SCANNER

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Summer 2005-3

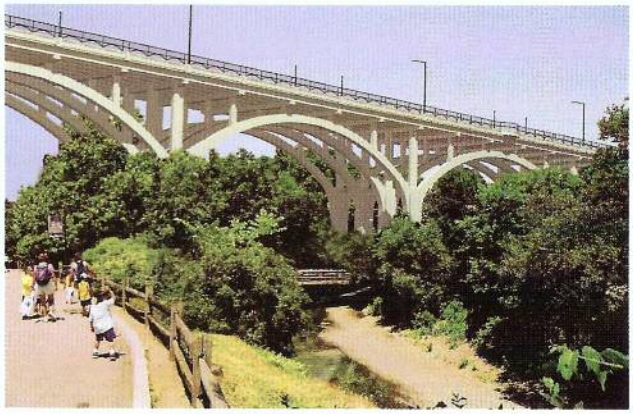
Context-Sensitive Design for the Fulton Road Bridge Replacement

John C. Dietrick, PE, SE, and Jeff W. Broadwater, PE, Michael Baker Jr., Inc., Cleveland, OH

Introduction

The Fulton Road Bridge in Cleveland OH, is a seventy-year-old concrete arch bridge. For many years this bridge has carried a significant volume of traffic 100′ above the Cleveland MetroParks Zoo, Brookside Park, Big Creek, and two active railroad lines. Replacement of this concrete open-spandrel deck arch bridge has become imperative because of its severely deteriorated condition.

Because of its location over the Cleveland MetroParks Zoo, which is patronized by over a million visitors yearly, the bridge has long been a highly visible structure and an important community symbol. The bridge is one of few of its type and era still in use in Ohio. Great care has been taken to solicit and implement feedback from stakeholders and the public. A bridge alternative study has been performed to evaluate replacement bridge types, focusing on maintaining the unique character of the structure and minimizing negative impacts to the zoo, in the spirit of context sensitive-design.



After evaluating a number of conceptual bridge replacement types, three feasible alternatives were advanced for more detailed study and presented in a public forum. Based on preliminary engineering and public input, a precast concrete arch alternative, with six 210-foot spans to resemble the existing structure, was selected and advanced to final design.

Final design has continued the context-sensitive approach by attempting to incorporate design solutions and construction methods that best address the unique context of the bridge and its site. Parabolic arch rib segments will be fabricated in 65-ft., 70-ton pieces, and erected using temporary towers and stays supported on the pier columns. This proposed top-down approach to the arch construction will minimize the negative impact to the zoo and railroads.

Project Background

The conceptual design effort also encompassed a number of environmental, cultural and historic issues associated with replacement of the structure. The prominence of the structure, its location in a culturally significant neighborhood, and its visibility from afar provided incentive for a context-sensitive approach guided by an extensive bridge concept development and type study effort assisted by significant input from key stakeholders and public involvement.

Existing Bridge

The Fulton Road Bridge was constructed in 1932 and consists of six 210-foot concrete open-spandrel cast-in-place deck arch spans and concrete approach spans. The overall length of the bridge is approximately 1,600 feet. Four lines of arch ribs support the deck, which is a flat-slab integral with the spandrel columns. The structure carries four lanes of vehicular traffic over the Cleveland Metroparks Zoo, Big Creek, John Nagy Boulevard, and the Norfolk Southern and CSX railroad lines. As a result of the structure's age and long-term exposure to deicing chemicals, significant deterioration has occurred, including moderate to severe spalling of concrete, and exposure and corrosion of reinforcing steel. Cantilevered sidewalks were removed from the structure many years ago, and in 2004 the four lanes of traffic on the structure were reduced to two lanes. Because of the extensive nature of the deterioration in the structure, rehabilitation of the structure was not judged to be a practical alternative.

"Fulton Road" continued p. 17

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President's Message

Ron Purvis, P.E.

Hopefully, I will have the opportunity to visit your section and meet many of you this year while serving as your 2005 - 06 President. My primary goal for the year is to work with the National Board in accomplishing the goals contained in the Strategic Plan. Each local Section is encouraged to use the Strategic Plan (available at the National web site www.highwayengineers.org/) to develop your program and define your local goals.

Membership growth is a strategic objective. Past growth was accomplished by person-to-person contact. New sections have typically been initiated by existing members, who were transferred to a new location. Consequently, growth has been somewhat random and unpredictable. We think that membership would increase if nonmembers in the highway industry knew more about ASHE. We must do a better job of promoting the organization with a uniform message and image. However as we grow, it is important that we do not lose sight of our mission.

How do we respond when someone asks for a reason to join ASHE? Unfortunately, the message differs depending on our personal prospective. It is important that the message outsiders receive be clear and accurate. The message should be consistent with our mission statement, which is to provide a forum for members and partners of the highway industry that supports education, innovation, and fellowship; promoting a safe and efficient highway system for mobility now and in the future

Partnering is a term used by transportation agencies to encourage a cooperative working relationship between the private and public sector groups involved in a highway project. The term is used to emphasize the importance of teamwork in accomplishing mutual goals. ASHE is an ongoing partnership between the public and private sector.

We are unique. We are the only organization that strives to encompass the entire highway industry. We provide a forum for the highway industry to communicate policy and procedures. An essential component of our mission is to support technology exchange and innovation within the industry. Members and leaders give of their personal time and energy to support that mission. ASHE membership includes both the public and private sector because the industry relies on both groups to provide a safe and adequate highway system.

It is important that we strive to maintain this balance between the different highway industry partners. There are many organizations in our industry. There are road builder organizations. There are organizations that focus on certain highway materials and products. There are organizations that restrict their membership to state DOT officials. There are organizations that focus on transportation research; on bridges; on transportation planning; on traffic engineering; and on intelligent highway systems. ASHE welcomes individuals from all these groups to participant as equal partners in our organization.

Our organization was created by individuals working in the highway industry from both the private and public sector. ASHE founders included state DOT, private consultants and construction contractors. Past ASHE National Presidents were state DOT employees. Local and national meetings provide a forum for public transportation agencies to communicate important issues to the local and national highway community. ASHE speakers include national, state and local political officials and DOT administrators.

We encourage public transportation agencies to support employee participation in ASHE. ASHE is a worthwhile investment in employee training. Technology exchange and industry contacts improve job performance. ASHE provides the opportunity for members, who are involved in only one aspect of the highway program, to be exposed to the "big picture." Members are also exposed to individuals in other organizations with jobs similar to theirs. ASHE fosters a positive image of the highway industry which improves employee moral.

ASHE dues are low so that everyone who qualifies can afford to be a member. We do not discriminate based on education, job classification or professional status. We are open to everyone involved in planning, designing, building and operating highways. Every member has the same opportunity to become a leader within the organization.

We are members of a great organization. It has the potential to become a significant influence on the national highway program and on the image of the highway industry. To accomplish this requires growth. My personal goal is to promote ASHE growth. This will require that we communicate a clear and accurate image to outsiders. Your help is needed to accomplish this goal. ■

ASHE Charters Middle Tennessee Chapter

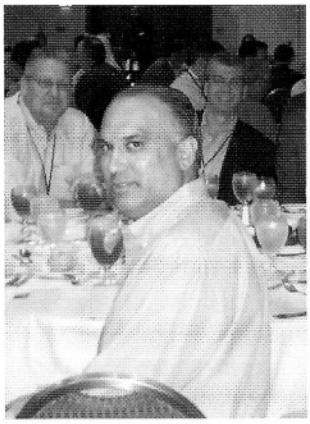
The Middle Tennessee ASHE Chapter charter meeting will take place August 9th, 2005. A luncheon meeting will be held at the Tennessee Engineering Center in Nashville, TN, from 11:30 a.m. - 1:00 p.m. Larry Ridlew will be installed as the Middle Tennessee incoming president by the ASHE National President, Ron Purvis, P.E. Gerald F. Nicely, TDOT Commissioner, will be the keynote speaker.

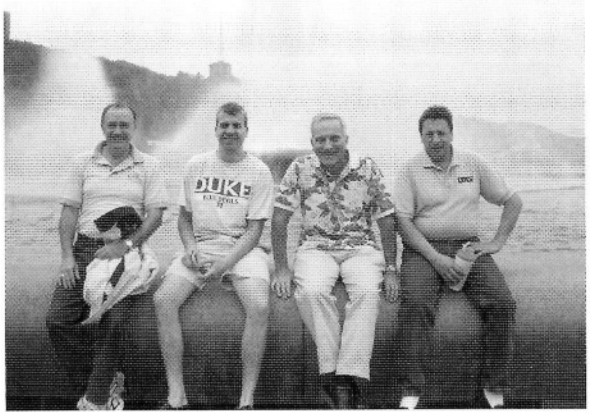
Congratulations Middle Tennessee!

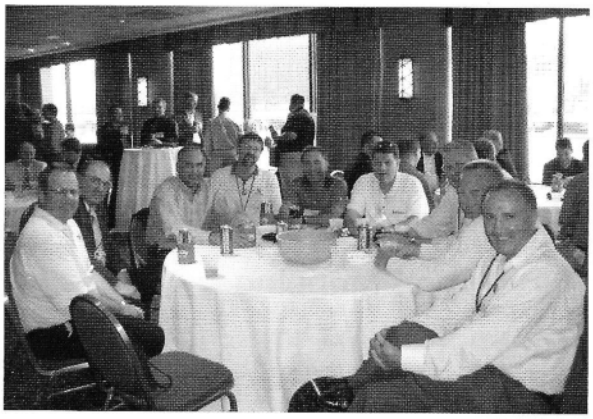
ASHE National Conference 2005 Review

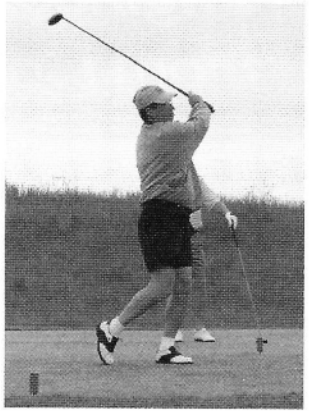
Sheraton Station Square, Pittsburgh, Pennsylvania
June 2-5, 2005

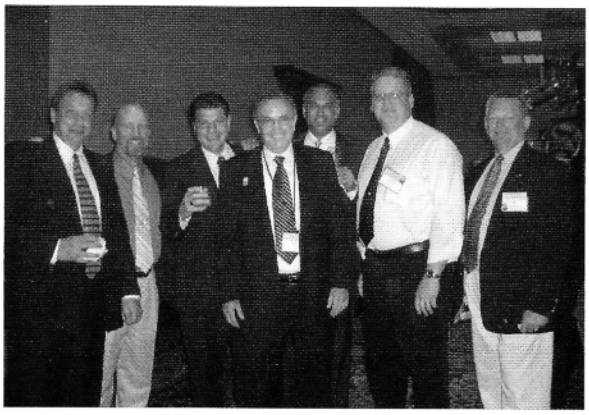
Since a picture says a thousand words, the most effective way we can think to convey the success of the ASHE 2005 National Conference is to give you a photo review. We can sum up the conference by saying... "A good time was had by all." If you weren't here with us, we look forward to seeing you next year, May 31-June 4, 2006, in Williamsburg, Virginia.









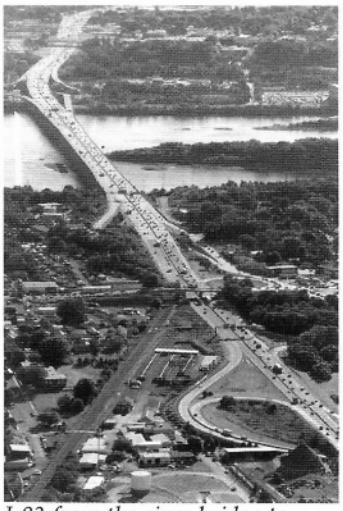


The I-83 Master Plan

A Tool for Planning and Programming

Joseph F. Hollinger

Often the best approach to a problem is the simplest. This concept is especially true when it comes to transportation planning studies. Too often the excessive volume of data overwhelms the message, complicating the meaning and making the product, which is the planning document, an unusable tool. Consequently, when the Pennsylvania Department of Transportation (PennDOT) initiated a study of Interstate 83 through the Harrisburg area, they envisioned a product that would be concise and user-friendly, would target the steps necessary to achieve a solution, and would be a beneficial tool for making project planning decisions.



I-83 from the river bridge to the I-83/PA/581 Interchange

Interstate 83 extends from Harrisburg, Pennsylvania to Baltimore, Maryland. It serves as an important regional connector in the Northeast United States, carrying people and goods from New York and New England to southern and western parts of the country. In the Harrisburg region, I-83 is part of the Capital Beltway, connecting with I-81, US 322, US 22, I-283, and providing access to the Capital City. The highway also offers access to the many commercial and industrial areas along the corridor.

Increases in both regional and local traffic have stressed the capacity of I-83 around Harrisburg. The section of I-83 between the New Cumberland Interchange (Exit 40B) and Interstate 81 (Exit 51) has reached a critical threshold. Average volumes in the corridor exceed 120,000 vehicles per day in some locations and are expected to reach 198,000 vehicles per day by the year 2030. Any incident such as a breakdown or accident has a profound and detrimental effect on the operation of the entire Harrisburg roadway network. PennDOT along with the local Metropolitan Planning Organization (the Harrisburg Area Transportation Study, or HATS) decided that a comprehensive approach would be required, but first they needed a plan.

Funding limitations and the challenge of maintaining traffic prohibited improving the entire eleven miles at one time. PennDOT needed to better understand the traffic characteristics and deficiencies throughout the corridor. Issues such as logical termini, construction sequencing, preliminary cost estimates for design, right-of-way acquisition, and construction needed to be addressed.

The consulting team led by McCormick Taylor, Inc. was retained by the Department of Transportation to prepare the I-83 Master Plan. The study featured intense coordination between PennDOT District 8, PennDOT Central Office, the Federal Highway Administration, and the consultant team. The time frame for completing the study was only 18 months, much less than is normally allocated for a project of this magnitude. The result is a concise, 65-page document that summarizes the findings with figures, tables, and photographs. It contains corridor-wide information to establish project needs, an environmental overview, a public involvement summary, consideration of improvement concepts, and a project deployment plan. The eleven-mile corridor was divided into four sections, based on logical termini. The deployment plan includes the schedule for design and construction sequencing. The I-83 Master Plan is easily distributed, easily referenced, and easily understood. It is available on the website www.I-83beltway.com

Preliminary solutions proposed in the Master Plan address existing deficiencies of the corridor, such as deteriorating pavement, inadequate safety characteristics, and high traffic volumes. Future multi-modal facilities such as the anticipated CORRIDORone commuter rail line and additional bus routes were factored into the plan.

The I-83 Master Plan is supported by a large amount of traffic, design, and environmental data that has been copied to DVD and is available to accompany the planning document. This data will be extraordinarily useful during the Preliminary Engineering phase of the four project sections.

Throughout the study process, an extensive public outreach plan was implemented that ultimately helped achieve public consensus on the Master Plan. Input from municipalities and many other special interest groups was solicited throughout the course of the study. In the end, the I-83 Master Plan presented a concept that centers around preserving the quality of life and promoting economic viability in the Harrisburg region.

Most importantly, by using the information provided in the I-83 Master Plan, PennDOT and HATS will be able to plan and program the four I-83 sections. The first section, I-83 East Shore Section 1, is expected to begin the preliminary engineering and environmental clearance phase in early 2006. ■

The I-83 / I-283 / US 322 Interchange

Traffic on the I-83 Susquehanna River Bridge

Environmental Streamlining Success in California

Len Bettess BE (Civil), MIEAust, CPEng, Quantm

In 2002, James Brown, P.E. Chief Engineer for Transportation Corridor Agencies (TCA), was facing what appeared to be an insurmountable obstacle to the planning, design and construction of the Southern California Foothill Transportation Corridor-South (FTC-S) project. After spending two years developing alternative route scenarios for the proposed 16-mile toll road using conventional GIS and CAD systems, TCA and their appointed consultant, the Corridor Design Management Group, found that they were unable to satisfy the multiple interests of different project stakeholders.

The scenario faced by Brown and his team is becoming increasingly common in transportation planning projects across the country, with many facing delays or even termination because of conflicts between the environment, the public and the economic viability of the project. The fact that the FTC-S project is located in a part of the State dense in population and natural habitat, and is subject to National Environmental Policy Act (NEPA) and California Environmental Quality Act (CEQA) regulations, meant that an alternative approach was required if the project was to proceed.

It was at this time that Parsons Brinckerhoff and the California High Speed Rail Authority released a study report that described the successful application of a new planning technology and methodology provided by Quantm, a route optimization technology firm, on the California High Speed Rail Study. While benefits such as substantial construction cost savings and crossing fault lines on the surface were documented in the report, Brown was attracted by the ability to integrate the requirements of all project stakeholders into a single analysis, and meet his objective of reducing project impacts.

The Quantm system for route alignment optimization had been developed by the Australian Government's scientific agency over a ten-year period to address similar planning challenges to those being faced over here. It had been widely used on road and rail projects in Australia and New Zealand, but the California High Speed Rail project was the first application in America.

The risk that Brown and his team took with a new technology has certainly paid off. The system greatly improved the collaboration between the engineering and environmental project teams by enabling comprehensive investigation of alternatives and providing an ability to quickly respond to emerging constraints. Workshops that would normally run over a four-month period were completed in just two weeks.

Over 150 different elements (including wetlands, sensitive habitats, cemeteries, utilities and other land-use) were defined for consideration, resulting in 3,750 individual constraint zones input into the system (utilizing existing GIS and other data sources). The team also defined crossing rules for existing features such as roads and streams, design criteria for the highway, construction rules for geology types (slope gradient and remedial removal depths) and unit costs for earthworks and structures.

The result is a planning time reduction of 6-12 months, a reduction in the number of alignments included in the Draft Environmental Impact Statement / Subsequent Environmental Impact Report (from 19 to 8), and improvements to the environmental and social outcome that include:

- Reduced impact to riparian ecosystems (wetlands) from 107 acres to 49 acres;
- Reduced impact to sensitive species by completely avoiding the Pacific Pocket Mouse habitat;
- Reduced landslide risk / disturbance limits by avoiding many of the existing landslides by identifying roadway geometry that more closely follows the natural terrain;
- Minimized impact on existing utilities; and
- Reduced residential displacement from 32 to zero homes.

As further reward for their commitment to the environment, and their pioneering spirit with new technology, the system also enabled the TCA project team to cut forecast construction cost by more than $100 million.

The Quantm system is now being applied on road and rail projects in California, Nevada, Texas, North Carolina, Indiana, Arkansas, Washington, Colorado, Louisiana, Delaware, Michigan and Idaho. ■

Contact for Quantm, Inc.: Kam Hashim; Boston Communications; 617-619-9803; khashim@bcww.com.

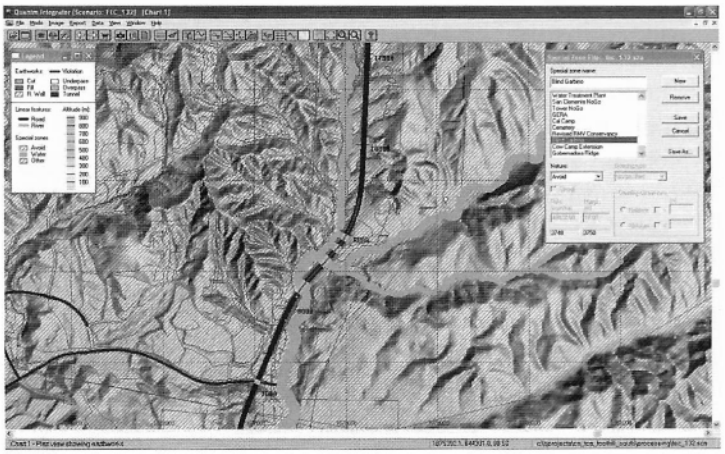


Figure 1: Conventionally derived alignments impact the wetlands

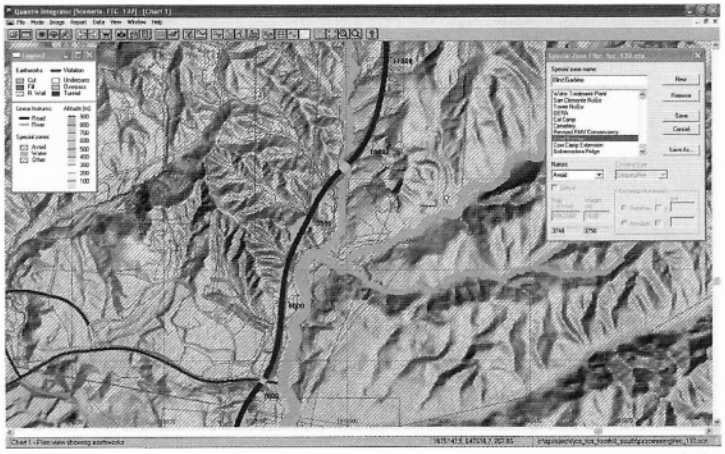


Figure 2: Quantm enables the team to identify alignments that avoid the wetlands and reduce the cost

Pavement Reclamation

The City of Charlotte's Cost-Effective Approach to Upgrading Annexed Streets

Submitted by the Carolina Piedmont Section

When the City of Charlotte needed to upgrade three recently annexed streets, poor roadway conditions allowed designers to use an innovative approach. In a collaborative effort, the City of Charlotte and their design consultant, Mulkey Engineers & Consultants, employed a combined pavement reclamation and soil stabilization technique in an attempt to stretch available construction dollars while preventing future maintenance problems.

Project Description

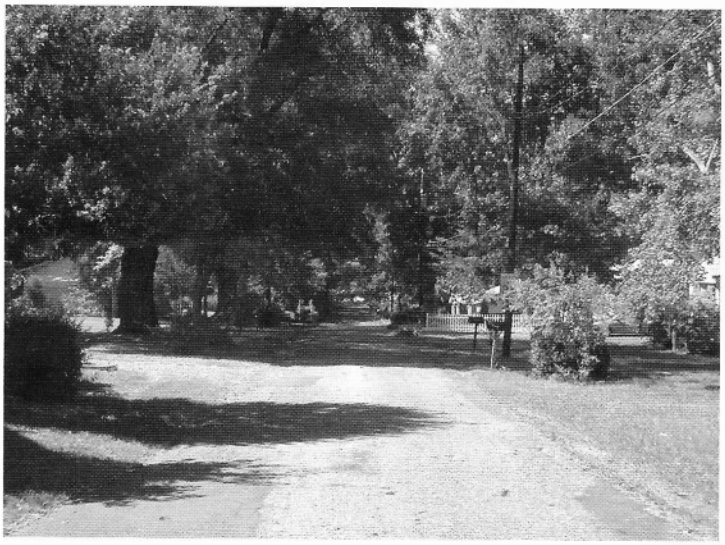
The City of Charlotte's Street Maintenance Department is regularly charged with the task of upgrading recently annexed area streets to meet minimum City design requirements. Many of these streets, mostly residential in nature, were originally constructed years ago when design requirements were not as stringent (or as regularly enforced) compared to today's standards.

When annexed, the City becomes responsible for maintenance of these streets, as well as providing residents with City services such as water, sewer, trash and recycling pick up. Typically these streets need widening, drainage improvements, and pavement structure stabilization. This specific project involved three residential streets in west Charlotte; all with cracking pavement, failing subgrade and substandard pavement widths.

The City of Charlotte and Mulkey Engineers & Consultants used an innovative approach to solve this problem: a combined pavement reclamation and soil stabilization technique. This process involved widening with new stone base material to the required width and depth. Then the existing pavement structure was pulverized and mixed with added stone base material. This was done in-place with a stabilization mixer. Portland cement was then added at the required rate and remixed to the specified depth. Finally, the mixture was set to grade, moistened, and compacted into a blended mixture. After curing, a new bituminous surface course was placed, and shoulder work was completed.

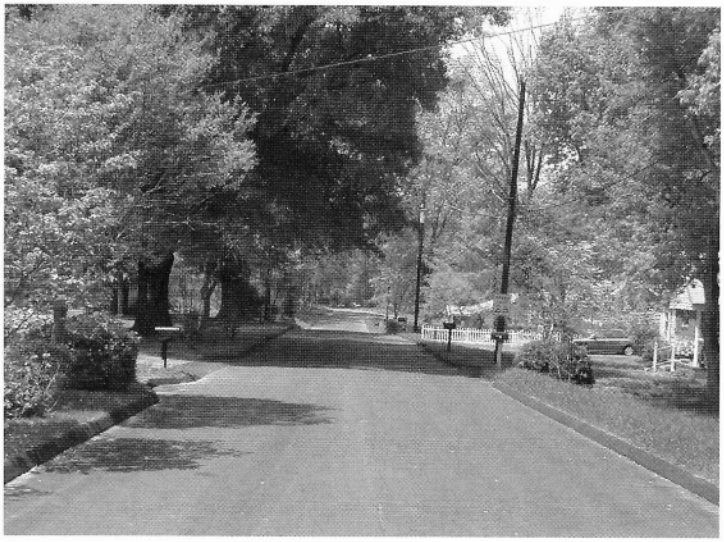
Similar stabilization practices have been used on the shoulders of local interstates in Charlotte for widening, but rarely has it been used in conjunction with reclaimed asphalt material. This annexation project posed as the perfect candidate for such an experiment because of the brittle asphalt conditions and the low volume of heavy truck traffic present on this type of street.

"Using this process, we were able to 'bridge' the unstable subgrade while making use of the existing pavement structure instead of hauling it away," said Jason Breda, PE, project manager with Mulkey. Dieter Crago with the City of Charlotte quotes, "The City saved an estimated 8% to 10% on construction costs for this project by using this technique." Crago and his staff agree that the City will use this method on future annexation projects because of the significant cost savings. ■



Prior to pavement reclamation

During pavement reclamation



After pavement reclamation

JFK Section 100

Utilization of Express Toll Lanes

Melissa Williams, Project Manager

Maryland's roadways are among the most congested in the country. Millions of people who rely on the State's highways to travel to work, school, or for other everyday travel are paying too high a price for this congestion – in time and money lost sitting idle in traffic. Since 1995, travel on Maryland's highways has increased by 20 percent, despite only a four percent increase in miles of highway lanes over the same period. To address the growing problem of congestion on Maryland's highways, the Maryland Transportation Authority is exploring new programs to increase highway capacity, including the use of express toll lanes.

In 2006, construction will begin on a nine-mile segment of the John F. Kennedy Memorial Highway (I-95), from the I-895 (N) split in Baltimore City, to a point north of MD 43 in Baltimore County. This section of I-95, called Section 100, is the most congested section of I-95 in Maryland north of Baltimore City. Currently, portions of the highway operate at a failing level of service during the morning and evening rush hours, meaning unstable flow, excessive delays, and significant back-ups. If capacity needs are not addressed, congestion levels will continue to worsen and extend the existing peak hour into a period several hours in duration, and will include failing peak hour levels of service on weekends.

To address this problem, the Section 100 project will reconstruct the roadway and all interchanges to include two express toll lanes and four general purpose lanes in each direction. The addition of express toll lanes will give motorists the option of paying a fee to drive in separate, relatively free-flowing highway lanes on any given trip. The fees will be collected electronically at highway speed to eliminate traditional lines at tollbooths. The pricing plan will be structured to encourage motorists to travel during off-peak hours, and will be adjusted based on time of day and traffic conditions. The express toll lanes also provide flexibility for the lanes to be used in situations where major accidents, highway maintenance, or other incidents block the movement of traffic on the general purpose lanes, while providing superior access to emergency response vehicles along this stretch of highway.

The express toll lanes will be physically separated from the general purpose lanes, with designated access points along the highway. Because of this, the interchanges present within the project limits will be reconfigured to allow access to and from the express toll lanes. The existing I-95/I-695 interchange configuration incorporates braided mainline roadways, with half of the entrance and exit ramps connecting to or from the left side, defying driver expectancy and requiring trucks and slower moving vehicles entering or exiting the facility to weave across multiple lanes of traffic. The new design will remove the existing braiding, and replace the general purpose lanes' left entrances and exits with entrances and exits on the right side. The new interchange will also include connections to and from the express toll lanes on I-95, and will be designed to accommodate planned improvements to the Baltimore Beltway, including the potential for future express toll lanes. The redesigned interchange will be a larger, taller, more complex yet more efficient four-level interchange.

In 2004, the Federal Highway Administration (FHWA) and the Maryland Transportation Authority prepared an Environmental Assessment document, detailing environmental impacts expected from the project. In the summer of 2005, a Finding of No Significant Impact was prepared, documenting that the project would result in no significant impacts to the natural or human environment.

Construction of this project will take place over a four-year period, with construction beginning in Fall 2006. Once complete, the Section 100 express toll lanes will offer an alternative to the near crippling congestion that clogs area highways, and will allow faster, and more reliable travel times for drivers who choose to utilize the express toll lanes. Use of toll lanes is by no means a cure-all for traffic congestion; however they do provide a viable choice for commuters tired of sitting in traffic, and for those who need to get where they are going on time. ■

Melissa Williams, Project Manager; Maryland Transportation Authority, Engineering Division; 300 Authority Drive; Baltimore, MD 21222; Phone: (410) 288-8400, extension 383; mwilliams9@mdtransportationauthority.com.

Conceptual drawing of the planned I-95/I-695 Interchange

MSG Delivers Quality Geotechnical Services for the US 24 "Fort to Port" Project

By: Sheri Bokros & Jeremy Heyerly, P.E.

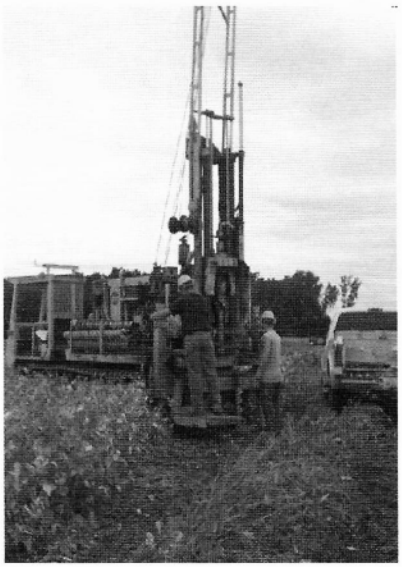
The Mannik & Smith Group, Inc. (MSG) was contracted by the Ohio Department of Transportation (ODOT) to lead the design effort for a 23-mile portion of the U.S. Route 24 "Fort-to-Port" project. The project aims to build a 61-mile divided highway on a new alignment between Fort Wayne, Indiana and Toledo, Ohio.

MSG is serving as the prime design consultant to the section extending from Napoleon to Toledo, Ohio. This phase of the project includes 23 miles of divided freeway, 3 interchanges and 17 bridges affecting over 200 individual properties. The design, right-of-way acquisition, environmental and construction costs for this section of U.S. 24 are estimated to be $200 million of the entire $438 million assigned to the overall project by the Transportation Review Advisory Council (TRAC).

A project of this size and complexity brings with it many challenges requiring innovative solutions. One such challenge was the subsurface investigation and geotechnical engineering services portion of the project. The client's schedule required a complete geotechnical assessment of subsurface conditions within 5 months, including 640 boring locations totaling over 11,300 linear feet of drilling. This process was complicated by crop growth on prime agricultural land.

Recognizing the critical nature of the subsurface investigation, MSG assembled a team of highly qualified geotechnical engineers to assist in this massive endeavor. Work was divided between TTL Associates, Inc., CTL Engineering, Inc., and Bowser Morner, Inc., with MSG taking the role of overall geotechnical coordination, consistency and peer review.

Accelerated fieldwork was necessary to meet the project schedule. As horizontal and vertical survey control had yet to be established along the alignment, layout of the proposed boring locations required use of low altitude aerial mapping and handheld GPS units by technical coordinators from each geotechnical firm. As boring locations were being established, a list of property owners was developed using a GIS database to facilitate property owner notification. MSG's real estate acquisition specialists methodically met with each landowner and scheduled layout and drilling activities, while documenting property access conditions and damage to crops.



The team completed over 2 miles of drilling in a seven-week period, using an average of six drill rigs, although as many as nine drill rigs were used on some dates. Over 100 damage claims were processed by MSG's real estate acquisition staff during the fieldwork; however no property owner complaints were filed with the local authorities, which is an impressive accomplishment given the history of the landowners' animosity towards the highway project.

Findings from the subsurface investigation characterized several geologic conditions including soft lacustrine deposits and an extensive area of surficial sand also known as the Oak Openings sand belt. In addition, poor surficial soils were encountered along 43,000 linear feet or 40% of the project length.

A detailed assessment of the surficial soils was conducted to evaluate embankment foundation improvement and subgrade stabilization options for the mainline roadway subgrade. Team recommendations included the strategic placement of granular and soil bridge lifts rather than undercuts and / or chemical stabilization, resulting in potential cost savings of $5 million compared to ODOT's conventional subgrade analysis.

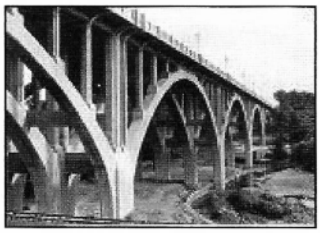
Variability in the subsurface profile, as well as variable depth to bedrock (from 10 ft. to over 85 ft.), required development of project consistency standards such that similar structures (e.g. bridges and culverts) with similar soil profiles, would be analyzed and designed in the same manner by each member of the MSG Team. The embankment settlement and stability, MSE retained fill settlement and stability, bearing capacity and deep foundations were analyzed at each of the 17 bridge locations. Various ground improvement techniques and applications of controlled fill rates associated with the instrumentation and monitoring programs were recommended based upon uniform criteria developed for the project.

Construction on the Napoleon to Maumee section of the multi-phase U.S. Route 24 "Fort to Port" project is scheduled to begin in January 2008 and should be completed in 2012. ■

"Fulton Road" continued from p. 1

Environmental, Cultural and Historic Issues

The existing Fulton Road Bridge possesses a number of unique characteristics that originate primarily from its appearance and location. The bridge crosses over the Cleveland Metroparks Zoo and is very visible from Brookside Park, Interstate I-71, and Pearl Road. The concrete cast-in-place deck arches give the bridge a unique appearance that is considered very desirable to maintain in this prominent site. Because of the significance of the existing structure and sensitivity of the site, considerable effort was put forth to identify environmental, cultural and historic issues that could impact the selection of replacement bridge types. Key issues included:



- *Brookside Park Bridge under Fulton Road Bridge* – The Brookside Park Bridge is a three-hinged concrete arch which was constructed in 1909 and currently carries pedestrian traffic in the zoo directly under the Fulton Road Bridge. This structure is on the Ohio Historic Bridge Inventory and must be protected during removal of the existing bridge and construction of the new bridge.
- *Big Creek* – Big Creek runs directly under the Fulton Road Bridge and flows nearly parallel to the alignment of the bridge near its center spans. The creek will affect access to portions of the bridge during construction and will affect the means available to the contractor for construction and demolition.
- *Railroad Coordination* – The Fulton Road Bridge crosses over two sets of tracks near the north end of the bridge, operated by CSX and Norfolk Southern. Measures will need to be taken during construction to ensure that negative impact to the operation of the railroads is minimized.
- *Zoo Operations* – Portions of the bridge are in close proximity to animal enclosures and zoo facilities; pedestrian trails are located directly under two spans of the bridge. Noise, vibration and reduced air quality from demolition and construction, as well as limitations on access to portions of the zoo during construction, have potential for negative impact on zoo operations.

Geometric Requirements

The issues described above helped to establish some overall geometric constraints for the new replacement bridge and provide the basis for the context of the bridge site. These general parameters included the overall form of the bridge, span lengths, pier locations, and vertical clearance limitations. Specifically, the following geometric parameters were decided upon at the outset of the preliminary design after careful consideration of the key issues described above.

- Because of strong sentiment and personal attachment to the existing arch bridge, it was decided prior to the development of alternatives that the new bridge would be "arch-like" in appearance.
- Because of the appeal of the existing structure's appearance, it was decided that a dramatic change in span lengths from the existing 210′ spans would not be desirable. More importantly, to limit the impact to the zoo and Brookside Park as described above, and to minimize right-of-way acquisition, it was deemed important to maintain piers at the existing pier locations.
- The presence of the two railroads at the north end of the structure introduced vertical clearance requirements that affected the permissible structure depth at this location. Since the bridge is very high over the valley, this would not prevent the use of normal structure depths for typical structures; however it does have an impact on the geometry of supporting arch ribs for deck arch structures.

These geometric parameters, established early in the conceptual design, provided a context for the development of bridge replacement alternatives and put practical limitations on feasible replacement types. By establishing these parameters early, determination of the preferred bridge replacement type was facilitated by eliminating some clearly inappropriate structure types from the beginning, and negatively or positively affecting the evaluation of others. This early focus was consistent with the context-sensitive approach established for the project and helped lay the foundation for the context-sensitive solutions developed in the preliminary design phase.

Concept Development

Development of appropriate concepts for replacement of the Fulton Road Bridge was carried out in a systematic process: the design team started with a wide range of possible structures, and in a step-by-step fashion, with the guidance of a Technical Advisory Committee, narrowed the options to a final preferred alternative. Eliminating concepts and determining a final preferred alternative was performed by measuring alternatives against a well-defined set of evaluation criteria, which were weighted on the basis of perceived importance and impact on the overall success of the project.

Technical Advisory Committee

A critical component of the design team's approach to the concept development was the formation of a Technical Advisory Committee (TAC) to supervise the development and evaluation of bridge replacement concepts. The TAC was comprised of key technical staff from the major stakeholders involved in the project, including Cuyahoga County (OH) Engineer's Office, City of Cleveland, Ohio Department of Transportation, Cleveland Metroparks Zoo and the Federal Highway Administration.

This group was comprised of those individuals who best understood the context of the bridge and could best promote a true context-sensitive solution for the new structure. The main functions this group provided included:

- Liaison between the design team and important stakeholders with significant interest in the project;
- Direction on the development of evaluation criteria used to assess concepts, as well as comparative weighting of evaluation criteria;
- Technical assistance with evaluation of alternatives against evaluation criteria;
- Assistance with communicating decisions and potential alternatives to the public.

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Determination of Feasible Alternatives

Based on analysis of preliminary alternatives, the design team determined three feasible alternatives which best met a series of objective criteria. This was accomplished by evaluating and ranking each preliminary concept according to the following key criteria:

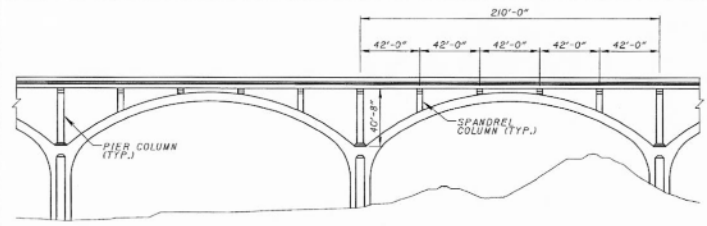
- *Aesthetics* - For reasons of visibility and cultural significance, global aesthetics was a very important criterion for evaluating the bridge concepts.
- *Stakeholder Preference* - This criterion is a measure of the reaction of stakeholders to the appearance of the structure and of the extent to which the public could be expected to accept and embrace the bridge.
- *Initial Cost* - This criterion is an evaluation of the estimated initial cost of construction for each alternative. Initial cost estimates were approximate, and were based on approximate structural quantities that had been determined from preliminary engineering analysis.
- *Construction Impact* - This criterion evaluated the extent to which construction would result in significant temporary or permanent impact on the surroundings, including the zoo and railroad lines.
- *Constructability* - Each alternative was evaluated on the basis of the ease of construction, the extent to which complexity and the potential for delays or problems in construction were minimized, and the extent to which the alternative would maximize the use of local labor and materials.
- *Future Maintenance and Life-Cycle Costs* - Future life-cycle costs refer to expenses that recur over the life of the structure that are necessary to maintain the functionality, serviceability, and safety of the structure.

At this stage, the design team and the TAC cooperatively rated the preliminary concepts on a scale from one to ten on each of the evaluation criteria. These ratings resulted from extensive discussion among the TAC members from which a consensus was achieved on both the ratings and the weighting of the importance factors for each criterion. Each criterion was assigned a weight factor in relation to its perceived relative importance. An overall score for each preliminary alternative was then calculated based on the sum of the ratings multiplied by the weighting factor. In this manner, the three feasible alternatives were identified:

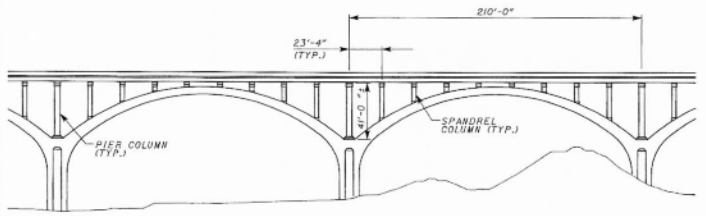
Feasible Alternative A - Precast (Contemporary) Concrete Arch – This alternative is a precast concrete arch bridge with 210-foot arch spans similar to the existing structure. This alternative employed the use of modern materials and construction methods with four spandrel columns in each span, giving it a more "contemporary" appearance than the existing bridge.

Feasible Alternative B - Precast (Traditional) Concrete Arch – This alternative is intended to match the appearance of the existing bridge. A cast-in-place concrete arch similar to the existing bridge evaluated very positively, on the strength of its aesthetics and stakeholder preference. Recognizing the impact that the formwork required for a cast-in-place solution would have on the park and zoo, this alternative attempted to recreate the appearance of the existing bridge with precast elements.

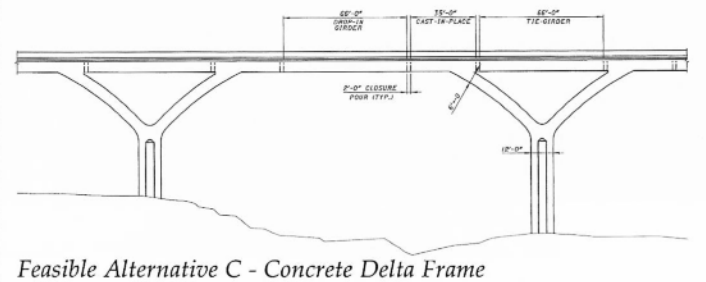
Feasible Alternative C - Concrete Delta Frame - The third feasible alternative was a precast concrete delta frame bridge with 210-foot spans. This alternative represents a more significant visual departure from the existing bridge. The delta frame was made to appear more "arch-like" by increasing the curvature of the supporting legs at the piers.



Feasible Alternative A - Precast (Contemporary) Concrete Arch



Feasible Alternative B - Precast (Traditional) Concrete Arch



Feasible Alternative C - Concrete Delta Frame

Public Involvement Process and Selection of Preferred Alternative

Public input on selection of a preferred alternative followed identification of the three feasible alternatives. The design team worked carefully to make sure that all feasible alternatives shown to the public were constructible and could be funded with available resources. No options were communicated to the public unless the alternative could meet these key criteria.

Input on a variety of issues associated with the project was obtained from key technical stakeholders and community stakeholders at various stages of the concept development. This input was a critical element in arriving at a true context-sensitive solution. After defining the feasible alternatives, the public was asked to select a preferred alternative. After receiving all public input, the Contemporary Concrete Arch alternative was selected as the preferred alternative.

Final Design

With a preferred alternative identified, final design has proceeded with the same focus on providing context-sensitive solutions to the replacement of this bridge. The primary goal of the context-sensitive approach at this stage is to identify final design elements and

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construction methods that will satisfy commitments made to stakeholders in the conceptual design phase and to minimize negative impact. The primary focus of the preliminary design that is currently ongoing consists of the following:

- Defining a construction scheme with precast concrete elements that will minimize negative impact to the site. The current design scheme uses three precast arch segments for each arch span, which will be prefabricated and shipped to the site. The end arch elements will be temporarily supported using stay cables attached to the pier columns; crown segments will be erected as drop-in elements and post-tensioned to the end segments.
- Further aesthetic enhancement. The public outreach effort and use of a context-sensitive approach to enhance the aesthetics of this highly visible structure have not yet concluded with the selection of a preferred alternative. The design team continues to solicit public input on focused elements of the bridge where aesthetic enhancement has been deemed to be appropriate. These elements include bridge barriers, fencing, structure lighting and feature lighting. This continued effort to solicit public input has helped maintain support and enthusiasm and has enhanced the context-sensitive nature of the project.
- Structural design elements. The final structural design has also focused on other elements important to a comprehensive context-sensitive approach, such as initial cost and life cycle costs. For example, the new bridge will be designed to have no intermediate expansion joints between the two abutments. In addition, a vertical curve has been introduced into the final bridge profile such that the drainage can be accommodated at the ends of the bridge only, with no intermediate downspouts or scuppers.

Final design of the preferred alternative is ongoing and will be completed by the end of 2005. The new Fulton Road Bridge is scheduled to be open to the public by the end of 2008. ■

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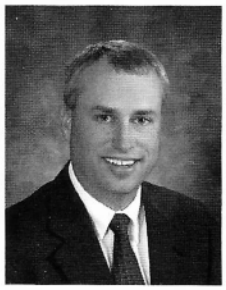

Erdman Anthony recently named **Todd B. Smeltz, P.E.** as a Principal Associate of the firm. Mr. Smeltz currently manages the Structural Engineering Department of the firm's Mechanicsburg office, which provides structural design and inspection for various transportation and building facilities. He has also played an important role in developing client relationships. He has 15 years of engineering experience and holds a masters degree in structural engineering.

Erdman Anthony also recently named **Donna M. Newell, P.E.** as a Senior Associate. Ms. Newell holds a masters degree in environmental engineering and has 11 years of engineering experience. She currently manages the Water Resources Group in the firm's Mechanicsburg office, which has grown in both size and services offered under her leadership. In addition to providing various engineering services, the group is providing training programs for PennDOT and other clients on water resources related topics.

Herbert, Rowland & Grubic, Inc. (HRG) is pleased to announce that **Tracy W. Gunther, P.E.**, has joined HRG as a project manager in the firm's Stroudsburg area Land Development Service Group.

Mr. Gunther is responsible for managing the completion of projects related to land planning, site investigation and analysis, site layout and grading design, stormwater management, erosion and sediment pollution control plans, roadway design, hydraulic and hydrologic studies, project permitting and representing clients at public meetings.

Mr. Gunther received his Bachelor of Science degree in Civil Engineering from West Virginia University and is an active member of the American Society of Civil Engineers.

Keller Engineers, Inc., is pleased to announce **Ronald L. Samuel, P.E., PLS**, has joined the firm. Mr. Samuel, former District Executive for Pennsylvania Department of Transportation, District 9-0, brings over 36 years in the transportation engineering field. Ron will be responsible for business development, quality assurance reviews and project management in the Transportation Division.

Mr. Samuel earned a Bachelor of Science Degree in Civil Engineering from the University of Pittsburgh and holds both Professional Engineer and Professional Land Surveyor registrations in Pennsylvania. He resides in Johnstown with his wife and enjoys spending time with their children and five grandchildren.

HNTB Corporation is pleased to announce that **Steve Boylan, P.E.**, highway department manager, has been appointed a director of the American Society of Highway Engineers (ASHE) Central Florida Section. ASHE is a nationwide organization dedicated to providing leadership and innovation to the highway industry and ensuring mobility for the future. Currently there are more than 5,000 members nationally and approximately 300 locally.

Boylan has been a member of ASHE since 1999 and served as the chapter's UCF Student Liaison prior to being appointed as a director for the Central Florida Section. "I will continue to serve as the UCF student liaison and am excited about the opportunity to lead the Central Florida Section," said Boylan. "I encourage others in the highway industry to get involved with ASHE as a way to promote education, innovation and fellowship with the mutual goal being a safe and efficient highway system, now and in the future." He is a graduate of Embry-Riddle Aeronautical University and has more than 11 years of transportation engineering experience, including 2 years with the Florida Department of Transportation (FDOT) District Five. ■

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