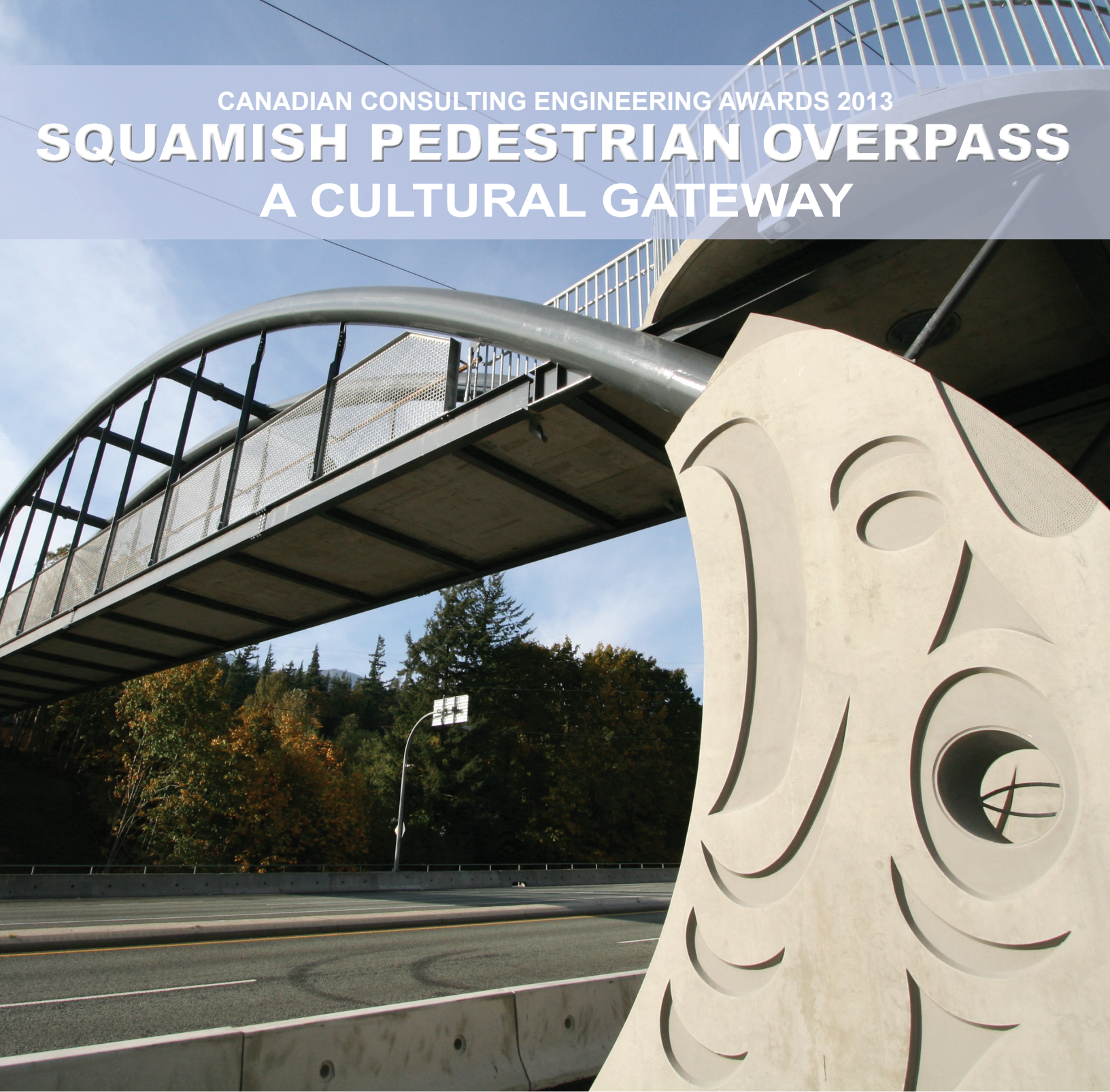


CANADIAN CONSULTING ENGINEERING AWARDS 2013

SQUAMISH PEDESTRIAN OVERPASS A CULTURAL GATEWAY



SEAMLESS INTEGRATION OF CULTURAL SYMBOLISM


CANADIAN | CONSULTING
engineer



**Hatch Mott
MacDonald**

**SQUAMISH PEDESTRIAN OVERPASS
A CULTURAL GATEWAY**

**OFFICIAL ENTRY FORM/
PROJECT SUMMARY
CONFIRMATION RECEIPT**



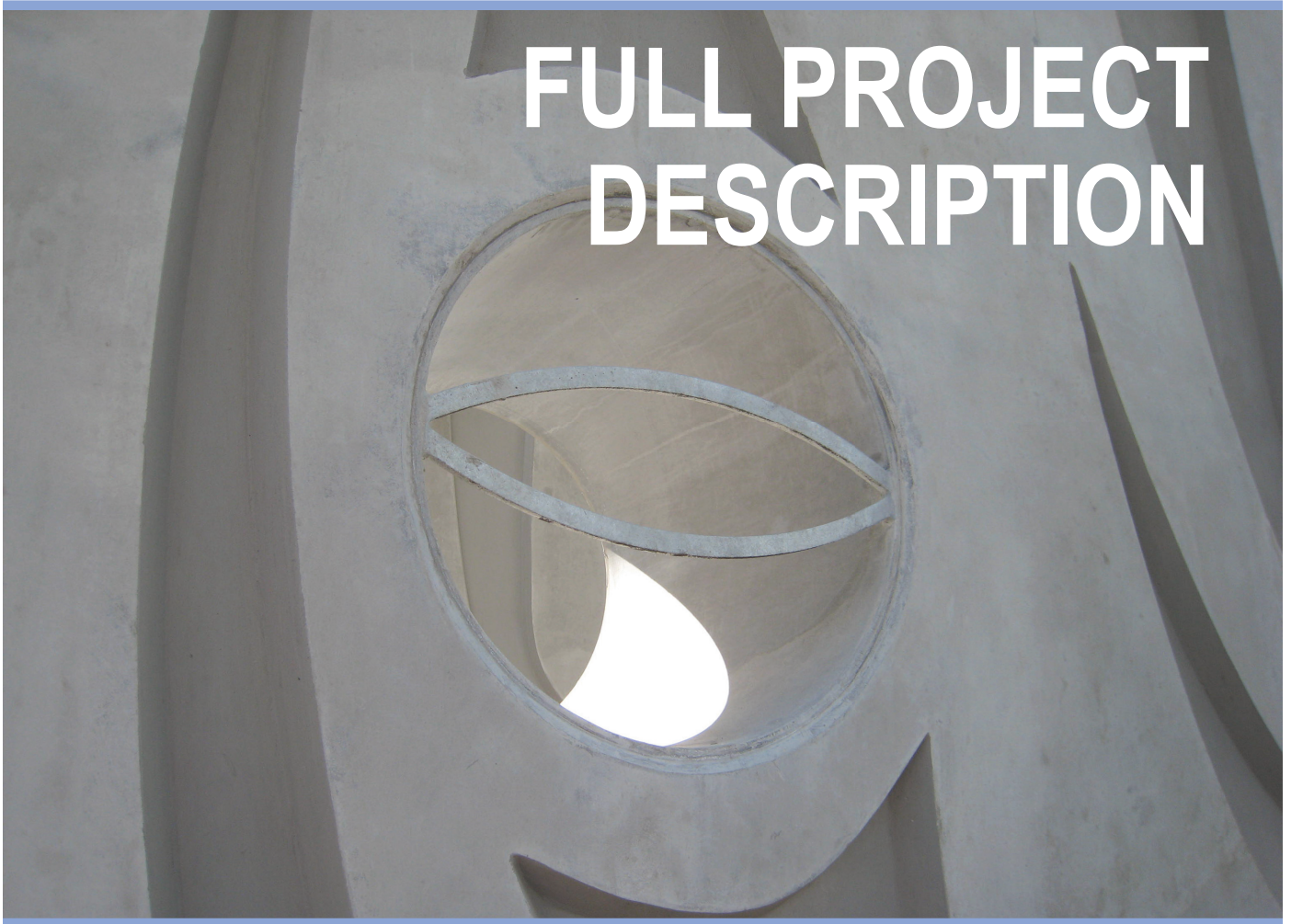
**SQUAMISH PEDESTRIAN OVERPASS
A CULTURAL GATEWAY**

ENTRY CONSENT FORM



**SQUAMISH PEDESTRIAN OVERPASS
A CULTURAL GATEWAY**

**FULL PROJECT
DESCRIPTION**



SQUAMISH PEDESTRIAN OVERPASS

A CULTURAL GATEWAY

EXECUTIVE SUMMARY

Hatch Mott MacDonald (HMM) was retained by the BC Ministry of Transportation and Infrastructure to deliver design and construction support services for Squamish Pedestrian Overpass. The overpass provides safe, pleasant passage for residents over both the CN Rail track and Highway 99, while becoming a landmark structure acting as a gateway to the community of Squamish.

The project faced numerous site constraints, difficult soil conditions, and a strict budget and timeframe. HMM was able to deliver a unique structure standing in harmony with its surroundings that incorporates a variety of cultural symbolism.

A single arch span maintains strict clearances to the road/railway below and keeps sufficient distance from the power lines overhead. To maintain an elegant and efficient arch shape, curved thrust walls are used to support the east end of the steel arch. These walls in turn become large canvases for Squamish Nation artwork of the serpent and thunderbird.

The bridge deck is suspended by closely spaced vertical supports that are shaped to look like spears. The carefully chosen total count of 16 “spear sets” is symbolic of the 16 hereditary chiefs of Squamish Nation. Cultural symbolism like this was sprinkled throughout the bridge to bring a strong identity to this important structure.

During the design process, HMM collaborated with the Squamish Nation and other key stakeholders to deliver this functional and appealing structure that will serve the community well into the future.



The fully-constructed steel arch awaiting installation on site. The blue-grey colour of the arch represents the story of the “great flood” in Squamish folklore.

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Members of the Squamish Nation, local government dignitaries, and public gathered for the opening of the overpass on October 11, 2012.

The opening ceremony included a traditional blessing of the structure that offers the first safe connection over the busy highway and railway.



The spear heads for the hangers mask the bolted connections from view. The carefully chosen count of 16 spear-heads represents the 16 hereditary chiefs of the Squamish Nation.

INNOVATION & COMPLEXITY

The Squamish Pedestrian Overpass is a project that epitomizes a design approach that is possible with a bit of vision and an open mind. It illustrates the responsive nature of the field of engineering to the layered reality of infrastructure design and construction. It is not enough to deliver an infrastructure project that solely considers the bottom line. These projects impact the landscape that we all share and it is the role of the engineer to positively contribute to this landscape in a way that brings pride to the immediate community.

For this complex project, Hatch Mott MacDonald (HMM) held overall responsibility for project management, concept development, detailed design, and construction support services. Led by Project Manager and Design Lead, Shaun Valdovinos, P.Eng. and supported by Senior Bridge Engineer Tony Martin, P.Eng., HMM was selected in a competitive process to deliver the Squamish Pedestrian Overpass Project for the BC Ministry of Transportation and Infrastructure (BC MOTI). As a sub-consultant, DMD and Associates Ltd. was responsible for lighting and electrical design. The construction contract was carried out by Wilco Civil Inc.

Before any design was undertaken, the project kicked off with a meeting between HMM, BC MOTI, Squamish Nation Chief Bill Williams, Squamish Lil'wat Cultural Centre, and artist Xwalacktun. Drawing on previous experience working on other successful pedestrian bridges, HMM led the meeting to brainstorm on what potential features might be incorporated into the overpass, with discussion of cultural symbolism, artwork, lore, art medium, significance of natural features, and other themes. In addition, difficult soil conditions, overhead clearances to high voltage power lines, property limitations, and other site constraints governed key elements of the overpass.

The result of the collaborative effort is a defining structure that involved the community at every step of the process, stands in harmony with its surroundings, and incorporates cultural symbolism while adhering to the project budget and schedule.

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The design of the overpass closely follows the cultural symbols of the Squamish Nation: the tale of “slaying the serpent” that lived on Stawamus Chief is captured in artwork on the arch “thrust walls” and the spear shaped hangers and struts. Similarly, the symbolic thunderbird is represented on the reverse side of the thrust walls and can be seen heading north on the highway towards Mt. Garibaldi and Black Tusk – its perch. In addition, the blue-grey colour of the arch represents the story of the “great flood” in Squamish folklore. The bridge is complimentary to the surrounding natural beauty and local Squamish community. In recognition of the importance of the overpass as a link/connection over a highway and railway that divides the community, safety and a pleasant user experience were important design considerations. The resulting structure is an innovative solution that is functional, efficient, and aesthetic – all in one.

Main Span

To construct a portion of the District of Squamish Corridor Trail connecting the east end of the overpass to the Stawamus Elementary School, stacked walls were used to accommodate the split trails, allowing a moderate elevation drop down from the main arch to the trail. The terrain proved to be difficult, and multiple iterations of the alignment were required to ensure maximum grades were kept below 1:12, while minimizing excavation and fill works.

The concept for the 50-metre main span was selected following extensive studies for five options at the site. The overall structure is constrained by the minimum clearance requirements to the CN Rail tracks below and the high voltage transmission lines above. The final location for the crossing was chosen to be at the pinch point of the highway and railway, enabling the bridge to cross over both in a single span.

Arch

Using a combination of steel and concrete to create the main arch and approach structures, the use of materials was optimized. This consideration allowed for ease of constructability, as the steel main arch was easier to handle and could be fabricated ahead of time to speed placement at the site.

The use of an arch allows for transparency of the structure to respect the beauty of the surrounding natural environment – a desire expressed by Squamish Nation elders. In addition, the arch structural system allows for a more efficient design and reduced use of materials. To maintain



The arch structural system allowed for an efficient design with reduced use of materials.

The slender main span accommodates the powerlines overhead and necessitated the thrust walls - which in turn became canvases for Squamish Nation artwork.

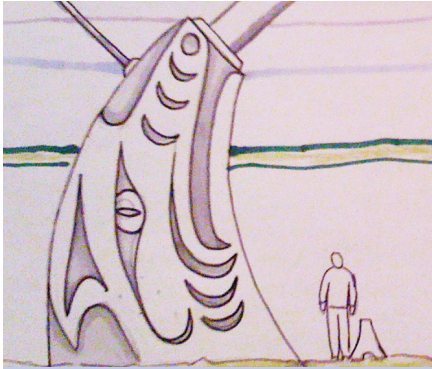


3D rendering overhead composite showing the overpass crossing Highway 99 and its proximity to the Squamish Nation's Totem Hall.

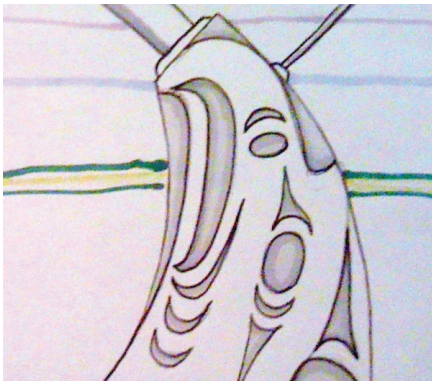
Successful collaboration between HMM, BC MOTI, Squamish Nation artist, Xwalacktun and the Squamish Lil'wat Cultural Centre was a highlight of the project.

SQUAMISH PEDESTRIAN OVERPASS

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Xwalacktun's serpent design for the south-facing pier.



Xwalacktun's thunderbird design for the north-facing pier.



Relief work pattern of the serpent cast into the pier wall is designed by Squamish Nation artist, Xwalacktun, and assembled by hand.

sufficient clearance to the overhead power lines, the arch profile had to be flattened, which necessitated the use of “thrust walls” at the east of the highway to support the arch at a higher level. These thrust walls in turn became a giant canvas for artwork. Where the deck edge beam and arch intersect at the west end of the span, stiffener plates, with artful circle and crescent shapes (a Squamish motif), are used to stiffen this critical structural node.

Hangers and Struts

The hangers and struts serve as connections from the deck to the arch. They are shaped like spears to enhance the visual appeal and represent the “slaying of the serpent”. The spear heads for the hangers mask the bolted connections from view. The hangers and struts are spaced strategically along the span to ensure efficient resolution of forces while resulting in a count of 16 to represent the 16 hereditary chiefs of Squamish Nation.

Pier and Abutment

The shape of the pier supporting the east end of the arch resulted from several design iterations that arose due to site constraints. As mentioned above, the pier walls are designed to take the thrust force from the arch down into the ground. The resulting crescent shaped walls further exemplify the efforts taken to incorporate culture into the structure. Squamish Nation artist, Xwalacktun, created the relief pattern cast into the walls by building the form liners from plywood marked using a CNC machine and cut and assembled by hand. Security and accent lighting illuminate the piers at night.

The unique abutment supporting the west end of the arch is the result of suiting the structure to the location's constraints. The reserve boundary at the west end of the bridge meant that all permanent structures needed to remain outside the property lines. To achieve this, the vertical abutment wall is made integral with the slope slab to resolve the earth pressure forces. The difficult soil conditions included potential liquefaction in the upper sands beneath the west pier. A micropile foundation was used to spread loads out to depth using a splayed array of micropiles supporting the base of the arch. The face of the abutment slope is covered with a layer of topsoil to allow for vegetation to grow and doubles as a drainage solution to absorb deck runoff, avoiding any positive flow into the CN Railway ditch.

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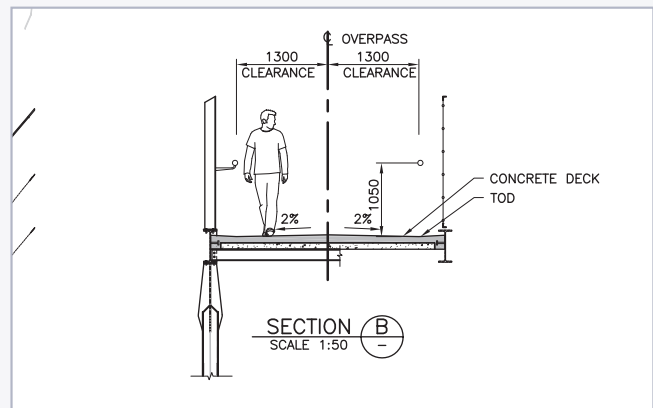
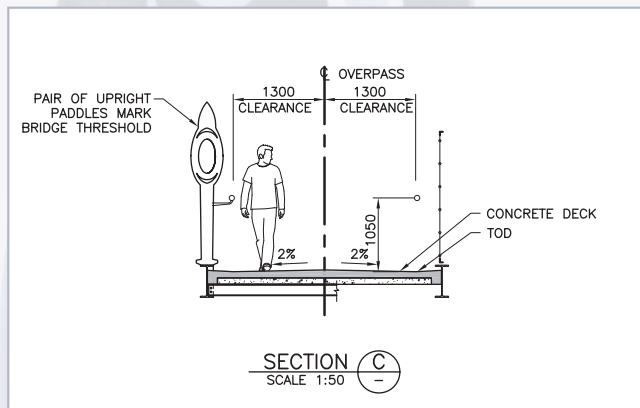
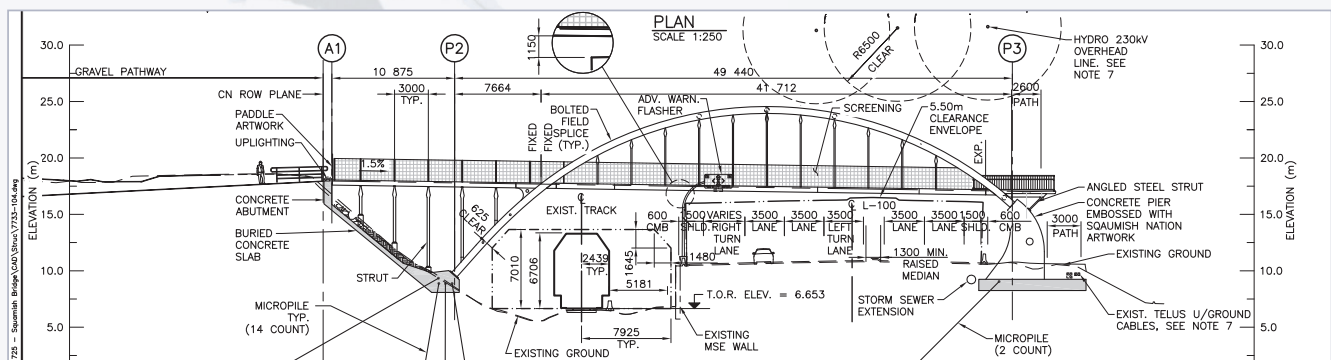
Jump Span

To keep the cost of the structure low and address any differential settlement issues, the mechanically stabilized earth (MSE) retaining walls carrying the approach ramp were set back from the west pier and connected using a 10-metre jump span. The jump span also allowed wall heights to be kept below 5 metres. As the retaining walls are expected to settle over the long term, the jump span needed to be long enough to yield a small rotation due to settlement and maintain a reasonable grade for user accessibility. In addition, the span creates spatial separation between the thrust walls and MSE walls to allow full view of the artwork on the pier while driving south.

The overpass exemplifies the result of technical innovation by showcasing an engineer's ability to provide a context-sensitive solution reached through a holistic approach.



The gently sloped east approach ramp and jump span provide a stunning view of the mighty Stawamus Chief while aiding the safe passage of multiple users across the highway. Local elementary school students are among the regular users of the overpass.



General arrangement drawings.

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Upturned paddles symbolize peace and respect.



Looking up between the serpent and the thunderbird to the underside of the circular observation deck.



Steel spear-head hangers represent the "slaying of the serpent" from Squamish Nation folklore.

SOCIAL & ECONOMIC BENEFIT

The Squamish Pedestrian Overpass provides a safe, unimpeded route from one side of Squamish Nation land to the other, enhancing the connections within the community. The significance of the artwork, evident in all elements of the bridge, is vital to a community that strives to preserve its rich history and traditions. The visual theme of "slaying the serpent" on the pier while driving southbound towards Stawamus Chief and seeing the thunderbird motif while heading northbound towards Mt. Garibaldi demonstrates the careful considerations that went into the structure's design. Upon reaching the bridge from the west side, users are greeted by a pair of upturned paddles, a symbol of peace and respect. An observation deck provides a rest area for users to pause and enjoy the expansive view before them of the 600-metre high mountain of rock known as Stawamus Chief.

With its extensive community involvement and focus on cultural symbolism, the overpass integrates artful elements into functional aspects of the design and provides a platform that enables the cultural stories to be passed on within not only the Squamish community, but beyond. Visitors are now exposed to the unique and rich history of the area while using the bridge and connecting to the Squamish Lil'wat Cultural Centre, who were heavily involved in the development of the project. The commemorative and educational function takes the bridge beyond just being an infrastructure project, to being an art piece of significant importance to the community.



Members of the Squamish Nation and local community celebrate the opening of the overpass.

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ENVIRONMENTAL IMPACT

The Squamish Pedestrian Overpass and Squamish Corridor Trail encourage more users to walk and bike to their destinations within the community, thus promoting the use of alternate travel modes and reducing carbon emissions. The theme of sustainability is inherent in the design of the bridge, in terms of encouraging sustainable modes of transportation, preserving a long-standing culture and minimizing use of materials by integration of artwork into structural elements. The design addresses the required functionality while tying together important themes with its visual form. For example, the use of an arch allows for transparency of the structure, to respect the beauty of the surrounding natural environment, while allowing for a more efficient design and reduced use of materials. The unique abutment supporting the west end of the arch is the result of suiting the structure to the location's constraints. The face of the abutment slope is covered with a layer of topsoil to allow for vegetation to grow and doubles as a drainage solution to absorb deck runoff. From structural efficiency, collaboration with multiple stakeholders, and consideration of bridge aesthetics, HMM delivered a landmark structure that wholly complements its surroundings.

MEETING CLIENT'S NEEDS

Previously, the only pedestrian crossing was at grade, so the key goal of the Squamish Pedestrian Overpass was to provide safer passage across the busy highway, while creating a unique and meaningful structure to the Squamish Nation community and maintaining a tight construction budget. It was imperative that the aesthetics of the project be integral to the structure such that cost premiums were negligible.

The project owner is the BC Ministry of Transportation and Infrastructure with key stakeholders being the Squamish Lil'wat Cultural Centre and Squamish Nation. In addition, the overpass integrates with the District of Squamish Corridor Trail via new trail segments along the east side of the highway, running from Valley Drive to Clarke Drive.

A collaborative process, such as was undertaken in the conception through completion of the overpass, can only be successful if the engaged members are respectful of the constraints and responsive to the evolving ideas. Squamish Nation members were consulted throughout the design development and the result is a fully functional structure that seamlessly integrates artwork and folklore into the structural system. In addition, the client's needs were met in the consideration



3D rendering of the vegetated retaining wall and spear-head



The overpass and approach ramps encourage users to walk/ bike to enhance community connections.



LED lighting is installed along the bridge approaches in addition to down lighting on the thrust walls.

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of materials and timeline for construction, thus keeping costs minimized. The combination of steel and concrete to create the main arch allowed for ease of constructability, as the steel main arch was easier to handle and could be fabricated off-site and put in place when ready. The arch maintains transparency to keep harmony with the surrounding natural environment. Visitors and local residents alike can appreciate the consideration and artfulness of the design that so efficiently reflects the beauty and history of the area connecting the community both physically and figuratively. Innovative, collaborative, functional and educational, the Squamish Pedestrian Overpass is a true 'cultural gateway'.



September 19, 2012 - 1:30pm
- view of the overpass looking north.



Northbound view of the thunderbird pier, main overpass structure and observation deck taken on opening day in October, 2012.

The observation deck offers unobstructed views of Stawamus Chief to the south.



The jump span and east approach ramp allow for long-term settlement and full view of the pier's artwork.



Early 3D rendering of the pier, approach ramp and deck - by day.



Early 3D rendering of the pier, approach ramp and deck - by night, to show lighting design.