OC Transpo

Transitway and Station Design Guidelines

June
2013

Ottawa

Transitway and Station Design Guidelines

REVISION RECORD

Revision No.	Date	Entered By

INTRODUCTION

OBJECTIVES OF THE TRANSITWAY SYSTEM

The Official Plan of the City of Ottawa gives priority to the development of public transit as the most effective means of meeting the transportation needs of the City. If public transit is to be successful in meeting these needs, it must be the most effective transportation mode. A Transitway system on exclusive rights-of-way is a practical means of achieving this objective in the City of Ottawa.

Apart from the fundamental feature of exclusive rights-of-way, the Transitway must incorporate features which will satisfy the desires and needs of passengers, the operator and the community as outlined below:

1. Passenger

The Transitway system must be perceived as a rapid transit service provided as an integral part of the OC Transpo network. The reduction in travel time due to the existence of exclusive rights-of-way must be accompanied by an impression of the entire system as a safe, comfortable and attractive service, with minimum transfer inconvenience and exposure to the elements. Features and design elements of the Transitway system must be integrated to develop a coherent theme embracing these objectives.

2. Operator

The Transitway system must offer an attractive service at an economical price if the Transit modal split is to be improved. Economy of operation and ease of maintenance are important considerations. Equally important, however, is that the Transitway system serves to sell the public transit system as an effective transportation alternative.

3. Community

The Transitway system must instill a sense of pride in the citizens of the City of Ottawa. Effective public transit service is fundamental in achieving this but it is not enough. The system must be compatible with the community it serves. It must not be regarded as a necessary nuisance even by those citizens in close proximity to the service. Intrusion on the landscape and on the sensibilities of residents must be reduced to a reasonable minimum by the judicious application of design principles and mitigating measures.

DESCRIPTION OF THE TRANSITWAY SYSTEM

For the foreseeable future, the Transitway system will operate as a busway. The Transitway will normally be fully grade-separated from other traffic but may include at-grade intersections in exceptional circumstances. Access will be restricted to buses and emergency or maintenance vehicles.

The existing and proposed OC Transpo fleet of standard, articulated, and double-decker buses will serve as carriers.

Generally, stations will be located at existing or potential high trip generator developments and at major cross streets with provisions made for convenient transfers to local bus routes. The "walk-in" stations will be located as closely as practical to, or fully integrated within, high density employment or residential centers. As a rule of thumb, pedestrian walking distances should not exceed 400 metres.

In general, stations will have side-loading platforms and an additional lane in each direction to accommodate the by-passing of the station by non-stopping buses. To safely facilitate such operation, deceleration and acceleration lanes and tapers are required.

The normal operating speed of buses on the Transitway will be 80 km/h but will be restricted to 50 km/h or less through stations.

These guidelines adopt the philosophy that passengers, once having boarded a bus in their community, should expect to be sheltered from the elements until they leave the bus at their transfer points and/or destination.

CONVERSION TO LIGHT RAIL

The City of Ottawa may at a future date for capacity reasons convert sections of the Transitway to light rail operation.

Provisions for conversion to a light rail system must be considered from the point of view of providing flexibility to accommodate the future system but also of reducing current construction expenditures for this purpose to a practical minimum.

The designer shall obtain the current Ottawa Light Rail design criteria from the City of Ottawa to confirm requirements for future conversion to light rail and accommodation of light rail vehicles. As a minimum, provisions for conversion which should be considered include:

a) Vertical and horizontal clearances

b) Horizontal and vertical geometrics

c) Structural loadings to accommodate light rail vehicles

Other considerations may include such criteria as load impacts on utilities and under ground infrastructure.

It is assumed that the future rail vehicles will stop "on line" and that stations will be reconstructed at the time of conversion.

USE OF DESIGN GUIDELINES

As with all design guidelines and manuals, the "Transitway and Station Design Guidelines" have been prepared to aid in the development of consistent designs for the Transitway, Stations and other related facilities. These Guidelines should be used in conjunction with other applicable design guides and manuals prepared by the City of Ottawa, Ministry of Transportation of Ontario and the Transportation Association of Canada to meet the current codes and regulations.

REFERENCES

The latest edition of the following manuals, design aids and codes shall be referenced:

a) Transportation Association of Canada (TAC)
Geometric Design Guide for Canadian Roads

b) Ministry of Transportation Ontario (MTO)
Geometric Design Standards for Ontario Highways

c) Ministry of Transportation Ontario (MTO)
Roadside Safety Manual

d) Ontario Traffic Manuals

e) Ontario Building Code

f) Accessibility for Ontario with Disabilities Act (AODA)

g) Accessible Built Environment Standard- Exterior Facilities

h) CSA / IEE Codes & Standards

i) Canadian Highway Bridge Design Code (CHBDC)

j) Manual for Railway Engineering Volume 2 Structures (AREMA)

k) City Accessibility Design Standards

The latest edition or version of the following City of Ottawa guidelines, policies and standards shall be referenced:

a) Official Plan

b) Transportation Master Plan

c) Ottawa Cycling Plan

d) Ottawa Cycling Plan Bikeway Planning and Design Guidelines

e) Ottawa Design Guidelines, Sewers

f) City of Ottawa Road Design Guidelines

g) Ottawa Design Guidelines, Water Distribution

h) Ottawa Pedestrian Plan

i) Ottawa Accessibility Design Guidelines - Buildings

j) Ottawa Environmental Noise Control Guidelines

k) Ottawa Right-of-way Lighting Policy

l) Ottawa Transit-Oriented Development Guidelines

m) Road Corridor Planning & Design Guidelines

n) Urban Design Guidelines for Greenfield Neighborhoods

o) Urban Design Guidelines for Large-Format Retail

p) Rural Village Design Guidelines

q) City of Ottawa By-laws

r) City of Ottawa Standard Tender Documents, Volume 1, Construction Specifications as supplemented by Ontario Provincial Standard Specifications (OPSS)

s) City of Ottawa Standard Tender Documents, Volume 2, Material Specifications and Standard Detail Drawings as supplemented by Ontario Provincial Standard Details (OPSD)

t) CAD Drafting standards: refer to Ottawa CADD Standards

Table of Contents

INTRODUCTION i

1.0 SCOPE OF GUIDELINES AND GENERAL CONSIDERATIONS 1.1

2.0 DESIGN REVIEW AND APPROVALS 2.1

2.1 AGENCY REVIEW 2.1

2.1.1 Federal Approvals 2.1

2.1.2 Provincial Approvals 2.1

2.2 CITY OF OTTAWA AND OC TRANSPO 2.1

3.0 TRANSITWAY GEOMETRY 3.1

3.1 GENERAL 3.1

3.2 ALIGNMENT CONTROL 3.2

3.3 DESIGN SPEED 3.2

3.4 DESIGN VEHICLE 3.2

3.5 SIGHT DISTANCE 3.3

3.5.1 Stopping Sight Distance 3.3

3.5.2 Horizontal Sight Distance 3.3

3.5.3 Passing Sight Distance 3.3

3.6 HORIZONTAL ALIGNMENT 3.3

3.6.1 General 3.3

3.6.2 Horizontal Curves 3.3

3.6.3 Superelevation 3.4

3.6.4 Spiral Curves 3.4

3.6.5 Compound Curves 3.5

3.6.6 Reverse Curves 3.5

3.6.7 Alignment in Vicinity of Stations 3.5
3.7 VERTICAL ALIGNMENT 3.5
3.7.1 General 3.5
3.7.2 Maximum Gradients 3.5
3.7.3 Minimum Gradients 3.6
3.7.4 Vertical Curves 3.6
3.7.5 Relationship of Horizontal and Vertical Alignment 3.7
3.7.6 Clearances at Structures 3.7
3.8 AUXILIARY LANES 3.7
3.8.1 General 3.7
3.8.2 Acceleration Lanes 3.7
3.8.3 Deceleration Lanes 3.8
3.8.4 Access Ramps and Slip-By Lanes 3.8
3.9 BUS TURNAROUNDS 3.8
3.10 BUS LAY-BYS 3.8
3.11 INTERSECTION GEOMETRY 3.9
3.11.1 Minimum Radii for At-Grade Intersections 3.9
3.11.2 Turning Vehicle Paths 3.10
3.12 DESIGN CRITERIA 3.10
3.13 FIGURES 3.10

4.0 TRANSITWAY ROAD DESIGN 4.1
4.1 GENERAL 4.1
4.2 CROSS-SECTION 4.1
4.2.1 Cross-Section – Rural 4.1
4.2.2 Cross-Section – Urban 4.1

4.2.3 Station Platform Areas 4.2
4.2.4 Platforms near At-Grade Intersections 4.3
4.2.5 Ramp Sections 4.3
4.2.6 Transitway Auxiliary Turn Lanes 4.3
4.2.7 Pavement Widening 4.3
4.2.8 Intersecting Roadways 4.3
4.2.9 Clearances 4.4
4.3 DRAINAGE 4.4
4.3.1 Minor and Major Drainage Systems 4.4
4.3.2 Storm Water Management 4.4
4.4 SAFETY AND SECURITY MEASURES 4.5
4.4.1 Right-of-way Fencing 4.5
4.4.2 Pedestrian Control Fencing/Railings 4.6
4.4.3 Traffic Barriers 4.6
4.5 PAVEMENT STRUCTURE 4.6
4.6 PAVEMENT MARKINGS AND SIGNAGE 4.7
4.7 TRAFFIC SIGNAL CONTROL AND COMMUNICATION DUCTS 4.7
4.8 UTILITIES 4.8
4.9 FIGURES 4.8

5.0 STRUCTURES 5.1
5.1 GENERAL 5.1
5.1.1 Introduction 5.1
5.1.2 Scope 5.1
5.2 SUPPLEMENTAL CODES 5.1
5.2.1 Transitway Structures, Pedestrian Structures, and Retaining Walls 5.1

5.2.2 Stations and Related Structures 5.2
5.2.3 Light Rail Transit Design Requirements 5.2
5.3 GENERAL PROVISIONS 5.2
5.3.1 Design and Analysis 5.2
5.3.2 Conversion of the System 5.2
5.4 GENERAL FEATURES 5.2
5.4.1 Structure Cross-Section 5.2
5.4.2 Structure Clearances 5.2
5.4.3 Barriers and Railings 5.3
5.4.4 Deck 5.4
5.4.5 Reinforcing steel 5.4
5.4.6 Drainage 5.4
5.4.7 Embedded Work in Structure 5.4
5.4.8 Joints 5.5
5.4.9 Approach Slabs 5.5
5.4.10 Structure Identification Numbers 5.5
5.4.11 Maintenance and Inspection 5.5
5.4.12 Aesthetics 5.5
5.5 LOADS 5.6
5.5.1 General 5.6
5.5.2 Dead Load 5.6
5.5.3 Snow Load 5.6
5.5.4 Live Load 5.6
5.5.5 Thermal Effects 5.6
5.5.6 Other Light Rail Transit Loads and Criteria 5.7

5.5.7 Earthquake 5.7
5.5.8 Loads on Appurtenant Structures 5.7
5.6 LOAD APPLICATIONS 5.7
5.6.1 General 5.7
5.6.2 Rail Loadings 5.7
5.6.3 Dynamic Effects 5.7
5.6.4 Vibrations 5.8
5.6.5 Fatigue 5.8
5.6.6 Long Term Effects 5.8
5.7 LOAD COMBINATIONS AND LOAD FACTORS 5.8
5.8 OTHER CONSIDERATIONS 5.8
5.9 FIGURES 5.9

6.0 COMMUNICATIONS AND CONTROLS 6.1
6.1 GENERAL 6.1
6.2 DESIGN REFERENCE DOCUMENTS 6.1
6.3 GENERAL DESIGN REQUIREMENTS 6.1
6.4 OC TRANSPO CONTROL CENTRE (PROVIDED FOR INFORMATION ONLY) 6.2
6.5 BUILDING AUTOMATION SYSTEM (BAS) 6.3
6.5.1 Existing Building Automation System 6.3
6.6 BAS EQUIPMENT REQUIREMENTS 6.4
6.7 REQUIREMENTS FOR THE BAS MONITORING AND CONTROL OF SYSTEMS 6.5
6.8 TRAINING 6.8
6.9 EXAMPLE POINTS LIST FOR MONITORING AND CONTROL 6.8
6.10 TELEPHONE SYSTEMS 6.14
6.10.1 Emergency Phones (Call Boxes) 6.14

6.10.2 Public Pay Phones 6.14
6.10.3 Electrical Requirements 6.14
6.10.4 Distribution Design Requirements 6.15
6.11 CLOSED CIRCUIT TELEVISION 6.15
6.12 COMMUNICATIONS INFRASTRUCTURE 6.15
6.12.1 Low Voltage Conduits & Distribution 6.15
6.12.2 Station Telephone Distribution 6.16
6.12.3 Communication Room Size 6.16
6.12.4 Station Facilities 6.16
6.13 COMMUNICATION CABLING REQUIREMENTS 6.16
6.13.1 Copper Paired Cable (Bell Canada - Outside Plant) 6.16
6.13.2 Network Cable System - Fiber Optic Cable System (Rogers (formerly Atria) Networks) 6.17
6.13.3 Network Cable System - Internal Copper Cable Network (Contractor Installed) 6.17
6.14 FIGURES 6.18

7.0 SAFETY AND SECURITY 7.1
7.1 GENERAL 7.1
7.2 GENERAL PRINCIPLES AND GUIDELINES 7.1
7.3 TRANSIT FACILITY ACCESS ROUTES 7.2
7.4 TRANSIT SYSTEM SAFETY AND SECURITY FEATURES 7.3
7.5 STATIONS/FACILITIES 7.5
7.5.1 General Architectural Features 7.5
7.5.2 Facility Access Control 7.5
7.5.3 Passenger Elevators 7.5
7.5.4 Lighting 7.5

7.5.5 Acoustics and Vibration 7.6
7.5.6 Directional and Informational Signage (by OC Transpo) 7.6
7.6 TRANSITWAY RIGHT-OF-WAY ACCESS CONTROL 7.6
7.6.1 General Transitway Ownership, Maintenance and Management 7.6

8.0 STATIONS 8.1
8.1 GENERAL 8.1
8.2 SUPPLEMENTAL CODES 8.3
8.3 STATION ACCESS 8.4
8.4 PUBLIC ART PROGRAM 8.4
8.5 STATION TYPES AND CONFIGURATIONS 8.5
8.5.1 General 8.5
8.5.2 Typical Station and Platform Configurations 8.6
8.5.3 Station Platforms 8.7
8.6 STATION DESIGN 8.8
8.6.1 General 8.8
8.6.2 Station Design Criteria 8.8
8.6.3 Public Waiting Areas 8.9
8.6.4 Pedestrian Underpass 8.9
8.6.5 Pedestrian Overpass 8.10
8.6.6 Building Service Rooms 8.10
8.6.7 Supervisor and Operator Rooms 8.10
8.6.8 Information Centre 8.10
8.6.9 Passenger Shelters 8.11
8.6.10 Vending Machines, Vendor Facilities 8.11
8.6.11 Bicycle Storage 8.11

8.6.12 LEED Considerations 8.11
8.7 MATERIALS 8.12
8.8 OTHER CONSIDERATIONS 8.16
8.9 FIGURES 8.17

9.0 INTERFACE WITH PEDESTRIAN AND CYCLING NETWORKS 9.1
9.1 GENERAL 9.1
9.2 DESIGN CRITERIA 9.1
9.3 OTHER CONSIDERATIONS 9.3

10.0 PASSENGER INFORMATION SYSTEM 10.1
10.1 GENERAL 10.1
10.2 INFORMATION SIGNAGE 10.1
10.3 STATION IDENTIFICATION AND DIRECTIONAL SIGNAGE 10.1
10.4 OVERHEAD AND PYLON SIGNS 10.1
10.5 SYSTEM MAP AND SCHEDULES 10.2
10.6 ROUTE/PAMPHLET DISPLAY CABINETS 10.2
10.7 BUS STOPS FLAGS 10.2
10.8 ROUTE DISPLAY – TELIDON 10.3
10.9 PASSENGER INFORMATION SYSTEM 10.3
10.10 PUBLIC ADDRESS SYSTEM 10.4
10.11 PUBLIC TELEPHONES C/W BUS INFORMATION AND SECURITY AUTODIAL FEATURES 10.4
10.12 NETWORK COMMUNICATIONS DUCTS 10.4
10.13 FIGURES 10.4

11.0 ACCESSIBILITY 11.1
11.1 GENERAL 11.1

11.2 STATION REQUIREMENTS 11.1
11.3 BUS SHELTERS 11.3
11.4 PLATFORMS 11.4
11.5 BENCHES 11.5

12.0 LANDSCAPING 12.1
12.1 GENERAL 12.1
12.2 DESIGN OBJECTIVES 12.1
12.3 REINSTATEMENT 12.3
12.4 BERMING AND GRADING 12.3
12.5 SUITABILITY AND AVAILABILITY OF PLANT MATERIAL 12.4
12.6 PLANT MATERIAL DESIGN GUIDELINES 12.4
12.7 LOW MAINTENANCE DESIGN GUIDELINES 12.4
12.8 OTHER CONSIDERATIONS 12.5

13.0 ENVIRONMENTAL PROTECTION 13.1

14.0 ELECTRICAL 14.1
14.1 GENERAL 14.1
14.1.1 Elementary Station Requirements 14.1
14.1.2 General Requirements 14.1
14.2 BASIC ELECTRICAL MATERIALS 14.2
14.2.1 General 14.2
14.2.2 Conduits, Cable Trays and Wiring Enclosures 14.2
14.2.3 Outlets, Switches 14.3
14.2.4 Wiring 14.3
14.3 DUCTBANKS, MAINTENANCE HOLES AND HANDHOLES 14.3
14.3.1 Ductbanks 14.3

14.3.2 Maintenance Holes and Handholes 14.4
14.4 SITE SERVICING 14.4
14.5 SERVICE EQUIPMENT AND DISTRIBUTION 14.5
14.5.1 General Requirements 14.5
14.5.2 Electrical/Communication Distribution Enclosures 14.5
14.6 LOW VOLTAGE SWITCHBOARD 14.6
14.6.1 Materials 14.6
14.6.2 Coordination and Short Circuit Evaluation Study 14.7
14.7 SECONDARY GROUNDING 14.7
14.7.1 Ground Electrode System 14.7
14.7.2 Continuous Ground Wire 14.7
14.7.3 Electrical Room/Cabinet Ground Bus 14.7
14.8 CONTACTORS AND CONTROL 14.7
14.9 LIGHTING 14.8
14.9.1 General 14.8
14.9.2 Materials 14.8
14.9.3 Lighting Computer Simulation 14.8
14.9.4 Lighting Design Criteria 14.8
14.10 FIRE PROTECTION SYSTEM 14.11
14.11 EMERGENCY POWER SYSTEM 14.12
14.12 COMMUNICATIONS AND CONTROLS 14.13
14.13 ELECTRICAL PROVISIONS - ELEVATOR, ESCALATOR AND MECHANICAL SERVICE 14.13
14.13.1 Elevators, Escalators 14.13
14.13.2 Heating and Ventilation 14.13
14.13.3 Heating Cables/Pipe Tracing 14.14

14.14 PROVISIONS FOR EQUIPMENT SUPPLIED BY OTHERS 14.15
14.14.1 Station Equipment 14.15
14.15 FIGURES 14.15

15.0 MECHANICAL 15.1
15.1 HEATING, VENTILATION AND AIR CONDITIONING 15.1
15.1.1 Introduction 15.1
15.1.2 Applicable Codes 15.1
15.1.3 Transitway Tunnels 15.2
15.1.4 Pedestrian Underpasses 15.2
15.1.5 Mechanical/Electrical Rooms 15.2
15.1.6 Supervisors Rooms 15.3
15.1.7 Elevator Machine Rooms/Elevator Pits 15.3
15.1.8 Janitors/Storage Rooms 15.4
15.1.9 Operator Facilities including Water Closets and Lounge Areas 15.4
15.1.10 Ticket/Information Rooms 15.5
15.1.11 Emergency Generator Rooms 15.5
15.2 EMERGENCY POWER SYSTEMS 15.6
15.2.1 HVAC Supporting System 15.6
15.2.2 Fuel System 15.6
15.2.3 Engine Exhaust System 15.6
15.2.4 Ministry of Environment Certificate of Air 15.6
15.3 DRAINAGE AND PLUMBING 15.7
15.3.1 General 15.7
15.3.2 Applicable Codes 15.7
15.3.3 Drainage 15.7

15.3.4 Plumbing 15.8

15.4 FIRE PROTECTION 15.11

16.0 ELEVATORS AND ESCALATORS 16.1

16.1 SCOPE 16.1

16.2 ELEVATORS 16.1

16.2.1 Use 16.1

16.2.2 Codes and Standards 16.1

16.2.3 Types 16.2

16.2.4 Maintenance 16.2

16.2.5 Standard Equipment 16.2

16.2.6 Specifications and Drawings 16.3

16.2.7 Operating Environment 16.3

16.2.8 Motor Drives 16.3

16.2.9 Controllers 16.3

16.2.10 Elevator Alarm Bell 16.4

16.2.11 Emergency Power 16.4

16.2.12 Bilingual Markings and Design 16.4

16.2.13 Vandal Resistant Design 16.5

16.2.14 Earthquake Design 16.5

16.2.15 Car Enclosures 16.5

16.2.16 Hoistway Entrances 16.5

16.2.17 Signals and Fixtures 16.5

16.2.18 Corrosion 16.6

16.2.19 Accessibility 16.6

16.3 ESCALATORS 16.6

16.3.1 Codes and Standards 16.6
16.3.2 Maintenance 16.7
16.3.3 Standard Equipment 16.7
16.3.4 Operating Environment 16.7
16.3.5 Motor Drives 16.7
16.3.6 Controllers 16.7
16.3.7 Bilingual Markings and Design 16.8
16.3.8 Vandal Resistant Design 16.8
16.3.9 Earthquake Design 16.8
16.3.10 Signals and Fixtures 16.8
16.3.11 Corrosion 16.8
16.3.12 Mechanical Considerations 16.9
16.3.13 Motor and Drive Considerations 16.9

17.0 OTHER FACILITIES 17.1
17.1 GENERAL 17.1
17.2 PARK AND RIDE LOTS 17.1
17.2.1 Entrances 17.1
17.2.2 Bus Stops and Platforms 17.2
17.2.3 Bus Lay-up Areas 17.3
17.2.4 Parking Area Design 17.3
17.2.5 Pedestrian Access 17.4
17.2.6 Bicycle Storage 17.5
17.2.7 Pavement and Drainage 17.5
17.2.8 Lighting, Security and Communications 17.5
17.2.9 Public Telephones 17.5

17.2.10 Landscaping 17.5
17.2.11 Site Security and Protection 17.5
17.2.12 Other Installations 17.6
17.3 PASSENGER SHELTERS 17.6
17.3.1 General 17.6
17.3.2 Prefabricated Shelters 17.6
17.4 OPERATOR FACILITIES 17.9
17.4.1 Precast Building Installations 17.9
17.4.2 Trailer Installations 17.10
17.5 EQUIPMENT AND VEHICLE STORAGE BUILDING 17.10
17.6 OTHER INSTALLATIONS 17.11
17.6.1 Security Camera/E-Phone Stanchions 17.11
17.7 FIGURES 17.11

LIST OF FIGURES

Figure No.	Description
3.6.1	Station Area Lane Arrangements
3.6.2	Station Area Geometric Details
3.8.4	Turning Lane Arrangements
4.2.1a	Typical Transitway Rural Fill Section
4.2.1b	Typical Transitway Rural Cut Section
4.2.2a	Typical Transitway Urban Cut Section Closed Drainage
4.2.2b	Typical Transitway Urban Section Restricted R.O.W.
4.2.3a	Typical Section at Station Platform
4.2.3b	Platform – Red Stamped Concrete
4.2.3c	Typical Station Area Aluminum Rail

Figure No.	Description
4.2.5a	Typical Ramp Rural Section Superelevated
4.2.5b	Typical Ramp Urban Section Superelevated
4.2.9a	Typical Bus Dimensions – Double Decker
4.2.9b	Typical Bus Dimensions – Standard
4.2.9c	Typical Bus Dimensions – Articulated
5.4.1	Transitway Bridge – Standard Cross Section
5.4.2a	Transitway Overpass Clearances
5.4.2b	Construction Clearances
6.2a	Transitway BAS Network Architecture Schematic
6.2b	Emergency Phone / Telephone Schematic
8.5.2a	At-Grade Transitway Station Example
8.5.2b	Grade-Separated Transitway Station Example (1 of 4)
8.5.2c	Grade-Separated Transitway Station Example (2 of 4)
8.5.2d	Grade-Separated Transitway Station Example (3 of 4)
8.5.2e	Grade-Separated Transitway Station Example (4 of 4)
10.4a	Pylon Sign
10.4b	Overhead Sign
10.5	Transitway Map Case
10.6	Route / Pamphlet Display Cabinet
10.7a	Bus Stop Flag
10.7b	Bus Flag Pole
14.5.1	Typical Single Line Diagram For Transitway Station
14.5.2a	Typical Pre-Cast Concrete Service Vault
14.5.2b	Pre-Cast Concrete Service Vault Examples

Figure No.	Description
14.5.2c	Typical Exterior Distribution Cabinet
17.2	Park and Ride Lot Facility
17.3.2a	Prefabricated Shelters – Examples
17.3.2b	Accessible Bench Examples
17.3.2c	Typical Bus Shelter Conduit Connections
17.4.1	Typical Precast Operator Facility
17.4.2	Typical Trailer Operator Facility
17.5	Typical Equipment and Vehicle Storage Facility
17.6.1	Security Camera / E-Phone Stanchion

1.0 SCOPE OF GUIDELINES AND GENERAL CONSIDERATIONS

The purpose of the "Transitway and Station Design Guidelines" is to provide a general source of information to be used in the design of facilities designated as a Transitway within the City of Ottawa. The manual has not been prepared for use in the design of Roadways nor Rail facilities. The manual also assumes that the planning of the system has been completed; however, the manual may be used as an aid during the planning of a future Transitway system.

Design criteria for the transit sections within mixed traffic and transit priority lanes are outside the scope of this guideline. The separate facilities are designed in accordance with appropriate road authority (municipal, provincial, federal) principles and standards.

The information presented in this design guideline was carefully researched. However, no warranty expressed or implied is made on the accuracy of the contents or their extraction from reference to publications; nor shall the fact of distribution constitute any responsibility by the City of Ottawa, OC Transpo or any researchers or contributors for omissions, errors or possible misrepresentation that may result from use or interpretation of the material herein contained.

The information contained herein is to be carefully used and good engineering judgment will be required on a project by project and site specific basis.

2.0 DESIGN REVIEW AND APPROVALS

Transit corridors and stations are designed to link the urban areas of the City of Ottawa together. As such, they must be integrated within the adjacent communities. Throughout the development of the design, care is required to ensure that the Transitway and stations reflect the City's policies and guidelines. It is anticipated that a general review of the requirements will be completed during the Environmental Assessment process and the outstanding approvals will be identified. Section 13.0 provides environmental protection considerations related to the design process. This section outlines some of the approval agencies that may need to be contacted.

2.1 AGENCY REVIEW

The design of the transit stations and corridors may require reviews and approvals from a range of federal and provincial government agencies, as well as City of Ottawa approvals. Prior to commencement of the design, a review of the approvals identified or required based on the environmental assessment phase should be completed, as well as any project specific design approvals. These approvals should be reviewed in order to determine the overall scope of approvals required. The following outlines the principle agencies which may have specific issues that will need to be addressed.

2.1.1 Federal Approvals

The City of Ottawa is located within the National Capital Region (NCR). The governing body for the overall vision for this region is the crown corporation, National Capital Commission (NCC). Any works that would be constructed on federal lands, or adjacent to federal lands, may require Federal Land Use approval from the NCC or other federal agencies. Depending upon complexity, the approvals could be completed by staff or require input from the Advisory Committee on Planning, Design and Realty (ACPRDR).

Other federal agencies may include Parks Canada and Department of Fisheries and Oceans (DFO), Agriculture Canada and Transport Canada.

2.1.2 Provincial Approvals

Undertakings will be subject to provincial regulations and approvals. Approvals may be required from the provincial government's ministries such as, but not limited to, the Ministry of Environment, Ministry of Infrastructure, Ministry of Transportation and Ministry of Natural Resources.

2.2 CITY OF OTTAWA AND OC TRANSPO

The designer shall ensure that the policies and procedures of the City of Ottawa are followed during the design development. For example, the City's design guidelines and utility circulation procedures shall be reviewed and complied with as appropriate. There may also be a requirement for Site Plan Approval for specific projects, particularly in urban or developed areas.

The designer shall review City of Ottawa by-laws during design development. For example, the City's Tree Protection By-law and Urban Tree Conservation By-law which applies to both private and public properties and require initial site review, confirmation of the tree species, size and location and preparation of a drawing identifying all trees that are to be preserved/protected and those that are impacted by the undertaking.

The preliminary designs are subject to approval by OC Transpo and City of Ottawa departments as may apply. A preliminary design approval must be received prior to proceeding with the detailed design. Where Transitway facilities affect adjacent infrastructure, approval of the preliminary design shall be obtained from the associated authority. A preliminary design circulation shall be completed through the City of Ottawa standard circulation procedure.

The final detailed design drawings are subject to approval by OC Transpo and City of Ottawa departments as may apply. Approval of the detailed design must be received prior to the issuance of contract drawings for construction.

Where the construction affects municipal infrastructure and services or impacts a municipal right-of-way then Municipal Consent must be obtained prior to commencing construction.

A detailed design and/or Municipal Consent circulation shall be completed through the City of Ottawa standard circulation process.

3.0 TRANSITWAY GEOMETRY

3.1 GENERAL

Transitway geometry is of fundamental importance to the efficient operation of the Transitway system and safety of its users. The geometry is established based on the Transitway corridor defined through the planning process but is also influenced significantly by the adjacent infrastructure, land use and terrain.

The various elements outlined in this section are applicable to the design of a bus rapid transit system however future conversion to a light rail system should also be a considered by the designer.

The general principles governing the geometric design contained in the current Transportation Association of Canada (TAC) publication entitled "Manual of Geometric Design Standards for Canadian Roads" will be followed. These principles may be augmented by MTO Geometric Design Standards for Ontario Highways and AASHTO standards and as may be otherwise noted in this section.

Geometry will influence the transit ride, especially for standing passengers. The design should consider alignments which reduce sags, crests and directional changes to a minimum consistent with reasonable economy. Design controls are imposed by characteristics and limitation of vehicle and driver performance. Design controls are also influenced by location.

The designer will need to consider:

- adjacent development or planning
- adjacent or crossing Provincial and Federal transportation facilities (highways, parkways)
- adjacent Provincial and Federal properties (NCC, PWGSC)
- adjacent or crossing urban and rural arterials, collectors and local roads
- adjacent or crossing railways
- surface water and storm water management
- servicing by utilities and municipal services
- design requirements related geotechnical, hydrogeological, etc. considerations

These controls shall also be coordinated with light rail and/or other transit measures/facilities covered under separate design manuals.

3.2 ALIGNMENT CONTROL

Chainage (Stationing) is the measurement of horizontal alignment from a given origin. The unit of measure is in increments of one kilometre and stationing is expressed in metres and decimals of metres (i.e. 1+234.567 or 12+345.67). Changes in direction of the engineering control line shall be noted at all intersections points showing either the included angle or the deflection angle.

Horizontal and vertical control for all alignments shall be based on a set of controls established throughout the project limits.

Horizontal control shall be coordinated from two independent pairs of permanent monuments which will be protected from any proposed construction. Vertical control shall be to Geodetic Datum and shall be based on the City of Ottawa's established bench mark networks. Primary horizontal and vertical control to be utilized for the design and construction of the project shall be obtained from City of Ottawa Surveys and Mapping.

Transitway alignments that are generally east-west in orientation are normally stationed increasing from west to east and alignments that are generally north-south in orientation are stationed increasing from north to south.

3.3 DESIGN SPEED

For the Transitway, desirable minimum design speeds shall be as follows:

	Design Speed (km/h)	Posted Speed (km/h)
Transitway - Outside of Station Areas	90	80
Transitway - Through Station Areas	60	50
Ramps and Access Routes	40	30

The designer shall undertake the geometric design based on the design speed as a minimum. In event that the designer identifies constraints that will require a reduction in the design speed criteria the designer shall obtain the approval of OC Transpo prior to proceeding with the preliminary design.

3.4 DESIGN VEHICLE

The Design Vehicle is dependent on the types of transit service vehicles in use and those other vehicles expected to use the facility in the future. The designer shall confirm the appropriate design vehicle(s) with OC Transpo prior to the development of design criteria.

There are four common bus body types currently in use by OC Transpo: standard vehicle, articulated, double-decker bus and Para Transpo vehicle. In addition to buses in use the designer

should consider the types of maintenance vehicles and emergency vehicles which may access the Transitway.

3.5 SIGHT DISTANCE

The ability to see ahead is of critical importance in the safe and efficient operation of a vehicle. Sufficient sight distance must be provided to allow for drivers of all skill and training levels to stop or maneuver around obstacles on the roadway surface and to make safe turns.

3.5.1 Stopping Sight Distance

Minimum stopping sight distance must be provided along the Transitway and associated ramps and access roads.

The designer shall refer to the TAC Manual of Geometric Design Standards for Canadian Roads for design criteria, guidelines and standards related to minimum stopping sight distance requirements.

3.5.2 Horizontal Sight Distance

Safe horizontal sight distances are required and shall conform to desirable TAC standards where feasible.

3.5.3 Passing Sight Distance

There is no provision for passing on the Transitway between stations.

3.6 HORIZONTAL ALIGNMENT

3.6.1 General

Horizontal alignment consists of tangents, lengths of circular curve and lengths of spiral or transition curve. Horizontal deflections (i.e. without curves) are easily perceived and contribute to rider discomfort and should be limited, with the rate of deflection minimized as much as practical.

Figures.3.6.1 and 3.6.2 provide typical layouts in the vicinity of stations.

3.6.2 Horizontal Curves

For the main Transitway, desirable minimum circular curve radii shall apply as follows:

	Design Speed (km/h)	Min. Radius (m)
Transitway - Outside of Station Areas	90	340
Transitway - Through Station Areas	60	130
Ramps and Access Routes	40	55

The designer shall obtain the current Ottawa Light Rail design criteria from the City of Ottawa to confirm minimum radii requirements for future conversion to light rail.

Radii of 340m should be considered a minimum for the Transitway, however, it is desirable to develop radii as large as possible taking into account constraints on horizontal alignment such as topography and development. The absolute minimum radius in the vicinity of stations shall be 130m. Any reduction in radii below the prescribed minimums shall be subject to the approval of OC Transpo.

Minimum curve lengths should conform to the TAC Geometric Design Guide design criteria.

Circular curves shall be specified by their radii in metres to three decimal places.

3.6.3 Superelevation

The maximum rate of superelevation for all sections of the Transitway, ramps and access roadways shall be 0.06m/m. Superelevation should be developed in accordance with the TAC Manual. In the tangent runout section of the curve, the slope of the outside pavement edge in relation to the center line should be 1:400. This may be increased to 1:200 when being applied to curves in the immediate vicinity of stations due to the lower operating speeds through the station area.

The preferred method of attaining superelevation on Transitways is through rotation about the road centerline.

3.6.4 Spiral Curves

Spiral curves shall be used on all Transitway curves having superelevation and are desirable on all other Transitway curves to transition from tangent to curve and curve to tangent. An exception to use of spirals may be where reduced radius curves in station area approaches are required, where property or other physical constraints are present or where approved by OC Transpo.

Spiral curves shall be provided in accordance with the TAC Geometric Design Guide.

3.6.5 Compound Curves

Where two or more circular curves are to be connected forming a compound curve the circular curves shall be joined by a spiral and the superelevation of each circular curve shall be so adjusted that the maximum permissible speed is identical for all parts of the compound curve. Broken back curves should be avoided.

3.6.6 Reverse Curves

Back to back reverse circular curves shall not be used on the Transitway. When reversal in alignment is unavoidable and a minimum tangent length to provide for 1:400 tangent runout shall be interposed between the two circular curves where practical.

3.6.7 Alignment in Vicinity of Stations

Station areas shall be located on tangent sections and preferably the tangents shall extend a minimum of 71m beyond the end of the station platforms to allow for complete pavement cross-fall rollover. However, a minimum tangent length of 30m beyond the platform limits is acceptable. Prior approval by OC Transpo is required to deviate from these criteria.

A minimum 1:200 rollover ratio should be used to transition from the reverse cross-fall condition to the normal crown condition.

Platforms in the station areas shall be on tangent alignments and shall be a minimum of 55m in length.

3.7 VERTICAL ALIGNMENT

3.7.1 General

Vertical alignments consist of straight line grades and the vertical curves used to connect them. There are two types of vertical curves, crest curves which occur on hills and sag curves which occur in valleys. The design of these curves is based on comfort or visibility criteria and a parabolic function is used to define them.

3.7.2 Maximum Gradients

The desirable maximum longitudinal gradient for the Transitway main alignment is 3.5% unless otherwise approved by OC Transpo.

The desirable standard for maximum gradient is based on flexibility for conversion to a rail system. Light rail facilities will tolerate more severe grades but compromising the above-noted maximum gradient shall not be considered without the prior approval of OC Transpo.

Transitway stations shall be located on a tangent grade with a maximum gradient through stations of 0.50% unless otherwise approved by OC Transpo. The maximum station grade is based on conversion to a future rail system. The tangent grade should be extended a minimum of 20m

beyond the end of the platform before the start of vertical curves. In crossfall rollover areas the designer should review the gutter grade to ensure positive drainage particularly where sag curves are being developed.

The maximum gradient for bus ramps and access routes shall not exceed 6%.

3.7.3 Minimum Gradients

The minimum longitudinal gradient for urban (curbed) sections of the main Transitway alignment shall be as follows:

Desirable standard: 0.50% minimum

Absolute minimum: 0.35%

In rural cross-sections the gradient for the Transitway alignment may be 0.0% where sufficient cross-fall (2% minimum) and adequate ditch grades (0.3% minimum) are provided.

3.7.4 Vertical Curves

All changes in longitudinal gradient shall be accomplished by the use of parabolic vertical curves.

The designer shall obtain the current Ottawa Light Rail design criteria from the City of Ottawa to confirm vertical curve criteria required for future conversion to light rail.

a) Crest Curves:

Based on a driver eye height of 1.05m an object height of 380mm, the following values of the design parameter K, shall apply:

	Design Speed (km/h)	Minimum Crest Curve, K (m)
Transitway - Outside of Station Areas	90	55
Transitway - Through Station Areas	60	15
Ramps and Access Routes	40	5

b) Sag Curves:

Based on a headlight control of 0.6m height and where the angle of the headlight beam is 1º upward from the plane of the vehicle, the following values of the design parameter K, shall apply:

	Design Speed (km/h)	Minimum Sag Curve, K (m)
Transitway - Outside of Station Areas	90	40
Transitway - Through Station Areas	60	18
Ramps and Access Routes	40	7

On illuminated sections of Transitway, the headlight criterion does not apply since the operator is able to see further ahead than the headlights illuminate. Under these conditions, sharper curves could be considered, where conditions warrant, and only upon the approval of OC Transpo.

c) Minimum Length of Vertical Curves:

For the Transitway, the length of vertical curve should not be less than 90m. In general, the length of vertical curve should be no less than the design speed (in metres).

The length of vertical curve on ramps and access routes should not be less than 50m.

3.7.5 Relationship of Horizontal and Vertical Alignment

The designer shall consider the coordination of horizontal and vertical alignments following the general principles outlined in the TAC Geometric Design Guide.

3.7.6 Clearances at Structures

The minimum vertical and horizontal clearance requirements for Transitways are detailed in Section 5.0, “Structures” on Figures 5.4.2a and 5.4.2b.

3.8 AUXILIARY LANES

3.8.1 General

Speed change lanes shall be provided on the Transitway for station lanes, access points and any other locations where operating speeds of various functions differ. Figures 3.6.1, 3.6.2 and 3.9 provide typical design criteria.

3.8.2 Acceleration Lanes

An acceleration lane length of 95m shall be provided with a lane taper length of 85m. In certain station configurations the designer may consider a reduction in lengths of the acceleration lane and taper in consultation with OC Transpo.

3.8.3 Deceleration Lanes

A deceleration lane length of 75m shall be provided with a lane taper length of 75 m. In certain station configurations the designer may consider a reduction in lengths of the acceleration lane and taper in consultation with OC Transpo.

3.8.4 Access Ramps and Slip-By Lanes

It is desirable to develop two-way ramps for bus movements on and off the Transitway. All movements should be provided at the Transitway/Ramp intersection to provide operational flexibility of bus movements, emergency vehicles, maintenance and snow clearing.

A slip-by lane is provided at locations on the main Transitway where vehicles may regularly decelerate and/or stop to access ramp connections to adjacent road network, left turns and bus turnarounds. A slip-by lane allows through buses to by-pass the slower/stopped bus or other OC Transpo vehicles.

A typical access ramp intersection including turning and slip-by lane arrangement and criteria at various design speeds is provided on Figure 3.8.4.

3.9 BUS TURNAROUNDS

Bus turnarounds are provided at termination points of Transitway or at locations where significant numbers of bus routes end. Turnarounds are typically independent of other geometric features but may be used in conjunction with stations and bus lay-by areas.

The bus turnaround shall be constructed with a minimum radius of 18m to the outside edge of pavement. The geometry shall be checked utilizing turning simulation software with the appropriate design vehicle.

Preferably the outside edge of shoulder will be demarcated with delineators in rural situations. The inside area of the turnaround should be finished with an asphalt surface for winter snow storage and should include suitable drainage outlets.

3.10 BUS LAY-BYS

Bus routes are normally scheduled with lay-by or recovery time at intermediate points or at the end of the route. Where identified by OC Transpo bus lay-bys are to be incorporated in the design. Typically, a bus lay-by will be required at identified transit stations and in conjunction with operator facilities.

The designer shall incorporate current requirements and review future requirements as identified by OC Transpo when establishing grading limits and other design elements.

The design and layout of the bus lay-by areas shall be integrated into the Transitway and station geometry. The design shall allow full access and egress to the Transitway in all directions including use as a bus turnaround.

To achieve the desired flexibility in access, the designer shall minimize the internal circulation of buses either in the bus lay-by area or around an adjacent station. Potential bus operation conflict points shall be kept to a minimum.

OC Transpo shall define the number of spaces required for current and future conditions at each lay-by facility. Refer to Section 17.0, "Other Facilities" for additional requirements and design criteria.

3.11 INTERSECTION GEOMETRY

The following are typical types of Transitway intersections:

- Grade separated crossing of a Transitway by a City road, MTO controlled access highway or railway
- Transitway access ramps
- At-grade (signalized) crossing of the Transitway by a City road or rail line
- At-grade intersection of a Transitway at a bus lay-by, bus turnaround or other service road

The geometric design of Transitway intersections with roadways and railways, whether grade separated or at-grade, shall be reviewed and approved by OC Transpo in conjunction with the road or rail authority.

The designer shall review the requirements of the TAC Geometric Design Guide for intersection design requirements. Where intersections are at-grade, it is desirable for the angle of intersection to be as close to 90º as possible. The intersecting angles shall not be less than 70º.

3.11.1 Minimum Radii for At-Grade Intersections

Minimum radii are used when speeds are low, the volume of turning vehicles is low and or property costs are high. The following are minimum radii for intersection sections at various turning speeds:

Turning Speed (km/h)	Minimum Inside Radii (m)
0 – 15	12.5
16 – 25	20
26 – 35	35

The designer should review the use of two centered curves in situations where there are property constraints present.

3.11.2 Turning Vehicle Paths

All turning movements shall be confirmed utilizing the appropriate bus turning templates and preferably by vehicle turning simulation analysis software. The designer shall consult with OC Transpo to establish the appropriate bus types to be reviewed in the analysis. In the absence of a specific bus type the designer should check the turning movements utilizing the most conservative city bus turning template.

3.12 DESIGN CRITERIA

The design standards presented in this section have been established primarily on the basis of rider comfort, safety and pavement drainage requirements and represent desirable minimums. Figure 3.12 presents a standard design criteria list that should be utilized by the designer to document project specific design criteria.

Geometric design criteria should be established early in the preliminary design phase and should be updated as necessary during preliminary design development. The designer shall obtain the current Ottawa Light Rail design criteria from the City of Ottawa and assess the geometric design criteria as they relate to any planned future conversion to a light rail system. The draft design criteria sheet shall be prepared and submitted for review and approval by the City Project Manager and OC Transpo during the preliminary design phase. Upon completion of the preliminary design phase the Final Design Criteria Sheet shall be signed off by the City Project Manager and OC Transpo prior to initiating the detailed design phase.

3.13 FIGURES

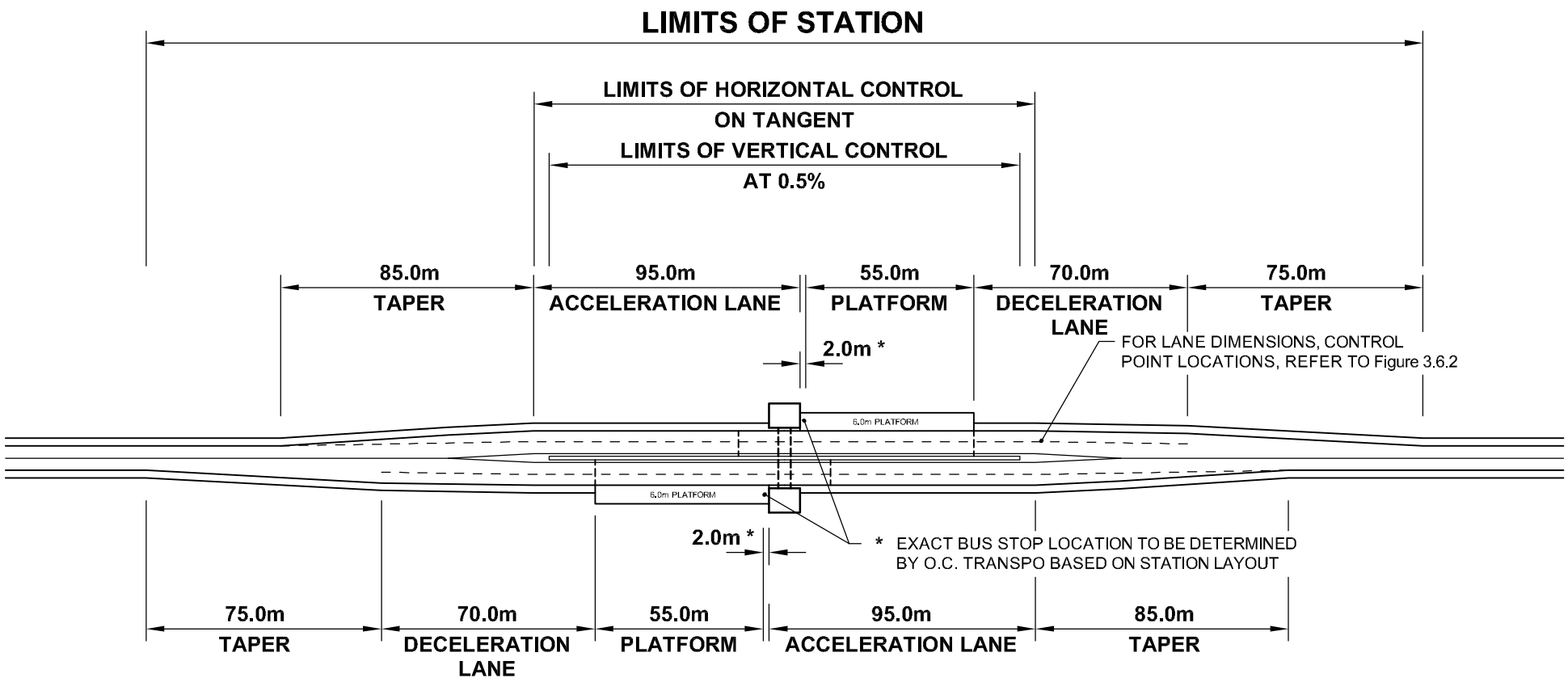
The designer shall refer to the following figures as referenced in above sub-sections:

Figure 3.6.1: STATION AREA LANE ARRANGEMENTS

Figure 3.6.2: STATION AREA GEOMETRIC DETAILS

Figure 3.8.4: TURNING LANE ARRANGEMENTS

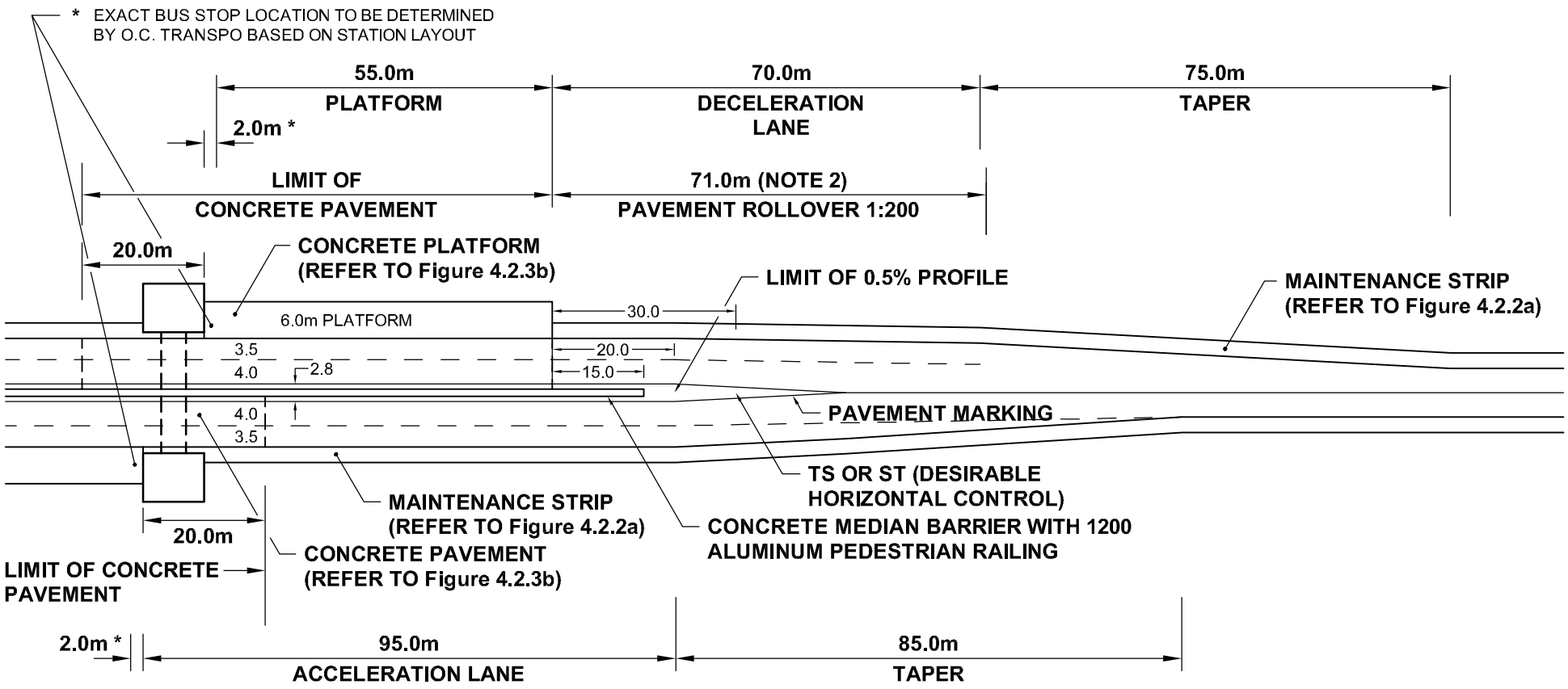
Figure 3.12: TYPICAL DESIGN CRITERIA SHEET



NOTES:

1. **Design speed 60 km/h through limits of station.**
2. **All dimensions are in metres.**
3. **This drawing is to be read with Figure 3.6.2.**

Ottawa / OC Transpo	**STATION AREA LANE ARRANGEMENTS**	*Scale* **N.T.S.**	*Date* **May 2012**
		Revision No. / Date	
	TRANSITWAY AND STATION DESIGN GUIDELINES	**Figure 3.6.1**	

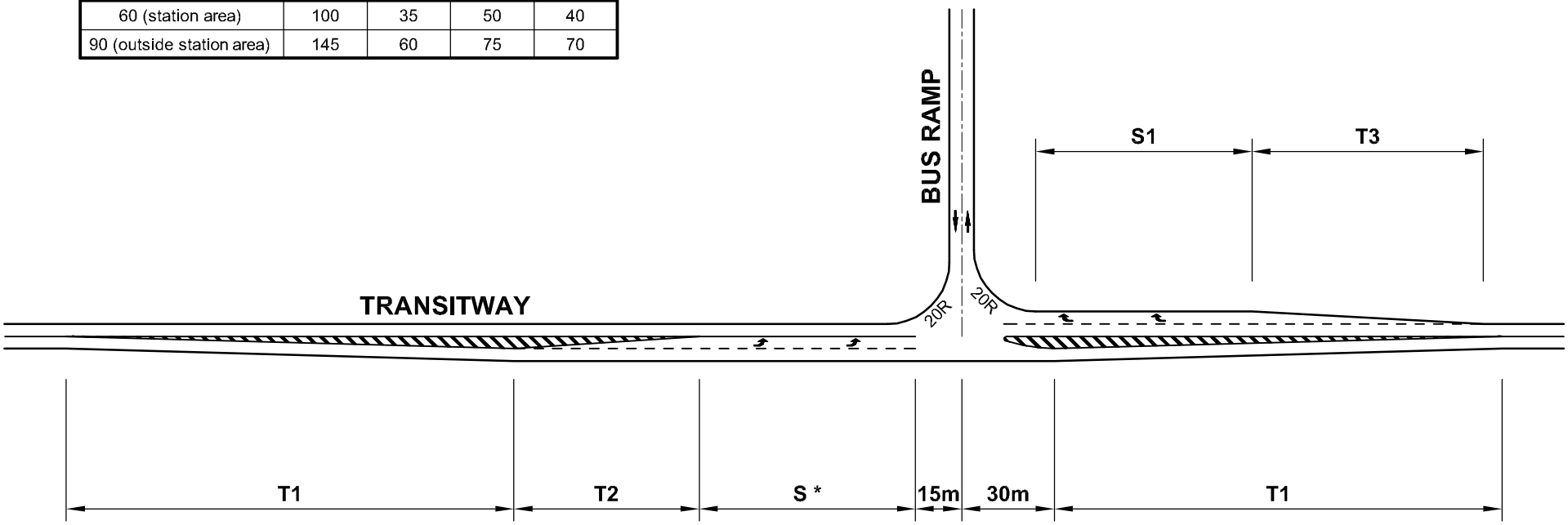


NOTES:

1. Dimensions indicated for preliminary purposes only. Final dimensions shall be determined by the designer based on site conditions and appropriate geometric design principles.
2. Desirable maximum pavement rollover rate is 1:200. Designer shall ensure positive drainage is maintained.
3. This drawing is to be read with Figure 3.6.1.
4. All dimensions are in metres.

Ottawa / OC Transpo	**STATION AREA GEOMETRIC DETAILS**	Scale: N.T.S. / Date: May 2012 / Revision No. / Date
	TRANSITWAY AND STATION DESIGN GUIDELINES	**Figure 3.6.2**

DESIGN SPEED (km/h)	T1 (m)	T2 (m)	T3 (m)	S1 (m)
60 (station area)	100	35	50	40
90 (outside station area)	145	60	75	70



$$S^* = \frac{NL}{30}$$

Minimum S (for deceleration):

Station Area S = 40m
Outside Station Area S = 70m

Where N = Volume of buses/hour turning

L = Bus length (18.0m)

NOTE:

1. **All dimensions are in metres.**

Ottawa
OC Transpo

TURNING LANE ARRANGEMENTS

Scale: N.T.S.
Date: May 2012
Revision No. / Date:

TRANSITWAY AND STATION DESIGN GUIDELINES

Figure 3.8.4

FIGURE 3.12 – TYPICAL DESIGN CRITERIA SHEET (1 of 2)

LOCATION:_____

DESIGN ELEMENT		EXISTING CONDITIONS	DESIGN STANDARDS	PROPOSED
AADT				
Design Speed	kph			
Posted Speed	kph			
Horizontal				
Stopping Distance	m			
Superelevation Rate (max)	%			
Horizontal Radius – Minimum	m			
Horizontal Radius – Reverse Crown (min)	m			
Horizontal Radius - Normal Crown (min)	m			
Tangent Runout (A)				
Vertical				
"K" Factor (min) – Sag				
"K" Factor (min) – Crest				
Vertical Curve Length (min)	m			
Grades (max)	%			
Grades (min), (urban, rural)	%			
Cross-section				
No. of Through Lanes	m			
No. of Through Lanes	m			
Urban Section				
Lane Width – Through Lane	m			
Lane Width – Auxiliary Lane Station	m			
Lane Width – Auxiliary Lane	m			
Curb Offset	m			
Median Width	m			
Inner Boulevard Width	m			
Station Platform Width	m			
Sidewalk Width	m			
Rural Section				
Lane Width – Through Lane	m			
Lane Width – Auxiliary Lane	m			
Shoulder Width	m			
Side Slope Ratio (Max./Desired)				
Pavement Widening	m			
Other	m			
Multi-use Pathway Width				

(Continued)

FIGURE 3.12 – TYPICAL DESIGN CRITERIA SHEET (2 of 2)

Other Requirements and Details:
Typical Section(s) – use additional sheets if required:

Prepared by:

Consultant PM:		
(print name)	(signature)	(date)

Approved by:

City Project Manager:		
(print name)	(signature)	(date)
OC Transpo Reviewer:		
(print name)	(signature)	(date)

4.0 TRANSITWAY ROAD DESIGN

4.1 GENERAL

The elements outlined in this chapter are applicable to a Transitway system designed for bus only use. The designer shall obtain the current Ottawa Light Rail design criteria from the City of Ottawa to review the requirements for future conversion to light rail to ensure that the design of the Transitway does not restrict the future flexibility of the system.

4.2 CROSS-SECTION

The standards indicate the various cut and fill arrangements developed for common situations. The designer shall consider economics, physical constraints, ease of maintenance, and property requirements in determining the appropriate cross-sectional elements.

4.2.1 Cross-Section – Rural

Figures 4.2.1a and 4.2.1b provide details of typical rural cross-sections.

Standard Transitway lane widths are 3.50m each with a full depth paved offset of 0.25m.

Shoulders are required for maintenance vehicles and disabled buses and shall be 2.50m in width. Shoulder roundings shall be 1.0m. Granular shoulders are acceptable except in situations where pavement drainage may be an issue (i.e. superelevated and sag profile sections). The desirable fore-slope is 3:1 for maintenance purposes. The designer shall review roadside safety warrants and adjust the fore slope as required.

The desirable back slope for cut sections in earth is 4:1 (four horizontal to one vertical) where there is available Transitway corridor width. Where there is a limited Transitway corridor side slopes shall be no steeper than 2:1 provided that low maintenance groundcovers and landscaping are provided. For grass maintenance, a maximum side slope of 3:1 is desirable.

The preferred offset from sectional features such as ditches, etc. to the right-of-way limit is 1.5m.

The designer should coordinate grading to accommodate any multi-use pathway requirements. Refer also to Section 9.0 – “Interface with Pedestrian and Cycling Networks”.

4.2.2 Cross-Section – Urban

Refer to Figures 4.2.2a and 4.2.2b for typical urban cross-sections.

Standard Transitway urban lane widths are 3.50m plus a curb offset of 0.50m.

An asphalt maintenance strip, 2.5m minimum width, is provided adjacent to the curbs for maintenance vehicles, disabled buses and snow storage. Where the Transitway is constrained at

critical locations (i.e. structures) the maintenance strip width may be reduced to 1.5m minimum with approval from OC Transpo. Any reduction in maintenance strip width shall be reviewed on a case-by-case basis. Stopping site distance requirements shall be reviewed in all cases.

The desirable side slopes, for both cut and fill sections in earth, are 4:1 (four horizontal to one vertical) where there is available Transitway corridor available. Where there is a limited Transitway corridor the side slopes shall be no steeper than 2:1 provided that low maintenance groundcovers and landscaping are provided. For grass maintenance, a maximum side slope of 3:1 is desirable. The designer shall coordinate slope grading with roadside safety requirements.

4.2.3 Station Platform Areas

Figure 4.2.3a provides details of the typical station platform area cross-section.

The Transitway platform lane widths are 3.50m (including curb offset). Transitway through lane widths are 4.00m plus a 1.00m offset to the face of the median barrier for snow storage and drainage.

The platforms are typically 55m in length and a minimum width of 6.0m. The length and width of the station platforms shall be confirmed with OC Transpo and is generally based on OC Transpo's projection of required bus stops, anticipated passenger volumes and shelter requirements. Platform widths in excess of 6.0m may be required depending on station functionality (i.e. center loading type platform arrangement). Smaller platform widths may be considered where property constraints exist but only upon approval of OC Transpo.

For grading requirements adjacent to platform areas refer to Section 4.2.1.

Platforms shall be of monolithic concrete construction with wire mesh reinforcement and steel faced curbs. Platform surfaces shall have a broom finish. Red coloured stamped concrete shall be placed into a formed recess; 500 mm in width, along the front edge behind the steel facing for the full length of the platform (refer to Figure 4.2.3b). Refer to the City of Ottawa Standard Details for the typical detail of the concrete platform and steel face curb. At depressed access to at-grade Transitway crosswalks, truncated dome panels shall be applied to the curb ramp.

Where prefabricated shelters are to be integrated into the platform design the concrete slabs shall be structurally designed in accordance with the Ontario Building Code.

To restrict unauthorized pedestrian crossings of the Transitway a concrete median barrier (i.e. standard Type "C" OPSD concrete barrier) with 1.2m high aluminum railing is required along the centerline through station areas. Figure 4.2.3c provides a typical station area median barrier aluminum rail.

Depressed curbs shall be provided in the vicinity of all platforms to provide access to the platform for maintenance vehicles and snow clearing equipment.

4.2.4 Platforms near At-Grade Intersections

For at-grade roadway crossings, platforms shall be incorporated at bus stops where designated by OC Transpo. In this case, the platform details are similar to those described under Section 4.2.3. At low volume bus stops the 2.2m x 3.5m concrete shelter bases per the City of Ottawa Standard Details shall be specified.

4.2.5 Ramp Sections

Figures 4.2.5a and 4.2.5b provide details for typical ramp cross-sections.

Single lane bus ramp widths shall be 4.75m minimum. Multiple lane ramps shall have 3.75m wide lanes. An urban section ramp shall have a curb offset of 0.25m added to each lane. For urban section ramps, mountable curbs and paved 2.5m wide maintenance strips should be included.

The designer should consider the use of ramps for maintenance vehicle access, as well as, Transitway design. Confirmation of appropriate lane widths should be undertaken using appropriate design vehicle turn template(s).

4.2.6 Transitway Auxiliary Turn Lanes

A standard turn lane width of 3.5m is required. If adjacent to a curb provide an additional 0.5m curb offset.

4.2.7 Pavement Widening

a) Transitway:

All curved sections of the Transitway shall include extra pavement widening where warranted.

Lane widening design values should be obtained from the current Ministry of Transportation of Ontario Manual Geometric Design Standards for Ontario Highways, “Table D3-2 Pavement Widening Values on Curves for Tractor-Semi-Trailer (WB-15) Vehicles”.

b) Ramps, Turning Roadways at Intersections:

Ramps or turning roadways at intersections should have widened lanes in accordance with the TAC Geometric Design Guide for Canadian Roads, “Table 2.3.7.1 Design Widths for Turning Roadways at Intersections, Design Traffic Condition “B”: Single Unit Truck”. However, the resulting design layout shall be checked using the appropriate bus design turn template.

4.2.8 Intersecting Roadways

The cross-sectional elements of intersecting roadways and/or railways shall be subject to the approval of the road and rail authority having jurisdiction in accordance with applicable design guidelines.

4.2.9 Clearances

Figure 4.2.9a, 4.2.9b and 4.2.9c provide typical dimensional information of buses currently in service including double decker, standard and articulated. The dimensional information is provided for the designer's reference during consideration of the various design elements particularly where there is any consideration of a reduction in any horizontal and vertical clearances. During the preliminary design phase the designer shall confirm with OC Transpo that the dimensional information as illustrated in the figures is current.

Minimum clearance dimensions for the structures are identified in Section 5.0, "Structures".

4.3 DRAINAGE

As with any urban drainage system, Transitway drainage systems are made up of two components, the Minor system and the Major system, each of which satisfies different objectives.

4.3.1 Minor and Major Drainage Systems

The design of the Minor Drainage System is the normal collection system for surface runoff and includes road gutters, storm sewer inlets, storm sewers minor swales, ditches and culverts. Its purpose is to provide for the safety of the travelling public, normal transit operations and the minimization of potential property damage by accommodating all of the runoff from the more frequent, less intense storms

The Major Drainage System is the route followed by storm runoff when the capacity of the Minor system is exceeded and must be designed to prevent excessive ponding, public hazards, or damage to buildings or property.

The design of both the Minor and Major drainage systems shall be developed based on the latest version of the "City of Ottawa Sewer Design Guidelines" and current design practice. The designer shall refer to sub-section 5.10 "Transitway Design Considerations" for specific design criteria related to Transitway facilities. Where a Transitway interfaces with a roadway or railway operated by another owner, the design of drainage facilities shall conform to the more stringent standard. The drainage design shall satisfy the requirements of OC Transpo and other approval authorities including but not limited to roadway or railway authorities, City of Ottawa, Local Conservation Authority, Ministry of Environment and the Department of Fisheries and Oceans.

The designer shall refer to "City of Ottawa Sewer Design Guidelines", Section 5.10 for Transitway specific design criteria.

4.3.2 Storm Water Management

In undertaking the design of any Transitway project, the minor and major drainage systems must fit within the broader context of storm water management.

Storm water management comprises the planning, analysis, design and construction of stormwater runoff control facilities to ensure protection from downstream flooding while sustaining or enhancing the environmental, aesthetic and recreational potential of the receiving watercourse.

Particular attention must be made to the provision for storm water management facilities at the early stages of any project, as these may have a significant impact upon the property requirements of the Transitway corridor.

Transitway projects shall comply with the established storm water management policies or guidelines of the City of Ottawa, Federal, Provincial and/or other regulatory agencies. The designer shall comply with the requirements of the "City of Ottawa Sewer Design Guidelines". In general, the post development runoff levels shall not exceed pre-development levels in terms of quantity and quality nor shall the receiving watercourse be negatively impacted. To comply with these principles, mitigation measures must be addressed to offset any impacts related to runoff and conveyance of stormwater discharge from the Transitway corridor. The designer shall ensure that common goals are established and met in consultation with the City of Ottawa and that facilities are shared where appropriate in conjunction with master drainage plans and site servicing plans. Where shared facilities are not possible standalone stormwater management facilities will be established in conjunction with the Transitway project.

4.4 SAFETY AND SECURITY MEASURES

4.4.1 Right-of-way Fencing

The designer shall review the warrants for right-of-way security fencing in consideration of such criteria as grading and drainage requirements, Transitway and station access restrictions, adjacent land use, community design plans, proximity of pedestrian and recreational uses including footpaths and multi-use paths, as well as, potential wildlife issues. The City of Ottawa fencing by-law shall be reviewed.

A 1.83m high black vinyl coated chain link security fence with top rail shall be used, as required, to provide pedestrian control, safety and corridor security.

Security fencing requirements and layout shall be reviewed and approved by OC Transpo during the preliminary design phase.

Where retaining walls are required, a suitable barrier, fence or handrail shall be incorporated in accordance with the Canadian Highway Bridge Design Code and Ontario Building Code as may apply. In general, the barrier or fence height shall be a minimum of 1.83m in height unless otherwise approved by OC Transpo.

Where required for maintenance purposes, a fence gate access shall be provided with suitable locking devices to prevent unauthorized use. The location of gates shall be confirmed with OC Transpo. Locking devices will be installed by OC Transpo.

4.4.2 Pedestrian Control Fencing/Railings

Pedestrian access within the Transitway corridor and at stations may be controlled by the following:

- Along through Transitway lanes at station platform areas a centerline median barrier and aluminum pedestrian handrail shall be provided (refer to Figures 4.2.3a and 4.2.3b).
- To direct pedestrians to platform areas and discourage access through landscaped plant beds, etc. pedestrian pipe handrails or fencing may be utilized as may be appropriate for the situation.
- Railings required for protection along the top of a retaining wall shall be designed in compliance with the Ontario Building Code. Selection of barrier material, design of barrier and height shall meet appropriate codes and shall be designed to meet local site conditions and vehicle impacts where applicable.

4.4.3 Traffic Barriers

Traffic barriers shall conform to the current Ministry of Transportation Ontario warrants and guidelines (refer to the Ministry of Transportation - Roadside Safety Manual) and Ontario Provincial Standard Details.

In general and wherever possible, the designer shall make every effort to accommodate designs that preclude the use of guiderail. This may be accomplished by measures such as ensuring roadside obstacles are located outside of the clear zone and ensuring fully recoverable slopes including flattening of embankment slopes.

Where traffic barriers are warranted they shall be designed in accordance with Roadside Safety Manual and Ontario Geometric Design Guide for Canadian Roads. Proper end treatments shall be incorporated.

4.5 PAVEMENT STRUCTURE

Outside station platform areas, the Transitway pavement structure shall be of a flexible (asphalt) pavement design unless otherwise approved by OC Transpo.

Within station areas a concrete pavement structure shall be incorporated within, at a minimum, the limits of the concrete platforms. Figure 3.6.2 illustrates the approximate limits for concrete pavement for a typical side loading station. For major stations with center loading platforms, the designer will review the concrete pavement limits on a case by case basis based on the station layout, bus access and operational requirements.

The pavement structure(s) shall be based on the recommendations of a geotechnical consultant and based on the City of Ottawa's current pavement design practices. At locations where there will be consistent tight bus turns (i.e. access ramps and lay-bys) the geotechnical consultant shall consider localized pavement designs that will mitigate potential pavement sliding or rutting issues.

Factors such as bus volume projections, design vehicles, subgrade conditions, environmental effects, availability of acceptable construction materials, performance of similarly loaded pavements in the area, and economics shall be considered in determining a suitable pavement design.

The influence of heavy equipment and delivery vehicles during construction should also be a consideration during the design process, particularly with respect to the thickness of sub-base material and the native subgrade conditions.

4.6 PAVEMENT MARKINGS AND SIGNAGE

Pavement markings, regulatory signage and warning signage shall be designed to comply with the Ontario Traffic Manual.

Signage design shall include but not be limited to the following:

- Maximum operating speeds
- Cautionary operating speeds
- Stop and Yield conditions
- Warning signage changes in roadway geometry
- Advanced Warning Signs (intersections, merges, signals)
- Transitway entry prohibitions
- Bicycle and private vehicle prohibitions
- Pedestrian prohibitions

The designer shall review available OC Transpo guidelines for information signage for incorporation into the design where appropriate.

Pavement markings for the Transitway are to be consistent with those required for City of Ottawa arterial roadway requirements.

The designer shall produce detailed pavement marking and signage drawings for the Transitway and associated ramps, lay-bys, etc., in accordance with OC Transpo and/or City of Ottawa procedures and practices. The designer shall submit the drawings to the City of Ottawa and OC Transpo for review and approval.

4.7 TRAFFIC SIGNAL CONTROL AND COMMUNICATION DUCTS

The designer shall coordinate all traffic signal control requirements required for at-grade crossings and connections with the City of Ottawa. The designer shall incorporate into the design all traffic control signals plant requirements, advance in-pavement detector loops, other bus identification devices and interconnecting ductbanks as identified by the City of Ottawa.

Two 100mm communications ducts are required throughout the Transitway system and shall be placed under the maintenance strip adjacent to the curb line in urban cross-sections and under the

maintenance strip in rural cross-sections. The communications ducts shall be continuous throughout the length of the Transitway through structures and shall interconnect to communications backboards in transit stations and kiosks. Handholes shall be placed at a maximum spacing of 90m, at all major directional changes and on each side of all pavement crossings. Stub ends at the limits of contracts shall be marked for future extension.

Where handholes are within granular shoulders a 2.0m x 2.0m surround of asphalt (90 mm depth) shall be applied to protect the frames and covers from damage during winter snow clearing operations.

The communication ducts are normally placed on the south or east side of the Transitway, however, the exact location shall be confirmed with OC Transpo. Refer to Figures 4.2.1a, 4.2.1b, 4.2.2a, 4.2.2b and 4.2.3a.

4.8 UTILITIES

To facilitate coordination, the various utilities and service providers shall be consulted at the appropriate stages of design to obtain information on existing utility plant, identify conflicts and relocation requirements and obtain requirements for new utility plant. The designer shall prepare a composite utility plan illustrating the existing plant, the utility relocation requirements and proposed new plant.

Generally, the location of new and relocated utilities shall be outside the Transitway right-of-way limits. Surface iron works shall not be permitted on the travelled portion of the Transitway. Under crossings of the Transitway pavement shall be minimized or avoided, where possible, particularly in sensitive soil conditions.

Utility relocations and new utility layout within the Transitway corridor is subject to the review and approval of OC Transpo.

A list of utility agencies (including contact information) is available from the City of Ottawa Utility Coordinator.

Circulations during preliminary and detailed design stage shall be conducted in accordance with the City of Ottawa utility circulation procedures.

4.9 FIGURES

The designer shall refer to the following figures as referenced in above sub-sections:

Figure 4.2.1a: TYPICAL TRANSITWAY RURAL FILL SECTION

Figure 4.2.1b: TYPICAL TRANSITWAY RURAL CUT SECTION

Figure 4.2.2a: TYPICAL TRANSITWAY URBAN CUT SECTION – CLOSED DRAINAGE

Figure 4.2.2b: TYPICAL TRANSITWAY URBAN SECTION – RESTRICTED ROW

Figure 4.2.3a: TYPICAL SECTION AT STATION PLATFORM

Figure 4.2.3b: PLATFORM – RED STAMPED CONCRETE

Figure 4.2.3c: TYPICAL SECTION AREA ALUMINUM RAIL

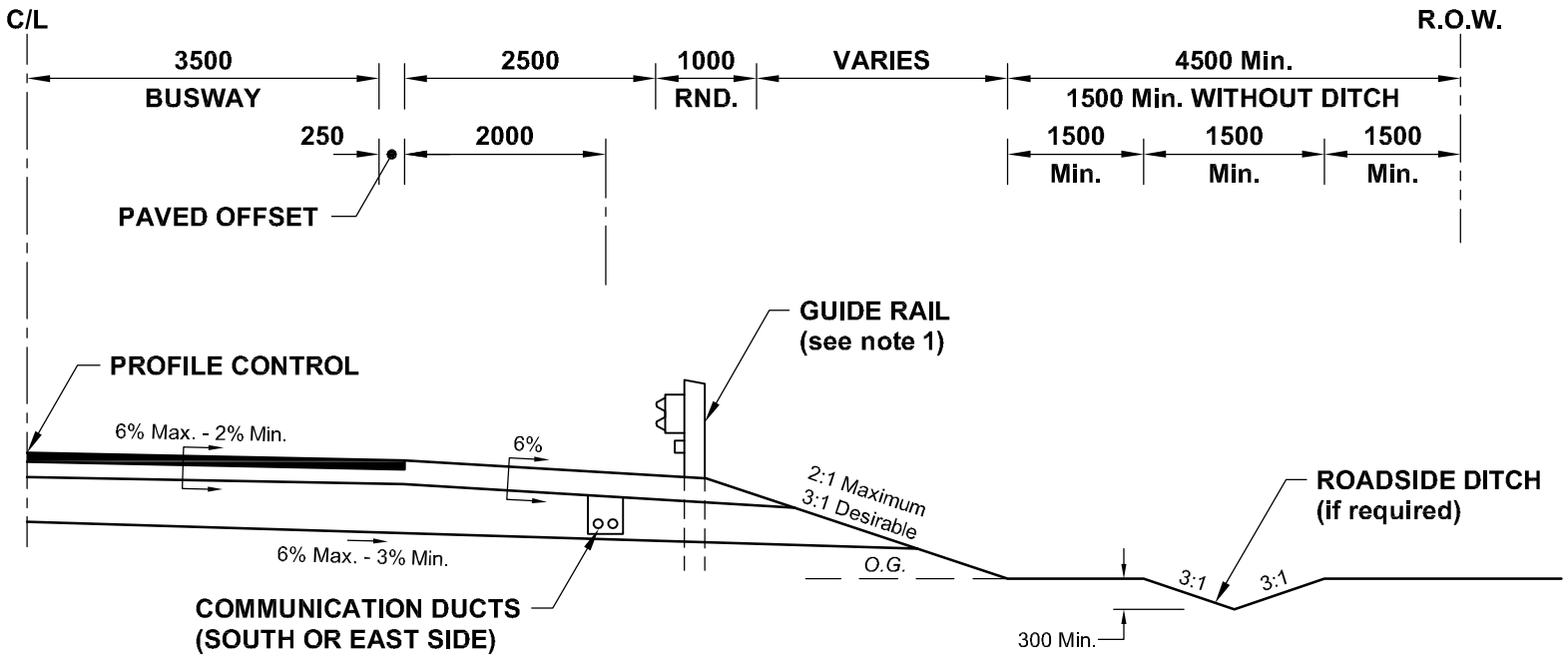
Figure 4.2.5a: TYPICAL RAMP RURAL SECTION – SUPERELEVATED

Figure 4.2.5b: TYPICAL RAMP URBAN SECTION – SUPERELEVATED

Figure 4.2.9a: TYPICAL BUS DIMENSIONS – DOUBLE DECKER

Figure 4.2.9b: TYPICAL BUS DIMENSIONS – STANDARD

Figure 4.2.9c: TYPICAL BUS DIMENSIONS - ARTICULATED

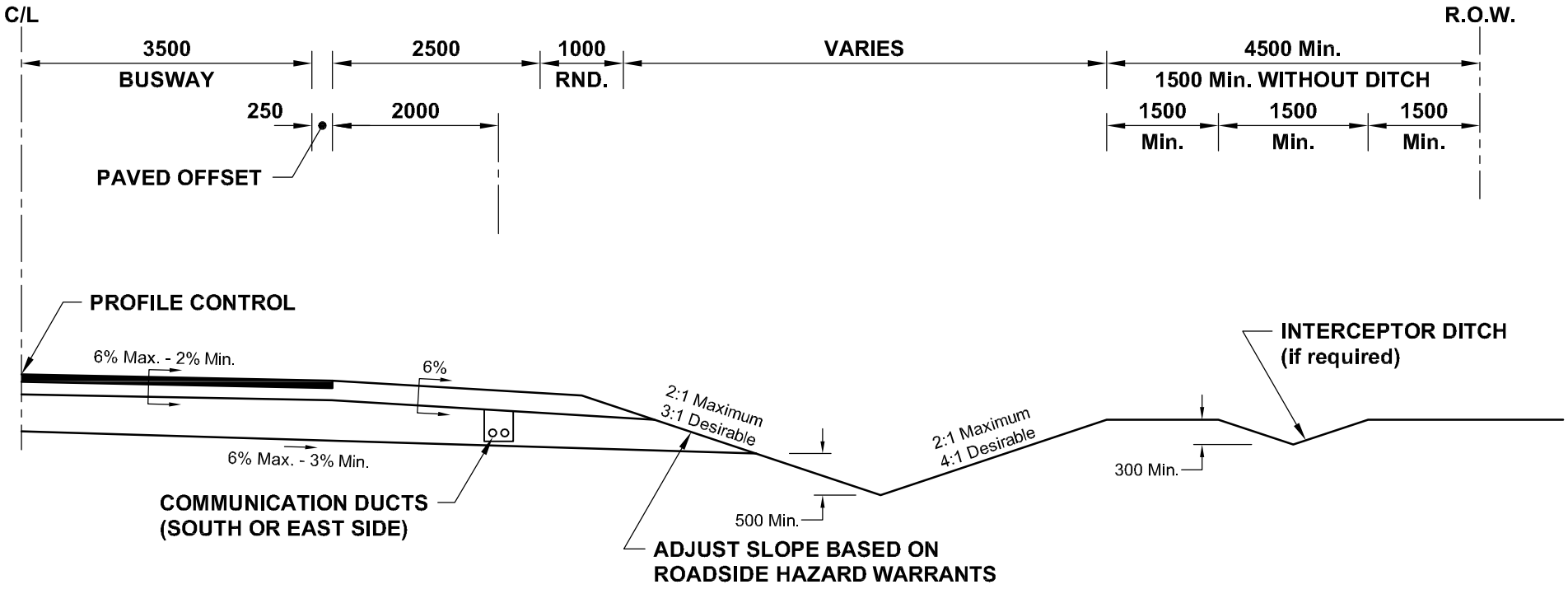


NOTES:

1. Guide rails required where warranted. Utilize slope flattening to avoid guide rails where possible.

2. All dimensions are in millimetres.

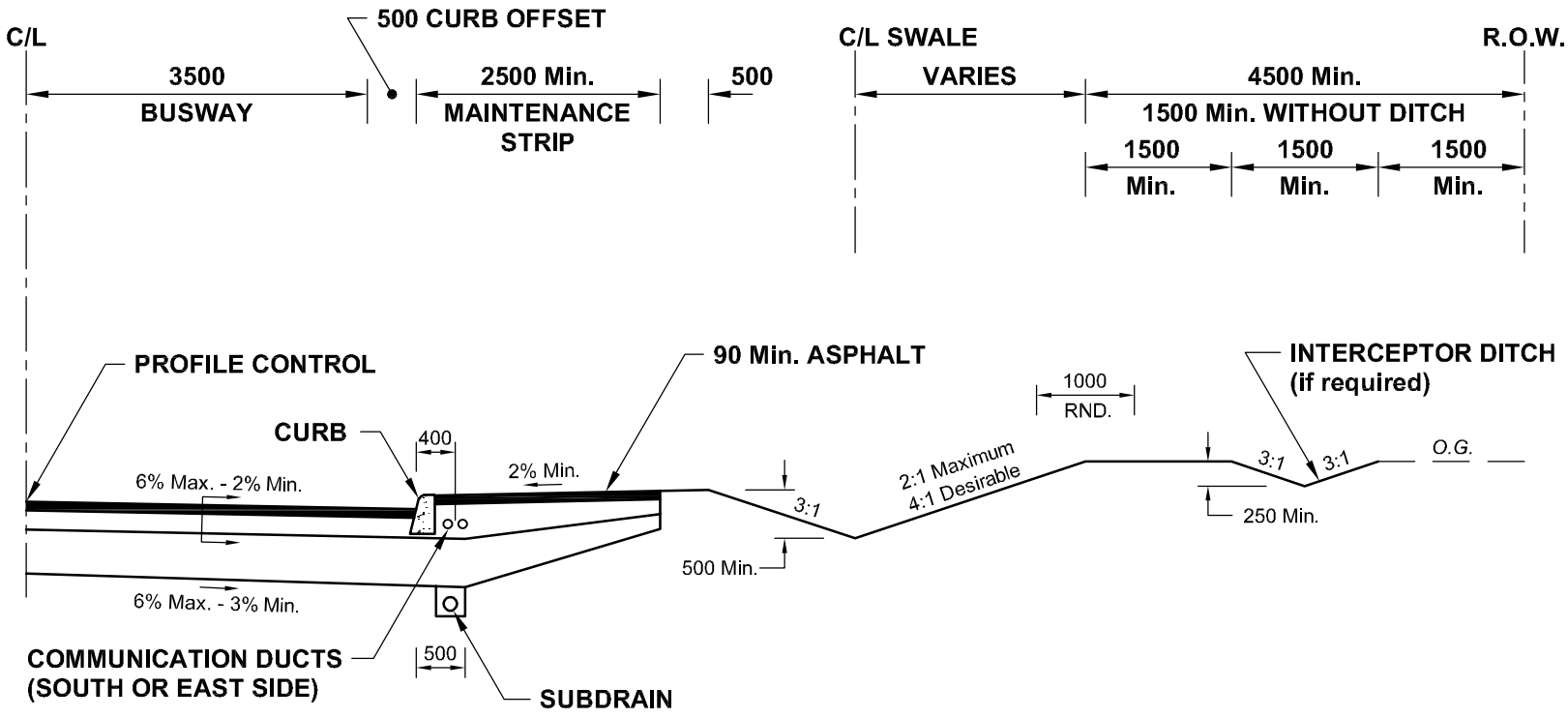
Ottawa / OC Transpo	**TYPICAL TRANSITWAY RURAL FILL SECTION**	Scale: N.T.S. / Date: May 2012 / Revision No. / Date
	TRANSITWAY AND STATION DESIGN GUIDELINES	**Figure 4.2.1a**



NOTE:

1. All dimensions are in millimetres.

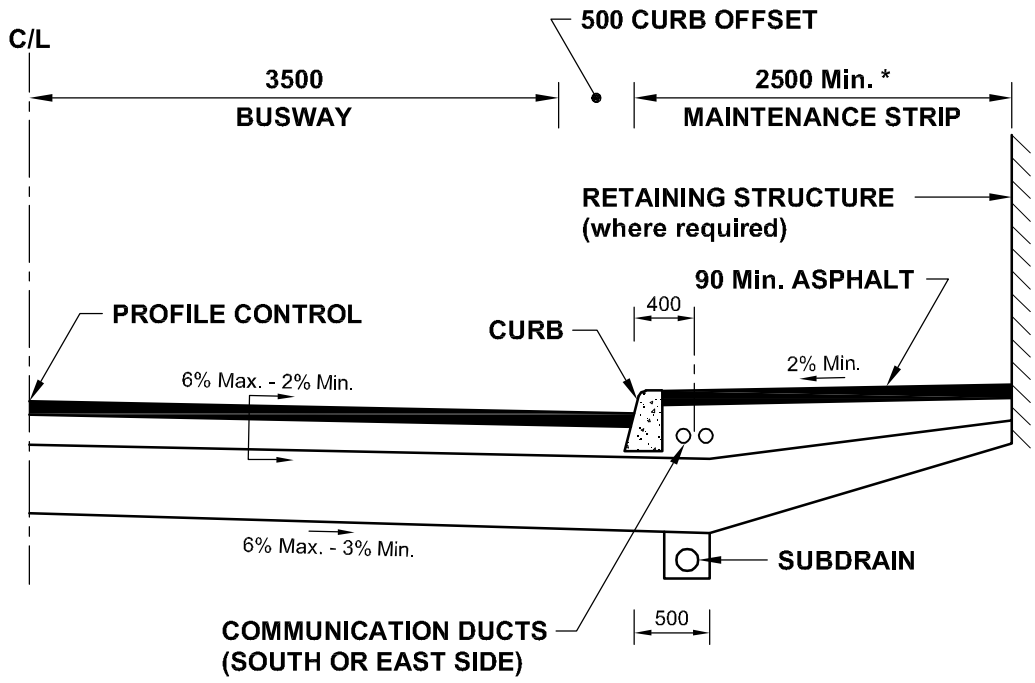
Ottawa / OC Transpo	**TYPICAL TRANSITWAY RURAL CUT SECTION**	Scale: N.T.S.	Date: May 2012
		Revision No. / Date	
	TRANSITWAY AND STATION DESIGN GUIDELINES		**Figure 4.2.1b**



NOTE:

1. All dimensions are in millimetres.

Ottawa / OC Transpo	**TYPICAL TRANSITWAY URBAN CUT SECTION CLOSED DRAINAGE**	Scale: N.T.S. Date: May 2012 Revision No. / Date
	TRANSITWAY AND STATION DESIGN GUIDELINES	**Figure 4.2.2a**

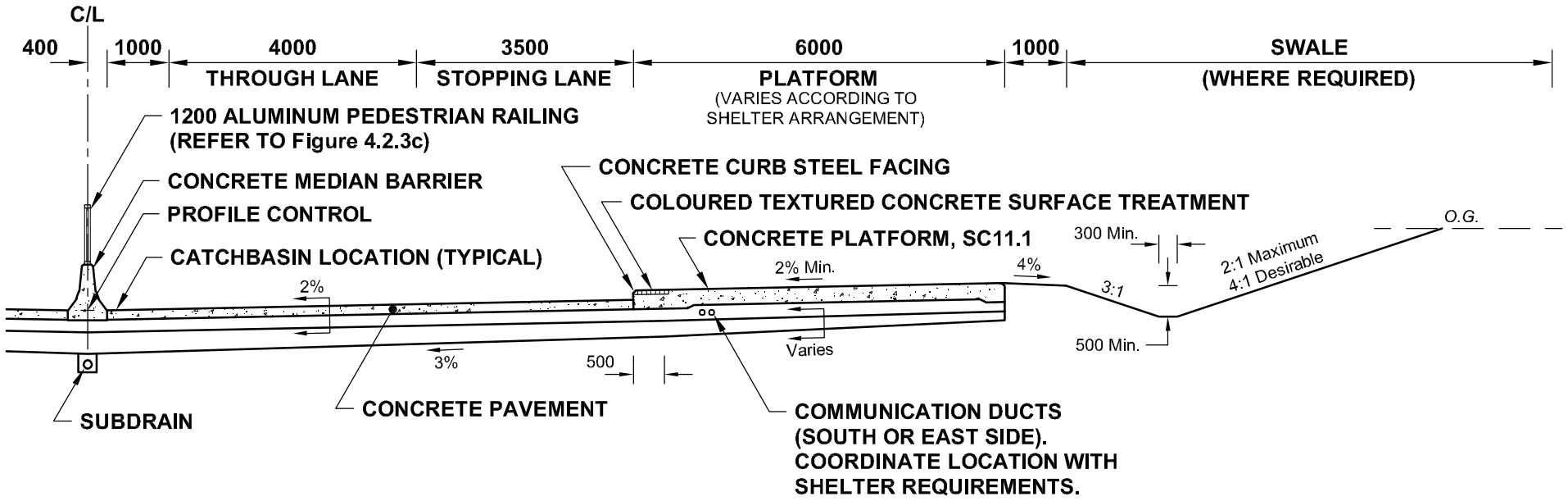


* Maintenance strip width may be reduced only upon approval of OC TRANSPO.

NOTE:

1. All dimensions are in millimetres.

Ottawa / OC Transpo	**TYPICAL TRANSITWAY URBAN SECTION RESTRICTED R.O.W.**	Scale: N.T.S. / Date: May 2012 / Revision No. / Date
	TRANSITWAY AND STATION DESIGN GUIDELINES	**Figure 4.2.2b**

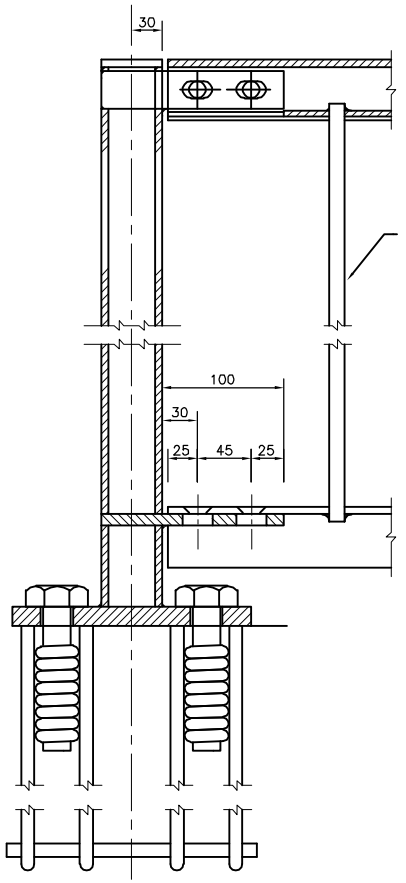


NOTE:

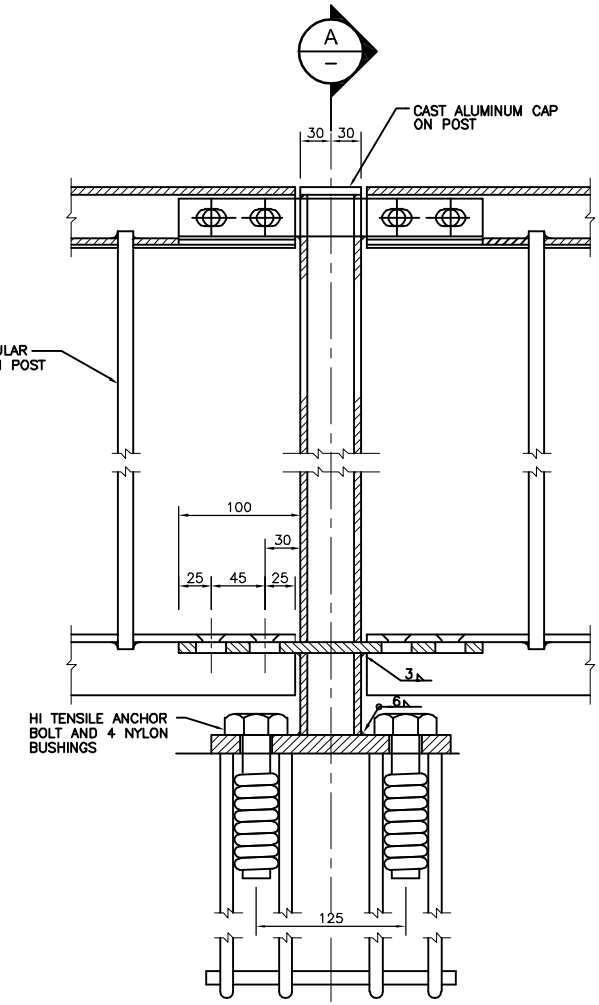
1. All dimensions are in millimetres.

Ottawa / OC Transpo	**TYPICAL SECTION AT STATION PLATFORM**	Scale: N.T.S.	Date: May 2012
		Revision No. / Date	
	TRANSITWAY AND STATION DESIGN GUIDELINES		**Figure 4.2.3a**

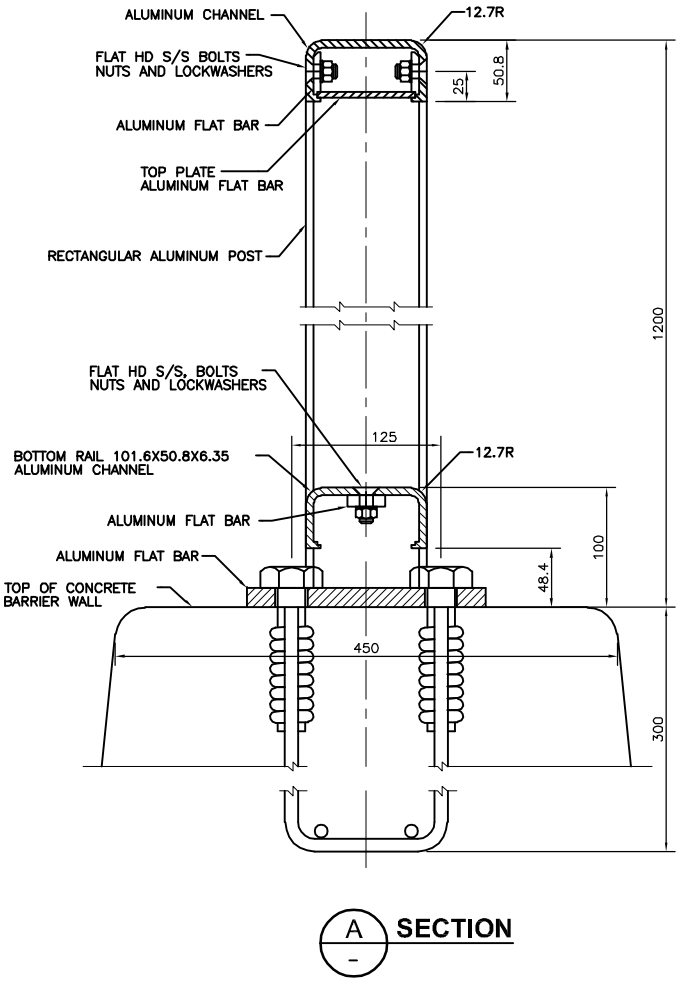
Ottawa OC Transpo	**PLATFORM – RED STAMPED CONCRETE**	*Scale* **N.A.**	*Date* **May 2012**
		Revision No./Date	
	TRANSITWAY AND STATION DESIGN GUIDELINES	**Figure 4.2.3b**	



DETAIL AT END POSTS



DETAIL AT INTERMEDIATE POSTS

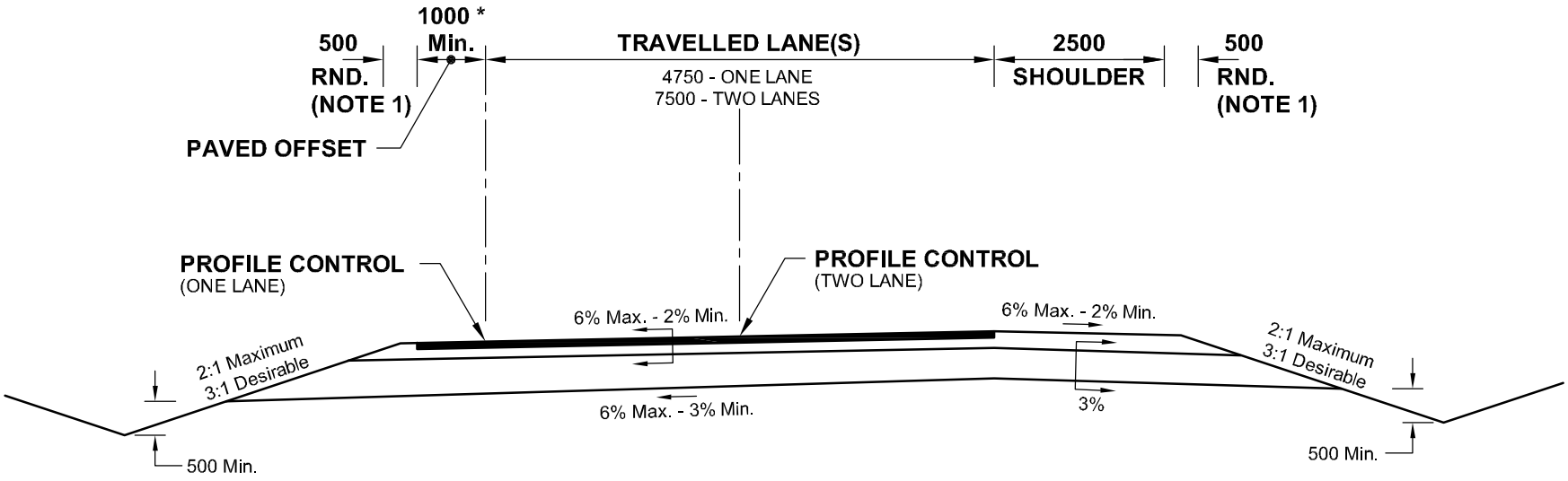


A SECTION

NOTE:

1. All dimensions are in millimetres.

Ottawa / OC Transpo	**TYPICAL STATION AREA ALUMINUM RAIL**	Scale: N.T.S.	Date: May 2012
		Revision No. / Date	
	TRANSITWAY AND STATION DESIGN GUIDELINES		**Figure 4.2.3c**

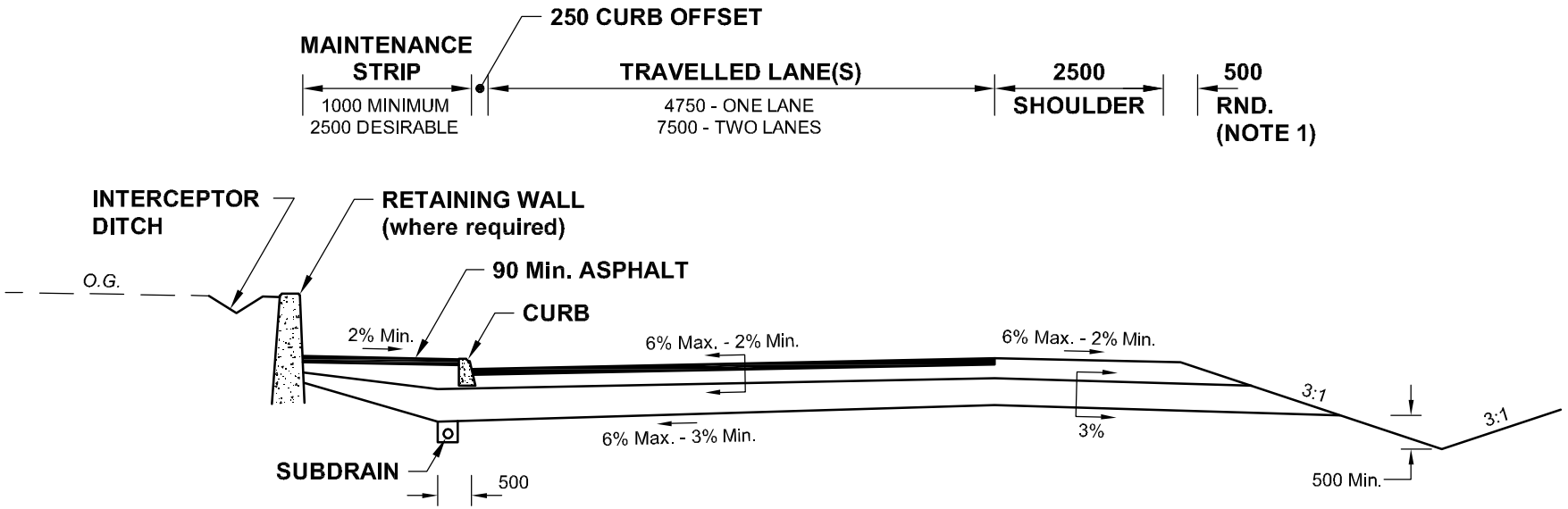


* This width varies according to radius of horizontal curve.

NOTES:

1. Where guide rail is required, width of rounding shall be 1000.
2. All dimensions are in millimetres.

Ottawa / OC Transpo	**TYPICAL RAMP RURAL SECTION SUPERELEVATED**	Scale: N.T.S. / Date: May 2012 / Revision No. / Date
	TRANSITWAY AND STATION DESIGN GUIDELINES	**Figure 4.2.5a**



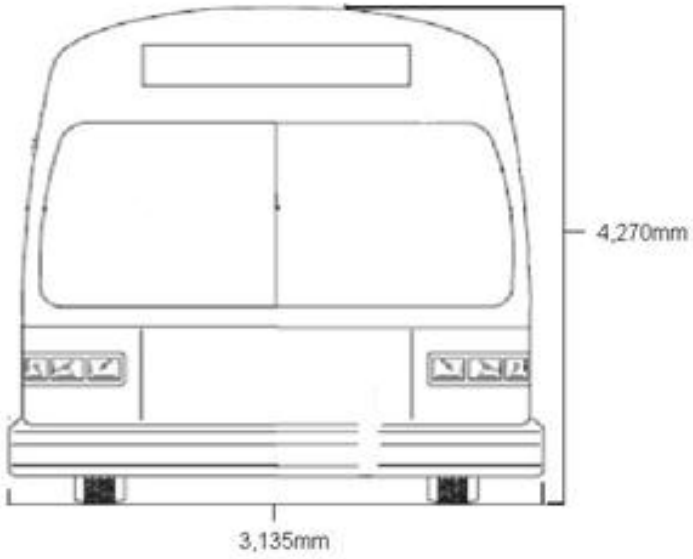
NOTES:

1. **Where guide rail is required, width of rounding shall be 1000.**
2. **All dimensions are in millimetres.**

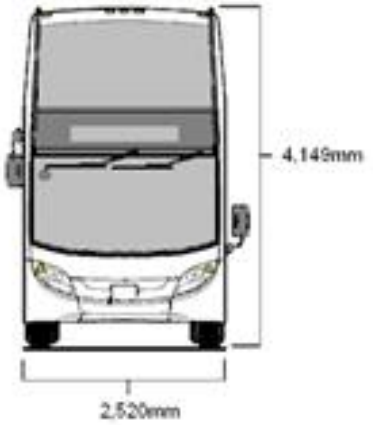
Ottawa / OC Transpo	**TYPICAL RAMP URBAN SECTION SUPERELEVATED**	Scale: **N.T.S.** Date: **May 2012** Revision No. / Date:
	TRANSITWAY AND STATION DESIGN GUIDELINES	**Figure 4.2.5b**

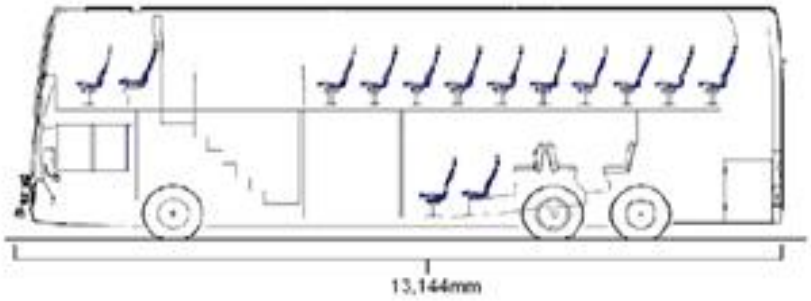
Maximum Double Decker Bus Dimensions

Maximum Bus Dimensions



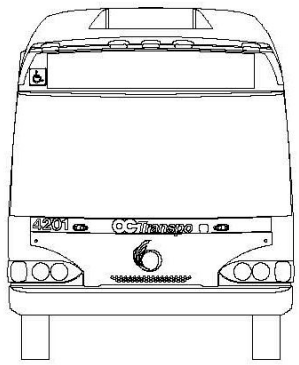
Length	18,500mm
Width	3,135mm
Height	4,270mm



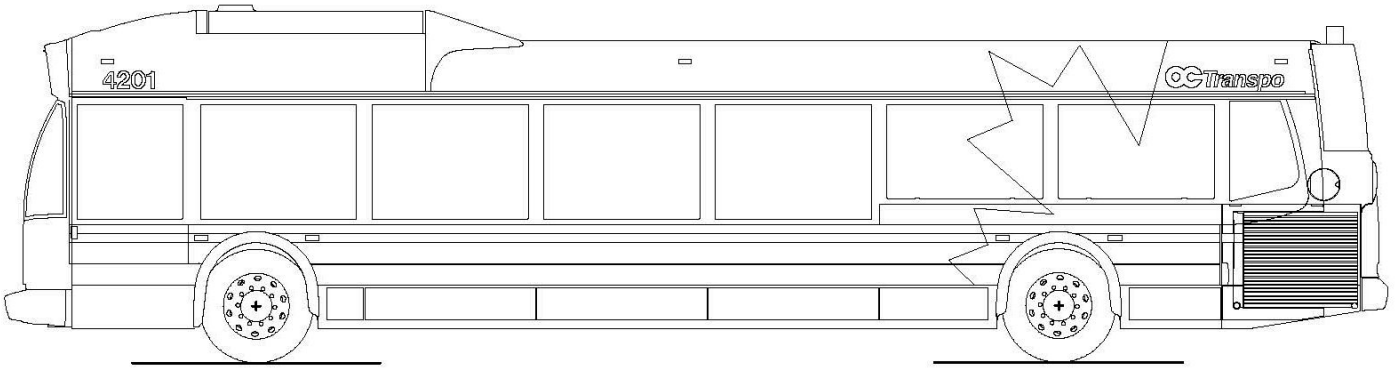


Note: Width does not include mirror overhang

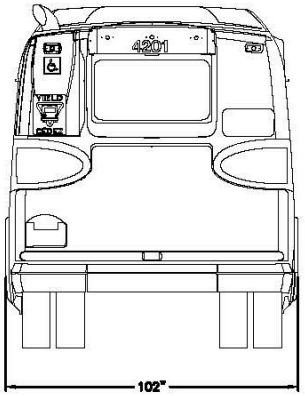
Ottawa OC Transpo	**TYPICAL BUS DIMENSIONS – DOUBLE DECKER**	*Scale* **N.A.**	*Date* **May 2012**
		Revision No./Date	
	TRANSITWAY AND STATION DESIGN GUIDELINES	**Figure 4.2.9a**	



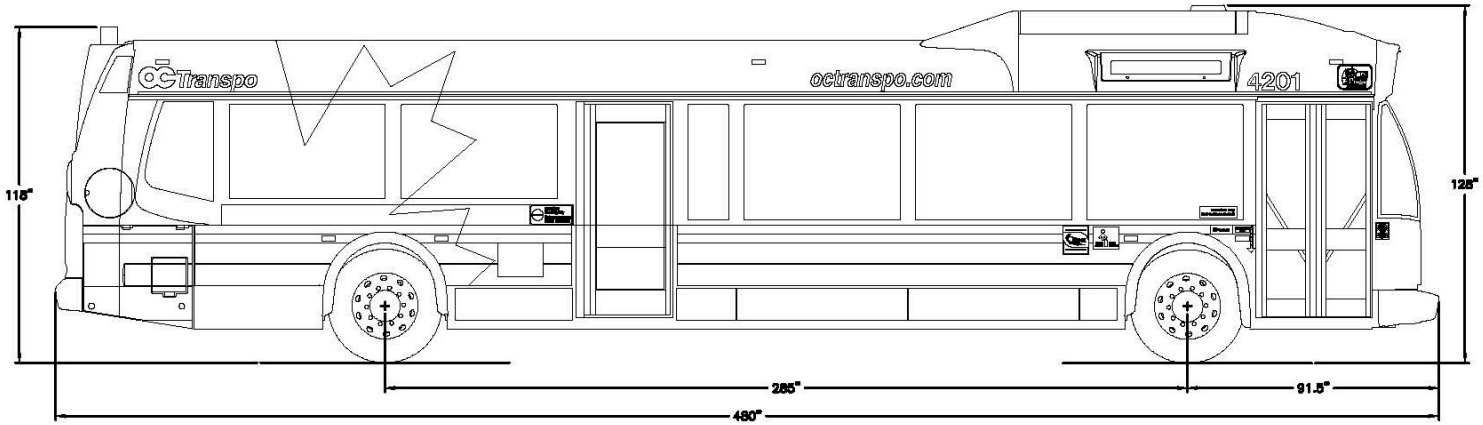
FRONT



STREET SIDE



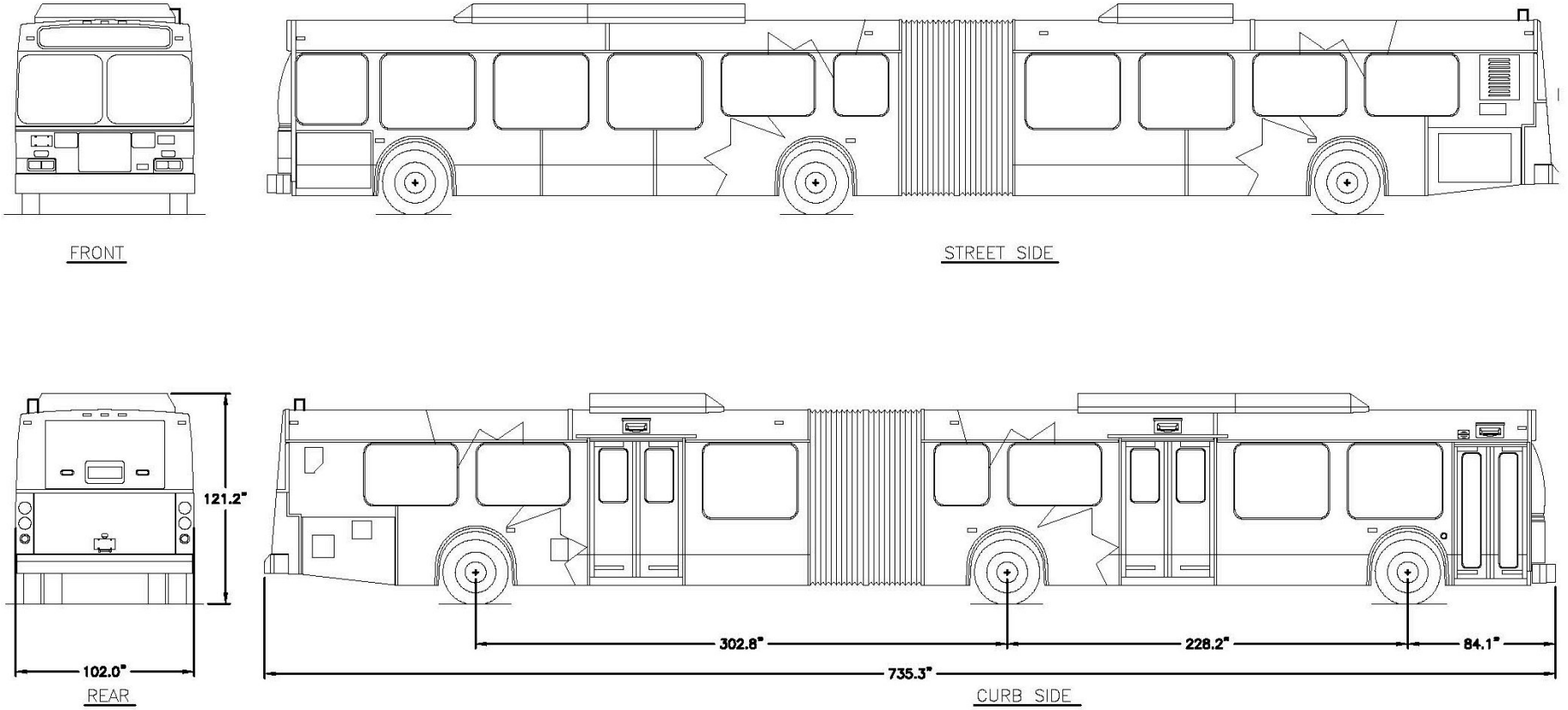
REAR



CURB SIDE

Note: Width does not include mirror overhang

Ottawa OC Transpo	**TYPICAL BUS DIMENSIONS - STANDARD**	*Scale* **N.A.**	*Date* **May 2012**
		Revision No./Date	
	TRANSITWAY AND STATION DESIGN GUIDELINES	**Figure 4.2.9b**	



Note: Width does not include mirror overhang

Ottawa OC Transpo	**TYPICAL BUS DIMENSIONS - ARTICULATED**	*Scale* **N.A.**	*Date* **May 2012**
		Revision No./Date	
	TRANSITWAY AND STATION DESIGN GUIDELINES	**Figure 4.2.9c**	

5.0 STRUCTURES

5.1 GENERAL

5.1.1 Introduction

These guidelines are to be used for the design of Transitway structures, bridges, culverts and retaining walls. These structures shall be designed in accordance with the current edition of the Canadian Highway Bridge Design Code (CHBDC). Unless otherwise designated by the City of Ottawa Transitway bridges shall include provisions for conversion to future Light Rail Transit (LRT). The designer shall obtain the current Ottawa LRT design criteria from the City of Ottawa to confirm requirements for future conversion to light rail. The designer shall undertake the bridge design to accommodate future light rail as defined by the City's LRT design criteria and in accordance with the current version of the Manual for Railway Engineering Volume 2 Structures (AREMA).

This section does not include design guidelines for vehicular and pedestrian bridges crossing the Transitway. The design of these bridges is governed by the relevant road authority design criteria and the CHBDC.

5.1.2 Scope

This section sets out guidelines for the design of Transitway structures excluding culverts with spans of 3.0 m or less.

The standards set forth are minimum requirements which are consistent with current practice.

For items not specifically covered in this section, the current editions of the supplemental codes/guidelines listed in Section 5.2 shall be referred to for the design of Transitway structures. Any deviation from current practice, codes and guidelines shall be subject to the approval of the City of Ottawa and OC Transpo.

5.2 SUPPLEMENTAL CODES

5.2.1 Transitway Structures, Pedestrian Structures, and Retaining Walls

a) CAN/CSA–S6-06 Canadian Highway Bridge Design Code (CHBDC) latest edition, including S6S1-10 Supplement No.1

b) ACI 358 – IR – 92 Analysis and Design of Reinforced Concrete Guideway Structures, latest edition

c) Ministry of Transportation Ontario (MTO) Structural Design Manual, latest edition

5.2.2 Stations and Related Structures

a) Ontario Building Code (OBC), latest edition

5.2.3 Light Rail Transit Design Requirements

a) Ottawa Light Rail Transit Design Criteria, obtain current design criteria from City of Ottawa, and,

b) AREMA Manual for Railway Engineering, latest edition

5.3 GENERAL PROVISIONS

5.3.1 Design and Analysis

Structures shall be designed in accordance with the CHBDC. Detailed rational methods of analysis and design are preferred. The method of Ultimate Limit (ULS) States Design shall be followed with Serviceability Limit States (SLS) followed for vibration and ride comfort criteria. These shall be subject to the approval of the City of Ottawa.

5.3.2 Conversion of the System

Unless otherwise designated by the City of Ottawa, Transitway structures shall be designed both functionally and structurally to accommodate future conversion to light rail operations. In the design of superstructure cross-sections, consideration should be given to aligning the centerlines of webs of primary members of girder type structures with the future LRT rail locations.

5.4 GENERAL FEATURES

5.4.1 Structure Cross-Section

Transitway structure deck cross-sections shall conform to Figure 5.4.1.

5.4.2 Structure Clearances

a) Clearance Under and Over Roads and Railways:

Horizontal and vertical clearances for structures over the Transitway shall conform to Figure 5.4.2a.

Horizontal and vertical clearances for Transitway structures over roads shall conform to the CHBDC.

Clearances and construction clearances for Transitway bridges over railways shall conform to the requirements of Transport Canada's Standards Respecting Railway (latest edition) and/or the applicable railway authority.

Construction clearances for Transitway bridges over roadways shall conform to the requirements of the City of Ottawa. Where no special requirements are imposed, the clearances shown on Figure 5.4.2b shall apply.

b) Navigational clearance:

Navigational clearance, if applicable, shall conform to the requirements of the authority having jurisdiction over the waterway and Transport Canada's Navigable Waters Protection Act (NWPA). The water level for navigational clearance shall be the maximum water level expected during navigation season.

c) Hydraulic clearance:

Hydraulic clearance shall comply with the requirements of the authority having jurisdiction over the waterway (i.e., local Conservation Authority) and shall be in accordance with the CHBDC. The Transitway shall be considered as an arterial road with respect to CHBDC hydraulic requirements.

5.4.3 Barriers and Railings

All traffic barriers and pedestrian safety railings on bridges shall be designed in accordance to CHBDC.

All Transitway bridges shall be provided with an 825mm high solid concrete barrier surmounted by a 225mm high galvanized pedestrian rail on the outside edge of the shoulder as illustrated on Figure 5.4.1.

The concrete barriers shall be designed to accommodate the future provision of security fencing or noise attenuation panels to a height of 1000mm above the top of the barrier.

If the Transitway bridge is to include a sidewalk or multi-use pathway, the exterior railing shall consist of an aluminum pedestrian barrier as generally illustrated on Figure 5.4.1a and shall meet the following height requirements:

- For sidewalks, height of barrier: 1.05m
- For multi-use pathways, height of barrier: 1.37m

Where local conditions warrant for the protection and/or safety of the Transitway, barriers on the outer edges of roadway and pedestrian overpass structures may consist of a combination of 825mm high concrete parapet wall with an inwardly curved chain-link fence providing an overall height of 2400mm. Requirements for fencing on bridges shall be reviewed on a case-by-case basis with the City of Ottawa and OC Transpo.

5.4.4 Deck

All Transitway bridges shall have concrete decks unless otherwise approved by OC Transpo and the City of Ottawa. The minimum compressive strength of concrete in decks shall be 35MPa.

All decks shall be protected by a waterproofing membrane complete with protection board and asphaltic concrete.

Unless otherwise designated by the City of Ottawa, Transitway bridges shall allow for direct fixation of future LRT rail on continuous concrete pads, constructed directly on the deck without ballast. The designer shall confirm these requirements based on a review of the current City of Ottawa LRT Design Criteria. For example, the designer shall consider:

- Location of longitudinal reinforcement and pre-stressing ducts shall not to be placed within 0.2m of the top of the deck and within 0.25m of the centerline of the future rail locations. Shrinkage reinforcement shall still be placed in this area.
- Deck voids should not be placed directly below the locations of future LRT rails.

5.4.5 Reinforcing steel

Epoxy coated bars shall be specified as defined in the MTO Structural Manual. Stainless steel bars shall be specified in locations that are highly vulnerable to salt-induced corrosion such as sidewalks, parapet walls and barrier walls.

Subject to the approval of the City of Ottawa Glass Fibre Reinforced Polymer (GFRP) reinforcement may be specified in sidewalks, parapet walls and barrier walls in accordance with Section 16 of the CHBDC and the MTO Structural Design Manual.

5.4.6 Drainage

A minimum transverse slope of 2% and a minimum longitudinal grade of 0.5%, unless precluded by vertical curves, shall be provided on bridge decks. Longitudinal drainage shall be to deck drains. The spacing and location of the deck drains shall be established by a hydraulic analysis to prevent surface water from intruding into the lanes beyond acceptable limits. A system of leads shall be required to direct discharge away from roads, sidewalks and bikeways.

There shall be no direct discharge to a watercourse. Drainage shall be conveyed to the Transitway drainage system outside of the structure limits.

5.4.7 Embedded Work in Structure

Provision shall be made in the design to incorporate the embedded ductwork, junction boxes and pole anchorages, etc. to accommodate the requirements of the various utilities, roadway lighting and communications.

5.4.8 Joints

Deck joints over intermediate piers are not permitted without the approval of the City of Ottawa. The maximum allowable continuous length of superstructure span shall be based on the acceptable characteristics of thermal behaviour of the entire structure including its interaction with the continuous welded rail tracks assumed for the future LRT rail system.

Where structurally and geotechnically feasible, integral abutment or semi-integral abutment bridges should be considered.

No open deck joints shall be permitted. All expansion joint assemblies, whether fixed or expansion type, shall be Ministry of Transportation Ontario approved (i.e., Ontario Good Roads Association – Designated Sources List) expansion joint assemblies. Any other treatment of deck joints shall be subject to the approval of OC Transpo and the City of Ottawa.

5.4.9 Approach Slabs

Approach slabs shall be used at the ends of all bridges. Approach slabs shall be at least 6.0m long and 250mm thick with reinforcement as detailed in the Ministry of Transportation Ontario (MTO) Structural Manual or as otherwise designed based on geotechnical considerations. For skewed slabs, a 2.5m wide strip centered on the centerline of each future set of tracks shall be squared off to the centerline of the structure.

Grooves 20mm x 20mm shall be saw-cut in the asphalt above both ends of all approach slabs and then filled with hot poured rubberized sealing compound.

5.4.10 Structure Identification Numbers

The designer shall specify and identify the locations of structure identification numbers for all Transitway structures including overpasses, underpasses, retaining walls, stations and culverts. Structure identification numbers will be assigned by the City of Ottawa.

5.4.11 Maintenance and Inspection

Consideration shall be given to ensure that structures are designed and fitted with proper appurtenances to allow for ease of cleaning, inspection and future maintenance. Inspection walkways and safety railings are to be considered where appropriate and are subject to review and approval by the City of Ottawa.

5.4.12 Aesthetics

Care shall be taken to enhance the aesthetic composition of structures by the use of single columns, tapered columns, tapered fascia of superstructure and the like. Superstructures should be detailed so as to reduce the apparent total depth and to blend into the landscape.

Aesthetic relief shall be considered, subject to the approval of the City of Ottawa, on large expanses of exposed areas of abutments, retaining walls and wing walls in the form of a controlled formwork panel design with recessed panel joints and tie holes or other appropriate methods.

Structures shall be designed to minimize details such as ledges, projections or pockets that would collect debris or encourage bird roosting.

The coating of exposed concrete surfaces with an anti-graffiti type sealer shall be considered in areas where access by the public is possible.

5.5 LOADS

5.5.1 General

Transitway bridges shall be proportioned for all loads and forces that may be expected during their intended lives. The loads and forces listed in the following sections are for Transitway bridges without provision for future LRT. For load and force effects not listed in the following sub-sections, the CHBDC shall apply. Unless otherwise designated by the City of Ottawa provision shall be included for future LRT loads and forces. The designer shall obtain the current Ottawa LRT design criteria from the City of Ottawa to confirm requirements for loads and forces related to LRT. The most stringent design criteria shall govern the design.

5.5.2 Dead Load

The dead load shall include the weight of the wearing surface (if applicable) and an allowance for future track and supports as defined by current City of Ottawa LRT design criteria.

5.5.3 Snow Load

For the design of structures carrying station platforms and/or pedestrian bridges, snow load on the roofs shall be in accordance with the Ontario Building Code and shall be considered as a live load when combining loads and their factors at serviceability and ultimate limit states.

5.5.4 Live Load

All Transitway bridges shall be designed for live loads specified in CHBDC or applicable future LRT live loads as defined by current City of Ottawa LRT design criteria, whichever governs. The designer shall determine the most critical conditions of stress and stability at Ultimate (ULS) and Serviceability (SLS).

5.5.5 Thermal Effects

Both the seasonal (extreme temperature variations prevalent during construction) and local temperature fluctuations (temperature gradients within an element) shall be accounted for in determining the structural response to stress and movements. The designer shall refer to the current City of Ottawa LRT design criteria for thermal effects related to future rail/structure interaction.

5.5.6 Other Light Rail Transit Loads and Criteria

The designer shall obtain the current Ottawa LRT design criteria from the City of Ottawa to confirm requirements for loads and forces (i.e., longitudinal, hunting, centrifugal, derailment, etc.) for Transitway structures.

5.5.7 Earthquake

Transitway bridges shall be classified an emergency route bridge for seismic design purposes.

5.5.8 Loads on Appurtenant Structures

a) Public Areas:

Pedestrian live load on platforms, ramps, and stairways shall be 5.0kPa.

b) Maintenance Vehicle:

If a platform or ramp is greater than 3.0m in width and accessible to maintenance vehicles, the maintenance vehicle load specified in the CHBDC shall be considered on these areas. Maintenance vehicle loads shall only be considered at U.L.S.

5.6 LOAD APPLICATIONS

5.6.1 General

Unless otherwise designated by the City of Ottawa the designs shall include provision for future LRT. For bus only structures the application of live loads shall be in accordance with CHBDC. The designer shall obtain the current Ottawa LRT design criteria from the City of Ottawa. For structures where provision of future LRT conversion is designated the application of loads shall be in accordance with CHBDC or the City of Ottawa LRT design criteria, whichever governs.

5.6.2 Rail Loadings

The application of all specified rail loadings shall be such as to produce the maximum effects in the structure. Structures with single or multiple tracks shall be loaded with units of single or multiple train vehicles (VEW or VCW) such that flexure, shear and torsion effects are maximized along the structure. For flexure and shear effects, all tracks shall be loaded simultaneously by whole vehicle trains located to produce maximum effects. For torsion, on straight or curved structures, tracks shall be loaded to produce the maximum effect. Provision shall be made at piers or abutments to transfer the total torsional moments to the substructure.

5.6.3 Dynamic Effects

Rational methods of dynamic analysis allowing for the relationships between vehicle characteristics and mass damping and stiffness of bridges are preferred.

The dynamic load allowance for live load on bus only structures shall be determined in accordance with CHBDC. Where the structure is designated for future LRT conversion, the impact factor for live load shall be determined in accordance with the City of Ottawa LRT design criteria. The more stringent condition shall govern.

For spread footings and for piles that support footings, the dynamic load allowance shall not be considered as a design load.

5.6.4 Vibrations

The effects of bridge vibration shall be examined in a rational manner in order to ensure that structure serviceability and vehicle ride quality are satisfactory.

Bridges supporting station areas and pedestrian bridges shall be isolated from the main Transitway structure and carried on independent superstructures to reduce the effects of vibrations due to live loads.

In cases where the above is not possible, the structures shall be designed to satisfy the human tolerance levels to bridge vibrations as specified in the CHBDC.

5.6.5 Fatigue

Areas of stress fluctuations and section discontinuity such as connections etc. must be carefully analyzed for the effects of fatigue.

The effects of fatigue shall be considered at the fatigue limit state (FLS) in accordance with CHDBC for bus only loading and City of Ottawa LRT design criteria for light rail transit loading where the structure is designated for future conversion.

5.6.6 Long Term Effects

Dead load deflections, including time-dependent deformations such as shrinkage, creep, pre-stress losses, etc., shall be counteracted in full by appropriately cambering the structural elements.

5.7 LOAD COMBINATIONS AND LOAD FACTORS

Transitway live loads shall not be combined with the specified rail live loads. Load combinations and load factors given in the CHBDC shall be used except when analyzing the structure for rail or associated loads where future conversion to light rail is designated. Load combination and load factors given in the City of Ottawa LRT design criteria shall be used when rail live loads are being considered. The most critical force effects shall govern the design of the structure or structural components under consideration.

5.8 OTHER CONSIDERATIONS

Consideration should be given for inclusion of proposed and future recreational pathways, sidewalks and platforms to meet future development needs. To this end, review future

requirements with OC Transpo and review the City of Ottawa Cycling Plan, any local Community Development Plans (CDP) and TMP should be completed. Consultation with City Planners may also be required to identify future needs.

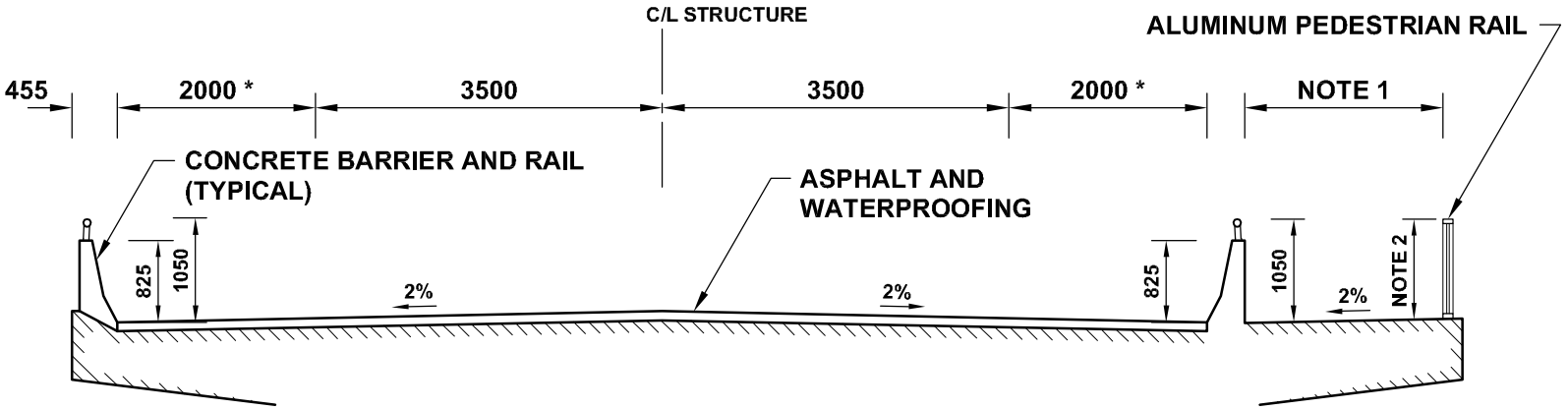
5.9 FIGURES

The designer shall refer to the following figures as referenced in above sub-sections:

Figure 5.4.1: TRANSITWAY BRIDGE – STANDARD CROSS SECTION

Figure 5.4.2a: TRANSITWAY OVERPASS CLEARANCES

Figure 5.4.2b: CONSTRUCTION CLEARANCES



NOTES:

1. Where required, sidewalk and recreational pathway minimum widths shall be as follows:

Sidewalks	2000mm
Multi-use Pathways	3000mm

2. Minimum Railing heights shall be as follows per CHBDC:

Sidewalks	1050mm
Multi-use Pathways	1370mm

3. All dimensions are in millimetres.

* Shoulder width may be reduced upon approval by OC TRANSPO.

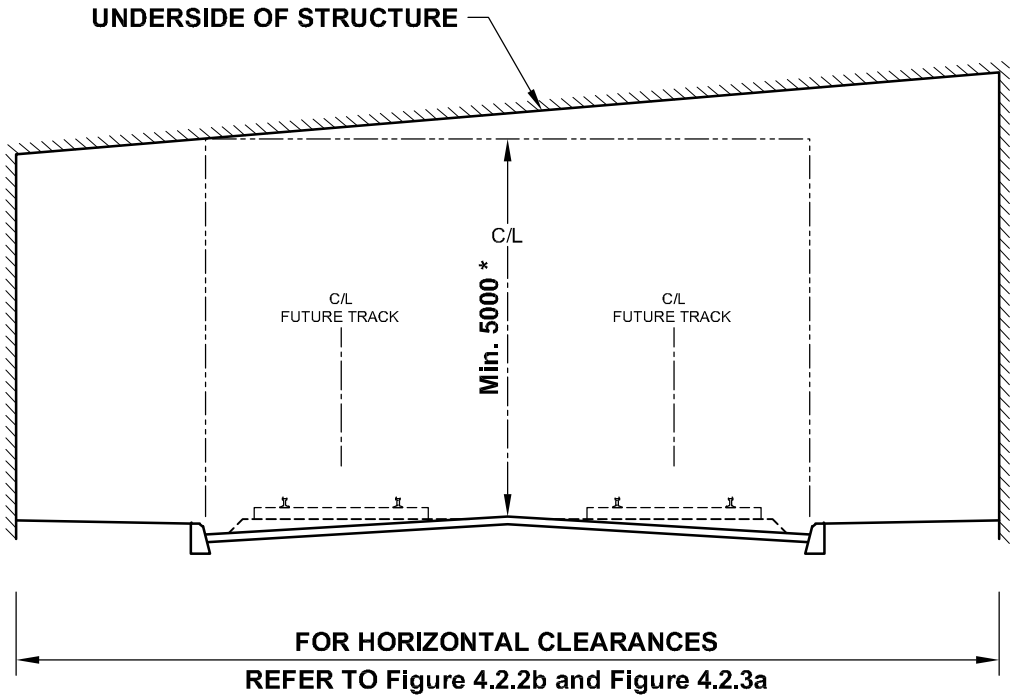
Ottawa
OC Transpo

TRANSITWAY BRIDGE - STANDARD CROSS SECTION

Scale: N.T.S.
Date: May 2012
Revision No. / Date:

TRANSITWAY AND STATION DESIGN GUIDELINES

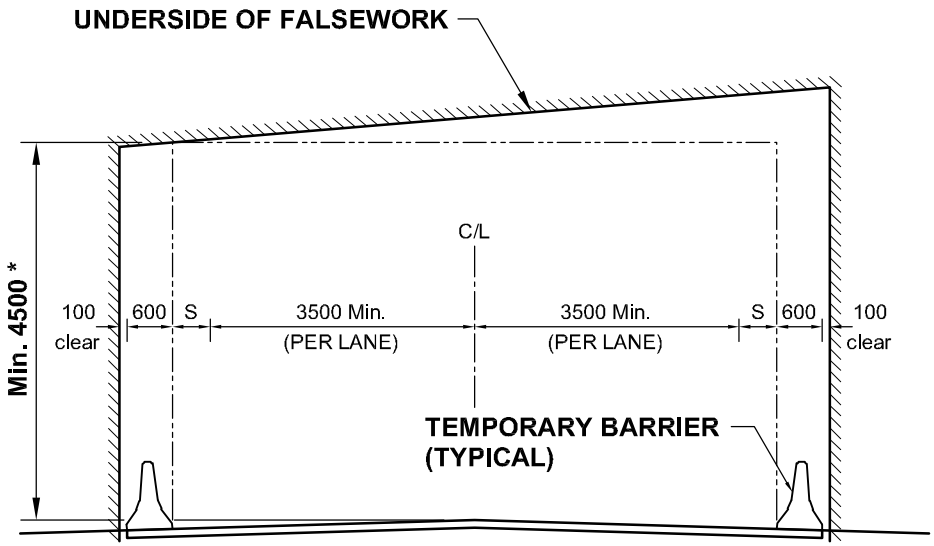
Figure 5.4.1



NOTE:

* Vertical clearance to the underside of pedestrian bridges and other light structures shall be 5300mm as required by the CHBDC. For minimum clearances related to future light rail, the designer shall obtain the current design criteria from the City of Ottawa.

Ottawa / OC Transpo	**TRANSITWAY OVERPASS CLEARANCES**	Scale: N.T.S.	Date: May 2012
		Revision No. / Date	
	TRANSITWAY AND STATION DESIGN GUIDELINES		**Figure 5.4.2a**



* Minimum 5000mm required where double decker buses are operating, unless otherwise approved by OC TRANSPO.

NOTES:

1. Construction clearances over roadways shall conform to the requirements of the agency having jurisdiction over the roadway. Where no special requirements are imposed, the minimum requirements of this standard shall apply.
2. The offset to barrier " S " shall be kept to an absolute minimum. Consideration of the road alignment, class of road and required vehicle movements is imperative in determining " S ".
3. " S " = 500mm minimum unless otherwise approved by OC TRANSPO.
4. All dimensions are in millimetres.

Ottawa / OC Transpo	CONSTRUCTION CLEARANCES	Scale: N.T.S.	Date: May 2012
		Revision No. / Date	
	TRANSITWAY AND STATION DESIGN GUIDELINES		Figure 5.4.2b

6.0 COMMUNICATIONS AND CONTROLS

6.1 GENERAL

The Transit communications system is designed to link the Control Centre related equipment facilities with Transitway Stations and facilities throughout the system. Transitway Stations are not manned on a 24/7 basis. The system must have the capability for Transit staff to remotely monitor and control, when necessary, passengers, intruders and equipment that are in these facilities.

The primary communications system is comprised of a number of sub-systems as follows:

Building Automation System:

The Building Automation System (BAS) is equipment and software that is necessary for monitoring and controlling various types of equipment at Transitway stations. Lighting, HVAC, life safety systems and some security features etc. are supported by the BAS system

Transit Telecom Equipment:

The main switch is located at 1500 St. Laurent Boulevard. The hardware is Nortel m1/option 61 c switch with option software running 25.40b.

Radio System:

***Note:** EDACS – Enhanced Digital Access Communication System

Closed Circuit Television (CCTV):

The CCTV system allows operations personnel and Controllers to remotely monitor and record activities at all Transitway stations and other designated locations.

6.2 DESIGN REFERENCE DOCUMENTS

Additional documentation that may be relevant to the design of the communication system components are listed below:

For a typical Transit BAS Network Architecture Schematic see Figure 6.2a.

For a typical Emergency Phone/Telephone Schematic see Figure 6.2b.

6.3 GENERAL DESIGN REQUIREMENTS

This section provides general requirements that must be taken into consideration for each of the communications subsystems.

The existing Transit communications system is comprised of a variety of different technologies and equipment. **These systems are currently being upgraded and the designer should confirm these changes with OC Transpo prior to new designs and construction.** If there are no changes, the designer should use the system that is currently being used. If certain equipment is no longer available, provide an appropriate interface or plan on replacing all existing obsolete and incompatible equipment.

The designer should investigate preferences or plans in place that will impact the selection of equipment and confirm with OC Transpo Operations, the City of Ottawa IT Department and Facility Maintenance personnel. Meetings between the designer and stakeholders must be conducted at the earliest stage of design to clarify the proposed work and systems being offered. The final design must be consensus based and inclusive of planning, changes and upgrades that are concurrent to Transit operations.

Systems should be specified that are capable of being maintained, repaired, modified and updated by City of Ottawa staff, or by one of a number of local City qualified contractors. It is not desirable to be limited to one source for maintenance, repair, and upgrading.

Much of the new communication equipment currently being manufactured is microprocessor based technology. Uninterruptible power supplies (UPS) are required for this equipment to prevent loss of data or problems associated with the restarting of the devices.

Environmental Factors:

During the design process, consider the following:

- Heating of areas where there will be temperature sensitive equipment installed
- Air quality (high in salt and dust particles) can affect newer electronic and computer equipment
- Noise and vibration from bus operations and activities from adjacent developments/ land-uses can create high ambient noise levels and vibration sensitivity issues
- Two way radios used by Transit staff have the potential for affecting sensitive electronic equipment
- Water leakage and high humidity levels in underground stations and in tunnels can be problematic

6.4 OC TRANSPO CONTROL CENTRE (PROVIDED FOR INFORMATION ONLY)

The Control Centre includes:

- Transit Operations
- Security
- Bus Operations

It is not currently possible or desirable to integrate all of the separate computer systems to reduce equipment requirements.

6.5 BUILDING AUTOMATION SYSTEM (BAS)

Transitway stations are provided with various building heating, ventilating, air conditioning, plumbing, electrical, security and fire alarm/protection systems which are all controlled and/or monitored by the BAS. Dedicated controllers within each facility or building perform all of the control and monitoring functions for the various building systems. They are remotely monitored at the OC Transpo Control Centre. The system is currently being updated as outlined in the following sections.

6.5.1 Existing Building Automation System

a) OC Transpo Enterprise Energy Management Control System:

The Schneider Electric I/A Series Enterprise Energy Management Control System (EEMCS) provides control and monitoring of the heating, cooling and ventilation systems, as well as, provides monitoring of critical systems such as generators, elevators, fire alarm systems, sump pumps, electrical systems etc. throughout OC Transpo Transit Stations, O-Train Stations, (as well as Maintenance Garages and Offices).

Each OC Transpo Building has its own Enterprise Network Controller, Local Area Network, Field Controllers and End-devices/interface devices (that are wired to the inputs and outputs of the Field Controllers).

The Enterprise Network Controller provides integrated control, supervision, and local network management solutions for any combination of the Local Operating Network (LON), BACnet, Modbus and Legacy field controllers that interoperate, share resources and reside across the building's Local Area Network. The Local Area Networks installed in the buildings are dedicated specifically to the Energy Management Control System.

All the Enterprise Network Controllers extend the communication from the building's Local Area Network into the OC Transpo Wide-area Network where the Enterprise Network Server resides. In some buildings, the Enterprise Energy Management System integrates to 3rd party systems such as Lighting Control Systems, Gas Detection Systems, and Electrical Metering. The 3rd party systems are directly connected to either the Local Area Network or OC Transpo Wide-area Network. The Enterprise Network Server provides database management, archiving of logs and alarms, alarm management, global commands, reporting, trending and messaging services for all the Enterprise Network Controllers connected to the OC Transpo Wide-area Network. The Enterprise Network Server is located remotely in a secure managed server room. Operator Workstations with the Enterprise Energy Management Control System software administration and configuration tools are installed throughout the OC Transpo Wide-area Network within maintenance garages and offices. OC Transpo Staff can log into the Enterprise Energy Management Control System by the Operator Workstation, any Internet Browser on the OC Transpo Wide-area Network or remotely via VPN access to the OC Transpo Wide-area network.

Depending on the user privileges, OC Transpo Staff can manage, control, visualize, troubleshoot and produce reports for all systems connected to the Enterprise Energy Management Control System via custom user interfaces that combine intuitive navigation screens with dynamic, real-time displays.

All generated alarms throughout the Enterprise are reported to the alarm management software installed on the Enterprise Network Server for distribution to the Alarm Management Client programs. All the alarms are first reviewed, acknowledged and/or dispatched to the appropriate OC Transpo Staff by Direct Energy's 24/7/365 facility monitoring/service centre. Additional alarm management software clients are installed on the Operator Workstations.

The Schneider Electric I/A Series Enterprise Energy Management Control System is completely scalable and has the software and hardware capability to integrate open-protocol (LON, BACnet, Modbus, oBIX) and legacy systems and controllers into the Enterprise.

b) OC Transpo Control Centre:

Monitoring is conducted on a 24/7 basis from the OC Transpo Control Centre. Operator work stations are provided for Transit Maintenance Operations and Transit Security.

6.6 BAS EQUIPMENT REQUIREMENTS

Maintenance monitoring for Transitway stations is done by the Transit Projects and Facilities Maintenance Section by connecting remotely to the BAS system using a laptop computer and a modem.

a) Conduit and Wire:

Conduit and wiring specifications must be provided in accordance with the Canadian Electrical Code (CEC) and the Ontario Electrical Safety Code. All control wiring must be provided in conduit suited to the application/installation location (i.e. no open wiring is permitted). The use of plenum rated cable is not allowed.

Minimum conduit size must be 21mm, and must specify a maximum 30% of allowable conduit fill to allow for future expansion. Low voltage wiring for end devices must be a copper stranded conductor minimum #18 AWG, twisted pair, and shielded. 120 VAC control wiring must be a minimum #14 AWG. The local area network serving the interconnection of BAS controllers must be CSA T529-95 compliant.

b) Labelling and Identification:

All control wiring should be labelled consistent with the existing system using typed (i.e. non hand written) snap or slip on type wiring labels. All control panels must be labeled with lamacoid labels attached with pop-rivets. All panels should be provided with input/output panel directories. All Point identification must follow current OC Transpo standards. All end devices must be labelled with identification tags or decals.

6.7 REQUIREMENTS FOR THE BAS MONITORING AND CONTROL OF SYSTEMS

Provide the monitoring and control functions for the various types of systems and/or equipment required by OC Transpo. These systems are located at stations throughout the City and to minimize the travel distance to specific locations, sufficient control and monitoring functions must be provided for each system to adequately monitor, control and troubleshoot operational and maintenance conditions from remote locations.

Critical and life safety systems include but are not limited to the following:

a) Compressed Air Systems Monitoring:

Monitor all compressed air systems for low pressure and power supply failure alarms.

b) Electrical Systems Monitoring:

The following main electrical service elements for a Transitway station shall be monitored:

- Main Service Entrance Breaker(s) Status
- Emergency Generator Power Breaker(s) Status
- Transfer Switch(s) Status
- Owner owned Main voltage (13.8 kV) Transformer High Temperature Alarms

c) Elevator Monitoring:

Monitor elevator availability status and elevator alarm

d) Escalator Monitoring and Control:

Monitor escalator status

e) Fire Suppression (Sprinkler) Systems Monitoring:

Where dry sprinkler systems are incorporated into the facility, monitoring of the compressed air pressure for the system should be provided

f) Fire Protection Alarm Monitoring:

The following shall be monitored:

- the status of the facility fire alarm system for remote alarming at the OC Transpo Control Centre
- the general, supervisory and trouble status as separate digital inputs
- The BAS must provide a dial out signal to the Transit Control

g) Emergency Generator Control and Monitoring:

The following shall be monitored:

- Generator operating
- Generator general alarm
- Provide a 4 to 20 mA tank level controller to monitor tank volumes and activate remote fill station alarms during the refueling process

h) Generator Exhaust systems Monitoring and Control:

The following shall be monitored:

- Operating status
- Dampers
- Space Temperature
- Start/Stop
- Enable/Disable

i) Heating Systems Monitoring and Control Electric heat trace systems:

The following shall be monitored:

- Radiant Infrared heating systems
- Facility space heaters such as unit heaters, force flows, radiant panels and radiant heaters

BAS controls for the various facility heating systems should include digital output control devices (enable / disable) and analog input space temperature feedback.

j) Lighting Monitoring and Control:

The following shall be monitored:

- Control of interior and exterior lighting
- Coordinate digital output requirements with lighting zone layouts for the facility
- Monitor operating status for all lighting zones
- Interconnect to lighting control system as required

k) Outdoor Air Temperature Monitoring:

Each Facility must include, at a minimum, one outdoor air temperature sensor located in a position least affected by the sun. The sensor should be utilized in conjunction with the facility monitoring and control functions.

l) Sump Monitoring:

Monitor for high level alarms independent of integral sump pump level controls.

m) Space Temperature Monitoring:

The following shall be monitored:

- Heating and cooling functions (monitor and control).
- Analog space temperature monitoring should be provided throughout the following areas of all facilities:
    - Communications rooms
    - Electrical rooms including Elevator machine rooms
    - Mechanical rooms
    - Common public areas of all stations including external and internal spaces
    - Rooms where water supply is available

Alarm conditions are to be set at both high and low limits consistent with similar space alarm conditions in existing facilities.

n) UPS System Monitoring:

Monitor the following integral alarms from each UPS or battery bank via digital inputs:

- AC power failure alarm
- Battery failure alarm
- Output failure alarm

o) BAS Graphics:

Graphics must be provided for all BAS monitored and controlled systems. Existing graphic formats previously used in existing facilities are to be utilized for consistency.

In some instances modifications and/or additions may be required to some graphics to accommodate new facilities. Possible existing graphics requiring modifications are:

- Station overview
- Lighting control
- Generator monitoring
- UPS monitoring

p) BAS Alarming:

All alarming is to be segregated and logged as follows:

- Security related alarms are to be assigned to the OC Transpo Transit security monitoring stations at the Control Centre with the exception of door access alarms. All door access alarms are processed by City of Ottawa Corporate Security Contractor.

- All maintenance alarms will be initially assigned to O C Transpo Security at the C ontrol Centre. Transit Operations will then dispatch to the OC Transit Maintenance OWS as required.
- All other alarms are to be assigned to the Transit control at the OC Transpo Control Centre.

6.8 TRAINING

Training must be provided to O C Transpo staff for all new facilities and their related systems, including expansions of the existing system.

BAS training will be limited to the system architecture for any new station including the control sequence strategy/logistics for new equipment.

6.9 EXAMPLE POINTS LIST FOR MONITORING AND CONTROL

As an example, Table 6.9 provides a points list for monitoring and controlling St. Laurent Transitway Station. St. Laurent Transitway Station monitors many functions including a Tunnel Ventilation System.

Table 6.9: EXAMPLE POINTS LIST FOR MONITORING AND CONTROL

Point types are: DI = Digital Input AI = Analog Input
DO = Digital Input AO = Analog Output

POINT	TYPE	POINT NAME	DESCRIPTION
UI 01	DI	SFN01STA	Tunnel Platform Supply Fan # 01 Status
UI 02	DI	SFN02STA	Tunnel Platform Supply Fan # 02 Status
UI 03	DI	EXF03STA	Tunnel Transformer Rm Exhaust Fan # 03 Status
UI 04	DI	EXF04STA	Tunnel Transformer Rm Exhaust Fan # 04 Status
UI 05	DI	FAPSWT01	Fireman STOP Switch for Supply fan # 1 & # 2
UI 06	DI	WEWINDIR	WEST, Wind Direction Sensor (Control Fans Direction 10,11,12,13,14)
UI 07	DI	PMP01ALM	Sump Pump # 01 High Level Alarm (near hydro manhole)
UI 08	DI	SFN10STA	Tunnel Supply Fan # 10 Status
UI 09	DI	SFN11STA	Tunnel Supply Fan # 11 Status
UI 10	DI	SFN12STA	Tunnel Supply Fan # 12 Status
UI 11	DI	SFN10DIR	Tunnel Supply Fan # 10 Direction Status

POINT	TYPE	POINT NAME	DESCRIPTION
UI 12	DI	SFN11DIR	Tunnel Supply Fan # 11 Direction Status
UI 13	DI	SFN12DIR	Tunnel Supply Fan # 12 Direction Status
UI 14	DI	SFN13STA	Tunnel Supply Fan # 13 Status
UI 15	DI	SFN14STA	Tunnel Supply Fan # 14 Status
UI 16	DI	SFN13DIR	Tunnel Supply Fan # 13 Direction Status
UI 17	DI	SFN14DIR	Tunnel Supply Fan # 14 Direction Status
UI 18	DI	PMP02ALM	Sump Pump # 02 High Level Alarm (near hydro manhole)
UI 19	DI	HTGFIALU	Upper Shelters GFI Radiant Heating Ground Fault Alarm
UI 20	DI	FAPFSD	Fire Alarm fan Shutdown
UI 21	DI	PMP04ALM	Sump Pump # 04 High Level Alarm (Janitor Rm North)
UI 22	DI	FAP1.STA	Fire Alarm Status (Upstair Panel)
UI 23	DI	FAPSWT02	Fireman START Switch for Supply Fans
UI 24	DI	BEL01RES	Alarm Bell Reset Button
UI 25	DI	ESC01ALM	Escalator # 1 Alarm
UI 26	DI	ESC02ALM	Escalator # 2 Alarm
UI 27	DI	ESC03ALM	Escalator # 3 Alarm
UI 28	DI	ELV01ALM	Elevator # 1 Alarm
UI 29	DI	ELV02ALM	Elevator # 2 Alarm
UI 30	DI	HTGFIALL	Lower Shelters GFI Radiant Heating Ground Fault Alarm
UI 31	AI	TUN_OAT	Tunnel South East Temperature
UI 32	DI	ESC04ALM	Escalator # 4 Alarm
UI 33	AI	SRM01TMP	Sprinkler Room Temperature

POINT	TYPE	POINT NAME	DESCRIPTION
UI 34	DI	FAPTRB01	Fire Alarm Panel Trouble
UI 35	DI	TLT01SWT	Tunnel Traffic Light Road Closed Status
UI 36	AI	SHT01TMP	Upper Shelter # 1 Temperature
UI 37	AI	SHT1ATMP	Upper Shelter # 1A Temperature
UI 38	DI	PMP03ALM	Sump Pump # 03 High Level Alarm (Electrical Rm South)
UI 39	AI	VLT01TMP	Sprinkler Room Temperature
UI 40	AI	ERM01TMP	Electrical Room Temperature
UI 41	DI	FHC01ALM	Fire Hose Cabinet # 01 Door Alarm
UI 42	DI	FHC02ALM	Fire Hose Cabinet # 02 Door Alarm
UI 43	DI	FHC03ALM	Fire Hose Cabinet # 03 Door Alarm
UI 44	DI	FHC04ALM	Fire Hose Cabinet # 04 Door Alarm
UI 45	DI	FHC05ALM	Fire Hose Cabinet # 05 Door Alarm
UI 46	DI	FHC06ALM	Fire Hose Cabinet # 06 Door Alarm
UI 47	DI	FHC07ALM	Fire Hose Cabinet # 07 Door Alarm
UI 48	DI	FHC08ALM	Fire Hose Cabinet # 08 Door Alarm
UI 49	DI	FHC09ALM	Fire Hose Cabinet # 09 Door Alarm
UI 50	DI	FHC10ALM	Fire Hose Cabinet # 10 Door Alarm
UI 51	DI	FHC11ALM	Fire Hose Cabinet # 11 Door Alarm
UI 52	DI	FHC12ALM	Fire Hose Cabinet # 12 Door Alarm
UI 53	DI	FHC13ALM	Fire Hose Cabinet # 13 Door Alarm
UI 54	DI	FHC14ALM	Fire Hose Cabinet # 14 Door Alarm
UI 55	AI	SHT05TMP	Upper Level Shelter # 5 Temperature

POINT	TYPE	POINT NAME	DESCRIPTION
UI 56	AI	SHT5ATMP	Upper Level Shelter # 5A Temperature
UI 57	AI	SHT04TMP	Upper Level Shelter # 4 Temperature
UI 58	AI	SHT4ATMP	Upper Level Shelter # 4A Temperature
UI 59	AI	SHT03TMP	Upper Level Shelter # 3 Temperature
UI 60	AI	SHT3ATMP	Upper Level Shelter # 3A Temperature
UI 61	AI	SHT02TMP	Upper Level Shelter # 2 Temperature
UI 62	AI	SHT2ATMP	Upper Level Shelter # 2A Temperature
UI 63	AI	LGT01PCL	Exterior PhotoCell
UI 65	AI	INFOTMP	Upper Level Info Space Temperature
UI 66	DI	TSFERSW	Transfer Switch Status
UI 67	DI	GEN01STA	Generator Run Status
UI 68	DI	GEN01TBL	Generator Trouble Alarm
UI 69	DI	GEN01TST	Generator Test Status
UI 70	DI	HYDROSTA	Main Power (Hydro) Status
UI 71	DI	60MINTIM	Lighting Timer Override
UI 72	AI	SHB2BTMP	Tunnel Shelter 2B Space Temperature (North ~ West Side)
UI 73	DI	SHB2BSWT DA	Tunnel Shelter 2B Push Button (North ~ West Side)
UI 74	AI	SHB1ATMP	Tunnel Shelter 1A Space Temperature (South ~ West Side)
UI 75	DI	SHB1ASWT DA	Tunnel Shelter 1A Push Button (South ~ West Side)
UI 76	AI	SHB1BTMP	Tunnel Shelter 1B Space Temperature (South ~ East Side)
UI 77	DI	SHB1BSWT DA	Tunnel Shelter 1B Push Button (South ~ East Side)
UI 78	DI	HTGFIALB RA	GFI Radiant Heating Ground Fault Alarm

POINT	TYPE	POINT NAME	DESCRIPTION
AO 01	0~20mA	SHB2BLTG	Tunnel Shelter 2B LED Lamp Status Indicator (North ~ West Side)
AO 02	0~20mA	SHB1ALTG	Tunnel Shelter 1A LED Lamp Status Indicator (South ~ West Side)
AO 03	0~20mA	SHB1BLTG	Tunnel Shelter 1B LED Lamp Status Indicator (South ~ East Side)

POINT	TYPE	POINT NAME	DESCRIPTION
DO 01	DO	SFN01STS	Tunnel Platform Supply Fan # 01 Start / Stop
DO 02	DO	SFN02STS	Tunnel Platform Supply Fan # 02 Start / Stop
DO 03	DO	SFN10STS	Tunnel Supply Fan # 10 Start / Stop
DO 04	DO	SFN11STS	Tunnel Supply Fan # 11 Start / Stop
DO 05	DO	SFN12STS	Tunnel Supply Fan # 12 Start / Stop
DO 06	DO	SFN0ADIR	Tunnel Supply Fan Group "A" Direction Selection
DO 07	DO	SFN13STS	Tunnel Supply Fan # 13 Start / Stop
DO 08	DO	SFN14STS	Tunnel Supply Fan # 14 Start / Stop
DO 09	DO	SFN0BDIR	Tunnel Supply Fan Group "B" Direction Selection
DO 10	DO	BEL01ALM	Communication Rm. Alarm Bell
DO 11	DO	NGTSTOP	Night Stop Lighting
DO 12	DO	ESC1STA	Supervisor Office Escalator # 1 Alarm Light Indicator
DO 13	DO	ESC2STA	Supervisor Office Escalator # 2 Alarm Light Indicator
DO 14	DO	ESC3STA	Supervisor Office Escalator # 3 Alarm Light Indicator
DO 15	DO	ESC4STA	Supervisor Office Escalator # 4 Alarm Light Indicator
DO 16	DO	TLT01STS	Tunnel Traffic Light Road Closed Bypass

POINT	TYPE	POINT NAME	DESCRIPTION
DO 17	DO	SHT01STS	Upper Shelter 1 Heater On / Off
DO 18	DO	SHT1ASTS	Upper Shelter 1A Heater On / Off
DO 19	DO	HTGINFO	INFO Heater On / Off
DO 20	DO	HTG05STS	Upper Level Shelter Heater # 5 Start / Stop
DO 21	DO	HTG5ASTS	Upper Level Shelter Heater # 5A Start / Stop
DO 22	DO	HTG04STS	Upper Level Shelter Heater # 4 Start / Stop
DO 23	DO	HTG4ASTS	Upper Level Shelter Heater # 4A Start / Stop
DO 24	DO	HTG03STS	Upper Level Shelter Heater # 3 Start / Stop
DO 25	DO	HTG3ASTS	Upper Level Shelter Heater # 3A Start / Stop
DO 26	DO	HTG02STS	Upper Level Shelter Heater # 2 Start / Stop
DO 27	DO	HTG2ASTS	Upper Level Shelter Heater # 2A Start / Stop
DO 28	DO	LGTCIRC1	Approach (L1A) - Lighting Control
DO 29	DO	LGTCIRC2	Approach (L2A) - Lighting Control
DO 30	DO	LGTCIRC3	Approach (L3A) - Lighting Control
DO 31	DO	LGTCIRC4	Interior (L3B) - Lighting Control
DO 32	DO	LGTCIRC5	Sidewall Interior (L3C / L3D) - Lighting Control
DO 33	DO	LGTCIRC6	Interior (L4A) - Lighting Control
DO 34	DO	LGTCIRC7	Lower Platform (L5A) - Lighting Control
DO 35	DO	LGTCIRC8	Misc Emergency (L5B) - Lighting Control
DO 36	DO	LGTCIRC9	Platform (NL - EL) - Lighting Control
DO 37	DO	LGTCRC10	Platform (TL) - Lighting Control
DO 38	DO	LGTCRC11	Plenum (LT) - Lighting Control

POINT	TYPE	POINT NAME	DESCRIPTION
DO 39	DO	SHB2BSTS DA	Tunnel Shelter 2B Heating Contactors # 4 & 6 (North ~ West Side)
DO 40	DO	SHB1ASTS DA	Tunnel Shelter 2B Heating Contactors # 1 & 3 (South ~ West Side)
DO 41	DO	SHB1BSTS DA	Tunnel Shelter 1B Heating Contactors # 2 & 5 (South ~ East Side)

6.10 TELEPHONE SYSTEMS

The telephone systems to be installed on the Transitway system are classified as follows:

- Emergency Phones including Elevator Phones
- Public Pay Phones c/w information and security autodial features

6.10.1 Emergency Phones (Call Boxes)

Emergency Phones shall be easily accessible, AODA/ADA compliant, and should be located as follows:

- Transitway station platforms and information areas (Lobbies)
- Park and Ride pedestrian areas in conjunction with CCTV locations, where possible
- In all elevators

Emergency Phones must be programmed as an auto ring down telephone line to OC Transpo Security at OC Transpo Control Centre. The phones are to time-out after 9 minutes if not properly hung up by OC Transpo Security.

All emergency and elevator phones are routed through OC Transpo Security Control Center and always recorded.

Signage for the public must be provided in English and French as well as in Braille in accordance with AODA requirements.

6.10.2 Public Pay Phones

The location of pay phones in new stations must be determined in conjunction with Bell Canada. Bell Canada should be consulted early in the design stage of a station to determine their requirements.

6.10.3 Electrical Requirements

a) Conduit:

Empty telephone conduit provisions must conform to the Ontario Electrical Safety Code. The minimum size of conduit must be 21 mm (3/4") complete with polypropylene pull string.

b) Pull Boxes:

Pull Boxes must be provided in sections of conduit run greater than 30 m, and/or after every two 90º bends or equivalent deflections. Pull boxes must be installed in easily accessible locations.

c) Outlet Boxes:

Outlet boxes should be flushed mounted PVC embedded in concrete or surface mounted cast aluminum sized as required (Minimum 100x50x70 (deep box)).

d) Communications Equipment Backboard:

To mount the equipment and terminations, a 20 mm thick one hour fire rated plywood backboard, painted grey, must be installed on **all** wall space available.

e) Wiring:

All wiring must be in accordance with the Ontario Electrical Safety Code.

6.10.4 Distribution Design Requirements

All future extensions must have a minimum of (1) 200 pair cable and (1) multi-pair (4) telephone cable to each phone (Emergency and Pay) installed within the Station or Park and Ride facility for the telephone connectivity requirements of that extension.

It is the designer's responsibility to contact Bell Canada and to arrange for telephone service at each Transitway Station. The civil infrastructure for the service must be included in the Contract in cooperation with the Bell Canada Regional Manager.

6.11 CLOSED CIRCUIT TELEVISION

OC Transpo is equipped with a Closed Circuit Television (CCTV) surveillance system that assists in the management of operations, public safety, and security. It is comprised of video imaging, processing, display, and recording equipment along with a fiber optic data transmission network to most locations.

6.12 COMMUNICATIONS INFRASTRUCTURE

6.12.1 Low Voltage Conduits & Distribution

This is the area set aside for cabling from within the facility to terminate in function specific cabinets such as Building Automation System (BAS), CCTV, Emergency Phone System, etc.

All conduits entering the Communications room shall be at or below the floor level so water and moisture will not drip onto equipment.

6.12.2 Station Telephone Distribution

All emergency phone circuits coming into the room from the station are terminated on a Remote Access Line Concentrator (RALC). Each RALC shall support a total of 8 Emergency Phones.

Bell terminations are on a set of BIX blocks where all the connections to the outside lines are terminated as well as pay phone provisions.

Connections to equipment are made to these respective blocks to connect lines to the rack mounted equipment RALC's. Cross connects are made when directly connecting station equipment to outside lines such as pay phones.

6.12.3 Communication Room Size

Generally the communications room size will depend on the available space. The minimum area shall be 25 sq. m. with a minimum width of 3m. The minimum allowable ceiling height is 3m.

The minimum door size is 915 x 2438 mm to allow for equipment servicing/installation.

Water supply and sprinkler systems shall **not** be allowed in the Communication Room unless precautions are taken into consideration in the design.

The general environment of the Communications room should be similar to an office environment due to the sensitivity of the equipment.

A copper grounding bus should be installed around the inside perimeter of the room and it must be connected to the station ground grid system.

6.12.4 Station Facilities

Generally there are a large number of different cable run types required to service the various areas of a station. A communications cable raceway/conduit system should incorporated in the station design. Provisions for the future cables requirements should be included in the design with ease of access for installation in mind.

Cable raceways should be from end to end on each platform with flexible access points. Often, devices such as CCTV, PA, or Emergency Phone devices can change location frequently before being finally located.

6.13 COMMUNICATION CABLING REQUIREMENTS

6.13.1 Copper Paired Cable (Bell Canada - Outside Plant)

Minimum Requirements:

Copper cables must conform to the following minimum requirements:

- Conductors must be 22 A WG, or larger, tinned copper, meeting Ontario Electrical Safety Code for the intended application.
- Conductors and cble inner/outer jacketing must be i nsulated with Polyethylene (PE), Polyolefin (XLPO), or Cross-linked Polyethylene (XLPE or UL type XHHW-2) that will meet the following minimum requirements:
  - Sunlight Resistant Flame Test Rated FT4 -CSA cold impact/bend test at -40 deg C Suitable for direct burial Rated for wet/dry environments with temperature range from -40°C to +70°C.
- Cables exposed or installed aerially must be rated for installations to -50° C.
- All outside plant cables to the Station are installed by Bell Canada. Underground duct provisions (2x 100mm) for the cables are provided from the nearest Bell plant to the Station as part of the construction. This requires co-ordination with the Bell Engineering Group at the design phase to confirm availability of service.
- Prior to installation, all ducts must be "proved" using a mandrel and cleaned. Duct bells must be placed upon all conduit ends. Sharp edges that the cable may be pulled over must be protected. Pulling eyes and cable racking must be added to all manholes where required.

6.13.2 Network Cable System - Fiber Optic Cable System (Rogers (formerly Atria) Networks)

The following communications systems currently transmit signal utilizing fiber optic cable:

- CCTV
- Network Provisions

The provision for Network Service at a Transitway Station is requested by OC Transpo through:

- Information Technology Services Dept
- Client Relations & Service Innovation Unit
- Client Services Branch
- IT Account Manager

6.13.3 Network Cable System - Internal Copper Cable Network (Contractor Installed)

The following communications systems currently transmit signals utilizing the copper cable network:

- Telephone (including Emergency Phones)
- CCTV
- BAS
- PA/VMS (where installed)

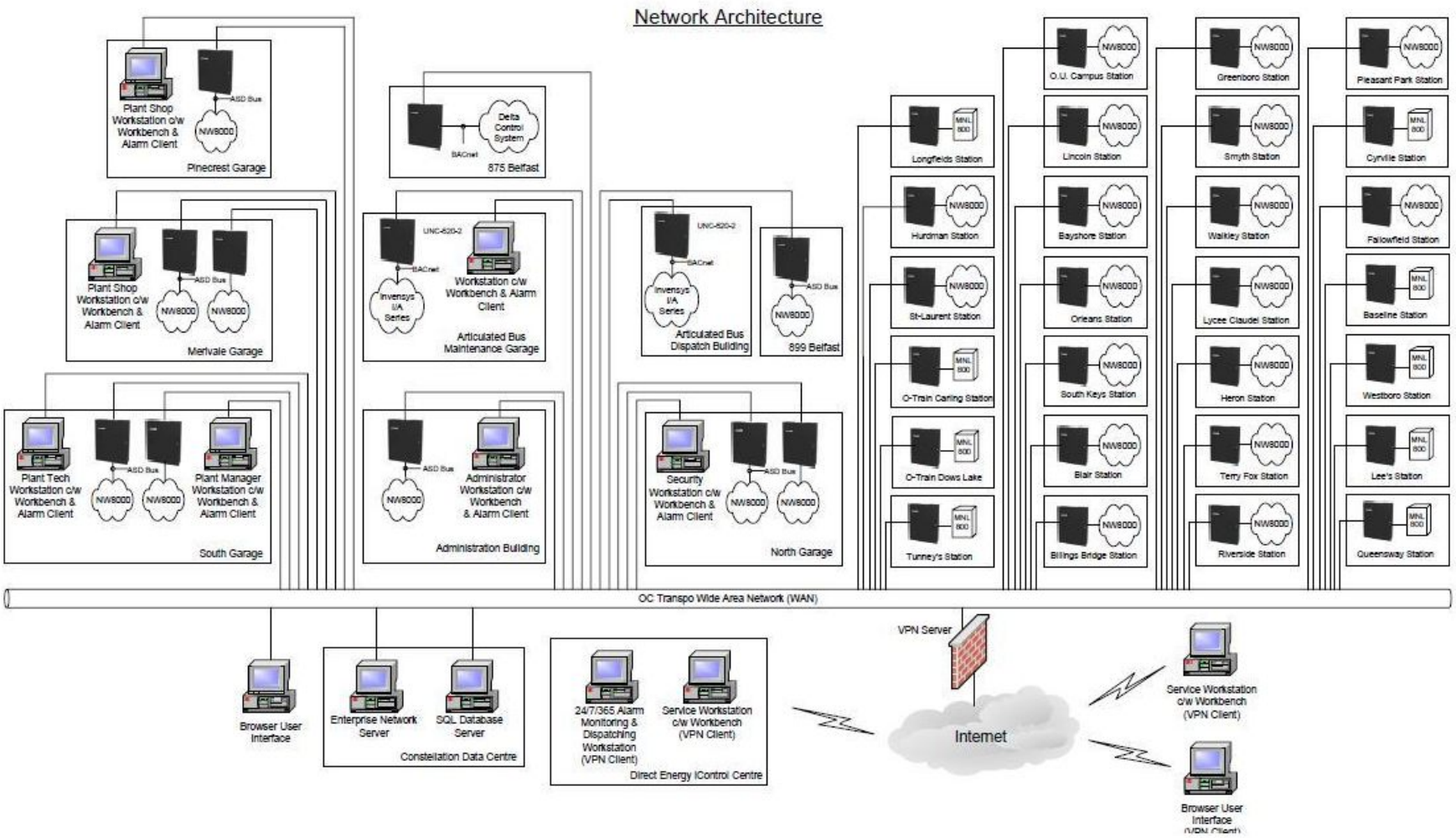
A 200-pair telephone cable shall be installed in one of the 103 mm dia. communication ducts interconnecting each station.

6.14 FIGURES

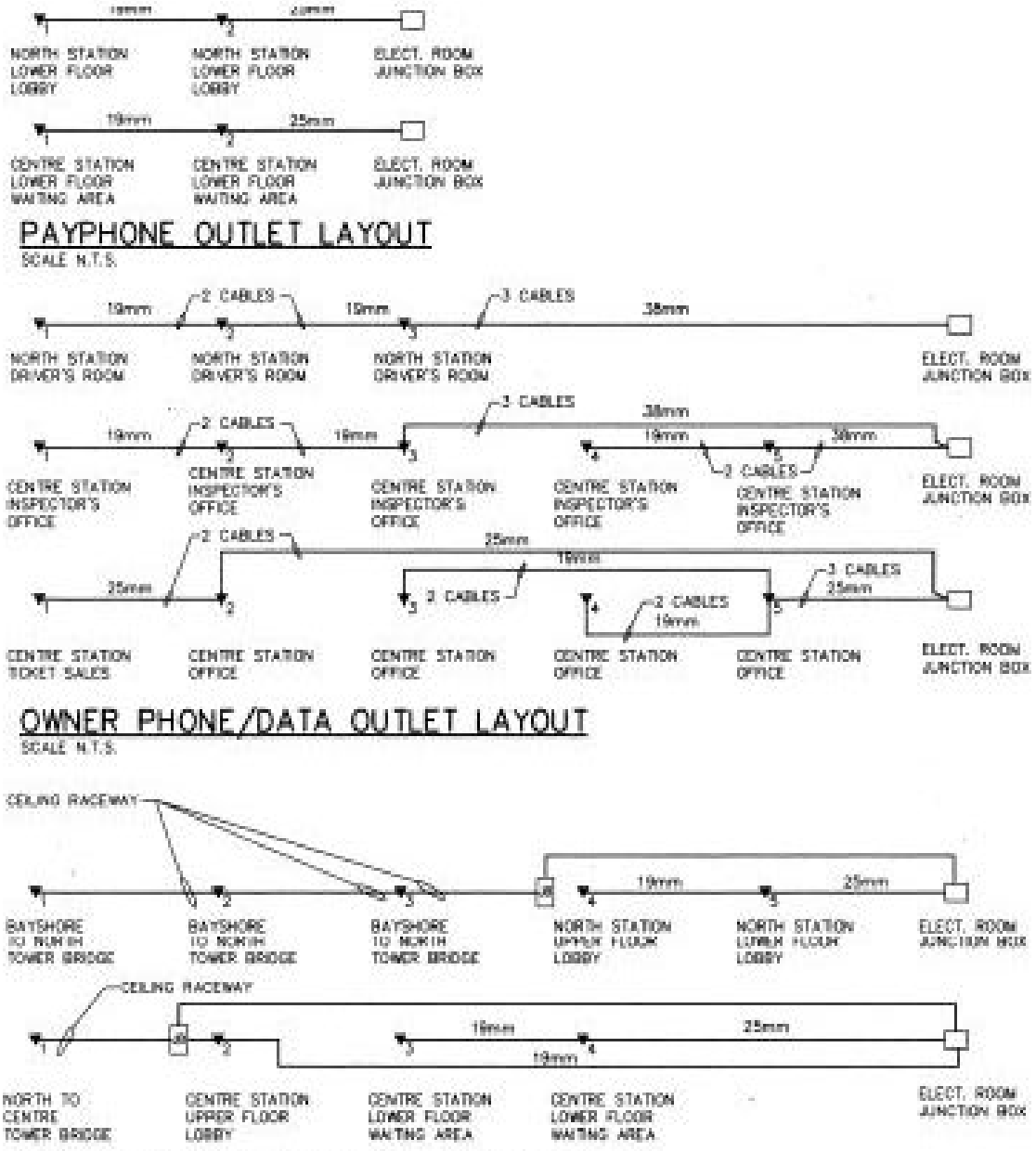
The designer shall refer to the following figures as referenced in above sub-sections:

Figure 6.2a: TRANSITWAY BAS NETWORK ARCHITECTURE SCHEMATIC

Figure 6.2b: EMERGENCY PHONE/TELEPHONE SCHEMATIC



Ottawa OC Transpo	**TRANSITWAY BAS NETWORK ARCHITECTURE SCHEMATIC**	*Scale* **N.A.**	*Date* **May 2012**
		Revision No./Date	
	TRANSITWAY AND STATION DESIGN GUIDELINES	**Figure 6.2a**	



EMERGENCY PHONE/TELEPHONE SCHEMATIC

Scale	N.A.	Date	May 2012
		Revision No./Date	

Figure 6.2b

TRANSITWAY AND STATION DESIGN GUIDELINES

7.0 SAFETY AND SECURITY

7.1 GENERAL

This section presents the principles, guidelines and required safety and security measures for Transit passengers, service and maintenance staff in the following Transitway facilities:

- Transitway Stations
- Exterior site areas including pathways, Park and Ride Lots and PPUDO drop off areas
- Transitway Right-of-Way

The security of Transitway facilities and equipment, including the prevention of losses through burglary, damage and vandalism are addressed, in part, by the surveillance measures outlined in Section 6.0, “Communications and Controls”.

Safety requirements related to traction power, signals, facility structure, electrical and mechanical design and barrier-free design are addressed in the Guideline sections dealing with these particular topics.

7.2 GENERAL PRINCIPLES AND GUIDELINES

The Station security design shall incorporate the Key Fundamentals and Basic Strategies which are tools of Crime Prevention through Environmental Design (CPTED) principals.

a) CPTED Key Fundamentals:

- Access Control
- Surveillance
- Territorial Reinforcement

b) CPTED Basic Strategies:

- Define borders and controlled space
- Provide clearly marked transitional zones between areas
- Provide gathering areas with natural surveillance and access control
- Place safe activities in areas to provide natural surveillance and an improved perception of the area

- Place vulnerable activities in safe locations
- Designate the use of space to provide natural safe barriers to conflicting activities
- Schedule activities in space to discourage unacceptable behaviour (i.e. don't leave space unused)
- Increase the perception of natural surveillance
- Minimize distance and isolation through communications and design efficiencies

c) Visibility to Others:

The ability to be seen by others is very important. By reducing the feeling of isolation through the improvement of the land use mix and incorporating activity generators, a feeling of security can be created. Transit users should be clearly visible from adjacent streets and buildings. Any walls, berms, bushes, hills, snow banks, power/utility boxes or solid fences that block the view should be eliminated or modified.

d) Signs and Information:

Passenger information signs should indicate route schedules and provide security/safety contact information for appropriate authorities (i.e. Transecure information) and provide the ability to communicate, find help or escape when in danger through signs and design features.

e) Reduce Isolation and Avoid Areas of Entrapment:

Transitway station entrances, where possible, should not be adjacent to isolated areas such as large parking lots, vacant land, alleys, ravines, or buildings set back from the street. Entrapment areas created by landscaping or solid structures should be eliminated or modified. Areas adjacent to the Transitway should be well lit where possible to avoid dark areas where attackers could hide.

f) Formal Surveillance:

The OC Transpo Transecure Program encourages Transit Employees to respond/report dangerous or suspicious situations through two way communications or panic alert buttons. All Transitway stations should have video, CCTV and/or other forms of formal surveillance and electronic communication devices (i.e. Call boxes/e-phones or radio).

7.3 TRANSIT FACILITY ACCESS ROUTES

a) Sightlines:

It is important to be able to clearly see what is ahead along a given travel route. The line of sight for access ways should not be obstructed by alignment changes, walls, berms, fences, bushes, trees, snow banks, large garbage dumpsters, signs, or large columns. Where grade separation and landscape/noise screens may be required for functional or aesthetic reasons, there should be consideration for sightline restrictions. Sightlines must be considered from all

appropriate viewer heights and angles including pedestrian (adult or child), vehicle or wheelchair heights.

b) Predictable Routes, Entrapment Areas, and Isolation Areas:

Predictable routes offer no escape alternatives for pedestrians. An attacker can predict where pedestrians will end up once they are on the path. Examples of predicable routes are pedestrian tunnels, overpasses, escalators and staircases. Predictable routes are of particular concern when they are isolated or when they terminate in entrapment areas. Entrapment areas can be small, confined areas near or adjacent to well-traveled routes that have barriers of some nature on three sides, such as walls or bushes.

Factors to consider are:

- Providing clear sight lines
- Introduce surveillance measures
- Introduce activity functions where possible
- Provide convenient emergency phones
- Provide appropriate security lighting

7.4 TRANSIT SYSTEM SAFETY AND SECURITY FEATURES

a) Surveillance:

Surveillance measures are used to manage and maintain security throughout the Transitway Stations. Natural surveillance should be encouraged through the placement of physical elements, activities and people to maximize visibility in accordance with the principles and criteria provided earlier in this section.

Formal surveillance including communication equipment is also necessary and should complement and improve upon the natural surveillance system.

The communications hub for the City of Ottawa Transitway System is the OC Transpo Control Centre. It incorporates the functions of Conventional Bus and Security Operations to allow for the dispatching of staff resources. Real time surveillance of the Transitway stations is performed from the Security Section at this location and also from the on street monitoring in conjunction with the City of Ottawa Traffic Department.

The OC Transpo Transitway System is equipped with a closed circuit television surveillance system (CCTV) that assists in the management of Transit facilities and operations, as well as public safety and security. It is comprised of video imaging, processing, display, and recording equipment along with its own dedicated video transmission system. Most cameras can be remotely controlled from the security area. The CCTV surveillance system serves two distinct functions defined as follows:

- Operational needs are those requirements deemed necessary for the safe and orderly dispatch of passengers. Monitoring is carried out for the purpose of ensuring the safe movement of people in both normal and crush conditions.
- Security needs are those requirements deemed necessary for protection of assets, prevention of vandalism, and the safe passage of passengers and the general public.

Camera coverage is required for the following security sensitive areas:

- Continuous coverage of all platform areas
- Emergency telephones
- Elevator / escalators (external)
- All entrance doors
- Lobby and shelter waiting areas

Camera coverage should be provided with the objective of eliminating all secluded areas. Station approach access routes and adjacent parking and loading areas also require coverage.

b) Telephone Systems:

The following telephone systems shall be provided at each Transitway station and Park and Ride Lot facility:

- Emergency Phones (Call Boxes)
- Elevator Emergency Phones
- Public Pay Phones (Security call button feature)

Emergency Phones are generally located on the station platforms next to information panels, seating areas and elevators.

Emergency phones must be readily identifiable through the use of high visibility color/ lettering/ markings, according to standards. Each phone has a direct connection to the OC Transpo Control Centre and is monitored by CCTV. When a call is placed a video recording is activated at the Control Centre.

Bell Pay Phones are located in most stations that also provide no charge calling buttons to provide direct access to OC Transpo Security and the Information Call Centre.

c) Public Address (PA):

Future stations on the City of Ottawa Transit System should be designed with provisions (conduit and space) for an amplified public address voice messaging systems. As a minimum, each station should rough-in for speakers at the platform level.

d) Mobile Security Patrols:

Security Officers patrol the entire Transitway system on a continuous basis during operating hours. Transit Law Enforcement Officers (TLEO's) and Transit Supervisors are equipped with two-way radios so they can contact the OC Transpo Control Centre if emergency assistance is required.

7.5 STATIONS/FACILITIES

7.5.1 General Architectural Features

The choice of surface treatments and construction materials should take into consideration safety, budget, practicality and maintenance.

Materials should be resistant to damage and extreme environmental conditions. Consideration should be given to textured surfaces to discourage graffiti. Avoid low ceilings as they are easily damaged and vandalized.

7.5.2 Facility Access Control

Prevent public access to potentially unsafe or restricted areas through the provision of:

- Gates, fences
- Locking gates/remote controlled doors with status indicators
- Intrusion alarms, motion sensors/detectors
- Landscaped and/or appropriate surface treatment to separate and delineate travel corridor.

7.5.3 Passenger Elevators

Elevators must be the observation type with at least one transparent side provided in an elevator car at each stop position with audible and visual location signals of cars.

All elevators must be equipped with a hands-free direct dial call box that connects with the OC Transpo emergency phone system at the OC Transpo Control Centre. Elevators should have the provision to be access controlled from the security monitor room at the OC Transpo Control Centre.

7.5.4 Lighting

Lighting is a critical security feature and must provide adequate and uniform light levels in each area. Avoid shadows created by insufficient and uneven lighting. The light level and type must be enough to allow the Transit patron and CCTV camera to detect, recognize, and identify objects and events and meet the criteria as noted in the electrical section of this manual. All lighting in public areas must be "white light" fluorescent, metal halide, or LED in some circumstances. All vulnerable areas should be illuminated. Lighting should not be present at ends of corridors, behind persons at reception areas or counters, and mounted away from all accessible routes.

All station public areas require emergency lighting for passenger safety and to maintain scheduled services during local power failures. Direct glare from flooring or working surfaces is to be avoided.

7.5.5 Acoustics and Vibration

Unnecessary or conflicting noises create confusion and causes difficulties when trying to deal with safety and security issues such as listening to the public address system or using help phones.

7.5.6 Directional and Informational Signage (by OC Transpo)

Well-designed and appropriately located signs and maps contribute to a feeling of security. Installations should be strategically located and plainly visible from all reader's heights with clear and consistent messages and are easy to understand. The signage designs must incorporate tactility features (where required) in accordance with the AODA.

7.6 TRANSITWAY RIGHT-OF-WAY ACCESS CONTROL

The design of Transitway facilities must permit the safe evacuation of passengers in the event of a safety or security issue. This may require the installation of gates in the fenced areas at strategically placed locations.

In addition, emergency lighting must also be provided for patron safety in enclosed tunnels exceeding 100 metres in length from portal to portal and in all enclosed tunnels where the portal is not within the line of sight.

7.6.1 General Transitway Ownership, Maintenance and Management

Transitway property should be well maintained to create a perception of responsible ownership and the provision of a safe and secure environment. Shared spaces or partnerships will require that consistent maintenance and management policies and agreement standards are established including prompt attention to cleaning, removal of graffiti, removal of snow and ice, and the maintaining/upgrading of the property (where required).

8.0 STATIONS

8.1 GENERAL

Station structures shall achieve the functional and operational requirements of the Transitway system while achieving an aesthetic which is recognizable and appropriate for the Transitway system and the community in which it is located. **A primary goal for the Station design is to enhance the customer experience along with the efficient movement of buses and customers.** The objective to Station design is to present a unique architecture for the new Stations within common architectural themes expressed along specific sections of the Transitway system.

The Station environment shall be safe and open with high visibility and no hidden corners or blind spots. The designer shall consider solid, clean lines, public spaces with height and illumination and good pedestrian flow characteristics. Providing unobstructed views to approaching buses is fundamental to the design. There must be no physical features which will obstruct transit users from viewing the approaching buses and their route destination information. Waiting transit users must also be visible to bus drivers. The station design should minimize sightline obstructions between the buses and the stations.

Convenience, comfort and safety shall be the major objectives of station operation including all provisions for persons with disabilities. To provide better site safety and security through environmental design the principles of Crime Prevention through Environmental Design (CPTED) shall be incorporated into the design of stations. The designer shall refer to Section 7.0, “Safety and Security”, for general principles and requirements.

Extensive glazing shall be used to augment security and introduce natural light. Primary station materials shall be concrete, aluminum and glass. All materials and components shall be high quality, durable, vandal-proof, corrosion resistant and easy to maintain. Pedestrian bridges and stairways shall be fully enclosed. Station structures shall be designed based on a basic module to provide the most standardized and cost efficient panel configuration in case of breakage. The use of standardized, easily sourced and replaceable components is a requirement for the design of every station. Given the harsh environment which includes but is not limited to vandalism, as well as, weather related conditions, it is necessary to avoid new, unproven technologies and “one off” components which may not be available through regular procurement channels or through OC Transpo’s maintenance group.

OC Transpo will provide final approval of all proposed elements and materials during the preliminary and detailed design phase. The station must be designed to provide an efficient layout which facilitates the transfer of passengers either to final destinations or to other elements of the system. Although the system is predominantly for buses, the design of each station must take into consideration the interface between the Transitway, local bus routes and other multi-modal connections. Station buildings and platforms are to be interconnected to adjacent streets, sidewalks, and pathways by barrier free path of travel.
The designer shall consider the eventual conversion of stations to a light rail transit system. Although some stations may be eliminated or replaced entirely during conversion, the designer shall

not provide designs which clearly preclude conversion, connection or addition to a multi-modal system. During the preliminary design phase the designer shall review future City of Ottawa Light Rail Transit requirements with OC Transpo for guidance in this regard.

A measure of success of mass transit resides in its appeal to the users. Stations that are located too far or are poorly integrated into their surrounding communities are unlikely to generate local ridership and will fail to achieve the City of Ottawa's long-term objectives with respect to transit-oriented development and increased modal share. As development occurs across the City, it is imperative to perceive the design of stations as integrally linked with the development of the surrounding community. This may include connections into local amenities such as multi-use pathways, shopping complexes and rail stations but can also be taken in the broader context of materials, finishes and community artwork. It is important for new station designs to be part of a meaningful dialogue early in the development of new sub-divisions and that the discussions with the developers include proper planning to address mass transit requirements.
In general, where a grade-separated Transitway occurs, linear station design is preferred where vertical circulation acts as the central organizing element and public lobbies are kept on the platform side. Ancillary spaces such as generator, water entry and electrical rooms are kept to the far side and aligned parallel to the platforms. This configuration also allows for any increases in lobby or ancillary rooms to be accommodated or additional modular shelter elements to be added without the need to re-organize the functional layouts. This allows for expansion of the public and non-public spaces away from the circulation core and in the opposite direction.

As the City pursues transit-oriented developments at rapid transit stations and looks for opportunities to integrate mass transit with commercial and institutional development, it is likely that station designs will increasingly be tied to areas of intensive development. Also, given that surrounding development will occur over a number of years, it is expected that ridership and traffic patterns in new development areas may not reach ultimate design load for some time. With Transitway extensions being considered to new communities, controlled at-grade crossings of the Transitway within the station area have become a consideration. The designer's recommendations for grade separation shall include intersecting road configuration requirements based on ultimate traffic volumes.

The design of stations located at existing or proposed grade separated roadway crossings shall take into consideration the proposed right of way width and required bridge spans. Although the preferred layout is for a clear span under the bridge, there are examples of current stations without clear span conditions. Any design will need to carefully consider security and customer safety, in particular, where columns are introduced. Further, the designer shall consider the cost implications of lengthening the bridge spans in relation to increased costs of bridge structure design and the property requirements.

Special attention shall be paid to the interface with multi-use pathway and accommodation of bicycle storage facilities. It is anticipated that both systems are likely to be co-located and safety concerns associated with higher travel speeds for bicycles and the potential for conflict with both bus and foot traffic will also need to be properly addressed. This may include provision of traffic calming

measures to reduce bicycle speeds or to restrict bicycle use in public areas in and around the stations and platforms.

OC Transpo will confirm their branding requirements on a project by project basis. New station designs will need to integrate these branding principles in a significant but appropriate way. In practical terms, stations should avoid designs which promote the brand through elements which are costly and difficult to replace or maintain.

The City of Ottawa's Official Plan established goals and objectives for maintaining environmental integrity and provides an environmental strategy. Designs should promote, where feasible, the maximum re-use of onsite materials, minimize off-site cartage and minimize the ecological footprint of the undertaking. Efforts should be made in the design of new stations to address the City of Ottawa's Environmental Strategy.

Certain basic amenities will continue to be provided in most stations such as benches and radiant space heaters. Benches shall be accessible and consist of durable material such as painted aluminum or steel design with full backs and armrests. Seat and armrest design shall conform to the latest Accessibility Guidelines.

Heaters shall be provided as defined elsewhere in this Guideline, however, the installation of the button controls shall minimize the visual impact of the devices and to facilitate the installation to adjacent concrete or painted aluminum surfaces.

The station design shall conform to the requirements of the Ontario Building Code and local By-Laws and Ordinances. The designer shall be responsible for making applications to the Municipality and obtaining the building permit for each station on the project.

The designer shall comply with all sections of the Ontario Building Code and, where applicable, the station shall be designed for future conversion to light rail transit. The designer shall undertake pre-consultation with the City Building Officials to determine the applicable Code requirements prior to advancing the design.

The designer shall confirm requirements of the "Art in Public Spaces" program with the City of Ottawa and coordinate any requirements with the design of the station.

8.2 SUPPLEMENTAL CODES

The designer shall conform to but not be limited to the latest edition of the following Codes and Regulations in the preparation of station designs:

Ontario, Building Code.

Building Code Act, 1992.

Accessibility for Ontarians with Disabilities Act (AODA).

Accessible Design for the Built Environment - CAN/CSA-B651-04 (R2010).

Accessible Built Environment Standard.

Ontario Fire Code.

Elevator Code – CSA B-44-07.

8.3 STATION ACCESS

Typical Transitway roadway layouts in the vicinity of stations are given in Section 3.0, "Transitway Geometry".

Access and egress shall be provided at either end of the platforms and care shall be given to ensuring accessibility to the station platforms in case of the mechanical breakdown or maintenance of an elevating device. The platforms shall still be accessible to all customers via pathways and sidewalks.

Convenience, comfort and safety shall be the major objectives of station operation including all provisions for persons with disabilities. OC Transpo shall be consulted early in the preliminary design stage to review the accessibility elements and to determine the design criteria for the station design.

At grade separated roadways and pedestrian crossings at the station facility shall accommodate barrier-free requirements. Access between the bus platforms and the roadway or pedestrian crossing level shall be provided with access pathways and/or ramps unless otherwise approved by OC Transpo. Stations must maintain the same slope and direction of a maximum 1:50 (2%). If the primary means of vertical circulation is mechanical (i.e. elevator), redundancy shall be incorporated in the design by means of the exterior walkways to provide an alternative means of vertical access in the event of elevator outages or maintenance. Where ramps are necessary they shall meet the requirements of Accessibility Guidelines CAN/CSA B651 and of the Ontario Building Code, whichever is the most stringent.

8.4 PUBLIC ART PROGRAM

The City's public art program is embodied within the City of Ottawa's 20/20 Arts Plan, Culture Plan Renewal and Public Art Policies available at the City of Ottawa website (Ottawa.ca). Public Art will play a significant role in shaping the design theme of all stations constructed as part of the Transitway. The City's Public Art Officer shall be consulted during the preliminary design phase to develop the objectives for the public art for the project. The objectives will identify a visionary and contextual approach to the potential scope of public art opportunities. The requirement is that public art informs and is integral to the design of all station designs from inception to completion.

All stations must integrate a component of public art, however, some stations due to their strategic location may be identified through the Public Art Plan to receive a greater share of the public art funding assigned to the project. Public art can be located outside of and/or within stations and may be stand-alone or be integrated with the architectural design of the station. Art projects can feature artwork from both local and national artists in a variety of mediums. All art components must meet strict requirements for maintenance, longevity, and public security. The Art Selection Jury, as part of the design process, will approve the final public art component of each station.

The general process for public art integration on Transitway projects is to be led by the City's Public Art Officer who will work closely with the City Project Manager and consultant throughout the project. The following generally summarizes activities undertaken prior to commencement of station detailed design, however, the designer shall confirm current requirements with the City Project Manager early in the project:

- The City's Public Art Officer will be responsible for organizing and undertaking the call for artists and the public art competition. Note that separate art competitions may be held if more than one station is included in the project.

- The City's Project Manager and Public Art Officer with assistance from the design team will establish potential locations and themes for the public art.

- The design team will provide resource materials such as plan drawings, location plans, site plans and detailed drawings such as wall elevations for use during the public art competition.

- The City Public Art Officer will undertake the Public Art competition. The design team (usually the building architect and consultant project manager) will participate in an initial briefing session for perspective artists. Display boards and handouts will be prepared by the design team.

- The City Public Art Officer will establish the Jury that will be tasked with evaluating the submissions, selection of the artist shortlist and ultimate selection of the successful artist. The City Project Manager and representative of the design team (normally the building architect) will assist the Jury during the evaluation process in an advisory capacity.

- A City Public Art Officer will be responsible for organizing the public information session to allow public art review of the shortlisted artist's proposals.

- The successful artist as selected by the Jury will finalize the public art in coordination with the detailed design of the station. The design team will provide updated drawings, as required, to the successful artist.

- The design team will ensure accommodation of the public art component in station design (i.e. footings, wall or floor space, reserved site area, electrical conduit and wiring) and incorporate into the tender documents any requirements for coordination of future installation of the public art.

8.5 STATION TYPES AND CONFIGURATIONS

8.5.1 General

Station layouts can be categorized into a few typical configurations and variants.

Where customers must cross the Transitway it must be at controlled at-grade crossings or through underpass or overpass grade separations. The designer's recommendation of the most appropriate

means of crossing shall be based on, but not be limited to, considerations including pedestrian and bus volumes, bus frequencies and road geometry.

The location of station core elements in relation to each other is site dependent. Past bus platform arrangements have included aligned and offset configurations which have either been integrated with or independent from adjacent bridge structures. Site considerations such as the width of the right-of-way, access to bus lay-by areas, connections to park and ride lots and integration of multi-use pathways have potential impacts on the location and arrangements of stations, platforms, and, desired interfaces to other amenities and to the community.

8.5.2 Typical Station and Platform Configurations

Stations should be located as close as practicable to cross streets, major roads carrying local bus traffic, Park and Ride Lots, drop-off areas and major employment, commercial or civic nodes. Station design should consider the existing and/or proposed built context and synergies should be developed between new development and station designs wherever possible.

At-Grade Stations:

Where approved by OC Transpo, a stop controlled at-grade pedestrian crossing of the bus lanes may be considered for stations with low bus or pedestrian volumes. Stations are side loading with a centerline median barrier/railing system. Handrails or fencing are to be incorporated to define the pedestrian crossing. Generally, the at-grade pedestrian crossings shall be positioned such that bus stops in both directions are positioned before the stop bar. Under this scenario the crosswalk would be centrally located with the platforms in a staggered layout or integrated with an adjacent road intersection with platforms directly across from each. Figure 8.5.2a provides an existing station that illustrates this type of arrangement.

Grade-Separated Stations:

The following station and platform configurations shall be considered based on operational requirements and physical restrictions:

a) Station towers can be designed on each side of the Transitway connected by an underpass or overpass to facilitate pedestrian crossings of the Transitway. Stations are side loading and bus stops are generally located on the approach side of the station tower. This configuration is typically found in stations that are not integrated with transit-oriented developments or major transit hubs. This station layout is also found where no other adjacent roadways or bus connections exist and is dependent upon walk-in transit customers only. Figure 8.5.2b provides an existing station that illustrates this type of arrangement.

b) Station towers can be integrated with the intersecting roadway bridges (i.e. arterial or collector road overpass structure) and can consist of two or four separate elevator/stairway towers depending on pedestrian access and station design requirements. Transitway platforms link the towers below the bridge while the sidewalks provide linkage between inbound and outbound platforms. Figure 8.5.2c provides an existing station that illustrates this type of arrangement.

c) Station towers can be integrated with a Transitway overpass structure at an intersecting roadway. This type of station would be side loading with platforms on the Transitway structure. Two or four separate elevator/stairway towers would be integrated depending on pedestrian access and station design requirements. The sidewalks of the crossing roadway below the overpass would provide the linkage between inbound and outbound sides of the Transitway. Figure 8.5.2d provides an existing station that illustrates this type of arrangement.

d) Transitway stations may also consist of separate center loading or side loading platform arrangements for local routes and Transitway routes with either horizontal or vertical connections. At-grade and/or grade separated pedestrian crossings will be required to provide access between platforms across active bus lanes. The selection of crossing type is dependent on bus and pedestrian activity and station operational requirements. Customer waiting enclosures should be oriented to align with the platform or separate modular enclosures located in the vicinity of the bus stops. Integration of the station with adjacent development may also be required. Figure 8.5.2e provides an existing station that illustrates this type of arrangement.

8.5.3 Station Platforms

Station platforms shall consist of the following:

- Reinforced concrete 6.0m in width with a minimum overall length of 55m
- Curbs with steel-facing
- Surfaces shall have a broom finish with a contrasting colour, edge strip of textured, red coloured stamped concrete
- Cross-fall shall slope down to the curb at a 2 percent minimum

The 6.0m width of the station platform is required to accommodate the passengers waiting for a bus including those queuing and moving from and to the station. The 6.0m width will also normally accommodate a prefabricated style shelter. Where OC Transpo identifies the need for shelters on the platforms the structural design of the concrete platform shall incorporate the shelter loads. In certain situations and only upon approval of OC Transpo, the width of platforms may be reduced to accommodate site specific constraints such as reduced right-of-way conditions or grading issues. Refer also to Section 4.0, “Transitway Road Design” for additional platform details and requirements.

For stations that are grade separated the platforms shall normally be linked to the second level with exterior walkways. All effort should be made to ensure platforms, or access to platforms, do not exceed a 5% gradient. If a gradient greater than 5% is required, ramps shall be constructed with appropriate amenities as per the Ontario Building Code for ramps and accessibility. If a gradient is greater than 3.33% a tactile walking surface must be provided.

8.6 STATION DESIGN

8.6.1 General

Station structures shall conform to the established standard for the Transitway system and shall provide a safe, open environment with high visibility.

Stations shall be designed to minimize the accumulation of dirt and waste by removing where possible ledges, soffits and open back components where accumulation occurs. All finishes shall have sealed edges and be selected on the basis of durability, resistance to vandalism and ease of cleaning. The station design shall minimize the need for specialized maintenance or equipment.

Life cycle costs should be considered early in the design process with special consideration to maintenance costs over the life of the structure. Consideration should only be given to materials which align with the maintenance procedures and equipment to be used by OC Transpo. The design of maintenance and janitorial areas must take into consideration the size, maintenance and operation of the equipment.

Where feasible, canopies or roof extensions should be provided at main entrances and should be of sufficient size to reduce the amount of environmentals (i.e. rain, snow, slush) that enters the station. Canopies shall be made of durable materials but should avoid custom architectural components such as curved glazing.

Stations should be designed to be un-heated spaces although heating shall be provided in ancillary rooms. Manually-activated radiant heaters shall be provided in the lobby areas as a convenience to customers. The designer shall note that stations will be subject to cold or heat extremes and the design of the station shall incorporate natural ventilation in the form of louvres or static non-powered vents.

The design of the station shall consider the integration of mechanical items including separate utility chases between the various station levels and the roof.

To provide security to transit customers the elevators shall be observation type which will require incorporation of hoistway and car glazing.

The designer shall consider incorporating OC Transpo standard amenities related to site furnishings such as benches, waste receptacles, radiant heater push buttons, actuator mounting requirements for door operator paddles, public phones, emergency phones and map cases. These items may require power and empty conduits to accommodate various quantities and sizes of cabling. The designer shall consider conduit sizing, routing and vandalism resistance and ensure that all elements are fully integrated into the structure and not surface mounted where possible.

8.6.2 Station Design Criteria

The designer shall establish site specific requirements for each station building and space. Specific requirements for each station design shall be confirmed with OC Transpo during the preliminary design stage. Figure 8.6.2 provides a typical checklist of requirements and the approval sheet that the

designer shall complete and submit for each building, area or space, as may apply to each station site, for review and approval by the City of Ottawa Project Manager and OC Transpo prior to initiating the detailed design of the facility. The following are typical station requirements that may be accommodated in the station design:

- Passenger Areas/circulation
- Service rooms
- Elevators
- Escalators
- Communications
- Security
- Emergency power
- Building Automation System (BAS)
- Washrooms
- Concessions/vending provisions
- Ticket sales area/Office space
- Supervisor's office
- Emergency evacuation provisions
- LEED
- Public Art

8.6.3 Public Waiting Areas

Passenger waiting area (i.e. lobbies, shelters) sizing is determined according to the projected ultimate volumes of occupants as provided by OC Transpo. Although there are alternate methods of determining the space, the following can be applied in the determination of the minimum waiting area required:

Number of Occupants x 0.28 sq. m. (3 sq. ft.) = Minimum Occupied Area

The designer shall also consult the Transit Cooperative Research Program (TRCP) "Report 100 Transit Capacity and Quality Service". The minimum lobby capacity requirements and the lobby size shall be confirmed with OC Transpo early in the preliminary design phase.

8.6.4 Pedestrian Underpass

Pedestrian underpasses are to be designed to be spacious, well lit and safe for patrons. Care should be taken to limit the length of the underpass and to provide spaces which feel secure and accessible. Typically, pedestrian underpasses are rigid concrete frame structures with minimum 3.0m clear width. The clear width should be at least 6.0m when combined with multi-use pathways.

The designer shall consider the provision of appropriate measures to separate the different multi-use modes. The design shall be reviewed with OC Transpo during the preliminary design phase.
The provision of natural light through skylights should be considered where feasible in order to enhance underpass lighting characteristics in combination with the underpass luminaires to appropriate illumination levels. Consideration shall be given to photocell control in these situations in combination with natural lighting.

Anti-graffiti coatings shall be included for the interior surfaces of all underpasses.

Underpasses have inherent condensation and drainage issues. The designer should consider measures to reduce the possibility of moisture seepage.

8.6.5 Pedestrian Overpass

The desirable minimum clear interior dimension of a pedestrian overpass is 3.0m.

Typically two types of pedestrian overpass structures are considered:

- Double steel truss frame system with concrete slab infill and glazed wall system
- Post-tensioned low profile slab/beam supporting a light framed glazed enclosure

Laminated tempered glazing shall be specified in all cases and care shall be taken to ensure that glass maintenance and replacement can be performed from the inside of the structures.

Condensation shall be controlled through the incorporation of operable windows complete with metal mesh screening.

8.6.6 Building Service Rooms

The designer shall coordinate the service room design with the requirements of their respective uses (i.e. elevator controllers and/or machine, electrical/communications, plumbing, maintenance, storage, etc.).

8.6.7 Supervisor and Operator Rooms

Locations identified by OC Transpo Supervisor and/or Operator Rooms including washrooms shall be incorporated into the station building design. Requirements for these spaces are site specific and shall be confirmed by OC Transpo prior to design.

8.6.8 Information Centre

Where identified by OC Transpo Point of Sales (POS) equipment may be installed in larger stations as part of information and ticket purchase counters. POS equipment continues to evolve quickly and may require an interface and exchange between OC Transpo employees and the user. It is important to note that POS equipment requires special attention and detailing. Power feeds must be adequate and may require emergency and uninterrupted power supplies. Countertops and millwork

must be adapted to the specifics of the equipment and to the interface between the public and the OC Transpo employee to ensure visibility and safety. Barrier-free accessibility is also critical in the design of both the secure side, as well as the public side and is doubly impacted by the security requirements which may involve security glazing and partition assemblies. The designer shall establish exact requirements including supporting facilities with OC Transpo. (i.e. offices, storage areas)

8.6.9 Passenger Shelters

Requirements for platform shelters are site specific based on ridership volumes and station layout. The designer shall confirm requirements for platform shelters with OC Transpo. Refer to sub-section 8.5.4 with respect to calculation of waiting area size. Refer also to Section 17.0, “Other Facilities”.

8.6.10 Vending Machines, Vendor Facilities

OC Transpo will identify whether any accommodation shall be included in the station design for provision of vending machines and vendor facilities.

8.6.11 Bicycle Storage

The designer shall accommodate bicycle storage/rack/equipment areas and/or facilities. Refer also to Section 17.0, “Other Facilities”.

8.6.12 LEED Considerations

In general, the City of Ottawa’s current Policy on Green Buildings does not apply to station design. The primary reason to date has been the small size of the facilities making them ineligible. However, the current result of the policy is the requirement to certify certain new structures according to the LEED (Leadership in Energy Efficient Design) standard. The underlying principles of LEED are the application of sustainable principles to the design process. The end result is a certification, which although important in some respects, is not the reason why sustainable strategies should be used in the design of any new structure. Based on this premise it is relevant to apply good environmental practices. Of particular interest in the design of stations and their surrounding location, would be:

a) Site erosion and sedimentation – The stations are designed as part of a network of roads and pathways. Much of the soil is disturbed and the route often passes near sensitive areas. Although much of this is subject to the EA (Environmental Assessment) process, additional conditions should be imposed within the Contract Documents to ensure that the bidders’ erosion and sediment control achieves the highest possible environmental goals. This will impact greatly the site design including the drainage conditions and may affect components from roadbed mix in terms of permeability through water retention scenarios.

b) Materials and finishes – Station design has largely responded to the concerns for the durability of finishes. For this reason, stations have largely consisted of concrete, steel and painted aluminum. In terms of sustainable strategies, there are substantial opportunities inherent in the finishes including but not limited to:

- High fly ash content in concrete products
- Recycled content in steel and aluminum
- Low VOC in paints and coatings – This would also include coatings on aluminum and steel components

c) Energy Management – Although the stations are essentially unheated spaces, attention must be provided to the type of electrical equipment and fixtures specified. The spaces are well lit 24/7 and the efficiency of fixtures both in terms of operation and maintenance (i.e. frequency, specialized equipment, etc.) are important considerations. Recent advancements in elevator technologies (no machineroom, gearless traction units) have also made the use of inefficient, hydraulic elevators questionable in future design.

d) The expressed requirement for the integration of stations to adjacent development and land uses may identify additional opportunities varying from green roofs to the use of local materials for landscaping (i.e. armour stone).

Each situation will demand a case by case review, however, from a design perspective sustainable strategies should be inherent and integrally considered. These strategies should be addressed during the preliminary design phase rather than an add-on process to provide fundamental and cost considered solutions for each project.

8.7 MATERIALS

a) Coating Systems:

All interior and exterior handrails and exposed structural members shall be made from durable, low maintenance materials such as aluminum (anodized or painted) or steel (galvanized, stainless or painted). Paint systems, where required, shall be resin based, premium, top coated applications involving a minimum 3 or 4 coat system. Systems such as Duranar XL shall be preferred over anodized systems in aluminum finishes given the high levels of salt concentrations found on the Transitway. Structural steel coating systems shall include as a minimum:

- Epoxy Zinc primer
- High build epoxy mastic intermediate coat
- A two coat component polyurethane top coat

Where paint is used, the coating system shall meet all Provincial Environmental Standards and under no circumstances shall have Cadmium based colour mixes.

Polyester powder coating systems may be specified for shelter applications.

b) Flashings/Roofing:

All roofing materials shall be specified to industry standards and shall be of durable, low maintenance materials such as modified bituminous membrane. Vegetated roofing membranes

may be specified, where appropriate, however, attention shall be given to plant selections requiring no irrigation and limited maintenance programs, as well as tolerance to a salt environment.

c) Doors, Hardware, Glazing and Framing:

Window members and public area doors shall be fabricated of prefinished aluminum. Colours shall be confirmed with OC Transpo. Members shall be fabricated from full extrusions of sufficient size to withstand wind loading and be provided with aluminum pressure plates. Preference shall be given to capped systems, however, structural silicone systems may also be used, where applicable, provided these are reviewed with OC Transpo for compliance to long-term maintenance planning.

Aluminum doors shall be heavy duty, heavy wall with 50mm nominal thickness and reinforced corner welds (instead of the standard 42mm regular door thickness). Panelized, thermally broken doors do not meet this requirement and should not be specified. Door stiles and headers shall be sized to accommodate the LCN door closer.

Steel doors to ancillary spaces shall be 1-1/2 hour fire rated, heavy duty, galvanized doors. Exterior doors shall be insulated. All doors shall be reinforced and prepared to receive Grade 1 stainless steel hardware as follows:

- 1.5 pairs of heavy duty butt hinges, non-removable pins for all exterior door applications and areas where there is public access
- Locksets with lever handles and strikes, *Acceptable product: Bestlock 83K-7D-4C-53*. Construction cores shall be initially installed
- Closer on non-power operated doors, *Acceptable product: LCN Series 4040 SRI, parallel arm surface mounted of sufficient size and strength to suit width of door and expected wind conditions with aluminum colour finish (626)*

Labels shall be provided with the appropriate fire rating on all fire rated doors and assemblies.

Exterior doors and exterior double doors (to generator rooms) shall be provided with the following additional hardware:

- Weatherstrip: Neoprene or vinyl, continuous
- Door-hold open: on all exterior steel doors, door holder/shock absorber, surface-mounted with stainless steel finish, complete with hold-open mechanism and door over-travel protection. Device to be selected to function integrally with all other hardware selected, specifically the door closer. All closers shall be mounted to the door
- Floor Sweeps: heavy duty, surface mounted, spring loaded door bottom, full width of door and complete with neoprene sweep
- Kick plates: 1.6mm thick, brushed finish stainless steel, 250mm high x door widths less 50mm. Mount on push inside face of each leaf
- Door sills: aluminum mill finish, 12mm high by width of door

- Acoustical seals: full gasketing on all doors to generator rooms applied as a secondary gasket to door main gasket.
- Latch astragal on double doors: *Acceptable Material: Folger Adam, 700 x snb-D134 with 626 finish*.

Aluminum Door Hardware shall consist of:

- Hinges: heavy duty stainless steel, full length, each leaf, 600 lb. rating or approved equivalent
- Closer on non-power operated doors: *Acceptable product: LCN Series 4040 SRI, parallel arm door mounted of sufficient size and strength to suit width of door and expected wind conditions, Aluminum colour finish (626)*
- Door Pulls: tubular "D" type 25 mm diameter, stainless steel, 300 mm high, 75 mm offset both sides of the door
- Fasteners: aluminum, cadmium plated steel, or stainless steel, finished to match adjacent material
- Weatherstrip: Mohair
- Thresholds: extruded aluminum alloy 13 mm high by width of door, mill finished
- Kick plates: 1.6 mm thick, brushed finish stainless steel, 300 high x door widths less 50. Mount on push face of each leaf
- Door Holder/Shock Absorber: surface-mounted with stainless steel finish, complete with hold-open mechanism and door over-travel protection
- Door Operators: automatic door operators, heavy-duty, built-in adjustable doorstop, field adjustable speed control, electronic back check, built-in electric strike interface, on-board 1 amp power supply and sequencing board. Actuator buttons to be remote controlled (wireless) or hard wired. LOGO ONLY, no wording. Key switch operated. *Acceptable product: Camden and Wikk.* Include mushroom cap activator switch
- All door hardware in station buildings shall be high quality, durabl e, vandal proof and corrosion resistant to OC Transpo's requirements

d) Exposed Concrete and Drywall Areas:

All exposed concrete surfaces shall be of architectural quality exposed concrete. Tie holes for formwork shall be filled-in and all surfaces shall be sack rubbed, as required, to ensure a smooth and visually consistent surface aesthetic throughout. Exposed concrete surfaces in all areas should be top-coated with an anti-graffiti system. The type of anti-graffiti coating material currently in use should be confirmed with OC Transpo. Attention should be paid to exterior areas to avoid areas of excessive sweating as in tunnel ceiling areas when using anti-graffiti coating systems which affect the surface characteristics of concrete. The specifics of each design should be reviewed with OC Transpo prior to finalizing the material selections.

e) Finished Walls in Public Areas:

Consideration may also be given to other high strength surface finishes for high traffic areas. These may include but are not limited to solid phenolic or aluminum composite panels as well as glazed concrete block. Materials should be non-combustible, easily maintained and suited for the proposed application. The designer shall review finishes with OC Transpo prior to the final selections of interior/exterior facing materials.

f) Floor Finishes in Public Areas:

Floors in public interior spaces shall receive a non-skid, epoxy matrix safety floor such as Stonhard's HRI system. The floor system shall be provided with 100mm high integral coves on all exposed areas. Preference shall be given to aggregate matrix broadcast systems over urethane top-coated systems which lack the slip resistance of broadcast systems with non-reflective coverings. All floor surfaces shall have an aggressive surface texturing to ensure non-slip qualities. The floor system shall include joints where appropriate depending on the underlying concrete structure. The joint material to be utilized at the concrete structure expansion and construction joints shall conform to manufacturer's requirements.

g) Floor Finishes in Service Rooms and Ancillary Areas:

Floor areas of heated ancillary spaces and services rooms shall be painted using a durable water based epoxy system. The designer shall confirm requirements with OC Transpo.

h) Floor Drainage:

All service rooms and lobby floor areas shall be provided with positive surface drainage towards floor drains, with the exception of potential fuel/oil/coolant spill locations.

Within underpasses and overpasses the minimum cross-falls shall be constructed to provide drainage to gutters with regularly spaced storm drains and outlets. The floors shall be crowned in the middle with gutter longitudinal drainage provided on both sides.

i) Seating:

Seating requirements shall be reviewed with OC Transpo during the preliminary design phase. All seating configurations shall be developed according to the latest accessibility guidelines and all design considerations shall be given to ensure that seating can be provided on a priority basis. Seating configurations shall include as a minimum, one 1200mm long bench in each Transitway level lobby and include for the accommodation of wheelchair accessible locations. The designer shall ensure that seating layout design shall be appropriately positioned to avoid conflict with pedestrian traffic flow.

Installation mechanisms shall be provided which minimize contact surface points with the floor of the station and maximizes clearance for removals and cleaning. The preference is to specify benches with wall mounted or cantilevered installations.

Exterior seating shall be provided and can be integrated with the exterior features such as upstand walls and retaining walls. The designer shall ensure that the requirements of the Ontario Building Code are met.

All seating shall be designed with consistent form and use inorganic materials which are durable, and require little or no maintenance; skateboard and vandal resistant, easily maintained with preference for wall or cantilever support. All seating shall be provided with full backs and armrests at both ends of any section of bench.

8.8 OTHER CONSIDERATIONS

a) Exposed Services and Chases:

Station designs may involve exposed ceiling conditions. Although this is an appropriate aesthetic, the designer shall take precautions to ensure that the various exposed mounted services (i.e. conduits, fixtures, plumbing, fasteners, etc.) can be accommodated in orderly fashion. Where feasible, routing of services should be accommodated in ancillary spaces or contained within the structure and sufficient flexibility should be incorporated to allow extension of the network to service future expansions of the station. In order to avoid unsightly installations attention should be given during the design phase to provide one or more chases to accommodate the services including potential future requirements.

In all cases, services should **not** be run exposed through elevator shafts given the limitations imposed by the Elevating Devices Act and Standard B44 and by the possible conflicts with the installation of elevator related equipment.

It is recommended that the designer consider the introduction of mechanical and electrical vertical chases and/or runways in order for all services to be located with as little conflict and exposure as possible. Potential services between floors and within spaces may include but not be limited to:

- Stack vents
- Roof and floor drain drainage
- Janitor room drainage and water feeds
- Electrical and fire safety feeds
- Trap seal primer water feed lines
- Telecommunication feeds and security feeds
- Heating and ventilation feed
- Emergency power electrical feeds
- Generator fuel tank filling station and associated vents

b) Design and Sizing of Elevator Shafts and Machine Rooms:

Elevator shaft and machine room sizing should be designed for the worst case scenario including the depth of the elevator pits. Given that elevator equipment will likely be specified generically, the designer should provide the most generous interpretation of the hoistway requirements to avoid expensive changes to contracts to accommodate Contractor selected equipment. This work should also include a review of the shaft structure to be able to support the worst case scenario from the major elevator suppliers especially in terms of hoist beam and support beam conditions. The specifications should refer to a preferred elevating device system used in the design of the station and state assumptions taken. **Non-proprietary** controllers and hardware should be specified in all cases and therefore design conditions such as elevator closet/machine room location and interface with elevator shaft will need to be based on the most accurate information provided by the manufacturers. The designer should specify that the dimensions of the elevator shaft and elevator machine room specified in the contract shall be verified based on the Contractor's proposed elevator and manufacturer's specifications.

c) Handrails:

Stairway handrails shall be stainless steel conforming to the Ontario Building Code. Handrails on stairwells and landings shall be continuous and provided on both sides of the stairway/landing. Refer also to Section 11.0, Accessibility".

d) Stair Nosing:

Stair nosing consisting of a tactile highly visible strip shall be incorporated in all stair treads. Detectable warning surfaces shall be provided at tops and bottom of each stairway run. Refer also to Section 11.0, "Accessibility".

8.9 FIGURES

The designer shall refer to the following figures as referenced in above sub-sections:

Figure 8.5.2a: AT-GRADE TRANSITWAY STATION EXAMPLE

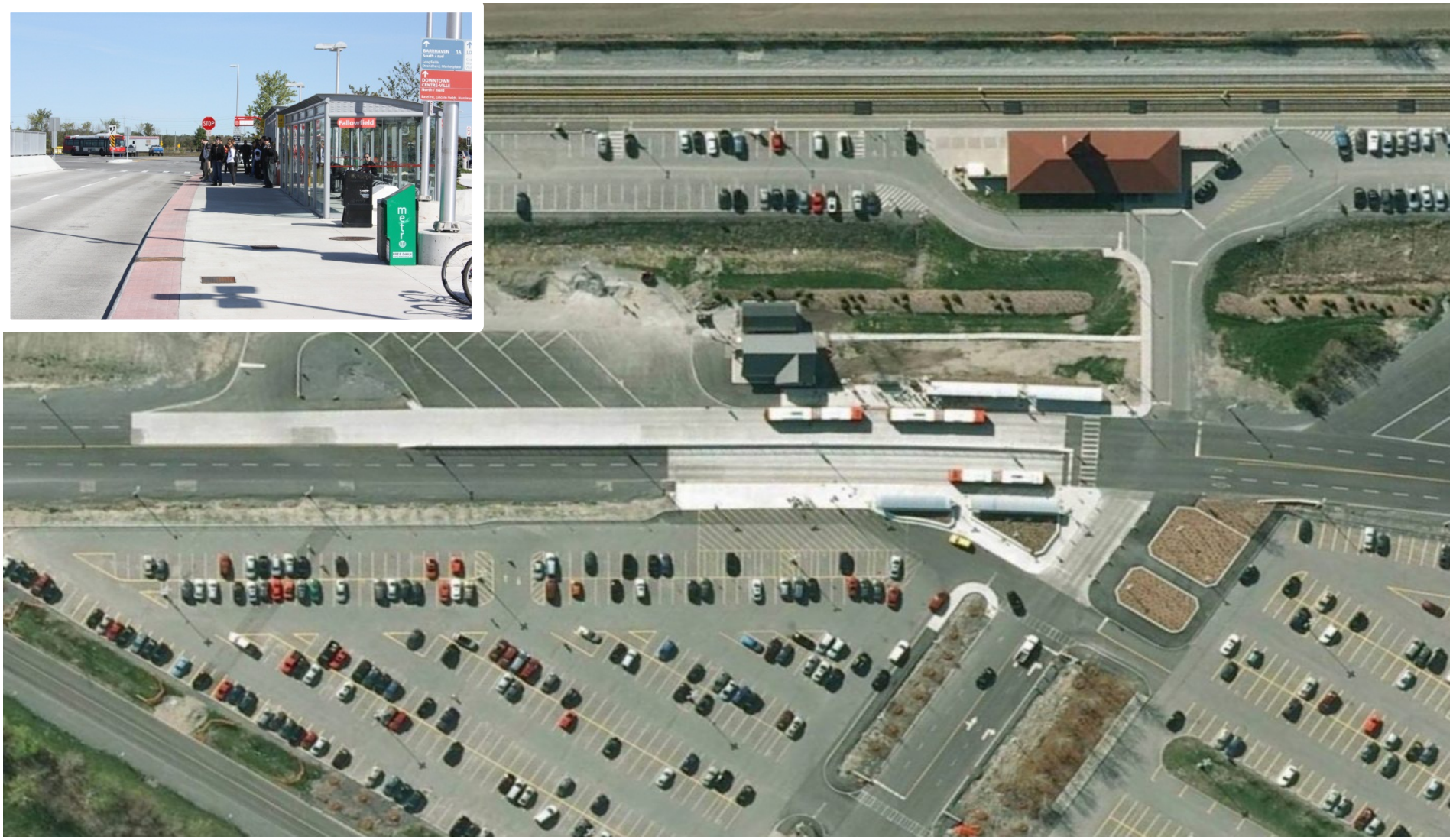
Figure 8.5.2b: GRADE SEPARATED TRANSITWAY STATION EXAMPLE - 1 of 4

Figure 8.5.2c: GRADE SEPARATED TRANSITWAY STATION EXAMPLE - 2 of 4

Figure 8.5.2d: GRADE SEPARATED TRANSITWAY STATION EXAMPLE - 3 of 4

Figure 8.5.2e: GRADE SEPARATED TRANSITWAY STATION EXAMPLE - 4 of 4

Figure 8.6.2: FACILITY DESIGN CRITERIA AND CHECKLIST



FALLOWFIELD STATION

Ottawa OC Transpo	**AT-GRADE TRANSITWAY STATION EXAMPLE**	*Scale* **N.A.**	*Date* **May 2012**
		Revision No./Date	
	TRANSITWAY AND STATION DESIGN GUIDELINES	**Figure 8.5.2a**	

SMYTH STATION

LYCEE CLAUDEL STATION

Ottawa OC Transpo

GRADE-SEPERATED TRANSITWAY STATION EXAMPLE 1 of 4

Scale	N.A.	Date	May 2012
Revision No./Date			

TRANSITWAY AND STATION DESIGN GUIDELINES

Figure 8.5.2b

CYRVILLE STATION

Ottawa OC Transpo	**GRADE-SEPARATED TRANSITWAY STATION EXAMPLE 2 of 4**	*Scale* **N.A.**	*Date* **May 2012**
		Revision No./Date	
	TRANSITWAY AND STATION DESIGN GUIDELINES	**Figure 8.5.2c**	

Ottawa OC Transpo	**GRADE-SEPERATED TRANSITWAY STATION EXAMPLE 3 of 4**	*Scale* **N.A.**	*Date* **May 2012**
		Revision. No./Date	
	TRANSITWAY AND STATION DESIGN GUIDELINES	**Figure 8.5.2d**	

LINCOLN FIELDS STATION

Ottawa OC Transpo	**GRADE-SEPERATED TRANSITWAY STATION EXAMPLE 4 of 4**	*Scale* **N.A.**	*Date* **May 2012**
		Revision No./Date	
	TRANSITWAY AND STATION DESIGN GUIDELINES	**Figure 8.5.2e**	

Figure 8.6.2

FACILITY DESIGN CRITERIA AND CHECKLIST

Station/Facility Name:		**Facility Location:**	
Consultant:			**Date:**

REQUIREMENTS FOR FACILITY (check those that apply or insert as required)

Passenger Areas/ Circulation ☐	Designated Waiting Areas ☐	Drinking Fountain ☐	ATM ☐
	Benches/Seating ☐	Heating ☐	Fire Extinguisher ☐
	Circulation Areas ☐	Ventilation ☐	Landscaping ☐
	Waste Receptacles ☐	Air Conditioning ☐	Lockup Provisions ☐
	Recycling Provisions ☐	Pedestrian Access Ramps ☐	Floor Drains ☐
	Information Panels ☐	Ticket Vending Machine ☐	Redundant Vertical Transportation (Ramp) ☐
	Dynamic Signage ☐	Pamphlet Display Rack ☐	
	Platforms ☐	Bike Racks ☐	Bus Flag Poles ☐
	Advertising Provisions ☐	Bike Shelters ☐	Night Stop Provisions ☐
	PA System ☐	Payphones ☐	Sprinklers ☐
Service Rooms ☐	# of Elevator Rooms =____	Heating ☐	Secondary Power ☐
	# of Elev. Machine Rms =____	Ventilation ☐	Access Control Req'ts ☐
	# of Escalator Mach Rms =___	Air Conditioning ☐	Service Phone ☐
	# of Janitor Rooms = ____	Lighting ☐	Equipment/Storage Rm ☐
	# of Storage Rooms = ____	Water Service ☐	Floor Drains ☐
	# of Water Entry Rooms = ____	Sanitary/Storm Service ☐	Fire Extinguisher ☐
		Communications ☐	☐
Elevator ☐	# of Elevators = _____	Traction ☐	Observation (glazed type) ☐
	# of Floors = _____	Hydraulic ☐	Inside Finishes (include list) ☐
	Size: _____ x _____	Emergency Operation ☐	Accessible AODA ☐
Escalator ☐	# Escalators = _____	Emergency Operation ☐	☐
	# Floors = _____	BAS Monitored ☐	☐
Communications ☐	PA System (2 Way) ☐	Route Information ☐	Variable Message Sign ☐
	Emergency Call Box ☐	Next Bus Display ☐	Remote Control Devices ☐
	# of Mapcases = _____	☐	☐
Security ☐	CCTV ☐	Site Access Control ☐	Special Lighting Type/Levels: _____
	Access Alarmed ☐	Emergency Push Buttons ☐	
Emergency Power	Diesel Generator ☐	Include the following:	
	Certificate of Approval ☐	BAS ☐	Life Safety Systems ☐
	UPS ☐	Lighting ☐	Elevators ☐
	☐	CCTV ☐	Communication Board ☐
Building Automation System ☐	Web Based Access ☐	Fire Panel ☐	Lighting Control ☐
	Stand Alone ☐	Generator ☐	(Fire Control) Elevators ☐
		Pumps ☐	Escalator Status ☐
		Station Temperature ☐	Push-button Alarms ☐
		Infrared Heating Control ☐	HVAC operation ☐
		High Temperature Alarm ☐	Fan Controls ☐
		Room Temperature ☐	High Water Alarm ☐

Figure 8.6.2

FACILITY DESIGN CRITERIA AND CHECKLIST (Cont'd)

Washrooms (for OC Transpo Use) ☐	Men's' WC Size _____x_____ Women's WC Size ____x____ Lockers ☐ Lobby Area (Chairs, Table) ☐	Access/Security ☐ Payphone ☐ Computer Terminal ☐ Kitchenette ☐ Drinking Fountain ☐	Accessibility Provisions ☐ Lighting ☐ HVAC ☐ Display Bulletin Board ☐ ☐
Concessions/ Vending Provisions ☐	Facility Area / Machines ☐ Storage Areas ☐	Communications/Power ☐ Access Provisions ☐	Washroom ☐
Accessibility Features Required? **Yes** ☐ **No** ☐	Benches ☐ Power Door Options ☐ Stair Nose Strips ☐ Stair Resting Stops ☐	Elevating Devices ☐ Curb Ramps ☐ Ramps ☐ Accessible Route ☐	Tactile Warning Strips ☐ AODA Requirements ☐ CSA Requirements ☐ City of Ottawa Requirements ☐
Operational Requirements	Bus Lay-up Area ☐ # of Buses = _____ # of Local Bus Stops = _____	Operator Rest Facility ☐ Transit Supervisor and Security Parking ☐	Bus Turnaround ☐ Service Vehicle Parking ☐ Passenger Pickup/Dropoff ☐
Ticket Sales, Office Space ☐	Facility Area/Machines ☐ Storage Areas ☐ Staff Area ☐ Access/Security ☐	Lighting ☐ Power/Communications ☐ Processing Area ☐ ☐	Accessibility Provisions ☐ Washroom ☐ HVAC ☐ ☐
Supervisor's Office ☐	# of Staff = _____ Office Size _____x_____	Lighting ☐ Power/Communications ☐ . ☐	Washroom ☐ HVAC ☐ ☐
Emergency Evacuation ☐	Emergency & Maintenance Vehicle Access ☐ Fire Safety/Evacuation Plan ☐ Posted Fire ☐	Stairs / Doors (access control) ☐ Lighting ☐ Fire Annunciator Panel ☐	Ventilation ☐ HVAC ☐ PA System ☐ ☐
LEED ☐	Required According City Policy? ☐	Accreditation Level? _____ ☐	☐ ☐
Public Art	Required per City Policy? Yes/No _____	Incorporate with Design & Construction ☐	Incorporate after Construction ☐
Other ☐	☐ ☐ ☐	☐ ☐ ☐	☐ ☐ ☐

Attachments:

Room Finish Schedules ☐		☐	
Door Schedules ☐		☐	
Hardware Schedules ☐		☐	
Millwork and Finish Schedules ☐		☐	
☐		☐	

Figure 8.6.2
FACILITY DESIGN CRITERIA AND CHECKLIST (Cont'd)

Other Requirements:

Prepared by (Consulting Firm Name):

Consultant PM:			
	(print name)	(signature)	(date)

Approved by:

City Project Manager:			
	(print name)	(signature)	(date)
OC Transpo Reviewer:			
	(print name)	(signature)	(date)

9.0 INTERFACE WITH PEDESTRIAN AND CYCLING NETWORKS

9.1 GENERAL

The subject of this section is to discuss the two distinct modes of accessing the Transitway stations, namely, cycling and walking. Each mode requires separate facilities to minimize conflicts and meet the City of Ottawa standards. To optimize the use of the station by the local community, each station design should carefully consider the access points for both cycling and walking to the station. The minimum standards for sidewalks and pathways should be reviewed within the specific site plan and enhanced to provide adequate facilities for both pedestrians and cyclists.

The practice for design standards for the City's multi-use pathways can be sourced from documents such as the Transportation Master Plan (TMP), Greenbelt Master Plan, various right-of-way design guidelines, the Pathway Network for Canada's Capital Region, the Ottawa Cycling Plan and the Bikeway Planning and Design Guidelines, Park and Pathway Development Manual, etc. The latest edition of the above-noted documents shall be consulted.

This section deals only with the design of the sidewalks or pathway linkages immediately adjacent to transit stations. The design of a multi-use pathway network that may develop within or adjacent to the Transitway corridor is not included in the scope of the Transitway and Station Design Guideline.

9.2 DESIGN CRITERIA

Table 9.2 provides recommended design criteria for pathway and sidewalk linkages. These criteria are provided as a guide for the design of local pedestrian and cycling access within or adjacent to a Transit or Park and Ride Facility and for the design of linkages to the adjacent network of sidewalks and multi-use pathways. The designer shall confirm the design criteria with the City of Ottawa during the preliminary design phase. The designer shall also review accessibility and comply with the Accessibility for Ontarians with Disabilities Act (AODA) by reviewing the requirements of the Accessible Built Environment Standards, the Ontario Building Code (OBC) and the Canadian Standards Association (CSA).

TABLE 9.2:
PATHWAY AND SIDEWALK LINKAGES
RECOMMENDED DESIGN CRITERIA

CRITERIA	PATHWAY DESIGN CRITERIA	SIDEWALK DESIGN CRITERIA
Horizontal Width	• Minimum width 3m • 4m to 4.5m width in high volume areas preferred.	• Minimum 1.8m width • Minimum 2.5m width in high volume areas preferred.
Lateral Clearance	• 1.5m lateral clearance on each side of the pathway surface (exceptions may occur in certain situations).	• 1.0m lateral clearance on each side of the pathway surface (exceptions may occur in certain situations).
Vertical Clearance (structures and underpasses)	• Minimum = 3.0 m • Preferred = 3.5 m for aesthetic and security reasons, as well as to allow maintenance vehicle access.	• See Pathway criteria.
Profile Grade	• 5% or less • Refer to Accessibility (below)	• See Pathway criteria
Transverse Slope	• Max = 2%	• Max= 2%
Surface	• Asphalt - pavement structure to be reviewed by geotechnical engineer based on intended use and potential maintenance vehicle access.	• Concrete – refer to City of Ottawa Standard Details.
Pavement Markings	• Continuous centerline yellow line marking (refer also to Ottawa Cycling Plan Design Guidelines)	• NA
Sight Distance	• 40 km/hr design speed - along curves and inclines. • No dense foliage close to pathway edge.	• Provide clear lines of sight along the sidewalk. • Maintain a maximum height of 1.5m for shrubs and 1.8m clear for deciduous trees. • Maintain an offset of a minimum of 5.0m for conifers.
Accessibility	• For slopes greater than 5% incorporate features that meet or exceed accessibility design standards as per OBC, CSA and Accessible Built Environment Standards.	• See Pathway criteria. • Sidewalk intersection ramps to meet the City of Ottawa Standard requirements for the visually impaired at Transitway and/or road

TABLE 9.2:
PATHWAY AND SIDEWALK LINKAGES
RECOMMENDED DESIGN CRITERIA

CRITERIA	PATHWAY DESIGN CRITERIA	SIDEWALK DESIGN CRITERIA
		crossings.
Signage	• Regulatory and safety signage. • Universal symbols or bilingual • Clearly defined wayfinding signage.	• Clearly defined wayfinding signage.
Lighting	• Required in the vicinity of Transit Stations. Refer to Section 14.0 .	• Required in the vicinity of Transit Stations. Refer to Section 14.0.

9.3 OTHER CONSIDERATIONS

The designer shall review the City of Ottawa Cycling Plan to determine requirements for existing and future multi-use pathways within planned Transitway corridors. Identification of any additional pathways which may improve the linkages between the adjacent community and the Transit Station should be reviewed with the relevant City departments during the preliminary design phase.

Transit stations may be constructed to meet the future needs of the development area as well as current needs. Therefore, while all planned pedestrian and cycling connections may not be initially required they shall be incorporated into the design. For example, provision for additional width under a bridge to accommodate a future recreational multi-use pathway shall be considered.

In close proximity to the stations, the cyclist shall be directed to dismount and walk the bike to the platform or bicycle storage location. During design development the designer should consider requirements for speed calming measures particularly in the vicinity of Transit Stations that include multi-use/pedestrian underpass structures.

10.0 PASSENGER INFORMATION SYSTEM

10.1 GENERAL

Public information and signage is provided so that an infrequent transit user with limited knowledge of the local area served by the Transitway station shall be able to use the entire transit system with user friendly resources and accessibility for all.

OC Transpo is currently preparing a Transit Signage Design Guideline which incorporates techniques and standards typical to the City of Ottawa and will incorporate an OC Transpo Branding program which is also being developed.

10.2 INFORMATION SIGNAGE

All information signage is designed and installed by OC Transpo and/or their representatives.

10.3 STATION IDENTIFICATION AND DIRECTIONAL SIGNAGE

Station Identification signs should be visible from all approach roads and pathway. Signage for Transitway stations follow precise standards, with details provided under OC Transpo's "Visual Design Standards".

These Standards follow the current branding of OC Transpo and are under review. Coordinate the station design with the OC Transpo Public Information Group to allow sufficient space for both Station Identification and Directional Signage.

10.4 OVERHEAD AND PYLON SIGNS

To assist in the control of vehicle access at the Transitway access ramps and connections to public roadways, the designer shall include the supply and installation of large illuminated overhead "Do Not Enter" signs where advance warning is required, as well as smaller illuminated "Do Not Enter" pylon signs locally at the entrance. Refer to Figure 10.4a and 10.4b for Pylon and Overhead Sign details respectively.

ILLUMINATED OVERHEAD SIGN

ILLUMINATED PYLON SIGN

10.5 SYSTEM MAP AND SCHEDULES

System maps, route maps and schedules are installed in custom designed illuminated map cases. Refer to Figure 10.5. These map cases are to be located as identified by OC Transpo during the preliminary design stage of the project. There can be as many as 3 map cases connected to allow sufficient space for information. The map cases require 120v power supply for operation.

TYPICAL MAP CASE

10.6 ROUTE/PAMPHLET DISPLAY CABINETS

At larger stations the designer shall include the supply and installation of Pamphlet Display Cabinets where directed by OC Transpo. Refer to Figure 10.6. These cabinets should be installed at locations that are highly visible to the public and approved by OC Transpo. There may be as many as 2 installed per location depending on the amount of information to be made available.

TYPICAL PAMPHLET CABINET

10.7 BUS STOPS FLAGS

Transitway stations currently have a custom designed aluminum Bus Flag that details the stop information. Refer to Figure 10.7a which provides the bus flag details and Figure 10.7b which provides the bus flag pole details. These flags can be pole mounted on a custom designed curved pole, wall mounted or suspended from a structure by various means. Flags should be placed in a location immediately adjacent to the bus stop and approved by OC Transpo. There must be at least 7ft. clearance below the flag.

SUSPENDED BUS FLAG

POLE MOUNTED BUS FLAG

10.8 ROUTE DISPLAY – TELIDON

OC Transpo currently operates video text display units at some of the major stations. These units are strategically placed at highly visible locations usually suspended for viewing by the customers. Each unit requires a communications conduit and a 120 volt power feed to the electrical room. The designer shall confirm with OC Transpo (Public Information Group) any requirements that should be incorporated into the station design related to the route displays.

TELIDON

10.9 PASSENGER INFORMATION SYSTEM

OC Transpo is currently investigating a real time bus information system that will utilize GPS information that will be displayed to the customers on the platforms and in the waiting areas. The designer shall confirm with OC Transpo any requirements that should be incorporated into the station design related to the Passenger Information System.

10.10 PUBLIC ADDRESS SYSTEM

The designer shall provide conduits from the main communication boards in the main electrical room to all shelters and public waiting areas for future installation of a public address system. The designer shall confirm with OC Transpo any requirements that should be incorporated into the station design related to the public address system.

10.11 PUBLIC TELEPHONES C/W BUS INFORMATION AND SECURITY AUTODIAL FEATURES

The designer shall provide conduits to locations for potential installations of public pay telephones. The payphones shall be readily accessible and visible to the public yet have an element of audible privacy. Bell Canada will authorize installation of phones where they deem them to be of financial benefit. The locations shall be coordinated with OC Transpo.

PUBLIC PAY TELEPHONES

10.12 NETWORK COMMUNICATIONS DUCTS

To provide for future flexibility for the installation of communications and information technology 2x100mm ducts shall be provided throughout the total length the Transitway through stations and structures. Provide sufficient service access and maintenance structures to install future wiring and connection points. The provision of communications wiring may be integrated in conduit for other uses. A thorough examination of the communications network should dictate the provisions.

Refer to Sections 4.0, “Transitway Road Design” and Sections 14.0, “Electrical” for specific requirements related to communications ducts.

10.13 FIGURES

The designer shall refer to the following figures as referenced in above sub-sections:

Figure 10.4a: PYLON SIGN

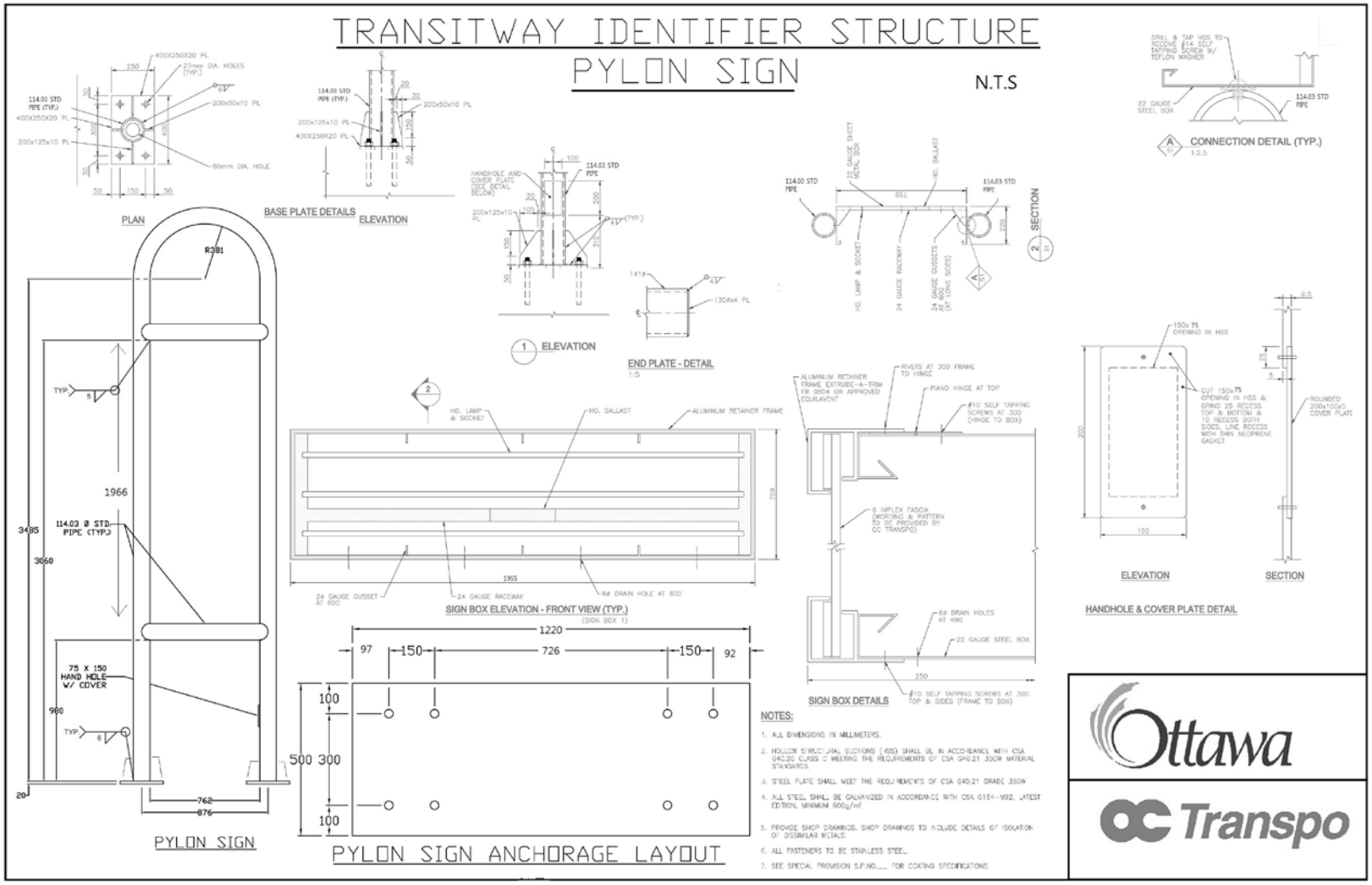
Figure 10.4b: OVERHEAD SIGN

Figure 10.5: TRANSITWAY MAP CASE

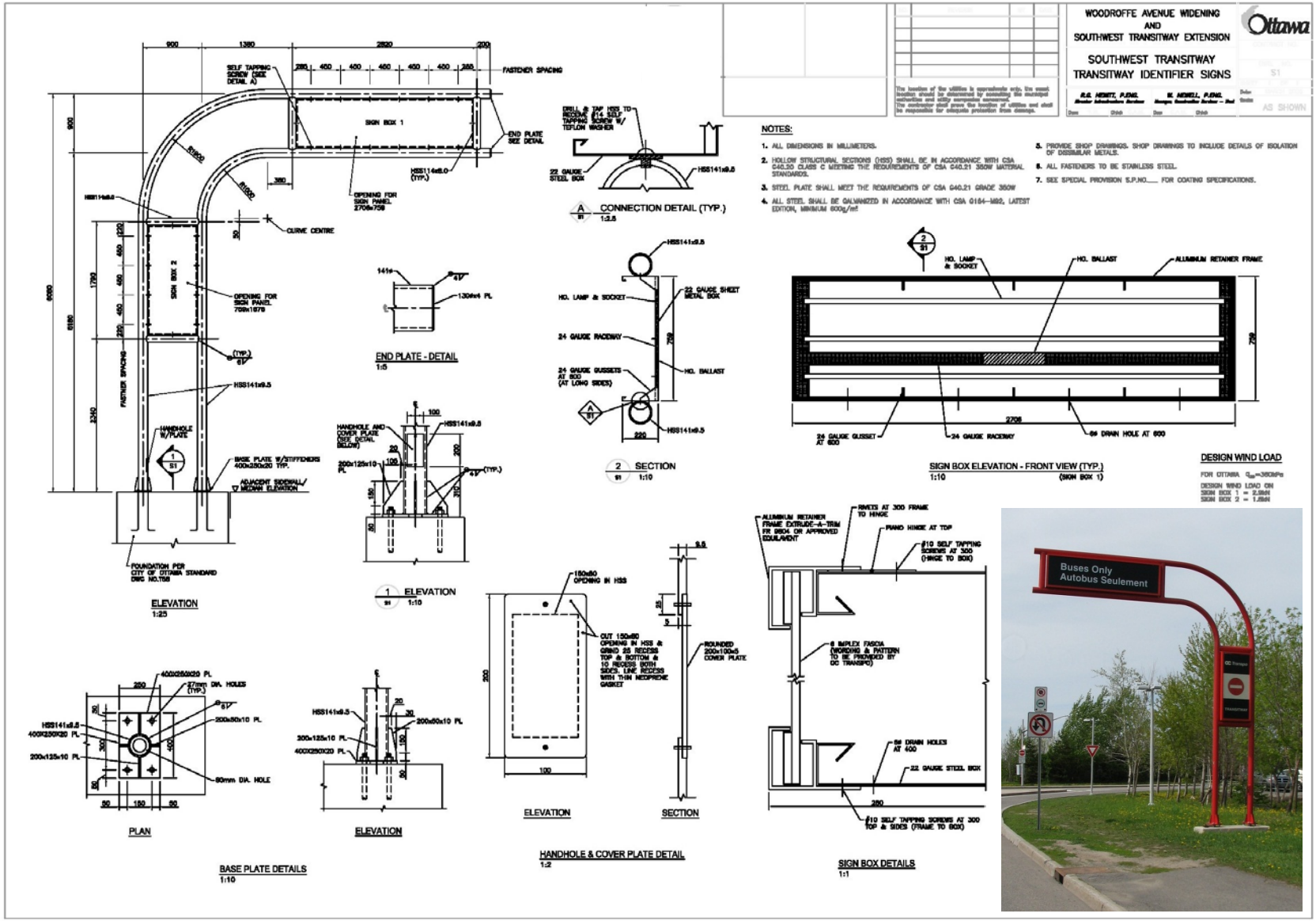
Figure 10.6: ROUTE / PAMPHLET DISPLAY CABINET

Figure 10.7a: BUS STOP FLAG

Figure 10.7b: BUS FLAG POLE



Ottawa / OC Transpo	**PYLON SIGN**	*Scale* **N.A.**	*Date* **May 2012**
		Revision No./Date	
	TRANSITWAY AND STATION DESIGN GUIDELINES		**Figure 10.4a**

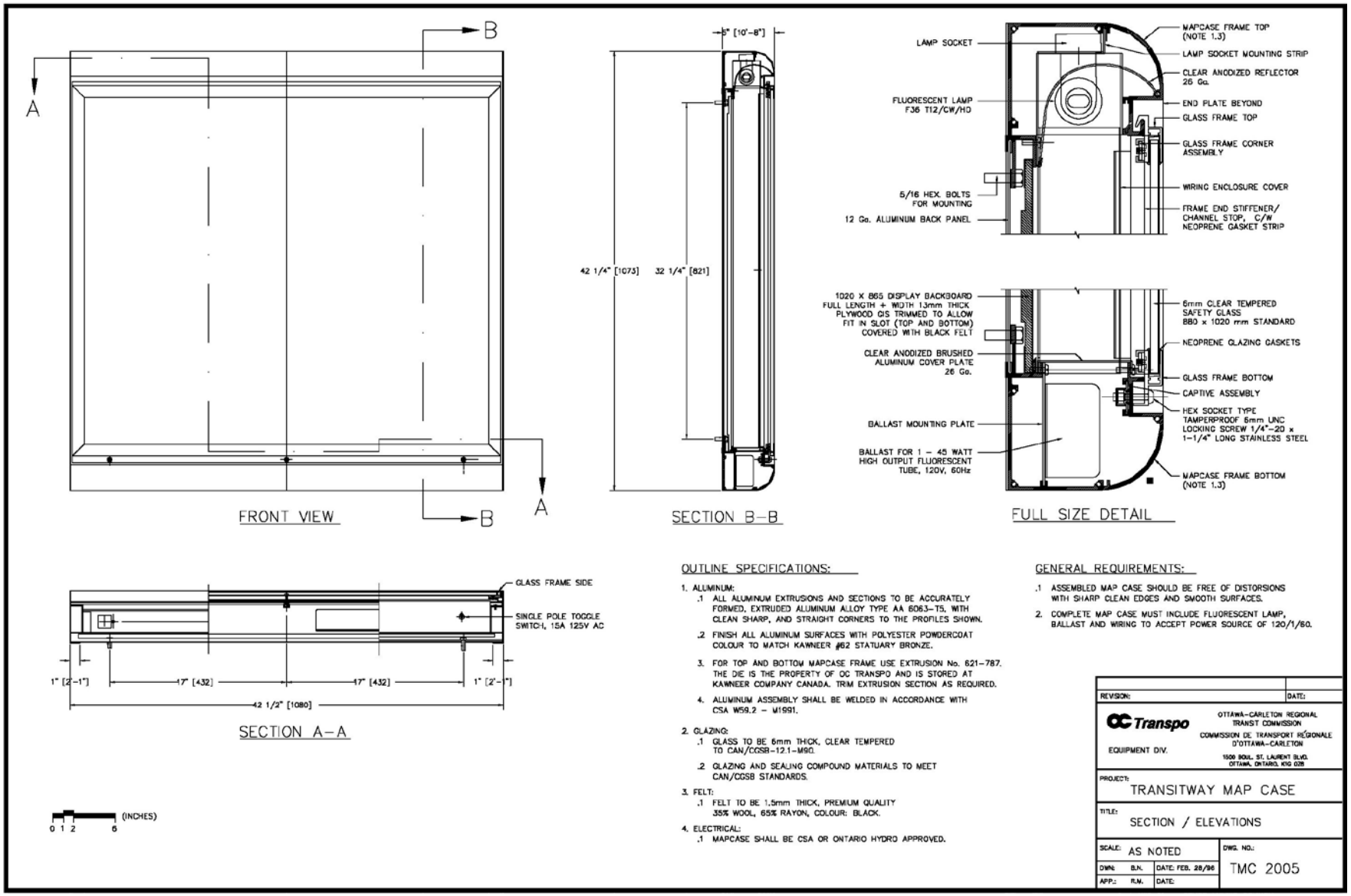


OVERHEAD SIGN

Scale	N.A.	Date	May 2012
Revision No./Date			

TRANSITWAY AND STATION DESIGN GUIDELINES

Figure 10.4b



Ottawa

OC Transpo

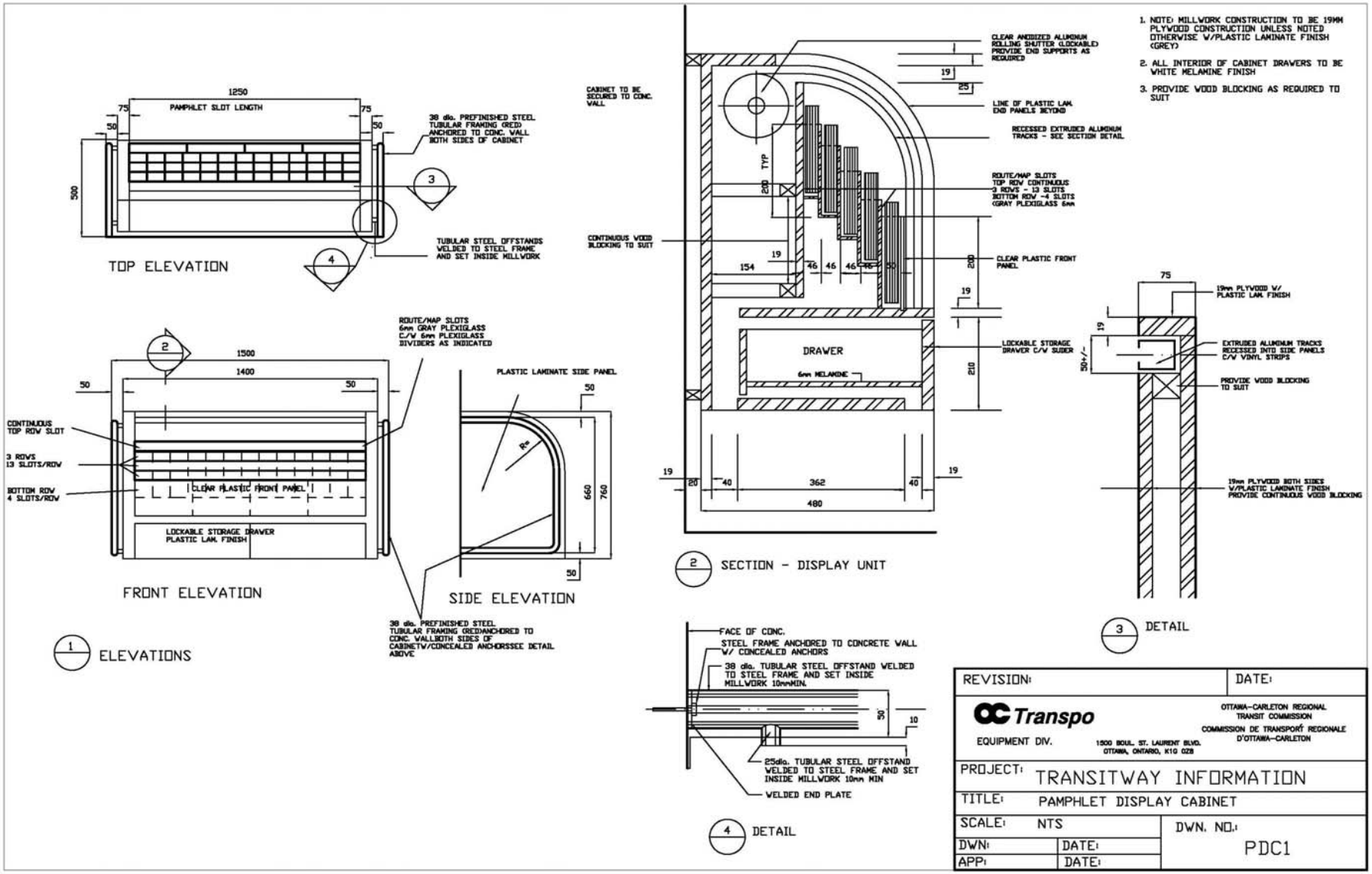
TRANSITWAY MAP CASE

Scale **N.A.** *Date* **May 2012**

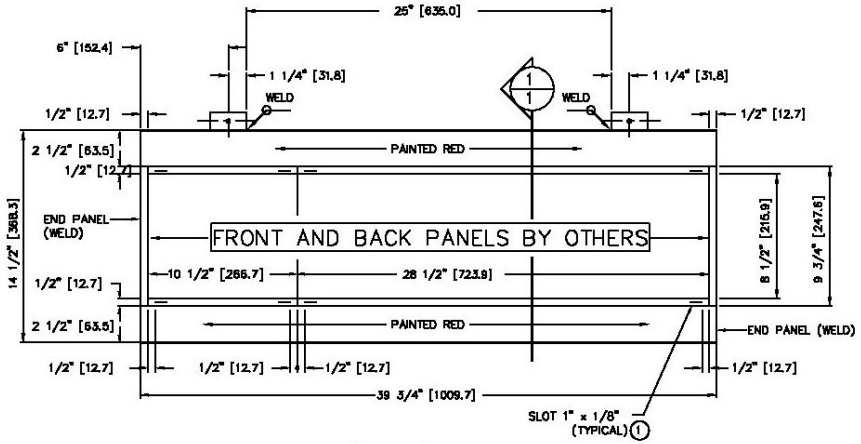
Revision No./Date

TRANSITWAY AND STATION DESIGN GUIDELINES

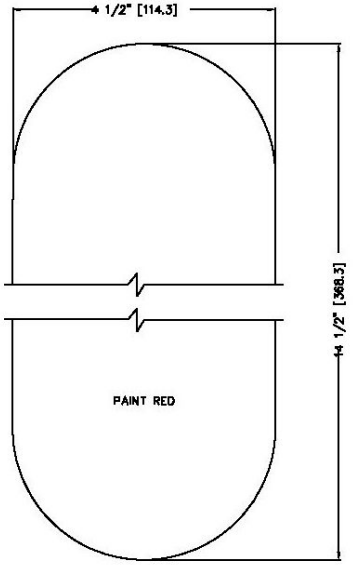
Figure 10.5



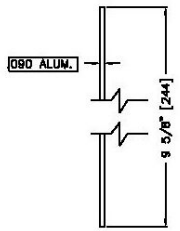
Ottawa / OC Transpo	**ROUTE / PAMPHLET DISPLAY CABINET**	*Scale* **N.A.**	*Date* **May 2012**
		Revision No./Date	
	TRANSITWAY AND STATION DESIGN GUIDELINES	**Figure 10.6**	



FLAG DETAIL
N.T.S.

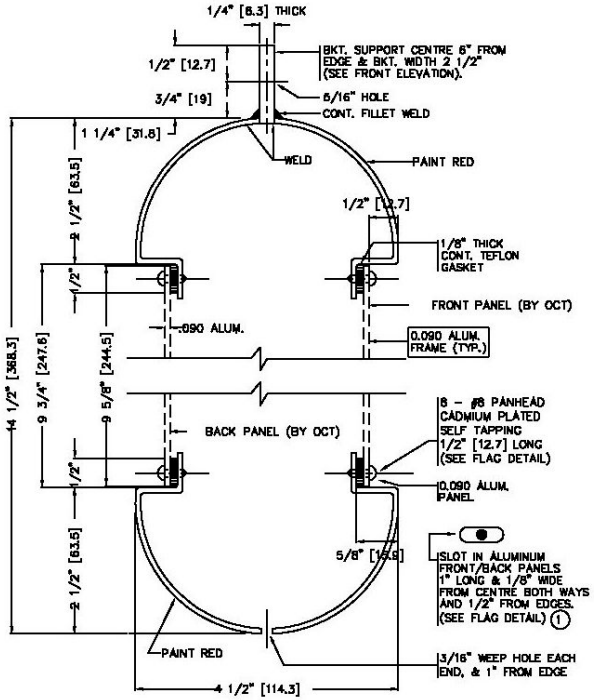


ALUM. END PANELS
N.T.S.



SEE FRONT ELAVATION FOR LENGTHS

ALUM. FRONT/BACK PANELS (BY OCT)
N.T.S.



FLAG DETAIL – SECTION 1–1
N.T.S.

NOTES:

1. FLAG: 0.090" ALUM.
2. PAINT– 1 COAT EPOXY PRIMER (3 mil D.F.T.)
   – 2 COATS POLYURETHANE (5 mil D.F.T. TOTAL)
   COLOUR TO MATCH OC TRANSPO RED

CAD RAW
COMPUTER AIDED DESIGN, DRAFTING & EDITING
6119 Lariviere Cr.
Gloucester, Ont.
K1W 1C6
T: (613) 830-1504
F: (613) 830-3249

PROJECT: BUS FLAG	DRAWN: P.N. / B.N.	OC Transpo	OTTAWA-CARLETON REGIONAL TRANSIT COMMISSION
	CHECKED: S.S.	PLANT DEPARTMENT	COMMISSION DE TRANSPORT REGIONALE D'OTTAWA CARLETON
TITLE: BUS FLAG DETAILS	DATE: OCT. 6, '93		1500 BOUL. ST. LAURENT BLVD. OTTAWA, ONTARIO, K1G 0Z8
	SCALE: N.T.S.	FILE NUMBER	DWG. NUMBER: BF 2005 / REVISION

Ottawa OC Transpo

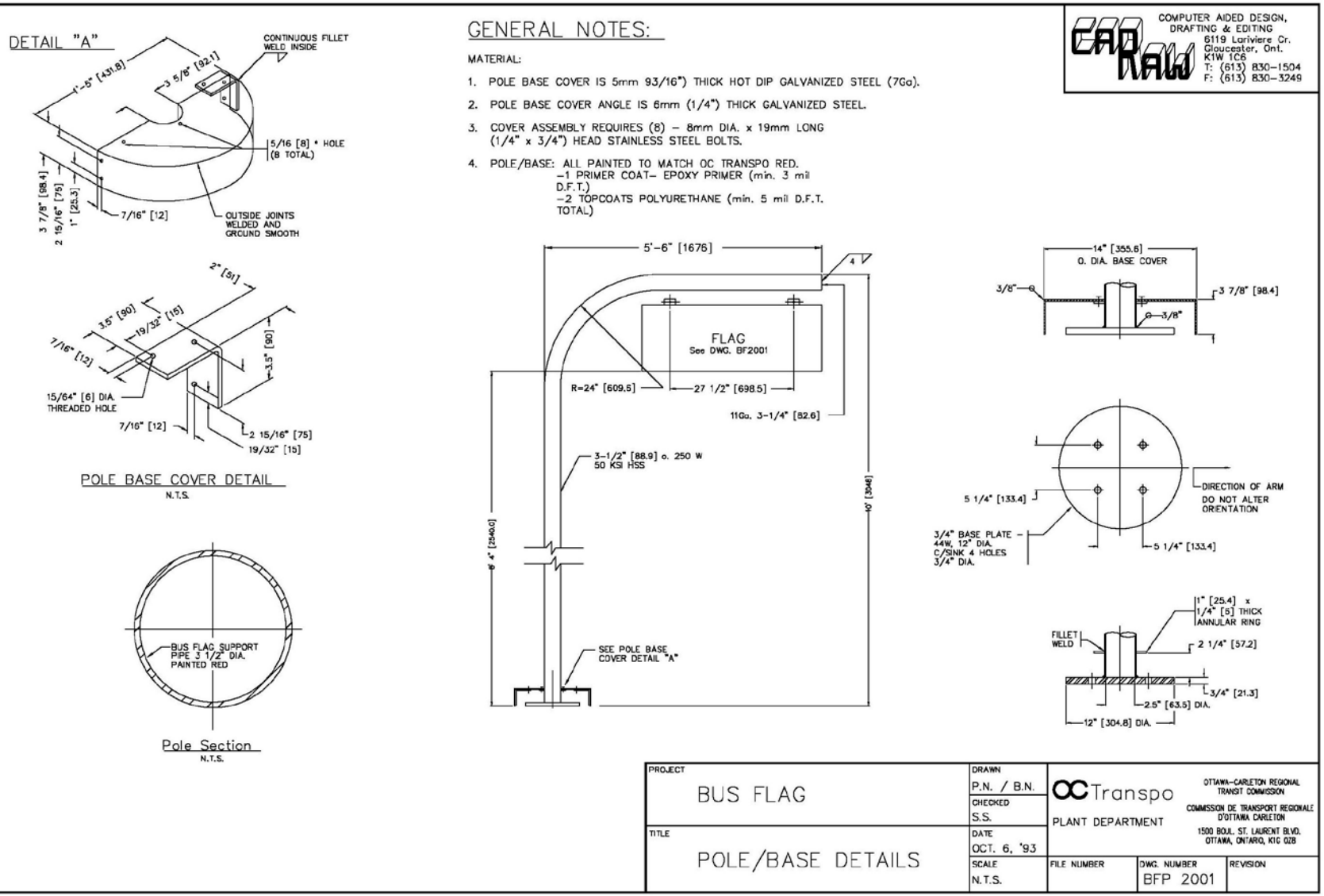
BUS STOP FLAG

Scale: N.A. | Date: May 2012

Revision No./Date

TRANSITWAY AND STATION DESIGN GUIDELINES

Figure 10.7a



Ottawa OC Transpo

BUS FLAG POLE

Scale **N.A.** | Date **May 2012**

Revision No./Date

TRANSITWAY AND STATION DESIGN GUIDELINES

Figure 10.7b

11.0 ACCESSIBILITY

11.1 GENERAL

Station design criteria related to accessibility are intended to conform to the Accessibility for Ontarians with Disabilities Act (AODA). To achieve these requirements the designer should review the Accessible Built Environment Standard and the City of Ottawa's Accessibility Technical Guidelines. As stated in these documents the aim of the standards and guidelines is to provide amenities and access to facilities which are universally accessible and which do not create distinction between customers. It is the designer's responsibility to ensure that the proposed design meets or exceeds the standards as presented.

11.2 STATION REQUIREMENTS

a) Access to Buildings and Platforms:

Transitway station buildings and platforms shall be interconnected to adjacent streets, sidewalks and pathways by a barrier free path of travel. This path, to the fullest extent possible, shall be the same for customers.

At least one fully accessible route shall be provided to each station platform (i.e. inbound and outbound platform).

The slope of concrete platforms shall be uniform and where parallel to the Transitway, maintaining the same slope and direction with a maximum average cross-fall of 2%.

b) Elevators:

Based on the Accessible Built Environment Standard, elevator cars shall have minimum cab interior dimensions of: 2030mm x 1295mm for centered doors, 1525mm x 1525mm for off-center doors.

All elevator entranceways shall have raised floor designations provided on both jambs. The centreline of the characters shall be 1500mm from the floor and such characters shall be 50mm in height.

All elevator call buttons shall be accessible to the disabled. Refer to Section 16.0 for additional details.

c) General Accessibility Criteria and Design Parameters:

Designers shall verify all accessibility design criteria based on a review of the applicable Codes and Standards. The most stringent criteria shall take precedence based on review of the requirements of the Accessible Built Environment Standard, Ontario Building Code and CSA. Where feasible, more stringent requirements can be used as required and the designer shall

review the potential impacts with OC Transpo. The following general accessibility criteria and design parameters are provided for reference purposes only and shall be verified by the designer:

- Minimum unobstructed path width: 1100mm (1200mmm preferable if wheelchair accessible)
- Maximum floor opening: 13mm
- Minimum/Maximum mounting height of operable items: 890mm/1500mm
- Minimum sidewalk width: 1800mm
- Minimum door opening: 915mm clear
- Maximum threshold height: 12mm with tapered edges
- Maximum door opening force as per OBC: 38N for exterior doors, 22 N for interior doors
- Minimum height glazed openings in doors as per OBC: 900mm from floor, 75mm minimum in width, and 250mm from latch side of door
- Minimum one-way ramp width clear dimension: 1000mm
- Maximum grade for sloped floor as per OBC: 1:20 at all points (not average grade)
- Maximum ramp gradient: 1:12 (1:10 permissible in non-barrier-free path of travel)
- Minimum ramp level area dimension (turns and rest areas) as per OBC: 1670mm or at least the width of the proposed ramp
- Maximum length of ramp before level area as per OBC: 9.0m
- Handrail height (min/max) as per OBC: 865/965mm from line drawn across top of treads
- Handrails dimensions: continuous, graspable with outside diameter of no less than 30mm and not more than 40mm and be provided with a clearance of 40mm to a smooth wall surface and 65mm to a rough wall surface
- Stairway handrails required on both sides plus middle handrail as per OBC: 2200mm clear width of ramp with no more than 1650mm between handrails. Handrails shall be continuous on both sides including landings
- Top of guard rail height for ramp adjacent to up to 9m vertical drop: 1070mm from line drawn across stair tread
- Top of Guard rail height for ramp adjacent to more than 9m vertical drop: 1500mm from line drawn across top of stair tread
- Maximum number of treads between rest areas: 14
- Minimum stair landing length at rest areas: 1200mm
- Controls for door operators as per OBC: Face dimension of no less than 100mm incorporating the international symbol for accessibility and centered no less than 1000mm and not more than 1100mm from floor level or ground and located not less than 600mm beyond the door swing where the door opens towards the control

- Climbable handrails and guards: shall be designed that no member or attachments between 140mm and 900mm in height facilitate climbing over the guard
- Size of opening in handrails and guards as per OBC: openings shall be limited to less than 100mm in diameter
- Loading values as per OBC: handrails and guards designed to withstand point loads of 0.9kN lateral force max and a uniform load of 0.7KN
- Where public telephones are present, at least one public telephone shall be equipped with Telecommunications Devices for the Deaf (TDD)
- Detectable warning surfaces at stairs shall be:
  - provided at the top of the stairs and at landings
  - extend the full width of the stair for a depth of at least 920mm commencing one tread depth back from the stair
  - provided at each landing incorporating an entrance into a stair system
  - provided where the regular pattern of a stairway is broken
  - provided where the run of a landing not having a continuous handrail is greater than 2100mm

  A detectable warning indicator shall be composed of continuous ridges that:
  - have a height of 4 ± 1 mm
  - have a width between 4–8 mm
  - are spaced between 40–60 mm on center

  A detectable warning indicator shall be installed to:
  - have the ridges run perpendicular to the route of travel
  - not create a tripping hazard

11.3 BUS SHELTERS

Bus shelters designs shall incorporate the following:

- locate on uniform concrete pads approximately at the same elevation as the sidewalk or walkway
- have minimum 1200mm clearance around at least two sides of the shelter, including the landing pad side
- provide a clear view of oncoming traffic
- incorporate sufficiently clear floor space to accommodate a person using a wheelchair or scooter
- feature at least one seat with armrests and a seat height between 450mm and 500mm

- shelters shall be designed to permit a person using a wheelchair or scooter to enter and to reach a minimum clear floor area of 750mm by 1200mm within the perimeter of the shelter unimpeded.
- All glazed panels surrounding bus shelters and at stations shall incorporate decals and other safety features, which shall include the following:
  - Fully-glazed sidelights at exterior entrances or vestibules, and fully-glazed screens shall be clearly identified with a horizontal row of decals, or a continuous stripe, minimum 50mm wide and of red colour, mounted with its centre line at a height of 1350mm to 1500mm from the floor or ground.
  - Where decals are used, they shall be located at a maximum of 150mm from center to center. The decals can either be 50mm square or round, and/or of a special design (e.g., a logo) provided the solid portion of the decals provides high colour contrast and is easy to identify by persons who are visually impaired.
  - Where etched or patterned glass is used, decals or a stripe of highly contrasting colour shall still be provided.
  - Where frameless glass panels are used, exposed edges shall be identified with a yellow vertical molding, applied to cap the end glass panel.

11.4 PLATFORMS

Where bus platforms or other boarding platforms are provided, they shall allow safe access for persons using wheelchairs, and where possible, provide level access into buses.

Platforms shall be designed to accommodate the following:

- Red coloured concrete with a stamped pattern shall be placed in a recess, 500 mm in width, along the front edge behind the steel facing for the full length of the platform. Refer to Figure 4.2.3b in Section 4.0, “Transitway Road Design”.
- A detectable hazard indicator shall be located at:
  - An unprotected drop-off edge (i.e., transit platform) where the change of elevation is greater than 250mm and the slope is steeper than in the ratio of 1:3 (33.3%).
  - At curb ramps
  - An entry into a vehicular route or area where no curbs or other elements separate it from the pedestrian route of travel such as traffic islands and pedestrian crosswalks

  The detectable hazard indicator shall have a detectable tactile warning strip of 600mm minimum width across the full length of the drop-off and be set back by 500mm. A detectable hazard indicator shall be composed of truncated domes with a height of 5mm ± 0.5 mm.
- If a walk crosses or joins a vehicular way and the walking surfaces are not separated by curbs, railings or other elements between the pedestrian areas and vehicular areas, the

boundary between the areas shall be defined by a continuous detectable warning surface, which is 920 mm wide.

- Lighting levels at all platforms shall be at least 100 lux

11.5 BENCHES

Benches shall be comprised of (refer also to Section 17.0, Figure 17.3.2b):

- a seat height between 450 mm (17-3/4 in.) and 500 mm (19-5/8 in.) from the ground
- arms and back rests
- be of contrasting colour to their background
- have an adjacent level, hard surface at least 920 mm (36 in.) x 1370 mm (54 in.)
- benches or seats should be set back from the route of travel. The level area adjacent to the seat may accommodate a person using a wheelchair, guide dog, stroller, walker, etc.
- If the area adjacent to the seat abuts a downward slope that is potentially hazardous, then a curb should be provided around the level area. A walking surface that contrasts in colour and texture assists persons with a visual impairment to locate the seating area.

12.0 LANDSCAPING

12.1 GENERAL

The site adjacent to the Transitways and Stations within the Transit corridors provides the overall aesthetic for both the passengers and general public. To this end, the landscape must create a welcoming, pleasant environment which encourages the public to use public transit throughout the year.

The development of the site design and landscape plan must be integrated from the initial stages of the design to fully address the requirements indicated within this document. This plan must meet all the technical requirements of the buses, stations, parking, laybys, bicycle parking, lighting, noise attenuation, access points, furniture, and maintenance into a comprehensive design solution. Microclimate, prevailing winds, station orientation (north, south, east, west), existing vegetation, adjacent built forms, land uses and topography should also be considered while completing the landscape plan. The planting will provide the unifying element for the overall site plan. It should articulate the main routes for vehicles and pedestrians, provide shading at stations and waiting points, connect to the adjacent landscapes and where feasible enhance the microclimatic conditions. Along transit corridors it should provide a buffer between the roadway and the adjacent communities.

12.2 DESIGN OBJECTIVES

The fundamental design objective will be to fully address the needs of OC Transpo and the community to provide a comprehensive solution. Within these parameters, the overall principle for the landscape will be to provide a high quality and durable design solution which can be reasonably maintained. To achieve this, there are several parameters which have been developed:

a) General Landscape Design Objectives:

- The site plan should be developed to respond to the adjacent communities and landscape treatments
- Integrate OC Transpo's objectives and requirements for the long term maintenance and standards for stations and transit corridors
- Review Crime Prevention Through Environmental Design (CPTED) requirements with OC Transpo prior to and during design development as required. Refer also to Section 7.0, "Safety and Security"
- Protect planting areas from cut-through pedestrian movements. This could include raised planters or cast in place concrete curbs
- Where noise attenuation walls are required, the landscape plan should address both sides of the wall to soften the visual impact and integrate into the landscape

- Walkways and recreational pathways should be clearly defined and shall provide clear access to pedestrian crossings at roadways.
- Pedestrian barriers controlling access points to stations and directing towards authorized pedestrian crosswalks crossing the Transitway should be integrated within the overall landscape plan.
- The planting design shall be developed to maintain views to and from the station and along walkways. Low shrubs, in combination with street trees will ameliorate the site, while providing a sense of comfort for the user.
- A variety of plant material species should be selected to provide a diversity of colours and textures throughout the year.
- Plant material should be protected from the winter maintenance requirements. This may include curbs, planters, etc.
- Review the prevailing winds and general microclimatic conditions of the site. Use plant material to assist in enhancing the public spaces in all four seasons. Examples may include deciduous trees to provide shade in the summer or hedgerows to reduce winter winds.

b) Station Area Landscape Design Objectives

Landscape design objectives related to station areas include the following:

- Pedestrian routes to the stations should be clearly articulated, and provide safe, barrier-free accessibility.
- Trees shall be incorporated adjacent to station platforms and at waiting areas to provide shade and aesthetic quality to the area.
- The plant material shall be designed to ensure key sight lines from the adjacent roadways and communities are maintained. Low shrubs and street trees should articulate the walkways.
- Concrete curbs to protect the planting beds from both pedestrian movements and maintenance equipment.
- Integrate seating areas within the public spaces. These may include raised planter beds or bench seating.
- Site furniture and lighting should be integrated within the overall site.

c) Transitway Landscape Design Objectives

Landscape design objectives related to the Transitway outside of station areas include the following:

- The transit corridor shall be integrated within the adjacent landscape. The combination of landforms and planting should enhance the experience of the transit user as well as provide an aesthetic value to the adjacent communities.

- The planting plan should be developed in a cost effective manner. Reforestation and hedgerow planting should be considered for woodlots and screen planting and caliper trees as accent planting.
- Planting offsets to consider snow clearing requirements.

d) Park and Ride Landscape Design Objectives

Landscape design objectives related to Park and Ride Lots include the following:

- The facility must balance the need for parking while providing a human scale. Use of tree lined access routes, vegetated islands at the ends of parking rows, distinct sidewalks and pedestrian lighting will assist in creating a positive environment for the users.

12.3 REINSTATEMENT

The final site development for Transitway stations and corridors must be fully integrated within the adjacent landscape. Care is required to ensure all damages caused by the construction of the infrastructure have been mitigated. To this end, the following items should be completed:

- Prior to completion of preliminary design, complete a site inventory of the existing vegetation to confirm previously identified species at risk and additional changes to the vegetation from the environmental assessment. Review the current City of Ottawa by-laws with respect to the existing trees, and identify all trees which require compensation. As per the by-laws, this will include a Tree Inventory Drawing identifying those trees to be preserved and those trees impacted by the undertaking.
- At the completion of the design stage, the site plan should provide a comprehensive solution which addresses the impacts and mitigation of the construction on the site, including tree replacement or compensation and the full extent of required reinstatements.
- Careful consideration of the drainage and grading is required for the side slopes of the embankments. Areas with slopes greater than 3:1 will require specific slope stability methods.
- Compare pre-construction conditions with the landscape plan to ensure the overall site has been addressed to mitigate for all construction damages.

12.4 BERMING AND GRADING

It is anticipated that there will be grade changes on the site to accommodate all the requirements for the stations and Transitways. The grading plan should ensure the technical requirements for the utilities, roadways and structures are integrated into the overall plan.

Any berms and slopes shall be coordinated with the planting plan.

Slopes greater than 3:1 will require specific treatment, as standard turf maintenance, such as mowing, will not be feasible.

12.5 SUITABILITY AND AVAILABILITY OF PLANT MATERIAL

The plant material selection for each site will depend upon the existing conditions and the specific design requirements. A full member of the Ontario Association of Landscape Architects (OALA) shall be responsible for the selection and location of all plant material. The following are the parameters for the selection of plant species:

- All plant species shall be reviewed in conjunction with the proposed location, existing soils, hardiness, wind, shade, root morphology, growth requirements, urban tolerance and the disease resistance.
- All plant species shall be reviewed with respect to salt tolerance. Plants located at stations or adjacent to walkways and parking areas must have an identified tolerance to salt.

12.6 PLANT MATERIAL DESIGN GUIDELINES

In addition to the general parameters for the plant material selection, there are specific requirements for the various types of planting as outlined below:

- All plant species shall comply with the most recent City of Ottawa approved tree species list.
- Deciduous trees shall have a minimum clear trunk height of 1.8 metres and a caliper size of 60 mm diameter.
- Deciduous trees shall be planted a minimum of one (1.0) metre from back of curb.
- Minimum planting bed or island width shall be three (3.0) metres.
- Coniferous trees shall have a minimum height of 1.5 metres.
- Coniferous trees shall be located a minimum of three (3) metres from any walking surface, and shall be located to ensure clear site lines along major pathways.
- Coniferous trees shall not be planted within sight triangles at intersections to ensure clear sight lines for operators.
- In locations where there are preferences to deter pedestrian movements or access, consideration to use of plant material rather than fencing should be considered. Shrubs shall be a blend of deciduous and coniferous material.
- Shrubs planted near walkways and public gathering areas should have a maximum mature height of 1.2 metres.
- Larger shrubs and trees should be planted to provide screening of views, walls, etc.
- Reforestation and hedgerow planting should be either lining out stock or whip stock. Select nursery stock trees may be interspersed as required for the overall design intent.

12.7 LOW MAINTENANCE DESIGN GUIDELINES

The landscape plan is a long term vision for the overall site. It is anticipated that there will be a higher level of maintenance for the initial establishment, then reduced on-going maintenance

requirements. The landscape plan will develop the criteria for the weekly, regular and seasonal maintenance requirements with OC Transpo. The plan should respond to the following parameters:

- Turf maintenance: Levels of cutting could vary from weekly mowing in high traffic, high visibility locations to seasonal mowing of meadow areas to control weeds. An overall plan delineating the cutting regimes should be developed for each site.
- Selection of turf grasses should be developed in response to the varying maintenance levels. Species such as fescues, trefoil, rye grasses or wild flower meadow mixes should be considered in seasonal mow areas.
- The landscape design should take into consideration the locations and sizes of turf areas. Small areas requiring hand cutting should not be created.
- Plant Material: In general, all the plant material species selected should be drought tolerant and able to grow in the seasonal varieties of the Ottawa area. An extended drought may require the occasional additional water of select plant material, such as tree planting on the station platforms.
- Shrubs: Consideration should be given to the ultimate size of the species for the Ottawa area. Seasonal pruning to maintain height or spread of shrub materials would not be acceptable.
- Regular weeding of the planting beds is anticipated. To assist in the control of weeds, a 60 mm depth of mulch in the beds should be specified to deter weed growth.
- Bed liners may be considered for use in select areas where weed control will not conflict with the establishment of rhizome spreading shrubs or trees.
- Slopes steeper than 3:1 should be reviewed for planting types and maintenance. Biodegradable erosion control blankets may be considered, however plant material establishment may be slowed.

12.8 OTHER CONSIDERATIONS

The designer should consider the following:

- The site plan must address all four seasons. Winter snow clearing and/or removal, de-icing of platforms and walkways will all affect the design and maintenance requirements. A review of all the maintenance alternatives should be completed with OC Transpo, and a maintenance regime developed. This should include both summer and winter maintenance requirements.
- Plant material at station locations must be able to withstand difficult urban conditions. Care is required to protect the plants from the pedestrians, traffic and maintenance requirements. Planting in traffic islands should have an additional 600mm interlocking paver maintenance edge on the back of the curb to protect the shrub planting.
- Include cast in place concrete curbs along pavement edges in Park and Ride Lots to minimize long term maintenance/repairs to landscaped areas. Where not feasible, consider use of anchored precast concrete curbs.

- Coordinate the planting plan with the design engineering team to ensure compatibility with underground services, roadway design, grading, drainage and station configuration.
- The overall site plan must accommodate the needs for the maintenance of the facility as well as the potential access for utility companies. Maintenance equipment access points should be considered during the design. Pathways may require roadway structure depths to allow maintenance vehicular access to the Transitway corridor depending on requirements.
- A site analysis, including micro-climate should be completed where required and methods of ameliorating the site may need to be considered.
- Bio swales and other techniques to reduce the environmental footprint of the development should be considered.
- To adequately establish the plant material, a two-year maintenance program for establishment of plant material should be specified. Supplemental watering, weeding, fertilizing, winter protection and miscellaneous maintenance activities should be identified and monitored.
- The areas of seed and sod should be reviewed to ensure the best economic solution while creating a minimum sod width of 900 mm.

13.0 ENVIRONMENTAL PROTECTION

Environmental assessments conducted for Transitways prior to 2007 were primarily completed as Individual Environmental Assessments. Since 2007, with the amendment to the Municipal Class Environmental Assessment (EA), municipal transit projects are now EA approved under the Ontario EA Act and planning of Transitways can be conducted in accordance with the Class EA for Municipal Transit Projects. Planning of a Transitway project under the EA process is not included in the scope of the Transitway and Station Design Guideline. However, the design and construction phases are essentially an extension of the EA process as outlined in the Municipal Class EA document.

The findings and recommendations of the Class EA will guide the Transitway designer in mitigating and/or minimizing the impacts of the Transitway construction on the existing and future environments.

As outlined in the Municipal Class EA document key considerations during the Environmental Assessment (EA) process are:

- Land-Use Planning objectives
- Natural Heritage / Environment features
- Social Environment
- Cultural Environment
- First Nations/Aboriginal Peoples
- Economic Environment
- Property
- Evaluation of Alternative Solutions

The environment that may be impacted by the project is defined during the EA process and the effects (both positive and negative) of the undertaking on the environment are identified. The established alternatives are assessed for their potential impacts on the defined environment. The EA process then establishes the preferred alternative based on the overall net effects. The Class EA process is intended to identify potential impacts and where possible avoid the impacts. Where this is not possible mitigating measures are identified to minimize or offset the impacts.

During the design stage, all commitments established during the environmental assessment shall be considered. The designer shall review the potential environmental effects established during the EA process and determine mitigating measures to reduce the impacts. In some cases, additional detailed analysis may be required to determine the mitigating measures and the resultant design and construction requirements.

During design development, the designer shall review the requirements of the various approving authorities and stakeholders and obtain any project specific approvals. These may include, but not limited to, the following issues:

- Environmentally Sensitive Areas
- Terrestrial Vegetation and Wildlife
- Fish, Aquatic Wildlife and Vegetation
- Heritage Resources
- Agriculture
- Property Impacts (Residential, Commercial, Institutional)
- Noise and vibration
- Surface Drainage
- Ground Water control and management
- Air Quality
- Materials Handling

During design and construction the policies and guidelines of the various provincial and federal authorities must be complied with including, but not limited to:

a) Provincial

- Conservation Authority Policies and Regulations
- Heritage Act
- Lakes and Rivers Improvement Act
- Water Resources Act
- Environmental Protection Act

b) Federal

- Canadian Environmental Assessment Act (CEAA)
- Navigable Waters Permit – Transport Canada
- Fisheries Authorization – Dept. of Fisheries and Oceans

The designer is responsible to determine and obtain the municipal, provincial and federal approvals, as well as, certificates of authorization, etc. as necessary to proceed with the tender and construction of the Transitway project. Further the designer shall incorporate into the design, drawing and tender documents any mitigating measures established during the design phase that are required to minimize the environment impacts.

14.0 ELECTRICAL

14.1 GENERAL

The lighting, heating and communications systems in the Transitway stations require superior quality, durable and aesthetically pleasing components capable of resisting abuse by vandals and the mechanized cleaning methods of OC Transpo. High pressure washing equipment is used to clean the public areas; consequently, all electrical components in these areas must also be rated for wet locations. The station buildings, pathways and platforms are to be fully illuminated to the design standards.

This section of the design guidelines for the electrical systems applies to all Transitway facilities and components including those on the roadways and access paths/walkways to Transitway facilities.

For the design of electrical systems, it is incumbent that the designer utilizes sustainable design elements including LEED protocol where applicable and practical.

The designer shall review the Accessible Built Environment Standard to determine requirements pertaining to mounting heights and specifications related to light switches, phones, push buttons, etc.

The designer shall incorporate servicing requirements for future potential expansion of the station wherever feasible as identified by OC Transpo. Review future plans for Transitway and station expansion with OC Transpo during the preliminary design phase.

14.1.1 Elementary Station Requirements

The Designer shall ensure that elementary station designs include embedded conduits and disconnecting means and transformer capacity to accommodate future features and systems which may be incorporated later in either the existing platform or an expanded station format. The future requirements of each station will be determined by OC Transpo.

14.1.2 General Requirements

The designer shall review the station layout with OC Transpo to establish general requirements for the following systems:

- Fire Protection
- Building Monitoring and Control System
- Real-Time Passenger Information Systems
- Public Address system
- CCTV Monitoring system
- Emergency phones
- Standalone CCTV/Ephone equipment (i.e.: stanchions)

- Video Information system.
- Fare vending machines.
- Wide Area Network (WAN) fibre optic communications system.
- Operator facilities (telephone, washroom, storage, etc.).
- Traffic Control Devices.

Conduit provisions for the above systems normally consist of appropriately sized conduits (25 mm to 50 mm diameter) installed from the site of the device to the communications backboard and/or to the location of the future distribution panels and capped and left for future use. The Designer shall provide for current and future requirements and include such system conduits based on input from OC Transpo.

14.2 BASIC ELECTRICAL MATERIALS

14.2.1 General

All electrical equipment and material must be installed in accordance with the Ontario Electrical Safety Code and all Supplements and Bulletins supplied in accordance with the applicable standard.

All electrical equipment and material shall conform to City of Ottawa Construction Specifications and Material Specifications.

14.2.2 Conduits, Cable Trays and Wiring Enclosures

The designer shall include the following:

- Embedded conduit is preferred and shall be rigid PVC. Embedded junction/pull boxes shall be PVC and shall not be used for fixtures support.
- All conduits and fittings exposed in areas accessible by the public shall be galvanized rigid steel with surface mount cast metal pull/junction boxes with appropriate conduit hubs. The exposed material shall be painted with semi-gloss exterior enamel, to match appropriate station colour schemes. Exposed conduit in all other areas shall be PVC.
- All shelters shall have minimum 25 mm diameter conduit or cable tray provisions for security, lighting and communications. Each shelter shall have its own single runs of conduits back to the appropriate distribution panels (unless more than one conduit is necessary for circuit loading purposes). This enables the use of dedicated circuit breakers for each function for each structure which facilitates maintenance and replacement.
- All cable trays shall be CSA/UL approved, solid heavy duty galvanized steel or may be incorporated integrally with lighting/climate control equipment if approved for use as a wire way.
- All empty or unused conduits shall have a polypropylene pull string installed and identified with a durable tag as to destination of the conduit to facilitate future use.

14.2.3 Outlets, Switches

The designer shall include the following:

- The standard outlet duplex receptacles used in service areas shall be specification grade, whereas, those in an electrical room on the emergency circuits shall be hospital grade.
- In public areas such as towers and shelters; the receptacles shall be tamperproof GFCI types, complete with a weatherproof cover.
- Switches installed in the service areas shall be of specification grade.

14.2.4 Wiring

The designer shall include the following:

- Conductors installed in conduits/ducts shall be of the following insulation types:
    - RW90 - installed above ground
    - RWU90 - installed underground
- All concealed wiring not embedded shall be armoured cable TECK 90 cable (wet or damp locations).
- Telecommunication wiring shall be rodent resistant double jacketed buried service wire consisting of solid annealed copper with high density polyethylene insulation.
- Network cabling shall consist of four-pair, 100 ohm balanced unshielded twisted pair (UTP) cable, flame test classification FT6.

14.3 DUCTBANKS, MAINTENANCE HOLES AND HANDHOLES

14.3.1 Ductbanks

The designer shall include the following:

- All ducts crossing below roadway pavements or platform areas shall be encased with reinforced concrete. Ducts may be directly buried in locations where the protection is not required in areas adjacent to a Transitway station. The following are typical duct usages to be incorporated in the provisions for the duct bank system:
    - Lighting, services
    - Telephone, security, and fibre systems
    - Power distribution
    - High voltage supply (if required)
    - Traffic signal loops and interconnects
- Phone and low voltage communications duct systems including electrical maintenance holes shall be kept separate from other systems. High voltage supply to a transformer vault (if required) must be kept totally independent from any other system in accordance with local power authorities.

- Two 100 mm diameter ducts are required for the Transitway station interconnects and under hard surfaces, for future OC Transpo requirements. Additional ducts shall be provided for security camera requirements as determined by OC Transpo. The layout of communication ducts and communication handholes shall be confirmed with OC Transpo.
- Requirements for ductbanks related to/for traffic control loops and interconnects shall be confirmed with the City of Ottawa.
- Requirements for ductbanks required for telephone services, hydro, etc. shall be confirmed with the service provider (i.e. Bell Canada, Hydro Ottawa, etc.).
- All duct banks and direct buried conduits shall have positive drainage towards maintenance holes and handholes but away from stations and buildings.
- All duct banks and conduits shall connect to Electrical rooms below electrical/control panels to avoid any potential water infiltration from draining into or onto the panel.
- Where possible, all the underground duct banks and conduits should be located under pathways, sidewalks and roadways to minimize potential conflicts with tree planting and other services.
- Duct installation shall comply with the City of Ottawa Material Specifications and Standard Detail Drawings.

14.3.2 Maintenance Holes and Handholes

The designer shall include the following:

- Maintenance holes and handholes shall be sized to accommodate the physical requirements and shall be rated for area of use and shall be spaced according to established cable friction/ pulling criteria.
- Communications/phone/CCTV maintenance holes and handholes shall be kept independent from other systems. The maximum spacing between maintenance holes and handholes shall be 90 metres.
- Drainage for each pit shall be provided to the nearest stormwater system, or if no alternative is available, to a granular/clear stone sump hole below the pit. All maintenance manhole drains where drained to an outlet pipe shall be fitted with backwater check valves.
- High voltage maintenance holes should be gravity drained to the nearest stormwater pipe, where possible.
- Maintenance holes and handhole structures including frame, covers, etc. shall comply with the City of Ottawa Material Specifications and Standard Detail Drawings.

14.4 SITE SERVICING

Site servicing and associated infrastructure requirements shall be coordinated with OC Transpo and service providers such as, Bell Canada, Rogers, etc. The design consultant is responsible for provision of all new/modified site services with utilities, including coordination of all contractual requirements on behalf of OC Transpo, during design and construction, as applicable.

The service transformers shall be supplied in accordance with the electrical power suppliers' regulations regarding service. Transformer sizing shall allow for expansion and/or future planning of the site as identified by OC Transpo and the City of Ottawa plus an additional allowance of at least 25% of the total loading, rounded upwards to the next standard rating (kVA or A). This criterion applies to any transformers, main feeder cables, and distribution breaker enclosures and panel boards.

14.5 SERVICE EQUIPMENT AND DISTRIBUTION

In order to reduce the amount of spare parts for maintenance purposes and facilitate product compatibility, the service and distribution equipment shall be supplied by manufacturers approved by OC Transpo.

14.5.1 General Requirements

Figure 14.5.1 provides a typical single line diagram for a Transitway station. The designer shall include:

- Panel boards - 3 phase:
    - Lighting and Distribution
    - Elevator and Escalator Services
    - Heating and ventilation

  Size, voltage and main breaker (as required) of panel boards are dependent on distribution and loading requirements.
- Disconnects - fusible or non-fusible, mechanical interlock, lockable, quick make, quick break, size as required.
- Transformers - ventilated dry type floor mount and sized as required with capacity for additional future loading.
- A power supply provision from the service panels shall be provided in each shelter and in various locations in the station building for maintenance use receptacles and for map cases as required by OC Transpo. Separate circuits are required for map cases as well as receptacle feeds. Provision shall be made for additional future separate circuits.

14.5.2 Electrical/Communication Distribution Enclosures

a) Pre-cast Concrete Service Vaults:

A new pre-cast concrete service vault shall be specified where an indoor electrical room does not form part of the project or service distance limitations deem a service vault necessary. The service vault shall be sized to allow for entry and for means for working within the vault. The location and details of the service vault shall be coordinated with and approved by OC Transpo.

The service vault shall include, but not limited to:

- main disconnecting means

- main distribution panel
- lighting panel
- lighting control
- transformer
- distribution panel
- heating
- provision for communication and security equipment

Refer to Figure 14.5.2a and 14.5.2b for typical details

b) Steel Distribution Cabinet:

A new stainless steel waterproof/water resistant distribution cabinet shall be specified where an indoor electrical room does not form part of the contract or it is deemed that service distance limits warrant that a distribution cabinet is necessary, as well as, locations where site specific space limitations do not allow for use of a pre-cast concrete service vault. Steel distribution cabinets are to be sized to allow for separate compartments to accommodate power and communication requirements. Separate doors are to be provided for independent access.

The distribution cabinet shall include, but not limited to:

- main disconnecting means
- main distribution panel
- lighting panel
- lighting control
- transformer
- distribution panel
- heating
- provision for communication and security equipment
- hasp latch for each door to accommodate OC Transpo padlock (provide double lock with Hydro Ottawa where required)

Refer to Figure 14.5.2c for typical details

14.6 LOW VOLTAGE SWITCHBOARD

14.6.1 Materials

Low voltage power distribution may consist of low voltage switchboards or individual components depending on wall and floor spaces available. The size and distribution requirements shall be determined once ultimate demand loading summaries have been calculated and coordinated with

the local electrical power supplier to clarify the size of supply transformers required. Metering provisions must be coordinated with the local electrical power supplier.

14.6.2 Coordination and Short Circuit Evaluation Study

For power systems of 400 A or greater, a power systems study including a Short Circuit, Device Evaluation, Over-current Coordination, and Arc Flash study shall be done by the design engineer. The study shall be done for all new equipment and for existing equipment that will be substantially affected by system modifications. The study shall be done to Institute of Electrical and Electronic Engineers (IEEE) Standard 242, ' Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems', the IEEE Standard 1584, 'IEEE Guide for Performing Arc-Flash Hazard Calculations' and the CSA standard Z462, 'Workplace Electrical Safety'. The study shall be updated during the shop drawing review process in order to reflect and confirm component compatibility based on the characteristics of the actual equipment to be supplied. The final study shall be sealed by a Professional Engineer licensed in Ontario.

14.7 SECONDARY GROUNDING

14.7.1 Ground Electrode System

For each Transitway Station the designer shall carry out a study and calculations of soil resistivity and grounding electrodes required to give a desirable resistance to ground of 5Ω maximum.

A grounding grid system shall be installed below, or adjacent to the electrical room. Where possible, the grid system shall be connected to a metal watermain system.

14.7.2 Continuous Ground Wire

All conduit systems shall have an internal ground wire installed between all equipment and structures.

14.7.3 Electrical Room/Cabinet Ground Bus

The electrical room shall have a solid copper ground bus around the inside perimeter of the room connected to the grounding grid system. All electrical panels, service equipment and cable trays shall be connected to the ground bus and/or grounding system.

Where communications rooms or boards exist, all electronic and telephone equipment shall be grounded to a common bus in a star configuration. The common bus shall be connected to the main electrical ground at a single location only.

14.8 CONTACTORS AND CONTROL

The control of the lighting panels/circuits shall be achieved by a station control system and a combination of timers, thermostats, and Photoelectric Controllers (PECs). The control systems are to be connected to OC Transpo's Building Automation System (BAS) control (see also Section 6.0, "Communications and Controls").

14.9 LIGHTING

14.9.1 General

Luminaire wattages are not a set standard but will vary according to the allowable fixture spacing to maintain the design horizontal illumination level at grade.

Generally, all building lighting together with Transitway station area and platform lighting shall be connected to the Transitway station emergency power source.

Where CCTV security cameras are to be installed, the recommended minimum luminance level at any point shall be 20 lux (using metal halide lamps) with particular attention to vertical components of the illumination to maximize contrast levels.

14.9.2 Materials

Exterior luminaires and poles shall conform to the City of Ottawa Material Specifications and Standard Detail Drawings. Exterior lighting within the station and platform area and Park and Rides shall consist of metal halide lamps. Outside the station area streetlighting along the Transitway, ramps, etc. shall be high pressure sodium.

All lamps for interior lighting shall be metal halide or fluorescent. LED lighting may be considered upon approval by OC Transpo. Interior lighting shall conform to CSA and Illuminating Engineering Society of North America (IES). The designer shall review all proposed lighting equipment selections with OC Transpo and obtain approval prior to proceeding with the illumination design.

14.9.3 Lighting Computer Simulation

The Designer shall provide a computer simulation for all new proposed lighting, as per the lighting design criteria specified in the following sections, to demonstrate that the design layout and light standard specifications meet requirements. Computer simulations are to be provided during the preliminary design stage and updated during the final detailed design stage and are to be prepared on a scaled drawing depicting illumination averages and uniformity, broken down per area. Computer simulations shall be reviewed and approved by OC Transpo.

Computer simulations are to be performed independently by the design consultant and shall not be performed by a manufacturer representative. Approved independent lighting software is to be used by the Designer (i.e. IES, AGI32)

14.9.4 Lighting Design Criteria

a) Transitway, Ramps and Platform Area Lighting Criteria:

The Transitway shall be illuminated over its full length or partially illuminated in station areas only as determined to be appropriate in consultation with OC Transpo. Station area Transitway lanes shall be fully illuminated from poles integrated into the centerline concrete barrier (where available).

Generally, the Transitway is not fully illuminated outside of the station lane taper limits unless adjacent stations or Transitway access ramps or at-grade intersections are in close proximity.

Transition lighting will be required between sections of full illumination and non-illumination.

Transitway access ramps shall be fully illuminated where lighting is warranted due to close proximity of illuminated roadway intersections and illuminated Transitway sections.

Platform and shelter lighting shall be designed to be a combination of lighting provided from all surrounding sources including Transitway median luminaires, platform luminaires, as well as, lighting provided within the shelters.

Where at-grade pedestrian crossings are provided on the Transitway within station areas enhanced illumination shall be provided

Table 14.9.4a provides illumination design criteria related to Transitway, Access Ramps and Platform Areas.

Table 14.9.4a

Illumination Design Criteria – Transitway, Ramps, Platforms

Location	Average Maintained Illuminance Level (Lux)	Uniformity (Avg/Min)
Transitway Lanes Within Station Areas (Metal Halide)	20	≤ 3:1
Transitway Lanes Outside Station Areas (where required) (HPS)	20	≤ 3:1
Access Ramps (where required) (HPS)	20	≤ 3:1
Station Platform and Shelter Lighting (Metal Halide or Fluorescent)	100	≤ 3:1
At-grade Transitway Pedestrian Crossings (Metal Halide)	100	≤ 3:1

b) Park and Ride Lots:

All parking areas, access roads, platforms and sidewalk areas associated with Park and Ride Lots shall be fully illuminated based on the design criteria provided in Table 14.9.4b.

Table 14.9.4b

Illumination Design Criteria – Park and Ride Lots

Location	Average Maintained Illuminance Level (Lux)	Uniformity (Avg/Min)
Parking Areas	20	≤ 3:1
Access Roads	10	≤ 3:1
Platform Areas and Shelter Lighting	100	≤ 3:1
Main Sidewalk Connections	50	≤ 4:1

c) Transitway Stations and Other Facilities:

Transitway stations, pedestrian overpasses/underpasses, operator facilities, supervisor rooms and exterior sidewalk/pathway areas are to be fully illuminated based on the design criteria provided in Table 14.9.4c.

Table 14.9.4c

Illumination Design Criteria – Transitway Stations, Other Facilities

Location	Average Maintained Illuminance Level (Lux)	Uniformity (Avg/Min)
Station Building (Public Areas)	100	≤ 2.5:1
Stairwells	100	≤ 2:1
Pedestrian Underpass / Overpass	100	≤ 2.5:1
Service Rooms, Elevator Machine Rooms	100	≤ 3:1
Exit Lighting	Conform to Ontario Building Code as supplemented by the Ontario Electrical Safety Code	
Operator Rest Facility	100	≤ 3:1

Table 14.9.4c (Cont'd)

Illumination Design Criteria – Transitway Stations, Other Facilities

Location	Average Maintained Illuminance Level (Lux)	Uniformity (Avg/Min)
Supervisor Room (Note: lighting shall be dimmable)	300	≤ 2:1
Exterior Areas – Sidewalk & Pathway Access and Connections	20	≤ 4:1

14.10 FIRE PROTECTION SYSTEM

Fire protection shall be in accordance with the Ontario Building Code and National Fire Protection Association (NFPA). The designer shall review the requirements of the Ontario Building Code as they relate to Transitway facilities. Each station must be evaluated to determine the requirements for the fire protection system in accordance with the Fire Safety Plan as developed by OC Transpo, local Fire Prevention Authorities, local bylaws and Ontario Fire Code (OFC).

As a minimum, the system shall incorporate the following:

- Smoke and heat detectors at the top and bottom of elevator hoistway and lobbies
- Electrical room heat detectors
- Elevator machine room heat detector
- Generator room heat detectors
- Service room heat detectors
- Janitor room heat detector

The fire protection panels should be fed from the low voltage switchboards with no means of disconnection except red coloured fusible disconnects immediately adjacent to the fire panels and clearly marked. The fire protection panels shall be connected to the input of dedicated control modules to indicate trouble, or alarm status and which shall be connected to OC Transpo's Building Automation System (BAS) control (see also Section 6.0 "Communications and Controls").

The fire protection panels shall be specified such that, if required, the units could control smoke activated dampers and ventilation fans or monitor sprinkler control systems.

Rooms in the stations, which may be considered as standard buildings by the local Fire Services, may have to be provided with sprinkler systems, smoke and heat detectors, pull-stations, hydrants, etc. as required by the applicable codes.

14.11 EMERGENCY POWER SYSTEM

The standby power for transit stations will be provided by diesel powered generators. The level of service for station operations during power outages will dictate the size of the standby power system. Generally the normal operation of lighting, emergency systems and communications should be maintained for the duration of a power outage. Fuel tank capacities, where applicable, shall be adequate for a minimum of 8 hours running time. Elevator operation is not considered to be an essential service, however, where identified by OC Transpo the elevator shall be supplied by emergency power (see also Section 16.0, "Elevators and Escalators"). Low wattage heating that is required to prevent freezing of critical systems is essential and normal operation is required during power outages.

The emergency generating system shall be designed in accordance to "CAN/CSA-C282, Emergency electrical power supply for buildings". The emergency generating system shall consist of:

- Diesel engine
- Alternator
- Alternator control panel
- Battery charger and battery
- Automatic engine room ventilation system
- Fuel supply system (c/w base tank)
- Exhaust system
- Steel mounting base
- Vibration isolators and seismic restraints
- Weatherproof generator enclosure (if required)

In addition to diesel generator sets, automatic transfer switches (ATS) are also required to transfer life safety and critical loads to emergency power when utility power supply fails and vice versa when the utility power is restored. The automatic transfer switches shall be able to:

- Monitor voltage on phases of normal power supply.
- Initiate cranking of standby generator unit on normal power failure or abnormal voltage on any one phase below pre-set adjustable limits for adjustable period of time.
- Transfer load from normal supply to standby unit when standby unit reaches rated frequency and voltage pre-set adjustable limits.
- Transfer load from standby unit to normal power supply when normal power restored, confirmed by sensing of voltage on phases above adjustable pre-set limit for adjustable time period.
- Shut down standby unit after running unloaded to cool down using adjustable time delay relay.

The automatic transfer switches shall be sized to accommodate at least 125% of the emergency loads they serve and shall be furnished with weatherproof enclosures if installed in outdoor

condition. In accordance with the latest Ontario Electrical Safety Code (OESC), both fire pumps and life safety loads shall be fed from dedicated automatic transfer switches.

The emergency power system shall be connected to the OC Transpo's Building Automation System (BAS) control (see also Section 6.0, "Communications and Controls").

Refer to Section 15.0, "Mechanical" for additional emergency power system requirements.

14.12 COMMUNICATIONS AND CONTROLS

Refer to Section 6.0, "Communications and Controls" for additional electrical requirements.

14.13 ELECTRICAL PROVISIONS - ELEVATOR, ESCALATOR AND MECHANICAL SERVICE

14.13.1 Elevators, Escalators

Refer also to Section 16.0, "Elevators and Escalators" for specific requirements. Requirements for electrical services related to elevator installations shall include:

- All equipment and electrical installations installed within the elevator hoistway/pit and machine room must be solely for the operation of the elevator.
- The fire alarm conduit for the hoistway heat detectors top and bottom shall be embedded in the hoistway walls.
- Each hoistway pit and machine room shall have a GFIC duplex receptacle on an individual circuit. Each hoistway/pit shall be heated with a removable plug-in type heater. Lighting in these areas shall also be on a separate circuit.
- The elevator shall have emergency audible alarm and visual beacon mounted on the exterior of the building to be activated when the alarm buttons in the cars are depressed. This system is on the lighting circuits of the cars and can be reset with an operator's key for the car light switches. The emergency alarm system shall also be connected to the building automation system. The exact location of the alarm and beacon shall be confirmed with OC Transpo.
- Additional communication wiring for remote-controlled PA systems in the cars within conduits from the elevator machine rooms to the Building Automation System shall be provided, as required.
- The cab lighting shall be separately fused with its own disconnect switch.
- The pit heater shall be a connected to a receptacle, not hard wired directly - plug-in type.
- Provide electrical connection and control of mechanical air conditioning unit in elevator machine room, where applicable.

14.13.2 Heating and Ventilation

Refer also to Section 15.0, "Mechanical" for specific requirements. Requirements for electrical services related to heating and ventilation include:

- The ambient temperature in all service rooms and elevator machine rooms shall be regulated by thermostats for unit heaters and ventilation fans. Single thermostat control for both heating and cooling shall be considered to avoid simultaneous heating and cooling.
- Radiant heaters in station lobbies and shelters where required are to be fed from a main distribution (or dedicated heating panel as required) and contactors in the main electrical room. Radiant heaters are to be controlled by the station Building Automation System with use of push button(s) to be mounted near the heaters. The heaters remain energized for a pre-set period of time and shut down until again energized. Circuit breakers for radiant heaters must be GFI or protected with a ground fault relay
- Heating is typically required in any elevator machine rooms during winter months to prevent condensation and frost from forming on control circuits and the hydraulic oil in the reservoir from becoming overly viscous. Self-contained thermostatically controllable electric forced air heaters shall be provided for this purpose. Non-flammable insulation treatments shall be used to minimize the energy requirements of the heaters. The heaters should be easily removable (plug connector) for seasonal servicing by OC Transpo personnel. At other times of the year, the heat generated from pumps and the heated hydraulic oil, if the elevator is heavily used, shall be dissipated through the provision of ventilation fans. The ventilation openings shall be capable of partial and full closure to allow the heaters to maintain acceptable temperatures. Air conditioning will also be supplied with application of traction elevators, appropriate electrical connecting and control to be provided.
- Similar requirements apply to the electrical and communications equipment enclosures and kiosks. Even in the winter it is likely that rack mounted communication equipment will need a fan to dissipate heat generated by some devices. Since it is difficult to isolate the communications components and connections from corrosive effects of de-icing salts, care shall be taken to minimize the chance for inside air to exchange with outside air. Where passenger shelters are heated, they shall be designed to minimize the amount of wind that can blow through the shelter when the heaters are in service and the heating system shall consist of radiant electrical heaters controlled by thermostats. Sump pumps shall be fed from the service panels and controlled by a pump controller.

14.13.3 Heating Cables/Pipe Tracing

Refer also to Section 15.0, “Mechanical” for specific requirements. Requirements for electrical services related to heating cables/pipe tracing include:

- Rainwater leaders from roof drains shall be internally heat-traced by mineral insulated cable. The cable shall be thermostatically controlled or a self-limiting type cable.
- External fire hose cabinets or Siamese connections for fire protection, where required, shall have all joints and valves externally heat traced and insulated where potential freezing may occur.
- Generally all water, sanitary and drain piping shall be heat traced if susceptible to freezing.

14.14 PROVISIONS FOR EQUIPMENT SUPPLIED BY OTHERS

14.14.1 Station Equipment

The designer shall confirm all ancillary equipment and amenities with OC Transpo and the City to determine the power and communication/control requirements. The equipment may include but not be limited to the following:

- Telephone and CCTV service feeds: location and requirements of incoming service lines. Confirm requirements with the service provider.
- Public phone system: public pay phones requirements in the station buildings & platforms. Confirm requirements with the service provider and/or OC Transpo.
- Advertising signs and map-cases: location and power supply requirements from the service panels. Confirm requirements with OC Transpo.
- CCTV security: location, power supply and communication supply requirements. Confirm requirements with OC Transpo.

14.15 FIGURES

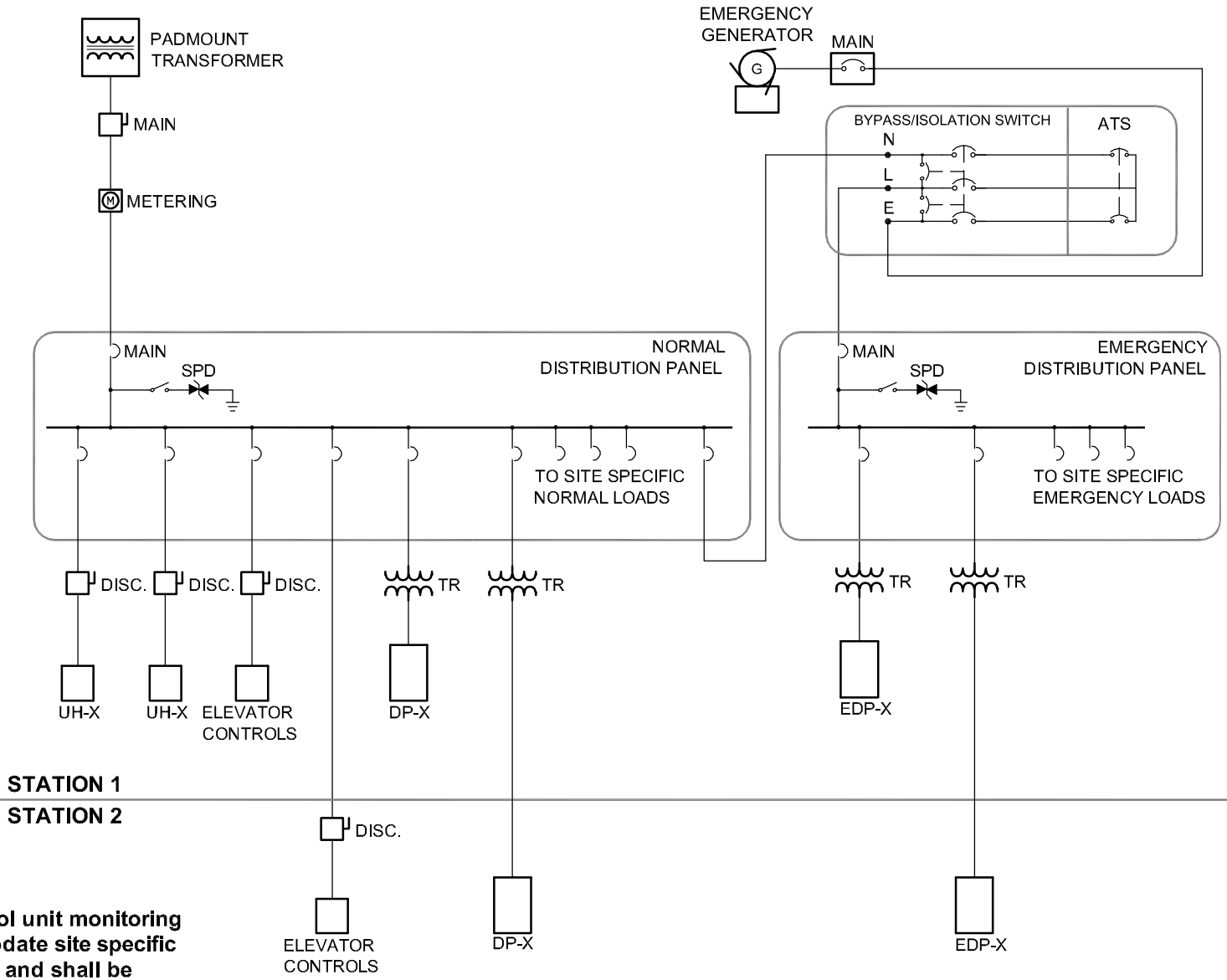
The designer shall refer to the following figures as referenced in above sub-sections:

Figure 14.5.1: TYPICAL SINGLE LINE DIAGRAM FOR TRANSITWAY STATION

Figure 14.5.2a: TYPICAL PRE-CAST CONCRETE SERVICE VAULT

Figure 14.5.2b PRE-CAST CONCRETE SERVICE VAULT EXAMPLES

Figure 14.5.2c: TYPICAL EXTERIOR DISTRIBUTION CABINET

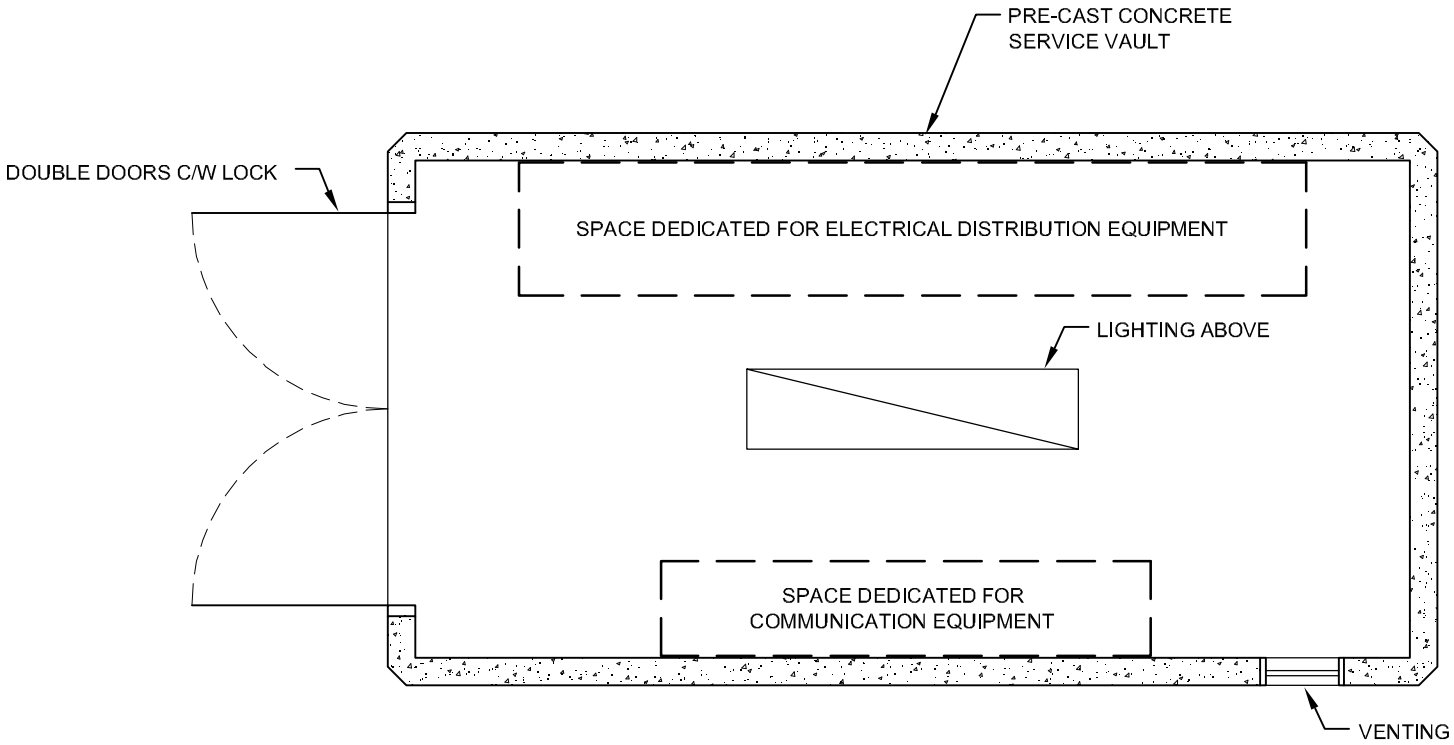


NOTE:

1. **Station control unit monitoring shall accomodate site specific requirements and shall be confirmed with OC TRANSPO.**

TYPICAL SINGLE LINE DIAGRAM FOR TRANSITWAY STATION

Scale	Date
N.T.S.	May 2012
Revision No. / Date	



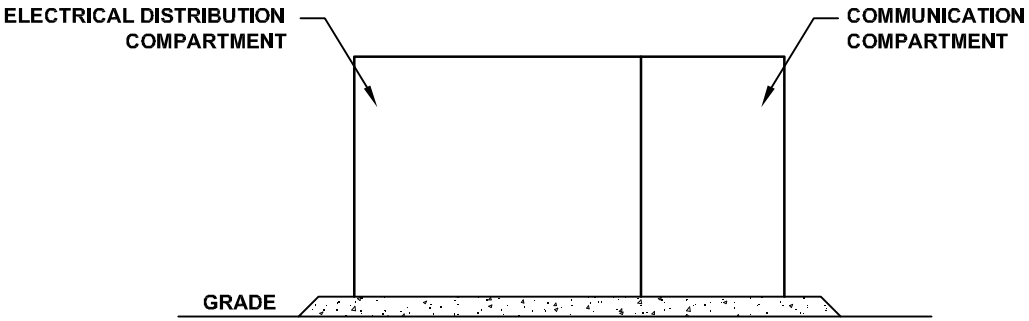
CONCRETE SERVICE VAULT PLAN VIEW

NOTE:

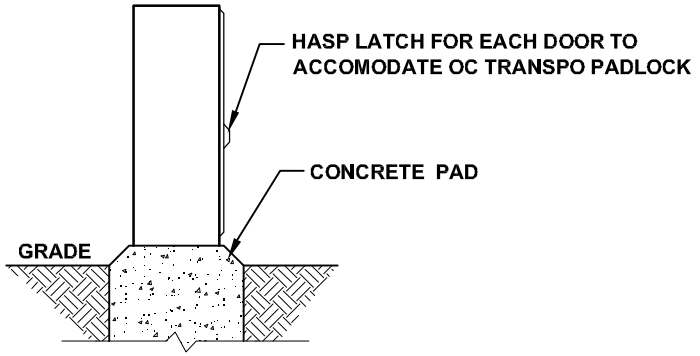
1. **Vault size shall accommodate site specific requirements which shall be confirmed with OC TRANSPO.**

Ottawa / OC Transpo	**TYPICAL PRE-CAST CONCRETE SERVICE VAULT**	Scale: **N.T.S.**	Date: **May 2012**
		Revision No. / Date	
	TRANSITWAY AND STATION DESIGN GUIDELINES		**Figure 14.5.2a**

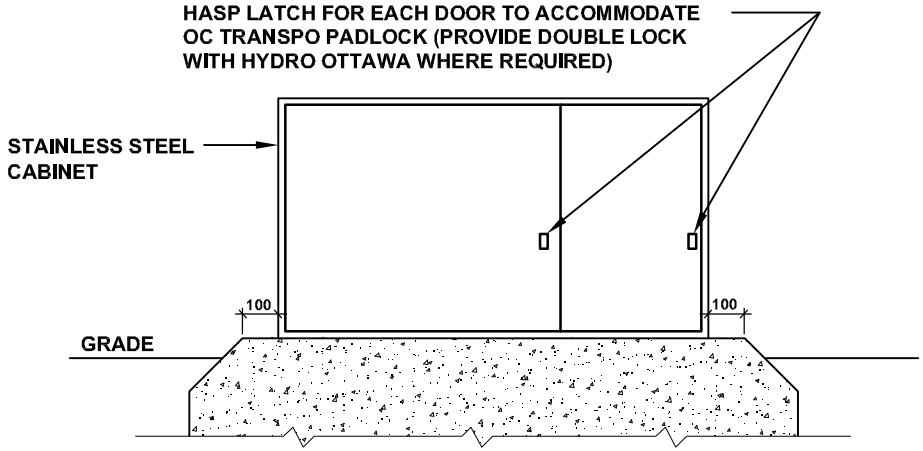
Ottawa OC Transpo	**PRE-CAST CONCRETE SERVICE VAULT EXAMPLES**	*Scale* **N.A.**	*Date* **May 2012**
		Revision No./Date	
	TRANSITWAY AND STATION DESIGN GUIDELINES	**Figure 14.5.2b**	



DISTRIBUTION CABINET LAYOUT (INTERIOR)



DISTRIBUTION CABINET END ELEVATION



DISTRIBUTION CABINET FRONT ELEVATION

Ottawa / OC Transpo	TYPICAL EXTERIOR DISTRIBUTION CABINET	Scale: N.T.S.	Date: May 2012
		Revision No. / Date	
	TRANSITWAY AND STATION DESIGN GUIDELINES		Figure 14.5.2c

15.0 MECHANICAL

The mechanical design requirements for Transitway stations include: heating, ventilation, and air conditioning in specific areas; drainage and plumbing for roofs, floors and service areas; potable water supply; limited fire protection systems, emergency generators and in special cases irrigation systems. Many of the above mentioned systems may not be installed in the initial phase of the transit way stations but the designer should ensure that provisions for future work are installed or that the future work is feasible both physically and economically. The information in this chapter is presented as though such features are to be installed so that designers may fully appreciate the mechanical aspects of Transitway stations.

15.1 HEATING, VENTILATION AND AIR CONDITIONING

15.1.1 Introduction

The typical Transitway station will not normally require consideration of ventilation and air conditioning but at stations which include one or more of the following elements such considerations shall apply.

- Transitway Tunnels - if the Transitway and station is located below grade
- Pedestrian Underpasses
- Mechanical/Electrical Rooms
- Supervisors Rooms
- Elevator Machine Rooms/Elevator Pits
- Janitors/Storage Rooms
- Operator Facilities
- Ticket/Information Rooms
- Emergency Generator Rooms

15.1.2 Applicable Codes

Ontario Building Code – latest edition

National Building Code – latest edition

CAN/CSA B139 ON – Installation Code for Oil Burning Equipment

National Fire Protection Association (NFPA) Codes and Standards – Latest Edition

CSA B44 – Safety Code for Elevators

City of Ottawa Bylaws & Guidelines (i.e. Sewer-Use)

15.1.3 Transitway Tunnels

a) Heating:

Heating of Transitway tunnels is not required except for station management or service facilities which may be located in the tunnel.

b) Ventilation:

Adequate ventilation must be provided in the tunnel for the comfort and safety of passengers and for the evacuation of smoke and fumes following a fire. Many variables and complex design factors must be considered in ascertaining the ventilation design requirements. The designer shall refer to and conform to the requirements of NFPA 130. Among these are peak bus loading and passenger volumes, as well as the problem of suspended salt particles during winter maintenance operations. The primary considerations are the comfort and health of the tunnel users, acceptable dilution of exhaust contaminants, maintenance of adequate visibility and public safety in emergency situation.

c) Air Conditioning:

Air conditioning of Transitway tunnels is not required except for operation or service facilities if located in the tunnel.

15.1.4 Pedestrian Underpasses

a) Ventilation:

A pedestrian underpass shall be considered similar to a tunnel in that level of contaminants such as carbon monoxide and nitrogen oxide must be kept at acceptable levels in accordance with the requirements of applicable Codes. Since these underpasses are usually short in length and receive a supply of fresh air from the exterior doors or are opened ended (i.e. not enclosed or with doors), additional fresh air supplied by a mechanical means may not be required.

If these underpasses are located such that this natural influx of fresh air is restricted, or not possible, an outside source of uncontaminated air must be provided. Depending on the dimension of the underpasses a specific design must be carried out to size and locate both the exhaust fans and any intake passages.

15.1.5 Mechanical/Electrical Rooms

a) Heating:

Electrical room dimensions will vary depending on station size and configuration; however, the heating equipment shall be fan-forced electric unit heaters capable of maintaining room temperatures between 20°C and 25° C. Single thermostat control for both heating and ventilation shall be included to avoid simultaneous heating and cooling.

b) Ventilation:

The main purpose of ventilation in the mechanical/electrical rooms is to limit the space temperature to a maximum of 25°C to 35°C. Intake louvers should be filtered and located remote from the Transitway environment where possible. Single thermostat control for both heating and ventilation shall be included to avoid simultaneous heating and cooling.

A dedicated vertical utility shaft is recommended for venting and other plumbing pipe routing between station levels and roof line.

c) Air Conditioning:

Air conditioning is not normally provided in these rooms, however, if specialized computer equipment is installed to control the station lighting or other events, room temperature and humidity will have to be controlled. Provision for this should be made at the time of final design when the cooling requirements of the proposed equipment are known. The designer shall confirm requirements with OC Transpo.

15.1.6 Supervisors Rooms

a) Heating:

Based on the architectural layout and an insulated space possibly surrounded by totally unheated areas, sufficient heating capacity using fan forced thermostatically controlled electric heaters shall be provided to maintain the temperature between 20°C and 22°C. Single thermostat control for both heating and cooling shall be included to avoid simultaneous heating and cooling.

b) Ventilation:

A dedicated fresh air intake shall be considered complete with duct heater for winter operation. Ventilation rate shall be in conformance with ASHRAE 62.1 for office occupancy.

c) Air Conditioning:

The air conditioning equipment should be capable of maintaining the room at a maximum temperature of 23°C. Minimum cooling capacity of 9,000 BTU/h with an air flow of 140 l/s shall be used. The unit shall be thermostatically controlled. The unit and controls shall be easily accessible for maintenance purposes. Single thermostat control for both heating and ventilation shall be included to avoid simultaneous heating and cooling. A split air conditioning unit is recommended.

15.1.7 Elevator Machine Rooms/Elevator Pits

a) Heating:

Based on the architectural layout, sufficient heating capacity to maintain temperatures at 20°C to 25°C shall be provided. A minimum temperature of 10°C shall be maintained in the elevator pit. A minimum 4 kW electric heater is required in elevator pit. For ease of replacement a plug-in type power connection is recommended for the elevator pit electric heater.

b) Ventilation:

Provide adequate ventilation to ensure the temperature of the machine room does not exceed 30°C. The intake louvers and exhaust fans should be custom designed to suit the room size and be screened and corrosion resistant.

c) Air Conditioning:

In situations where maximum 25°C ambient temperature is required for the modern elevator controller (i.e. traction type) space mechanical cooling shall be provided by means of split Air Conditioning unit. Cooling capacity shall be determined based on the heat dispersion data provided by the elevator manufacturer. A minimum cooling capacity of 9,000 BTU/h with an air flow of 140 l/s shall be used. The unit shall be thermostatically controlled. The unit and controls shall be easily accessible for maintenance purposes.

15.1.8 Janitors/Storage Rooms

a) General:

The mechanical requirements for janitor/storage rooms will depend largely on the size of the room which is determined by the overall station function and size.

b) Heating:

In all cases the janitors room must be heated by either a separate heating unit or be located within a generally heated area in the case of a smaller station. Sufficient heating capacity using fan forced thermostatically controlled electric heaters shall be provided to maintain the temperature between 20°C and 25°C.

c) Ventilation:

In the case of a major station, natural ventilation will occur under the door with an exhaust fan exhausting to the exterior. The exhaust fan shall be wired into the light switch such that it is operational when the light is on.

15.1.9 Operator Facilities including Water Closets and Lounge Areas

a) Heating:

Adequate heating shall be provided using fan forced thermostatically controlled electric heaters to maintain the temperature of 20° C to 22° C. Single thermostat control for both heating and cooling shall be included to avoid simultaneous heating and cooling.

b) Ventilation:

Exhaust fans exhausting to the exterior shall be provided in each washroom. Minimum ventilation rate is 25 l/s per toilet/urinal as per Ontario Building Code. A dedicated fresh air

intake shall be considered for lounge area complete with duct heater for winter operation. Ventilation rate shall be in conformance with ASHRAE 62.1 for office occupancy.

c) Air Conditioning:

The air conditioning equipment should be capable of maintaining the room(s) at a maximum temperature of 23°C. Minimum cooling capacity of 9,000 BTU/h with an air flow of 140 l/s shall be used. The unit shall be thermostatically controlled. The unit and controls shall be easily accessible for maintenance purposes. Single thermostat control for both heating and cooling shall be included to avoid simultaneous heating and cooling. Split air conditioning unit is recommended.

15.1.10 Ticket/Information Rooms

a) Heating:

Based on architectural layout possibly surrounded by totally unheated areas, sufficient heating capacity using fan forced thermostatically controlled electric heaters shall be provided to maintain the temperature between 20°C and 22°C. Single thermostat control for both heating and cooling shall be considered to avoid simultaneous heating and cooling.

b) Ventilation:

Dedicated fresh air intake shall be considered for complete with duct heater for winter operation. Ventilation rate shall be in conformance with ASHRAE 62.1 for office occupancy.

c) Air Conditioning:

The air conditioning equipment shall be capable of maintaining the room at a maximum temperature of 23°C. Minimum cooling capacity of 9,000 BTU/h with an air flow of 8.5m3/min shall be used. The unit shall be thermostatically controlled. The unit and controls shall be easily accessible for maintenance purposes. Single thermostat control for both heating and cooling shall be considered to avoid simultaneous heating and cooling. A split air conditioning unit is recommended.

15.1.11 Emergency Generator Rooms

a) Heating:

Sufficient heating capacity using fan forced thermostatically controlled electric heaters shall be provided to maintain the temperature between 10°C and 15°C to facilitate generator starts. Single thermostat control for both heating and ventilation shall be considered to avoid simultaneous heating and cooling.

b) Ventilation:

Generator room ventilation shall be specifically designed based on the size of generator to provide adequate combustion air intake and radiator heat release. The generator radiator shall

be ducted to the exterior directly with discharge air bypass damper to allow warm air recirculation at initial start. A local controller shall be provided in conjunction with temperature sensors and a generator control panel to enable automatic sequence of operation upon generator starts.

Thermally insulated motorized dampers shall be provided at all air intake and exhaust louvers with thermally insulated plenum for maximum energy savings.

15.2 EMERGENCY POWER SYSTEMS

Generator system designs are dependent on the general electrical design of the station distribution. Refer also to Section 14.0 “Electrical”.

15.2.1 HVAC Supporting System

Refer to Section 15.1.11.

15.2.2 Fuel System

Base mount double wall fuel oil tanks to ULC S602 are recommended for the generator fuel oil system with adequate capacity to provide 8 hours fuel oil supply at the full load condition. The fuel oil system shall be complete with interstitial vacuum leak detection system, fuel level gauge, remote high level alarm, fill port, vent pipe, fill pipe, supply/return connections, fire valve, and low level alarm. An independent horizontal double fuel tank to ULC S602 is acceptable as alternative. All piping and flexible hose for the fuel system shall be certified for the fuel oil service. A watertight, lockable cover shall be provided for fill station. The designer shall confirm the required location of the fill station with OC Transpo based on operational requirements.

In situations where the static head is intended to exceed 35 kPa (5 psi), the fuel tank shall be designed by a professional engineer to CSA B51 or ASME Boiler and Pressure Vessel Code. A ULC S602 tank is not acceptable.

15.2.3 Engine Exhaust System

The engine exhaust muffler shall be provided to meet the sound level criteria set out by the approved Ministry of Environment Certificate of Air. The muffler shall be fully insulated with a minimum 25mm high temperature insulation blanket.

The exhaust pipe shall be pre-engineered double wall stainless steel with 25mm high temperature fiber glass insulation, designed for an engine exhaust application and suitable for 760 Degree C (1400 Deg. F) continuous duty. The engine exhaust system shall include all fittings, bellow expansion joint, anchors, guides, roof thimble, flashing, and flip top termination as required. Schedule 40 steel pipe is not acceptable for engine exhaust.

15.2.4 Ministry of Environment Certificate of Air

A Ministry of Environment (MOE) Certificate of Air is generally required for the emergency generator installation. A report shall be prepared and submitted as per MOE guidelines to

demonstrate compliance with MOE air emission and noise criteria. Emission modeling is required based on the generator model emission data, as well as, site conditions. The acoustic assessment report requirements can be determined after the initial screening process. The mechanical system design shall incorporate sound attenuation and emission control requirements. A catalytic convertor may be required at engine exhaust in certain situations.

The acoustic insulation requirements (i.e. application of insulating materials on interior walls and exterior doors), as identified by the acoustic assessment report, shall be incorporated into the design as required.

15.3 DRAINAGE AND PLUMBING

15.3.1 General

Transitway stations typically include some, or all, of the following components:

- Transitway Tunnels
- Pedestrian Underpasses/Overpasses
- Lobbies and waiting areas
- Mechanical/Electrical Rooms
- Janitors/Storage rooms
- Supervisor's Room
- Operator Facilities
- Ticket/Information Rooms
- Elevator machine rooms/Elevator pits

15.3.2 Applicable Codes

Ontario Plumbing Code

National Plumbing Code

City of Ottawa Bylaws (i.e.: Sewer Use)

15.3.3 Drainage

a) Transitway Tunnels**:**

The drainage of any Transitway (i.e. roadway) tunnel shall be designed in coordination with the roadway/structural works and shall be connected into the storm drainage system.

b) Pedestrian Underpasses/Overpasses**:**

The drainage of any pedestrian underpass or bridge shall be achieved by designing the structural crossfall and longitudinal grades to direct the water to gutter type floor drains. A

crowned design is recommended to provide surface drainage to both sides of the underpass/overpass. In a closed pedestrian underpass the drains may need to discharge into the sanitary sewer. Overpass deck drains may be permitted to discharge to the area below, provided they are not located over traffic lanes or passenger areas. The designer shall confirm that this is permissible with OC Transpo. The designer shall consider requirements for heat tracing.

c) Lobbies and Waiting Areas**:**

All passenger lobbies and waiting areas shall be provided with floor drains with trap seal primers. Heat tracing is required for drain pipe located in unheated spaces. An electronic trap seal primer is required if there is no frequently used plumbing fixture to allow for proper operation of mechanical trap seal primer.

d) Service Rooms**:**

All service rooms including mechanical, electrical, janitor and storage spaces shall be provided with floor drains with trap seal primers. Floor drains are not allowed in emergency generator service rooms. In the case of janitor and storage spaces, locations are dependent on the equipment installed in these areas. Heat tracing is required for drain pipe located in unheated spaces. An electronic trap seal primer is required if there is no frequently used plumbing fixture to allow for proper operation of mechanical trap seal primer.

e) Operator Facilities**:**

All operator facilities, kitchen and washroom spaces shall be provided with floor drains with trap seal primers.

f) Elevator Machine Rooms/Elevator Pits**:**

Provide a floor drain in the elevator sump pit connected directly to a sump well outside the pit. The drain from the sump well to the sewer shall have a back water check valve and be trapped and vented as required by applicable codes and regulations.

Ensure that no conduit or piping other than that required for the operation or security of the elevator is installed within the elevator shaft. A dedicated vertical utility shaft is recommended for venting and other plumbing pipe routing requirements.

If gravity drainage of the sump well serving the elevator sump pit is not possible, provide a sump pump complete with a check valve and an isolation valve to discharge into the sanitary sewer.

15.3.4 Plumbing

a) Minimum Flow Rates and Pipe Sizes**:**

As recommended by the National Building Code as supplemented by the Ontario Building Code and City of Ottawa Bylaws and Design Guidelines.

b) Janitors/Storage Rooms**:**

The following are acceptable equipment and fixtures:

Hot Water Heater, 20 gallon minimum. *Acceptable Material: A.O. Smith 'DSE' series for electric type.* Note: Shared with other hot water requirements where applicable.

Floor mounted Janitor Sink, *Acceptable Material: Stern Williams SB-900 'Serviceptor' Mop Sink.*

Faucet, *Acceptable Material: Stern Williams #T-10-VB Faucet.*

Note: Station floor cleaning will be completed utilizing a floor washing unit stored in the janitor room. There is no requirement for large hose connections, etc. at the stations.

c) Operator Facilities**:**

The designer shall note that all operator facility equipment and fixture installations and materials shall conform to barrier free requirements.

The following are acceptable equipment and fixtures:

- Restroom
  - 2 required (1 female and 1 male).
- Sink and counter – stainless steel
  - 2 required in each restroom, *Acceptable Material: Kindred 'Collection' series.*
- Urinal – wall mounted and occupancy activated flush
  - 2 required, Acceptable Material: American Standard 'Wash Brook' with Sloan 'Optima' hands-free flushing valve.
- Water Closet
  - per Building code, 4 minimum, two for each gender, occupancy activated flush, Acceptable Material: American Standard 'Madera FloWise' with Sloan 'Optima' Hands-free flushing valve.
- Lavatories – occupancy activated flush
  - 2 required in each restroom, wall hung complete with carrier. *Acceptable Material: Sloan 'Optima' heavy commercial duty hands-free faucet.*
- Hot Water Heater
  - 1 required, 20 Gallon minimum, Acceptable Material: A.O. Smith 'DSE' series for electric type. Note: Shared with other hot water requirements where applicable.
- Drinking Fountain (Include supply line, filter and cooler)
  - 1 required (in foyer area), *Acceptable Material: Haws stainless steel wall hung with built-in cooler.*
- Soap Dispensers (OC Transpo supplied and installed)
  - 2 required in each restroom.

- Paper Towel Dispenser (OC Transpo supplied and installed)
  - 2 required in each restroom.
- Napkin Disposals (OC Transpo supplied and installed)
  - 1 required in each female water closet.
- Mirrors
  - 2 required in each restroom.
- Coat Hooks
  1 required per water closet, installed on back of door.
- Kitchen Sink and Counter – stainless steel
  - 1 required, Acceptable Material: Kindred commercial LBS stainless steel sink with Chicago 'marathon' faucet.

d) Elevator Towers and Lobby Roofs**:**

The drainage of all roofs is achieved by installing rainwater piping, heat-traced where necessary, discharging into the storm water pipes in accordance with applicable Codes. The specified roof drain model shall be compatible with the roofing type.

A dedicated vertical utility shaft is recommended for venting and other plumbing pipe routing requirements.

e) Heat Tracing**:**

Self-regulating heat tracing with pipe insulation shall be considered for plumbing services passing through the unheated spaces. Underground heat tracing shall be avoided where possible and if required the specified product shall be suitable for the application.

f) Pumping Station**:**

In situations where gravity drainage is impossible, an outdoor pumping station shall be provided to facilitate the transfer of flows.

The pumping station shall be a complete duplex pump system package with pump control panel and level controls to be designed with the required flow capacity and shall include the following accessories:

- Wet well
- Aluminum Access Ladder
- Interior Pipes and fittings (discharge piping): Copper Type K
- Isolation Valves and Check Valves
- Aluminum Vent mounted on top of the wet well
- Pipe Supports
- Aluminum hatches

15.4 FIRE PROTECTION

The station construction, of concrete, steel and glass, is essentially non-combustible and the anticipated fire loading of the shelters and rooms within the stations will be low. Consequently, the anticipated fire severity is slight and the buildings will provide a high degree of fire safety.

The use of a full fire protection system (i.e. sprinklers, fire hose cabinets, pull stations, etc.) is not normally a requirement in the design of Transitway stations. However, if the station is integrated into a commercial complex or is located underground the requirements for fire protection according to the Ontario Building Code Clause 3.13 and local fire protection codes must be met. For stations which require provision for future light rail, NFPA 130 shall be followed to facilitate the future conversion.

Hydrant protection is required at stations so that all areas of the stations are within 90 m of a hydrant. Hydrant positions shall be subject to the approval of the City of Ottawa Fire Services. All mechanical/electrical rooms and elevator machine rooms must be provided with fire extinguishers of appropriate size and type as per Ontario Building Code and NFPA 130.

In tunnels, smoke evacuation/air charging fans may be required as part of the fire protection scheme. These fans shall be reversible and shall be used as the normal ventilation fans. Fan control may use smoke detection, heat detection and anemometer input. Wall hydrants may be required. Refer to Section 14.0 “Electrical” for co-ordination with the electrical aspects of fire protection.

16.0 ELEVATORS AND ESCALATORS

16.1 SCOPE

This section outlines recommendations and requirements for elevators and escalators to be incorporated in Transit Stations. This section is intended to serve as a guide to those involved in the design of new buildings or in the renovation or modernization of existing buildings. Elevator systems in the Transit Stations require superior quality; durable and aesthetically pleasing components; capable of resisting abuse by vandals and the mechanized cleaning methods of OC Transpo. Additionally, exposure to road salts, human urine and temperature extremes must be taken into account in the equipment design. It is incumbent that the designer utilizes sustainable design elements including LEED protocol where practical.

General design considerations for various elements of the elevator design and system are discussed in the section particularly as they relate to Ottawa's transit environment.

Escalator use should be minimized in a transit environment but could be appropriate where the vertical distance between platforms make stairs inconvenient for even able-bodied passengers and when there is a very high passenger flow, such as at a central transit depot. Design considerations for escalators are also listed in this guideline.

Reference shall also be made to Section 6.0, “Communications and Controls”, Section 11.0, “Accessibility”, Section 14.0, “Electrical”, and Section 15.0, “Mechanical”.

16.2 ELEVATORS

16.2.1 Use

Normally, a two stop transit installation should have 2,500 pound capacity elevators with 42” wide side opening doors serving both platforms. Car speed can be 100-120 fpm for hydraulic elevators and 150 fpm for traction.

The designer shall consider incorporation of spare hoistways where future expansion or increased use may create a need for additional elevator equipment.

16.2.2 Codes and Standards

As a minimum, comply with the latest requirements of the Canadian Electrical Code (CSA C22.1), the Canadian Standards Association CAN/CSA-B44 Safety Code for Elevators, Escalators, Dumbwaiters, Moving Walks and Freight Platform Lifts, the National Building Code of Canada and provincial and local codes or regulations which govern the requirements of the installation.

The American Public Transportation Association publishes specific recommendation for transit-duty elevators – designated as standard APTA RT-FS-008-03. Compliance to aspects of these recommendations can be considered, however, full compliance is likely to greatly increase project

costs and in the case of Ottawa Transitway projects may lead to a lack of competitive bids from any contractors currently undertaking elevator work in the National Capital Area.

16.2.3 Types

In order to clearly convey to the elevator industry the required equipment, classify the components of the vertical transportation as passenger elevators, service elevators, freight elevators, or dumbwaiters. Classify elevators according to the drive type as gearless traction, geared traction or hydraulic.

Traction elevators should be classified according to machine location as overhead, side-mounted, basement-mounted or hoistway-mounted (MRL).

Passenger elevators may be further classified as observation elevators, shuttle elevators or service elevators used to carry both passengers and freight.

16.2.4 Maintenance

It is important that all system “bugs” and defects be remedied before the equipment responsibility reverts from installer to the OC Transpo maintenance provider. Accordingly the designer should specify post-installation warranty maintenance and regular systematic examinations and adjustments, including repairs and replacements due to defect in materials or workmanship and normal wear and tear, for a period of 12 months following the date of Total Performance of the Work. Post-installation maintenance should incorporate the current version of OC Transpo’s maintenance specification.

Post-installation maintenance should be specified to keep the equipment in substantially new condition, maintain its performance as originally designed and to ensure that the equipment constantly and consistently meets the standard specified for the original installation. A third party inspection should also be specified prior to the expiry date of the warranty.

As a general guide, a minimum maintenance duration per month (exclusive of time spent on repairs and service calls) of 4 man hours per traction elevator, 2 man hours per hydraulic elevator may be assumed.

The contract documents shall specify that as-built drawings of the complete installation (electrical and mechanical), parts lists and detailed maintenance procedures shall be submitted.

16.2.5 Standard Equipment

Due to the large number of elevator installation in the Transitway system the designer should endeavor to specify standard equipment wherever possible, except where use of such equipment is not feasible or where standard equipment of the required configuration does not exist. In any one project, use identical or similar layouts, designs and components wherever possible.

16.2.6 Specifications and Drawings

The designer should develop contract specifications and drawings incorporating the equipment of manufacturers expected to bid on the work and where requested by OC Transpo manufacturers that are pre-approved.

Detailed elevator plans, sections and elevations shall be included in the contract drawings including as a minimum:

- Plan view at each floor level.
- Plan view of machine room, pit and secondary levels showing space allowance and access.
- Plan view of the hoistway showing size, construction, entrance design and any special hoistway conditions.
- Vertical sections/elevations of hoistway, entrances, pit, secondary levels, machine room and access doors.
- Details of structural hoist beam support.
- Fixtures and location of fixtures, including hall buttons, car stations, position indicators, hall lanterns, central control consoles, car lighting, emergency car lighting, car telephone, intercom.
- Hall entrances and car cab enclosures plans and elevations.

16.2.7 Operating Environment

Specify equipment that will survive the local transit environment including machine room temperature range between 10°C and 33°C and hoistway temperature range between -25°C and 40°C. Specify equipment to operate normally with variations of up to ±10% in the electrical power supply voltage.

16.2.8 Motor Drives

In order to satisfy the public sector expectations of “green” technology consider wherever possible traction elevators with regenerative solid state motor drives.

16.2.9 Controllers

Due to the public tender environment, it is important that only fully non-proprietary elevator equipment is specified, with non-proprietary defined as:

- All required diagnostic are “on board”
- All programming and diagrams required for long-term maintenance are provided with the controller

- The controller will not shut down or alter functionality after a pre-determined increment of time or use.
- Any elevator contractor shall be allowed to purchase parts, supplies, diagrams, support or training directly from the factory at similar pricing as the original installer.
- Parts including circuit boards shall be available for purchase from the factory in numbers and not on an “exchange only” basis.

16.2.10 Elevator Alarm Bell

As the Transitway stations are generally unstaffed, it is important each elevator be equipped with an easily operable emergency phone which is monitored 24/7. A passenger trapped in the elevator may not always be able to clearly communicate the problem or even the elevator location therefore the activation of the phone should relay location information to the emergency monitoring station. Activation of the elevator alarm bell should set off the station alarm and beacon, visible to passing drivers and shall also be monitored by the Building Automation System (BAS).

16.2.11 Emergency Power

Elevator operation is not considered to be an essential service and need not be supplied by standby power unless otherwise identified by OC Transpo. Specify the use of battery packs to arrange elevator lowering and release of trapped passengers.

16.2.12 Bilingual Markings and Design

Specify bilingual markings or symbols in accordance with the National Signage Program and CAN/CSA-B44.

Provide all signs and instructions in both English and French including:

- Car operating panels
- Telephone cabinets
- Service and attendant cabinets
- Top of car operating devices
- Special risers and hoistway access switches
- Corridor control and indicator panels
- Central control and emergency power selection switches
- Signal fixtures

Locate English wording above and French wording below or English to the left and French to the right.

16.2.13 Vandal Resistant Design

In view of the importance for the elevators to have resistance to vandalism provide the following features:

- The unsupervised transit stations are subject to regular vandalism and misuse of varying degrees. It is important that the elevators provide resistance to abuse.
- Equip car interiors with removable panels which can be readily removed and refinished. Alternatively, fabricate the car enclosure with rigidized stainless steel.
- Provide hall and car pushbuttons of the metal mushroom-type or flush-mounted with minimum stroke.
- Provide concealed fasteners, designed to discourage tampering. Where exposed fastenings must be used, provide specially designed spanner head or similar type screws. Mechanical fastening is preferred over adhesive fastening systems.
- Provide specially designed vandal resistant telephones.

16.2.14 Earthquake Design

If the transit station is equipped with seismic structural design, the elevator design should withstand seismic acceleration per requirements of National Building Code of Canada, latest edition.

16.2.15 Car Enclosures

Years of trial and error on the Ottawa Transitway have yielded a standard cab design that is resistant to vandalism, wear and tear and at a reasonable price. This includes cab walls of textured (Avesta) stainless steel, car lighting that is protected by Lexan panels behind a metal cove and small tile flooring with Mapei adhesive installed over Marine grade plywood. Depending upon the cab arrangement, windows are often provided in landing doors and the cab wall panels in order that activity within the cab can be observed from the exterior.

16.2.16 Hoistway Entrances

Entrances should never be provided as less than 1067 mm wide, in order that wheelchairs can easily be accommodated. Vision panels are provided as 150 mm x 330 mm and must include wired glass.

16.2.17 Signals and Fixtures

Elevator fixtures and signals are highly prone to vandalism and therefore must only be provided in the most durable form. The use of Dupar US 93 buttons should be considered for a good combination of visibility and vandal resistance. An out of service pilot light must be provided at each Hall station so that physically disabled users are not left waiting for an inoperative elevator for an extensive time.

In order to accommodate the many staff persons involved in transit activities all keyed switch functions should be provided as standard Epco 1, except where prohibited by elevator code.

16.2.18 Corrosion

Corrosion damage is one of the most severe issues compromising elevator equipment life in the Transitway environment. Corrosion is exacerbated by road salts, temperature extremes, moisture from station cleaning equipment and quite commonly from persons urinating in the elevator cabs and into the elevator pits. Premature equipment failure due to corrosion is nearly inevitable, however, the designer can mitigate the corrosion problem as follows:

- Manufacture gibs and retainers from aluminum or stainless steel
- Provide galvanized or bituminous-protected sill support steel
- Provide galvanized or stainless steel apron plate and fascia in hoistway
- Electrically isolate all dissimilar metals in the construction of the elevator
- Provide hollow, two skin landing doors. Clad hoistway doors on both sides and on top edge with stainless steel and minimize edges and crevices that could retain water
- Do not employ water absorbing materials such as untreated plywood or felt in the construction of the elevator car, cab or within the elevator hoistway
- Provide a waterproof cover over landing door equipment at each floor
- Locate pit oil lines, conduits or raceways a minimum of 350 mm above the pit floor

16.2.19 Accessibility

Compliance to accessibility standards is critical for transit station elevators. Previously noted information complies with current standards but as a minimum compliance to CSA B44 Appendix E should always be referenced. The designer shall also ensure conformance to the Accessibility for Ontarians with Disabilities Act (AODA). Refer also to Section 11.0, “Accessibility”.

16.3 ESCALATORS

Escalators do not achieve handicapped accessibility therefore are useful only for movement of large numbers of the able-bodied general public. Due to the large number of safety features of modern escalators, they are very prone to “failsafe” shutdowns when subjected to adverse conditions including vandalism, extremely heavy use, cold temperature and road salts. Where installation of escalators is appropriate consider the use of heavy duty Transit escalators rather than conventional “mall duty” escalators. Such escalators typically have upgraded step chains, metal balustrades, vandal resistant fixtures and other improvements.

16.3.1 Codes and Standards

As a minimum, comply with the latest requirements of the Canadian Electrical Code (CSA C22.1), the Canadian Standards Association CAN/CSA-B44 Safety Code for Elevators, Escalators, Dumbwaiters, Moving Walks and Freight Platform Lifts, the National Building Code of Canada and provincial and local codes or regulations which govern the requirements of the installation.

The American Public Transportation Association publishes specific recommendation for transit-duty escalators – designated as standard APTA RT-FS-007-02. Compliance to aspects of these

recommendations can be considered, however, full compliance is likely to greatly increase project costs and in the case of Ottawa Transitway projects may lead to a lack of competitive bids from any contractors currently undertaking escalator work in the National Capital Area.

16.3.2 Maintenance

It is important that all system "bugs" and defects be remedied before the equipment responsibility reverts from installer to the OC Transpo maintenance provider. Accordingly the designer should specify post-installation warranty maintenance and regular systematic examinations and adjustments, including repairs and replacements due to defect in materials or workmanship and normal wear and tear, for a period of 12 months following the date of Total Performance of the Work. Post-installation maintenance should incorporate the current version of OC Transpo's maintenance specification.

Post-installation maintenance should be specified to keep the equipment in substantially new condition, maintain its performance as originally designed and to ensure that the equipment constantly and consistently meets the standard specified for the original installation. A third party inspection should also be specified prior to the expiry date of the warranty.

As a general guide, a minimum maintenance duration per month (exclusive of time spent on repairs and service calls) of 4 man hours per escalator may be assumed.

The contract documents shall specify that as-built drawings of the complete installation (electrical and mechanical), parts lists and detailed maintenance procedures shall be submitted.

16.3.3 Standard Equipment

The designer should strive to use standard equipment wherever possible, except where use of such equipment is not feasible or where standard equipment of the required configuration does not exist. In any one project, use identical or similar layouts, designs and components wherever possible.

16.3.4 Operating Environment

Specify equipment that will survive the local transit environment found to range between -25°C and 40°C. Specify equipment to operate normally with variations of up to ±10% in the electrical power supply voltage.

16.3.5 Motor Drives

In order to satisfy the public sector expectations of "green" technology consider dual-speed escalators that slow when unoccupied or similar reduced torque systems.

16.3.6 Controllers

Due to the public tender environment, it is important that only fully non-proprietary equipment is installed, with non-proprietary defined as:

- All required diagnostic are "on board".

- All programming and diagrams required for long-term maintenance are provided with the controller.
- The controller will not shut down or alter functionality after a pre-determined increment of time or use.
- Any contractor shall be allowed to purchase parts, supplies, diagrams, support or training directly from the factory at similar pricing as the original installer.
- Parts including circuit boards shall be available for purchase from the factory in numbers and not on an “exchange only” basis.

16.3.7 Bilingual Markings and Design

Specify bilingual markings or symbols in accordance with the National Signage Program and CAN/CSA-B44. Provide all signs and instructions in both English and French. Locate English wording above and French wording below or English to the left and French to the right.

16.3.8 Vandal Resistant Design

The unsupervised transit stations are subject to regular vandalism and misuse of varying degrees therefore it is important that the equipment is resistant to abuse.

The designer shall choose concealed fasteners, designed to discourage tampering. Where exposed fastenings must be used, provide specially designed spanner head or similar type screws. Mechanical fastening is preferred over adhesive fastening systems.

16.3.9 Earthquake Design

If the transit station is equipped with seismic structural design, the escalator design should withstand seismic acceleration per requirements of National Building Code of Canada, latest edition.

16.3.10 Signals and Fixtures

In order to accommodate the many staff persons involved in transit activities all keyed switch functions should be provided as standard Epco 1, except where prohibited by code.

16.3.11 Corrosion

Corrosion damage is one of the most severe issues compromising equipment life in the Transitway environment. Corrosion is exacerbated by road salts, temperature extremes, moisture from station cleaning equipment and quite commonly from human urine. Premature equipment failure due to corrosion is almost inevitable, however, the designer can mitigate issues as follows:

- Provide aluminum, stainless steel, galvanized or bituminous-protected steel
- Electrically isolate all dissimilar metals

16.3.12 Mechanical Considerations

The designer shall incorporate the following in the contract specifications and drawings:

- Design escalator truss for deflection of at most 1/1000 of inter-support distance under full load. Specify corrosion protection coating on truss.
- Design tracks so that the distance between track supports does not exceed 1200 mm. Construct track of minimum 2.5 mm structural steel angle.
- Specify two step chains per escalator of the endless roller type; one located on each side of the steps with heat-treated steel step chains and pins, minimum diameter of 16 mm, 38 mm roller chain. Design for breaking factor of safety (defined as ratio of chain breaking load to chain traction force) of at least 5, based on 145 Kg. per step load.
- Specify handrails constructed of rubber with a nylon inner layer and steel reinforcement to minimize stretch. Design the handrail guide and the handrail so that the handrail cannot be twisted more than 5 mm when forces of 34 NM are applied 300 mm apart, anywhere along the handrail.
- Favour stainless steel Balustrades over glass and specify panels fabricated 14 Gauge stainless steel designed to withstand 850 Kg/ square meter, without permanent distortion.
- Design Landing Floor Plates and Access Doors to withstand 1,200 Kg/square meter, without permanent distortion.
- Design step treads as wear resistant, corrosion resistant, non-combustible and no-slip design. Painted demarcation on steps tends to fade so prefer permanent means to delineate three edges of the steps.
- Broken comb teeth are a constant problem with escalators under heavy duty therefore comb plates are required having replaceable sections with closely spaced comb teeth with 3 - 7 teeth per section. Design for upward direction load of 100 Kg. applied at the tip of a tooth, if allowed by applicable codes.

16.3.13 Motor and Drive Considerations

The designer shall incorporate the following in the contract specifications and drawings:

- Design the motor for continuous operation at heavy-duty step loading of 90 Kg. per step. Motor bearings should require no field lubrication. Do not exceed 1800 rpm synchronous speed. Design the machine so as not to require any external means of ventilation other than ambient.
- Consider an enclosed controller cabinet to NEMA-3 or better.
- Specify heavy-duty brake capacity designed for 300 Kg. per inclined step, static load, dynamic brake load (running escalator, down direction) of 140 Kg per step.

17.0 OTHER FACILITIES

17.1 GENERAL

This section deals with other facilities associated with Transitway construction. The inclusion of these facilities is site dependent depending on OC Transpo operational requirements.

The designer shall establish site specific requirements with OC Transpo related to Park and Ride Lots and other facilities as identified in this section. Refer to Section 8.0, "Stations", Figure 8.5.2 which provides a checklist of typical facility requirements and approval sheet. **The designer shall complete the form for any facilities identified in this section for review and approval by the City of Ottawa Project Manager and OC Transpo prior to initiating the detailed design of the facility.**

17.2 PARK AND RIDE LOTS

Park and Ride lots are an important part of the Transitway system. They are located adjacent to Transitway stations or important transit nodes and are readily accessible by the public from the nearest major roadway. Although Park and Ride facilities may be located remotely from a Transitway, they will be serviced by a bus route. Certain Park and Ride facilities may be served by local bus routes, as well as, express bus routes, therefore, the facility layout must be designed accordingly. The designer shall obtained complete details of anticipated transit operations from OC Transpo before commencing design.

The location and capacity of each park and ride lot, as well as, construction phasing requirements will be determined in consultation with OC Transpo. Property requirements for phased Park and Ride development will be established during the planning stage based on forecasted parking capacity requirements. The construction phasing of the Park and Ride lot will normally be dependent on anticipated ridership levels from the feeder communities, as well as, the timing of full build out of development.

The designer shall establish site specific requirements for the Park and Ride facility in consultation with OC Transpo during the preliminary design stage. The Station Design Criteria shall be established for the review and approval by the City of Ottawa Project Manager and OC Transpo prior to initiating the detailed design of the facility.

Figure 17.2 illustrates an example of a Park and Ride Lot facility.

17.2.1 Entrances

Generally, it will be necessary to provide both bus and vehicle access from the surrounding road system into the park and ride facility. The designer shall confirm bus access requirements with OC Transpo.

As it may be necessary to install traffic control to the lot, traffic operational issues shall be taken into account when considering the main entrance to the lot. A traffic analysis should be undertaken to determine warrants for signalization and roadway modification requirements on the adjacent road

system. The analysis shall consider the characteristics of Park and Ride operations, vehicle and pedestrian access and impacts of existing and future traffic volume conditions.

The design of the main Park and Ride Lot access should follow the same principles as the design of a local collector road. The number of lanes required should be established through a traffic study based on ultimate parking capacity of the Park and Ride Lot.

Entrances shall be designed to accommodate the turning movements for appropriate design vehicles. The requirement for a median will be based on geometry and/or pedestrian control. The entrance/exit should also address the geometric requirements of the road authority (pedestrian, signal and lighting) requirements and ensure adequate storage for anticipated queuing. Both the entrance and exit pavement widths should accommodate vehicle movements.

Pedestrian and bicycle access from the surrounding community and adjacent roadways are also an important consideration during design. Shared use or dedicated bike lanes may be required along the main entrance roadway depending on the expected volumes.

17.2.2 Bus Stops and Platforms

Bus stop locations and associated platforms shall be located either adjacent to the Transitway or centrally located within all other Park and Ride facilities. Refer also to Section 4.0, “Transitway Road Design” for details.

Platforms shall include:

- Reinforced concrete 6.0 metres wide with the length established based on shelter and passenger waiting area requirements as determined by OC Transpo.
- Monolithic construction with wire mesh reinforcement and steel faced curbs.
- Surfaces shall have a broom finish.
- Red coloured concrete with a stamped pattern shall be placed in a recess, 600-650mm in width, along the front edge behind the steel facing for the full length of the platform (refer to Figure 4.2.3b in Section 4.0, “Transitway Road Design”). Refer also to City of Ottawa Standard Details (Volume 2) for typical details of the platforms and steel face curb.
- At depressed access to at-grade Transitway crosswalks, truncated dome panels shall be applied to the curb ramp.
- Cross-fall shall slope down to the curb at 2 percent maximum.
- The width shall be 6.0 metres to accommodate the passengers waiting for a bus, those queuing, and those moving through the platform area.
- Concrete platforms shall incorporate the shelter loads where OC Transpo identifies the need for platform shelters.
- In certain conditions and upon approval of OC Transpo, the width of platforms may be reduced to accommodate site constraints.

17.2.3 Bus Lay-up Areas

Where OC-Transpo identifies the need for Bus Lay-up Areas the designer shall confirm the number of spaces required and review the required location and orientation related to the platform areas with OC Transpo. Generally, bus lay-by areas shall be located in close proximity to any planned operator facilities. The number of bus lay-up stalls required shall be confirmed with OC Transpo. Angled bus lay-up stalls are normally a minimum of 21.0 metres in length and 6.0 metres in width. Parallel lay-up bus stalls may be reduced to 3.6 metres in width. The designer shall check the lay-by layout utilizing turning movement software in order to confirm that there is adequate maneuverability during bus access and egress.

17.2.4 Parking Area Design

The designer shall confirm with OC Transpo the number of total parking spaces required within the Park and Ride Lot, the number of disabled parking spaces required adjacent to each bus stop or platform location, as well as, the number of special pass parking spaces required.

Generally, parking for the disabled should be positioned closest to the platforms, short term parking for PPUDO use should be located in close proximity to the platforms.

a) Disabled Parking**:**

Parking spaces for the disabled should be positioned in close proximity to the platform areas or local bus stops. Wherever possible, disabled persons should not be required to cross aisles or internal roadways. The design of access to these locations shall comply with the requirements of the "Accessibility for Ontarians with Disabilities Act". A parking spot shall be designated for exclusive use by Para Transpo.

The number of disabled parking spaces shall be confirmed with OC Transpo and shall meet the minimum requirements as per the City Acessibility . The size of the stalls shall comply with the City of Ottawa parking by-law. Appropriate signing and pavement markings are required for these spaces, along with depressed curb access according the City of Ottawa standard details to the platform areas.

b) Passenger Pick-up and Drop Off (PPUDO)**:**

Short term parking is required for PPUDO operations. These areas should be as near as possible to the platform areas or bus stops and shall not restrict access to/from the Disabled Parking area. The location of the PPUDO should be easily recognizable with convenient access and egress from the internal road system and shall not conflict with internal traffic flow. The PPUDO should also be easily visible from the platform and bus stop areas. PPUDO waiting capacity required should be determined through consultation with OC Transpo. PPUDO shall also include an area designated for exclusive use by Para Transpo.

c) Taxi Stand**:**

The inclusion of a taxi stand within the Park and Ride facility should be considered. The taxi stand should be in close proximity to the PPUDO, shall not restrict access from the

Disabled Parking area and not conflict with internal traffic flow. The Taxi Stand area shall be identified by appropriate signage. The number of spaces should be determined in consultation with OC Transpo.

d) Long Term Parking**:**

The parking lot layout design shall minimize the walking distance to the platform areas or local bus stops. Preferably the platforms will be centrally located such that transit users parking at the extremes are about equal distance to the pl atform areas. It is desirable that the maximum pedestrian walking distance between a parking space and the platform shall be 300 metres.

e) Parking Lot Layout**:**

Each parking lot must be designed to best suit the particular site geometry and available property. The parking aisles should be al igned to fac ilitate convenient pedestrian movement and would normally permit two-way traffic. All main parking aisles within the lot should be oriented towards the platform area and should encourage the pedestrian movements along the aisles and towards designated sidewalks.

Parking stalls shall normally be 90 degrees to the aisle as right-angle parking is the most effective use of s pace. Other types of parking stall orientation may be us ed in constrained areas to maximize the number of spaces. The minimum size of parking spaces, aisles and other general design requirements shall conform to the City of Ottawa parking by-law. The ends of the parking rows should generally not be defined with curbed end islands. The use of curbed islands shall be kept to a minimum to aid in snow clearing operations. Generally, curbed islands should only be used for situations such as defining the main access laneways.

Access/egress to the lot and movements within the lot should be reviewed versus maneuverability of snow clearing and maintenance equipment.

Large parking lots should be subdivided into sections to reduce the scale and for ease of reference by users. Walkways and landscaping should be considered during design. Vehicular movement from one section to another shall not be restricted.

Where raised islands are required the size should be designed to accommodate landscaping.

17.2.5 Pedestrian Access

The overall facility should be developed to identify pedestrian access with a heightened priority that should be easily recognizable to drivers. Pedestrian access should take into account desire lines between the parking locations and the platform areas. Main pedestrian walkways and roadway crossings preferably should be identified by a distinct surface material and have distinct pavement markings and appropriate signage.

Pedestrian walkways shall generally consist of at l east 3.0 metre wide concrete sidewalks. Any reduction in sidewalk width shall be approved by OC Transpo. Walkways should be designed to collect pedestrians along the edge of the lot at the end of the parking stall aisles directing them to a main walkways leading to the platform areas.

17.2.6 Bicycle Storage

The designer shall incorporate dedicated bicycle storage areas into the Park and Ride facility design. The bicycle storage area shall generally be in close proximity to the bus platform area.

The designer shall confirm the bicycle storage capacity, acceptable bicycle rack products and shelters, if required, with OC Transpo. The bicycle storage area shall consist of a concrete surface sized to accommodate the capacity and space requirements identified.

17.2.7 Pavement and Drainage

Park and Ride lots shall be asphalt paved with permanent perimeter concrete curbs. The pavement structure designs should take into account those routes that will require bus access to the platform areas and bus lay-ups.

Main access roads will normally have an urban crossection with sidewalks. Secondary access roads may have either urban or rural crossections depending on site conditions and site design considerations.

The designer shall undertake a stormwater management study in conformance with the City of Ottawa Sewer Design Guidelines to establish the drainage design principles required for the parking lots and access roads. The study will establish whether storm runoff conveyance will be a closed or open system design or a combination of both. Stormwater quality and quantity requirements may necessitate sheet flow conveyance within the lots via depressed curbs and spillways to infiltration ditches or stormwater management ponds.

17.2.8 Lighting, Security and Communications

Provision for lighting, security cameras and emergency phones shall be incorporated into the design of the Park and Ride facility including requirements for access roadways, pedestrian walkways, platforms and parking areas. Refer to Section 14.0, “Electrical” for illumination requirements. Refer also to Section 6.0, “Communications and Controls” and Section 7.0, “Safety and Security”.

17.2.9 Public Telephones

Provision for public telephones and associated services shall be confirmed with the service provider and OC Transpo.

17.2.10 Landscaping

Landscaping will generally be required in conjunction with Park and Ride facility development. Refer to Chapter 12.0, “Landscaping”.

17.2.11 Site Security and Protection

Fencing and/or handrails may be required for security measures and pedestrian control. Site security requirements are to be reviewed with OC Transpo. The designer shall utilize pipe

handrails to direct pedestrians towards walkways and to discourage pedestrians from short cutting through restricted areas and landscaping. Pipe handrails shall either be installed through the concrete sidewalks or on concrete upstand curbs.

17.2.12 Other Installations

The designer shall review with OC Transpo the need for other servicing (or provision for). Consideration shall be given for servicing including such items as information signage, map cases, waste/recycling receptacles, newspaper vending stands, vending services, etc.. Provision of these services shall not conflict with pedestrian flow or maintenance operations.

17.3 PASSENGER SHELTERS

17.3.1 General

Passenger shelter requirements shall be established in consultation with OC Transpo.

Shelter structures shall conform to the established design theme and shall be designed to provide safe, open environments with high visibility and without hidden corners or blind areas. This requirement is fundamental to the design of both stations and shelters. No physical feature shall impair the ability of passengers to see oncoming vehicular traffic and particular attention shall be given to provide clear line of sight from bench locations. Refer to Section 8.0," Stations" for additional requirements related to Transitway Station design. Also refer to Section 14.0, "Electrical".

The modular width of links and shelters should generally be 2.4m if constructed with an additional 1.5m canopy on the shelters. These dimensions are nominal and depend greatly on the platform width. In the case where the platform must conform to specific site conditions and is either wider or narrower than the standard 6.0 x 55.0m platform, adjustments should be made to accommodate these conditions.

Shelters shall be constructed of durable, low maintenance materials such as concrete, glass and aluminum. Where paint coatings are used on aluminum, preference shall be given to high build, resin based, multi-coat, top-coated paint systems usually involving a layering of 3 to 4 coating applications. Close attention should be paid to the compatibility and completeness of the paint system given the corrosive and salt laden nature of the Transitway environment.

For those locations where shelter design are not integral with the design of the Transit Station prefabricated shelters are a viable option which shall be considered on a case by case basis in consultation with OC Transpo. The following section deals with prefabricated shelter design criteria, however, much of the criteria discussed would apply to both site specific custom shelters and prefabricated shelters.

17.3.2 Prefabricated Shelters

Prefabricated shelters are now in general use on the Transitway. Typical configurations should be based on current OC Transpo requirements and may include both permanent and non-permanent shelter configurations. In all cases, shelters should be designed to be easily constructed and

deconstructed and/or relocated using standardized modules, panels, components and appurtenances. Typical prefabricated shelters are provided on Figure 17.3.2a.

Shelter inside clear dimensions should preferably be between 2.0 and 2.4 metres but where site constraints dictate the clear inside dimension shall not be less than 1.5 metres. The length of the shelter can vary due to the specifics of the site, and of construction methods and details but generally should be minimum 15.0 metres in total length. The designer shall confirm the capacity and shelter size requirements with OC Transpo. The designer shall also consult the Transit Cooperative Research Program (TRCP) “Report 100 Transit Capacity and Quality Service”.

The following can be applied in the determination of the minimum waiting area required:

Number of Occupants x 0.28 sq. m. (3 sq. ft.) = Occupied Area

Accessible benches shall be provided in all shelters. Refer to Figure 17.3.2b for examples of acceptable benches.

Shelters shall be highly illuminated as per the design criteria defined in the Section 14.0, “Electrical”

All shelters shall be equipped with wind skirts. Where OC Transpo identifies that the shelters are to be fully enclosed, heavy duty doors and frames shall be specified including at least two door locations in each shelter with at least one door equipped with an accessible power door operator. For fully enclosed shelters the designer shall incorporate concrete upstand walls into the shelter design. Where designated by OC Transpo radiant heaters shall be provided within the shelters.

Non-mechanically assisted natural ventilation shall be provided at each end of each shelter in the form of louvered openings. Openings shall be of sufficient size and located strategically to provide natural air circulation.

Prefabricated shelters shall include provision of the following:

- Construction of reinforced concrete pads structurally designed to support the shelter unit.
- Provision for clearances around at least two sides of the shelter, including the landing pad side, of at least 1220mm.
- Provision for clear unobstructed view of oncoming buses.
- Provision for at least one bench with armrests and a seat height between 400 mm and 450 mm.
- Shelters shall be designed to permit a wheelchair or scooter to enter and to reach a minimum clear floor area of 750mm by 1200mm within the perimeter of the shelter unimpeded. The designer shall review the requirements of the Accessibility for Ontarians with Disabilities Act (AODA).
- Glazed panels fully enclosing the shelter with a minimum of two openings which shall incorporate decals and other safety features; and comply with the following:

- Glazing shall be clearly identified with a horizontal row of decals or a continuous strip with a minimum width of 50 mm (2 in.) wide of red colour mounted at a height of 1350 to 1500mm from the floor.
- Where decals are used, they shall be located at a maximum of 150 mm (6 in.) from center to center. The decals can either be 50 mm (2 in.) square or round, and/or of a special design (e.g., a logo) provided the solid portion of the decals provides high colour contrast and is easy to identify by persons who are visually impaired.
- Where etched or patterned glass is used, decals or a stripe of highly contrasting colour shall still be provided.
- Where frameless glass panels are used, exposed vertical edges shall be identified with a vertical yellow safety molding, applied to cap the end of glass panel.

- Doors/Hardware/Glazing and Framing (for fully enclosed shelters where designated by OC Transpo) shall consist of:
  - Window members and public area doors shall be fabricated of aluminum and shall be prefinished.
  - Colours shall be as per OC Transpo Standards.
  - Members shall be fabricated from full extrusions of sufficient size to withstand wind loading and be provided with aluminum pressure plates. Preference shall be given to capped systems. However structural silicone systems may also be used where applicable and provided these are reviewed with OC Transpo for compliance to long-term maintenance planning.
  - Aluminum doors shall be heavy duty, heavy wall to prevent racking and door misalignment from vandalism. A 50mm thick nominal thickness is preferred over the standard 42mm door.
  - Doors shall be fitted with reinforced corner welds. Panelized, thermally broken doors do not meet this requirement and should not be substituted. Note: this door is a special order product and may not be available from manufacturers other than Kawneer.
  - Aluminum Door Hardware shall consist of:
    - Hinges: Heavy Duty, full length, each leaf, 600 lb. rating or approved equivalent.
    - Closers (on-power operated doors): LCN Series 4040 SRI, parallel arm surface mounted of sufficient size and strength to suit width of door and expected wind conditions, Aluminum colour finish (626).
    - Door Pulls: Tubular "D" type, 25 mm diameter, stainless steel, 300 mm high, 75 mm offset both sides of the door.
    - Fasteners: Aluminum, cadmium plated steel, or stainless steel, finished to match adjacent material
    - Weatherstrip: Mohair
    - Thresholds: Extruded aluminum alloy 12 mm high by width of door, mill finished

- Kick plates: 1.6 mm thick, brushed finish stainless steel, 250 high x door widths less 50. Mount on push face of each leaf.
- Door Holder/Shock Absorber: Surface-mounted with stainless steel finish, complete with hold-open mechanism and door over-travel protection.
- Door Operators (automatic door operators): Heavy-duty complete with 2 y ear warranty, built-in adjustable doorstop, field adjustable speed control, electronic back check, built-in electric strike interface, on-board 1 amp power supply and sequencing board. Actuator buttons to be remote controlled (wireless) or hard wired and mullion mounted. Camden and Wikk are acceptable, LOGO ONLY, no wording. Key switch On/Off required.

- Coating systems: It is noted that p refabricated shelter manufacturers may not be able to provide wet coat based paints for their extrusions given the nature of their manufacturing processes. It may therefore be important for the designers to carefully list the performance characteristics required of the coating system in order to obtain close comparables. It is expected that pre-fabricated shelter manufacturers will prefer to substitute the required wet coat systems for proprietary dry powder, electrostatically applied systems. Although there are some advantages to these applications, the specifications must be clear in order to obtain a premium type application that matches more closely the performance characteristics of wet coat based paints while providing the warranties and longevity expected.

- Electrical and Communications: Provision for shelter lighting, map cases, advertising signs, emergency phones, public phones, security cameras and door operators (where applicable) shall be accommodated in the design. Refer to Section 6.0,“ Communications and Controls”, Section 7.0, “Safety and Security” and Section 14.0, “Electrical” for requirements. Figure 17.3.2c provides a typical schematic arrangement for shelter conduit connections. The designer shall confirm the site specific requirements with OC Transpo.

17.4 OPERATOR FACILITIES

At sites identified by OC Transpo an Operator Facility shall be included in the design. The Operator Facility may be established as a permanent facility or a temporary facility where required for a period of less than five years. Selection of type of facility and design requirements of the facility will be established on a site by site basis in consultation with OC Transpo.

Operator Facilities will require servicing such as water, sewer, power and communications.

All internal fit-up requirements will be confirmed by OC Transpo.

17.4.1 Precast Building Installations

OC Transpo may identify that a precast building shall be provided for the Operator Facility. The designer shall confirm site specific requirements and specifications with OC Transpo.

17.4.2 Trailer Installations

For temporary installations (i.e. less than five years) a trailer facility as illustrated on Figure 17.4.2 may be acceptable upon approval of OC Transpo. The following provides general requirements which shall be modified to suit the project and site requirements:

- 7.3 m x 3.0m trailer consisting of wood frame construction on a steel chassis, running gear with electric brakes, parking legs and insulted skirting; hinged steel landings with steps and railings; transportation support rack, adjustable steel tripod stabilizers with a pin/seat box.
- Exterior Finishes - Pre-painted 30 gauge metal exterior siding; 47 mil PVC roofing membrane
- Insulation - R20 floor; R12 walls; R20-28 roof
- Interior Finishes - 13mm fire code gypsum board ceiling; prefinished wall panels; 100% vinyl floor covering
- Exterior door – insulated metal; fixed window; check chain; passage lockset and deadbolt
- Two separate men's and women's washroom facilities consisting of:
  - Men's washroom (1 urinal, 2 toilet, 2 sinks incl. faucet sets, 2 mirrors)
  - Women's washroom (2 toilet, 2 sinks incl. faucet sets, 2 mirrors
  - Metal partitions
  - 15 Amp GFI duplex receptacle and switch controlled exhaust fan
- Rest area - table with 4 chairs; bulletin board; filtered water cooler including connections to water service and electrical connections
- Electrical service including mast and meter box; connections to incoming power and communications services; regular 15A duplex receptacles; electric baseboard heaters with integrated thermostat; receptacle located below floor for heat tracing cable; fluorescent lighting including diffusers.
- Water cooler, filtered, for connection to water service and electrical connections
- Water heater (size to suit)
- Floor drains, sanitary piping connections including heat tracing, as required
- Water connections to incoming service including heat tracing, as required
- Air conditioning (capacity to suit)

17.5 EQUIPMENT AND VEHICLE STORAGE BUILDING

Where identified by OC Transpo that an equipment and vehicle building is required at the Park and Ride Facility the designer shall prepare tender drawings and specifications based on the building represented on Figure 17.5. The designer shall confirm with OC Transpo the requirements of the building to be incorporated on the specifications and drawings.

17.6 OTHER INSTALLATIONS

17.6.1 Security Camera/E-Phone Stanchions

The designer shall coordinate with OC Transpo for requirements and layout of the security camera/ emergency phone stanchions required at the Park and Ride Facility. Figure 17.6.1 illustrates a typical Security Camera/E-Phone Stanchion installation.

17.7 FIGURES

The designer shall refer to the following figures as referenced in above sub-sections:

Figure 17.2: PARK AND RIDE LOT FACILITY

Figure 17.3.2a: PREFABRICATED SHELTERS - EXAMPLES

Figure 17.3.2b: ACCESSIBLE BENCH EXAMPLES

Figure 17.3.2c: TYPICAL BUS SHELTER CONDUIT CONNECTIONS

Figure 17.4.1: TYPICAL PRECAST OPERATOR FACILITY

Figure17.4.2: TYPICAL TRAILER OPERATOR FACILITY

Figure 17.5: TYPICAL EQUIPMENT AND VEHICLE STORAGE FACILITY

Figure 17.6.1: SECURITY CAMERA / E-PHONE STANCHION

Ottawa OC Transpo	**PARK AND RIDE LOT FACILITY**	*Scale* **N.A.**	*Date* **May 2012**
		Revision No./Date	
	TRANSITWAY AND STATION DESIGN GUIDELINES	**Figure 17.2**	

Ottawa
OC Transpo

PREFABRICATED SHELTERS - EXAMPLES

Scale N.A. | Date May 2012

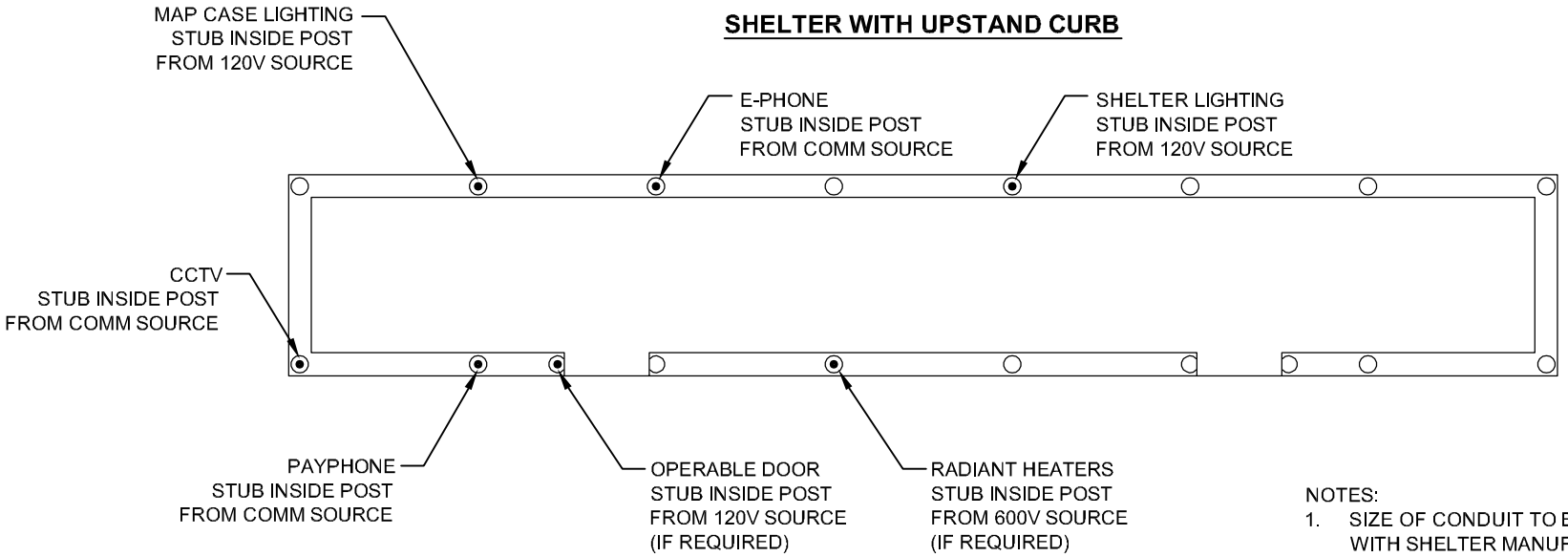
Revision No./Date

TRANSITWAY AND STATION DESIGN GUIDELINES

Figure 17.3.2a

Ottawa OC Transpo	**ACCESSIBLE BENCH EXAMPLES**	*Scale* **N.A.**	*Date* **May 2012**
		Revision No./Date	
	TRANSITWAY AND STATION DESIGN GUIDELINES	**Figure 17.3.2b**	

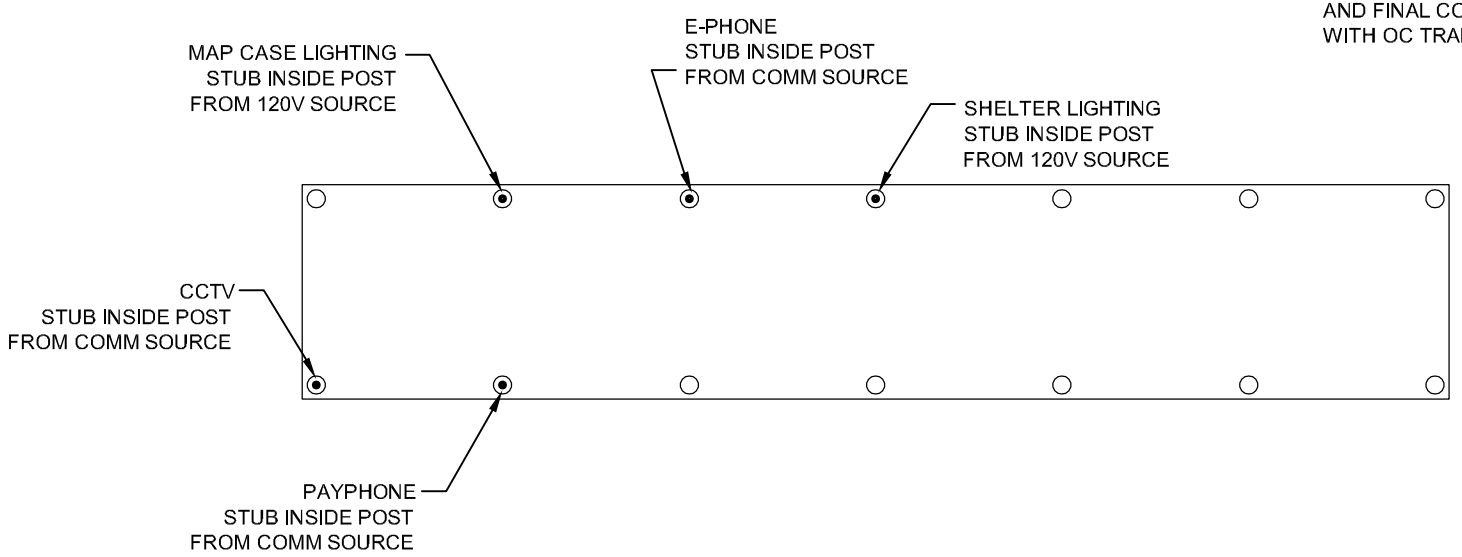
SHELTER WITH UPSTAND CURB



NOTES:

1. SIZE OF CONDUIT TO BE COORDINATED WITH SHELTER MANUFACTURER.
2. CONFIRM SITE SPECIFIC REQUIREMENTS AND FINAL CONDUIT STUB UP LOCATIONS WITH OC TRANSPO.

SHELTER ON CONCRETE SLAB



Ottawa
OC Transpo

TYPICAL BUS SHELTER CONDUIT CONNECTIONS

Scale	Date
N.T.S.	May 2012

Revision No. / Date

TRANSITWAY AND STATION DESIGN GUIDELINES

Figure 17.3.2c

Ottawa OC Transpo	**TYPICAL TRAILER OPERATOR FACILITY**	*Scale* **N.A.**	*Date* **May 2012**
		Revision No./Date	
	TRANSITWAY AND STATION DESIGN GUIDELINES	**Figure 17.4.2**	

Ottawa OC Transpo	**TYPICAL EQUIPMENT AND VEHICLE STORAGE FACILITY**	*Scale* **N.A.**	*Date* **May 2012**
		Revision No./Date	
	TRANSITWAY AND STATION DESIGN GUIDELINES	**Figure 17.5**	

Ottawa OC Transpo	**SECURITY CAMERA / E-PHONE STANCHION**	*Scale* **N.A.**	*Date* **May 2012**
		Revision No./Date	
	TRANSITWAY AND STATION DESIGN GUIDELINES	**Figure 17.6.1**	