2023

"ASBI Bridge Award of Excellence"

ASBI

American Segmental Bridge Institute

ASBI Bridge Award of Excellence

In Recognition of the Owners of Bridges Which Exemplify Concrete Segmental Bridge Design and Construction Excellence

In the 12th biennial American Segmental Bridge Institute (ASBI) Bridge Award of Excellence competition, 4 projects were selected as outstanding examples of concrete segmental bridge construction. Judging for the 2023 program was conducted via webinar.

All concrete segmental or cable-supported bridges located within the 50 United States and completed between January 1, 2021, and August 1, 2023, were eligible for the 2023 awards competition. The jury also considered international projects involving ASBI members. Entrants in the competition were judged on the basis of the following criteria:

- Innovation of Design and/or Construction
- Rapid Construction
- Aesthetics and/or Harmony with Environment
- Cost Competitiveness
- Minimization of Construction Impact on the Traveling Public (when applicable)

Bridge Awards Jury

Nyssa Beach, *Chair*
Colorado DOT

Timothy Barry
RS&H, Inc.

Wally Jordan
Kiewit Infrastructure South Co.

Bridge Award Of Excellence Winners

Awards will be presented to bridge owners' representatives during the 2023 ASBI Convention on Tuesday, November 7, 11:30 a.m. – 12:00 p.m., at The Westin La Paloma Resort & Spa, Tucson, Arizona. Following are jury comments, project details, and participant credits for the winning entries *(ASBI Members are noted in bold)*.

Cline Avenue Bridge, East Chicago, Indiana

Category: Urban Bridges

The new Cline Avenue Bridge in East Chicago, Indiana, is a precast concrete segmental bridge that crosses the Indiana Harbor and Ship Canal and connects SH 912 to I-90. This elevated expressway connection provides a sustainable and vital link to important commercial industries and employment centers along the Lake Michigan shoreline, the Gary/Chicago Airport, and the Lake County Region.

To overcome the challenges of working over the canal and active railroads and to avoid environmental and navigational impacts, the concrete segmental solution was built using the balanced cantilever method of precast segment erection. Each of the 685 precast concrete superstructure segments was cast in a casting yard located on the Cline Avenue Bridge property. The site allowed access for erecting segments primarily with ground-based cranes. Erection was performed at two headings using two large-capacity cranes to lift and set the segments. Only the 314'-6" long main span was erected with marine operations over the canal. With the casting yard on the west side of the canal, approximately one-half of the segments were delivered to the cranes by the straddle lift. Once erection progressed across the canal, the remaining segments were transported to the other side of the canal to complete erection of the east side spans.

The new bridge has an estimated design life of 100 years. Concrete segmental bridges as a structure type are inherently durable due to the use of sustainable materials and biaxial post-tensioning.

The precast superstructure segments incorporate an integral wearing surface with a low-permeability, high compressive strength concrete mix. The new bridge construction used local materials and provided over 300 local jobs, which enhanced economic opportunities throughout the area.

The City of East Chicago's goal of completing the new bridge as expeditiously as possible was accomplished with a precast concrete segmental solution. This design facilitated rapid construction of the superstructure, regardless of weather, while concurrently building the substructure. Balanced cantilever construction techniques were utilized to build the bridge continuously and without interruption.

Construction team leaders collaborated with the engineering team during design to ensure all constructability reviews were incorporated efficiently from the start. Design team leaders worked with the inspection team during construction to ensure design intent was incorporated and questions were addressed quickly.

It is important to the City of East Chicago and surrounding communities that the new bridge serves as the Gateway of Lake County. To honor beautiful aesthetics while remaining low-maintenance and highly durable. The new bridge both complements and blends into the local setting, allowing the bridge to enhance the surrounding environment rather than distract from it. Color and texture are predominantly that of natural concrete, accented with a vibrant blue, complementing the hues of the adjacent areas.

The superstructure features long open spans and box girder webs that taper down to a narrow width at the top of the pier cap. The slender rectangular piers flare transversely at the top and include colorful blue inset reveals to enhance the bridge's appearance. Aesthetic lighting located within each inset reveal uses soft white LED lighting to accentuate the pier shape at night. Energy-efficient, low-maintenance LED roadway lighting provides focused illumination on the bridge deck while minimizing light spillage.

The new Cline Avenue Bridge construction cost was $436/SF. Because traditional Department funding was not available to

Photos Courtesy of FIGG

Owner:
United Bridge Partners

Owner's Engineer:
FIGG

Designer:
FIGG

Design-Build Team:
FIGG Bridge Builders

Contractor:
FIGG Bridge Builders

Construction Engineering Services:
FIGG

replace the bridge, the design, construction, operation, and maintenance of the new bridge was privately funded without using any federal, state, or local tax dollars. This new project is supported by user fees (tolls) and uses a modern all- electronic open road tolling system. The new bridge provides ample cost savings to the Lake County Region by restoring a critical transportation route after an 11-year shutdown.

The new bridge was constructed with minimal impact on the traveling public. The bridge is located within a congested industrial area surrounded by businesses and residences with limited access points for construction. The project site also includes numerous underground utilities, overhead electric lines, and tracks and facilities for multiple railroads. Segmental balanced cantilever construction eliminated impacts to these facilities and allowed for uninterrupted railroad operations during construction. Segmental balanced cantilever construction also eliminated the need for temporary piers in the river and allowed the construction to minimize the impact to the Indiana Harbor and Ship Canal below.

The new Cline Avenue Bridge utilized concrete segmental construction techniques to overcome the challenges of working in a congested industrial area, over the canal, and over-active railroads. The concrete segmental design achieved aesthetics, form, and function while reconnecting a region that was disconnected for 11 years, enhancing the quality of life and providing the community with an improved transportation network.

Jury Comments

The use of segmental construction provided a solution to a challenging corridor that included a rail yard and a marine crossing. Collaboration among multiple stakeholders and solutions presented, such as ensuring construction operations could advance independent of weather conditions, demonstrated a unique and driven problem-solving approach to delivering this bridge for the community. The project was also able to provide a very cost-effective solution while providing an aesthetically mindful structure in its simplicity that incorporates lighting, color, and clean geometric lines to honor its role as the Gateway to Lake County.

Constructability Review/Estimating Services:
Armeni Consulting Services, LLC

Construction Engineering Inspection:
FIGG Bridge Inspection

Precast Producer:
Cline Precast, LLC (A FIGG Company)

Formwork for Precast Segments:
Ninive

Erection Equipment:
FIGG Bridge Builders

Post-Tensioning:
Structural Technologies VSL

Bearings:
Cosmec

Expansion Joints:
D.S. Brown Company

Epoxy Supplier:
Pilgrim

Prepackaged Grout:
Euclid Chemical Company

Rose Fitzgerald Kennedy Bridge

Wexford – Waterford, Ireland

Category: International

The Rose Fitzgerald Kennedy Bridge, located in Ireland, is a ground-breaking segmental structure with an iconic design, the longest post-tensioned all concrete extradosed span in the world of its kind. As part of the N25 New Ross Bypass scheme, the bridge serves to enhance connectivity between Wexford and Waterford, spanning the River Barrow, a wide tidal river. The bridge's all concrete design aims to blend harmoniously with the surrounding landscape while providing a durable and low-maintenance structure.

The bridge features a three-tower extradosed design, with all three towers having different heights and the central tower being the tallest rising 27m (88ft) above deck level. The proportions of the bridge follow the golden ratio, and the cable arrangement forms a harp configuration with shallow angles for the cables. The four central spans have lengths of 95- 230-230-95m (3 I 1-754-754-311ft) and the difference in height between the two ends of the bridge result in the difference in tower heights, creating a unique rhythm that addresses the road's continuous climb.

The bridge's cables are arranged in a clean and elegant manner as a single plane of cables located in the center of the 21m (69ft) wide deck with two lanes of traffic in each direction. Cable sizes vary from 109 to 121 strands at shallow angles varying from 9 to 11 degrees due to the longitudinal slope of the deck. The deck is slender, with a 3.5m (11.5ft) deep section (span/depth ratio of 1/65) at midspan, 8.5m (28ft) over the central tower (span depth ratio of 1/27) and 6.5m (21.5ft) over the side towers (span depth ratio of 1/35).

The design of the bridge was done to Eurocodes and focuses on maximizing durability and minimizing long-tem1 maintenance. Extensive analyses were conducted to ensure the structure's resilience and robustness against extreme events such as ship impact, fire, and wind. The presence of the central plane of cables in the extradosed configuration presented challenges in the transverse flexural design of the deck, which required careful consideration and detailing of reinforcement and transverse post-tensioning.

Sustainable design principles were integrated into the project, aiming to reduce the embedded carbon footprint, and utilizing locally sourced materials. High-strength concrete, up to 80MPa (12ksi) and ground granulated blast-furnace slag (GGBS) were used to optimize the structure's strength and durability. Stainless-steel reinforcement was used in the central tower to ensure a long design life in a tidal zone.

Full section form travelers were used to construct the main spans, with a combination of in situ and precast elements used. The main box was cast in situ with precast slabs used in the outer inclined webs that support the cantilevers. Internal steel struts were used at the cable locations to optimize the transverse flexural behavior. Constructing the main spans in this method allowed a minimization of environmental impact on the river and impacts on the navigational channel as no support towers were required. The approach spans were built using a falsework truss for the central box and a wing traveler for the cantilevers which were poured in a second stage.

Photos Courtesy of Arup

Owner:
Transport Infrastructure Ireland

Owner's Engineer:
Mott MacDonald

Designer:
Arup and Carlos Fernandez Casado

Design-Build Team:
Dragados UK-Ireland and BAM Construction

Contractor:
Dragados UK-Ireland and BAM Construction

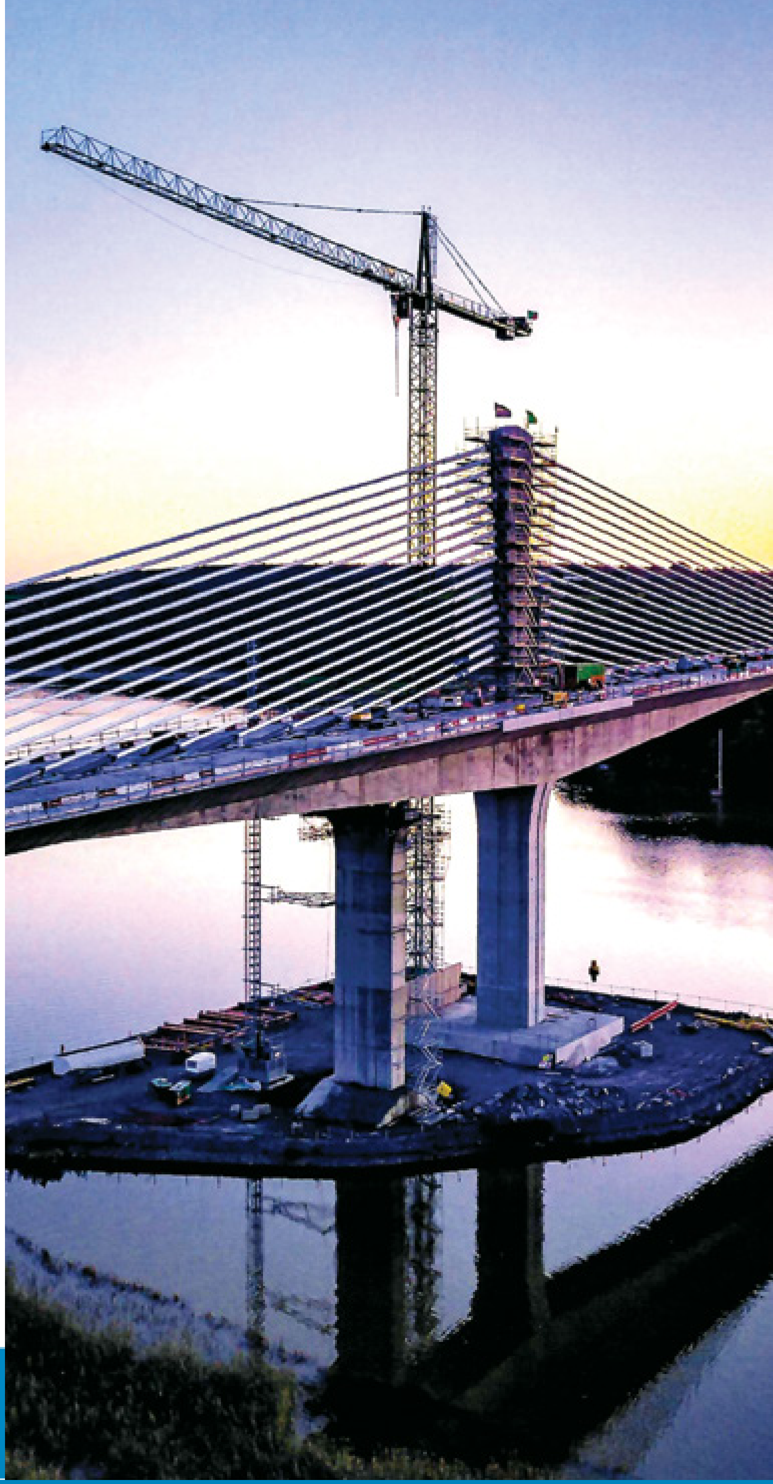
Construction Engineering Services:
Arup and Carlos Fernandez Casado

The asymmetry in height between the central and lateral towers led to a balanced cantilever construction of 140m (459ft) from the central tower, which is a world record in extrados concrete construction.

The construction of the central tower cantilevers posed significant challenges due to their asymmetry, shallow cables, and relatively shallow structural depth. State-of-the-art analysis techniques were employed to predict the behavior of the structure during construction, and the bridge proved to be flexible with substantial deflections as it neared closure. Despite the complexity of the form traveler cycle which included reinforcement placement, concreting, precast panel installation and multiple stressing operations, a cycle of 8 days was achieved at peak production. The whole construction took 42 months from foundations to road opening.

The bridge is equipped with a comprehensive structural health monitoring system to continuously measure bearing reactions, displacements, cable forces, and strains. This monitoring system aids in the maintenance and upkeep of the structure. Final construction cost was around $95,000,000 which represents a cost per square foot of approximately $450, a competitive cost for a world record breaking concrete segmental extradosed bridge with an iconic tower arrangement.

The Rose Fitzgerald Kennedy Bridge stands as a remarkable engineering feat, seamlessly blending aesthetics, functionality, and sustainability. It has greatly improved connectivity, reduced congestion, and enhanced the lives of residents in the area, while also being a visually striking landmark in Ireland.



Jury Comments

Stunningly beautiful bridge design. There was clearly a great deal of thought and ingenuity put into the design development to achieve an impressive world class structure, while still maintaining cost effectiveness by combining segmental technology and numerous construction innovations. Leaning on the golden ratio for both the geometric design of the structure as well as aesthetics creates a beautiful balance for this bridge where it is nestled in the Irish landscape and rolling hills. This bridge met the project's unique structural challenges, delivered a world record for extradosed construction, while also serving as a masterful work of art.

Constructability Review/ Estimating Services:
Arup and Carlos Fernandez Casado

Construction Engineering Inspection:
Arup and Carlos Fernandez Casado

Precast Producer:
Banagher (Wing Panels)

Formwork for Cast-in-Place Segments:
Rubrica

Erection Equipment:
Ulma (Approach Span Falsework)

Post-Tensioning:
Tensa

Stay Cable Materials:
Tensa

Bearings:
Mekano4

Expansion Joints:
Maurer

Prepackaged Grout:
BASF

The Wekiva Parkway Section 6 Project

DeLand, Florida

Category: Bridges Over Water

The signature Wekiva Parkway Section 6 project rehabilitated a vital stretch of the Florida Department of Transportation's (FDOT) $1.6 billion Wekiva Parkway through conscientious design and construction practices. The Wekiva Parkway (SR 429) connects to SR 417, completing a beltway around Central Florida. FDOT divided its Wekiva Parkway project into eight self-contained contracts and hired the Superior Construction-WGI, Inc. design-build team to complete Section 6 of the parkway. WGI, Inc. (WGI) was the lead designer for the project, supported by Finley Engineering (now COWI) for the segmental portion of the project.

This $243 million design-build project, which received the American Council of Engineering Companies of Florida (ACEC-FL) Grand Engineering Excellence Award, redirects traffic from the congested I-4 corridor and improves traveler safety. Section 6 of the Wekiva Parkway comprises nearly six miles of limited access toll road primarily along the existing SR 46 corridor from SR 429 to just west of Longwood-Markham Road. The project scope included a non-tolled service road for local travel, three new bridges over the Wekiva River, and nine wildlife bridges to allow animals to pass safely between the Seminole State Forest and Rock Springs Run State Reserve, for a total of 18 bridges with over 1.268M square feet of new bridge deck.

The design-build team used 13 alternative technical concepts to improve upon the preliminary design, maximize mobility during construction, expedite construction, and enhance safety without compromising the surrounding environment. Because Section 6 is part of eight total adjoining Wekiva Parkway sections, the project management team

Photos Courtesy of WGI

Owner:
FDOT

Owner's Engineer:
FDOT

Designer:
Finley Engineering Group

Design-Build Team:
Superior Construction and WGI

Contractor:
Superior Construction

Construction Engineering Services:
Finley Engineering Group

had to strategically interrelate various features, including utility adjustments, with the adjoining Wekiva Parkway projects to the west to ensure cohesion.

Additionally, The Wekiva River is designated as a Federal Wild and Scenic River, which necessitated environmentally conscious construction methods. Throughout the preliminary design process, the Superior Construction-WGI team coordinated extensively with local agencies, and stakeholders including the National Park Service to achieve approval in accordance with the National Wild and Scenic Rivers Act.

The project's most visible aspect is the Wekiva River Crossing, which includes three complex 2,068-foot-long bridges, each of which included cast-in-place (CIP) concrete segmental spans totaling 880 feet with a 360-foot main span. They were constructed from the top down to protect the surrounding environment during the construction phase and provide undisturbed and safe habitats for wildlife after completion. The design-build team's innovative use of top-down balanced cantilever construction for the segmental bridge spans over the Wekiva River minimized environmental impacts by eliminating work in the water. They also used wireless turbidity sensors to continuously monitor water turbidity.

Superior and WGI developed their creative construction concept alongside Shelby, a qualified team with unique segmental bridge construction experience, and through a strategic partnership with FINLEY Engineering. Because segmental construction requires post-tensioning systems that must be protected, Superior used a flexible filler of microcrystalline wax instead of grout to provide strand protection for continuity tendons, enabling tendon strand replacement over time, if necessary. For the conventional bridges, the design-build team used an overhang system that was delivered in 20-foot pre-constructed sections, enabling faster deck pours. The contractor also used a TyBot system, which uses lasers and cameras to make reinforcing steel tie connections, further speeding up production.

To minimize the impact of construction on the traveling public and maintain a wildlife crossing, the contractor placed an ACROW Bridge for use during one phase of construction. The proprietary modular steel bridge was delivered on-site and assembled for temporary use during the traffic shift from the existing CR 46. Once traffic shifted onto the permanent SR 429, crews disassembled the ACROW bridge and shipped it back to the owner.

The entrant provided the best value project by leveraging the design-build team's design, innovation, and construction expertise in the collaborative design-build process, overcoming numerous karst topography challenges, including extending a span to bridge a raveled zone, using rigid inclusions for five sinkholes that developed, and redesigning two pile-supported bridges and one wildlife crossing. FDOT evaluated the team on its value-added features as part of the proposal evaluation. To this end, the Superior/WGI team provided a table of 22 value-added features impacting aspects of the project ranging from asphalt pavement to bridge elements to intelligent transportation systems components, and more. Ultimately, the design-build team was able to deliver the following features:

- A parallel service road for local travel
- A multi-use trail facility
- Electronic tolling gantries
- Side-street construction
- Intelligent transportation systems (ITS)
- An entrance road for Rock Springs Run State Reserve Park
- Three signature cast-in-place segmental bridges over the Wekiva River
- Nine wildlife bridges (>17,328 feet)

This project provided important transportation infrastructure that minimized impacts on the Wekiva River Basin resources, helped maintain wildlife habitat continuity, reduced vehicle-wildlife conflicts, and improved connectivity in Florida's burgeoning central region.

Jury Comments

This bridge includes an impressive three signature bridges built using segmental construction and true top-down methods that were key to providing a successful project in a highly environmentally sensitive area. The project team showed unique problem solving and a drive to push innovation for the segmental bridge industry through its use of robotics, construction monitoring solutions, and innovative and safe construction techniques. Many other technological and innovative features were utilized to deliver this project and provide an aesthetic structure to match the surrounding natural beauty. The elimination of impacts to the waterway during and after construction are a testimony to one of the key attributes of concrete segmental bridging. While experiencing challenging circumstances, the project maintained cost effectiveness and was delivered successfully.

Constructability Review/ Estimating Services:
Stantec

Construction Engineering Inspection:
RS&H

Formwork for Cast-in-Place Segments:
NRS

Erection Equipment:
NRS

Post-Tensioning:
Structural Technologies VSL

Bearings:
R.J. Watson, Inc.

Expansion Joints:
Watson Bowman Acme

Epoxy Supplier:
Pilgrim Permocoat

Prepackaged Grout:
BASF and **Euclid Chemical Company**

JFK Memorial Causeway

Corpus Christi – Padre Island, Texas

Category: John E. Breen Segmental Innovation Award

(This is a special award category for historical projects that made significant contributions to concrete segmental technology.)

The John F. Kennedy (JFK) Memorial Causeway Bridge, completed in 1973, carries Texas Park Road 22 over the Gulf Intracoastal Waterway (GIWW), connecting Corpus Christi to North Padre Island, Texas.

The original causeway was built in 1950 as a 2-lane toll road with swing bridges across two channels, and in 1973, it was converted to a 4-lane public roadway. Today, it consists of thirty-six prestressed concrete beam approach spans and a continuous three-span segmental unit over the GIWW. The total bridge length is 3,280 ft, and the width is 60 ft, carrying two lanes in each direction. The main span continuous unit was the first precast, post-tensioned (PT), segmental bridge built in the U.S. and was primarily designed by the University of Texas (UT) with an assist from the Texas Department of Transportation (TxDOT).

The project started with a TxDOT research project conducted in 1969 by John E. Breen, PhD, PE, of UT, to identify a viable concrete alternate to structural steel bridges in the 130- to 350-ft-span ranges. This project, *Long Span Prestressed Concrete Bridges of Segmental Construction, State of the Art* (0-121-1), identified segmental bridges as a viable candidate based on their studies of bridges recently constructed in Europe. TxDOT then extended UT's contract to study other design and construction aspects of segmental construction in four subsequent studies—: *Epoxy Resins for Jointing Segmentally Constructed Prestressed Concrete Bridges* (0-121-2); *The Design and Optimization of Segmentally Precast Prestressed Box Girder Bridges* (0-121-3); *Computer Analysis of Segmentally Erected Precast Prestressed Box Girder Bridges* (0-121-4); *Construction and Load Tests of a Segmental Precast Box Girder Bridge Model* (0-121-5); culminating with a final report, *Minimizing Construction Problems in Segmentally Precast Box Girder Bridges* (0-121-6F). Actually, the JFK Causeway was the second precast segmental bridge built because the first was the 1/6 scale model constructed and tested by UT for the 121-5 project. UT held several meetings with prospective contractors during scale model construction and testing to help them understand the challenges to be faced during construction.

For the contract documents, UT developed the specifications for the segment casting controls, epoxy- joining of segments, and stressing and grouting of tendons. UT also provided some construction oversight both in the casting yard and at the bridge site to supplement and train TxDOT personnel.

The segmental unit has a 200-ft-long main span over the GIWW, with 100-ft-long back spans for a total continuous unit length of 400 ft. The unit consists of a pair of segmental precast box girder sections that are 13 ft wide at the base, 28 ft, 8 in. wide at the wings, and 8 ft deep. The bridges are supported by two reinforced concrete columns at each interior pier, with the pier supported on large pile footings. The ends are supported on three-column transition bents.

The typical span segments were 10 ft long while the end segments and the pier segments were 5 ft long each. The precast segments included shear keys in each web to transfer vertical shear loads between adjacent segments and an alignment key in the top and bottom slabs

Photos Courtesy of WJE TxDOT Bridge Assessment, April 30, 2020

Owner:
TxDOT

Owner's Engineer:
University of Texas at Austin

Designer:
John E. Breen, PE, Ph.D.

Contractor:
HB Zachry Corporation

at the box centerline to aid in segment alignment during erection.

Post-tensioning tendons, consisting of a varying number of prestressing strands, were threaded through metal ducts cast into the segments to hold the segments together and provide a minimum level of compression, under all service loads, over the full cross-sectional area of the box sections. During segment erection, cantilever tendons in the top slab were used to hold the segments in place as subsequent segments were erected. Once the full complement of segments was erected, a cast-in-place closure pour was made at midspan of the main span. Continuity tendons were threaded into metal ducts running from the deck down into the bottom of the box segment to produce a fully continuous structural unit. The pier hold-down bars were released and abandoned at this point.

The cantilever tendons were anchored in the box webs near the large shear keys and the continuity tendon anchors were located either at the end of the unit or in the top slab.

The precast segments were cast by PCI member, Heldenfelds Brothers Construction Corporation, at their Corpus Christi precast yard. The main unit was constructed by first erecting the two 5-ft-long pier segments on top of the reinforced concrete piers and engaging hold-down bars to temporarily connect the pier segments to the piers. The span segments were transported to the site and lifted into position using cranes and a custom-designed erection jig to hold the segments in place for application of the epoxy. The segment-mating faces were coated with epoxy before joining them together. The epoxy serves both as a lubricant when the segments are brought together, as well as a permanent joint seal between the precast segments. The span segments were erected on alternating sides of the piers so that the span remained no more than one segment out of balance at all times during construction—a process known as "balanced-cantilever construction." The precast segments included large shear keys in each web to transfer vertical shear loads between adjacent segments and an alignment key in the top and bottom slabs at the box centerline to aid in segment alignment during erection. No permanent moment connection was made between the span and the main piers.

PT tendons, consisting of a varying number of prestressing strands, were inserted through metal ducts cast into the segments. The tendons were stressed to hold the segments together and provide a minimum level of compression under all service loads, over the full cross-sectional area of the box sections. During segment erection, cantilever tendons in the top slab were used to hold the segments in place as

Jury Comments

This project remains an iconic piece of history for our industry and was the first post-tensioned concrete segmental bridge built in the United States and is deserving of recognition for its innovation and impact to the segmental industry. The choice to explore and ultimately utilize a new technology, not yet done in the United States was groundbreaking. The research implemented on this structure, and continued research, condition assessments, and monitoring throughout the life of the structure, has served as key knowledge and inspiration to be disseminated to following generations of industry professionals and into the implementation of segmental bridges that followed in its footsteps. With it's marine-exposure environment and the lack of modern corrosion-mitigating features included in its original design, the overall good condition of this structure demonstrates the durability and longevity of segmental bridge construction and the quality and care in the implementation of this specific bridge.

Construction Engineering Inspection:
TxDOT

Precast Producer:
Heldenfelds Brothers Construction Corp.

Photo Courtesy of WJE TxDOT
Bridge Assessment, April 30, 2020

subsequent segments were erected. Once the full complement of segments was erected, a cast- in-place closure pour was made at the middle of the main span. Continuity tendons were inserted into metal ducts that extended from the deck down into the bottom of the box segment to produce a fully continuous structural unit. The pier hold-down bars were then released and abandoned. The cantilever tendons were anchored in the box webs near the large shear keys. The continuity tendon anchors were located at the ends of the unit and in the top slab.

Construction challenges for this new type of construction were to be expected. The contractor had substantial diffculty inserting some of the tendons and matching the actual and calculated elongations. High friction values were noted early on in this process. The diffculties were attributed to the contractor's choice to use a relatively thin-walled duct material that was more susceptible to denying, pinching and kinking during fabrication. The contractor also elected not to use any duct stabilizing devices, such as inflatable rubber tubes, to internally brace the ducts during casting operations. They decided to address the friction issue by using a water-soluble oil to coat the tendons before inserting them into the ducts. This meant the ducts had to be flushed with water before grouting. This duct flushing practice is no longer used. Grouting was performed within 48 hours of stressing to protect against corrosion in the marine environment.

In a few cases they had significant difficulties inserting the tendons into the ducts. In one case reported, the tendon sock used to pull the tendons through the duct became entangled on a lip of duct and the force of the tendon unwound the spiral metal duct from the concrete and created a large blockage. The damaged spiral metal duct was removed, and the tendon was grouted in the affected segments without a duct in place.

Web cracking was noticed early on in construction as the segments were erected, and the negative moment (cantilever) tendons were stressed. These cracks followed the tendon path and were visible on the interior and exterior of the boxes. At this point all 84 segments had been cast so the project was halted while UT conducted a study of the cracks to determine their cause and impact on the structure. UT determined that there were three primary causes of the cracks, which did not show up in the original 1/6 scale model upon which the design was based:

1. In many of the as-cast segments, reinforcing steel that had to be cut to place the anchors was not replaced or was only partially replaced, leaving the region around the anchors with less reinforcing than called for in the plans. These bars were always replaced in the model.
2. The actual anchors used in the bridge were a cone-type anchor whereas the model had used a flat plate bearing type anchor.
3. The spiral reinforcing in the model (considering its scale) was much more substantial than that used in the bridge segments.

UT's accelerated study concluded that the cracks did not affect the capacity of the bridge and they did/would not extend or grow under service load. TxDOT subsequently required the contractor to "Vee" and seal the cracks with epoxy on both the interior and exterior surfaces for corrosion protection.

In a recent (2020) condition assessment commissioned by TxDOT, Wiss, Janney, Elstner Associates, inc. (WJE) concluded that the bridge overall was in fair to good condition considering its age and location along the Gulf Coast, with only a few minor corrosion-related issues largely attributed to ineffective quality control during fabrication of the segments. The PT system was investigated closely and found to be in very good condition. The web cracking identified during construction has not resulted in any long-term performance issues. Although the documented grouting procedures included some practices that are no longer recommended—primarily flushing of tendon ducts and use of expanding admixtures—WJE identified no evidence of significant or systemic problems with either the installation or composition of the tendon grout.

ASBI

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