

GO Design Requirements Manual

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METROLINX
An agency of the Government of Ontario

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Superseded

TABLE OF ACRONYMS

Acronym	Definition
AC	Alternating Current
AFF	Above Finished Floor
ANSI	American National Standards Institute
AODA	Accessibility for Ontarians with Disabilities Act
APTA	American Public Transportation Association
AREMA	American Railway Engineering and Maintenance of Way Association
ASHRAE	American Society of Heating, Refrigerating, and Air-Conditioning Engineers
ATR	Above top of rail
ATS	Automatic Transfer Switch
AVL	Automatic Vehicle Location
AVM	Add Value Machine
AWG	American wire gauge
BAS	Building Automation System
CC	Concentrator Complex
CCTV	Closed-circuit television
CEC	Canadian Electrical Code
CGSB	Canadian General Standards Board
CGVD	Canadian Geodetic Vertical Datum
CISPR	The Comité International Spécial des Perturbations Radioélectriques
CN	Canadian National
CNIB	Canadian National Institute for the Blind
CP	Canadian Pacific
CPTED	Crime Prevention Through Environmental Design
CPU	Central processor unit
CQD	Credit Query Device
CRI	Colour Rendering Index
CSA	Canadian Standard Association
CSRS	Canadian Spatial Reference System
CT	Current Transformers
cUL	Canadian Underwriters Laboratories
DC	Direct Current
DGZ	Dedicated Ground Zone
DHW	Domestic Hot Water
DRM	Design Requirements Manual
DTMF	Dual tone multi-frequency
DWA	Designated Waiting Area
EEMAC	Electrical Equipment Manufacturers Association of Canada

EIA	Electronic Industries Alliance
EMT	Electrical Metallic Tubing
EPA	Environmental Protection Agency
ERV	Energy recovery ventilators
ESA	Electrical Safety Authority
EV	Electrical Vehicle
FCC	Federal Communications Commission
FLC	Fuzzy Logic Control
FTA	Federal Transit Administration
GFI	Ground Fault Circuit Interrupters
GTHA	Greater Toronto Hamilton Area
HCR	Handheld Card Reader
HM	Hollow Metal
HOV	High occupancy vehicle
HP	Horse Power
HVAC	Heating, ventilation and air conditioning
IAQ	Indoor Air Quality
IEC	International Electrotechnical Commission
IEEE	The Institute of Electrical and Electronics Engineers
IES	Illuminating Engineering Society
IESNA	Illuminating Engineering Society of North America
IGBT	Insulated Gate Bipolar Transistors
IT	Information Technology
LED	Light-emitting diode
LEED	Leadership in Energy and Environmental Design
LRT	Light Rail Transit
LV	Low voltage
MCC	Motor Control Centres
MIL STD	Military Standard
MOE	Ministry of the Environment
MRL	Machine-Room-Less
MTM	Modified Transverse Mercator
MTO	Ministry of Transportation
NAD	North American Datum
NEMA	National Electrical Manufacturer Association
NFPA	National Fire Protection Association
NPT	National Pipe Thread
NRC	National Research Council
OBC	Ontario Building Code
OESC	Ontario Electrical Safety Code
OHSA	Occupational Health and Safety Act
OPSD	Ontario Provincial Standard Drawing

PA	Public Address
PA	Public Address System
PCB Card	Printed circuit board card
PDF	Photometric Digital File
PLC	Programmable Logic Controller
PPUDO	Passenger Pick up and Drop off
PSR	Pre-Start Health and Safety Reviews
PT	Potential Transformers
PTZ	Pan Tilt Zoom
PUC	Public Utilities Commission
PVC	Permanent Virtual Circuit
PWM	Pulse width modulation
RGS	Rigid galvanized steel
ROW	Right of way
RSA	Railway Safety Act
RFI	Radio Frequency Interference
SCADA	Supervisory control and data acquisition
SCC	Station Control Computer
SCR	Silicon Control Rectifiers
SFTP	Station Fare Transaction Processor
SMACNA	Sheet Metal and Air Conditioning Contractors National Association
SOV	Single occupant vehicle
SPD	Surge Protective Devices
SPOS	Station Point of Sale
STC	Sound Transmission Class
TC	Tangent-Curve
TCP/IP	Transmission Control Protocol/Internet Protocol
TSSA	Technical Standards and Safety Authority
TTC	Toronto Transit Commission
TVM	Ticket Vending Machine
TVSS	Transient Voltage Surge Suppression
ULC	Underwriters Laboratories of Canada
UPE	Union Pearson Express
UPS	Uninterruptible Power Systems
USB	Universal Serial Bus
VCP	Visual Comfort Probability
VOC	Volatile Organic Compound
VT	Voltage Transformer
WAP	Wireless Access Points
WC	Water Closet
WMA	Wheeled Mobility Aids

A INTRODUCTION

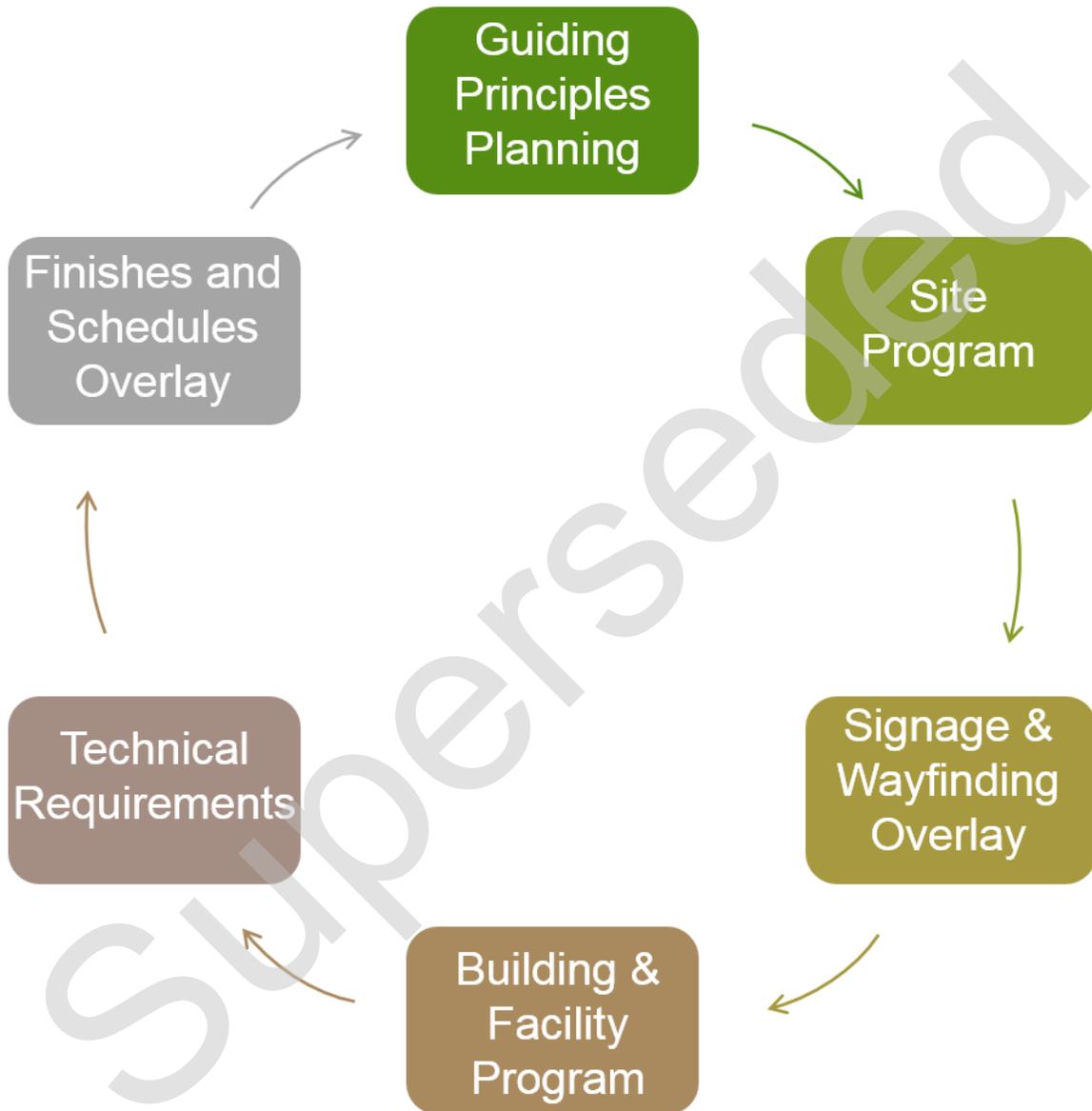


Figure A-1: Document Overview

Overview

GO Transit is an inter-regional public transit system in Southern Ontario who primarily serves the GTHA, with operations extending to several communities in the Greater Golden Horseshoe. GO Transit operates commuter rail and coach bus services that connect with other regional transit providers such as VIA Rail Canada, the Toronto Transit Commission (TTC), and local municipal bus services.

This GO Design Requirements Manual (DRM) is a document that outlines the Guiding Principles and technical details for the infrastructure requirements to design and build GO stations, terminals, and facilities.

This Manual balances and harmonizes corporate objectives, stakeholder requirements, and industry best practice by defining a performance-based set of technical requirements and guidelines used as detailed instructions for designers and users.

Ownership and Location

GO Transit owns this Manual, in both printed and/or digital form, and will keep a record of issuance, and forward amendments to all consultants, designers, and contractors registered with us as Manual Holders.

Manual Holders may reproduce the contents of this DRM for use as required during a project assignment from GO Transit, and is responsible to ensure that the most recent version, and all its requirements, is used at the time the assigned project.

How to use the DRM

The DRM is the starting point of infrastructure design for GO Stations, Terminals, and Facilities.

It is a combination of guidelines and requirements that are performance based and exceed industry regulations and codes.

The DRM does not absolve the designer of record from current regulations and codes or professional duty of care.

Information is in the order of design development, starting with identification of program elements, site planning, to architectural design and wayfinding, and then to technical details such as electrical, mechanical, communications, etc.

Design requirements are performance-based and expected to be used as the starting point for design development. The DRM is part of a suite of products that inform the design.

The suite of products also includes:

- Standard Static Signage Catalogue
- Standard Drawings
- Standard Specifications & Guidelines

Codes and Regulations

It is required that consultants design in accordance with all applicable standards, regulations, and codes to the approval of all authorities having jurisdiction.

Where design alternatives will provide substantially equivalent or where conflicts exist between the requirements of this Manual and standards or legislation enacted by the federal or provincial governments, the most stringent requirements shall apply.

Consultants for specific projects shall define codes as applicable and list them in the contract tender documents.

Other codes and regulations, imperative to the business that must be adhered to include but not limited to:

- Ontarians with Disabilities Act
- Railway Safety Act (RSA)
- Transport Canada Grade Crossing Regulations
- Canadian Road/Railway Grade Crossing Detailed Safety Assessment Field Guide
- Transport Canada RTD-10 Technical Standards Manual; RTD-10 will govern requirements for active warning system
- AREMA (American Railway Engineering and Maintenance of Way Association) Communications and Signals Manual
- Existing Railway Corridors Standard and Specifications for Crossing Warning Systems
- Manual of Uniform Traffic Control Devices for Canada

Document Amendment Record

The Amendment Record identifies revisions, by subject category and date. Consultants, designers, and contractors shall use the Amendment Record to ensure they are working

from the latest version. An e-mail notification is issued whenever a revision/addition has been made to the Design Requirements Manual. The revision/addition is noted on the Amendment Record and immediately posted on our intranet and external website by the Standards team. The Amendment Record can be found in the DRM as Appendix A.

Superseded

B GUIDING PRINCIPLES

B.1 Universal Access

Overview

The GO Design Requirements Manual Guiding Principles underpin the end-to-end design development process.

The Guiding Principles define what is truly important for the success in delivering an EASY customer experience and minimizing operational costs.

They serve as the foundation for the application of technical requirements in existing site conditions.

GO Transit strives to build, for all customers, an effective and fully accessible public commuter rail and bus service.

GO Stations and Terminals are deemed “accessible” when step-free access is provided from, and between, all public areas of a station building to the accessible railcar or bus. GO Transit requires the provision of amenities for customers who use mobility devices; have hearing or sight impairments; are elderly or ill; or travel with children. The needs whether physical, sensory, or cognitive disabilities are to be included at the planning and design stage of projects including renovations and new construction.

Easier Access Design Features

In addition to regulatory accessibility standards and guidelines, GO transit has introduced a series of “Easier Access Features” that exceed regulatory requirements and best practices.

Easier Access Design Features are not limited to the needs of customers with mobility disabilities.

- Sidewalks, bus bays, and bus platforms with curb cuts to accommodate barrier-free access
 - Benches in customer waiting areas
 - Visual (color contrast, photo-luminescent strips) and tactile cues
 - Power door operators and door guards
 - Accessible washrooms
 - Floor grilles compatible with the use of canes and crutches and grating located away from the main pedestrian traffic flow
 - Barrier-free service counters and accessible audio communication systems
 - Increased illumination near customer loading and waiting areas
 - Signage for Station Wayfinding
 - Public Address System
 - Elevators and ramps
 - Elevated Accessible Rail Platform (Mini-Platform)
- Delineated pedestrian crosswalks and pavement markings
 - Designated barrier-free parking spaces and barrier-free loading areas

B.2 Customer Service

The GO customer journey is a series of sections that is identified with an integrated, seamless, harmonized, customer-focused approach with related key brand touch points of interaction in station design.

The mission of GO Transit is to deliver an easy and delightful passenger experience.

The five strategic priorities include:

- Design Excellence
- Delight and eliminate barriers
- Promote seamless travel
- Strong partnerships and offerings
- Communications

It shall be easy in every way for the passenger allowing them to travel stress free and intuitively. Through design, comfort, and amenities, we will make GO the preferred choice for customers. With the customer experience at the forefront of responsive, GO Transit's corporate brand and identity shall be extended throughout the GO Transit System by application of the latest GO logo and colour to all stations consistent with the requirements defined in this Manual.

B.3 Sustainable Design

GO has adopted American Public Transportation Association's (APTA's) framework for approaching transit sustainability with supporting Guiding Principles relevant to GO's infrastructure.

Smart Land Use and Livable Neighbourhoods

- Encourage neighbourhood integration and connectivity and the provision of green amenities
- Reduce heat island effect
- Increase soft landscaping are key drivers

Materials & Construction / Operations Optimization

- Flexibility and longevity
- Green construction practices and materials

- Address easy long term maintenance and adaptability/conversion

Energy and Resource Efficiency

- Lower the energy consumption and carbon footprint
- Operational and maintenance cost savings (i.e. energy harvesting, conservation/recovery and efficiency)

Quality of Ambient Environment and Health

- Provide a comfortable, healthy and safe environment

Emissions and Pollution Control

- Contribute to reduced air emissions and wastewater discharges
- Strategies for waste reduction and water conservation

Corporate Policies

Implement corporate policies that support green operations throughout the life of the facility, such as Green Cleaning, Solid Waste Management, and Green Education, and select LEED credits for certification.

As the industry evolves and new certifications become relevant to GO, they too can be explored, upon approval from Metrolinx.

GO LEED Credits

All buildings, terminals, and facilities are to achieve LEED Gold certification. Specifically, select credits (Appendix B) have been identified to ensure that only LEED credits that bring value to GO Transit's goals of energy efficiency and reduced operating and maintenance costs are targeted.

B.4 Integrated Design

The holistic and integrated design of stations shall enhance the customer experience by providing a consistent experience across the GO Transit System that is dependable, smart, caring, and responsive.

Planning for integrated design requires identified station components of a typical GO Station

- Defined interrelationships between the component
- Functional requirements
- Customer amenities and furnishings
- Signage and wayfinding

GO Design Excellence Guidelines define architectural and landscape intent to produce more consistency in quality, look and feel, and identifiable signature architectural elements.

Further details on the evaluation and review process are available with your Metrolinx Delivery Team.

GO Design Excellence

Design excellence refers to the successful interplay between FUNCTIONALITY, DURABILITY, BEAUTY, and VALUE.

Superseded

C WAYFINDING AND SIGNAGE

Overview

There is a hierarchy to GO communications, which provides direction for all GO signage, to ensure brand consistency and proper execution throughout the customer journey.

There are four defined “Zones” of Communication that a customer experiences.

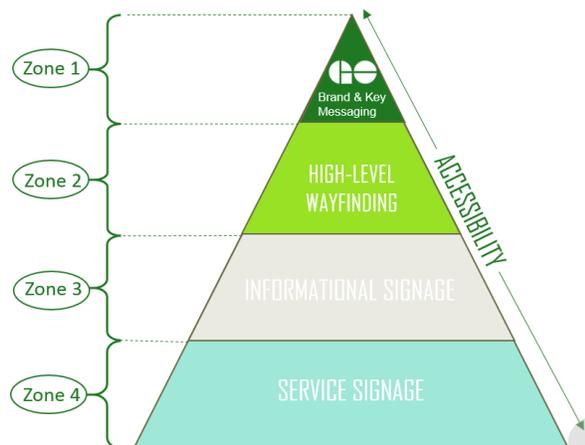


Figure C-1: Communication Hierarchy Zones

These types of communication occur within, and increase with frequency, as a customer progresses through GO Transit's fourteen Customer Journey Sections as illustrated and noted to the right.

Four Key High Level Principals Regarding Zone Communication Types:

Brand and Key Messaging

Locating Brand and Key Messaging takes precedent. The established GO Brand Guidelines must be adhered to so that consistency across the GO system is created and maintained. The consultant must implement the established Station ID and Signage Standards to provide consistency across the system.

High-Level Wayfinding

High-Level Wayfinding Signage must be clear, easy to comprehend from a distance, and in alignment with GO Brand Guidelines and established GO Static Signage Standards.

Informational Signage

Informational Signage must be grouped in central locations within station exterior and interiors, indicating an understanding of site specific customer paths of travel to ensure messages are communicated clear, consistent and consolidated manner so that over-signing and unnecessary visual clutter is avoided. Third-Party Advertising must be suitably located and if possible integrated within the overall consolidated signage group.

Service and Regulatory Signage

Reduce and consolidate Service and Regulatory Signage to eliminate repetition and reduce visual clutter. Place notices in the proper location, and for safety, doorways should be kept clear of unnecessary signage.

GO Customer Journey Sections

- | | |
|-----------------------|--------------------|
| 1. Property Entrance | 8. Teamways |
| 2. Parking | 9. Train Platforms |
| 3. Station Exterior | 10. Bus Platforms |
| 4. Station Interior | 11. Train Exterior |
| 5. Service GO | 12. Train Exterior |
| 6. Information Boards | 13. Bus Exterior |
| 7. Tunnels / Bridges | 14. Bus Interior |

The **five criteria** informing the design and placement within the Customer Journey are:

Experience—GO customer experience shall be easy and efficient.

Consistency—In alignment with GO Brand Standards, Design Requirements Manual and Static Signage Catalogue.

Location—Placed in ideal location in Customer Journey to best serve customers

Scale— Signage is clear and legible

Quantity—Do not over sign, and seek potential efficiencies to achieve same message

The consultant must reference and implement established GO Static Signage Standards where applicable and adhere to the dimensional and technical information regarding their fabrication and installation located within the Design Requirements Manual and GO Static Signage Catalogue.

The GO Passenger Charter will be given a prominent location in Station Interior adjacent waiting areas and onboard vehicles to emphasize its importance. It may not be located on the exterior of station buildings.

Digital Signage is discouraged from being placed within tunnels and bridges to prevent congestion in customer paths of travel. For Digital Signage content please refer the relevant Design Requirements Manual section.

Physical Information and Service Messages are prohibited from being placed on the glass partitions of Service GO Message Centres.

The supporting GO Communications Hierarchy Ideal State Renderings located in the Design Requirements Manual do not capture all site and station conditions. It is understood that signage design and placement may need to be adapted to suit specific site and station conditions to ensure wayfinding legibility and clear, consolidated information and service messaging.

In all instances regarding location, placement and housing, considerations of safety and accessibility should take precedent.

Figure C-2: Property Entrances-Ideal State

PARKING: IDEAL STATE



Figure C-3: Parking-Ideal State

STATION INTERIOR: IDEAL STATE



Figure C-4: Station Interior-Ideal State

TRAIN PLATFORM: IDEAL STATE



Figure C-5: Train Platform-Ideal State

PROPERTY ENTRANCES: IDEAL STATE



BUS PLATFORM: IDEAL STATE**Figure C-6: Bus Platform-Ideal State**

The GO overall wayfinding and signage program requirements and guidelines are the tools that we provide to our customers, which enable them to navigate easily throughout a GO site.

The key principles of the overall wayfinding and signage guidelines are:

- To provide a philosophical guide on “what” are our expectations for developing a comprehensive wayfinding and signage program including trailblazing during the design of a GO site, station, and facility
- To address typical signage, methodology, application and placement and installation including signage that is temporary in nature

It is intended that all wayfinding and signage plans be developed with these basic principles, incorporate appropriate corporate colours and contrast, defined French Language treatment, minimize the use of text, and increase the use of icons

C.1 Wayfinding

The Wayfinding Signage program shall be designed to aid the customer to navigate the site with ease while addressing the functionality in these spaces. Key services and amenities located within a site shall be identified within the wayfinding program. It shall be well thought out, easy to use, aid in self-orientation and to enable a seamless trip journey by creating an inclusive, excellent customer experience for all types of users.

Early application of wayfinding design, comprising of elements for Information, Confirmation, and Identification for planning the customer journey and an understanding of the needs of various user groups, provide the framework for an effective wayfinding system.

Considerations include at a minimum, the positioning of entrances and exits, the use of colour contrasting, pattern direction on floors or walls, tactile markings, the arrangement of architectural features such as walls or columns, acoustics, and lighting to help direct people to their intended destination.

A consistent appearance or theme shall be presented throughout the facility. Signage for entrances and directions shall be clear and kept at appropriate driver’s eye levels.

Coordinate with related disciplines, e.g., Architectural, Structural, Electrical, etc., for placement of signage requirements (i.e., locations).

Provide power, communication, feeder, and conduit to facilitate the installation of dynamic and/or back/top lit signage.

Directional signs shall always be located at decision points.

Where possible, signs shall be located perpendicular, not parallel, to the visitor’s line of sight and movement.

At facilities with multiple lots, where one or more parking areas may not all be connected to the accessible route, trailblazing is required at the local street level to provide direction to the proper lot.

C.2 Signage

There are two main types of mediums for signage typically used at GO stations, terminals, facilities etc.:

- Static Signage
- Digital Signage

Static and digital signage within the GO system serves four (4) primary functions:

- Identify–Site and entrance
- Direct–Vehicular and pedestrian movements
- Inform–Maps etc.

- Regulate—Governing bodies

Detailed information on sign templates and design files are located in the GO Static Signage Standards.

Digital Signage uses digital media for display of information such as schedule/service information, GO Marketing, Third Party Advertising, and other customer service amenities.



Refer the Fixtures and Furnishings section of the DRM for details on Digital Signage.

Program signage that is designed to be read in close proximity at standard reading height, such as a washroom sign, shall also include braille.

Supergraphics shall be used as a secondary means of signage, where the space is ample and the destination and corresponding supergraphics can be seen from far away.

Signage design, placement and layout shall take into account the varying mobility and cognitive skills of potential customers.

C.3 Placement and Installation

Safety clearances shall be observed at all times.

Support and mounting structure shall be designed as an integrated part of the architecture: recessed in walls, or part of a self-service kiosk organization.

Signage shall be strategically located and grouped with other information/ advertising, consistently placed where customers could have clear visibility and access to this information.

Stations and Tunnels

Typically wall mounted or mounted on customized bracketing and hardware, or adhesive tapes/backing film

Rail and Bus Platforms

Utilize structures and supports. Where a stand-alone support is required, driven U-Channel posts are typical.

Parking lots and access lanes

Banding to light stands, where possible or driven U-Channel post and related brackets and hardware

Installation at GO facilities is typically accomplished through use of the following methods:

- Bolted to driver Post (U-Channel, PT 4" x 4" or 6" x 6" wooden post, galvanized solid and perforated 2" x 2" square steel and 3" round poles
- Banding and brackets
- Pressure-sensitive adhesive tapes and backing films
- Exclusive use of high quality non-staining fasteners (typically, stainless steel)
- Avoid plastic ZIP tabs fasteners except for temporary construction signs
- Avoid mounting signs on posts/poles that house CCTV Cameras
- Wall-mounted signs are facilitated by stainless steel screws in either drilled and tapped or anchor plugged holes, or with double-sided pressure sensitive adhesive tapes
- Fence-mounted signs use fence blocks or signs are mounted back-to-back with appropriate sized nut bolts and washers
- Use double side pressure sensitive adhesive tapes for signs mounted to a structure's glazing or on doors
- Decals applied to structural glazing and doors will use pressure sensitive adhesive backing films with blockout film so message is seen from appropriate direction only.

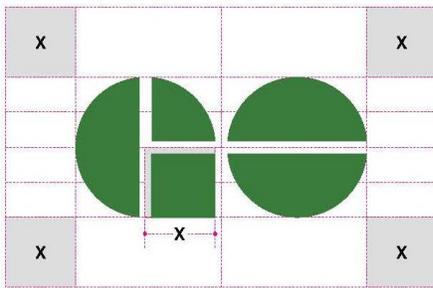


GO Logo and Station Name

The GO logo is five individual elements with a negative space.

The negative space shall be open, showing the background material making the "T"

Two shapes for the GO logo are not permitted.



Typical Signage Layout Grid, Clearance zone

Figure C-7: GO Logo

Permitted colors = Pantone 364C or Black

- Any material variation to integrate with building massing to be approved by GO Transit
- The GO Logo shall be used sparingly, and not applied to every façade of a building
- The GO Logo and/or Station Name are typically not to be placed on bridges (pedestrian, rail, vehicular, etc.) or on elevator overrun shafts
- GO Logo and Station Name shall ideally be mounted on a solid background
- Recommended materials:
 - UV stabilized Polycarbonate
 - Flex face for larger, high mounted items (mounted at least 3m above grade)
 - Backlit signs to be illuminated with LED targeting white 6500 to 7,000K colour temperature
 - Illuminated sign may not be placed on a building or structure facing rail traffic

GO logo on Station Buildings and Structures

Table C-1: GO Logo Station and Building ID

Location	Application	Placement Guidelines
<p>On Station Building Façade</p>	<p>Station name + GO logo</p> 	<ul style="list-style-type: none"> • Illumination of both station name and logo made on case by case basis • Title case for letters (capital first letter, lower case on balance for each word) • “GO logo” and “name” positioned together, with Station name first. Station name is 2/3 height of GO Logo. • Flat plane applications preferable (no substantial curved surfaces) • Align station name and logo at bottom
<p>On Parking Structures</p>	<p>GO logo only</p>	<ul style="list-style-type: none"> • Illumination of the logo made on case by case basis • Flat plane applications preferable (no substantial curved surfaces) • Station name only in cases where there is no other beacon/identified • In this case, both station name and logo likely to be illuminated

Station Entrance Signage

Table C-2: Station Entrance Signage

Station ID Sign Type	Image	Placement Guidelines	Sign Content
Primary Totem Main Vehicular Entrance		<ul style="list-style-type: none"> To be placed perpendicular to public road Mandatory 1 totem sign at primary municipal address location only Location of the Additional totems are permitted for sites with multiple addresses sign is not to interfere with daylight triangles and sightlines for vehicular traffic 	<ul style="list-style-type: none"> Station Name GO Logo Station Address
Pylon ID Park and Ride/Carpool Lots		<ul style="list-style-type: none"> Located at sites where Primary totem would not be visible in addition to Primary Totem sign To be placed to maximize distance viewing 	<ul style="list-style-type: none"> Station Name GO Logo
Secondary Vehicular ("Blade") Secondary vehicular entrances		<ul style="list-style-type: none"> To be located at remote parking lot vehicular entrances Perpendicular to public road Location of the sign is not to interfere with daylight triangles and sightlines for vehicular traffic 	<ul style="list-style-type: none"> Station Name GO Logo GO parking Icon Remote Parking Lot Name Identifier

Facility ID Signs

Table C-3: Facility ID Signs

Facility ID Sign Type & Purpose	Image	Placement Guidelines	Sign Content Order
Main ID Sign Main Vehicular Entrance		<ul style="list-style-type: none"> • Perpendicular to the direction of travel • Location of the sign is not to interfere with daylight triangles and sightlines for vehicular traffic 	<ul style="list-style-type: none"> • GO logo • Facility name • Facility type • Address
Gate ID Sign Wayfinding Sign at Entrance		<ul style="list-style-type: none"> • Perpendicular to the direction of travel • Consideration to be given to the view for exiting or incoming vehicles not to be obstructed • Note: Signs within the property do not require the GO logo and facility name 	<ul style="list-style-type: none"> • GO logo • Location and facility name • Gate number • Directions

D SITE PROGRAM

SITE COMPONENTS



Accessible Route – Promoting universal access for all including barrier free access, hearing impairments, and visual impairments.



Rail Platform and Platform Access – Direct access, ramps, stairs, tunnels, elevators



Pedestrian Connections -Allow pedestrians safe access to components of the site



Bus Loop - Convenient intermodal transit transfer points



Kiss n' Ride - Convenient intermodal transit transfer points



Bicycle Infrastructure - Dedicated system with conveniently located bike storage



Vehicular Access - Efficient, safe, and integrated roadways with the surrounding community



Parking - Distributed lots or parking structure to manage vehicle volumes and flow



Station Building/Bus Terminal - Focal point for customer care and site navigation



Ancillary Structures - Discreet operational support spaces



Civil Works and Landscaping - Sustainable site features that resonate with local environment

Figure D-1: Site Components

D.1 Site Planning and Organization

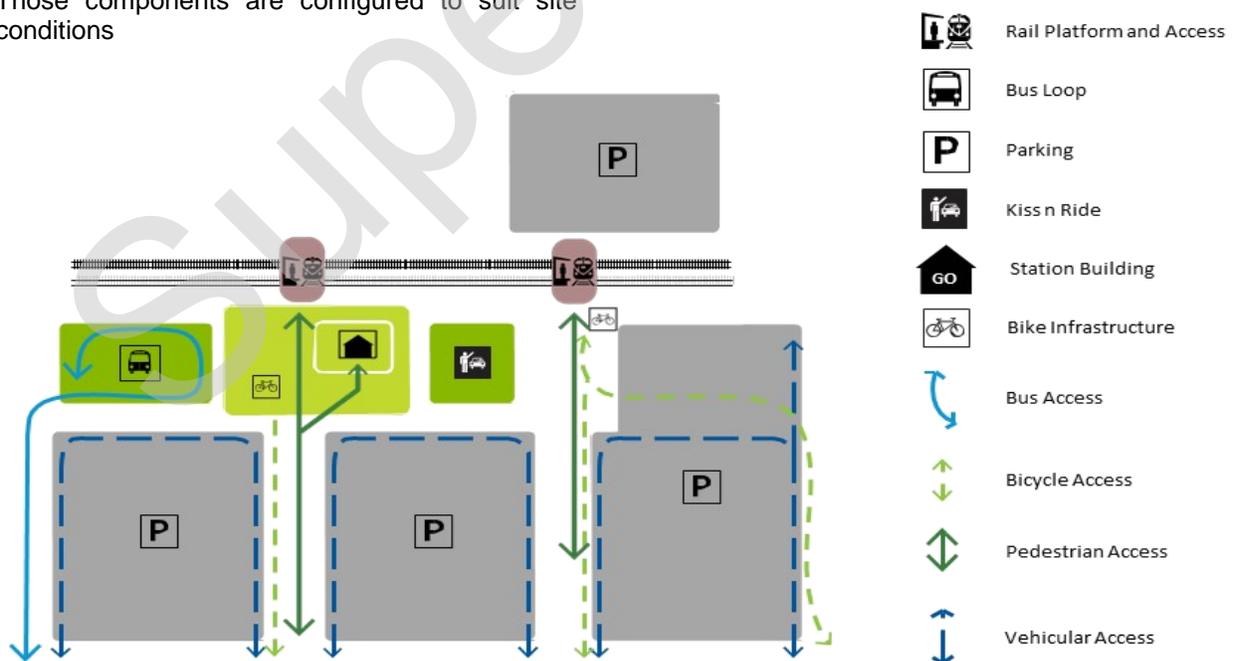
Station site planning consists of a system of components that support the GO transit service.

Key principles in planning and organizing GO sites include:

- Separate modes of travel
- Connectivity to community pathways, walkways and transit
- Plan for future/flexibility
- Intuitive wayfinding to major elements
- Maximization of barrier free routes
- Network and pedestrian pathways
- Use of sustainable materials and technologies
- Integration with local communities and municipalities

Site Components and Typical Schematic Layout

Each station site consists of a system of components that support the GO transit service. Those components are configured to suit site conditions



FigureD-2: Diagram–Station Site Components

Accessible Route

The accessible route is defined as a continuous unobstructed external and internal path connecting all accessible elements and spaces to enable personal barrier free mobility.

At GO facilities, the accessible route is identified as the travel path to/from/between the barrier free parking or drop off area, to the rail mini platform / bus platform.

Redundant Access

Provide a secondary barrier-free means of access/egress from the rail platform to the station building or pick-up area.

All island platforms shall be equipped with two elevators connecting to an underground pedestrian tunnel or an overhead pedestrian bridge.

- Side platforms shall have various direct access points where covered ramps are the preferred means of egress

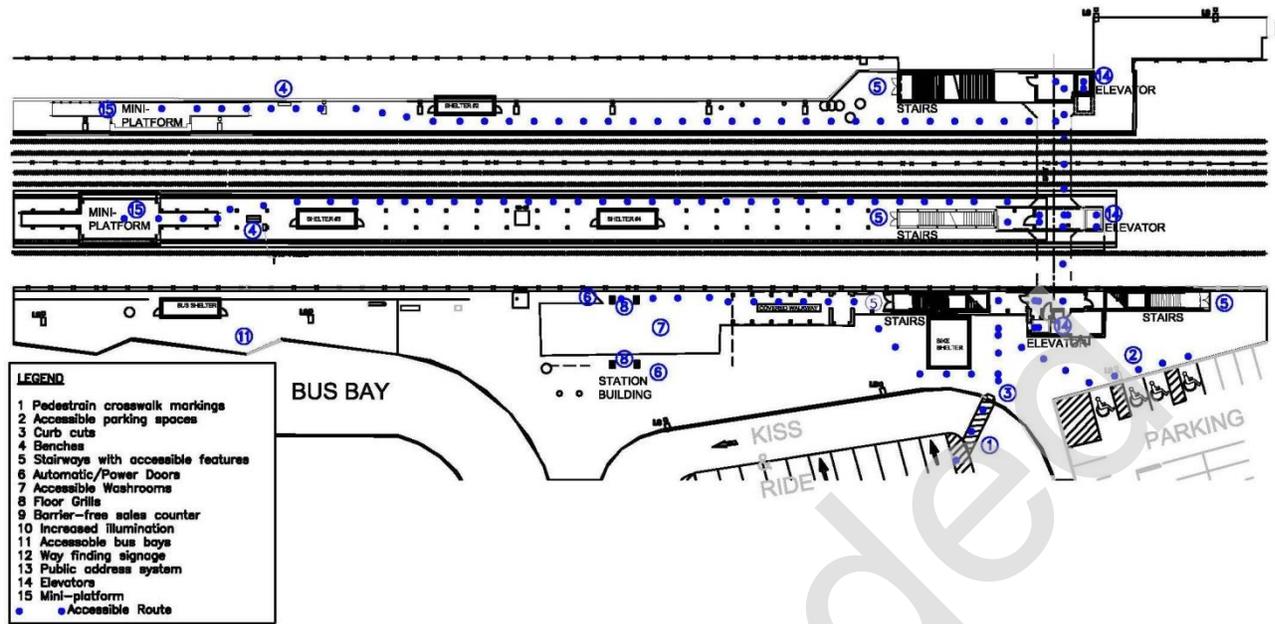


Figure D-3: Diagram-Accessible Route

Mini-Platform

Barrier-free access to the trains is provided by an accessible elevated “mini-platform” which is aligned with the designated accessible rail car. Refer to Standard Drawings for mini-platform details.

Designated Waiting Area (DWA)

The Designated Waiting Area (DWA) at GO stations is to be located on the rail mini-platform.

It is intended to be a convenience feature, whereby a customer can expect to avail assistance and have a reasonable sense of safety.

The DWA has augmented functionality and visibility at the station mini-platform. Key features include:

- Enhanced lighting
- Dedicated CCTV coverage
- DWA ID signs
- Two-way communications (telephone)
- PA system
- Overhead cover (canopy)

- Bench seating on rail platform in the proximity of the DWA
- Enhanced accessibility features in the mini-platform design
- Wayfinding signs on the accessible route
- Station ID sign
- Minimum horizontal and vertical clearances as mandated by functionality; and advanced warning identifiers

D.2 Rail Platform and Platform Access

Refer to respective GO rail standards for track infrastructure standards.

Rail platforms are a foundational item to GO rail stations. Their orientation, design, alignment, geometry, and site conditions are the framework around all other site components are configured.

- The use of side platforms are preferred
- Island platforms to allow for multiple points of access and egress
- Locate the platforms to minimize travel distances to adjacent transit modes
- Maximize barrier-free travel

- Where there are reduced width locations, include warning pavement markings and signage (refer the GO Static Signage Catalogue for “No Standing” and “Reduced Platform Clearance” signage requirements)

When locating and orienting the mini platform the steps outlined below shall be followed:

Step 1—Orient mini platform, with an understanding of train consist orientation and operation

Step 2—Locate mini platform and rail platform dimension, dependent on island vs. side platform configuration in accordance with criteria and specifications and subsequent tables.

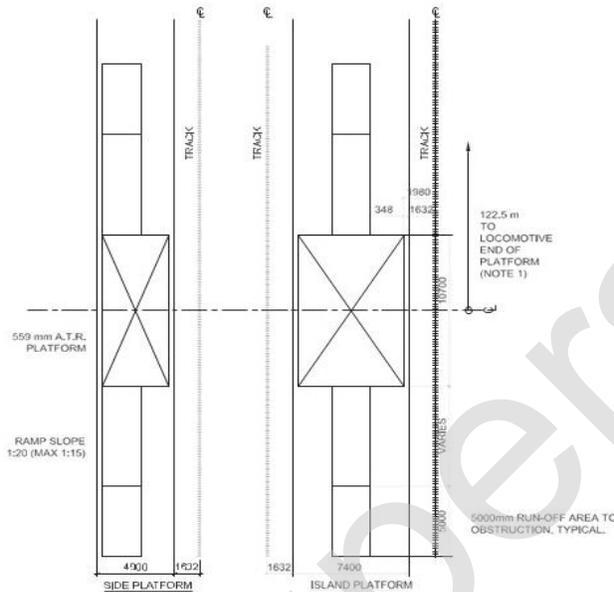


Figure D-3: Typical Configuration of Mini Platforms

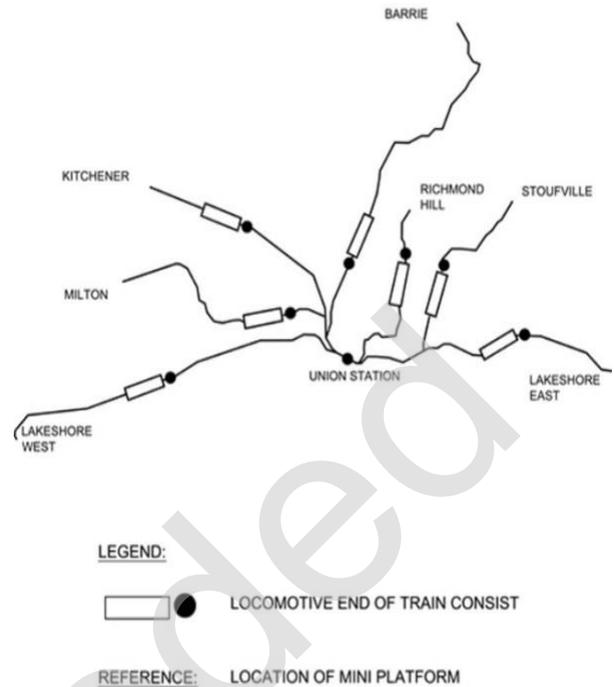


Figure D-4: Typical Orientation of Locomotive end to locate Mini Platforms

Rail Platform

These criteria are based on CN Rail data, applicable also to CP Rail, for preliminary design. Detail design shall be reviewed by the appropriate railway authority and GO Transit, at which time some dimensions may be defined more precisely

Table D-1: Rail Platform Design Criteria

Rail Platform Design Criteria	Specifications
Track centres, centre line to centre line, new station facilities only	4.27 m
Centre line of track to edge of platform	1.632 m
Width of island platform	7.4 m
Width of side platform	3.6 m–4.9 m
Length of platform	315 m
Centre line to centre line of tracks serving island platform	10.668 m
Passenger and Freight Operations, maximum height of platform A.T.R.	0.127 m
Exclusive GO Transit tracks, maximum height of platform A.T.R.	0.25 m
Passenger circulation zone, edge of platform-to-platform structures (shelters/stair enclosures, etc.)	2.44 m
Maximum height of mini-platform A.T.R.	0.559 m
Yellow Tactile attention indicators Tile at Platform Edge	0.61 m
SLOPES	
Island platform cross	2% maximum
Side platforms	Drain away from the tracks
Where platforms slope longitudinally: <ul style="list-style-type: none"> • Tracks, elevator floor, stair enclosure and shelter buildings shall be raised • Transitionally adjusted at door locations to prevent water entry 	1% maximum
CLEARANCES	
Minimum horizontal (from track CL)	2.546 m
Minimum vertical clearance (A.T.R)–end of line, terminus, low speeds	6.7 m
Lateral clearance from centre line of track to mini-platforms	1.98 m
Lateral clearance to major and elevated platform structures, centre line of track to canopies, roof overhangs, etc.	3.35 m
Tunnel (pedestrian underpass) clearance, top of tunnel roof membrane overlay to underside of rail, minimum approximately	0.8 m
 Additional pavement markings and signage are required for reduced platform clearances (Refer Static Signage Manual)	

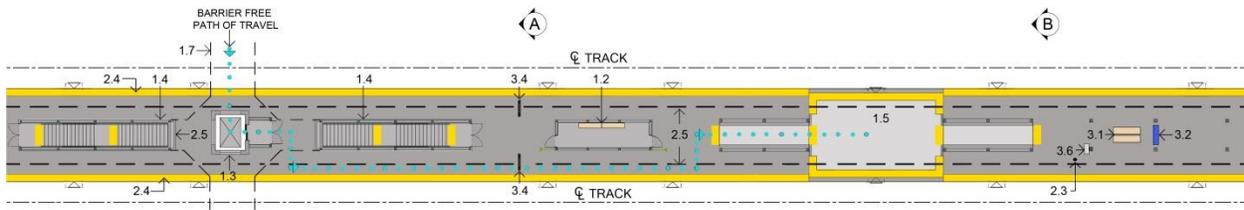


Figure D-5: Typical Rail Platform Configuration

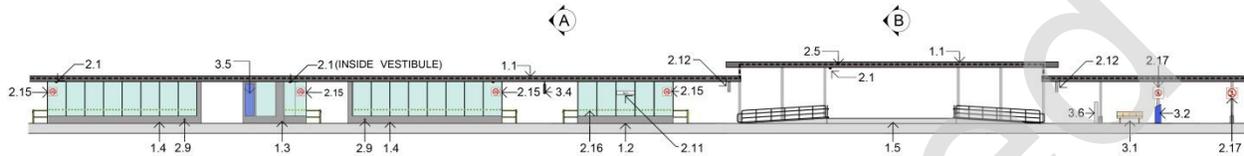


Figure D-6: Typical Rail Platform Elevation

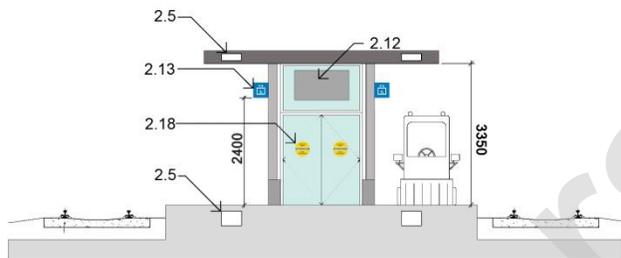


Figure D-7: Section A

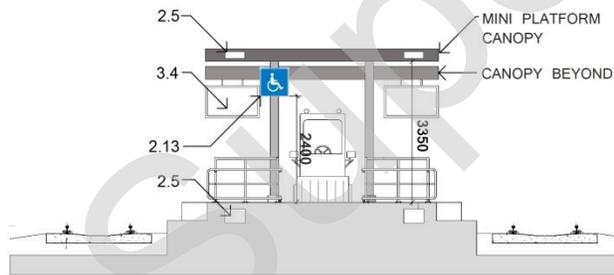


Figure D-8: Section B

LEGEND

- | | | |
|---------------------------------|---|-------------------------------|
| 1.1 Continuous Platform Canopy | 2.1 CCTV | 3.1 Platform Bench / Seating |
| 1.2 Integrated Platform Shelter | 2.2 PA (not shown) | 3.2 Waste Containers |
| 1.3 Elevator and Vestibule | 2.3 Snowmelt System w/ Platform Sensors | 3.3 Information Board |
| 1.4 Stair Access and Vestibule | 2.4 Detectible Platform Edge Tile | 3.4 Platform Digital Monitors |
| 1.5 Mini Platform | | 3.5 Advertising (TBD) |

1.6 Platform Lighting (not shown)	2.5 Platform/Canopy/Vertical Raceway	3.6 Two Way Communication Devices
1.7 Tunnels	2.6 Corridor Raceways (TBD)	3.7 Wi-Fi (not shown)
1.8 At Grade Pedestrian Crossings (not shown)	2.7 Drainage (not shown)	
1.9 Pedestrian Bridges (not shown)	2.8 IT Node/Cluster Infrastructure (not shown)	
1.10 Poles (PA and CCTV-not shown)	2.9 Hose Bib	
1.11 Ramps (not shown)	2.10 Fencing (Not Shown)	
	2.11 Platform Sign ID	
	2.12 Directional / Way finding Signs	
	2.13 Accessibility Signage	
	2.14 Amenity Signage	
	2.15 Regulatory Signage	
	2.16 Safety Signage	
	2.17 Warning Signage	
	2.18 Operational Signs	

Rail Platform Canopies

Canopies on all rail platforms with integrated shelters and accesses such as elevator and stair enclosures and related amenities shall be provided.

The canopy shall be continuous and should extend to provide maximum coverage (at least 85% of platform cover) over the rail platforms.

Canopies to contain two (2) separate raceways along the full length - one for data, the other for power.

Height max. 3350 mm from t/o platform to u/s canopy.

Min. 400mm high concrete pier at each support column.

Integrate canopy lighting and other fixtures and amenities such as CCTV, digital signage etc in the canopy ceiling structure.

Rail Platform Access— Tunnels/Ramps/Stairs

Provide a network of barrier-free pedestrian pathways that connects all of the station components to facilitate easy intermodal transit connections.

Connect the station site with adjacent communities via sidewalks, local pathways, or

bridges to maximize the pedestrian access to the site and minimize walking distances.

Provide direct pedestrian paths, continuous from the closest local road to at least two of the barrier-free platform access points.

When side platforms are used, provide direct walk on platform paths to maximize access to each platform.

At least one barrier-free rail platform access must be as close as possible to the mini-platform.

Connect one of the rail access tunnels with the station building to provide additional convenience and customer service.

Consider whether the tunnels or bridges connecting to the platforms can also act as barrier-free community connection points on either side of the tracks. If so, ensure each community connection point can remain open when the station needs to be closed.

Platform access shall be visually discernible from site access points to encourage intuitive site navigation to the rail platform.

Provide redundant means of barrier-free access to island platforms by means of two elevators.

This section covers platform access structures including but not limited to:

- Pedestrian Tunnels
- Stairs and Stair enclosures

- Ramps
- Elevators
- Bridges and Pedestrian Overpasses
- At Grade Pedestrian Crossings

Pedestrian Tunnels

- Platform access pedestrian tunnels must be linked to the station building or remotely located, as determined by site layout
- Location of conduit, including location of raceways and crossovers must be coordinated
- For wall cladding, final panel to wall attachment details & dimensions to be coordinated and verified with porcelain panel fabricator
- Vertical chases for conduit to be cast-in-place in tunnel transitions to stairways and elevators to be provided
- Conduit shall be designed within floor of the tunnel or in dedicated duct bank

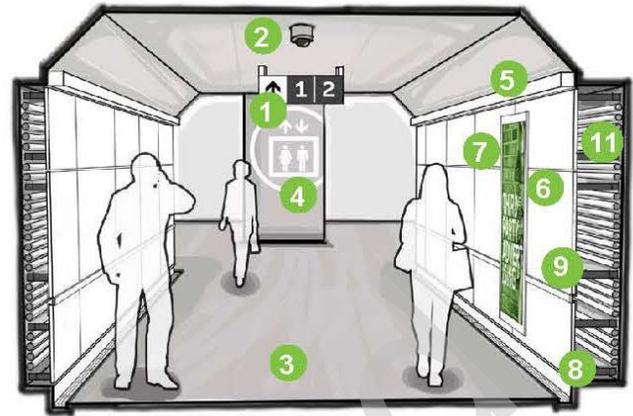


Figure D-9: Pedestrian Tunnels Design Elements

Legend

1. Wayfinding signage
2. CCTV ceiling mount
3. Smooth finish concrete floor
4. Supergraphics applied to elevator shaft wall
5. Concealed continuous LED light fixture in aluminum valance, with down (70%)- and up (30%)-lights on both sides
6. Porcelain removable panels (hinged access preferred) at pull box locations for maintenance access
7. Digital advertising box (Note: Consultant to coordinate mounting details with porcelain panel supplier)
8. Metal grate over gutter secured to floor with removable retaining clips
9. Photoluminescent emergency egress strip mounted on metal trim at porcelain panel joint line, Installed to be flush with porcelain panel
10. Full-height cast-in-place conduit raceway with appropriate crossovers

Pedestrian Tunnel Design Criteria

Table D-2: Tunnel Design Criteria

Criteria	Specifications
Height	<ul style="list-style-type: none"> • Compatible with CCTV requirements • Overhead signs shall not obscure the field view of CCTV • Min. height shall be 2.7 m inclusive of concrete floor topping
Width	3.66 m under the tracks
Slope	Min: 0.30% for drainage
Conduits	Located behind porcelain panels
Drainage	<ul style="list-style-type: none"> • Side-gutters 40 mm deep by 80 mm wide • NOT to be located at the bottom of stairs or in front of service doors or

	elevator doors <ul style="list-style-type: none"> • Provide pump rooms with pits
Construction	Concrete construction in accordance with railway requirements and structural site needs
Raceways	<ul style="list-style-type: none"> • Integrated into walls and floors • Located behind porcelain panels
Clearance	From top to base of rail min of 0.508 m
Corners	<ul style="list-style-type: none"> • 45° angled (300 mm x 300 mm minimum corner cuts at 45 degrees) • Convex mirror units at internal 90° corners and angled wall corners at directional changes
Photoluminescent Strips	<ul style="list-style-type: none"> • Tunnel walls (both sides) • Surface mounted • Integrated within wall panel system • Installed continuously along entire length of tunnel transitioning in a continuous manner to all stairwells
Digital Signs	Installed at tunnel entrances (in accordance with overall digital sign placement requirements)
3rd Party Advertising	Advertising signs integrated within wall paneling system
Vertical Clearance	800 mm top of tunnel roof membrane overlay to underside of rail (This is based on 300 mm sub-ballast, 300 mm ballast to bottom of ties and 178 mm ties)
Wall and Floor	Walls: Porcelain wall system, Floor: Smooth finish, no advertising to be placed on floor of tunnels

Ramps

Where there is an opportunity to provide direct access, or ramped access, as an alternative to stairs, ramps shall be explored.

Provide pedestrian ramps with access from grade to side platforms. Adverse weather can cause slippery conditions on exterior ramps; based on the infrastructure availability at the location, heat the pedestrian ramp surface or cover the ramp.

The colour and tonal contrasting requirements of ramp elements shall all be designed and provided in accordance with the current Ontario Building Code and industry standards on accessibility. Ramps shall have a 100 mm painted line-marking indicator at the start and finish of a ramp slope. Design vehicular ramps with excessive slopes with a snow melting system.

Rail Platform Stairs and Enclosures

Stair systems not only provide a means of access and egress to and from rail platforms, but also provide means of vertical travel for many people with disabilities, children, seniors, parents with strollers etc.

Stairs shall be/have:

- Easy to find
- Clearly identified with wayfinding
- Located near the major circulations routes
- Offset from the direct route of travel so that they are not a hazard
- Uniform riser heights and tread depths
- Nosings, handrails, landings, etc. and all other regulatory and barrier free requirements

Stairs shall be clearly marked, located near the major circulations routes and offset from the direct route of travel so that they are not a hazard

and easy to find. Stairs shall have uniform riser heights and tread depths with nosings, handrails, landings, etc.

Rail Platform Stair Design Requirements

Table D-3: Rail Platform Stair Design Requirements

Criteria	Specifications
Walls	Fully glazed, clear, fully-tempered, designed for local wind loads, and high speed train turbulence
Photoluminescent Strips on Walls	<ul style="list-style-type: none"> • Surface mounted at 300 mm above stair nosing's and landings • Installed continuously along entire length of stairwell wall transitioning in a continuous manner at tunnel level
Stairwell Openings	Extended across tunnels for day-lighting and to reduce the apparent tunnel lengths
Handrails	<ul style="list-style-type: none"> • Stair centre handrails shall terminate at landings to permit crossover. • Material, anchorage and fittings = stainless steel or rust resistant finish
Stair Enclosures	Stair enclosures can be stand alone or combined with elevator enclosures, where applicable
Floor Elevation	Floor elevation to be set to provide positive slope from the doors to the platform
Tactile Attention Indicators	<ul style="list-style-type: none"> • At each landing, extended full width of the stair • Depth of 610 mm (24 in) commencing one tread depth from the edge • Color and texture contrasted with the adjacent surfaces
Floor	Concrete floor, broom finished, sealed
Wall Base	<ul style="list-style-type: none"> • Concrete wall base, to be sandblasted finish, and sealed, no paint • Base shall be 600 mm high (minimum) above the rail platform • Top of the base shall slope on the exterior as a sill, away from the glazing
Enclosure Structure	<ul style="list-style-type: none"> • Fully glazed enclosures with stainless steel framing system • Frameless with silicone butt-joint glazing, with top and bottom stainless steel glazing channels • Contained within the building envelope • All exposed structural steel framing, including all anchors and fasteners, shall be non-corrosive • Provide appropriate protective coatings or cover plates as required
Cladding	Designed to minimum 1.0 kPa Reference Wind Pressure, with appropriate gust factor and wind pressure coefficients applied to the railway platform.
Guardrails	<ul style="list-style-type: none"> • Stainless steel guardrails shall be provided behind the window walls of

	<p>stair and elevator wells, for safety in the event of glass breakage</p> <ul style="list-style-type: none"> • Height of guardrails: to code minimum above platform level • Space for window washing shall be provided between columns/guardrails and glazing
Conduits and Wiring	<ul style="list-style-type: none"> • Both vertical and horizontal wiring conduits shall be concealed and integrated with the structure

Elevators

The guidelines do not constitute a project specification. Each project shall have its own specification based upon the GO Master Elevator Performance Specification.

Variance requests shall be supported by an explanation of the reason for the deviation and detailed information on the proposed alternative.

Key design objectives for vertical transportation include:

- Highest degree of safety and security
- Functionality for universal accessibility
- Service reliability
- Convenient operations and maintenance
- Non-proprietary tools, equipment, and knowledge



Refer to Elevator Performance Specification for details

Refer to GO Standard Drawings for the Elevator Cab Button configuration

Configuration

- GO Transit Elevators shall be Machine-Room-Less (MRL) Elevator type
- Standby power shall be provided to permit continued operation of the elevator(s)
- All elevators shall be provided with battery powered emergency lighting
- Barrier-free, “flow through” configuration
- Elevator shaft, car enclosure and entrance doors shall be constructed with the maximum amount of glazing

Communications

- All elevators shall have CCTV camera mounted inside elevator cab
- Camera mounted in vestibules and lobbies shall view inside and outside of each elevator at each level where possible

Heating

- Fan forced heater with built-in thermostat
- Heat Pump with hyper heating capability down to -25°C, ducted type and located outside the hoistway

Ventilation or Air Conditioning

- Air conditioning via Heat Pump with low ambient cooling
- All elevators shall be provide with two speed ventilation fans shall be supplied with HVAC systems

Floor Grille

- Constructed from stainless steel and shall be designed for cleanout by one person, unaided

Elevator Numbering Convention

- Elevators north of the tracks shall be assigned numbers first (if not applicable, east side of track shall be first)
- Elevators serving platforms shall be numbered in a sequence following platform numbers being served (i.e. platform one first, followed by subsequent platforms)
- Elevator groups serving a parking structure to be numbered in one sequence

Bridges and Overpasses

Open Overpasses

Open overpasses shall not have solid guards.

Enclosed Overpasses

Enclosed overpasses and stairs shall have windows/skylights, including at the ends. Overpasses connecting platforms shall have unobstructed interior barrier-free routes and turn-around spaces. Corridors shall be free of overhead and protrusion hazards. Stair center handrails shall terminate at landings to permit crossover.

Pedestrian Bridges

Pedestrian bridges over tracks shall be single-span structures with supports beyond the operating right-of-way, to the approval of the Railway. Intermediate supports are not allowed. Pedestrian bridges connecting platforms shall have unobstructed interior barrier-free routes and turn-around spaces. Corridors shall be free from protruding hazards.

Bridges at Public Thoroughfares

Bridges at public thoroughfares may have intermediate supports, subject to the approval of the authority having jurisdiction.

Bridge Structure

Where pedestrian overpasses over the ROW have stairs/elevators down to an island platform, the bridge structure shall be cable-stayed to uphold the bridge in case of derailment.

D.3 Bus Loops

- Bus Loops shall provide separate access for bus, segregated from other vehicular, bicycle and pedestrian traffic
- Decorative Fencing and / or Landscaping is to be used to control pedestrian traffic and limit pedestrian access through the bus loop
- Bus access and egress must allow clearances necessary to accommodate coaches
- Passenger waiting bus platform shall be hard, level materials

- Concrete Curbs to be painted yellow (top and side) along the entire length of the bus loop

Bus Loop Configuration Traffic Flow

The configuration for a bus loop is to be selected based on-site constraints and optimal traffic flow patterns (vehicle, cyclists, local services, and connections). The following guidelines provide standard requirements and details for each of these options. Refer to the Bus Loop Configuration and Traffic Flow figures for examples of each.

- Figure D-10: Linear Configuration–Linear Traffic Flow (Preferred)
- Figure D-11: Island Configuration–Clockwise Traffic Flow
- Figure D-12: Teardrop Configuration–Counter-Clockwise Traffic Flow
- Figure D-13: Bi-Directional Configuration–Clockwise and Clockwise Traffic Flow

Linear Configuration–Linear Traffic Flow (Preferred)

The linear configuration has a platform along the passenger side of the bus loop where passengers have access to the bus. In linear bus loops, buses follow a linear flow of traffic to circulate the loop.

Proceed to Island Configuration (B) if:

- Anticipate significant volume of bus service (both GO and Municipal) as linear loops have limited
- Space for platform expansion and accessibility concerns (lengthy distances) for bus to bus transfers

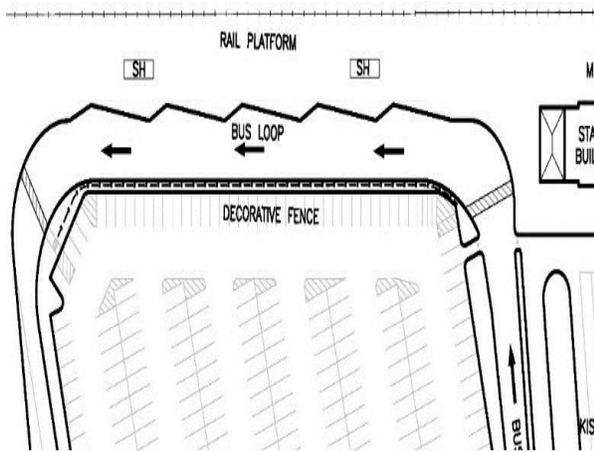


Figure D-10: A. Linear Bus Loop Configuration Linear Traffic Flow

Island Configuration–Clockwise Traffic Flow

- Effective at bus terminals and stations with bus to bus (GO and local transit) transfers
- At stations with limited real estate
- At stations with multiple points of access / egress to municipal roads allowing for controlled and predictable movements within the loop

Proceed to Teardrop (C) Configuration if:

- Anticipate significant level of bus service at location as islands have limited room for platform expansion
- Anticipate safety concerns from clockwise traffic flow and limited access / egress points (bus route crosses at throat of loop and passengers cross loop to access platforms)

Teardrop Configuration–Counter-Clockwise Traffic Flow

- At stations with a high volume of GO Bus service
- At stations anticipating future expansion
- At stations with high bus-to-rail transfers
- Anticipate safety concerns resulting from clockwise flow of traffic (bus routes do not cross at throat of loop and platforms are on perimeter)

- No real estate restrictions
- Proceed to Bi-Directional Configuration (D) if:
- Largest stations or bus terminals with highest volumes of GO and Local bus service

Bi-Directional Configuration–Clockwise and Counter-Clockwise Traffic Flow

- Effective at high volume stations and bus terminals with both GO bus and local bus
- Availability of tunnels to connect pedestrians to island platforms without crossing bus loops
- No real estate restrictions, although this configuration offers an efficient use of real estate

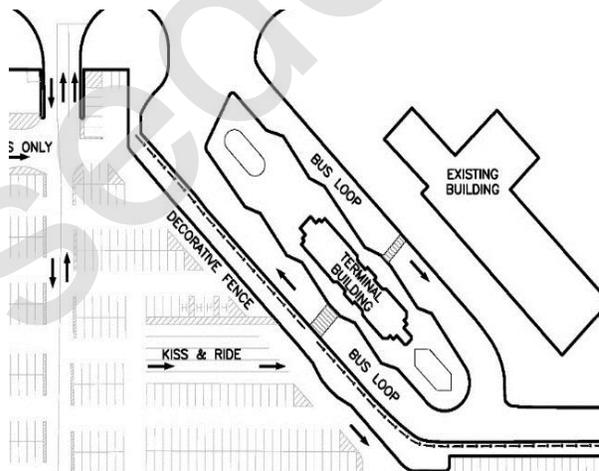


Figure D-11: B. Island Bus Loop Configuration Clockwise Traffic Flow

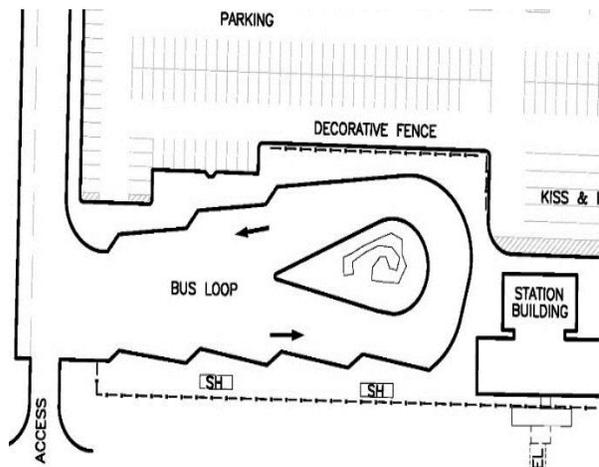


Figure D-12: C. Teardrop Bus Loop Configuration Counter Clockwise Traffic Flow

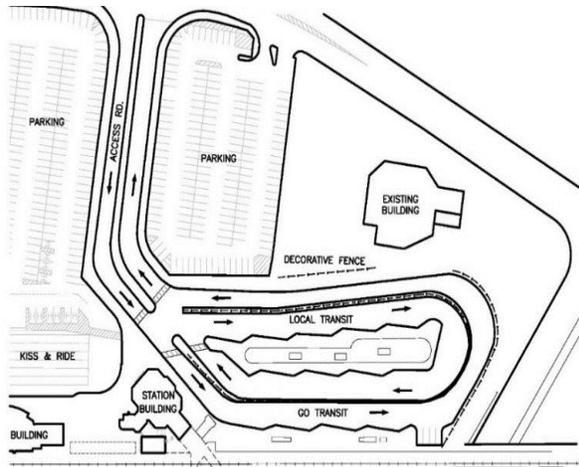


Figure D-13: D. Bi-Directional Bus Loop Configuration and Traffic Flow

- Lateral clearance of 500 mm
- Bus turn does not begin until the rear wheels have reached the Tangent–Curve (TC) point of the inside face of curb or other obstruction

The design bus turning template shall be used where the operating speed of the bus is low, 15 km/h, and sharp short turns can be made without rider discomfort, for the design of surface features such as: Straight and saw-toothed platforms; Bus bay entrances; Bus loops; Entrance roads; and Bus maintenance and storage facilities.

Bus Radii

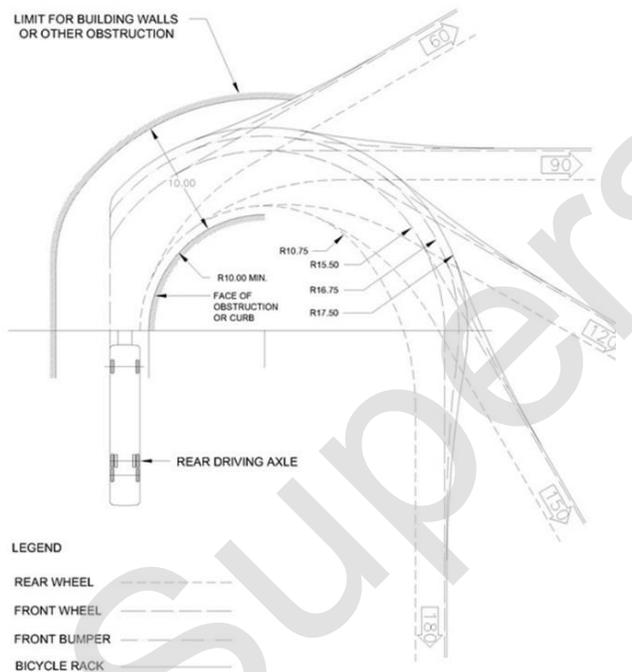


Figure D-14: Bus Radii Turning Template

The following criteria shall be considered when using the turning template guidelines:

- Design Vehicle GO Bus Model MCA D4500
- Bus speed–15 km/h
- Bicycle rack deployed
- Steering wheel turned all of the way to the Right stop

D.4 Kiss & Ride

GO provides short-term parking facilities called Kiss n Ride's for passengers being dropped-off and picked-up. "Kiss n Rides" shall be designed to:

- Locate on the shortest possible accessible route to the station or tunnel entrance
- Provide capacity of a minimum 5 % of total parking spaces
- Allow space 3000 mm wide by 6000 mm long for each vehicle
- Include a 3000 mm x 7400 mm wide hatched area for lift equipped vehicles with a minimum vertical clearance of 3600 mm
- Be visible from enclosed passenger waiting areas
- Have pedestrian movement parallel with the flow of traffic, minimizing the conflict between cars and people
- Ensure a barrier-free drop-off zone, complete with curb cuts and dedicated loading area
- Allow physical separation through a 2500 mm, raised curb or landscaped buffer between vehicles and pedestrians

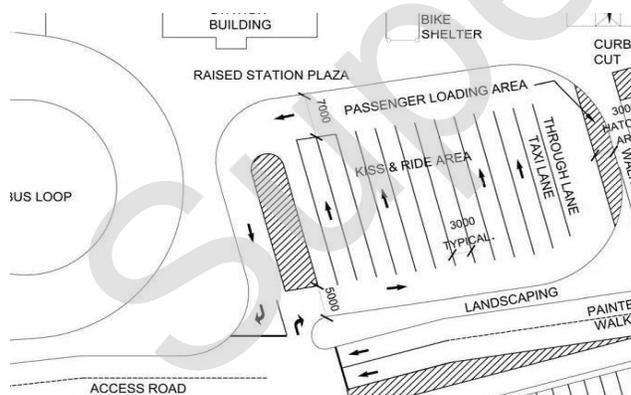


Figure D-15: Typical Kiss & Ride Configuration

D.5 Pedestrian Connections

Walkways

Accessible curbs (curb cuts) shall be provided where pedestrian paths intersect with vehicular roads, at barrier-free parking spaces, and wherever there is change in level along a barrier-free path of travel.

- Use dedicated and continuous routes, throughout the station and connections to surrounding areas
- Create separation from vehicular traffic, whenever possible
- Make walkways a minimum 1600 millimeters (mm) wide
- When a pedestrian entrance is provided from a recreational trail, provide a clear opening between 850 mm and 1,000 mm, whether the entrance includes a gate, bollard, or other barrier
- Raised and constructed of hard and sustainable level materials that are slip resistant
- Smooth with few joint and visually distinct from surrounding areas

Delineated Crosswalks

Shall be installed in conjunction with signs and accessible crosswalk markings provide guidance for pedestrians and alert road users of a designated pedestrian crossing point by defining and delineating paths.

D.6 Vehicular Access & Accommodations

Provide a complete system of vehicular roads and access points that promotes efficient circulation and maintains fluid access and egress to and from local streets.

Maximize the number of vehicular access points, in particular egress lanes, to mitigate the congestion.

Design of vehicular access roads shall passively encourage speed reduction.

Organize large surface parking areas into smaller lots to manage traffic flow, facilitate better site navigation.

Locate parking structures to balance desired direct access to the rail platform.

- Provide barrier-free parking directly adjacent to the rail platform access and station building
- Access roads = one for 300 parking spaces
- Single lane access roads = 4500 mm wide for single lane one-way traffic
- Two-lane access road = 7000 mm wide
- Three lane access road = 10500 mm wide lane
- Parking lot aisles shall be 7000 mm wide



Parking layouts shall respond to property size and site geometry. Parking structures and surface parking shall be designed as an integral component of the coordinated site plan and architectural theme.

Awkward, irregular gaps in parking layouts shall be filled in wherever possible.

Parking Stall Design Requirements

Table D-4: Parking Stall Requirements

Criteria	Specifications
Standard parking stalls	2500 mm wide and 5500 mm long
Stalls abutting curbs	4500 mm long with a 1000 mm allowance for vehicle overhang
Parallel parking stalls	3000 mm wide x 7000 mm long
Vehicular overhang	1000 mm
Sign posts	Shall be provided at parking row locations to indicate tow away zones (refer to the Static Signage Standards for details)

Accessible Parking Space Requirements

Table D-5: Accessible Parking Space Requirements

Accessible Parking Space Requirements			
Total Number of Parking Spaces	Number of Designated Spaces		
	Percentage (%)	Min. Spaces (Type A) minimum width of 3400 mm by a depth of 5500 mm	Min. Spaces (Type B) minimum width of 2600 mm by a depth of 5500 mm
		1500 mm wide barrier free access aisle is required adjacent to space	
1-100	4	1	1
101-200	3	2	2
201-500	2	3	3
501-1,000	1.5	4	4
1,001 +	1	5	5

If the total number of accessible spaces is an even number, the types required are divided equally. If the total number of accessible spaces is an odd number, the one remaining 'odd-numbered' space may be a Type B.

- Each Barrier Free Parking space shall be clearly marked with a sign bearing the International Symbol of Accessibility
- Where the location of designated accessible parking spaces is not obvious, directional signage incorporating the International Symbol of Access shall be placed along the

route leading to the designated parking spaces

- If there are more than three (3) designated spaces adjacent to each other, there shall be continuous low curb with a tactile attention indicator along the entire length of multiple designated spaces (no curb ramp for each unloading area)

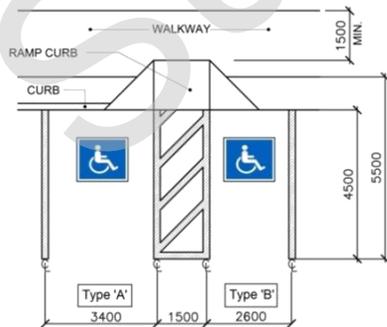


Figure D-16: Designated Parking Configuration for Two or Less Parking Spots

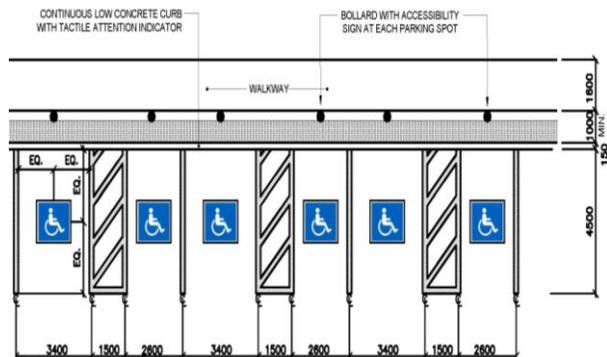


Figure D-17: Designated Parking Configuration for Multiple Parking Spots (More than two)

Multi-Level Parking Garages

The basic requirements for a Multi-Level Parking Garage are:

- Efficient traffic flow patterns for access and egress based on GO passenger patterns
- Functional Parking geometries with consideration for size, height, and turning radius of automobiles
- Efficient internal pedestrian & vehicular flow with redundant access / egress points
- Consideration for pedestrian and bicycle access
- Incorporate CPTED (Crime Prevention Through Environmental Design) principles
- Emergency response and access
- Accommodation for communication and electrical other related equipment
- Appropriate Wayfinding Measures; Signage; Building Identification and Corporate Branding
- Incorporation of Sustainable Design Principles, energy efficient lighting and other proven 'green' initiatives and/or technologies to mitigate potential environmental impacts
- Accommodation for salt protection and safe service and maintenance activities / equipment and user friendly, easily operated building design
- Include space counting system with a dedicated UPS for car counting system

Access-Entry and Exit

- Adequate queuing accommodation/space
- Internal circulation patterns shall minimize vehicular and pedestrian conflict, minimize travel distances, conflicting movements, and number of turn, and avoid congestion
- All vehicular ramps shall be provided with transition zones at the top and bottom of the ramp at a minimum

Snow Management

- Allow easy snow removal and minimize any damage from its operations and chemical treatment applications
- Architectural elements such as spandrel or enclosure panels shall minimize snow drifting and wind
- Exterior ramps and stairway areas to be provided with hydronic or electric resistance snow melting embedded below the traffic surface
- In all areas, floor drains and floors shall be configured to prevent ponding and allow for quick and easy drainage

Exterior Elevation

- Exhibit a high level of architecture detail such as decorative screens, overhead canopies over pedestrian walkways that establish a comfortable and well-proportioned human scale
- Satisfy building code requirements of fall arrest and to ensure that the over- all building envelope meets the open air requirements
- Maintenance, bird control, and lighting shall be considered in the exterior finishes and configuration

Finishes

- All traffic surfaces will be capable of taking paint for pavement markings
- All exposed structural steel structures will be hot dip galvanized
- All exposed Mechanical and Electrical systems to be painted
- Improved surface friction at entrance locations using a variety of techniques such as (but not limited to) grooves, heated ramps, additional drainage, shall be used that will preserve contact between the vehicle and the inclined surface
- Include a gritty material into the surface sealer with a suitable balance of micro and macro textured granules to increase the friction coefficient of vehicle tires on concrete surface

- Ramps exposed to exterior elements will require increased texture, provisions for snow melting systems, and a chevron pattern spaced maximum 30 mm apart and 5 mm deep to help with drainage

Electrical

- Electrical rooms are not to be below grade
- Emergency Backup Power Systems shall be provided
- Service entrance distribution panel board, transformers, transfer switches, contactors and controls and branch circuit panel boards shall be located in the electrical room
- Provide access controls i.e. fob access and keypad to the electrical and communications rooms
- Energy Management System/ Smart Panels shall provide the most flexible control system available: multi-level lighting, occupancy lighting changes, light harvesting, programmable circuit control, IP addressable, open architecture (backnet / modbus compliant)
- Convenient 20 amp 5-20R duplex GFI receptacles shall be located at each stairway and elevator area, on each level, around equipment on roofs, in service and storage rooms, near entrances and exits and at convenient locations on each parking level
- All electrical components, panels, ducts are to be mounted on standoffs
 - No direct connections to the wall or ceilings are permitted
- LED lighting to be used in all areas

Mechanical Systems

 All pipes and mechanical fixtures shall be designed to be corrosion free (no Copper type M is permitted)

- Mechanical systems to be designed without confined spaces
- Connect sanitary sewer to level 1 drainage
- If not possible, provide duplex epoxy coated sanitary sump pump with:

- 2 independent seal assemblies
- Guide bars
- Four float level control system
- Lifting equipment including lifting davit
- Chain hoist and hook
- Lifting de- vice
- Gas tight access frame
- Self-opening cover complete with piston kit and safety grid cover shall be traffic bearing where needed and completely assembled stainless steel

- There shall be no need for personnel to enter the wet well to service the pumps. Utility water meter to municipal standards shall be provided with 3 valve by-pass arrangement
- Accommodate water service on every level
- Provide exterior non-freeze water hydrants evenly spaced along the perimeter
- Incorporate heat tracing
- Provide heavy duty parking area drains, duty grate and sediment buckets

Service and Maintenance Area

A designated storage area in the parking structure shall be provided to accommodate service equipment, sweeper storage, and tools in a secure location.

The room(s) shall be accessed by a double leaf Hollow Metal (HM) door and the doors shall not open onto vehicular traffic; a concrete apron shall be provided with bollards

Service rooms shall contain, but not be limited to:

- Sprinklers
- Water valves
- Switches
- Mechanisms

Signage

 For signage design requirements at Parking garages refer the GO Standard Parking Garage Signage Requirements

D.7 “Green Zone”

The “Green Zone” is part of the Smart Commute program that identifies a variety of modal options that promote sustainable station access such as cycling, local service integration, carpool, electric vehicles, walking, etc.

Bicycle Infrastructure

Connect the cyclist pathways on site with local cyclist infrastructure via roadways and community trails.

Ensure a direct and delineated system of bike paths leading from the local access points to the bike storage locations on site.

! Sheltered bike areas integrated with the station design such as canopies and overhangs shall be placed in highly visible locations in vicinity of platform access points.

Only, where there are no opportunities for an integrated sheltered approach, standalone bike shelters shall be used. Refer GO Standard drawings and specifications.

Shared paths are to be implemented in conjunction with and leading to sheltered bicycle areas.

Shared Bike Path Design Requirements

Table D-6: Shared Bike Path Design Requirements

Criteria	Specifications
Yellow Line	100 mm solid, standard yellow, painted centreline
Width	minimum 3100 mm wide
Surface	hard and sustainable level materials that are stable, and slip-resistant
Grades	maximum slope of 4% Level landings or rest areas shall be provided at appropriate intervals
Cross slopes	maximum slope of 2%

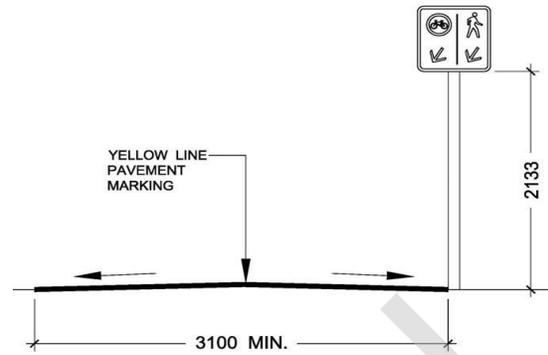


Figure D-18: Typical Cross Section for Shared Pedestrian/Cyclist Path

A “shared path” is considered a single lane of travel, delineated for pedestrians and a single lane of travel delineated for cyclists.

The shared path shall have a centreline pavement marking, to reduce the cyclists’ perception of freedom to maneuver between lanes.

Key features include bike shelter, trail access points, grade, cross-slope, street crossings, curb cuts design, railings, and signage.

Motorcycle/Scooter Parking

Motorcycle/Scooter parking is located in parking areas that would otherwise not be useable for standard vehicular parking. Each parking space shall be a minimum of 1500 mm wide by 2500 mm long. Individual stalls are not required

The parking area shall have a concrete base with steel reinforcing.

A designated dismount area is to be provided

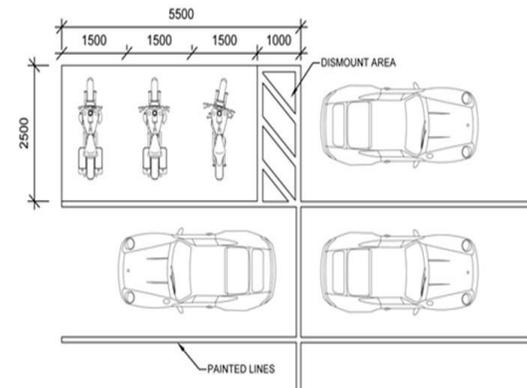


Figure D-19: Motorcycle End of Parking Row Configuration

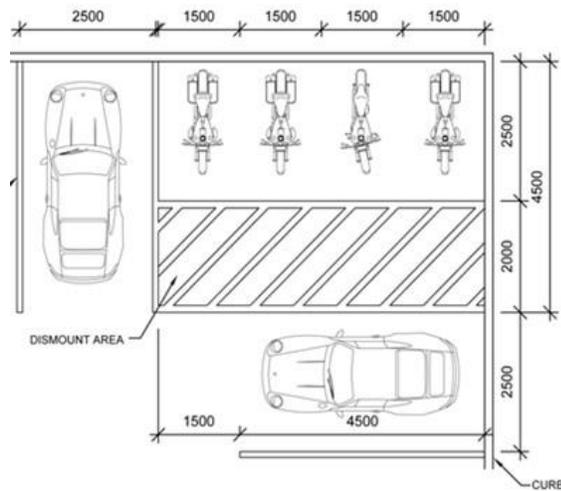


Figure D-20: Motorcycle Corner/Dead Space Configuration

Carpool to GO Parking

- 1% of total parking spaces in proximity to barrier free parking
- Carpool to GO Signage includes: Carpool to GO Introduction and Information Billboard sign, Banner signs, parking stall marker signs
- Signage shall be provided at each carpool parking space location (Refer to Figure Carpool to GO Installation Details)

EV Charging Station

- EV charging stations shall be placed indoors if a parking structure exists
- EV Charging Stations Spaces
- EV Charging Station Electrical details

D.8 Pavement and Line Markings

Table D-7: Slopes

Slopes				
Location	Longitudinal		Cross Slopes	
	Pref.	Max	Pref.	Max
Walks	0%	4%	OPSD	OPSD
Platforms (Rail & Bus)	0%	1%	1%	2%
Parking Lots	1%	3%	1%	3%
Fire Access Routes	Slopes to suit OBC fire access route criteria.			

Table D-8: Line Markings

Line Marking	
Location	Colour
Parking stalls, parking restricted areas and islands	Yellow
Directional dividing lines	Yellow
Rail Platform safety line	Yellow (tactile tile)
Lane lines, stop lines and arrows	Yellow
Pedestrian crosswalk lines	Yellow

Table D-9: Line Marking (Parking Structures Only)

Line Marking (Parking Structures Only)	
Location	Colour
Parking stalls, parking restricted areas and islands	Yellow
Directional dividing lines	White with reflectorizing glass beads
Lane lines, stop lines and arrows	White with reflectorizing glass beads
Lane lines, stop lines and arrows	White with reflectorizing glass beads
Pedestrian crosswalk lines	White with reflectorizing glass beads
Barrier Free Parking Symbol	White and Blue (Pantone 300)

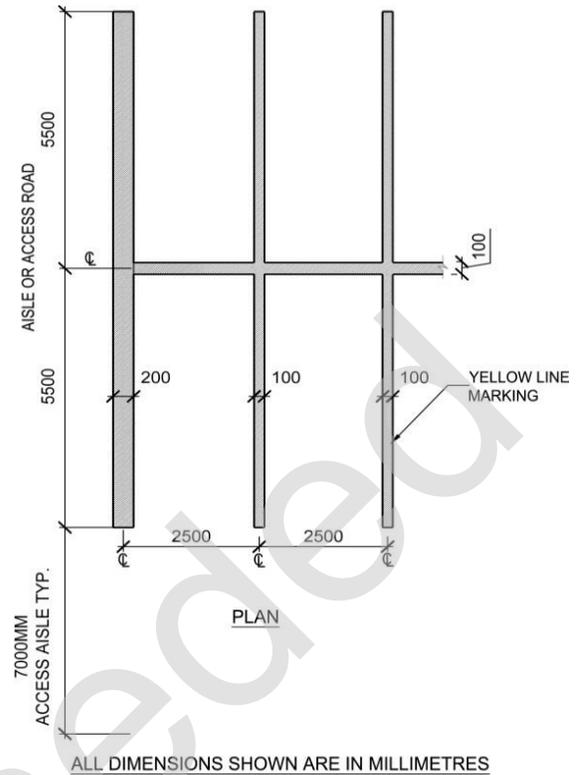


Figure D-22: Vehicular Parking Diagram

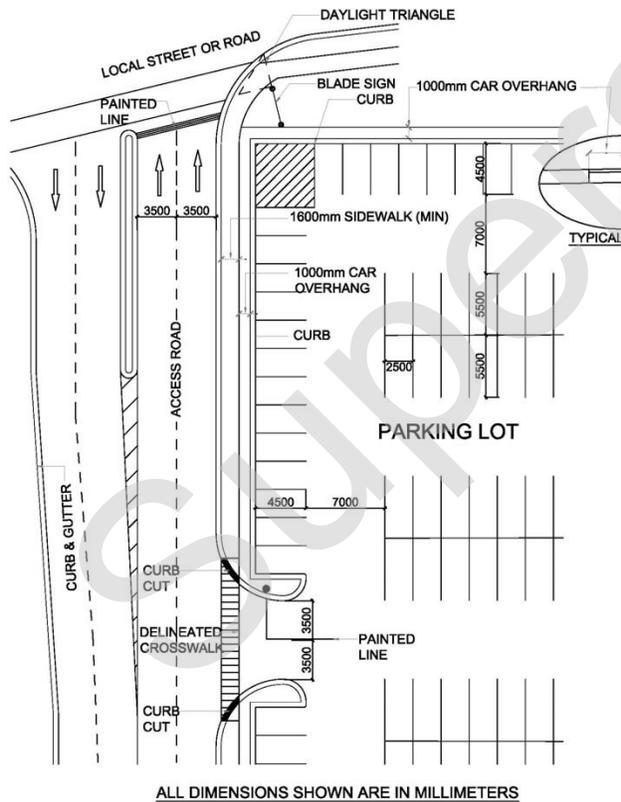


Figure D-21: Vehicular Parking Diagram

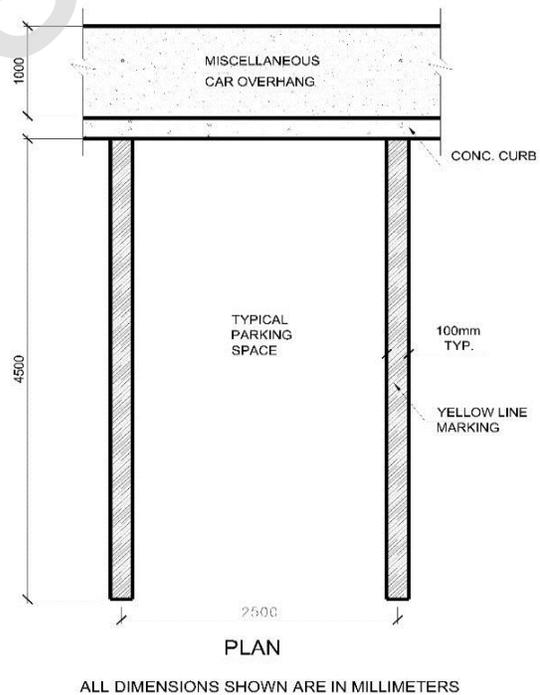


Figure D-23: 19: Line Marking-Row Parking Stalls

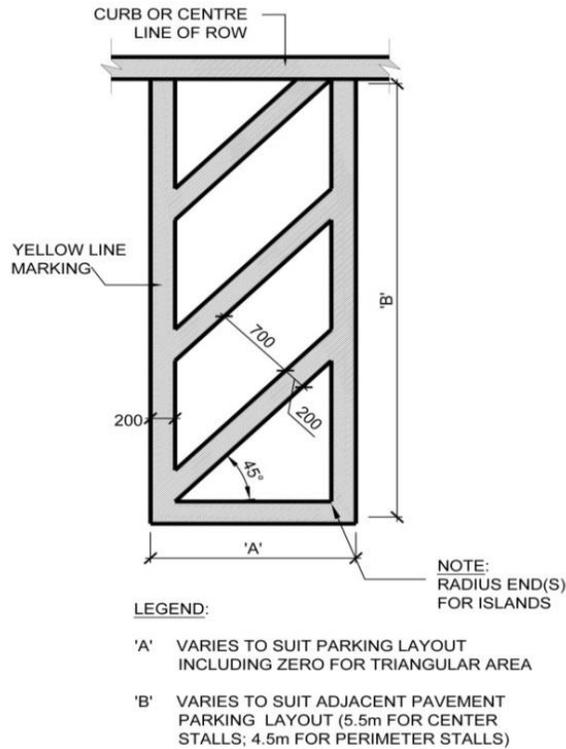


Figure D-24: Hatched Parking Area Configuration

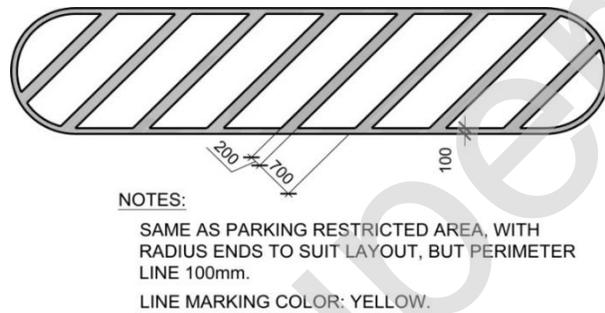


Figure D-25: Line Marking for Islands

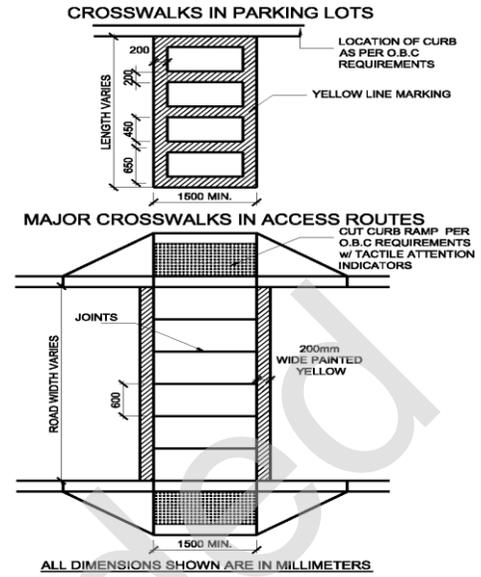
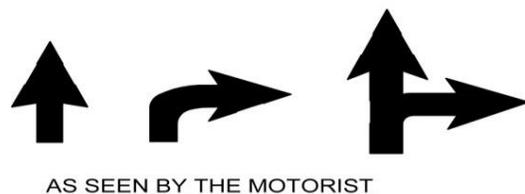
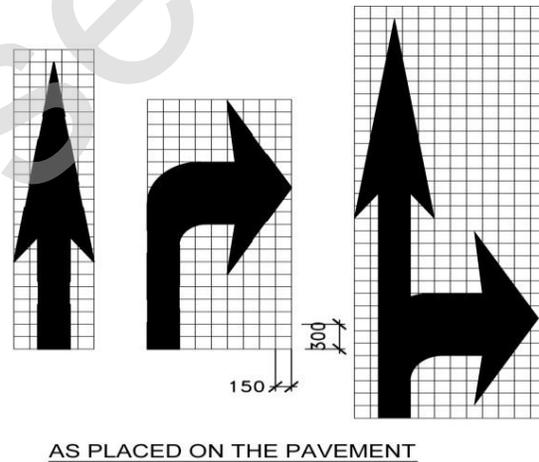


Figure D-26: Crosswalks in Parking Lots and Major Crosswalks on Access Routes



NOTES: GRID MODULE IS 150mmx150mm
COLOR - LINE MARKING: YELLOW

Figure D-27: Line Marking-Pavement Arrows

D.9 Park and Ride Lots

Park & Ride lots are intermodal transfer facilities. They provide a location for travelers to transfer between the auto mode and transit or between the single occupant vehicle (SOV) and other higher occupancy vehicle (HOV or carpool) modes.

All requirements from applicable sections apply, specifically:

- Site Plan Layout & Organization
- Bus Loops
- Vehicular Access and Accommodations

Park & Ride Lots are typically on MTO property and operated by GO Transit. The lots are serviced by GO transit and may be used by other local and regional carriers.

Carpool Lots are owned by the regions or MTO, whose standards govern. They may be serviced by GO Transit and other transit agencies.

D.10 At Grade Pedestrian Crossings



Where at grade rail pedestrian crossing is required, in addition to adhering to Transport Canada regulations, approval must be obtained from Railway Corridors and System Safety at Metrolinx.

Table D-10: At Grade Pedestrian Crossings

Element	Design Requirement
Flangeway Gap	<ul style="list-style-type: none"> The flangeway width may not be less than 65 mm and shall not exceed 75 mm Extend rail seal and taper asphalt at least 254 mm beyond edge of crossing surface Material: Use rubber rail seal to match the rail size and profile Use 3048 mm lengths and specify a flangeway width of "2 ½ inches"
Crossing Width	<ul style="list-style-type: none"> The total crossing width including the 254 mm tapered shaller of the crossing shall be a minimum of 3048 mm The total crossing surface width, level from shaller to shaller, shall be a minimum of 2540 mm The travelled or usable crossing surface width, which represents the minimum clearance distance for two wheel chairs to pass between the pavement marking lines, shall be no less than 1829 mm The width of the approaching walkway, where there is one, shall be designed so that the crossing width shall extend a minimum of 500 mm beyond the shaller of the approaching walkway
Crossing Surface	<ul style="list-style-type: none"> Material: Asphalt 150-200 mm HL3A to match top of rail Geotextile to be placed directly on ties and ballast and must continue to top of rubber rail seal Construction tolerance between crossing surface and top of rail—3mm Grade between rails: match elevations of top of rail
Crossing Approach	<p>Material:</p> <ul style="list-style-type: none"> Asphalt 200 mm HL3A (typical) Subgrade: 150 mm granular "A" Gradient (Accessibility Standard) The gradient shall not exceed a ratio of 1:20 (5%) A gradient exceeding 1:20 (5%) would require the approach to be designed as a ramp <p>In accordance with the Ontario Building Code, ramps can have a maximum gradient of 1:12 (8.3%).</p> <p>Furthermore, ramps require a handrail on both sides; therefore, this application would only be possible outside of the clearance envelope.</p>

Element	Design Requirement
	<p>Crossing approach shall be detectable at the boundary between the platform and the crossing to identify a safe stopping location outside of the clearance envelope.</p>
Crossing Location	<p>Where a train will not occupy the crossing during a regular Station stop the inside edge of the crossing shall be located no less than: 6 metres from the front of the facing cab-car.</p> <ul style="list-style-type: none"> • Fencing shall be installed to prevent pedestrians from crossing the tracks between a locomotive/cab-car and a designated level crossing • Rail joints shall not be located within the crossing
Guide Rails	<p>Guide rails are required for gate application only for the purposes of:</p> <ul style="list-style-type: none"> • Providing a means to close-off the counter weights and mechanism, thereby providing a protective barrier for pedestrians • Guiding pedestrians and closing off access to the corridor when the gates are down, i.e. the gate arm shall "slot" into the guide rails
<p>Z-Barrier (Maze Barrier) (non-accessibility standard)</p>	<p>Consider specific application depending on approach, e.g. not envisaged on platforms but may have a use on the parking side of the tracks where there is a large/lengthy approach and e.g. poor sightlines. The application would be used to slow down and control pedestrians so as to focus direction (sightlines) and attention to the crossing, or to force cyclists to dismount e.g. when using steps on approach.</p> <p>The following shall be considered for application only if required as per Transport Canada RTD-10 Technical Standards Manual:</p> <ul style="list-style-type: none"> • Flashing Lights and Bell: Only to be considered if maximum permissible train speed exceeds 60 mph • The maximum permissible train speed exceeds 15 mph and there are two or more tracks at the grade crossing where trains may be passing one another • Specification: Mechanical or electrical Bell as per AREMA <p>Gates:</p> <ul style="list-style-type: none"> • Only to be considered where grade crossing warning systems are installed and the maximum permissible train speed is 50 mph or more • There are two or more tracks where trains may be passing one another • When the sightlines along the railway right of way for a pedestrian stopped at the grade crossing are not at least equal to the minimum requirements as per RTD-10 Specification • Short arm gates as per AREMA <p>Active Warning Devices as above will require standard control equipment as per AREMA, e.g., solid state crossing controller, event recorder, track circuits, bungalow, batteries and chargers, etc. and installation shall conform to AREMA and RTD-10.</p>

D.11 Landscaping & Civil Works

The Landscaping Guidelines respond to both the urban design and environmental challenges associated with various surfaces at GO facilities.

Landscaping for all surfaces involves planting trees and plants, providing good quality soil and generous landscaped areas, enhancing pedestrian and cycling infrastructure, managing stormwater on-site, reducing the urban heat island effect, and using sustainable materials and technologies.

Landscaping design shall reflect the following objectives:

- Maximize shade along pedestrian routes, and for stormwater retention
- Consolidate soft landscaping areas to support plant growth and keep maintenance requirements to a minimum
- Mitigate the urban heat island effect
- Manage stormwater quality and quantity on site
- Incorporate sustainable materials and technologies
- Where possible, collect water for plant irrigation
- For edges not adjacent to the public realm, provide soft landscaping with variety of deciduous and coniferous trees and plantings. Include bio-retention or other stormwater management systems as appropriate
- When not feasible to provide areas of landscaping, planters shall be introduced to enhance the appearance when approaching site, around buildings and waiting areas

Plant Material

Select plant material that is suitable to the growing environment of the site:

- Use species (native or non-native) that are hardy, drought and salt-tolerant, and resistant to the stresses of compacted soils and weather exposure

- Avoid planting invasive species near ravines and other natural areas
- Avoid monocultures which can be susceptible to disease
- Consider sun, shade and irrigation requirements when choosing plants
- Incorporate a variety of deciduous and coniferous trees and shrubs for year-round interest, texture, shape and seasonal colour
- Boulders excavated from sites shall be retained and incorporated into the landscape design; and
- Wood chip, brick chip, gravel and rock groundscaping shall have geotextile underlays to eliminate weeds, and shall be contained by edge strips. Such a groundscaping under fences shall extend 300 mm on each side of a fence
- Groundscaping must be provided under roof overhangs, where adjacent to landscaped areas
- Gas meters, transformers, etc. in landscaped areas shall have patio stones or equal service access pathway

General Plant Specifications

Install plant material that meets or exceeds the following minimum sizes:

- Coniferous trees 1500 mm ht.
- Deciduous shrubs 600 mm ht.
- Coniferous shrubs 600 mm ht. or spread
- Perennials 2 years container grown
- Where landscaping might impact motorist/pedestrian sight distance, keep shrubs below 850 mm
- Ensure overhanging branches of trees or shrubs adjacent to pedestrian pathways maintain clear head- room of at least 2100 mm

General Soil Quality Specifications

Good quality soil shall consist of a minimum 0.9 m* depth, over and above any required drainage system and/or granular material, of sandy loam soil with the following composition:

- Sand (50%-60%)
- Silt (20%-40%)
- Clay (6%-10%)
- Organic (2%-5%)
- pH = 7.5 or less

Note: In landscaped areas without tree planting, the minimum depth for good quality soil can be reduced to 0.6 m

Islands/Curbs

The use of curbed islands shall be minimized, with line-marked islands preferred. Raised curbs shall be restricted to the perimeter, access/egress, bus loop platforms, and pedestrian walk areas to facilitate traffic flow and control.

Raised islands between access roads and parking or the Kiss n Ride shall be a:

- Minimum 2600 mm wide between curb faces
- Include a 1000-mm section for vehicle overhang
- Remaining width shall be used for either pedestrian circulation or landscaping

Incorporate raised islands and soft landscaped buffers within large parking lots to define major vehicle and pedestrian routes and to break up large paved areas.

Fencing

A fencing system is a component of safety and access control systems. Installation of fencing systems shall be conducive to operations and not become a maintenance burden.

All fencing shall include the following characteristics and features, regardless of the intended performance of the fence at a given location (varying only in height). Each fence shall be:

- Secure
- Anti-climb
- Anti-cut
- Vandal-proof
- Highly transparent
- Attractive

Types and Application

Fences are required at, but not limited to, the following categories of GO facilities:

- Railway Corridors—refer to Railway Corridors Operational Requirements
- High Risk Facilities—2,400-mm-high security fencing at, but not limited to, the following facilities:
 - Layover yards and sites
 - Electrical sub-stations
 - Fuel yards and tanks
 - Maintenance facilities
- Medium Risk Facilities: Minimum 1800-mm-high security fencing at, but not limited to, the following facilities:
 - Storage and warehouse facilities
 - Signal bungalows
- Low Risk Facilities and Site Components: Knuckles down fencing, no higher than 1200 mm with an attractive appearance and with no vertical protrusions (especially around facilities serving public and transit passengers), at the following facilities:
 - Fencing dividing multiple tracks
 - Rail side platforms
 - Significant grade and elevation change
 - Boundary definition as directed by GO
 - Bus loops and platforms
 - Access control flow
 - Ponds, ditches, swales, and high embankments

(Note that condensers and generators adjacent to a station or terminal building shall have decorative fencing and lockable gates.)

Gates

- Maintenance access gates shall be a minimum of 2,700-mm-wide, hinged single or double gates
- Sliding gates between tracks shall be a minimum of 2700 mm wide, single, or bi-parting gates

- All gates must be lockable, single, or double locks if required by the Railway, Hydro, or other users
- Grounding and bonding is required for metal gates

Site Furnishings

Garbage and Recycling Storage Areas

The Consultant shall verify garbage and recycling bin sizing with station, local municipality and/or service provider to validate garbage enclosure dimensions prior to design. At a minimum, garbage enclosures must be large enough to conceal two 6-yard bins.

The following criteria shall be considered when deciding on a location for a garbage enclosure:

- Garbage truck access
- Staff access / proximity to station
- Place on surplus land (land which cannot be used for anything else)
- Keep away from pedestrian paths and waiting areas
- Keep out of direct view when entering the site
- Where required, gates shall be equipped with "No Parking" signage to ensure accessibility is always maintained (for "No Parking" signage please refer to the Static Signage Standards)
- Consultant to verify signage sizing with GO prior to proceeding

Exterior Bollards

- Shall be 200 mm diameter galvanized steel pipe, concrete filled, and protected with 3 mm minimum thick high density polyethylene 'safety yellow' (or other colour as specified by GO) coloured cover, projecting 1.2 m above grade and set minimum 1.2 m into concrete pier
- At bus fuel storage areas, provide 250 mm diameter concrete filled bollards
- Provide bollards to protect electrical equipment locations

Interior Bollards

- 150 mm diameter galvanized steel pipe
- Concrete filled
- Protected with 3 mm minimum thick high density polyethylene 'safety yellow' (or other colour as specified by GO) coloured cover
- Projecting 1.2 m. above floor
- Cast with welded plate and 4 anchors into concrete slab

Removable Bollards

- Permanently installed receiver below grade, with a top that is flush with the pavement and a cap to prevent dirt accumulation while the post is removed
- Removable post that can be manually lifted out of the receiver to allow access
- Exposed locking mechanism, with a padlock keyed to the station master
- Dimensions, covers and color schemes shall meet Exterior and Interior Bollard's requirement

Civil Works

Storm Drainage

The design flood criteria for all sites shall comply with the MOE Storm Water Management Practices, Planning and Design Manual, the OPSD and MTO Drainage Manuals, as well as Regional and/or Municipal Storm Water Management requirements. Oil and grit separators and inlet control devices.

Generally surface water flow shall be directed from landscape areas to parking lot catch basins. Catch basins in landscape areas shall be avoided if possible.

Catch Basins

Catch basins shall be located upstream of pedestrian crossing areas, and 1500 mm clear of any driveway curb depressions. Grates shall be diagonal type. Catch basins shall not be located in the path of bus wheels, especially in bus loops.

Retention ponds and catch basin flow restrictors shall be provided in accordance with Storm Water Management requirements. Catch basins shall

not be located on walkways and/or in front of building doors.

Gutter Drainage

Gutter drainage shall be restricted to access roads if required to prevent storm run-off onto adjacent property. Road and gutter gradients shall not exceed Fire Access Route requirements.

Ditch Drainage

Where a storm sewer system is not available, or where an "interim" type of development is desired, ditches and related culverts may be used to carry the drainage down one or both sides of the paved areas. Culverts shall have safety grilles at ends, and ditches subject to substantial ponding shall be fenced, for safety, or filled with riprap, and topped with geotextile fabric and granular topsoil and sod.

Grading

Grading shall be designed to avoid excessive slopes and shall be integrated with surrounding landforms to provide slope stabilization and positive flows to the drainage system.

Where existing landforms, or vegetation, are to be preserved, appropriate protection and construction controls shall be designed.

Retaining Wall

The Consultant shall select the optimum permanent retaining method (wood shall not be used for retaining walls). Where concrete retaining walls are in proximity to the public, they shall be sandblasted. Low retaining walls shall be precast concrete units. Gabion walls may be used in non-public areas. Where retaining walls are adjacent to buildings, the material shall be compatible with the architecture.

Stormwater Management

Manage rainwater and snowmelt on-site with designs that encourage infiltration, evapotranspiration and water re-use:

- Sustainable materials paving for parking surface, drive aisles, overflow parking, snow storage areas and other hard surfaces in the parking lot
- Provide a planting medium, composed of good quality soil, with a minimum depth of

0.6m and at least 0.9m depth if trees are planted

- Plant trees (if applicable) above grade from ponding areas and clear of stormwater flow
- Ensure that any surface water is fully drained within 48 hours or less
- Use poured in place curbs with cuts for water inlets
- Include a perforated subdrain, check dams and overflow catchbasins as required to manage excess water
- Ensure overland flow routes and stormwater inlets and outlets are clear of debris and snow piling

Snow Control

Provision for snow control to reduce snow deposits in unwanted areas shall be employed. Generally, a vertical barrier will provide protection for a distance equal to 45 degrees projection. A porous barrier will protect for a distance of 10.0 m times the height although, the degree of protection may be reduced

Snow Storage

Snow storage areas shall be:

- Identified on the Landscape Plan
- Provide snow storage areas away from public streets and other areas where
- Motorist/pedestrian sight distance and continuous landscape screening is essential
- Sodded areas or portions of landscaped areas may be identified for snow storage with plant material selected accordingly
- Where overflow parking or bio-retention areas are provided, those areas may be used for snow storage
- Hard surfaces areas used for snow storage are encouraged to have sustainable materials to retain snowmelt on-site

D.12 Station Geographical Coordinates

For GO Stations, the official geographical coordinates are to be located at the centre of the edge of the mini platform as outlined in figure–Geographical Coordinate Placement at Mini-Platforms.

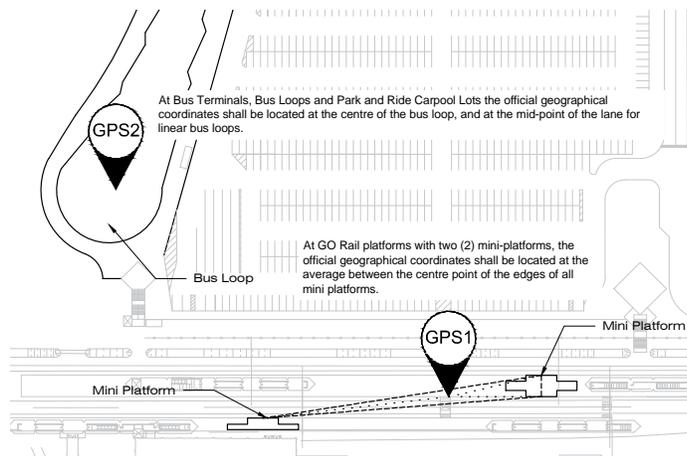


Figure D-28: Geographical Coordinate Placement

Projection System

The following Reference Datums and Grid System shall be used, in accordance with the MTO's Engineering Survey Manual dated October 2006:

Map Projection →	3-degree Modified Transverse Mercator (MTM)
MTM Zone 10	
Horizontal Reference Datum →	North American Datum (NAD) 1983, using the NAD83 Canadian Spatial Reference System (CSRS) adjustment
Horizontal Datum / Ellipsoid:	NAD83 CSRS v.6 (epoch 2010.0) / GRS80
Vertical Reference Datum →	Canadian Geodetic Vertical Datum (CGVD) 1928
Orthometric Elevation:	CGVD1928:78 Adjustment

Three-Dimensional Geodetic Control Points

- All GO Stations, Bus Terminals and Park and Ride Carpool Lots shall have three-dimensional geodetic control points installed with both Vertical and Horizontal known measurements
- Along the rail corridors, three-dimensional geodetic control points shall be installed and the monuments placed on fixed and stable

structures including: bridges, abutments, retaining walls and grade separations

- Control points shall be placed on a fixed and stable structure, including, station buildings, parking structures, tunnels, bridges or abutments
- At locations with existing geodetic control points, benchmarks shall be removed and replaced during construction

Accuracy:

- Horizontal Control Points:
 - Network Accuracy of 4 cm (95% Confidence Interval) for Northing, Easting, and Ellipsoid Elevation relative to the Active Control Stations
 - Local Accuracy of 2 cm (95% Confidence Interval) for Northing, Easting, Ellipsoid Elevation relative to the adjoining station baselines at each location
 - Vertical Control Points:
 - Elevation values of all installed monuments to be established by precise leveling. Methodology, equipment, and procedures shall comply with "Vertical Control Survey Specifications," MTO, May 2011.
 - Vertical accuracy shall be first order
 - Level loops to begin and end on an existing first order vertical benchmark
 - For each existing benchmark used, a stability check shall be done prior to commencement of leveling
 - All existing 1st Order geodetic benchmarks adjacent to a GO station must be measured
- In cases where stable 1st Order benchmarks do not exist in areas adjacent to a GO station, other benchmarks may be used subject to authorization and instructions from the GO lead surveyor.

E BUILDING PROGRAM

LEGEND

Customer Journey Activities

-  Decision Space
-  Circulation Space
-  Opportunity Space
-  Support Space

Site Services

-  Train
-  Bus
-  LRT/Subway
-  Kiss & Ride

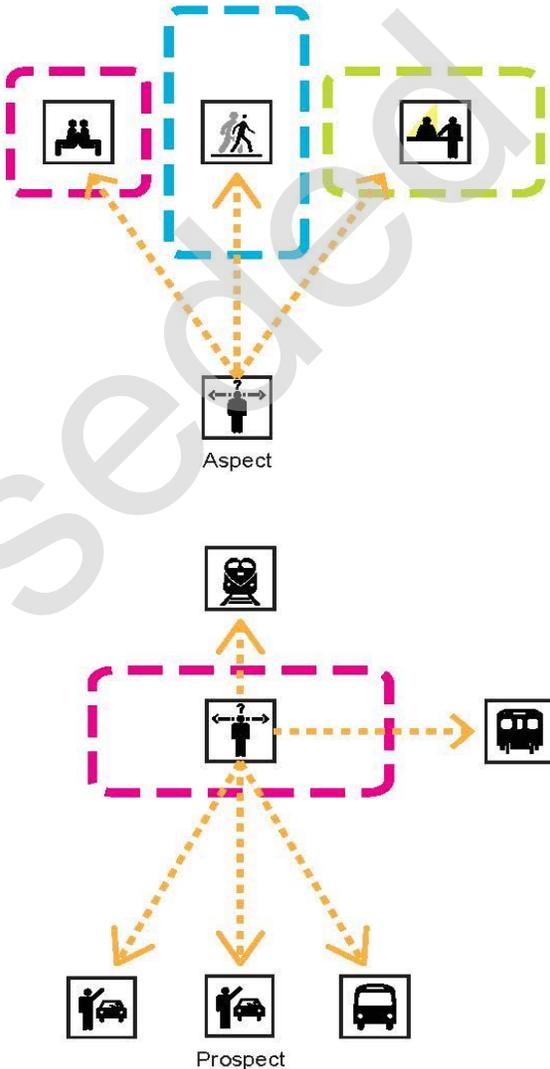


Figure E-1: Station Building Program–Wayfinding and Customer Journey Points

E.1 Station Buildings

The interior planning and design of the station building shall be integrated with the site environment to facilitate safe and convenient intermodal transfer, based on intuitive wayfinding and the customer journey. Intuitive wayfinding is based on the concept of aspect and prospect views.

Aspect can be described as a facade design that is open and welcoming on the customer approach to the station building, with clear sight lines into the station interior.

Prospect is about setting up clear sight and panoramic views from key customer journey activity points, with privileged views from the Service and Waiting areas of the station out to the Kiss N Ride and bus loop.

The customer journey, which is the way a customer circulates through GO sites, shall be the primary placement strategy used when laying out the interior programs. The customer journey can be broken down into four key types of activities:



Decision Space

Purpose: prioritizing passenger decisions, key customer orientation points
Characteristics: clear sight lines, wayfinding and signage, free of visual clutter



Circulation Space

Purpose: prioritizing clear connections to program areas that are unobstructed
Characteristics: unobstructed lines of movement respecting customer desire lines



Opportunity Space

Purpose: emphasis on passenger comfort and amenities
Characteristics: welcoming, comforting, safe, clear sight lines



Support Space

Purpose: key point of customer interface and service
Characteristics: welcoming, open, pleasant

Figure E-2: Customer Journey Key Activities

These activities are points along the customer journey and are the tools in framing the critical adjacencies within the station building between program areas. They shall be arranged to suit specific site constraints, while maintaining the appropriate adjacencies required.

Along with the concept of aspect and prospect views, the customer journey and intuitive wayfinding contribute to a holistic approach to the design of stations, making the site and station experience comfortable and easy.

The interior design shall establish visual relationships to particular site features and promote the following:

- Establish sight lines to adjacent transit modes
- Establish sight lines to key station building amenities
- Promote customer safety and comfort

- Promote natural daylighting

Key Sustainability Accommodations

- Apply passive means of reducing energy where it does not conflict with other customer service and operational design requirements
- Maximize the use of natural light coupled with photocells, motion sensors and controls to activate lighting when necessary
- Reduce energy consumption and emissions at all buildings. Use heat recovery to conserve energy for heating and cooling
- Design sites using Crime Prevention Through Environmental Design (CPTED) principles to provide natural surveillance and safe travel through the site for all. This includes safe routes for pedestrians and cyclists. Provide thermal comfort for staff and customers with protection from weather via canopies and shelters

²Small buildings do not require multi-use washrooms. Provide two universal washrooms, which can be used by either sex.

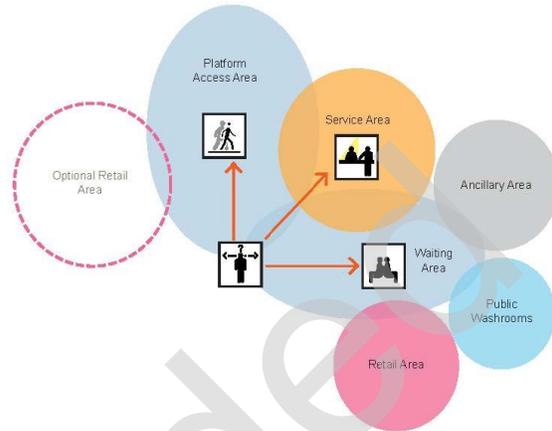


Figure E-3: Station Building Program Areas

Station Program Areas and Building Sizing

Building Type	Size "A" (large)	Size "B" (medium)	Size "C" (small)
Building Size	>500m ²	300-500m ²	< 300m ²
Average Customer Weekday Traffic	>8000 persons	2000-8000 persons	up to 2000 persons
Program Area	% of Total Size	% of Total Size	% of Total Size
I. Platform Access Area	40%	20%	30%
Circulation			
Self-Service Area			
II. Waiting Area	10%	10%	10%
Dedicated Seating			
III. Service Area (1)	5%	10%	10%
Customer Service			
Staff Back-of-house			
Staff W/C			
IV. Public Washrooms	10%	5%	15%
Women W/C			
Mens W/C			
Universal W/C			
V. Retail/ Concession	10%	10%	10%
including storage			
VI. Ancillary	15%	25%	25%
Mechanical (min 45m ²)			
Electrical (min 15m ²)			
Communication (min 10m ²)			
Maintenance Rm (min 7m ²)			

Station Building Interior Design: Program Areas Platform Access Area



Figure E-4: Rendering of Platform Access Area

Station buildings with additional facilities such as Retail, GO Staff Room with universal washroom(s), Bus Driver Room with universal washroom(s), Bus Dispatcher Room, and Transit Security Room will be in addition to the station building size determined above.

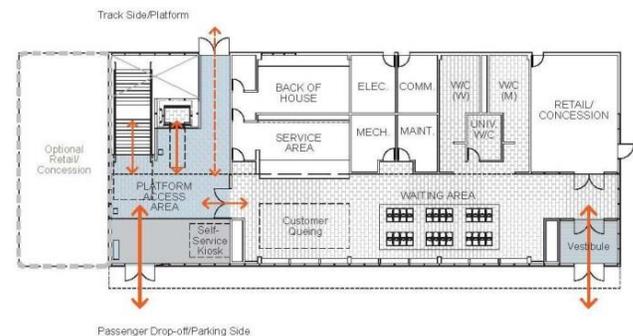


Figure E-5: Schematic of Platform Access Area

Feature Elements

- Linear light fixtures in varying lengths, suspended from the ceiling, positioned lengthwise in the direction of travel.
- Floor Finish: light grey ceramic tile
- Ceiling Finish: suspended metal pan ceiling
- Wayfinding Band placed perpendicular to direction of travel
- Self-Service Kiosk which includes fare devices, digital signage, and marketing communications
-  Refer the Fixtures and Furnishings section of the DRM for details on Digital Signage.

Key Fixtures and Furnishings

- Fare devices
- Seating
- Recessed walk-off mats at all exterior doors
- Waste receptacles
- Third party advertising

Lighting Strategy

- Shall be illuminated by a downlight linear suspended LED fixtures
- Fixtures must to be suspended at a consistent height, just above the wayfinding
- Provide a mix of 1220mm long and 2440mm long fixtures suspended in a random pattern, suspended from the ceiling with stems.
- Fixtures are not to be located over stairs except at landings

Waiting Area



Figure E-5: Rendering of Waiting Area

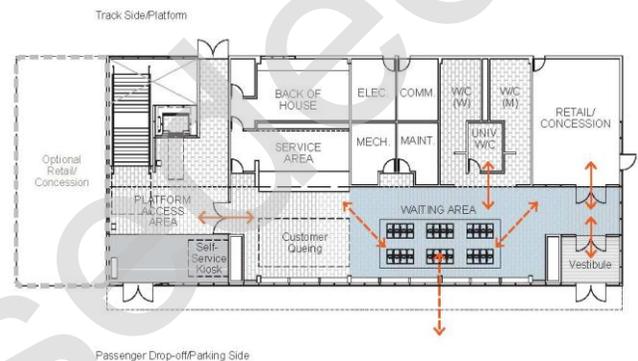


Figure E-6: Schematic of Waiting Area

Design Requirements

- Finish ceiling height shall be between 3600 to 4000 mm maximum
- Do not combine a circulation path within a seating zone
- Ensure accessibility seating requirements are met by providing a clear area designated for wheeled mobility aids (WMAs), outside of the circulation path

Feature Elements

- Linear light fixture in waiting area outside of the delineated seating zone
- Drum light fixture, suspended from coffered ceiling over the delineated seating zone
- Floor Finish: Light grey ceramic field tile; dark grey ceramic tile at dedicated seating zone
- Ceiling Finish: Suspended modular wood grille ceiling system

- Wayfinding Band placed parallel with circulation path
- Self-Service Kiosk (at stations where deemed necessary, such as hub stations)



- Refer the Fixtures and Furnishings section of the DRM for details on Digital Signage.

Other Elements: Fixtures and Furnishings

- Fare devices
- Digital signage (service information, infotainment, 3rd party advertising)
- Refer the Fixtures and Furnishings section of the DRM for details on Digital Signage.
- Static information signs
- Seating (both integrated and free standing)
- Charging stations (power receptacles with USB plug-in)
- Waste receptacles
- Recessed walk-off mats at all exterior doors
- Pay phone
- Retail (where applicable): fixtures and furnishings as per retail strategy guidelines

Lighting Strategy

- Provide linear light fixtures between the suspended modular wood grill ceiling system, outside of the delineated seating zone
- Provide a custom drum-shaped suspended light fixture over the delineated seating zone
 - The drum fixture is to be equipped with multiple light sources
- The number of drum fixtures depends on the size of the seating zone

Service Area



Figure E-7: Rendering of Service Area

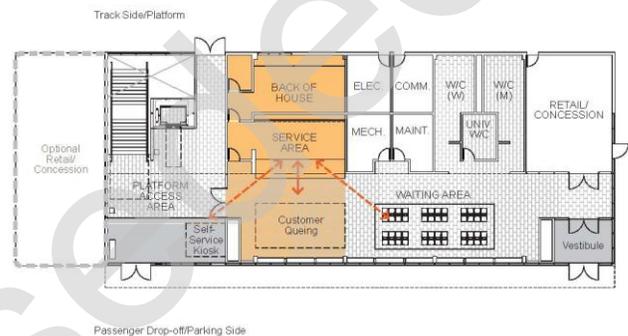


Figure E-8: Schematic of Service Area

Design Requirements

- Service Counters and Self-Service Kiosks shall be designed to be barrier-free. Queuing areas shall be wide enough for people using mobility aids including electric wheelchairs and scooters
- Minimum clear space in front of Service Counter shall be 5-7 customers per attendant, which includes barrier-free accommodation
- Minimum clear space in front of Self-Service Kiosk shall be 2-3 customers per kiosk, which includes barrier-free accommodation
- Refer GO Standard Guideline Specifications and Drawings for detailed requirements.

Feature Elements

- Service Counter

-  Refer the Fixtures and Furnishings section of the DRM for details on Digital Signage.

Lighting Strategy

- Semi-recessed slot lighting system around the perimeter of the finish ceiling system to be used to create a soft front illumination on the fascia and customer side of the counter, and lengthwise along the walls of the adjacent spaces
- Adjustable recessed pot lights to be provided on the customer side in the bulkhead of the Service Counter
- Task eyeball lights provided at ceiling level on either side of the station attendant work area, with light direction concentrated at the centre of the attendant work surface, minimizing glare off desk surface
- Puck light at underside of station attendant counter for servicing with built in on/off controls
- 200mm cube pendant light above each station attendant service position to be individually programmed to indicate whether service position is open (ON), or closed (OFF)
 - This is an ambient light, not a task light. Consider placement of CCTV cameras to avoid conflict with pendant lights

Public Washrooms

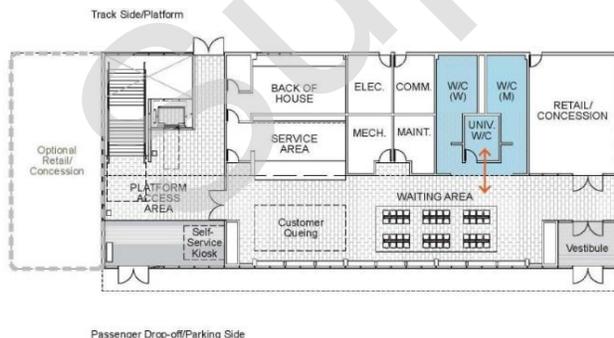


Figure E-9: Schematic of Public Washrooms

Design Requirements (In addition to all code requirements)

- Entrances into multi-use washrooms (i.e. female/male) shall be door-less
- All plumbing fixtures to be located on interior walls
- One standard infant change table/unit shall be provided in each washroom
- Floor drains shall not be in pedestrian or wheelchair paths
- The door swing into the universal washroom shall screen and partially obstruct the line of vision to the lavatory
 - It shall be equipped with a power operator
 - The door hardware shall be a lever handle passage set, with a latch operable from the interior, to display "vacant" or "occupied"
- An emergency two-way call system shall be provided and follow the same call flow as the two-way intercoms outside elevators (i.e. call directed to Station Attendant first, then Transit Safety, etc.)

Feature Elements

- Feature wall tile at Washroom entry to be different in colour from the general station wall finish
 - Use of smaller format tile with distinct patten is supported
- Refer to Materials + Finishes Performance Specifications for additional information

Other Elements: Fixtures and Furnishings

- Partitions
- Lavatories (toilets/urinals), wall hung, lever handle faucets, wrist-blade type
- Sinks, wall-hung (barrier-free)
- Tilt mirrors, stainless steel frames (barrier-free)
- Electric Hand Dryers

- Toilet Paper Dispenser, surface mounted, multi-roll vertical type, lockable, commercial grade
- Waste Receptacles, wall-mounted, stainless steel, vertical type with a capacity of 20L minimum, commercial grade
- Soap dispensers, wall-mounted, commercial grade, room deodorizers, feminine Napkin Disposal Bin, free-standing (supplied by GO)
- Coat Hooks, two: one at standard height, one at barrier-free height

Lighting Strategy

- Use linear LED lighting in the ceiling cove at back wall of washroom stalls to create a soft uniform glow in the space
- Use recessed LED fixtures for the rest of the washroom area
- Provide a perimeter ceiling cove and linear lighting along the wall within the female/male washroom stalls

Retail/Concession

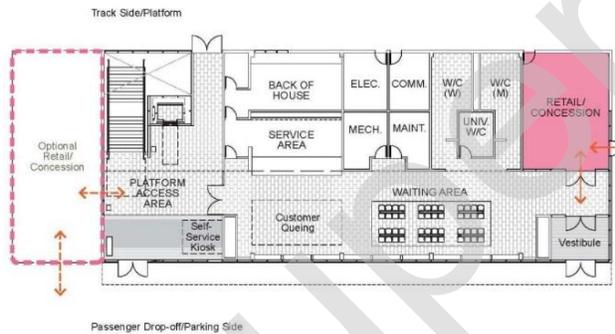


Figure E-10: Schematic of Retail/Concession

Design Requirements

- Provide Retail/Concession area to be located in close proximity to the Public Washrooms
- Provide direct access from building exterior for after-hour access, when possible
- Provide mechanical, electrical, plumbing, and communication rough-ins to accommodate retail functions
- Detailed retail typology allocations, service offerings, footprint selection, building access and mechanical/electrical service

requirements can be found in the GO Standard Retail base building requirements.

Lighting Strategy

- Base building fit-out as per retail strategy guidelines

Feature Elements

- None

Other Elements: Fixtures and Furnishings

- Base building fit-out as per retail strategy guidelines

Ancillary Spaces

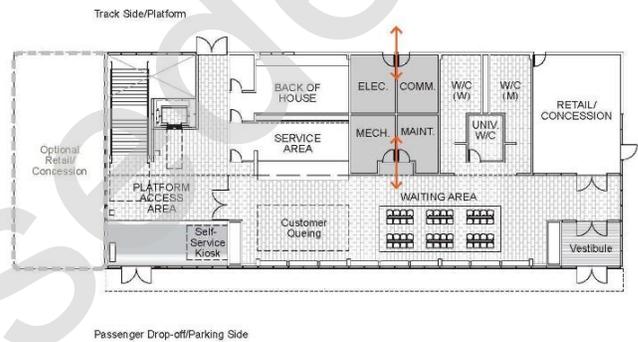


Figure E-11: Schematic of Ancillary Spaces

Design Requirements

- Ancillary area includes Maintenance Room, Mechanical Room, Electrical Room, and Communications Room
- Service structures to house boilers, garbage bins, or generators, shall be consolidated where possible to reduce the amount of structures obstructing wayfinding and sightlines on site
- Provide direct access to the Maintenance Rooms from the building interior
- Ensure the Maintenance Room is adjacent to the Public Washrooms, and no meters, water tanks, or other intrusions are placed in this room.
 - It shall be dedicated for maintenance equipment and storage only
- Ensure the Maintenance Room door is an in-swinging door. It shall be an extra wide

heavy duty hollow metal double door with a single 34" leaf and a second 12" latching section, for a total opening of 46"

- Provide a minimum of four (4) butt hinges per door
- If required, provide roof access hatch with a wall mounted ladder in the Maintenance Room for rooftop mechanical equipment access
- Provide direct access to the Electrical and Communication Rooms from building exterior for after-hour access
- Ensure spare wall space for future equipment due to additions or renovations is provided in the Electrical Room
- Ensure the Communications Room is located adjacent to Service Counter and near the Electrical Room, when possible

Lighting Strategy

- Base building fit-out
- Refer to Lighting Performance Specifications for additional information

Feature Elements

- None

Other Elements: Fixtures and Furnishings

- (Refer to Electrical and Mechanical sections of DRM for technical requirements and specifications)
- In Maintenance Room:
 - 4-6 power receptacles with 208V and 110v supply and 60-amp service.
 - Floor mounted slop sink with easy access clean out for slop sink P trap
 - Faucets and floor drains
 - Exhaust fan
 - Open shelving and mop hooks
 - Mop and broom hangers, floor sweepers
 - Four (4) staff lockers, full height with vented louvers at base
 - Metal storage cabinet, lockable

- Desk and chair
- Key fob access

- In Mechanical Room:

- Power receptacles
- Floor drains
- Spare and additional filters, etc.
- Storage shelves and/or cabinets

Feature Elements at Station Building

Feature Elements are key infrastructure pieces that are designed to be the same at every station—in application, form, function, and finish. The intent is that these feature elements portray a consistent presence and brand at our stations, making the customer experience intuitive, familiar, and comfortable. There are four feature elements that are intended to ensure the GO Brand and identity is strong and immediately identifiable across all applications. These are identified in the example station layout below, along with the specified ceiling material finish:

- Service Counter
- Self-Serve Kiosk
- Delineated Seating Area
- Wayfinding Band

These four feature elements can be adapted with ease at different locations across the network as an integral part of the overall interior design language. Based on the station plan and design, the location of the feature elements may differ from the Example Station shown. The feature elements shall not be placed based off a previous station building design, but be assessed based on the customer journey and strategically placed using the guidelines outlined in this section. The following diagrams use existing station buildings and illustrate where feature elements would be placed at different locations based on the customer

journey.

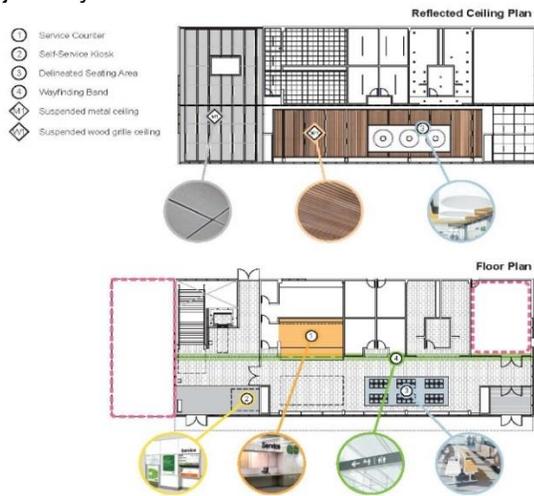


Figure E-12: Feature Elements

Feature Element: Self Service Kiosk



Figure E-13: Self Service Kiosk Rendering



Figure E-14: Info Wall in Station Waiting area Rendering

Purpose

To create a self-serve area for fare dispensing and service information, clustering essential amenities needed to use the GO service.

Requirements

The kiosk shall be designed with three distinct sections:

- Section 1: GO ticketing (fare dispensing interface)
- Section 2: GO marketing and information (static interface)
- Section 3: GO Schedules and trip planning (customer interactive interface)

Each section can be multiplied as many times as needed to meet service demands, or it can be deleted if deemed not required. It is meant to be flexible and scalable for its location and projected use. Note that Sections 1 and 3 are located at the ends to encourage “interactive” use, while Section 2 is centered between to encourage a more “static” viewing-only use, creating a buffer between the interactive interfaces.

The kiosk shall, be integrated with the architecture of the building as much as possible, creating an uncluttered and organized environment resulting in an easier and intuitive way of using the service and improved the customer experience.

The shell of the kiosk shall be white, referencing the “system” wall used at the Customer Service Counter, making it distinguishable both in brand and amenity type.

The material finish shall have a high gloss finish, be resilient, durable, and vandal resistant.

Access shall be provided from the front using flip maintenance doors, as much as possible. Where station conditions permit, access from the back is acceptable.

All Platform Access Program Areas shall be equipped with at least one Self Service Kiosk. It shall be placed just off the main circulation path. Ensure a minimum clear space for 2-3 customers in front of kiosk is provided, which includes barrier-free accommodation.

At exterior platform access points where the entrance is not enclosed, a kiosk shall be placed by the entrance just off the circulation path,

protected against the elements by a canopy or shelter.

Where deemed required, waiting areas can also be accommodated with a Self Service Kiosk, in addition to the platform access points. These additional locations shall be based on the station size, ridership demand, limited service stations, or where a Service Counter is not provided.



Refer the Fixtures and Furnishings section of the DRM for details on Digital Signage.

Feature Element: Delineated Seating Area

Purpose

To provide a comfortable delineated touchdown area for customers with added amenities such as charging stations

Requirements

Integrated seating shall be designed as an architectural element of the station, typically located along the length of a wall (not fixed in the middle of the space). It shall be provided throughout the station where designed for.

When additional seating is provided, it shall be delineated as a distinct zone, reinforced and highlighted by a darker floor tile finish and coffered ceiling above featuring a pendant drum light fixture, giving the space a more intimate, comfortable human scale. This delineated seating zone shall be within the waiting area, away from but adjacent to the circulation path, and in close proximity to GO information and retail, when these amenities are provided. The seating provided shall consist of stand-alone benches and other non-fixed furnishings.



Figure E-15: Rendering of Delineated Seating Zone

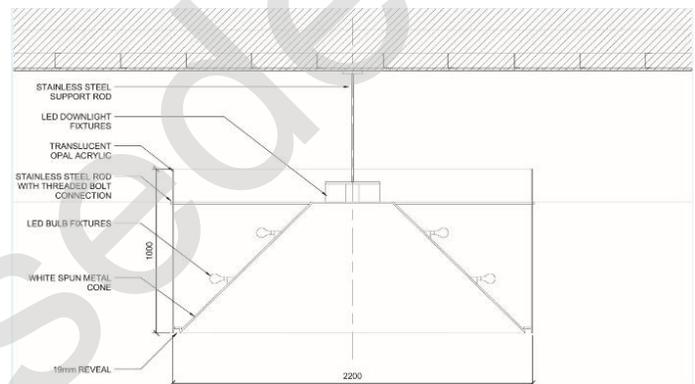


Figure E-16: Lighting Configuration of Delineated Seating Zone

Feature Element: Wayfinding Band

Purpose

To provide wayfinding information in stations, improving navigation by identifying services and amenities.

Requirements

The information on the wayfinding band shall be of program areas (such as Service Counter, Public Washrooms, etc.), excluding ancillary spaces. For information on the graphics and icons, refer to the Signage Catalogue.

The wayfinding band shall be continuous in application, extending wall to wall where it is placed. The placement of the wayfinding band shall be assessed station-by-station, working with the circulation and decisions spaces of each station. The band shall typically be seen on approach, perpendicular with the decision point

along the customer journey, informing customers where they need to go. As such, the band will not always be in the same location at every station (i.e. above the Customer Service Counter)—it shall be designed and placed according to the customer journey.



Figure E-17: Wayfinding Band

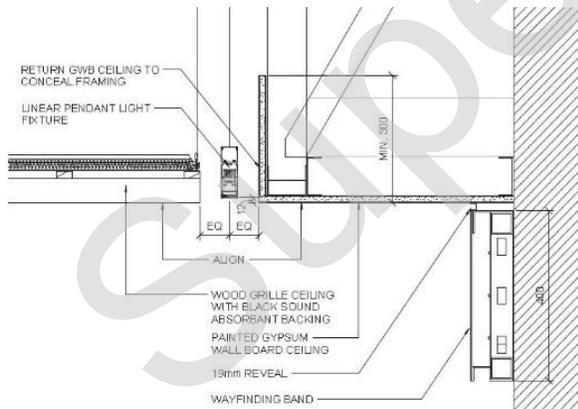


Figure E-18: Wayfinding Band Conceptual Details

E.2 Bus Terminals

Building Program for Terminals follows the Station Building requirements with the exception of the following areas provided in addition:

Dispatcher Room

The bus dispatcher room, where required, shall be elevated to permit the dispatcher in a seated position to have sight lines of all buses. It shall be located strategically for visibility of bus bays, particularly of arriving buses, where possible. The usual location is on an external wall, but it may also be located within the waiting room. Generally, it shall be adjacent to the driver room and shall have access from the driver room.

Both rooms may also be adjacent to the station attendant room, in which case a staff room may be provided in common for the dispatcher, drivers, and station attendants, with shared washroom and kitchenette facilities. Depending on the size of the facility, separate male and female staff/driver washrooms may be required.

The floor shall be elevated a minimum of 570 mm above the waiting room floor level and platform level, equivalent to a minimum 3-riser stair requirement. The seated dispatcher's eye level will then be approximately 1.69 m above platform level, over the heads of most passengers. Other design requirements include:

- Desk-height counter with insulated glazing above, knee-space below
- Side and/or back counters to be typical counter height with task lighting from wall-hung cabinets
- Wall hung cabinets with adjustable shelves and lockable doors
- Non-glare recessed LED luminaries with 12 x 12 x 12 mm parabolic egg-crate lenses; if the room is on an exterior wall, insulating glass shall be fully tempered tinted low-E glass
- Interior locations to have fully tempered 10 mm clear glazing
- Where a dispatcher room is adjacent to a driver room, but has a separate entrance, a pass-through sliding-glass window shall be provided between them, operable by the dispatcher, for receiving driver reports and direct communications
- Where a dispatcher room is in a waiting room, the pass-through window may be required into the waiting room

E.3 Operational Facilities

Rail Operational Facilities

- Refer to standalone GO specifications for Rail Operational Facilities

Bus Operational Facility

GO owns a number of Bus Operational Facilities for the purpose of storage, repair, maintenance, cleaning, and fueling, with ancillary administrative offices. Bus Operational Facilities are classified as Type A, B, or C based on land sizing, parking, facilities provided and fleet requirements. Refer

to the Table for Bus Operational Facility Typology and associated amenities.

Detailed design criteria will be provided by GO at the commencement of new projects. This Section is not intended to be a specification; the intent is to ensure uniformity in the Bus Operational Facility designs.

The standard Bus Operational Facility program is based on the following:

- Maintenance Facility
- Storage Facility
- Office Facilities

Bus Operational Facility Typology

Table E-1: Bus Operational Facility Typology

Bus Operational Facility Typology					
			<i>Type A Full Service</i>	<i>Type B</i>	<i>Type C</i>
Land Requirements			15+ acres	5-12 acres	3-4 acres
Parking	Buses	Indoor	40-105	21-42	12
		Outdoor	12	0-5	0-4
	Cars	Employee	140-200	33-56	14-20
		Corporate	10-12	2-6	1-2
Facility Requirements		Rooms	Yes	Yes	Yes
		Showers	Yes	Yes	Yes
		Lockers	Yes	Yes	Yes
		Lunchroom	Yes	Yes	Yes
		Kitchenette	Yes	Yes	Yes
		Lounge	Yes	Yes	-
		Office	Yes	Yes	Yes
Bus Fleet Maintenance	Fueling	Indoor	Yes	Yes	-
		Outdoor	-	Yes	Some
		Offsite	-	Some	Yes
	Repair Area	# Hoist Repair Bays	0-2	0-2	-
		Hoist	Yes	0	-
		Pit	2-3	0-1	-
		Bus Wash	2	1	-

Type “A” Bus Operational Facility

This program describes the general spatial provisions at a Type “A” bus operational facility.

Table E-2: Exterior Circulation

Exterior Circulation	
<i>Feature</i>	<i>Design Requirements</i>
Roadway Tie-Ins	Interface with existing and future road and walkway networks One way traffic is preferred with minimum reverse operations.
Paving	Paving shall support vehicle types without cracking or settlement from standing or moving traffic. Concrete surfaces shall be provided for high bus traffic areas especially corners and outdoor fueling areas.
Curbs	Shall be designed and located per site conditions and industry standards.
Exterior Stairs/Ramps	Provide for barrier free and pedestrian access
Fencing	Fencing shall be a 2.44m high wrought iron fence along the front façade. The remaining perimeter will be 2.4m high black vinyl coated chain link fence.
Gates	Require high-speed by-fold automatic gates to be operated remotely from area(s) designated by the owner or through the FOB, phone/intercom system if available. Gates must be activated by underground loop detectors, proximity cards, and existing bus transponders. Electrical controls shall be provided as part of the gate system and gate height is to match site fencing.
Stormwater Management	Stormwater Management shall be designed by grading the site to direct run-off water to catch basins and subsequently to storm sewer system. In areas where drainage to grade would run to paved areas, direct to storm sewer. Ensure grades are provided to slope away from the building. No surface storage/ponding of water will be accepted in parking areas during storm events.
Impact Protection	Provide impact protection to hydrants and any other structures or equipment installed within 2.0m of vehicle traffic areas, with 0.2m diameter concrete filled bollards. It must also provide bollards to protect all outdoor equipment and control monuments.

Table E-3: Landscaping

Landscaping	
<i>Feature</i>	<i>Design Requirements</i>
Design	Landscape design shall ensure ease of maintenance. Materials shall be durable (e.g., salt resistant) and resistant to vandalism. Snow storage shall be taken into consideration. Landscape design shall respect the form, scale, and materials of both the surrounding area and proposed development. Circulation, comfort and safety, environment and crime protection (CPTED) shall also be considered in the choice of landscaping elements
Native Plant Material	Native plant material as appropriate is encouraged. Patio areas with coloured concrete are preferable
Lawn Sprinkler Systems	Lawn Sprinkler systems, if required, shall be provided with timer (plus manual override)
Future Expansion	Landscape shall be able to accommodate future expansion with minimal disruption or disturbance.

Table E-4: Landscaping

Signage	
<i>Feature</i>	<i>Design Requirements</i>
Signage	Refer to GO's Signage Catalogue

Table E-5: Clearance and Circulation

Clearance and Circulation	
<i>Feature</i>	<i>Design Requirements</i>
Heights	Coordinate clear building heights with actual heights of buses, equipment, and the like. Maintain minimums provided and as required for full and complete operation of the facility.
Features	Design the facility to accommodate ample clearance requirements in plan and elevation of all current GO buses and equipment and GO standard vehicle turning radius' and sweep paths with allowable safety factors.

Table E-6: Structural Elements

Structural Elements	
Feature	Design Requirements
Structural System	The design shall be based on the most cost effective structural system when considered in the context of both the capital cost of construction and the projected life-cycle cost of the maintenance facility garage assuming a 50-year service life.
Building	The building shall be reinforced concrete, pre-stressed concrete, structural steel, or a combination of these.
Loading and Deformation Requirements	The design shall consider the loading and deformation requirements of the structure in relation to the requirements of other disciplines. These disciplines shall identify the loading and deflection requirements and the anticipated structural deformations and movements of their work for incorporation in the structural design and construction.

Table E-7: Architectural Elements

Architectural Elements	
Feature	Design Requirements
Architectural Pre-Cast Panels	<p>Panels must comply with OBC requirements and have R-values as required by current industry standards.</p> <p>Rainscreens, if proposed, are to be installed with proper joint treatment using low VOC sealant. Interior of the precast panels shall be finished smooth suitable for paint application.</p> <p>Architectural elements carrying branding features need prior approval from GO</p>
Insulated Metal Siding	Shall be designed to withstand windload from inside and outside as required by current industry standards
Explosion Relief Panels	<p>Design pressure relief panel system and shop calibrate to release at a static pressure differential between interior and exterior.</p> <p>Design panels and structural supports to withstand wind loads as required by current industry standards</p>
Pre-Finished Aluminum Panels	<p>Oil canning and deflection are unacceptable.</p> <p>Standard materials, components, fasteners and cap flashing per industry standards are preferred</p>
Canopy	Soffit and flashing shall be prefinished aluminum panels.
Roofing	Easily maintained, roofing system technologies to meet specific LEED criteria.
Aluminum Curtain Walls And Windows	<p>Fenestration shall comply with CAN/CSA standards regarding air and water leakage for aluminum windows.</p> <p>Exterior doors shall meet air-leakage rate requirements.</p> <p>The system shall be designed to accommodate expansion and contraction with a service temperature range of -35° C to +35° C</p>

Architectural Elements	
Roof Items	Above ground, roof serviceable items shall be designed to avoid fall hazards.
Skylights	Tinted, sealed, double-glazed units in clear anodized aluminum framing with positive drainage, and complete with integral curbs, is recommended. Sealed glass requirements shall be the same as specified for curtain walls but with heat strengthened exterior light and laminated heat strengthened interior light
Exterior Bollards	To be 200 mm diameter steel pipe, concrete filled, galvanized covers, projecting 1.2 m above grade and set min. 1220 mm. into concrete pier. At fuel storage areas, provide 250 mm diameter concrete filled bollards.
Sound Transmission Class (STC)	Private offices, meeting rooms, training rooms, drivers' quiet areas, and all office washrooms shall be designed to achieve a minimum STC rating of 55. Stores and Simulator rooms shall have a STC rating of 63, unless otherwise specified
Masonry Partitions	Block size; fire rating, etc. shall be standard concrete block, reinforced to Code Requirements.
Exterior Industrial Doors Overhead Doors	Exterior Industrial Doors/Overhead Doors are Foam-in-place, insulated, sectional overhead, torsion spring counterbalanced and electrically operated. Controls and equipment and shall be of minimum lift 30' per sec speed with multiple safety systems to prevent damage or injury. Doors shall have a min. R-value of 12.5. Edge protection for operators (Machine Safeguarding) shall be provided. Door height shall accommodate overhead clearances per bus type at designated facilities
Interior Hollow Metal Doors	To have the maximum glass lights as allowed by Code. All exterior hollow metal doors shall have clear insulating vision lights (150 x 600 typical).
Oversized Doors	At electrical rooms, storage rooms, mechanical rooms, compressor rooms, etc. shall allow for equipment delivery and removal
Wood Doors	Hardwood veneer in species in all administration areas with side and door lights
Overhead Coiling Fire Doors	Shall be face-of-wall mounted galvanized steel, manually operated complete with locking mechanism, fabricated in accordance with NFPA 80 standards
Counter Shutter	Coiling steel in the administration area shall have similar requirements as above and electrical powered.
High-Speed Fabric Doors	High-speed fabric doors shall be fabric curtain with breakaway and electric reversing bottom bar, view windows, frames, counterbalance mechanism, controls, operators, and dual electric safety eyes. Curtain shall be selected to suit door opening width.
Office Doors	Office doors shall have frosted glass for glazing and adjoining windows to have roller shades.
Traffic Lights	Shall be provided for all non-pedestrian doors: Green and red signals to indicate safe or unsafe conditions for vehicle "IN" movement. Lights shall be traffic style, complete with signs.
Motion Sensors	Shall be provided to increase monitoring distance to stop and reverse

Architectural Elements	
	doors when in downward motion.
Sliding Automatic Entrance Doors (Exterior and Interior)	Sliding automatic entrance doors shall include operator, header and track, jambs, sliding door panels, and sidelights. Units can be mounted within rough opening with sliding panels sliding along sidelight. Units will be bi-part and slide-swing panels shall slide along interior side with Microprocessor Master Control.
Internal Handrails and Guardrails	Internal handrails and guardrails shall be stainless steel. All external and wet location handrails and guardrails shall be Hot Dip Galvanized.
Interior Bollards	Shall be 150mm diameter steel pipe concrete filled, galvanized and protected with a yellow 1/8" thick high density polyethylene 'safety yellow' coloured cover, projecting 1.2 m. above floor and cast with welded plate and 4 anchors into concrete slab, they shall be equipped with pole sleeve covers
Lockable Gates	Shall be minimum (600 mm x 1200 mm wide) with heavy-duty hinges and cylinder locks. Barrier free gates where located, shall be sliding and motorized with security features
Wash Splash Guards	Wash splash guards shall be provided on each side of service lanes between bus wash equipment and building wall. Splash guards shall be corrosion-proof, minimum height 1.2 m above top of wash equipment
Hallway Windows	Shall allow natural light infiltration, UV protection film is recommended for sunlight diffusion.
Bike Lockers	Bike lockers shall be provided with power outlets for electrical bikes as determined by GO staff.
Concrete Curbs	Underneath the electrical panels shall be provided to protect conduits from the maintenance equipment (floor sweepers, etc.).

Table E-8: Architectural Finishes

Architectural Finishes	
Feature	Design Requirements
Ceramic Tiles	Ceramic tiles shall be installed on high traffic area walls (4' high tile cladding for corridors) and wall dado installation for washrooms.
Porcelain/Resilient Tile Flooring	Tile flooring shall be provided in maintenance offices, hallways, vestibules, and high occupancy areas.
Carpet Tile	Shall be provided in offices, meeting rooms, etc.
Rubber Sports Floor	Rubber sports flooring shall be provided in the Wellness Room.
Stair Treads and Landings	Stair treads and landings shall be rubber treads with non-slip nosings to meet current industry accessibility standards.
Service Lanes and Degrease Bay Floors	3-part trowelled system consisting of a two-part epoxy sand aggregate and topcoat in manufacturer's standard colour range.

Architectural Finishes	
Shop and Garage Area Floors	Minimum 4.88 kg/m ² trap rock, water cure, and liquid densifying sealer. Floor sealant shall provide necessary traction to avoid bus skidding at storage/service area/garage area.
Interior Painted Lines	Interior painted lines shall be provided along Safety Area around electrical panels and fire hoses and at hoist bays, pits and all shops. Epoxy based line painting shall be provided in all bus storage and maintenance areas.
Stock Room Counter	Shall be stainless steel with wood backing
Touch Zone	Up to 3m of the maintenance and storage facilities shall be epoxy coated to allow for pressure washing.

Table E-9: Fixtures

Fixtures	
Feature	Design Requirements
Toilet Partitions and Urinal Screens	Toilet partitions and urinal screens shall be stainless steel, ceiling, or wall mounted.
Sloped Top Lockers	Top lockers shall be pre-finished, sloped top, located on concrete base.
Coat and Hat Racks	Coat and hat racks shall be provided in administration areas.
Foot Grilles	Foot grilles shall be vinyl surfaced, recessed type, in extruded 6063-T52 aluminum alloy framing.
Roller Shades	Roller shades shall be provided for all windows in the Administration Building.
Meeting Rooms	Meeting rooms shall be equipped with ceiling mounted motorized projection screen, projectors, and speakers.
Kitchen	Kitchens shall be commercial quality, energy star compliant. Kitchens shall include refrigerators, ovens with a range ventilation hood to the outside, built-in or counter top microwaves, and dishwashers.
Dual Burner Coffee Makers	Coffee makers shall have an in-line water filter and be provided in the Training Centre and Administration Lunch Room
TVs	TVs shall all be LCD or Plasma and provided to suit the Lunch Room size.
Countertops	Countertops in all kitchens, washrooms, and dispatch areas shall be solid surfacing 12 or 13 mm thick with a backsplash–6 mm thick.
Pop and Snack Dispenser	One (1) pop and snack dispenser each shall be located in the lunch area.

Table E-10: Specialties

Specialties (the facility design shall incorporate these specialty features)	
<i>Feature</i>	<i>Design Requirements</i>
Hybrid Bus Wash System	Hybrid bus wash systems shall be environmentally friendly, with front and rear high-pressure wash and side brush systems.
Fueling Monitoring	Indoor or outdoor bus fueling service bays per facility type with full TSSA compliance for operation and maintenance
Inspection Pit Bays	Shall comprise of inspection pits, pit jacks, central pit catch basins, fluids distribution, waste fluid drains and compressed air distribution and explosion proof low voltage lighting / ventilation (bottom pit air vents).
Fluid Dispensing and Tank Storage	Fluid dispensing and tank storage shall be designed for spill containment.
Compressed Air	Compressed air distribution
Tracking Systems	Radio/Antennae/Vehicle tracking systems/Satellite TV provision
High Speed Doors	With machine safeguarding
Traffic Signals	Traffic Signals/detector loops
Environmental Controls	Separators/sand pits and Sand and oil interceptors.
Control	Geodetic control survey movements
Arrest System	Roof Fall Arrest System Travel Arrest as Required
Elevators	Electric Traction MRL Elevator(s)
Snow Melting	Snow melting at desired locations.
Floor Heating	Radiant floor heating.
Equipment	Equipment shall include Loading Dock, Door, Seal, Trailer Restraint, and Leveller Equipment.
Architectural Specialties	Include toilet partitions and screens, washroom accessories, lockers, coat and hat racks, foot grilles, coat hooks and shelf unit, ceiling mounted projection screen, pass-thru window.

Table E-11: Life Safety

Life Safety	
Feature	Design Requirements
Fire Safety Plan	<p>Fire Safety Plan to be developed specifically to the category / facility type it is design for, and consistent with local Fire Department requirements. The facility design shall incorporate the following features:</p> <ul style="list-style-type: none"> • Alarm systems–interface/monitoring including vehicle emission alarms with CO2 and NO sensors. • Automated energy and environmental monitoring/management systems • First Aid/Emergency routing • Monitoring systems • Sprinklers

Table E-12: Safety and Security

Safety and Security	
Feature	Design Requirements
Design Optimal Safe Solutions	<p>Design Consultant to demonstrate their design's optimal safe solutions based on comprehensive Risk Assessment and sound Safety Engineering Principles.</p> <p>Some elements may include Cost Benefit Analysis, Alternatives Comparison, Threat Vulnerability Assessment, Safety Factors, and Residual Risks. Office of System Safety shall be consulted for solution assessment.</p>
Site Assessment	<p>Each site shall be assessed to determine the extent to which perimeter security and controlled access points are provided. In general, perimeter fencing and controlled gated vehicular access shall be required to protect the Bus Maintenance Facility from unauthorized entry, vandalism, theft, and terrorism.</p>
Points of Entry	<p>All points of entry must be furnished with street lighting, controlled access systems monitored with closed circuit video system camera which is to be fed to a central location named by GO.</p>
Fencing	<ul style="list-style-type: none"> • Fencing shall be designed as one of the physical delineation measures around the facility to control and monitor authorized access into the area. • Designs shall consider first passive security measures i.e., CPTED (Crime Prevention Through Environmental Design) before active ones.
Design Features	<p>The design shall incorporate the following features:</p> <ul style="list-style-type: none"> • High speed gates • Surveillance

Safety and Security	
	<ul style="list-style-type: none"> • Access control–Proximity cards • Local intercom controlling gates onto property • Design facilities to follow basic Safety Engineering principles: • Eliminate hazards by engineering design • Follow FTA / APTA recommendations, guidelines for Bus Facilities • Exceed relevant safety legislations (i.e., OHSA, TSSA, CSA, OESC, CEC etc.) as required to minimize risk(s) • Consider potential future expansion, modifications, retrofits • The design of the facility shall be safe and easily serviceable, maintainable and user friendly.
Design Concerns	<ul style="list-style-type: none"> • Some of the typical, but not limited concerns include: • Fall Hazards (adequate roof perimeter protection–parapet, guardrails if necessary, adequately load rated skylights, location and position of serviceable equipment above ground level / at height, roof access, adequate clearance from the roof edge (min. 3.0 m), etc. • Aligning of lighting fixtures, gas lines, power lines (and other serviceable components) with flat landing section and avoid interference with structural components for easy access. • Avoid Confined Spaces (adequate ventilation, atmospheric condition, access, egress, rescue, etc.). • Avoid pinch points / spots / corners (adequate walkways, clearances, visibility, access, egress, reach, etc.). • Any sources of energy to be lockable–(CSA Z 460) • All qualified equipment / machine to be properly safeguarded–(CSA Z 432) • Electrical, for information on Arc Flash Hazards and labeling” after reference to Arc Flash • PSR's (Pre-Start H&S Reviews–Industrial Establishments, O. Reg. 851 / 06 section 7) to be conducted as required. • Ergonomics, cognitive concepts to be utilized (signage, information effectiveness etc.) • Human Factors, Ergonomics, cognitive concepts to be utilized (signage, information presentation, effectiveness etc.); MIL STD 1472 is suggested as a minimum, may be supplemented by other respected references. • Traffic flow to separate / reduce crossovers (cars, buses, pedestrians)
Securing and Monitoring of Facilities	<ul style="list-style-type: none"> • Design Facilities to be adequately secured and monitored

Safety and Security	
	<ul style="list-style-type: none"> • Some of the typical, but not limited, concerns include: <ul style="list-style-type: none"> ○ Follow proper Safety & Security Planning (i.e., TVA, study crime rate within the specified area etc.) ○ Entire facility's perimeter to be adequately delineated / fenced (physical security, CPTED principles to be utilized). ○ Gates / Access control plan. ○ Fire Separation Zones (vulnerable areas) ○ CCTV cameras / system ○ Other Security measures ('cash in / out' activities, secure transactions) where applicable.
Environmental Concerns	<ul style="list-style-type: none"> • Design Facilities to be environmentally friendly • Some of the typical, but not limited concerns: <ul style="list-style-type: none"> ○ Isolate and protect vulnerable areas, enhance detection systems, hardened protective materials i.e., storage tanks. ○ Spill containment to be within the room, few levels of redundancies anticipated. ○ Septic tank, if required, to be isolated from oil collecting system (potential overflow concern). ○ Bulk fluids tank to be strategically placed and protected (accidental damages).
Bus Traffic Flow	<ul style="list-style-type: none"> • Bus Traffic flow: • To eliminate 180 degree bus turns. • To separate / reduce traffic crossovers (passenger cars, buses, pedestrians) • Skylights shall be designed with consideration for material, location, position, fall protection, etc.). • Guardrails on the roof shall be provided if required as a fall arrest system.

Table E-13: Communications

Communications	
<i>Feature</i>	<i>Design Requirements</i>
Key Components	<ul style="list-style-type: none"> • The key components of communications in bus maintenance facilities are as follows: <ul style="list-style-type: none"> • CCTV • Security and Telephone (interconnected with GO regional offices) • Network synchronized clock and coax cable distribution. • PRESTO

System Interface	<ul style="list-style-type: none"> • The following systems shall interface with existing GO related services: • Radios Trunking system • Telephones • IT/LAN • Public address system • Intercom system • Cable TV distribution system • Security system • Building Automation System (BAS) • Refer to Building Automation Systems performance specification for details. • Tank and Fuel Card Lock System • CCTV system • Signal lights
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Table E-14: Mechanical

Mechanical	
<i>Feature</i>	<i>Design Requirements</i>
Guidelines	<p>Guidelines for the design, specification, and installation of mechanical equipment are to be used in conjunction with GO's Design Requirements Manual.</p> <p>The Consultant shall ensure that all applicable codes and standards are included in the construction documents.</p> <p>Fire suppression systems shall be provided in all applicable areas.</p> <p>Domestic hot water will be supplied by natural-gas fire instantaneous hot water heaters.</p> <p>Floor drains shall be used in the office and general area and trench drains or precast concrete catch basins and degrease bays are to be provided in repair garages, bus bays and storage areas.</p> <p>Control Flow of roof drainage with heat tracing shall be provided.</p> <p>Standpipe system for type "A" facilities shall be provided.</p> <p>Use CSA approved plumbing fixtures in all washrooms, showers, lunchrooms and kitchenettes and wherever else applicable.</p> <p>Provide gravity drainage systems wherever possible.</p> <p>Comply with code requirements for indoor air quality.</p> <p>Ensure proper maintenance of repair garages, inspection pits, service lanes, and storage garages.</p> <p>High-level ducted exhaust shall be provided.</p> <p>Unit heaters or radiant heating system shall be provided at every external</p>

	<p>door location.</p> <p>Central hot water generating and distribution system shall be provided.</p> <p>Bus engine exhaust and bus auxiliary heater exhaust system, battery charging areas, lube room and hazardous materials storage, shall be provided.</p> <p>Insulate ductwork and piping shall be provided as specified.</p> <p>Piping materials, which are compatible with environmental conditions, shall be used.</p> <p>Valves, thermometers, pressure gauges shall be installed as detailed.</p> <p>Complete building automation system shall be provided. Refer to Building Automation Systems performance specification for details.</p> <p>Where applicable, provide fuel storage and dispensing system, which shall be designed and certified by a licensed engineer.</p> <p>Provide gas fired, heated, multi-station pressure washer systems.</p> <p>Provide vehicle wash systems as specified by GO standards.</p> <p>Provide in-ground bus hoists, mobile lifting columns, inspection pit axle hoists, service fluids, central vacuum systems, compressed air systems, and gas detection systems as specified by GO standards.</p> <p>Mechanical systems and services must be designed to permit future expansions with minimum disruption in operations</p>
Mechanical Requirements	<ul style="list-style-type: none"> • The following shall also be provided as part of the mechanical requirements of the facility: • Commissioning • Energy efficiency • Construction IAQ managing • Electric heat tracing and snow melting
Process Equipment and Systems	<ul style="list-style-type: none"> • Process equipment and systems to include: • Fuel storage and dispensing • Pressure-washer systems • Vehicle wash systems • Bus hoists • Fueling card lock system • Tank monitoring system • Service fluids dispensing system • Central vacuum systems • Compressed air system • Hose reels • Gas Detection Systems

Table E-15: Electrical

Electrical	
Feature	Design Requirements
Studies	<p>The following studies need to be completed for design:</p> <ul style="list-style-type: none"> • Short circuit • Protective device • Device evaluation and arc flash hazard with coordinated ground fault protection • Electrical, for information on Arc Flash Hazards and labeling • Feeder plus main brace feeders on the main switchboard
System Voltages	<p>Ensure that system voltages are adequately selected, Provide appropriate main incoming service and transformer.</p>
Power Factor Correction System	<p>Provide a power factor correction system with the following characteristics: Capacitors in banks, automatic switching of banks, maintain power factor between 0.9 and 1.0.</p> <p>Ensure that power is supplied by the nearest available utility freestanding enclosure, located near the main switchboard.</p>
Utility Power Failure	<p>In the event of a utility power failure, provide emergency power by means of a standby diesel generating set or a group of generator sets connected to a common bus.</p> <p>Also, provide an uninterruptible power system for critical components.</p>
Electrical Handholes	<p>Electrical handholes shall be precast concrete and designed for heavy traffic areas.</p> <p>Cast iron covers shall be bolted down. All metal components are to be grounded, except the cover.</p>
Surface Mounted or Suspended Equipment	<p>Provide galvanized steel mounting channel for all surface mounted or suspended equipment.</p> <p>No equipment is to be mounted directly to any wall or structural element.</p>
Enclosures	<p>Provide enclosures with the following characteristics:</p> <ul style="list-style-type: none"> • Sprinkler proof, NEMA type 1 (dry and damp) • NEMA Type 4 (outdoor and wet) • 100mm concrete housekeeping pads for floor mounted equipment, disconnect switch at each motor
Disconnect Switches	<p>Provide dedicated disconnect switches at electrical equipment.</p>
Grounding System	<p>Provide a grounding system consisting of 19mm copper clad steel ground rods and bare copper conductors around the perimeter of the building.</p>
Electrical Equipment Connections	<p>Major electrical equipment connected to systems at 600V and higher to be connected to ground system through a minimum of two (2) paths</p>

Electrical																							
Lighting System	Provide a lighting system to be designed to IESNA recommendations for industrial facilities with the following characteristics:																						
	<table border="1"> <thead> <tr> <th>Area</th> <th>Specification</th> </tr> </thead> <tbody> <tr> <td>Exterior circulation areas</td> <td>30 lux</td> </tr> <tr> <td>Exterior parking areas</td> <td>30 lux</td> </tr> <tr> <td>Pedestrian gates</td> <td>100 lux</td> </tr> <tr> <td>Building entrances and exits</td> <td>100 lux</td> </tr> <tr> <td>Interior repair garage, general</td> <td>500 lux</td> </tr> <tr> <td>Interior repair garage, workbenches</td> <td>750 lux</td> </tr> <tr> <td>Bus garage areas</td> <td>300 lux</td> </tr> <tr> <td>Utility areas</td> <td>200 lux</td> </tr> <tr> <td>Office areas</td> <td>200 lux</td> </tr> <tr> <td>Emergency and night time lighting</td> <td>20 lux</td> </tr> </tbody> </table>	Area	Specification	Exterior circulation areas	30 lux	Exterior parking areas	30 lux	Pedestrian gates	100 lux	Building entrances and exits	100 lux	Interior repair garage, general	500 lux	Interior repair garage, workbenches	750 lux	Bus garage areas	300 lux	Utility areas	200 lux	Office areas	200 lux	Emergency and night time lighting	20 lux
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	Office areas	200 lux																					
Emergency and night time lighting	20 lux																						
Lighting Control	Control interior lighting by local switches, occupancy sensors and the low voltage lighting control system. Control exterior lighting by means of a photocell and contactor with a manual override; provide a computer based low voltage lighting control system to switch various lighting circuits through the building.																						
Receptacles	All receptacles are to be duplex type spec grade to code use. Receptacles are to be located in the following places: <ul style="list-style-type: none"> • Plant Areas • Offices • Control and Electrical Room • On a dedicated circuit, at each workbench • On the roof adjacent to each HVAC unit • In wet and outdoor locations • Distributed equally along the building perimeter • Pendant cord mounter single receptacles in the repair garage and the front and rear of each hose location 																						
Welding Outlets	Welding outlets shall be installed at appropriate location for supplying power to portable welders.																						
Traffic Signals	Provide traffic signals as required near the entrances of the facility.																						
Fire Alarm Systems	Multiplex fire alarm system to be provided.																						
Bus Storage Garage	Lighting not to interfere with structural components, gas lines, power lines (easily accessible for maintenance).																						
Stair Shaft	Lighting to be easily accessible for maintenance																						

Table E-16: Future Expansion

Future Expansion	
Feature	Design Requirements
Mechanical and Electrical Systems and Services	Mechanical and electrical systems and services must be designed to permit future expansion with minimum disruption to operations.
Radiant Floor Heating Systems	Radiant floor heating systems must be expandable without cutting the slab previously installed.
Fire Suppression Systems	Must be designed so that zones installed may be expanded without modification of existing piping, or spare piping must be run from the header or pre-action control unit, for connection extension in the future. Headers and/or pre-action control equipment must be sized to accommodate the future expansion
Compressed Air Piping	Must include valves and capped connection to permit extension of the system installed in this phase without disruption to operations.
Sanitary Drainage Systems and Storm Drainage Systems	Sanitary and storm drainage systems must be installed with invert elevations and configuration to permit expansion without removal of more than 2 m ² of slab on grade at each connection within 1.2 m of building exterior wall.
Control Systems	Control systems shall include provision for future expansion without replacement or duplication of operator's workstation.

Table E-17: CCTV

CCTV	
Feature	Design Requirements
Location	Exterior to the main facility may have storage for buses and other maintenance equipment
Bus Movement	Bus movement is restricted to authorized and appropriately licensed personnel with directional control in and around the facility.

Table E-18: Automated or Monitored Gates

Automated or Monitored Gates	
Feature	Design Requirements
Features	<ul style="list-style-type: none"> • Dedicated cameras • Individual cameras for each gate • Identify individual and vehicle movement • Read license plate and or any vehicle identifiers • PTZ type set to maximize control point area • May be mounted on building or dedicated 6m pole, depending on

	location
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Table E-19: Main Gate

Man Gates	
Feature	Design Requirements
Features	<ul style="list-style-type: none"> • Individual cameras for each man gate • Identify individual and movement • PTZ type set to maximize control point area • May be mounted on building or dedicated 6m pole, depending on location

Table E-20: General Office

General Office	
Space	Design Requirements
Main Entrance Vestibule and Lobby	Main entrance vestibule and lobby shall have reception counter and separate workstation.
Unisex Visitors Washroom	Unisex visitors' washroom shall be barrier free.
Managers' Offices	Fleet Transit Safety and Facilities Managers, rooms shall be sized as per GO Standard Office Module Furniture.
Radio System Specialist Office	GO Standard Workstation Modules.
Senior Fleet Supervisor Office	GO Standard Workstation Modules.
Bus Facilities Supervisor Office	GO Standard Workstation Modules.
Administrative Staff Workstations	GO Standard Workstation Modules.
Customer Care Coordinator	GO Standard Workstation Modules.
Performance Advisor	GO Standard Workstation Modules.
Spare 'hoteling' Workstation	Spare hoteling workstation shall be common to all functions.
Storage Room	Storage room shall secure File Storage, Printer, Fax, and Vault.
Meeting Rooms	Capacity: (8/12/20 persons), as advised by GO.
Lunchroom / Kitchen	Lunchroom / kitchen shall accommodate 12 people at any given time.
Printer / Fax / Photocopier Room	Printer / fax / photocopier shall be centrally located room with supply storage, work surfaces, and office mail slot.
Men's Washroom	Men's washroom shall be barrier Free, WC's and urinals as per program requirement.
Women's Washroom	Women's washroom shall be barrier Free, 3 WC's.
File Area	File area shall be a central file and office supply and MTO Records Storage.

Table E-21: Safety and Training Programs

Safety and Training Programs (as Advised by GO)	
<i>Space</i>	<i>Design Requirements</i>
Transit Safety Group Supervisors (Min. 2)	GO Standard Workstation Modules.
Transit Safety Staff Coordinators Workstations	GO Standard Workstation Modules.
Video Viewing Room	Video viewing room Shall contain Video Storage Shelves.
Transit Safety File Storage Room	Secure file Storage Printer and Fax.
Driver's Safety & Training Centre	To be used by Transit Safety for presentations to 30 people.
Simulator room	To be used by Transit Safety for presentations to 30 people.
Training Centre Supply Room	The Training Centre Supply Room shall be provided with shelving.
Kitchenette–Training Centre	-
Safety & Training Supervisor	File storage area required.

Table E-22: Administration and Services- Operations

Administration and Services: Operations	
<i>Space</i>	<i>Design Requirements</i>
Manager of Operations and Bus Facilities	Room sized per GO Standard Office Module Furniture.
Superintendent of Operations	GO Standard Workstation Module.
Bus Operations Supervisor	GO Standard Workstation Module. File storage area required.
Bus Driver's Quiet Room	Bus drivers quiet room to accommodate recliners per program requirement.
Bus Driver's Reporting Room	Bus drivers reporting room shall have no more than 20% attendance at any time.
Dispatch Area	Adjacent to Reporting Area, with pass thru window, Radio system, Bus AVL, Train AVL, White Board, TV. Monitors faced away from general viewing. These include workstations per program requirement.
Main Communications Equipment	-
Cash In Room	Cash in room shall be located with a view to Dispatch and shall be provided with built-in workstation and pass-through window.
Driver's Mail & Forms Room	Driver's mail and forms room shall be equipped with shelving for storage and mail slots.
Men's Washroom & Showers	WCs, urinals, showers, lockers for the Wellness Centre and full lockers for Transit Safety and Station Services per program requirement.

Administration and Services: Operations	
Women's Washroom & Showers	Close to Wellness Centre, with ½ size lockers as required, placed on a 100mm concrete curb.
Bus Drivers Lockers	-
Meeting Room	-
Records Storage Room	-
Wellness Centre (With External View)	Separate Wellness Centre lockers are required. Lockers shall accommodate half size lockers per facility type requirements.
Bus Drivers' Lunchroom	Bus drivers' lunchrooms shall be sized to suit program requirement, outdoor patio with natural gas connection, and be provided with a BBQ with provision for outdoor furniture.
Bus Drivers' Kitchen	The bus drivers' kitchen shall be adjacent to Lunchroom.
Bike Storage Room	The Bike Storage Room capacity shall meet LEED requirements with electrical receptacles.
Uniforms Room	Operations and Maintenance.
First Aid Room	-

Table E-23: Maintenance Facilities- Service Lanes

Maintenance Facilities: Service Lanes	
<i>Space</i>	<i>Design Requirements</i>
Service Lanes	<p>Service lanes are drive through bays, bus wash lanes, and bypass lanes as per program requirements.</p> <p>They shall include:</p> <ul style="list-style-type: none"> • Rapid doors when required • Additional 3m at the end of a bus <p>The layout shall incorporate smooth functional-flow forward movement with minimized reverse movements, one-way traffic, and the ability to circulate buses within the property while designed to eliminate potential for sharp and abrupt turning (more than 90°).</p>
Unisex Washroom	Unisex washrooms shall be barrier free.
Wash Equipment Room	<ul style="list-style-type: none"> • Within Service Lanes • Pressure Wash in separate room

Table E-24: Maintenance Facilities- Plant Maintenance

Maintenance Facilities: Plant Maintenance	
<i>Space</i>	<i>Design Requirements</i>
Internal Driveway	In-floor heating system shall be embedded in the concrete apron and snowmelt system for all exterior door areas. Heat tracing systems shall be installed, if required.
Special Clean (Double Bay)	There shall be a minimum of one bus per bay. Industrial vacuum with six outlets and commercial grade hoses, hangers and tools, pressure washer, hose bibs, sink and trench drains. Hot & cool water source required. Vehicle exhausts system and wet area to be provided. Bus wash equipment shall be placed on elevated concrete pads. Harvested rainwater could also be used for bus wash.
Mechanical Room	Between Special Clean and Degrease. Houses pressure washer, vacuum cleaner, air compressor and related equipment and supplies. Provide foot operated wash basin(s).
Shop Electrical Room	Between Special Clean and Degrease.
Degrease Bay	In-ground hoist with sediment pits, trench drains and pressure washer with reels and hoses (wet area). Complete fluid distribution system. Vehicle exhausts system. Floor mounted equipment shall be placed on elevated concrete pads.
Body Repair Bay	The body repair bay shall contains a portable hoist to assist in transporting bus windows, windshields during removal and installation, and a vehicle exhausts system.
Fabrication Rebuild Shop	The Fabrication Rebuild Shop shall include a drill press, band saw, welding materials supplies, sink / parts washer, portable hoists, exhaust hoods and additional ventilation. Design foundation (concrete base) with adequate capacity to accept mobile hoists.
Inspection Pit Bays	The inspection pit bays shall include waste oil removal and pit jacks. Complete fluid distribution system. Vehicle exhausts system.
In Ground Hoists	Complete fluid distribution system with side drains and central drains. Vehicle exhausts system.
Above Ground Hoists	Portable bus hoists. Vehicle exhausts system and fluid distribution.
Waste Fluids Disposal Area	-
Pump Room	Oil/grease interceptors. Dedicated catchbasin as floor drains shall be provided.
Fleet Equipment Storage	Fleet equipment storage shall include mobile repair equipment.
Parts Degrease Room	Wash/spray equipment (area).
Bus Wash Area	Hybrid water recycling & wash, all structural steel to be galvanised, walls, no copper or schedule 40 pipe PVC or stainless only

Maintenance Facilities: Plant Maintenance	
Fuel Area	Anti-Slip floor, one dispenser per lane, monitoring system
Shop Equipment Storage	-
Small Comp. Rebuild / Storage	Shelving
Transit Enforcement Storage Room	Caged parts storage area
Radio Storage Room	Shelving
Radio Repair	Shelving with HVAC

Table E-25: Maintenance Facilities- Training Area

Maintenance Facilities: Supervisory Training Area	
<i>Space</i>	<i>Design Requirements</i>
Fleet Maintenance Supervisors	Workstations to be located in one room at centre of shop. Good view of shop.
File Storage, Fax/Photocopy	File storage, fax, and photocopiers shall be in the Maintenance Supervisor space.
Kitchenette	The kitchenette shall be attached to the Maintenance Supervisor's office.
Meeting Room	Seating capacity per program requirement, kitchenette, smart board, projector and power screen.
Mechanic's Training Room	The mechanic's training room shall be located on the exterior wall, soundproofed with a small kitchenette.
Classroom with Kitchenette	Seating capacity per program requirement, kitchenette, smart board, projector and power screen.
Classroom Storage	Accessible from classroom, storage for wheel chair, scooter.
Training Supervisor's Office	The training supervisor's office shall be located on the exterior wall and soundproofed.
Men's & Women's Washroom	The men and women's washroom shall be adjacent Fleet Maintenance Supervisors.

Table E-26: Maintenance Facilities- Shop Employee Service Rooms

Maintenance Facilities: Shop Employee Service Rooms	
<i>Space</i>	<i>Design Requirements</i>
Men's Washroom & Showers	The men's washroom and showers shall be barrier Free with urinals, WCs, and showers.
Women's Washroom & Showers	The women's washroom and showers shall be barrier Free with WCs and showers.

Men's Lockers	Men shall have two lockers per person & Half-Bradley's adjacent to the washroom.
Women's Lockers	Women shall have two lockers per person.
Lunchroom	Seating capacity as advised, outdoor patio.
Laundry Room	-
First Aid Room	-
Eyewash Station and Drinking Fountains	The eyewash station shall be tucked or 'nicked' in, located on the shop floor, and provided with bottle fill spouts and fillers.

Table E-27: Storage Facilities- Bus Storage Garage

Storage Facilities: Bus Storage Garage	
<i>Space</i>	<i>Design Requirements</i>
Garage	Capacity based on a Type "A" facility. Based on a (±) 14.5m long (±) 2.75m wide bus. Double Decker buses need a minimum height clearance of 5.2m in the storage garage and minimum 7m height clearance at the repair shops (includes the portable hoists clearances). Provide for future expansion (as advised by GO).

Table E-28: Storage Facilities- Stores

Storage Facilities: Stores	
<i>Space</i>	<i>Design Requirements</i>
Part's Counter	<ul style="list-style-type: none"> • Workstations with PC's, rugged stainless counter • Under counter storage for computers and office supplies
Large Parts Storage	Adjacent to Shipping / Receiving Dock, Shelving requirements
Small Parts Storage	Racking requirement
Tool Storage Room	Shelving requirement
Bulk Drum Storage & Dispensing	Area included in Parts Storage
Empty Drum Storage	Area included in Parts Storage
Store's Office	Office staff in on enclosed space with HVAC
Station Services Area	Includes one (1) office and storage room with shelving and HVAC
Tire Storage & Repair Area	Used/rebuild tires, maximum of 125 with appropriate storage and racking
Battery Storage & Charging	Shelving and chargers, special ventilation and forklift access
Bulk Fluid Storage (Oils/Lube/etc.)	Special Ventilation adjacent flammables room
Flammable Dispensing Room	<ul style="list-style-type: none"> • Blast wall, grounding, containment, special ventilation and fire safeguards

	<ul style="list-style-type: none"> • Threshold (concrete) to contain spills and dedicated catchbasin as floor drain
Mezzanine	Over Small Shop Areas with clear fork lift access.
Receiving Loading Dock	There shall be two loading docks (one at grade, one below grade with dock leveler) and one workstation shielded when doors are open.
Men's & Women's Washroom	The men and women's washroom shall be located close to the Parts Counter.

Table E-29: Other–Interior Spaces

Other–Interior Spaces	
Space	Design Requirements
Sprinkler Room	<ul style="list-style-type: none"> • Workstations with PCs • Rugged stainless counter • Under counter storage for computers and office supplies
Mechanical Room	Adjacent to Shipping / Receiving Dock, shelving requirements
Electrical Room	-
Communications Closets	Placed as needed, easily accessible
Janitor's Room	In Administration Office Area
Garbage Recycling Room	-
Other	<p>Catwalk by the clerestory windows provides access to bay fluid lines on/off valves.</p> <p>Sound Isolation shall be provided for all noise generating equipment.</p> <p>High Pressure hot water equipment shall not be located in wet areas.</p>
PRESTO Room	Placed as needed, easily accessible
Electrical Closet	Placed as needed

Table E-30: Other–Exterior Spaces

Other–Exterior Spaces	
Space	Design Requirements
Transformer	Exterior Location
Generator	Exterior Location
Patio	Exterior Ground Level Location
Gatehouse	Exterior Location
Brake Test Area	Exterior Location (included in circulation driveways)
Compressed Gas Storage Area	1 for propane, 1 for oxygen–gated, fenced with roof.
Compressor Room	Scroll Compressor with dryer

Other–Exterior Spaces	
Garbage/Recycling Storage Area	Exterior Location, visually hidden
Bulk Fuel Storage	<ul style="list-style-type: none"> • Exterior, In ground Location for 2 X 50,000 litres • Card lock system with remote access shall be provided. • SS Fittings • Double fuel pump hoses: • (1) ¾" nozzle for light trucks • (1) 1" nozzle for buses shall be provided
Service Fluids tanks	Service fluid tanks shall be guarded with additional containment near shop. Automatic Tank gauges monitoring system shall be provided with remote access.
Powered Gas Tools Storage Shed	-
Service Vehicles Parking	For Operations, Fleet and Transit Safety
Bus Storage Parking	<ul style="list-style-type: none"> • Exterior, 12 buses in a single area near fleet shop • 115V 15Amp circuits for block heaters and battery chargers
Staff Parking	<ul style="list-style-type: none"> • Exterior, parking spots with gated personnel entrance to the secure facilities compound +16 parking spots for GO Transit support • Motorcycle Pad • EV plug in locations as advised
Bus Storage Parking Expansion space	As advised
Tri-generation	If provided, minimum area needed =15m X 8m

F TECHNICAL REQUIREMENTS

F.1 Electrical

Electrical systems for GO Transit facilities shall comprise the following, including all relevant supply, protection, distribution, and control of alternating and direct current systems:

- Primary and secondary power services
- Illumination
- Grounding
- Equipment labelling and identification

Supply of Primary and Secondary Power Sources

Incoming Utility Services

Utility services to a site or building will be supplied by the local Supply Authority (PUC). Services to an electrical room or kiosk shall be underground.

Service Requirements

- Line Stations: 120/208 volt service or 347/600 volt; 400 amp min
- Maintenance, Repair, Shop and Garage facilities and facilities with elevators: 347/600 volt service
- Remote facilities: 120/208 volt service
- Incoming services, utility metering, dedicated GO Transit metering complete with remote monitoring, disconnected switches, distribution breakers shall be in one switchboard/distribution panel
- Where GO Transit has tenants, check meters shall be required. One for each tenant
- Service size shall be based on the application of conservative engineering design principles consistent with cost effective provisions for future station/terminal or other facility expansion
- Temporary facilities shall have overhead service

- Disconnect switches shall come equipped with visual means to ensure power disconnection (LED indicator or viewing window)Utilization Voltages

Table F-1: Utilization Voltages #1

System	Utilization	Voltage
Lighting	LED	347V or 120 V 1 phase interior, 347 V or 120 V 1 phase for all exterior application

Balancing of Phases

Where single-phase power is taken from a 3-phase source, the loads shall be balanced among the three distribution phases. Sites that have a single-phase source are to maintain the load on the distribution panels balanced.

Voltage Drop

The maximum allowable voltage drop is 2%.

Power Factor

The overall system power factor shall be greater than 90%. Power factor design calculations are to be 80%.

Table F-2: Utilization Voltages # 2

System	Utilization	Voltage
Life Safety Egress Lighting	LED	347V or 120 V 1 phase interior, + Life safety emergency power

System	Utilization	Voltage
Heating	Greater than 5 kW 5 kw or less	600/347 V 3 phase 120/208 V 1 phase
Life Safety Fire Pumps		600/347V or 208/120 V 3 phase interior, + Life safety emergency power
Motors	Greater than ½ HP ½ HP or less	120/208V, or 600/347V 3 phase 120V 1 phase
Elevators	Motors and Controls	120/208V, or 600/347V 3 phase + emergency power
P.A.		120V 1 phase + emergency power
Telephone System		120V 1 phase + emergency power
CCTV		120V 1 phase + emergency power to each exterior camera
Security/Alarm		120V 1 phase + emergency power
Passenger Information		120V 1 phase + emergency power
Fire Alarm		120V 1 phase + Life safety emergency power
Proof-of-Payment Fare Collection System		120V 1 phase + emergency power
Electronic Payment		120V 1 phase + emergency

System	Utilization	Voltage
Systems		power
Intercom		120V 1 phase + Life safety emergency power
Video Transmission		120V 1 phase + emergency power
Digital Clock System (network)		120V 1 phase + emergency power
Signage and Display System		120V 1 phase + emergency power
Wayside Power System:		600V 3 phase
Building Automation System		120V 1 phase + emergency power
Computers		120V 1 phase + emergency power
Fuel Management Systems		120/208V, or 600/347V 3 phase + emergency power
Sand Distribution Systems		120/208V, or 600/347V 3 phase + emergency power
Electric Vehicle Charging Systems		120V/208 1 phase
Car counting Systems		120V1 phase + emergency power

Backup Power Systems

This subject describes the functional requirements for Metrolinx facilities backup power system. The power generated by the backup system shall be either true sinusoidal 60 Hz or DC, depending on the requirements.

The intent is to ensure the continuing operation of essential equipment and services, and to

effectively move passengers from station buildings and train platforms to outside parking areas in the event of a sustained power failure.

The final design of the backup power system must include an as-built schematic drawing of the system distribution. It shall also include a checklist for commissioning, operation, and maintenance, respectively.

Back-up power generators are a mandatory requirement, for providing the majority of our operational elements/ systems for 8 hours system operational duration (and additional 16 hours of testing capacity), in the event of a power failure at the following GO facilities:

- GO Rail Line Stations (including Parking Structures)
- GO Bus Terminals (facilities with a station building only)
- GO Rail Layover Facilities
- GO Operational Support Facilities (i.e. Wolfdale, GTCC, Middlefield)
- GO Bus Maintenance Facilities
- GO Rail Maintenance Facilities

Backup Required Time

Backup Power System's design can include components such as Generator, UPS, Inverter, Rectifier, etc. As a minimum, the backup Power

System shall include diesel or natural gas generator complete with UPS systems having a minimum of 30-minute duration or UPS systems with 90-minute minimum duration if there is no diesel/natural gas generator set.

In each case, the UPS shall be double conversion continuous duty type to provide the electronic communications systems with clean sine wave power. The UPS shall be rated for life safety applications and shall be provided with signals for indication of UPS general alarms and with dial in remote monitoring control, plus a remote alarm to the station alarm system.

Diesel is the preferred fuel for backup generators. Where site and operational conditions do not allow for the use of diesel fuel, natural gas fuel powered generators are acceptable with GO approval.

Rectifiers shall be used for backup DC power in maintenance and layover facilities where required.

Design Requirements

The following table shows a list of items that are considered essential. The table shows both backup power system conditions (i.e. Generator + UPS or UPS only) and provides an estimated power draw for each item. The actual power draws shall be considered in the detail design and specification must be verified on a project-by-project basis.

Table F-3: Backup Power Systems–Design Requirements

Backup Power Systems–Design Requirements				
Essential Load	Estimated Power Draw (Watts)	WITH Generator		No Generator
Life Safety		Diesel Generator	UPS System	UPS System
Exit signs–buildings, tunnels and similar structures (LED type)	100	x		x + Life Safety
Public Address System	2,000	x	x	x
CCTV System	2,000	x	x	x
Any additional rack in the Comms. Room	2,000 ea	x	x	x + Life Safety
GO Transit telephone system	500	x	x	x
All Passenger Elevators and shafts	4,500 ea	x		
Elevator controls	2,000	x		
Alarm Monitoring Systems	400	x	x	x + Life Safety
Lighting				
Tunnels, bridges and stairwell illumination (at least 1 fixture on normal power)	2,000	x		x + Life Safety
Electrical Room Illumination (at least 1 fixture on normal power)	100	x	x	x
Communications Room Illumination (at least 1 fixture on normal power)	100	x	x	x
Service Area Illumination	300	x		x
Waiting Area Illumination–minimal	1,000	x		x + Life Safety
Platform Lighting (Train and Bus)	9,000	x		
Main Parking Lots (Surface Parking)	Project Specific	x		
Parking Structures	Project Specific	x		
Kiss n Ride (PPUDO)	Project	x		

Backup Power Systems–Design Requirements				
(Passenger Pick up and Drop off)	Specific			
Bus Loop Lighting	Project Specific	x		
Systems				
Ticket Sales Equipment	3,000	x	x	x
Communications Equipment (White board, Pins etc.)				
Presto	4,500	x		
Door Operators (Building, Vestibules, Shelters)	Project Specific			
Mechanical				
Sump/Sanitary Pump	3,000	x		
HVAC for electrical & communication room	7,500	x		
HVAC for Service Counter and Waiting Area	Project Specific			
Water Heater Equipment	Project Specific			
HVAC and Exhaust of Elevator Shafts	Project Specific			
Estimated Total Power Draw In Watts		44,000	15,000	13,500

Diesel Generators

The generator shall be provided as a factory tested single unit and rated kW, 120/208 or 347/600 Volts, 3-phase, 4-wire, 60Hz, 1800 rpm. The generator shall be certified to CSA C22.2 No. 100, EEMAC MG1-22.40, and NEMA MG1, and shall meet the requirements of Ontario Electrical Safety Code, ESA, EPA, MOE, TSSA, along with all applicable local codes and regulations.

The generator shall be self-ventilated and shall be a single bearing type direct coupled to the engine. Under short circuit conditions, the generator shall be capable of delivering sufficient current to enable protective breakers to trip.

- Ambient working temperature: -35°C to 40°C
- Acceptable noise level: MOE standards or as per table below at 7 °C or whichever is the most stringent

Noise Matrix Table

Table F-4: Generators Noise Levels

kW	dB(A)	Metres
≤ 150	65	7.0
175 to 500	75	7.0
600 to 1200	80	7.0

Diesel Engine

The engine shall be EPA compliant with maximum NOx plus HC of $3.87 \frac{g}{kW/hr}$.

ULC/CSA labelled double wall construction sub-base mounted steel fuel tank with an enough storage capacity to run the generator set at full load for 24 hours without refueling. The tanks and fueling system has to be accepted by TSSA and equipped with fuel paddling system.

Natural or Propane Gas Engine

Include liquid cooled, spark ignition engine.

Furnish engine and cooling system capable of driving generator at specified load for minimum of 120 minutes, taking into account fuel type and altitude duration and at maximum ambient temperature of 122 °F (50 °C).

Isochronous Governor: Speed regulation plus or minus 0.25 cycle from no load to full load with two-second recovery to steady state.

Integral 10-amp system battery charging system, unit mounted to maintain emergency system batteries at required charge levels.

Listed Fuel Systems

Include CSA Certified Listed Natural Gas regulator for 7-14" water column gas pressure entering, complete with the following cUL Listed installation accessories:

- Flexible engine connection fuel line
- Electric fuel solenoid valve
- Fuel line strainer

Dual Fuel Systems

Include the following:

cUL Listed Natural gas regulator for 7-14" water column gas pressure entering complete with the following cUL Listed installation accessories:

- Flexible engine connection fuel line
- Electric fuel solenoid valve
- Fuel line strainer

cUL Listed LP vapour regulator complete with the following cUL-listed installation accessories:

- Flexible engine connection fuel line
- Electric fuel solenoid valve
- Fuel line strainer

Accessories

Include replaceable type oil filters, dry type air cleaners, automatic choke, lubricating oils, greases, and coolant.

Alternator

The alternator (generator) shall be 120/208 or 347/600 Volt, 3 phase, 4 wire, 60 Hz AC, drip proof, rotating field type with an integral exciter of

the brushless or static type and a static voltage regulator utilizing silicon rectifiers on solid state amplifiers.

Voltage regulation shall be within plus or minus 2% of rated voltage for all loads from no load to full load. Output voltage shall be manually adjustable over a range of plus or minus 5% of rated voltage.

Rotors shall be salient pole type with amortisseur windings. The generator shall include for 300% short circuit capability for 10 seconds.

Engine-Generator Mounting

The engine and generator shall be aligned and mounted on a common fabricated steel base of sufficient rigidity to maintain adequate alignment. Approved adjustable steel spring vibration isolators shall be supplied with such set by the set manufacturer.

Control Panel

Environmentally sealed, solid state, microprocessor-based module for engine control, monitoring, protection, and metering.

The controller shall meet the CSA (Z462). The controller shall be listed under ULC and UL-508. Set-mounted controller capable of facing right, left, or rear shall be vibration isolated on the generator enclosure. Remote-mounted controller shall also be supplied.

The microprocessor control board shall be moisture proof and capable of operation from -40° C to 85° C. Relays will only be acceptable in high-current circuits.

The unit must be able to interface easily to provide remote monitoring and control capabilities over the Metrolinx Windows based Network. Monitoring shall include, but not be limited to, the following:

- Dual range voltmeter +/- 2% accuracy
- Maximum demand ammeter +/- 2% accuracy
- Voltmeter-ammeter 3 phase selector switch
- Battery charging voltmeter and AMP
- Coolant temperature reading
- Oil pressure reading
- Running time

- Direct reading frequency meter 0.5% accuracy on 45 to 65 Hz

System Protection

Circuitry to shut down the engine when signal for high coolant temperature, low coolant level, low oil pressure, or over speed is received. Circuitry shall be of plug-in design for quick replacement. Controller shall be equipped to accept a plug-in device capable of allowing maintenance personnel to test controller performance without operating the engine. The controller shall include:

- Indicating Lights to signal
- Standard (Not-in-Auto [flashing red])
- Equipment (Over crank [Red])
- UPS + Generator Stop [Red]
- High Engine Temperature (Red)
- Over speed (Red)
- Low Oil Pressure (Red)
- Air Damper (Red)
- Battery Charger Malfunction (Red)
- Low Battery Voltage (Red)
- Low Fuel (Red)
- Auxiliary Pre-alarm (Yellow)

Exterior Enclosure

Table F-5: Exterior Enclosure

Exterior Enclosure	
Exterior Weatherproof Enclosure:	<ul style="list-style-type: none"> • Common keyed pad-lockable doors • Compliant with CSA Standard • Sound Attenuated • Capable of withstanding 150mph sustained winds • Designed to resist rainfall angles of up to 45 degrees without interior flooding • Enclosure to be rodent and serpent proof
Construction:	<ul style="list-style-type: none"> • Aluminum panel construction • Power baked paint
Roof:	<ul style="list-style-type: none"> • One piece pitched roof designed to prevent water accumulation

- Auxiliary Fault (Red)
- System Ready (Green)
- Optional (Pre-alarm High Engine Temp. [Yellow])
- Anticipatory (Pre-alarm Low Oil Pressure [Yellow])
- Group (Low Coolant Temp. [Red])
- Push to test button for indicating lights
- Alarm horn with silencer switch per CSA (Z462)

Note: Terminals shall be provided for each signal in above, plus additional terminals for common fault and common pre-alarm

Minimum Required Accessories

- Line circuit breakers
- Dedicated load bank of 100% capacity for each generator (On Site)

There shall be a load bank for testing available on site rather than bringing a load bank onto site and connecting and disconnecting it. This load bank shall be able to be added in steps for testing up to 110 of the generators capacity. The controller shall have provisions for disconnecting a load bank (during exercise) if there is a loss of normal power by an Electrical and Mechanical interlock through ATS.

Exhaust System:	<ul style="list-style-type: none"> Internally mounted muffler and sound insulating Panels Catalytic Converter: Include catalytic converter when defined by local codes
Doors:	<ul style="list-style-type: none"> Door Hardware: Corrosion resistant, zinc plated or stainless steel Hardware locks to be keyed the same Door drip caps designed to keep moisture accumulation off the top of doors Doors hinged to allow 180 degree opening
Sound Attenuation:	<ul style="list-style-type: none"> Generator to be sound attenuated Average dB level, measured at 7 meters from generator center, at full load, not to exceed 73 dB
Block Heater:	<ul style="list-style-type: none"> 1500 watt
Space Heater:	<ul style="list-style-type: none"> Include inside enclosure, thermostatically controlled to maintain 10 °C, except when engine is running, in accord with CSA C282, 208v
Motorized Louvers:	<ul style="list-style-type: none"> Include on air intake to meet CSA C282, level 2 sound attenuated
Emergency Lighting:	<ul style="list-style-type: none"> Include inside enclosure, 50 lumens, DC battery powered, two hour operation, in accord with CSA C282
Engine Fluid Containment Pan:	<ul style="list-style-type: none"> Sized to 110 percent of available fluid in accord with CSA C282

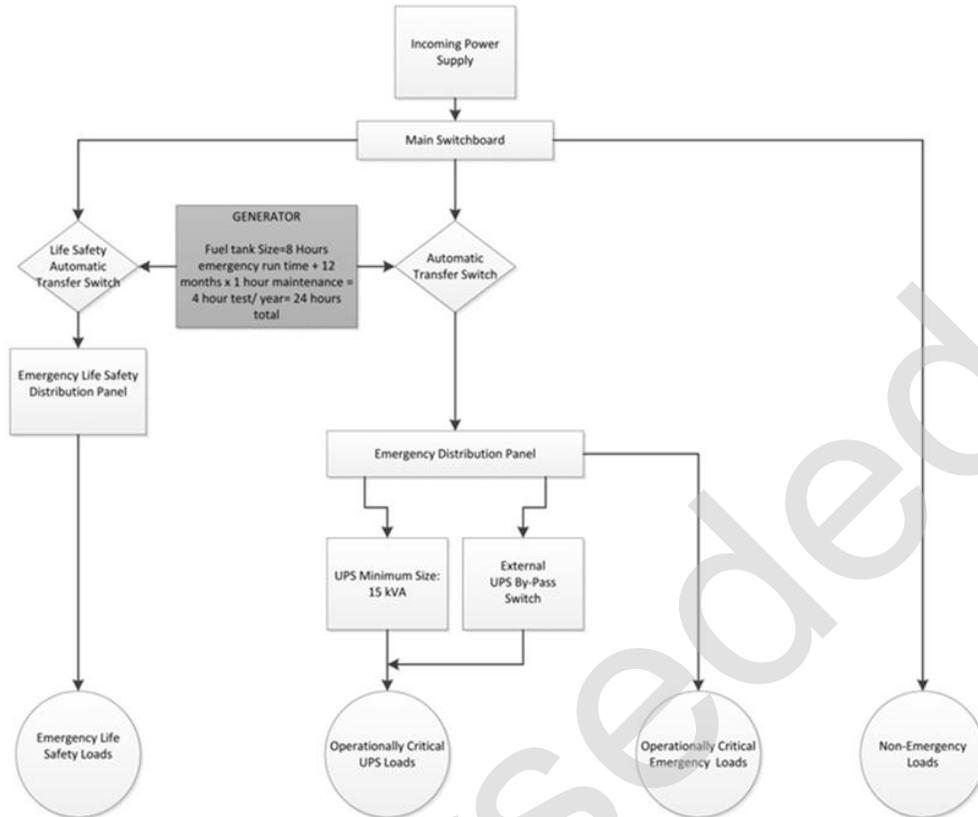
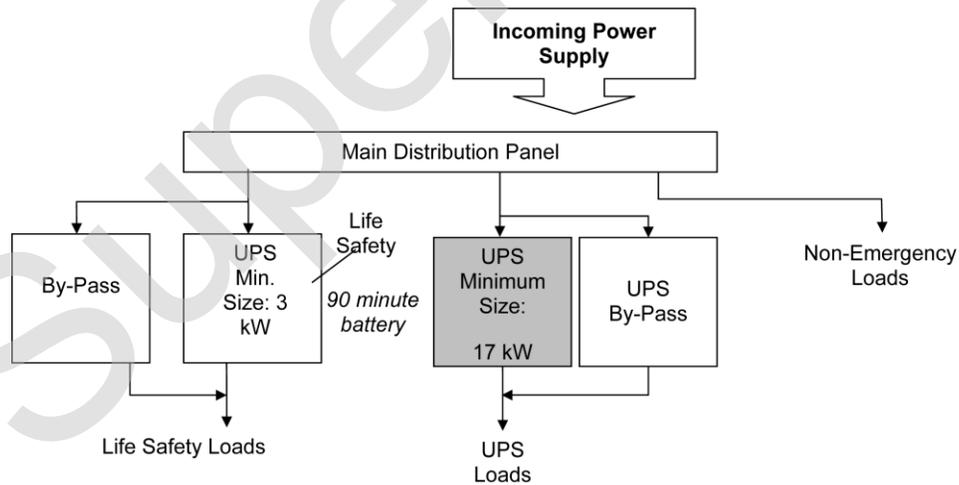


Figure F-1: Emergency Power Distribution with Generator



N.B. The above estimated size of generator/UPS would be the minimum size allowed. The actual size is to be based on specific facility requirements such as parking lot size, building size, number of platforms and tunnels, elevators, etc.

Figure F-2: Emergency Power Distribution without Generator

Uninterruptible Power Supply (UPS)

Uninterruptible Power Supplies (UPS) are used to support Life Safety systems and protects computers and other sensitive electronic loads from power outages and other power anomalies. This Section includes 3 phase ≥ 3 kVA and Single phase < 3 kVA, on-line, static-type, UPS system, comprising the following:

- Complete rectifier/charger-battery-inverter system with automatic static switch and maintenance by-pass circuit
- Central Monitoring System for all UPS units, along with proper interfacing with Metrolinx software, IT communication, and station operations shall be provided in order to display and control all required parameters.
 - All intercommunication shall be through the Mod bus, BAC Net, etc.
- Input isolation transformer for UPS units, where technically required
- Connection of normal AC power from assigned terminals/switch/circuit breaker

The UPS shall be of commercial type and shall comply with relevant IEC, EIA, NEMA, NFPA 70, IEEE, ISO 9001, ISO 14001, UL-1778, CSA, FCC Class A, and Life Safety certified standards. Radio frequency interference (RFI) suppression shall be in accordance with CISPR and IEC 50091-2 recommendations. UPS shall be certified for use to support Life Safety Systems.

UPS assembly shall include a mimic diagram with digital and LED displays, indicating instruments and control devices, in true relative positions.

To meet the existing codes, a separation of equipment backup power and life safety devices must be achieved by a life safety approved UPS system. The UPS shall be interposed between normal AC power supply and critical load, to secure a minimum period of continuity of no-break battery backup in case of failure of normal AC supply, maintain output voltage, frequency, and phase deviation within specified tolerances. An initial 50% expandability shall be incorporated for future provisions added in later. The UPS is not to be loaded more than 80% of its overall capacity

System shall be of the programmable type, microprocessor based with CPU and memory capabilities for storage of alarms, faults, status change, etc. The UPS shall permit setting parameters for the environment and type of usage to be specified. UPS shall be of the self-diagnostic type, equipped with a self-test function to verify correct system operation. The self-test shall identify the parts of the UPS requiring repair in case of a fault. The system shall be provided with multi-password levels to limit access to software and data

Non-Redundant System: System complete with one set of rectifier-battery-inverter with integrated static switch and external maintenance bypass. UPS shall be maintained (continuously supplying load through the inverters), with automatic no-break transfer to or retransfer from alternate source (bypass) in case of failure or overload on rectifier- battery-inverter system

- System overall efficiency shall be not less than 92% at full load and 91% at half load
- Noise level of complete assembly is not to exceed 55 dB (A) at 1.0 m distance anywhere within the room that the UPS is located
- Temperature limits within which equipment is to be designed to operate are 0°C to +40 °C at 100% rated output.
- Equipment shall be capable of operating up to 55°C ambient conditions with a derating factor of 1.25% per °C over 40°C
- The system shall have an external maintenance bypass that will allow the removal and replacement of the UPS without rewiring.
- The Voltage supplied to the UPS shall be the voltages on the output of the UPS
- The UPS is to be located inside the Electrical Room

Rectifier/Charger

- Nominal input voltage: 208 or 600 V as required, 3 phase, 4 wire, 60 Hz or available voltage upon approval
- Voltage input variation: +10%, -15% from nominal
- Frequency: +/-2% from nominal
- Transformer exciting current in rush: less than 600% nominal current
- Power factor: 0.8 smooth and step less at full load and nominal input voltage
- Total harmonic feedback: maximum 5% (total)
- Current limiting: 120% maximum of that required to operate inverters and charge battery at full
- Rated load, adjustment possible between 100% and 130%
- Walk-in current in rush: 25% to 100% FLC in 15 seconds
- Over-load rating: 130% for 10 minutes, 150% for 60 seconds, and 110% continuous
- Input Filter Disconnection: UPS control system shall disconnect the input filters in case of
- Interruption of utility power supply failure while the UPS is operating at light loads (less than 25%) output
- Float and equalize operation: Adjustable, automatic, compatible with battery
- Regulation: +/-1% maximum from 0-100% load
- Ripple: +/-2% rms. (0–100% resistive loads)

Battery

High rate discharge, heavy duty, industrial, high impact resistant, clear plastic encased, sealed (gas recombination) type cells with automatically re-closing explosion proof safety vents.

- Ampere-hour rating shall be sufficient for UPS + Generator period specified with all inverters operating at full rated output, to a discharge limit of not less than 1.65 V per cell

- Cells shall be normally maintained at 2.25 V per cell
- Equalize charging of battery cells according to manufacturer's written instructions
- Record individual-cell voltages

Inverters

Inverter shall employ Insulated Gate Bipolar Transistors (IGBT) technology in three-leg, pulse width modulation (PWM) design with high frequency switching technique, and complete with output transformer and filters. Inverter start-up shall be automatic, to reach full voltage within milliseconds and deliver power to the load within 2 seconds. Inverter shall start at any load including short-circuit.

- Nominal net system power output rating
- Nominal output voltage: 208 or 600 V as required, 3-phase, 4-wire, 60 Hz, adjustable +/-2% of nominal

Output transformer shall be two winding dry-type, Class H insulated, class B temperature rise, with metallic electrostatic shielding, high efficiency (98%). Output voltage regulation:

- Balanced load: +/-1% (0–100% load)
- Unbalanced load (3-phase output only): +/-3% (at 10% unbalance)
- Phase displacement: 120° (+/-5°) at 100% load unbalance
- Inverter Output Neutral: Designed to continuously carry twice the full load phase current
- Output voltage waveform: 5% max
- Total harmonic 3% max single harmonic
- Frequency stability: Normally synchronized to input line frequency over +/-2 adjustable ranges, free running at +/-0
 - Full battery voltage variation, load and P.F. range; slew rate not to exceed 0.1 Hz/sec. Battery

Control and Monitoring Panel

Local panel instruments shall include at least the following digital readings:

- Inverter output overload, indicating inverter output beyond specified rating failure of any stage, DC bus earth fault, and inverter output earth fault
- Event history display for at least last 200 events
- System on battery supply
- Inverter phase locked to verify synchronization between inverter output and normal AC supply input
- Static switch on normal AC supply (bypass mode)
- Static switch inhibited
- Over-temperature, indicating excessive temperature in heat sinks for transformers, rectifier/charger and inverter (alarm to automatically transfer load to by-pass circuit)
- Inverter input voltmeter, measuring DC bus volts
- Battery ammeter, measuring charge/discharge current with battery status monitoring system
- AC voltmeter to measure inverter output voltage, normal supply voltage or system output
- UPS output ammeter and frequency meter

System Protection

- Inverter on / off
- Battery input circuit breaker
- Auto / Manual reset-test switch, Manual reset switch, Hybrid switch transfer test push-button and Indicator test / reset switch
- Re-transfer auto/inhibit selector switch to allow automatic re-transfer of load to inverter after timed interval of normal operation and inhibit re-transfer of load to inverter until hybrid switch is in auto-mode
- Battery automatic/equalize recharge timer, 0-30 hours adjustable, with

automatic/boost/equalize switch (accessible to maintenance personnel only and to be used only with manufacturer's recommendation for battery specified)

- Voltage and frequency adjustment controls with locking devices (accessible to maintenance personnel only)
- Control power supply isolator (accessible to maintenance personnel only)
- Alarm test-accept-reset

Transfer Switch (Automatic and Manual Bypass Switch)

General Requirements

The transfer switch shall be 120/208 or 347/600 V, 4 wire, 3 phase, 100% rated in Amperes for total system transfer including control of motors, electric-discharge lamps, electric heating, electronic and tungsten-filament lamp load. Switches rated 400 A and below shall be suitable for 100% Amp loads. Switches rated above 400 A shall be suitable for 80% Amp loads.

Automatic transfer switch shall be rated for continuous duty or repetitive load transfer switching. The bypass-selector switch shall provide operating positions: Bypass Normal, Bypass UPS + Generator, and Bypass Open.

A two-way bypass isolation switch shall provide manual bypass of the load to either source, permit isolation of the automatic transfer switch from all source, and load power conductors. All main contacts shall be manually driven. Electrical and Mechanical interlock arrangements utilizing electrically driven contacts are prohibited. The manual bypass handle will provide two operating modes: Bypass Open and Bypass Closed. Bypass to the load-carrying source shall be affected without any interruption of power to the load (make-before-break contacts). Load break-type bypass for ATS test and isolation shall not be acceptable. In the bypass open mode, bypass contacts shall be open so they will not be subjected to fault currents.

The control module shall be mounted separately from the transfer mechanism unit for safety and ease of maintenance. Interfacing relays shall be industrial control grade plug-in type with dust cover. All moveable parts of the operating mechanism shall remain in positive mechanical contact with the main contacts during the transfer operation without the use of separate mechanical interlocks.

Alarm Monitoring Services

- Fan failure: Alarm only
- Over Temperature: Alarm with automatic transfer of load to by-pass after a safe pre-set period
- D.C. Volts out of Limits: Alarm with indication
- Fuse Failure: Alarm only
- Battery on Load/Disconnected: Alarm only
- Overloads: Alarm only with a trip command if pro-longed, for each rectifier/inverter unit
- Normal AC Supply Failure: Alarm only
- Hybrid Switch Operation to By-Pass Mode: Alarm only
- Low and High Output Voltage: Alarm only
- Figure: Emergency Power Distribution with Generator

Distribution of Primary and Secondary Power Sources

In general, loads shall be locally fed from power panels, distribution panels, and motor control centers. General lighting and system circuits shall be alternately circuited to maintain partial lighting in the event of circuit failure.

Service Duct Banks

Service duct banks shall conform to OESC (Ontario Electrical Safety Code) latest edition inside property line, or rail corridor per AREMA, CSA Standard C22.3 No. 7 Underground Systems, and OESC, coordinate with local Hydro and Bell for area having jurisdiction and for utility requirements.

Provide concrete encased duct banks in heavy vehicular areas and fire routes. Minimum 30% spare conduits with pull-cords shall be provided in duct banks for future use, coordinate with Metrolinx.

Wiring Methods

Raceways

Raceways and branch circuitry shall be implemented to minimize failure of a complete system due to failure or malfunctioning of any single electrical component. Distribution minimizing conductors of different circuits sharing common raceways and pull-boxes, etc., shall be implemented. Raceways selected shall suitably resist mechanical damage and environmental deterioration effects. In particular, special attention shall be applied to corrosion inhibitors and protective coatings or treatments on surface mounted conduit in underground areas (e.g., tunnels, below grade electrical rooms, Bridges and parking structures etc.).

A minimum 12 AWG stranded copper wire green insulated RWU90 below grade and RW90 above grade shall be placed inside each raceway. This wire is to be used as a tracer wire inside a buried raceway for the purpose of locates after installation.

Refer GO Standard specifications for detailed requirements

Conduits

Rigid galvanized steel conduit, or other GO Transit approved cabling methods shall be used for all exposed work in normally dry areas not likely to present corrosion problems. Rigid steel or rigid PVC conduit may be used embedded in slabs where high impact protection is required. Rigid non-metallic conduit shall be used below ground, either direct buried or concrete encased.

PVC or epoxy coated rigid galvanized steel conduit shall be used in corrosion problem areas. Conduit, having a minimum of 50mm shall be used in parking lots when deemed necessary. Concrete encasements shall be provided for bus loops, road crossings, and railway Right-of-Ways. In finished areas, all conduits shall be concealed.

Refer GO Standard specifications for detailed requirements

Cable Trays

Where required, hot dip galvanized cable trays shall be ladder type; steel or aluminum or non-metallic as required for the application, complete with vertical barriers to separate systems or cables as required. Class shall be selected based on conductor weight plus 50% spare capacity as a minimum. Cable trays to be cantilever-supported for ease in installation of cables. Fire barriers of multi-transit type shall be provided at firewalls and fire separations, and shall be in accordance with the O.B.C. and CAN4-S115-M.

Types of Cable trays to be used:

- Wire Cable Trays: Used under raised floors
- Ladder Cable Trays: Used in Electrical/Communication Rooms
- Enclosed Cable Trays-Cable bus from transformers to main substation switch gear, outdoors

Wire and Cable

All conductors shall be stranded copper. Conductors smaller than No. 12 AWG shall not be permitted for lighting or motor branch circuit wiring, except that No. 14 AWG multi-strand type conductors may be used for control circuits only. Provide appropriate connection for terminating and standard wire.

Conductors shall have a minimum insulation temperature rating of 90°C, but design shall be for 75°C. All conductor insulation shall be colour coded.

Responsibility

The Consultant shall specify responsibility for wiring and equipment connections. Examples: For voice-activated intercoms, the type of wiring is to be as recommended by the equipment supplier, and is to be installed by the electrical contractor, but connected by the equipment supplier. For the P/A, CCTV, and security systems, the electrical contractor shall provide conduit with pull-strings, and the equipment supplier shall install wiring and the equipment, making all connections, testing and commissioning.

Enclosures

Enclosures shall be selected for the environment in which they are intended to be installed. In

general, enclosures for indoor, dry application shall be EEMAC sprinkler proof type 1 or type 12 where applicable. Enclosure for damp and wet areas (e.g., tunnels and escalators or elevator pits) shall be EEMAC type 4x.

- Where installed in public areas, all enclosures, cover-plates, outlets plates, access panels, and handwells shall be provided with method of securing doors and covers. All enclosures and panels shall have a common key and in an enclosed, protected area where possible
- Manholes and handholes shall be located remotely from doors and main road and pedestrian traffic areas
- No splices are permitted below grade
- Underground conduits entering Mechanical, Electrical and Communications Rooms from the exterior shall be sloped to ensure positive drainage away from room
- Underground raceways entering any Mechanical, Electrical or Communications Room shall be interrupted by a drained manhole or handhole within 3000 mm of the room
- The minimum opening in the top of the handhole shall be no smaller than 460 mm
- The lip of the handhole and manholes shall be identified as to the type of service within by means of grooves cut into the collar of the handhole or manhole.
- These markings are on the collar shall be 2 grooves; 3 mm deep for communications in the direction of conduit in and out and 1 groove; 3 mm deep in the direction of conduit in and out for electrical
- All electrical or communications handholes placed in the path of vehicular traffic or snow removal equipment shall be OPSD-2112.040 with OPSD-401.030 covers. If OPSD-2112.02 handholes are used, the covers shall be reinforced

Relay Protection and Metering

Relays shall have RS485 communication port and connectivity to monitoring system using Modbus RTU protocol as a minimum. Communication ports of relays and meters on the bus shall be daisy chained from breaker cell to breaker cell and connected to a separate terminal block for connection to a SCADA system.

Phase overcurrent and ground fault devices shall be coordinated such that ground faults, short circuits, or overloads will trip only the immediate upstream protective device from the point where the fault or overload occurs.

The Preliminary Arc Flash hazard study analysis shall be submitted along with the design drawings prior to the co-ordination study. The preliminary arc flash study shall be used to modify the design in order to minimize the hazard. The study shall also be used for the floor boundary marking. The Preliminary Short Circuit, Load Flow, and Coordination study analysis shall be submitted with design. The final studies shall be provided after purchasing of equipment.

Dedicated incoming digital metering shall be provided, beside Hydro metering, and shall measure true RMS current, voltage and display and provide 2 years history capabilities per phase.; Volts, Amps, kW, KVA KVAR, Pf, Hz, kW demand and peak. Communication port shall be provided; Meters shall be mounted at eye level (approximately at 5'-6" A.F.F) Metering devices shall be housed in a separate compartment enclosure, have no exposure to 600 Volt bus or terminators. Contractor to obtain validation certificate from Hydro Utility for the meter installed on behalf of the owner.

Surge Protective Devices (SPD, formerly known as TVSS), Lightning, Phase Over & Under Current and Ground Fault Protection shall be provided as required for protection and safety of building, equipment and personnel. SPD is to be distributed through the distribution system.

Dedicated incoming digital metering, besides Hydro metering, and sub-metering, shall be provided, and shall measure true RMS current, voltage, and display, minimum 3 years history capabilities. Units to be measured: per phase Volts, Amps, also kW, KVA KVAR, Pf, Hz, kW demand, and peak.

Receptacles

Receptacles shall be specification grade suitable for back and side wiring and complete with wire ground terminal. Receptacles shall be 20 amp 120 volt duplex non-locking grounding type (CSA configuration 5-20R) in service areas and 15 amp 120 volt duplex locking ground type (CSA configuration L5-15R) in public areas. Stainless steel face plates shall be used throughout. Twist lock receptacles and special coloured ground receptacles to be used in communications.

Receptacles shall not be on lighting circuits, and there shall be no more than six (6) receptacles per circuit in public areas, and no more than four (4) receptacles per circuit in service areas.

In general, building areas—janitorial outlets are required for cleaning and maintenance. In public open areas, receptacles shall be spaced at 5 m centres maximum, and at ceiling level for Christmas Lights as directed by GO transit. Tunnel and exterior building receptacles shall be GFI type, located at spacing to suit 15 m extension cords or as required by GO user groups during detail design review.

Refer GO Standard specifications for detailed requirements

Other receptacle requirements:

- Electrical/mechanical rooms—minimum 2 receptacles per room
- Station attendant room—See Tab 4: electrical and communications outlets for computers and fare equipment, voice-links and alarms, etc., in millwork and walls and partitions
- Elevator and escalator machine room, as required by Code
- Maintenance facility, shop and garage receptacles shall suit equipment requirements
- Receptacles shall also be provided for tenants and vending machines as required
- Communications room—minimum of 4 receptacles with 2 on emergency power

Switchboards

- Factory assembled, dead front, metal enclosed and self-supporting switchboard. Complete with line and load side terminations
- Bus material to be copper, silver-plated
- Bus bracing minimum 65 ka rms
- Enclosure: CSA type 2, indoor use equipped with arc flash reduction protection
- Control compartments to be installed on front of the board away from buses
- Future Provisions: fully equipped spaces for future devices with bussing and bus connections suitably braced for short circuit currents
- Allow for 25% spare breakers on new installations

Construction and Ratings

Factory assembled, dead front, metal enclosed and self-supporting switchboard. Complete with line and load side terminations. Bus material to be copper, silver-plated. Bus Bracing minimum 65 kA RMS. Enclosure shall be CSA Type 2, Indoor use equipped with arc flash reduction protection. Control compartments to be installed on front of the board away from buses. Future provisions shall have fully equipped spaces for future devices with bussing and bus connections suitably braced for short circuit currents. Allow for 25% spare breakers on new installations.

Service Entrance Circuit Breakers

Provide Sensor and trip plug, solid-state trip circuit breakers, 100% continuous duty rating, factory mounted.

Monitoring and Metering

Provide dedicated digital monitoring meters system and sub-meters c/w remote communication capability and capable of storing data for minimum 3 years.

Trip Unit Functions

Trip unit functions shall have adjustable; long time ampere rating; long time delay; short time pick up; short time delay; Instantaneous pick up.

Ground fault protectors shall be as per OESC requirements. If ground fault is required, main breakers provide ground fault protections for downstream breakers as well.

Panelboards

Shall be flush or surface mounted as required, complete with hinged locking door and flush catch, and finished with corrosion-resistant primer, equipment gray. Surface mounted panelboards shall be installed on unistrut galvanized steel framing channels with 75 mm clear between back of panelboard and wall. Where practical, panelboards shall be grouped in proximity.

Panelboard shall be copper bus type, with full capacity solid neutral design and sequence style bussing, composed of an assembly of bolt-in-place moulded case circuit breakers with thermal and magnetic trip and trip-free position separate from either the "ON" or "OFF" positions. Multi-pole circuit breakers shall have common simultaneous trip.

Overcurrent devices feeding emergency equipment shall be located only in electrical equipment rooms, and fitted with breaker locking devices. Provide 30% spare breakers in panel; Allow for 30% spare Amp capacity and spaces in each panel. Panel boards shall be provided with type-written directories indicating loads controlled by each circuit installed in metal framed clear acetate cover, affixed to the inside cover of the panel board.

Provide panels that will allow the monitoring and control of each circuit. The CT/PT, transducers, relaying, shall be able to send information by means of a network connection and address system to both a local and remote communication to power monitoring system.

For retrofit panels, provide relays, CT's and PT's in a relay control panel as close as possible to the power meter monitoring system which is connected to the local and remote communication to power monitoring system.

Provide dedicated relay panel, smart panels, powerlink panels, multi circuit monitoring panel or equivalent, for circuit control, energy saving and monitoring capability. Requirements shall be established on site-by-site basis together with Metrolinx.

Refer GO Standard specifications for detailed requirements

Switches and Disconnects

Refer GO Standard specifications for detailed requirements

Switchgear

All components at the completed assembly shall be CSA approved and bear a CSA label. Dimensional Coordination: Verify that dimensions of switchgear do not exceed spaces provided.

Refer GO Standard specifications for detailed requirements

Construction and Ratings

- Use arc-resistant, metal-clad switchgear, free standing, and dead front steel structure. Vendor shall provide details describing that arc-resistant testing of equipment
- The switch gear assembly shall be suitable for bolting each cell to steel rails embedded in concrete floor of a substation building
- Sheet steel barriers shall be provided between the vertical units and between the control compartments and the power compartments
- The switchgear shall be suitable for the future additions of units at each end
- A copper ground buss shall be installed for the entire length of switchgear, affording connection to all units and equipped with solderless #2/0-4/0 cable connectors at each end
 - Bus material to be copper, silver plated
- For outdoor units provide waterproof and tamper proof equipment
- Space heaters 240 volts, operated at 120 volts
- Meters, indicating lights, protective relays shall be mounted on the front of the switchgear panels and arranged in an approved, logical, symmetrical manner
 - Meters and readout devices shall be mounted at eye level (approx. 1675 mm A.F.F.)
- Digital Metering and Relaying: Provide dedicated power monitoring meters system

and sub-meters c / w remote communication capability and capable of storing data for minimum 3 years

Building Automation System (BAS)

Refer to the Building Automation Systems performance specification.

Monitoring and Controls

Power Circuit Breakers

- The power circuit breakers shall be 3 pole, single throw, vacuum break, and draw-out type, 5 cycle operation, with self-aligning primary and secondary disconnecting devices
- The breakers shall be 100% continuous duty, 5 cycle operation maximum
 - Each breaker shall be equipped with “stored energy operation” type, anti-pump operating mechanism. It shall be possible to open and close all breakers manually
 - Remote operation of each breaker from a remote control panel
 - OPEN and CLOSED complete with visual verification (indicating light)
 - Breakers to have capability of lock out, tag out, and locked in open position
- The draw out mechanism shall hold breaker rigidly in the fully connected, and full test/disconnect position, with the door closed
 - Breaker shall be capable of being locked in the test/disconnect position
 - Breaker cell door handle shall be capable of being locked in the door closed position
- Interlocks shall be provided that will prevent disconnecting the breaker from the bus stabs or inserting the breaker into the bus stabs unless the breaker is in the tripped (open) position
 - Interlocks shall be provided to only allow installation of the properly rated breakers in the appropriate rated cells

- A non-metallic barrier shall be provided that effectively closes six “bus” stab disconnect holes when the breaker is withdrawn
 - Breaker shall be capable of being manually racked into or out of the connected position with the front door closed.
 - A toggle switch shall be provided on the cell door to disconnect the breaker
 - Breakers shall have digital read out capability complete with network connectivity
- Vendor shall state any requirements necessary to provide protection from transient overvoltage’s that could result during operation of the breakers quoted

Instrument Transformers

Current Transformers (CT)

Current Transformers shall have 5-ampere secondary and primary rating as specified on the attached single line diagrams. Current transformers shall not saturate (i.e. reach the knee of the saturation curve) at short circuit currents of KAic asymmetrical. Saturation curves shall be supplied.

Accuracy shall be in accordance with ANSI C37.20 and CSA C13 for the metering or relay applications for which they are being used. The manufacturer shall stake the CT accuracy in the quotation. All taps from multi-ratio and dual-ratio CT’s shall be wired out to shorting terminals

Voltage Transformers (VT)

Voltage transformers shall be mounted in a separate draw out compartment. With the compartment closed, the transformers shall be completely isolated and the primary and secondary disconnect contacts engaged with their respective stationary contacts to complete the circuit. On opening the compartment, the contacts shall automatically withdraw (breaking the primary and secondary connections and grounding the primary for inspection and maintenance. PT and CPT compartments and drawers shall have ability to be padlocked in the open or drawn out position.

VT shall be protected with fuses on primary and secondary sides and shall be designed to withstand the basic impulse level of switchgear.

Main switchgear requires its own control power transformer c/w fuses and terminal strip distribution. These systems must be readily accessible from front of switchboard.

Low Voltage Transformers

Refer GO Standard specifications for detailed requirements

Circuit Breakers-Moulded Case

Protective disconnect devices shall be moulded case automatic thermal-magnetic circuit breakers except where distribution system fault current dictates the use of fuse disconnect switches. The single line-wiring diagram for the building shall indicate the available fault current at the service entrance and on each main bus.

Voltage surge, lightning, phase overcurrent, and ground fault protection shall be provided as required. For load protection other than motors, use moulded case circuit breakers with thermal-magnetic trip technology wherever possible. Limit the use of electronic trip technology to situations where flexibility and coordination in circuit protection is necessary. Only bolt-on circuit breakers may be used in panel boards.

Motor Starters

Refer GO Standard specifications for detailed requirements

Motor Control

Design Requirements

In general, circuit breaker type combination starters in Motor Control Centres shall be used for 600-volt motors. However, individually mounted circuit breaker type combination starters may be used where practicable. All starters shall be magnetic, full voltage start, single speed, non-reversing type (except when the driven equipment characteristics or power company limitations require other types), and shall be equipped with an additional one open and one normally closed contact for possible remote status indication at the Motor Control Centre.

Each starter shall be equipped with 120-volt transformer and three thermal overload relays. To be able to be monitored, solid state overload relays to be equipped with controller capable of remote communication. Each motor starter shall have stop and start button and/or hand/off/auto switch with indicator lights. A local heavy-duty unfused isolating disconnect shall be provided

within sight of the motor to safely disconnect equipment for servicing.

The power for the control circuit shall be from the downstream of the breaker supplying power for the motor. The MCC shall be built-up of vertical sections of the manufacturer's standard dimensions joined together to form a rigid freestanding, dead front structure. There shall be provision for future extension at both ends of each MCC and extension openings shall be covered with removable steel cover plates. Back to back, MCC's sharing common horizontal and vertical bus shall not be allowed.

The rear of each vertical single sided power section shall have a bolted steel cover plate. All components shall be accessible from the front. The overall height of the MCC shall be approximately 2286 mm (90 inches), exclusive of the channel base and lifting angles.

Each MCC shall be provided with a steel channel base extending along the front and back of the MCC, complete with boltholes for bolting the motor control centre to the floor.

Horizontal control wiring trough shall be provided at the top and bottom of each section such that when sections are fastened together, they shall form continuous wireway that extend the full length of the control centre. Each vertical section shall be provided with an individual full-height wiring trough, which shall connect to the horizontal troughs at the top and at the bottom. Access to this trough shall be through a hinged door having captive type fastening. These wireways shall, when in service, provide complete isolation from all 600V bus and terminations and shall provide sufficient space to easily accommodate all power and/or control cables related to that section.

Dead front bus barriers are required. The vertical bus shall have automatic shutters that isolate the bus from accidental contact when starters/wrappers are withdrawn. Blank sections, or future spaces, shall have similar barriers complete with removable covers for the bus stab openings. Each phase of the vertical bus shall be isolated and insulated from each other and form the front and rear compartments.

Where specified, "back to back" construction will consist of two standard single front access units mounted back to back with a double steel wall between the front and back unit. The front and back units shall have two separate buses and be provided with a bus interconnection link so that

either side of the unit may be disconnected from the incoming cables.

The total Motor Control Centre assembly shall have a current fault rating according to short circuit calculation, unless specified otherwise on the MCC specification. In addition, all main and vertical buses shall be braced to withstand stresses developed by fault currents of minimum 42,000 amperes RMS symmetrical, verify with short circuit calculation.

For layover sites, use 1200A rated MCC. Provide MCC with arc flash reduction protection complete with pressure relief system, arc containment door latches, insulated power bus plates at the ends of each MCC line-up. The incoming power supply cables shall enter at either the top or the bottom, as shown on the consultant drawings. Provide top hat or bottom entry cabinet for service feeds.

Sufficient space shall be provided in the incoming section for the supporting and the termination of these incoming power cables along with suitable compression type terminal-lugs (YA hylug or equivalent) shall be provided. Lugs shall be long barrel, minimum two-hole NEMA compression type for copper conductors. All connectors shall be provided. Each 3-phase connection shall be supplied with a reusable form fitting indoor insulating boot, suitable for voltage level application.

Digital Metering devices shall be housed in a separate compartment having no exposure to the 600 Volt bus or terminations. Metering compartments shall be installed such the metering unit is viewable at approx. 5' -6".

Metering shall be as specified on specification sheet. In addition, each MCC shall have an incoming Power Measurement meter. The meter shall be complete with Modbus RTU communications module, and 2 PT's and 3 CT's. Provide fuse blocks for PT's and shorting blocks for CT's. Only dead front fuse holders shall be utilized in metering circuits.

Monitoring and Controls

Installation of supervision monitoring and control systems at selected locations, will monitor status of equipment, power quality and demand, control and will provide capacity for automated reporting. Metrolinx Main Computer Centre will monitor the selected sites via the Metrolinx Network. Meter additions are considered in designated locations.

- One (1) or a maximum of two (2) Internet Static (IP) addresses 10Mb will be required per selected Central Office. For each new installation, inform Metrolinx IT representative that a new IP address is required
- The Main Meter/Controller is set up with BACnet network Card
- Communication is established through Metrolinx Corporate Network utilizing TCP / IP
- Sub Meters are connected to the Main Meter/Controller through a local RS-485 communication bus.
 - The main meter/controller shall ideally be placed in the control compartment of the main switchboard
 - If space is confined an auxiliary wall mounted box shall be installed
- The cabling will be routed directly to the main meter/controller and the physical connection shall be isolated within the control compartment or the auxiliary panel where the meter resides.
- The compartment or the auxiliary Panel shall be located in electrical room.
- Design and Installation shall be done in AutoCAD.
- Send Cad design to Metrolinx Representative to confirm acceptance and allows comments.

Power Measurement Controller

At selected offices and sites, install Power Measurement Controller, providing per-phase power monitoring, analysis and control capabilities, at each low voltage incoming main distribution point.

The following option shall be included depending on the applications:

Limit the required Digital Inputs and the Return Input in consideration of:

- Connection with other Counters such as Gas Meter, Water Meter, etc.
- Counters taking in consideration that they can use the same return Input

- Synchronization with Hydro Meter

Monitor Controller for MCC

At each motor control centre in selected central offices install a Power Measurement providing per-phase power monitoring and analysis.

Monitor Breaker Controller

At each supervised breaker in selected Central Offices, install Power Measurement meter providing per-phase power monitoring.

For local supervised breaker in remote Offices, install a breaker controller Power Measurement meter providing per-phase power monitoring.

Monitors for load sharing

When load sharing is required, install Power measurement meter providing per-phase power monitoring.

Monitor Panels or equivalent

Special monitoring panels are to be manufactured by an external supplier to house power meters.

The meters to be mounted at the factory into a metal box that needs to be attached on the wall as close as possible to the panel to monitor. The panels to include all the accessories to allow proper functioning of the unit (even the current transformers). All the current transformers not included in the power monitoring panels are split-core in order to allow installation without having to disconnect the power cables. A wide variety of monitoring panels are available depending on:

- The model on power meter model
- Amperage capacity

Panels to be available for the following Power Measurement meters:

- Main Power measurement controller
- Monitor Controller for MCC
- Monitor Controller for Breaker
- Monitor Controller for load sharing

Panels are available in different ampere capacities to accommodate the most common sizes of panels.

Electric Power Monitors–Installation

Coordination with Metrolinx Technical Support Representative:

The installation of power monitoring units in a Metrolinx Main Computer Centre office (number and models of units to install, location of units,) must be coordinated with a representative of the Metrolinx Technical Support group.

Install three (3) Current Transformers (CT's) even if a two (2) CT's arrangement is feasible, to ensure proper collection of the parameters and the waveform. Always provide CT's Shorting Device. When existing CT's are reused validate, their ratio in comparison with the load.

Even if not required by the manufacturer, install two (2) Potential Transformers (PT's) where there are no neutral conductors. Otherwise, install three (3) PT's to prevent injuries and isolate the Meter from 600 V or 208 V Source. Ensure that primary and secondary PT's are protected with fuses (IC of 100 kA minimum). When existing PT's are reused validate, their accuracy (better than 1%) and their protection.

Connect all meter power supply from a UPS or inverter circuit.

Request commissioning by the manufacturer's representative for proper configuration.

Install the power meters in compartments of the switchboards; Power-metering arrangement will vary among locations. The Metrolinx IT Representative will review each installation approach.

Physical location, Communication (i.e. BACnet network)

Supply a 6"x6" box on a wall as close as possible from the Main Power Measurement Controller master unit in electrical room.

Supply a 19mm conduit and a communication cable.

Between the 6"x6" box and the Main Power Measurement Controller master unit, install a 19mm conduit and cable inside. The length of the cable must be 25' at the maximum.

RS-485

Starting from the Main Power Measurement Controller master unit, install a 19mm conduit between all powers monitoring unit in order to

create a daisy chain. The sequence used to link all those units has no importance.

Use #12AWG, 2 conductors cable with metal shield, type FT-4 to link all the power-monitoring units.

The metal shield in the daisy chain sequence must be continuous.

When connecting the cable to the RS-485 port, the shield of the incoming cable must be linked to the shield of the outgoing cable.

The metal shield in the daisy chain sequence must be connected to the terminal of only one (1) power-monitoring unit. This is to avoid a ground loop.

120V Power Feed

The 120V power feed of the power monitoring devices must continuous, i.e. come from a UPS or an inverter.

Install a 19mm conduit between the UPS or inverter and the Main Power Measurement Controller master unit.

Starting from the Main Power Measurement Controller master unit, install a 19mm conduit between all powers monitoring unit in order to create a daisy chain. The sequence used to link all those units has no importance.

Connect the 120V power feed of all power monitoring units to one UPS or inverter circuit of 15A.

Use a #12AWG cable, type multi-strand, for the 120V power feed.

Current Transformers (CT's)

Follow CT polarity at the time of installation. The dot must be towards the source (not towards the load).

Special case: when replacing an old analog meter by a new unit from Power Measurement, if the re-usage of existing CT's is needed, do not assume that the polarity of the existing CT's is correct. Functioning of an analog meter is not affected by the incorrect polarity of one or more CT but the functioning of Power Measurement is affected.

In the case of the Breaker controller and Power Measurement controller master units, the CT's must be installed at the output of the breaker (load side).

In the case of the Load sharing and MCC controller, if there is not enough space inside the Panel cabinet to install the CT's, install in the nearest structure located before the panel (example: pull-box, output of the transformer feeding the panel.)

Use a #12AWG cable, type multi-strand, to link the CT's to the power-monitoring unit. If the distance exceeds 25', use a #10AWG cable.

Cover the two connectors of each CT with black tape, 2000V.

CT's transformer will be split core type with a maximum of 3% of tolerance drift and ratio to five (5).

CT's transformer will be provided by contractor.

Voltage Measurement Points

In the case of Breaker controller and Power Measurement controller master unit, the voltage measurement points must be installed at the input of the breaker (feeder side).

Use a #12AWG cable, type multi-strand, to link the voltage measurement points to the power-monitoring unit. If the distance exceeds 25', use a #10AWG cable.

Special case: when the use of an external power measurement panel is not possible and the power monitoring unit must be installed directly on the front of an existing panel, the CSA specifications require is such a situation that we use Power Transformers (PT's) if the voltage of the point to monitor is more than 250V.

Status of Breakers or/and Automatic Transfer Switch

When monitoring the status of breakers (or/and the automatic transfer switch), install a 19mm conduit between each breaker and the Power Measurement controller master unit.

The relay on the breaker (or the automatic transfer switch) must be Normally Open, form-A or form-C, dry type relay.

Connect the Main breaker or transfer switch relay contact on input I/O of Power Measurement controller master unit meter

Connect the Diesel Generator breaker relay where applicable

Use a #12AWG cable multi-strand, to link each breaker to the Power Measurement controller master unit.

20mA Output Signal

When the 4-20mA output signals generated by the Controller for Breakers unit must be used, install a 19mm conduit between Controller for Breakers unit and the Energy Management System of the site.

Use a #12AWG, 2 conductors cable with metal shield, type FT-4 to link the Controller for Breakers unit to the Energy Management System of the site.

Commissioning

When the installation activity performed by the electrician is done and that all monitoring units are functional, commissioning of these units must be performed.

An agreement with GO/ Metrolinx has to be signed for commissioning activities.

Commissioning agent to be present on site and verify the quality of installation, program and calibrate the monitoring units, verify the communication between the units and between the Power Measurement controller master unit and the server.

Power Monitors–Monitoring Program

Install Monitoring Program to locally monitor all Power Meters at selected sites.

Wayside Power

Wayside power requirements for trains and buses (bus layover bays). Refer to GO STANDARD DRAWINGS.

Provision for Future EV Charging

If provisioning for future Electric Vehicle Charging Stations, provide empty conduit, complete with #12 AWG green insulated grounding conductor RWU90 for easy tracing terminated in a handwell, sized as per OESC (Ontario Electrical Safety Code) but, not smaller than 2" (50mm) for future use. Impact on existing power services and building infrastructure shall be investigated by the designer.

When considering the provision of Electric Vehicle Charging Station infrastructure, ensure the physical space required for an EV Charging Station panel is reserved in the Electrical Room for its future installation.

Service Rooms Requirements (General)

Design Considerations

Incoming utility services at Metrolinx facilities shall be located in the primary Substation and/or Electrical Room, kiosk, bunker, Hub and Communications Room.

All Electrical Rooms and Communications Rooms shall be dedicated and not be shared with other functions, including, but not limited to: custodial, access services, communications, electrical, mechanical and storage.

Access to Electrical Rooms and Communications Rooms via (pass through) shall be avoided.

The main Electrical Room and the main Communications Room shall be located next to each other with exterior access.

Electrical Room, Hub, and Communications Room walls shall not have windows, skylights, roof access hatches/doors, etc.

Locating Electrical Room and Communications Room on perimeter curtain walls where windows comprise the entire surface of walls shall be avoided.

The Service rooms' floor plan shall always be rectangular or square in shape. The room shall never be L- shaped, triangular or any other odd shape. Electrical Room, Hub and Communications Room shall always be a one level room and preferably above grade. The room shall be sized for the known equipment with a provision for a minimum of 25% extra space to accommodate future additional equipment.

Drawings shall indicate to scale the arrangement of allocated equipment inside Electrical Rooms, Hub, and Communications Rooms, including spaces and clearances. Elevation drawings shall show to scale all related wall mounted equipment for each wall.

A minimum 1 m clear working space shall be provided in front of access points, which may occur behind equipment and patch panels, and in front of and behind racking. Racking shall not be positioned closer than 1 m from any wall.

A wall mounted, flip down work surface will be provided in each communication room. The work surface will be 25.4 mm thick, 762 mm wide by 610 mm deep, solid wood, plastic laminate on both main surfaces with a vinyl self-edge. The

work surface will be mounted at a height of 915 mm above the finished floor. The location of the work surface will be adjacent to the main CC rack and maintain all regulatory clearances from exit and equipment as required by code when in the open position. One (1) duplex receptacle and one (1) RJ-45 data connection will be provided at the workstation and mounted above the tabletop in the open position. Provide heavy duty hinges, mechanism to hold the table open and blocking in the wall as required.

No liquid piping, steam piping, drainage piping, and/or dry liquid piping shall pass through or within walls of any Electrical Room, Hub, or Communications Room, except for refrigerant and condensate piping for the A/C unit in the room. Sprinkler systems that are located in these rooms shall be a dry type pre-action system.

All Electrical Rooms, Hub, and Communications Rooms shall have a break in all ducts within 3000 mm of the building by a junction box, handhole, or manhole. All manholes or handholes shall be designed so that water is drained away. All ducting shall have the piping slope away from the room.

Ducting in the Electrical Room, Hub, and Communications Room shall be tray and rigid galvanized steel conduit above floor. EMT is accepted only with compression type connectors (screw connectors are not allowed).

Design Requirements

Walls

The building envelope shall be insulated to meet or exceed ASHRAE 90.1 requirements. Walls shall extend from finished floor to the structural ceiling and shall be structurally sound for wall-mounted equipment. Concrete cinder blocks shall be used on all walls where poured concrete structural walls are not present. Studded walls are not permitted. Walls shall be fire-rated as required by the applicable codes and regulations and shall be painted with a minimum of two coats of fire-retardant non-dust producing white or light gray paint.

1200 mm wide x 2440 mm x 21 mm A-C grade or better fire retardant plywood, void free, shall be installed all around Communications and Hub Room walls for wall mounted communications equipment. The bottom of plywood shall be mounted 150 mm above finished floor. Paint plywood with a minimum of two coats of fire-retardant white or light gray paint. The fire rating

designation shall be placed in an area that is visible and shall not be painted over.

Floor

Poured concrete sealed floor is preferred in Electrical Room, Hub and Communications Room. Floor finish shall be antistatic dissipative light gray epoxy sealer, applied per manufacturer's published specifications for Hub and Communications rooms. A 100 mm rubber wall base shall be provided. No floor drain is allowed.

Doors

- The doors shall be at least 915 mm wide x 2135 mm high and shall be hollow metal slab type (no windows) with hollow metal frames
 - Double or oversized doors shall be provided for rooms that have large equipment to be installed and maintained
- If the door to the Room is in a fire separation then the door shall have an appropriate fire resistance rating per O.B.C.
- When feasible, the rooms shall have exterior access but doors shall not open onto a public space
 - The Electrical Room and Communication Room within a parking structure may be exempt from having an exterior door access, providing access to the Room door is unrestricted
 - Doors shall not open in to the path of vehicle traffic
- Access shall be provided through GO Transit uniform master key system and a centrally controlled alarm keypad and proximity access device system, with an access override feature
 - The door shall be lockable from outside only

Ceiling

- No suspended ceiling shall be installed
- Finished ceiling minimum height shall be 3050 mm (10'- 0")
- Prime and paint the ceiling with a minimum of two coats of non-dust producing fire retardant paint

- Where OWSJ are present, prime and paint all exposed structures to meet flame spread and smoke developed ratings designated by local Code requirements

Flood Prevention

Locate Electrical Room and Communications Room above any threat of flooding. Avoid locations that are below grade or adjacent to potential water hazards (restrooms, tunnels, etc.). Roof drains and pipe penetrations into the room shall be avoided.

Fire Protection

Fire-stop all room penetrations (cables, pipes, pathways, trays, conduit slots). Ensure that the fire-resistance rating of installed fire-stopping assembly shall be not less than the fire-resistance rating of surrounding floor and wall assembly to match the corresponding fire rating of fire separation.

For fire suppression, install a hand held 10lbs CO2 (10 B:C rated) fire extinguisher, with current certification, meeting NFPA 10 requirements. The extinguisher shall be wall mounted on the latch side of the entry door and installed in accordance with manufacturer's recommendations. All panels, boxes, and conduit shall be sprinkler proof if required.

HVAC

Heating, ventilation, and air conditioning of Electrical Room and Communications Room shall be provided by a heat pump AC unit with the following features:

- Low ambient cooling
- Heating at -25°C
- R 410A refrigerant
- Variable compressor speed

A fan-forced heater shall be provided as a redundancy in case the heat pump does not provide enough heating during the extreme cold days. Because a Hub Room is smaller than a typical Communications Room and a bunker or kiosk is smaller than an Electrical Room, a heat pump with hyper-heating may not be available on the market. If this is the case, a split A/C unit with ambient cooling would provide cooling and the fan-forced heater will provide heating. Control of both systems shall be central in order to avoid both systems fighting each other. The

heat pump and heater shall be fed from the regular power panel located in the Room. Temperature and humidity requirements are on a 24 hours, 7 days a week basis, regardless of the heat generated by normally operating electrical and communications equipment.

The required capacity shall be calculated based on the following:

- For sensible heat gain from electrical equipment use 2000 Watts per rack (in the Communications Room)
- Sensible heat gain from lighting
- Include the future growth of systems by 25%
- Determine heat gain/loss to the room from the outside (heat transfer through building structures, including solar load) g the following design criteria
- Outdoor temperatures

Use 2½% winter & summer design temperatures per Ontario Building Code for the geographical location. Indoor temperatures:

- Winter design: 15°C
- Summer design: 22°C D B with a maximum of 50% relative humidity
 - An infiltration rate from outside of 0.5 air changes per hour
 - A recirculation rate of 100% for the air conditioning system
 - A safety factor of 5%

The air conditioning system shall be selected to suit the specific capacity by taking into consideration the room's very high sensible load factor. Heat loss calculation shall not include credit for equipment and lighting heat gain.

Emergency Cooling

Provisions for emergency cooling in communication and electrical rooms:

- Provide a 6" vent opening provision, secured from inside, for portable A/C unit in both electrical and communication rooms, venting to the outside
- Provide dedicated 120V, 20A, 5-20R and 120V, 30A, 5-30R power receptacles (generator backed-up) from dedicated circuit

breakers for portable A/C unit, in Electrical and Communication rooms.

- Receptacles to be mounted at 300mm height above finished floor
- Contractor to provide Labels above receptacles stating: the respective Amps, panel and circuit numbers and "DEDICATED FOR PORTABLE A/C UNIT"

- Provide an exhaust fan controlled by a reverse acting thermostat and an override switch
- High/low temperature alarm

The sequence of operations shall be as follows:

- When A/C unit fails and temperature starts rising, the high temperature sensor sends an alarm to the current corporate supplier of security and monitoring services
- Station Operations will be notified to send a portable A/C unit and the HVAC service contractor is notified to repair the broken A/C unit
- The ventilation system will then kick-in to help reduce the temperature until a portable A/C unit is installed
- Station Ops will install the portable A/C unit and switch off the ventilation system

Electrical Rooms

Design Considerations

Electrical service Substations are typical at GO Rail Service Centres. For details, see GO Standard Layover document. Install HVAC in all electrical rooms w/auto changeover.

Whenever possible there shall be one main Electrical Room that feeds the entire site, as it is the goal at most facilities to have only one utility power source. Sub Room(s) shall be strategically placed around the main Electrical Room to facilitate an efficient distribution of power to loads to boilers, tunnels, bridges, main and sub- structures (e.g. parking structures, stations, service and storage buildings and maintenance facilities), as required. Electrical closets shall be provided to minimize the number of home runs from distribution panels to their respective sub-panels or equipment loads, and to

reduce the number of conductors and minimize voltage drop or in preparation for future requirements.

The typical Electrical Room at Metrolinx facilities shall include space for locating:

- Distribution panels
- Metering Cabinets
- Transformer
- Uninterruptible power supply (UPS)
- Transfer Switches
- Automatic Transfer Switch (ATS)
- Data and telephone outlets
- A service-working station by the door with power and data connections
 - The station shall be a cabinet-lectern combination sized to hold ANSI B drawings, to serve as a working surface and storage for drawings, manuals and onsite component and parts
 - A minimum continuous 17 m of wall space is required for equipment installation

All wall installed panels and conduits or ducts shall be installed on strut channel mounting system. All floor mounted panels and equipment shall be installed on housekeeping concrete pads. The housekeeping pad shall be a minimum of 100 mm above the floor and shall extend beyond the equipment footprint as per manufacturer's requirements.

A non-fade single line diagram of the electrical system related to the room shall be framed and posted under a polycarbonate cover adjacent to the entrance of the Electrical Room. The diagram shall be legible from a distance of 1 m.

Provide markings on the floor showing the arc flash boundaries in around equipment and panels.

Communications and Hub Rooms

Design Considerations

All Communications Rooms shall be designed in accordance with ANSI/TIA/EIA-569-A-Commercial Building Standard for

Telecommunications Pathways and Spaces. The Room shall accommodate the following equipment (refer to IT Telecommunications and Systems Document for list of IT equipment):

- Network System Rack
- CCTV System Rack
- PA System Rack
- Passenger Notification System (PINS, Whiteboard, etc.)
- Telephone Infrastructure
- Two-way Communication Infrastructure (elevator cab intercom and information intercom)
- Fare Collection Equipment: Presto and legacy
- Alarm and Security Monitoring Equipment
- Fire Safety System
- Space Counting System (in parking structures)
- Building Automation System Server
- Snow melt management system

At facilities where the distance of cable runs exceeds 90 m (300 ft.) between the end device and accumulation point as deemed necessary by Metrolinx, Communications Hub Room(s) shall be implemented. Hub Rooms are satellite Communications Rooms, designed to accommodate a minimum of two floor-mounted racks. Hub Room's purposes are to minimize the number of home runs from remote devices to their respective head end equipment; reduce usage of optical fiber and associated equipment; concentrate the distribution of collocated devices; facilitate future implementation of Communications systems.

At multi-level parking structures, Communications Hub Room(s) shall be strategically placed directly above the main Communications Room and centrally located to meet the 90 m (300 ft.) cable run distance limitation. One Hub Room can serve more than one floor. In Parking Structures, careful planning is required when locating the Communications and Hub Rooms. Attention must be paid to equipment placement within these rooms in relation to the structural ceiling elements. The required vertical clearance above

the racks must also be taken into account. Ideally, cable trays shall be kept level, precast openings in structural "T's" as determined by the structural engineer, to get to the sidewalls of the room.

Communications Room shall be located next to the Electrical Room with exterior access if possible, within parking garages these rooms shall open onto the interior of the garage.

Communications Room and Hub Room shall be dedicated and not be shared with other functions, including, but not limited to: custodial, access services, electrical, mechanical and storage. Access to Communications Room and Hub Room via (pass through) Electrical, Mechanical, Janitor's Rooms, etc., shall be avoided.

Room Construction

Room dimensions (minimum wall to wall):

Table F-6: Room Dimensions

Location	Size
Communications Hub Room	3200 mm wide x 3600 mm long
Communications Rooms at stations and small to medium sized facilities	3200 mm wide x 4800 mm long
Communications Rooms at Large Facilities and/or Parking Structures Note: Small, medium, and large size facilities are determined by the number of racks that are needed to house all equipment systems and varies per facility.	3200 mm wide x 5400 mm long
For Type A Bus and Rail Facilities	3200 mm x 6600 mm Space for 6 Racks
Type B Bus Facilities	3200 mm x 5400 mm Space for 5 Racks
Type C Bus Facilities	3200 mm x 4800 mm Space for 4 Racks

Connectivity

A minimum of nine (9) 53 mm (2") dedicated conduits shall provide connectivity from the Communications Hub Room to its respective Communications Room. If more than one Hub Room is required, then each Room must have its own direct dedicated set of conduits linking it to the Communications Room, which may be designed as a pass-through layout.

If more than one Communications Room on site, a minimum of nine (9) 53 mm (2") dedicated conduits shall provide connectivity from one Communications Room to the other. Refer to IT Telecommunications and Systems Document for list of equipment

Electrical Guidelines

All communications equipment in the Communications Room shall be serviced by a dedicated 120/208 V 3 phase 4W 225 A panel located inside the Room, and fed from an UPS placed inside the Electrical Room. If 208 V service is not available, 120/240 V 1 phase 3W 225 A panels shall be used. There is one exception, Presto shall be fed from a dedicated 120/208 V 3 phase 4W 225 A regular generator backed up panel located inside the Room

All communications equipment in the Hub Room shall be powered from a sub-panel fed from the dedicated back-up electrical panel located in the Communications Room.

A dedicated electrical panel shall be provided for regular power inside each Communications Room. This panel grounding shall be connected to the Electrical Room grounding system.

All panels shall be sized to meet Design Requirements Manual guidelines. All panels shall have remote monitoring and control of all circuits' capabilities.

Half of the light fixtures inside Communications and Hub Room shall be powered from the UPS backed-up panel.

Heating and air conditioning of the Communications and Hub Room shall be generator backed-up only (no UPS back-up).

All panels, boxes, and conduit shall be sprinkler proof.

Power Outlets

Each communications equipment rack shall be fed from two independent tray mounted twist lock L-20R single receptacles. Each such receptacle shall be fed from a dedicated circuit. Refer the IT telecommunications and Systems document for detailed specifications.

See Presto subsection under Fare Handling Systems section for power requirements.

Provide a minimum of three (3) normal power 5-20R 120 V duplex receptacles, powered from three dedicated circuits, for maintenance and identified as such. These receptacles shall be wall mounted and not located on cable tray or cable ladders, as not to be confused with communication-dedicated receptacles.

Provide a power bar for the equipment mounted on the plywood backboard. Each connection on the power bar shall have nameplates to provide power tracing ease. The power bar shall be a multi-outlet raceway. All equipment connecting to the power bar shall have nameplates indicating model, capacity, and electrical data. Install equipment in accordance with manufacturer's recommendations.

Illumination

Lighting Design

This section addresses interior and exterior illumination and lighting design strategy for GO site and building facilities. The intent is to provide good uniform quality lighting design strategy that meets the locations application. The Lighting design strategy shall be applied as a sequential overlay of Guiding Principles; followed by lighting design considerations, lighting typology applications and selection criteria and individual lighting design requirements.

Lighting Design Guiding Principles → Design Considerations → Typologies → Design Requirements

Lighting Design Guiding Principles

- A cohesive and adaptable hierarchy of lighting
 - Provide a consistent and flexible lighting approach across all sites will promote intuitive wayfinding

- Utilize built site elements with internal lighting as beacons to support wayfinding
- Associate lighting types with the same conditions/activities at each element, to provide a recognizable visual language.
- The hierarchy of lighting is identified as:
 - Areas of transition and boarding of GO services that are highlighted to enhance the experience of movement
 - Illuminated built structures that serve as lanterns and aid wayfinding throughout the site
 - Pedestrian scaled illumination for areas of rest and waiting that promote comfort
 - Areas of vehicular movement and parking
- Durable and adaptable design with sustainable maintenance and operational efficiencies
 - Use LED technology for its low energy consumption and long lifecycle
 - Integrate control systems and sensors to assist energy management and contribute to sustainable practices.
- Shall guide customers through the sequence of unique customer journey touchpoints at a site
 - Use lighting to articulate each site element's sense of place
 - Highlight areas of transition to heighten the experience of movement
 - Reinforce site order and hierarchy by emphasizing important zones with light
- Deliver an engaging, comfortable, and safe experience for the customer
 - Use a variety of lighting types to create ambiance and provide comfort
 - Highlight significant edges of site elements—thresholds—to create a dynamic and engaging experience
 - Provide lighting levels that ensure visual and physical comfort of customers
 - Use light sources with good colour rendering and colour temperature to support comfort and well-being

- Highlight edges of train platforms and curbs to provide a high level of safety and legibility

Lighting Design Considerations

- The levels and quality of lighting for the various types of areas shall be as outlined in the latest edition of the Illuminating Engineering Society of North America (IES) Lighting Handbook, as modified here and as required to accommodate the Ontario Building Code and Ontario Electrical Safety Code. They shall take into consideration the aging population and the needs for accessibility of all groups (e.g. CNIB recommendations)
- Illumination systems shall require minimal maintenance, and shall be energy efficient and readily accessible, designed for passenger safety and security
 - Illumination shall be designed to provide visual comfort and minimum glare for GO staff and passengers.
 - The illumination systems shall be compatible with CCTV systems
- Building luminaires in public areas shall be integrated with the architecture
 - Luminaires shall be in locations designed by the architect, complementing daylight sources
 - All luminaires must be accessible for maintenance and lamp replacement without having to construct special means of approaching the fixture
- Urban light fixtures for each station site shall be selected from one fixture family and matched to the uses and lighting types called for at each site element
- Wayfinding through each station site shall be supported by using fixtures that are common to the scale of the user wherever possible
 - For example, for pedestrian areas, a common lamppost design and scale shall be used throughout the site to identify pedestrian areas
- Light fixture design shall be simple, elegant and contemporary

- Site lighting controls, including sensors and timers, shall be provided for all site element lighting where appropriate, and shall be integrated into the station building automation system
 - Lighting controls shall support daylight harvesting where applicable
- Photosensors are to be located so that there is a direct view of the sun and that no shadows or obstructions will interfere with readings
- Occupancy sensors are to be provided in the following areas: Parking garage lobbies
- Photosensors shall be provided for site lighting in the following areas
 - Bus platforms, including shelters
 - Surface parking lots
 - Station plaza
 - Rail platforms
 - Open bridges, including stairways
 - Closed bridges

Refer GO Standard specifications for detailed requirements

- Lighting in enclosed stairways and parking garages shall remain on at all times, unless otherwise noted
- Lighting fixtures and ballasts shall be selected and installed to ensure ease of access for servicing and ease of maintenance
- All light fixtures shall be LED with the following criteria:
 - CRI (Colour Rendering Index) to be a minimum of 80 unless otherwise noted
 - Colour temperature to be 4000K unless otherwise noted
 - Exterior luminaires to have CSA or CUL Wet Location labels
- Use light fixtures equipped with industry standard LED light engines that are equal or better in performance and build quality to Bridgelux or Xecato or equivalent

- Specify light fixtures that limit glare and uplight, and support dark sky policy
- Specify light fixtures that are locally distributed and serviced
- Lighting fixtures to have a minimum 5-year warranty
- Negotiate longer warranties where option is offered by the manufacturer
- Where accessible by the public, light fixtures are to have vandal resistant features
- The underside of ceiling mounted fixtures is to be a minimum of 2750mm above the finished floor
- Glare: Adjacent properties shall be shielded from glare or light trespass. There shall be no interference with railroad signal or operations systems due to glare. The discomfort Glare Rating shall have a Visual Comfort Probability (VCP) of 65% or greater for interior lighting. Station attendants and passengers at service counters shall be able to see each other 100% when the sliding glass panel is in the closed position. Luminaries in this location shall have parabolic egg crate lenses, with all illumination directed vertically down to the task. Passengers and station attendants shall be capable of seeing out to the exterior at night. All glass shall be clear and not tinted, for maximum visibility of the interior. Luminaries' placement shall take into account viewing angles and fields of view of close circuit television cameras. Luminaries shall not present a source of glare to surveillance cameras.
- Exit lights shall be of the fully self-contained and low energy LED type
- Emergency lighting shall be in accordance with the OBC, the Ontario Electrical Safety Code, and the latest CSA standards
- Daylight—Particular attention shall be directed to parking structure, rail station and bus terminal entrance/ exit areas, especially on large projects. Illumination shall provide for a visually comfortable transition from outdoors to facility entry areas during all hours of system operation. Illumination levels will likely have to be graduated during the daylight hours to minimize otherwise abrupt changes from outdoors to indoors, and vice versa. Photoelectric cells for the automatic operation of additional lighting fixtures may be utilized
- Sundry: All rail platform poles shall be hinged to avoid flagman services. Hinged poles shall be installed in such a manner to avoid obstructions when lowered. Hinging shall be always parallel to the track. CCTV camera(s) shall have dedicated split pole(s). PA speakers can be installed on existing lighting poles only if they are split. High-mast lighting poles shall have no objects attached onto (e.g. parking identification, PA speakers, etc.) to avoid obstruction of the lowering device
- Standard Light Pole Drawings: Digital drawing files (AutoCAD 2012) are available for 3 and 6 metre hinged pole, 6 metre, 12 metre and 30 meter (high mast) pole under PMPS GO Standard Drawings
 - Uniformity Ratio:
 - Maximum to minimum: 4:1 or better
 - Average to minimum: 3:1 or better
 - Where lighting is of a complex or unique nature or if required by GO, the Consultant shall engage the services of a qualified Illumination Designer
 - Design photometric digital file in PDF or DWG format, complete with printouts using recognized computer lighting design software, shall be provided for GO review of design illumination levels. These photometric files shall be included in the As-built drawings

Lighting Design Typology

- The following Design Typology shall be adapted to applicable site configurations to provide a consistent approach for the illumination of site elements

Graphic

- Visually distinct from its context
- Linear, geometric or curvilinear
- Animates and provides a visual cue, supporting wayfinding
- Defines edges or thresholds and suggests movement and direction
- Can be created by a line of luminaires viewed from a distance

Integrated

- Recessed (integrated) or concealed within an architectural element or object
- Can provide direct or indirect illumination
- Accentuates form and volume
- Creates ambiance

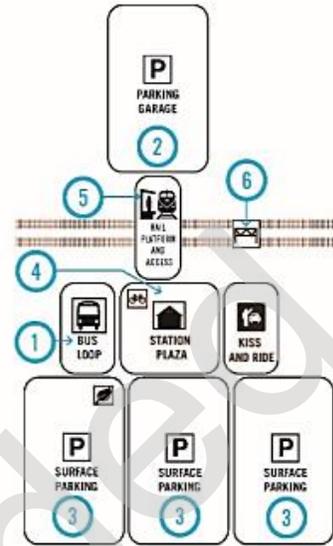
Object of Light

- Emanates from a surface of a defined form or area
- Light becomes a form in itself
- Can be the result of lighting that comes from a built structure, creating a lantern effect

Lighting Typology–Selection Matrix

SITE ELEMENTS LIGHTING TYPES

			
	GRAPHIC	INTEGRATED	OBJECT OF LIGHT
① Bus Loop	X	X	X
② Parking Garage	X	X	
③ Surface Parking		X	
④ Station Plaza	X	X	X
⑤ Rail Platform	X	X	X
⑥ Bridges	X	X	X



The site lighting strategy is adaptable to various site layouts and identifies a consistent approach for the illumination of site elements.

Figure F-3: Site Elements Lighting Types

LIGHT FIXTURE TYPES

	Lampost - High Head	Lampost - Low Head	Lampost - Ambient	Recessed / Semi Recessed Linear	Direct / Indirect Industrial Grade	Direct/ Indirect Linear	Handrail
① Bus Loop	X	X					
② Parking Garage				X	X		
③ Surface Parking	X	X					
④ Station Plaza	X	X	X				
⑤ Rail Platform		X		X			X
⑥ Bridges						X	X

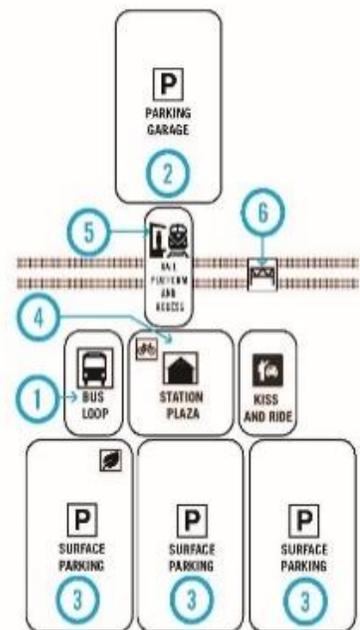


Figure F-4: Light Fixtures Types

Lighting Design Requirements

Bus Loops:

- General illumination for bus platform shall be provided by a line of full cut-off single-headed downlights on lampposts aligned with the back of bus shelters
- Lamppost height shall be kept to a minimum, based on site layout and context

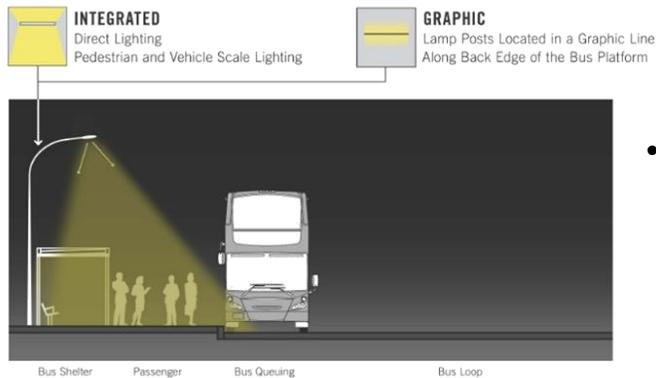


Figure F-5: Lighting Design Requirements- Bus Loops

- Lamppost height shall be kept to a minimum, based on site layout and context
- Pedestrian scale fixture head shall be between 3.5 and 4.5 metres above the plaza surface
- Lighting of the bus shelter, while not within the scope of site lighting, shall be taken into Consideration in calculations and overall balance of lighting design
- Minimum average maintained illumination levels shall be:

- General illumination for bus platforms with pedestrian walkways behind shelters shall be provided by a line of full cut-off double-headed downlights on lampposts aligned with the back of bus shelters
- One head will provide platform lighting; the other head will provide pedestrian scale lighting on the pedestrian walkway behind the shelter
 - Bus Platform Boarding Area: 100 lux horizontal and 50 lux vertical
 - Bus Platform: 50 lux horizontal, 25 lux vertical
- Colour temperature shall be 3500K and shall be confirmed through testing with site materials.

Parking Garage:

- The lighting in the parking area of the garage shall be provided by direct/indirect fixtures positioned above the bottom edge of structural beams
- The lighting in the elevator lobby shall be provided by graphic direct LED fixtures positioned parallel to the elevator doors
- In cases where the design and layout of the garage permit, use graphic direct LED fixtures to highlight key pedestrian areas and promote wayfinding within the garage
- Minimum average maintained illumination levels shall be:
 - General Parking and Pedestrian Areas: 55 lux horizontal
 - Ramps and Corners: 110 lux horizontal
 - Elevator Lobbies: 200 lux horizontal
 - Parking Garage Entrance Areas– Nighttime: 110 lux horizontal, 55 lux vertical
 - Parking Garage Entrance Areas– Daytime: 550 lux horizontal, 275 lux vertical
- Colour temperature–4000K preferred, 3500K minimum
- CRI–80 preferred, 70 minimum

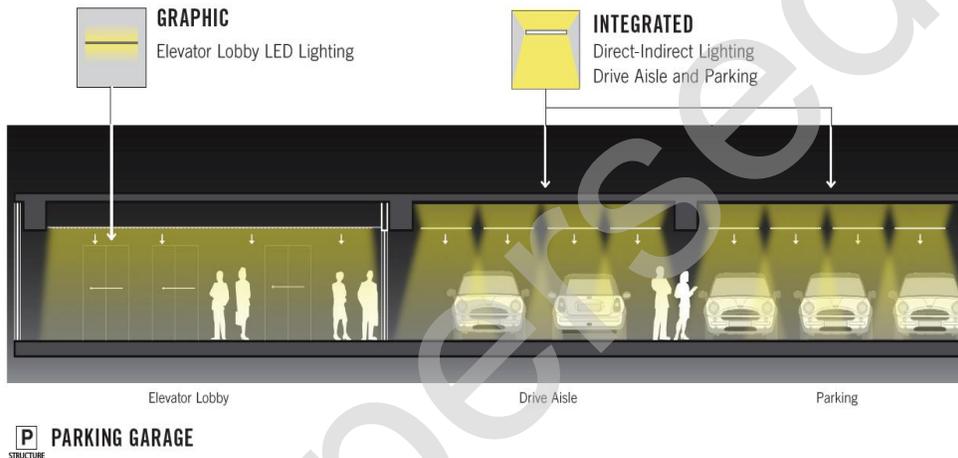
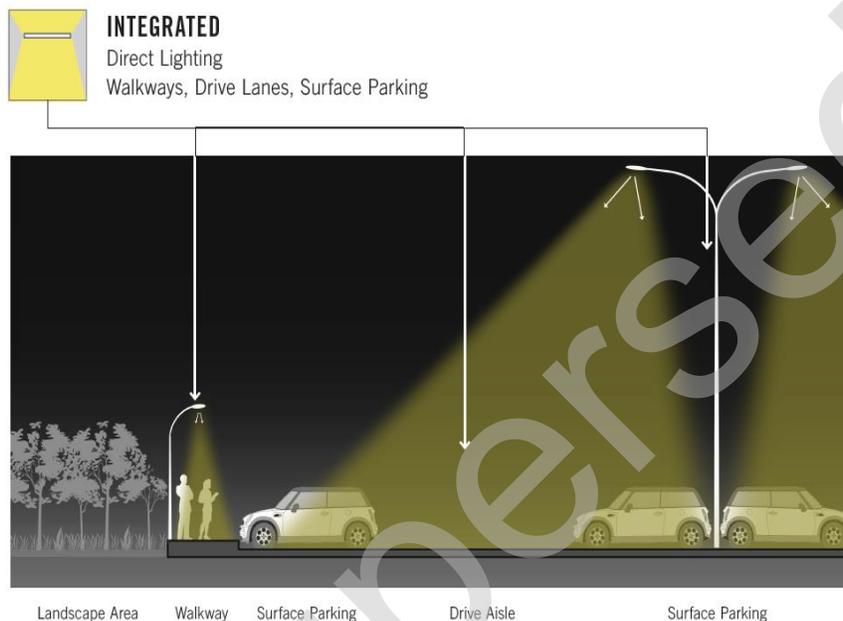


Figure F-6: Lighting Design Requirements-Parking Garage

Surface Parking:

- The lighting in the parking and drive aisle areas shall be provided by full cut-off single and double-headed downlights on lampposts
 - Lamppost height shall be kept to a minimum, based on site layout and context
- The lighting in the pedestrian walkways shall be provided by full cut-off single-headed lighting fixtures on lampposts
 - Fixture head shall be between 3.5 and 4.5 metres above the walkway surface
- Minimum average maintained illumination levels shall be:
 - Parking Lot: 20 lux horizontal, 10 lux vertical
 - Pedestrian Walkways: 20 lux horizontal
- Colour temperature—4000K preferred, 3500K minimum
- CRI—80 preferred, 70 minimum



P SURFACE PARKING

Figure F-7: Lighting Design Requirements-Surface Parking

Station Plaza:

- Lighting along the Plaza Edge/Drop Off and Pick-up Area shall be provided by full cut-off double-headed downlights on lampposts aligned parallel to edge of plaza
 - One head will provide roadway lighting, the other head will provide pedestrian scale lighting on the plaza
 - Lamppost height shall be kept to a minimum, based on site layout and context
- Lighting of the station building shall be taken into consideration in calculations and overall balance of lighting design
- Minimum average maintained illumination levels shall be:
 - Plaza Edge/Drop Off and Pick-up Area: 50 lux horizontal, 25 lux vertical
 - Pedestrian scale fixture head shall be between 3.5 and 4.5 metres above the plaza surface
- Lighting within the plaza shall be provided by indirect light lampposts aligned parallel to the station building and integrated with the planting zone if one exists
 - Pedestrian scale fixture head shall be between 3.5 and 5 metres above the plaza surface
 - Plaza: 50 lux horizontal
- Colour temperature shall be:
 - Plaza Edge/Drop Off and Pick-up Area: 4000K preferred, 3500K minimum
 - Plaza: 3500K

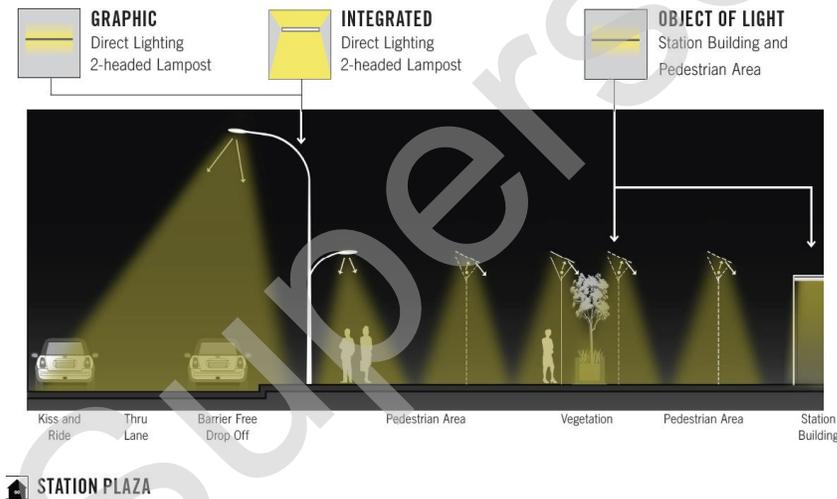


Figure F-8: LightingDesignRequirements-StationPlaza

Rail Platforms:

- The lighting of the platform area and its stair and elevator access points shall be provided by direct/indirect lighting fixtures that produce a graphic effect, aligned parallel to the platform edge
- At platforms without roof soffits, lighting is to be provided by direct full cut-off lighting on 2 headed lampposts
 - Each head will illuminate one side of the platform
 - Lamp post height shall be kept to a minimum, based on site layout and context
- Stairwells and their handrails shall have integrated lighting
 - Avoid placing lights in the ceiling above stairs
- Minimum average maintained illumination levels shall be:
 - Platform Boarding Area: 100 lux horizontal, 50 lux vertical
 - Platform: 50 lux horizontal, 25 lux vertical
 - Stairwells: 200 lux horizontal
- Colour temperature shall be 3500K

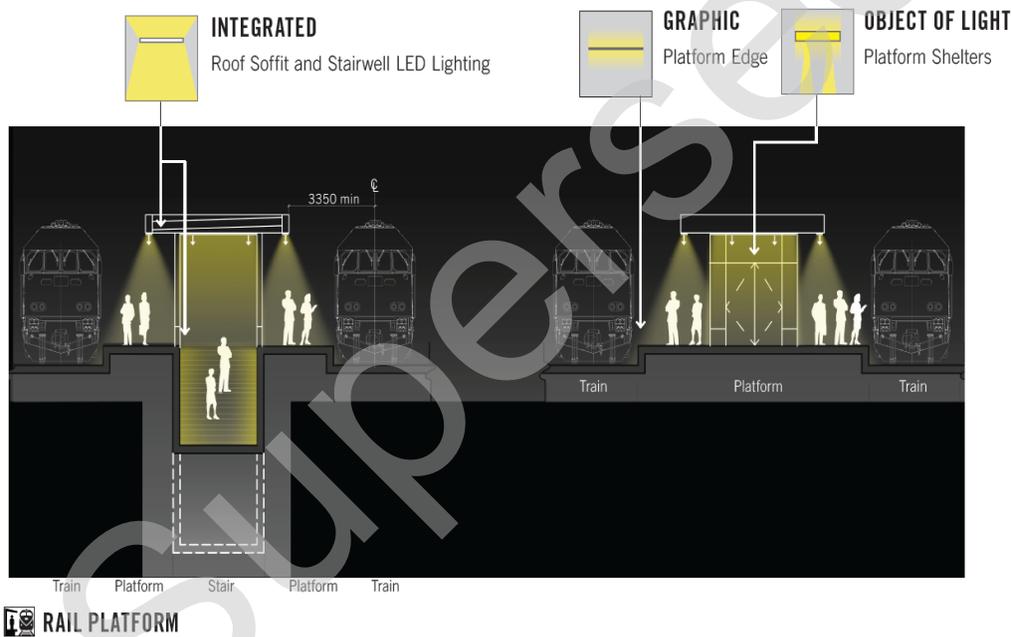


Figure F-9: Lighting Design Requirements-Rail Platform

Bridges:

- Enclosed bridges shall have ceiling integrated direct/indirect lighting that produces a graphic effect
- Open bridges shall have lighting integrated on the interior, into side elements such as structure, handrails and guards
- Light sources shall not to be visible from the point of view of train conductors
- Enclosed stairs to bridges shall have lighting integrated into side walls above head height, and lighting integrated into handrails
- Open stairs to bridges shall have lighting integrated into handrails
- Minimum average maintained illumination levels shall be:
 - Enclosed and Open Bridges: 150 lux horizontal, 75 lux horizontal
 - Enclosed and Open Stairs: 200 lux horizontal
- Colour temperature shall be 3500K

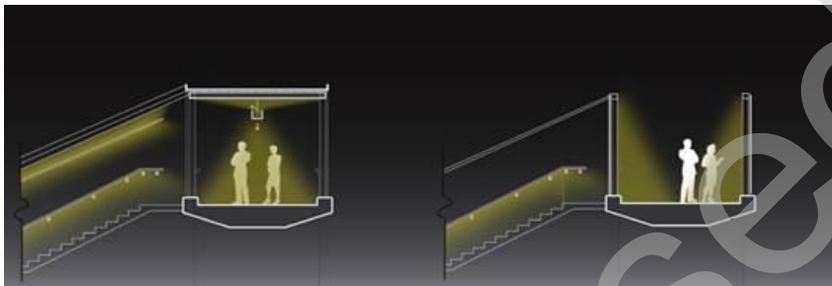


Figure F-10: Lighting Design Requirements-Bridges

Lighting Control Design Criteria

Early Morning Period

Interior Controls:

One half (1/2) hour before the first AM train and/or bus:

- Station Building and/or Bus Terminal lighting to be 100% ON excluding ancillary area
- Tunnel and Bridge lighting shall be 100% ON
- Parking structure lights to be 100% ON

Occupancy sensors shall be provided in driver washrooms, maintenance rooms, mechanical, electrical, and communications rooms, staff service and back-of-house area.

Tunnel lighting shall be on occupancy sensors. When no motion is detected, the lights shall dim to maximum 50% output (not less). Once motion is detected, lighting shall turn on to 100%.

Bridges shall be connected to daylight harvesting photocells to save on energy when there is sufficient daylight entering the bridge.

Parking structure lights to turn OFF with the aid of photocells where light levels are high enough from daylight harvesting.

Exterior Controls:

One half (1/2) hour before the first AM train and/or bus:

- Platform, platform canopy, platform shelter, information signs and shelters, and building canopy lighting to be 100% ON
- Bus loop and bus loop shelter lighting to be 100% ON
- Parking lot lighting shall be 100% ON

Evening Period

Interior Controls:

One (1) hour after the last PM train and/or bus:

- Station Building and/or Bus Terminal lighting to drop to 30% illumination
- Tunnel lighting to drop to 50% illumination
- Parking structure lighting to drop to security lighting (i.e. 30% or better)

- Occupancy sensors shall be provided on Station Building and/or Bus Terminal lighting controls
- Tunnel lighting shall be on occupancy sensors. When no motion is detected, the lights shall drop 50% output, as noted above. Once motion is detected, lighting shall turn on to 100%
- Occupancy sensors shall be provided on Parking Structure lighting controls

Exterior Controls:

One (1) hour after the last PM train and/or Bus:

- Platform, platform canopy, platform shelter, information signs and shelters, and building canopy lighting to be 100% OFF
- Building canopy security lighting (i.e. 30% or better, as determined by Station Services) to remain on
- Parking lot lighting to drop to security lighting (i.e. 30% or better, as determined by Station Services)
- Illuminated Station ID sign to turn OFF
- Bus loop and bus loop shelter lighting to be 100% OFF

Exterior Lighting On/Off Controls

The lighting controls shall be designed to provide the following functions:

- The lighting controller (i.e. timer) shall be programmable controlled, PLC, complete with automatic daylight savings adjustment
- Provide a photocell control on all control designs where the default is “dusk to dawn”
- Sites that are being rehabilitated shall have their lighting controls modified to meet these requirements

Dimmable Illumination

- Photocells, motion and occupancy sensors are to be used within multi-level parking structures, tunnels and pedestrian bridges
- Occupancy sensors are to be placed to allow no blind spots

- Refer to Illumination Levels table on page 478–479 TAB 7: ELECTRICAL for minimum lighting levels within multi-level parking structures, tunnels and pedestrian bridges as recommended by IESNA
- The lighting control shall be flexible i.e. programmable controlled per circuit complete with IP addressable and remote access and control
- Methods of reducing energy usage and maintenance shall be considered in design. LED Lighting shall be continuous dimmable (0 to 10 V DC). The design shall consider occupied and a 50 % reduction in light levels when unoccupied. Light harvesting systems shall also be considered

Override Switches

Station lighting is to be wired into separate zones listed in the table and controlled independently by one of three master override switches.

- Switches shall be strategically located at the following 3 locations within:
 - Service Counter area
 - Electrical Room
 - Exterior of the station
- Switches shall be labeled and housed in a weather tight, PVC lockable box accessible to GO staff, and GO approved contractors/agents
- Remote parking shall have its own override switches following the same guidelines as above.
 - The locations shall be inside the local power cabinet and outside the cabinet housed in a weather tight, PVC lockable box
- Overall Master Shut Off overrides programmed lighting controls for a prescribed timeframe. When prescribed time frame elapses, programmed lighting resumes

Zones for Override Switches

- Station building
- Surface parking
- Multi-level parking
- Bus loop
- Rail Platform
- Kiss and Ride
- Access Road
- Overall Master Shut Off

Illumination Levels

- The lighting control shall be flexible i.e. programmable controlled per circuit complete with IP addressable and remote access and control
- The design shall consider methods of reducing energy usage and maintenance. LED Lighting shall be continuous dimmable (0 to 10 V DC)
 - The design shall consider occupied and a 50% reduction in light levels when unoccupied. Light harvesting systems shall also be considered
- The system shall be controlled by a Programmable Logic Controller which can handle multiple lighting levels and areas complete with unique on and off, a remote override, and a changeable daylight savings time
 - The changes to the on and off configurations shall be done either remote or local computer connections
- Service areas like electrical rooms are to have ceiling mounted occupancy sensors on all light switches
- Exterior decorative, illuminated signage and perimeter lighting shall be all part of the design
- Pole lighting shall be to GO Standards for referenced in the DRM
- Reduction of light pollution of flood lights and wall washers (spill off into surrounding canopies) is to be considered

- Station locations with a high probability of vandalism shall have extra bright illumination, if required and viable in terms of adjacent neighbourhoods
- Photocells and occupancy sensors are to be used
- The lighting levels for inside a covered Parking Facility shall be to a minimum recommended by IESNA and as follows:

Illumination Levels

Table F-7: Illumination Levels

Location	Working Plane Height
<i>Circulation Areas both public and non- public including exterior traffic areas</i>	<i>Floor level</i>
Public Seating (waiting areas)	850mm
Workshops	850mm
Vertical illumination (task lighting)	At the task

Interior Lighting Illumination Levels

Table F-8: Interior Lighting Illumination Levels

Location	Illumination Level
Waiting Room	20 Fc (200 LUX)
Station Attendant Room	20 Fc (200 LUX)
Service Counter task lighting	40 Fc (400 LUX)
Staff Washroom	20 Fc (200 LUX)
Public Washroom	20 Fc (200 LUX)
Electrical Room	75 Fc (750 LUX)
Communications Room	75 Fc (750 LUX)
Janitorial/Storage Room	75 Fc (750 LUX)
Elevator/Escalator (incl. elevator vestibules)	20 Fc (200 LUX) (Note 1)
Shelter	5 Fc (50 LUX) (Note 2)
BRT Building (Bus Rapid Transit)	15 Fc (150 LUX)
Shop/Workbenches	30 Fc (300 LUX)
Electronic Shop Workbenches (task lights)	As per IES
Garage	30 Fc (300 LUX)
Mechanical Room	75 Fc (750 LUX)
Dispatch Room	15 Fc (150 LUX)
Hallway/Corridor/Tunnel/St airwell	20 Fc (200 LUX)
Office	As per IES or CIBC
Other	As per IES or as directed by GO or CNIB

Minimum average maintained illumination levels as per IES / CNIB or as directed by GO:

Note 1: Elevator Code to govern

Note 2: Low illumination level to equalize visibility of the platform

Exterior Lighting Illumination Levels

Table F-9: Exterior Lighting Illumination Levels

Location	Illumination Level
Parking Lot	20 Fc (200 LUX)
<i>Parking Structures</i>	
General Parking and Pedestrian Areas Occupied	5 Fc (55 LUX)
Unoccupied Areas	2.5 Fc (28 LUX)
Ramps and Corners	10 Fc (110 LUX)
Entrance Areas	50 Fc (540 LUX)
Passenger Drop-off & Pick-up Areas	5 Fc (50 LUX)
Train Platform	5 Fc (50 LUX)
Mini-Platform/Designated Waiting Area	15 Fc (150 LUX)
Access Road	2 Fc (20 LUX)
Bus Platform	5 Fc (50 LUX)
Platform Boarding Area (bus and train)	10 Fc (100 LUX)
Canopy Separate from Buildings	20 Fc (200 LUX)
Canopy Walkways at Buildings	10 Fc (100 LUX)
Canopy at Platform	5 Fc (50 LUX)
Canopy at Mini Platform	15 Fc (150 LUX)
Canopy at Station	10 Fc (100 LUX)
Platform Union Station and UP Express	20 Fc (200 LUX)
Canopy at Boarding Edge	10 Fc (100 LUX)
Bridges, Tunnel or Overpass & Open Stairwell at a Building	20 Fc (200 LUX)
Exterior Stairs & Walkways Separate from Buildings	20 Fc (200 LUX)
Pedestrian Paths and Bike Ways	2 Fc (20 LUX)
Layover General Lighting	2 Fc (20 LUX)
Wayside cabinet and Switch Area	5 Fc (50 LUX)
Pedestrian Bridges	20 Fc (200 LUX)

Minimum average maintained illumination levels as per IES / CNIB or as directed by GO

Lighting Levels for Inside a Covered Parking Facility

Table F-10: Lighting Levels for Inside a Covered Parking Facility

Area	Specification	Colour Temperature
General Parking and Pedestrian Areas	5 Fc (50 LUX)	4000 K
Ramps and Corners	10 Fc (110 LUX)	4000 K
Entrance Areas	50 Fc (540 LUX)	4000 K
Service Rooms	50 Fc (540 LUX)	4000 K
Stairways and Elevator Lobbies	20 Fc (200 LUX)	4000 K

Light Sources and Controls

Interior Lighting Sources and Controls

Table F-11: Interior Lighting Sources and Controls

Location	Light Source	Control and Backup
Platform Access (Tunnels and Bridges)	LE-1, LE-2	Time of day controller, 100% station open hours, 50% minimum station closed with occupancy sensors, 10% on generator. Daylight harvesting where possible
Waiting	LE-3, LE-4, LE-5	Time-of-day controller, 100% station open hours, 10% minimum station closed, 10% on Generator. Day light harvesting were possible.
Station Attendant	LE-3, LE-4, LE-6, LE-7, LE-8, LE-10	Local switches. One fixture UPS + Generator backed-up over service counter, one over cash area and safe, or 10% minimum station closed
Staff Washroom	LE-11	Occupancy sensor switch. One luminaire on UPS + Generator
Public Washroom	LE-12, LE-13	On/Off switch with occupancy sensor, one fixture on UPS + Generator
Electrical, Comms., Mechanical, Janitor, and Storage Rooms.	LE-15	On/Off switch with occupancy sensor, 50% on UPS + Generator in Mechanical, Electrical and Comms. Rooms only
Shop	Linear LED 2438 mm long, suspended. Task lights over equipment and work-benches to suit functions	Local switching or to suit particular application, 10% on UPS + Generator
Garage Maintenance Shop	LED for shops. LED Task lights where required	Panel or central switching to suit particular application. 10% on UPS + Generator or to Code requirements
Dispatch	LED, and supplementary illumination for maintenance with task lights to suit	Local switches, dimmers, 10% on UPS + Generator.
Vestibule and Other Miscellaneous Areas	LE-14	Time-of-day controller, 100% station open hours, 10% minimum station closed, 10% on Generator. Day light harvesting where possible
Office	Per IES	10% on UPS + Generator

Exterior Lighting Sources and Controls

Table F-12: Exterior Lighting Sources and Controls

Location	Light Source	Control and Backup
Parking Lot Passenger Drop-off and Pick-up Areas Bus Loop Bus Platforms	LED area lights or down lights on 6 or 12 m high galvanized steel poles or 30m high masts (use of LED on 30m high masts approved by GO Transit on a case-by-case basis).	Circuited and dimmed for 30% in operation during station closed hours (photo-control only) and to have manual override of the photo control and time-clock (the manual override shall not be digital) on generator
Access Roads	LED area lights or down lights on 6 or 12 m high galvanized steel poles or 30m high masts (use of LED on 30m high masts approved by GO Transit on a case-by-case basis).	Circuited for 30% in operation during station closed hours (photo-control only) and to have manual override of the photo control and time-clock (the manual override shall not be digital)
Parking Structure	LED	Day light harvesting and occupancy sensor control of two light levels and timer on generator
Rail Platform	LED on 6 m hinged poles on 300 mm high concrete bases or in canopy.	Both timer and photocell controlled, on Generator. During station closed hours 100% off. Override switch (snow removal use): 100% on
Mini-Platform	Same as Rail Platform	Controlled as part of Rail Platform
Tunnel, Enclosed Bridges and Canopies	LED, 1219 mm long, c/w vandal resistant lenses, lights shall be dimmable, when space not occupied. Allow for at least 2 circuits, alternate circuits every other pole	Breaker control, 50% on UPS + Generator
Internal Stairwell (tunnel, parking structure)	LED luminaries, semi-recessed in walls, below handrails	Breaker control, 30% on UPS + Generator
Exterior Stair and Walkway	Same as parking lot, Pole location to suit	Same as parking lot

The Consultant shall examine the different alternatives of parking lot illumination design: high mast, flood lighting, and area lighting. Generally, stations near residential areas shall have area lighting. (Flood lighting shall be

avoided where ever possible). Where floodlighting is used, upward glare shall be addressed and minimized. High mast lighting shall be considered for parking lots in industrial areas.

For ease of lighting maintenance, large areas (tunnel, bride, waiting area, boardrooms, lunchrooms, maintenance facilities, etc.) lighting shall have at least two sources of light control.

LED Lighting Requirements

- LED light fixtures shall be warranted for a minimum of five years
- LED light fixtures shall work with the available power supply on site
- Every fixture shall have surge suppression
- Fixtures shall be provided with a lighting facts label
- Outdoor fixtures must have an IP65 general use rating. For locations subject to high pressure washing (tunnels, platforms, or parking structures) the fixtures shall have an IP66 rating
- The lighting design shall be such that the specified minimum lighting levels shall be maintained for a minimum of 15 years
- Fixtures' lighting efficiency shall equal the most current industry accepted standard
- The lighting efficiency shall not be achieved by overdriving the LEDs
- The LEDs in the fixture must be of the same colour temperature
- LEDs with CRI below 75 are not acceptable for indoor lighting
- Colour temperature of LED light fixtures shall be uniform throughout the area (3500 K for indoors, 4000 K for outdoors)
- The fixture shall meet LM 79 rating and the chips shall meet LM 80 rating. LED B50 and L70 lifetime graph shall be provided
- The fixture must be vandal resistant and shall be modular in design for easy upgrade of the LED light engine, simple maintenance (straightforward part replacement) and installation
- The component connections shall be of plug-in type, tool-less removal and replacement
- The fixture shall be dark sky compliant, with good light control and minimum to no glare

- Lens, if required, shall be flat tempered glass, unless otherwise noted
- The fixtures shall have network connectivity and be remotely dimmable

Grounding and Lightning Protection

Grounding and Bonding

This Section outlines protective grounding and equipotential bonding requirements, based on the TN-S system arrangement, including:

- Transformer neutral grounding
- Electrical and Communications Rooms
- Exposed conductive parts of electrical equipment
- Extraneous conductive parts
- Building main ring electrode

The design of the ground system shall be based on:

- Ground resistivity data
- Ground resistance of the whole system and its components
- Ground potential rise
- High ground resistance
- Systems fault currents and their duration
- Conductor ratings

The design calculations shall show that the fault currents and DC stray currents will not damage the grounding system.

Soil and Survey Calculations

A ground resistivity survey shall be carried out at each site. The weather conditions prior to and at the time of the surveys shall be recorded in the report and an assessment made of the seasonal variations in resistivity based on meteorological data for the area.

System Requirements

Grounding system components include:

- Ground electrode
- Main grounding terminals or bars
- Grounding conductors
- Protective conductors
- Equipotential bonding conductors
- Electrically independent ground electrodes for special systems (clean ground)

Shared neutral is not allowed. Ground electrode total combined resistance value shall not exceed 0.5 ohm, during any season of the year and before interconnection to other grounded systems or grounding means.

Protective conductors shall not be formed by conduit, trunking or ducting. Ground Fault Loop Impedance for complete circuits shall be recorded. Supplementary Equipotential Bonding: Connect all extraneous conductive parts of the buildings such as metallic conduit and raceways, cable trays and cable armour to nearest grounding terminals by equipotential bonding conductors.

A Ground Inspection Chamber shall be provided for each ground rod where connected to a grounding conductor and shall extend 150 mm below top of ground rod.

Transformer Grounding

Transformer body grounding terminal shall be connected to MV main grounding bar by insulated copper grounding conductor not less than 3 AWG per 100 kVA of transformer rating, with a minimum of 2 AWG.

Transformer neutral (star point) shall be connected by insulated grounding conductor (colour White) directly to independent grounding electrode. Neutral grounding conductor shall be sized for maximum ground fault current for 5 seconds.

Grounding of Distribution Boards, Lighting Installations and Wiring Accessories

Distribution, lighting and power panel boards shall be connected by separate insulated protective conductors run together with incoming feeder cable, connecting ground terminals in panel boards with respective main distribution board grounding bar.

Final Ring Sub-circuits: Protective conductor of every final ring sub-circuit shall be in the form of a ring having both ends connected to ground terminal at origin of circuit in panel board.

Lighting fixtures and other exposed conductive parts of electrical installations, such as switches, heaters, air conditioning units, etc. shall be connected by protective ground conductors to grounding terminals of their respective panel boards.

Grounding of Electrical and Communications Rooms, and Fixed Machinery

A common 50 mm wide x 6 mm thick grounding copper bus shall be connected to the door frame and encircle the Electrical Room and Communications Room.

Motor and other equipment ground terminals shall be connected also by protective ground conductors of each branch circuit to ground terminal/bar at motor control centre, panel, or distribution unit.

Conductors shall be securely fixed, recessed in floor grooves or niches, or fixed to walls by appropriate staples. Ground bar or loop shall be securely fixed to building wall with copper or brass saddles.

Grounding of Road/Parking Lot Lighting Poles

Separate protective grounding cables for lighting pole circuits shall be run with power circuit, terminated at LV supply position in lighting control panel, and looped into pole grounding terminals. Any metal surfaces associated with handwells and manholes, including non-conductive metal surfaces, must be grounded.

Every second pole shall be grounded with a minimum of one ground rod complete with inspection chamber.

Grounding of Signal and Communication Systems

For telephone, alarm, voice and data, and other communication systems, provide a clean system to each service location, terminal cabinet, wiring closet, and central equipment location. Terminal Cabinets: Terminate grounding conductor on cabinet grounding terminal.

Clean Ground

In general, clean ground grounding system shall be provided for data system, telephony and other communication systems, and:

- Shall be single point ground to main electrical system ground
- Grounding cables shall not be run parallel with other grounding cables or power cab

Grounding of Fences

Metallic fences within 1.8 m of any equipment or structure above the surface of the ground, which is connected to the main grounding system, shall be bonded to the grounding system.

Ground rods shall be driven adjacent to the posts inside the fence line to a depth of not less than 3.0 m. Where no metallic posts are provided, the groundrods shall be connected directly to the metal wires, mesh, or other components of the fence.

High Resistance Grounding Systems

The high resistance grounding system shall limit the ground fault through the transformer neutral. The equipment will be located indoors in a climate-controlled building. The resistor shall be stainless steel edge wound type. The resistor shall be provided with taps for the adjustment of ground current magnitude in several steps.

Meter relay with auxiliary contacts shall sense voltage across the grounding resistor and initiate remote annunciation of a ground fault condition. The resistor to include appropriate taps to limits the ground current flow between 0.9 to 5.0 Amperes for 600V.

Service, Communications and Hub Room Grounding

The Communications rooms and Hub rooms shall form a Dedicated Ground Zone (DGZ). All communications equipment in the Communications and Hub Room shall be

electrically insulated from the building structure. A single point grounding method shall be employed in grounding the communications equipment. The access doorframe and door to the communication room shall be grounded using the same grounding method and loop as the Communications and Hub Room.

Lightning Protection

Lightning protection system is designed to protect structures from damage due to lightning strikes by intercepting such strikes and safely passing their extremely high voltage and current to "ground." Such system shall be installed were there are no surrounding structures that would provide a cone of protection.

- Lightning protection systems shall include a network of lightning rods, metal conductor, and ground electrodes, designed to provide a low resistant path to ground for potential strikes
- In general, grounding conductor connections to structures, connections within the lightning protection system conductors, shall be exothermic copper-weld type unless stated otherwise specified

Label and identify all equipment, instruments, control and electrical devices etc. to indicate duty, nomenclature identification number, service/function, to the satisfaction of GO. Identifications shall be in English. Alternative methods of labelling may be submitted for approval.

Coordinate names, abbreviations, colors, and other designations used for electrical identification with corresponding designations indicated in the Contract Documents or required by codes and standards. Use consistent designations throughout Project. All designations shall be to client approval.

Conflict: Shall an instance occur in the document or on the drawings in which material or construction methods called for is less than minimum requirement of the Regulations, the Engineer shall be immediately in- formed in writing. Consequent to the Engineer's approval, supply the materials and perform the work as through called for to code standards. In the event of any conflict arising between the local regulations, IEEE, IEE, IEC standards, and / or the document, the more stringent of these are to be followed.

Identification Devices: A single type of identification product for each application category. Use colors prescribed by these guidelines.

- Name plates and labels
- Wire and cable markers
- Conduit markers
- Panel & race way identification
- Pull and junction box identification
- Receptacle identification
- Fire Alarm identification
- End of line resistances
- Communication cabinets identification
- Manhole and handhole markers
- Underground warning tapes
- Labelling nomenclature

Electrical Rooms are to have a framed Single Line Drawing of the Electrical Distribution System, which is to be updated with any addition or deletion of part of the system.

ARC Flash

Electrical Arc Flash hazard levels to be designed for minimum hazard risk. Preliminary Electrical Arc Flash hazard level study will indicate possible hazard. The equipment selection will be done to minimize the Hazard prior to equipment purchase. The final arc flash study will verify the Levels. At the completion of work, all equipment in the space at the site shall be labeled and floors permanently marked showing boundaries for all hazard levels above level 0.

Wire Markers

Locations: Each conductor in a panel board, pull boxes, outlet and junction boxes, patch panel, rack and each connection.

Wire Identification Materials. Use one of the following:

- Heat shrink sleeves, blank
- Clear plastic tape wrap on strips with white writing section
- Wrap on strips, pre numbered

- Slip on identification bead markers or sleeves, blank or pre numbered
- Power and Lighting Circuits: Branch circuit/feeder number indicated on drawings
- Control Circuits: Control wire number indicated on schematic and interconnection diagrams on drawings and shop drawings

Nameplate Identification of Equipment

What are the things that require nameplate/label/ID?

- List table
- Equipment
- Sand board
- Comms. cable and equipment
- Wiring
- Conduits/boxes/splitters
- Voltage equipment
- Fuel and tax
- Receptacles/five alarm/duct
- Wpg vanity tapes
- Man/hand hole marker
- Panels

Nomenclature Appendix

Identify equipment with lamicoid nameplates as indicated in Equipment Identification Schedule.

- Engraved three layer laminated plastic, black letters on white background
- Lamicoid Nameplates:
 - 3 mm thick plastic engraving sheet
 - Black face
 - White core
 - Mechanically attached
 - Sizes as per the following table:

Nameplates

Table F-13: Nameplates

Name Plate	Size	Line	Height
Size 1	10 x 50 mm	1 Line	3 mm high letters
Size 2	12 x 70 mm	1 Line	5 mm high letters
Size 3	12 x 70 mm	2 Line	3 mm high letters
Size 4	20 x 90 mm	1 Line	8 mm high letters
Size 5	20 x 90 mm	2 Line	5 mm high letters
Size 6	25 x 100 mm	1 Line	12 mm high letters
Size 7	25 x 100 mm	2 Line	6 mm high letters
Size 8	53 X 100 mm	1 Line	25 mm high letters

- Nameplate Identification Of Equipment
- Panel board Directories
- Communications Cabinets, Cable and Equipment Labelling
- Intermittent Colour Coding of Conduit and Cable
- Identification of Pull and Junction Boxes
- Colour Identification of Wiring
- Name/Number Identification of Wiring
- Identification of Receptacles & Fire Alarm End-of-Line Resistors and Duct Detectors
- Equipment Identification Schedule
- Use 3 mm [1/8 inch] letters for identifying individual equipment and loads
- Use 6 mm [1/4 inch] letters for identifying grouped equipment and loads

Labels

Embossed adhesive tape, with 5mm [3/16inch] white letters on black background. Use only for identification of individual wall switches and receptacles, control device, and junction boxes.

Panel Board Directories

Identify loads controlled by each over current protective device in each panel board, by means of a typewritten panel board directory.

Communications Cable and Equipment Labelling

- Label communication outlets, panels and ports with lamicaid nameplates as specified in Equipment Identification Schedule
- Label each of cables with other ends addressing the Enter and Exit Point of Junction Box, Pull Box & Panels using Wire Identification Materials
- Label outlets with labels vertically aligned in each row
- Position panel labels in the same position on each panel
- Identify loads controlled by each over current protective device in each panel board, by means of a type- written panel board directory

Colour Identification of Wiring

- Identify wiring larger than No. 4/0 AWG by continuous insulation colour or by colour banding tape applied at each end and at splices
- Colour coding shall be in accordance with Canadian Electrical Code, and as follows:

Table F-14: Colour Identification of Wiring

Number	Voltage	Colour
1	12V, 24V and 120 V dc	Blue
2	120/208 V, 3 phase:(300V ax)	Red, black and blue (neutral White)
3	120/208 V emergency: (300V max)	Red, black and blue with Yellow tracer (neutral white)
4	347/600 V 3 phase	Orange, brown and yellow (neutral White)
5	347/600 V emergency	Orange, brown and yellow with red tracer (neutral White)

Where multi-conductor cables are used, use same colour-coding system for identification of wiring throughout each system. Maintain phase sequence and colour coding throughout each system.

Name/Number Identification of Wiring

- Identify No 8 AWG wiring & smaller using wire identification methods
- Types or print on blank wire identification materials using indelible black ink
- Identify wiring at all pull boxes, junction boxes, and outlet boxes for all systems
- Identify each conductor as layout in section Labelling Nomenclature include in labelling panel & circuit, terminal, terminal numbers, system number scheme& polarization, as applicable

Table F-15: Name/Number Identification of Wiring

Equipment	Colour	Nameplate Identification	Plate Size
Main Distribution Centre	Voltage Colour	Building name, consulting engineer, date installed, amp, volt	
		Main breaker, Metering cabinet	
		Instrument transformer enclosure	
		Loads controlled by each over current protective device	
		Metering devices	
Distribution Centre	Voltage Colour	Distribution centre designation, amperage, and voltage	
		Loads controlled by each over current protective device	
Panel boards	Voltage Colour	Panel board designation	
MCC	Voltage Colour	M.C.C. designation, amperage and voltage	
		Relay terminal and transformer compartments	
Manual Motor starters	N/A	Load controlled and mnemonics	
Ground Bus	N/A	System Ground	
On / Off Switches	N/A	Load controlled	
Disconnect Switches	Voltage Colour	Voltage and equipment controlled and mnemonics	
Transformers (Trx)	Voltage Colour	Trx designation, capacity, secondary & primary volt	
Emergency Power Equipment	Voltage Colour	Designation and voltage	
Wire ways	N/A	Voltage and system designation	
Line Voltage	Voltage	Designation and voltage	
Poles		Each pole shall have a unique id number above the electrical access hole stamped into the metal or pole material by the manufacture.	
Low Voltage Cabinets and Enclosures	System Colour	System name; system name and number if more than one cabinet or enclosure	
		Major components within cabinets and enclosures	
Communications handholes and manhole		Two (2) markings ground in to surface 24.5 mm apart on the entry and exit side of the manhole on the collar of the manhole or handhole. Inside manhole and handhole shall be painted the handhole or manhole number.	

Equipment	Colour	Nameplate Identification	Plate Size
Power handholes and manhole		No markings on the collar of the manhole or handhole. Inside manhole and handhole shall be painted the handhole or manhole number.	
Outlet: Data, clocks, radio, fair system, video, telephone and PA			
Outlet to power communication equipment			
Panels	N/A	Panel Designation	

Identification of Conduits, Boxes, Splitters and Panels

Conduit Markers

Location: Provide markers for each conduit longer than 2 m [6 ft.]

- Colour Banding Tape: Adhesive backed plastic tape, integrally coloured
- Code conduits and cables where conduits or cables enter or leave walls, ceilings or floors
- Spacing: maximum spacing 6m [20feet] on centre
- Colour: Prime colour to be 25 mm wide and the Auxiliary Colour to be 19 mm wide

Colour Identification of Equipment

Conduits, boxes, splitters and Panels Electrical equipment shall be prefinished in coded colours designating voltage or system as indicated in Equipment Identification Schedule.)

Voltage Colour Identification for Line Voltage Equipment

Table F-16: Voltage Colour Identification for Line Voltage Equipment

Voltage	Colour (In Boxes & On Ducts)	Colour of Wire
Fibre O V	Bronze	Blue = Ungrounded DC power Blue/white stripe = DC grounded voltage white with blue tracer = dc common
12V, 24V, 120 V dc	Blue	Red = AC 3 Ph-phase A Black = AC 3 Ph-phase B Blue = AC 3 Ph-phase C(neutral White)
120/208 V/120/240 V / under 300V ac	Grey	Red, black & blue with yellow tracer (neutral White)
120/208 V 120/240 V: or under 300V ac emergency:	Grey with auxiliary Red	
347/600 V Up to 600V	Sand	Brown = AC 3 Ph-phase A Orange = AC 3 Ph-phase B Yellow = AC 3 Ph-phase C(neutral White)
347/600 V emergency:	Sand with and auxiliary Red	Orange, brown & yellow with red tracer (neutral White)
High voltage (above 750 V):	White with a Black stripe up to 5K Yellow with auxiliary blue	
High voltage (above 5KV):	up to 15K ; Black with auxiliary Yellow	
High voltage (above 15K V):	up to 30K ;Black with auxiliary Orange	

System Colour Identification for Low Voltage Systems Equipment

Table F-17: Colour Identification for Low Voltage Systems Equipment

S. No	Systems	Colour (In Boxes and On Ducts)
1	Evacuation, Fire Alarm and Fire Telephone, Emergency Call, Fireman's Emergency power off	Red emergency Voice red/blue
2	Security, Card Access and Security TV	Yellow Red / Yellow
3	Telephone Cabinets	Brown
4	CCTV and TV Distribution	Brown
5	Intercom System	Brown
6	Public Address	Brown
7	Mobile Radio	Brown
8	Building automation, Computer and Data systems	Purple
9	Clock System	Purple
10	Digital information Signage	Purple
11	PRESTO	Pink
12	Dedicated Ground	Green
	All other communications	Green / Blue

Where impracticable to obtain equipment prefinished in coded colours, equipment may be site painted in coded colours. Coordinate with other work.

Identification of Pull and Junction Boxes

Identify pull and junction boxes over 100 mm size as follows:

- Use boxes which are prefinished in coded colours, or spray paint inside and outside of boxes prior to installation, in coded colours designating voltage or system
- Apply size 2 lamicaid nameplates to cover for each box. Identify system name. Where sequence identification is required, identify system name and number

Identify pull and junction boxes 100 mm or less in size as follows:

- Spray paint inside of boxes in coded colours designating voltage or system. Apply permanent identifying markings directly to box covers designating voltage or system using indelible black ink
- Legend—See Tables “Colour Identification of Equipment” including conduits, boxes, splitters and panels above
- Fire alarm end-of line resistors & duct detectors: Identify zone number with 6 mm high white lettering on red background on lamicaid nametag located on wall above device. Identify remote LED indicators for duct detectors

Identification of Receptacles, Fire Alarm and Duct Resistors

Standard duplex receptacles: provide lamicaid nametag with 6 mm high white lettering on black background (red background for emergency receptacles), indicating circuit, and panel designation and locate on wall above receptacle. On all other receptacles, provide nametag indicating voltage, phase, amps, and circuit and panel designations.

Underground Warning Tape

- Underground warning tape shall be yellow ribbon type
- Underground conduits shall use underground warning tape, Install one tape per trench at 75 mm [3 inches] below finished grade

Manhole and Handhole Markers

Electrical and Communication manhole or handhole collars shall be provided with a single and two grooves respectively with minimum of 3 mm deep and 25 mm apart in the direction of the conduits entering and exiting the manhole or handhole.

Installation Procedures

- Install nameplate & label parallel to equipment lines after Degrease & Clean surfaces to receive
- Secure nameplate to equipment front using adhesive, and screws
- Secure nameplate to inside surface of door on panel board that is recessed in finished locations
- Identify conduit using field painting to painting section
- Paint coloured band on each conduit longer than 2m [6 feet]
- Paint bands 6m [20 feet] on centre
- Colour: See Table “Colour Identification of Equipment” including conduits, boxes, splitters and panels

Labelling Nomenclature

Use the following identification standard when labelling communications cabling components:

- Include required cabling designations on the drawings
- The nomenclature for Wire labelling is as follows: The type of service, source is to be identified & device id, a unique number id & a destination id, XXXX- YYYY- NN-NNN- DDDD-NNN
- The source ID is as follows: “YYYY-NN-NNN... Is one of following sources:
 - Where N can be a sequential unique alphanumeric address, which will ‘designating any’ of the following building, floors, room, panel or rack and the wire ID.

- The Destinations ID are as follows: “DDDD–NN...”is one of following sources. Outlet assembly: YYYY- NN–nnn where:
- “NN” is the source alphanumeric identifier panel or rack, etc.
- “nnn” is a digit address .i.e. circuit number, etc.

Destinations ID

Table F-18: Destinations ID

Service ID “XXXX”	Source ID “YYYY”	Destination ID “DDDD”
“T” for telephone outlet.	“EU” for electrical utility supply	
“C” for data (copper) outlet.	“EG” for Emergency standby generator	
“FO” for data (fiber) outlet.	“UPS” for Uninterruptible Power Supply or inverter	
“D” for data.	“COG” for cogeneration Power	
“FA” for fire alarms equipment.	“PV” for Photovoltaic power source	
“PA” for PA & intercom systems.	“DP” for distribution panel	
“FARE” for Presto Rack	“DPE” Emergency Distribution Panel	
“RF” for radio system.	“DPU” for UPS distribution panel	
“S” for security systems.	“PP” for Power Distribution Panel	
“TV” for CCTV and TV systems.	“PPU” for UPS Power Distribution Panel	

“EL” for ELECTRICAL POWER.	“LP” for Lighting panel	
“RK” for rack	“MCC” for motor control centre	
“ST” for Station	“PDB” for Punch down block	
“PG” for Parking Garage	“NS” for network server	
“PF” for Platform	“RT” for router, multiplexer etc.	
“OB” for Outside Building (Bunker, Kiosk etc.)	“RK” for rack	
“CCTV” for CCTV Cabinets	“FL” for floor followed by B9-B1–Sub Grade Floors or 1–99–Above Grade Floors	
“NET” for Network Cabinets	“RM” for room followed by: MC–Main Telecommunications Room or CR–communication s Room (Any other space designated as a communication s room, which is not the primary.) or CC–Communication s Closet (Typically located in the Service area.)	
“IS” for information signage	“SS” for substation	
“EVC” for electric Vehicle charging and recovery	“ES” elect closets / sub elect room	

system		
“PARK” for Parking Systems (car counting)	“HUB” communication hub room	
“LFS” for Layover Fueling Station	“Bell D” for BELL DEMARCATIO N	
“LCS” for Layover compressor Station	“PX” for patch panel	“PX” for patch panel
“LWS” for Layover Wayside Station	“SEL” sub electrical rooms	“MHC” for Manhole communications
“LPMB” for Preventive Maintenance Bay	“RDC” for Rectifier	“HHC” for Hand well Communication
“LWR” for Wheel Maintenance House	“INV” for Inverter	“MHE” for Manhole Elect Power
“LWL” For Locomotive Wash	“DPLS” for Emergency Distribution for Life Safety	“HHE” for Hand well Elect Power
“BSM” for Boiler Snow Melt	Building Out Building to be determined	“PL” for Pole

Wall Jack Colour Standards

Table F-19: Wall Jack Colour Standards

Use	Colour
Data / Corporate Network	Blue
Telephone	Blue
Radio Data / Communication	Orange

Back Bone Fibre

Minimum number of strands of a backbone cable is to be no less than 24 strands. All fibres are to be terminated

Backbone Cables

Table F-20: Backbone Cables

Meaning	Buffer/Jacket Colour
Single-mode optical fibre	Yellow
Multi-mode optical fibre	Orange
10 gig laser-optimized 50/125 micrometer multi-mode optical fibre	Aqua
Sometimes used to designate polarization-maintaining optical fibre	Blue

Patch Copper Cable Colour Standards

All copper patch cables being provided must be Category 6 cables. Cable lengths will be of reasonable length allowing for proper cable routing needed for a tidy and organized installation.

All Fibre patch cables being provided must be either single or multimode matching the type of cable it is to be connected. Cable lengths will be of reasonable length allowing for proper cable routing needed for a tidy and organized installation.

Electrical Room

Panels and Racks:

- Horizontal Distributions: DDDD H, where:
 - “DDDD” is destination, numbers, or lost services manhole, handhole, Pole etc. as described above
 - “H” indicates “Horizontal”
 - Port Labelling: three digit address of workstation connected
 - Equipment: DDDD EQ
 - “DDDD” is Destination number as described above
 - “EQ” indicates “Equipment”
 - Port Labelling: three digit sequential number
 - Risers: DDDD R
 - “DDDD”, or lost services manhole, handhole, Pole, etc. as described above

- “RZ” indicates “Riser”
- Port Labelling: three digit sequential number

Attach inter-room connection to identically numbered panel or data outlets, and, wherever possible, to outlets at same position on each panel.

Cables:

Equipment Room/Riser/Backbone Cables: will follow the same principle of type of service, source is to be identified and device id, a unique number id and a destination id, i.e., (XXXX-YYYY-NN-NNN-DDDD-NN...-)

F.2 Communication

Communication design is meant to be a proactive, preventive approach to security through the identification and development of strategies that minimize potential threats and vulnerability to employees and customers, protects company assets from theft, abuse, and vandalism, and reduces unnecessary damage or waste.

The level of design and installation at each station, facility, or wayside layover will depend upon the unique conditions of each site and in accordance with GO Metrolinx corporate policy. Monitoring and recording requirements will be determined by the stakeholders.

This Section is a guide to the design requirements for Communications of GO Transit fixed facilities in terms of the following subjects:

- Close Circuit Television (CCTV)
- Public Address System (PA)
- Information Technology (IT)
- Telephone Network
- Security System
- Fare Handling Systems
- Service Counter Talk Thru Systems
- Building Automation Systems
- Radio

Closed Circuit Television (CCTV)

Closed Circuit Television (CCTV) systems provide a method to remotely monitor and assess areas identified either as secure, public, or controlled access. GO utilizes Closed Circuit Television systems at stations, terminals, and other locations to monitor train, bus arrivals, and departures, observe customer flow, and to conduct surveillance related to the protection of its corporate assets.

The level of CCTV system design and installation at each station or facility depends upon the unique conditions of each site and in accordance with GO corporate needs. Monitoring and recording requirements are determined by the stakeholders.

All the CCTV cameras at various GO locations can be viewed by the following user groups:

- Rail Operations and Bus Operations
- Station Services
- GO Transit Safety

The CCTV systems are divided into two significant groups, Operational systems, and Security Systems.

Coordination with Lighting and Signage System installation:

- For new facilities, Lighting and Video Systems shall be designed concurrently
- For existing facility that already have lighting, the Video System must be designed to work with the existing lighting or upgrades may be needed for the existing lighting, privacy concerns of viewing and recording video images, work rule concerns of viewing and recording video images, and/or legal implications of video surveillance

The corporate standard system for archiving recorded video must be used. This includes, but it is not limited to, the following factors:

- Legal requirements
- Secure and controlled storage area

Design Plans shall comprise of:

- CCTV Block Diagram, line and riser diagrams

- CCTV coverage zones and locations
- Power support for systems, including Emergency and UPS power
- Communication support for systems
- Temperature control for systems

Operational system

This system supplies operational assistance to various GO Transit departments by providing and recording real time images.

Security system

This system also provides and records images in real time, and it is used to deter the entry of unauthorized personnel, and provide record for System Safety investigations. The video information derived from the cameras of the Operational and Security systems are recorded on local servers. The CCTV system records on a 72-hour cycle.

Local Monitoring

All cameras, including pan/tilt/zoom (PTZ) at each site are viewed locally on a dedicated video monitor and manipulated by means of a keyboard, mouse, and/or joystick.

Remote Monitoring

The systems are connected via GO Transit network, which allows remote and local access to all cameras on all systems. The current method of transmission of video images is operating on MPLS circuits and Metrolinx

IT WAN Infrastructure. Various CCTV system viewing and monitoring rights are granted through administrative privileges as set out by GO System Safety.

CCTV Head End System

Refer the IT Station Telecommunications and Electronic Systems document for detailed specifications.

Components

The equipment required for either the Operational or the Security CCTV system generally includes, but is not limited to the following:

- Colour Monitors–24” or 32” display monitor inside station service area, 32” or 50” at Transit Safety Dispatch, wall or ceiling

mounted each site is dependent on local requirements and conditions

- This will include all hardware required for the installation
- Outdoor grade platform monitors to assist CSA to ensure doorways are clear of passengers
 - Typically used on curved platforms with obscured vision and installed on mini-platform on dedicated pole
- Cameras–Fixed or Pan/Tilt/Zoom, high sensitivity (0.08fc) and other new technology compatible and approved with the corporate standard system
- Camera Housings–weatherproof (outdoor), moisture and dust-proof, maintain the ambient temperature within the housing in the camera operating temperature range of –10°C to +50°C
 - A sunscreen is fitted to protect the camera from direct sunlight
 - Indoor housings are either high impact polycarbonate or epoxy coated steel, dust-proof, with top mount assembly, suitable for cameras with fixed focal length
- Lenses–Fixed with auto-Iris. Aspherical lenses are used on platforms to suit lighting conditions

Design/Installation Criteria

CCTV system implementation is part of the overall facility design. The level of design and installation at each station, facility, or wayside layover will depend upon the unique conditions of each site and in accordance with GO corporate needs. Monitoring and recording requirements will be determined by the user groups.

Data and Power Transmission

Must be included in the overall system wiring and power design, and includes the following:

Cable Systems (wire and fiber optic)

- Twisted Pair
- Coaxial Cable
- Fiber Optic–preferred medium of data transmission

Transmission Architecture

- Network

Transmission Distance

- Repeaters
- Signal Boosters
- Equalization

Environmental

- Temperature extremes (high and low)
- Weather (rain, snow, icing, flooding, etc.)
- Physical (topographic conditions)
- Lightning and Transients (electrical grounding)

Installation: CCTV Cabling

All cables shall be run in a neat and orderly fashion in a conduit system.

CCTV cables shall be designated at both ends as per design requirements provided in Section A.1: Electrical.

All cables that run from cameras to terminating equipment shall be single length (splices in these cables are not allowed)

Sufficient slack (1 meter) shall be left in case it is necessary to re-terminate the cable.

Emergency power—all systems and components shall be powered via a single source from the emergency power panel within the communication room.

Conduits

Conduits shall be designated with “CCTV” at terminating ends.

Wiring shall be run in conduit. Outdoor cable shall be run in epoxy coated rigid galvanized steel; indoor cable may be R.G.S. or E.M.T. depending on the location.

All underground conduits shall be rigid PVC.

Conduit breaks prior to entry in to a building shall be incorporated in the design. For detailed design, requirements refer to Section A.1: Electrical

Connections

All copper connections shall be copper-to-copper compression type with insulating covers.

Poles with cameras shall have one-meter slack cable in raceway.

Fish cord in all CCTV raceways shall be installed for future use.

Splices are not allowed.

Hand Wells

Dedicated handwells, located away from doors and main traffic areas, shall be provided for CCTV, separate from power.

Where installed in public areas, all enclosures, cover-plates, outlet plates, access panels, and handwells shall be provided with keyed temper-proof hardware.

Drainage shall be considered for all handwells.

CCTV Camera Placement

Placement shall include the following considerations:

- Mount cameras at 6 m height to prevent damage and provide good field of view
 - 6 m dedicated poles are to be used for normal mounting
 - If higher installation is required, firm mounting masts shall be used to prevent motion
- Utilize and include existing physical characteristics and infrastructure using CPTED guidelines
- Civil structures—roads, building, windows, important rooms, etc. existing barriers and fencing, terrain and ground contours
- Use of lens, zoom, and terrain conditions when setting and selecting camera locations
- Be aware of rising and setting sun when setting camera alignment to avoid the flare and blinding effects on the camera
- Mount cameras inside secure areas and provide tamper protection assume all cameras are subject to tamper
- Outdoor, cold, hazardous conditions, etc. Provide appropriate camera housings for worst-case environmental conditions

- Existing lighting; existing power; existing data and communication networks
- Existing environmental controls
- Impact considerations on neighbouring properties
- At a minimum, an illumination of 2 foot-candles throughout assessment area shall be maintained

Table F-21: CCTV Camera Placement in Parking Garages

Parking Garages			
Area	Activity	Primary Purpose(s)	Image Quality
All Vehicle and Pedestrian Entrances & Exits	Identify vehicle license plates, facial recognition of drivers and pedestrians entering or exiting the parking garages, not both. (Preference given to entering) RECORDING (FIXED)	<ul style="list-style-type: none"> • Security, public confidence, deterrence • Investigations • Claims management • Maintenance 	Recognize
Stairwell Entrances and Exits	Facial recognition of pedestrians entering or exiting, not both on each floor / entrance. Not in stairwells RECORDING (FIXED)	<ul style="list-style-type: none"> • Security, public confidence, deterrence • Claims management • Investigations • Maintenance 	Recognize
Parking Levels	One fixed camera visible from any location within a vacant facility. + increased signage RECORDING (FIXED)	<ul style="list-style-type: none"> • Security, public confidence, deterrence • Investigations • Maintenance 	Monitor and detect
Exterior Perimeter	One fixed camera visible from any perimeter location. RECORDING (FIXED)	<ul style="list-style-type: none"> • Security, public confidence, deterrence • Investigations • Maintenance 	Monitor and detect

Table F-22: CCTV Camera Placement- Station Operations

Station Operations			
<i>Area</i>	<i>Activity</i>	<i>Primary Purpose(s)</i>	<i>Image Quality</i>
Bicycle Shelters	One PTZ in close proximity but not necessary dedicated or necessary unless history of criminal activity. RECORDING (FIXED)	<ul style="list-style-type: none"> • Security, public confidence, deterrence • Investigations • Maintenance 	Monitor and detect
Open Pedestrian Bridges	Not required unless history of criminal activity / accidents.	<ul style="list-style-type: none"> • Maintenance • Claims Management 	Monitor
Elevators	Observe occupants inside the elevator cab. Identify pedestrians entering or exiting. RECORDING (FIXED)	<ul style="list-style-type: none"> • Equipment failure / medical emergency / redundancy • Security, Public confidence, deterrence 	Recognize.
Escalators	Maximum achievable length of each escalator. LIVE MONITORING (PTZ)	<ul style="list-style-type: none"> • Maintenance / Ops • Claims Management 	Monitor
Exterior Stairs	Maximum achievable length of each staircase. RECORDING (FIXED)	<ul style="list-style-type: none"> • Maintenance • Claims Management 	Monitor
Pedestrian Tunnels	One fixed camera visible from any location within the tunnel. Eliminate blind spots. RECORDING (FIXED)	<ul style="list-style-type: none"> • Security, public confidence, deterrence • Investigations • Claims management 	Detect
Entrance and Exit Doorways at stations	Facial recognition of pedestrians entering or exiting, not both on each floor / entrance. LIVE MONITORING	<ul style="list-style-type: none"> • Security, public confidence, deterrence • Claims management • Investigations • Maintenance 	Recognize
Platforms	PTZ at either end to monitor trains and deter trespassing.	<ul style="list-style-type: none"> • Rail operations • Security, public 	Detect

Station Operations			
	View maximum length of platform achievable. LIVE MONITORING (PTZ)	confidence, deterrence <ul style="list-style-type: none"> • Maintenance 	
Union Station Platforms	100% coverage and PTZ at either end to monitor trains and deter trespassing. View maximum length of platform achievable. LIVE MONITORING (PTZ)	<ul style="list-style-type: none"> • Rail operations • Security, public confidence, deterrence • Maintenance 	Detect
Designated Waiting Area (Platforms)	Full view of entire accessible platform. LIVE MONITORING (PTZ)	<ul style="list-style-type: none"> • Rail operations • Security, public confidence, deterrence • Maintenance 	Recognize
Platform Monitors for CSA	Assist CSA to ensure doorways are clear of passengers. Typically used on curved platforms with obscured vision. Camera shall not be used for any recording.	<ul style="list-style-type: none"> • Rail operations safety • Passenger safety 	Detect.
Ticket Vending Machines (TVM)	At all rail stations, one camera visible to customers. Pin pad not visible by camera. Identify customers using the TVM machines. RECORDING (FIXED)	<ul style="list-style-type: none"> • Security, public confidence, deterrence • Investigations • Conduct Control • Registering Evidence • Operational requirements 	Recognize.
Hold-up	One camera per service attendant to identify the customer currently at the window. RECORDING (FIXED)	<ul style="list-style-type: none"> • Security, public confidence, deterrence • Investigations 	Recognize.

Table F-23: CCTV Camera Placement in Parking Lots

Parking Lots			
Area	Activity	Primary Purpose(s)	Image Quality
Vehicle Entrances/Exits	<p>Parking lots with a capacity greater than 1,000 cars and/or higher crime rates.</p> <p>Identify vehicle license plates, facial recognition of drivers entering or exiting the parking lot, not both. (Preference given to entering.)</p> <p>RECORDING (FIXED)</p>	<ul style="list-style-type: none"> • Security, public confidence, deterrence • Claims management • Investigations • Maintenance 	Recognize.
<p>Parking Area</p> <p>Parking lots with a capacity greater than 1,000 cars and/or higher crime rates.</p>	<p>One PTZ camera visible from any location within the lot</p> <p>Max 10% blind spots</p> <p>Record vehicle movements</p> <p>LIVE MONITORING (PTZ)</p>	<ul style="list-style-type: none"> • Security, public confidence, deterrence • Claims management • Investigations • Maintenance 	Monitor
<p>Parking Area</p> <p>Parking lots with a capacity less than 1,000 cars and/or low crime rates.</p>	<p>One PTZ camera visible from any location within the lot.</p> <p>Max 25% blind spots.</p> <p>Record vehicle movements.</p> <p>LIVE MONITORING (PTZ)</p>	<ul style="list-style-type: none"> • Security, public confidence, deterrence • Claims management • Investigations • Maintenance 	Monitor
<p>Bus Loop</p> <p>(Attached to station)</p>	<p>Support operations, bus scheduling.</p> <p>LIVE MONITORING (PTZ)</p>	<ul style="list-style-type: none"> • Bus Operations • Security, public confidence, deterrence • Claims management • Investigations • Maintenance 	Detect
<p>Passenger Waiting/Shelter Area</p>	<p>On lakeshore stations, one camera visible to customers.</p> <p>No cameras required on limited lines unless history of criminal activity / accidents.</p> <p>RECORDING (FIXED)</p>	<ul style="list-style-type: none"> • Security, public confidence, deterrence • Claims management 	Detect

		<ul style="list-style-type: none"> • Investigations • Maintenance 	
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Table F-24: CCTV Camera Placement-Rail Operations

Rail Operations			
Area	Activity	Primary Purpose(s)	Image Quality
Layover Site Entrances	Identify vehicle license plates, facial recognition of drivers entering or exiting the facility, not both. (Preference given to entering.) RECORDING (FIXED)	<ul style="list-style-type: none"> • Security, deterrence • Investigations • Maintenance 	Recognize
Layover Site–Rail Equipment	Highly visible PTZ at either end to monitor trains and deter trespassing. Highly visible PTZ on both sides of railway equipment with capability to view full length of train. High Mast PTZ with full view of yard and equipment. Due to unique characteristics of layover yards, CPTED audits shall be performed prior to finalizing CCTV plan. LIVE MONITORING (PTZ)	<ul style="list-style-type: none"> • Security, deterrence • Investigations • Operations 	Detect
Major Support Facilities (Rail)	Identify vehicle license plates, facial recognition of drivers entering or exiting the facility, not both. (Preference given to entering.) Facial recognition of pedestrians entering or exiting at each entrance. PTZ if gate supported by intercom access. LIVE MONITORING (PTZ)	<ul style="list-style-type: none"> • Security, public confidence, deterrence • Investigations • Maintenance 	Recognize
Corridors (UPE)	View train location, operations LIVE MONITORING (PTZ)	Operations	Monitor

Table F-25: CCTV Camera Placement-Bus Operations

Bus Operations			
<i>Area</i>	<i>Activity</i>	<i>Primary Purpose(s)</i>	<i>Image Quality</i>
Bus Maintenance and Storage Facilities	Identify vehicle license plates, facial recognition of drivers / pedestrians entering <u>or</u> exiting the facility, not both. (Preference given to entering.) PTZ only if gate supported by intercom access. LIVE MONITORING	<ul style="list-style-type: none"> • Security, deterrence • Investigations • Maintenance 	Recognize
Bus Terminal Buildings	Identify vehicle license plates, facial recognition of drivers / pedestrians entering or exiting the facility, not both. (Preference given to entering.) PTZ only if gate supported by intercom access. LIVE MONITORING	<ul style="list-style-type: none"> • Security, public confidence, deterrence • Investigations • Maintenance 	Recognize

Table F-26: CCTV Camera Placement-Miscellaneous

Miscellaneous			
<i>Area</i>	<i>Activity</i>	<i>Primary Purpose(s)</i>	<i>Image Quality</i>
Carpool Lots	Nil		
Park and Ride Lots	Nil		
Bus Rapid Transit	Nil		
Transit Safety Interview Rooms	Inside interview room, full view of room. Exterior camera with full view of receiving area. LIVE MONITORING (PTZ)	<ul style="list-style-type: none"> • Security, deterrence • Investigations 	Recognize
Treasury Room	Inside interview room, full view of room. Exterior camera with full view of receiving area. LIVE MONITORING (PTZ)	<ul style="list-style-type: none"> • Security, deterrence • Investigations 	Recognize
Reception areas	Facial recognition of pedestrians entering or exiting at each entrance. RECORDING (FIXED)	<ul style="list-style-type: none"> • Security, deterrence • Investigations 	Recognize

Vault rooms	Inside interview room, full view of room. Exterior camera with full view of receiving area. Facial recognition of pedestrians entering or exiting at each entrance. RECORDING (FIXED)	<ul style="list-style-type: none"> • Security, deterrence • Investigations 	Recognize
Elevator Lobby	Facial recognition of pedestrians entering or exiting at each entrance. RECORDING (FIXED)	<ul style="list-style-type: none"> • Security, deterrence • Investigations 	Recognize
Monitors	Live view monitoring Monitors shall be positioned to protect against public access.	<ul style="list-style-type: none"> • Operations, security 	

Public Address System (PA)

Public Address Systems are provided at bus terminals and rail stations for direct communication to passengers. These systems are used by Station Operations and Rail Operations and predominantly include rail and bus platforms, bus loops, passenger waiting areas, tunnels/stairways, and shelters. Announcements are made from a wall-mounted touch-tone DTMF paging phone located in the Station Service Area. This phone is compatible with the zone selection equipment in the Communication Control enclosure.

Coverage–Local

A system of speakers divided into zones enable announcements from the service counter throughout the station or to specific areas, e.g., tunnels or platforms. Under normal working conditions, pages are made using the all call feature to all areas.

Remote

Rail Station P.A. Systems can be accessed through a Bell Canada SST Red phone interface to enable announcements to be made by Rail Operations at Union Station. This allows GO Operations personnel to access rail stations P.A. systems to make announcements.

Paging

Paging is presently conducted manually throughout the Rail System P.A. Network. However, both Union Bus and Rail Stations have

the capability of automatically making pre-recorded announcements. An IP Ethernet link between these stations also allows access to either system. Replacement or new systems at bus and rail stations will contain provision for connection for any future system-wide IP network.

References

The design and installation of the P.A. System will comply with the following:

- GO Transit Station Telecommunications and Electronics Systems Document
- Electrical Specifications

Controller

The controller provides, through a system processor, audio input to the various groups of speakers, referred to as zones. This is accomplished by means of Zone Drivers and Zone Relay Cards. It also interfaces with the Red and Local Paging Phones

DTMF

Dual Tone Multi Frequency

RED Phone

A Bell Canada SST system serves as an emergency communications network and provides a direct link with the Meridian phones at the stations and terminals. Both Red phones are interfaced with the P.A. system at each facility.

Existing Systems

If required by GO Transit to phase out, disconnect, and remove an existing system, the Consultant shall specify that the Contractor turn over all removed and unused equipment to GO Transit. The process of phasing in the new system shall not cause any undue disruption to the services of the existing system.

System Requirements

The P.A. System generally consists of zone-grouped speakers strategically located in or at GO Transit facilities, buildings, tunnels, stairwell entrances, elevator vestibules, rail platforms, Kiss and Ride Areas, and Bus Loops, and a System Controller located in the Communications Room of the facility.

For Station and Terminal Facilities

The System shall accept local inputs from local RED phone and DTMF paging phone in the Service Area and a remote input from GO Transit 'RED' phone system (Bell Canada SST System).

Emergency Power

P.A. System equipment shall be supplied from the emergency power panel located inside the station communication room.

Prioritized Paging

The P.A. system shall be user configurable to provide prioritized paging announcements when announcements are generated simultaneously from different inputs. Initial configuration shall establish to the following priority level.

Highest Priority

- GO Operations 'Red' Phone, Local 'Red' Phone

Lowest Priority

- Other Paging telephones including Service Area

The system shall provide for a separate 600-ohm audio input whose priority access level in the system is also user configurable.

The P.A. system shall interface with a maximum of seven and minimum of four P.A. paging phone inputs and up to three–600 ohm audio circuits. All three audio inputs shall provide independent audio adjustment of the incoming signal. A common audio adjustment shall also be provided for the P.A. paging phone inputs. Signal levels

for the local paging and remote paging shall be separate inputs requiring individual adjustments. The equipment provided shall be capable of adjusting all audio inputs over a range of -30db to +6db.

A solid-state controller shall provide the switching and signaling required for priority calls, selective zone paging, zone "group" paging, all call, background music mute, paging alert tones and emergency override.

On-site user-configurable, prioritized paging access for audio inputs shall be provided. The P.A. system shall interface with the GO Transit 'RED' phone system to allow both 'RED' phone paging from Union Station and local 'RED' phone paging from the service counter. The local 'RED' phone paging facility shall automatically provide service counter paging speaker override whenever the local 'RED' phone system is used.

Groupzone

- Selection codes shall be configurable through the system configuration menu
- The operation of either RED phone shall automatically select independent user-defined 'group' zones

Time Clock

The system shall provide for volume adjustment of the P.A. announcements using an internal real time clock. Automatic adjustment of clock changes shall be provided for daylight savings time.

Audio Power, Coverage and Quality

The amplifier capacity of the system shall be determined by the number of speakers required to achieve the design criteria: three amplifiers minimum, as follows.

A minimum of two amplifiers shall be provided for the Platform area in order to maintain continuous system functionality. The amplifiers shall operate independently of each other. The first amplifier shall not be used to feed an audio signal to the second amplifier.

A third amplifier shall be provided to cover the Kiss and Ride area, Station building, tunnels, stairwell entrances, elevator vestibules, and if required, a third platform or bus platform.

The method of cable installation and speaker mounting on the rail platforms shall be arranged

such that, not more than a 6dB drop shall be experienced whenever one amplifier fails.

Platform speakers shall be arranged in such a way as to maintain 50% coverage on each platform upon failure of a single amplifier.

For all areas, which require coverage, the P.A. system shall maintain a uniformly distributed sound pressure level measured at 1.5 m above floor level. The minimum sound pressure level at station platforms shall be 10dB above the measured ambient noise level to a maximum of 82dBA at day

Time hours and a maximum of 76 dBA at night time hours. The speech quality of the system shall be high and messages shall be clean and intelligible. There shall be no unwanted noise or spurious audio signals (20dB or less) emanating from the system.

A real time clock shall be used to provide the timing signals for volume adjustment. The real time clock shall run continuously even when power is removed and it shall maintain full date and time with automatic spring and fall Canadian daylight-saving time adjustments.

The P.A. system shall be designed to minimize unwanted noise at nearby residences in compliance with applicable noise control bylaws, shall these be less than the maximum values specified above, without however, reducing the effectiveness as an emergency voice communication system.

Components

P.A. System Controller

Rack

- The P.A. System Controller shall be housed in a clear width 483mm (19") 35U rack enclosure having external dimensions of (559mm W X 635mm D X 1,500mm H) (22"W x 25"D x approx. 60" H)

Quick Disconnect Terminal

- All speaker cabling entering the communication enclosure shall be individually connected to a "quick" disconnect terminal
- The quick disconnect facility shall allow individual outgoing zone cables to be quickly disconnected from the controller without the use of a screwdriver

- The rail shall be marked to identify each respective zone/cable and incoming cables shall be tie-wrapped to rigid internal cable bars to prevent undue movement
- The termination rail also provides individual earth (ground) terminals to allow the screen of each zone cable to be grounded
- A laminated termination rail diagram, in addition to a control riser and/or single line block diagram shall be mounted on the inside of the rear door and a copy of such drawings shall also be included in the system manual

Surge Protection

An independent transient voltage suppression and surge protection device shall be provided meeting UL 1449 TVSS rating power source located at the bottom of the enclosure. All required control system power supplies shall be installed on a "quick disconnect" DIN rail.

Limiter Circuits

The enclosure shall incorporate all the required driver assemblies suitably wired to their respective control circuits and terminal rail connections.

Voltage Adjustment

The System Controller shall provide for automatic volume adjustment for configurable Day/Night time periods using an integrated real time clock in addition to automatic daylight saving time adjustment. The automatic volume adjustment shall be available for all input channels via the system controller.

PCB Cards (Printed Circuit Board Cards)

The System Controller shall include a 483mm (19") card frame shelf, with suitable backplate assembly to receive the following plug-in PCB cards:

- Amplifier
- Processor Control card c/w Real Time Clock Chip
- Zone Switch Card
- Zone Switch
- SST Red Phone/Paging Phone Interface
- Zone Driver Cards (quantity as required)

- Zone Relay Cards (quantity as required)
- Power Supply
- Back Plate

Zone Cards

- Each Zone Card shall provide independent audio level adjustment, all audio inputs shall have independent level control in order to adjust incoming signal
 - Any audio channel shall be capable of automatically being connected to any combination of zones for broadcast of P.A. messages
- “Power On” and “Status” LED indicators shall be provided on the front panel of the Display Card in addition to a processor reset button. All system processor modules shall be interchangeable
- All P.A. system components shall be protected by electrical current limiting and thermal overload devices

Amplifiers

- Amplifiers in the P.A. rack shall provide input for telephone and microphones
- Amplifiers shall have automatic voice limiter circuit to compensate for varying voice levels and paging styles
- Amplifiers shall include RFI filtering, input/output overload protection, and open short circuit protection

Speakers—Outdoor Pole-Mounted

Mounting

- Speakers shall be outdoor weatherproof types mounted on lighting poles in such a manner as to eliminate the necessity of drilling the lighting poles (by stainless steel banding) and to provide resistance to vandalism
- Speakers shall be resistant to the environment and provide for the direct entry of any connected P.A. cable
- Speakers shall use an NPT threaded gland entry with liquid tight cable gland and be

coupled to the pole gland plate using liquid tight flexible conduit

- No exposed P.A. cable is allowed. Refer to GO Standard Electrical Drawings

Height

- The mounting height for speakers on light standards shall be generally 4m above grade

Audio Coverage

- The distance between speakers and the number of speakers required to achieve the specified audio coverage will depend upon the station's inherent acoustic properties and the locations of the light standards and shelters on the platform

Temperature

- The operating temperature shall be between -30 °C to 70 °C

Features

- Line voltage 70V and maximum wattage 15W RMS continuous
- Full adjustment in both the vertical and horizontal plane
- Speaker Format shall be dual cone phenolic impregnated resin manufactured with 70V multi-tap transformer and a sealed back for extra protection and audibility

Speakers—Indoor

Surface and Recessed Types

- Speakers shall be dual cone, treated paper design with a built-in 70V multi-tap transformer
- A steel baffle or suspended ceiling tile support bridge and back box shall be provided for either flush or surface mounting applications to suit the location
- The speaker's back box shall be supported independently of the grid in a ceiling tile application
- The finish shall match location colour or as required by GO Transit
- Speakers in public areas shall be flush mounted or camouflaged whenever possible

- The Consultant shall co-ordinate flush or surface mounted locations with the architect

Volume Control in Waiting Areas

- Flush mounted speakers shall incorporate an integral volume control accessible from the front baffle plate that shall provide attenuation of 20 dBA at any wattage tap

Temperature

- Operating temperature range shall be within 0°C to 50°C

Features

- Line voltage 70V and maximum wattage 10W RMS continuous

Speakers–Shelter and Tunnel

Housing

- Speakers shall have a vandal resistant diecast housing complete with stainless steel tamper-resistant “TORX” screws to prevent unauthorized access (Phillips or Robertson screws are not acceptable)

Output and Power

- Speakers shall be designed for maximum output at a minimum power loss and shall be installed in accordance with manufacturer’s recommendations

Format

- Speakers shall be sealed dual cone construction and manufactured of phenolic impregnated resin
- Speakers shall incorporate a sealed back for extra protection and audibility. They shall be white in colour or finished as required by GO Transit

Brackets

- When used in exposed areas or inside tunnels, a stainless steel speaker-mounting bracket must be used

Features

- Line voltage 70V and maximum wattage 8W RMS continuous
- Operating temperature range of -30°C to +50°C

Installation

P.A. Cabling

- All cables shall be run in a neat and orderly fashion in a conduit system
- P.A. cables shall be designated at both ends as per information supplied on tender
- All cables that run from speakers to terminating equipment shall be single length (splices in these cables are not allowed—that is: no splices in conduits)
- Sufficient slack (1 meter) shall be left in case it is necessary to re-terminate the cable
- Emergency power—all systems and components shall be powered via a single source from the emergency power panel

P.A. Cabling specifications

- AWG: 14
- Stranding: 41 x 30
- Conductor: TC, 2 conductors
- Insulation: 0.02" Polyolefin
- Capacitance: 30 pF/ft. (conductor to conductor)
- 58 pf/ft. (1 cond. and other cond. connected to shield)
- Shield: Delfoil Aluminum/Polyester
- Jacket: Blue or White Polyvinylchloride (depending on application)
- Nom. Cable OD: 0.302"
- Voltage: 600
- Temp: 80°C
- Weight: 56 lbs/mft
- CSA: AWM, CMG
- UL: CM
- Flame Test: FT4
- Application: 70V PA Speaker Applications

Conduits

- Conduits shall be designated with “P.A.” at terminating ends

- Wiring shall be run in conduit
- Outdoor cable shall be run in epoxy coated galvanized rigid steel; indoor cable may be R.G.S. or E.M.T. depending on the location
- All underground conduits shall be Rigid PVC

Connections

- All speakers connected in a single zone shall be run in a single line configuration
- All splices or connections shall be copper-to-copper compression type with insulating covers
- Poles with speakers shall have one metre slack cable in raceway
- Fish cord in all P.A. raceways shall be installed for future use

Telephone Network

The main telephone switch shall consist of trunk lines supplied as either individual or T1 circuits to allow for local and/or long distance calling. The network is to be capable of interfacing with 4-digit dialing as well as integrating with the voice mail system.

Telephone switches at remote sites such as Middlefield or Wolfdale shall be linked to the main switch at Head Office to permit 4-digit dialing between all sites.

All systems are to be provided with backup power supplies from Uninterruptible Power Sources at each location and where available by generator power.

The network shall be capable of permitting paging to be performed through the local telephone system at all stations.

Provision shall be made for local caller I.D., call hold, call waiting, transfer, and conferencing.

Individual telephones shall be speaker type, capable of accepting multiple lines and speed dialing.

Conduits and power for the telephone network shall be provided at each trunk switch location.

Talk-Thru System

The talk-thru system provides instant 2-way voice communication between the public and station

attendants through the glass divider at the station service counter.

The talk-thru unit provides hands free and effective duplex communication between the station operator and the passengers. The voice switching function is automatically biased in the direction from the passenger to the operator. Noise cancelling and omnidirectional microphones will be mounted on the passenger and service attendant sides respectively, of the booth glass divider. Two rotary encoded controllers will be provided to adjust the volume of each microphone. The operator's boom microphone will automatically override the passenger microphone when activated. Provision will be made for inter speech pause time. Components:

- Microphone Override Pushbutton
- Power On/Off L.E.D. Switch
- Noise Cancelling Microphone
- Seller's Mike-Off Switch
- Wiring-Conduits and 120 volt A/C source power outlets for each voice link assembly

Security Systems

Security at GO Transit Rail and Bus Stations is managed by integrated access control and alarm systems. These systems are supplied and installed, as well as monitored by Chubb Security Systems on a 24-hour basis.

Access Control

Entry into the station sets off the time-delay actuated intrusion alarm, which is disarmed by entering an accepted.

I.D. code in the system keypad

The alarm control panel will continue to monitor all connected functions except the intrusion alarm sensors. When the premises are exited, re-entering the accepted I.D. code will reactivate the intrusion alarm. Designated employees are provided with individual I.D. codes to permit access into the premises. Time and date are recorded at central monitoring stations at the East and West Region facilities.

Building Alarms

Actuation of any equipment failure or fire alarm devices will cause a digital signal to be transmitted to Chubb Security central alarm

monitoring location, as well as the local keypad. Activation of a hold up pushbutton will cause a silent signal to be transmitted to the Chubb central monitoring location, indicating where the alarm originated.

Alarm Systems

Devices are strategically located throughout the buildings to detect and alarm the following conditions:

- Intrusion
- Smoke
- Low Temperature
- High Temperature
- Hold Up (manually operated by the Station Attendant)
- Sump Pump Failure
- Inverter and UPS Failure
- Low Voltage (station main power supply)

General Features

The complete station alarm system shall include, but not be limited to, the following components:

- Chubb AFX Control Panel
- AFX User Interface
- Signal Transmitter and Receivers
- Audible Signal Device
- Hold-Up Alarm Buttons
- Intrusion Detectors
- Smoke Detection Devices
- Low and High Temperature Sensors
- Inverter System–Trouble and AC Output Sensors
- Smoke Detector By-Pass Switch
- Central Commercial Monitoring Services

Alarm Monitoring Equipment

Chubb alarm Control Panel

The system controls are housed in a surface wall-mounted EEMAC cabinet either with a hinged lockable door and gasket or a secured by screws for tamper protection. A tamper switch is

included to provide an alarm in the case of tamper for the latter protection. The alarm control panel is microprocessor controlled for monitoring 8 to 128 zones including the following:

- Fire alarm detection with smoke detectors
- Intrusion alarm with dual microwave and infrared motion detectors
- Hold up alarm from high collar pushbuttons
- AC power failure, voltage sensor relays
- Low station temperature alarm
- Inverter system–trouble and AC failure output sensors
- Alarm system trouble/low battery condition
- Annunciation time delay devices for voltage sensors and thermostats

System Test momentary contact pushbuttons are provided to test the alarm control functions including alarm output and telephone transmission. A manual “System Reset” pushbutton is provided to reset each alarm function at the keypad after the initiation devices have been set. An “Alarm Signal Silence” pushbutton in the alarm control panel is provided at the keypad to silence the audible alarm signals. An 8,192 event memory is either retrievable on site or from a remote PC located at a central facility. The system shall be subdivided from 2 to 16 areas that can carry up to 4,000 programmable codes, with 50 levels of authority. The system shall have false alarm prevention zones. All zones to be displayed on a liquid crystal display.

Power supply

A 12 volt DC power supply for all system supervision, control and alarm functions shall be provided in the alarm control panel as an integral part of the system, complete with sealed gel type batteries and solid state charging equipment through 120 volt, 1 phase, 60 Hz normal power supply and step down transformer.

The battery capacity will be sufficient to operate supervisory conditions for a minimum of 12 hours, including audible alarm signals and auto-dialer and at the end of this period to energize all alarm devices simultaneously for a period of 5 minutes continuously.

The automatic charger shall be capable of restoring 90% of dead battery capacity within 12

hours. Discharge protection shall be provided to disconnect the charger when the voltage drops below 60%. The system shall report locally on the display loss of power and battery failure.

Audible signal Device

The audible signal device shall be a vibrating horn with 110dB rating for intrusion and fire, operating at 12 volt DC.

User Interface

The user interface shall be surface mounted with tamperproof alarm. This unit will be used for entering application-oriented commands such as BA day-set/night-set, silencing audible annunciation and programming of access codes, etc. It contains a sounder and a liquid crystal display, which annunciates zones and system status. Shall more than one alarm be registered at the same time, the liquid crystal display will scroll through all alarms.

Intrusion Detector

Dual technology (microwave and infrared) motion detectors shall have Fresnel lenses, multi-segment mirrors, and automatic temperature compensation.

Smoke Detector

A single zone, single state detection system shall be installed. The photoelectric combustion detector is of solid-state design, surface or flush mounted. At stations with an existing Fire Alarm Panel, the output contacts will be wired to The Alarm Control Panel.

Hold-Up Button

The hold-up pushbuttons shall be of the high collar momentary type.

Low Temperature Sensor

The temperature sensor shall have an adjustable setting with a scale from 10C to 30C. The thermostat shall be housed in a vandal-resistant enclosure with maximum air circulation over the sensing element.

AC Voltage Adaptor

The AC voltage sensor shall be of solid-state type with adjustable pick up and drop out settings.

Inverter System

The inverter unit shall have trouble and AC output failure alarm settings as provided by the manufacturer. Dry output contacts from the Inverter shall be wired to the security control panel.

Trouble Alarm Set

AC Failure: Shall indicate failure of AC supply to the unit.

Low Battery Voltage: Shall indicate the battery voltage has fallen below a pre-set limit during the discharge process.

High Battery Voltage: Shall indicate that the battery voltage has risen above a pre-set limit during the charging process.

Charger Failure: Shall indicate the charger is not providing any output to the batteries.

The occurrence of any of the above conditions will provide a common alarm.

AC Failure Output Alarm Set

No AC Output: This alarm shall trigger upon the absence of AC output for any reason.

Smoke Detector Bypass Switch

A smoke detector bypass pushbutton switch, a double contact shunt switch, shall be provided to indicate to central monitoring that the detector is in the by-pass mode.

System Functional Performance

Actuation of any intrusion alarm-initiating device will cause the system local alarm panel to operate as follows:

- To transmit a signal, depending on the location and type of alarm, to a central alarm monitoring location and to annunciate on the local keypad
- An audible alarm signal in the station will sound continuously for 5 minutes and then be automatically silenced

Actuation of any fire alarm initiating devices will cause the system local panel to operate as follows:

- To transmit a digital signal, depending on the location and type of alarm, to a central alarm monitoring location and to annunciate on the local keypad

- Actuation of a hold-up pushbutton will cause the alarm control panel to transmit a silent alarm to a central alarm monitoring location, identifying to the operator the station where the alarm originated and the type of alarm

Actuation of a thermostat for low temperature, AC power failure, inverter system trouble, or security system trouble, will cause the alarm panel to:

- Transmit a digital signal, depending on the location and type of alarm, to a central monitoring location and to annunciate on the local keypad after the pre-set time delay has expired
- An audible signal in the keypad will sound continuously for 5 minutes and be automatically silenced

Sequence of Operation

The following is a typical procedure for entry into and exit from a station:

- Entry–The designated door is unlocked and the time delay intrusion alarm is immediately activated
 - The alarm is disarmed by key-in at the keypad located in the station before expiry of the time delay
 - If the code is accepted, the intrusion alarm is disarmed and the alarm control panel will continue to monitor all the connected functions except the intrusion alarm sensors
- Exit–The exit code is entered in the keypad and the system will respond by initiating the time delayed intrusion alarm
 - The station must be exited and the door locked before the end of the time delay

- The system will respond at the end of the time delay by arming all of the intrusion sensors

F.3 Mechanical

Heating, Ventilation, and Air Conditioning (HVAC)

Overview

Design Considerations

This section applies to the mechanical engineering design related to:

- Heating, Ventilation and Air-Conditioning (HVAC)
- Radiant Heating and Snow Melting Systems
- Plumbing and Drainage
- Fire Protection
- Equipment, Identification and Noise Vibration

Applications of compliance with good Engineering practice. The design shall address energy and water conserving systems to reduce consumption. Basic and user-friendly computerized and automated equipment controls and energy-management programs shall be utilized. Remote monitoring of equipment shall be provided if required by GO.

Design Requirements

Heating, Ventilation and Air-Conditioning shall be by means of the most cost-effective energy source available at the site. Temperatures (Daytime: with Nighttime setbacks) Daytime design temperatures for rooms shall be as tabulated.

Table F-27: Heating, Ventilation, and Air Conditioning (HVAC)

Room	C Winter Min.	C Summer Max	Energy Source
Passenger Waiting (including vending/ concessions)	18	25	HVAC
Station Attendant	22	22	HVAC
Staff Room	22	22	HVAC
Dispatcher	22	22	HVAC
Office	22	22	HVAC
Communications	15	22	HVAC (Note 1)
Electronics Workshop	22	22	HVAC
Washrooms	*	*	Ventilation & Heating
Janitor	*	*	Ventilation & Heating
Battery	*	*	Ventilation & Gas Monitoring
Electrical	15	25	HVAC (Note 1)
Mechanical Equipment	*	*	Ventilation
Elevator Mechanical	5*	25	Ventilation
Workshop	22*	22	Ventilation
Storage	20	22	Ventilation
Station secondary entrances and tunnels	N/A	N/A	
Hydro Vaults	N/A	N/A	
Shelters	N/A	N/A	

Electric heating if required (supplementary) to maintain 18°C winter temperature.

Note 1: High wall, heat pump with hyper-heating and low ambient cooling (no nighttime setback).

HVAC Design Requirements at Stations

Stations

- Radiant Heating shall be provided in Station buildings
- Heating and Air Conditioning of the waiting area and the service area shall be achieved by one high efficiency, premium quality furnace c/w outdoor condensing unit
- The service area will have a VAV box controlled by a thermostat, while the main thermostat shall be located in the janitor room and interlocked with the waiting area temperature sensor
- Communications room and Electrical room shall have dedicated split Heat Pump A/C unit for each room
- Refer to Communications room section for HVAC and ventilation details
- Depending on area, washrooms shall be ventilated by Energy Recovery Ventilators or exhaust fans, and shall be heated by radiant heating (if available in the building) or by electric baseboard heating
- Refer to Elevators section for Elevator hoistway HVAC

Facilities

- Radiant heating shall be the main heating system in the entire facility
- Offices area shall be heated and air conditioned by energy efficient, premium quality rooftop packaged gas heating/electric cooling A/C units
- Storage area and repair area shall be ventilated by heavy-duty industrial Air Handling Units c/w heat recovery unit
- This system shall be controlled by thermostats and gas monitoring system.
- To minimize infiltration through open overhead doors in rail facilities, heavy-duty industrial air curtains shall be installed above overhead doors

- Small Communications room shall be supplied with a split Heat Pump A/C unit
- Large Communications rooms and/or Computer rooms shall have an independent dedicated HVAC system including precision air conditioning equipment and underfloor plenum supply
- The complete HVAC system shall comply with ASHRAE Thermal Guidelines for Data Processing Environments

Rooftop Packaged Air

- Shall be provided from a recognized manufacturer with proven product testing
- Refer GO Standard specifications for detailed requirements

Air Curtains

- Shall be provided from a recognized manufacturer with proven product testing
- Refer GO Standard specifications for detailed requirements

Split Heat Pump Unit

- Refer GO Standard specifications for detailed requirements

Air Filters

- Refer GO Standard specifications for detailed requirements

Air Distribution Equipment

- Refer GO Standard specifications for detailed requirements

Duct Work & Accessories

- Refer GO Standard specifications for detailed requirements

Fans

- Airfoil or backward inclined design is preferred
- Forward curved wheels may be used for low pressure applications
- Variable pitch axial fans shall be considered for fan wheel diameters greater than 610mm and where system air volumes vary, due to

control characteristics of summer/ winter operation

- Propeller fans may be used where they serve non-public or unoccupied areas
- Additional ventilation with emergency power backup may be required in large facilities.
- Refer GO Standard specifications for detailed requirements

Energy Recovery

- Energy Recovery Ventilators (ERV) shall be specified for energy conservation in all GO facilities, where practical and cost effective
- In station buildings they shall be above the public washrooms or the janitor room, in the attic space, where applicable
- Access by ceiling hatch

Filters

- Filters used in supply air systems shall be 50 mm (2") thick throwaway type minimum efficiency of 30%
- Refer GO Standard specifications for detailed requirements.

System Control

- HVAC systems shall be controlled using programmable thermostats to achieve night setbacks.
- Interlocks for fire protection to be as per OBC and NFPA
- If a room has two HVAC systems, both systems shall be controlled by a single programmable automatic heating/cooling changeover controller

Heaters

Electric fan forced heaters shall be considered in the waiting area and entrances. Heaters can be wall or ceiling mounted. Heaters shall be controlled by wall mounted space sensors. No built-in thermostats shall be allowed.

Supplemental electric fan forced heater shall be considered in the service area. Electric resistance duct heaters shall have Silicon Control Rectifiers (SCR), minimum airflow switch, and two high-temperature limit sensors.

Gas fired unit heaters and infrared heaters shall be considered in large facilities.

Refer GO Standard specifications for detailed requirements for shelter heaters.

Diffusers

- Diffusers shall be aluminum
- For perforated metal ceilings diffusers to be perforated type to match the ceiling profile and colour
- For high-traffic door locations, or where drafts are a problem with station attendants, linear diffuser air-curtains shall be provided at the doors.

Ducts

Air ducts shall be galvanized sheet metal conforming to ASHRAE, SMACNA Duct Construction Standards, and NFPA 90A.

Diffuser branch-ducts and air terminal ducts may be circular metal flex-ducts where concealed.

Exposed ducts in public areas shall be aluminum spiral ducts. Hangers and fasteners shall also be protected from the detergents and moisture or be fabricated of materials that are not subject to corrosion. Refer GO Standard specifications for detailed requirements.

Fire Dampers

Fire dampers shall be fusible link type conforming to ULC-S505.

An access door shall be installed for inspection and resetting. Refer GO Standard specifications for detailed requirements.

Connectors

Flexible connectors shall be provided between vibrating equipment and connecting ducts. Refer GO Standard specifications for detailed requirements.

Insulation

Acoustical and thermal duct insulation shall be in accordance with the O.B.C. and ASHRAE 90.1.

Acoustical insulation shall be provided to maintain a maximum room sound rating of 40dBA.

Piping insulation shall be in accordance with ASHRAE 90.1, with PVC jackets. Refer GO Standard specifications for detailed requirements.

System Controller

The System Controller shall provide the following primary functions:

- Switches of audio channels to the required zone drivers
- The switching function shall be performed by the zone switching card
- Allows programming and testing through a RS 232 /RS 485 port
- Supplies power to the system processor, display and interface cards
- Interfaces all Red Phone circuits to the required Zones
- Four audio input channels that can each provide an audio output on any pre-configured group combination or manually selected zone
 - Provision shall be made for an ALL Call broadcast to all zones simultaneously
- Appropriate Zone Driver and Zone Relay Cards for the requisite number of drivers/zones within the system
 - The audio channels are interfaced to the driver input/output circuits by zone driver and relay cards
- Provides appropriate Paging Telephone interface
- Configurable automatic Day/Night audio level capability
- Automatic Daylight saving time adjustments

Building Automation System (BAS)

All facilities, stations, and terminal buildings shall have a central computer-based, Building Automation System installed that will control and / or monitor the following building systems at a minimum:

Table F-28: Building Automation System (BAS)

Mechanical	Electrical	Communications
All ventilation and exhaust systems, Fire Alarm Systems, All HVAC units and associated systems, Air compressors, Chillers and Chilled Water, Vehicular and Pedestrian Gates and Doors, Gas, Hydro and Water, Sump pumps and Pits, Gas Detection Systems, Interlock with Detection System, Well water systems, if installed, Elevator Alarms, Compressed air dryers, Drainage interceptors, Generator and Emergency Power Systems (loss of power, monitoring of damper status, batteries status and alarms), All third party (retail, users): water, gas, Well Water Systems,	Power Systems, Lighting Systems, Programmable Logic Controller (PLC), Shelter Heater System, Panel Loads per circuit, SCADA Remote Monitoring, Car Counting System, All third party (retail, users): power, Environmental readings, Radio Systems (power consumption), Monitoring of signalling system capability,	<ul style="list-style-type: none"> • Telecommunications Systems (excluding CCTV) • PA and Intercom Systems • Security and Access Management Systems

Compressed Air Dryers, Drainage Interceptors, Layover Systems (Sand, Fuel, Air, Track Load).		
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Provide sub-metering for panels and sub-panels with remote communication capability from IT Central Gathering Centre. The system shall be able to store data for a minimum of three (3) years.

The local BAS shall be able to communicate and send information to an IT Central Gathering Centre.

The location of the BAS control panel and location of the outlets is to be included on the electrical drawings. Refer to the Building Automation Systems performance specification for additional information.

Radiant Heating and Snowmelt

Design Requirements

Rail Station

Full width hydronic snow melting shall be installed on all rail platforms

Bus Facilities

Radiant Heating shall be installed in all Bus Facilities.

Partial snow melting shall be provided at bus facility rapid entrances.

For detailed specifications and drawings, refer to the GO Standard Drawings Specifications section.

Plumbing and Drainage

Design Requirements

This Section deals with cold and hot water distribution, building storm and sanitary drainage, and special applications within the immediate vicinity of any building. Typical Applications include:

- Distribution
- Elements
- Fixtures
- Storm and Sanitary Drainage
- Special Applications
- Staff washrooms
- Public washrooms
- Tenant and vending premises

- Bus and rail maintenance facilities
- Hose bibs at buildings, tunnels and on platforms
- Sump pits for tunnels, elevators and buildings (if applicable)

Specialized installations include:

- vehicle wash equipment
- Progressive maintenance bays (PMBs) for locomotive and coach water supply and sewage disposal, and wells and septic systems or holding tanks at rural sites, if required

Distribution

Hotwater

Where gas is available, and tempering is not required, a standard DHW tank is to be used.

Where gas is not available, service hot water shall be provided at station and terminal washbasins in washrooms tempered to 40°C. Shops, maintenance and garage facilities may have higher temperatures if required. A re-circulation system normally is not required in a typical GO Station building.

Hot water heaters in stations/terminals shall be located in janitor rooms, ceiling-hung to suit space requirements. Relief valves shall be piped to floor drains with air break. A gas fired tankless type hot water system may be used where approved by GO, to minimize piping.

Landscape Water

Buried water supply piping systems shall be provided for the manual watering of landscaping only if specifically requested by GO. If requested, they shall consist of PVC piping and

quick coupling hose attachments spaced so that every point in the landscaped area can be reached by a 30 m hose extended from the hose attachment.

- The system shall be capable of being completely drained or air-blown dry in the autumn

Storm Drainage

Drainage shall be designed to meet the requirements of local authorities, and the relevant stormwater management study.

Drainage: oil and grit interceptors and inlet control devices may be required.

The location of scupper drains and splash pads shall be coordinated with the prime consultant.

Rail platform shelter roof drains where required, may be directed to Railway R.O.W. ditches, where approved by the Railway, or to a sump pit in the tunnel and then pumped to the storm system.

Sanitary Drainage

Drainage shall be designed to meet the requirements of local authorities.

All washrooms, janitor rooms, mechanical rooms, vending and concession areas and certain maintenance areas as directed by GO, shall be provided with floor drains and strainers.

Strainer and sediment buckets shall be provided for heavy-duty floor drains, trench drains, and tunnel floors. Tunnels shall have open shallow trench drains at the wall perimeters.

Food preparation areas require grease interceptors. This applies particularly to tenant premises.

Service stations, repair shops, and garages require oil interceptors. Parking lots and elevator pits do not require oil interceptors as per O.B.C.

Water Piping

Water piping shall be copper, type "L" above ground, type "K" for buried services. Copper type "M" and galvanized pipe shall not be used. Hangers and fasteners shall also be protected from the detergents and moisture or be fabricated of materials that are not subject to corrosion.

Waterlines in unheated areas shall be protected from freezing with electric tracing, thermostatically controlled. These sections of

piping shall be valved to enable isolation and drainage.

Insulation shall be in accordance with ASHRAE 90.1 standard.

Piping shall be concealed in public areas. Exposed chrome piping shall have chrome-plated anchors and hangers.

Pipes shall not be routed through electrical rooms, control rooms or communication rooms.

Cathodic protection for buried pipes shall be provided if required.

Hydrants and Hose Bibs

Wall hydrants and hose bibs shall be minimum 20 mm anti-siphon, non-freeze type in flush mounted box with locking cover and located at buildings, tunnels and on platforms to suit maintenance requirements as directed by GO.

Tunnel/platform hose-bib pipe systems shall have gravity drain capability for water shut-off.

Hose-bibs shall also be located in shops, maintenance facilities, loading docks, bus platforms, etc. as directed by GO, sized to suit.

Pipe Sleeves

Galvanized steel pipe sleeves shall be provided in concrete structures to accommodate future piping installations, if required.

Hangers and fasteners shall also be protected from the detergents and moisture or be fabricated of materials that are not subject to corrosion.

Water Meters

Water supply lines shall be sized for the specific requirements of the facility.

The incoming service shall be metered inside with an exterior readout acceptable to the local utility.

Major tenants shall have check-meters.

Valves: Each fixture shall have a key operated service valve or shut-off valve.

Additional shut-off valves shall be provided for each group of fixtures, e.g., a washroom. At least one shut-off valve shall be provided for each room with one or more fixtures.

Sump Pumps

Where storm or sanitary drains cannot be discharged to the sewer by gravity flow, flow shall

be discharged into a tightly covered and vented sump pit, from which the liquid is lifted and discharged to the sewer by an automatic duplex pump system with automatic changeover and guide bars. Each pump shall be sized for 100% flow. Pumps shall be epoxy coated with two independent seal assemblies.

A 4-float control system shall be provided (OFF-LEAD ON-LAGG ON-ALARM). Provision shall be made for dry 'C' contacts for connection to a remote alarm. Pumps shall be easily removable for maintenance without the need to enter the wet well.

Pit cover shall be gas tight, self-opening with piston kit and safety grid.

System shall be complete with lifting equipment including lifting davit, chain hoist, lifting device, and chain hook.

Sump pits are used for shelter, roof, and tunnel drainage, and in elevator or escalator pits.

Special sump pumps may be required for maintenance facilities or rural stations (TBD). For further details, refer to GO Standards Master Specifications.

Fixtures: General

All fixtures except janitor sink shall be vandal resistant vitreous china Certified to CAN/ CSA-B45.0, "General Requirements for Plumbing Fixtures"

Fire Protection

Table F-29: Fire Protection Design Requirements

Elements	Typical Location	Features
Sprinklers		Sprinkler systems shall be provided in facilities and regional offices, Where sprinklers are required by code, sprinkler systems shall be designed, constructed, installed, and tested in conformance with NFPA 13. Sprinkler heads in public areas shall be concealed flush type, where sprinklers are code-required for major station or terminal facilities.
Fire Hydrants		Hydrants shall be provided at all facilities. Fire hydrants in landscaped areas or snowdrift areas shall be raised or marked with raised identification "flag" devices. Minimum burial depth of piping and pipe-marking/protection shall be to municipal requirements.
Dry Fire Suppression		Dry Fire Suppression Systems or clean agent systems for main computer and telephone equipment rooms shall be provided

All trims to be touchless, electronic, hard-wired barrier free where applicable.

Refer GO Standard specifications for detailed requirements.

Special Requirements

- Septic systems and/or holding tanks for rural facilities
- Filling stations for locomotive and coach washroom water supply.
- Coach washroom sewage removal facilities at PMBs in train maintenance facilities
- Train and bus wash facilities including recycling of wash water
- Wells or water reservoirs at rural facilities to approval of authorities having jurisdiction, including filtration and purification systems
- A minimum GO requirement is ultraviolet purification for coliforms and E.coli bacteria with pre-filters
- Thermostat controlled electric pipe heating cables shall be used on all water pipes in unheated areas, where the temperature may fall below freezing
- Minimum burial depth of piping shall be 1650 mm or to municipal requirements

		where required by GO Transit.
Fire Extinguishers	All facilities	The Consultant shall specify fire extinguishers to be available during construction, identify, and locate fire extinguishers that are required to be supplied and installed by GO Transit for occupancy of premises.

Equipment, Identification and Noise Vibration

Identification

Equipment, piping, and systems shall be clearly identified according to industry standards. Equipment shall include manufacturer's nameplate, CSA, and/or CUL registration plates where applicable. Piping and ducting systems shall be identified using a standard identification system, ASHRAE, CGSB or similar. All labels, tags, nameplates, etc., shall be stainless steel, brass, or thick laminated plastic, as appropriate to suit application.

Appearance

All equipment, vent, access door, door grille, diffuser, return air grille, and exposed duct locations shall be coordinated by the architect/prime consultant. Roof-mounted equipment shall be screened. Where permitted, multiple exhaust ducts shall be combined to minimize building penetration. On sloping station roofs, exhaust ducts shall be directed to vertical gable vents, if applicable.

Exterior grade-level equipment (condensing units, etc.) shall be elevated 300 mm minimum above grade, and screened by fencing. Grilles, vents and diffusers shall be recessed or flush with adjoining base-building materials, as detailed by the architect/prime consultant, and shall not be surface-mounted over base-building materials.

Noise/Vibration

Isolators and vibration control devices shall be specified as required to ensure that equipment-noise and vibration do not interfere with GO Transit operations, as well as to protect adjacent properties from noise and vibration, where necessary.

F.4 Fixtures and Furnishings

Fixtures and furnishings provide information, convenience, and comfort to GO passengers along their journey.

Detailed specification sheets for Fixtures and Furnishings can be found in the standard suite of performance specs on MyLinx. The following itemized list covers fixtures and furnishings to be planned for and placed along integral customer journey points:

Table F-30: Fixtures and Furnishings

Fixture or Furnishing	Location
Automated Teller Machine	<ul style="list-style-type: none"> • Station Building interior (waiting area) • Station Building exterior
Automated External Defibrillator	<ul style="list-style-type: none"> • Station Building interior (waiting area)
Benches	<ul style="list-style-type: none"> • Rail Platform–in shelters • Rail Platform - standalone • Bus Platform–in shelters • Bus Platform - standalone • Station Building interior (waiting area) • Station Building plaza • Park and Ride lots - in shelters • Refer GO Standard Cut sheet for bench selection and order form.
EV Charging device	<ul style="list-style-type: none"> • Parking structure
Shelters	<ul style="list-style-type: none"> • Rail Platform • Bus Platform • Park and Ride lots • Remote/Ancillary parking lots • On Street
Two-Way Intercom	<ul style="list-style-type: none"> • At each elevator lobby on site including tunnels, pedestrian bridges and parking structures • In the vicinity of the Mini platform (to replace existing Bell telephones) • In all universal washrooms • Secure entrance points for GO Operational Facilities • In each elevator cab

Fixture or Furnishing	Location
	<ul style="list-style-type: none"> • At each Carpool/Park and Ride site
Charging Stations (cellphone, laptop)	<ul style="list-style-type: none"> • Integrated seating in Station Building waiting areas.
Waste Receptacles	<ul style="list-style-type: none"> • Station Building interior (waiting area) • Platform Access areas • Bus Platform • Rail Platform • Park and Ride lots • Washrooms • Service Counter
Wi-Fi	<ul style="list-style-type: none"> • Station building interior • Rail platform • Bus platforms—located in the proximity of the station building
Vending Machines	<ul style="list-style-type: none"> • Station Building interior (waiting area) • Station Building exterior
Digital Signs—S4	<ul style="list-style-type: none"> • Bus Platforms Entrances • Bus Platforms • Rail Platforms • Rail Platform Entrances • Station Buildings interior • Parking Structures
Infotainment/CP 24	<ul style="list-style-type: none"> • Station Building Interior—waiting area
Network Clock	<ul style="list-style-type: none"> • Station Building Interior—waiting area
Newspaper boxes	<ul style="list-style-type: none"> • Bus Platform • Station Building
Self-Serve Kiosk	<ul style="list-style-type: none"> • Platform Access enclosed area • Amenities shelter • Station Building Interior—waiting area
Static Sign Display Case	<ul style="list-style-type: none"> • Station Building exterior • Park and Ride lots • Remote/Ancillary parking lots

Fixture or Furnishing	Location
Presto–Credit Query Device (CQD)	<ul style="list-style-type: none"> • Station Building Interior • Tunnel Entry • Bus Terminal locations require CQDs and SPOSSs only
Presto–Station Fare Transaction Processor (SFTP)	<ul style="list-style-type: none"> • Platform Access locations • Station Building Interior • Tunnel Entry • Bus Terminal locations require CQDs and SPOSSs only
Presto–Add Value Machine (AVM)	<ul style="list-style-type: none"> • Station Building Interior • Platform Access Locations
Ticket Vending Machine (TVM)	<ul style="list-style-type: none"> • Platform Access locations • Bus Platform • Station Building Interior • Parking Structure • Park and Ride lot • Self-Serve Kiosk • Amenities Kiosk
Bollards	<ul style="list-style-type: none"> • Station Site exterior • Maintenance Facilities • Parking Garages • Service Buildings
Garbage Enclosure	<ul style="list-style-type: none"> • Station/Terminal Site exterior • Bus Maintenance Facilities
Salt Bin	<ul style="list-style-type: none"> • Rail Platform • Bus Platform • Park and Ride lots • Maintenance Facilities

General Placement Guidelines

- Shall be laid out to facilitate convenient access to services and information along the passenger's journey
- Locate with clear visibility to encourage intuitive wayfinding, passenger safety, and passive surveillance of adjacent environments
- Minimum clearance of 500 mm between two adjacent furnishings or devices shall be maintained
- Ensure clearance is provided for barrier-free paths and approach
- Provide queueing areas that will not interfere with pedestrian/passenger traffic
- Ensure that each seating area provides a clear space for side approach and side transfer to a seat
- Cluster devices where possible to clearly identify points of passenger service, information and efficiently utilize station infrastructure
- Installation tolerances and operational requirements shall be provided to facilitate ease of ongoing site operations and maintenance
- Materials and assemblies shall have a robust design and durable materials to ensure longevity
- Fare handling devices shall be placed to avoid work within the Structure Clearance Envelope on/or beside Railway Track

Shelters

Because GO is primarily a commuter system, operating in accordance with timetables, most passengers arrive on platforms to coincide with train or bus departures.



Sheltered areas for customer comfort integrated within the canopy on the rail or bus platform are the preference for application of the sheltered areas.

Sheltered areas should typically provide the following amenities:

- Heaters
- Digital Information Walls
- GO Standard Benches
- Wi fi
- Charging Receptacles

Fare Systems (only in certain applications at car pool lots and or remote station access locations or where there is no station building)

Where the integrated sheltered option is not available, standalone shelters shall be provided within the GO Standard suite of shelters, comprising of:

- Passenger Shelters
- Car Pool Shelters

Number of sheltered areas on a bus or rail platform are determined such that each shelter would accommodate approximately a bus-load of passengers or two rail shelters would accommodate approximately a half coach-load of passengers.

Digital Signs at Line Stations, Terminals and Carpool Lots

Suite of sign types

- Digital Departure Signs (Train and/or Bus)
- Digital Platform Specific Signs (Train or Bus)
- Digital Parking Counter
- Digital Way finding Interactive Kiosks(TBD)
- Infotainment

Digital Departure Signs (Train and/or Bus)

Location Criteria

- Digital Departure Sign (Train and/or Bus) shall be located at:
 - Inside Station/Terminal buildings, adjacent to waiting area; mounted at barrier free height as per OBC and AODA regulations
 - At Rail Platform Access Points (platform access area, entrances to tunnels, bridges, parking structures,

- side platforms – via ramp and/or walk-on)
- At Primary Bus Loop Access Point(s)
- At Car Pool Lots shall be located at:
- At remote parking lot locations (at GO's discretion)

Placement & Appearance Criteria

- Placement to be perpendicular to path of travel; avoid disruption of pedestrian traffic flow that may be caused by queuing.
- Do not place departure signs above doors.
- Co-locate access points where possible
- Co-locate Digital Departure Sign (Train and/or Bus) with Fare Systems (Ticket Vending Machine, Add Value Machine), and GO marketing, integrated into Information and/or Service Modules
- Consider passenger flow and intuitive wayfinding in establishing Information and Service Modules
- Where multiple modes and/or transit agencies are provided, co-locate signage and fare systems
- Establish one common point if multiple access points and station building /terminal waiting areas are in close proximity
- Use static signage if required to way find to Information and Service Modules
- Information and Service Modules to be used for interior and exterior applications, with modules adjusted as required, based on site conditions (in consultation with GO)
 - For exterior applications, integrate within building envelope where possible and provide weather protection i.e. building canopy
 - Provide independent weather protection if integration with building canopy is not possible (in consultation with GO).
 - Where an Information or Service Module cannot be established due to site conditions, consider suspending the screen from underside of canopy. At remote locations consider implementing the concept of the suite of shelters.

- At car pool lots, integrate into car pool shelter
- Where possible recess eye-level digital signs into walls to prevent potential injuries. Install such that face of screen is flush with adjacent surfaces. Ensure entire screen is visible from all angles. Conceal all conduits, connections and infrastructure

Monitor Size

- Use current I&IT standard

Number of Monitors

- Minimum one Digital Departure Sign for Train, plus one for Bus, or one combination Train and Bus Digital Sign (confirm with GO).
- For larger sites with significant service, confirm number of monitors for each of the above with GO.

Mounting Height

- Barrier free height as per OBC and AODA regulations, as noted in location criteria, and
 - 2.134 m (7'-0") minimum clearance to u/s of monitor (interior application)
 - 2.438 m (8'-0") minimum clearance to u/s of monitor/housing where maintenance and snow clearing equipment is used

General Mounting Bracket Requirements

- Monitor mounting bracket to be stainless steel weldment system and stainless steel hardware.
- Bracket to be vandal proof, corrosion resistant and exterior grade with a minimum safe loading capacity of 500kg.
- Tilt capability (20 degrees).
- No exposed fastening.
- Required bracket mounting configurations:
 - Ceiling mounted
 - Wall mounted
 - Pole mounted
- Back to back, side to side and double back to back mounting options required.
- Ability to support attachment of NEMA enclosure.

- Monitor mounting bracket to be stainless steel weldment system and stainless steel hardware



Figure F-11: Conceptual Digital Service Module



Figure F-12: Conceptual Information Module



Figure F-13: Digital Departure sign in Car Pool Shelter

Digital Platform Specific Signs (Train or Bus)

Location Criteria - Rail

- Island Platforms: three sets of back to back Digital Platform Specific Signs (Train) at each track used by GO.
- Side Platforms: three sets of back to back Digital Platform Specific Signs (Train) at each track used by GO.
- Avoid clustering of digital signs in close proximity; Digital Departure Sign locations take precedence over Digital Platform Specific Signs.
- Always locate one set of Digital Platform Specific Signs at mini platform and the other two equally spaced.
- Digital Platform Specific Signs should be mounted to underside of rail platform canopy.
- Ensure digital screens are outside of train envelopes.

Location Criteria - Bus

- At each bus platform at Line Stations, But Terminals and Car Pool Lots: one set of back to back Digital Platform Specific Signs (Bus).
- Locate digital signs consistently at driver end of each platform, outside of road envelope.
- Mount Digital Platform Specific Signs from underside of canopy, where possible. If not possible, use standard GO pole. Ensure poles are away from the barrier-free path of travel.

Placement & Appearance Criteria

- Follow GO standard drawings for poles and canopy mounts.
- At rail platforms, place static platform number on track side.
- At bus platforms, place static platform number on road side.

Monitor Type/Size

- LED type (Use current I&IT standard)

Number of Monitors

- Set of two screens, back-to-back, at each location

Mounting Height

- 2.438 m (8'-0") minimum clearance to u/s of screen/housing

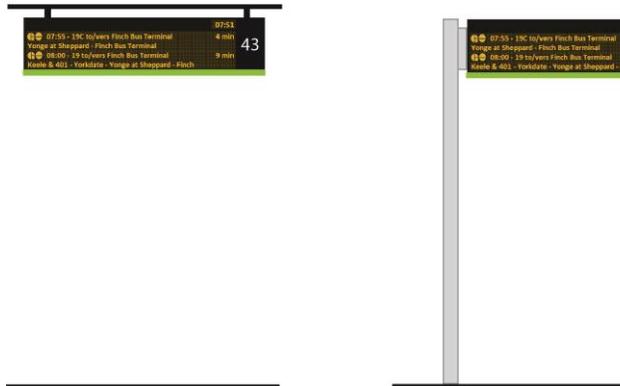


Figure F-14: Conceptual Digital Platform – Canopy and Pole mounted modules

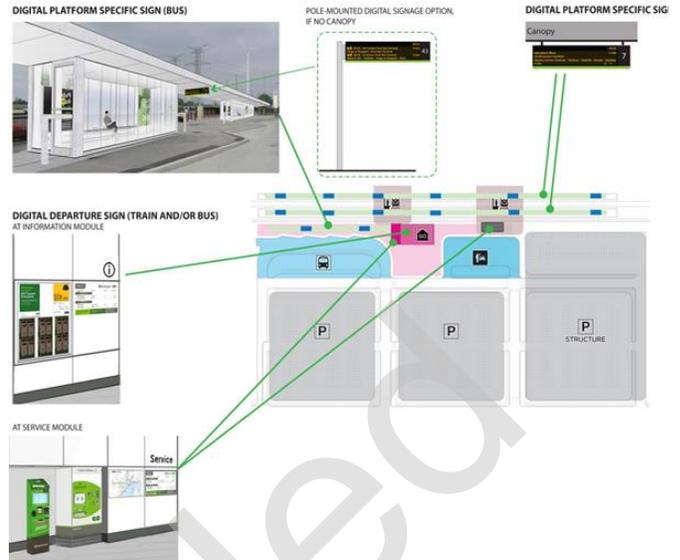


Figure F-16: Conceptual Typical Application of Digital Signs at a Rail Line Station

Digital Parking Counter

Location Criteria

- At vehicular entrance(s) to parking structures, visible when approaching by road

Appearance

- Follow look and feel below. Integrate with GO Station ID Totem suite

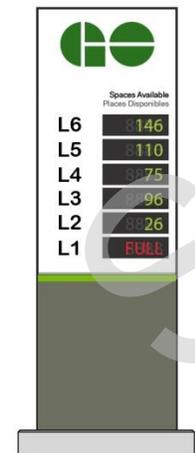


Figure F-15: Conceptual Digital Parking Counter Totem

Technical Requirements

Process

- The digital signs will be supplied, commissioned and maintained by Information and Information Technology (I&IT), except for the Digital Parking Counter. I&IT will install the PCs, routers, and switches in the communications room
- Capital Project Delivery will perform the physical installation of the monitor, power cabling, and data cabling to the monitors from the communications rooms
- Screens and digital media players (DMP's), CPU's to be provided by IT and installed by the Contractor. Pick up from storage to be by Contractor.
- Transceivers, cabling terminations, communication room racks, and all civil work (conduits, pulling of wiring, pole footings, pole structure, mountings, NEMA boxes, etc.) to be by the Contractor.
- Fully installed and tested solution by the Contractor.
- Commissioning by the Contractor in coordination with IT and Station Operations.

Technical Design Requirements

- Each Digital Sign location must be shown on the electrical drawings and must include data and electrical outlet locations as well as any enclosures or other infrastructure associated with these signs
- Monitors: (Use current IT standard)
- Digital Media Player (DMP):(Use current IT standard)
- Contractor to provide transceivers/receivers, associated with cabling type and the balance of digital sign components. Provide receivers with minimal profile; by Extron or approved equivalent – reference products:
- Extron DTP HDMI 4K 330 Transmitter/ Receiver for shielded cable
- Extron HFX 100 Transmitter/Receiver for fiber
- Poles and mounting standards – refer to digital signage guidelines; GO pole conceptual design drawings under development. Shop drawings to be developed by the Contractor in coordination with digital signage equipment.

Connectivity

- Each of these devices requires a minimum of one CAT6 network outlet. These network outlets are to be cabled back to the nearest telecommunications room network rack and terminated as per the copper horizontal cabling standard.
- CAT6 shielded cable for devices placed within 90m from the Communications (Hub) Room.
- Multimode 6 strand fiber for installation beyond the 90m mark.

NEMA Enclosure

- NEMA enclosures shall be provided for receivers and fiber terminations at digital screens.
- NEMA/EEMAC Type 4X IP-65 with solid door capable to accept box lock requested by IT Field Services, and physically separated into two compartments to isolate power from communications devices.

- BEL R SS Series EEMAC/NEMA 4-4x-12 / IP-65 or Hoffman CONCEPTTM Type 4x or any other box meeting NEMA Type 4X IP-65, physical separation capabilities and box lock requirements.
- The enclosure size selection shall be based on the electrical and electronic equipment to be housed inside the box.
- All NEMA enclosures to be concealed within poles or finishes adjacent to screens. Visible NEMA boxes shall not be accepted. Provide access to concealed NEMA boxes. Do not drill or perforate the integrity of the NEMA box in any manner.

Conduit

- One 53mm conduit for power and separate 53mm conduit for data from the communications (hub) room all the way to the last pull point before the device; from the last pull use 25mm conduit to the device.
- Follow DRM in terms of conduit selection (PVC for buried conduit, RGSEC (Rigid Galvanized Steel Epoxy Coated at the factory) for all exposed locations such as tunnels, etc); 53mm liquid-tight conduits from the NEMA enclosure to the monitor mounting bracket. Provided with drip loops and easy release on the NEMA enclosure side.
- All conduits and connections to be concealed within poles or adjacent finishes.

Power

- Dedicated single 20amp duplex receptacles shall be used.
- Outdoor locations require sizing based on external enclosure and screen power draws. All receptacles must be GFI Type which may be reset at the NEMA enclosure. This is to be coordinated at time of design and must adhere to DRM.
- All devices shall be UPS backed-up. If the existing UPS does not provide enough capacity or if there is no UPS whatsoever, provide a Surge Protection Device in the local panel where the monitor and DMP is fed from. This device shall be appropriate for the specific panel at each location.

Data

- DMP's to be placed in Communication (Hub) Rooms.
- Assume one DMP per digital display. (confirm with IT)
- For design assumptions, use Cisco Interactive Experience Client 4650.

Fare Systems

Fare handling machines are proprietary equipment and will be provided and installed by the appropriate supplier. Consultants shall meet with GO Transit staff to ensure the required facilities needed to operate these machines, e.g., power, are provided.

The following equipment identified below are typical fare handling devices:

- "Interac", etc. (including data polling, Station Control Computer (SCC), Debit and Credit equipment)
- Smart Card equipment PRESTO
- Ticket Vending Machines (TVMs)

PRESTO Overview

Presto Fare Handling System is a smartcard-based fare payment system designed to support the use of one common fare card for fare payment on various participating public transit systems.

PRESTO equipment is proprietary, provided, and installed by the appropriate supplier, and comprises:

- SPOS (Station Point of Sale)–located on the Service Counters
- SFTP (Station Fare Transaction Processor)
- CQD (Card Query Device)
- HCR (Handheld Card Reader) and the HCR Cradles–located in Safety Systems Offices
- WAP (Wireless Access Points)–located at bus facilities
- CC (Concentrator Complex)–installed in main racks
- AVM's (Add Value Machines)

Location

Devices may be located either in the station building, on the platforms, at access points to platforms (tunnels, pedestrian bridges, walkways, stairs, ramps, etc)

General Placement Criteria

- Placement of devices and way-finding signage is site specific
- Devices shall be placed to avoid work within the Structure Clearance Envelope on/or beside Railway Track
- Bus Terminal locations require CQDs and SPOSs and TVM's; all fare collecting equipment is located on the bus
- Minimum clearance of 500 mm between two adjacent devices shall be maintained.
- Devices shall not impede accessible clearances and accessible routes.

SFTP Placement Criteria

- Devices shall be placed at all rail platform access points. Devices shall be placed maximum 75 m apart at locations with direct parking lot to rail platform access.
- Devices shall be placed along passenger natural flow, at clear and visible locations, and shall be readily accessible by Cardholders for fare payment.
- Remote locations shall be provided with two (2) devices on different circuits, to provide redundancy in case of power failure.

CQD Placement Criteria

- Shall be located outside the passenger flow, near TVM and/or Information Board/Digital Station Information Signs.

Refer to Standard Drawings for Presto System Architecture and installation details.

Ticket Vending Machines (TVM) at Line Stations, Terminals and Carpool Lots**Placement Philosophy:**

- Each Rail Line Station and GO Bus Terminal shall provide, when possible a minimum of 2 TVM at the following mandatory locations

- 1 TVM located within the vicinity of the station building
 - If no station building is provided, 1 TVM will be placed at main entrance to platform (as per site conditions) along the Barrier free path of travel in such a way that the path remains barrier free
- 1 TVM to be located at an additional platform access point
- Additional TVM's locations to be considered at the following pedestrian access points for the following areas within Rail Line and Bus Station sites:
 - Main Bus Loop/Platform
 - Parking Structure
 - Pedestrian bridge, mid span, as site conditions allow
 - Satellite surface parking lot
 - Any additional areas as determined by GO Design Standards staff
 - Park and Ride Facilities may be provided 1 TVM located on passenger platform adjacent to the shelter where power and communication infrastructure is available
- Preference is for a shelter over the TVM
- TVM's are to utilize sunshade top (both large and smaller sized sunshades) as site conditions warrant where a full shelter is not possible
- A minimum queuing space in front of TVM shall be three customers
- Queuing space shall be increased based on historical peak station demand information provided by GO staff
- Placement and orientation of TVM's and queuing areas shall not adversely impact the main flow of customers
- TVM concrete base installation details as per GO Standard Drawings TVM-001, TVM-002 and TVM-003
- TVM Electrical and Communication details as per F.1 Electrical and F.2 Communications

Two Way Intercom

Design Requirements—General

The Two Way communication device is a customer service amenity, which assists customers with inquiries at rail station site to provide an enhanced customer service amenity at our platforms, elevators, parking structures, universal washrooms and maintenance facilities.

Two Way Communication Devices shall be placed at the following locations at a typical GO Rail station site:

TVM Configuration Criteria

- When site configuration allows, it is encouraged to locate TVM's that satisfy both mandatory and preferred locations. The intention is to maximize TVM accessibility and convenience to customers with the use of a single TVM. The TVM must be visible from main entrance and located where there is a high volume of passengers. Ensure that placement does not block major egress locations
- Location of TVM to be coordinated with the location of CDQ tower, S4 Digital Information Sign, and the SFTP tower where possible
- When a cluster of all 4 devices is possible, the TVM and CQD shall be placed adjacent to each other
- A minimum 500 mm horizontal clearance is required between the CQD and the TVM
- TVM to be weather sheltered where possible

- At each elevator lobby on site including tunnels, pedestrian bridges and parking structures (new device technology to address current technical and operational issues)
- In the vicinity of the Mini platform (to replace existing Bell telephones):
- In all universal washrooms:
- Secure entrance points for GO Operational Facilities;
- In each elevator cab;
- At each Carpool/Park and Ride site;

The Call flow shall be:

Call made to service attendant with call backup available 24/7 by Transit Safety.

Enhanced Accessibility Features include:

- Localized Hearing Loop to support tele-coil wireless technologies,
- Clear, barrier free identification using standard signage, colours and graphics in accordance with the principles outlined in the GO Transit Static Signage Catalogue, AODA and FLSA requirements.

Refer GO Standard Guideline Performance specifications for detailed two way communication device requirements.

Appearance

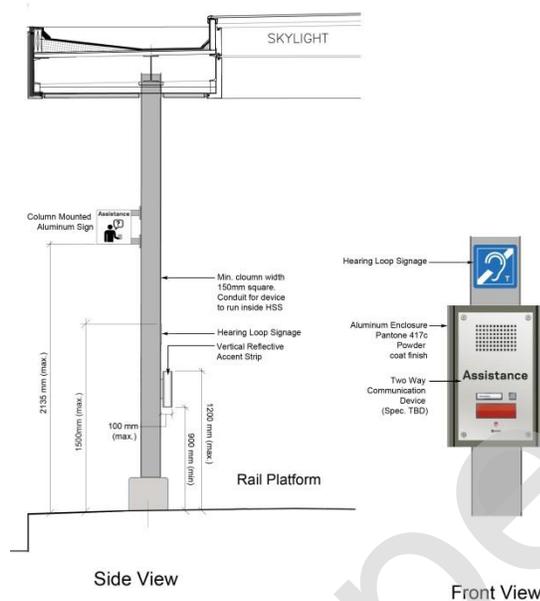


Figure F-17: Conceptual two-way intercom column support application (At Mini Platform Area)

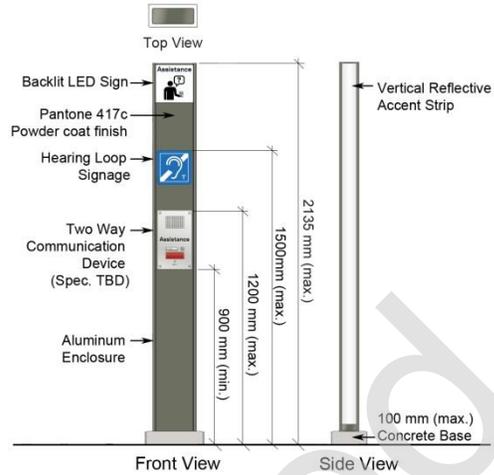


Figure F-18: Conceptual two-way intercom free standing application

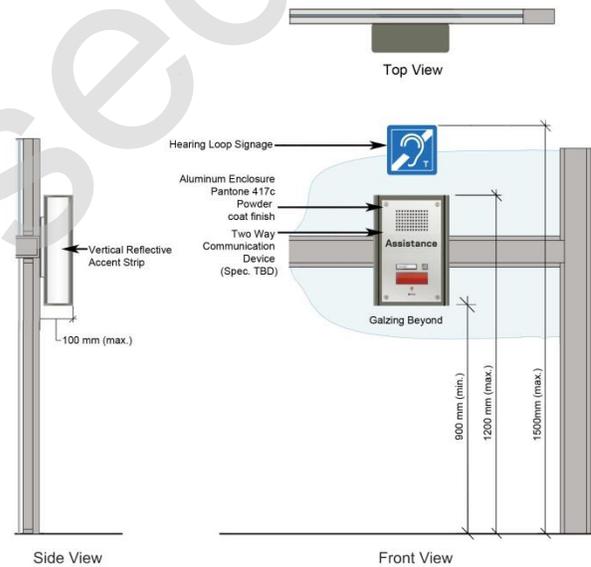


Figure F-19: Conceptual window Mullion Application

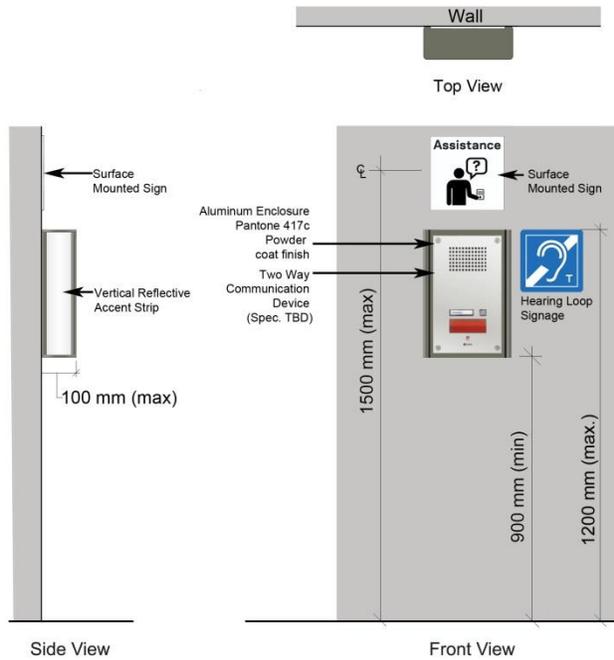
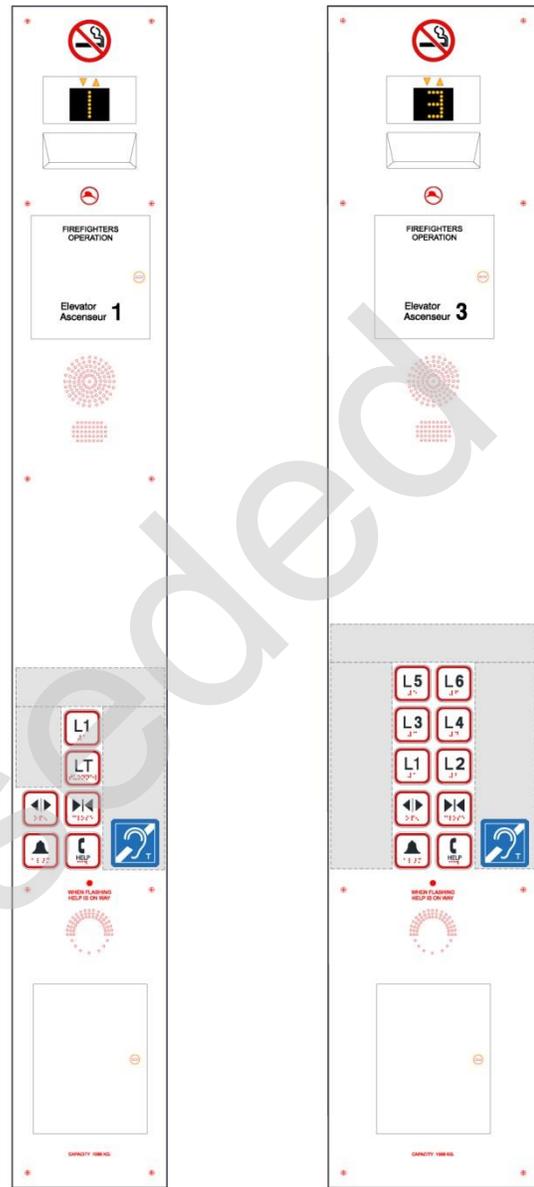


Figure F-20: Conceptual Wall mounted Application (Tunnels)



**Elevator Cab Console
Typical Layout
(Linear Button array)**

**Elevator Cab Console
Parking Structures
(Keyboard button array)**

Figure F-21: Conceptual Interior Elevator Cab Application (Diagram only)

F.5 Finishes and Materials

Design Requirements—General

Materials selected shall:

- Be visually and tactilely pleasing

- Avoid creating floor patterns that are disorienting to patrons moving across them due to high contrast or distracting patterning
- Facilitate passenger guidance, information, safety, and security in a manner that contributes to overall brand and design excellence

Safety

- Materials shall be selected so as to reduce the risk of hazard to patrons and maintenance staff and shall have the following safety considerations
- Proper fasteners and adequate bond strength shall be used to minimize hazards from dislodgment due to temperature change, vibration, wind, seismic forces, aging, or other causes, such as vandalism

Sustainability

- Material selection shall reflect green initiatives of sustainable development and meet the LEED mandatory requirements
- Use low emitting materials, particularly within the building envelope, and implement an indoor air quality management plan during construction
- Choose materials and building design approaches that maximize the ability to recycle/reuse/repurpose building materials or components when a building is required to be demolished or significantly altered
- Use local materials with a high recycled content that are durable, vandal proof and easy to maintain

Durability and Performance

- Materials with excellent wear, strength, and weathering qualities shall be used, with due regard to both initial replacement costs and required maintenance
- Waste during construction and regular operations to be diverted from landfill back to the manufacturing process and reused wherever possible
- Materials shall maintain their good appearance throughout their useful life and

shall have a minimum twenty-five (25) year performance capability

- For ceiling and canopy finishes/systems and their application, materials shall allow for commissioning, adjustment, and future retrofitting of subsystems such as CCTV and public address systems
- Materials shall also be:
 - Easily maintainable and repairable
 - Of high quality and installed at high levels of workmanship
 - Selected with consideration to the total acoustic environment, so as to minimize reverberation while meeting other design and performance criteria
 - Selected with respect to costs by balancing initial material costs against long-term maintenance costs
 - Easily replaced/repared, such as by including a wear surface separate from the structural slab to facilitate replacement when a floor is in a heavy wear area
 - Chosen, where appropriate, with reference to the potential need for access to service ducts, etc.
 - Shall be chemically inert, acid and alkali-resistant, dense, non-porous and non-staining
 - All materials shall be able to withstand corrosion and uphold its intended use and function, and maintain its appearance (no rusting or fading in colour)

Maintenance and Cleaning

- Materials selected shall have matching replacement stock available for the expected life of the material
- Shall be selected for ease of cleaning, repair, or replacement
- Shall resist soiling and be cleanable with commonly used equipment and environmentally benign cleaning agents
- Platform enclosures, tunnels, and walking surfaces shall utilize materials that are not damaged by pressure washing

- Access to windows for cleaning shall not be obstructed except where absolutely necessary (required structural member, etc.)
 - Windows above ground level shall be placed such that they can be accessed from below using a lift, and accessing windows for cleaning shall not require getting into traffic or onto tracks
- If cleaning or replacing windows or maintaining a structure requires access by rappelling down the side of the structure, then safety tie-off anchors shall be provided per code

Unit Size

- Units shall be large enough to reduce the number of joints yet small enough to facilitate replacement if damaged
- Standardized grids shall be designed wherever possible to accommodate for standardized glazing for windscreens and vertical elements of shelters
- All specified floor materials shall be resistant to damage from common deicers

Installation and Application

- Materials shall be detailed and specified to be installed in accordance with industry standards and manufacturers printed directions for long life, low maintenance, and compliance with warranty requirements
- All materials shall be installed using tested and proven methods, in accordance with established trade standards
- All materials, hardware, and fasteners shall be able to withstand the anticipated pressures of ground-borne vibration, as well as air pressure changes generated by wind and by the passage of the GO Transit vehicle
- All materials shall be secured in a manner which deters and prevents tampering and vandalism
- Installation of materials shall generally facilitate their removal without affecting the integrity of adjacent materials

Colour, Pattern, Tonal Contrast and Texture

- Colours shall exclude dedicated corporate and signing colours except for those purposes
 - Use noticeably different colours to distinguish the different key building elements. The recommended colour and brightness contrasts of key building elements by the Accessibility Standards Is 70% or more
 - Integral and applied colours shall be selected which resist undue fading in the environment in which they are used
 - Textures shall not conflict with those used in the information and guidance system
 - Materials with staining and colour shall have through-colour properties and non-fading characteristics
 - Finishing of steel shall be appropriate to the location of the material, i.e. exterior vs. interior
 - All interior finish steel (such as handrails) shall be stainless steel unless otherwise noted
 - All exterior finish steel shall be stainless steel or galvanized
 - Anchors and fasteners as required shall match with fixture
 - Mixing of materials is not recommended
 - Finishing of steel in the field shall be kept to a minimum by designing structures that can be shop fabricated in sections, primed, and finished in the shop, and bolted together on site
 - Designers shall minimize field welding and touch up galvanizing
 - Any galvanized metals to receive a paint finish shall be factory primed and painted
 - Field painting on site is not acceptable
- ### Public Areas—General Criteria
- Sound attenuating materials shall be used as required to minimize noise levels

- Public areas are subject to intensive use and hardware
 - They shall be divided into high and low contact zones to identify those areas particularly susceptible to public contact

High Contact Zone

- This zone covers areas within normal passenger reach and extends from the floor, up to 2.5 m above the floor
- Ceilings less than 3.8 m shall also be treated as High Contact Zones
- The selection of materials for use in this zone shall reflect outstanding durability, especially in and around passenger circulation routes or public amenities
- Finishing materials used in the lowermost 500 mm of this zone must be unaffected by salt and slush, and shall be capable of being quickly and easily cleaned

- Edges of finishing materials shall be reinforced where vulnerable to damage
 - This includes platform edges, stair nosings, outside corners and projecting sills
- Paint applied to walls, ceiling, etc. shall be graffiti-resistant
- Hardware and fastenings in this zone shall particularly discourage tampering

Low Contact Zone

- This zone is less susceptible to public contact and extends up from 2.5 m above the finished floor
- Materials in the Low Contact Zone are subject to less convenient service access, and are still vulnerable to vandalism, dirt, and grime

Floors–Design Requirements

Table F-31: Floors–Design Requirements

Criteria	Requirements
Slip resistance	Floors shall be non-slip and shall retain their slip resistance under both wet and dry conditions.
Thresholds	Beveled to accommodate different floor materials.
Sprinklered Floor Areas and those containing plumbing fixtures or water lines or are subject to weather penetration	Shall be sloped and drained
Gutters	Shall discharge directly into drains
Tactile attention indicators at Rail platform Including mini platform	<p>Shall be slip resistant and shall have tactile attention indicator lined up with the platform edge along the full length of the rail platform. Tiles shall be bright yellow, 610mm wide, composed of a truncated dome design that meets AODA and OBC requirements. Refer to Figure: Line Marking Rail and Mini Platform and GO Standard Drawing for Curb.</p> <p>For retrofit application, cut tile at dual substrate. Seal and install as per manufacturer's instructions. Sealant at joint between cut tiles to match colour of tile. Tile applied to platform surface only. Wall cap tiles are not permitted.</p>
Floor drains	Shall be screened and capped flush with finished floor.

Walls–Design Requirements

Table F-32: Walls–Design Requirements

Criteria	Requirements
Finish	Smooth, non-glossy, non-abrasive
Wall bases	<p>Shall be provided at 150 mm up from the finished floor; Electrical boxes and other wall-mounted equipment shall not project into this base; and</p> <p>The bases of floor-anchored equipment shall be continuous, matching adjacent wall base details.</p> <p>Thresholds shall be flush with the finished floor. Thresholds higher than 10 mm from the finished floor shall be beveled to a 30° angle.</p>
Communication room walls	Painted drywall over suitable framing system
Electrical room walls	Major electrical panels, inverters and the UPS unit is floor mounted and transformers are generally exterior located. Walls shall be concrete block with a latex eggshell enamel painted finish.
Mechanical room walls	As above
Office walls	Drywall, latex eggshell enamel painted or to suit
Maintenance Building walls	Painted with a vinyl base
Steel columns	Shall be painted
Walls in platform access buildings	Stairwells, elevator shafts, etc. shall have concrete walls with a smooth architectural finish.

Doors–Design Requirements

Table F-33: Doors–Design Requirements

Criteria	Requirements
Colour	Contrasted with surrounding wall colors, this includes fire exit doors, fire hose cabinets, and fire extinguishers
Public entrance doors	Thermal-break clear anodized aluminum in medium bronze anodized aluminum thermal-break frames
Door Frames Colour	Painted to match the medium bronze anodized window frames
exterior door frames	Bottoms foamed closed. Frames shall be dipped 600 mm into a silicone type clear sealant, and caulked at the base with clear silicone.
Entrance door hardware	Mullions and a horizontal push bar
Door Guards	Power-assisted doors where they open into a barrier free route of travel shall be provided with cane-detectable guardrails or other barriers at right angles to the wall containing the door
Controls for power assisted doors	To be clearly visible before reaching the door with clear floor area and placement for door opening. Power door operators when mounted onto a wall surface shall be 150 mm in diameter at all door entrances. Power door operators when mounted on shelter guardrails shall be 50 mm in width and 100 mm in height.
Public Area Doors	With exception of washroom and service room doors, all doors shall be either fully or partially transparent. Multi use Washroom doors to be undercut only. Thermally broken frames and doors with continuous hinges and reinforced as required for closers and doorstops, holders and backsets. Sump pump closet doors to be painted gray, unless they are access hatch doors: then they are to be stainless steel, textured No. 4 finish, or equal.
Non-Public Area Doors	Where washroom doors have an air transfer grille, dimensions to be determined by the H.V.A.C. Consultant. Single use washroom doors shall be undercut.

Windows–Design Requirements

Table F-34: Windows–Design Requirements

Criteria	Requirements
Frames	<ul style="list-style-type: none"> Thermal break anodized aluminum, medium bronze finish
Glazing	<ul style="list-style-type: none"> clear fully tempered insulating glass
Glazing Thickness	<ul style="list-style-type: none"> To suit windloads and air pressure changes generated by high-speed trains and vibration Minimum 6 mm thickness for buildings, 10 mm thickness for standard shelter fully tempered single glazing, platform access building shall be fully tempered single glazing, and thickness shall be engineered to suit
Distraction Pattern	<ul style="list-style-type: none"> Required on any glazing that extends to the ground and there is no 600mm curb or object, such as a railing, behind
Sashes	<ul style="list-style-type: none"> 600 mm minimum above grade for all elevator and stair enclosures and anodized to match fixed glass frames
Finish	<ul style="list-style-type: none"> Solid laminate (solid surfacing polymer) interior sills, sloped away from windows

Skylights–Design Requirements

Table F-35: Skylights–Design Requirements

Criteria	Requirements
Frames	<ul style="list-style-type: none"> Shall be anodized aluminum thermal-break frames with condensation gutters to suit the ceiling finish
Glass	<ul style="list-style-type: none"> Shall be insulating triple-glazing, with low-E glass and shall have fixed glazing
Luminaires	<ul style="list-style-type: none"> Shall be located to illuminate skylight interiors

Foot Grilles–Design Requirements

Table F-36: Foot Grilles–Design Requirements

Criteria	Requirements
Location	<ul style="list-style-type: none"> Foot grilles inside public doors shall be recessed flush with the finished floor and the recess.
Maintenance	<ul style="list-style-type: none"> Foot grilles shall be fabric type, closely spaced so as not to trap high heels, and shall have stainless steel or aluminum frames The pans shall be removable for cleaning

Specialty Items–Design Requirements

Table F-37: Specialty Items–Design Requirements

Criteria	Requirements
Grilles and Covers; outlet plates; screens, signs, light standard or shelter column electrical access covers, hose bibs, soap dispensers, coat hooks, etc.	Shall be flush-mounted using a vandal resistant security system, tamper resistant screws shall be used for smaller items.
Door hardware	
Foot Grilles	
Toilet Partitions	
Millwork	
Christmas lights	Shall have outlets in walls, switches and covers for these fittings and fixtures attached to walls and ceilings

Toilet Partitions–Design Requirements

Table F-38: Toilet Partitions–Design Requirements

Criteria	Requirements
Stainless Steel Toilet Partitions	In multi-use public washrooms and maintenance facilities, shall be embossed, ceiling hung.

Millwork–Design Requirements

Table F-39: Millwork–Design Requirements

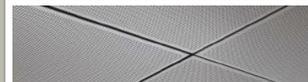
Criteria	Requirements
Service Counter Millwork	See Standard Drawings for Service Counter Millwork details and typical arrangement.

Table F-40: W1–Wood Grille Ceiling System

W1–Wood Grille Ceiling System	
Location	<ul style="list-style-type: none"> • Service area • Waiting area
Performance Requirements	
Material	<ul style="list-style-type: none"> • Modular suspended wood grille ceiling system • Solid wood standard stock
Colour/Texture	<ul style="list-style-type: none"> • Warm, light brown birch tone, wooden surface, low saturation • T-bar suspension system above wood grille panels to be black
Finish	<ul style="list-style-type: none"> • Natural wood finish, varnished, smooth, matt, no reflection
Size/Pattern	<ul style="list-style-type: none"> • Recommended panel size: 610x610 (24"x24"), 610x1220 (24"x48") • Standard manufacture size to be used • Vertical blades at 50mm (2") nominal O.C., blade size to be 16x67 wide nominal
Acoustic Properties	<ul style="list-style-type: none"> • NRC 0.75 minimum

**Table F-41: M1–Perforated Metal Concealed Ceiling System W/ Edge Trim**

M1–Perforated Metal Concealed Ceiling System W/ Edge Trim	
Location	<ul style="list-style-type: none"> • Platform access area • Vestibules
Performance Requirements	
Material	<ul style="list-style-type: none"> • Modular suspended metal panel ceiling system, complete with extruded aluminum trim • Aluminum, standard stock
Colour/Texture	<ul style="list-style-type: none"> • Silver to reflect light • Smooth, not brushed • Colour of panel and trim to match
Finish	<ul style="list-style-type: none"> • Matt finish, no reflection (panel and trim)
Size/Pattern	<ul style="list-style-type: none"> • Recommended panel size: 610x610 (24"x24"), 610x610 (24"x24")–smallest: 1220x3050 (48"x120")–largest; standard sizes to be specified • Panel joints to have 6 mm (1/4") reveal for monolithic appearance



	<ul style="list-style-type: none"> • Extruded aluminum trim around suspended ceiling system to also include a 6mm (1/4”) reveal • Minimum depth of trim: 100mm (4”)
Acoustic Properties	<ul style="list-style-type: none"> • NRC 0.80–0.95

Table F-42: SS1–Solid Surface

SS1–Solid Surface		
Location	<ul style="list-style-type: none"> • Service area (service counter) 	
Performance Requirements		
Material	<ul style="list-style-type: none"> • Solid polymer surfacing 	
Colour/Texture	<ul style="list-style-type: none"> • Grey with dark and light small aggregate (to match ‘Corian Dove’) 	
Finish	<ul style="list-style-type: none"> • Non- porous, smooth, polished finish • Ensure all edges or aprons are sufficiently rounded 	
Size/Pattern	<ul style="list-style-type: none"> • Size varies to suit site conditions and length of counter 	

Table F-43: MS1–Painted Metal Strip

MS1–Painted Metal Strip	
Location	<ul style="list-style-type: none"> • Service area (service counter, between PP1 & PP2)
Performance Requirements	
Material	<ul style="list-style-type: none"> • Anodized metal strip
Colour/Texture	<ul style="list-style-type: none"> • Light green, colour to match Pantone 376c
Finish	<ul style="list-style-type: none"> • Smooth, glossy or polished finish
Size/Pattern	<ul style="list-style-type: none"> • ~50mm high • Length varies to suit sit conditions and length of service wall

Table F-44: PP1–Porcelain Panel 1

PP1–Porcelain Panel 1	
Location	<ul style="list-style-type: none"> • Service area (service counter) • Waiting area
Performance Requirements	
Material	<ul style="list-style-type: none"> • Porcelain panel
Colour/Texture	<ul style="list-style-type: none"> • Bright white, to match RAL 9016
Finish	<ul style="list-style-type: none"> • High-gloss finish, reflective, smooth
Size/Pattern	<ul style="list-style-type: none"> • Panel size to suit site conditions and wall mounted fixtures and devices • Panel joints to have #mm (##") reveal, finished with standard metal trims • Panel thickness: 3mm min. with fiberglass reinforced backing
Features	<ul style="list-style-type: none"> • Fire and chemical resistant • VOC free • High recycled content material (optional)

Table F-45: PP2–Porcelain Panel 2

PP2–Porcelain Panel 2	
Location	<ul style="list-style-type: none"> • Service area (service counter)
Performance Requirements	
Material	<ul style="list-style-type: none"> • Porcelain panel
Colour/Texture	<ul style="list-style-type: none"> • Greenish grey, to match Pantone 417c
Finish	<ul style="list-style-type: none"> • High-gloss finish, reflective, smooth
Size/Pattern	<ul style="list-style-type: none"> • Panel size to suit site conditions and wall mounted fixtures and devices • Panel joints to have #mm (##") reveal, finished with standard metal trims • Panel thickness: 3mm min. with fiberglass reinforced backing
Features	<ul style="list-style-type: none"> • Fire and chemical resistant • VOC free • High recycled content material (optional)

Table F-46: PLAM–Plastic Laminate

PLAM - Plastic Laminate	
Location	<ul style="list-style-type: none"> • Service area (back wall, back-of-house)
Performance Requirements	
Material	<ul style="list-style-type: none"> • Wood, wood veneer
Colour/Texture	<ul style="list-style-type: none"> • Light 'birch' wood; cool to warm light brown tone
Finish	<ul style="list-style-type: none"> • Smooth, matt
Size/Pattern	<ul style="list-style-type: none"> • Varies to suit site conditions and millwork requirements
Features	<ul style="list-style-type: none"> • Millwork and cabinetry to be flush with adjacent door frame(s), door(s), and wall(s)

Table F-47: LS–Linoleum Sheet Flooring With Cover Base

LS–Linoleum Sheet Flooring With Cover Base	
	
Location	<ul style="list-style-type: none"> • Service area (back wall, back-of-house) • Dispatcher room • Driver room
Performance Requirements	
Material	<ul style="list-style-type: none"> • Linoleum sheet flooring, cove base
Colour/Texture	<ul style="list-style-type: none"> • Mid-grey and brown tone with striations and linear design; hints towards natural wood or stone impressions
Finish	<ul style="list-style-type: none"> • Matt
Size/Pattern	<ul style="list-style-type: none"> • Sheet flooring • Cove base to match flooring
Features	<ul style="list-style-type: none"> • Slip Resistance Values: ASTM, wet >0.60 / dry >0.60 • Pre-consumer recycled content: 45% or greater • Rapidly Renewable Materials: 33% by weight, or greater • Impact Sound Reduction: 6dB or greater, ISO 717-2 • Low VOC

Table F-48: CT1–Ceramic Floor Tile

CT1–Ceramic Floor Tile	
	
Location	<ul style="list-style-type: none"> • All public areas (platform access, service, waiting, retail, etc.) except for the delineated seating zone and areas where pedestrian floor mats are used at vestibules and entrances
Performance Requirements	
Material	<ul style="list-style-type: none"> • Ceramic floor tile
Colour/Texture	<ul style="list-style-type: none"> • Light grey tone with small light and dark aggregate, speckle texture
Finish	<ul style="list-style-type: none"> • Textured, matt (speckled to hide dirt)
Size/Pattern	<ul style="list-style-type: none"> • 300 x 600mm • staggered, brick layout • Floor installation notes: When installing rectangular tiles in a staggered, brick layout, do not stagger the long side more than 1/3 of the length of the tile; joints of at least 2mm are recommended when installing rectified tiles and a minimum of 4mm for unrectified tiles

	<ul style="list-style-type: none"> • Tile Edge Trim: Install finishing edge protection trim to exposed edges of floor and wall tile including ceramic tile wall base
Features	<ul style="list-style-type: none"> • Slip Resistance Values: ASTM, wet > 0.60 / dry > 0.60 • Pre-consumer recycled content: 20% or greater

Table F-49: CT2–Ceramic Floor Tile & Wall Base

CT2–Ceramic Floor Tile & Wall Base		
Location	<ul style="list-style-type: none"> • Delineated seating zone in Waiting Area 	
Performance Requirements		
Material	<ul style="list-style-type: none"> • Ceramic floor tile & wall base 	
Colour/Texture	<ul style="list-style-type: none"> • Mid-grey tone with small light and dark aggregate speckles texture 	
Finish	<ul style="list-style-type: none"> • Textured, matt (speckled to hide dirt) 	
Size/Pattern	<ul style="list-style-type: none"> • 300 x 600mm • Staggered, brick layout • Floor installation notes: When installing rectangular tiles in a staggered, brick layout, do not stagger the long side more than 1/3 of the length of the tile; joints of at least 2mm are recommended when installing rectified tiles and a minimum of 4mm for unrectified tiles • Cut perimeter tiles as necessary to provide a rectilinear delineated seating zone • Tile Edge Trim: Install finishing edge protection trim to exposed edges of floor and wall tile including ceramic tile wall base 	
Features	<ul style="list-style-type: none"> • Slip Resistance Values: ASTM, wet > 0.60 / dry > 0.60 • Pre-consumer recycled content: 20% or greater 	

Table F-50: CT3–Ceramic Glazed Wall Tile

CT3–Ceramic Glazed Wall Tile	
Location	<ul style="list-style-type: none"> • Public washroom entry accent wall
Performance Requirements	
Material	<ul style="list-style-type: none"> • Ceramic glazed tile
Colour/Texture	<ul style="list-style-type: none"> • Colour to a complex neutral, and/or in line with the GO Brand palette • Unique tile pattern is supported • Accent wall to contrast from general surrounding wall in

	Service/Waiting Area
Finish	<ul style="list-style-type: none"> • Matt, glossy, or combination, pending design intent
Size/Pattern	<ul style="list-style-type: none"> • Up to 100x300mm max • Installation patter to vary based on design intent of accent wall

Table F-51: PT1 Porcelain Wall Tile

PT1–Porcelain Wall Tile	
Location	<ul style="list-style-type: none"> • All other public area walls not identified; maintenance room (around slop sink only)
<i>Performance Requirements</i>	
Material	<ul style="list-style-type: none"> • Porcelain wall tile
Colour/Texture	<ul style="list-style-type: none"> • Colour to be white, and/or light tone (to be approved by GO) to match with station interior design and Service Counter finishes • Flat or textured tile acceptable, pending approval by GO
Finish	<ul style="list-style-type: none"> • Matt, glossy, or combination, pending design intent
Size/Pattern	<ul style="list-style-type: none"> • Large format tile • Installation pattern to vary based on design intent

Table F-52: VCT–Vinyl Composite Tile

VCT–Vinyl Composite Tile	
Location	<ul style="list-style-type: none"> • Maintenance rooms
<i>Performance Requirements</i>	
Material	<ul style="list-style-type: none"> • Vinyl composite tile
Colour/Texture	<ul style="list-style-type: none"> • Colour to be standard neutral tone, readily available, easy to replace
Finish	<ul style="list-style-type: none"> • Standard size tiles to be used, easy to replace and maintain

Table F-53: CONC.–Concrete with Epoxy

CONC.–Concrete with Epoxy	
Location	<ul style="list-style-type: none"> • Ancillary rooms, other than maintenance room

Performance Requirements	
Material	<ul style="list-style-type: none"> Concrete, sealed with epoxy coating
Finish	<ul style="list-style-type: none"> Clear coating

Table F-54: GYP–Gypsum Board

GYP–Gypsum Board	
Location	<ul style="list-style-type: none"> All other surfaces requiring a finish (ceilings and walls)
Performance Requirements	
Material	<ul style="list-style-type: none"> Gypsum, drywall
Colour/Texture	<ul style="list-style-type: none"> Paint colour to generally be white, other colour recommendations to be approved by GO Ceilings may explore black or grey if design intent is to mask ducts and conduit
Finish	<ul style="list-style-type: none"> Paint finish, eggshell

Station Building Interior Lighting Fixtures Schedule

Table F-55: Station Building Interior Lighting Fixtures Schedule

Station Building Interior Lighting Fixtures Schedule			
LE1 LUMINAIRE LE-1	LE5 LUMINAIRE LE-5	LE9 LUMINAIRE LE-9	LE13 LUMINAIRE LE-13
LE2 LUMINAIRE LE-2	LE6 LUMINAIRE LE-6	LE10 LUMINAIRE LE-10	LE14 LUMINAIRE LE-14
LE3 LUMINAIRE LE-3	LE7 LUMINAIRE LE-7	LE11 LUMINAIRE LE-11	LE15 LUMINAIRE LE-15
LE4 LUMINAIRE LE-4	LE8 LUMINAIRE LE-8	LE12 LUMINAIRE LE-12	

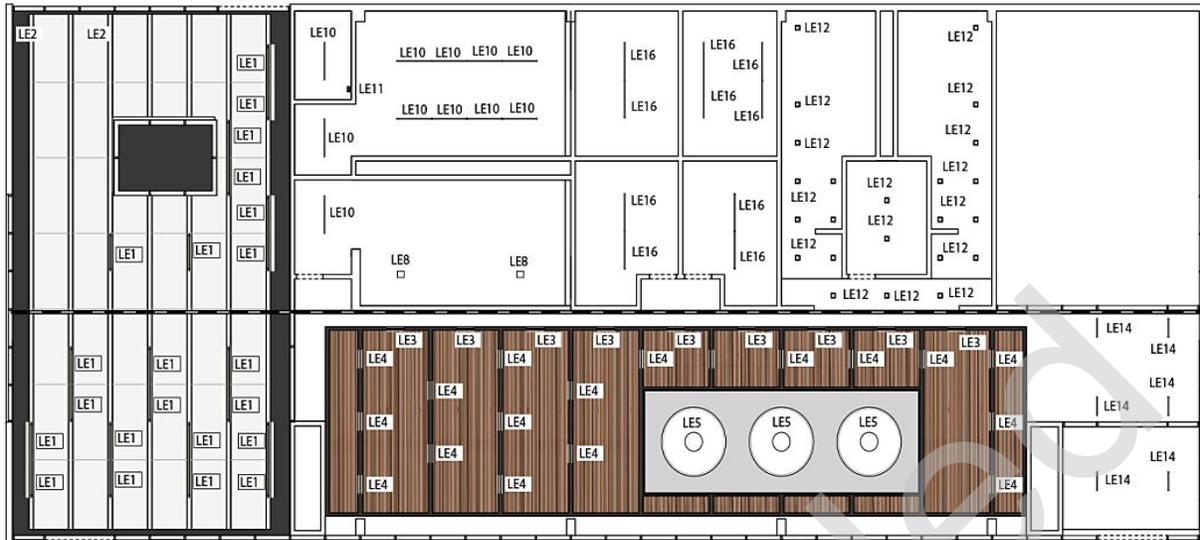


Figure F-23: Lighting Fixture Reflected Ceiling Plan

Table F-56: Luminaire LE-1

Luminaire LE-1	
Location	
Platform Access	
Performance Requirements	
<ul style="list-style-type: none"> • Use downlight linear suspended LED fixtures to produce a sufficient light level for circulation (250 lux) • Fixture to be suspended higher than the top of the wayfinding • Use 1220mm and 2440mm (two 1220 long fixtures end-to-end) long fixtures placed in a random pattern • General lighting will be used to light the elements in the space including the Self-service Kiosk (250 lux horizontal and 100 lux vertical) 	
Product Description	
<ul style="list-style-type: none"> • Direct linear LED lighting fixture labeled as LE-1 on the example reflected ceiling plan. • Lighting fixture has a minimum lumen output of 1857 lumens at 3000K without a diffuse lens. • 457 lm/ft • Lighting fixture has a 80 CRI at 3000K • Colour temperature to be 3000-5000K • Aluminum housing, stainless steel fasteners and factory sealed diffuser • Dimensions: 2.25" (58mm) x 3.5" (89mm) • Mounted on stems • Custom suspension stem length • Dimming by 0-10V, DMX, Lutron, Dali, or approved alternate • Specify models that feature easy installation and maintenance • LM80 tested > 100 000 hours • Integral power supply • LE-1 to have diffuser lens • Fixture rated IP66 	

Table F-57: Luminaire LE-2

Luminaire LE-2	
<i>Location</i>	
Platform Access Stairs	
<i>Performance Requirements</i>	
<ul style="list-style-type: none"> • Indoor-outdoor LED-based handrail that delivers functional illumination • High h output must deliver proper illuminance levels that are applicable to interior environments thus a minimum of 10 foot-candles along the path of egress 	
<i>Product Description</i>	
<ul style="list-style-type: none"> • Integrated LED lighting fixture handrail which has a high lumen output per foot at 3000K of 284 • Integrated LED lighting fixture handrail has a power consumption of 3.81W per foot • Integrated LED lighting fixture handrail with 55° beam spread • Integrated LED lighting fixture handrail has an 83 CRI • Projected average rated life is 50 000 hours at 70% of lamp lumen output • IES LM-80 compliance • Integrated LED lighting fixture handrail must have the options of being post mounted and wall mounted • Vandal resistant access chamber must allow units to be removed for maintenance purposes • Integrated LED lighting fixture must be approved for wet locations, and rated IP66 • Integrated LED lighting fixture to be dimmable • Handrail alloy options must include stainless steel satin finish • Maximum diameter of the handrail is 1.66" • Fixture to suit custom length of handrail sections • Power supply driver must be remote (71'-0" (21.6m) with 12 AWG) 	

Table F-58: Luminaire LE-3

<p>Luminaire LE-3</p>	
<p><i>Location</i></p>	
<p>Service and Waiting Area</p>	
<p><i>Performance Requirements</i></p>	
<ul style="list-style-type: none"> • Suspended between the perimeter of the wood grille ceiling system and the finished ceiling in front of the Service Counter and along the length of the main wall • Linear Pendant with a 5 LED Module to be used along the length of the main wall of the Service Area, Waiting Area and Retail Area • The linear pendant is used to create an inviting atmosphere through lighting on the front of the Service Counter • The linear fixture is to be specified so that it can perform as a spot light 	
<p><i>Product Description</i></p>	
<ul style="list-style-type: none"> • Visually minimal light fixture: 1-1/2" width x 4-9/16" height x 9" depth • LED lenses creating a unique round light effect • 5 LED module integrated in an extruded aluminum profile combined with die-cast end caps • 5 LED module 3000K, LARGE OPTIC 49°, 85CRI • Supplied standard with 0-10V dimming • 5 LED module die cast aluminum body and heat sink • Custom length aircraft cable suspension • Round canopy Ø4.5" • Clear power cable grouped with suspension cable • 5 LED Module 13W 3000K 85 CRI • Delivered lumen output of 747 • Low luminance optics with reflectors, baffles and 49° optics • System weight at maximum 8.2 lbs • Linear Pendant to be damp location IP20 • Linear Pendant finish: metallic 	

Table F-59: Luminaire LE-4

Luminaire LE-4	
<i>Location</i>	
Service Area and Waiting Area	
<i>Performance Requirements</i>	
<ul style="list-style-type: none"> • Suspended between the panels of the wood grille ceiling system • Pendant with 10 LED Module is use between the wood grilles panels on the ceiling • The linear pendants are to produce a sufficient light level (100 to 200 lux) for the Service Area and/or Waiting Area but positioned relative to the underside of the suspended ceiling to avoid glare • The linear fixture is specified to perform as a spotlight to create an interesting and varied quality to the lighting in the Service Area and/or Waiting Area. 	
<i>Product Description</i>	
<ul style="list-style-type: none"> • Light fixture dimensions: 38mm width x 115mm height x 457mm depth • LED lenses creating a unique round light effect • 10 LED module integrated in an extruded aluminum profile combined with die-cast end caps • 10 LED module 3000K, MEDIUM OPTIC 33°, 85CRI • Supplied standard with 0-10V dimming • 10 LED module die cast aluminum body and heat sink • Custom length aircraft cable suspension • Round canopy Ø4.5" • Clear power cable grouped with suspension cable • Delivered lumen output of 1488 • Low luminance optics with reflectors, baffles and 33° optics • Linear Pendant must be damp location IP20 • Linear Pendant finish: metallic grey • Die cast aluminum body and heat sink • Provide a 5 years warranty 	

Table F-60: Luminaire LE-5

Luminaire LE-5	
Location	
Waiting Area	
Performance Requirements	
<ul style="list-style-type: none"> • Custom fixture designed to be suspended over the Delineated Seating Zone in the Waiting Area, when provided as part of the building program • This fixture is meant to be visible from the exterior as the customer approaches the Station Building • The fixture defines the delineated seating zone in the station building • Suspended lighting fixtures for use above the delineated seating zone in the Waiting Area • The custom fixtures will have a cylindrical form and be suspended in the ceiling coffer 	
Product Description	
<ul style="list-style-type: none"> • The materials used in the fabrication of these fixtures shall be selected for ease of maintenance and to inhibit any dust accumulation • The material selected for the diffuser elements to be UV resistant • The material selected shall be non-corrosive • Use warm white color temperature (~3000K) • Light level shall stay between 150 and 200 lux • The drums shall be equipped with multiple light sources with different purposes • A single light source (flood beam led bulbs) shall be used to make the drum glow like a lantern • This led bulb shall have a binning between 1 and 3 step MacAdam ellipse • The bulbs shall be located in order to avoid any shadows on the drum surface and to create a nice and uniform lighting of the drum • The bulb shall be accessible for maintenance and replacement • The material of the drum shall be opalescent in order to diffuse the light, minimize the appearance of hot spots • Provide an opaque surface at the underside of the light as indicated to shield direct views of the lamps • The top of the drum fixture shall be open to allow uplighting to the ceiling • A second light source within the drum would be used for directional lighting focused on the floor and the seating: these fixtures shall be LED downlights surface mounted at the underside of the light fixture • The colour to the downlighting fixture components shall match the drum finish (i.e. white) • Specify LED fixtures that can accommodate two accessories at the same time: for example, a hex 	

<p>louver and a beam softener to reduce glare</p> <ul style="list-style-type: none"> • The optics for this fixture shall be close to 25° • The drivers will have to be accessible for maintenance: ideally, the drivers would be located in the drum so that the unit does not cast any shadows on the drum surface • These fixtures shall be adjustable so that the light can be focused to a specific point • The CRI of the lighting fixture shall be a minimum of 80 • The ceiling finish of this area shall be matt to inhibit any reflection of the LED strip lighting and to create the effect of a glow on the ceiling • Fixture to be dimmable

Table F-61: Luminaire LE-6

Luminaire LE-6
<i>Location</i>
Service Area
<i>Performance Requirements</i>
<ul style="list-style-type: none"> • Located in the bulkhead directly above the Service Counter, customer side • Customer side pot light for additional illumination for customer tasks at service counter • Task lighting to be adjustable to prevent glare from metal cash scoop
<i>Product Description</i>
<ul style="list-style-type: none"> • LED pot light lens • Fixture shall be adjustable so that the light can be focused to a specific point • Colour temperature to be ~3000K • Illumination level to be ~40 Fc, 400 lux • Fixtures must be damp location IP20 • Fixture to be dimmable • Light to be controlled by a single switch located in the general service counter area of the station

Table F-62: Luminaire LE-7

Luminaire LE-7	
Location	
Service Area	
Performance Requirements	
<ul style="list-style-type: none"> • Located in side bulkheads of the Service Counter, attendant side • Two fixtures are provided per attendant, one on each side of the attendant for task lighting • Task eyeball lights on either side of service position at bulkhead, with light concentrated at the centre of the station attendant’s work surface, minimizing glare off desk surface, glazing, and computer screens • Task lighting to be individually controlled by station attendant, with separate circuits for each service position 	
Product Description	
<ul style="list-style-type: none"> • Light fixture dimensions: ~Ø85mm (3.4”) • 30° pivoting center “eyeball” • Thin profile 316 stainless steel bezel • Integrated drive electronics • Colour temperature to be ~3000K • Illumination level to be ~40 Fc, 400 lux • Fixtures must be damp location IP20 • Task light finish: white • Fixture to be dimmable • Locate on/off and dimmable controls at station attendant right partition 	

Table F-63: Luminaire LE-8

Luminaire LE-8	
<i>Location</i>	
Service Area	
<i>Performance Requirements</i>	
<ul style="list-style-type: none"> • Located above each station attendant wicket centered with glass opening, attendant side. Cube pendant with A19 LED bulb • The cube pendant is to produce an ambient light feature at each service position of Service Counter, individually programmed to indicate whether service position is open (ON), or closed (OFF) 	
<i>Product Description</i>	
<ul style="list-style-type: none"> • Light fixture dimensions: 200mm x 200mm x 200mm • LED bulb to create a uniform glowing effect • LED bulb suspended by stainless steel rod from ceiling above, custom rod length based on site conditions • Material of the cube to be translucent white acrylic, matte finish • Cube to have a closed bottom, and straight corners • Breathing holes to be provided at the top of the cube • Delivered lumen output of 800 • Colour temperature to be ~ 2700K • LED bulb must be damp location IP20 • Fixture to be dimmable • Locate on/off and dimmable controls at station attendant right partition 	

Table F-64: Luminaire LE-9

Luminaire LE-9
<i>Location</i>
Service Area
<i>Performance Requirements</i>
<ul style="list-style-type: none"> • Located below the Service Counter countertop, attendant side, for maintenance assistance • LED puck light with built-in on/off controls
<i>Product Description</i>
<ul style="list-style-type: none"> • LED light for maintenance assistance • Standard, thin profile fixture

Table F-65: Luminaire LE-10

Luminaire LE-10	
<i>Location</i>	
Staff Area	
<i>Performance Requirements</i>	
<ul style="list-style-type: none"> • Located in the Service Staff Support Areas • Surface mounted direct linear LED luminaire system is used for the staff support room 	
<i>Product Description</i>	
<ul style="list-style-type: none"> • Multi-source linear modular lighting system • Linear luminaire made of extruded aluminum profile combined with die-cast end caps • Minimalist light fixture: 38mm width x 115mm height • Continuous lengths between 1220mm and 3657mm • 10.6 W per foot, 617 lumens per foot, 3000K LED, 85CRI • Snap-in frosted diffuser lens • Finish to linear LED luminaire: metallic grey • Fixture to be dimmable • Provide a 5 years warranty 	

Table F-66: Luminaire LE-11

Luminaire LE-11	
<i>Location</i>	
Staff Washroom	
<i>Performance Requirements</i>	
<ul style="list-style-type: none"> • Located in the Staff Washroom within the Staff Support Area • Wall mounted LED luminaires used for the staff washroom above the lavatory mirror 	
<i>Product Description</i>	
<ul style="list-style-type: none"> • Modern square design • Machined aluminum end caps and die-stamped steel structure with plated finish • Diffuser: Custom blended and extruded PMMA • (Acrylic composite) with high diffusion and transmission • Machined steel endcaps mechanically attached to structure with one-way security screw • Minimalist light fixture: 57mm width x 97mm height 23" luminaire length • LED 11W, 3000K, 80 CRI • Delivered lumen output of 950 • Luminaire finish: satin chrome finish • Projected average rated life is 50 000 hours (IES LM-79/L70 compliance) • Provide 5 years warranty 	

Table F-67: Luminaire LE-12

Luminaire LE-12	
<i>Location</i>	
Public Washroom	
<i>Performance Requirements</i>	
<ul style="list-style-type: none"> • Provides general lighting to the Public Washrooms • Use fixture LE-10 for washroom stalls • Recessed adjustable LED fixture • Light levels must have minimum 50 lux horizontal and 30 lux vertical 	
<i>Product Description</i>	
<ul style="list-style-type: none"> • Adjustable round LED module integrated with a gray finish square trim • Die cast aluminum optical assembly and frame with black steel housing • Vacuum plated metallized PC reflector available in 29° • Optical assembly adjustable 30° in all axes • Optical accessories options (Frosted lens/ Louver/Visor) • LED module 3000K, 29°, 80 CRI • Delivered lumen output of 742 • Dimming option to be provided • System weight at maximum 5 lbs • Recessed fixture must be rated IP67 • Projected average rated life is 50 000 hours (IES LM- 80/LM-79 tested) • Remote driver • Provide 5 years warranty 	

Table F-68: Luminaire LE-13

Luminaire LE-13	
<i>Location</i>	
Public Washroom, Above Stalls	
<i>Performance Requirements</i>	
<ul style="list-style-type: none"> • Located above the stalls in the public washrooms • Use of linear led lighting in cove to create a soft uniform glow in the space • The cove shall be used in the stalls • Light levels must have minimum 50 lux horizontal and 30 lux vertical. 	
<i>Product Description</i>	
<ul style="list-style-type: none"> • LED recessed linear perimeter slot system • Extruded aluminum trim with formed cold rolled 20 gauge steel black box housing • Extruded aluminum module with reflector • LED 3000K, 318 lumens per foot, 6W per foot • 0-10V dimming standard • LED slot system must be damp location • IES LM-80/LM-79 compliance • Provide 5 year warranty 	

Table F-69: Luminaire LE-14

Luminaire LE-14	
Location	
Ancillary Spaces	
Performance Requirements	
<ul style="list-style-type: none"> • Located in the entrance vestibule and in other general ceiling areas outside of the wood grille ceiling system (such as in front of the Retail Amenity) • Use of linear led lighting in cove to create a soft uniform glow in the space • Recessed 10 LED Module must produce a sufficient light level (100 to 200 lux) avoiding glare 	
Product Description	
<ul style="list-style-type: none"> • Linear fixture that performs as a spot light • Minimalist recessed light fixture: 49mm width x 280mm depth • LED lenses creating a unique round light effect • 10 LED module integrated in an extruded aluminum profile combined with die-cast end caps • 10 LED module 3000K, MEDIUM OPTIC 46°, 83CRI • Supplied standard with 0-10V dimming • 10 LED module die cast aluminum body and heat sink • Delivered lumen output of 2098 • Low luminance optics with reflectors, baffles and 46° optics • Linear Pendant must be damp location IP67 • Recessed trim finish: metallic grey • Die cast aluminum body and heat sink • Provide a 5 years warranty 	

Table F-70: Luminaire LE-15

Luminaire LE-15	
Location	
Ancillary Spaces	
Performance Requirements	
<ul style="list-style-type: none"> • LED vapor tight linear fixture to provide proper light levels for the equipment rooms (750 lux) 	

Product Description

- Low profile housing with impact resistant deep acrylic frosted lens
- 1220mm 4000K LED
- 6898 lumens for 4-foot fixtures
- Linear fixture must be damp location IP66/67

Superseded

Table F-71: Tunnels Finishes Schedule

Tunnels Finishes Schedule			
<i>Material</i>	<i>Product Spec./ Colour/ Finish</i>	<i>Notes</i>	<i>Image</i>
Porcelain Panel	<ul style="list-style-type: none"> • Porcelain Panel system with reinforced backing • Colour: Light gray with dark and light small aggregate • Material: 1" overall panel thickness with 1/8" thick porcelain facing 	<p>Always finish last panel with a corner/return panel to conceal all visible conduits for a complete installation. Design consultant shall coordinate all mounting details with porcelain panel supplier prior to construction.</p>	
LED Light Valance Fixture	<ul style="list-style-type: none"> • LED down- and up- (70% and 30% up respectively) lights in sections matching porcelain panel lengths • C/w opal polycarbonate lens • 25W/2250lm (equivalent to approx. 8fc or 80 lux per tunnel side installation) • Colour temperature: 3500K, with +80 CRI • IP66 rating minimum • Complete with anodized aluminum casting, and stainless steel mounting hardware for a complete installation • Self-contained ballast 	<ul style="list-style-type: none"> • Minimum of 150 lux is required, 160 lux provided • Install fixture with continuous on both sides of tunnel wall • Coordinate with the lighting and porcelain panel suppliers on the mounting details prior to construction 	

G HEAVY RAIL

For all Heavy Rail, standard requirements comply with CNETS, CN Recommended Methods, or CN Capital Standard Plans (unless otherwise directed) for all capital construction and maintenance queries.

Superseded

H INFORMATION TECHNOLOGY; TELECOMMUNICATION & SYSTEMS

For all IT Telecommunication and Systems requirements refer the I&IT Standard Telecommunication and Systems document

Superseded

APPENDIX A—AMENDMENT RECORD

Table 0-1: Appendix A—Amendment Record

Date	Section Ref.	Description

Superseded

APPENDIX B—LEED MANDATORY CREDITS

Guidance on How to Use the GO LEED Mandatory Credit Checklist

Mandatory credits have been established for each building type to ensure that credits that are important to GO Transit’s goals of energy efficiency and reduced operating and maintenance costs are targeted, integrated into the design early and achieved.

Designers are to incorporate LEED Gold and the GO Transit Mandatory credits into each project’s scope of work. LEED has five key areas under which credits are obtained. These are:

- Sustainable Sites;
- Water Efficiency;
- Energy & Atmosphere;
- Materials & Resources and
- Indoor Environmental Quality.

Each area has Prerequisites that the project must achieve in order to consider going for LEED certification, these are non-negotiable. There is also an Innovation & Design section where innovative systems not accounted for elsewhere, exemplary performance and operational procedures can be considered for a credit. Each credit is worth anywhere from one to nineteen points, the number of points obtained determines the LEED rating achieved.

In order to achieve LEED Gold certification, anywhere between sixty (60) and seventy nine (79) points must be granted by the Canadian Green Building Council (CaGBC). It is recommended that sixty five points are targeted on each project pursuing Gold certification since the CaGBC is the final arbiter on which points are granted, so some points may be lost.

The GO LEED credit checklist that follow indicate the Prerequisites and GO Transit Mandatory credits which must be targeted and achieved. There are additional columns indicating optional points for consideration from which the shortfall can be made, credits that are not to be pursued are also identified in the checklist.

Table 0-1: Appendix B—LEED Mandatory Credits

Mandatory	Optional	Not to be Pursued	Project Totals (pre-certification estimates): 110 Points Certified: 40-49 points Silver: 50-59 points Gold: 60-79 points Platinum: 80 points and above	Available Points
47	57	8		110

7	17	2	SS	SUSTAINABLE SITES	26
			SSp1	CONSTRUCTION ACTIVITY POLLUTION PREVENTION	
	1		SSc1	Site Selection	1
	5		SSc2	Development Density & Community Connectivity	5
	1		SSc3	Brownfield Redevelopment	1

Mandatory	Optional	Not to be Pursued	Project Totals (pre-certification estimates): 110 Points Certified: 40-49 points Silver: 50-59 points Gold: 60-79 points Platinum: 80 points and above		Available Points
47	57	8			110
6			SSc4.1	Alternative Transportation, Public Transportation Access	6
		1	SSc4.2	Alternative Transportation, Bicycle Storage & Changing Rooms	1
	3		SSc4.3	Alternative Transportation, Low-Emitting & Fuel Efficient Vehicles	3
	2		SSc4.4	Alternative Transportation Parking Capacity	2
	1		SSc5.1	Site Development, Protect or Restore Habitat	1
		1	SSc5.2	Site Development, Maximize Open Space	1
	1		SSc6.1	Stormwater Design, Quantity Control	1
	1		SSc6.2	Stormwater Design, Quality Control	1
	1		SSc7.1	Heat Island Effect, Non-Roof	1
1			SSc7.2	Heat Island Effect, Roof	1
	1		SSc8	Light Pollution Reduction	1

7	3	0	WE	WATER EFFICIENCY	10
PREREQUISITE			WEp1	Water Use Reduction	
4			WEc1	Water Efficient Landscaping	4
	2		WEc2	Innovative Wastewater Technologies	2
3	1		WEc3	Water Use Reduction	4

14	17	4	EA	ENERGY & ATMOSPHERE	35
PREREQUISITE			EAp1	Fundamental Commissioning of Building Energy Systems	
PREREQUISITE			EAp2	Minimum Energy Performance	
PREREQUISITE			EAp3	Fundamental Refrigerant Management	
7	12		EAc1	Optimized Energy Performance	19
	3	4	EAc2	On-Site Renewable Energy	7
2			EAc3	Enhanced Commissioning	2
2			EAc4	Enhanced Refrigerant Management	2
3			EAc5	Measurement & Verification	3
	2		EAc6	Green Power	2

7	6	1	MR	MATERIALS & RESOURCES	14
PREREQUISITE			MRp1	Storage & Collection of Recyclables	
	3		MRc1.1	Building Reuse: Maintain Existing Walls, Floors, Roof	3
	1		MRc1.2	Building Reuse: Maintain Interior Non-Structural Elements	1
2			MRc2	Construction Waste Management	2
	2		MRc3	Materials Reuse	2

Mandatory	Optional	Not to be Pursued	Project Totals (pre-certification estimates): 110 Points Certified: 40-49 points Silver: 50-59 points Gold: 60-79 points Platinum: 80 points and above		Available Points
47	57	8			110
2			MRc4	Recycled Content	2
2			MRc5	Regional Materials	2
		1	MRc6	Rapidly Renewable Materials	1
1			MRc7	Certified Wood	1

8	6	1	EQ	INDOOR ENVIRONMENTAL QUALITY	15
PREREQUISITE			EQp1	Minimum Indoor Air Quality Performance	
PREREQUISITE			EQp2	Environmental Tobacco Smoke Control	
	1		EQc1	Outdoor Air Delivery Monitoring	1
		1	EQc2	Increased Ventilation	1
1			EQc3.1	Construction IAQ Management Plan, During Construction	1
	1		EQc3.2	Construction IAQ Management Plan, Before Occupancy	1
1			EQc4.1	Low Emitting Materials, Adhesives & Sealants	1
1			EQc4.2	Low Emitting Materials, Paints and Coatings	1
1			EQc4.3	Low Emitting Materials, Flooring Systems	1
1			EQc4.4	Low Emitting Materials, Composite Wood & Laminate Adhesives	1
	1		EQc5	Indoor Chemical & Pollutant Source Control	1
1			EQc6.1	Controllability of System: Lighting	1
	1		EQc6.2	Controllability of System: Thermal Comfort	1
1			EQc7.1	Thermal Comfort, Design	1
	1		EQc7.2	Thermal Comfort, Verification	1
1			EQc8.1	Daylight & Views, Daylight	1
	1		EQc8.2	Daylight & Views, Views	1

4	4	0	ID	INNOVATION & DESIGN PROCESS	6
1			IDc1.1	Innovation in Design: Green Housekeeping	1
1			IDc1.2	Innovation in Design: Solid Waste Management Policy	1
1			IDc1.3	Innovation in Design: Green Education	1
	1		IDc1.4	Innovation in Design: Low Mercury Lamps	1
	1		IDc1.5	Innovation in Design: Exemplary Performance SSc4.1 or other	1
	1			Innovation in Design: Process Water Reuse, vehicle wash (if applicable)	
	1			Innovation in Design: TBD	
1			IDc2	LEED AP	1

Mandatory	Optional	Not to be Pursued	Project Totals (pre-certification estimates): 110 Points Certified: 40-49 points Silver: 50-59 points Gold: 60-79 points Platinum: 80 points and above		Available Points
47	57	8			110
0	4	0	RP	REGIONAL PRIORITY	4
	1		RP1	Durable Building	1
	1		RP2.1	Regional Priority Credit 1	1
	1		RP2.2	Regional Priority Credit 2	1
	1		RP2.3	Regional Priority Credit 3	1

LEED Mandatory Credits for Maintenance Facilities

Table 0-2: LEED Mandatory Credits for Maintenance Facilities

Mandatory	Optional	Not to be Pursued	Project Totals (pre-certification estimates): 110 Points Certified: 40-49 points Silver: 50-59 points Gold: 60-79 points Platinum: 80 points and above	Available Points
47	57	8		110

8	17	1	SS	SUSTAINABLE SITES	26
PREREQUISITE			SSp1	Construction Activity Pollution Prevention	
	1		SSc1	Site Selection	1
	5		SSc2	Development Density & Community Connectivity	5
	1		SSc3	Brownfield Redevelopment	1
3	3		SSc4.1	Alternative Transportation, Public Transportation Access	6
1			SSc4.2	Alternative Transportation, Bicycle Storage & Changing Rooms	1
3			SSc4.3	Alternative Transportation, Low-Emitting & Fuel Efficient Vehicles	3
	2		SSc4.4	Alternative Transportation Parking Capacity	2
	1		SSc5.1	Site Development, Protect or Restore Habitat	1
		1	SSc5.2	Site Development, Maximize Open Space	1
	1		SSc6.1	Stormwater Design, Quantity Control	1
	1		SSc6.2	Stormwater Design, Quality Control	1
	1		SSc7.1	Heat Island Effect, Non-Roof	1
1			SSc7.2	Heat Island Effect, Roof	1
	1		SSc8	Light Pollution Reduction	1

7	3	0	WE	WATER EFFICIENCY	10
PREREQUISITE			WEp1	Water Use Reduction	
4			WEc1	Water Efficient Landscaping	4
	2		WEc2	Innovative Wastewater Technologies	2
3	1		WEc3	Water Use Reduction	4

14	17	4	EA	ENERGY & ATMOSPHERE	35
PREREQUISITE			EAp1	Fundamental Commissioning of Building Energy Systems	
PREREQUISITE			EAp2	Minimum Energy Performance	
PREREQUISITE			EAp3	Fundamental Refrigerant Management	
7	12		EAc1	Optimized Energy Performance	19
	3	4	EAc2	On-Site Renewable Energy	7
2			EAc3	Enhanced Commissioning	2

Mandatory	Optional	Not to be Pursued	Project Totals (pre-certification estimates): 110 Points Certified: 40-49 points Silver: 50-59 points Gold: 60-79 points Platinum: 80 points and above		Available Points
47	57	8			110
2			EAc4	Enhanced Refrigerant Management	2
3			EAc5	Measurement & Verification	3
	2		EAc6	Green Power	2

7	6	1	MR	MATERIALS & RESOURCES	14
PREREQUISITE			MRp1	Storage & Collection of Recyclables	
	3		MRc1.1	Building Reuse: Maintain Existing Walls, Floors, Roof	3
	1		MRc1.2	Building Reuse: Maintain Interior Non-Structural Elements	1
2			MRc2	Construction Waste Management	2
	2		MRc3	Materials Reuse	2
2			MRc4	Recycled Content	2
2			MRc5	Regional Materials	2
		1	MRc6	Rapidly Renewable Materials	1
1			MRc7	Certified Wood	1

7	6	2	EQ	INDOOR ENVIRONMENTAL QUALITY	15
PREREQUISITE			EQp1	Minimum Indoor Air Quality Performance	
PREREQUISITE			EQp2	Environmental Tobacco Smoke Control	
		1	EQc1	Outdoor Air Delivery Monitoring	1
		1	EQc2	Increased Ventilation	1
1			EQc3.1	Construction IAQ Management Plan, During Construction	1
	1		EQc3.2	Construction IAQ Management Plan, Before Occupancy	1
1			EQc4.1	Low Emitting Materials, Adhesives & Sealants	1
1			EQc4.2	Low Emitting Materials, Paints and Coatings	1
1			EQc4.3	Low Emitting Materials, Flooring Systems	1
1			EQc4.4	Low Emitting Materials, Composite Wood & Laminate Adhesives	1
	1		EQc5	Indoor Chemical & Pollutant Source Control	1
1			EQc6.1	Controllability of System: Lighting	1
	1		EQc6.2	Controllability of System: Thermal Comfort	1
	1		EQc7.1	Thermal Comfort, Design	1
	1		EQc7.2	Thermal Comfort, Verification	1
1			EQc8.1	Daylight & Views, Daylight	1
	1		EQc8.2	Daylight & Views, Views	1

4	4	0	ID	INNOVATION & DESIGN PROCESS	6
1			IDc1.1	Innovation in Design: Green Housekeeping	1

Mandatory	Optional	Not to be Pursued	Project Totals (pre-certification estimates): 110 Points Certified: 40-49 points Silver: 50-59 points Gold: 60-79 points Platinum: 80 points and above		Available Points
47	57	8			110
1			IDc1.2	Innovation in Design: Solid Waste Management Policy	1
1			IDc1.3	Innovation in Design: Green Education	1
	1		IDc1.4	Innovation in Design: Low Mercury Lamps	1
	1		IDc1.5	Innovation in Design: Exemplary Performance SSc4.1 or other	1
	1			Innovation in Design: Process Water Reuse, vehicle wash (if applicable)	
	1			Innovation in Design: TBD	
1			IDc2	LEED AP	1
0	4	0	RP	REGIONAL PRIORITY	4
	1		RP1	Durable Building	1
	1		RP2.1	Regional Priority Credit 1	1
	1		RP2.2	Regional Priority Credit 2	1
	1		RP2.3	Regional Priority Credit 3	1