Portals & Retaining Walls

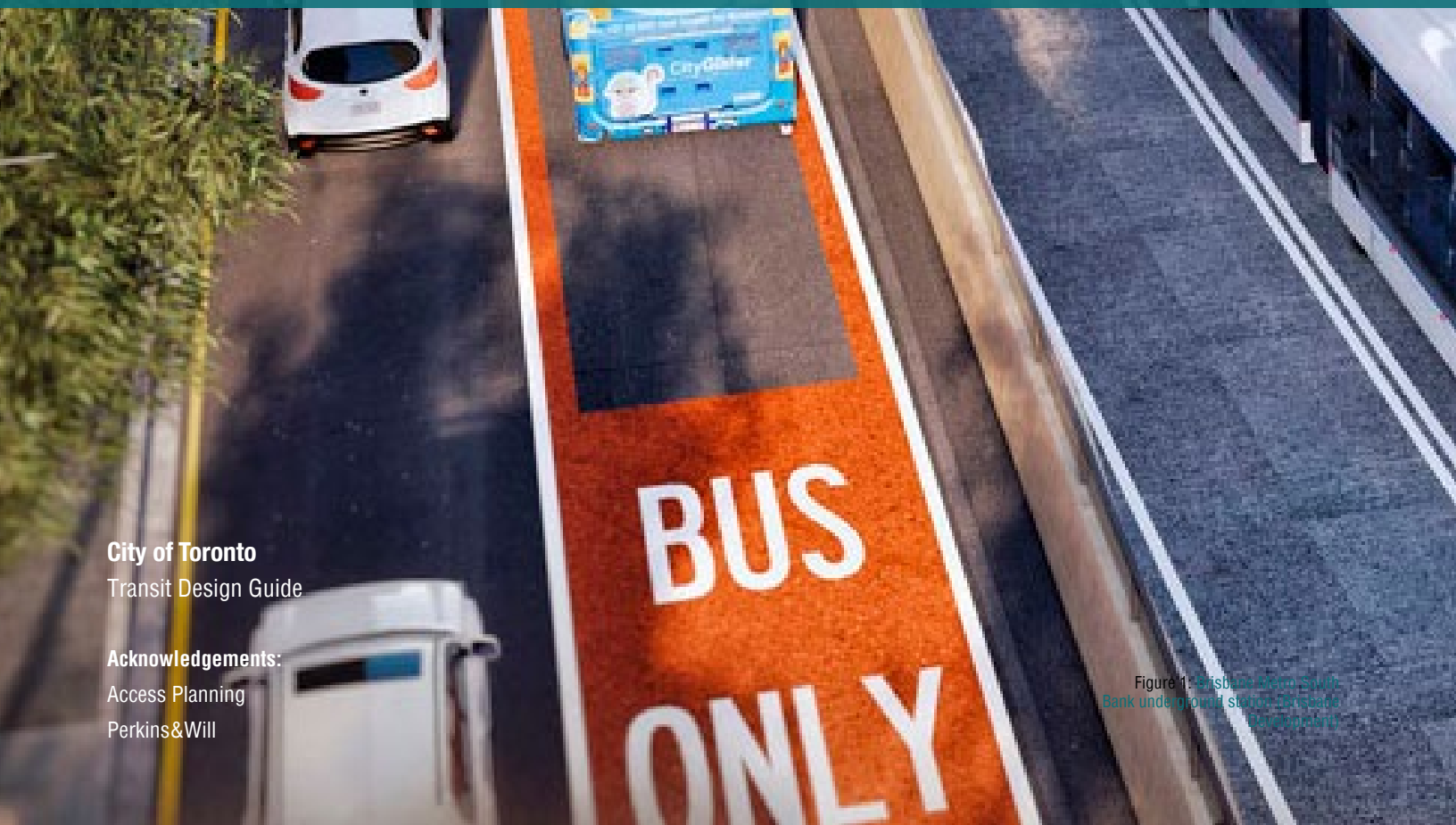

Figure 1: Brisbane Metro South Bank underground station Structural Development

City of Toronto
Transit Design Guide

Acknowledgements:
Access Planning
Perkins&Will

1.0 INTRODUCTION

1.1 Definition

A transit portal creates a reinforced structure that provides an opening for transit vehicles to enter or exit, changing from a below-grade to an at- or above-grade alignment. Retaining walls are provided on both sides of the tracks to reinforce the surrounding earth and adjacent grade. To facilitate the change in grade, these portals range in scale or length.

A series of factors influence the location and length of the portal structure, including:

- Depth of the underground portion and distance to the at- or above-grade portion of the transit line it connects to, with consideration of maximum track steepness
- Location of underground utilities
- Required space within the right-of-way
- Adjacency to other infrastructure, public amenities, or properties

The components of portals and retaining walls are:

- **Tunnel:** Underground portion of the transit alignment
- **Threshold:** The transition zone between under-ground tunnel and at-grade track
- **Portal Roof (Area above Tunnel):** This area transitions from the 'top' or 'roof' of the portal to the median or boulevard at-grade.
- **Retaining Wall:** Walls on both sides of the track that hold back the surrounding earth where there are changes in grade

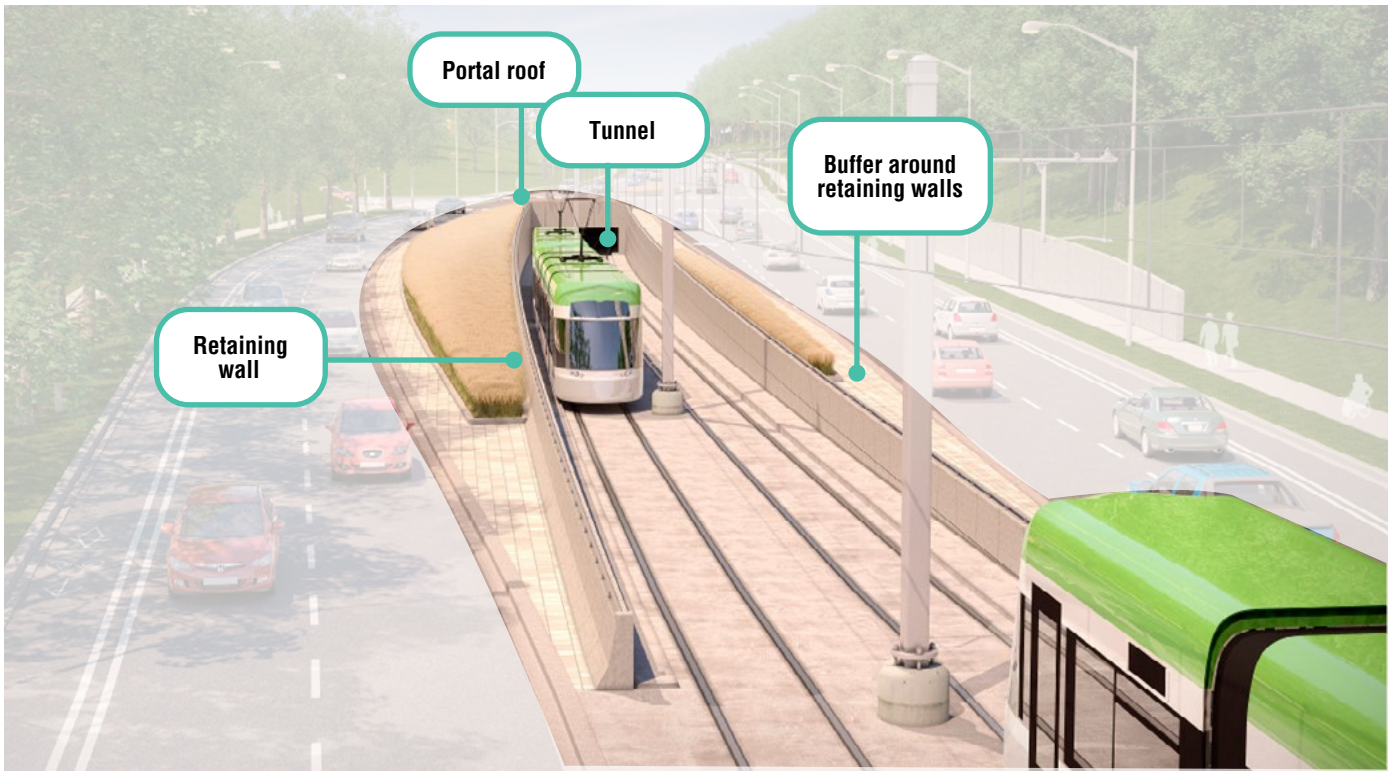

Figure 2: Diagram depicting the various components of a typical portal and retaining walls

1.2 Areas of Influence

In the context of portals and retaining walls, the areas of influence can be defined as follows:

Zone 1: Includes the local context in which the portal or retaining wall is located. The surrounding streetscape shall be generally consistent with existing City of Toronto standards and guidelines. There will be some coordination required for zone 1 to ensure the fit of the portal infrastructure within the right-of-way, service access, and maintenance.

Zone 2: Includes the retaining walls, barriers, and the landscaping within the median, along the boulevard or above the tunnel. This zone must provide the operational and functional requirements of the transit infrastructure. However, there is potential to design this zone to integrate with local context and mitigate impact on the surrounding streetscape.

Zone 3: Includes the guideway, track, tunnel, overhead catenary system and poles. The design of these elements is largely subject to functional requirements of the transit infrastructure, including track slopes, grades, alignments, and clearances. However, there are opportunities to shape and locate portals during early planning stages in ways that support urban integration and Transit-Oriented Development (TOD).

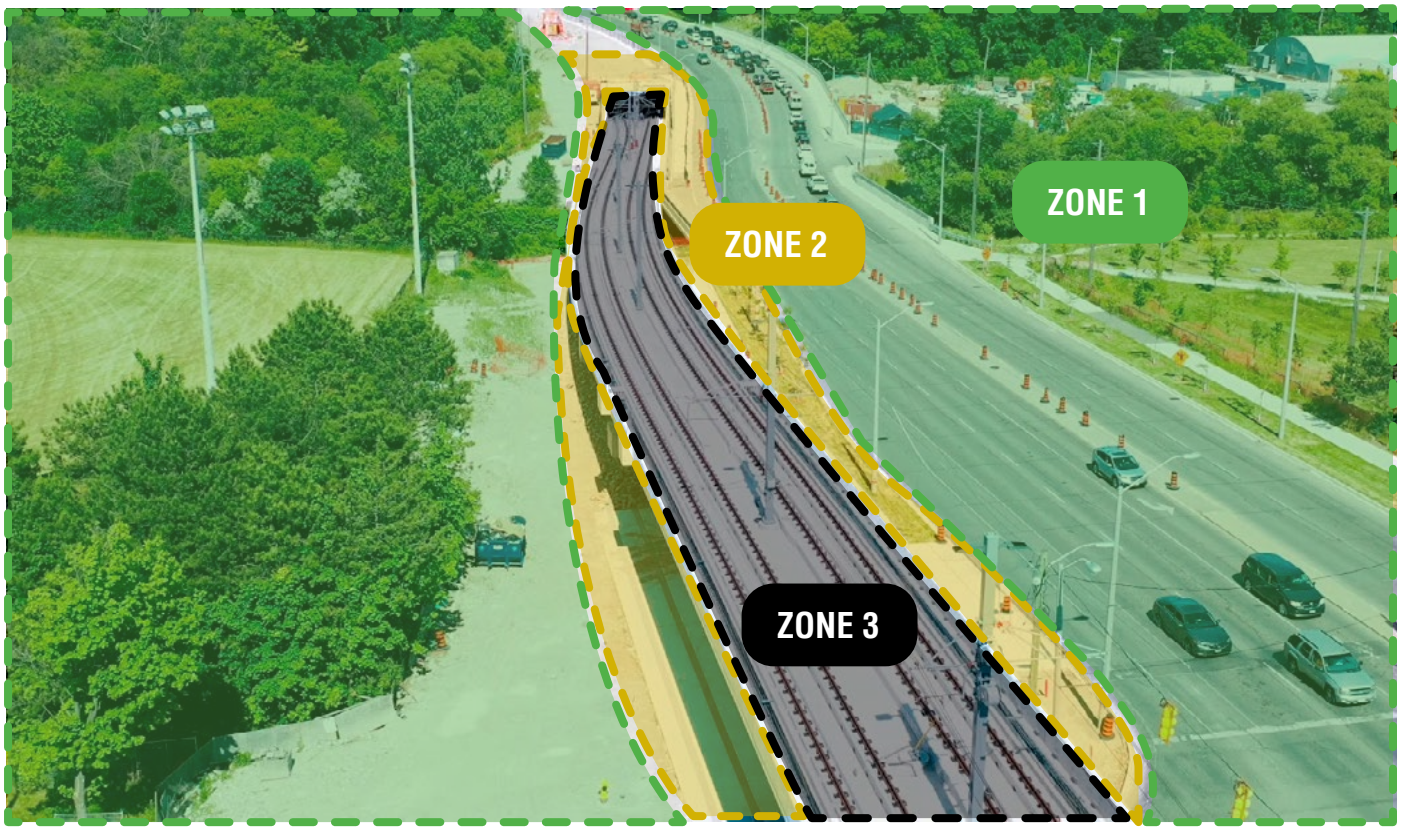

Figure 3: Annotated diagram depicting how the areas of influence apply to portals and retaining walls

1.3 Applications of Portals and Retaining Walls

Portals and retaining walls are generally composed of a combination of the following characteristics.

Change in grade:

Figure 4: Conceptual rendering of the eastern portal of the Eglinton Crosstown, Toronto (Photo Credit: Metrolinx)

Below-grade to at-grade

This application refers to a portal where the vertical alignment of the transit line, transitions from below-grade (underground tunnel) to at-grade. With this typology, emphasis on how the portal fits into the streetscape cross section and how it integrates with the surrounding urban fabric is critical.

Figure 5: Conceptual rendering of the western portal of the Eglinton Crosstown, Toronto (Photo Credit: Metrolinx)

Below-grade to above-grade

This application refers to a portal where the vertical alignment of the transit line transitions from below-grade to above-grade (elevated) between transit stops. With greater vertical transitions associated with this typology, portals have longer lengths.

Figure 6: Underground station to embankment, between Gare Centrale and Griffintown–Bernard-Landry stations, Montreal (Photo Credit: Google Earth)

Below-grade to embankment

This application refers to a portal where the vertical alignment of the transit line transitions from below-grade (underground tunnel) to tracks on an embankment.

Location and Alignment:

Figure 7: Side-running guideway and portal around Northgate Station, Seattle (Photo Credit: Andrew Villeneuve, NPI)

Figure 8: Centre-running Brisbane Metro South Bank portal (Photo Credit: Brisbane Development)

Side-Running

This application refers to where the guideway and change in grade (i.e. portal) is located along or parallel to the right-of-way. With this typology, ensuring the portal is not a barrier but integrates with and enhances the public realm is critical.

Centre-Running

This application refers to where the guideway and portal is located in the centre of the right-of-way, with vehicular traffic lanes along both sides of it.

Parks, Open Spaces, and Natural Areas

This application refers to where the guideway and portal are located through a park and open space area. This condition should be avoided as some environmental and/or ecological impacts may not be able to be fully remediated post-construction. Should there be a situation where this is unavoidable, ensuring the portal does not compromise parkland needs but instead is well integrated to create a sense of place or subltly enhance its context.

Level of Right-of-way Protection

Figure 9: Controlled access portal, Marine Gateway, Vancouver (Photo Credit: Google Earth)

Controlled Access

This application refers to alignments where access to the transit corridor right of way is strictly controlled as a key component of operations. This may include alignments using automatic train control or ground-based electrical supply systems such as linear induction or third rails. Access control to secure safety of operations is a critical element in the design and implementation of this typology.

Mixed Traffic

This application refers to less controlled access where it typically includes catenary poles and larger vertical clearances for portals/tunnels. With this typology, less visually impactful measures may be used while safely managing potential pedestrian and vehicle interactions.

1.4 Typical Project Delivery

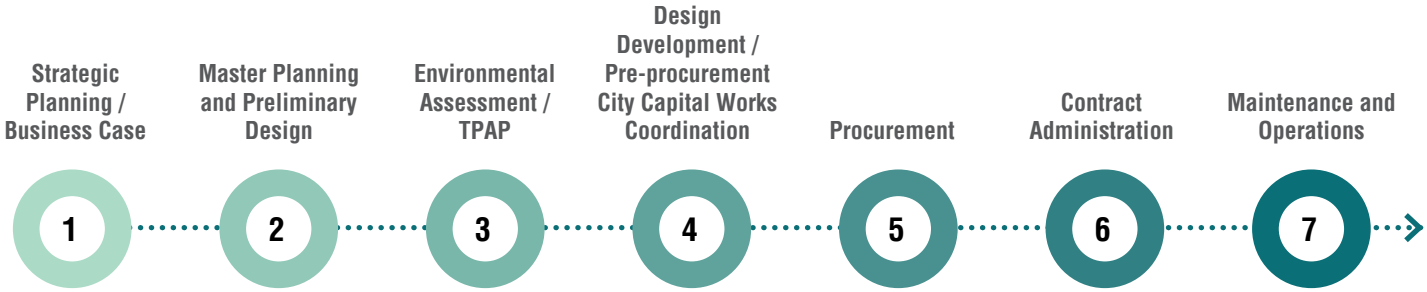

Figure 10: The typical delivery process for transit infrastructure

Due to the size of the infrastructure, portals require careful consideration in regards to their impact to the public realm. The decisions around alignment and location of portals is often made early on in the process, such as at the **Strategic Planning/Business Case**, the **Master Planning and Preliminary Design**, or the **Environmental Assessment/TPAP** stages. The location of portals can have impacts on decisions such as land expropriation, permeability and connections (e.g. pedestrians crossing the street), and vehicular traffic. Due to their prominence, it's important that these pieces of infrastructure demonstrate design excellence.

These considerations need to be aligned with the specific technical requirements of the alignment – both vertically and horizontally – and the surrounding topographical constraints. Their location also offers an opportunity to highlight the passenger journey and celebrate transitions.

The **Design Development/Pre-procurement** phases, provides an opportunity to fine tune the specifications for retaining walls, track bed, guard rails, landscaping, and the architectural finishes. Details of such are finalized in later **Contract Administration** stages. Public art as part of the portal infrastructure also offers another opportunity to celebrate the thresholds that come with portals.

Portals are typically delivered as one part of an overarching transit line project, such as a **P3 Procurement** process. Under these circumstances, it is expected that:

- The transit agency delivering the project should produce project-specific guidance documents that address overall cohesivity of the design of the elements (guard rails, retaining walls) within the local context, while ensuring continuity throughout the transit line.
- City of Toronto staff should participate in the preparation of the procurement documents and provide input as per the guidelines included in this document.
- Access and maintenance are important considerations as some portals may be located adjacent to key pedestrian circulation pathways, or with vehicular travel lanes on either side.

2.0 EXISTING GUIDANCE

The following is a non-exhaustive, illustrative list of existing guidance and requirements that should be read together with this Guide:

- **City of Toronto Green Streets Technical Guidelines, 3.2.5 Green Walls:** Contributes to place-making and integration of certain context, as well as contributing to biodiversity and resilience.
- **TTC Design Manual, DM-0408-02 Landscaping:** Specifies no timber or timber planter; use materials to deter inappropriate use.

While the guidance within this section is intended to clarify the fundamental principles for design and implementation, project-specific design guidance will focus on applying these principles to create context responsive solutions that achieve a consistant design expression across all elements of the transit line including station plazas, open spaces, stops and portals.

3.0 OBJECTIVES

Portals and retaining walls are necessary elements of some transit infrastructure and should be designed as high-quality features of the public realm with minimum impact to the surrounding environment.

Urban Integration

Portals and retaining walls should integrate seamlessly with the existing and planned urban context. Together with associated features such as guardrails, lighting, and signage, they provide opportunities for integrated public art and landmark architectural design, enhancing legibility and visual cues to the public/ secure access points.

User Experience

Portals and retaining walls should maintain and/ or enhance safe, accessible and direct access for all modes of active transport to the surrounding public realm rather than create barriers within a community.

Sustainability & Resilience

Portals and retaining walls should be sustainably designed with low-carbon materials, optimal use of green infrastructure, and increased resilience to climate change.

Intermodal Operations

From a transportation operations perspective, the design of portals and retaining walls must accommodate the geometric requirements of the alignment, facilitate a high level of service speed and quality, and minimize weather impacts to ensure uninterrupted, reliable service.

Accountability

Portals and retaining wall design should consider the entire lifecycle, use of materials and construction methods that account for their whole life cost, and foresee the need to accommodate new transit lines, improved service, changes in capacity and new technology. Importantly, the siting and design of portals and retaining walls should facilitate physical and visual access to frontages of surrounding development, including TOD.

4.0 DESIGN GUIDANCE

4.1 Urban Integration

1. Refer to area plans and studies to ensure integration with the planned context.
2. Explore alternatives to retaining walls where other landscape options are feasible (e.g., vegetated embankments, terraced landscape features).
3. Ensure a straight alignment where portals should to limit 'visual clutter' that comes with catenary and structural systems along curved portions of the alignment.
4. Plan and locate portals to:
    a. Mitigate impact to existing circulation that crosses the planned portal area wherever feasible and facilitate safe and direct planned pedestrian crossings and intersections.
    b. Allow for active frontages, including entrances and plazas as part of adjacent TOD; and
    c. Limit noise and vibration impacts.
5. Avoid the introduction of retaining walls within Parks and Open Spaces. If necessary, minimize size and scale of wall in order to simplify future ownership, maintenance and access issues.
6. Minimize impacts to natural heritage and open space features through restoration, enhanced landscaping, and minimizing grade changes.
7. Design portals so the physical scale, footprint, and bulk of the infrastructure is discreet and well-integrated into the surrounding context.
8. Design retaining walls to seamlessly transition or 'blur' the lines between changes in grade and continue high-quality treatment on retaining walls outside of the portal area (i.e., between the guideway and the roadway).
9. Integrate barriers and noise walls along retaining walls with the overall design of portals, catenary and associated landscape elements.
10. Evaluate retaining structures/strategies based on protection for future placement of utilities.

Figure 11: Noise barrier with native plants and detailed design treatments to create a more pedestrian-friendly environment (Photo Credit: Dan Coogan)

Figure 12: The Eastlink has multiple installations and architectural features that add to the travelling experience, Victoria (Photo Credit: DesignBoom)

Figure 13: Added visual interest improve feelings of safety, especially when adjacent to pedestrian or cyclist networks, Eastlink Freeway, Melbourne (Photo Credit: Karen Graham)

4.2 User Experience

1. Locate and design portal elements (including barriers, guardrails and posts or signs) to reduce impact on sightlines.
2. Clearly identify zones along the guideway or portal areas that are prohibited for certain modes (e.g., no car access into portal) through lighting, signage, materiality, or landscaping. Utilize planting and landscaping to define edges between public zones (e.g., between sidewalk vs. portal buffer zone, or public zones vs. restricted-access areas).
3. Protect any impacted existing driveways or multiuse paths and reinstate them in place.
4. Provide lighting that supports overall design narrative as well as functional requirements and safety.
5. Provide portal wall lighting to enhance both visibility and passenger experience.
6. Integrate public art into portal and retaining wall elements including overhead canopies, horizontal surfaces, guards or structural elements.
7. Extend treatment and visual language from nearby transit infrastructure (stations, plazas, etc.) into the design of portals and retaining walls to ensure continuity.
8. Integrate public art as a design strategy to celebrate transitions, when travelling between different contexts, important civic destinations, or at portal thresholds.
9. Incorporate murals or form-liner surface treatment on public facing retaining wall surfaces susceptible to tagging and graffiti to address perception of safety.
10. Consider a landscape buffer zone to protect retaining wall structures.
11. Design retaining walls with materials and structural elements that align proportionally with other system-wide elements.
12. Determine design expression and materiality, especially within the space around the portal and retaining walls, based on the local area context, while maintaining the identity of the overall transit line.
13. Use durable graffiti-resistant surface treatments on portal and retaining wall structures, including mural or art installation.

Figure 14: Retaining wall to celebrate transitions and local context, Weldon Canyon, California

Figure 15: Texture and landscaping add visual interest, Victoria, BC (Photo Credit: Atlantic Industries Limited)

4.3 Sustainability and Resilience

1. Consider contextually appropriate landscape strategy and structural requirements for portal roofs to not preclude future design options.
2. Integrate green walls along retaining walls to reduce visual impact and provide more soft landscaped surfaces.
3. Consider seasonality and design infrastructure to withstand extreme climate conditions. For example, provide setbacks from retaining walls that may impact winter maintenance and road operations.

Figure 17: Green wall along highway infrastructure, Vancouver (Photo Credit: Green over Grey)

4.4 Intermodal Operations

1. Provide safe and clearly demarcated pedestrian crossing on either side of portals in order to avoid trespassing.
2. Locate and orient portals away from intersections to minimize vehicular conflicts and ensure legibility of areas for different modes.
3. Protect exposure to facilities of electrified corridors.

Figure 18: Vertical green walls (Photo Credit: Patrick Blanc)

Figure 16: Vertical green wall, Culver City (Photo Credit: Pinterest)

4.5 Accountability

1. Determine issues of ownership, maintenance, and access during the design process.
2. Choose materials that easily allow for frequent inspection and maintenance including options for removable cladding panels and green wall elements.
3. Consider and evaluate retaining wall alternatives based on their life cycle costs, including but not limited to materials, construction methods and maintenance.
4. Choose planting and landscaping features to not obstruct the inspection of the retaining wall. Consider planting types where the roots of plants will not outgrow towards the walls and cause potential damage.
5. Provide space and lighting as required to support emergency evacuation access/egress.
6. Consider operations and maintenance of canopy structures that may induce a lot of snow/ice accumulation, to prevent hazards to the road and/or transitway user below.