METROLINX

Capital Projects Group Rail Corridor Raceway Requirements

MX-ELEC-RCWY-2018-REV0

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Preface

This is the first edition of the Metrolinx Rail Corridor Raceway Requirements (MX-ELEC-RCWY-2018-REVH). This document provides implementation requirements for raceways needed to run power and communications conductors for Electrification, Signalling, I&IT and Radio Systems in the Rail corridor right-of-way. It is intended to supplement DRM requirements.

Standardizing rail corridor raceway requirements is important to maintain uniformity throughout the Rail Corridors. Designers, consultants and contractors will have to reference this document in all new project drawings, specifications and installations.

Suggestions for revisions and improvement can be sent to the Metrolinx Engineering and Design Standards (E&DS) team, Attention: Director of E&DS. Be sure to submit a standards justification form which includes a description of the proposed change, background of the application and rationale. Include your name, company affiliation (if applicable), e-mail address, and phone number.

November 2018

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1 Introduction

1.1 Purpose

1.1.1 The purpose of this document is to provide implementation requirements for raceways (conduits run underground, above ground, cable trough, cable trays) needed to run power and communications (control and data) conductors for Electrification, Signalling, I&IT and Radio Systems in the rail corridor right-of-way which is intended to supplement DRM requirements.

1.1.2 Raceways shall be provided along the ROW when any civil or track expansion is being undertaken on a Rail corridor.

1.1.3 This document shall be read in conjunction with DRM and all related Metrolinx Standard Drawings and Specifications, including Electrification requirements.

1.1.4 Wiring and cabling details and installations are not covered under this guideline.

1.2 Scope

1.2.1 The Consultant and Contractor shall design and install the raceway system along rail corridor in such a way to ensure the provision for existing and future needs are fulfilled.

1.2.2 The raceway system shall consider safety, stray currents and their effects, lightning protection, grounding and bonding, EMF, EMI, containment of interferences, electromagnetic compatibility, electrical noise reduction, and corrosion control.

1.3 Abbreviations

Abbreviation	Description
AREMA	American Railway Engineering and Maintenance-of-Way Association
ANSI	American National Standards Institute
ASTM	American Society for Testing Materials
ATS	Acceptance Testing Specifications
CEC	Canadian Electrical Code
CN	Canadian National
CP	Canadian Pacific
CSA or	Canadian Standards Association (CAN is the prefix to indicate that

CAN/CSA	it is a National Standard)
DRM	Design Requirements Manual
E&DS	Engineering & Design Standards
EEMAC	Electrical and Electronic Manufacturer's Association of Canada
EMI	Electromagnetic Interference
EMF	Electromagnetic Field
EN	European Standards
FRE	Fiberglass Reinforced Epoxy
FY	Yield Strength
GPS	Global Positioning System
HDPE	High Density Polyethylene
IEC	International Electrotechnical Commission
IEEE	Institute of Electrical and Electronics Engineers
I&IT	Information & Information Technology
MTO	Ministry Of Transportation
NEMA	National Electrical Manufacturers Association
NETA	InterNational Electrical Testing Association
NFPA	National Fire Protection Association
OCS	Overhead Contact System
OESC	Ontario Electrical Safety Code
OHS O. REG	Occupational Health and Safety, Ontario Regulation

OPS	Ontario Provincial Standards
OHSA	Occupational Health and Safety Act
PVC	Polyvinyl Chloride
RGSC	Rigid Galvanized Steel Conduit
SCADA	Supervisory Control And Data Acquisition
SCP	Special Containment Procedures
SDR	Standard Dimension Ratio
TIA	Telecommunications Industry Association
UV	Ultra Violet

1.4 List of Standards, Codes and Specifications

1.4.1 Use the latest edition of the following standards, but not limited to:

No	Description
1	AREMA Manual for Railway Engineering
2	AREMA Communication and Signals Manual (AREMA C & S)
3	Bell Canada 360 Specifications
4	GO Transit Signal & Communication Standards (RC-0506-03SIG-Volume 1 & RC-0506-03SIG-Volume 2)
5	Union Pacific Fiber Specifications Standards Manual
6	OPS - Ontario Provincial Standards
7	CAN/CSA C22.3 No.7 Underground Systems
8	CAN/CSA C22.3 NO.1 Overhead Systems

9	CAN/CSA C22.1-12 Safety Standard for Electrical Installations
10	IEEE 1100: IEEE Recommended Practice for Powering and Grounding Electronic Equipment
11	EN 50122-1: Railway Applications, Fixed Installations – Protective Provisions Relating to Electrical Safety and Grounding
12	IEC 60479: Effects of Current on Human Beings and Livestock – Part I General Aspects
13	NFPA 780: Standard for Lightning Protection Systems
14	CAN/CSA - C22.3 No.6 Coordination between Pipelines and Electrical Supply
15	ANSI/NETA ATS: InterNational Electrical Testing Association Standard
16	ANSI T1.333, ANSI T1.334
17	Radio - Motorola-R56 standard
18	ANSI/TIA-568-C, ANSI/TIA-607-B Generic Telecommunications Bonding and Grounding (Earthing) for Customer Premises, ANSI/TIA-606-B Administration Standard for Commercial Telecommunications Infrastructure, ANSI/TIA-1005 Telecommunications Infrastructure for Industrial Premises
19	CAN/CSA OESC, Ontario Electrical Safety Code
20	CAN/CSA CEC, Canadian Electrical Code
21	EEMAC Electrical and Electronic Manufacturer's Association of Canada
22	Performance Specifications for Electric Traction Enabling Works (MX-ELEC TRAC EW-SPEC-2016-Rev0)
23	GO Electrification Enabling Works ET Standards Drawings (MX-ELEC TRAC EW-DW-2016-Rev0)

24	Interim Standards for the Selection of New Electronic Devices and Cables in Metrolinx Facilities to Mitigate Potential EMI Effects Generated by the RER Electric Traction System (MX-ELEC EMI-SPEC-2017)
25	Performance Specifications for Structures Passing Over Electrified Corridors (MX-ELEC STR-SPEC-2017-Rev3.0)
26	Design Requirements Manual (DRM) (GO-DRM-STD-2017-Rev1)
27	Metrolinx Electrical Identification and Nomenclature Specification (MX-ELEC-ID-SPEC-2017)

1.5 Related Work

a) Raceway for Electrical Systems Specification (Section 26 05 34)

b) Design and Construction Guidelines for Tunneling on the GO Transit Right-of-Way

c) GO Track Standards (RC-0506-02TRK)

d) Raceway for Electrical Systems Specifications (Section 26 05 34)

2 Raceway General Requirements

2.1 General

2.1.1 There are a number of third party utilities running along and crossing Metrolinx corridors which are not the subject of this document. For Electrification Requirements, please refer to Electrification Standards, Drawings, and Specifications.

2.1.2 Metrolinx shall use right-of-way rail corridor raceways, either running along or crossing the corridor, for the following systems:

System	Power	Control and Data	Traction Power
Signalling	Signalling, SCADA & communication systems	Signalling, SCADA & communication systems	
I&IT		I&IT communications mainline & Station Services	
Radio		Radio systems & communications mainline	
Electrification	Electrification and SCADA system house power	Electrification, SCADA & system communications mainline	Electrification & traction house power

2.1.3 Typical types of raceways used in the rail corridor will consist of:

a) above ground and underground conduits and ducts;

b) duct banks;

c) cable trays;

d) casing pipes;

e) cable troughs complete with covers.

2.1.4 Power and communications (control and data) systems shall be run in separate raceways and set a minimum of 610mm apart. Refer to Figure 3: Cable Depth around Culverts and Ditches (Appendix A).

2.2 Cable locates

2.2.1 Cable locates shall be completed in accordance with CN- SCP1005 and Bell Canada 360 Fiber Spec.

2.2.2 Damage to underground cables can have severe impact to Metrolinx, CN, CP, and clients that offer important services such as: cable, banking, national defence, air-traffic control, emergency communication services (i.e. 911).

2.3 Grounding and Bonding

2.3.1 Grounding and bonding shall be in accordance with but not limited to:

a) AREMA C & S Manual;

b) AREMA Manual for Railway Engineering;

c) Ontario Electrical Safety Code for the safety of persons, live stock, and property; and

d) CSA standards for safe step and touch voltage levels.

2.3.2 Coordinate requirements with Signalling and Electrification.

3 Installation on railway rights-of-way

3.1 Loading

3.1.1 Installation methods within 7.5m of the centerline of the outermost railway track shall withstand minimum Cooper E80 load.

3.2 Longitudinal installations

3.2.1 General

1) The minimum allowable distance from the raceway to the centerline of track shall be per Figure 1: Fill Installation Directional Bore (Appendix A).

2) The preferred location of raceway is to be outside and clear of OCS pole foundations. Where these foundations have not been installed the anticipated location is between 1.5m and 4.5m from the centerline of outside track. Where this cannot be achieved it is recommended that the raceway be installed between the OCS pole foundations and the track

3) The raceways shall be placed, where possible, longitudinally along the length of the track and in a straight run between the pull access points.

4) The installation shall not impact drainage patterns.

5) The duct banks shall be located away from the end of the track ties at a depth meeting the most stringent requirements of AREMA and OESC (Ontario Electrical Safety Code).

6) Where obstacles such as OCS (Overhead Contact System) structures, pole or foundations, signal foundations, utility manholes, etc., are encountered, the raceway shall be gradually offset around the obstacle.

7) Raceway offsets shall allow for conductor bending radii no less than manufacturer's specifications. Refer to Figure 6: Typical OCS Pole (Appendix A).

8) When locating raceway, consideration should be given to corporate expansion, track re-alignment, double tracking, etc.

9) Details of power and communication backbone raceway are shown in Figure 1: Fill Installation Directional Bore and Figure 3: Cable Depth around Culverts and Ditches (Appendix A).

3.2.2 Track Crossing

1) When necessary, crossings below the track are permitted as long as the duct banks/culvert/casing pipe meets the most stringent requirements set by AREMA, CSA C22.3 No. 7 Underground systems, and OESC.

2) Crossing under rail tracks shall be done in casing pipe or duct bank:

   a) not less than 1.52m from base of rail to top of casing at its closest point:

   b) of a size sufficient to allow for the removal of the cable without disturbing the casing pipe or road bed;

   c) Extending 600mm beyond the toe of the slope of the roadbed;

   d) 1.0m beyond the ditch;

   e) 2.0m from the outside rail; and

   f) not extending beyond the rail right-of-way.

3) All under track bores shall be at 90 degrees when using a directional bore. An angle of 60 degrees can be used at the discretion of Metrolinx.

4) Bore pit shall start at a minimum 9.14m from centerline of the closest track.

5) Refer to Figure 5: Cable Crossing Under Rail Tracks (Appendix A).

3.2.3 Road Crossing

1) Crossing under the roadway at a level rail crossing shall be approved by authorities having jurisdiction: Road Authority and Rail Authority. Crossing under roads shall be done in a reinforced concrete duct bank or in a casing pipe.

2) Minimum depth cover shall be 1.52m below top of pavement.

3) Crossing will need to accommodate existing infrastructure while providing protection for the conductors.

3.2.4 Bridge Crossing

1) Install conduits supported under/on the bridges, if authority having jurisdictions allow for such installation. Follow Ministry of Transportation (MTO) and Ontario Provincial Standards (OPS) standards.

2) Where a duct system crosses a stream, river, or canal, it shall be placed 1.52m below the bottom of the waterway unless the controlling authority requires additional depth, in which case the greatest depth shall apply.

3) For Submarine Cable Installation follow AREMA Communication and Signal manual (AREMA C & S).

4) When the raised track encounters a spur, long bridges along the track, the raceway shall be continuously supported and protected.

3.2.5 Pipeline Crossing

1) Pipeline owners shall be consulted as early as possible to determine their crossing procedures prior to any design and construction activity in their right-of-way. Under no circumstances shall any construction activity take place within the pipeline right-of-way without written permission from the pipeline owner.

2) All the standards and specifications of the pipeline owner and the National Energy Board shall be incorporated into procedures for cross pipelines.

3) The separation between the outside of the duct and the outside of the pipeline shall be minimum 1.0m or as directed by pipeline representative.

4) Permission from Pipeline Company shall be obtained prior to entering a pipeline ROW (Right-of-way) with heavy equipment.

3.2.6 Utility Crossing

1) Utility owners shall be advised as early as possible regarding the requirements to cross the rails and obtain all permits before any construction commencement.

2) Minimum separation between duct and utility shall be 1.0m from the outside of the duct.

3) All existing utilities shall be exposed prior to installation of new raceways. Obtain any locates necessary.

4) Mechanical equipment shall not be operated within 1.0m of the pipeline or raceway. Hand excavation shall be performed when locating and digging within 1.0m of the pipeline or raceway.

3.3 Casing Pipe Material, Culverts

3.3.1 General

1) All installations adjacent to or under the rail tracks or road crossings shall be designed for minimum Cooper's E80 loading. Provide cathodic protection and grounding as needed.

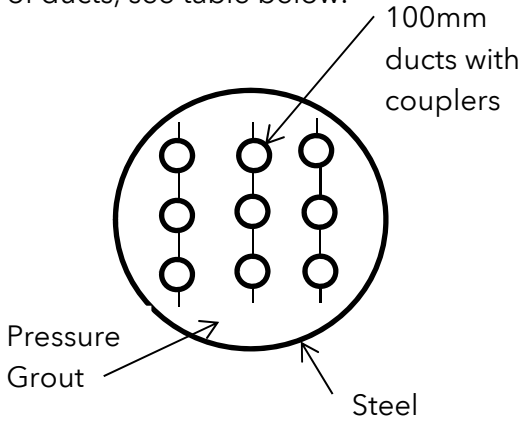
3.3.2 Casing Pipe - Galvanized Steel

1) When constructed of galvanized steel, casing pipe shall withstand railroad loading per ASTM A53/A53M, grade B or better or per CSA Z245.1, grade 241 or better.

2) Steel casing shall be spiral welded steel pipe with a minimum FY of 2500MPa. The casing wall thickness varies depending on soil conditions and depth. Check with the latest railway guidelines E-10 for steel casing thickness.

3) The diameter of the casing varies based on the number of ducts, see table below:

Nominal Casing Diameter		Maximum Number of 100mm (4") ducts
mm	Inch	
300	12	1 Duct
400	16	2 Ducts
450	18	3 Ducts
500	20	4 Ducts
600	24	5 Ducts
750	30	9 Ducts
900	36	12 Ducts
1050	42	16 Ducts
1200	48	24 Ducts



Steel Casing Pipe (with 9 conduits)

4) Refer to Figure 5: Cable Crossing Under Rail Tracks (Appendix A).

5) The crossing shall be suitably identified with markers located on each side of the railway tracks.

6) The ducts shall be installed in the pipe and the pipe shall be backfilled with pressure grout.

3.3.3 Casing Pipe – Other Materials

1) If constructed of materials other than steel, casing pipe shall:

   a) be resistant to the chemicals likely to come in contact;

   b) have a max deflection of 5% of the diameter from E-80; and

   c) be designed to take into account:

      1) differential settlement;

      2) temperature induced stress;

      3) ground movement;

      4) seismic conditions;

      5) erosion; and

      6) longitudinal/horizontal loadings due to uneven settlement of pipe bedding.

2) Refer to Figure 2: Typical Bore Crossing (Appendix A).

3.3.4 Depth below base rail

1) For vertical separation, see Figure 2: Typical Bore Crossing, Figure 3: Cable Depth around Culverts and Ditches and Figure 5: Cable Crossing Under Rail Tracks (Appendix A).

3.3.5 Horizontal distance from rails

1) Refer to Figure 1: Fill Installation Directional Bore (Appendix A).

3.4 Conduits

3.4.1 General

1) Conduits shall be limited to a maximum of 3 x 90˚ bends. Provide pull points at 90˚ bend and changing direction as necessary.
2) Conduit supports shall be as specified in OESC (Ontario Electrical Safety Code).
3) Conduits fill shall not exceed 30%.
4) Where conduits are being exposed to the weather, they shall be weatherproof, sunlight resistant, and UV stabilized.
5) Outdoor conduits and ducts having exposed open ends shall be fitted with either heat shrink boot or sealed bushing.
6) Conduits and ducts entering the buildings shall be sealed with conduit sealing bushing.
7) Conduits terminated in an enclosure shall have bushings and gaskets.
8) All raceways shall be grounded to meet OESC (Ontario Electrical Safety Code), IEEE, CSA, and Electrification requirements.
9) Inner-ducts shall be provided with smaller diameter conduits installed in larger conduits for fiber optic cables as necessary during detail design. Consideration should be given to cable tracking technologies built into raceways/conduits.

3.4.2 Conduit Material Requirements

1) Conduits shall be:
   a) PVC Schedule 40, or PVC Schedule 80; or
   b) HDPE 80, or HDPE 80 multi-duct; or
   c) PVC or epoxy coated rigid galvanized steel; or
   d) FRE rigid non-metallic; or
   e) liquid-tight flexible metal.
2) Material shall be selected to eliminate the risk of conduit crushing. Follow AREMA Communication and Signals Manual of Recommended Practices and ASTM standards.
3) On bridges and other structures, exposed raceways shall be PVC or epoxy coated rigid galvanized steel conduit (RGSC), complete with expansion deflection assemblies, see Ministry of Transportation drawings MTOD-2930.070, MTOD-2930.060. If raceways are concealed in concrete as an integral part of a bridge or overpass, Schedule 40 PVC conduit may be used.

4) Transitions, structural expansion joints, and expansion couplings at bridges shall be provided.

5) Installation damage to epoxy or PVC coated conduits shall be touched up/coated using aerosol spray to give an original coating thickness.

6) For HDPE 80 and HDPE 80 multi-duct conduit plowed into the ground with a railroad plow or tractor-drawn plow, standard dimension ratio (SDR) wall thickness shall be established during detail design. SDR shall withstand bending and tensile stress, compression loads and potential damage, ovalization, kinking, crashing, excessive sidewall loading, severe bending in the long run, and UV protection (Proposed SDR9).

3.5 Conductor Pull Access Points

3.5.1 General

1) Conductor Pull Access Points shall be placed less than the maximum pull distance allowed by the conductor manufacturer and shall be staggered to minimize footprint.

2) Conductor pull points shall be coiled at the same end of each set of pull boxes, throughout the rail corridor.

3) All pull points shall be identified.

4) Pull points shall be installed at each level crossing, bungalows, bridges, tunnels and other structures, before and after platforms, towers, change in raceway direction and transition points. See Station Platforms for more requirements.

3.5.2 Manholes, Handholes, Pull Boxes

1) All manholes, handholes, pull boxes and junction box covers on rail right-of-way shall withstand vehicle traffic, minimum E80 Cooper loading, be lockable, be flush with ground and be able to be engraved.

2) Manholes and handholes outside rail right-of-way, in stations area, shall be per Ontario Provincial Standards of pre-cast concrete or fiberglass type complete with cable supports, pulling irons and grounding rods.

3) All metallic parts shall be internally grounded.

4) Cover plates shall be provided and secured with bolts.

5) Manholes shall be provided at every change in direction, at all wayside bungalows and at each end of passenger station platforms, see Figure 4: Cable Depth at Station Platform (Appendix A).

6) Manholes and handholes shall be designed to drain water away by natural drainage or mechanical means.

7) Pull boxes type shall be selected to withstand the environmental conditions they are being installed in, complete with “knock-out” holes. Use NEMA 4X for outdoor mounted pull boxes above grade.

8) GO Transit/Metrolinx confined space regulation and protocols shall be followed: OHS O.REG. 623/05 and GO Transit Safety Guidelines for Contractors.

9) Traction Power Manholes shall be 2.5m L x 2.5m W x 3.0m D (inside dimensions), minimum 200mm thickness, c/w galvanized pulling irons, knockouts, minimum 2 cable racks per wall, precast concrete type.

10) Hand holes and manholes shall be drained.

3.5.3 Slack Pit Requirements

1) Vault/slack storage pits shall be provided for cable slack storage in electrical chamber (usually the last 3.0m from handhole/manhole into bungalows/cases to equipment, tunnels, bridges, road and track crossing, culverts, ends of station platforms, per detail design) where the cables are usually coiled near cable ends.

2) Ducts shall be terminated with end bells, ground and drain electrical chamber, see Ministry of Transportation drawing MTOD-2930.010 and Ontario Provincial Standard OPSD 2117.010., 2117.02.

3) Where a detailed cable distribution design or cable management plan is not available, the constructor shall, as a minimum, provide a slack pit installed:

   a) at each cable entry point; or

   b) at grade or bridge crossing for the storage of cable loops (slack).

4) This extra length shall be provided for a minimum of 2 new joints at each end of the cable should repairs or re-terminations be required, or for the provision of a new service in a location between established points. The extra cable shall be pulled back from a slack pit so that new joints can be made as per the manufacturer's recommendations when required.

5) A cable entry point is considered to be as follows:

   a) The cable chute to the termination board in a Signals Bungalow, or for a joint in a fibre splice case.

   b) The "big O" pipe for cable access to an electrical panel.

   c) As defined by other stakeholders with regard to raceway requirements.

6) Slack pits shall contain enough loops of excess cable to achieve the above requirements.

7) When looped; cables shall comply with the manufacturer's specifications for maximum bending radius.

8) The cable shall be coiled in a way to prevent twists and so that the cable, when removed from the pit and laid out on the ground, is as straight as possible. There shall be no torsion or twist on the cable.

9) The cable shall be coiled such that all cables entering the pit are parallel to each other and coiled neatly together.

10) Where there are multiple cables, the cable coils shall not be entangled. They shall be able to be individually separated and removed from the pit to be worked upon without the disturbance of other cables in the pit.

11) When cables are coiled in slack pits, methods of withstanding EMI and heat shall be provided.

12) At each equipment room, at all pits containing a joint or coil of slack, and at every termination, all cables shall be labelled with a cable identification alpha numeric number, source and destination.

3.6 Duct banks

3.6.1 General

1) An assembly of underground installed conduits form a duct bank.
2) When directly buried in open trench, sand fill shall be provided as a minimum around the conduits.
3) Reinforced concrete encased duct banks shall be used at vehicular areas.
4) Duct banks shall be set on a prepared and compacted bed and shall be sloped to drain to manholes or hand holes.
5) Where shallow manholes (less than 1.22m deep) are utilized, minimum depth of duct bank shall be 762mm as it enters the manhole. Refer to AREMA C & S Manual.
6) Power conduit spacers shall be provided in the duct bank and maintain a minimum spacing of 190mm between conduits.
7) All duct banks in open trench installations shall have as a minimum 304mm warning tape width, mounted 500mm below surface, and conduit organizers.
8) All conduits in duct banks shall have a trace wire and pull cords installed along the entire length, initiating from a manhole and terminating at the duct banks end.
9) Trace wires installed within a manhole shall be terminated within an appropriately rated enclosure and color, on a terminal strip and identified with its corresponding duct bank number and color.
10) Transitioning from below grade to above grade shall be PVC or epoxy coated rigid galvanized steel conduit (RGSC) , extending above the ground 150mm, capped and sealed, see AREMA C & S Manual.
11) All conduits not used shall be capped.

3.6.2 Minimum number of mainline conduits including spares

1) Power Raceways:
   a) Provide a minimum of 4 x 100mm (4 in), **red** color conduit and **red** color with different strips for easy identification (2 Signaling, 2 Electrification).
2) Communication Raceways:
   a) Provide a minimum of 6 x 53mm, **orange** color, for Fiber Optic Systems.
   b) Provide a minimum of 2 x 53mm, **purple** color, for Corporate Network, Operation/Station, Leasing, and Communications System.
   c) Provide a minimum of 1 x 53mm, **brown** color, for Radio System.
3) All Raceways shall have a unique identification in addition to the above colours. Refer to Metrolinx Electrical Identification and Nomenclature Specification.
4) A minimum of 610mm separation shall be provided between power and communications.
5) The numbers above do not include conduits required to run local services for signals, heaters, switches, etc., which shall allow for 30% minimum spare conduits.

3.6.3 Traction Power and High Voltage raceway

1) Duct banks initiating from facilities to the first manhole outside of the alignment and to all subsequent manholes and feeder poles within the alignment, shall be Schedule 80 PVC conduit, FRE conduit, with PVC or epoxy coated rigid galvanized steel conduit elbows, with a radius greater than 1.8m (6 foot), encased in steel-reinforced concrete.

2) High voltage (voltage greater than 750V) raceways that are maintained by Metrolinx, and are used for feeders, shall be FRE or PVC conduits, encased in steel-reinforced concrete and the conductors shall be separated from other systems per the OESC/CEC.

3) If required because of electromagnetic interference (EMI), high voltage conductors shall be installed in epoxy or PVC coated rigid galvanized steel conduit. Other means shall be adopted to mitigate the effects of the EMI.

3.7 Cable Tray

3.7.1 Design circumstances may require physical protection of the cables, in which case ventilated cable trays and covers may be used. Cable trays use is restricted to radio towers between bunker and tower within system buildings, across pedestrian bridges and rooms (i.e. bungalows, bunkers, electrical and control rooms). Cable trays and supports shall be designed to provide adequate strength to support the weight of the cables and future cables, minimum load Class E, complete with stainless steel hardware, extra heavy duty.

3.8 Cable Trough

3.8.1 Cable trough shall be rated for:

a) heavy duty vehicle traffic, complete with “knock-out” holes or “T” configurations;

b) exterior below grade use;

c) resistant to sunlight exposure; and

d) suitable for use in wet locations.

3.8.2 Individual cable trough sections shall interlock together to make a continuous cable trough without gaps.

3.8.3 The cable trough shall have integral dividers to maintain separation between power and communication cables.

3.8.4 Cables shall only enter or exit the cable trough through cable trough hand holes or pull boxes that are an integral part of the cable trough system.

3.8.5 The cable trough shall be placed in a level trench and installed per manufacturer recommendation by qualified personnel.

3.8.6 Cable trough transition from trough trench shall have protected entry/exit point so as not to cause damage by vibration or movement.

3.8.7 Drainage at track structure shall be no closer than 304mm from edge of tie. Elevation of drainage shall be below top of tie.

3.8.8 Covers for cast-in-place cable troughs shall be pre-fabricated High Density Polymer Concrete or cast iron type and be secured with stainless steel vandal proof hardware.

3.8.9 Covers shall sit inside the trough, be flush with the finished grade, and be designed to withstand excessive, or heavy traffic loading.

3.8.10 The weight of each cover shall not exceed the allowable handling weight as per OHSA requirements.

3.8.11 Cable troughs shall not be located directly above longitudinal runs of utilities.

3.8.12 The use of cable trough and lids where accessible by motor vehicles shall be rated to withstand H-20 loading.

3.8.13 Special circumstances will be determined as required. For example, cast-in-place type cable troughs shall be located on bridges as an integral part of a pedestrian walkway.

3.9 Raceways at Passenger Stations

3.9.1 These requirements are set in place for corridor infrastructure backbone raceways and they shall be implemented in conjunction with, and independent, of the DRM set criteria for passenger station, tunnels and platform dedicated infrastructure raceways.

3.9.2 For passenger stations, backbone raceways shall be a continuation of the Rail corridor raceways and shall form continuous run from the corridor to the station main Electrical and Communication Rooms. If there is no other routing other than the platform see Figure 4: Cable Depth at Station Platform (Appendix A).

3.9.3 Locate and coordinate the design to accommodate platform obstructions such as: platform services, heat tracing, snow melt, platform ducts, structures, and foundations.

3.9.4 Manholes and handholes shall be located at each end of the platform and along the platform at the entrance of a tunnel, bridge, or shelter, and outside pedestrian traffic areas, to provide junction points for the communications and power conductors.

3.9.5 Dedicated manholes shall be provided for backbone express raceway, for power and for communication conduits, connecting to electrical and communication rooms. Extend the 9 in and 9 out (communication conduits) and 4 in and 4 out (power conduits) from main backbone to main electrical and communication room and back. See Figure 4: Cable Depth at Station Platform (Appendix A).

3.10 Pedestrian Tunnels

3.10.1 For pedestrian tunnels, raceways shall be concealed into the side walls or floor, concealed from view.

3.10.2 Concealed pull points (Pull Boxes) shall be provided at each change in direction.

3.10.3 Locate the raceway, in a dedicated cable shaft, running vertically to the platforms and then distributed to the loads.

3.10.4 Design shall be coordinated to accommodate routing and avoid obstructions such as: platform services, heat tracing, snow melt, platform ducts, structures, and foundations.

3.11 Marker Posts and Tie plate markers, Warning Decals

3.11.1 Marker Posts

1) Cable route marker posts shall be placed on either side of the rail right-of-way, immediately following burial of a cable.
2) Posts shall be placed at 300m intervals or less to identify the raceway and cable route, and at locations of major change in direction.
3) The post shall be orange, high impact post, 1.8m long with anchor fin at the bottom.

4) The marker shall include a warning digging or driving stakes.

5) The cable posts shall be set in 450mm into the ground, away from traffic area:

   a) at culverts;

   b) where other utilities cross the raceway/cable;

   c) on both sides of railroad tracks, rivers and streams; and

   d) at points where raceway/cable route change direction.

6) No marker posts shall be placed in locations where raceway/cable is located within devil strip, on high steep sided embankments.

3.11.2 Tie Plates

1) Tie plate markers shall be used where raceway/cables passes under the track or is within devil strip (raceway/cable crosses multiple tracks).

2) The tie plates shall be placed on the main track tie and the siding tie so the markers are on either side of the cable.

3.11.3 Warning Decals

1) Warning decals shall be sized 75mm x 240mm, with black letters and a white background stating warning of buried cable and contact information for before digging.

3.12 As-Built Drawings

1) As-built drawings shall be provided for all designed raceways.

2) The raceways shall be in multi-view format (xyz coordinates, northing/easting, elevation)/ (GPS pending) located on all plans and record design drawings.

A Appendix A

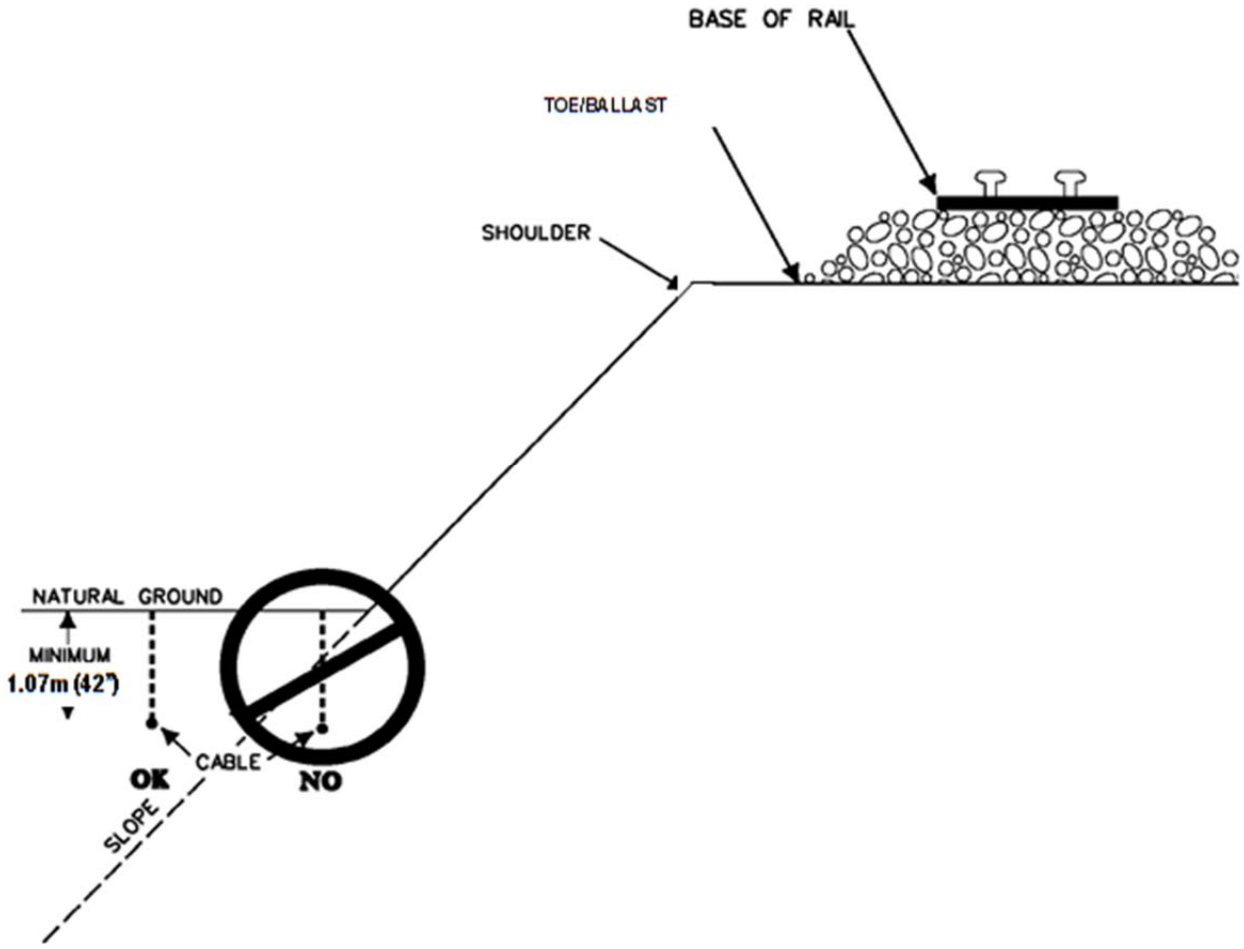


Figure 1: Fill Installation Directional Bore

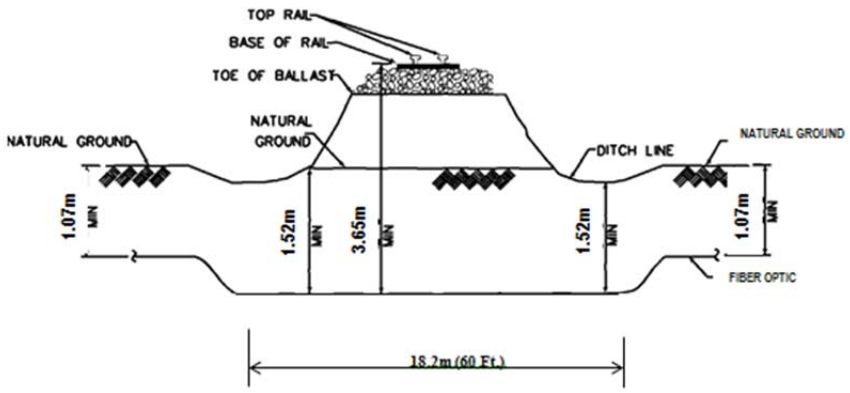


Figure 2: Typical Bore Crossing

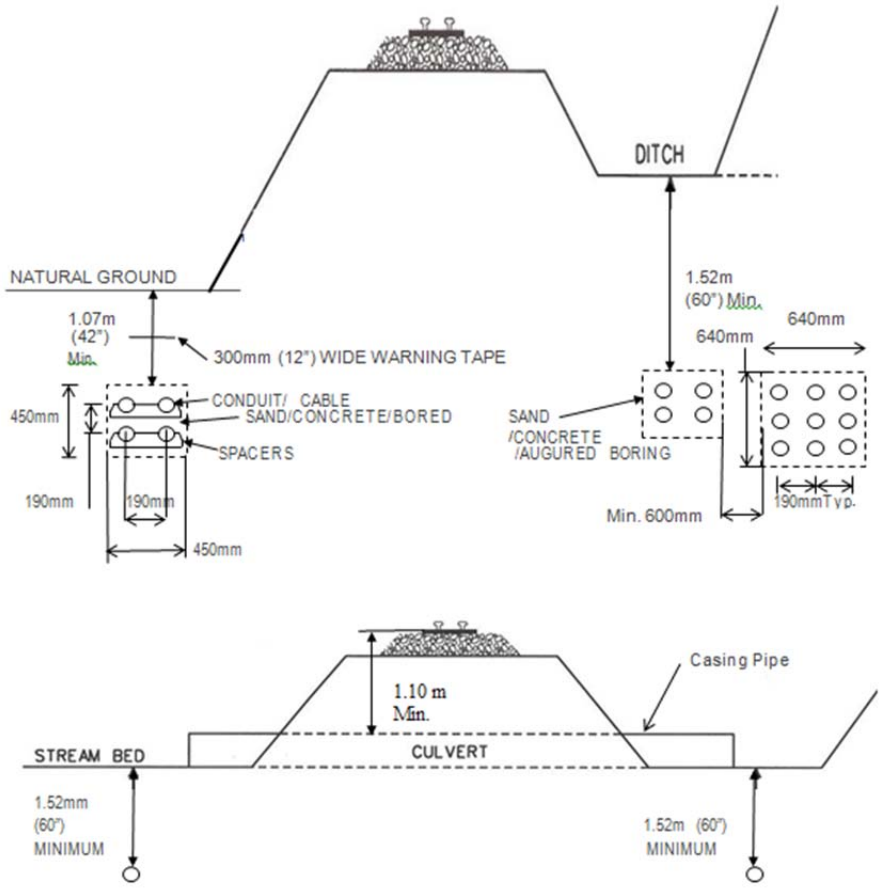


Figure 3: Cable Depth around Culverts and Ditches

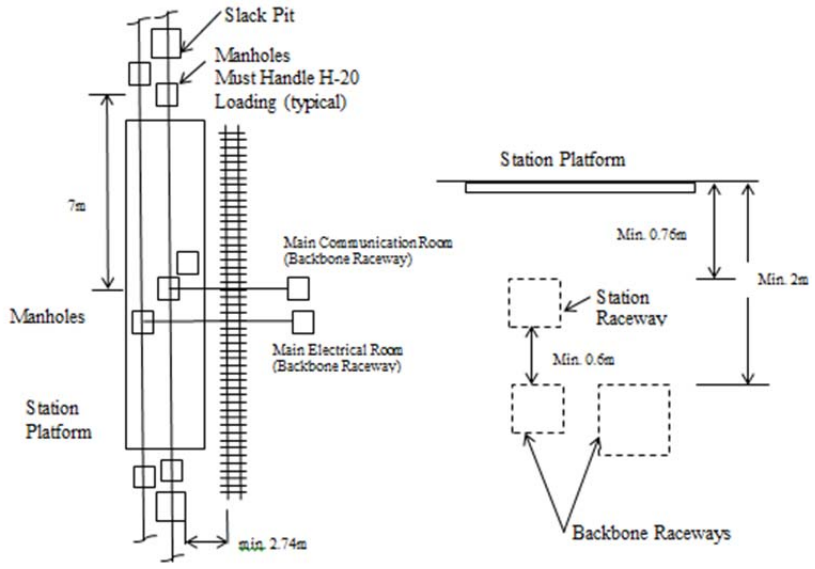


Figure 4: Cable Depth at Station Platform

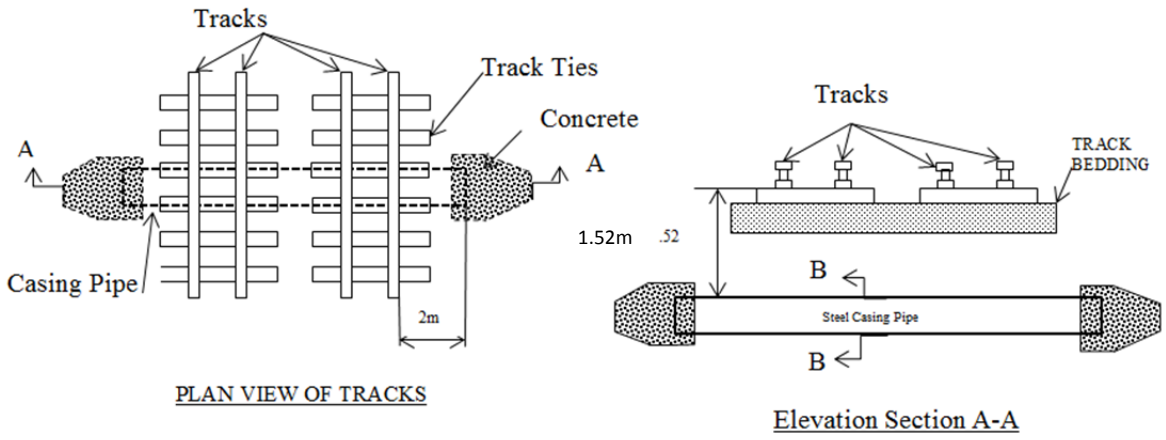


Figure 5: Cable Crossing Under Rail Tracks

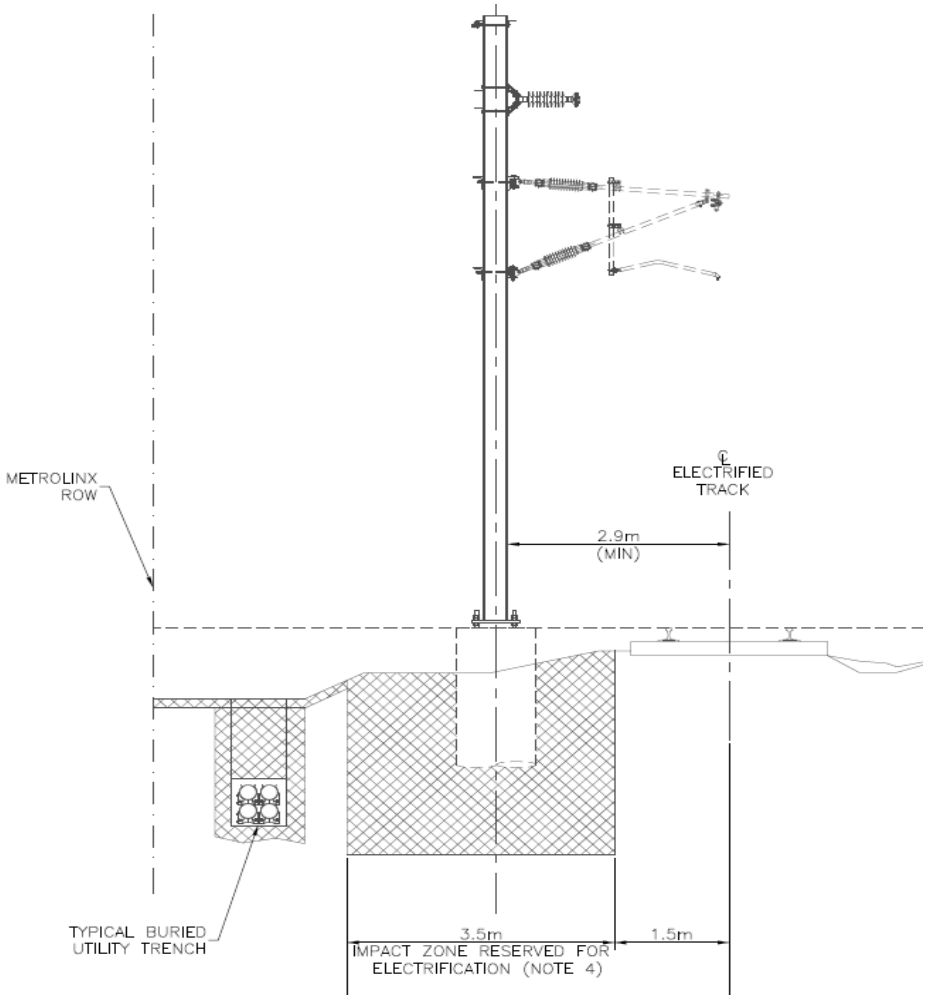


Figure 6: Typical OCS Pole

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