Owner, Consultant, and Contractor Collaboration for Rapid Delivery of the Marine Drive Transit Priority Project

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ABSTRACT

The Old Capilano River Bridge in West Vancouver, B.C. was a two-span steel through truss structure originally built in 1930, with a span added in 1949. It carried all westbound traffic on Marine Drive coming into West Vancouver from North Vancouver and off the Lions Gate Bridge from Vancouver. The aging bridge was in need of replacement and widening, but it carried a large volume of traffic daily and interruption of service during construction was not an option. The Marine Drive Overpass just to the east, carrying Lions Gate Bridge traffic over Marine Drive, built in 1938 and expanded in 1956, had inadequate vertical clearance and also needed widening. Dedicated transit lanes were needed to get transit buses onto Lions Gate Bridge faster during peak hour traffic. Improvements were needed to provide access for pedestrians, cyclists, and transit users. Finding solutions to all of these needs drove the Marine Drive Transit Priority Project, jointly funded by the governments of B.C. and Canada. This fast-paced project saw the replacement of both bridges, the addition of transit-only lanes, improved cyclist and pedestrian paths, and general enhanced safety in the area. The entire project was conceived, designed, and constructed in less than two years. Contributing to the success of the project were a number of factors including: advance planning and early construction of some key elements of the work during seasonal environmental windows; good communications between client and many consultants all channelled through a key person for each; a streamlined submittal review and approval process; advance environmental permitting; sliding the Capilano bridge laterally overnight to create a detour route with no interruption to traffic; construction staging for the new Marine Drive Overpass that kept traffic moving while building the new bridge in two halves; maintaining pedestrian traffic through the middle of a bridge construction site; and adapting the bridge design to accommodate seasonal construction issues to reduce risk to the scheduled completion date, which was tied to the project cost sharing formula. The paper describes the project, the issues, innovations and successes, and lessons learned for future projects.

BACKGROUND

The Marine Drive corridor across the North Shore of Greater Vancouver, British Columbia, is a major arterial connector. The segment of Marine Drive joining the major north-south arterials of Taylor Way in West Vancouver and Capilano Road in North Vancouver includes the interchange connecting to the north end of the Lions' Gate Bridge, and two bridges over the Capilano River. This section of road provides critical connections between West Vancouver, North Vancouver, the City of Vancouver, and the Sea to Sky Highway, which leads to ferries, Squamish, Whistler, and beyond. Traffic congestion here is frequent, and with the ever increasing transportation demands of the area, enhancement to the traffic flow, transit service, and cyclist and pedestrian access was needed. Key factors in achieving this included the improvement of the westbound bridge across the Capilano River and the overpass carrying Lions Gate Bridge traffic over Marine Drive. These improvements would allow the addition of a dedicated lane for buses onto Lions Gate Bridge and reduction of congestion between Lions Gate and Taylor Way, thereby reducing transit travel times and increasing the efficiency of the transit system.

The need for this major improvement to the local infrastructure drove the creation of the Marine Drive Transit Priority Project, jointly funded by the governments of B.C. and Canada.

The location of the project is shown in Figure 1.

Figure 1: Key Map of Project Location

The overall scope of the project included the following major components:

- Replacement of the two-lane westbound Capilano River Bridge with a modern three-lane structure including a wide cyclist/ pedestrian path;
- Replacement of the low Marine Drive Overpass structure with a wider and longer bridge providing a dedicated bus lane and improved vertical clearance;
- Addition of a transit-only lane along Marine Drive, all the way onto Lions Gate Bridge;
- Addition of transit priority signals for buses eastbound on Marine Drive at Taylor Way;
- Improvement of pedestrian and cyclist paths throughout the project area;
- Upgrading of lighting, signage, and traffic signals throughout the project;
- Improvement of drainage systems;
- Relocation of BC Hydro lines from overhead to underground;
- Pavement renewal throughout the project area; and
- Landscaping improvements.
- All of the above project components were integrated into two primary construction contracts: the Capilano River Bridge Replacement Project; and the Marine Drive/ Lions Gate Transit Priority Project. Figure 2 shows an overall plan of the project area.

STAKEHOLDERS

The BC Ministry of Transportation and Infrastructure (BCMoT) operates Highway 99, which includes the Lions Gate Bridge and approach and the section of Marine Drive between Lions Gate and Taylor Way. In addition to BCMoT, this project had numerous other governments, groups, and agencies affected by and/or providing input to the project. These stakeholders included:

- District of West Vancouver;
- District of North Vancouver;
- First Nations;
- Federal Department of Fisheries and Oceans;
- BC Ministry of Environment;
- Translink (buses);
- Local residents;
- Local businesses;
- BC Hydro;
- Terasen Gas (now FortisBC Inc.); and
- Other utility companies.

Figure 2: Overall Project Plan

SCHEDULE

The inclusion of the project in the Canadian Federal Government Infrastructure Stimulus Fund Program allowed this project to be moved forward from the previously-anticipated replacement date. Along with the commitment of the funding partner came the requirement of project substantial completion by March 31st, 2011.

The project was initiated on April 9th, 2009, providing just two years to design and construct $40 million worth of work, including two main structures, temporary detours, and demolition of the original structures, all while maintaining full traffic through the project site.

Along with the tight overall project timeline there were several key schedule constraints to the construction. In 2010 Vancouver and Whistler hosted the Winter Olympic and Paralympic Games in February and March. This added the additional restriction of prohibited construction in the first quarter of 2010 along Olympic transportation corridors, in which the bridge was a vital link connecting Vancouver to Whistler. Detour road works for the Capilano River Bridge replacement were to be completed prior to January 2010, with no construction during the 2010 Olympic and Paralympic Games period.

The Capilano River is a major fish bearing stream with a salmon hatchery upstream from the Bridge location. Environmental protection requirements limit any construction in the river to approximately a two-month period from July to September each year, giving just two possible in-river construction windows for the project. This required the detour construction in the river to be completed during the 2009 fish window, prior to completion of the final bridge design. It also meant that the new bridge design had to be completed, the project tendered and awarded, and the existing bridge moved, all prior to July 2010 so that the demolition of old substructures and construction of a new pier could take place during the 2010 fish window.

Due to the greater schedule constraints of the Capilano River Bridge replacement, design and tendering of this project proceeded first, with the remainder of the work on Marine Drive beginning partway through the Capilano design. This spread out the administrative and engineering burden and had the added benefit of allowing the costs of the Capilano project to be confirmed at an advanced state of design, thus ensuring that there would be sufficient funding for the Marine Drive portion before significant work on it was initiated.

CAPILANO RIVER BRIDGE

The existing, westbound, Capilano River Bridge was a two-span, steel through truss structure with two narrow traffic lanes, no shoulders, and a single narrow sidewalk. This configuration accepted three approaching lanes and exited into three through lanes and two turning lanes. This condition regularly impacted traffic flow into West Vancouver. The structure was regularly inspected and assessed, and although functionally challenged, the structural condition did not necessitate load restrictions.

The east 76m (250’) steel truss span was constructed in 1929, along with a short approach span at each end, after a concrete arch bridge at that location was destroyed by flooding. The west 55m (180’) span was added

Figure 3: Existing Bridge Prior to Moving

in 1949 after another flood washed away the west river bank, abutment and approach span. The bridge originally carried two-way traffic, but in 1956 a new three-lane girder bridge was built immediately downstream to carry eastbound traffic and the truss bridge then carried the westbound lanes. Over the years the local urban environment has grown up nearby to the point where upscale condominiums are now in very close proximity to the bridges. The existing bridge, prior to being replaced, is shown in Figure 3.

The replacement bridge is on the same general alignment, within a very tight right-of-way in a congested urban setting. The new bridge includes three traffic lanes, a wide shared pedestrian/cyclist lane, and shoulders. The structure consists of five two-span composite steel girders, integral with piled abutments and supported on a single piled pier in the river.

A rendering of the new crossing is shown in Figure 4.

Figure 4: New Capilano River Bridge

MARINE DRIVE OVERPASS

The existing Marine Drive Overpass was a two-span structure with four narrow lanes and no shoulders, crossing over two lanes of eastbound Marine Drive and two and a half lanes (two lanes merged under the overpass) of westbound Marine Drive. The original overpass was a two-lane single span concrete rigid frame built in 1938 with Lions Gate Bridge. This was expanded by doubling both the width and length in 1956 with the opening of the eastbound Capilano bridge. The expansion used steel plate girders in a through configuration. The end result was actually three separate structures appearing as one. The vertical clearance under most parts of the overpass was 4.0m (13 ft), with some locations as little as 3.8m (12.5 ft). The structure was frequently impacted by vehicles in excess of these heights.

The existing overpass, prior to being replaced, is shown in Figure 5.

Figure 5: Existing Marine Drive Overpass

The new Marine Drive Overpass has two lanes northbound, coming off Lions Gate Bridge, and three lanes southbound onto Lions Gate, one of which is a dedicated bus lane. The structure consists of multiple two-span precast prestressed concrete box girders, jointless, with integral abutments on spread footings and an open, multi-column pier, also on spread footings.

A rendering of the new overpass is shown in Figure 6.

Figure 6: New Marine Drive Overpass

DELIVERY METHODS

The extremely tight time frame and construction window opportunities for the project required investigation and implementation of a variety of means of developing and delivering engineering and construction within the schedule. Overall planning and vision of the combined sub-projects was led by the BCMoT engineering team.

The initial Capilano River Bridge detour design, the engineering assessment report for sliding the Capilano River Bridge laterally, and the subsequent design of the temporary pier were delivered for construction by utilizing two existing General Engineering Services contracts with road design and structural engineering consultants. This allowed the project to proceed with the design of the extremely time critical elements required for construction of the detour components, in time for the 2009 fish window.

The construction of the temporary river pier for the Capilano detour was tendered through traditional methods, with complete design drawings and specifications. The design and tender process was managed to minimize the time required to go from start of design to completion of construction.

The construction of the temporary detour road and associated retaining walls and temporary abutments was managed by BCMoT staff on site. This allowed the BCMoT to purchase materials directly through standard channels and obtain equipment and labour to complete the work.

The consulting services for the detailed design of the new Capilano River Bridge and affected roadway, including the designs for sliding the existing bridge and demolishing the old bridge, were obtained through one of the standard BCMoT methods of obtaining and evaluating technical proposals in the selection of a design consultant. This method was also used for the selection of a consultant for the design of the Marine Drive / Lions Gate Transit Priority Project including the new Marine Drive overpass.

The tender process for both main construction contracts, for construction of the new Capilano River Bridge and the Marine Drive work, also followed standard BCMoT procedures.

SUCCESS FACTORS

During design and construction of the entire project, key goals were met with respect to schedule (and thus funding), the environment, accommodation of the travelling public, and project costs. A number of success factors are identified that significantly contributed to this achievement, including:

- Advance planning and early construction of some key elements of the work during seasonal environmental windows;
- Good communications between client and many consultants, all channelled through a key person for each;
- A streamlined submittal review and approval process;
- Advance environmental permitting;
- Sliding the Capilano bridge laterally overnight to create a detour route with no interruption to traffic;
- Construction staging for the new Marine Drive Overpass that kept traffic moving while building the bridge in two halves;

- Maintaining pedestrian traffic through the middle of a bridge construction site
- Adapting the bridge design to accommodate seasonal construction issues to reduce risk to the scheduled completion date, which was tied to the project cost sharing formula; and
- Providing highly experienced, capable site representation from the BCMoT, responsible for the entire project area, enabled to communicate directly with consultants and provided with reasonable provisional sums for site modifications during construction.

These success factors are the focus of this paper, and are discussed individually in more detail below.

ADVANCE PLANNING & EARLY CONSTRUCTION

It was recognized at the outset of the project that the high traffic demands and limited alternate routes for the Capilano River Bridge would require the use of a detour bridge to provide continuous passage of the westbound vehicles on Marine Drive. This detour would have to be as close as possible to the original alignment while allowing adequate space to construct the wider new bridge. The adjacent properties and existing road alignment restricted opportunities for such a detour. Original detour options that involved the use of modular bridge components eventually gave way to a plan to slide the existing bridge laterally to become the construction detour. This is discussed in more detail further on. The success of implementing this plan while meeting the overriding schedule constraints was highly dependent upon advance planning and preliminary construction that started almost at the inception of the project.

The early development project was led by the BCMoT engineering team. The concept of the new bridge was conceived for configuration and location relative to the 1956 structure and the surrounding infrastructure. This established a general path forward to be used as the basis for the development of the temporary detour necessary for the construction of the new bridge. This process included consideration of public access during construction, effects on local stakeholders, and environmental concerns.

Following completion of the study and confirmation of the concept for sliding the existing bridge, the next design stage was for the temporary pier, which had to be designed, tendered and awarded in one month in order to be built within the 2009 fish window. The BCMoT tendered the temporary pier and supervised its construction, and then left it to sit for nine months until it was time to slide the bridge.

The temporary abutments and the associated detour approach roadways were designed by consultants and then constructed directly by the BCMoT to have construction of these works completed prior to the 2010 February and March Olympic & Paralympic Games shutdown.

During the detailed design of the new Capilano River Bridge by Buckland & Taylor Ltd. (B&T), which included the sliding design, the final geometry of the sliding and the detailed design of the sliding runways which connected the existing and temporary abutments were completed. These runways were then constructed by the BCMoT as they completed the temporary abutments, which reduced the pre-sliding work to be done by the contractor after award and alleviated any schedule impacts from concrete strength or initial settlement issues.

COMMUNICATIONS

Each of the two main design phases of the project, for the Capilano River Bridge and for the Marine Drive work, was completed within a three month period, including concept identification and development, concept selection, and several detailed design stages. For the scale of the work involved, this is approximately half of the time that would normally be allotted. The success of this schedule depended in part upon excellent communications between the BCMoT, the two prime consultants, and the

many sub-consultants involved. There was no time for any missteps in the design, delays due to lack of response, or back-tracking in design. A key to this communication success was the designation of a single key contact at the BCMoT and at each of the prime consultants. ALL communications were funnelled through these contacts, copied as needed to others, but always through the primary person. This ensured that issues were addressed in a timely manner, problems identified and dealt with, and information needed by other parties highlighted with any needs acted upon quickly.

SUBMITTALS & REVIEWS

Also key to meeting the schedule described above was a streamlined process for design submittals, reviews, and revisions. The traditional approach to this process with the BCMoT would have been to submit hard-copy designs, specifications, reports, and cost estimates at various steps in the process: design criteria, conceptual design, 50% complete detailed design, 90% complete, 100% complete, and tender-ready. At each of these stages, traditionally two weeks would be allotted for various BCMoT stakeholders to review and comment, whereupon collected comments would be passed to the consultant to be addressed. Discussion on comments and resultant decisions would often then consume additional time before the design became further advanced.

For this project, the process was very different. All submittals were made electronically directly to a SharePoint® site on a specified day. In addition to the owner, BCMoT, all consultants and other stakeholders had access to the submitted materials and could review and print them as needed. A full-day review workshop was scheduled for two days after the submittal, with all parties in attendance and lunch supplied. The entire submittal was reviewed in detail, with the appropriate consultant presenting each portion and affected stakeholders providing comments and questions during the meeting. Needed decisions were made and agreed upon on the spot, and very few decisions were deferred for a later date. The workshops included meeting minutes to all parties, with every action item including “by who, by when”.

ENVIRONMENTAL

To be able to accelerate the construction of the temporary works and the new bridge, it was necessary to substantially develop the ideas and construction methods in order to present them to the Federal Department of Fisheries and Oceans and the BC Ministry of the Environment. Much of this approach was worked out by the BCMoT engineering staff, with support from the design consultants involved early in the project. This close working relationship and detailed explanation of constraints and possible timelines allowed a mutual understanding of the construction process and structural components that would be located inside environmentally sensitive areas. This helped the design consultants evolve their designs appropriately and enabled the environmental agencies to have confidence in the results.

Advance permitting for environmental aspects of the project were obtained by the BCMoT, and contract language included in tendering that required the contractor to meet the terms of the permitting. This not only removed construction schedule uncertainty related to obtaining permits, but provided an informed basis for bidding with respect to environmental aspects.

MOVING CAPILANO BRIDGE

As described previously, the early work studying the detour needs for the westbound Capilano River Bridge identified the prospect of sliding the existing bridge upstream to use it as the detour. The expected advantages of this idea included:

- An environmentally sound solution, with river disturbance minimized by requiring just a single temporary pier that could be installed during the 2009 fisheries window;
- Ability to meet a very tight schedule, without risks associated with constructing a new temporary bridge;

- Avoidance of significant traffic disruption;
- Easy accommodation of pedestrian and cyclist traffic; and
- Considerable cost savings, estimated on the order of $500,000.

Original options for the detour considered the use of a temporary two lane bridge using modular bridge components. The configuration taken forward maximized the truss spans to 36.6m (120'), requiring three temporary piers in the river.

Once the decision to slide the existing bridge was made, supported by an engineering study completed by B&T, the BCMoT proceeded with construction of the necessary temporary works: pier, abutments, and approaches.

Figure 7 shows the temporary pier that was constructed in advance of the tendered bridge project.

Figure 7: Temporary Pier for Detour

Figure 8 shows one of the temporary abutments constructed in advance of the tendered bridge project, complete with the sliding runway connecting to the existing substructure.

Figure 8: Temporary Abutment for Detour

The design of the sliding operation itself was completed during B&T's design of the new Capilano River Bridge, and tendered as part of the new bridge contract, along with demolition of the existing bridge at the end of the project.

There were a number of factors that led the Ministry to include the actual design of the sliding rather than leaving it as a design-build construction task to be entirely the contractor's responsibility. These included the need to pre-construct the temporary pier and abutments, thereby locking in certain parameters; the very limited time available between contract award and the date the bridge had to be slid to meet the fish window, limiting contractor design time; and the crucial nature of the bridge to the Ministry. The decision was made early in B&T's design process to fully detail the major elements of the sliding scheme, including the overall configuration and geometry of the slide, the sliding runways, sliding tracks, guiding system, vertical jacking details, sliding shoes, existing bridge reinforcement, and the overall procedure. Left up to the contractor to design, to prescribed parameters, were the actual jacking and pulling systems for the slide, detailed procedures, and contingency plans.

The primary goal of the sliding design was to come up with a system that would safely move the bridge on its existing bearings, without modifying its structural behaviour, through a curved sliding path, and to ensure that it was done with as little disruption as possible to traffic. One of the innovations in the sliding design was to eliminate the need for jacking the bridge vertically at the end of the slide to change from sliding shoes to bearings, and thus reduce the total time for traffic interruption. This was done by having the abutment sliding elements become the sliding bearings for the duration of the bridge's life as a detour. The bridge was slid laterally, and when it arrived at the final position, keepers were welded in place on the sliding tracks to provide transverse restraint while allowing longitudinal expansion.

Contract tender documents included a set of 17 drawings detailing the overall scheme and procedure, the designed elements, and the parameters for contractor-supplied designs. Special provisions in the contract specifications spelled out responsibilities, submittals, contingency requirements, and traffic closure allowances. Included was a requirement that the contractor set up and perform a test slide, moving the bridge 20mm (3/4 in) several days prior to the actual move, in order to verify all equipment, personnel understanding, and communications.

The contract allowed for a closure of the bridge for a period not to exceed 36 hours, from 6:00 pm Saturday through to 6:00 am Monday, for the actual sliding operation. This maximum time had to include the actual slide, the installation of the deck joints in the new position, rearrangement of traffic barriers to divert the traffic and complete the detour, and a contingency amount in case of problems. The contractor was also required to maintain one lane of westbound traffic at all times, by providing counter-flow on the eastbound bridge, so that traffic was never significantly impacted.

At 6:00 pm on Saturday, June 19, 2010, the bridge was closed to traffic and westbound traffic was diverted to one lane of the eastbound bridge. As speeches were being made to a press briefing, the pulling jacks at each location began to work, pulling the bridge to the detour alignment. This continued smoothly until the bridge arrived at its final position at 11:45 pm.

Once the bridge was in the final alignment, final details were completed overnight and the bridge was re-opened to traffic by 10:30 am on Sunday, June 20, approximately 20 hours ahead of the permitted schedule.

Figure 9 shows the bridge partway through the move .

Figure 9: Bridge Partway Through the Move

Figure 10 shows the bridge at the completion of the move .

Figure 10: Bridge at Completion of the Move

The authors of this paper, along with a third co-author, Nick Sandhu of BCMoT, have prepared a separate paper focused on this aspect of the project, entitled “Moving the Capilano River Bridge to Use as a Construction Detour” which was presented at the 2011 International Bridge Conference in Pittsburgh, PA. Two time-lapse videos of the move are available upon request.

OVERPASS CONSTRUCTION STAGING

The Marine Drive Overpass carries all of the traffic westbound on Marine Drive that is accessing the Lions Gate Bridge, and all of the traffic coming off Lions Gate going westbound on Marine Drive, well over 25,000 vehicles per day. It was therefore imperative that full traffic be maintained throughout construction. Due to the constraints of the bridge alignment and proximity, the adjacent roadway alignments, limited right-of-way, and lack of possible property acquisition, it was necessary to construct the new overpass on the existing alignment.

To ensure that traffic could be accommodated uninterrupted on the overpass, a staged construction procedure was developed as follows:

- Install single-lane modular detour bridge for northbound traffic, immediately beside the existing overpass, with approaches (a single lane was sufficient without significant disruption since the two lanes on the overpass had always merged into one not far beyond the overpass)
- Divert southbound traffic onto original two northbound lanes
- Demolish the west half of the overpass and construct new west half comprising three lanes
- Divert northbound and southbound traffic onto new half overpass
- Demolish remaining portion of old overpass, and remove detour bridge
- Construct second half of new overpass
- Open all five new lanes across overpass

During the detailed design of the overpass, the construction stages were taken into account in all aspects, ensuring a trouble-free staged approach to its construction. The detailed staging scheme was included as a requirement in the tender package.

While the Marine Drive Overpass package was out to tender, the BCMoT pre-built the detour approaches and abutments, using the contractor engaged for the Capilano River Bridge on a force-account basis. This advance work assisted the schedule for the Marine Drive work once that contract was let.

Figure 11 shows the overpass at the half-built stage of construction, with the detour bridge still in place at the right of the photo.

Figure 11: New Overpass Halfway Built

Figure 12 shows the new overpass upon completion.

Figure 12: New Overpass Completed

MAINTAINING PEDESTRIAN & CYCLIST TRAFFIC

In order to minimize the impact on the local populace, who use this area extensively as foot and bicycle traffic, access for pedestrians and cyclists was maintained at all times through the site. Requirements for the contractor to accommodate this were included in the contract documents.

To maintain this traffic through the Capilano Bridge site, the existing sidewalk on the bridge remained in use immediately after the bridge was moved, aligning with paths on the temporary approaches. Pedestrian paths crossing under the bridge at both abutments were protected by constructing wooden hoarding.

ADAPTING DESIGN

Part of the strategy of ensuring that the scheduled completion date could be met, which was necessary to ensure the cost-sharing by the federal government, included removing schedule risk elements where possible from the actual design.

For the Capilano River Bridge, this included designing a river pier that could be built with confidence in a short-duration fisheries window, even after some of that time window had been used for the demolition and removal of the old pier.

The standard practice of the BCMoT in this region is to install waterproofing membranes and asphalt pavement overlays on all concrete bridge decks. For both the Capilano River Bridge and the Marine Drive Overpass, the anticipated date for completion of the bridges and placement into service would come in the middle of the cold, wet winter, when the risk of being unable to install membranes and pave would be significant. To avoid this risk, a departure was made from the BCMoT standard, specifying a cast-in-place concrete deck with full normal cover to the reinforcing steel, but using all stainless steel bar. This allowed the concrete surface to be the final running surface without concerns about the long-term durability of the deck.

CONSTRUCTION SUPERVISION

This was a fast-paced project, involving multiple small preliminary works, two main contracts, accelerated design, some unusual techniques and innovations, and an extreme amount of accommodation required to maintain traffic through the site. One of the keys to the successful execution of the construction for the project was the assignment of one of the BCMoT's most experienced and knowledgeable on-staff construction supervisors for the duration of the project.

This representative was brought into the team while design was still underway, attended the review workshops and helped finalize the construction documents, and was responsible for the entire project area. He was enabled to communicate directly with consultants to resolve issues in a timely manner. Finally, he was provided within the contracts with some reasonable provisional sums for site modifications during construction. With such a fast-paced design, a complicated site, and some unknowns with respect to buried utilities, these provisional sums enabled efficient modifications to the work to proceed when needed, without serious impact to the schedule.

LESSONS LEARNED

The overall result of this project was highly successful, and most of the lessons learned are that the success factors described above are worth repeating on other projects, specifically:

- Providing sufficient advance planning, and early construction of some elements where appropriate, to help advance schedules and lessen risks;
- Facilitate excellent communications between all parties to design work, including assignment of key contact people at each entity;
- Streamline submittal and review processes, taking advantage of technology.
- Get people together, inform them, make decisions, and don't look back;

- Remove permitting risk from the equation when possible;
- Consider innovative approaches such as moving an existing bridge to be the detour, when possible;
- Ensure that designs address issues that may become schedule risks, especially due to seasonal construction considerations; and
- Ensure that designs include allowances for construction factors, such as the need to build a bridge in two halves, and build these right into the tendering.

Success of this project depended heavily on cooperation, commitment, and teamwork between the Owner's staff, multiple consultants, environmental agencies, contractors, suppliers, and other stakeholders -recognizing this and fostering it is also key!

Figure 13 shows the new Capilano River Bridge, with two of its lanes in service. Next to it is the old bridge in its detour position, now closed and being demolished.

Figure 13: New Capilano River Bridge

ACKNOWLEDGEMENTS

MAJOR PARTIES INVOLVED IN THE PROJECT:

Owner, Project Manager, Construction Supervision, Detour Road Construction: BC Ministry of Transportation and Infrastructure

For Capilano River Bridge Replacement:

- Prime Consultant, Initial Sliding Study, Temporary Pier Design, Sliding Design: Buckland & Taylor Ltd.
- Detour Alignment Design: Urban Systems Ltd.
- Temporary Abutment Design: McElhanney Consulting Services Ltd.
- Roadway & Geotechnical Design: EBA Engineering Consultants Ltd.
- Electrical Design: PBA Engineering Ltd.
- Hydrology: Northwest Hydraulic Consultants Ltd.
- Environmental Consultant: Hatfield Consultants
- Temporary Pier Contractor: Surespan Construction Ltd.
- General Contractor: Neelco Construction Inc.
- Contractor's Engineer: All-Span Engineering Ltd.

For Marine Drive Overpass Replacement and Marine Drive Modifications:

- Prime Consultant, Roadway & Traffic Design, Detour Design: Urban Systems Ltd.
- New Overpass Design, Construction Staging for Overpass, Detour Structural Design: Buckland & Taylor Ltd.
- Geotechnical Design: EBA Engineering Consultants Ltd.
- Electrical Design: LCP Signal Management Inc.
- General Contractor: BA Blacktop Ltd.