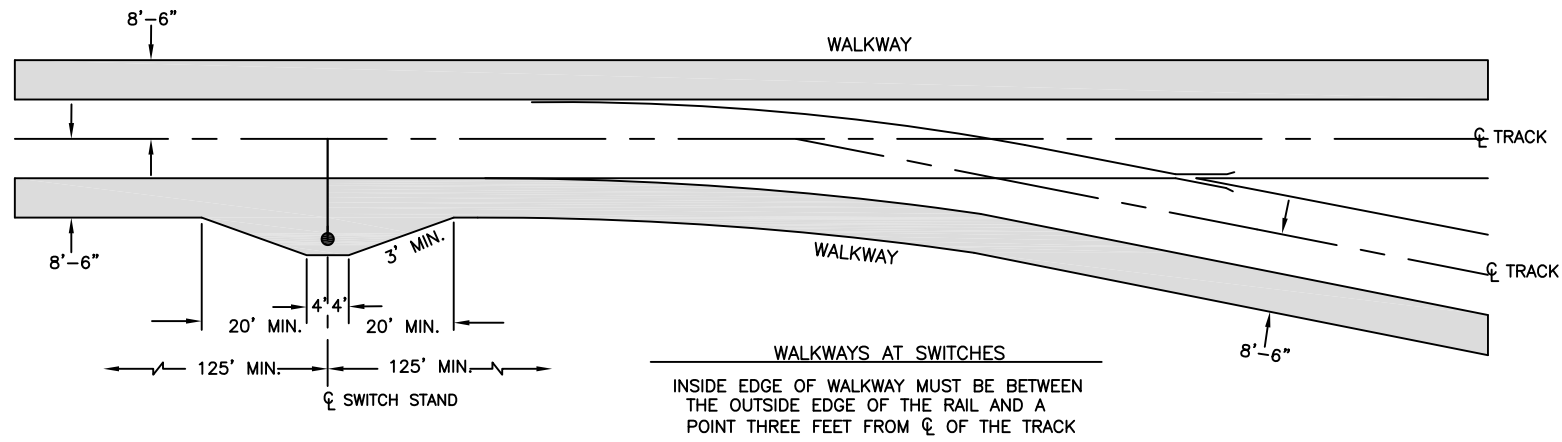
SWITCH STANDS  
36E / 36EH

NOTES:

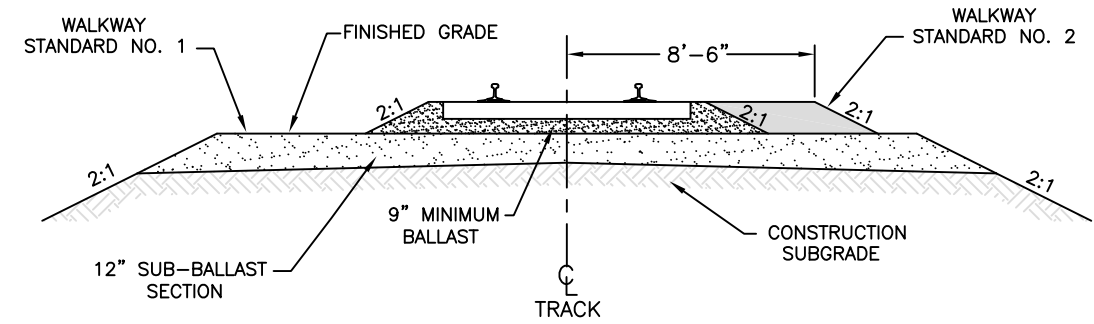
1. SEE DWG. 2156 & 2160 FOR SPINDLE AND CRANK EYE DETAILS.
2. HANDLE KITS (STRAIGHT OR TRI-HANDLE) ARE AVAILABLE FROM FIELD RETRO FIT OR EXISTING 36 STYLE SWITCH STANDS.
3. STAND 36 EH IS FOR MAIN LINE AND PRIVATE TRACK. FURNISHED WITH NO. 1.2 STAFF.
4. STAND 36E IS FOR YARD USE, FURNISHED WITH NO. 2 STAFF. HIGH STAND REQUIRED.
5. USE 18" TARGETS FOR 36EH STANDS AND 6" TARGETS FOR 36E STANDS.
6. SWITCH STANDS ARE TO BE INSTALLED WITH HANDLE DIRECTED TOWARD FROG WHEN LINED TO THE NORMAL POSITION.
7. USE RED TARGETS TO INDICATE "REVERSE" ROUTE ON MAINLINE TURNOUTS. USE YELLOW TARGETS TO INDICATE "REVERSE" ROUTE ON ALL OTHER TURNOUTS.
8. GREEN TARGETS WILL BE INSTALLED ON ALL TURNOUTS INDICATING "NORMAL" POSITION.
9. TRACK IDENTIFICATION NUMBERS TO BE APPLIED TO EACH SIDE OF "REVERSE" TARGET.
10. TRACK IDENTIFICATION NUMBERS TO BE 3" FLAT BLACK BLOCK TYPE FONT.
11. SWITCH STAND TO BE SECURED WITH SCREW SPIKES

A23

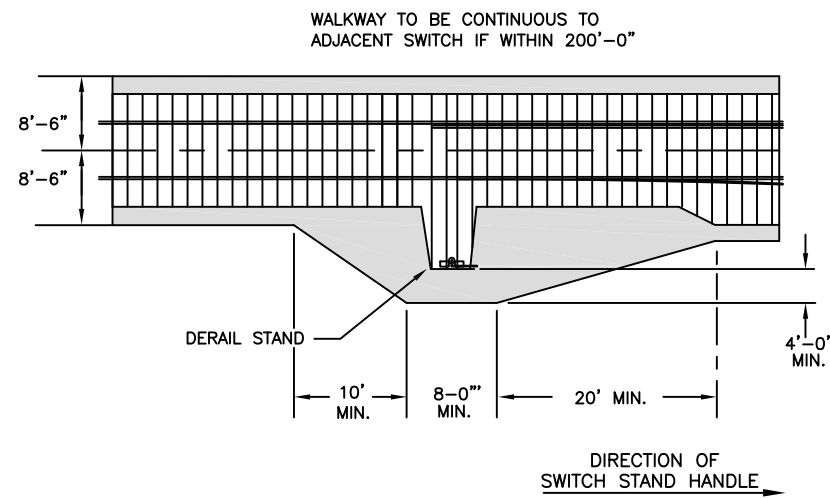
REVISIONS		DATE		BY
				
<b>SWITCH STANDS</b> <b>36E/36EH/31B</b>				
OFFICE OF DESIGN & CONSTRUCTION				
SHEET	DRAWN BY: DAP	SCALE: NONE	DWG NO:	
1 OF 1	CHECKED BY:	DATE: 15 NOV 15	FILE:	



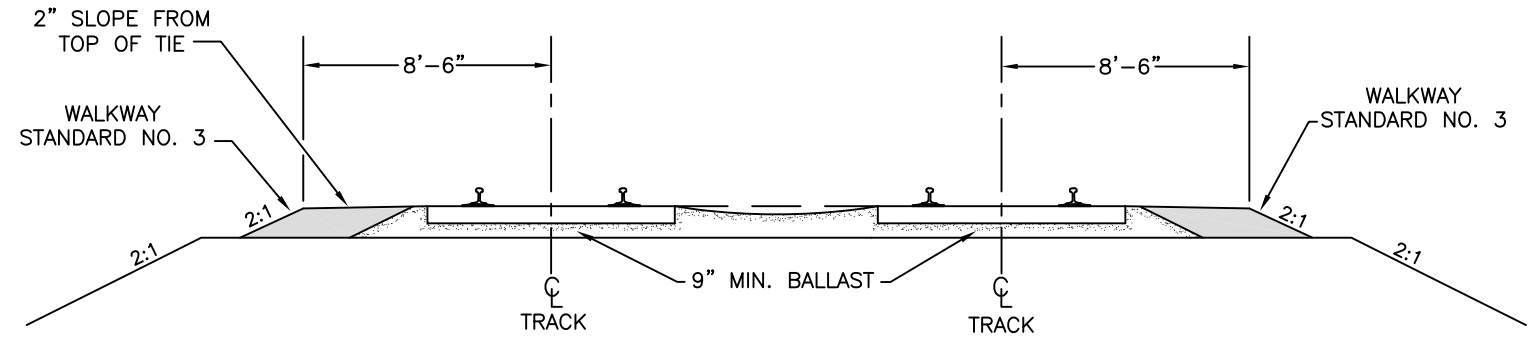
**WALKWAY STANDARD NO. 3**  
INDUSTRIAL TRACK ROADBED ONLY



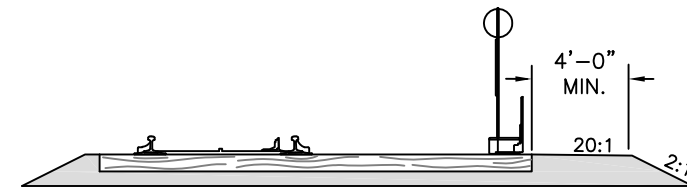
**WALKWAY STANDARD NO. 1 AND 2**  
INDUSTRIAL TRACK ROADBED



**WALKWAY STANDARD NO. 4**  
INDUSTRIAL TRACK ROADBED



**WALKWAY STANDARD NO. 5**  
INDUSTRIAL ROADBED FOR TWO OR MORE TRACKS



**TYP. SWITCH STAND SECTION**

**NOTE:**

WALKWAYS ARE TO BE CONSTRUCTED ONLY WITHIN LIMITS OF INDUSTRIAL TRACKS AND ARE NOT TO BE BUILT ALONG MAIN TRACK SWITCHES. USE ONLY NO. 5 TYPE BALLAST

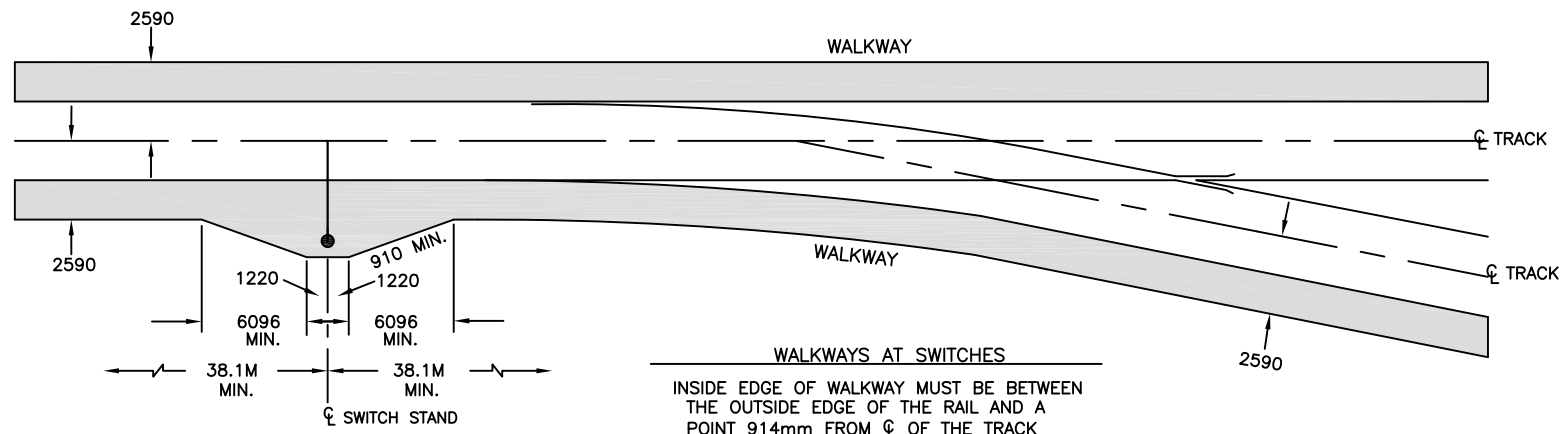
REVISIONS	
DATE	BY
APPROVALS	
SHEET	DRAWN BY: DAP
1 OF 1	CHECKED BY: DATE: 15 NOV 15



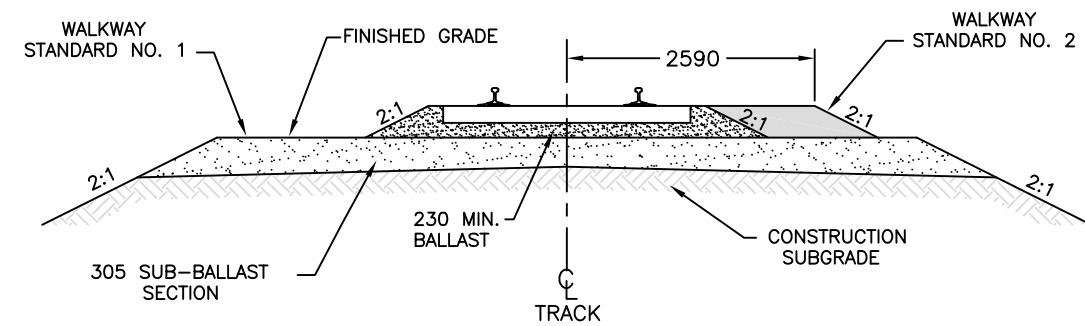
**WALKWAYS FOR INDUSTRIAL TRACKS**  
**US ONLY**

OFFICE OF DESIGN & CONSTRUCTION  
DWG NO: FILE:

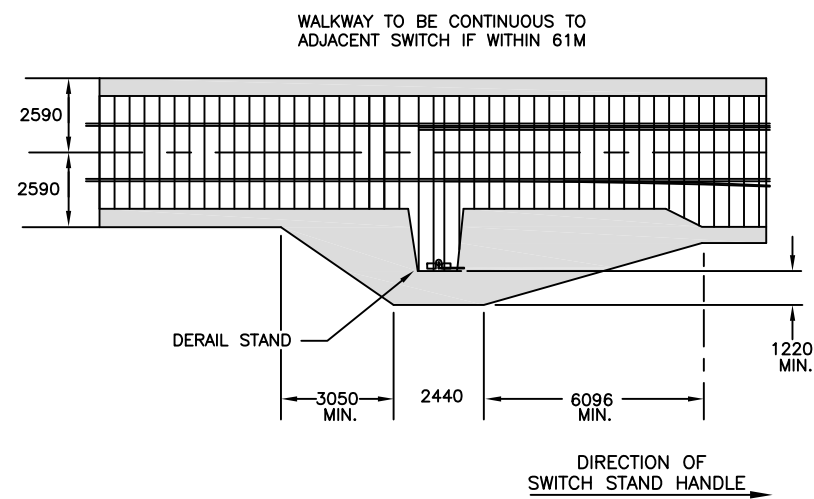
A24



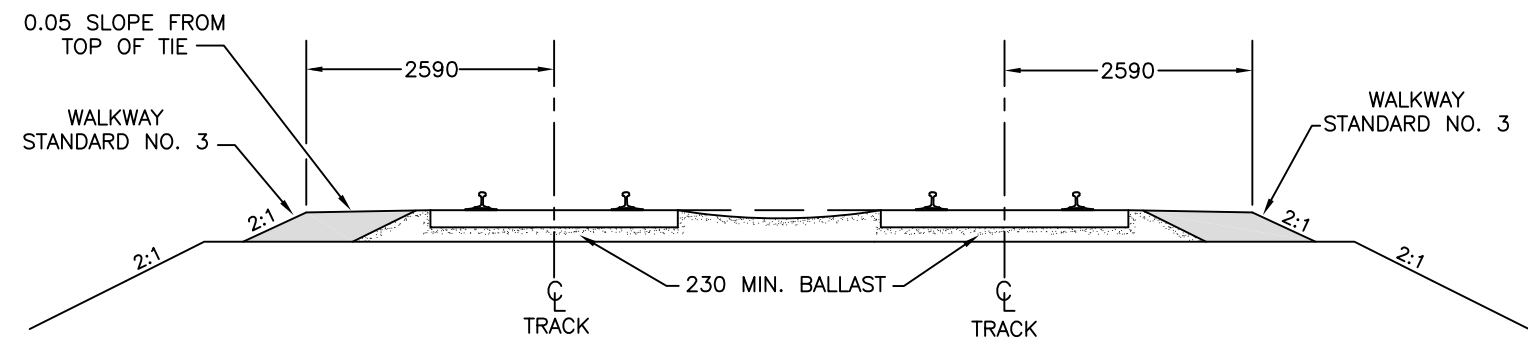
**WALKWAY STANDARD NO. 3**  
INDUSTRIAL TRACK ROADBED ONLY



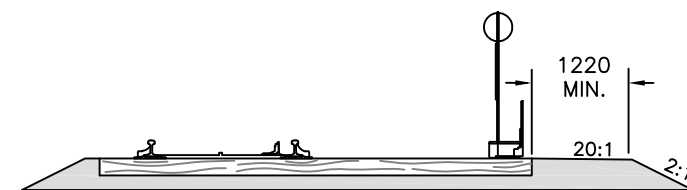
**WALKWAY STANDARD NO. 1 AND 2**  
INDUSTRIAL TRACK ROADBED



**WALKWAY STANDARD NO. 4**  
INDUSTRIAL TRACK ROADBED



**WALKWAY STANDARD NO. 5**  
INDUSTRIAL ROADBED FOR TWO OR MORE TRACKS



**TYP. SWITCH STAND SECTION**

**NOTE:**  
WALKWAYS ARE TO BE CONSTRUCTED ONLY WITHIN LIMITS OF INDUSTRIAL TRACKS AND ARE NOT TO BE BUILT ALONG MAIN TRACK SWITCHES. USE ONLY NO. 5 TYPE BALLAST  
  
ALL MEASUREMENTS IN MILLIMETERS EXCEPT WHERE INDICATED

REVISIONS	
DATE	BY
APPROVALS	
SHEET	DRAWN BY: DAP
1 OF 1	CHECKED BY: DATE: 15 NOV 15



**WALKWAYS FOR INDUSTRIAL TRACKS-m CANADA**

OFFICE OF DESIGN & CONSTRUCTION  
DWG NO: FILE:

A25



# CONSTRUCTION DRAWINGS

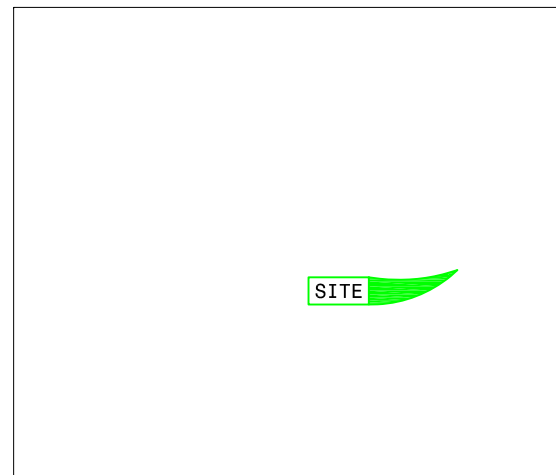
## TITLE SPECIFIC TO PROJECT

NNN STNAME STREET

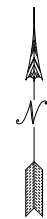
XXCITYXX, XXSTATE/PROV.XX XZIP/POSTALCODEX

DD MMM YYYY

### INDEX



SITE LOCATION MAP  
SCALE: N.T.S.



SITE VICINITY MAP  
SCALE: N.T.S.

#### SHEET TITLE

TITLE SHEET  
GENERAL NOTES  
TYPICAL SECTIONS/ DETAILS & QUANTITIES  
GENERAL PLAN & PROFILE SHEETS  
CROSS SECTIONS  
EROSION CONTROL DETAILS  
SWPP PLAN

#### SHEET NO.

#### STANDARD REFERENCE DRAWINGS

THE REFERENCE DRAWINGS LISTED ON THIS PLAN SHALL BE CONSIDERED A PART THEREOF:

NONE USED

#### BENCHMARKS

BM #1  
TOP OF RAILROAD TRACK AT \_\_\_\_\_, TOP OF THE LETTER "O" OF "xx".  
PAINTED \_\_\_\_\_.  
ELEVATION = XXX.XX' (NAVD XX)

BM #2

#### FLOOD ZONE INFORMATION

THIS IS TO CERTIFY THAT THIS PROPERTY (THE SUBJECT PROPERTY OR PORTION OF SURVEYED) IS NOT WITHIN THE LIMITS OF A DESIGNATED FLOOD HAZARD AREA. THIS PROPERTY FALLS WITHIN AN "OTHER AREAS", ZONE X BEING DEFINED AS, "AREAS DETERMINED TO BE OUTSIDE 500-YEAR FLOOD PLAIN" PER FEMA FIRM MAP NUMBER \_\_\_\_\_ DATED MMM XX, YYYY BASED UPON OUR INTERPRETATION OF THE LOCATION OF THE FLOOD HAZARD BOUNDARY LIMITS IN RELATION TO THE PROPERTY LINES. NO FLOOD STUDY WAS PERFORMED FOR THIS SURVEY.

A26

ISSUED FOR  
XXXXXX

SUBDIVISION: XXSUBDIVISION NAMEXX  
MILE POST.: XXNUMBER.OXX  
RR STATION: XXNEAREST STATIONXX

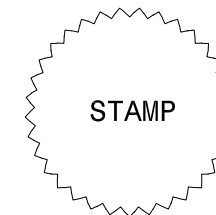
FOR  REVIEW

DIG LOGO

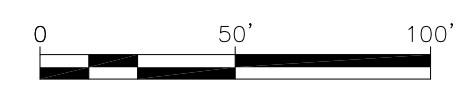
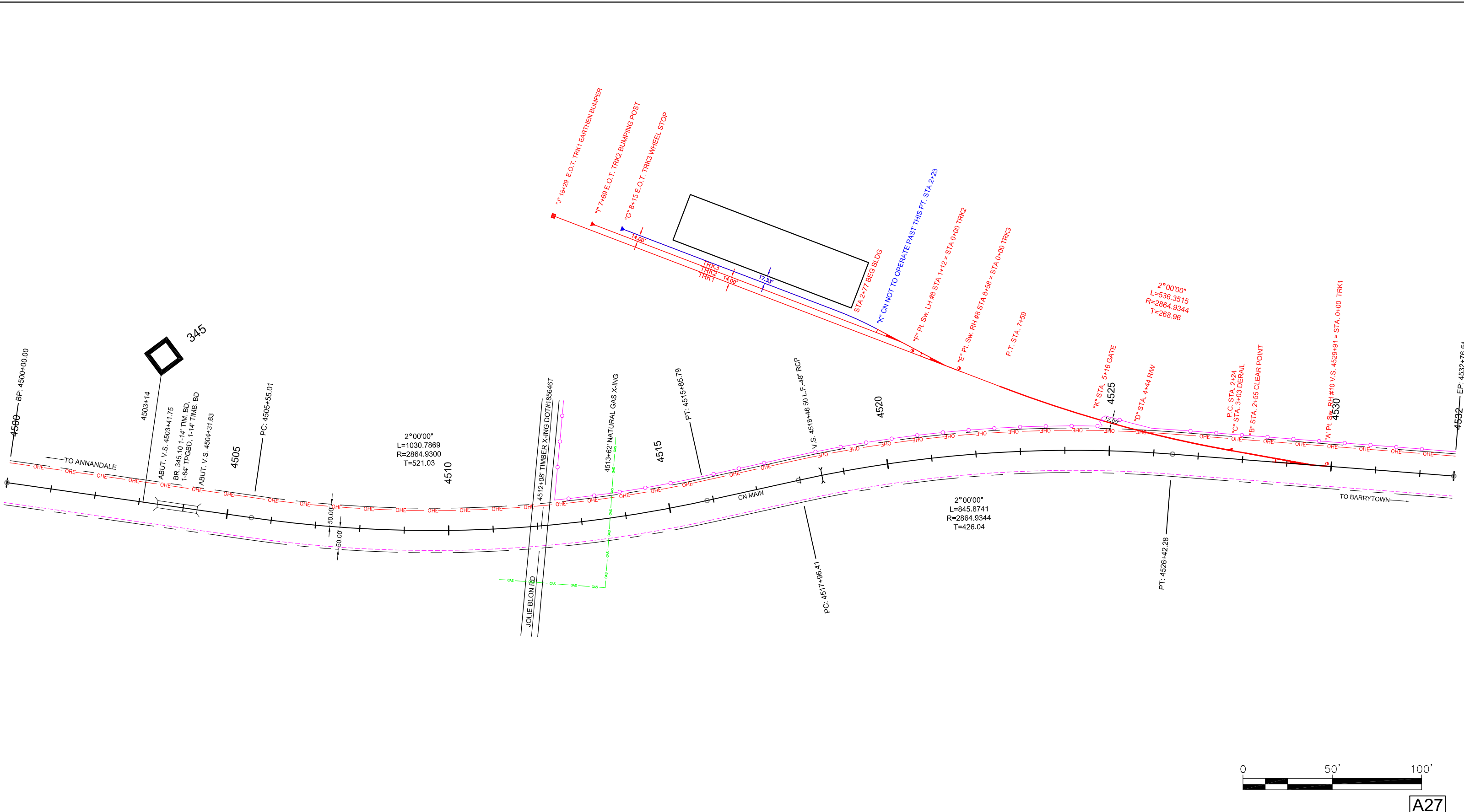
SAFE DIGGING  
INFORMATION  
CALL BEFORE YOU DIG  
1-800-XXX-XXXX

ENGINEER LOGO

ADDRESS  
CITY, STATE  
PHONE: (XXX)XXX-XXXX  
FAX: (XXX)XXX-XXXX  
WWW.WEBSITE.COM



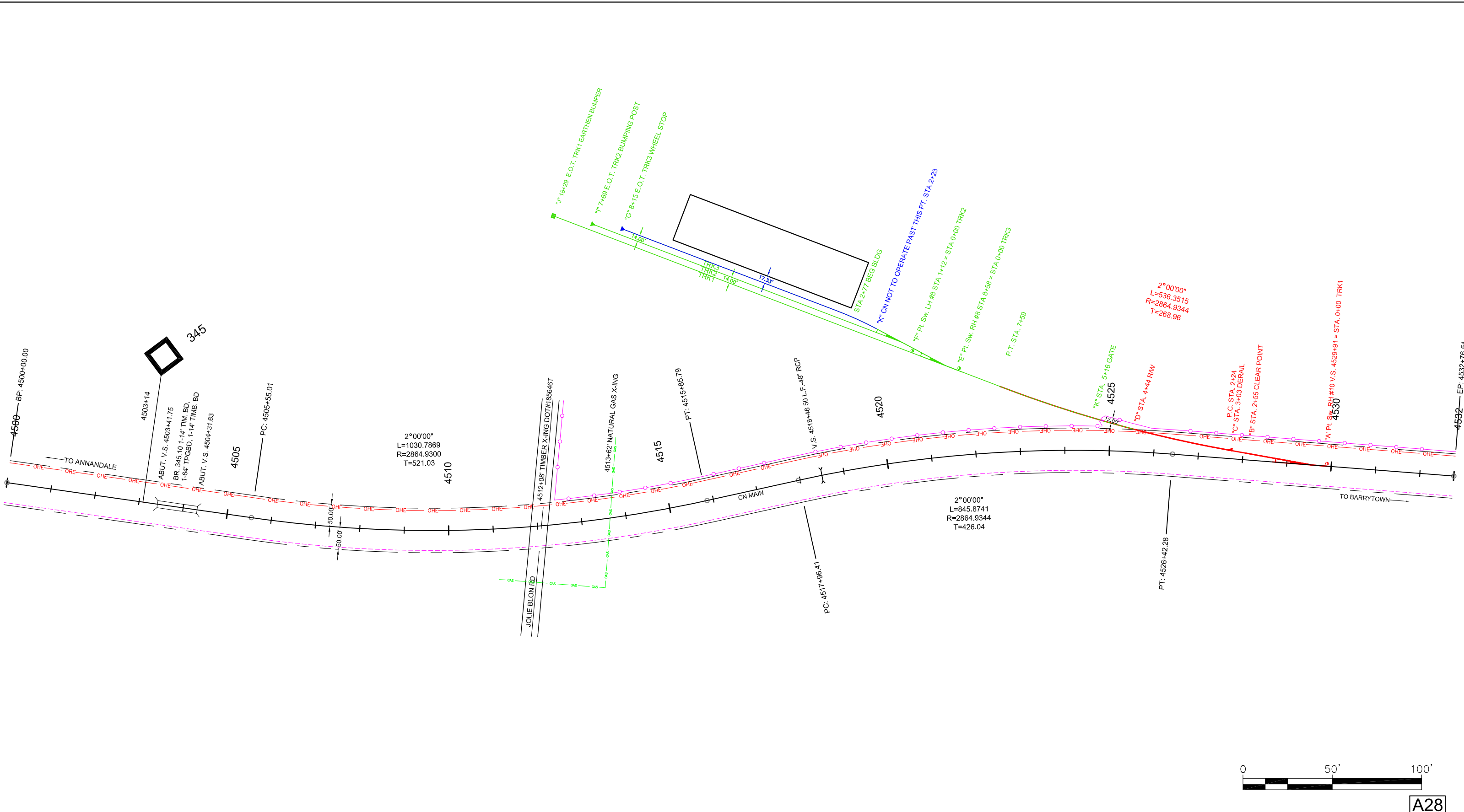
REV.	DATE	DRN.	CHK'D	REVISIONS	DESCRIPTION	APPR.
INDUSTRY LOGO HERE						
APPROVED	REV. #	LOCATION		TITLE		
BY	DATE	UNIT-BLDG		"EXAMPLE" TITLE SHEET		
		DRN.				
		DATE				
		CHK'D				
		DATE		DRAWING NO.		REV.
		SCALE				
		PLOT				
PROJ. #		PROJ. TITLE				



A27

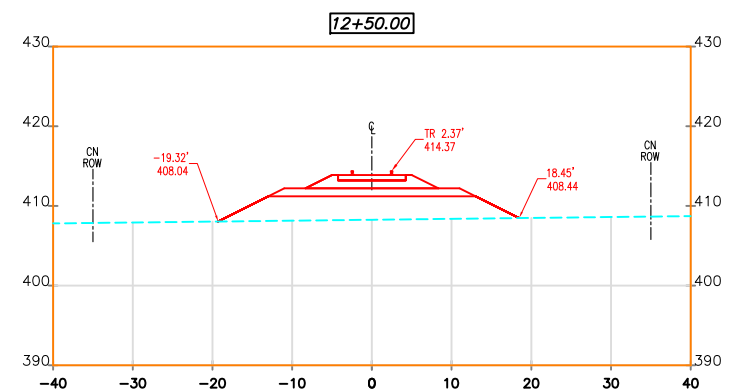
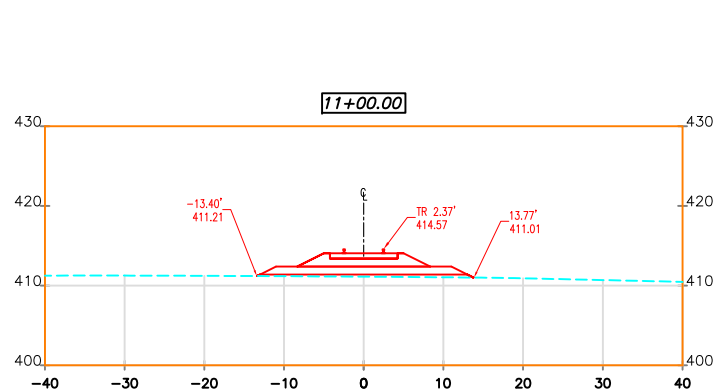
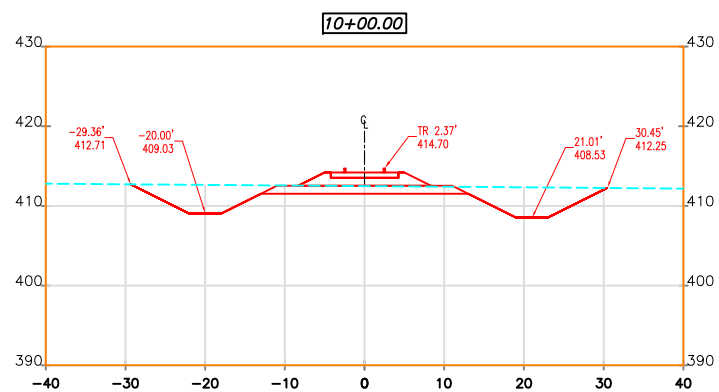
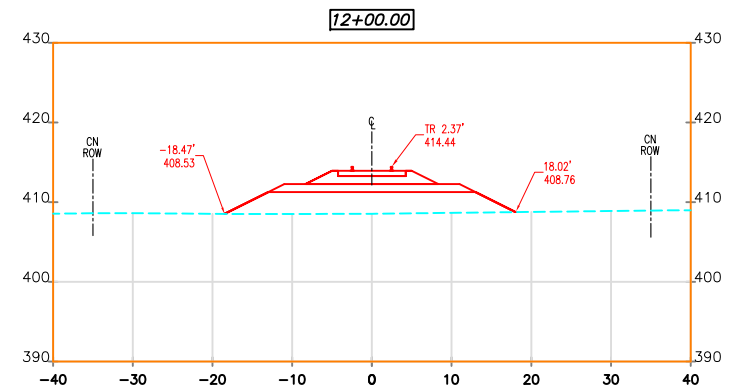
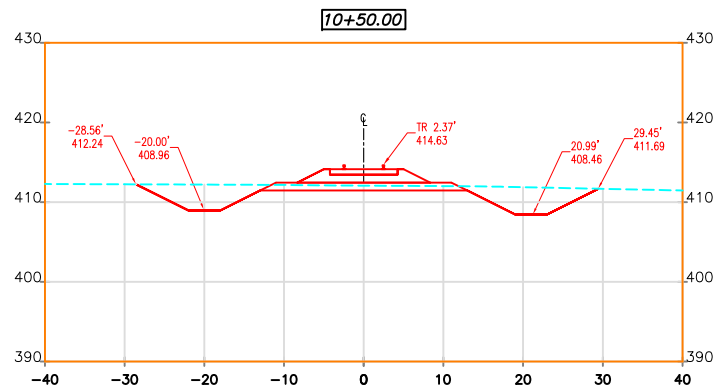
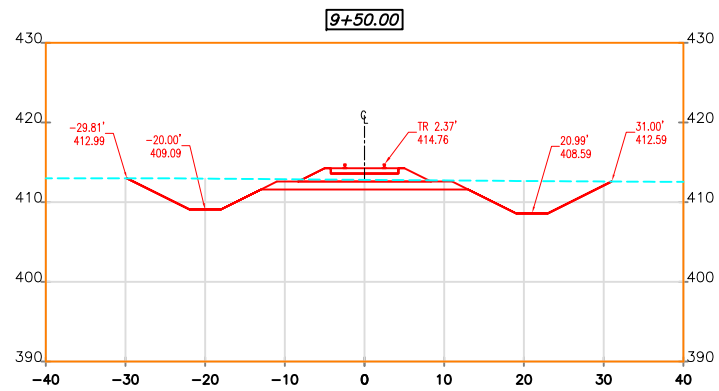
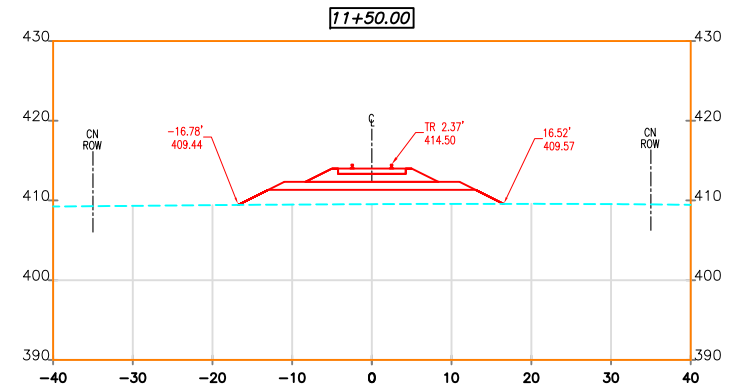
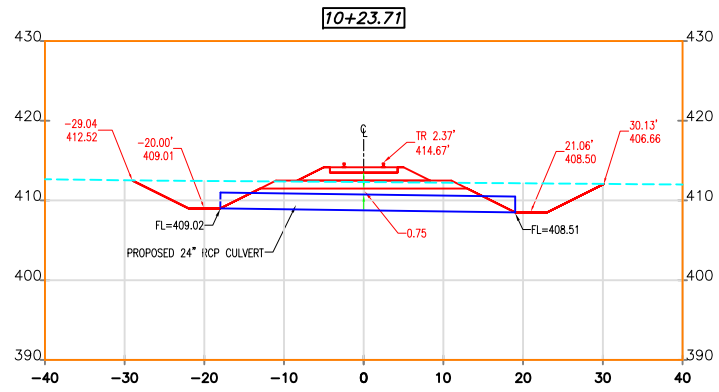
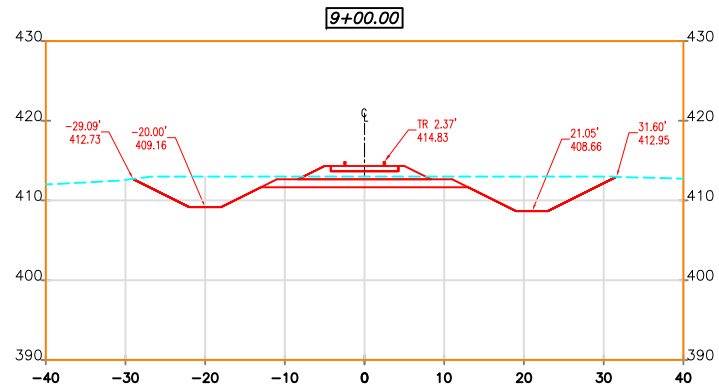
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REVISIONS			OPERATING RAILROAD	
DATE	BY		XXXX DIVISION	
			XXX SUB	
APPROVALS		<b>"EXAMPLE"</b> <b>TRACKAGE TO SERVE: INDUSTRY NAME</b> <b>REVIEW/CONSTRUCTION DRAWINGS</b>		
		OFFICE OF DESIGN & CONSTRUCTION		
SHEET	DRAWN BY: XXX	SCALE: 1" TO XXX'	DWG NO:	
X OF X	CHECKED BY: XXX	DATE: DD MMM YY	FILE:	



A28

REVISIONS DATE BY				OPERATING RAILROAD		
				XXX DIVISION		
APPROVALS				XXX SUB		
				LOCATION		
<b>"EXAMPLE"</b> <b>EXHIBIT A</b> <b>TRACKAGE TO SERVE: INDUSTRY NAME</b>						
OFFICE OF DESIGN & CONSTRUCTION						
SHEET X OF X	DRAWN BY: XXX	SCALE: 1" TO XXX'	DWG NO:	CHECKED BY: XXX	DATE: DD MMM YY	FILE:



A29

REVISIONS	
DATE	BY
DD MMM YY	XXX

APPROVALS

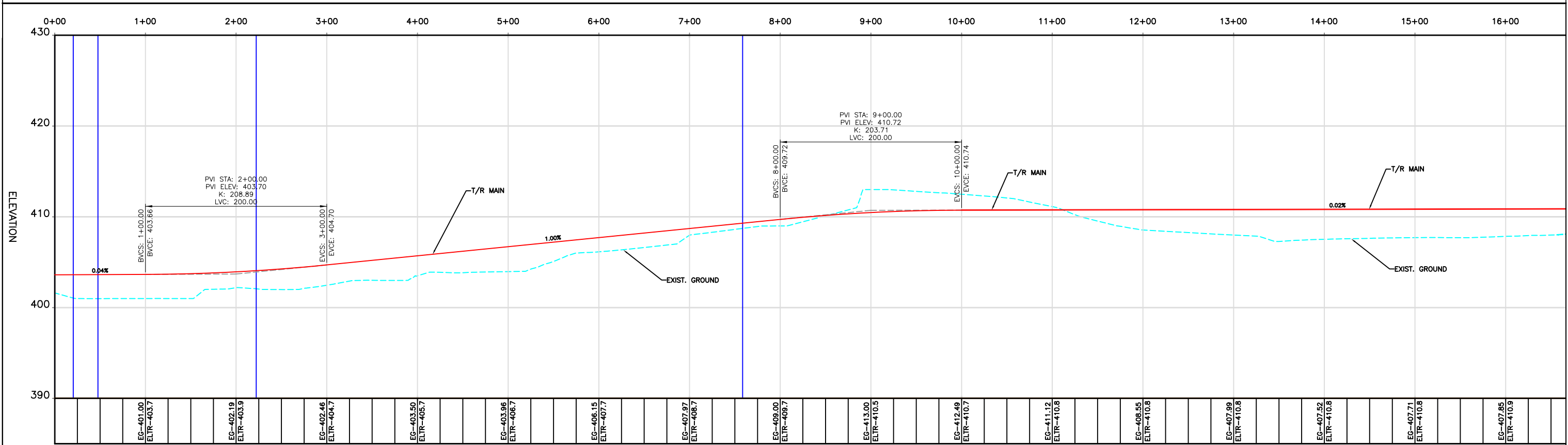
SHEET 1 OF 1




OPERATING RAILROAD  
XXXXX DIVISION  
XXXXX SUB  
LOCATION

"EXAMPLE"  
PROJECT NAME  
TYPICAL CROSS SECTIONS  
9+00 TO 12+50

OFFICE OF DESIGN & CONSTRUCTION  
DRAWN BY: XXX SCALE: 1" TO XXX' DWG NO:  
CHECKED BY: XXX DATE: DD MMM YY FILE:



A30

REVISIONS			OPERATING RAILROAD	
DATE	BY		XXXXX DIVISION	
DD MMM YY	XXX		XXXXX SUB LOCATION	
APPROVALS		<p style="text-align: center;"><b>"EXAMPLE"</b> (TYPICAL PROFILE) PROJECT NAME PROFILE 0+00 TO 16+00</p>		
SHEET 1 OF 1		OFFICE OF TECH. SERVICE ENGINEER		
DRAWN BY: XXX		SCALE: 1" TO XXX'	DWG NO:	
CHECKED BY: XXX		DATE: DD MMM YY	FILE:	





**WIRE LINE CROSSING AND ENCROACHMENT SPECIFICATIONS**

**OVERHEAD WIRE LINE CLEARANCE CHART**

FORMULA: .5" Increase for every 1,000 volts in excess of 50 KV  
6" Increase for every 12,000 volts in excess of 50 KV

Voltage	Minimum Clearance Required above top of Rail	Minimum Clearance (Including Static Wires) Required above Communication and Signal Lines
0 to 750	27'0"	4'0"
8,700	28'0"	4'0"
15,000	28'0"	6'0"
50,000	30'0"	6'0"
74,000	31'0"	7'0"
98,000	32'0"	8'0"
122,000	33'0"	9'0"
146,000	34'0"	10'0"
170,000	35'0"	11'0"
194,000	36'0"	12'0"
218,000	37'0"	13'0"
242,000	38'0"	14'0"
266,000	39'0"	15'0"
290,000	40'0"	16'0"

**THESE CLEARANCES ARE TO INCLUDE ALL TRACKS OPERATED AS MAIN TRACKS, SIDINGS, AND OTHER AUXILIARY TRACKAGE**

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REVISIONS			
DATE	BY		
APPROVALS		<b>WIRE CROSSING AND ENCROACHMENT SPECIFICATIONS</b>	
OFFICE OF DESIGN & CONSTRUCTION			
SHEET	DRAWN BY: DAP	SCALE: NONE	DWG NO:
1 OF 1	CHECKED BY:	DATE: 15 NOV 15	FILE: