WSP DESIGN AND CONSTRUCTION ENGINEERING EXPERIENCE

COMPLEX BRIDGES

ARCH & CABLE-SUPPORTED

George Washington Bridge, designed by legacy WSP designer, O.H. Ammann

Photo Credit: John Svensson

A BRIEF HISTORY OF WSP AND LONG SPAN BRIDGES

WSP's design of record-setting long span structures in the United States and the rest of the world is a well-known chapter in the history of bridge engineering. Since O.H. Ammann's design of the George Washington, Triborough and Bronx-Whitestone Bridges, the firm has designed numerous long-span structures including the Verrazzano-Narrows, Walt Whitman, Delaware Memorial, Throgs Neck, Newport-Pell, Arthur Ravenel Jr. (Cooper River), William P. Coleman, Veteran's Memorial, Pensacola Bay, and Koscuiszko Bridges, as well as the second deck on the George Washington Bridge, among others. WSP also developed the FHWA's current Design Guidelines for Long Span Bridges.

Internationally, WSP cable-supported bridge designs include the South Outer Bangkok Ring Road Bridge (Thailand); Crusell Bridge (Finland); Binh Bridge (Vietnam); Świętorkzyski Bridge (Poland); Rao 2 Bridge (Vietnam); Raippaluoto Bridge (Finland); Tähtiniemi Bridge (Finland); Lumberjack's Bridge (Finland); and the award-winning, fire-breathing, multispan arch Dragon Bridge (Vietnam).

Today, WSP is engineering new structures and rehabilitating existing bridges to sustainably extend their service life. We have other unique expertise in new bridge design and rehabilitation, particularly bridge suspension systems. This requires special technical skills and knowledge, which is an area where WSP's expertise is unparalleled. Capabilities encompass analysis, inspection and rehabilitation design. Key facets of suspension system rehabilitation include determining the level of corrosion and its particular effect on cable elements, designing repairs to corrosion-damaged members, and developing ongoing and sustainable maintenance programs. Remaining at the forefront of the industry, WSP uses emerging technologies, state-of-the-art monitoring and non-destructive testing techniques to ensure that bridges reach their full life cycle potential.

Numerous awards and consistent recognition for technical, innovative achievements demonstrate WSP's commitment to excellence. Our design for the Arthur Ravenel Jr. (Cooper River) Cable-Stayed Bridge (SC), Phase II Kosciuszko Cable-Stayed Bridge (NY) and completion of the historic Bayonne Bridge Navigational Clearance Program (NY/NJ) have won numerous highest honor awards at state and national levels. Our unwavering dedication to client satisfaction, collaborative spirit and quality of service are demonstrated through our many repeat clients.

LONG SPAN BRIDGES AT A GLANCE

Suspension Bridge Experience	Inspection	Health Monitoring	WIM	Structural Steel Repairs	Concrete Repairs	Deck Evaluation	Deck Repairs	Partial/Full Deck Replacement	Joint Repairs/Replacement	Complex Analysis	Main Cable Evaluations	Main Cable Dehumidification	Anchorage Dehumidification	Suspender Rope Replacement	Hardening	Complex MOT	Painting Containment Analysis	Seismic Evaluation
Throgs Neck Bridge	√	√	√	√	√	√	√	√	√	√	√			√	√	√	√	
Bronx-Whitestone Bridge	√	√	√	√	√		√	√	√	√	√			√		√	√	√
Verrazzano-Narrows Bridge	√			√	√	√	√		√	√	√		√	√		√	√	√
Robert F. Kennedy Bridge	√	√	√	√	√	√	√	√	√	√	√			√	√	√	√	√
Newport-Pell Bridge	√			√	√	√	√	√	√	√	√		√	√		√	√	√
Mount Hope Bridge	√			√	√	√	√		√	√	√						√	√
William Preston Lane Bridge	√		√	√	√	√	√	√	√	√	√	√			√	√	√	√
Walt Whitman Bridge	√			√						√	√		√			√	√	
Ben Franklin Bridge	√			√							√				√	√		
Golden Gate Bridge				√	√	√	√	√	√	√				√		√	√	√
San Francisco-Oakland Bay Bridge (East or West)	√									√	√			√		√		√
George Washington Bridge	√	√	√	√	√				√	√	√	√	√	√	√	√		√
Bear Mountain Bridge	√	√								√	√							
Mid-Hudson Bridge	√															√		
Delaware Memorial Bridges	√			√	√	√	√	√	√		√	√		√		√		
Williamsburg Bridge	√			√	√	√	√	√	√	√	√			√		√	√	√
Brooklyn Bridge	√			√	√	√		√										
Royal Gorge Bridge	√			√						√	√			√				
Lion's Gate Bridge								√	√	√						√		

SUSPENSION BRIDGES

THROGS NECK BRIDGE

Client: Triborough Bridge and Tunnel Authority
Location: New York, New York
Core Services: Original Design, Rehabilitation, Biennial Inspection

—Designed by legacy WSP designer, O.H. Ammann.

—Completed 1961, main span of 1,800 ft (548 m) over Long Island Sound. ADT 119,000.

—Access Catwalk and Miscellaneous Structural Repair: Provided TD/CSS for a new OSHA-compliant catwalk under the suspended spans and bridge structural repairs.

—Approach span deck replacement for Queens and Bronx approaches.

—Anchorage Dehumidification: Reviewed weather data, inspected the anchorages, and developed scoping documents for cable strand dehumidification / improvements to the interior drainage system.

—Fender System Vessel Impact Protection: Performed vessel impact study by analyzing vessel traffic, explored protection concepts, selected preferred alternative, and prepared report and final design.

—TN-49 Suspended Span Deck Replacement: TD/CSS for removing existing deck and replacing with orthotropic deck in the suspended spans, concrete deck at towers and anchorages, steel upgrades to stiffening truss.

—Biennial Inspections: 2007 2011, Special Inspections 2008 & 2012.

BRONX-WHITESTONE BRIDGE

Client: Triborough Bridge and Tunnel Authority
Location: New York, New York
Core Services: Original Design, Rehabilitation, Biennial Inspection

—Designed by legacy WSP designer, O.H. Ammann.

—Completed 1939, main span of 2,300 ft (701 m) over Long Island Sound. ADT 124,000.

—Seismic Investigation: WSP assessed seismic performance and developed rehab recommendations using WSP-developed site-specific seismic criteria.

—Queens and Bronx Approach Component Rehabilitation: TD/CSS. Developed numerous approach viaduct rehab interim repairs before total replacement. Included load rating analysis.

—BW-89 / BW-89C / 82 Approach Widening and Anchorage Rehab: Provided TD/CSS services for staging, replacing, and widening of the Bronx and Queens approaches, totaling 3,250 ft (990 m). Included anchorage rehab, new salt storage, new maintenance facility, and design of WIM system.

—Sign Structure Replacement at the Queens Anchorage: WSP provided TD/CSS to replace overhead sign structure spanning over I-678 after destruction by oversized truck.

—Biennial Inspections: 1999, 2005, 2009, Special Inspections 2000, 2006 & 2010.

VERRAZZANO-NARROWS BRIDGE

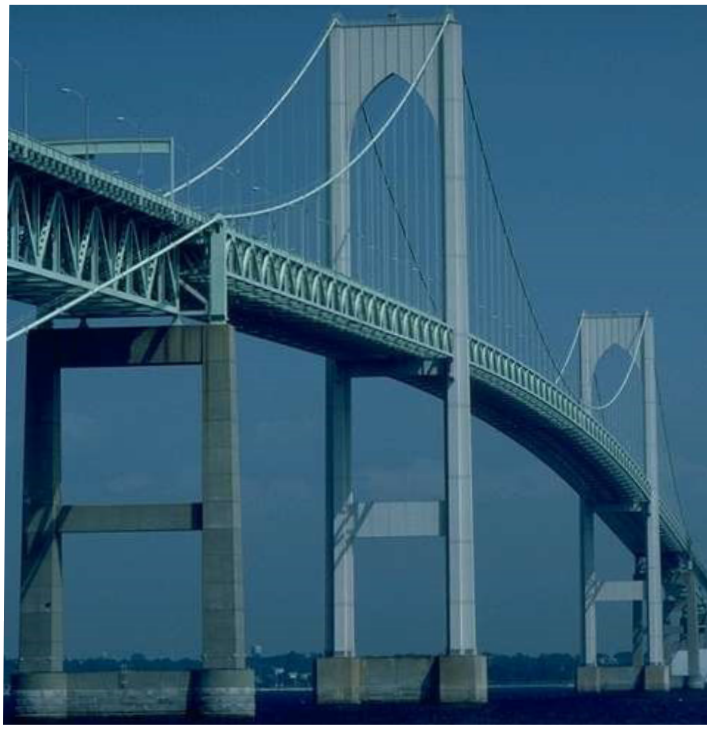
Client: Triborough Bridge and Tunnel Authority
Location: New York, New York
Core Services: Original Design, Rehabilitation, Biennial Inspection

- Designed by legacy WSP designer, O.H. Ammann.
- Longest suspension bridge in the world when it opened in 1964. Main span 4,260 ft (1,298 m) over New York Harbor. ADT 200,000.
- Suspender Rope Replacement: WSP leads in the complex analysis of jacking and load transfer.
- VN-10 Rehabilitation of Anchorages: Rehabilitation, waterproofing, and dehumidification of the cable strands.
- VN89/30 Rehabilitation of Tower Pedestals and Elevators: WSP led DB.
- VN-32/49X Structural Steel Retrofit and Painting: TD/CSS.
- VN-84 Master Plan and Conceptual Design, Reconstruction of the Upper Level Approaches, Connector Ramps, and Belt Parkway: WSP performed LCCA and interim/full rehab timeline.
- Emergency Repairs including heat straightening of a floorbeam and replacement of a center column on the Staten Island Anchorage.
- Seismic Evaluation and Retrofit: WSP led JV and included evaluation of the effects of the New York City Marathon. One of the first major bridges using NYSDOT/ NYCDOT seismic code for downstate bridges. ACEC Platinum Award.
- WSP is finalizing our Main Cable Evaluation.
- Biennial Inspection 2004, Special Inspection 2005.

ROBERT F. KENNEDY (TRIBOROUGH) BRIDGE

Client: Triborough Bridge and Tunnel Authority
Location: New York, New York
Core Services: Original Design, Rehabilitation, Biennial Inspection

- Designed by legacy WSP designer, O.H. Ammann.
- Completed 1936, main span of 1,380 ft (421 m) over the East River, the bridge network connects the boroughs of Manhattan, the Bronx, and Queens in New York City. ADT 164,000.
- TB/RK Redecking Contracts TB-61, TB-63B, TB-64A and TB-64B, including prototypes for proof-of-concept, new orthotropic deck for suspended spans and Bronx Kills truss spans, and new lightweight precast panel decks for the remaining approach and truss spans as well as a new pedestrian ramp and exit ramp to Randalls Island.
- RK-04: WSP investigated relative movement between anchorage elements , using detailed inspection, monitoring, coring, and structural analysis. Repair strategies were recommended.
- RK-19/70 RFK Suspended Span Stringer Instrumentation, Testing and Retrofit: WSP investigated the causes of steel cracks in the suspended spans using structural analysis. WSP used strain gages and load testing to calibrate the models. A pilot repair program was recommended.
- Biennial Inspections: 2002, 2006, 2010, 2020, Special Inspections 2003,2007,2011 & 2021.



NEWPORT-PELL BRIDGE

Client: Rhode Island Turnpike and Bridge Authority
Location: Newport/Jamestown, Rhode Island
Core Services: Original Design/Construction, Inspection, General Engineering On-Call Services, Biennial Inspections

- Completed 1969, main span is 1,600 ft (488 m) carrying four lanes of Route 138 over the East Passage of Narragansett Bay. ADT 27,000.
- Engineering Services Engineer continuously for over 50 years.
- First use in US of shop-fabricated parallel wire strands to construct the main cables.
- WSP planned the crossing of the East Passage for almost three decades, producing an engineering study for a tunnel crossing in 1955 and for a bridge crossing in 1959.
- Assignments include replacement of frozen hanger links, replacement cost valuations, wind studies, partial-depth deck replacement, bearing replacement, introduction of approach link slabs and UHPC, dehumidification of anchorages, and detailed investigation of suspenders and main cables.
- Biennial Inspections: since 1969.

GOV. WILLIAM PRESTON LANE JR. BRIDGES

Client: Maryland Transporation Authority
Location: Maryland
Core Services: Rehabilitation, Main Cable Strength Evaluation, Main Cable Dehumidification

- Bridges completed in 1952 (current eastbound) and 1973 (current westbound), main spans of 1,600 ft (488 m) carrying Routes US 50 and US 301 over Chesapeake Bay. The bridges connect the Baltimore-Washington, D.C. metro area with Maryland's eastern shore. ADT 61,000.
- Prepared design for unwrapping, cleaning, wire splicing, rewrapping, cable band sealing, and main cable dehumidification, as well anchorage chamber dehumidification, SCADA system, and structural improvements. Reviewed contractor's final dehumidification system design detailing, construction management, field oversight, shop-witnessing, and commissioning to confirm that final system met contract requirements. This is the first main cable dehumidification in North America.
- Designed supplemental cable system for westbound bridge, comprising two new galvanized structural strand cables installed adjacent to each of the two existing main cables, increasing capacity of the cable system by approximately 12%. New suspenders were installed at each existing suspender group via newly designed brackets, using a multi-step, controlled load transfer process.

NEW OAKLAND BAY BRIDGE (EAST)

Client: American Bridge/Fluor Enterprises JV
Owner: California Department of Transportation
Location: Oakland, California
Core Services: Construction Engineering

—Completed in 2013, this two-mile (3.2 km) connector over the East Bay from Oakland to Yerba Buena Island features the world's longest self-anchored suspension bridge (SAS) consisting of a 590-ft (180 m) back span and a 1,263-ft (385 m) main span.

—WSP provided engineering services to the contracting team of American Bridge and Fluor Enterprises (in joint venture). Using our expertise in cable-supported structures, we developed erection procedures for the SAS. This task included dynamic property computations of the bridge at different construction stages for wind tunnel tests.

—WSP's work included developing the cambered shape of the girders for fabrication and computing the geometry of the main cables and lengths of the suspenders during each phase of the erection. Since the horizontal component of the cable force is resisted by compression in the deck, the deck was supported on temporary structures until cable installation was complete.

—The suspension deck system consists of twin steel orthotropic box girders (OBGs) which form a 10-lane wide bridge interconnected with shear-link seismic fuses supporting the inclined cable and hanger suspension system. The project won the 2015 ACEC Grand Conceptor Award.

NEW OAKLAND BAY BRIDGE (WEST)

Client and Owner: California Department of Transportation
Location: Oakland/San Francisco, California
Core Services: Cable Initial Inspection, Preliminary and Final Design

—These twin suspension bridges in series with a shared central anchorage in the Bay opened in 1936. The main spans are each 2,310 ft (704 m) and carry five westbound lanes to San Francisco on the upper roadway and five eastbound lanes to Oakland on the lower roadway. ADT is 260,000.

—WSP provided cable inspection services to determine which cable panels should be opened for internal wedging and wire inspection. The inspection also determined representative suspenders that should be removed for laboratory destructive testing. In addition, new access doors will be installed at the tower tops for better maintenance access and better sealing to prevent water intrusion into the main cables.

—WSP is providing design and field services for the in-depth cable inspection phase and determination of the main cable remaining strength. The in-depth inspection will take place according to the principles in NCHRP Report 534.

GEORGE WASHINGTON BRIDGE

Client: Port Authority of New York and New Jersey
Location: New York/New Jersey
Core Services: Original Design, Rehabilitation, Biennial Inspection

—Designed by legacy WSP designer, O.H. Ammann.

—Completed 1931 over the Hudson River, it was the longest suspension bridge when built, at main span of 3,500 ft (1,067 m). Second deck added 1962. ADT 289,800.

—Main Cable Dehumidification: WSP was the Prime Consultant and designed most details for the main cable dehumidification for the four 3-ft diameter (0.9 m) main cables and anchorages, with cables dried from a single plant in the New York anchorage. Anchorage dehumidification system replacements were also designed. Construction support is included with this work.

—Main Cable Evaluation and Rehabilitation, including unwrapping and rewrapping for the full length and wedging and inspecting interiors hands-on for 64 panels and under 16 cable bands at various locations along the four (4) main cables. WSP also performed acoustic monitoring of the main cables.

—Performed aerodynamic analysis and oversaw wind tunnel testing. Suspender Replacement: WSP is providing TD/CSS for full replacement of existing suspender ropes with improved connection details. Also, both sidewalks on the main bridge are being replaced, and new bicycle/pedestrian ramps are being constructed on both sides and at both ends of the bridge.

—Biennial Inspection: 2005.

DELAWARE MEMORIAL BRIDGES

Client: Delaware River and Bay Authority
Location: New Jersey/ Delaware
Core Services: Rehabilitation, Construction Inspection, Biennial and Interim Inspection

—Bridges completed in 1951 and 1968, main spans of 2,150 ft (655 m) carrying NJ Turnpike over Delaware Bay. ADT 80,000.

—General Inspection and Engineering Design Services since 2014.

—Main Cable Preservation and Dehumidification: Owner's engineer for this design-build project.

—DRBA General Engineering Services: WSP reviewed jacking system for suspender rope replacement and supervised the design and construction inspection effort for the steel component structural repairs.

—DMB 13-05 Tower Painting: Construction support and inspection for cleaning/painting the four towers, using freestanding 400-ft tall (122 m) scaffolding/ containment/ventilation.

—DMB 15-06 Spot Repair and Overcoat Painting: Oversaw CSS construction support services.

—Pilot UHPC Deck Overlay: Led assessment of existing deck evaluation on the approach and suspended spans. Pilot UHPC Deck Overlay installed in 2020 as a precursor for full implementation.

CABLE-STAYED BRIDGES

ARTHUR RAVENEL JR. BRIDGE

Client: South Carolina Department of Transportation
Location: Charleston, South Carolina
Core Services: Design-Builder's Engineer

- This cable-stayed bridge's main span is 1,546 ft (471 m) and carries eight lanes of US Route 17 and a 12-ft wide (3.6 m) walkway/bikeway over the Cooper River. It was completed in 2005, ADT is 96,000.
- This is the third-longest cable-stayed bridge in the Western Hemisphere.
- This was a design-build contract. Design and construction were completed in four years, 1 year ahead of schedule. The design was particularly challenging as Charleston's seismicity is on the same order of magnitude as southern California; it is the second busiest port on the East Coast and is vulnerable to hurricanes.
- Towers supported on 10-ft diameter (3-m) high-capacity drilled shafts. Each of the lighted towers is protected from ship collision by a large rock island. The main navigation channel is 1,000 feet (305 m) wide.
- In 2006 and 2007 it won over 10 national and international awards from PTI, PCI, ACEC, FHWA, International Bridge Conference, Roads & Bridges, ASCE, NCSE, and NSBA.

GERALD DESMOND BRIDGE

Client: Port of Long Beach
Location: Long Beach, California
Core Services: Program and Construction Manager

- Southern California's first signature bridge was opened to traffic in October 2020 with a 1,000-ft (305 m) main span and two equal side spans of 500-ft (152.5 m) carrying 6 lanes of traffic (3 in each direction) over the Port of Long Beach's Back Channel. The entire crossing, including approaches, is 8,800 feet (2,682 m). ADT 68,000.
- The Gerald Desmond Bridge Replacement is a vital part of the country's trade infrastructure, with 15 percent of the nation's imported waterborne cargo trucked over it. In addition, it is a critical access route for commuters between the Port of Long Beach, downtown Long Beach and surrounding communities.
- The western terminus of the bridge is on the east side of Terminal Island; the eastern terminus is close to downtown Long Beach. The bridge separates the inner harbor (north of the bridge) of the Port of Long Beach from the Middle Harbor.
- WSP served as the Program Manager/Construction Manager for this signature bridge replacement project and was responsible for all aspects of contract administration, including, but not limited to: Submittals Management; Submittal Review; Specialty Materials Testing; Surveying; Community Outreach; Project/Document Controls; Cost Estimating; Scheduling; Funding/Grant Support; Traffic Engineering; and, ROW coordination.

INDIAN RIVER INLET BRIDGE

Client: Delaware Department of Transportation
Location: Sussex County, Delaware
Core Services: Design and Construction Quality Control Services

—Completed 2012, main span is 950 ft (289 m) carrying four lanes of State Route 1 over the Indian River Inlet. The crossing includes one pedestrian/bikeway lane. ADT 5,700.

—The crossing length is 2,600 ft (792 m) with the three suspended spans flanked by four continuous bulb-tee spans on both north and south ends. Twenty-six of the segments around the main span were CIP with a form-traveler, while the remaining segments were cast on falsework. The pylon legs were cast in place and rise about 196 feet (60 meters) above the roadway.

—WSP provided design and construction quality control services for this concrete cable-stayed bridge as a sub-consultant to the design-builder, Skanska USA SE, but had a dual reporting function to the design-builder's quality manager as well as the bridge owner.

—The design quality control services involved the performance of independent structural analyses to assess the design-builder's design. Construction quality control activities included planning and intense coordination with the design-builder to achieve the aggressive construction schedule.

JOHN JAMES AUDUBON BRIDGE

Client: Louisiana Department of Transportation and Development
Location: Louisiana
Core Services: Program Management, Design Review, Construction Support

—Completed 2011, main span is 1,581 ft (482 m) carrying four lanes of LA State Route 10 over the Mississippi River, between Pointe Coupee and West Feliciana parishes. ADT 3,000.

—Longest cable-stayed bridge in the US.

—It also includes approximately 12 miles (19.3 km) of two-lane roadway connecting LA 1 east of Hospital Road at New Roads to U.S. 20/61 south of LA 966 and St. Francisville. It also provided four new intersections at existing LA 1, LA 10, LA 981 (River Road) and U.S. 61 for entry to and exit from the new roadway and bridge.

—Developed performance specifications for the cable-stayed bridge, evaluated proposals from bidders, reviewed the final design submittals, and provided technical oversight of construction for the LADOTD.

—This design-build cable-stayed bridge project replaced an existing ferry and it also serves as the only bridge structure on the Mississippi River between Natchez, Mississippi and Baton Rouge, Louisiana, approximately 90 river miles (145 km).

KOSCIUSZKO BRIDGE

Client: New York State Department of Transportation
Location: New York, New York
Core Services: Preliminary Design and Owner's Engineer for Phase 1, Final Design for Phase 2 Bridge

- Completed 2017 (Phase 1 westbound bridge) with 1,001-ft (305 m) main span, and 2019 (Phase 2 eastbound bridge) with 952-ft (290 m) main span. The entire crossing includes a 1.1-mile (1.8 km) elevated highway segment of I-278 over Newtown Creek. ADT 163,000.
- While many cable stayed bridges use two towers, for the Kosciuszko Bridge Main Span, a single tower was proposed for each roadway. The towers serve as a gateway, and the single towers best fit the constrained site conditions. The tower supporting the westbound roadway is located in Queens and the tower supporting the eastbound structure is located in Brooklyn, each providing a gateway into the respective boroughs.
- Provided Phase 1 Conceptual 30% Design, Scoping Documents, and QC/Independent Checking for Design-Build contract including demolition of the existing deck truss approach spans using explosives and removal of the through truss main span via strand jacks that lowered the span on to barges.
- Provided Phase 2 Final Design/CSS for Phase 2 Design-Bid-Build contract including a cable-stayed main span, prestressed girder approach spans and new ramps. The design includes a shared use path across the bridge.

LEONARD P. ZAKIM BRIDGE

Client: Massachusetts Department of Transportation
Location: Boston/Charlestown, Massachusetts
Core Services: Concept and Preliminary Design, Program Management, Final Design Check, Construction Support

- Bridge completed 2003, main span 745 ft (227 m) carrying ten lanes of I-93/US Route 1 over the Charles River. ADT is 200,000.
- The bridge carries traffic between the Thomas P. "Tip" O'Neill Jr. Tunnel and the elevated highway to the north. The bridge and connecting tunnel were built as part of the Big Dig, the largest highway construction project in the United States.
- The cable-stayed signature bridge uses the harp-style system of nearly-parallel cable layout, coupled with the use of cradles through each pylon for the cables.
- At 183 ft (56 m), the bridge is one of the widest cable-stayed bridges in the world.

LEWIS AND CLARK BRIDGE

Client: Kentucky Transportation Cabinet
Location: Kentucky/Indiana
Core Services: Conceptual Design and Type Selection

—Completed 2016, main span of 1,200 ft (366 m). ADT 20,000. Connects KY Route 841 in Louisville to IN Route 265 over the Ohio River.

—WSP developed the Preliminary Design including structure type selections for the Lewis and Clark Bridge (initially known as the East End Bridge) with 2D and 3D FE analysis models using soil-foundation-structure interaction. The project was subsequently bid under a design-build contract.

PEARL HARBOR MEMORIAL BRIDGE

Client: Connecticut Department of Transportation
Location: New Haven, Connecticut
Core Services: Program Manager and General Engineering Consultant

—Completed 2015, main span of 515 ft (157 m). Carries ten lanes of I-95 over the mouth of the Quinnipiac River in New Haven. ADT 140,000.

—First extradosed bridge in the US.

—The program included 7.2 miles (11.6 km) of I-95 improvements, 20 highway bridges, and 20 retaining walls, and enhancements to four Shore Line East commuter train stations, along with the new State Street rail station in downtown New Haven.

—It won the 2016 America's Transportation Award from the American Association of State Highway and Transportation Officials and the U.S. Chamber of Commerce, and it was a finalist at the 2017 Bentley Systems' Year In Infrastructure event.

TILIKUM BRIDGE

Client: Oregon Department of Transportation
Location: Portland, Oregon
Core Services: Conceptual Design and Preliminary Engineering

—Opened 2015. Used for light rail, bicyclists, pedestrians, and emergency vehicles.

—WSP provided conceptual engineering for major river crossings of the South/North LRT Project - Columbia River at I-5, Ross Island, and Caruthers Street over the Columbia and Willamette Rivers. Work included cost, bridge type, aesthetic, economic impact and environmental issues analysis.

—Preliminary engineering performed for the Tilikum Bridge crossing at Caruthers Street. Preliminary design was a two-span, cable-stayed bridge of 1,650 ft (503 m). Provided two lanes of light rail plus two bike / pedestrian paths, one on each side of the light rail tracks. The tower consists of a concrete "H" shape with a horizontally curved, steel truss superstructure. The smooth, curved form of the superstructure truss connects the banks in a balanced S-curve as influenced by the station locations and alignment restrictions underneath the Marquam Bridge.

TALMADGE BRIDGE

Client: Georgia Department of Transportation
Location: Savannah, Georgia
Core Services: Original Design in Joint Venture

—Completed 1991, main span of 1,100 ft (335 m). Carries four lanes of US 17/State Route 404 over the Savannah River. The crossing is 7,400 ft long (2,255 m). ADT 140,000.

—WSP designed the main span foundation, the high-level approach spans and the low-level trestle structure.

—A structural system using precast segmental I-girder drop-in construction was chosen for the high-level approach spans. The approaches are on a 5.5-percent grade. Nine girders support the deck, which is over 81 ft wide (25 m). Drop-in spans are AASHTO Type 6 girders, while the pier girders are variable-depth I-sections.

—Solid piers with heights varying from 110 to 170 ft (35 to 52 m) above grade are located on 190-ft centers (58-m). Erection of the spans using a pre-tensioned girder placed on the pier cap with temporary braces. Drop-in girders were placed between the pier girder arms. Joints between the pier and drop-in girders were grouted and post-tensioned, making the girders continuous.

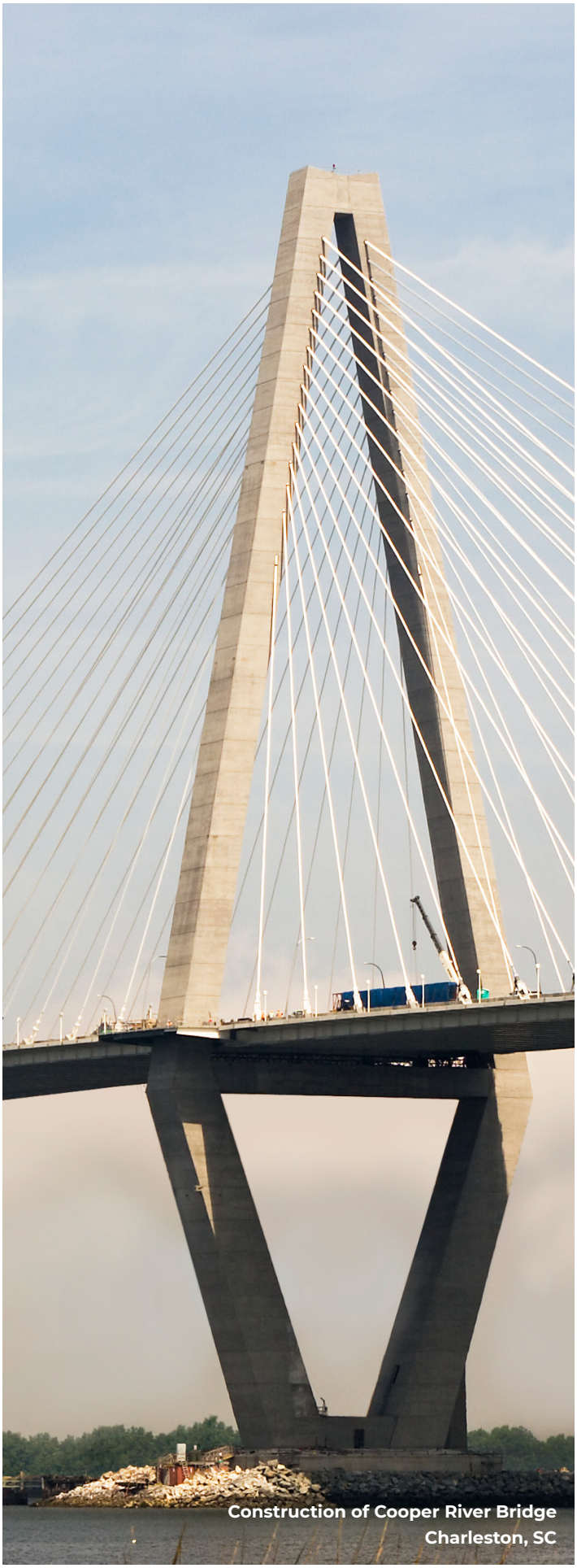
—Casting of the composite deck slab and subsequent barrier erection completed the construction.

—The new bridge was designed to withstand Zone 2 earthquake loads.

WILLIAM H. NATCHER BRIDGE

Client: Kentucky Transportation Cabinet
Indiana Department of Highways
Federal Highway Administration
Location: Kentucky/Indiana
Core Services: Conceptual, Preliminary and Final Design

- Completed 2002, the main span is 1,200 ft (366 m) carrying four lanes of US Route 231 over the Ohio River, connecting Owensboro, KY with Rockport, IN. ADT is 5,700.
- WSP provided state-of-the-art hydraulic modeling and scour analysis of the total crossing, ship-impact analysis, and seismic evaluation and analysis, and preparation of contract documents for the bridge, including the approach structures and the main-span. Innovative design elements also facilitated both construction and subsequent maintenance.
- The bridge towers and anchor piers are supported by 6-ft-diameter drilled shafts (1.8-m) extending 126 ft deep (38 m) below the water level.
- Many design features were believed to be used for the first time in the USA, such as a counterweight to eliminate backstay tie down, placing cable anchors above the deck level, and ladders and platforms accessing all cable tower anchors. It is a "User-Friendly Bridge".



Construction of Cooper River Bridge
Charleston, SC

ARCH BRIDGES

ALEXANDER HAMILTON BRIDGE

Client: New York State Department of Transportation
Location: Manhattan/Bronx, New York
Core Services: Rehabilitation Value Engineering Design for Adding Redundant Approach Girders

—Original Bridge completed 1963, arch span is 555 ft (169 m), carrying eight lanes of I-95 over the Harlem River. ADT 177,800.

—Contractor's Engineer for Halmar International, Inc. Rehabilitation was completed in 2013.

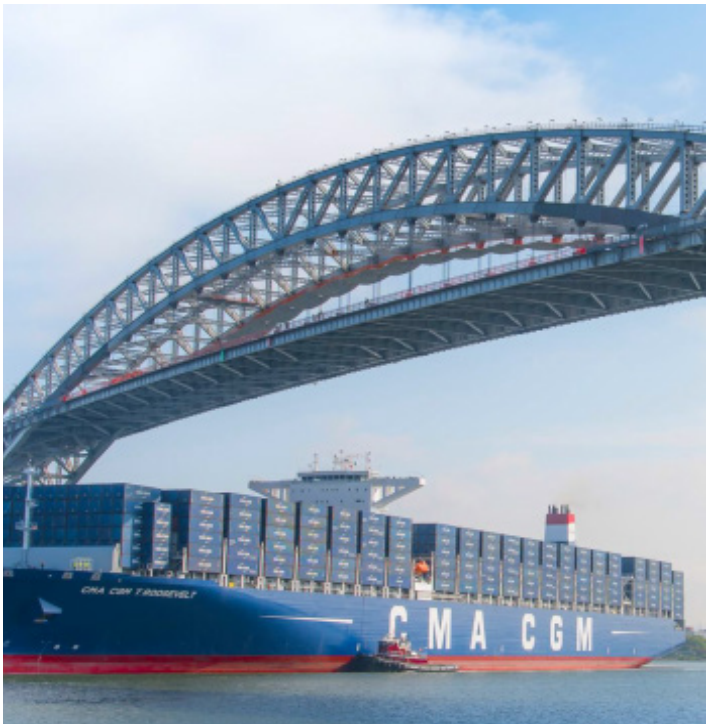
—WSP studied the feasibility of revising the complex staging and introducing new plate girders from roadway level above, in lieu of constructing new truss girders from below as per contract design. There are steep slopes with difficult access below the approaches in Manhattan and the Bronx.

—WSP performed analysis that allowed cutting of existing floorbeams to install new plate girders rather than construct the truss girders around the floorbeams.

—Plate girders reduced girder weight by half with respect to truss girders, and allowed girder deflections similar to existing adjacent girders.

—A crane gantry on rails for the crossing was designed to transport girders to the work zone for installation.

—The work reduced construction costs by several million dollars and also reduced the duration of a critical vehicular staging phase for short truck weaving distances from the George Washington Bridge to exit onto the Major Deegan Expressway.



BAYONNE BRIDGE

Client: Port Authority of New York and New Jersey
Location: New York/New Jersey
Core Services: Peer Review, Original Design, Rehabilitation, Biennial Inspection

—Designed by legacy WSP designer, O.H. Ammann.

—Completed 1931, arch span is 1,652 ft (503 m), carries Route 440 over Kill Van Kull waterway. Rehab completed 2020. ADT 19,000.

—Constructability Review of Preferred Alternative: Reviewed the constructability of the rehabilitation alternative to raise navigational clearance to 215 ft (65 m) for post-Panamax vessels.

—Navigation Clearance Program: Provided TD/CSS for the Raise the Roadway Project in joint venture. Project involved complex staging to keep vehicular and shipping traffic in service during construction.

—Scope included new precast segmental approaches and piers. The arch was strengthened to accommodate the new higher roadway. The project was awarded the ACEC's highest honor, the National Grand Conceptor Award in 2018, and the ASCE National Prize in 2020.

—Biennial Inspections: 1993, 2003, 2019.

FREMONT BRIDGE

Client: Oregon Department of Transportation
Location: Portland, Oregon
Core Services: Conceptual/Final Design

- WSP prepared type study, preliminary and final design and construction phase services for this three-span continuous tied arch bridge for Route I-405/US 30 over the Willamette River. 1,255-ft (382 m) main span (at the time the longest tied-arch bridge in the world). Opened in 1973. ADT 128,000.
- The 900-ft (274 m) central portion of the main span weighs 6,000 tons (5,443 metric tons), and was floated and installed in one lift.
- Most Beautiful Long-Span Bridge of 1974, American Institute of Steel Construction; James F. Lincoln Arc Welding Foundation 1974, First Award for Bridge Design.

JOHN GREENLEAF WHITTIER BRIDGE

Client: Massachusetts Department of Transportation
Location: Massachusetts
Core Services: Conceptual / Preliminary Design and Design-Build Tender Preparation/Owner's Engineer Services

- Completed 2018, main span is 480 ft (146 m) carrying eight lanes of I-95 over the Merrimac River using two network arch bridges. ADT 72,600.
- WSP led the conceptual design of steel network arch main span and steel plate girder approaches, segmental concrete, extradosed, and cable-stayed alternatives at the sketch plan design phase. Subsequently, WSP managed the design – build final design and construction for MASSDOT.
- As originally proposed, the project would involve a three-phase build and a two-phase demolition. The team developed an innovative sequencing solution to meet MassDOT's Accelerated Bridge Program goals.
- One of only six transportation projects on the White House Top 14 List to have successfully achieved expedited permitting.
- First MA interstate bridge to include pedestrian/bikeway.

LEWISTON-QUEENSTON INTERNATIONAL BRIDGE

Client: Niagara Falls Bridge Commission
Location: Lewiston, NY, USA/Queenston, Ontario, Canada
Core Services: Capital Planning, General Engineering Consulting Services, Annual Condition Inspections

- The bridge crosses the Niagara River Gorge approximately 5.5 miles (8.9 km) north of Niagara Falls. It connects Lewiston, NY with Queenston, Ontario. It is considered the 3rd busiest US-Canada border crossing. Originally designed with four travel lanes, the bridge was reconfigured and re-decked in 2005 and now carries five lanes of vehicular traffic. The bridge has a total structure length from abutment to abutment of 1607 ft (490 m). The main arch span is 1,000 feet (305 m) and provides a vertical clearance of approximately 350 ft (107 m).
- WSP serves as the General Engineering Consultant for the Niagara Falls Bridge Commission. Work tasks have included annual capital planning and in-depth condition inspections; approach span joint/slab rehabilitation; Level 1 Load rating of main and approach spans; and miscellaneous repairs to structural steel, sidewalks, railings, and access systems.

RAINBOW INTERNATIONAL BRIDGE

Client: Niagara Falls Bridge Commission
Location: Niagara Falls, NY, USA/Niagara Falls, Ontario, Canada
Core Services: Capital Planning, General Engineering Consulting Services, Annual Condition Inspections

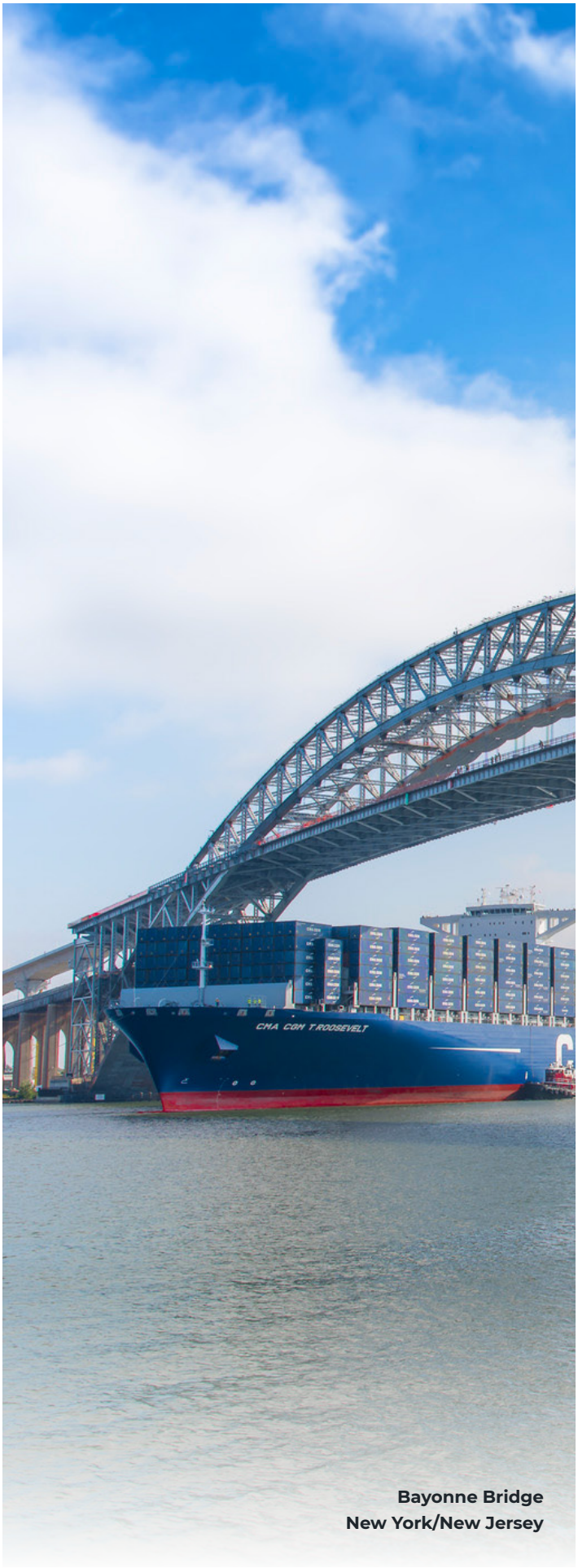
- The bridge crosses the Niagara River Gorge immediately downstream of the falls, connecting Niagara Falls, NY with Niagara Falls, Ontario. The main span is a 950 ft (290 m) steel hinge-less spandrel arch. When completed in 1941, it was the longest hinge-less arch span and the fourth longest arch span in the world.
- WSP serves as the General Engineering Consultant for the Niagara Falls Bridge Commission. Work tasks have included annual capital planning and in-depth condition inspections; deck rehabilitation; removing deck joints and installing UHPC link slabs; Level 1 load rating of main and approach spans; and miscellaneous repairs to structural steel, sidewalks, railings, and access systems.
- Replacing deck joints with UHPC link slabs won a 2020 award from the American Council of Engineering Companies.

WHIRLPOOL-RAPIDS INTERNATIONAL BRIDGE

Client: Niagara Falls Bridge Commission
Location: Niagara Falls, NY, USA/Niagara Falls, Ontario, Canada
Core Services: Capital Planning, General Engineering Consulting Services, Annual Condition Inspections

—The bridge was built in 1897 and carries both rail and vehicular traffic between Niagara Falls, New York and Niagara Falls, Ontario. The bridge carries two lanes of vehicular traffic on the lower deck and a single-track railroad line on the upper deck. The 1,078 ft (329 m) crossing consists of a 550 ft (167 m) two-hinged bi-level main span truss arch flanked by bi-level eye-bar truss spans. The original double-track alignment on the upper deck was reduced to single-track in 1963. The main arch provides a vertical clearance of approximately 225 ft (68 m).

—WSP serves as the General Engineering Consultant for the Niagara Falls Bridge Commission. Work tasks have included annual capital planning and in-depth condition inspections; abutment/retaining wall rehabilitation; special inspection, analysis, and retrofit of eye-bars and pins; Level 1 Load rating of main and approach spans; and miscellaneous repairs to structural steel, sidewalks, railings, and access systems.



Bayonne Bridge
New York/New Jersey

INTERNATIONAL BRIDGES

BÍNH BRIDGE

Client: Haiphong People's Committee/Finnroad Ltd.
Location: Hài Phòng City, Vietnam
Core Services: Preliminary and Final Design

—This cable-stayed bridge crossing the Cấm River carries four vehicular lanes and two pedestrian lanes of Route 10. The main span is 850 ft (260 m), and the bridge opened in 2005.

—The bridge has composite steel with concrete deck. The 335-ft tall towers (102 m) are constructed of reinforced concrete. The erection of the main span used the balanced cantilever method.

—The bridge replaced the existing ferry and eliminated frequent traffic congestion, and has played an important part in connecting Quảng Ninh and Hai Phong. This has fostered development of the transport network and the economy of coastal areas in northern Vietnam.

—The deck was built using prefabricated elements.

CHENAB RAILWAY BRIDGE

Client: KONKAN Railway Corporation/
Chenap Bridge Project Undertaking
Location: Jammu-Kashmir, India
Core Services: Preliminary and Final Design

—A new railway line from Udhampur to Baramulla is under construction in the States of Jammu and Kashmir about 373 miles (600 km) north of New Delhi. The crossing of the Chenab River between Bakkal and Kauri is the most challenging part of the project.

—The height from the river to the bridge deck is 1,148 ft (350 m) which requires the large 1,532 ft (467 m) main span. The arch and its spandrel columns consist of steel trusses. The steel deck consists of two open girders with stiffened steel deck plate and lateral and vertical stiffening steel trusses.

—The steel arch halves were connected in late March 2021.

CRUSELL BRIDGE

Client: City of Helsinki
Location: Helsinki, Finland
Core Services: Feasibility Study, Conceptual Design, Cost Estimate

—This asymmetric cable-stayed bridge has a main span of 302 ft (92 m) and side span of 169 ft (51.5 m) with steel pylons. The bridge crosses the Ruoholahti Bay and opened in 2011.

—It carries two lanes of vehicular traffic, one lane along each fascia, with two tram tracks traversing the center of the bridge.

—The bridge superstructure is constructed from longitudinally post-tensioned concrete beams.

—The bridge was designed in 4D using BIM. At completion, the entire bridge was laser-scanned in addition to traditional as-built drawings, and an easy-to use, lightweight version of the point cloud was provided to the client. The detailed point cloud can be used for future rehabilitation.

—The bridge won a Special Recognition Award by software provider Tekla in the 2009 Global BIM Awards, and also won the 2013 Bridge of the Year Award by the Finnish Association of Civil Engineers.

DRAGON BRIDGE

Client: Dà Nẵng People's Committee
Location: Đà Nẵng, Vietnam
Core Services: Final Design

—The bridge crosses the River Hàn at Dà Nang, Vietnam and provides the shortest access from the airport to Dà Nang City. The bridge opened in 2013 and breathes fire and water each Saturday and Sunday night.

—The bridge's total length is 2,185 ft (666 m), with the longest span 660 ft (200 m) with the suspended spans' hangers emanating from a single central arch.

FORTH ROAD BRIDGE

Client: The Forth Estuary Transport Authority
Location: Fife, United Kingdom
Core Services: Expert Consulting and Review Services, Main Cable Evaluation and Analysis

—This bridge, completed in 1964, spans the Firth of Forth with four vehicular lanes and two pedestrian/bike lanes. It is a vital link between North England's Yorkshire Lowlands with Edinburgh, Scotland to the north. Its main span is 3,300 ft (1,006 m).

—WSP evaluated options for strengthening or replacing the main cables. The Forth Estuary Transport Authority commissioned this study as a proposed long-term solution. WSP prepared the initial concepts for three replacement and three augmentation alternatives and also designed the new cables, suspenders, and connections to the superstructure as well as load transfer procedures using a global computer model of the bridge.

—When the in-depth inspection revealed the corrosion damage, WSP evaluated the main cables' strength and rate of future degradation. WSP also performed an independent analysis and review of the main cable assessment.

—WSP reviewed the contract documents for suspender rope replacement and advised the owner on the design and construction for replacement of the suspender ropes. WSP also performed the third internal inspection and strength evaluation on the bridge's main cables in 2012.

HUMBER BRIDGE

Client: The Humber Bridge Board
Location: East Yorkshire, United Kingdom
Core Services: Main Cable In-Depth Inspection

—The Humber Bridge carries four traffic lanes across the Humber Estuary and opened in 1981 as the longest main span suspension bridge in the world at 4,626 ft (1410 m). The superstructure consists of a steel box girder deck suspended by an inclined hanger system.

—WSP performed an internal inspection of the main cables, including a cable walk to determine the cable panels to be opened, assisted in developing tender documents, and performed the on-site internal cable inspection. This included determining wire condition according to NHCRP Report 534, sampling and testing wires, and splicing wire segments where samples were taken. After the cable strength was modeled from the inspection data, WSP checked the computations to verify the remaining cable capacity.

KANCHANAPHISEK BRIDGE

Client: Thailand Department of Highways
Location: Bangkok, Thailand
Core Services: Initial Study for Tunnel or Bridge, Conceptual and Preliminary Design, Supervision of Final Design, Construction Supervision

—This 3,087-ft crossing (941 m) that forms part of the South Outer Bangkok Ring Road is the longest cable-stayed bridge in Thailand, and opened in 2007. The main span is 1,540 ft (469 m). It carries six vehicular lanes of Route 9 over the Chao Phraya River on the South Outer Bangkok Ring Road.

—The tower design includes traditional Thai and contemporary architecture. The main span construction avoided interrupting heavy marine traffic below.

—The superstructure consists of steel box edge girders composite with precast deck panels.

—The bridge uses counterweights to eliminate the uplift at anchor piers to increase the factor of safety of the bridge and reduce the maintenance requirements. The bridge was designed for easy maintenance and ready accessibility to all major bridge components.

—Diamond Award from the New York Chapter of the American Council of Engineering Companies (ACEC) and an Engineering Excellence Award from the National ACEC Chapter.

KRUUNUNVUORENSILTA BRIDGE

Client: City of Helsinki / Urban Environment Division, Helsinki City Transport
Location: Helsinki, Finland
Core Services: Bridge Structural Analysis and Design, BIM Modeling, Wind Tunnel Testing / Aerodynamic Analysis, Geotechnical Design, Maintenance Manual

—This bridge is scheduled to start construction in 2021 and will link the new Laajasalo district to the heart of Helsinki. The bridge is in a nature area, an important part of the city coastline when arriving from the sea. It will be one of the longest bridges in the world built specifically for public transportation (trams), pedestrians and cyclists. The main visual element of the bridge is the tower which stands as a balanced counterpoint to the landscape and will become a signature structure for the city.

—The main bridge consists of two 850 ft (260 m) cable-stayed main spans supported by a single pylon. The approach spans consist of continuous composite girders and total 1,388 ft (423 m).

—The design is based on a 200-year life in an aggressive marine environment. Construction durability is therefore an important design consideration to ensure that the lifetime requirement is met.

RAIPPALUOTO BRIDGE

Client: Finnish Roads Administration
Location: Finland
Core Services: Conceptual Design, Final Design, Construction Supervision, Maintenance Program

—Raippaluoto Bridge, on the seacoast of Vaasa, is the longest bridge in Finland. The main span is 820 ft (250 m) with a total crossing length 3,428 ft (1045 m). It carries two vehicular traffic lanes from the mainland to Replot Island in the Gulf of Bothnia. It opened in 1997.

—The bridge was designed and analyzed to resist heavy sea wind loads in a difficult sea foundation environment. Wind tunnel tests were performed.

—The bridge was erected using the free cantilever method in the main span. The superstructure in the approach spans is a typical composite girder system that changes to the cable-supported structure in the main spans without any expansion joints-- as a continuous girder from start to end.

—The bridge was awarded an Honorable Mention in the 1997 Construction Engineering competition and in the Concrete Structure of the Year competition.

RAO 2 BRIDGE

Client: Haiphong People's Committee / Finnroad Ltd
Location: Hài Phòng City, Vietnam
Core Services: Feasibility Study, Detailed Design with tender documents, Seismic / Aerodynamic Analysis, Construction Supervision

—This cable-stayed bridge carries four vehicular traffic lanes and two pedestrian/bicycle lanes across the Lach Tray River. The main span is 394 ft (120 m) and the side span is 131 ft (40 m), with a total length of 814 ft (248 m). It opened in 2012.

—The bridge consists of one pylon with a peak height of 155 ft (47 m). The bridge superstructure is a composite steel girder with concrete deck slab.

—The erection of the main bridge was carried out using the balanced cantilever method, with the deck slab cast in-situ in segments.

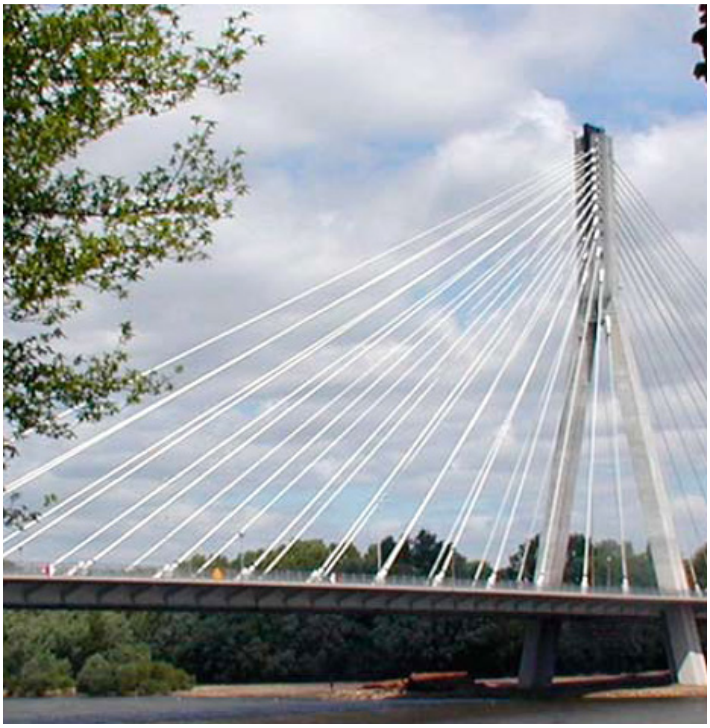
ROVANIEMI (LUMBERJACK'S) BRIDGE

Client: Finnish Roads Administration
Location: Finland
Core Services: Preliminary and Final Design

—This cable-stayed bridge carries four lanes of vehicular traffic over the Kemijoki River. The main span length is 1,050 ft (320 m) and the bridge opened in 1989.

—It was the first cable-stayed vehicular bridge in Finland.

—Highest pylon: 154 ft (47 m). The main tower is intended to look like a lumberjack's candle.



ŚWIĘTOKRZYSKI BRIDGE

Client: Trasa Świętokrzyski Spolka z.o.o., Warsaw
Location: Warsaw, Poland
Core Services: Preliminary and Final Design

—This cable-stayed bridge extends Świetokrzyska Street from the city center and carries two vehicular lanes as well as pedestrian/bicycle paths in each direction over the Vistula River. The main span is 590 ft (180 m). The total crossing is 1,470 ft (448 m). The bridge opened in 2002. Average daily traffic is 23,400 vehicles.

—The bridge consists of a single A-tower with the top of the pylon symbolizing piano keys to honor Warsaw native pianist and composer Frederick Chopin.

—The steel superstructure was launched over the permanent piers and some temporary piers. Casting of the deck was done by movable casting formwork.

TÄHTINIEMI BRIDGE

Client: Finnish Roads Administration, YIT Corp., Rautaruukki Oy
Location: Heinola, Finland
Core Services: Preliminary and Final Design

—WSP designed this harp-form cable-stayed bridge with a crossing length of 3,031 ft (924 m). The bridge's main span is the second-longest in Finland, at 541 ft (165 m). It carries four lanes of Finnish National Route 4 across Lake Ruotsalainen. The bridge opened in 1993.

—The superstructure is an open I-girder system with two main girders. The deck slab is post-tensioned transversely.

—Erection used launching technique.

—The concrete towers have a green surface layer.

THU THIEM 2 BRIDGE

Client: Dai Quang Minh and People's Committee of HCMC/ Department of Transport
Location: Ho Chi Minh City, Vietnam
Core Services: Final Design

—The crossing carries four lanes of vehicular traffic, two motorcycle lanes, and two pedestrian lanes over the Saigon River. The main span is 656 ft (200 m).

—The unique curved tower is shaped like a dragon's tail and leans toward Thu Thiem, across the river from Ho Chi Minh City.

—The project follows the Finnish Transport Agency's BIM guideline for bridge building.

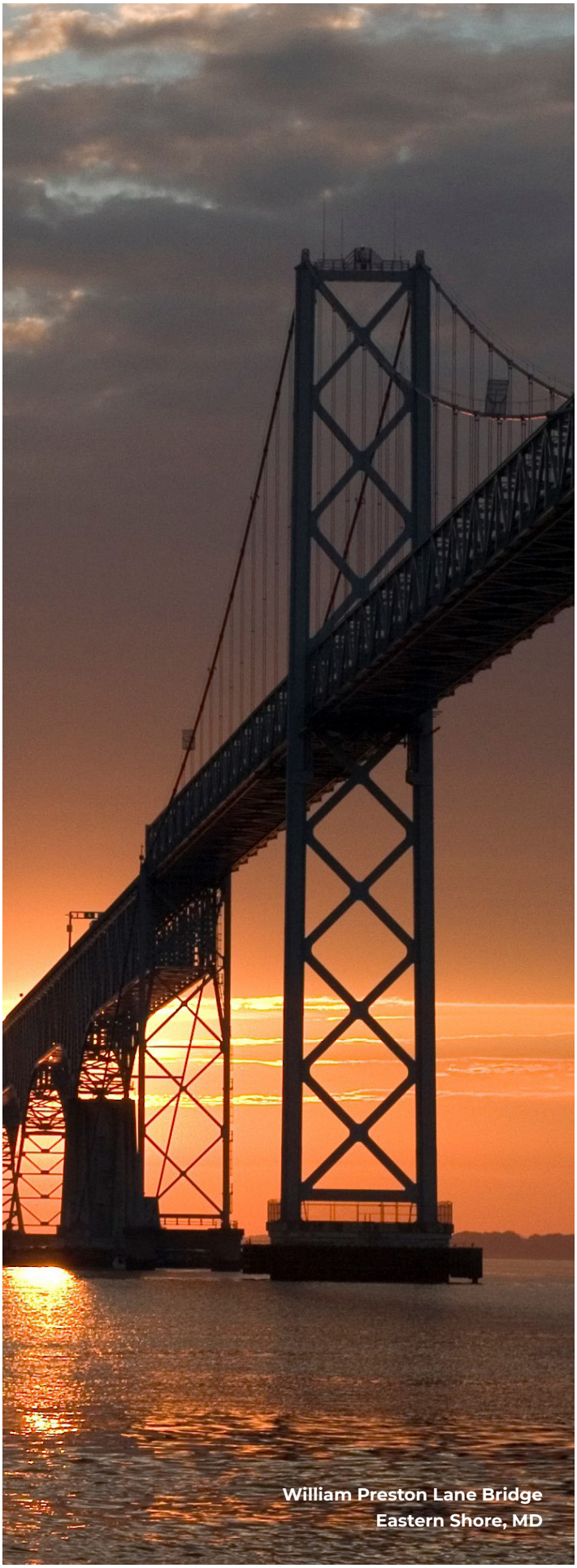
—The main span consists of reinforced concrete deck and composite beam structure, using precast and cast-in-place structures. The rear and side spans are tensioned both longitudinally and transversely.

—The bridge is expected to open in 2023.

TRẦN THỊ LÝ BRIDGE

Client: City of Đà Nẵng,
Department of Transportation
Location: Đà Nẵng, VIETNAM
Core Services: Preliminary and Final Design

- This cable-stayed bridge spans the Hàn River in the city of Đà Nẵng and opened 2013. It has an overall length of 2,398 ft (731 m) with a main span of 754 ft (230 m). Its single inclined tower is 476 ft (145 m) tall and cables fan out from each side. The bridge has six vehicular lanes and two pedestrian sidewalks.
- The inclined towers are constructed of concrete due to its ready availability in Vietnam.
- Due to the weight of the tower and superstructure, the tower bearings are among the biggest spherical bearings ever fabricated.



William Preston Lane Bridge
Eastern Shore, MD

GLOBAL PEDESTRIAN BRIDGES

GEORGE C. KING BRIDGE

Client: City of Calgary
Location: Calgary, Alberta CANADA
Core Services: Preliminary and Final Design
Construction Administration Services

—This iconic three-span pedestrian bridge comprises steel-network tied network arches and is 597-ft (182-m) long, and crosses the Bow River just northeast of downtown Calgary. The bridge opened in 2014.

—This bridge serves to act as a catalyst for the redevelopment of East Village in Calgary. Linking and expanding the City's network of soft modes of transportation, the George C. King Bridge brings districts together and facilitates access to key destinations and landmarks throughout the community.

—Its size and elegant form, like a stone skipping off the water surface, make the footbridge distinctive and recognizable.

—The bridge is supported solely from land, by four piers, with the only supports below 100-year flood levels being those located on the river banks. From the viewpoint of the riverside pathways and river craft, the river corridor appears minimally occupied.

—Awards: 2015 Global Best Project Award of Merit – Engineering News Record Magazine; 2014 Top Project, Civil Design – Alberta Construction Magazine; 2014 Top Project, People's Choice Award – Alberta Construction Magazine.

MORRIS STREET BRIDGE RECONSTRUCTION

Client: Triborough Bridge and Tunnel Authority
Location: New York, New York
Core Services: Evaluation for rehabilitation/ replacement, Preliminary/Final Design

—This 166-ft (50 m) bridge spans over the Manhattan Approach to the Hugh L. Carey Tunnel in lower Manhattan. The existing bridge, built in 1944 as part of the new tunnel at that time, was a three-span structure with stair access and a 10-ft (3 m) wide deck.

—The bridge was evaluated for rehabilitation to provide ADA-compliant ramps, strengthening deteriorated steel members, upgrading for seismic compliance, and replacing worn bearings. Ultimately, a full replacement was chosen because it would provide a faster construction and completion timeline at only slightly higher cost.

—The new bridge conforms to current seismic and ADA codes and uses a single span design, eliminating two piers in the multi-lane highway below. Additional architectural facades and fencing, artistic signage, and decorative lighting were also included in the design. The design and preparation of contract documents were completed within two months.

UNIVERSITY OF MEMPHIS BRIDGE

Client: Tennessee Board of Regents
Location: Memphis, Tennessee
Core Services: Preliminary and Final Design, Construction Phase Services

- Completed 2019, the main span is 156 ft (48 m) carrying pedestrian traffic over Southern Avenue and CSX rail tracks from the north main campus to new campus development to the south.
- Single-span, leaning tower cable-stayed signature bridge that is ADA-compliant. “This bridge will prove to be the single most transformational structure ever constructed by the University of Memphis.” – University President Dr. David Rudd.
- An average of 20 daily freight trains caused students parking on the south side of campus to be late for classes.
- The concrete/steel towers have a support system of two planes of five fanned cable stays and four back stays. The concrete walkway is supported by steel floorbeams and edge girders. The cross slope and vertical profile allow for water drainage to flow to the joints at each end of the main span, obviating the need for bridge scuppers. The bridge also includes decorative lighting and a sweeping architectural railing.
- Because the connecting land bridge viaduct is a separate structure, the horizontal force of the bridge deck is transmitted to the tower legs at walkway level.

UTAH VALLEY UNIVERSITY BRIDGE

Client: Utah Valley University
Location: Orem, Utah
Core Services: Conceptual and Final Design, Construction Supervising Engineer

- WSP designed the new 1,000-ft (305-m) long pedestrian bridge crossing the I-15 highway, Union Pacific Railroad (UP), and Utah Transit Authority (UTA) rail lines to facilitate a campus expansion.
- The bridge includes a roof structure, semi-enclosed sides, and a heated deck, with the goal of creating an aesthetic bridge that provides a branding opportunity for the university, and providing a comfortable crossing in all seasons across this long structure, while meeting Utah Department of Transportation, UP, and UTA requirements.

WALKWAY OVER THE HUDSON (WOTH) AS-BUILT REVIEW

Client: New York State Bridge Authority
Location: Poughkeepsie, New York
Core Services: As-built design review: design criteria and modeling, strategy and prioritization of repairs

- The structure, originally built as the Poughkeepsie Railroad Bridge, was converted from rail to pedestrian use. Structurally, the bridge was a railroad bridge with applied loads far smaller than the original design loads.
- WSP investigated the loading criteria for future review and evaluation of the pedestrian structure:
  - Apply AASHTO requirements for pedestrian bridges and identify latest AASHTO specifications applicable to the bridge with reference to AREMA
  - Set design criteria and applicable load cases
  - Develop site-specific bridge data for determining extreme load cases
  - Perform analysis; apply a two-tier approach using 2D simple models and 3D complex models as warranted
  - Calculate as-built and as-inspected demand/capacity ratios
  - Provide remedial solutions where needed

WHIPPLE TRUSS PEDESTRIAN BRIDGE

Client: Erie Canal Harbor Development Corporation (Empire State Development Corporation)
Location: Buffalo, New York
Core Services: Preliminary Design, Final Design, Construction Administration Services, Construction Inspection

- This is a modern version of the Whipple truss bridge originally designed/patented by Squire Whipple in 1841. It was a common crossing for the Erie Barge Canal in the 1800s.
- Instead of the requested modern bowstring bridge, WSP researched the history of the Erie Canal and presented an alternative Whipple truss bridge to the client.
- Using original photos and patent drawings, WSP accurately recreated the 3D geometry.
- The truss arches were shop fabricated, shipped by barge, and lifted by crane onto the abutments.
- This bridge became a historic centerpiece of the downtown waterfront revitalization. The project won the 2008 ACEC-NY Platinum Award.

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About WSP USA
WSP USA is the U.S. operating company of WSP, one of the world's leading engineering and professional services firms. Dedicated to serving local communities, we are engineers, planners, technical experts, strategic advisors and construction management professionals. WSP USA designs lasting solutions in the buildings, transportation, energy, water and environment markets. With more than 9,500 employees in 150 offices across the U.S., we partner with our clients to help communities prosper

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