



BRIDGES

**SYSTRA**

## Global Bridge Network Iconic Infrastructures

SYSTRA has been a world leader in the field of transportation infrastructure for more than 60 years. Bridges are a major product line and a cornerstone of our technical excellence in providing safe, efficient, and economical solutions.

**International Bridge Technologies** joined SYSTRA in 2017. The two companies have combined their complementary technical expertise to offer specialized engineering services in all facets of bridge design, construction, and maintenance.

SYSTRA's **Global Bridge Network** consists of over 350 bridge specialists deployed worldwide, with Bridge Design Centers located in San Diego, Montréal, São Paulo, Malmö, Wrocław, Paris, Dubai, New Delhi, and Seoul.



**Floating Bridge**  
EVERGREEN POINT FLOATING BRIDGE  
Seattle, Washington  
Total Bridge Length: 5,135 ft (1,565 m)



**Cable-Stayed Concrete Bridge**  
3rd PANAMA CANAL CROSSING  
Colón, Panama  
Main Span: 530 m (1,738 ft)



**Suspension Bridge**  
CHACAO BRIDGE, Chacao, Chile  
Main Spans: 1,155 m (3,789 ft) and 1,055 m (3,461 ft)

SAN DIEGO

MONTRÉAL

SÃO PAULO

MALMÖ

WROCLAW

PARIS

DUBAI

NEW DELHI

SEOUL

 BRIDGE DESIGN CENTERS



**Sea Bridge**  
SHEIKH JABER AL-AHMAD AL-SABAH  
CAUSEWAY, Kuwait  
Total Length: 48.5 km (30.1 mi)



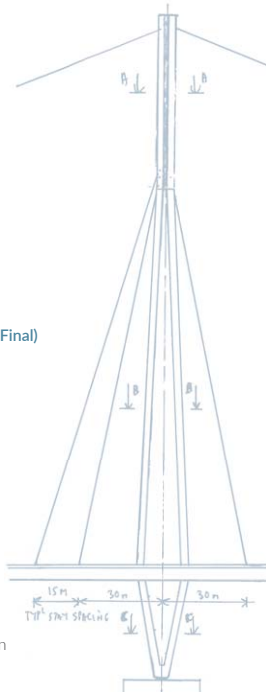
**Railway Cable-Stayed Bridge**  
TIANXINGZHOU BRIDGE, China  
Main Span: 504 m (1,654 ft)



**Fast-Track Metro Design**  
MASHAAER MMMP MECCA, Saudi Arabia  
Design and Construction Supervision in 17 mos.  
Total Length: 17 km (10.6 mi)

## Services

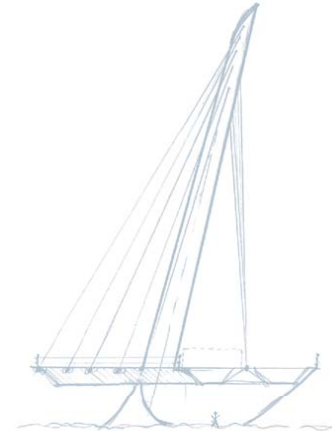
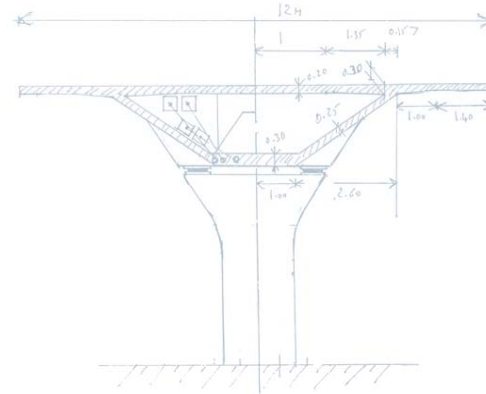
- TENDER PREPARATION
- CONCEPTUAL DESIGN
- PRE-BID ENGINEERING
- PROPOSAL PREPARATION
- SPECIFICATIONS PREPARATION
- BIDS ANALYSIS
- ESTIMATING
- INDEPENDENT CHECKING
- DETAILED DESIGN (Preliminary & Final)
- DEMOLITION DESIGN ANALYSIS
- LOAD RATINGS
- SPECIAL ANALYSES
  - Dynamic Analyses
  - Wind Analyses
  - Site-Specific Seismic Studies
  - Seismic Analyses
  - Passenger Comfort Analysis
  - Rail-Structure Interaction
  - Environmental Impacts Evaluation
  - Interface Management



- **GEOTECH/FOUNDATION**
  - Recommendation for Investigation
  - Results Interpretation
  - Foundation Design
- **BIM / BRIM**
- **COMPLEX DRAFTING & SPECIALIZED DETAILING**
- **REALISTIC GRAPHICS**
  - 3D Renderings
  - Visual Animation
  - Construction Sequence Animation
- **TECHNICAL ASSISTANCE DURING CONSTRUCTION**
- **CONSTRUCTION SUPERVISION**

- **CONSTRUCTION ENGINEERING**

- Integrated Shop Drawings
- Conflict Identification and Resolution
- Construction Planning/Scheduling
- Step-by-Step Construction Analyses
- Camber Computations
- Geometry Control Systems
- Temporary Works Design
- Construction Manuals
- Prefabrication Plant Design



- **ASSESSMENT / REPAIR**

- Structural Assessment
- Maintenance Manual Preparation
- Condition Evaluation and Inspection
- Design of Repair Works
- Rehabilitation
- Stay-Cable Replacement Design
- Seismic Retrofit

# SUSTAINABLE INFRASTRUCTURES

## SYSTRA mission's core

The production of concrete and steel, the two materials most widely used in construction, is responsible for 8% of carbon dioxide emission in the world. In this context, SYSTRA has an important role to play by optimizing the technical solutions to reduce our **environmental and carbon footprint**, develop and promote a sustainable approach during the whole life cycle of our projects. All our bridge realizations deal with challenges of climate change and sustainable development with relevant economical considerations.

Most specifically, our iconic solution, the U-shape viaduct solution, patented by SYSTRA, is an environmental solution which **optimizes** the quantity of material used, and helps the viaduct to integrate better into its environment.



**Sheikh Jaber Al-Ahmad Al-Sabah Causeway, Kuwait**  
140 thousand CO2 tons compared to base design.



**Samuel de Champlain Bridge, Montreal, Canada**  
Platinum Envision Award for the excellence and sustainability of its design.



**Kingston Third Crossing, Canada**  
Placing an environmental turbidity curtain and wildlife passages, allowing safe passage of turtles and wildlife through the temporary rock causeway during construction.



**HS2, United Kingdom**  
A target of 50% reduction in CO2 emissions to be achieved through the different design phases.



**Chambal Bridge, India**  
Noise barriers were installed on the deck to avoid disturbing river crocodiles.



**Mauritius Extradosed Bridge, Mauritius Island**  
SYSTRA proposed an alternate concept design with savings of 39% in concrete, 33% in reinforcing steel and 20% in stay cables, compared with the existing design.

## Bridges To Prosperity

We serve territories and communities especially in countries and areas where there is a lack of safe transportation access to essential services.

SYSTRA is working with residents and the non-profit organization **Bridges To Prosperity** to build footbridges opening up isolated rural populations.



**Challoma Chico Bridge, Bolivia**  
A safe year-round crossing between two sister villages, located on opposite sides of the river.



**El Corozo Bridge, Nicaragua**  
The footbridge provides safe access to schools, health care, markets, government services, and employment opportunities to four rural communities.



**El Limón Bridge, Nicaragua**  
This foot-bridge serves to link locals to schools, medical care, and markets on the other side of the river during the rainy season.

# BIM & DATA MANAGEMENT

## Creating BIM Data

To fulfill our client demands in terms of BIM, SYSTRA has developed an innovative solution, BIM in One Click, which facilitates and accelerates the BIM design of bridge and linear infrastructure. Our in-house tool allows us to construct and manage a consolidated BIM model to address the requirement of different BIM use cases. Based on a centralized database and developed closely with domain experts, BIM in One Click enhances existing design processes and enables BIM data management on infrastructure projects.

In compliance with the ISO 19650 standard, SYSTRA creates and manages your information on the whole project life cycle.

## International Awards



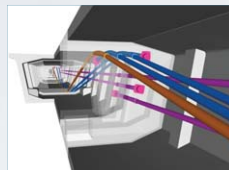
### BIM d'Argent

The solution BIM In One Click has been awarded several times: French award BIM d'Argent 2017 and 2018 for the Toulouse Aerospace Express and Bogota Metro projects respectively.



### HS2 Project

The Special Recognition Award for Advancing Digital Workflows through Digital twins in The Year in Infrastructure 2019 Awards for HS2 Project.



### PrestressBIM

Offers an innovative BIM process for designing, modelling and producing deliverables for pre-stressing in bridge structures.



### CarbonTracker

A decision-making tool that estimates and manages the carbon footprint of an infrastructure. The application is incorporated into our BIM design methodology.



### eLODy & Pablo

Web applications developed by SYSTRA that allows the analysis of the data and edit any object properties associated to a BIM object.

# CHACAO BRIDGE

Chacao, Chile

The Chacao suspension bridge, which connects Chiloé Island with mainland Chile, is the longest suspension bridge in Latin America. It is also the world's longest double suspension bridge with three pylons. The bridge is located near an active fault, and it is designed to resist severe seismic motion.

**Owner:** Ministry of Public Works, Chile

**Contractor:** HDEC - OAS and AAS-Jakobsen-SYSTRAs as JV member

**Our Role:** SYSTRAs, along with JV Partner, AAS-Jakobsen, was responsible for the full detailed design of the bridge. SYSTRAs led the seismic studies and design, geotechnical engineering, and the design of the steel orthotropic deck, central pylon, suspension cable, anchor blocks, and foundations.

## Design-Build

**Main Spans:** 1,155 m and 1,055 m (3,789 ft and 3,441 ft)

**Total Length:** 2,754 m (1.7 mi)

**Width:** 23.8 m (78 ft)

**Construction:** In progress



COAST MERIDIAN OVERPASS, Vancouver, British Columbia, Canada  
 PITT RIVER BRIDGE, Vancouver, British Columbia, Canada  
 PORT MANN BRIDGE, Vancouver, British Columbia, Canada  
 CHARLES W. CULLEN BRIDGE, Rehoboth Beach, Delaware, USA  
 HALE BOGGS MEMORIAL BRIDGE, St. Charles Parish, Louisiana, USA  
 ABRAHAM LINCOLN BRIDGE, Louisville, Kentucky, USA  
 LEWIS AND CLARK BRIDGE, Louisville, Kentucky, USA  
 GOETHALS BRIDGE REPLACEMENT, New York/New Jersey, USA  
 VETERANS' GLASS CITY SKYWAY, Toledo, Ohio, USA

Panama

CHAMPLAIN BRIDGE CORRIDOR PROJECT, Montréal, Québec, Canada  
 OLIVIER-CHARBONNEAU BRIDGE, Montréal, Québec, Canada  
 CARLOS CAMACHO ESPÍRITU BLVD BRIDGE, Puebla, Mexico  
 PUENTE DE LA UNIDAD, Monterrey, Mexico  
 PUENTE ZARAGOZA, Puebla, Mexico  
 3<sup>RD</sup> PANAMA CANAL CROSSING (THE ATLANTIC BRIDGE),  
 Colón, Panama

Brazil

ALÇA VIÁRIA DE BELÉM, Belém, Brazil  
 SANTOS GUARUJÁ BRIDGE, São Paulo, Brazil  
 BRAZIL PARAGUAY BRIDGE, Paraguay, Brazil  
 ANEL VIÁRIO METROPOLITANO DE SÃO PAULO, São Paulo, Brazil  
 COMPLEXO VIÁRIO PADRE ADELINO, São Paulo, Brazil  
 RIO NEGRO BRIDGE, Manaus, Brazil

Norway

Turkey

Egypt

Kuwait

UAE

India

Malaysia

NEW GREENLAND BRIDGE, Porsgrunn, Norway  
 GOLDEN HORN, Istanbul, Turkey  
 ASWAN BRIDGE, Aswan, Egypt  
 MAIN BRIDGE SHEIKH JABER CAUSEWAY, Kuwait City, Kuwait  
 HODARIYAT BRIDGE, Abu Dhabi, United Arab Emirates  
 WAZIRABAD SIGNATURE BRIDGE, New Delhi, India

China

WEH BRIDGE, Mumbai, India  
 CHAMBAL BRIDGE, Kota, India  
 TIANXINGZHOU BRIDGE, Wuhan, China  
 PENANG BRIDGE, Penang, Malaysia  
 BATAM-BINTAN BRIDGE, Riau Islands, Indonesia  
 ELEANOR SCHONELL BRIDGE, Brisbane, Australia

Australia



# 3<sup>RD</sup> PANAMA CANAL CROSSING

Colón, Panama

The 3<sup>rd</sup> Panama Canal Crossing, known as The Atlantic Bridge, is a 3,081 m (10,108 ft) long bridge near the city of Colón, Panama. At 530 m (1,739 ft), the main span is the longest all-concrete deck in the world. The cable-stayed spans consist of two parallel box girders connected with transverse diaphragms. The deck, which is built using the balanced cantilever method, is supported by two planes of stay cables anchored along its edges.

**Owner:** Panama Canal Authority

**Owner's Engineer:** Louis Berger Group-CCCC Consortium

**Contractor:** Vinci Construction Grands Projets

**Our Role:** Redesign and construction engineering for main span, independent checking for approaches.

**Design-Bid-Build-Value Engineering**

**Main Span:** 530 m (1,738 ft)

**Total Length:** 3,081 m (10,108 ft)

**Width:** 20.8 m (68 ft) (approaches)

**Construction Completed:** 2019





# SAMUEL DE CHAMPLAIN BRIDGE

Montréal, Québec, Canada

The Samuel De Champlain Bridge spans the St. Lawrence River from Île-des-Sœurs to Brossard downstream from the original Champlain Bridge. The 240 m (787 ft) cable-stayed main span crosses the St. Lawrence Seaway.

**Owner:** Infrastructure Canada

**Developer:** Signature on the Saint Lawrence Group

**Contractor:** Signature on the Saint Lawrence Construction (SNC-Lavalin Major Projects, Dragados Canada and Flatiron Constructors Canada Joint Venture)

**Bridge Design Consultant:** TYLI-SYSTRASLI Joint Venture

**Our Role:** Design of steel approach superstructure, independent check of cable-stayed main span.

## Design-Build

**Total Bridge Length:** 3335 m (10,942 ft)

**Approach Spans:** 80.4 m (263 ft) typical, 110 m (360 ft) maximum.

**Width:** 50.255 m (164 ft) wide deck allows for 8 lanes of traffic, 2 lanes of a transit corridor, and a multiple-use-path.

**Construction Completed:** 2019



# LEWIS AND CLARK BRIDGE

Louisville, Kentucky, USA

This bridge links Kentucky Highway 841 to Indiana Highway 265, creating an alternate route across the Ohio River. It is supported by two planes of stay cables in a semi-fan arrangement anchored along the deck with arched diamond shape pylons.

**Owner:** Indiana Finance Authority

**Design/Build Contractor:** Walsh Construction Group/Vinci Construction Grands Projets JV

**Prime Consultant:** Jacobs Engineering

**Our Role:** Bridge design consultant and construction engineering.

**Design-Build-Operate-Maintain**

**Main Span:** 1,200 ft (365 m)

**Total Length:** 2,280 ft (695 m)

**Width:** 124 ft (38 m)

**Construction Completed:** 2016



# PUENTE DE LA UNIDAD

Monterrey, Mexico

This is a signature bridge that crosses the Santa Catarina River in Monterrey, Mexico. The bridge was delivered on a fast track schedule, and it was designed and built in 23 months. In 2004, the project received the prestigious Grand Award from ACEC, the top award for a bridge project in the United States.

**Owner:** State of Nuevo León Secretary of Communications and Transport

**Contractor:** Grupo Garza Ponce and VSL Corporation

**General Consultant:** Sistemas Óptimos Constructivos, S.A. (SOCSA)

**Our Role:** Detailed design and construction engineering for the cable-stayed bridge, technical assistance on site.

**Main Span:** 137 m (449 ft)

**Total Bridge Length:** 304 m (997 ft)

**Width:** 24 to 33 m (79 to 108 ft) (four traffic lanes, shoulders, and a central walkway).

**Construction Completed:** 2003



# HODARIYAT BRIDGE

Abu Dhabi, UAE

This 1.3 km (.8 mi) long bridge connects Abu Dhabi to Hodariyat Island. It consists of a 36.3 m (119 ft) wide single cell precast segmental concrete box girder with stiffening struts inside and outside the box. The 55 m (180 ft) long approach spans were built by incremental launching and the cable-stayed main spans were built in balanced cantilever. The approach piers are made of precast segments, and precast shells were used to form the foundation caps.

**Owner:** Tourism Development & Investment Co.

**Contractor:** Overseas AST/VSL Joint Venture

**Our Role:** Detailed design and construction engineering.

## Design-Build

**Main Span:** 200 m (656 ft)

**Total Length:** 1.3 km (.8 mi)

**Width:** 36 m (118 ft) (six lanes, shoulders, and two walkways)

**Construction Completed:** 2011  
Completed in 27 months



# PORT MANN BRIDGE

Vancouver, British Columbia, Canada

This 2,073 m (6,801 ft) long bridge carries the Trans Canada Highway over the Fraser River. It is the second widest bridge in the world. The 850 m (2,789 ft) long cable-stayed structure includes a 470 m (1,542 ft) main span and 190 m (623 ft) side spans.

Each separate roadway is supported by two planes of stay cables and consists of a composite structure of steel edge girders and floor beams with precast concrete deck panels. The approach spans consist of three parallel precast segmental box girders built in balanced cantilever above the water and span-by-span on land.

**Owner:** Ministry of Transportation, British Columbia, Canada

**Design/Build Contractor:** Peter Kiewit Sons' Co./ Flatiron Constructors

**Bridge Design Consultants:** T.Y. Lin International and SYSTRA

**Our Role:** Detailed design and construction engineering.

## Design-Build

**Main Span:** 470 m (1,542 ft)

**Total Bridge Length:** 2.1 km (6,889 ft)

**Width:** 65 m (213 ft) (2 x 5 lanes, shoulders, and a sidewalk)

**Construction Completed:** 2012



# CHAMBAL BRIDGE

Kota, India

This cable-stayed bridge, which opened in 2017, has the longest all concrete span in India. The bridge provides a bypass around the city of Kota, thereby reducing congestion within the city. The deck, built using the cantilever method, consists of 30.2 m (99 ft) wide, 4.1 m (13.5 ft) deep prestressed concrete box girder segments. Noise barriers were installed on the deck to avoid disturbing river crocodiles.

**Owner:** National Highway Authority of India

**Owner's Engineer:** Louis Berger Group

**Contractor:** Hyundai E&C and Gammon India

**Our Role:** Tender design, detailed design of the entire bridge and construction services.

**Design-Build**

**Main Span:** 350 m (1,148 ft)

**Total Length:** 1,100 m (3,608 ft)

**Width:** 30.2 m (99 ft)

**Construction Completed:** 2017



# TIANXINGZHOU BRIDGE

Wuhan, China

When built, this bridge held the world record for the longest railway cable-stayed span. It supports mixed-use roadway and rail traffic.

The 17 m (55.8 ft) deep double-deck truss superstructure provides a 455 m (1,493 ft) wide by 20 m (65.7 ft) high navigation channel. The bridge carries six roadway lanes on the upper deck level and four railway tracks on the lower deck level.

**Owner:** Ministry of Railway, China

**Contractor:** CRCC (China Railway Construction and Corporation) and MBEC (Major Bridge Engineering Co., Ltd)

**Our Role:** Independent check of detailed design, geometry control, construction supervision.

## Design-Build

**Main Span:** 504 m (1,654 ft)

**Total Length:** 4,657 m (2.9 mi)

**Width:** 31.3 m (103 ft) (six roadway lanes on the upper level and four railway tracks on the lower level)

**Construction Completed:** 2009  
Completed in 27 months



# PITT RIVER BRIDGE

Vancouver, British Columbia, Canada

This bridge connects the municipalities of Pitt Meadows and Port Coquitlam. The 380 m (1,250 ft) long main bridge, which provides a 190 m (623 ft) main span, consists of a steel-concrete composite deck supported by three planes of stays in a "harp" arrangement. The project was delivered over a three-year design and construction period.

**Owner:** Ministry of Transportation, B.C. Canada

**Design/Build Contractor:** Kiewit Corp.

**Prime Consultants:** ND LEA Inc., Associated Engineering

**Our Role:** Detailed design and construction engineering for the main bridge, technical assistance on site.

## Design-Build

**Main Span:** 190 m (623 ft)

**Total Bridge Length:** 380 m (1,250 ft)

**Width:** 40-48 m (131-158 ft) (seven traffic lanes, bikepath, shoulders, provision for eighth traffic lane)

**Construction Completed:** 2009





# ELEANOR SCHONELL BRIDGE

Brisbane, Australia

This bridge across Brisbane River in Australia connects Dutton Park to the University of Queensland campus. This project received the 2008 Golden State Award, ACEC's highest honor for projects engineered in the State of California.

**Owner:** Brisbane City Council

**Contractor:** John Holland

**Prime Consultant:** GHD

**Our Role:** Detailed design and construction engineering for the cable-stayed bridge, technical assistance on site.

## Design-Build

**Main Span:** 184.4 m (604 ft)

**Total Bridge Length:** 391.4 m (1,284 ft)

**Width:** 19.4 m (63 ft) (two traffic lanes, two side-walks with canopies for pedestrians and bicycles)

**Construction Completed:** 2006



# COAST MERIDIAN OVERPASS

Vancouver, British Columbia, Canada

This bridge provides a critical transportation link between the north and south of Port Coquitlam, British Columbia. It includes a new structure over the Canada Pacific Railway yard and the Lougheed Highway. In order to maintain operations for one of the busiest railroad yards in the world, the entire bridge was push-launched from the south abutment. The 125 m (410 ft) maximum span was one of the longest ever to be launched in North America.

**Owner:** City of Port Coquitlam, B.C., Canada

**Design/Build Contractor:** SNC-Lavalin

**Our Role:** Detailed design and construction engineering.

## Design-Build

**Maximum Span:** 125 m (410 ft)

**Total Length:** 580.3 m (1,903 ft)

**Width:** 23.8 m (78 ft) (four traffic lanes, shoulders, two bicycle paths, and a sidewalk).

**Construction Completed:** 2010



# GOLDEN HORN BRIDGE

Istanbul, Turkey

The Golden Horn Bridge allows the Istanbul Metro to cross the Golden Horn River. It carries two tracks and two pedestrian walkways. It includes access viaducts made from prestressed concrete, a cable-stayed bridge made entirely from steel (piers, pile caps, piers, deck, pylons), and a steel swing span for navigational purposes. A station is located on the main 180 m (591 ft) span.

**Owner:** Istanbul Metro Company

**Developer:** Hakan Kiran

**Contractors:** Astaldi SpA-Gülermak JSC

**Our Role:** Conceptual and basic design, tender preparation.

**Main Span:** 180 m (591 ft)

**Total Length:** 917 m (3,009 ft)

**Width:** 36 m maximum (118 ft)

**Construction Completed:** 2014



# CHARLES W. CULLEN BRIDGE

Rehoboth Beach, Delaware, USA

This cable-stayed bridge carries the SR1 Coastal Highway across the Indian River Inlet in Delaware. The superstructure consists of all concrete edge girders, floor beams, and deck slab.

**Owner:** State of Delaware Department of Transportation

**Design/Build Contractor:** Skanska USA

**Prime Consultant:** AECOM

**Our Role:** Subconsultant for cable-stayed spans, concept design, and detailed design in association with AECOM.

## Design-Build

**Main Span:** 950 ft (289 m)

**Total Bridge Length:** 2,600 ft (792 m)

**Width:** 106 ft (32 m) (four traffic lanes, shoulders, and a sidewalk)

**Construction Completed:** 2011



# OLIVIER-CHARBONNEAU BRIDGE

Montreal, Quebec, Canada

This is a signature structure on the long awaited roadway between Montreal and Laval in Québec, Canada. The Olivier-Charbonneau Bridge Completion Project is a 7.2 km (4.5 mi) long toll road between Boulevard Henri Bourassa in Montréal, and Highway 440 in Laval. The 1.2 km (.75 mi) main bridge consists of a plate girder approach with continuous spans up to 96 m (315 ft) and a 512 m (1,678 ft) long cable-stayed structure with a 280 m (918 ft) long main span. The 36 m (118 ft) wide bridge super-structure consists of a steel-concrete composite deck supported by two planes of stay cables in a fan arrangement along the edges.

**Owner:** Le Ministère des Transports du Québec

**Design/Build Contractor:** Kiewit - Parsons JV

**Prime Consultant:** Parsons

**Our Role:** Conceptual design, detailed design, and construction engineering for the main bridge.

## Design-Build

**Main Span:** 1.2 km (.75 mi)

**Total Length:** 280 m (918 ft)

**Width:** 36 m (118 ft)

**Construction Completed:** 2010



# RIO NEGRO BRIDGE

Manaus, Brazil

The road bridge over the Rio Negro was designed to establish the connection between the Cities of Manaus and Iranduba in the State of Amazonas. It's the only bridge that crosses the Brazilian section of the Rio Negro. Its implantation was a landmark for the State of Amazonas and contribute to the development of the Region.

The total length of the project is approximately 11 km (6.83 mi) involving a road access system and a cable-stayed bridge over the Rio Negro with a length of 3,595 m (11,794 ft) and a platform width of 20.70 m (68 ft). The work was designed with main spans in a 400 m (1,312 ft) long cable-stayed structure, with 200.00 m (656 ft) for each side of the main support, intended for navigation and structures with current spans, being 1,485.00 m (4,872 ft) on the left bank and 1,710 m (5,610 ft) on the right bank, in pre-cast prestressed concrete beams.

**Owner:** Executive Secretariat of the Sustainable Development Council of the Metropolitan Region of Manaus (SRMM)

**Contractor:** Rio Negro Consortium (Camargo Corrêa and Construbase Joint Venture)

**Our Role:** Detailed design, environmental impact assessment and Project Management Consultant.

**Main Span:** 200 m (656 ft)

**Total Length:** 3,595 m (11,794 ft)

**Width:** Platform width of 20.70 m (67 ft) and 22.60 m (74 m) in the cable-stayed part.

**Construction Completed:** 2013



# WAZIRABAD SIGNATURE BRIDGE

Delhi, India

This is a signature cable-stayed bridge with a 251 m (823 ft) main span, a 151 m (495 ft) high steel pylon with sophisticated architectural shape, and a very wide composite steel-concrete deck with 3 longitudinal girders.

**Owner:** DTTTC

**Designer:** SBP

**Contractor:** Gammon India

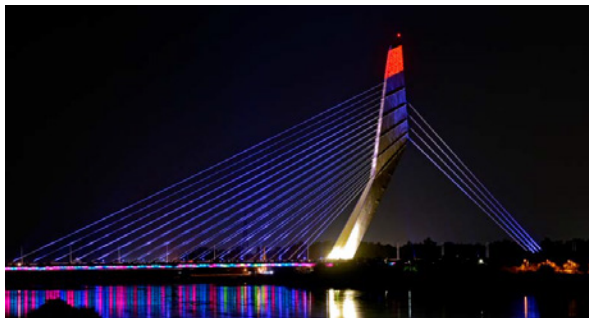
**Our Role:** Independent Checking Engineer

**Main Span:** 251 m (823 ft)

**Total length:** 575 m (1886 ft)

**Width:** 35 m (115 ft)

**Construction Completed:** 2018



# WEH BRIDGE

Mumbai, India

This cable-stayed bridge for the Mumbai Metro Line-1 (VAG Corridor) includes laterally inclined pylons and a U-shaped concrete deck girder. The main span was built in cantilever with form travelers.

**Owner:** Mumbai Metro

**Contractor:** SEW

**Our Role:** Concept design, basic design and detailed design.

**Main Span:** 86 m (282 ft)

**Total Length:** 178 m (584 ft)

**Construction Completed:** 2013







# SR 520 EVERGREEN POINT FLOATING BRIDGE

Seattle, Washington, USA

This is an 8,700 ft (2,652 m) long crossing of Lake Washington near Seattle,

Washington. It includes both floating and fixed-based bridge components. The unique design consists of a 5,135 ft (1,566 m) long low-rise structure of precast segments supported at a typical 30 ft (9.1 m) spacing. The project received the 2017 ACEC Grand Conceptor Award – the highest honor for an engineering project in the United States.

**Owner:** Washington State Department of Transportation

**Design/Build Contractor:** Kiewit-General-Manson JV

**Prime Consultant:** KPFF Consulting Engineers

**Our Role:** Conceptual design, detailed design, and construction engineering.

## Design-Build

**Total Bridge Length:** 5,135 ft (1,565 m)

**Width:** 113 ft (34.5 m) (six traffic lanes, shoulders, pedestrian walkway)

**Construction Completed:** 2017



# SHEIKH JABER AL-AHMAD AL-SABAH CAUSEWAY

Kuwait City, Kuwait

The total length of this bridge is 48.5 km (30.1 mi) including Main and Doha links. The Main link project includes an access bridge, off shore bridge, reclamation island and a cable-stayed bridge to allow for a larger navigation channel. The construction started in 2013 and was completed in 2019. This sea bridge (Main Link and Doha Link) was the world's longest at the time of inauguration. SYSTRA is responsible for the full design and all activities from the tender to detailed design stages.

**Owner:** Public Authority for Roads and Transportation (PART), Kuwait

## **Design-Build**

### **Main Link:**

**Contractor:** Hyundai E&C and CGCC

**Our Role:** Conceptual design, full detailed design.

**Total Bridge Length:** 36 km (22 mi)

**Typical precast span:** 60 m (197 ft)

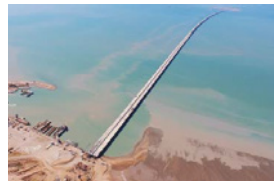
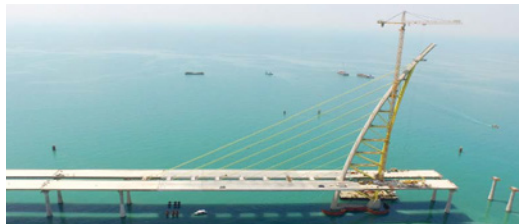
**Width:** Two decks of 17 m (56 ft) each

### **Doha Link:**

**Our Role:** Independent check

**Total Bridge Length:** 12 km (7.5 mi)

**Construction Completed:** 2019



# OTAY RIVER BRIDGE

San Diego, California, USA

This high-level valley crossing is part of a toll road connection between State Route 54 south of San Diego, California and State Route 905 near the Mexican border. It was designed in accordance with Caltran's rigorous standards for state-of-the-art bridges in high seismic zones. The twin side-by-side precast segmental box girders were built in balanced cantilever from the top using a single side-shifting overhead gantry.

**Owners:** South Bay Expressway and Caltrans

**Design/Build Contractor:** Otay River Constructors (Washington Group and Fluor Joint Venture)

**Prime Consultant:** Washington Infrastructure Services

**Our Role:** Detailed design and construction engineering, technical assistance on site.

## Design-Build

**Typical Span:** 90.5 m (297 ft)

**Total Length:** 1,012 m (3,320 ft)

**Width:** 23.1 m (75 ft)

**Construction Completed:** 2007



# MUMBAI TRANS-HARBOUR LINK MTHL

Mumbai, India

The MTHL Project connects Sewri on the Mumbai side to Chirle on the Navi Mumbai side in Maharashtra State, India. The project comprises construction of approximately 21.8 km (13 mi) long and a 6-lane carriageway viaduct across the Mumbai Bay plus the interchange ramps at Sewri. MTHL has about 0.5 km of land viaduct at Sewri plus ramps, about 16.3 km (10 mi) of viaducts over sea/creek and around 4.9 km (3 mi) of viaduct and earth sections on land on Navi Mumbai's side.

Package 1 consists of the Sewri Interchange Ramps and a 10 km (6.2 mi) marine portion. The typical roadway along the alignment includes a 3-lane traffic carriageway in each direction. The bridge consists of a precast segmental dual box girder, built using the span-by-span method.

**Owner:** Mumbai Metropolitan Region Development Authority (MMRDA)

**Owner's Engineer:** AECOM, Dar Al-Andasah & T.Y. Lin International

**Contractor:** Larsen & Toubro Limited/IHI

**Design Consultant:** COWI

**Our Role:** Independent Design Checking (cat.3) of the structures, geotechnical design and roadway.

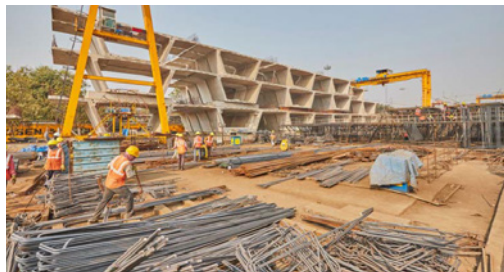
## Design-Build

**Typical Span:** 60 m (195 ft)

**Total Length:** 37 km (23 mi)

**Width:** 2 x 14.5 m (46 ft)

**Construction:** In progress





**CABLE CAR**   
TELEO CABLE CAR, Toulouse, France

**FUNICULAR RAILWAY**   
ENSHI FUNICULAR RAILWAY, Enshi, China

**FOOT BRIDGES** 

- EL LIMÓN BRIDGE, Cinta Verde, Nicaragua
- EL COROZO BRIDGE, San Dionisio, Nicaragua
- CHALLOMA CHICO BRIDGE, Challoma Chico, Bolivia

**INCREMENTAL LAUNCHING** 

- COAST MERIDIAN OVERPASS, Vancouver, B.C., Canada
- HODARIYAT BRIDGE, Abu Dhabi, United Arab Emirates

**REPAIR & RENOVATIONS** 

- GRAMMONT BRIDGE, Tours, France
- SAINT MICHEL BRIDGE, Toulouse, France
- WHARF DE LAAYOUNE BRIDGE, Morocco
- WILSON BRIDGE, Tours, France
- OGOUE BRIDGE, Transgabonais, Gabon
- SANTIAGO U-SHAPED VIADUCT, Metro, Santiago, Chile
- PENANG BRIDGE, Malaysia
- TRANSAMÉRICA BRIDGE, São Paulo City, Brazil
- DOUTRO PLINIO DE QUEIROZ BRIDGE, São Paulo City, Brazil

**EXTRADOSED BRIDGES** 

- ST. CROIX CROSSING, Oak Park Heights, Minnesota, USA
- 2ND RING ROAD, Hanoi, Vietnam
- DIEN BIEN PHU BRIDGE, Ho Chi Minh City, Vietnam
- GYEONG AN BRIDGE, Gyeong An, South Korea
- MOOLCHAND BRIDGE, New Delhi, India
- PRAGATI MAIDAN BRIDGE, New Delhi, India
- SECOND VIVEKANANDA BRIDGE, Kolkata, India
- A1-M1 LINK ROAD EXTRADOSED BRIDGE, Mauritius, Africa

**ARCH & TRUSS BRIDGES** 

- THIRD CROSSING, Kingston, Ontario, Canada
- LEZ BRIDGE, Nimes-Montpellier HSL, France
- VIDOURLE BRIDGE, Nimes-Montpellier HSL, France
- DODAM BRIDGE, Dodam, South Korea
- MOAM BRIDGE, Seoul-Busan HSL, South Korea
- MOAM TRUSSES, Seoul-Busan HSL, South Korea
- WUSHAN DANING RIVER ARCH BRIDGE, Chongqing, China
- TAIWAN TRUSSES, Taiwan HSL, Taiwan
- PARKLINKS BRIDGE, Quezon City, Philippines

## SECOND VIVEKANANDA BRIDGE

Kolkata, India

The Second Vivekananda Tollway Concession is a private road over the Hooghly River operated by the Second Vivekananda Bridge Tollway Company (SVBTC). The bridges of the concession were open to traffic in 2007 and include over 3 km (1.86 mi) of precast segmental viaduct and a major 880 m long (2,890 ft) extradosed bridge, designed by SYSTRA. SYSTRA was subsequently engaged by SBVTC between 2013 and 2020 for the technical management of the bridge assets. The missions undertaken include the inspection and assessment of the bearings, the design and supervision of the replacement the external post-tensioning, the measurement of the forces in the stays, the review of the main bridge as-built geometry and the structural assessment of the bridge further to subsequent updates of the IRC Code.

**Owner:** National Highways Authority of India

**Developer:** Second Vivekananda Bridge Tollway Company

**Design/Build Contractor:** Larsen & Toubro

**General Consultant:** Consulting Engineering Services and Parsons Brinckerhoff Asia

**Main Stakeholder:** Morgan Stanley

**Bridge Asset Contractor:** VSL & Tensa

**Our Role:** Preliminary design for approach spans and main bridge, detailed design for main bridge superstructure, construction engineering for main bridge. Bearing inspection/external cable replacement/stay forces measurement/as-built geometry review/bridge structural assessment for revised IRC.

**Design-Build-Operate-Maintain**

**Main Span:** 110 m (360 ft)

**Total Length:** 880 m (2,887 ft) (main bridge)

**Width:** 29 m (95 ft)

**Construction Completed:** 2007



## LEZ BRIDGE

The Lez bridge is located on the high-speed railway line between Nîmes and Montpellier in southern France. It is a steel box girder bowstring arch with a 90 m (295 ft) span and a 17.5 m (57.4 ft) rise. This bridge carries the first railway line in France to support both high-speed and heavy freight trains. For aesthetic reasons, the hangers are oriented radially rather than vertically.

**Owner:** Oc'via-Bouygues  
**Contractor:** Oc'via-Bouygues  
**Our Role:** Independent check

**Design-Build**  
**Span:** 90 m (295 ft)  
**Construction Completed:** 2018

Nîmes-Montpellier HSL, France



# DODAM BRIDGE

Dodam, South Korea

This project is a double-track railway bridge on the Dodam-Yeongcheon line and crosses the Nama Han River over a length of 480 m (1,575 ft). The structure of this bridge is a combination of steel truss and arch bridges with a maximum span length of 120 m (394 ft).

**Owner:** Korea Railway Network Authority

**Design/Build Contractor:** Hyundai E&C

**Our Role:** Responsible for the tender design and detailed design.

## Design-Build

**Main Span:** 120 m (394 ft)

**Total Length:** 480 m (1,575 ft)

**Width:** 14 m (45.9 ft)

**Construction Completed:** 2017





# KINGSTON THIRD CROSSING

Kingston, Ontario, Canada

The City of Kingston, Third Crossing Bridge involves the construction of a new 1.2 km (9.7 mi) bridge that will extend over the Cataraqui River connecting the east side and west side communities. The bridge is the largest infrastructure project the City has ever undertaken.

The bridge is a combination of concrete girders and concrete deck for the approach spans (19 spans) and a composite structure with variable depth steel girders (main bridge 3 span continuous). The structural steel depth varies from 2 m (6 ft) at mid span to 9 m (29 ft) over the two main piers and create an underarch bridge to span the navigational channel. The bridge carries 2 traffic lanes and a separated multi-use path. The third crossing is the first bridge in Canada to be build using an Integrated Project Delivery model.

**Client/Owner:** The Corporation of the City of Kingston

**Designer:** Hatch Ltd. and SYSTRA

**Contractor:** Peter Kiewit Sons ULC

**Our Role:** Detailed design and construction surveillance of the main bridge.

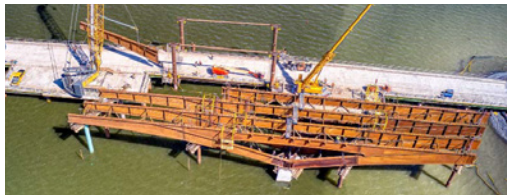
## Integrated Project Delivery

**Total length:** 1.2 km (.74 mi)

**Main Span:** 95 m (311 ft)

**Width:** 15.6 m (51 ft)

**Construction:** In progress, completion planned 2022.

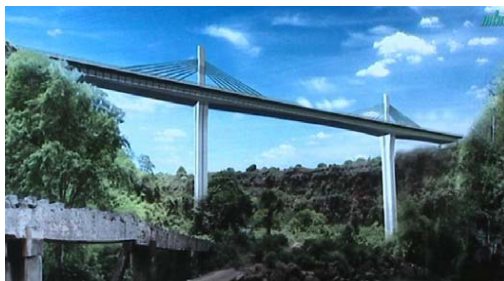


## A1-M1 LINK ROAD EXTRADOSSED BRIDGE Coromandel, Mauritius

The A1-M1 Link Road is a Highway Project of approximately 1 km (62 mi), currently under construction in Mauritius. The project will cross the Grand River North West Valley, a natural gorge with a depth of approximately 90 m (295 ft), with a 25 m (82 ft) wide dual carriageway 3-spans extradosed concrete bridge with spans of 100 m (328 ft), 130 m (426 ft) and 100 m (328 ft), supported by slender 100 m (328 ft) tall pylons. The deck is a single box girder, constant depth, cast in place by typical balanced cantilever method and required the use of temporary stay cables to progress the cantilever construction towards the abutments. Being subjected to major cyclonic winds, a detailed wind climate study of the project site was conducted to derive wind buffeting loads for the bridge design both in construction and service.

**Owner:** Road Development Authority (RDA) of Mauritius  
**Owner's Engineer:** Korean Expressway Corporation (KEC)  
**Contractor:** Bouygues Travaux Publics & VSL  
**Independent Checker:** COWI UK  
**Our Role:** Concept design for redesign, detailed design, deflection analysis, site support.

**Design-Build**  
**Main Span:** 130 m (426 ft)  
**Total Length:** 330 m (1,080 ft)  
**Width:** 25 m (82 ft)  
**Construction:** In progress



## WUSHAN DANING RIVER ARCH BRIDGE Chongqing, China

The Wushan Daning River Bridge is a key project of the Chongqing Section of Zhengzhou-Wanzhou High-speed Railway. The half-through arch bridge has a total length of 372 m (1220 ft) with a main span of 282 m (925 ft). The arches consist of a steel skeleton encased in reinforced concrete. The design speed is 350 km/h (217 mph). It is the country longest high-speed railway span with parallel reinforced concrete arches.

**Owner:** Yuwan Railway Co.,Ltd.  
**Designer:** China Railway Eryuan Engineering Group  
**Constructor:** China Railway Erju Group (CREG)  
**Supervisor:** SYSTRA and ZTCY (Beijing ZhongTieChengYe Construction Supervision Company) JV  
**Our Role:** Assistance to the construction supervisor.

**Total length:** 372 m (1220 ft)  
**Main Span:** 282 m (925 ft)  
**Construction:** In progress



# ENSHI FUNICULAR RAILWAY

Enshi, Hubei, China

The Enshi funicular railway, 1 km (.62 mi) long, is carried by steel twin-girder decks, steel box girder decks and a box truss over half of its length, and a slab track over the other half. These metallic structures have unique designs, dictated by the major constraints of the cable railway system and the constraints of accessibility, constructibility and transport to the site. For instance, most of the supports are bi-articulated steel bents and the structure carrying the passing track consists of twin-girder segments with steel box transition structures. This funicular railway system and its infrastructures were designed and built in only eighteen months.

**Owner:** Hubei Province

**Contractors:** POMA and TAIAN

**Independent Checkers:** Safety Center China and Bureau VERITAS

**Our Role:** Concept design, detailed design, deflection analysis, fatigue design, geotechnical design of all viaducts and slab track sections

**Design-Build**

**Main Spans:** 40 m (131 ft)

**Total Length:** Steel twin-girder deck 338 m (1,109 ft), steel box truss 290 m (951 ft)



# TELEO CABLE CAR

Toulouse, France

The TELEO project is a high capacity urban cable car project in Toulouse (France), with 3 stations over a length of 3 km (1.9 mi) connecting Toulouse metro line B to the Oncopole research center with an intermediate station at Toulouse main University Hospital (CHU Rangueil). The cable car line is supported by architectural pylons and complex concrete and steel lattice stations. The intermediate station is a bridge-like structure supported by a steel box truss 80 m (262 ft) long. The five slender pylons supporting the line over its 3 km (1.9 mi) length are made of steel box-girders. Wind tunnel tests of the pylons were necessary and tuned mass dampers were installed on top of each pylon to reduce wind vortex shedding induced movements and counter the risk of aeroelastic fluttering.

**Owner:** TISSEO (Toulouse transportation Authority)

**Owner's Engineer:** INGEROP

**Contractors:** POMA & BOUYGUES TP Régions France

**Our Role:** Concept and detailed design of all infrastructures (pylons and stations), geotechnical design.

**Design-Build**

**Pylon Height:** Up to 70 m (230 ft)

**Total Length:** 3 km (1.9 mi)

**Longest distance between pylons:**

G1 - P1: 407 m (1335 ft)    P1 - P2: 1014 m (3327 ft)

P2 - P3: 417 m (1368 ft)    P3 - G2: 137 m (450 ft)

G2 - P4: 217 m (712 ft)    P4 - P5: 573 m (1880 ft)

P5 - G3: 125 m (410 ft)

**Construction:** In progress



# GYEONG AN BRIDGE

Gyeong An, South Korea

This signature bridge is part of the Seongnam-Janghowon highway in South Korea. The 30 m (98 ft) wide extradosed structure supports six lanes of traffic over the Gyeong An River. The extradosed concrete box girder main bridge includes a 130 m (427 ft) main span and has a total length of 270 m (886 ft).

**Owner:** Ministry of Land, Infrastructure and Transport

**Design/Build Contractor:** Hyundai E&C

**Our Role:** Tender design (concept and basic design) for the entire bridge and detailed design for the main bridge superstructure.

**Design-Build**

**Main Span:** 130 m (427 ft)

**Total Length:** 270 m (886 ft)

**Width:** 30 m (98 ft)

**Construction Completed:** 2013



# MOOLCHAND BRIDGE

New Delhi, India

This bridge, located on the Delhi Metro Violet Line, crosses a busy roadway and highway. The structure is an extradosed bridge with a central plane of stay-cables. The deck is a precast segmental concrete box girder built in balanced cantilever.

**Owner:** Delhi Metro Rail Corporation (DMRC)

**Designer:** SYSTRA

**Contractor:** Gammon India

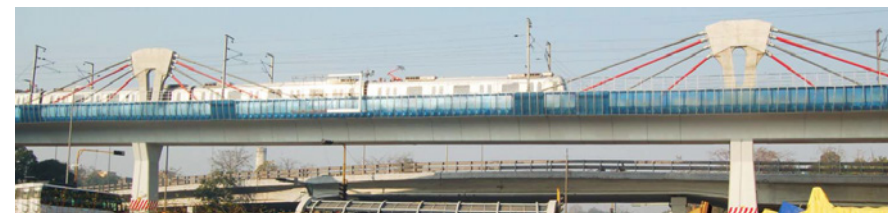
**Our Role:** Conceptual design, preliminary design, detailed design and technical site assistance, geometry control.

**Main Span:** 65.5 m (215 ft)

**Total Length:** 167.5 m (550 ft)

**Width:** 9.36 m (31 ft)

**Construction Completed:** 2010



## VIDOURLLE VIADUCT

Nîmes-Montpellier HSL, France

The Vidourle Viaduct is a composite steel-concrete bridge with steel trusses above the River Vidourle. It carries two tracks, and the design allows for the use of both high-speed rail passenger and heavy freight trains with a maximum speed of 350 km/hr (217 mph).

**Owner:** Oc'via-Bouygues

**Contractor:** Oc'via-Bouygues

**Our Role:** Concept, basic design, independent check of the detailed design.

**Design-Build**

**Span:** 90 m (295 ft)

**Construction Completed:** 2018



## MOAM BRIDGE

Seoul-Busan HSL, South Korea

This bridge is a composite steel-concrete bowstring arch. When completed, it was the world record span for high-speed rail bridge. It was erected in one piece parallel to the roadway then rotated into its final position.

**Owner:** Korea Railway Network Authority

**Client:** DAEWOO E&C

**Our Role:** Detailed design variant for Daewoo and assistance during construction.

**Span:** 125 m (410 ft)

**Width:** 14 m (46 ft)

**Construction Completed:** 2003





# DUBAI METRO

Dubai, UAE

The Green Line and Red Line of the Dubai Metro include 58.7 km (36.5 mi) of elevated guideway, mainly consisting of a U-shape precast segmental superstructure. The project won the French Engineering Award, the nation's highest honor for an engineering project.

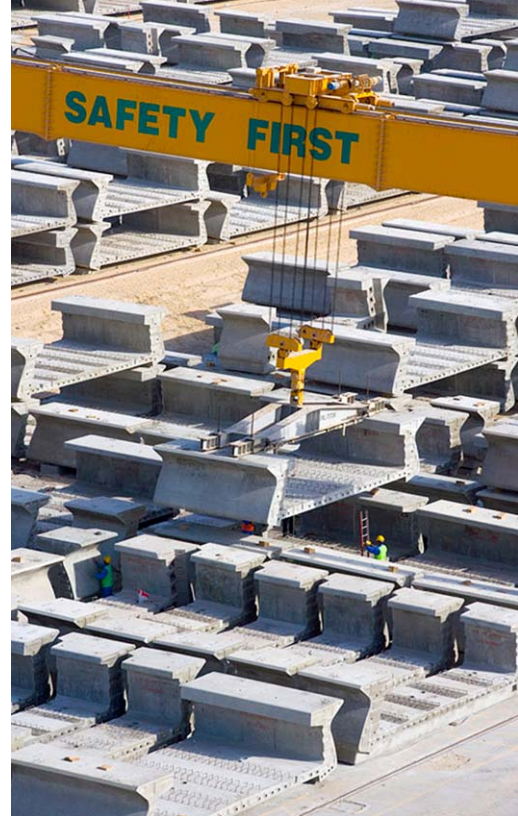
**Owner:** RTA

**Contractor:** Obayashi-Kajima-Yapi Merkezi JV

**Our Role:** Concept, basic design, checking of detailed design, construction supervision.

**Length:** 58.7 km (36.5 mi)

**Construction Completed:** 2010



# SOUND TRANSIT LINK LIGHT RAIL

Seattle, Washington, USA

This 5 mi (8 km) stretch of light rail elevated guideway extends from Boeing Field, at the southern outskirts of the city of Seattle, to the Seattle-Tacoma Airport. The project includes 4 mi (6.4 km) of elevated guideway carrying twin tracks. A unique V-shaped cross section was developed for the typical precast segmental superstructure built span-by-span. The long-span structures with spans ranging from 220 ft (67 m) to 350 ft (107 m) were built in balanced-cantilever using the same gantry used to erect the typical spans.

**Owner:** Central Puget Sound Regional Transit Authority

**Prime Consultant:** Hatch Mott MacDonald

**Contractor:** PCL

**Our Role:** Detailed guideway design, construction supervision.

## Design-Bid-Build

**Main Span:** 350 ft (107 m) maximum, 120 ft (36.6 m) typical.

**Total Bridge Length:** 4 mi (6.4 km)

**Width:** 26.5 ft (8.1 m)

**Construction Completed:** 2008





# RIYADH METRO

Riyadh, Saudi Arabia

The Riyadh Metro is a rapid transit system under construction in Riyadh, Saudi Arabia, which includes six lines with a total length of approximately 180 km (112 mi). It is scheduled to open between end 2022 and end 2023. Lines 1 and 2 contain 22 km (13 mi) of precast segmental viaduct consisting of simple spans, balanced cantilever bridges, and station viaducts. Line 3 comprises 26.4 km (16.4 mi) of segmental box girder viaduct with 37 m (122 ft) typical spans, 50 m (164 ft) continuous spans, and special structures with spans varying from 60 m to 95 m (197 ft to 312 ft). Typical and continuous spans are erected with an overhead truss, and long spans are erected in balanced cantilever.

**Owner:** Arriyadh Development Authority

## **Lines 1 and 2:**

**Contractor:** Bechtel, Almagbani, CCC, Siemens

**Lead Consultant:** AECOM

**Our Role:** Cat.3 check of foundations, substructure and superstructure.

**Construction:** In progress, completion planned 2022.

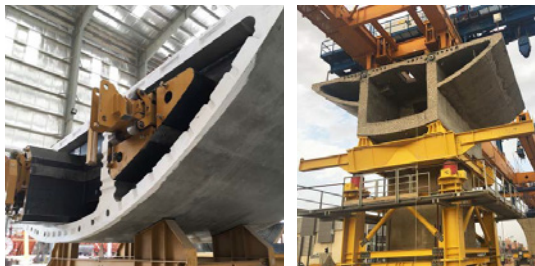
## **Line 3:**

**Contractor:** Impregilo, Larsen & Toubro, Nesma & Partners, Ansaldo, Bombardier

**Lead Consultant:** Idom

**Our Role:** Detailed design of bridges, construction engineering, and site support to contractor.

**Construction:** In progress



# MASHAAER MMMP MECCA

Mecca, Saudi Arabia

This critical link transports pilgrims between holy locations during the Hajj. When built, this system provided the greatest passenger capacity of any line in the world. It comprises a 17 km (10.6 mi) precast concrete guideway. The typical deck consists of twin precast single-track U-girders. The line includes nine 300 m (984 ft) long stations. The entire project was design and built within a 17-month period. This project received the FIDIC Centenary Award, the organization's highest honor.

**Owner:** MASHAAER

**Contractor:** CRCC

**Our Role:** Concept, basic design, detailed design, and construction supervision.

**Length:** 17 km (10.6 mi)

**Construction Completed:** 2010



# GREATER JAKARTA LRT

Jakarta, Indonesia

This project includes six corridors totaling 83 km (52 mi). Each span is composed of twin single-track U-girders. Typical simple spans are utilized for span lengths up to 30 m (98 ft). Extended pier caps connected by typical 30 m spans allowing up to 45 m crossing. The longest 27 long spans, with lengths between 45 m and 120 m (148 ft and 394 ft), are constructed using balanced cantilever box girders. It is scheduled to open in 2022.

**Owner:** Ministry of Transport Indonesia: Directorate General of Railways (DGR)

**Contractor:** PT ADHI KARYA (Persero) TBK

**Lead Consultant:** PT Adhi Karya

**Our Role:** Concept and detailed design of viaduct deck and pier caps, special bridge deck and substructures.

## Design-Build

**Total Bridge Length:** 42 km (26 mi)

**Long Span:** Three continuous span (main span: 75 m (246 ft), 90 m (295 ft), 120 m (394 ft) U-box and box girder type

**Width:** 12.1 m (39.7 ft)

**Construction:** In progress



# HCMC METRO

Ho Chi Minh City, Vietnam

The HCMC Urban Railway is a rapid transit system under construction in Ho Chi Minh City, Vietnam. The alignment consists of a 2.6 km (1.6 mi) underground section and 17.1 km (10.6 mi) of elevated metro. The line includes three underground stations, eleven elevated stations, five special bridges, two substations, and one depot. The viaducts are precast segmental U-girders with a typical span length of 35 m (115 ft). The typical spans were erected with a launching gantry.

**Owner:** Management Authority for Urban Railway of Ho Chi Minh City People's Committee

**Contractor:** Sumitomo-Cienco6 Consortium

**Our Role:** Designer for technical design of contract package 2 - elevated structure and depot (viaduct, bridges, elevated stations, buildings inside the depot).

## Design-Build

**Total Bridge Length:** 17.1 km (10.6 mi)

**Typical precast U-girder span:** 35 m (115 ft)

**Long Span:** Three span continuous (main span: 70 m (230 ft), 102.5 m (336 ft), 105 m (344 ft), 110 m (361 ft) box girder, four span continuous (main span: 70 m (230 ft) extradosed bridge.

**Width:** 11.1 m (36.4 ft)

**Construction Completed:** 2021



# DMRC LINE 6 EXTENSION BADARPUR FARIDABAD CORRIDOR

New Delhi NCR, India

This extension of the Delhi Metro includes 13.8 km (8.55 mi) of elevated viaduct and nine stations. Twin precast single-track U-girders comprise each span. Typical 27 m (88.6 ft) spans were erected with a launching gantry or two mobile cranes. Extended pier caps were utilized together with typical spans to achieve span lengths of up to 36.5 m (120 ft).

**Owner:** Delhi Metro Rail Corporation Limited  
**General Consultant:** Pacific Consultants International (PCI), Parsons Brinckerhoff International, Japan Railway Technical Service, TONICHI Engineering Consultants and RITES Ltd.  
**Contractor:** Larsen & Toubro  
**Our Role:** Tender and detailed design of viaduct structures, station structures, architecture and MEP services.

**Total Corridor Length:** 13.765 km (8.55 mi)

**Station No. & Length:** Nine elevated stations, each 140 m (459 ft)

**Typical Precast Span:** 27 m (88.58 ft)

**Width:** Two decks of 10.15 m (33.30 ft)

**Construction Completed:** 2018



# BUSAN-GIMHAE LRT

Gimhae, South Korea

The automatic metro line (LRT) connecting Busan and Gimhae via Busan airport is being constructed under the Korean Act governing private public partnerships in infrastructure projects. The 23 km (14.3 mi) long line is entirely built as a composite viaduct and includes 18 stations and one depot. It is operated with 28 m long driverless trainsets.

**Owner:** Busan-Gimhae Light Rail Transit Co., Ltd.

**Contractor:** Posco E&C, Hyundai Development Company and SYSTRA Joint Venture Systems

**Supplier:** Hyundai Rotem Company

**Our Role:** Detail design of the viaduct superstructures (23 km) and review of the design (substructure and stations) produced by our Korean subconsultant Dong Il, management of the interfaces between civil engineering and systems, assistance with testing and commissioning.

**Total Corridor Length:** 23 km (14.3 mi)

**Station:** 18 elevated stations

**Typical spans:** 37.5 m (123 ft) to 50 m (164 ft)

**Width:** 8.9 m (29 ft)

**Construction Completed:** 2011



# RÉSEAU EXPRESS MÉTROPOLITAIN (REM) Greater Montréal, Canada

The Réseau Express Métropolitain (REM) is the most important public transport infrastructure project in the region since the creation of the Montreal Metro in the 1960s and will be in 2023, date of its complete opening, one of the four largest driverless light rail systems in the world. The REM, with its 37.5 km (23.3 mi) of at grade tracks, 21.5 km (13.4 mi) of elevated tracks and 8.0 km (5.0 mi) of underground tracks, will double the current size of the Montréal metro system by linking the northern, western and southern suburbs to the city centre. The REM will be accessible 20 hours a day and 7 days a week through its 26 stations.

**Owner:** CDPQ Infra Inc., subsidiary of Caisse de dépôt et placement du Québec (CDPQ)

**Owner Engineer:** CIMA+/Hatch

**Contractor:** NouvLR consortium composed of SNC Lavalin Major Projects Inc., Dragados Canada Inc., Groupe AECOM Quebec Ltee, EBC Inc and Pomerleau Inc.

**General Consultant:** SNC Lavalin Inc., AECOM Consultants Inc.

**Subconsultant for the segmental elevated guideways design:** SYSTRA

**Subcontractor for the segmental guideway erection:** Rizzani de Eccher

**Rolling Stock and exploitation:** Groupe PMM composed of Alstom and SNC Lavalin O&M

**Our Role:** Tender and detailed design of segmental guideway, detailed design of 4 elevated stations, shop drawings production for the viaduct, construction services.

**Length:** 67 km (41.6 mi)

**Total elevated structure length:** 21.5 km (13.4 mi)

**Segmental guideway length:** 16.2 km (10 mi)

**Typical segmental span lengths:** 39m (127.95 ft) and 42.5m (139.44 ft)

**Deck width:** 9.3 m (30.5 ft)

**Construction:** In progress



# HIGH SPEED 2

United Kingdom

HS2 is a new high speed railway linking up London, the Midlands and the North, serving eight of Britain's 10 largest cities. High speed trains will travel between London and Birmingham on 134 mi (215 km) of dedicated track. They will pass through 31 mi (49 km) of tunnels and over 10 mi (16 km) of viaducts. Once operational, HS2 will serve over 25 stations connecting around 30 million people. Water Orton No.1&2 Viaducts are two long continuous single-track concrete box girder viaducts which carry High Speed 2 lines over significant major transport links (motorways, railway lines) and also the River Tame and its floodplain.

The viaducts have a precast concrete post-tensioned segmental deck supported on in-situ concrete piers and abutments which have piled foundations.

Birmingham & Fazeley Canal Viaduct is a five spans composite structure composed of three deck sections of total length 235 m (770 ft). The superstructure comprises a composite deck formed from a welded steel dual I-girder and precast/cast-in-situ reinforced concrete deck slab units.

**Owner:** HS2 Limited

**Contractor:** Balfour Beatty Vinci Construction JV

**Our Role:** SYSTRA is the Designer in a Design JV with Mott MacDonald, responsible for scheme and detailed design of these viaducts.



## Design-Build

**Total Bridge Length:** Water Orton 1 Viaduct is 1,423 m (4668 ft) long and includes 33 spans. Water Orton 2 Viaduct is 1311 m (4301 ft) long and includes 31-spans. Typical span length is 45 m (147 ft).

**Width:** Each deck supports one track and has therefore a narrow width of 7.22 m (24 ft).

**Birmingham & Fazeley Canal Viaduct total length:** 235 m (770 ft)

**Width:** Deck slab width is 12.35 m (4.5 ft)  
**Construction:** In progress





## ETIHAD RAIL - STAGE 2

United Arab Emirates

The Etihad Rail network will link freight facilities and passenger stations across the United Arab Emirates (UAE). It forms part of the wider Gulf Cooperation Council (GCC) railway network.

The Etihad Rail Stage 2 Package A comprises the design and construction of the permanent-way infrastructures works covering part of the rail network from Ghweifat to Ruwais through approximately 140 km (87 mi). SYSTRA is in charge of preparing and delivering the detailed design and shop drawings of 1 railway viaduct, 22 underpasses, 8 overbridges and 70 culverts. The viaduct consists in a 6 simple supported spans box girder casted in situ, with a variable length from 22 m (72 ft) to 36.50 m (118 ft). All spans are simply supported and designed to carry both freight and passenger trains.

The Etihad Rail Stage 2 Package D comprises the design and construction of the permanent-way infrastructure works covering part of the rail network in the Dubai, Sharjah and Northern Emirates through approximately 146 km (90.7 mi). SYSTRA is in charge of preparing and delivering the detailed design of 20 railway multi-span bridges totaling 7.72 km (4.3 mi) consisting in either precast I-girder bridges articulated in 40 m (131 ft) long typical spans, and cast-in-situ box girder bridges featuring 40 m (131 ft) to 45 m (147 ft) long spans. All spans are simply supported and designed to carry both freight and passenger trains. I-girders are 2.5 m (6.6 ft) deep and weighs about 120 t.

The Etihad Rail Stage 2 Package F2 comprises the design and construction of a series of freight facilities along the proposed Etihad Railway Network. The Khalifah Port Bridge is a 1 km (.62 mi) long sea-crossing heavy freight railway bridge linking the Khalifa Port Container Terminal and the mainland of Abu Dhabi. It is a single-track railway bridge of 26 spans of 40 m (131 ft), built with simply supported precast post-tensioned beams, erected with a special heavy-duty launching girder. Each beam is 3.3 m (10 ft) deep and weighs about 200 t.



**Owner:** Etihad Rail  
**Owner's Engineer:** Jacobs  
**Package A**  
**Contractor:** CSCEC-SKEC  
**Independent Checker:** Socotec  
**Package D**  
**Contractor:** CRCC - NPC JV  
**Independent Checker:** SMEC  
**Package F2**  
**Contractor:** Larsen & Toubro Limited/Power China  
**Independent Checker:** Socotec

**Design-Build**  
**Package A**  
**Package D**  
**Typical Span:** 40 m (131 ft)  
**Total Length:** 7,717 m (4,795 mi)  
**Width:** 14.8 m (48.5 ft)  
**Package F2:**  
**Typical Span:** 40 m (131 ft)  
**Total Length:** 1,040 m (.646 mi)  
**Width:** 8.5 m (28 ft)  
**Construction:** In progress



## SYSTRA VIZ 3D Renderings



### PHOTO CREDITS

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