American Segmental Bridge Institute

2021

"ASBI Bridge Award of Excellence"

2021 Bridge Awards of

In recognition of the owners of bridges which exemplify concrete segmental bridge design and construction excellence.

In the 11th biennial American Segmental Bridge Institute (ASBI) Bridge Award of Excellence competition, 5 projects were selected as outstanding examples of segmental concrete bridge construction. Judging for the 2021 program was conducted via webinar.

Excellence

All concrete segmental or cable-supported bridges located within the 50 United States and completed between January 1, 2019 and August 1, 2021 were eligible for the 2021 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)***

2021

Bridge Awards Jury

Kevin Western, Chair
Minnesota DOT

John Armeni
Armeni Consulting Services, LLC

Allan Brayley
Flatiron

BRIDGE AWARD OF EXCELLENCE WINNERS

Awards will be presented to bridge owners' representatives during the 2021 ASBI Convention Monday, November 8, 4:00 p.m. – 5:00 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).

All Photos Courtesy of Volkert, Inc.

I-59/20 Birmingham Central Business District Bridges

Category: Urban Bridges

The I-59/20 Birmingham CBD Bridges carry heavily traveled Interstates 59 and 20 through downtown Birmingham. The original structures were designed for 80,000 vehicles per day but current traffic exceeds 160,000 and the bridges exhibited signs of deterioration due to age and use. Alabama DOT decided to replace the CBD Bridges, creating a new, higher capacity highway. The new bridges carry up to six travel lanes and shoulders both directions. Alignments follow the original, with construction progressing with demolition. Separate eastbound/westbound structures, each approximately 6,500' long, carry mainline traffic. Each bridge is comprised of two precast segmental concrete box-girders joined by a longitudinal closure strip. In total, this includes 172 spans and 2,316 superstructure segments. Average span lengths of 165' were constructed in the span-by-span fashion.

Innovation of Design and/or Construction

A precast segmental concrete box-girder bridge was the only option that could be erected within the mandated 14-month closure. This allowed for offsite precasting with fast erection times. The precast segmental concrete option also offered increased span lengths, improved durability, and aesthetics.

Substructure challenges included limited right-of-way, utility conflicts, varying geotechnical conditions along the corridor, and limited vertical clearance under existing structures for pre-closure foundation work. The new bridges are in the same footprint as the original. The new columns were strategically located during design to avoid the original foundations. This allowed substructure work to begin prior to closure. The substructure included elements that could be installed with low-height equipment, allowing work to commence prior to closure.

The design team utilized single column piers placed under each segmental girder line. The Contractor elected to precast piers as separate columns and caps. Reinforcement for pier sections was made continuous with grouted couplers, allowing for faster pier construction once demolition was completed. Prior to closure of I-59/20 and due to limited vertical clearance, Johnson Bros. built as many of the footings that could be constructed using low overhead equipment to install drilled shafts, micropiles, and steel h-piles. The footings were covered with fill for protection prior to demolition.

The superstructure design featured elements that could be precast and erected quickly. By standardizing many common elements, the Contractor would be able to work in "assembly-line" fashion.

The casting yard was four miles away, allowing precast concrete segments to be easily transported. The Contractor utilized a unique technique, erecting each span on falsework towers, with each segment supported individually, allowing work on up to eight spans simultaneously, facilitating non-linear construction. By interstate closure, 1,000 segments were cast and ready for erection. All segments were erected in 217 days.

Rapid Construction

ALDOT decided to allow I-59/20 to be closed for 14 months of construction. The contractor was given an incentive/disincentive of $250,000/day, with the maximum bonus capped at $15 million. The I-59/20 corridor reopened to traffic on January 17, 2020, two months early. The entire process was efficient; demolition was completed in just over half the allotted 90 days. Seventy percent of foundations were installed before demolition. During peak construction, up to 400 superstructure segments were installed per month. By July 2019, 50% of bridge segments were in place; the last precast sections were delivered and installed in October 2019.

Aesthetics and/or Harmony with Environment

The highway passes through Birmingham's Central Business District, adjacent to many local landmarks. The new viaduct has a sleek, modern appearance meshing with downtown, projecting a vibe of renewal and growth; a new 10-block, 31-acre project, CityWalk BHAM, will be constructed under the highway with a mix of amenities. Bridge height was maximized to provide a sense of openness along the corridor. Columns under each individual girder line were aligned to minimize visual disruption; column design was single-column piers with vertical fluted lines.

Jury Comments

This project showcased what a successful segmental bridge can be: efficient design, minimizing traffic interruption, contractor/designer optimization of construction techniques through several challenges (urban setting, changing foundations, short construction schedule). The clean aesthetics will allow the city to utilize the open areas and color options to truly create a gathering place under the bridge. An outstanding application of segmental construction noteworthy for the innovative erection method of using conventional cranes and supporting the segments on falsework towers rather than an overhead gantry or underslung trusses allowed work on multiple headings to meet the 14-month project schedule.

Cost Competitiveness

In planning projects, ALDOT considers the cost/benefit ratio, usually between $1,000-$8,000 per motorist; this project falls between $2,000-$3,000, making it highly cost-effective. The I-59/20 Birmingham CBD Bridges cost was $195 million, or approximately $190 per square foot. This was a cost competitive project that will last for many decades into the future. The challenges and time constraints of this project proved how beneficial segmental bridge design and construction can be.

Minimization of Construction Impact on the Traveling Public

The most efficient way for this project to be constructed was for the entire one-mile downtown segment of highway to be closed to traffic for a year. There was extensive outreach and publicity about the impending closure, so travelers could plan to use nearby I-459 instead. The project-dedicated web site featured detailed detour maps. Travelers could also use ALDOT's project hotline for information and updates. The shorter construction duration also meant a quicker return to normal traffic conditions. Allowing the construction team unimpeded access to the site was a win-win for everyone.

CREDITS

Owner:
Alabama DOT

Owner's Engineers:
Volkert, Inc.

Designer:
Corven Engineering Inc./
Hardesty & Hanover (Superstructure)
Volkert, Inc. (Substructure)

Contractor:
Johnson Bros. Corporation,
a Southland Company
Oscar Renda Contracting (JV)

Construction Engineering Services:
McNary Bergeron & Associates
Infrastructure Consulting & Engineering

Constructability Review/
Estimating Services:
Armeni Consulting Services, LLC

Construction Engineering Inspection:
Volkert, Inc.

Precast Producer:
Johnson Bros. Corporation

Formwork for Precast Segments:
Structural Technologies (VSL)

Erection Equipment:
Structural Technologies (VSL)
McNary Bergeron & Associates

Post-Tensioning Materials:
Structural Technologies (VSL)

Bearings:
Scougal Rubber

Expansion Joints:
D.S. Brown Company

Epoxy Supplier:
SIKA Corporation

Prepackaged Grout:
BASF Masterflow

Open vista created
under the new bridges.

Roosevelt Bridge Emergency Repair Project

Category: Special Projects

The Roosevelt Bridges are twin precast segmental structures, each being approximately 60 ft. wide and 4,500 ft. long, that carry northbound (NB) and southbound (SB) US Route 1 (SR-5) over the St. Lucie River in Stuart, FL. US-1 is a major north-south artery that connects the City of Stuart with Jensen Beach and the City Port St. Lucie and has an Average Annual Daily Traffic (AADT) of approximately 60,000 vehicles per day.

On June 16, 2020, during a routine biennial inspection and based on feedback from local partners, inspectors found cracks in Span 1 of the SB Bridge which necessitated its closure as well as the roadway traversing underneath the bridge (Dixie Highway). Out of an abundance of caution, the NB Bridge was also closed until a thorough inspection of the structure could be performed. Inspections of both bridges determined that SB bridge had sustained significant structural damage in Span 1 and would need to remain closed for an extended duration however, the NB Bridge was deemed safe to re-open with a few minor enhancements.

The inconvenience posed by the SB bridge closure, weight restrictions, detours and overall capacity conveyance reduction on US-1 was significant and had far reaching impacts within the local community. This necessitated that "time was of the essence" to complete the repairs needed to re-open the SB Bridge, lift the weight restrictions, and remove the detours. Thus, the Department decided to utilize the Construction Manager/ General Contractor (CM/GC) contract delivery method in order to accomplish the repairs expediently.

Innovation of Design and/or Construction

The Roosevelt Bridge restoration could not have been successful without innovative solutions. Integration of multi-discipline inspection results with structural analysis, innovative procurement processes and pioneering contracting procedures all played an important role. The most dramatic concept was the cutting free and temporary support of the southernmost 70' of bridge weighing 600 tons. The staged cutting was accomplished with a combination of a wire rope saw and demolition hammers to allow critical utilities in the barriers to remain undamaged in the process. The remaining tendons were then slackened by cutting at the segment joints. This procedure required the continual adjustment of temporary supporting jacks and surveying.

Rapid Construction

Scheduling challenges were addressed by an aggressive partnering effort and innovative procurement process. A core team of consultants, **FDOT**, local government and industry representatives, technical experts, and legal experts met daily to build a (first of its kind for **FDOT**) CM/GC team which achieved an extremely fast paced and successful project. Procurement was accelerated with an award to **Structural Technologies** after a 3-week procurement process. Once the contract manager was on-board, bridge and roadway design plans were completed in 24 days. Construction began immediately and within 130 days the final traffic configuration was restored on US-1. During these 130 days, preservation plans were developed and the repairs implemented.

Aesthetics and/or Harmony with Environment

The current bridge was constructed using a bridge type that provided a visually and architecturally pleasing structure, inherent in segmental box structures. Therefore, **FDOT** ensured that the existing aesthetics were considered as part of all modifications. With few exceptions all mitigation repairs are internal and not visible to the public. Where external connections were required to transfer high tension loads to new cables, steel plates were added under the bottom of the slab. These thin steel plates used counter sunk bolts and were coated to harmonize their appearance to the surrounding concrete structure.

Jury Comments

CM/GC process allowed for the state to partner together to complete the rehabilitation in a short schedule. Assembling the right team with the right experience ensured success. Bringing the state, contractor, designer, and specialists allowed the complex bridge work to be done safely and efficiently. Getting contractor involvement was key.

CREDITS

Owner:
Florida DOT – District 4

Owner's Engineers:
HDR

Designer:
Corven Engineering Inc./ Hardesty & Hanover

Contractor:
Structural Technologies

Construction Engineering Services:
Janssen & Spaans Engineering

Construction Engineering Inspection:
Cardno

Post-Tensioning:
Structural Technologies (VSL)

All Photos Courtesy of the Florida Department of Transportation

Cost Competitiveness

Reduced capacity and resulting traffic limitation on the Roosevelt Bridge had the potential for considerable cost impacts to the surrounding community. Given this, time literally was money and thus, for the first time in **FDOT's** history, the CM/GC contract delivery method utilizing open book cost estimating was chosen to ensure fair and equitable pricing for the project. This delivery method allowed for continued repair scope refinement throughout the construction phase which ensured that only the critical repairs needed to expeditiously open the road to the full six-lanes of traffic were completed as part of the emergency contract.

Minimization of Construction Impact on the Traveling Public

The project began with the sudden and unplanned loss of a major bridge link, and restoring traffic became a top priority. More specifically, restoring traffic to the greatest extent possible as early as possible. This was realized through a series of monetary milestone capacity restorations targeting high demand days. First, repairs allowed for partial re-opening on SB bridge to open (2 lanes) within 3 months. Secondly, full capacity (3 lanes on each of the two bridges) was restored prior to the Christmas holiday and the Stuart Boat Show. There were also no impacts to marine or railroad traffic, beyond the initial temporary bridge closure. This required work at night and off-peak to avoid impacts and meet these goals.

Selmon West Extension

Category: Urban Bridges

All Photos Courtesy of Sarah Lesch

The Design-Build Project is a 1.9-mile elevated extension of an existing tolled expressway in Tampa, Florida. Seeking to reduce commuter traffic throughout the South Tampa neighborhoods and address the expanding population growth, the team responded with a solution that would work with the local community's needs and provide regional connectivity. The project provides a critical, regional link for businesses, freight, and people.

Innovation of Design and/or Construction

To achieve the owner's goals, the design-builder designed an extradosed post-tensioned concrete fin structural system that allowed for top-down, Progressive Span-By-Span (PSBS) segmental construction of long span lengths not previously possible with similar construction methods. The viaduct design and construction method is the first of its kind in North America.

The 30-ft. tall bridge, double the height of standard bridges, allows drivers to have clear visibility of businesses on both sides of the boulevard.

Three different bridge types: precast concrete segments, steel tub girders, and prestressed concrete beams—combined for the elevated bridge structure.

First post-tensioned segmental bridge project in Florida to use the new flexible wax filler material to protect the tendons rather than cementitious grout. This assists the owner's ability to inspect, maintain, and repair any future issues.

Sustainability and environmentally friendly aspects that complement and beautify the project footprint.

Rapid Construction

The bridge was completed expeditiously as possible by having the 744 segments precast offsite and transported to the project site for erection and post-tensioned into the viaduct structure. As spans were completed, temporary towers were advanced. Segment installation, tensioning, and gantry/truss advancement activities were performed at night when the inside lanes next to the median could be closed. Simultaneously, work within the interchange area took place.

Utilizing high-strength concrete and steel reinforcement reduced the size and weight of the segmental bridge structure. The usage of this material, along with the unique fin-back extradosed tendon design, allowed the team to construct the superstructure in a timely manner.

The owner took a grassroots approach with ongoing community outreach to ensure that it was responding to their needs. This paved the way for the project to begin and get completed in a much faster, harmonious manner.

Aesthetics and/or Harmony with Environment

The owner engaged the public by asking them to vote for their favorite aesthetic design. The community overwhelmingly chose the "Estuary" design for the Project's columns and fins, the cream-and-blue pattern representing nature envisioned in the form of a river delta.

Honoring Tampa Bay's natural environment, the team unveiled an innovative design that has never been used before in the United States. The bridge's distinctive "fins" are aesthetically pleasing and are a nod to the diversity of waterways and marine life that the area is known for.

In a feat few accomplish, the agency's rendering versus the final build is almost identical. The sleek design takes the bridge out of a driver's line of sight, reduces the number of piers supporting the structure, and allows the driver to see businesses and turn lanes from both sides of the boulevard. This unique feature helps harmonize with the business environment and their needs.

Jury Comments

An outstanding application and advancement of segmental technology. In particular, the innovative design and construction methods to fill the gap between economical span-by-span and balanced cantilever span lengths. The fin-back design as an alternative to traditional balanced cantilever was very innovative. Others should consider this solution. With a highly congested work area that allowed columns in the median only, financial penalties for closures during the day, and stakeholder engagement in the development of the aesthetics, this project had many challenges. This innovative solution met them all.

The corridor was aesthetically enhanced with more than 2,600 recycled brick pavers at the West end of the project and in the median, and used more than 30 bald cypress trees along with Florida flame-red maples, Muskogee crape myrtle, and sweet bay magnolia trees. Palm trees, colorful flowering plants, and plans are underway for two parks in the locations where construction worksites and staging areas were set up enhance the livability of this project. The project also preserved the existing ornamental street lighting.

Cost Competitiveness

The project was advertised as an adjusted score (best value) design-build project. The agency issued bonds in September of 2017 for the project and again in December 2017 to take advantage of better rates. Toll revenues and bonds fully funded the project without using any taxpayer dollars. The Design-Build Bid Price was $230,059,000 million and the total cost of the project was $233,974,977 million. This project overall exemplifies the best value effectiveness of concrete segmental bridge structures.

Of special note, precasting proved more economical and reliable, and minimizing field construction work also provided savings during construction.

Minimization of Construction Impact on the Traveling Public

Pile driving, segment installation, tensioning, and gantry/truss advancement activities were performed at night when the inside lanes next to the median could be closed. However, during the daytime, two lanes of traffic remained open, as were driveways to most of the businesses. Simultaneously, work within the interchange area took place as well, and did not impact traffic and was performed during the day.

Community outreach directly engaged the public to voice concerns and prompted the owner to come up with an innovative and aesthetically pleasing design, one that would minimize the negative effects of construction on the businesses and the traveling public along the corridor.

CREDITS

Owner:
Tampa Hillsborough County Expressway Authority (THEA)

Owner's Engineers:
HNTB

Designer:
AECOM

Design-Build Team:
Kiewit – Kiewit Infrastructure South Co.

Contractor:
Kiewit – Kiewit Infrastructure South Co.

Construction Engineering Services:
McElhanney Consulting Services
Kiewit Infrastructure Engineers

Constructability Review/
Estimating Services:
Kiewit Infrastructure Engineers

Construction Engineering Inspection:
Atkins

Precast Producer:
Kiewit – Kiewit Infrastructure South Co.

Formwork for Precast Segments:
DEAL

Erection Equipment:
DEAL

Post-Tensioning:
Schwager Davis, Inc.

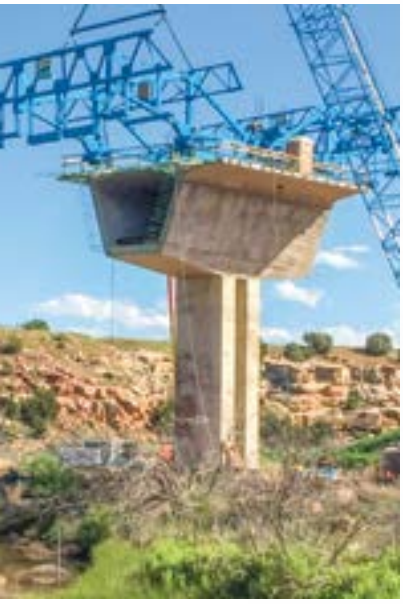
Stay Cable Materials:
Schwager Davis, Inc.

Bearings:
R.J. Watson

Expansion Joints:
D.S. Brown Company

Epoxy Supplier:
Pilgrim Permocoat, Inc.

Prepackaged Grout:
FUCHS Lubricants



US 54 Canadian River Bridge

Category: Rural Bridges and Viaducts

In the Village of Logan, the locals will tell you, "We are not the middle of nowhere, but you can see the middle of nowhere from here." The new US 54 bridge is a source of pride for the community in which it is built. This bridge's innovation and award-worthiness are demonstrated in the successes achieved due to its remote location, unique environmental constraints, ability to sustain the economic vitality of the adjacent communities, and as New Mexico's first cast- in-place segmental bridge.

Replacement of the existing steel deck truss bridge was an urgent priority for NMDOT due to the structure's deficient, fracture-critical, condition. As the need for the project progressed into conceptual development, public engagement was at the team's forefront.

Innovation of Design and/or Construction

Innovation of design and construction is showcased for this bridge in distinct ways as the project team tailored solutions to the environment in which this bridge was built. Throughout the design and construction, long-term maintenance and durability were high priorities. The project team worked extensively with NMDOT District 4 to fully understand their maintenance needs and challenges, then developed solutions within the design that were practical to the owner's future care of the bridge and capital budget.

During construction, the work-force pool and availability of workers with bridge construction experience was particularly limited. The full project team approached training proactively to guarantee success. This included the creation of a full-scale segment reinforcement mock-up at the rebar fabricator yard, 3D form traveler equipment training tools for the field crew, and partnership with ASBI to bring ASBI grouting training to the project site to train NMDOT and the project team ahead of grouting operations.

Rapid Construction

An ever-present concern of NMDOT's Bridge Bureau was the condition of the existing steel deck truss bridge. This structurally deficient structure contains the same typical fracture critical details that have turned close attention to many of the nation's deteriorating steel bridges. With this consideration, rapid construction was imperative.

The project team proactively addressed efficient and rapid construction by working to streamline construction processes and continually keep the project moving on schedule. This included collaboration on a comprehensive concrete repair plan, advance training and tracking of post tensioning and grouting operations, a seamless geometry control communication process, and quick team action during COVID19.

Jury Comments

This is a fine example of a balanced cantilever cast-in-place segmental bridge. It is the obvious choice given the size and location. The remote location actually worked to the advantage for segmental solution by not having to haul large pieces or use large cranes to set girders. Expect great long-term performance in this environment. A very clean and attractive structure that fits the site well.

All Photos Courtesy of Malcolm International

CREDITS

Owner:
New Mexico DOT

Owner's Engineers:
Jacobs Engineering

Designer:
Jacobs Engineering

Contractor:
Malcolm International
(Segmental Subcontractor)
Fisher Sand and Gravel

Construction Engineering Services:
McNary Bergeron & Associates

Construction Engineering Inspection:
New Mexico DOT District 4

Form Travelers for Cast-in-Place Segments:
Schwager Davis, Inc.

Post-Tensioning:
Schwager Davis, Inc.

Bearings:
D.S. Brown Company

Expansion Joints:
Watson Bowman Acme

Prepackaged Grout:
US Spec

Aesthetics and/or Harmony with Environment

Aesthetics and harmony with the environment were identified as another critical element. The environmentally sensitive wetlands around the Canadian River, as well as state- and federally protected species within the river, necessitated a bridge solution that would have no construction impact on these locations. Cast-in-place segmental construction ultimately provided an ideal solution for these environmental challenges. The simplicity and aesthetics of the final structure provide a beautiful balance with the surrounding desert landscape.

Cost Competitiveness

The structure selection process identified the cast-in-place solution as the most cost competitive amid the project criteria. The rural environment presented unique consideration of the structural selection criteria as construction feasibility, cost, and future maintenance had to take special consideration of the remote location and its impact on material, equipment, labor, and costs.

Minimization of Construction Impact on the Traveling Public

Minimizing construction impacts to the community and US 54 users (public and commerce) was of paramount concern. Our engagement led to a new US 54 alignment which swept south of the existing bridge at the river and tied back into the US 54 alignment within the village, providing the village with the commerce it needs.

All Photos Courtesy of SUN International

4th Ring Transportation Corridor in Zhengzhou

Category: Urban Bridges (Within City Limits)

The city of Zhengzhou, with a history of over 5,000 years, is a major transportation hub. Its 10.1 million population will increase by 5 million in the next years, making large infrastructure projects imperative.

The 4th Ring Transportation Corridor in Zhengzhou is an elevated viaduct expressway above the existing 4th Ring around the city center and increased the traffic capacity to 18 lanes.

Accelerated Bridge Construction with the precast segmental bridge technology was used for this Mega-Project. This largest precast segmental bridge project in the world was opened partially to traffic in 2020 and is now fully operational.

Innovation of Design and/or Construction

The elevated expressway has a total length of 58 miles and faced complex boundary conditions, with:

- 27 Main Interchanges with Additional 56 Miles
- 21 River Crossings
- 12 Railway Crossings
- Underground Utility Relocations

70% are elevated viaducts, while 28.4 miles are segmental bridges for the main line and 31.1 miles for the interchange ramps. The viaducts were designed for a 100-year service life.

1,200 different bridge frames with only four basic precast segment lengths were designed for the entire elevated expressway. Most of the precast segmental bridges are continuous rigid frame systems without any bearings, consisting of 3-4 spans, ranging from 112 ft. to 151 ft. for each span.

Only five basic precast segment forms were used for the fabrication of 50,000 unique segments. Many variations of span length, varying width, and ramps with small radius, could be produced with these precast templates.

The general design concept was to build the viaducts in the center (two piers with prestressed pier-caps, two single cell precast box girders) or, if not possible, at the outsides of the existing road (single cell precast box girder on an integral pier).

The total project area, including surface roads and bridge viaducts:

- 34.4 million sq.ft.
- 1.2 million tons of steel
- 212 million c.ft. of concrete
- 50,000 segments

Another remarkable aspect are the precast yards. Eight completely new precast yards with over 400 stations were designed and ready for production within five months. The locations of the eight precast yards were strategically selected with a cost-distance analysis to guarantee an ideal workflow. A state-of-the-art data management system and geometry control software was combined to analyze millions of data daily. This entire paperless process was extremely efficient, allowing the production of 200 precast segments every day.

Rapid Construction

An astonishing achievement is the fabrication and erection of 50,000 precast segments within only 40 months, which are world records for both fabrication speed (50,000 precast segment within 18 months) and number of precast segments for a single project. At an average speed, the eight precast yards produced 200 segments per day. A fabrication cycle of only 1.5 days per segment was achievable at peak times.

Given the large number of continuous bridge frames, ramps, and special bridge frame structures on high piers, the balanced cantilever erection method was the ideal choice. The contractors could choose their preferred erection equipment, varying from overhead gantries, travelers, mobile cranes, portal cranes, or simple falsework. A segment pair was erected in five hours and a span was completed in only two days. The bridge contractors were able to work at multiple locations – at peak times there were 50 bridge erection sites at once. The erection speed for the precast bridge frames was an average of 2,600 ft/day, with a maximum erection speed of 4,900 ft/day. A management platform was utilized to assist the owner to monitor the project schedule and resources at all times.

Jury Comments

Great planning and execution on a very large scale. The magnitude of this project and the speed of design and construction is nothing short of astounding. It would be very difficult to accomplish this project with construction methods other than segmental. A very attractive project as well. A true factory setting for casting of segments created huge advantages in quality and cost effectiveness.

Aesthetics and/or Harmony with Environment

An urban public space was designed along the 4th Ring Transportation Corridor. The landscape will be cohesive and consistent to integrate the ecological concept of the city. The greenbelt around the city will enhance the quality of life, including bike lanes, running tracks and recreational areas. These green areas are also essential to reduce the urban heat island effects.

The superstructure of the elevated bridge viaducts with the constant shallow bridge section presents a simple and slender design, with longer spans and fewer piers, successfully resulting in an aesthetically pleasing and economical solution. The two piers at the center section were tapered 1:30 from the bottom up to express a sense of rising strength. The single piers at the outside present a slimmer and more elegant shape, with the aesthetically pleasing combination of elegant superstructure and unique piers, the bridge design presents a kind of strength and softness at the same time.

The precast segmental technology using the balanced cantilever erection method shortened the construction time and minimized the temporary environmental impacts. The innovative design made an extreme effort to save construction material, which translated to a reduction of 560,000 tons of carbon emissions.

Cost Competitiveness

- Total Project Cost was $7.1 billion
- Average Construction Cost for the Elevated Viaducts $88/sq.ft.

The 54.1 ft-wide and 7.2 ft-deep single-cell cross-section with longer overhangs, reduced material usage by 15%, compared to conventional bridge cross-sections. The structural frame system with fewer bearings will reduce the maintenance cost.

Minimization of Construction Impact on the Traveling Public

From the onset, one of the important project considerations was the need to keep continuous traffic flow during construction. With the precast segments being fabricated in the precast yards off-site, reduced the amount and duration of work performed along the 4th Ring Corridor. The elaborate planning of the eight precast yard locations avoided long transportation routes, reduced traffic impact, and led to transportation cost savings. Due to this accelerated bridge construction process various sections were opened earlier, which also helped to reduce the traffic impact. With no traffic lights on the elevated expressway, the speed limit could be increased from 60 km/h to 80 km/h reducing the travel time around the whole loop tremendously from 4-6 hours to 1-2 hours.

CREDITS

Owner: Zhengzhou Urban and Rural Construction Bureau
Designer: Shenzhen Municipal Design & Research Institute Co. Ltd.
SUN Engineering Consultants International, Inc.
T.Y. Lin International Engineering Consulting (China) Co. Ltd.
Henan Provincial Communications Planning & Design Institute Co. Ltd.
Zhengzhou Transportation Planning Survey and Design Institute

Contractor:
Henan First Construction Group
Henan Fifth Construction Group
Zhengzhou New Dafang Heavy Industry Science and Technology Co. Ltd.
Zhengzhou First Construction Group Construction Engineering Co. Ltd.
TIHOME Construction and Development Co. Ltd.
China Construction Seventh Engineering Co. Ltd.
China Railway 21st Bureau Group Co. Ltd.
China Tonghao (Zhengzhou) Electrification Bureau Electrical Service Company
Zhengzhou Municipal Engineering Corporation
SINOHYDRO Bureau 11 Co. Ltd.
China Railway Engineering Group Limited
CCCC First Highway Engineering Group Co. Ltd.

Construction Engineering Services:
SUN Engineering Consultants International, Inc.
SUN Engineering & Technology International, Inc.

Construction Engineering Inspection:
Henan Wanan Engineering Construction Supervision Co. Ltd.
Henan Gaojian Engineering Management Co. Ltd.
Henan Guangda Construction Management Co. Ltd.
Zhengzhou Hengji Construction Supervision Co. Ltd.
Gansu Tieke Construction Engineering Consulting Co. Ltd.

Precast Producer:
SUN Engineering Consultants International, Inc.
SUN Engineering & Technology International, Inc.
Zhengzhou New Dafang Heavy Industry Science and Technology Co. Ltd.
Henan First Construction Group
Henan Fifth Construction Group
Zhengzhou Construction Group Construction Engineering Co. Ltd.
TIHOME Construction and Development Co. Ltd.
Zhengzhou Municipal Engineering Corporation
Zhengzhou Urban Construction Group Investment Co., Ltd.

Formwork for Precast Segments:
Guangzhou Luyu Construction Machinery Engineering Co., Ltd.
Tianjin Liandong Dongxingda Technology Co., Ltd.
Zhuozhou Sanbo Bridge Formwork Manufacturing Co., Ltd.
Hunan China Railway Wuxin Steel Membrane Co., Ltd.
Shandong Boyuan Heavy Industry Co., Ltd.
Shandong Zibo Huanyu Bridge Formwork Co., Ltd.

2021

"ASBI Bridge Award of Excellence"

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American Segmental Bridge Institute

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