SCANNER

NEWSLETTER OF THE AMERICAN SOCIETY OF HIGHWAY ENGINEERS

May 2000 - 2

North Central West Virginia Section Honors Norman H. Roush, Deputy Commissioner, WVDOH

Left to Right: Norm Roush, Domenic M. Piccolomini, President-Elect, ASHE

On April 12th , at Flatwoods WV Days Inn, the North Central WV Section honored Mr. Norm Roush, Deputy Commissioner, WVDOH.

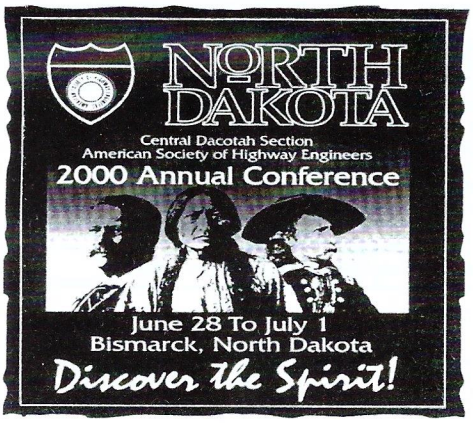
Mr. Roush has served the WVDOT for 34 years. He was appointed Deputy Commissioner in February 1998. Among other duties, he is in charge of all development with the state, and is the liaison within City, County, State, and Federal agencies.

Previously, he was the Chief Engineer for Development, which carried the responsibility for all projects through their design and right-of-way stages, including management supervision of the Roadway Design, Structures, Traffic Engineering, and Right-of-Way Divisions.

He has attended and spoken at several American Association of State Highway and Transportation Officials committee meetings. He also was a speaker for the Division on many occasions.

Mr. Roush has served on several AASHTO task forces, and is currently chairman of the Task Force on Preconstruction Engineering Management. He serves on the Task Force in Geometric Design, which is further developing the new "Green Book."

He has served on NCHRP panels and is currently chairman of NCHRP Panel, 20-7, Roadway Widths on Very Low Volume Roads. A member of the Design Committee for 20 years, Mr. Roush was the recipient of the Region II Design Award in 1986 and the National Award of the Subcommittee onDesign in 1998.



National Board News

National board members met for a regular board meeting on April 29, 2000, at the Ramada Inn, Morgantown, West Virginia. National President Charlie L. Flowe, P.E. presided over the meeting. The following are highlights of the committee reports and board actions:

Membership:

Total ASHE membership stands at 5,051 including 33 Sections over the nine ASHE Regions. This count is an increase of 198 members since the January 2000, national board meeting for a total membership increase of 183 members this year.

Presidents' Report:

President Flowe attended the formation meeting of the Greater Hampton Roads Section, which chartered on January 18, 2000 with 73 members.

At the direction of President Flowe, Past President Roland Nesslinger continued facilitation of ASHE's strategic plan, vision, mission and values. This effort is nearly complete and on target for distribution to the sections at the 2000 National Conference in Bismarck, ND.

Regional Organization:

Representatives of the Pittsburgh Section provided the board a special presentation requesting consideration of a seat at large on the board. This request is due to the size and major contributions of the Pittsburgh Section to the benefit and growth of national. A motion carried to table the request at this time and defer to the Operations Committee that is being created under the new strategic plan. This committee will be charged with evaluating the regional boundaries every two years due to growth of the organization. The first evaluation will be complete by Conference 2001.

New Sections:

Second Vice President Cooper Curtis presented a report from Director Dave Jones on new sections activity since the January board meeting. New interest in forming a section in southeast Ohio was followed up with an informational package in February. An initial meeting may be held in May or June of this year.

Director Jones is continuing to follow up on interest from possible sections in Fargo, ND and Pierre, SD that he visited in conjunction with the October board meeting held in Bismarck, ND. Central Dacotah section has sent registration forms for the 2000 Conference.

National Conferences:

Director David Jones reported on the status of Conference 2000. Registrations are beginning to come in. North Dakota DOT recognizes the importance and relevance of this conference to the highway industry and will encourage employee attendance. Exhibitor and sponsor participation is coming in as expected.

Director Dominic Piccolomini reported that the Southwest Penn Section would like to host the July 21 national board meeting at the Seven Springs Resort, near Somerset, PA which is the site of Conference 2001. All committees are in place and subjects for the technical sessions have been selected. Entertainment and the spouse programs are in progress.

Regarding future conferences after 2003, the National Conference Committee is continuing to formulate guidelines and recommendations for conference rotation and distribution of conference profits.

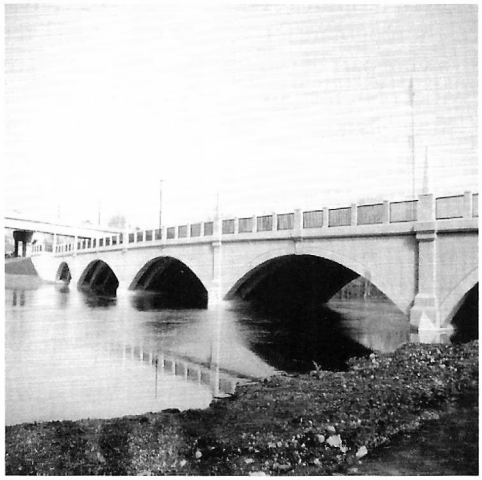
Technical & SCANNER Committee:

Director Peda presented a proposed two-year agreement to the board to continue Executive Management Services by Wanner Associates, Inc. This agreement covers web site management, SCANNER publication, display booth management and miscellaneous services. The board approved and signed the contract. ■

The King Avenue Bridge

by
Mark Sherman, P.E.
Franklin County Engineers, First Vice President
ASHE Central Ohio Section

The new King Avenue Bridge is a unique structure comprised of a combination of precast and cast-in-place concrete members, using high performance concrete and light- weight concrete. This bridge has pre-stressing, post-tensioning and field splicing of precast concrete members, as well as regular reinforced concrete. The piers and abutments are normal ODOT class C concrete while the design of the arch rib segments and splices consist of 5,000 psi high performance concrete. The actual concrete strength in the arch ribs is much higher in order to meet the fabricator's production schedule. The deck is ODOT High Performance Concrete mix 4, that uses mirosilica and granulated blast-furnace slag. The spandrel walls are 4000-psi lightweight concrete. One unusual aspect of this bridge is the lampposts, which are precast concrete, as is the traffic barrier and railing posts. This provided quicker construction and a more architectural finish.



The King Avenue Bridge replaces a concrete arch structure that had tremendous civic value to the community. Our replacement bridge is designed with a high degree of aesthetic quality that meets the community's expectations. The special attention paid to aesthetics as an integral part of the design process added about 15 to 20 percent to the construction cost and in order to insure the preservation of this investment, we designed the bridge for a service life in excess of 100 years. This added another15 to 20 percent to the construction cost. These two costs appear to be consistent among all of our significant bridges with extended service lives and high aesthetic quality regardless of the structure type.

The bridge replacement on King Avenue is the third of four unique bridge types that Franklin County has already replaced, or has in the final design process for the lower Olentangy River corridor of Columbus. All are concrete structures that utilize high performance concrete, precast members and post tensioning. The King Avenue Bridge is a five span, precast-post-tensioned, reinforced concrete, segmented arch bridge, with cast in place segment splices, abutments and deck. The other four bridges are different in structure type and had different design criteria. The Third Avenue bridge consists of a two span, precast, field spliced, arched bulb-tee bridge girder on wall type piers and abutments. Our first significant replacement was the Broad Street Bridge which was a five span, cast-in-place post-tensioned concrete girder frame; and the Lane Avenue bridge, in detailed design is a two span, cable-stayed bridge.

Each of these structures was born out of a design process that required the establishment of design goals and criteria for each project and community involvement in the design. We believe they are an investment in our community that represents the best in engineering design and construction provides a longer service life and greater civic value to the community. ■

Historic New Jersey Bridge Renovated

by

H. Meyers - Anselmi & DeCicco, Inc., P. Imperiale - HNTB Corporation, P. Natalizio - Anselmi & DeCicco, Inc.

The Route 46 bridge over the Passaic River in Bergen and Passaic counties was recently renovated to meet current Federal and State highway design standards. Built in the 1930's, the bridge was showing signs of its age. Due to its eligibility for the National Register of Historic Places, the bridge reconstruction had to address not only structural, traffic and environmental design issues, but also maintain the historic and architectural integrity of the bridge.

The structure, which is located at the northern terminus of New Jersey's Rt. 21 Traffic Corridor, is a critical thoroughfare for inter-state and intra-state commuters. It is also a vital part of the region's economy, supporting the business activities of numerous commercial and industrial enterprises along Rt. 46 and its adjacent communities in northern N.J.

The existing bridge was 538 feet long by 66 feet wide. Its roadway, which was located 33 feet above the normal river level, contained four traffic lanes with two sidewalks. The structure was a five-span, reinforced concrete, open spandrel arched bridge that was designated structurally deficient and functionally obsolete. The bridge's superstructure was in poor physical condition and its live load capacity was below current standards. The substructure was in good condition. The historic and architectural significance of the bridge resided in its arches, vertical spandrel columns, abutment pylons, balustrades, faience tiles and medallions.

The new structure is a five-span, arched structural steel, plate girder bridge with a reinforced concrete deck. The reconstruction widened the structure to create a roadway containing three traffic lanes with a sidewalk eastbound and four traffic lanes west bound. Architecturally significant details, including the balustrade, faience tiles and medallions, were replicated in the new construction to mimic the look of the old bridge. The historically significant arches and vertical spandrel columns were preserved and are incorporated into the look of the new structure as non-bearing members. The abutment pylons were removed, restored and reattached atop the new abutments.

The contract plans required the bridge reconstruction to be accomplished in three stages. In each stage, the traffic was diverted to allow the construction of a different longitudinal third of the bridge. The work encompassed the removal of the complete bridge superstructure and sufficient substructure to allow for the construction of a north and south extension on each abutment, a north and south cantilevered overhang on each pier, a new pier shaft (incorporating the existing pier shaft) at each pier pedestal, structural steel, a roadway deck.

Stage 1 construction started with the relocation of traffic onto the northern three-quarters of the existing bridge and away from the stage 1 work along the south side. A construction trestle was installed parallel to the stage 1 work. South side cofferdams were driven and excavated for the construction of the abutment extensions. Prior to any deck demolition, a temporary deck support beam was installed over the existing deck at the intersection of stages 1 and 2. The existing deck was then hung from the beam. To facilitate the preservation of the arches and vertical spandrel columns, all demolition was performed with a wiresaw. The wiresawn pieces were trucked off site and demolished. Concurrent with stage 1 demolition, the abutment extensions and pier cantilevers were constructed. Stage 1 structural steel and roadway deck were constructed from the trestle.

Stage 2 construction started with the relocation of traffic from the stage 2 deck to the new stage 1 deck. The demolition, steel erection and deck construction occurred simultaneously. As the deck demolition progressed to a point were the beams could be erected, the deck removal was halted and the beam erection was performed. The deck construction followed promptly after the beam erection.

Stage 3 included the construction of the north side abutment extensions and pier cantilevers as well as the demolition, steel erection and deck construction work. The stage 3 work was performed similarly to stage 2 except that the abutment extensions and the pier cantilevers were constructed from the stage 3 deck prior to its demolition.

The successful completion of this project was the direct result of the excellent working relationship, communication and cooperation between representatives of the N.J. D.O.T., HNTB Corporation and Anselmi and DeCicco, Inc. This rapport benefited both the Owner and Contractor by expediting the reconstruction, circumventing design and field problems, reducing costs and lessening the impact on the traveling public. ■

NDDOT's Rest Areas

by

Bennett Kubischta, Local Government Division, North Dakota Department of Transportation

If you travel by land in June to Bismarck for the ASHE Conference, you will likely see and probably use the North Dakota Department of Transportation's new rest areas.

Thematic in design, each rest area tells a tale of its own. About seven miles east of Bismarck, on I-94, you will encounter the Apple Creek Rest Areas. The westbound rest area is built in the style of a 1930s gas station. Outside, motorists are greeted with replica gas pumps. On the inside, North Dakota's story of oil exploration is told on cast metal plaques.

Across I-94 from the westbound rest area is a rest area built in a warehouse style. Told here is the story of the Port of Bismarck on the Missouri River. On the walls are metal plaques with photos and text describing the port and boats that were used on the river. Travelers are also treated to a table containing an historic map of the Missouri River in North Dakota, showing the locations of existing towns, ghost towns, Lewis & Clark campsites, and photos and sketches from 1800 to 1950.

Additional rest area design goals are to make facilities that will better serve the motoring public. Large exterior windows enable the approaching users to see into the lobby. A separate family rest room is included. These family rooms can be used by the disabled, dad traveling with his little girls, mom with her little boys, or a woman traveling with her husband who needs help. Increased site lighting will make the rest areas more comfortable after the sun has set.

Public service rooms have been installed in several rest areas. These rooms have a sink and cabinets, and a counter top where coffee can be served to the public. We anticipate public-spirited groups to donate coffee and tourist information to the public. A car club, promoting an upcoming weekend show, could set up for a few hours. We do not expect long-term commitments, as it is difficult to coordinate volunteers, but we see these groups serving a weekend or two.

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I will present our exciting rest area story in more detail at the ASHE Conference in June. You will hear of the ups and downs of the program, see photos of our different buildings, get an in-depth look at their amenities, and learn about how we funded them. Come with questions for, pleasant motoring, and make sure you take a potty break! ■

Non-Payment Does Not Necessarily Justify Suspension of Work

by
Robert Ewing, Esquire, Kaplan, Stewart, Meloff, Reiter & Stein

Nearly every contractor has either stopped work because of non-payment or at least contemplated such a step. However, the Pennsylvania Superior Court's recent decision in Lane Enterprises, Inc. v. L. B. Foster Co., 700 A.2d 465 (Pa. Super. Ct. 1997), demonstrates that any decision to suspend performance can have serious consequences and must, therefore, be carefully considered.

In the Lane Enterprises case, Hammond Construction, Inc. ("Hammond") contracted with the Ohio Department of Transportation ("ODOT") for the construction of a bridge. L. B. Foster Co. ("Foster") agreed to supply Hammond with various bridge structural components, and Lane Enterprises, Inc. ("Lane") agreed to clean and coat those components for Foster in accordance with ODOT specifications. The sub-subcontract between Foster and Lane for the coating work (the "Coating Agreement") separated the coating work into two stages and similarly divided Lane's total compensation into two parts.

During the project, ODOT inspectors visiting Lane's coating facility questioned the amount of contamination under the coating being applied by Lane ("backside contamination"), and ODOT eventually rejected the Stage I components after they arrived at the bridge site for failure to meet a zero percent backside contamination standard. Lane argued that ten to twenty percent backside contamination was allowable and informed Foster, Hammond and ODOT that it could not meet a zero percent contamination standard. After some preliminary negotiations, ODOT agreed to accept the coated components if certain field repairs were made. Foster notified Lane of ODOT's proposal; Lane agreed to accept responsibility for the field repair costs; and Foster advised Lane that it would withhold payment from Lane until the field repairs were completed. Before the field repairs were performed, Foster owed Lane $18,018.06. After the field repairs were performed by another Hammond subcontractor at a cost of $10,935.84, Lane requested payment of the $7,082.22 balance still owing on Stage I of the project.

Before issuing any further payment, Foster sent Lane two letters which inquired whether Lane intended to perform the Stage II coating work and indicated that the Stage I balance would be paid when Foster received assurance that Lane would perform the Stage II work. Lane responded to both letters by simply stating that it would not proceed with any further work until it received the Stage I balance. Foster, faced with the threat of delay damages, proceeded to hire another contractor to perform the Stage II coating work at a cost of $99,329.15, which was $42,055.00 more than Lane would have been paid for that work under the Coating Agreement.

In the litigation which followed, Lane sought payment of the balance due under Stage I from Foster, and Foster sought to recover from Lane the $42,055.00 excess costs incurred to obtain substitute performance for Stage II. The trial court found in favor of Lane on its claim for the $7,082.22 Stage I balance and ruled that Lane was not liable for the excess costs paid by Foster to the Stage II replacement contractor. Foster appealed, however, and the Superior Court reversed, determining that Foster was entitled to recover the $42,055.00 in excess costs incurred to complete Stage II, less the $7,082.22 Stage I balance due Lane. Thus, the litigation resulted in a net judgment in favor of Foster and against Lane for $34,972.78.

In reversing the trial court's ruling, the Superior Court found that, while Foster had indeed breached the Coating Agreement by failing to pay the undisputed Stage I balance, the breach was not a "material breach" which would entitle Lane to suspend performance. Consequently, Lane was responsible for the additional costs incurred by Foster to obtain substitute performance. The Superior Court rationalized its decision: (a) by suggesting that since Foster was only withholding approximately five percent (5%) of the total contract price, the non-payment was too insignificant to be considered material; (b) by concluding that Foster had a right to demand assurances from Lane that it would perform the Stage II work before making the final Stage I payment, because Lane had previously stated it would be unable to meet the ODOT backside contamination standard; and (c) by noting that it was uncontradicted that Foster planned to pay Lane once it received the requested assurance.

The Court's opinion in Lane Enterprises leaves undecided the most important question for contractors in Pennsylvania — at what point does the percentage withheld become large enough to justify suspending performance. In fact, the Court could easily have decided the Lane Enterprises case differently if it had compared the amount withheld to the price of the Stage I contract work completed by Lane (i.e. $7,082.22/$65,712.41, or a failure to pay nearly 11%) rather than comparing the amount withheld to the total contract amount for both Stage I and Stage II. In order to remove this uncertainty, construction contracts should always address when and under what circumstances a contractor may suspend performance. Many widely-used contract forms, such as the Standard AIA contracts and subcontracts and the Engineers Joint Contract Documents Committee standard General Conditions address this situation by allowing work stoppages and even termination for failure to pay any amount properly billed and/or certified by the architect/engineer. In the absence of such specific contract provisions, however, contractors and subcontractors performing work in Pennsylvania, or under contracts subject to Pennsylvania law, must take the Lane Enterprises decision into consideration and evaluate whether the unpaid amount is large enough to justify "walking off" a job or otherwise ceasing performance.

Robert P. Ewing, Esquire is an attorney who focuses his practice in the areas of construction law and litigation. Mr. Ewing is currently associated with the law firm of Kaplin, Stewart, Meloff, Reiter & Stein located at 350 Sentry Parkway, Building 640, Blue Bell, Pennsylvania 19462 (610-941-2471).

A New Way to Look at Traffic Control Plans

by
Gregory R. Alford, P.E., Reynolds, Smith and Hills, Inc.
Melissa S. Atchley, Reynolds, Smith and Hills, Inc.

With the advances in technology it has been possible to provide highway project information in mediums that used to be only a pipe dream. Two dimensional CADD drawings have given way to realistic three dimensional representations. Anyone who has ever had to interpret a set of traffic control plans for highway construction whose sheet count number in the hundreds can appreciate the subject of this article.

Reynolds, Smith and Hills, Inc. was selected by the Florida Department of Transportation (FDOT) to provide a construction phasing video concurrent with the design of a multi-level fully directional interchange where Interstates 95, 295 and SR 9A come together in southern Duval County, Florida. The FDOT had elected to forgo a physical model of the interchange, as was originally intended, in lieu of one from the virtual world, fully animated to provide a higher sense of realism than that of a physical model. This virtual model also enabled animation of traffic control and construction phasing. The goal was to produce a 20-minute video that would be shown primarily to engineering, construction and construction administration personnel to aid in the interpretation of a nine-phase traffic control scenario, which included many sub-phases.

Although RS&H is accomplished in highway design of similar projects and experienced in computer rendering and animation, this project provided a formidable challenge. Temporary alignments, temporary profile adjustments, and temporary bridges were just part of what added to the complexity.

Gathering Data:

The first step in video production was gathering the vast amount of data required to generate the existing model and the proposed interchange. The RS&H team began the project with Microstation CADD files of the proposed interchange, a digital terrain model of the existing site, photographs, alignment/point databases in Geopak format and more than 800 plan sheets. The core software applications for the production of the video were Microstation, Geopak Road, Geopak Bridge, and Discreet's 3D Studio MAX and VIZ.

Building the Existing Interchange:

The first step in modeling the existing interchange was converting a multimegabyte digital terrain model from Geopak to a 3D Studio file of a manageable and workable size.

The next step was to bring the two dimensional planimetric file to three-dimensional life. To recreate the existing 3D interchange the planimetric lines provided from survey were projected onto the digital terrain model elevations where mesh surfaces could be accurately applied to create the three dimensional mesh surfaces.

Modeling the Proposed Interchange:

The creation of the proposed model began with the production of three-dimensional alignments. These were created utilizing Geopak Bridge software, combining horizontal and vertical alignments to create 3D splines. Typical roadway and bridge sections were then converted from Microstation design files into 3D Studio VIZ. These typical sections were then lofted along the three dimensional alignments. The lofting process involves projecting a two dimensional, closed shape along a three dimensional line to produce a virtual "extrusion." This lofting process accounted for the majority of the proposed interchange model.

Since the project involved illustration of construction sequences and traffic control sequences it was important to loft and assemble the proposed model in the same logical fashion in 3D Studio as it would be put together in construction.

Cars and trucks, signage, ponds, culverts and landscaping were also created to complement the model.

Application of Lighting and Surfaces:

Once models were complete it was time for the team to begin the process of creating the realism of the interchange. The computer model was, at this time, a mathematical representation of solid three-dimensional shapes without respect to color or texture. Surfaces needed to be applied to all solids, such that they would independently know what type of material they represent. The need to distinguish between old roadway, bridge materials, asphalt and concrete were key in the model interpretation.

Another critical component was the selection and placement of light sources within the model. The ultimate goal, of course, is to replicate sunlight to create the photo-realistic effect necessary to bring the interchange to life. For this simulation the sunlight utility within 3D Studio VIZ was used.

Setting up Cameras and Animating:

The next step in the creation of the video is the production process. This involves the placement of cameras, their movements, the movement of the model, including vehicles, and the rendering of frames. This all must be done with the mindset of a movie production, with respect to how much time each phase will take to illustrate, the amount of voice-over required for that aspect, all while considering the perception of the video viewer—a difficult process requiring much trial and error.

The rendering process itself is the most laborious task of all. Consider one second of smooth animation requires 30 frames to be rendered. For a 20-minute video with a minimum of two layers of animation, that equates to over 60,000 frames requiring rendering. Each frame can take up to two minutes to render. Therefore, the machine time required to render the video one time is in excess of 1,000 machine hours. 3D Studio allows for rendering jobs to be sent for processing on multiple computers from a single rendering "manager." This allows for many machines (20-40) to run rendering jobs in the evenings and through the weekends to accomplish this intense task.

Narration and Production:

The most difficult part of the production process was defining a script that concisely describes the animation and construction operations while at the same time fits in the time frame allowable overall and for the individual scenes. The project team reviewed the script on numerous occasions. Once a script was agreed to by the project team it then came time to perform the narration in the recording studio. Sound bytes were produced and digitally transferred to compatible file format for video production.

These were then imported into 3D Studio in order to test and tweek the timing of the animation. The motion and narration needed to be timed so that no components flew by too quickly to understand or too slowly as to loose interest of the viewer.

Final Production:

Final production involved bringing together of several layers of animation, still imagery, titles and narration. Composed using Adobe After Effects and a Media 100 Suite, the final video met its 20-minute estimated length.

As is evidenced here, the days of ink and mylar are far gone. One can only imagine when we will be "virtually" constructing projects during the design phase, providing deliverables as 3 dimensional models consisting of elements that represent physical media with respect to size, shape, and material. ■

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by

Bennett Kubischta, Local Government Division, North Dakota Department of Transportation

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I-95/Aramingo Avenue Interchange Ramps 1999 Delaware Valley Section Project of the Year

by Alex Houseal, P.E.

The Betsy Ross Bridge, completed in 1976, was originally intended to connect Route 73 in New Jersey to Interstate 95 (the Delaware Expressway) and the proposed, but never constructed Pulaski Expressway in the City of Philadelphia. This objective was only partially fulfilled as the bridge currently terminates at U.S. Route 130 in New Jersey and with only I-95 in the City of Philadelphia. As constructed, the bridge has completed ramp connections to I-95. The result is that there is no access available between I-95 and the local street system in Philadelphia at this interchange. The I-95/Aramingo Avenue Interchange Ramp Project linked I-95 to the local street system at Aramingo Avenue.

Existing gaps in the access to local streets are apparent. The first available exit on I-95 south of the interchange is Allegheny Avenue, a distance of 1.4 miles. Access from the local street system to I-95, south of the interchange, occurs at Castor Avenue for motorists going to I-95 northbound (0.7 miles) and at Allegheny Avenue for motorists going to I-95 southbound (1.4 miles). Access to and from I-95, north of the interchange is available at Aramingo Avenue near Margaret Street (1.0 miles from the interchange). The lack of access to and from the city street system results in traffic filtering through local streets to get to the few existing points of access to and from I-95. The I-95/Aramingo Avenue Interchange Ramps Project alleviated the need to travel to the north or south of the project area in order to gain access from the project area to the interstate system, and vice versa. In particular, since much of this traffic is comprised of trucks with origins and destinations within or near the study area, residential areas along the connecting roads are experiencing reduced truck traffic.

Improved access to Interstate 95 will also facilitate economic development of this area. The area is in an economic development enterprise zone with many properties surrounding the area owned by the Philadelphia Industrial Development Commission (PIDC). The improved access to Interstate 95 has already resulted in one trucking business relocating to the area.

A secondary benefit of completing the interchange was the remediation of hazardous wastes located within the interchange's footprint. Historical land-use in the study area consisted of industrial land uses including lead and zinc smelters, metal fabrication, battery refurbishes, retail petroleum sales, and extensive landfill practices. Investigations of the near surface fill materials identified battery casings, heavy metals contaminants with hazardous levels of lead, and petroleum hydrocarbon contamination. Using the Land Recycling and Remediation Standards Act (Act 2 – Brownfields Legislation) for this designated Enterprise Zone, special industrial standards under Act 2 were used to remediate the site. Using maximum on-site re-use of the material in the area the contaminated soil was re-used using "soil washing". These efforts reduced the clean up costs from initial estimates of over $13 million to $3 million, which fit within the project budget. This was the first application of this law by the Pennsylvania Department of Transportation.

The project benefits the community in many ways by alleviating truck traffic from the local roadways, making the area a more desirable location to live and work and cleaning up the local environment.

Even though the direct connection of Aramingo Avenue with the Betsy Ross Bridge is still not completed with the construction of this project, it was mandated that provisions should be made to allow this connection in the future. This required constructing the reinforced concrete deck for I-95 southbound off-ramp to an ultimate configuration cross slope that is necessary when it connects to the Betsy Ross Bridge approach, but then constructing a concrete overlay on the deck to provide the necessary superelevation for the present condition. Threaded rebar couplings were also installed in the new deck adjacent to where the widening of the bridge structure would occur when the Betsy Ross Bridge connection is made. Although this cost slightly more to construct now, future construction cost will be significantly reduced since the need to dowel or chip away the existing deck to get proper rebar lap will not be required. The above provisions for future construction were done for minimal cost, which fit easily within the project budget, but will pay big future benefits.

The construction contractor (Wagman, Inc.) also used innovative means to save time and money. One construction technique of particular note was the use of slip forming to construct the bridge parapets rather than conventional stationary forming and casting methods. On a project of this magnitude, with about 8,500 linear feet total length of bridge parapet, utilization of the slip forming method for the construction of the parapets proved to be quick and cost effective while still providing good quality.

The project was awarded for a construction cost of $25.2 million and was constructed under budget and on time.

The design team for the project was led by URS Greiner Woodward-Clyde's King of Prussia, PA office. Subconsultants included A.G. Lichtenstein and Associates, Chilton Engineering, Inc. and BCM Engineers, Inc. ■

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