BRIDGES

BUCKLAND
& TAYLOR LTD.
Bridge Engineering

HISTORIC MILESTONES

1980
World's longest span (404 m, 1325 ft.) conveyor bridge, in operation at Similkameen, designed by Robert McLellan Co. Ltd. and Buckland & Taylor Ltd.

1984
Brian Morgenstern became a Principal.

1986
Alex Fraser Bridge opened, the longest span cable-stayed bridge in the world.

1998
Buckland & Taylor Ltd. joined the COWI group of companies. COWI, also bridge experts, designed Storebaelt, the second longest span bridge in the world.

2000
Jorge Torrejon became Vice-President, and later President in 2001.

2001
Don Bergman became Vice-President.

2001
Darryl Matson became Vice-President.

1975
First major project is renovation of Lions' Gate bridge viaduct; first replacement of a concrete deck with a steel orthotropic deck during short night-time closures.

2001
Suspended structure of the Lions' Gate Bridge replaced without major interruption to traffic.

1972
Peter Taylor joined to form Buckland & Taylor Ltd.

2002
Rama 8 bridge spans the Chao Phraya River at the centre of Bangkok.

1970
Burrard Inlet Crossing shelved. Peter Buckland formed Buckland & Associates.

1969
A group of bridge engineers came together in Vancouver, BC, to design the Burrard Inlet Crossing over the harbour. Peter Buckland and Peter Taylor were among them.

BUCKLAND & TAYLOR LTD.
Bridge Engineering

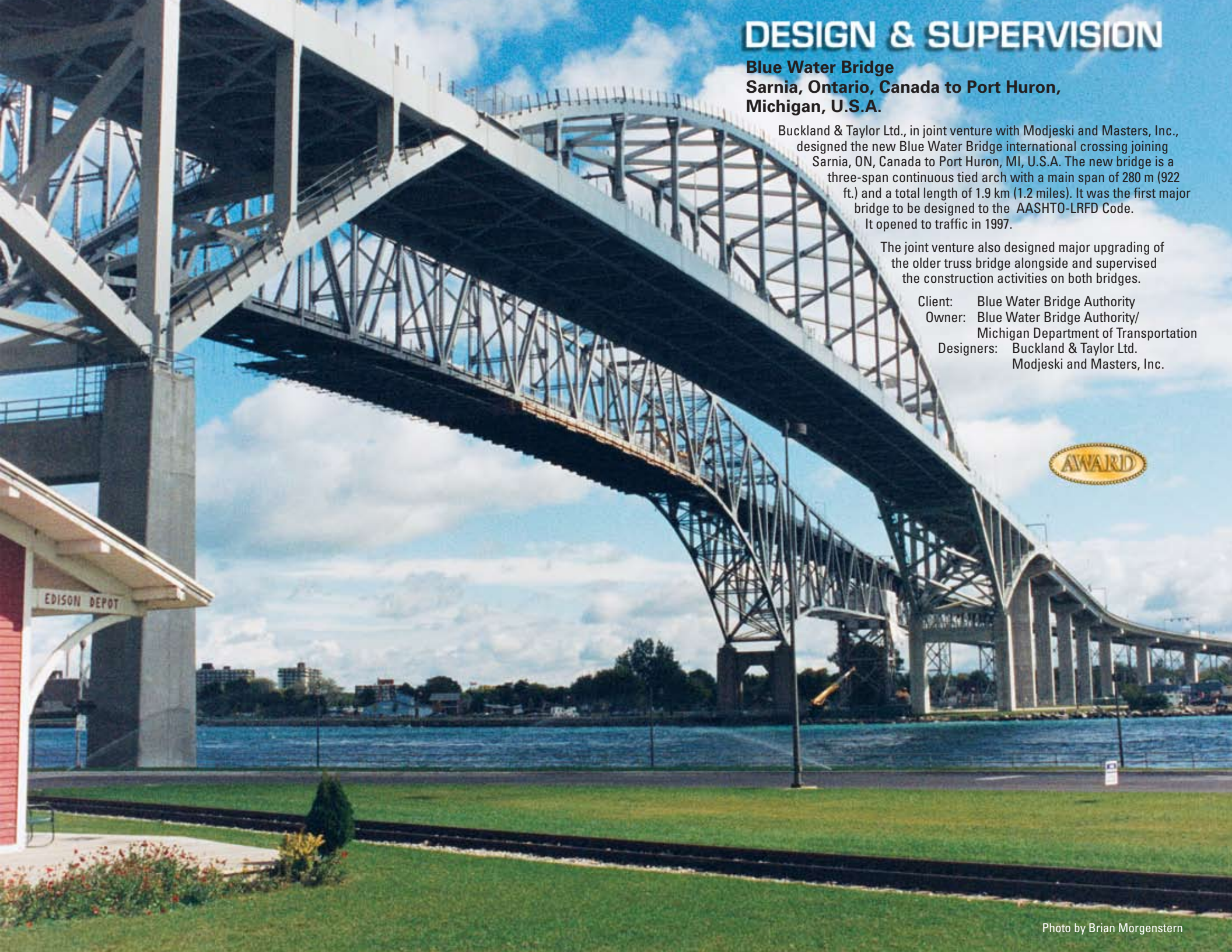
MISSION STATEMENT

Buckland & Taylor Ltd. is a world leading bridge engineering Company. Our business is bridges of all types and sizes.

We provide the greatest possible value to our Clients, regard integrity as central to our business, and employ the best staff to stay at the forefront of our profession.

For more information, please visit our web site at www.b-t.com.

2003
Design completed for Stonecutters Bridge, one of the longest cable-stayed bridges in the world.



DESIGN & SUPERVISION

Blue Water Bridge
Sarnia, Ontario, Canada to Port Huron, Michigan, U.S.A.

Buckland & Taylor Ltd., in joint venture with Modjeski and Masters, Inc., designed the new Blue Water Bridge international crossing joining Sarnia, ON, Canada to Port Huron, MI, U.S.A. The new bridge is a three-span continuous tied arch with a main span of 280 m (922 ft.) and a total length of 1.9 km (1.2 miles). It was the first major bridge to be designed to the AASHTO-LRFD Code. It opened to traffic in 1997.

The joint venture also designed major upgrading of the older truss bridge alongside and supervised the construction activities on both bridges.

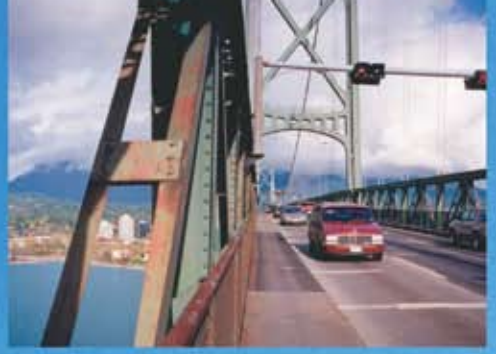
Client: Blue Water Bridge Authority
Owner: Blue Water Bridge Authority/ Michigan Department of Transportation
Designers: Buckland & Taylor Ltd. Modjeski and Masters, Inc.

AWARD

Photo by Brian Morgenstern

RENOVATION & SEISMIC RETROFIT

Lions' Gate Bridge
Vancouver, BC, Canada
(as featured on the back cover)



Before Photo by Peter Buckland

After Photo by Darryl Matson

Constructed in 1938, the three lane Lions' Gate suspension bridge has a 472 m (1550 ft.) main span. Including the north approach viaduct, the crossing is 1.5 km (4978 ft.) long.

Since 1972, Buckland & Taylor Ltd. has been the engineer of record for all significant work done on the bridge. With 70,000 vehicles using it each day, the bridge has one of the highest traffic counts per lane anywhere, and maintaining traffic is paramount to the economy of the area.

The work performed to date by Buckland & Taylor Ltd. has included several world firsts, has won many awards, and has led to changes in the structure that have resulted in significant structural and safety improvements to the crossing. The traffic lanes on the entire crossing have been widened from 2.95 m (10 ft.) to 3.6 m (12 ft.), and the sidewalks have been widened from 1.2 m (4 ft.) to 2 m (6.5 ft.), all without interruption to normal daily traffic.

Owner and Client: Government of British Columbia
Contractor: Viaduct - Canron Construction Corp. West
Suspension Span - American Bridge / Surespan, a Joint Venture

AWARD

Photo by Darryl Matson

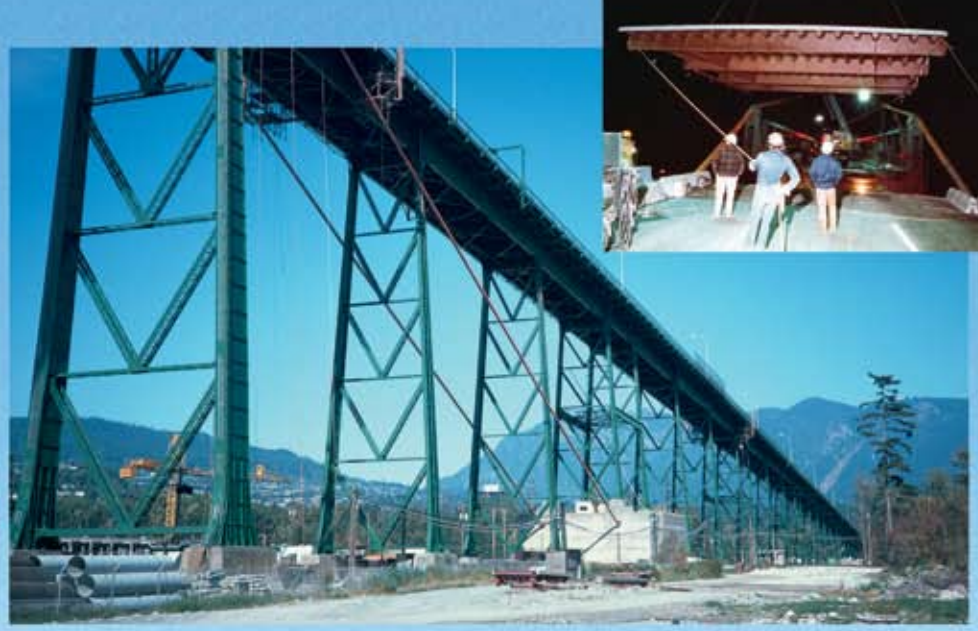
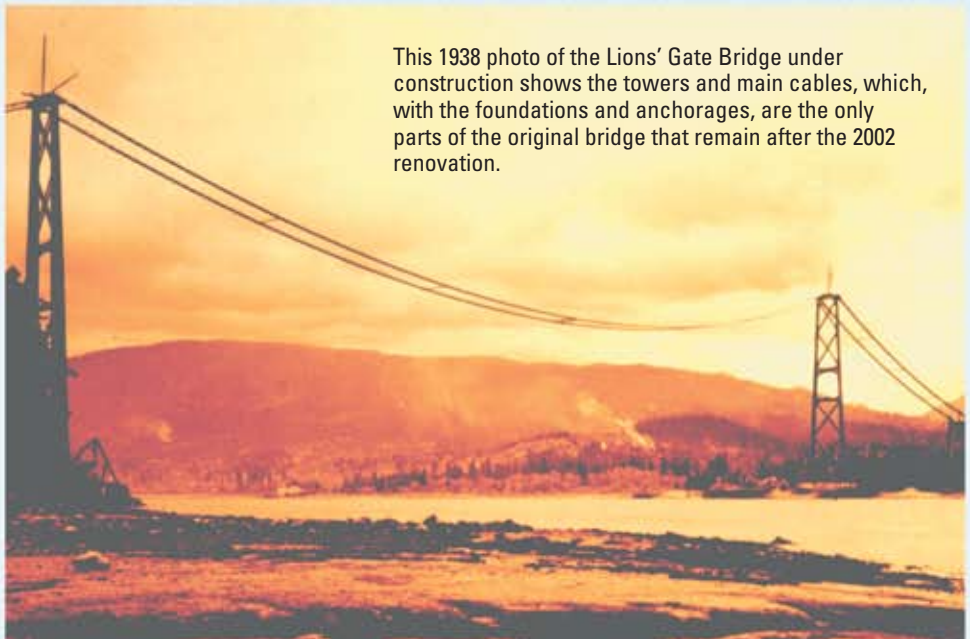


Photo by Peter Buckland

By the early 1970's, over one thousand potholes were being repaired each year in the concrete deck of the Lions' Gate Bridge north approach viaduct. In 1975, history was made when the entire concrete roadway of the 671 m (2200 ft.) viaduct was replaced with an orthotropic steel deck during a series of short night-time closures.

Buckland & Taylor Ltd. devised the replacement scheme and designed the new wider deck. This ground breaking technique has subsequently been used to replace deteriorated decks on many bridges in the world, including the Golden Gate Bridge in San Francisco and the George Washington Bridge in New York.



This 1938 photo of the Lions' Gate Bridge under construction shows the towers and main cables, which, with the foundations and anchorages, are the only parts of the original bridge that remain after the 2002 renovation.

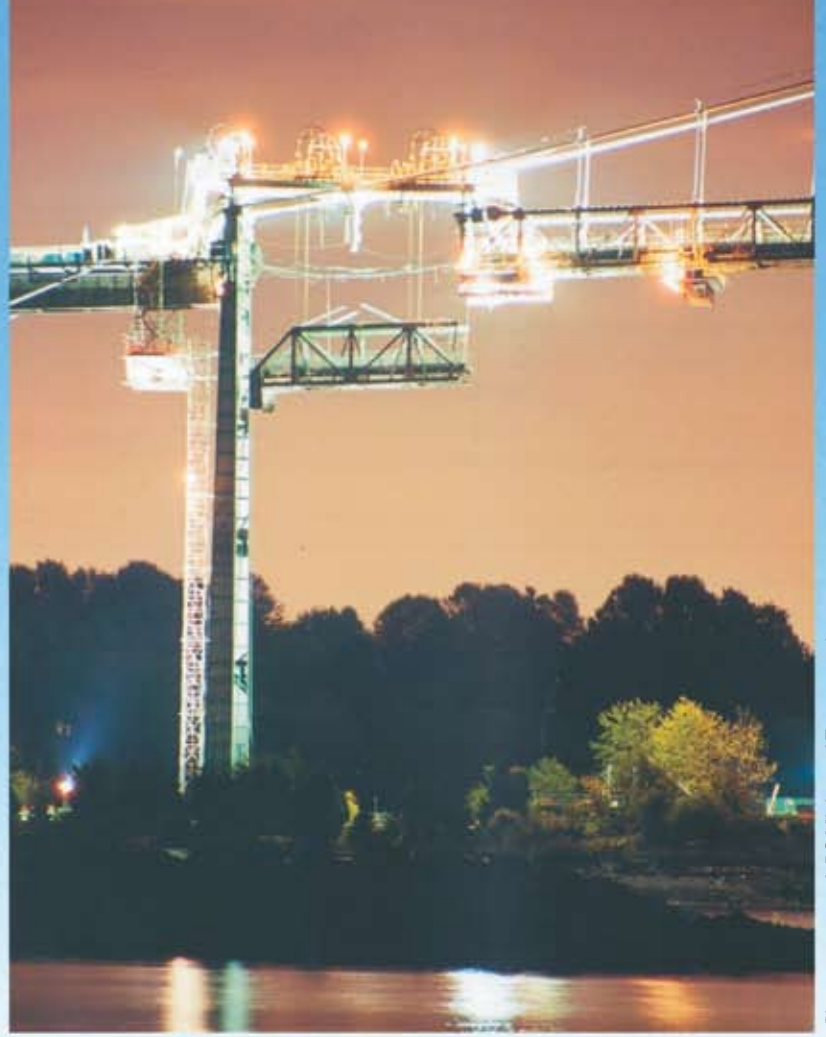


Photo courtesy of BC Ministry of Transportation

By the mid-1990's, the road deck of the suspended spans of the Lions' Gate Bridge had seriously deteriorated. Also, the lanes were too narrow, and seismic resistance was sub-standard. To add to the challenge, no interruption of daytime traffic was permitted during renovation.

Following intense investigation and some lateral thinking, Buckland & Taylor Ltd. designed a new, wider and stronger, suspended structure (deck, sidewalks, stiffening trusses, and suspension hangers) to be replaced during a series of night-time closures. Reconstruction, including upgrading the bridge to modern earthquake standards, was completed in 2002.

Replacing the entire suspended structure, while traffic continued to use the bridge each day, was another world's first for the Company.

Golden Gate Bridge
San Francisco, California, U.S.A.

SEISMIC RETROFIT

With a main span of 1280 m (4200 ft.), this is one of the world's longest span bridges that has been seismically upgraded.

Buckland & Taylor Ltd. was a key player in the team led by Sverdrup Corp. (now Jacobs Engineering Group Inc.) to provide the seismic analysis, conceptual design and final design (plans, specifications and estimate) for the seismic retrofit of the south approach viaduct, the south anchorage housing, the Fort Point Arch, Pylon S1 and Pylon S2. Design was completed in 1996.

Owner and Client: Golden Gate Bridge Highway and Transportation District

In 1998, Buckland & Taylor Ltd. provided conceptual design and an independent check for the Contractor's falsework necessary for the seismic retrofit of the north approach viaduct. The viaduct had to be propped up while the supporting towers and foundations were demolished and rebuilt, all while keeping traffic running.

Client: Balfour Beatty Construction, Inc.

Photo by Darryl Matson

ERECTION ENGINEERING

Ting Kau Bridge
Hong Kong, China

The Ting Kau Bridge in Hong Kong is one of the few multi-span cable-stayed bridges ever built and, with 1177 m (3862 ft.) of cable-supported deck, it is one of the longest cable-stayed bridges in the world.

It has two adjacent main spans with stabilizing cables from the top of the main tower to the deck of the side towers. With further stabilizing cables in the transverse direction, the towers of the bridge appear like masts of a sail boat.

Buckland & Taylor Ltd. provided expert advice on criteria and on-site direction of the erection engineering for this complex structure. The bridge opened to traffic in 1998.

Owner: Highway Department of Hong Kong
Client: Ting Kau Contractors Joint Venture, comprising Grupo Acciona SA of Spain, Ed. Züblin AG of Germany, Downer and Company Ltd. of New Zealand. Paul Y. Construction Ltd. of Hong Kong joined shortly after commencement of the works.
Designer: Schlaich Bergermann und Partner

Photo by Don Bergman

Photo courtesy of Ben C. Gerwick, Inc.

SEISMIC RETROFIT

California Arches
California, U.S.A.

Buckland & Taylor Ltd. designed the seismic retrofit for eight historic arch bridges in California.

Cold Spring Canyon Bridge
Near Santa Barbara, California, U.S.A.

Built in 1963, it is California's longest span arch, at 213 m (700 ft.), and won the American Institute of Steel Construction (AISC) Most Beautiful Steel Bridge (Long Span) Award.

Buckland & Taylor Ltd.'s detailed analysis revealed that the skewbacks and the steelwork in the vicinity of the springing line needed to be retrofitted. No access by road was permitted to the skewbacks, so everything was designed to be retrofitted from the roadway deck. The retrofit scheme made use of the existing continuity of the deck from end to end by adding CIDH restraining piles at the abutments, while allowing for expansion. The arch ribs and the main towers were strengthened and the skewbacks were modified. Construction was completed in 1997.

Owner and Client: State of California

AWARD

Photo by Peter Buckland

Photo Courtesy of Niebrugge Images

Bixby Creek Bridge
Near Carmel, California, U.S.A.

This reinforced concrete arch has a main span of 98 m (320 ft.) and is one of the most photographed bridges along the picturesque Monterey coast.

The retrofit design had to accommodate severe aesthetic and environmental constraints. The retrofit could not change the appearance of the bridge, and no damage was permitted to the sensitive ecological reserve that surrounds the bridge. The final design involved linking the deck so that it behaves as a continuous diaphragm and ensures that the arch remains stable under seismic displacements. Construction was completed in 1999.

Owner and Client: State of California

AWARD

INDEPENDENT CHECK DESIGN/BUILD

Rion Antirion Crossing Greece

The Rion Antirion Crossing links the Peloponnese of southern Greece to the Greek mainland across the western end of the Gulf of Corinth. The cable-stayed bridge has three central spans of 560 m (1837 ft.) each and two flanking spans of 286 m (938 ft.) making it one of the longest cable-stayed bridges in the world.

Buckland & Taylor Ltd. filled the role of Independent Design Checker and signed off on all construction drawings. The Design/Build project is scheduled for completion in 2004.

Owner: Government of Greece
Client: GEFYRA S.A. (Joint Venture led by Vinci)
Designer: Rion Design Joint Venture (Ingerop, Vinci, DOMI)

Photo courtesy of GEFYRA S.A.

EVALUATION

Tacoma Narrows Bridge
Washington, U.S.A.

In 1950, this four lane bridge with an 853 m (2800 ft.) main span replaced its famous predecessor which was destroyed by wind in 1940.

Buckland & Taylor Ltd., in association with Arvid Grant and Associates, Inc., provided a thorough inspection and assessment of the crossing using the powerful survey and analysis technique for suspension bridge evaluation developed by the Company. Completed in 1984.

Buckland & Taylor Ltd., with TAMS Consultants, examined the feasibility of adding more lanes to the crossing. Completed in 1994.

Buckland & Taylor Ltd. prepared the Independent Engineer Report for the Developer, United Infrastructure Washington, Inc., addressing the cost of a twin crossing, reviewing the feasibility of the design and proposed construction techniques for the project, and reviewing the initial design. Completed in 2001.

Owner and Client for inspection and feasibility study:
State of Washington
Client for independent engineer report:
United Infrastructure Washington, Inc.
Contractor for twin bridge:
Tacoma Narrows Constructors
(Kiewit Pacific and Bechtel Infrastructure)

Photo courtesy of Tacoma Narrows Constructors

DESIGN FOR DESIGN/BUILD

Photos courtesy of Palmetto Bridge Constructors

Cooper River Bridge
Charleston, South Carolina, U.S.A.

When completed, this will be the longest cable-stayed bridge in North America with a main span of 471 m (1546 ft.). The new bridge will replace the two aging truss bridges over Cooper River and Town Creek, and will increase the capacity from five to eight lanes of traffic. Seismic and wind demands were both stringent as the bridge is located in a hurricane zone and its site has one of the highest seismic demands in North America.

Buckland & Taylor Ltd. developed the bid design for the cable-stayed portion of the crossing. The Company prepared the final detailed design for the two high level approach structures and six curved steel approach ramps; provided the independent check of the cable-stayed bridge; and provided erection engineering for the cable-stayed bridge. Design was completed in 2002. Construction is scheduled for completion in 2005.

Owner: State of South Carolina
Client: Parsons Brinkerhoff Quade & Douglas Inc.
Contractor: Palmetto Bridge Constructors
(a joint venture of Tidewater-Skanska and Flatiron Contractors Inc.)

DESIGN

Castlegar-Robson Bridge
Castlegar, BC, Canada

Although at first sight the 475 m (1560 ft.) long Castlegar-Robson Bridge looks elegantly simple, it is a state-of-the-art bridge that minimizes impact on the environment and provides maximum aesthetic harmony, both at the most economical cost.

Castlegar and Robson are situated in southeastern British Columbia near the confluence of the Kootenay and Columbia rivers. The new bridge was designed by Buckland & Taylor Ltd., in a design competition. There were no bids for the competing design. Completed in 1994.

Owner and Client: Government of British Columbia

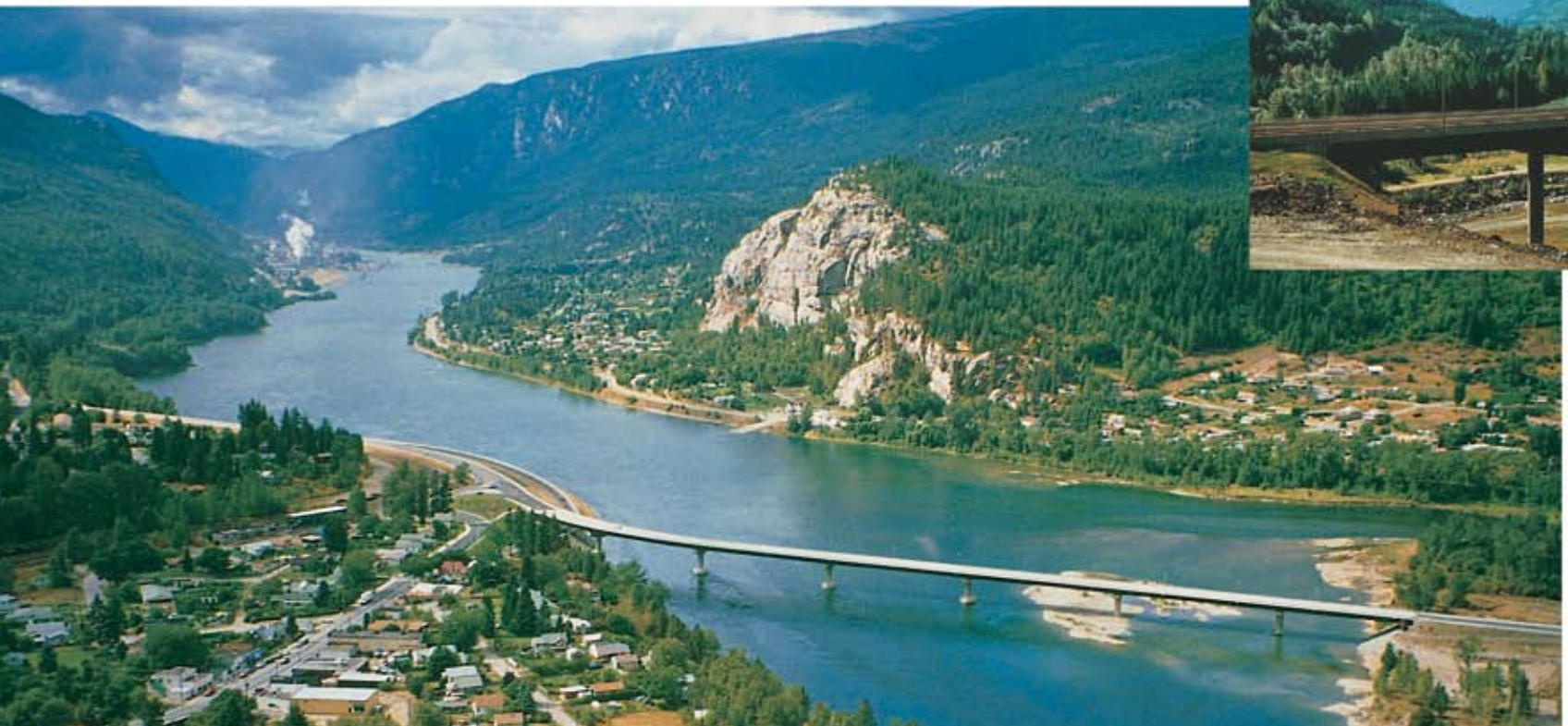
Ashcroft Bridge
Ashcroft, BC, Canada

After reviewing a scheme for widening the old truss bridge at this site, Buckland & Taylor Ltd. was asked to fast-track design a replacement bridge, resulting in this composite trapezoidal box structure erected by launching from each bank. This two lane bridge over the Thompson River comprises 5 spans with total length of 239 m (785 ft.). Its main span is 85 m (279 ft.). Opened in 1991, on schedule and under estimate.

Owner and Client: Government of British Columbia

Photo by Darryl Matson

Photo by Darryl Matson



Ladner Creek Bridge
Coquihalla Highway,
BC, Canada

Designed on a fast-track schedule by Buckland & Taylor Ltd., this four lane bridge is 254 m (833 ft.) long with 6 spans. It is the second longest bridge on the Coquihalla Highway linking the lower mainland of BC with the Province's interior. The bridge was completed in 1986.

Owner and Client:
Government of British Columbia

INDEPENDENT ENGINEER DESIGN/BUILD

Confederation Bridge
Prince Edward Island to New Brunswick, Canada

Claimed to be the world's longest continuous bridge over freezing sea water, with a total length of 13 km (8 miles), it comprises a single prestressed concrete box girder on precast pier bases and pier shafts. It has 43 main spans of 250 m (820 ft.) each.

As the Independent Engineer, Buckland & Taylor Ltd. confirmed that the proposed project could be built; checked the design (including the design criteria); monitored the Contractor's QA and QC procedures and practices; calculated the cost to complete the bridge monthly; certified payments to the Developer and the Contractor; and confirmed the substantial and final completion.

Buckland & Taylor Ltd.'s mandate as Independent Engineer includes annual inspections of the bridge until 2032.

As a Design/Build project, Confederation Bridge is an excellent example of integrating design and construction methods. The bridge was entirely precast on shore in large units up to 7,000 tonnes each, then placed by marine equipment during the ice free months from mid-April to mid-December. It was designed and built in 5 years and opened to traffic in May 1997.

Joint Clients: The Owner, the Developer and the Contractor
Owner: The Government of Canada
Developer: Strait Crossing Development Inc.
Contractor: Strait Crossing Joint Venture, a consortium of Janin Atlas Inc., Ballast Nedam Canada Inc. and Strait Crossing Inc.
Designer: J. Muller International/Stanley Joint Venture

Photos courtesy of Boiley Photo

Shaikh Zayed Bridge
Abu Dhabi

This spectacular piece of architecture is a twin deck, concrete box girder bridge suspended from a pair of undulating 3D steel arches. The total length of the bridge is 842 m (2762 ft.) and the main span is approximately 140 m (459 ft.).

Buckland & Taylor Ltd. reviewed the Contractor's general construction sequence, prepared step-by-step detailed construction sequence, and provided an independent check of temporary works designed by the Contractor. The bridge is scheduled for completion in 2007.

Owner: Works Department, Emirate of Abu Dhabi, United Arab Emirates (UAE)
Architect: Zaha M. Hadid
Designer: High-Point Rendel
Client and Contractor: Archirodon Construction (Overseas) Co. S.A.

Photo courtesy of Archirodon Construction (Overseas) Co. S.A.

Photo by Andreas Felber

Photo courtesy of C.J. Mahan Construction Co.

Photo by Andreas Felber

US Grant Bridge
Portsmouth, Ohio, U.S.A.

Built in 1927, the suspension bridge had a 213 m (700 ft.) main span. By 2001, it had reached the end of its useful life and was replaced with a new cable-stayed bridge.

Buckland & Taylor Ltd. prepared the demolition engineering plan for the suspension bridge. The Company analyzed the capacity of the bridge to ensure it could safely support its own weight and wind loading during all stages of demolition. The bridge deck and trusses were cut into 11 m (35 ft.) long pieces and removed using a barge mounted crane.

Once the trusses and deck were removed, the main cables were cut using explosives, dropping the towers and cables into the river clear of the navigation channel for subsequent removal. Completed in 2001.

Owner: State of Ohio
Client: C.J. Mahan Construction Co.

EVALUATION & RENOVATION

Hagwilget Bridge
New Hazelton, BC, Canada

Buckland & Taylor Ltd. increased the capacity of the 140 m (460 ft.) suspension bridge from 13.5 tonne (15 ton) to 50 tonne (55 ton) trucks without strengthening. This was achieved by making the replacement grating deck composite with the trusses and adjusting the hangers (suspenders) to put an upward bending moment in the stiffening trusses under dead load.
The roadway deck was replaced in full width sections during 8 hour night closures. Completed in 1990.

Buckland & Taylor Ltd. designed additional steelwork repairs including replacement and testing of 8 eyerods. The Company also designed a new load path for braking loads on the approaches, and designed the repair of corroded steelwork components. Completed in 2001.

Owner and Client: Government of British Columbia

AWARD

Photo by Darryl Matson

Sundial Bridge
Redding, California, U.S.A.

This 220 m (722 ft.) long cable-stayed pedestrian bridge, with a 126 m (413 ft.) main span, was designed by the Spanish architect Santiago Calatrava. The most prominent feature of the bridge is a striking, sculptured, inclined steel pylon, which is 58.2 m (191 ft.) high. The pylon leans due north and acts as a sundial interpreted on the circular plaza at the tower base. Locked coil cable-stays support a trussed tubular steel superstructure with a unique translucent glass deck. The bridge connects the Turtle Bay Park, Museum and Amphitheater with the Redding Arboretum.

Buckland & Taylor Ltd. provided erection engineering for both the pylon and the deck. Detailed modeling of the complex stiffened double-walled steel tower was required to assess stability and strength during both tower and deck erection phases. 3D cambers were required to achieve the desired final structure geometry and stay forces.

Buckland & Taylor Ltd. also provided value engineering and re-designed the foundations and substructure to reduce overall costs of the structure. Completed in 2004.

Owner: Turtle Bay Museum and Arboretum on the River
Client: Kiewit Pacific Co.

Photo courtesy of Dick York

DESIGN FOR DESIGN/BUILD & ERECTION ENGINEERING

Rama 8 Bridge
Bangkok, Thailand

(as featured on the front cover, photo courtesy of Bangkok Metropolitan Administration)

As a tribute by the King of Thailand to his late brother, King Rama 8, this 300 m (984 ft.) main span, single tower cable-stayed bridge spans the Chao Phraya River at the centre of Bangkok. The bridge is one of the largest asymmetric cable-stayed bridges in the world.

Buckland & Taylor Ltd. designed the bridge and provided detailed construction engineering and step-by-step analysis for its erection.

Owner and Client:
Bangkok Metropolitan Administration
Joint Venture:
Contractors -
China State Construction & Engineering Co.
PPD Construction Co., Ltd.
BBR Systems Ltd.
BBR Holding Ltd.
Designers -
Buckland & Taylor Ltd.
(cable-stayed bridge design)
Scott Wilson Kirkpatrick (Thailand) Ltd.
(site inspection and geotechnical design)
Scott Wilson Asia Pacific Ltd.
PCD Group Engineering Consultant Co., Ltd.
(design of approaches)
Asdecon Corporation Ltd.
(electrical)

AWARD

Photo courtesy of Bangkok Metropolitan Administration

The bridge deck has two traffic lanes, one pedestrian sidewalk, and one bicycle lane in each direction. Architectural lighting produces a spectacular night-time view from both the bridge deck and the surrounding area of Bangkok.

The lotus in the crest of King Rama 8 is used throughout the bridge, including the gold spires atop the two handicap lift towers and over the roof of the observation deck on the very top of the main tower.

Photo courtesy of Bangkok Metropolitan Administration

Octagonal concrete enclosures encase the base of each leg of the tower, giving a sturdy and culturally significant look. These enclosures resemble the feet of an elephant.

Photo by Don Bergman

Stairways provide pedestrian access around the handicap lift towers. Two unique gold features at the mid-height of the two tower legs give the illusion of another lotus shape in the space created between the tower legs.

Photo by Don Bergman

The lotus motif in the ornate cast steel pedestrian fences.

Photo by Don Bergman

DESIGN/BUILD

Second Bridge to Incheon Airport
Incheon, Korea

The Second Bridge to Incheon Airport will link the City of Incheon, which neighbours Seoul, with the Incheon (Seoul) International Airport. The bridge will be 12 km (7.4 miles) long with a main span of 700 m (2300 ft.) and a vertical clearance of 74 m (242 ft.).

KODA Development Co. Ltd., a partnership of AMEC and Incheon City, has been designated as the Project Concessionaire by the Ministry of Construction and Transportation of Korea. They will build and operate this US$1 billion toll bridge. Buckland & Taylor Ltd. developed the basic bridge design and supported KODA in securing turnkey construction bids and in finalizing technical aspects of the Concession Agreement. Construction is scheduled for completion in 2008.

Owner: Government of Korea
Client: KODA Development Co. Ltd., a partnership of AMEC and Incheon City

Photo courtesy of KODA Development Co. Ltd.

DESIGN FOR DESIGN/BUILD

Fredricton-Moncton Highway
New Brunswick, Canada

Buckland & Taylor Ltd. designed the superstructures for the two longest bridges on the Design/Build Fredricton-Moncton Highway.

Saint John River Bridge
New Brunswick, Canada

The Saint John River Bridge is a fourteen span crossing consisting of twin bridges. It has a maximum span of 120 m (394 ft.) and a total length of 1062 m (3484 ft.).

During construction of the substructure (designed by others), the Owner accepted an alternative superstructure design prepared by Buckland & Taylor Ltd. The Company reviewed and, where needed, modified the design of the substructure, designed the superstructure, and provided analysis for the erection of the steel girders. Completed in 2001.

Owner: Maritime Road Development Corp.
Client: Maritime Steel & Foundries Ltd.

Photo by Rodger Welch

Jemseg River Bridge
New Brunswick, Canada

The Jemseg River Bridge is an eleven span bridge with a curved alignment comprising twin composite plate girder structures, each carrying two lanes of traffic. It has a maximum span of 140 m (459 ft.) and a total length of 976 m (3202 ft.).

Buckland & Taylor Ltd. designed the superstructure. The Company also redesigned and validated the partially constructed substructure, which had originally been designed by others. Completed in 2001 (20 months after Buckland & Taylor Ltd. started the design).

Owner: Maritime Road Development Corp.
Client: Maritime Steel & Foundries Ltd.

ERECTION ENGINEERING

Peace River Bridge
Peace River, Alberta, Canada

The 734 m (half mile) long steel girders of the Peace River Bridge were launched from one bank. The bridge has four 4.5 m (15 ft.) deep plate girders, and typical spans are 112 m (367 ft.) each. The total weight of the bare steel was 4500 tonnes (4950 tons), which constitutes one of the largest bridge launch projects undertaken in Canada.

Buckland & Taylor Ltd. designed the entire launching scheme and provided on-site assistance during critical launches. Completed in 1991.

Owner: Government of Alberta
Client: Northern Steel Inc.

Even with a light 20 m (65 ft.) nose section, the tip deflection at its maximum cantilever was 3.5 m (11 ft.). To eliminate the need for expensive jacking at the piers, the nose was inclined to automatically lift the leading end. This resulted in creating enough speed and automation to completely launch 112 m (367 ft.) in only 10 hours.

Photos by Gil Medilek

Stonecutters Bridge
Hong Kong, China

When completed, Stonecutters Bridge will be one of the longest span cable-stayed bridges in the world. The main span is 1018 m (3340 ft.) and the towers are 295 m (968 ft.) tall.

Buckland & Taylor Ltd. was a sub-consultant to COWI A/S, who was a member of the Arup design team. The Company designed the stainless steel clad composite upper towers and directed the design of the lower reinforced concrete towers. In addition, the Company provided an internal design review of the entire structure for the design team. The bridge is scheduled for completion in 2008.

Owner: Hong Kong Highways Department
Client: COWI A/S

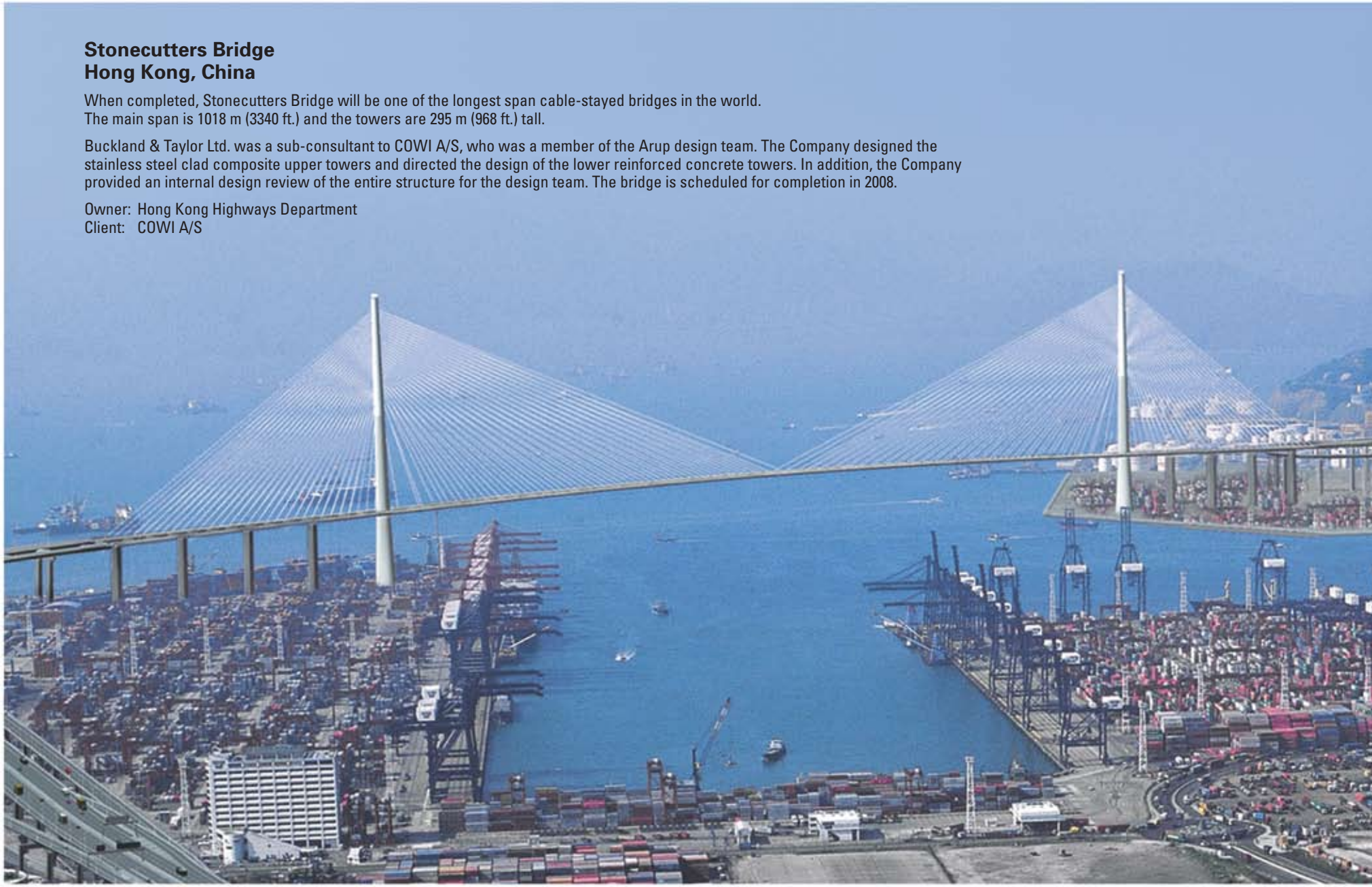


Photo courtesy of Ove Arup and Partners

CABLE-STAYED ERECTION ENGINEERING

Buckland & Taylor Ltd. has provided detailed construction engineering and step-by-step analysis for the erection of numerous cable-stayed bridges.

Custom designed, in-house software that accounts for cast-in effects and creep and shrinkage produces graphical output that is easy to visualize and understand.

Alex Fraser Bridge
Vancouver, BC, Canada
1986
Owner: Government of British Columbia
Client: Government of British Columbia
Bridge Designer: CBA-Buckland & Taylor

Burlington Bridge
Burlington, IA, U.S.A.
1994
Owner: State of Iowa
Client: John F. Beasley Engineering, Inc.
Bridge Designer: Sverdrup Corp. & Parcel and Associates Inc.

Talmadge Memorial Bridge
Savannah, GA, U.S.A.
1991
Owner: State of Georgia
Client: Guy F. Atkinson Construction Company and Monterey Groves
Bridge Designer: Parsons Brinkerhoff Quade & Douglas Inc./DRC Consultants Inc.

Photo by FMSM Engineers Geotechnical Consultant

William H. Harsha Bridge
Maysville, KY to Aberdeen, OH, U.S.A.
2000
Owner: State of Kentucky and State of Ohio
Client: Traylor Brothers Inc.
Bridge Designer: American Consulting Engineers, Plc

William Natcher Bridge
Owensboro, KY to Rockport, IN, U.S.A.
2002
Owner: State of Kentucky
Client: Traylor Brothers Inc.
Bridge Designer: Parsons Brinkerhoff Quade & Douglas Inc.

Rama 8 Bridge
Bangkok, Thailand
2002
Owner: Bangkok Metropolitan Administration
Client: Bangkok Metropolitan Administration
Bridge Designer: Buckland & Taylor Ltd.

Sundial Pedestrian Bridge
Redding, CA, U.S.A.
2004
Owner: Turtle Bay Museum and Arboretum on the River
Client: Kiewit Pacific Co.
Bridge Designer: Santiago Calatrava

Provencher Pedestrian Bridge
Winnipeg, MB, Canada
2003
Owner: City of Winnipeg
Client: MD Steele Construction
Bridge Designer: Wardrop Engineering Inc.

US Grant Bridge
Portsmouth, OH, U.S.A.
Scheduled 2005
Owner: State of Ohio
Client: C.J. Mahan Construction Co.
Bridge Designer: HNTB Architects Engineers Planners

Cooper River Bridge
Charleston, SC, U.S.A.
Scheduled 2005
Owner: State of South Carolina
Client: Parsons Brinkerhoff Quade & Douglas Inc.
Bridge Designer: Parsons Brinkerhoff Quade & Douglas Inc.
Contractor: Palmetto Bridge Constructors (a joint venture of Tidewater Skanska, Inc, and Flatiron Construction, Inc.)

ERECTION ENGINEERING & EVALUATION

SkyTrain Guideway
Greater Vancouver, BC, Canada

SkyTrain was the first system to use automated driverless trains propelled by linear induction motors. Buckland & Taylor Ltd. provided construction engineering for the placement of 1100 prestressed concrete beams to an accuracy of 3 mm (1/8 in.). Completed in 1984.

Client for construction engineering: Peter Kiewit Sons Co. Ltd.

Buckland & Taylor Ltd. assisted in evaluating the entire guideway, including the 616 m (2021 ft.) cable-stayed SkyBridge, to determine its capacity to carry heavier Mark II trains. This review identified several deficient guideway components for which Buckland & Taylor Ltd. designed structural upgrades and monitored the installation of the upgrades. Completed in 2001.

Owner and Client for evaluation: BC Transit (TransLink)

SEISMIC RETROFIT & WIDENING

Port Mann Bridge
Vancouver, BC, Canada

The Port Mann Bridge is a critical link on the Trans Canada Highway and is classified as an essential post-disaster structure. The steel three-span tied-arch structure is 585 m (1920 ft.) long with a main span of 366 m (1200 ft.). The entire 2093 m (6867 ft.) of bridge sits on weak river delta soils and the tied-arch foundations reach down through 70 m (230 ft.) of soft soils to glacial till.

After studying a variety of options for adding capacity to the crossing, Buckland & Taylor Ltd. designed the widening of the bridge from four to five lanes and provided support to the Owner during construction. The addition of the fifth lane was completed in 2001.

Buckland & Taylor Ltd. then carried out an extensive seismic analysis involving complex soil-structure interactions and designed a seismic retrofit for the bridge.

Owner and Client:
Government of British Columbia

AWARD

Photo by Robert Harris

Boundary Road Pedestrian Overpass
Vancouver, BC, Canada

This elegant prestressed concrete footbridge spans between Vancouver and Burnaby. Speed of construction was a requirement, so the entire bridge above ground, comprising only 5 precast prestressed concrete elements, was constructed in one week. The bridge was completed in 1981.

Owner and Client: City of Vancouver

ERECTION ENGINEERING

Al Zampa Bridge
Carquinez Strait, California, U.S.A.

This is the first new suspension bridge built in the United States in 25 years, and it replaces the existing westbound bridge that was built in 1927. It has a main span of 728 m (2390 ft.), and its towers are 125 m (410 ft.) tall.

Buckland & Taylor Ltd. provided construction engineering services for Pier P1 and the two main Towers, T2 and T3. Completed in 2003.

Owner: State of California
Client: FCI Constructors Inc./Cleveland Bridge California Inc. - a Joint Venture
Designer: De Leuw - OPAC - Steinman

Photo by Darryl Matson

Photo courtesy of FCI Constructors Inc./Cleveland Bridge California Inc. - a Joint Venture

ERECTION ENGINEERING

Woodrow Wilson Bridge Potomac River, between Maryland and Virginia, U.S.A.

The Woodrow Wilson Bridge on I-95/I-495 (Capital Beltway) is being replaced in three separate contracts. Construction of the Virginia approach spans includes approximately 670 m (2200 ft.) of dual roadway leading to the central bascule span.

Buckland & Taylor Ltd. provided detailed construction engineering services for the concrete segmental V-piers of the Virginia approach spans. This included erection sequence analysis and procedures, casting curves, geometry control, erection equipment design, and review and approval of temporary shoring design. The bridge is scheduled for completion in 2008.

Owner: The State of Maryland
Client: Virginia Approach Contractors (JV of Granite Construction and Corman Construction)

Photos courtesy of Virginia Approach Contractors

SHIP IMPACT

Photo by Darryl Matson

Ironworkers Memorial Second Narrows Bridge Vancouver, BC, Canada

Buckland & Taylor Ltd. assessed the risk of ship collision with the bridge. Using data on ship traffic patterns through and near the Narrows, Buckland & Taylor Ltd. made specific design recommendations to prevent damage in the event of a collision. The assessment was completed in 1991.

Owner and Client: Government of British Columbia

Photo courtesy of Henning J. Wulff

Alex Fraser Bridge Vancouver, BC, Canada

Buckland & Taylor Ltd. performed a risk analysis that resulted in the design of protection berms to withstand ships of 65,000 tons travelling at 10 knots (5 m/s). The berms were shaped to allow respite habitat for the migrating Fraser River salmon. Completed in 1982.

Owner and Client: Government of British Columbia

DESIGN & SUPERVISION

Alex Fraser Bridge
Vancouver, BC, Canada

Designed by CBA-Buckland & Taylor, Alex Fraser Bridge was the world's first major composite cable-stayed bridge, the first to use long lay parallel wire cable-stays, the first to have precast concrete deck panels and the first major North American bridge to be designed to modern seismic standards.

Many details never used before in cable-stayed bridge design were developed to make the composite superstructure efficient, economical and constructible. These details have subsequently become industry standards for major composite cable-stayed bridges which are now commonly built worldwide.

The bridge was built in only 31 months and was 20% under budget. With a main span of 465 m (1526 ft.), it was the longest cable-stayed span in the world from 1986 (when it was completed) until 1991.

Owner and Client:
Government of British Columbia

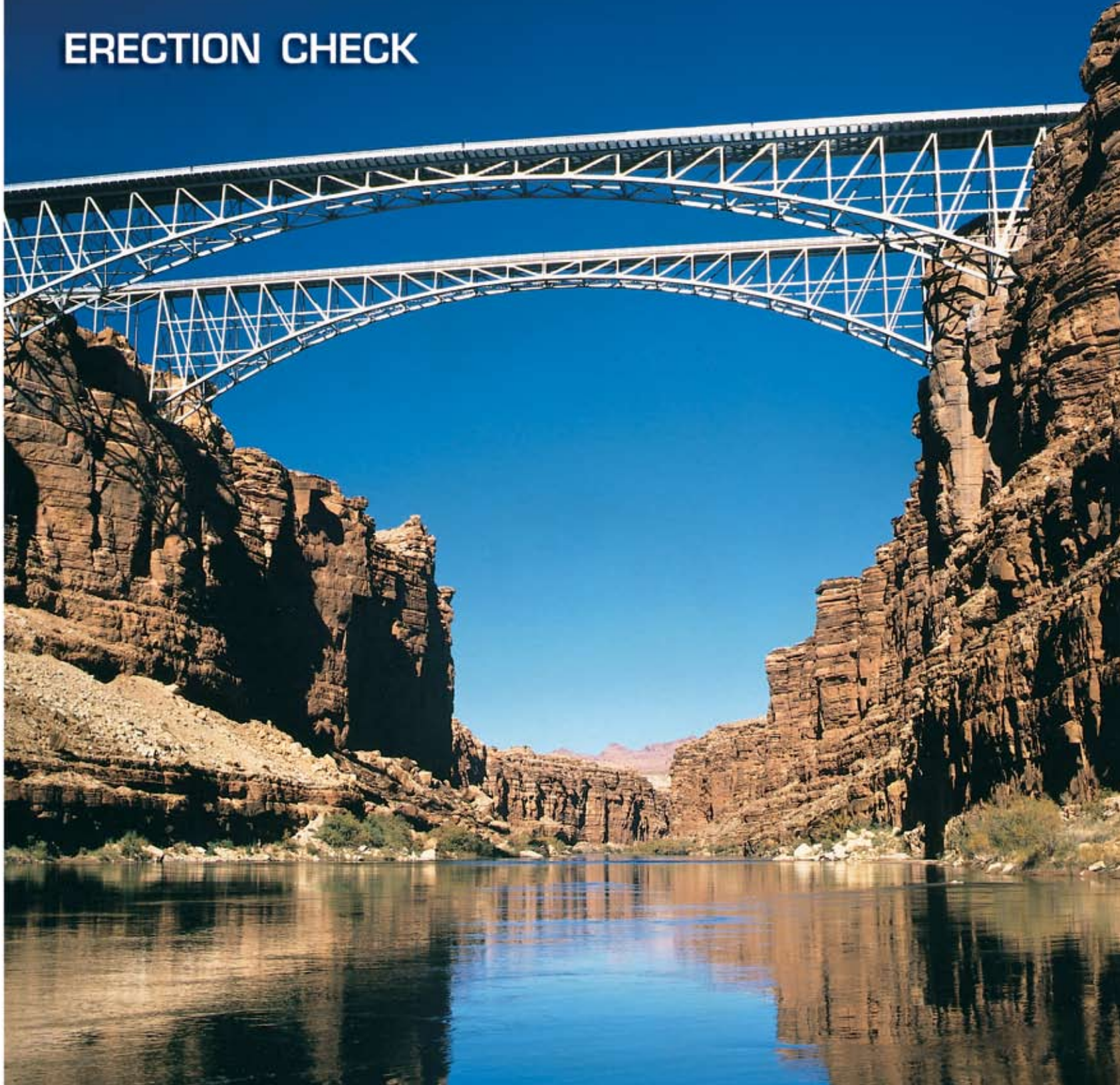
AWARD

Tower photo courtesy of Henning J. Wulff

The slender 155 m (509 ft.) tall towers were designed for ease of construction using simple repetitive forming techniques.

Photo by Wedgwood Photography

ERECTION CHECK



Navajo Bridge Grand Canyon, Arizona, U.S.A.

Buckland & Taylor Ltd. checked the Contractor's erection scheme on behalf of the State of Arizona (as subconsultant to Cannon & Associates). The bridge spans 221 m (726 ft.) between canyon walls, 143 m (470 ft.) above the Colorado River. The bridge was completed in 1995.

Owner: State of Arizona
Client/Designer:
Cannon & Associates, Inc.

Photo courtesy of Richard D. Strange

SEISMIC RETROFIT

Granville Bridge
Vancouver, BC, Canada

Buckland & Taylor Ltd. evaluated the seismic capacity of three major bridges (Granville, Burrard, and First Avenue) in Vancouver, recommended phased improvements that accommodated limited annual budgets, and provided design and construction supervision for the retrofit work. Cost effective retrofits for the three bridges included member strengthening, cable restrainers, concrete and steel jacketing, fibre-wrapping, and seismic isolation bearings.
Completed in 1991 (Phase I), 1993 (Phase II), 1995 (Phase III).

Owner and Client: City of Vancouver

Photo by Peter Buckland

AERODYNAMICS

Buckland & Taylor Ltd. has directed more than 20 aerodynamic studies and wind tunnel tests of bridges including, in 1976, the largest bridge model tested in turbulent flow and, in 1985, the world's first taut tube model tests.

In 1998, the company used COWI's computer program DVM Flow to predict aerodynamic behaviour of the Lions' Gate Bridge, and confirmed the results with wind tunnel tests.

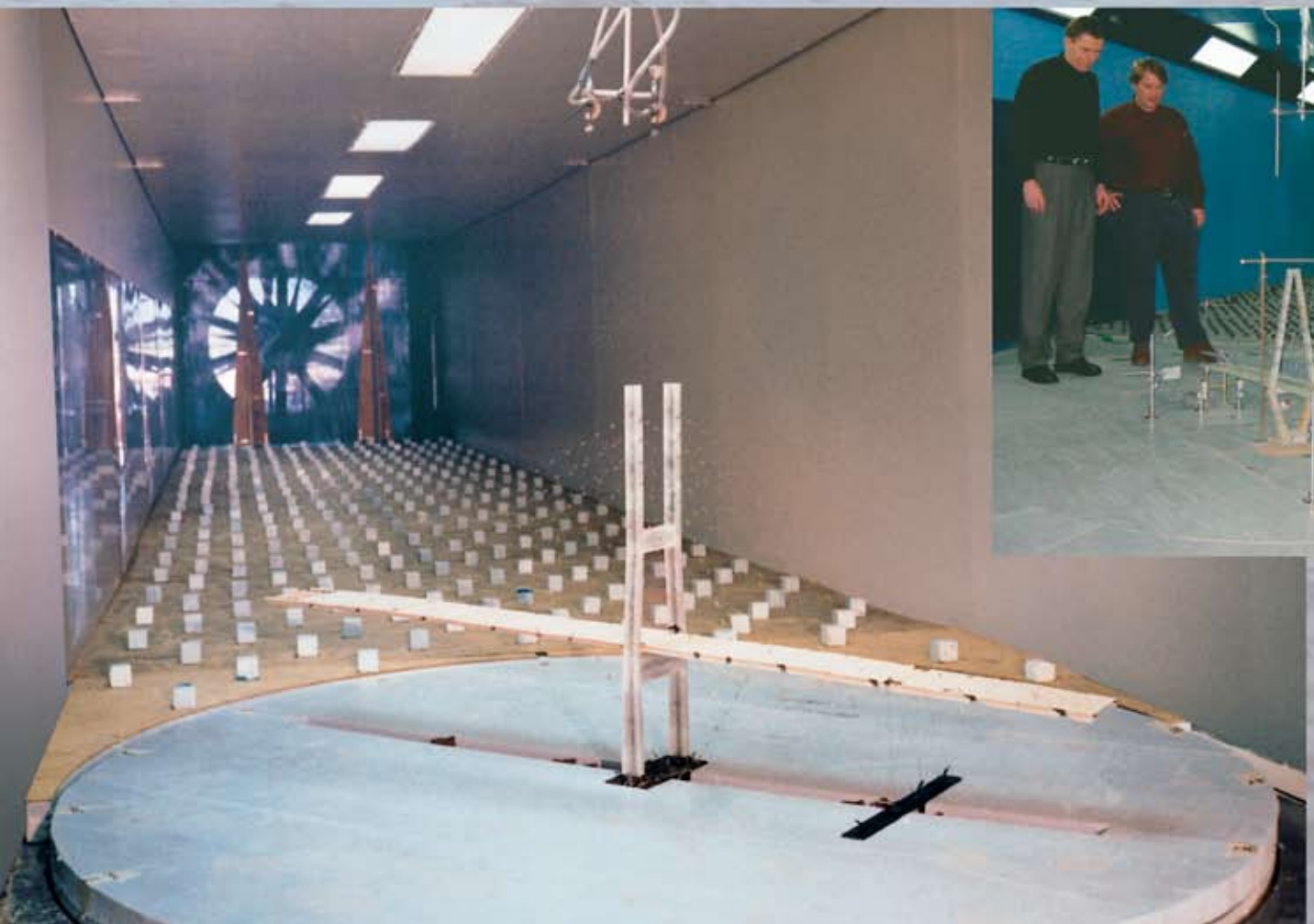
Alex Fraser Bridge
Vancouver, BC, Canada

A critical windspeed well in excess of 50 m/s (112 mph) was achieved for this plate girder section by structural optimization and careful aerodynamic model investigation of the section geometry, particularly at the edges.

To determine its behaviour in wind during critical construction phases, the bridge was tested in turbulent flow at various stages of erection, with the wind coming from different directions.

Lions' Gate Bridge
Vancouver, BC, Canada

To accurately model the effects of natural turbulence in the wind, a full aeroelastic model of the Lions' Gate Bridge was tested in smooth and turbulent flow in the 9 m (30 ft.) wind tunnel at the National Research Council of Canada. In 1976, this was the largest bridge model ever tested in turbulent flow and remained so for another 15 years.



Cooper River Bridge
Charleston, South Carolina, U.S.A.

As part of the erection engineering, Buckland & Taylor Ltd developed temporary cable restraints to control the buffeting response of the partially erected Cooper River Bridge in turbulent winds. The system was confirmed by aeroelastic testing of the critical erection stages in the RWDI wind tunnel in Guelph, Ontario. Wake effects from the existing Grace Memorial and the Silas Pearman Bridges, still present during construction of the new bridge, were carefully accounted for in the modeling and testing.

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