ASBI

AMERICAN SEGMENTAL BRIDGE INSTITUTE

2007

Bridge Awards of Excellence

2007

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Bridge Awards of Excellence

In the third biennial American Segmental Bridge Institute (ASBI) Bridge Award of Excellence Competition, six projects were selected as outstanding examples of segmental concrete bridge construction. Judging for the 2007 program took place at the Federal Highway Administration Federal Lands Bridge Office in Sterling, VA, hosted by **Hala Elgaaly**, Chair, ASBI Awards Committee, Bridge Program Administrator, U.S. Coast Guard.

All concrete segmental or cable-supported bridges located within the 50 United States and completed between January 1, 2005 and August 1, 2007 were eligible for the 2007 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

David Hohmann
Texas Department of Transportation

ASBI President
Raymond McCabe
HNTB Corporation

Benjamin Tang
Office of Bridge Technology, Federal Highway Administration.

George Christian
New York State Department of Transportation

BRIDGE AWARD OF EXCELLENCE WINNERS:

Lee Roy Selmon Crosstown Expressway Expansion, FL
The Otay River Bridge, CA
Penobscot Narrows Bridge and Observatory, ME
Susquehanna River Bridge, PA
Second Vivekananda Bridge Tollway, India
Woodrow Wilson Memorial Bridge, MD/VA

Awards will be presented to bridge owners' representatives during the 2007 ASBI Convention Awards Luncheon, Monday, November 5 at The Orleans Hotel and Casino in Las Vegas, Nevada. Following are jury comments, project details, and participant credits for the winning entries (ASBI Members are noted in bold).

TAMPA,
FLORIDA

LEE ROY SELMON

Crosstown Expressway

Precast concrete segmental construction helped the Tampa Hillsborough Expressway Authority, owner of the Lee Roy Selmon Crosstown Expressway, achieve or exceed all of their project goals for a recently completed expansion. In order to be a success, the project had to be built while traffic on the at-grade lanes of the expressway flowed freely; the aesthetics of the new elevated expressway had to meet the expectations of nearby residents and business owners, and it had to be within the Authority's budget. All three of these critically important goals were achieved by the selection of concrete segmental as the bridge type for the newly expanded expressway.

Innovation of design and/or construction

Typical spans of 142' feet, erected span-by-span in the median of the existing expressway, create a ribbon of concrete on the skyline of Tampa. The 3,032 segments were cast in a facility established for this purpose in the Port of Tampa. Concurrently, construction of foundations and cast-in-place piers in the median of the expressway was being completed. Cast-in-place piers, ranging from 25' to 60' in height, have a curved flare at the top with a maximum width of 13'-8" to correspond to the width of the bottom slab of the box girder. The curved bottom of the superstructure overhangs the top of the pier, hiding the bearings and providing a smooth transition between the pier and box girder.

Rapid construction

Eleven casting cells produced all of the required match cast segments in 24 months, with an average of 46 segments per week (40 typical and six pier or expansion joint segments). As much as 2400 linear feet of bridge was constructed in a single month, while traffic flowed on the adjacent expressway lanes.

Aesthetics and/or harmony with the environment

A key during design was that drivers utilizing the original at-grade expressway lanes feel comfortable with the elevated lanes in close proximity. This was addressed through the use of precast concrete segmental technology which provided the opportunity to create a sculpted rounded, smooth bridge structure that is visually appealing to the traffic below, as well as for those viewing the project from areas adjacent to the corridor.

Cost competitiveness

With more than 3,000 nine-foot long segments included in the construction, the elevated lanes project reached maximum efficiency. For the project as a whole, the extremely low cost of the bridge, coupled with the elimination of the need to acquire virtually any right-of-way for these new express lanes, resulted in one of the lowest costs for a major urban expressway expansion anywhere in the United States. Cost of construction based on the bid, was $65 per square foot of bridge deck. A total of 17.5 lane/miles were constructed at approximately $120 million; translating to $7 million per lane/mile - a relative bargain among U.S. transportation projects.

JURY
COMMENTS

Extremely efficient, cost effective use of precast concrete segmental construction for a long viaduct. Production of 3,000 segments in a 24month period, and erection of 2,400 feet of bridge in a single month, an excellent example of rapid construction. The project cost based on the bid of $65.00 per sq. ft is exceptionally low by current standards. Use of the streamlined box girder with gracefully shaped piers created superb aesthetics.

Minimization of construction impact on the traveling public

One of the most important elements of the design and construction was maintaining traffic on the existing Crosstown Expressway while the new elevated lanes were constructed. Impact on the traffic flow could negatively impact the Authority's revenue, so it was extremely important to maintain traffic on the existing expressway. A significant factor in maintaining traffic was the selection of precast concrete segmental technology as the bridge type, allowing for off-site fabrication of high quality concrete segments that could be erected in the median utilizing the span-by-span erection method.

CREDITS

Owner:
Tampa Hillsborough Expressway Authority

Designer: **FIGG**

Contractor:
PCL Civil Constructors, Inc.

Construction Engineer:
DMJM Harris

Construction Engineering Inspection: **FIGG**

Formwork for Precast Segments:
Southern Forms

Post-Tensioning Materials: **VSL**

Bearings and Expansion Joints:
The D.S. Brown Company

Prepackaged Grout: **Sika**

CONCLUSION The elevated reversible lanes of the Lee Roy Selmon Crosstown Expressway have opened the door to solving vehicular congestion in developed urban corridors across American and major cities world wide. Concrete segmental bridge technology holds the key to the efficiency, constructibility, durability and beauty of the solution.

SAN DIEGO COUNTY, CALIFORNIA

OTAY RIVER BRIDGE

San Diego County's rapid growth has outstripped the capacity of the local freeway network. To address this bottleneck, an extension of state highway SR I25 was constructed. The southern portion of this highway is being built as a Public-Private Partnership between the State of California and South Bay Expressway (SBX), a private entity. Development was financed by SBX, who will operate the highway as a toll road for the duration of their concession period. At the end of that period, ownership will revert to Caltrans. Construction of the highway was carried out under a design-build contract.

The Otay River Bridge is a critical link in the toll road portion of the highway. It carries four lanes of traffic across the wide Otay River Valley, a seasonal river and environmentally sensitive area. Spanning a total of 1012 meters from abutment to abutment, the bridge is broken into ten spans of 90.5 meters, and two end spans of 53.5 meters. The bridge has a twin box girder configuration, with two trapezoidal box girders connected by a longitudinal cast-in-place closure pour.

Design

The design of the bridge was largely influenced by two defining requirements. The first was the need to integrate a precast segmental bridge with the existing design standards of the State of California. The second was to accommodate the seismic demands on the structure in a way that did not impact the benefits of segmental construction.

There were two important concepts that influenced the seismic design. The first was that the design was ductility based, rather than force-based. That is, the bridge substructure was not designed to withstand a specific set of seismic forces, rather, it was designed to accommodate a set of seismic displacements while exhibiting limited damage. The effects of this design philosophy were largely limited to the bridge columns, where seismic forces are no longer a controlling factor in determining the vertical steel, but influence the design of the confining steel.

The second important concept was that of capacity-protected elements. In this philosophy, bridge elements such as foundations and pier caps are designed for the failure load of the column. Therefore, the more heavily reinforced the columns are, the more robust the surrounding elements must be. The design goal, then, was to limit loads due to service-level actions such as live load, wind, temperature and creep. This minimized the required reinforcement in the columns, and therefore the demand on the foundations and superstructure.

Construction

Bridge construction was divided into two main categories. The foundations, columns and pier caps were cast in place reinforced concrete. The pier caps also included transverse post-tensioning. The remainder of the superstructure consisted of precast segments. The segments range in depth from three to five meters, and their average weight is 70 tons.

Superstructure erection was achieved by the balanced cantilever method. A self-launching overhead gantry was used to erect the segments, which were delivered from the north abutment over the completed portion of the viaduct. By delivering the segments over the completed deck, disruption to the site was minimized. Segments were generally stored behind the north abutment, and rarely touched the floor of the valley. The truss was also configured so that it could erect both box girder alignments in a single pass. The two main supports for the truss consisted of steel beams that spanned transversely across both box girders. The truss could then slide back and forth to erect on either alignment.

Superstructure erection began in January of 2006, and the last segment was placed in March of 2007, with 640 segments placed in fourteen months. Precise data on the bridge cost is not available, but the price is estimated to be $300 per square foot.

JURY COMMENTS

As elegant structure that is well proportioned and compatible with its surroundings. Balanced cantilever construction using a self-launching overhead gantry facilitated construction and minimized environmental impact. Innovative design approach to adapt precast segmental technology to a high-seismic area. Rapid construction reflected in placement of 640 segments in 14 months.

Aesthetics and/or harmony with the environment

Environmental sensitivity was a key driver behind the selection of a segmental bridge at this site. The bridge crosses one of the few open spaces remaining in the city of San Diego. The Otay River Valley is the home to a number of protected plant and animal species, and serves as a vital natural oasis in a rapidly developing area. These considerations guided the type selection towards a segmental bridge, which could be erected with minimal disruption.

CREDITS

Project Owner:
South Bay Expressway, Caltrans

Designer:
International Bridge Technologies, Inc.,
Washington Infrastructure Services International

Contractor:
Otay River Constructors, a joint venture of
Washington Group International and Fluor

Construction Engineer:
International Bridge Technologies, Inc.

Construction Engineering Inspection and Construction Manager:
Parsons

Post-Tensioning Materials/Stay Cables:
Dywidag Systems International, USA, Inc.

Formwork for Precast Segments:
Rizzani de Eccher

Erection Equipment:
Rizzani de Eccher

Gantry Supplier:
Rizzani de Eccher

Precaster:
Pomeroy Corporation

CONCLUSION

The project team set out two major goals at the beginning of design; to create a bridge that blends harmoniously with the site with a minimal construction impact, and to adapt precast segmental technology to fit the specific demands of design and construction in California. Close coordination between the Owner, State, Contractor and Designer was the key to accomplishing these goals. The Otay River Bridge stands as a model for using segmental construction to accomplish the goals of constructability, seismic performance, and environmental sensitivity.

PENOBSCOT NARROWS

For 75 years, the Waldo-Hancock Bridge carried U.S. Route 1 over Maine's Penobscot River. In 2003, during a planned renovation, the main suspension cables were found to be more corroded than anticipated. Maine Department of Transportation was faced with emergency replacement for one of their largest bridges, a well-loved landmark, and it had to happen quickly. The result is the Penobscot Narrows Bridge & Observatory - conceived, designed and constructed with great passion, innovative engineering, significant public participation, the perseverance to continue asking *'why not?'* - and opened to traffic in just 42 months.

Given the remote location of the bridge site, severe winter weather and steep banks of the Penobscot River, the selected bridge type is cast-in-place concrete segmental, with the bridge constructed in balanced cantilever using form travelers. This minimized the impact on the environment, allowed construction to continue year round and delivered a durable and beautiful bridge.

Innovation of design and/or construction

Maine's first cable stayed bridge incorporates a state-of-the-art cable stay system that allows for an increase in the number of strands, more economical and aesthetically pleasing pylon shapes, simplified inspection, and improved accessibility of strands to extend bridge service life well beyond 150 years.

The bridge also showcases the world's tallest public bridge observatory at the top of the western pylon. The three story glass observatory provides visitors with views from 420' above the Penobscot River, across coastal Maine and the surrounding area. By turning the necessary height to an advantage and partnering with the state Department of Conservation, which manages adjacent Fort Knox, Maine's most visited historic site, the new bridge provides necessary Transportation, while also attracting visitors to the site and generating economic development opportunities.

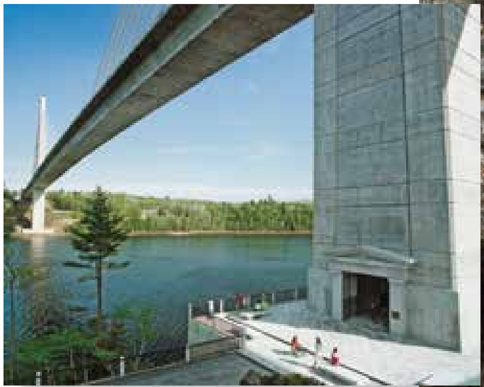
To meet the aggressive project schedule, the pylon foundations are located on the Penobscot River shores (out of the river), which determined the length of the 1,161' main span and defined the shortened back spans to create an asymmetrical design. In the back spans, the segmental box cross section thickens to the inside to provide the ballast for the asymmetric design. Additionally, the western back span has a 380' radius curve at the end that challenged the cable stay placements.

The Penobscot Narrows Bridge & Observatory was completed in a unique 'owner-facilitated' design/build process in which the designer and the contracting partners were each contracted directly by the owner. Unlike conventional design/build projects, the designer and builder were not directly contracted together, but only committed to a partnering agreement that was facilitated by the owner.

Aesthetics and/or Harmony with the Environment

The new bridge is adjacent to historic Fort Knox, a granite military establishment built in 1844 to protect Maine from the British and named in honor of General Knox, who commanded the Artillery under General George Washington during the Revolutionary War. The fort is open to the public and has hosted an annual average of 60,000 tourists - Maine's most frequented historic site.

During public involvement and working with the community to develop an aesthetic theme for the bridge, *"Granite – Simple & Elegant"* was selected nearly unanimously. For many years



BRIDGE AND OBSERVATORY

granite has been quarried near the bridge site and utilized for building projects across the country, including in the core of the Washington Monument.

As the public workshops progressed, it became clear that the participants were uncomfortable with how much taller the pylons for the new cable stayed bridge were than the older suspension bridge. In order to turn the pylon height to an advantage, the idea of adding a public observatory at the top of the pylon developed and the public quickly embraced this concept.

Cost Competitiveness

The bridge was completed through sequential negotiated construction contracts under a very aggressive schedule. The final contracted construction cost for the bridge is $68.5 million. The structure type, material and details were all developed in partnership among the owner, designers and contractor during the rapid design phases. The contractor, working under a stipend for the owner, provided cost estimates for all of the materials as design options were explored. This provided an extremely accurate Value Engineering check on the costs of the entire bridge design, in terms of real-time market prices.

Minimization of construction impact on the traveling public

The new bridge was constructed on an alignment nearly parallel and slightly downriver from the existing Waldo-Hancock Bridge, thus traffic continued to utilize the existing bridge until December 30, 2006 with minimal disruption. On that day, the old bridge was closed and the new bridge immediately opened with a fire truck parade, despite a nearly blinding blizzard. Local residents and business owners enjoyed observing the construction of the bridge year round and following progress closely.

JURY COMMENTS

Excellent and innovative use of stay cradle system and stay force monitoring. Cost-effective tower construction out of the water. The clean lines of the obelisk shaped towers and the segmental concrete superstructure spanning the full river blend well with the site. The aesthetic theme for the bridge "GRANITE – SIMPLE AND ELEGANT" and the pylon observatory contributed to public enthusiasm for the project.

CREDITS

Owner: Maine Department of Transportation

Designer: **FIGG**

Contractor: Cianbro/Reed + Reed JV

Construction Engineer: **FIGG**

Construction Engineering Inspection: **FIGG**

Form Travelers for Cast-in-Place Segments: Strukturas

Post-Tensioning Materials/Stay Cables:
Dywidag Systems International, USA, Inc.

Bearings and Expansion Joints: EJ Fabricator – ARC Enterprises, Inc.; Bearings – R.J. Watson

Prepackaged Grout: Five Star Products, Inc.

I-76 SUSQUEHANNA RIVER

Construction is complete on the first concrete segmental bridge on the nation's first superhighway, the Pennsylvania Turnpike. The new Susquehanna River Bridge opened to traffic on May 17, 2007 following a community fund raising event that saw more than 2,000 runners complete a race that included "one turn and done" on the new structures.

The bridge design features twin structures, each 5,910' in length and 57' wide to accommodate three lanes of traffic in each direction with wide shoulders. Typical spans are 150' and were erected span-by-span on cast-in-place piers founded on drilled shafts. The twin bridges cross the shallow, non-navigable Susquehanna River, in addition to rail lines, a state roadway on the river bank and Culver Island, in the middle of the river.

Innovation of design and/or construction

The Pennsylvania Turnpike Commission took a bold step forward by committing to the introduction of concrete segmental construction in the Commonwealth of Pennsylvania.

Traditional span-by-span erection was completed with a self-launching underslung erection truss that was advanced from the eastern end of the bridge for the first half of the eastbound structure, then returned to begin the westbound structure, building from the eastern end to Culver Island in the middle of the river. The temporary causeway that had been constructed in the river on the eastern side of Culver Island, then shifted to the west side and the structures completed from Culver island to the western shore. This allowed for the economic delivery of segments over the completed structure from the casting yard that had been established on a hillside in close proximity to the bridge site.

The contractor used a unique segment setter to set segments as they were delivered to the erection site across the most recently completed spans. The segment setter efficiently lifted the segments from a low - boy transport truck and lowered them to the truss. The low profile of the setter alleviated concerns over using a traditional crane with a tall boom in close proximity to Harrisburg International Airport. Additionally, the segment setter was able to work under transmission lines at one end of the bridge, allowing the lines to be reset to their new permanent location in one move and eliminating an intermediate and temporary line relocation.

Rapid construction

The project was bid in the fall of 2004, and the low bid was $82 million. Notice to proceed was given soon after, and casting of all 1,040 segments was completed in less than two years. The 40 spans in each of the twin bridges were erected sequentially, utilizing one erection truss. The contractor easily and regularly achieved an erection rate of two 150' spans per week.

Aesthetics and/or harmony with the environment

The Susquehanna River Bridge is the longest bridge on the Pennsylvania Turnpike system and in close proximity to the Commission's headquarters. During the design phase of the project, an owner's charette was held with participants from the Commission who reviewed options for the pier shape and aesthetic treatment, the superstructure box shape and aesthetic lighting of the bridge. A form liner was used during the casting of piers to mold a stone inlay that reflects the quarried limestone facade of the Headquarters building. The form liner created a ribbon of texture vertically up the center of the pier, visually adding to the pier slenderness. At the top of the pier, the limestone texture splays across the pier cap in the shape of a keystone, honoring Pennsylvania, the Keystone State.

Accent lighting is located under a lip on the segment wing. The emanating light is captured by a slight curvature formed in the segment web at the bottom soffit interface. An open barrier rail provides those crossing the new bridge with clear views of the wide river valley.

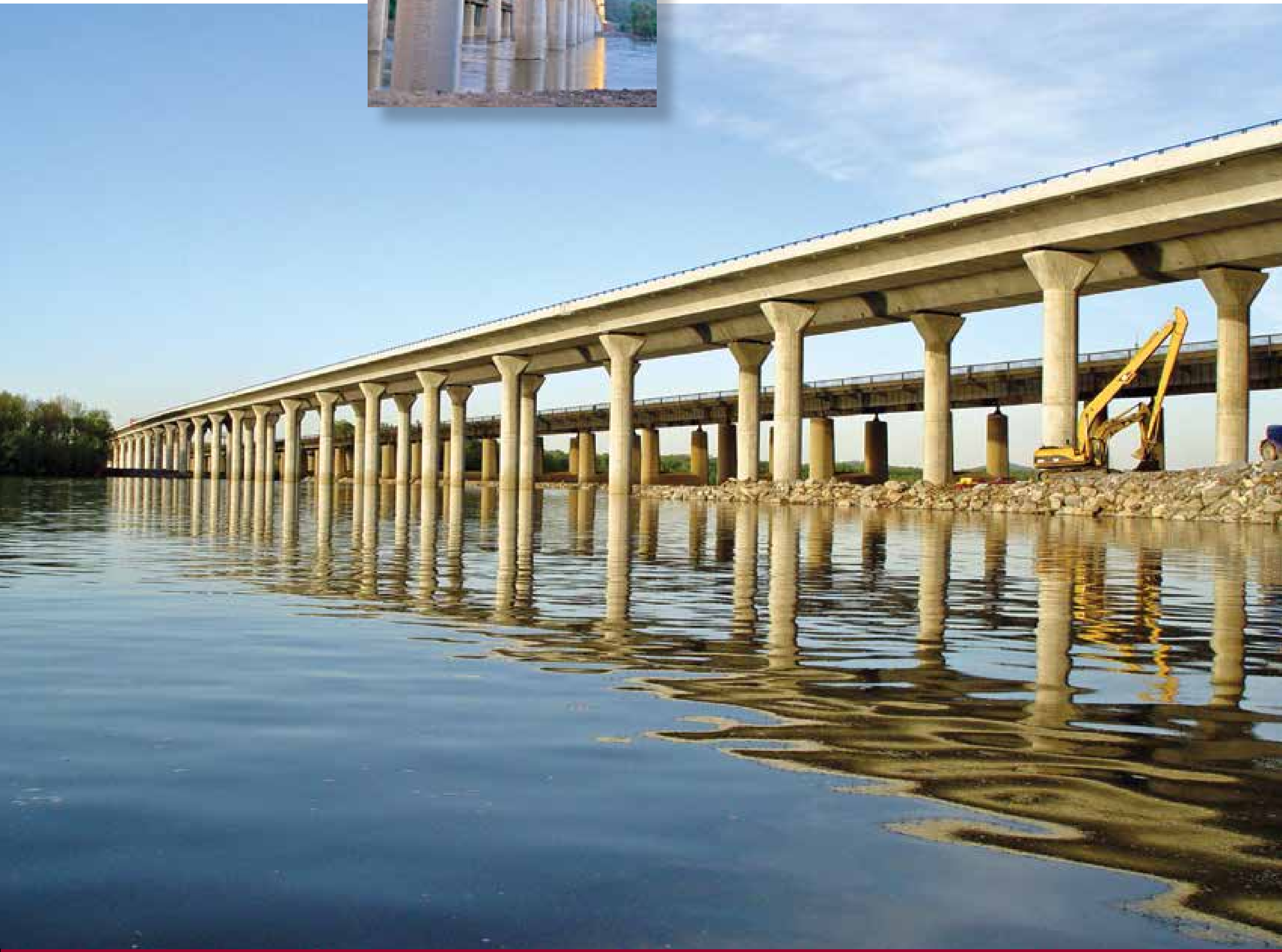
JURY COMMENTS

The uniform spans and constant depth girder design of the I-76 Susquehanna River Bridge are appropriate for a broad river crossing site. Efficient precast construction and erection resulted in an economical structure at $120.00 per sq. ft. Inlaid stone pier treatment and accent lighting provide enhanced aesthetics. A beautiful structure.

Cost competitiveness/Minimization of construction impact on the traveling public

Low bid for the twin 5,910' structures was $82 million or approximately $120 per square foot of bridge deck. This price is competitive with historical Pennsylvania bridge costs at the time of the bid. Selecting precast concrete segmental technology offered the shortest construction duration of major bridge types, a significant advantage.

BRIDGE



CREDITS

Owner: Pennsylvania Turnpike Commission

Designer: **FIGG**

Contractor: Edward Kraemer/G.A. and G.F. Wagman Joint Venture Team

Construction Engineer: **McNary Bergeron**

Construction Engineering Inspection: **Parsons/FIGG**

Formwork for Precast Segments: **Southern Forms, Inc.**

Erection Equipment: **DEAL**

Post-Tensioning Materials/Stay Cables:
Dywidag Systems International, USA, Inc.

Bearings and Expansion Joints:
Bearings – Seismic Energy Products
Expansion Joints – Watson Bowman Acme Corp.

Epoxy Supplier and Prepackaged Grout:
Sika

KOLKATA, INDIA

SECOND VIVEKANANDA

On July 4th, 2007 the Second Vivekananda Bridge Tollway (SVBT) was opened to traffic, three years and two months after Notice to Proceed was issued to the Design/Build Contractor, Larsen and Toubro (L&T). The Honorable Transport Minister of the Government of West Bengal, Shri Subhash Chakraborty was one of the first to drive through the new tollway.

General Project Description

The SVB Tollway is a 6.1 km-long integrated six-lane bridge and approach roadway network, with the main river crossing located 50 meters downstream of the existing bridge. The existing bridge, originally built in 1931, carries twin railroad tracks and is equipped with 5.5 meter-wide carriageways on either side for vehicular traffic. All vehicular traffic is now moved to the new bridge.

The main structure across the Hooghly River is an 880 meter-long, 29 meter-wide "Extradosed Bridge". Approaching the main structure on both sides are six-lane viaducts connected to approach ramps and access roads on embankments on either side. The total length for the approach viaducts is 724 m for the Howrah side and 2240 m for the Kolkata side. The approach viaducts consist of a combination of two-lane ("D2") and three-lane ("D3") precast segments erected by the span-by-span method with a combination of overhead and underslung trusses. Typical approach spans are 35 m-long.

With the 29 m width of the roadway, the choice of cross section was between a three-web and a "D6" box girder (single cell box girder with internal stiffening struts). The D6 section was found to be lighter and easier to build. The sloping webs allowed for an efficient transfer of loads between superstructure and substructure with a significant reduction of the pier shaft dimensions. It was also well adapted for anchoring the stay cables along the bridge centerline. The segment length was set at 3.37 m resulting in a maximum segment weight of 150 t.

Unlike other extradosed bridges, this bridge has a constant depth. This allowed for the use of "D6" segments with sloping webs, and simplified casting operations, with the additional advantage of enhanced appearance for the river crossing. This was made possible by increasing slightly the depth of the box girder to 3.4 m (L/32), and adding some stay cables close to the pylons to reduce shear.

The eight stay cables at each pier vary in size from 63 to 73 x 15mm diameter strands and are placed inside steel pipes filled with cement grout. The stay cables are designed to be replaceable with double pipes through the pylons and at the deck anchorages. Due to the low variation of stresses under live loads in the stay cables and consequently low fatigue loading, the stay cables are designed for a maximum stress of 60% GUTS in service, and 75% GUTS under ultimate loading.

Main Bridge Construction

The pier tables were made of two precast segment shells placed on top of the piers with a catamaran barge and strand lifting system. The pylon base was cast in place inside the segment shells. The pylons were then cast with self climbing forms.

JURY COMMENTS

Constant depth slender profile for 110 m spans combined with single cable planes present a very attractive structure. The use of single cell strutted box girder is very efficient for a wide deck, the single-plane extradosed design minimized the pylon height to avoid overshadowing the adjacent Dakshineshwar Temple, and provided significant economies in construction of the 40 m-deep foundations.

The superstructure segments were precast with three casting cells in the casting yard located near the Kolkata side abutment. The segments were then loaded on a barge with a gantry and erected in balanced cantilever using a beam and winch system. Special procedures were used for the two end spans on land: segments were placed in lifting position on the ground with a combination of rails and turning tables.

The stay cables were pulled through the deck pipes and pylon saddles in a single bundle of strands and stressed with 1000 t hydraulic jacks inside the box girder.

The steel beams were installed at the expansion joints after completion of parapets and deck overlay.

As required by the IRC code, the bridge had to be load tested at the end of construction with the full design live loads. The load test was successful with actual deflections meeting the calculated deflections, and full rebound of the superstructure after removing the test loads.

BRIDGE TOLLWAY

CREDITS

Owner: Second Vivekananda Bridge Tollway Company in Partnership with National Highways Authority of India

Engineer of Record: CES-PB Consortium in Association with **International Bridge Technologies, Inc**.
(main bridge design)

General Contractor: Larsen & Toubro Limited

CONCLUSION

The Second Vivekananda Bridge completion represents an outstanding accomplishment in many ways:

- Unique application of Public Private Partnership project delivery in India.
- Largest bridge Build-Operate-Transfer project in India
- Critical link for the eastern India roadway network.
- State of the art precast segmental "extradosed" bridge.
- Cost efficient design: construction cost for main bridge US $170/sq. ft.
- Design and construction completed on schedule.
- Bridge blending harmoniously in the environment (existing bridge, temple).

WASHINGTON, D.C.

WOODROW WILSON

The Woodrow Wilson Memorial Bridge is located at the southern tip of Washington, DC and carries one of the most congested interstate highways on the east coast (I-95/I-495) over the Potomac River between Maryland and Virginia. The new bridge replaces one that was opened in 1961 designed to carry an anticipated traffic volume of 75,000 vehicles per day (vpd). The traffic volume has reached in excess of 195,000 vpd and the projection is for nearly 300,000 vpd by year 2020. While not only functionally obsolete, the original bridge was rapidly deteriorating from heavy trucks and increased traffic.

The new Woodrow Wilson Bridge is intended to be a symbol of local, regional and national pride. Its function and appearance are important not only to the local community, but also for the impression they will impart on visitors and travelers from across the nation and the world. This was the intent behind the explicit and focused design goals for the project. To produce a fittingly world-class design, the sponsoring agencies embarked on a bridge design competition. The year-long effort challenged the engineering world to create a design that citizens and visitors will use and enjoy for many generations to come.

Innovation of design and/or construction

In order to effectively meet the projected traffic volume and minimize the impact on the traveling public during construction, it was decided to build two new structures, each carrying six lanes of traffic, to replace the old six-lane drawbridge. The new bridges were designed with the potential of later converting the innermost lane on each bridge to accommodate a mass transit rail line. In addition to the lanes of travel, the north bridge has accommodations for pedestrians and bicycle travel, resulting in a slightly wider bridge structure.

One significant challenge was to build the replacement bridge with minimal disruption to traffic along the I-95 corridor without changing the location of the bridge between Oxon Hill, Maryland and the city of Alexandria, Virginia. With this in mind, twin bridge structures were designed such that the first bridge could be constructed prior to closing the existing bridge to traffic.

While one of the aesthetic objectives was to build an arch-like structure similar to others along the Potomac River through the nation's capital, the use of an arch structure at this location was not economically feasible due to the poor soils comprising the river bed. Therefore, the designers developed an innovative solution that provided the appearance of an arch without large horizontal thrusts on the foundations that a conventional arch would have produced. V-pier structures were designed to provide a graceful curving support for the variable depth plate girder superstructure. The combination provides a remarkably efficient structure spanning up to four hundred feet between foundations.

Rapid construction

The bridge project is broken into three distinct elements along its more than one-mile overall length. The 270-foot-long bascule span over the navigational channel separates the 2,339-foot-long approach structure on the Virginia side from the 3,466-foot-long Maryland approach. The overall cost per square foot for the five contracts to construct the complete bridge was $442/square foot. Both the Maryland and Virginia approaches are typically supported by a set of two V-piers at each foundation. The V-piers utilize precast segmental box structures for the ribs which are cantilevered from the foundation to the bearing seat for the superstructure spans. The tops of opposing ribs are connected longitudinally by a precast spliced girder or tie-beam. The tie beam is heavily post-tensioned to carry the tension loads generated by the superstructure reactions.

The designer, recognizing the importance of giving the contractor as much flexibility as possible, allowed variations in the construction methods. The specifications were specifically written to allow either precast segmental construction, cast-in-place segmental construction using form travelers, or cast-in-place construction on falsework. However, even though two distinct contractors are building the Virginia and Maryland approaches, both contractors elected to use the precast segmental cantilever construction method.

The V-pier structures supporting the bascule structure over the navigation channel were also constructed using a modified segmental construction method. The high loads on these structures required sections much larger than were considered feasible to precast. Therefore, the designer elected to design the V-piers using concrete box structures cast segmentally on falsework.

JURY COMMENTS

Repetitive segmental V-shaped piers to simulate arches provide an aesthetic structure suitable to the Washington, D.C. environment, as well as, an innovative solution for poor foundation conditions. Complex, but typical segment shapes used for upper portions of all piers. Segmental technology addressed the needs of a highly complex project of national significance.

MEMORIAL BRIDGE

CREDITS

Owner:
Maryland Department of Transportation – State Highway Administration
Virginia Department of Transportation

Designer:
Parsons

Contractors:
American Bridge Company/Edward Kraemer & Sons, J.V.
Potomac Constructors, LLC
(Edward Kraemer & Sons/American Bridge/Trumbull Corp.)

Virginia Approach Constructors:
(**Granite Construction Co.**/Corman Construction Co.)

Construction Engineer:
Buckland & Taylor, Ltd.
Janssen Spaans Engineering, Inc.

Construction Engineering Inspection:
Potomac Crossing Consultants

Formwork for Precast Segments:
EFCO
SYMONS

Erection Equipment:
DEAL

Post-Tensioning Materials/Stay Cables:
Dywidag Systems International, USA, Inc.

Bearings and Expansion Joints:
Dynamic Isolation Systems
King Fabrication

Epoxy Supplier and Prepackaged Grout:
SIKA

CONCLUSION Now that the construction of the first bridge is complete, all of the stakeholders can look back on the many difficult decisions with satisfaction as the graceful spans of the new Woodrow Wilson Memorial Bridge reach proudly across the Potomac River.

AMERICAN SEGMENTAL BRIDGE INSTITUTE

9201 N. 25th Avenue, Suite 150B, Phoenix, Arizona 85021-2721
Tel: (602) 997-9964 Fax: (602) 997-9965
e-mail: asbi@earthlink.net web: www.asbi-assoc.org