FRANKLIN COUNTY'S SUCCESSFUL PRECAST BRIDGE HISTORY AND THE LANE AVENUE BRIDGE

James A. Pajk, P.E., Franklin County Engineers Office, Columbus, Ohio
David W. Jones, P.E., Jones-Stuckey, Ltd., Inc., Columbus, Ohio

ABSTRACT

The presentation will discuss Franklin County's past successes in the construction of unique precast bridges and how it led the agency in developing tight precast specifications for the Lane Avenue bridge to assure aesthetic goals and quality control. This resulted in precasters unwilling to bid the precast items. Without compromising original design goals and parameters, the bridge, which serves as a gateway to The Ohio State University campus, opened five months ahead of schedule as a result of construction modifications and cast-in-place concrete.

Keywords:

Introduction

Having replaced many of its aging major structures in the past fifteen years, The Franklin County Engineers Office next daunting task was to replace what would be its largest capital improvement to date, the Lane Avenue Bridge. Being the gateway to The Ohio State University campus, our office realized that public perception and opinion would play a significant role in this project and that it would build on its past successes and problems from its recent bridge reconstructions. This paper will discuss Franklin County's success with innovative bridge construction using precast concrete and the difficulties it experienced on a recently completed cable-stayed structure. This led to the development of strict precast specifications to ensure aesthetic quality and minimize the time of construction. As a result the prime contractors were unsuccessful in finding precasters willing to bid portions of the project. The paper will also discuss how the county and contractor dealt with these obstacles to achieve success in opening the project five months ahead of schedule without compromising structural integrity and aesthetic appearance.

Public Perception

Just like the new ballparks such as PNC Park, Jacobs Field, Camden Yards and Coors Field to name a few, communities have expressed strong sentiment to replace deteriorating bridges with retro-like or in-kind structures. The neighborhood gateways created by these old structures with intricate architectural features and much history remain important and integral landmarks of a community's personality. In a sense they are saying "We love what he have, don't take it away from us"

The Franklin County Engineers Office has always listened to community feedback in regard to these issues. With the county engineer being an elected official in Ohio, it is extremely important to be open minded during public involvement meetings to ensure people that their opinion counts and that the office is sensitive to their needs.

Knowing that to replace these structures in-kind is not exactly a product of modern engineering practice and inherit original design problems back into the structure, the county engineers office was given the task of establishing project specific design criteria to meet the needs of the local community and the entire county while still trying to think "out of the box" on a design that is fiscally responsible. What evolved in the past decade for Franklin County was a collection of unique structures, each with its own personality to fit its location and community, while utilizing the latest in concrete bridge design technology. The common theme for these future landmarks was building with precast/prestressed concrete.

The Olentangy River Corridor

In 1908, the City of Columbus assembled a commission to develop a plan, which became known as the 1908 Master Plan. This plan placed a major emphasis on the development of river corridors. This was at a time where there was a national movement called the City Beautiful movement, where neoclassical designs with European flair from cities such as London, Paris and Zurich were the basis for improving the quality of life. As a component of this, the Columbus Master Plan of 1908 would incorporate the European vision with the suggestion that bridges be built as “distinctive and important civic monuments”. This was entirely evident along the Olentangy River corridor.

Franklin County owns many of the bridges crossing the Olentangy River. During this period, the King Avenue bridge was the first bridge to be constructed. Keeping in line with this master plan, it was an earth filled, reinforced concrete barrel arch bridge. In 1913, heavy rains caused major flooding and destroyed the existing truss bridges at Third Avenue and Lane Avenue. The new King Avenue bridge survived the flood and was considered “flood proof”. As a result, the bridges built at Third Avenue(1917) and Lane Avenue(1919) were designed in the same sense as King Avenue. These inspired structures, constructed by renowned bridge engineer Wilbur J. Watson, incorporated ornate concrete which extolled both beauty and strength while serving the growing transportation needs.

Having served their usefulness, Franklin County developed a plan to begin replacing these structures. With the approval of the Franklin County Engineer the late John Circle, P.E., P.S. and the current County Engineer Dean Ringle, P.E., P.S., the county began the public involvement process, which would eventually lead to the selection of structure types for each location. Third Avenue would be the first bridge to be replaced.

Third Avenue over the Olentangy River

The existing Third Avenue bridge, which serves as a gateway to the historic community of Harrison West in Columbus, Ohio, was a four-span, earth filled, reinforced concrete barrel arch structure. Since it was eligible for the national register of historic places, it became apparent early in the public involvement process that a standard bridge would be unacceptable to the local community groups. In addition, environmental groups such as Friends of the Lower Olentangy River Watershed (FLOW) voiced concerns over potential construction impacts on the river. Factors such as limiting construction time in the river, reducing the number of permanent obstructions, incorporating a bike path and developing a bridge that would satisfy the aesthetic goals to reflect the spirit of the 1908 master plan were all important elements in the structure type selection.

With additional concerns for geometric and hydraulic constraints and the desire to maintain a high degree of quality control, durability and making it constructible, the structure type chosen was a two-span, precast/post-tensioned modified bulb tee. The structure type was widely accepted by the community. Since each span is 135 feet, the girders had to be constructed in two parts and connected in the middle by a diaphragm that would allow the segments to be post-tensioned. The girders, for which there were seven rows to support a cast-in-place deck, vary in height from 4'-9" at the center of the span to 10'-6" at the abutments. Each segment contains eight ½" diameter pretensioned strands and include four ducts which house fourteen ½" strands for post-tensioning. This enabled the agency to utilize precast construction techniques while providing an arched looking bridge to satisfy the desires of the community.

Fig. 1 Third Avenue over the Olentangy River

The superstructure sits on reinforced concrete substructure units with pile driven foundations. With a single pier in the center of the structure, which would be a focal point on the bridge, it was important to give special consideration as to size and shape, so as not to take away from the classical lines of the arched girders. The deck consists of high performance concrete, as does the girder diaphragms, and is post-tensioned transversely using ½" diameter seven wire strands to add additional strength and prevent the development of cracks in the deck.

Additional enhancements to the bridge included a decorative outside rail, which consisted of concrete posts with steel railing units. Mockups for different types of traffic barriers were made and placed on the bridge for review and final acceptance of type and style. This gave the engineers and community a chance to preview the different types of concrete barriers and what the appearance would look like at the actual location.

Much detail was given to the appearance of the plaza areas, Fig. 2. A combination of brick pavers, built in concrete bench seating, extensive landscaping to be maintain by the neighborhood associations as well as locations on both ends of the bridge to place historical and builder plaques completed the aesthetic treatments to make the bridge not only functional but to restore the prized gateway to Harrison West.

The design consultant for the project was Jones-Stuckey, Ltd., Columbus, Ohio while the prime contractor was the C.J. Mahan Construction Company, Grove City, Ohio. The approximate cost for just the bridge portion was $165 per square foot of superstructure. Total project cost including all roadway and miscellaneous items was $4,031,000.

Fig. 2 Third Avenue plaza areas

King Avenue over the Olentangy River

With the Third Avenue and King Avenue bridges in close proximity to one another, Franklin County decided to hold open houses for both structures around the same time. Unlike Third Avenue Bridge's neighborhood location, the King Avenue Bridge is adjacent to the south entrance to The Ohio State University main campus, while another large employer, Battelle Institute, is also adjacent to the bridge. In addition, the Olentangy River bike path runs along the eastside of the bridge.

With no major geometric restrictions on the site, the bridge lent itself to many structural type possibilities. The opinion of the public, however, was to create another aesthetically pleasing structure which would reflect the arch appearance of the old reinforced concrete earth-filled bridge, yet be able to have its own personality. Franklin County's task, with the assistance of Eriksson Engineering, Columbus, Ohio and HNTB, Kansas City, Missouri, was to have the public refer to King Avenue in its own sense without taking away the history and arch appearance.

Through much debate and thought, the design team was able to successfully create an aesthetically pleasing and unique structure. The result was a five-span segmented, precast concrete arch superstructure on arched wall type piers. This bridge type is the first of its kind in Ohio and received an award in 2001 from PCI for it beauty and creative design, Figure 3.

Numerous unique precast elements were incorporated into the superstructure. First and foremost were the precast arch ribs. With seven rows of arches and five spans, this meant that seventy individual units would need to be created. The precaster, Tecspan, Columbus, Ohio, needed to develop a plan to mass-produce these units to keep the project on schedule. Using high early strength concrete to obtain a strength of 4000 psi within 24 hours, the precaster was able to pour one arch section per day, while preparing another unit to be poured the following day, Figure 4. Later, the arch rib sections were post-tensioned at the plant before shipping and erecting on the job site.

Fig. 3 The King Avenue over the Olentangy River

Fig. 4 Placement of reinforcing steel cage for arch rib section

A diaphragm was poured to connect the seven girder lines at each mid span and to connect the two adjacent arch sections. Prestressed box beams, Figure 5, were placed to span from the pier to a seat on the arch to complete the girder, Figure 5. The units were then posted tensioned at mid span. A deck, utilizing high performance concrete, was poured, cured and post-tensioned in both directions.

A final precast element worth mention was the traffic barrier. These units were cast on site and then put into their final position. This enabled the contractor to keep the project on task even during inclement weather. As was done with the Third Avenue bridge, aesthetic detail was given to the plaza areas using stamped concrete, steel railings were added and ornate light fixtures were used to complete the project. The contractor, C.J. Mahan Construction Company, was able to build the bridge portion for $150 per square foot of superstructure, with a total project cost for all roadway and miscellaneous items of $6,629,000.

Fig. 5 Setting prestressed box beams on precast arch units and pier

After the completion of the new Third Avenue bridge in 1998 and King Avenue bridge in 1999, public approval for what the County Engineers Office was able to accomplish was extremely positive and supportive. The county believes it was able to preserve the vision of the 1908 Columbus Master plan while thinking "out of the box" with 21st century concrete technology.

Beach Road over Big Darby Creek

The next major crossing to be replaced was the historic Pratt truss on Beach Road over the Big Darby Creek. The bridge is located in a remote rural section of the county. While there was no public outcry to replace the existing bridge with a new truss, there were still many issues facing the designers that had to be resolved with the main problem being how and what to construct over the Big Darby Creek, a river that has a national scenic river designation and is environmentally sensitive.

To address the needs of the environmental groups, which would be out in watchdog-like force, the design team of Franklin County and Jones-Stuckey, Ltd., Inc. needed to design a bridge that would have minimal impacts on the stream, both during and after construction. It was determined early to avoid many conflicts by simply building the new abutments behind the existing stone abutments, thus keeping the bridge out of the water.

This meant a clear span of 213 feet would be needed to replace the existing 173 foot truss. The design solution was to construct a cable-stayed, precast concrete girder structure with a composite reinforced deck, Figure 6. The bridge would become the first cable-stayed bridge to be built entirely within the state of Ohio. The use of concrete created an extremely majestic look in this natural setting. It also provided the county with valuable experience in cable-stayed bridge construction, which would play a significant role in the structure selection for the Lane Avenue bridge.

Fig. 6 Beach Road over the Big Darby Creek

With a focus on constructability and aesthetics, the use of precast elements became an important part of the detail design. Precasting would also minimize in-stream construction activities to limit potential environmental impacts.

The edge girders are precast units, constructed in four sections per side and spliced together with cast-in-place(CIP) high performance concrete(HPC), Figure 7. Lightweight

Fig. 7 Beach Road edge girder splice section

HPC was used for the edge girders with a compressive strength of 8000psi, Figure 8. Once erected, the units were then post-tensioned together with four- 2 3/8" diameter ducts containing nine- ½" diameter strands. The center to center spacing of the girders measures 39'-6".

Fig. 8 Fabrication of precast edge girder section

Fig. 9 Finished edge girder section

To provide support for the composite CIP deck, precast floor beams and deck panels were used. The floor beams, seventeen total, sit on a ledge in the edge girders. The floor beams are made with HPC, compressive strength 5500psi , and four- two inch diameter ducts each containing five- 5/8" diameter strands. The precast prestressed concrete deck panels were designed based on a previous Ohio Department of Transportation (ODOT) standard drawing DP-1-84. A six inch HPC deck, compressive strength 5500psi , was then placed to complete the superstructure.

The four towers, rising over 70 feet above the deck surface, was made with HPC, compressive strength 5500psi, using CIP methods. During the removal of forms for the east side towers, it was discovered that the plywood forms on the inside were not adequately braced, thus creating a distorted and warped look to the tower. Additional bracing and support was used on the west side towers to avoid the same problems. The contractor was able to repair the east towers after much effort and delay.

Additional concrete items, without going into detail, include the back span edge girders, tower anchorages, abutments, wingwalls, drilled shafts, barriers and anchor pier. A formliner, rectangular cut stone, was used on the abutments to replicate the existing truss abutments.

Finally, the stay-cable system consists of 1 3/8" diameter threaded Dwiydag bars, ASTM A722, 150 ksi steel, enclosed in a polyethylene pipe sheathing and grouted. Twelve bar cables from each tower extend to near mid span, eight cables extend to near quarter span and twenty cables are anchored on the back span.

The bridge was completed in 2001 at a cost of $270 per square foot of superstructure. Total project cost, including all roadway and miscellaneous items, was $4,238,000.

Confidence in precasting

With the completion of the Beach Road bridge, Franklin County was now ready to move ahead on what would be its largest capital improvement to date, the Lane Avenue Bridge over the Olentangy. The question then became "what did the agency learn from these recent projects that could be brought to the public involvement and design table that would make Lane Avenue extremely successful in public perception and cutting edge technology.

The items of importance included:

- Franklin County had much success in hosting open houses and public involvement for King and Third Avenue. The ability to balance historical significance, past master plans(Lane Avenue being in the Olentangy River corridor for the 1908 Columbus plan), while utilizing the lasted in technology are important in getting the public onboard with the project.

- Precast concrete can open up many possibilities in both structure type and ease of construction. The success with bulbed tee, precast arch and cable-stayed structures showed that Franklin County and local design consultants had the creative experience to produce award winning results.

- Precasting allows us to produce and/or construct modern structures that have the same level of aesthetic quality as the historically significant bridge they are replacing.

- With the evolving of HPC, precasting and post-tensioning techniques, bridges can be built with services lives exceeding 100 years old.

- Environmental impacts can be minimized and/or avoided with careful planning. The bridge at Beach Road received many accolades in its environmentally friendly approach in an area where many organizations kept a watchful eye. Since the time of construction for King Avenue, environmental permits and requirements have become increasingly more important in construction projects.

- Cable-stayed structures are not limited to areas that require megaspans. They can be effectively used for spans in the 200 foot range as well without dominating the landscape.

- Precasting can allow the owner to achieve a high level of quality control, aesthetics and strength. With the problems regarding the warping of the towers at Beach Road by using CIP concrete, the county believed it could easily avoid the problem by precasting.

- The county can create specifications to achieve all project goals.

- Franklin County believed after Third Avenue, King Avenue and Beach Road that by utilizing precasting, it is can be possible to construct almost anything imaginable.

With a strong confidence, the Franklin County Engineers Office went into the preliminary design for Lane Avenue believing that this project will become their crowning jewel that would be a significant and positive part of the central Ohio landscape.

Lane Avenue Project Development

The Lane Avenue bridge serves as a major gateway into the Ohio State University campus. The bridge itself is located in the heart of the main athletic campus, and during football Saturdays in Ohio, becomes a focal point during home games. With over 100,000 people attending any particular games, Lane Avenue becomes on the more important pedestrian access points to Ohio Stadium. Also, Columbus Parks and Recreation is continuing to develop the Olentangy River bikeway. The section around the bridge would be the next piece to complete in this development.

Recent regional studies done by the Mid Ohio Regional Planning Commission (MORPC) had determined that the level of service along Lane Avenue was extremely insufficient. In addition, immediately west of the bridge, the intersection at Lane Avenue and Olentangy River Road is considered one of the most dangerous intersections in Franklin County and ineffective in handling large pedestrian events. With the bridge deteriorating as well, a plan was put into motion to widen the street and replace and widen the bridge.

The existing bridge, built in 1919, was similar to those at Third and King Avenue; an earth-filled reinforced concrete arch, comprised of fives spans comprised of four spans containing three lanes of traffic with two- 5'-6" sidewalks. A wetlands area is located just north of the site and the proposed bike path will run parallel along the east bank.

Public involvement would once again play a crucial role in the early plan development stages. Major players in the project included the Ohio State University, City of Columbus, The University Area Commission, Columbus Parks and Recreation and the Friends of the Lower Olentangy River Watershed(FLOW). Our office decided early on to aggressively move on the public involvement meetings to tackle as many issues to avoid heart ache or delays.

Franklin County had prepared a questionnaire to get input from area groups that would help expedite the structure selection process. Having successfully built major structures, the design team of Franklin County and Jones-Stuckey, Ltd, Inc. presented the public with the following four alternatives, Figure 10:

- Third Avenue type modified bulbed tee girder
- King Avenue type precast segmented arch girder
- Broad Street (not discussed in this paper) post-tensioned haunched girder
- Cable-stayed bridge

Fig. 10 ***A PICTURE OF THE 4 ALTENATIVES WILL GO HERE***

In addition, design goals and parameters were established to assist in moderating these meetings. Some of the major design parameters and goals included:

- Widening the bridge from the existing three lane, two- 5'6" sidewalks to six lanes with two- 12'-0" sidewalks
- Incorporate the bike path on the eastside of the river to make it functional and appealing to the public
- Avoid the wetlands to the north
- Include the intersection improvement at Lane Avenue and Olentangy River Road
- Create a gateway to the university's main campus

- Design a structure to handle a 100 year storm event
- Design a structure that would maintain the core values of the 1908 master plan, yet be able to create its own legacy

and finally,

- Minimize the closure time on Lane Avenue to avoid as many OSU football games as possible. Without overstating, the fact is it appears the entire state of Ohio convenes in Columbus, Ohio on a home football Saturday. While 100,000 fans may attend the game, at least another additional 100,000 or more are there to merely partake in the festivities.

After much discussion, it was decided that a two-span cable-stayed alternative would best meet the project criteria, Figure 11. Surprisingly, it appeared that the local community groups were more receptive and excited about this structure type, while many engineering peers questioned its selection. It seems that most people, including engineers, have a misconceived notion that cable-stayed structures are for major crossings over large rivers, channels and

Fig. 11 Rendering of the future Lane Avenue Bridge

bays. However, it did not take much debate to convince the doubters that this structure type best fit the project expectations. Some of the reasons for the use of a cable-stayed bridge for Lane Avenue included:

- The model presented to the public demonstrated what a truly magnificent and significant structure it would be in the landscape. The towers would not dominate the area, yet the gateway the bridge would create would be awe inspiring to all who passed over it.

- The Olentangy River is very shallow. To maximize the clearance underneath for a bike path, it was important to minimize the depth of the superstructure. A cable-stayed bridge can accomplish this better than an arch bridge.

- With environmental considerations another strong issue, a bridge of this type would limit the number of piers to one instead of the existing three piers with the current bridge. This would not impact the 100 year floodplain.

- Since the bridge will be more than twice as wide as the existing bridge(110 feet versus 43 feet) and with a bike path located underneath the eastside, the designers did not want to create a tunneling effect that would result from an arch type structure. The cable-stayed bridge allows more natural light to enter under the deck and open up the area making it more appealing to pedestrians.

- With plaza areas on both ends of the bridge, there would be plenty of opportunity for aesthetic enhancements.

- Based on previous construction schedules for the four alternatives, it was believed that the cable-stayed alternative would minimize traffic disruptions since portions of the bridge could be built without closing the road.

While it is obvious that structural integrity is the most important factor in any public works project, one should not ignore constructability issues nor compromise aesthetic appearances. If we wanted this project to be our landmark signature bridge, it would be important for Franklin County to develop a strong set of specifications for aesthetic assurances and provide itself the clout to reject any element that does not meet plan requirements. This was partly based on the previous problems experienced with casting-in-place the towers on Beach Road.

We believed that to assure ourselves of minimal problems and construction delays, utilizing precast concrete in a majority of the structure would give the county greater control. With a tight schedule, precast elements would enable many components to be fabricated off site while work proceeded on the substructure units. Successfully precasting the edge girders and deck panels and having dealt with forming problems on the cast-in-place towers on Beach Rd., it was decided to design all of these elements to be precast and post-tensioned for Lane Avenue.

Lane Avenue Precast Specifications

With the Lane Avenue bridge being such a high profile project, we believed that there would be an attraction for many contractors to bid the job and that with the large amount of precast concrete in the plans, precasters would welcome the opportunity to bid those portions and stake their name to the bridge. Developing strong specifications and special provisions for the architectural precast concrete, in particular that used for the towers, would be important.

Using a specification from components of the PCI award winning COSI building in Columbus, Ohio as a guide, we felt the importance for the precaster to have a PCI A1 certification. Since the towers shells would ultimately be post-tensioned together to provide the bulk of the strength of the towers, we wanted a precaster that has a strong architectural quality assurance program and track record, Figure 12. As a result, the special provisions required the precaster to adhere to PCI's MNL-117 "Manual for Quality Control of Plants and Production of Architectural Precast Concrete Products". While we felt this was a good basis for our special provisions, we wanted to instill more assurances and project control into the plans. To this we also required the following:

- 12" x 12" x 2" samples would need to be submit for finish an color approval.
- The casting of a 4' x 4' x 2' mock-up corner section.
- No architectural precast concrete cold be fabricated until written approval of the mock-up section was received.
- The precaster needs to demonstrate the ability to produce all units without delaying the project.
- A mock-up section will be created and used on the project site as a template for unit approval.
- All pieces will be fabricated in successive order, basically using a match cast approach. This would assure that tolerances are met.
- Any unit will be rejected should it show any signs of staining, cracking or chipping on the exterior surface.
- Rejection of units may also result from, but not limited to, units not matching the mock-up, imperfect proportions and mixing, non-corner surface chips on the face, failure to meet ultimate compressive strengths and required in the plan documents and misalignment of unit for fit-up.
- Units must be shipped and stored to prevent any damage.

In addition to these items, most fabrication requirements needed to adhere to MNL-117 and tolerance requirements were project specific. Finally, there were tight tolerances for erection and location of the units and that all precast elements must be fabricated at least six weeks prior to field erection.

We had felt confident that a quality specification was written for the architectural precast items to allow for maximum quality control, provide an easily constructible item and allow multi-tasking on the project to minimize construction time. Avoiding some of the pitfalls from the Beach Road bridge towers seemed certain.

While not having the ultra strict standards of the tower shells, plan notes were developed for the edge girders and precast deck panels. Since we had previous success with these items on previous projects, and these elements would not be as visible as the tower segments, more emphasis was placed on developing strong structural specifications without totally avoiding architectural features.

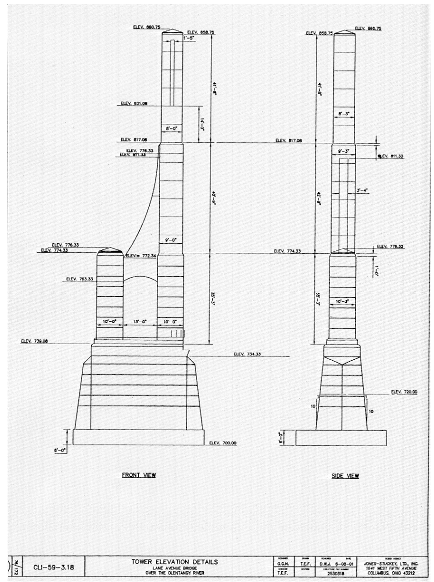

Fig. 12 Proposed precast tower plan

Other important bridge features

Before we continue with the discussion regarding the bidding and construction process, it is important to mention other aesthetic and design features.

The towers were originally envisioned to have a short tower that would be needed to provide lateral stability for the tall tower. A stainless steel tower brace would connect these two components. This would also provide a pleasing element to the bridge, inviting pedestrians to pass through the structure. Once the detail design process began, it was determined that the tall tower did not require any lateral stabilization, however, the public was sold on the original look of the bridge. Thus, it was determined to keep the short tower and tower ties. The south side short tower does house an electrical room for the bridge lighting system.

The deck system was the next element to design. A combination of concrete edge girder tubs with steel box section floor beams with stringers was the chosen system. The box sections would allow inspectors easy access and would be galvanized or metallized to avoid any future painting maintenance. Precast deck panels with a reinforced post-tensioned concrete deck. The post-tensioning is to limit cracking on the deck surface. This total system allowed the superstructure to remain as this as possible to allow more natural light underneath the deck without compromising safety or structural integrity.

Since the stay-cables tie into the edge girder and thus, separate the vehicular and pedestrian traffic, a concrete barrier was detailed on the traffic side, which allowed latitude in designing an appealing rail for the pedestrians. It was determined that with the abundance of concrete on the bridge, the use of stainless steel for the railing would compliment the structure. Stainless steel was also used for the tower tie braces, tower caps and light fixtures, Figure 13.

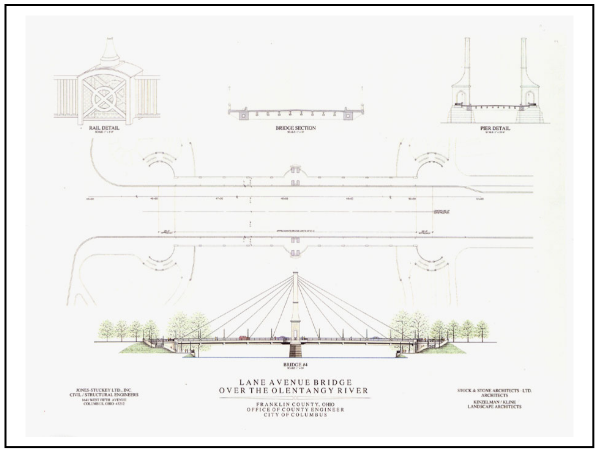

Fig. 13 Rendition of cable-stayed architectural features

Other features included the cables enclosed with a protective HDPE sheathing colored metallic gray. Architectural lighting is abundant throughout the bridge from lighting the edge girders and towers, to providing safety lights along the walkway and driving area, to the stainless steel sconces.

Although the sconces are purely ornamental, Figure 14, they tie many aspects of the

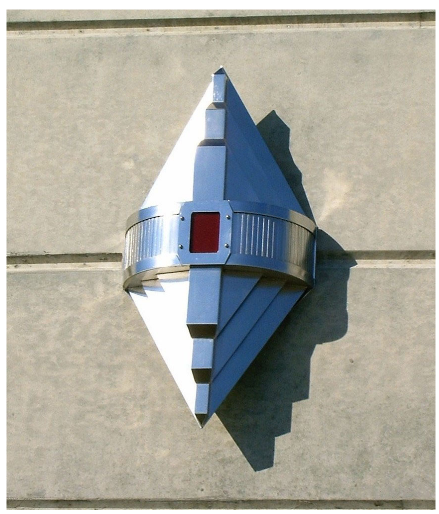

Fig. 14 Architectural sconce

bridge together. They are stainless steel, have the basic shape of the bridge towers and highlight the lower tower sections. The add a finished quality to the bridge, thus helping it fit in and compliment the architectural character of the OSU campus setting, Figure 15.

Fig. 15 Lane Avenue Bridge with architectural lighting

The bidding dilemmas

Franklin County has qualified for $5 million in federal funding and another $5 million in Ohio Public Works Commission funding for the project, the latter of which only $3.2 million could be applied to the bridge portion. An engineer's estimate for the project at $16.6 million dollars included the bridge, roadway, bike path and temporary bridge. Since bids were to be opened in the middle of January, 2002, we felt that there would be many hungry prime and subcontractors wanting this project.

As had been pointed out earlier, this is an important crossing for not only vehicles, but even more so for pedestrians. One item that was important to Franklin County and OSU was to maintain pedestrian access at all times. This is was the reason the plans called for a temporary pedestrian bridge to be built and open before the existing bridge could be demolished. With crucial time restraints for the project, it was important to sell the project early to limit the closure time of Lane Avenue to one football season and have the new bridge fully operational by April, 2004.

A prebid meeting was held in December, 2001 to address any early concerns. It appeared that there would be three to five prime contractors submitting bids, and though there were a few addendums, the process was proceeding smoothly. That is until calls started coming in to the office two weeks prior to bid opening with major concerns over the precast bid items.

Prime contractors could not find any precaster willing to give a price for that work. We were baffled by this development. Surely there would be somebody willing to bid those items. We had a numerous times seen contractors attempt to get plans changed in the bidding process to improve their position. Based on our successes from Third and King Avenue and Beach Road, we had seen that precasting allowed creative designs to work and work well. The problem was that a lot of calls came from the precasters. The specifications were stringent, but we felt that they were biddable. Apparently, this was not the case. Some of the reasons for not bidding that were cited were:

- The requirement for the plant to be a PCI certified plant for Group A1- Architectural Concrete.
- The requirement to comply with PCI-MNL-117, which is for quality control for architectural, precast concrete production.
- The excuse that it may be difficult to cast large members and match the finish and color of the mock-up example. They believed that there would be variances in color and finish beyond what was acceptable in the special provision.
- Any unit delivered to the job site that was stained, cracked or chipped would be rejected. These large members would be handled numerous times prior to erection. What if the hauler or erector damaged the piece?
- These members would have to be stored for a long period of time.
- Since the pieces are required to be cast in sequence, what would happen if a middle piece of the tower is damaged? Would the contractor have to remove any erected segments to match cast a damaged piece to fall within acceptable tolerances?

These were a few of the major concerns posed to us. We had many of our own decisions to make immediately. It was critical to sell the job soon to allow construction to begin late winter, early spring. The plans were set up to only allow precast units with no provisions for cast-in-place as an alternative. To change the plans at this stage would set the project back months.

What type of prices would we be getting? One contractor sent a fax listing all the precasters they had contacted and not one was going to submit a price. Other contractors had suggested that they had the capabilities to cast the units themselves. Would they be able to obtain the same quality as a precast facility and follow PCI MNL-117?

We decided that the playing field was level for all bidders and that we could not afford to delay the bids. Just like sitting at the final table at the World Series of Poker, we decided to go "all in" and would have to live or die with the cards we were dealt, or in this case, dealt ourselves.

Lane Avenue construction success

We were able to get a total of three bidders on the project with the awarded low bidder, C.J. Mahan Construction Company, submitting a bid more than $1 million under the engineers estimate. Franklin County had avoided the possibility of high or no bids. The problem still lurked as to who would construct the precast members.

As was expected, the contractor submitted a value engineering proposal early in the project to eliminate all precasting in lieu of cast-in-place concrete. We were extremely hesitant in the early stages to entertain this idea due to the belief that the original design plans were what was needed to achieve the project goals. Another concern was the questions that would be expected from the losing bidders as to why the county gave in so easily to a major change in plan philosophy. There would have to be significant justification and benefit from these changes if they were to be considered. After months of negotiating and plan review we agreed to the value engineering proposal. We were able to make a sound decision since all of the substructure work was not contingent on these changes. Some of the key points in this agreement and decision included:

- The only way to meet the demands from the precasting special provision requirements and complete the fabrication would be to have the contractor perform these tasks.
- The contractor was willing to precast, but would need to do this on-site to eliminate as much handling of the units as possible.
- The contractor believed they could have more control over the construction schedule.
- The falsework required to support the precast edge girders was just as extensive as if the girders were cast-in-place, Figure 16.

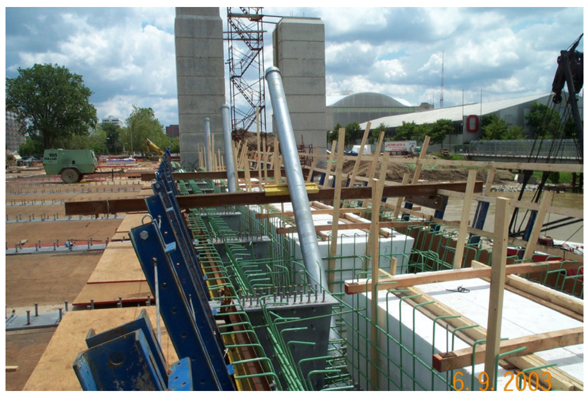

Fig. 16 View of cast-in-place edge girders

- The south side tower could be completed prior to demolition of the existing bridge.
- The need for post-tensioning the tower shells would be completely eliminated.
- The floor system could be redesigned using simpler plate girder floor beams even though more would be required, Figure 17.

Fig. 17 Revised floor system with cast-in-place edge girders

- The original tower concrete requirement was HPC 7000 psi minimum strength. This could be changed to HPC 5500 psi minimum strength, which was used in other elements of the bridge.
- The contractor assured the county that the concrete would be consistent in color and finish throughout the tower and edge girders. The material would still come from the same stock piles.
- There would be a savings to the project of $500,000 to be shared equally.
- There was a possibility of an accelerated schedule to open the bridge.

Franklin County, in turn, expected and/or required:

- The contractors engineer would accept all responsibility in the redesign of the towers and deck system.
- There would be no change in the original design concept and appearance of the bridge. The original design in the abutments, pier, plaza areas and cable-stay design including the tower anchorages and configuration remained the same. On a side note the upper tower anchorages, weighing 42 tons each, were cited by *Engineering News Record* as the heaviest single pieces of steel to be galvanized in the United States, Figure 18.

Fig. 18 View of the upper tower anchorage

- The resulting mass concrete pours in the towers would require temperature monitoring to prevent unsightly shrinkage cracks.
- The county would still retain the strong position to reject any cast-in-place element that did not satisfy the requirements as detailed in the original specifications. The

contactor would be made aware that the problems on the Beach Road tower would not be tolerated.

- The schedule could not change.

It was important for the county to complete this project on time and on budget to justify any of these decisions. To make the change even better, as stated earlier, the contractor felt that even though there would be a project cost increase, by working double shifts there was a strong possibility to open the bridge five months ahead of schedule. The county would agree to pay its portion of the value engineering savings to the contractor in exchange for a new agreed upon date for the bridge to be open to traffic. This was November 14, 2003, the Friday before the last home football of the season. There would be no time extensions granted for any reason including weather. Any day the bridge was open after this date would result in the county receiving back their portion of the savings. It turned out to be a win/win situation for all parties.

With many dignitaries on hand with Franklin County Engineer Dean Ringle, including the Governor and Lieutenant Governor of Ohio, the president and athletic director of The Ohio State University and other state and county officials, the Lane Avenue bridge opened five months early and under budget. The cost of the bridge was built for $285 per square foot of superstructure.

Conclusions

After completion of the Lave Avenue Bridge, Figure 19, Franklin County came away with an even better understanding as to advantages and disadvantages of structural precasting.

The requirements to refer to PCI MNL-117 may have been better served by referring to PCI MNL-116 "*Manual for Quality Control for Plants and Production of Precast and Prestressed Concrete Products*". A bridge is structural in nature with aesthetic enhancements to complete the project. PCI's new certification for Group BA- Bridge Products with an Architectural Finish, may be better for these types of situations.

While it is important to develop complete specifications for any project, the designer and owner must be aware that even the larger contractors may not be willing to bid a project if the risk far outweighs the rewards. It was have been a benefit to us had we used PCI's manual on *Architectural Precast Concrete, Second Edition*, to develop allowable and reasonable tolerances. Even though assurances that items won't be rejected for minor blemishes can be made by the owner, the contractor is still governed and must bid accordingly as to what is stated in the bid documents.

While the strict specifications scared many would-be bidders away, it still provided us with the needed leverage and insurance that they would attain the original project goals.

This gave us the ability to negotiate a fair and beneficial resolution during the value engineering review.

Franklin County has successfully constructed and will continue to view precasting as a viable choice in bridge building. The landmark structures we have created serve the public's needs, puts us is good standing with the voting public and allows our designers to explore different options that will last for generations and create civic pride.

Fig. 19 Completed Lane Avenue Bridge