Stantec

Memo

To:	Darryl Matson COWI	From:	Josh Workman Stantec Consulting Ltd.
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Reference: George Massey Crossing – Tunnel Treatment Considerations for Pedestrians and Cyclists – Draft

INTRODUCTION

The purpose of this memo is to provide an overview of precedent examples from around the world where pedestrians and cyclists are accommodated in long span tunnels in a variety of conditions and configurations. Based on the precedents reviewed, a summary of recommendations are provided for consideration to inform the design of the George Massey Crossing Project.

SUMMARY OF PRECEDENTS

A number of long span pedestrian and cyclist tunnels have been constructed over the last century. A range of examples from Europe, North America, and Asia are summarized in **Table 1**, followed by a more detailed description of each.

Table 1 - Summary of Precedent Pedestrian and Cyclist Tunnels for Comparison

City	Country	Location	Length (m)	Year Completed
European Precedents				
Rotterdam	Netherlands	Maastunnel	585	1942
Amsterdam	Netherlands	Central Station Tunnel	110	2015
Rotterdam	Netherlands	Benelux Tunnel	800	2002
Lyon	France	Croix Rousse	1763	2013
Antwerp	Belgium	Sint Anntunnel	572	1933
North American Precedents				
Thorold	Canada	Thorold Tunnel	840	1967
Seattle	USA	Mount Baker Tunnel	390	1940
Los Angeles	USA	2nd Street Tunnel	460	1924
San Francisco	USA	Broadway Tunnel	490	1952
Asia Pacific Precedents				
Honshu-Kyushu	Japan	Kanmon Tunnel	780	Unknown
Goseong	South Korea	Tongyeong Undersea Tunnel	480	1932

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EUROPEAN PRECEDENT TUNNELS

MAASTUNNEL

Location: Rotterdam, Netherlands
Length: 585 m
Year Completed: 1942

This tunnel connects two sides of the river Nieuwe Maas between Charlois and central Rotterdam. A number of different technology options were initially considered for this crossing, including a bridge. Due to the port requirements for significant vertical clearances in a bridge option, a tunnel was selected as the preferred option. The tunnel provides separate tubes for motor vehicles, pedestrians, and cyclists, and accommodates approximately 75,000 vehicles per day, and approximately 4,500 cyclists per day. The pedestrian and cyclist tubes are stacked, with the cyclist tube above the pedestrian tube. A diagram showing access to the tunnel for pedestrians and cyclists is provided in **Figure 1**.

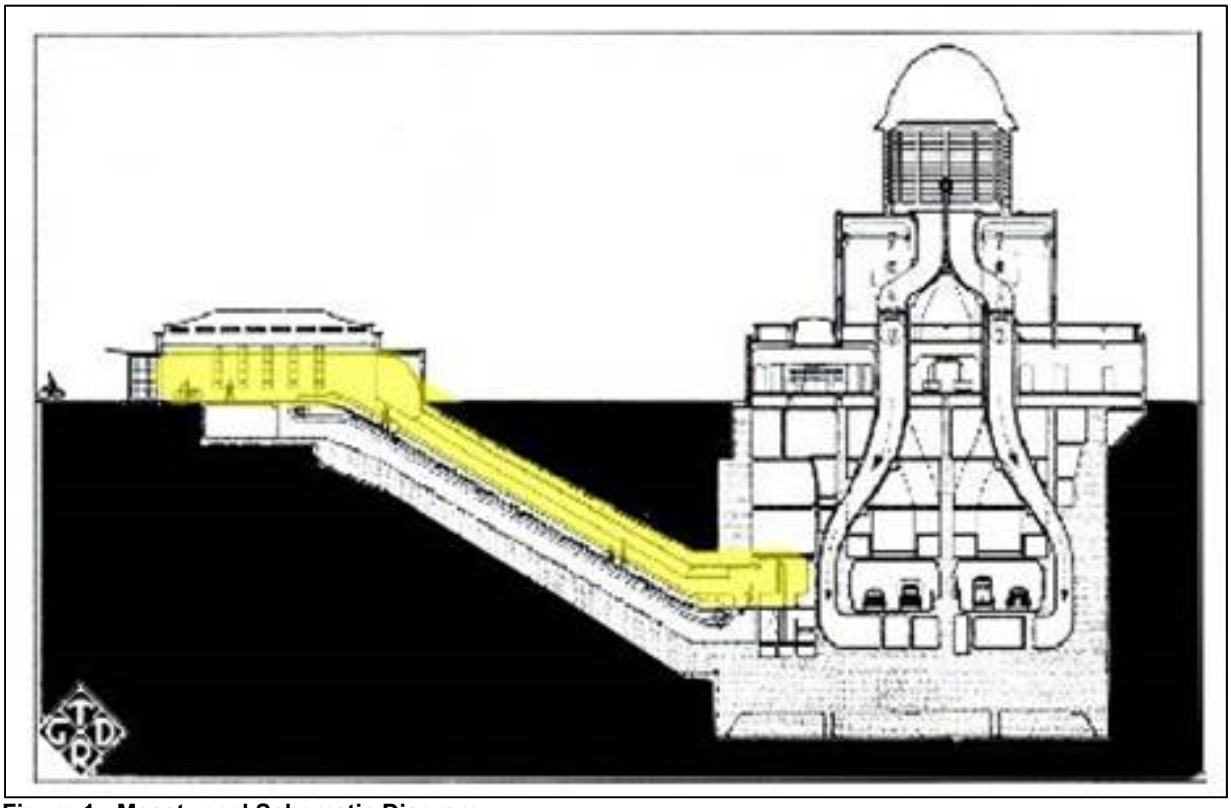

Figure 1 - Maastunnel Schematic Diagram
(Source: https://bicycledutch.wordpress.com/2011/03/29/maastunnel-rotterdam/)

An image of the cyclist tunnel (taken from a video capturing the experience of the tunnel) is shown in **Figure 2**.

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Figure 2 - Maastunnel Existing Cross Section
(Source: https://www.youtube.com/watch?v=4laLKXKkD1M)

The tunnel appears to be approximately 4.00m wide, and accommodates bi-directional bicycle travel.

CENTRAL STATION TUNNEL

Location: Amsterdam, Netherlands
Length: 110 m
Year Completed: 2015

This tunnel connects two sides of the Amsterdam Central Station, and provides access to a ferry terminal behind it. The tunnel is used exclusively for walking and cycling, and has separate cross section areas for each, reflected not just in the floor finish of the tunnel, but also in the wall and ceiling treatment to better delineate modal separation. The tunnel uses bright lighting treatment and public art to enhance the travel experience.

Images of the tunnel in use are shown in **Figure 3** and **Figure 4**.

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Figure 3 - Entrance to Amsterdam Central Station Tunnel
(Source: https://bicycledutch.wordpress.com/2015/11/24/amsterdam-central-station-tunnel/)

Figure 4 - View from cycle path showing light treatment and public art adjacent to walking path in tunnel
(Source: https://bicycledutch.wordpress.com/2015/11/24/amsterdam-central-station-tunnel/)

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BENELUX TUNNEL

Location: Rotterdam, Netherlands
Length: 800 m
Year Completed: 2002

This tunnel was an expansion and modification of a tunnel that initially accommodated only motor vehicle traffic. Significant focus was placed on the interior finish of the tunnel to create a feeling of social safety for users traveling through. Specific features utilized were a curved ceiling lit from below, a mirror of polished steel on one side in certain segments of the tunnel to create a greater sense of spaciousness, high quality tile finishing, and the use of public art. The tunnel accommodates bi-directional bicycle users, and appears to be approximately 3.0m wide, as shown in **Figure 5**.

Figure 5 - Bicycle users in Benelux Tunnel
(Source: https://bicycledutch.wordpress.com/2011/11/24/benelux-cycling-tunnel-rotterdam/)

CROIX ROUSSE TUNNEL

Location: Lyon, France
Length: 1763 m
Year Completed: 2013

This is parallel to an existing tunnel used by motor vehicles. The tunnel accommodates pedestrians, cyclists, and buses. In order to reduce the anxiety for users in the tunnel, an animated light, music, and video treatment is used on the walls, as shown in **Figure 6** and **Figure 7**.

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Figure 6 - Light treatment within la Croix-Rousse Tunnel
(Source: https://www.lyoncapitale.fr/politique/tube-mode-doux-pret-pour-les-lumieres-moins-pour-les-velos/)

Figure 7 - Bicycle users within la Croix-Rousse Tunnel
(Source: https://www.citycle.com/15706-lyon-un-tunnel-pour-le-velo-et-les-pietons-inaugure/)

SINT ANNTUNNEL

Location: Rotterdam, Netherlands
Length: 572 m
Year Completed: 1942

This tunnel accommodates a shared space for pedestrians and cyclists, and is accessed through wooden escalators on either side. It is adjacent to a separate motor vehicle tunnel. An image in **Figure 8**.

Figure 8 - Bicycle User in Sint Anntunnel
(Source: https://bicycledutch.wordpress.com/2019/03/13/the-scheldt-tunnel-in-antwerp/)

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NORTH AMERICAN PRECEDENTS

THOROLD TUNNEL

Location: Thorold, Ontario
Length: 840 m
Year Completed: 1967

This is an underwater tunnel carrying Highway 58 under the Welland Canal consisting of two tubes, each containing two motor vehicle travel lanes. The westbound tube also has a sidewalk for pedestrians, as shown in **Figure 9**.

Figure 9 - Thorold Tunnel configuration with pedestrian walkway separated by barrier on right side of image (Source: Google Imagery)

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MOUNT BAKER TUNNEL

Location: Seattle, Washington
Length: 390 m
Year Completed: 1940

This is a pedestrian and cyclist only tube configured on top of two other tubes for bus and motor vehicle traffic. Photographic reference within the tunnel is limited, however, a example is provided for consideration in **Figure 10**.

Figure 10 - Mount Baker Tunnel Bicycle User
(Source: Google Imagery)

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2 STREET TUNNEL

Location: Los Angeles, California
Length: 460 m
Year Completed: 1924

This tunnel connects under Bunker Hill in Downtown Los Angeles. The lane configuration was modified in 2013 to accommodate a bicycle lane and a motor vehicle travel lane in each direction as shown in **Figure 11**.

Figure 11 – 2 Street Tunnel with bicycle lanes and sidewalk on one side
(Source: Google Imagery)

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BROADWAY TUNNEL

Location: San Francisco, California
Length: 490 m
Year Completed: 1952

This tunnel connects between Chinatown/North Beach and Russian Hill/Van Ness Avenue. It accommodates pedestrians on one side in both tubes. An image of one of the tubes in provided in **Figure 12**.

Figure 12 - Broadway Tunnel (single tube) complete with pedestrian accommodation on one side (Source: Google Imagery)

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ASIA PACIFIC PRECEDENTS

KANMON PEDESTRIAN TUNNEL

Location: Honshu-Kyushu, Japan
Length: 780 m
Year Completed: Unknown

This tunnel connects across the Kanmon Strait between Shimonoseki, Yamaguchi, and Kitakyushu, Fukuoka in western Japan. An image within the tunnel is shown in **Figure 13**.

Figure 13 - Kanmon Tunnel Cross Section
(Source: https://www.welcomekyushu.com/event/?mode=detail&id=9999900054936)

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TONYEONG UNDERSEA TUNNEL

Location: Goseong, South Korea
Length: 480 m
Year Completed: 1932

This tunnel links the Goseong ward of Tongyeong to the Mireukdo island. It is the first undersea tunnel that was built in Asia.

Figure 14 - Tongyeong Pedestrian Only Tunnel
(Source: http://ttnotes.com/undersea-tunnel.html#gal_post_16823_undersea-tunnel-tongyeong-1.jpg)

RECOMMENDATIONS FOR THE SOUTH ARM CROSSING

In addition to baseline safety considerations for fire life safety of pedestrians and cyclists using a tunnel treatment, the following recommendations are proposed for consideration by the project team:

- **Allow for high quality interior finishing and lighting.** In all modern pedestrian and tunnel examples explored, as well as in renovations for aging pedestrian and cyclist tunnels, high quality finishing was prioritized along with an extremely well lit traveled way. This was done to mitigate anxiety and discomfort that users could experience when traveling through an extended tunnel with no sight line to the exit.

  Further exploration of security considerations for pedestrian and bicyclist tunnels should also be undertaken, and mitigation measures introduced to ensure that a tunnel treatment does not impact inclusiveness of use for all types of active transportation users accessing the tunnel.

- **Incorporate varied architectural and public art finishes within the tunnel.** Many of the precedent examples reviewed incorporated unique architecture finishes and public art to create an experience

variation and change within the tunnel. This helps users to experience progress and visual engagement while moving through the tunnel, helping to mitigate potential experiences of discomfort or boredom.

- **Incorporate clear security system with cameras and emergency phone stations.** A coherent and reliable security system within the tunnel will help provide users with a greater level of confidence in traveling through the tunnel system. Communication of the security system should be prominent to discourage unlawful activity within the tunnel.

- **Include indicators of location within the tunnel and time/distance estimates to the other side of the tunnel.** To help users understand their location within the tunnel, it is important to provide frequent signage and/or visual markers representing their location within the tunnel, as well as the estimated time or distance to the nearest exit from the tunnel.

- **Explore requirement for separation of pedestrians and cyclists**. Consistent with the BC Active Transportation Design Guidelines (2019) and the Transportation Association of Canada Geometric Design Guidelines (2017), anticipated pedestrian and cyclist volumes should be evaluated to determine if separate tubes or physical separation within the same tube should be utilized to mitigate potential conflict between pedestrians and cyclists within the tunnel.

  It is recommended that the width and separation criteria be based on conservative (high) estimates of travel volumes of pedestrians and cyclists anticipated to use the tunnel upon completion.

CLOSING

The above summary provides a preliminary assessment only. Additional information can be investigated for each of the precedent examples shown, as well as for additional precedents as required. If there are any questions or clarification needed, please don't hesitate to contact the undersigned.

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