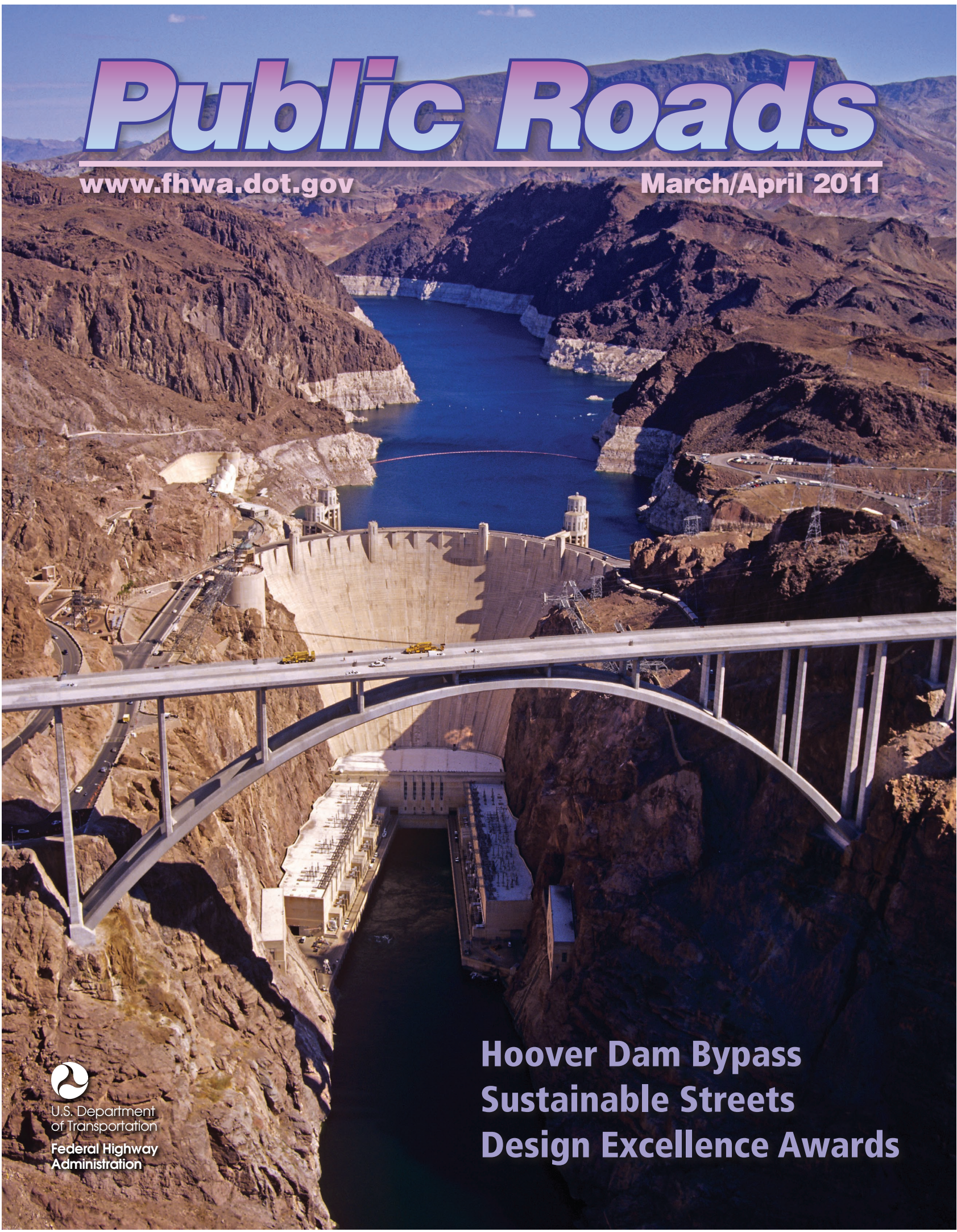
Public Roads

www.fhwa.dot.gov

March/April 2011



Hoover Dam Bypass
Sustainable Streets
Design Excellence Awards

U.S. Department of Transportation

Federal Highway Administration

Public Roads

—featuring developments in Federal highway policies, programs, and research and technology—

March/April 2011 www.fhwa.dot.gov Vol. 74, No. 5

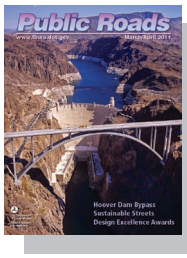
Articles

Page 2

Page 8

Page 28

Departments



Front cover—The new Mike O'Callaghan-Pat Tillman Memorial Bridge, shown here in a dramatic aerial photograph, is located just downstream of Hoover Dam, east of Las Vegas on the Arizona-Nevada border. The new structure is the Western Hemisphere's longest single-span concrete arch bridge. A number of notables attended the bridge's dedication ceremony on October 14, 2010. For more information, see "A Majestic Showcase" on page 2 in this issue of PUBLIC ROADS.

Back cover—Reconstruction of St. Louis' Interstate 64 included construction of this flyover ramp at the I–170 and I–64 interchange, which was one of 13 interchanges and 8 overpasses rebuilt during the project. The reconstruction finished ahead of schedule and under budget, and included an award-winning public outreach campaign. For more information, see "From 'Carmageddon' to Complete Success" on page 20. *Photo: Dan Galvin, Granite Construction Inc.*

U.S. Department of Transportation
Federal Highway Administration

U.S. Department of Transportation
Ray H. LaHood, *Secretary*

Federal Highway Administration
Victor Mendez, *Administrator*

Office of Research, Development, and Technology
Michael Trentacoste, *Associate Administrator*

Paula Magoulas, *Editor-in-Chief*

Paula Magoulas, *Publication Manager, Creative Director*

Norah Davis, *Editor*

John J. Sullivan IV, *Associate Editor*

Paula Magoulas, *Distribution Manager*

Editorial Board
J. Paniati, chairman; J. Baxter, J. Curtis, D. Elston, K. Gee, J. Lindley, A. Lucero, A. Masuda, R. McElroy, P. Prosperi, G. Shepherd, J. Toole

Public Roads (ISSN 0033-3735; USPS 516-690) is published bimonthly by the Office of Research, Development, and Technology, Federal Highway Administration (FHWA), 1200 New Jersey Avenue, SE, Washington, DC 20590. Periodicals postage paid at Washington, DC, and additional mailing offices.

POSTMASTER: Send address changes to *Public Roads,* HRTM, FHWA, 6300 Georgetown Pike, McLean, VA 22101-2296.
The editorial office of *Public Roads* is located at the McLean address above.
Phone: 202–493–3398. Fax: 202–493–3475.
Email: paula.magoulas@dot.gov.

Public Roads is sold by the Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402. Requests for subscriptions should be sent directly to New Orders, Superintendent of Documents, P.O. Box 979050, St. Louis, MO 63197-9000. Subscriptions are available for 1-year periods. Paid subscribers should send change of address notices to the U.S. Government Printing Office, Claims Office, Washington, DC 20402.

The electronic version of *Public Roads* can be accessed through the Turner-Fairbank Highway Research Center home page (www.fhwa.dot.gov).

The Secretary of Transportation has determined that the publication of this periodical is necessary in the transaction of the public business required by law of this department.

Guest Editorial

Public Affairs and Highway Projects

Americans seem to have an enduring interest in the Nation's roads. One reason, perhaps, is that road construction is very visible and often inconvenient for motorists. And traffic continues to be a point of discussion on news programs and among individuals. Communicating about the status of construction projects, highway congestion, roadway incidents, and related news is a top priority of the Federal Highway Administration's (FHWA) Office of Public Affairs and State and local departments of transportation (DOTs).

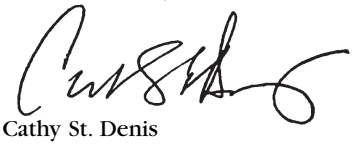
FHWA's Office of Public Affairs strives to build understanding of, and support for, the agency's programs and policies. The office provides a variety of services, including developing the agency's communications strategies, writing and distributing press releases, responding to inquiries from reporters, drafting speeches, and coordinating special events, such as groundbreakings and ribbon-cuttings for highway and bridge projects.

One of 2010's most visible examples of the coordination of special events was the dedication of the $240 million Mike O'Callaghan-Pat Tillman Memorial Bridge at Hoover Dam last October. For months leading up to the ceremony, FHWA public affairs staff worked with reporters, the project team, State DOTs, and the Secretary of Transportation's office. The public affairs staff helped develop the event agenda, pitched story ideas to reporters, coordinated interviews with senior DOT officials, and handled logistics for local and national media. The event drew nearly 2,000 participants and generated major national and international news coverage. For more about the bridge's construction and recent unveiling, see "A Majestic Showcase" on page 2 in this issue of PUBLIC ROADS.

Just as engineers constantly explore new technologies, materials, and techniques to build better and safer roads and bridges, the U.S. Department of Transportation and many State DOTs are embracing new social media technologies to improve communication with the public. *Fast Lane*, the U.S. Secretary of Transportation's official blog, is an online forum for dialogue on transportation issues and is the most widely read Cabinet blog. Through it, Secretary Ray LaHood and guest contributors share news, event highlights, and project updates. Readers can leave comments, post entries to their own blogs, or share the item on Digg or Twitter.

States also use creative strategies to reach the public. For a major reconstruction project on Interstate 64 in St. Louis, the Missouri Department of Transportation (MoDOT) cohosted a weekly one-hour chat room on the Web site of the *St. Louis Post-Dispatch*. "I-64 Live" became the newspaper's second busiest chat room, exceeded only by its sports chat room. The chat room was so successful that it lives on, even after the project's completion. Now called "The Road Crew," it provides a venue for MoDOT, city, and county officials to share information on regional road issues. For more on this project, see "From 'Carmageddon' to Complete Success" on page 20.

The media world changes rapidly, but cutting-edge tools like these help public affairs professionals communicate quickly, efficiently, and effectively. FHWA will continue to use innovative techniques to reach stakeholders where, when, and how they want to be reached—whether in person at a public event, through television and radio, online, or through handheld mobile devices like smartphones. Though it may not be as visible as the interstate system, the information superhighway is fueling a communications renaissance, leaving public affairs professionals more excited than ever about what lies beyond the horizon.



Cathy St. Denis
Associate Administrator
Office of Public Affairs
Federal Highway Administration

A Majestic Showcase

The new Hoover Dam bridge reaffirms that American engineering can build great infrastructure despite the current economic challenges.

(Above) Shown here is the new Mike O'Callaghan-Pat Tillman Memorial Bridge, which is located at Hoover Dam east of Las Vegas on the Arizona-Nevada border. At the October 14, 2010, dedication ceremony, Transportation Secretary Ray LaHood said that the bridge is "proof positive that America is not afraid to dream big."

by Doug Hecox

Soaring protectively near the Hoover Dam and straddling the boundary between Arizona and Nevada, the Mike O'Callaghan-Pat Tillman Memorial Bridge has made history several times over. Not bad, considering that the bridge—one of the world's largest—was once thought to be unbuildable.

Once the new bridge began carrying thousands of vehicles and trucks every day over Black Canyon, the structure became one of the most awesome anywhere. Towering nearly 900 feet (274 meters) above the Colorado River, the bridge sits atop the world's tallest precast concrete columns. Its central span—at 1,060 feet (323 meters) long—is the Western Hemisphere's longest single-span concrete arch.

At the project's dedication on October 14, 2010, U.S. Transportation Secretary Ray LaHood said, "This majestic bridge reaffirms a powerful idea. Americans can still build great things—not just in spite of enormous economic challenge, but as the means of overcoming it." The bridge was opened to traffic on October 19, 2010.

Funding

The dedication drew a crowd of nearly 2,000, including members of the O'Callaghan and Tillman families. O'Callaghan was a former governor of Nevada, and Tillman was a professional football player with the Arizona Cardinals who lost his life serving in the U.S. Army in Afghanistan in 2004.

Federal Highway Administrator Victor Mendez, the event's master of ceremonies, enjoys a unique perspective on the project. As director of the Arizona Department of Transportation from 2001 until 2009, Mendez played a critical role in ensuring the project had the funds it needed from Arizona and Nevada. Together, the two States provided $140 million, primarily through bond funds—representing more than half the project's total cost. Their partnership was widely considered vital to the project's completion. Through a variety of Federal funding measures, the Federal Highway Administration (FHWA) provided an additional $100 million.

"This bridge is a unique accomplishment for the Nation," Mendez said at the ceremony. "This is the kind of smarts and attitude we need to bring in more of these projects and put more people back to work. The bridge shows what we can achieve when we set aside individual agendas and work toward a partnership. I hope [it] serves as a model for the future."

Some Key Facts

The Mike O'Callaghan-Pat Tillman Memorial Bridge is the fourth-longest single-span concrete arch bridge in the world. In addition:

- Each arch rib is made up of 56 cast-in-place sections with construction starting from the canyon walls and a closure pour that locks the two halves together.
- Approximately 9,000 cubic yards (6,881 cubic meters) of 10 kips per square inch (68.950 megapascals) compressive strength concrete is cast in the arches.
- The outer dimensions of each hollow arch rib are 20 feet (6 meters) wide by 14 feet (4 meters) tall, with 14 inch (36-centimeter)-thick walls.
- Structural steel struts connect the arches at each column and are covered with precast concrete panels. The largest struts weigh nearly 45 tons (41 metric tons).
- The 440 10-foot (3-meter)-tall concrete segments were each precast offsite and erected to form the pier columns. At 290 feet (88 meters), the tallest of the precast columns are the world's tallest of this type.
- The structural steel tub girders were fabricated offsite and placed with the cableway cranes. The heaviest girder was nearly 50 tons (45 metric tons).
- The temporary cable stay tower and support system for erection of the arch incorporated more than 2 million feet (609,600 meters) of cable-stay strand.

Beginnings

In 1928, the Federal Government began planning construction of a hydroelectric dam on the lower Colorado River. Three years later, construction of the mammoth project began, led by engineer Frank Crowe. Thousands of people worked round-the-clock, 7 days a week, in triple-digit heat to complete the dam by September 30, 1935. By every standard, it remains one of history's greatest engineering feats and an icon of America's can-do attitude.

Innovations borne of the project's difficult conditions forced early engineers and construction workers to develop solutions that have become staples of the modern construction industry, including hardhats and onsite fabrication of steel pipe.

A narrow two-lane highway running across the dam's crest connected Arizona and Nevada on either side of Black Canyon. The volume of traffic served by the two-lane U.S. 93 was initially small but swelled significantly in the decades that followed.

The new structure is the Western Hemisphere's longest single-span concrete arch bridge and one of the tallest in the world. Seen here is a view during the finishing of the bridge deck in April 2010.

Posing at the dedication ceremony are (left to right): U.S. Representative Dina Titus (D-Nev.), U.S. Transportation Secretary Ray LaHood, Federal Highway Administrator Victor Mendez, Arizona Gov. Jan Brewer (R-Nev.), U.S. Senator Harry Reid (D-Nev.), and Nevada Lt. Gov. Brian Krolicki (R-Nev.).

By the 1980s, the Hoover Dam road was a major traffic chokepoint between Las Vegas and Phoenix, each of which had grown substantially during the intervening years.

In the late 1980s, the U.S. Department of the Interior's Bureau of Reclamation (BOR) created the Colorado River bridge project management team to plan a new bridge. An environmental study began in 1990 but, 3 years later, BOR withdrew as the project's lead agency. Work stopped until 1997, when FHWA's Central Federal Lands Highway Division agreed to lead the project.

After extensive research, FHWA selected the Sugarloaf Mountain alternative, which included a 1,900-foot (579-meter) river crossing about 1,500 feet (457 meters) downstream from the dam. This site would require 3 miles (4.8 kilometers) of new highway approach in Nevada and about 2 miles (3.2 kilometers) of new highway approach in Arizona. The bypass also features eight other bridges and numerous animal underpasses to help the area's mountain sheep cross U.S. 93 without putting themselves or drivers at risk.

In 2000, FHWA offered Central Federal Lands engineer Dave Zanetell—widely known as "Z"—the position of project manager. Fully aware that the Hoover Dam bypass project would be a mammoth undertaking, he was cautious.

Here the dam is shown in the foreground, the new bridge behind it, with both structures rivaling the magnificence of the surrounding mountains.

This aerial photograph shows the bridge with the approach segments of the new bypass, straddling the State line between Arizona (in foreground) and Nevada.

Many of his peers tried to discourage him from taking on the project. His colleagues told him, "That job will never be properly funded. Two hundred forty million is not nearly enough for a bypass like this. Stakeholders will never support the job. It's a pipe dream. It's career suicide." And so on. But Zanetell thought about it and "realized that nothing great—certainly, no great public works project—ever happened because it was easy."

As he did playing football for the Colorado School of Mines, Zanetell tackled the challenge head on. "I never had a doubt about this project—not one," he says. "I have to believe that Frank Crowe, who had my position with the construction of the Hoover Dam, was surrounded by people who were naysayers. I know for a fact he never doubted. I think it's important that, when you're leading the effort, your team knows, 'Our leader has no doubt.'"

Construction

Unlike other bridges, which are typically constructed from the ground up, the O'Callaghan-Tillman Bridge was built from the top down. Extensive cabling above the canyon transported materials from one side to the other while workers lowered key components of the bridge into place.

"Right out of the chute, we had to gain access to the canyon to construct the foundations," says Zanetell. "Physically, there were significant challenges: getting off the canyon wall, containing rockfalls, and so on. Also, we had to design the plan so there were simultaneous activities. We were building precast segments near Las Vegas while we were fabricating steel girders in Oregon for the superstructure."

Relocation of electrical utilities from south of Hoover Dam began in 2002, and preliminary engineering for the bypass itself began in early 2003. Construction of the O'Callaghan-Tillman Bridge—the largest span of the nine bridges used in the bypass—began in early 2005.

"The initial access, the first little notch in the canyon wall—what we call 'getting a toehold'—was mostly done by hand," says Zanetell. "Literally with a single worker on a little crane and a jackhammer. Eventually we could get a larger drill down there, and the toehold got big enough to lower in a full-size excavator."

Rockfall was a challenge for the Hoover Dam construction 75 years earlier and remained a problem for workers building this bridge. "It's just a different day and age," Zanetell adds. "When the dam was built, there weren't major rockfall containers like we have today. Everything we did was small scale and contained, so rock would not be allowed to release into the canyon. It was measured, careful, and surgical."

While the excavation took place, 440 column segments were

This view of the future bridge alignment was taken from Abutment 2 (Arizona) looking west toward Abutment 1 (Nevada) in January 2006. Visible in the foreground is a tower crane erected on the left footing of Pier 15. In the background are the footings and excavations for Abutment 1, Piers 1 through 5 (Nevada skewback), along with a tower crane erected on the left footing of Pier 4.

Shown here in June 2006 are the approach spans looking from Pier 3 to Abutment 1.

precast offsite. Because every segment had to fit together perfectly, the challenge was to ensure that they were sized correctly and not too large for the crane to lift into place. The process required extraordinary attention to detail, engineering analysis, and execution.

Constructing the arch was a sequence of specific steps. The arch is flexible and allows the weight of vehicles and the bridge itself to be borne by the canyon walls. It was not constructed with precast segments hoisted into place but rather by pouring concrete in place into each of 26 sections, one after the other, until both legs of the arch met in the middle for a closure casting.

"After we completed one of the segments on the arch, we would then advance the form traveler," says Zanetell. "The traveling frame would fit like a sleeve over the completed section and then we'd bring in the rebar to set in that form. Then we'd pour the concrete, connect the next set of cables or stays, and slide it forward and do it again. It's kind of a repetitive process, but as we went along, it kept sequentially building the tension in the structure. It was meticulous and methodical, and not a brute force effort."

These constructed stay cables, stored on the Nevada approach bridge deck, are part of the cable-stay erection system that supported the arch ribs until closure.

Workers are shown placing concrete for the bridge's deck section in June 2005.

This view of the bridge, taken in August 2009, shows the Nevada approach (left) with the arch headings projecting outward to segment 26 with all stay systems installed. The Arizona approach (right) is visible with the arch headings also projecting outward to segment 26 with all stay systems installed.

Zanetell continues the story: "Bringing the arch together was a moment of incredible pride for the trade and craft workers who had worked toward it. By the time we got to the deck, which is a relatively routine engineering act, we were looking to build a great one. We focused on all the little details that can be the difference between an average job and a great job. It's like the entryway to your house: it's the most visible part. We wanted to make sure the faceplate of the job was done right."

With summer temperatures routinely topping 120 degrees Fahrenheit (49 degrees Celsius) and high winds year-round, workers on the project endured hostile weather and scorching temperatures.

"Ensuring workers were adequately hydrated was critical, but the local trade and craft workers were pretty hardy," says Zanetell. "It has to be said that this bridge wouldn't have been possible without the collective skills of the project's many workers, design engineers, erection engineering consultants, and construction contractors who shared our vision of building a world-class bypass. Everybody accepted the heat as a part of the challenge, but having the dam nearby helped to motivate us all."

Zanetell is modest about the achievement of his team: "We believe we have done something very special and very great, but we know that Hoover Dam will always be number one. It was an incredible engineering feat."

Nevertheless, the new span is a magnificent accomplishment. "When people physically see the bridge first-hand, they can't believe the magnitude of it," he adds. "What is clear is that a project of this magnitude can be done on budget, with fiscal responsibility from day one. I feel like we have an obligation to take what we've done here and apply it elsewhere."

Secretary LaHood agrees. "I am overwhelmed by the human achievement the bridge embodies—engineers, crane operators, and concrete workers. Like the Hoover Dam upriver…this marvel is a monument to America's can-do spirit... In solving the problems of the clogged Hoover Dam crossing, we have demonstrated once again our ability to tackle a complex challenge with American ingenuity and dedication. We can still dream big. We can roll up our sleeves and make this Nation's infrastructure the envy of the world once again."

The ambitious project employed more than 1,200 workers. Here, the new engineering marvel soars over the dam.

Doug Hecox is a spokesman with FHWA's Office of Public Affairs. He has a journalism degree from the University of Wyoming, teaches journalism and public relations writing at American University, and has authored two books.

For more information, contact Doug Hecox at 202-366-0660 or doug.hecox@dot.gov.

Sustainable STREETS

by David J. Carlson, Ellen Greenberg, and Morgan Kanninen

Road projects around the country are demonstrating that they can deliver livability and environmental benefits while achieving mobility and safety objectives.

Transportation professionals face an increasingly complex set of competing demands in the delivery of road projects that involve public rights-of-way. Designing a safe facility, constructing the roadway, and installing traffic control measures are only part of a much larger picture. In many cases, today's road projects also need to meet the objectives of regulatory, policy, and community requirements aimed at integrating the roadway into the existing natural and built environments. Many projects call for features that promote livability and sustainability objectives, such as providing transportation alternatives, protecting public spaces, preserving landscapes and natural elements, meeting climate change goals and regulations, and using natural resources responsibly and efficiently.

Interest in developing a framework for creating more sustainable streets is gaining traction in the United States, as evidenced by efforts such as the Interagency Partnership for Sustainable Communities. Established in June 2009 by the U.S. Department of Transportation, U.S. Environmental Protection Agency (EPA), and U.S. Department of Housing and Urban Development, the partnership has put a national focus on livability. The interagency partnership ties the quality and location of transportation facilities to the need for access to good jobs, affordable housing, quality schools, and safe streets, while aligning Federal resources and encouraging place-based solutions. Creating an effective and sustainable transportation network requires this kind of multidisciplinary approach that draws from diverse perspectives.

"The interest in complete streets is part of a growing demand for retooling the rights-of-way in cities to reflect changing values that citizens have now," says Clark Wilson,

A bioswale to help control storm water occupies this section of a redeveloped corner on Sandy Boulevard in Portland, OR. The adjacent thoroughfare cuts obliquely across a grid of streets, presenting pockets of opportunity for the city to apply sustainable streets techniques, such as improvements to storm water, pedestrian, and transit facilities. *Photo: Ellen Greenberg, Arup.*

senior urban designer, with EPA's Office of Policy, Economics, and Innovation. "Federal departments and agencies are responding by, for instance, including criteria related to livability and sustainability. This approach not only addresses community values, but also is more fiscally sound because of multiple objectives being met with limited funding."

To help transportation professionals respond to the emerging demand for sustainability, the Federal Highway Administration (FHWA), EPA, and other partners are collaborating to identify and define sustainability concepts and develop rating tools for sustainability features. In support of EPA's Smart Growth program, researchers with the Sustainable Transportation Center at the University of California, Davis, recently cataloged a variety of case study projects that demonstrate a comprehensive approach to creating complete, multimodal, green, and livable streets. In *Sustainable Streets: Foundations for an Emerging Practice*, the researchers define sustainable streets as "multimodal rights-of-way designed and operated to create benefits relating to movement, ecology, and community that together support a broad sustainability agenda embracing the three Es: environment, equity, and economy."

From storm water management on high-volume streets to pedestrian-friendly enhancements on a downtown street, cities are applying sustainability principles to real-world situations. Several case studies are described below. They include two high-volume streets, one urban State highway, and one downtown local street. All the projects were completed within the past decade, and all involve economic development and improvements to pedestrian rights-of-way. Two projects increase multimodal access, and three incorporate natural drainage features for managing storm water.

Plus, a number of evaluation and ratings systems—including one being developed by FHWA—are available to help assess the overall sustainability of highway infrastructure.

Michigan Avenue Bioretention

Responding to a 2004 mayoral task force on livability and economic development, city officials in Lansing, MI, incorporated rain gardens, known as bioretention cells, into a streetscape redesign in the downtown area. When the city required storm water improvements as part of an ongoing sewer separation project, the Public Service Department spearheaded a project to line six blocks of Michigan Avenue—a main thoroughfare leading to the State's capitol building—with bioretention cells.

Designed in 2006 and constructed in 2007, the Michigan Avenue cells look like wide planting strips built into the sidewalks. They help protect local streams and marshes by treating runoff, filtering out pollutants, and preventing sewer overflows after heavy storms. Decorative ironwork fencing and new benches adjoin the cells and offer attractive seating areas along sidewalks and corner bulbouts. The city also integrated educational signage to explain various features of the project, including ground water protection,

Benefits of Sustainable Streets

- ***Mobility:*** Sustainable streets connect people and goods to their destinations through greater use of nonpolluting and less polluting modes and reductions in vehicle miles traveled.
- ***Community:*** Sustainable streets reflect community values while supporting urban development patterns that reinforce mobility goals.
- ***Ecology:*** Sustainable streets protect and enhance natural resources and processes within and beyond rights-of-way.

Perspectives on Multifunctional Streets

Many jurisdictions and organizations have coined various phrases to describe multifunctional roads and their benefits, such as smart growth streets, complete streets, green streets, etc.

Smart growth streets are roadways designed and operated to support compact communities, promote least polluting transportation performance, and preserve environmental resources within and beyond the right-of-way. According to EPA, the concept of smart growth streets includes the following principles:

- Incorporate ecological, community, and mobility functions
- Protect and enhance environmental resources and processes throughout the street's life cycle
- Design for context sensitivity that contributes to the character of the natural and built environment of the immediate and wider surroundings
- Form highly connected networks of complete streets
- Help to create comfortable settings for walking, gathering, and lingering, especially in neighborhoods and shopping districts
- Design and manage with speeds and intersections appropriate to the context

Complete streets, according to the National Complete Streets Coalition, are public rights-of-way that are safe and comfortable for all users, such as pedestrians, bicyclists, motorists, transit riders, and people of all ages and abilities, including children, older adults, and people with disabilities.

Green streets, according to the Charles River Watershed Association, can be defined as streets designed to meet the following objectives:

- Integrate a system of storm water management within the right-of-way
- Reduce the amount of water that is piped directly to streams and rivers
- Be a visible component of "green infrastructure" that is incorporated into the aesthetics of the community
- Make the best use of the street tree canopy for storm water interception, temperature mitigation, and air quality improvement
- Minimize the impact on their surroundings, particularly at locations where they cross a stream or other sensitive area

Living streets, as defined by the Denver Living Streets initiative, are vibrant places where people of all ages and physical abilities feel safe and comfortable using any mode of travel, including walking, biking, transit, or automobile.

Context sensitive solutions, as defined by FHWA, are collaborative, interdisciplinary approaches that involve all stakeholders in providing a transportation facility that fits its setting. Context sensitive solutions lead to preserving and enhancing scenic, aesthetic, historical, community, and environmental resources, while maintaining or improving safety, mobility, and infrastructure conditions.

City of Lansing, Public Service Department

(From left) Then City Council President Derrick Quinney, Councilmember Kathie Dunbar, and Mayor Virg Bernero of Lansing, MI, celebrate the installation of bioretention cells along Michigan Avenue in downtown Lansing.

use of pervious surfaces, and selection of native plants for landscaping.

Developing a solution responsive to the city's diverse needs required engaging a variety of stakeholders, including elected officials and city staff from other offices. According to Chad Gamble, Lansing's director of public service, a comprehensive approach to stakeholder involvement was critical because of the urban context. Engineering solutions arose only after presenting project goals to a diverse panel of experts. "Any successful project in an urban core has to synthesize the pedestrian, economic, environmental, and traffic variables to yield a true complete/smart growth street," Gamble says.

The Clean Michigan Initiative of the Michigan Department of Environmental Quality (now the Department of Natural Resources and Environment) funded the project, along with the Michigan Department of Transportation in conjunction with FHWA. The $1 million project included a hydraulics analysis, design of a retaining wall and footing, adoption of an engineered soil specification, and selection of plants and trees. Community co-benefits are evident, as city officials report increased pedestrian traffic in the area.

Aurora Avenue Retrofits

In Shoreline, WA, city officials and the Washington State Department of Transportation (WSDOT) used a 32-point checklist of features approved by a citizens advisory task force to help guide the redesign of a 1-mile (1.6-kilometer) portion of Aurora Avenue, which carries State Route 99 through the suburban community. Improving the high-volume arterial, which has an average daily traffic volume of 45,000 vehicles, had been on the city's to-do list since Shoreline incorporated in 1995. In 1998, the city kicked off a predesign study, including extensive outreach involving public meetings, open houses, and presentations at city council meetings. With the support of a citizens advisory group made up of businesses, residents, and transit users, the city council unanimously approved a preferred design concept in 1999.

The preferred design incorporated a complete streets policy with a set of implementation principles dubbed "32 Points." The points included features to improve safety for motorists and pedestrians, access for pedestrians and the disabled, vehicular capacity, traffic flow, transit speed and reliability, nighttime visibility and safety, storm water quality, economic investment potential, and streetscape amenities, such as displays of public art.

Constructed in 2007, the project brought dramatic change to the street, which now stands in stark contrast to the unimproved segments to the north and south. The area features pedestrian access enhancements such as two bridges for pedestrians and bicyclists that are part of a 20-mile (32-kilometer) interurban trail system, of which 3 miles (4.8 kilometers) are in the city of Shoreline, and continuous 7-foot (2.1-meter) sidewalks where no continuous sidewalks had existed previously. In addition, Aurora Avenue features new street lighting, intersection capacity improvements, medians for access management, curb lanes dedicated to business access and bus movement, and underground utilities.

Measures to manage storm water include landscaping; gravel interceptors and underdrains installed along the bicycling and walking trail; and storm water treatment devices for the roadway including gravity separation treatment, vaulted filtering systems, oil-control facilities at high-traffic volume intersections, and a large biofiltration swale on a side street.

The project received the Best Practices Award from the Institute of Transportation Engineers' Transportation Planning Council, the Washington Quality and National Quality Awards from the American Public Works Association, the 2008 WSDOT/FHWA Award of Excellence for "Best City Project," and a Globe Award for excellence in environmental protection and mitigation from the American Road & Transportation Builders Association.

Sandy Boulevard Redesign

In Portland, OR, a streetscape improvement project on Sandy Boulevard addressed community, ecological, and mobility objectives. With average daily traffic of almost 30,000 vehicles, Sandy Boulevard is an important arterial route through Portland and is the city's first project to install green facilities on a high-volume street. The city initiated the redesign after identifying several problems, including pavement damage, distress, and rutting; few and difficult crossings for pedestrians

(Continued on page 12)

BEFORE

AURORA AVENUE

AFTER

As shown here, Aurora Avenue in Shoreline, WA, had five travel lanes, no visible landscaping, and no pedestrian accommodations before its redesign. After the redesign, the street now has bus-only lanes, landscaping, continuous sidewalks, and a bike/pedestrian bridge. *Photos: Tim Bevan, CH2M HILL.*

Nevue Ngan Associates

A newly installed storm water management facility on Sandy Boulevard in Portland, OR, includes the bioswales, trees, and benches shown here. The passing bus hints at the area's multimodal character.

and bicyclists; confusing street circulation; inadequate separation between vehicles and pedestrians; and inadequate space for bus shelters.

Completed in 2007, the Sandy Boulevard project included intersection reconfigurations to improve safety and installation of curb extensions at transit stops, median pedestrian refuges at larger intersections, street trees and benches, parking, wayfinding information, and 70 custom-designed bike racks. A key green feature was incorporation of five landscaped storm water treatment areas in the right-of-way. Infiltration basins and landscaped curb extensions achieve the dual purposes of managing storm water and improving aesthetics at select intersections.

"The angle of Sandy Boulevard against the city grid provided opportunities to reduce the asphalt-paved areas and create sizable vegetated storm water facilities that also increase pedestrian safety by reducing the crossing distances at intersections," says Chris Armes, project manager with Portland's Office of Transportation.

According to a followup report released by the city, "The new construction has successfully made pedestrians crossing Sandy [Boulevard] safer and more comfortable. . . [H]ousehold surveys showed a statistically significant increase in respondents' perception of safety while crossing Sandy [Boulevard]."

This project provides an example of how transportation agencies can put remnant right-of-way segments to use for community purposes and serve ecological functions while maintaining necessary roadway capacity.

Riverfront Parkway And Downtown Street Conversions

In Chattanooga, TN, a major downtown revitalization transformed a riverfront highway from a five-lane, limited-access facility into a two-lane surface street with new intersections at downtown streets, continuous sidewalks, a 13-foot (4-meter)-wide riverfront promenade, and pedestrian access to major visitor attractions. The improvements were part of an ambitious strategy to attract investment to downtown Chattanooga.

Completed in 2005, the redesign of the Riverfront Parkway, which now carries about 19,000 vehicles per day, included narrowing travel lanes, reducing the posted speed limit, and adding onstreet parking and crosswalks. The city also created a park along the waterfront and now uses the area for festivals and special events. Realignment of the roadway created new downtown housing sites, supporting compact development. The changes demonstrate the city's new emphasis on livability rather than accommodating movement of through traffic.

In addition to the parkway redesign, the city converted two downtown one-way couplets (pairs of one-way streets that run in opposite directions to provide two-way mobility in a specific area) into four separate two-way streets with additional parking and landscaping. The conversions slow traffic, facilitate pedestrian and bicyclist access on the commercial streets, and disperse through traffic onto underutilized streets. The route from Riverfront Parkway to major downtown destinations now is more direct, as are routes to employment at nearby health care and educational centers.

Prior to construction, proponents feared the planned changes might be incompatible with the Tennessee Department of Transportation's (TDOT) design guidance. To avoid potential conflicts, TDOT delisted the facility from the State's system and transferred responsibility for maintenance to the city before implementation.

"Before the redesign, the facility felt like a highway, but now it feels like a road through a park," says Karen Hundt, director of the Chattanooga-Hamilton County Regional Planning Agency's Planning and Design Studio, which contributed to the project. "Chattanooga's experience is quite transferable because other cities still have similar highways along their waterfronts."

Evaluation and Rating Systems

In each of these case studies, the cities employed a variety of strategies and techniques to make their streets and roads more sustainable within their specific contexts. Now that the projects are completed, how can these cities—and others doing similar types of sustainability projects—measure success and continue the progress and momentum?

In general, evaluation processes seek to provide tools for monitoring progress toward sustainability goals and incentivizing sustainable practices. Sustainability evaluation and rating systems also provide a framework to examine and balance the interconnections among social,

economic, and environmental factors. Several ratings systems have been developed recently that do not specifically focus on transportation infrastructure, but may nevertheless benefit road projects.

For example, for projects where landscape preservation or enhancement is desired, there is the Sustainable Sites Initiative (SITES™), launched in 2005 by the American Society of Landscape Architects, the Lady Bird Johnson Wildflower Center at the University of Texas at Austin, and the United States Botanic Garden. The SITES system, slated for release in 2013, takes a comprehensive view of the impacts of landscaping in a variety of project types. The system is organized into categories such as site selection, predesign assessment and planning, site design, construction, and operations and maintenance. A 2-year pilot study of more than 150 projects, including 16 transportation corridor and streetscape projects, began in June 2010.

For road projects that are developed as part of a neighborhood, the Leadership in Energy and Environmental Design (LEED) rating system, a product of the U.S. Green Building Council, includes land use and transportation elements. The LEED® for Neighborhood Development (LEED-ND) certification, launched in April 2009, offers credits in two categories that reference transportation. The Smart Location and Linkage category encourages communities to consider location, transportation alternatives, and preservation of sensitive lands, while discouraging sprawl. The Neighborhood Pattern and Design category emphasizes vibrant, equitable communities that are healthy, walkable, and mixed use. In LEED-ND, streets are not rated individually but factor into an evaluation of the broader context, including buildings, parks, and other features.

Sustainability evaluation systems designed specifically for road projects also have been developed, such as New York's Green Leadership in Transportation Environmental Sustainability (GreenLITES) program, Washington State's Greenroads™ system, and FHWA's Sustainable Highways Self-Evaluation Tool. The goal is to provide information and direction to practitioners for making sustainable choices and measuring performance and progress rather than labeling winners or losers. Another goal of the transportation sustainability systems is to stimulate conversations within the transportation community regarding how to build "smart" projects and determine if the right project is being built.

State-Level Developments In Rating Systems

New York and Washington State have taken the lead in creating rating systems. New York's GreenLITES program, established in 2008, is the primary internal management tool for the New York State Department of Transportation (NYSDOT). GreenLITES is a self-certification program that distinguishes transportation projects and operations based on the extent to which they incorporate sustainable choices.

NYSDOT uses GreenLITES to measure performance, recognize effective practices, and identify needs in roadway design and maintenance. Federally funded local projects also use GreenLITES, and NYSDOT is developing a new regional awards program to highlight those road investments that most benefit each region in the State. In April 2009, GreenLITES released a companion Operations Certification Program, which encourages mobility, community, and ecological sustainability principles in all aspects of maintenance and operations. This program was designed in recognition of the fact that much of a State DOT's day-to-day work consists of operating and maintaining lane miles, bridges, small and large culverts, and hundreds of thousands of acres of right-of-way, rest areas, and facilities. Through this daily work, a DOT has numerous opportunities to make either a positive or negative impact on the environment, the economy, and social equity. GreenLITES Operations, therefore, includes some 100 tasks that a DOT can incorporate into maintenance and operations planning so sustainability tradeoffs can be quantified and performance can be tracked. NYSDOT also is developing GreenLITES for Sustainable Planning, which is a project solicitation tool to assist municipalities in identifying and developing sustainable transportation projects.

In January 2010, the University of Washington released its rating system called Greenroads. The Greenroads rating system specifies up to 37 credits and 11 project requirements,

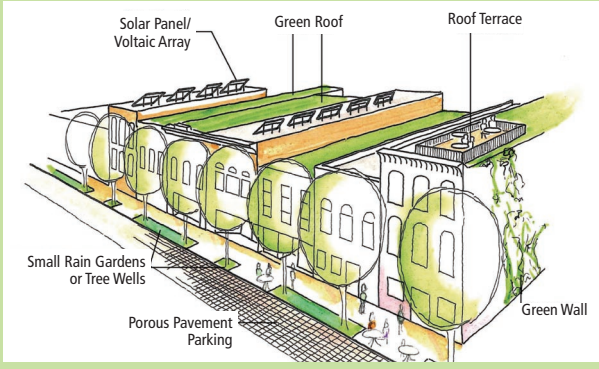
Chattanooga Planning & Design Studio

Chattanooga, TN, transformed its Riverfront Parkway to support active recreation and boost the local economy. Shown here is the parkway with adjacent park amenities, including a riverside esplanade, parking, and landscaping.

Sustainable Streets in Small Towns

The principles of sustainable street design can serve small and rural towns, even where municipal infrastructure budgets are small. These two recent projects, from Duncanville, TX, and West Union, IA, address ecological concerns and community economic priorities in small towns.

(Right) The city of Duncanville, TX, with a population around 38,500, established a vision and form-based codes for its Main Street corridor to ensure future economic vitality as land for new development becomes scarce. The codes emphasize creating a pedestrian-friendly environment where non-auto trips are possible. As explained in the city's visioning document, "Main Street Vision is a formal plan the city has put into place to transform Main Street from a disconnected chain of disparate businesses into a seamless, integrated socioeconomic epicenter." The first phase, design of streetscape improvements, is underway. Shown here is a rendering of the reconstructed N. Main Street between Wes Jespersen Way and East Davis Street, with street parking, sidewalks, and landscaping improvements. *Photo: MoonDesign, Kimley-Horn and Associates, and Gateway Planning Group, Inc.*



(Left) Construction began in 2010 for sustainable streetscape treatments in a six-block downtown district of West Union, IA, which is home to about 2,400 residents. The planned treatments include porous pavement, rainwater harvesting, geothermal heating, midblock sidewalk bump-outs, and street furnishings. The upgrades are part of a larger "green infrastructure" effort that aims to renovate each city block with an eye toward sustainability, supporting the local economy and lowering operating costs. *Photo: Conservation Design Forum, Elmhurst, IL.*

such as having an environmental review process, performing a lifecycle cost analysis, and developing waste management and pollution prevention plans. Point levels then qualify projects for one of four achievement levels (certified, silver, gold, and evergreen). All points are independently verified by a Greenroads review team based on documentation.

Greenroads focuses on the technical design and construction phases, though prerequisites include plans for context sensitive solutions and pedestrian, bicycle, and transit or high-occupancy vehicle access. Currently in a pilot phase, Greenroads is evaluating 30 projects across the country.

FHWA's Evaluation System

For FHWA, sustainable transportation means providing exceptional mobility and access in a manner that meets development needs without compromising the quality of life of future generations. A sustainable transportation system is safe, healthy, affordable, renewable, operates fairly, and limits emissions. The development and use of a sustainability framework and rating system allows for the establishment of a shared vision of sustainability in planning, design, construction, operations, and maintenance.

In October 2010, FHWA announced the availability of its own sustainable evaluation system for roads and highways. The Sustainable Highways Self-Evaluation Tool, available online at sustainablehighways.org, covers the transportation process from planning through funding, project development, design, construction, operations, and maintenance. For each phase of a project, practitioners can select sustainability goals and objectives that reflect stakeholder values and expectations, and fit within the project's context. As practitioners select the goals, they begin to populate a sustainability course-of-action spreadsheet. The spreadsheet is project-specific and provides easy identification and evaluation of the selected criteria, evaluates performance based on the weight of the activities, and offers best practices to fulfill criteria and potential benefits.The evaluation system also contains illustrative practices to demonstrate the outcomes of the selected objectives. For example, for the storm water runoff management credit, the FHWA tool discusses a project in Bellingham, WA, that used porous pavements and a new storm water management system that offered measureable benefits to water quality.

The FHWA self-evaluation tool enables stakeholders to apply the metrics to quantify outcomes and make decisions. Although FHWA plans to sponsor an awards program to recognize projects that use the tool successfully, there is neither an independent certification process nor a comparison among projects or States.

"By creating the sustainable roads evaluation system, FHWA is building upon a longstanding commitment to context sensitive solutions, planning and environment linkages, and environmental stewardship," says April Marchese, director of FHWA's Office of Natural and Human Environment. "We have taken a leadership role to provide technical assistance to our State and local sponsors that will enable them to create solutions that work on all three levels of sustainability—environment, equity, and economy."

Toward A Sustainable Future

The emerging focus on designing sustainable streets and highways reflects the diversity of contemporary demands on public rights-of-way. In response, the practice of design is changing as Federal, State, and local policies and objectives increasingly require integration of livability and sustainability features such as multimodal facilities, space for social interaction, and natural landscaping elements. To support and stimulate sustainable practices, evaluation and ratings systems establish benchmarks and create a blueprint within a framework of context sensitive design.

Looking ahead, the road design, construction, and maintenance fields can expect further innovations in sustainable streets. With the development of intelligent transportation systems, tomorrow's roads will need to respond to emerging vehicle technologies, such as vehicle-to-infrastructure communications, where drivers are given real-time data, such as road conditions, transit time tables, or parking availability, to make better choices and potentially reduce congestion. Electric vehicles and their charging infrastructure may need to be part of sustainable design. Advancements in rooftop and building photovoltaics could influence roadway network and building orientation for optimal solar gain and maximum energy generation. The emergence of new materials with multiple co-benefits—such as 100 percent recycled concrete and stone pavers, recycled aluminum LED light standards, and photocatalytic cement (also known as pollution-eating cement)—could provide new opportunities for designing sustainable streets. Additional innovations could include integration of dynamic information systems that provide real-time information in response to community indicators (such as ambient noise levels or energy use), space dedicated to new models for vehicle ownership and use (such as neighborhood- and district-level fleet vehicles, bike stations, and car-sharing programs), increased use of shared rights-of-way, and analyses that provide a greater understanding of transportation's role in developing sustainable communities.

Without a doubt, stretched Federal, State, and local budgets underscore the growing need to obtain as much value from investments in transportation as possible. By aiming for sustainability, departments of transportation can find innovative ways to design road projects that meet safety and mobility requirements while delivering maximum benefits to communities, motorists, and the environment.

Ellen Greenberg, AICP, is associate principal at Arup in San Francisco, CA, where she leads the integrated planning practice. Greenberg is an urban planner who holds master's degrees in both city planning and civil engineering from the University of California, Berkeley. In 2007–2008, she was a visiting practitioner at the University of California, Davis's Sustainable Transportation Center.

David J. Carlson is director of sustainable development with Parsons Corporation's Transportation group. He was formerly a senior environmental specialist on the Sustainable Transport and Climate Change Team in FHWA's Office of Natural and Human Environment. He holds a bachelor's degree in natural resource management from the University of Massachusetts.

Morgan Kanninen is a graduate urban planner in the integrated planning group at Arup's San Francisco office. She holds a bachelor's degree in community and regional development from the University of California, Davis, where she contributed research to the Sustainable Transportation Center's sustainable streets project.

For more information, contact Ellen Greenberg at 415-946-0248 or ellen.greenberg@arup.com, David Carlson at 202-775-3355 or dave.carlson@parsons.com, or Morgan Kanninen at 415-946-0272 or morgan.kanninen@arup.com.

Today's sustainable streets incorporate new innovations such as this Bikestation® in Washington, DC, that offers secure bike parking, rentals, and repairs. *Photo: Clark Wilson, EPA.*

Researchers in Las Vegas, Miami, and San Francisco studied the effectiveness of tailored approaches to reducing pedestrian crashes.

Evaluating Pedestrian Safety Countermeasures

by Tamara Redmon

Pedestrians hit in roadway crashes account for nearly 12 percent of all traffic fatalities and 59,000 injuries each year. Because crashes involving pedestrians tend to be sporadic events that do not occur at the exact same location, a one-size-fits-all approach to mitigating pedestrian safety problems is unrealistic. To help shed light on which countermeasures will be most effective at specific types of locations, the Federal Highway Administration (FHWA) initiated pilot projects in Las Vegas, NV, Miami, FL, and San Francisco, CA. The study, known as the Pedestrian Safety Countermeasure Deployment Project, looked at the effectiveness of various safety engineering and intelligent transportation systems (ITS)-based countermeasures installed at target intersections in those cities.

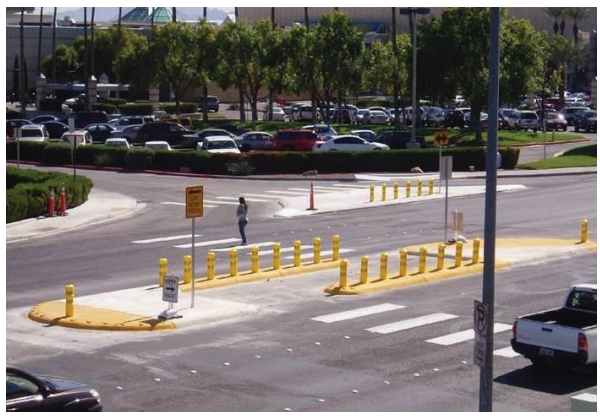
In 2002, FHWA selected the three cities through a competitive grant program. The cities chosen were aware of their pedestrian safety issues and recognized the importance of making data-driven decisions. Countermeasures deployed and evaluated included automated video detection of pedestrians, flashing beacons, instreet pedestrian signs, and median refuge islands. The main goal was to demonstrate how a city can improve safety by performing a detailed analysis of its pedestrian crash problem, identifying and evaluating high-crash locations, observing factors such as driver and pedestrian behavior, and deploying various countermeasures tailored to the site.

Over the 6-year study, with a budget of approximately $1 million, each city identified problem locations, selected and installed countermeasures, and evaluated the impact on pedestrian safety. After the completion of each city's self-evaluation (between 2007 and 2008), FHWA conducted an independent assessment to compare the effectiveness of the deployments.

"People of all ages and abilities should be able to walk in and around their communities safely, which is why making our streets safer for pedestrians is a priority for FHWA," says FHWA Associate Administrator for Safety Joseph S. Toole. "The lessons learned from the pilot cities participating in this project will help other cities across the country prevent pedestrian injuries and fatalities."

A Two-Phased Approach

The study took place in two phases: (1) problem identification and countermeasure selection and (2) countermeasure implementation and evaluation. During phase one, a team of researchers in each city documented pedestrian fatal and nonfatal



The Las Vegas field team installed Danish offsets, which orient the pedestrian toward the oncoming traffic (shown here), in combination with high-visibility crosswalks, advance yield markings, and "Yield Here to Pedestrians" signs at two sites. The team found this combination of countermeasures led to an increase in safe pedestrian and driver behaviors. *Photo: University of Nevada, Las Vegas, Transportation Research Center.*

(Above) At this test site in Miami, FL, the intersection includes a pedestrian refuge island, but the continuous right turn lane in the foreground can prove hazardous to pedestrians. Shown here is the intersection prior to the treatment, which involved adding a sign directing turning traffic to yield to pedestrians. *Photo: Tamara Redmon, FHWA.*

crashes by reviewing police reports to identify high-crash locations where the countermeasures could be installed. The teams also used the data to determine which countermeasures to install. For example, at a location in Las Vegas where pedestrian crashes were occurring midblock, the city decided to install a median refuge island to give pedestrians a safe place to stand while waiting to cross the second half of the road.

Researchers collected data on all fatal and nonfatal crashes involving pedestrians and then mapped the data using geographic information system (GIS) technology. This zone analysis method, developed by the National Highway Traffic Safety Administration (NHTSA), helps focus resources on locations with high potential for collision and injury reduction. Ultimately, the researchers chose locations with high numbers of pedestrian crashes for the countermeasure installations.

During phase two, the teams implemented the countermeasures at the specific sites identified during the first phase. Phase two took place between 2004 and 2008. Las Vegas studied 15 countermeasures, while Miami studied 16 and San Francisco 13.

Self-Evaluations

Field teams consisting of city staff, university researchers, and other local partners in the three cities assessed the impacts of the countermeasures through self-evaluations. To assess the site-specific impacts, each team developed its own deployment strategies and experimental designs, albeit somewhat differently.

Although the Miami and San Francisco field teams deployed many of the countermeasures at multiple sites, they selected one or more sites for the study of each countermeasure and collected data at those sites only. The countermeasure under study was always the first and only one deployed to allow for a before-and-after comparison of the data. The Miami team also conducted several studies where it varied the treatments of countermeasures at the study sites. For example, after testing the impacts of the electronic "No Turn on Red" sign, the team then tested and compared the impacts of static and conditional "No Turn on Red" signs.

"Overall, our evaluation approach was very strong," says Frank Markowitz,

Countermeasures and Deployment Locations

Countermeasure	Description	Las Vegas	Miami	San Francisco
"Turning Traffic Yield to Pedestrians" signs	Signs used to remind drivers making turns that they must yield to pedestrians in the crosswalks	✘	✘	✘
Instreet pedestrian crossing signs	Flexible signs placed in the median or centerline	✘	✘	✘
Pedestrian zone signs	Signs that alert drivers to watch for pedestrians		✘	
"No Turn on Red" signs	Static, static conditional, and electronic signs that prohibit right turns at red traffic signals		✘	
Portable radar speed trailers	Used to deter speeding, these devices can be installed along the side of the road—typically in parking areas—and display the speed of each approaching vehicle	✘	✘	✘
High-visibility crosswalk treatment	Including ladder and diagonal markings, these crosswalks enhance the visibility of the crossing area to alert drivers to where pedestrians will be crossing the roadway	✘		
Advance stop lines	A line typically painted 4–10 feet (1.2–3 meters) ahead of a crosswalk to discourage motorists from stopping in the crosswalk and to improve visibility			✘
"Look" pavement stencils	Thermoplastic stencils applied on pavement in crosswalks (within 4 feet, 1.2 meters, of curb) to encourage pedestrians to watch for vehicles			✘
Pedestrian countdown signals	Signals that show the time remaining for the pedestrian crossing	✘	✘	
Call buttons that confirm the press	Buttons that give feedback to pedestrians by lighting up or making a noise when activated	✘	✘	
Automated pedestrian detection	Technology that detects pedestrian presence and does not require pedestrians to push a button to activate it		✘	✘
Activated flashing beacons	Flashing lights near a crosswalk that alert drivers when activated by a pedestrian	✘		✘
Rectangular rapid flashing beacon	Apparatus consisting of two LED flashers placed on either side of a pedestrian warning sign that flash in a left to right pattern		✘	
Leading pedestrian interval	Traffic signal cycles that give pedestrians a head start before the light turns green for motorists		✘	✘
Prohibition of permissive left turns	This treatment involves reconfiguring signal heads to eliminate permissive left turns; drivers must wait for a left-turn arrow to make left turns		✘	
Median refuge island	Raised islands placed in the street at intersection or midblock locations to separate crossing pedestrians from motor vehicles	✘		✘
Danish offset	Advance yield markings and "Yield Here to Pedestrians" signs at high-visibility crosswalks; the crosswalks orient pedestrians to face oncoming traffic	✘		
Dynamic lighting	Crosswalk lighting that only comes on at night when activated by pedestrians	✘	✘	

senior transportation planner with the San Francisco Municipal Transportation Agency, who served as a project manager for the San Francisco study. "But some impacts are hard to measure. A device like automated pedestrian detection to extend crossing time may have little noticeable effect, especially on pedestrian behavior, but could make a difference in every 1 in 10,000 crossings that prevents injury."

In Las Vegas, the researchers used a multistage approach to deploy and evaluate a variety of countermeasures at 14 study sites. Each stage allowed for a before-and-after analysis of the impacts of the countermeasures. However, only the impacts of the countermeasures in the first stage could be compared to the true baseline. In subsequent stages, the researchers could measure only the incremental impacts.

According to Srinivas S. Pulugurtha, associate professor and assistant director of the Center for Transportation Policy Studies at the University of North Carolina at Charlotte, who was a project manager on the Las Vegas study, although the "results were generally encouraging, lack of time between different installations leaves some ambiguity of the effectiveness of each countermeasure."

Measuring Effectiveness

At the conclusion of the self-evaluations, FHWA completed a study that brings together the findings from the States' evaluations and contains crosscutting analyses of those countermeasures deployed by more than one of the field teams. FHWA published the results of its study in *Pedestrian Safety Engineering and ITS-Based Countermeasures Program for Reducing Pedestrian Fatalities, Injury Conflicts, and Other Surrogate Measures Final System Impact Report*, available at http://safety.fhwa.dot.gov/ped_bike/tools_solve/ped_scdproj/index.cfm. The report discusses the evaluation results for 18 countermeasures.

Because the effects of a countermeasure on crashes may take years to be fully realized, FHWA did not have crash data available for Las Vegas and San Francisco during its evaluation of their projects, although the information was available for Miami. Instead, FHWA researchers looked at measures of effectiveness (MOEs) related to pedestrian and driver behavior. The MOEs included vehicle speed, percentage of drivers braking when pedestrians are present, percentage of pedestrians trapped in a crosswalk, percentage of pedestrian-vehicle conflicts, percentage of drivers stopping or yielding, and percentage of illegal pedestrian crossings.

Spot Devices

When implemented in appropriate locations, rectangular rapid flashing beacons, such as the one shown here, are a highly effective countermeasure for improving pedestrian safety.

By comparing MOEs across the three cities' sites, FHWA determined seven highly effective countermeasures: leading pedestrian intervals, pedestrian countdown signals, in-street pedestrian signs, activated flashing beacons, rectangular rapid flashing beacons, call buttons that confirm the press, and Danish offsets combined with high-visibility crosswalks, advance yield markings, and "Yield Here to Pedestrians" signs. Each of these countermeasures offers something more than traditional countermeasures, such as normal crosswalk markings and pedestrian crossing signs. For example, a rectangular rapid flashing beacon is much more visible and attention getting to motorists than the traditional pedestrian crossing sign. And leading pedestrian intervals, which allow pedestrians extra crossing time before cars can go, give more of an advantage to pedestrians than signals that release cars and pedestrians at the same time.

www.pedbikeimages.org, Laura Sandt

The researchers found that the "Look" pavement stencil, shown here, proved to have low effectiveness in terms of increasing pedestrian safety.

FHWA classified the remaining countermeasures as having either medium or low effectiveness. Those deemed medium were "No Turn on Red" signs, prohibition of permissive left turns, portable speed trailers, and automated pedestrian detection. Low-effectiveness countermeasures included high-visibility crosswalks, advance yield markings, "Look" pavement stencils, "Turning Traffic Yield to Pedestrians" signs, and "Pedestrian Zone" signs. In addition, FHWA noted that for some countermeasures, such as median refuge islands and dynamic lighting, the effectiveness depends on their application. However, the researchers only deployed and evaluated the advanced yield markings in San Francisco; this fact could have some impact on the study results, as the deployment was not more widespread.

In Miami, FHWA used MOEs and crash data to evaluate the countermeasures. Prior to FHWA's project, NHTSA conducted a study to look at the effects of law enforcement and educational programs on reducing crashes in Miami-Dade County. As reported in *Evaluation of the Miami-Dade Pedestrian Safety Demonstration Project* (DOT HS 810 964), NHTSA collected data for zones in the county with abnormally high pedestrian-crash experiences. NHTSA collected data there for 9 years prior to the FHWA project, and an additional 2 years during FHWA's project—providing a total of 11 years of crash data. These data show an average of 51 crashes involving pedestrians per year after installation of the countermeasures and in combination with the NHTSA enforcement and educational efforts. These data represent a 50 percent reduction over the baseline level and a 41 percent reduction in crashes from the NHTSA project levels.

"The crash data showed that the installations were associated with large reductions in crashes in the treated corridors," says Ron Van Houten, psychology professor at Western Michigan University, who was a project manager for the Miami study. "We also learned a good deal about the behavioral effects of a number of the treatments. For example, pushbuttons that confirm they have been pressed increased the percentage of pedestrians who pushed the call button and the percentage of pedestrians who waited for the WALK indication."

Lessons Learned

Despite mixed results due to the wide range of real-world variables (no two sites are exactly the same), the project demonstrated that implementing carefully planned and targeted countermeasures can help improve pedestrian safety. The study also generated guidance for selecting, installing, and educating the community on countermeasures.

To select an appropriate treatment, local engineers first must evaluate the characteristics of a particular intersection or crossing area and deploy countermeasures based on engineering studies of the individual locations. No device or method will work well in every location because each site is unique. For example, Las Vegas has some wide roads, while Miami's roads tend to be narrower. Road width can be problematic with some countermeasures, such as the instreet pedestrian signs, which work best on narrower roadways where they are more visible to drivers.

Proper placement of the countermeasure also is important. For example, the instreet pedestrian signs lasted only a few hours at some of the study locations because they are placed in the center of the road and are easily run over by large vehicles. These signs will likely perform better in areas with minimal truck traffic or where they can be placed on a median.

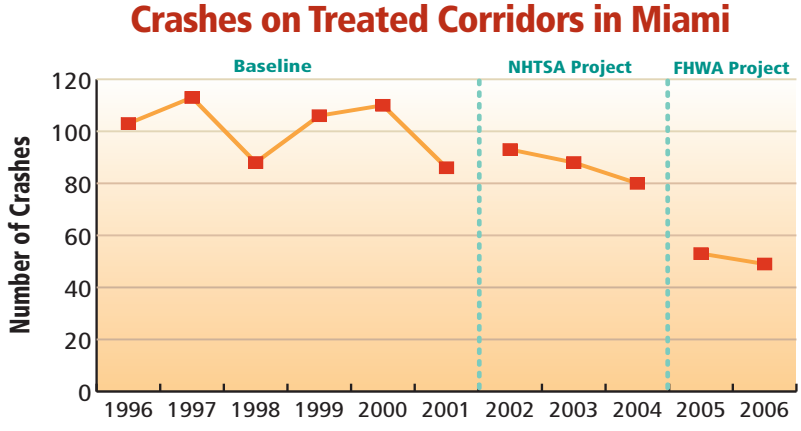
Another necessary element to consider before deciding on and implementing treatments is the road users. Pedestrians and motorists might initially be confused by a new treatment, so localities should make a special effort to educate community members about the use of any new treatments. Educational and communication efforts should target the specific audience. For example, if there is a large non-English-speaking population, localities should translate public service messages into the appropriate languages to reach the target audiences successfully.

"The lessons we've learned from the pedestrian countermeasure study are vital steppingstones to understanding how to better protect pedestrians," says FHWA's Toole. "We think this is a promising approach and hope that other localities will use what we've done here to help them reduce pedestrian injuries and fatalities."

Pedestrian safety improvements such as the ones deployed during this study are likely eligible for funding under most categories of Federal-aid funds. The most applicable funding categories would be Transportation Enhancements, Safe Routes to School, and Highway Safety Improvement Program.

www.pedbikeimages.org, Peter Speer

FHWA found that instreet pedestrian crossing signs like this one are very effective at drawing motorists' attention to the presence of pedestrians. The signs have proven most effective on two-lane roadways.



The number of crashes at all eight treated corridors in Miami remained reasonably stable with a slight downward trend during the 6 years prior to the introduction of the NHTSA project. After the NHTSA enforcement and educational program, the number of crashes annually continued to decrease, even more after installation of the countermeasures during the FHWA study. *Source: Developed by Ron Van Houten, University of Florida, for FHWA.*

Tamara Redmon is a program manager for the Pedestrian Safety Program in FHWA's Office of Safety. She has worked for FHWA for 19 years. She develops products and programs to help reduce pedestrian and bicyclist crashes, fatalities, and injuries. Recent accomplishments include development of a 15-year pedestrian strategic plan and delivery of a webinar series on designing for pedestrian safety. She holds a bachelor's degree from Virginia Tech and a master's degree from Marymount University.

For more information, contact Tamara Redmon at 202-366-4077 or tamara.redmon@dot.gov. To view the final reports for each location and FHWA's evaluation, visit http://safety.fhwa.dot.gov/ped_bike/tools_solve/ped_scdproj/index.cfm.

The reconstruction of St. Louis' Interstate 64 went from disaster to victory, thanks to innovative procurement, regional partnerships, and award-winning public outreach.

by Linda Wilson

From "Carmageddon" to Complete Success

(Above) These crew members are aligning new steel girders for a flyover ramp at the I–170 and I–64 interchange during the first year of Missouri's reconstruction of I–64. *Photo: Dan Galvin, Granite Construction Inc.*

How do you completely close the oldest interstate in St. Louis, MO, for reconstruction and expect to survive the public scrutiny? From 2007 to 2010, Missouri did just that, while on a limited budget and using a flexible contracting approach, finishing the Interstate 64 (I-64) project in St. Louis ahead of schedule, $11 million under budget, and with a public satisfaction rating of 95 percent.

I–64 (also U.S. 40) is the oldest highway in St. Louis, dating back to the 1930s. Originally designed for cars with a posted speed of 30 miles per hour (mi/h) (48 kilometers per hour, km/h),

the interstate had more of a parkway feel as it meandered through the heart of St. Louis. But by 2000, more than 150,000 vehicles used the highway every day at a posted speed of 55 mi/h (89 km/h).

Unfortunately, the oldest 10-mile (16-kilometer) section of the highway and its 30 bridges were deteriorated and outdated, so they had to be replaced to improve safety and capacity and to meet interstate standards. Limited funds, restricted space, and the need to complete the project quickly to reduce the impact on the traveling public complicated the situation.

The I–64 project involved complete reconstruction of 13 interchanges (including a freeway-to-freeway connection with I–170), eight major overpasses or other bridges, and removal and replacement of the mainline pavement between Spoede Road in St. Louis County and Kingshighway Boulevard in the city.

A New Model for Design-Build

With an original budget of $535 million, the I–64 project was the largest construction contract that the Missouri Department of Transportation (MoDOT) had ever awarded and its first-ever design-build project. Early estimates indicated that the reconstruction would cost more than the available funds, so MoDOT implemented a flexible procurement process that allowed for creative innovations in contractor bidding.

"This project was going to be more than we had money for," says Kevin Keith, MoDOT's director. "Keeping traffic on [the highway] and rebuilding it conventionally would have taken 5 to 7 years." Keith recalls that MoDOT said to potential contractors, "Here is how much money we have. This is what we'd like to have built, and we'd like this done in not more than 4 years."

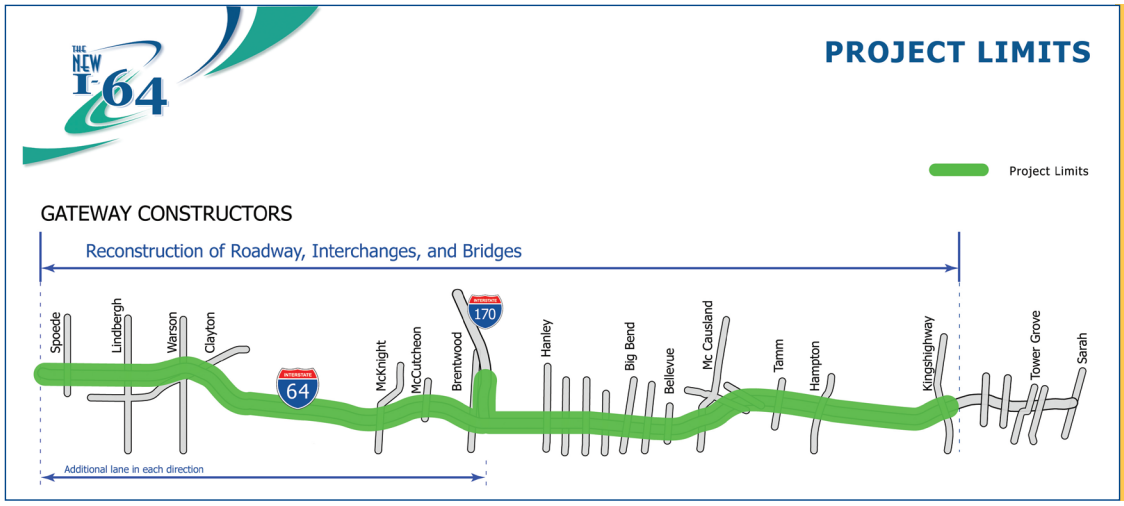
The normal approach for design-build contracts includes a fixed scope based on specific State standards, with the bidders competing

MoDOT

(Left) This aerial photograph shows the I–64 and I–170 interchange during reconstruction. The interchange served as the hinge point for a traffic detour. The western half of I–64 was closed, but traffic could continue to flow easily between the open section of I–64 to I–170 through the central part of St. Louis County.

(Below) The new I–170 and I–64 interchange, shown here, is a complicated system of ramps and collector roads handling more than 150,000 vehicles per day on I–64 and 100,000 per day on I–170.

MoDOT



The I–64 reconstruction project, shown in this project limits map, covered 10 miles (16 kilometers) of new roadway and 13 interchanges. *Source: Gateway Constructors.*

on price. For I–64, Missouri's approach provided a fixed-cost, flexible-scope process with innovative contract bidding that allowed the competitors to identify which federally approved State standards they would use. The agency based the selection on how well the contractors reached MoDOT's goals for the project: being on time and on budget, building the maximum number of improvements that would last 50 years, minimizing impacts by handling traffic well and communicating effectively with the public, and creating a new model for design-build.

MoDOT had budgeted $535 million to cover the cost for the design-build contract as well as the cost for the environmental study, property acquisition, staff salaries to administer the contract, utility relocations, and contingency. There was a fixed cost of $420 million for the contract.

In 2005, the agency issued its request for qualifications, and two teams emerged. The following year, MoDOT initiated the request for proposal process by saying, "We have $420 million to pay for design and construction…How much can you build with that?" Typically, States stipulate how traffic will be handled during construction. With I–64, Missouri specified only that the contractor could not close the project's entire 10 miles (16 kilometers) for the project's 4-year duration.

"We told the contractors to tell us how they would construct the project and keep traffic moving around the region," says Ed Hassinger, MoDOT's St. Louis district engineer. "It was a controversial approach with the public, but we knew the region could not sustain the impact of a long construction project on this key central interstate. It had to be done fast."

In November 2006, MoDOT selected a proposal submitted by the joint venture firm Gateway Constructors as maximizing the creativity and flexibility needed to develop a project that would deliver the most quality improvements, as quickly as possible, with the least cumulative impact on traffic. The contractor's approach included complete closure of 5-mile (8-kilometer) segments at a time for 2 years. The company's maintenance of traffic approach, or transportation management plan, kept I–64 open to I–170. Then a direct interstate-to-interstate detour helped to move traffic around the closure. In an aggressive, proactive traffic plan, the contractor also proposed to improve signal timing on the four parallel arterial routes closest to I–64. The proposal provided all of the desired improvements in MoDOT's original scope, as well as a commitment to hiring a diverse, local workforce.

Schedule

As part of the flexible-scope process, MoDOT required the contractor to develop its own schedule as long as the project would be completed by October 1, 2010. The contractor

MoDOT

MoDOT former Director Pete Rahn addresses the St. Louis media following the first morning rush hour after the first I–64 closure on January 2, 2008.

MoDOT

These traffic engineers from MoDOT and the contractor are discussing intersection issues the morning of the first closure.

actually committed to a completion date of July 31, 2010, exceeding MoDOT's goal by 2 months. The overall schedule contained four phases spread over 3.5 years.

The first year (2007) included some overpass closures and offpeak closures at the I–170 and I–64 interchange and the I–64 and Kingshighway interchange. The second year involved the complete closure of I–64, all lanes in both directions, from I–270 to I–170. The third year incorporated the complete closure of the other 5 miles (8 kilometers) of I–64 from I–170 to Kingshighway. The final year of 2010 had minor offpeak closures for cleanup and punch list items. MoDOT believed this approach was simpler to communicate and safer for the public and workers than trying to keep some lanes open to traffic. It also kept construction disruptions on local streets to a minimum because the work would take place within the closed section of the highway, including dirt moving and trucking from the concrete batch plant.

MoDOT provided the contractor with an incentive for exceeding the key schedule commitments. The first incentive was $2 million for reopening the western 5 miles of I–64 by December 31, 2008. A second $2 million was available for reopening the eastern 5 miles by December 31, 2009. The contractor exceeded the first goal by 2 weeks and the second by more than 3 weeks. For its ongoing efforts to maintain regional traffic flow, the contractor earned an additional $1 million incentive, giving a total of $5 million in incentives related to traffic impacts.

The State required the contractor to adopt a proactive, regional approach to handling traffic flow in its construction staging. The contractor hired a traffic engineering subconsultant to adjust signal timing continuously and proactively on the four major arterials parallel to I–64. During the major closures and even the minor overpass closures, the subconsultant adjusted the signals to handle the changing traffic patterns. In addition, altering the contractor's schedule by only a few days avoided the major impacts to traffic trying to reach special events. Each month the contractor presented a report to MoDOT outlining these traffic handling efforts. The cumulative reports documented the actions that enabled the contractor to earn the $1 million for traffic handling.

Preparing for the First Closure

Completely closing two sections of the interstate would affect the entire region because of changes in traffic patterns. The late 2006 selection of the contractor and announcement of the schedule gave MoDOT engineers 1 year to prepare for the January 2008 western-half closure. The contractor was responsible for traffic handling on the closest parallel arterials and the cross streets to I–64. But MoDOT and its city and county partners were concerned about traffic on all the region's roads and especially the parallel interstates. MoDOT's plan included preparing the rest of the regional roads to handle the extra traffic, working with regional partners to get their roads ready for additional flow, planning specific detours for each closure, and developing the incident command structure to proactively monitor traffic changes.

Also, MoDOT striped an additional lane in each direction on I–70 and I–44, the two major parallel interstates. The agency upgraded signals on State arterials that would serve as alternate routes. In addition, St. Louis County worked on its alternate roads to prepare them for the extra traffic. For the first time, State, county, and city engineers worked as a team to coordinate their signal systems and make arrangements for the big closure.

"Our partners came to the table and did the things we needed them to do to get other roads ready to handle the extra traffic," Hassinger says. "We couldn't have done it without those partnerships."

Developing Regional Partnerships

Just the thought of closing an interstate for 2 years generated concerns across a broad spectrum of audiences. In response, MoDOT staff engaged in extensive outreach to all the major users of the road system.

"As we planned for the I–64 closure, we quickly realized it was much more than a construction project," says Hassinger. "It was going to take all of the regional partners to make this a success."

One concern was emergency response. The I–64 project affected the center of the city and directly or indirectly impacted 10 hospitals. How would emergency responders reach fires or other incidents quickly and transport patients requiring urgent care to those facilities?

In 2006, MoDOT began a series of meetings with the emergency

Dan Galvin, Granite Construction Inc.

During construction in 2007, the new I–64 and I–170 ramps create what looks like a puzzle of crossing steel.

community, including two dozen local police, fire, and emergency management services (EMS) providers responsible for covering the city and most of St. Louis County. MoDOT's district engineer and I–64 project director began meeting regularly with the presidents of the 10 hospitals to discuss their concerns and form alliances. By listening to their input and working with these core emergency stakeholders, MoDOT developed a team approach to finding solutions proactively rather than pointing fingers after the fact.

The State staff also visited all the major school districts, schoolbus providers, and private schools to discuss the construction plan and alternate routes for school traffic. Some of the private school districts created carpools for the first time and even developed satellite parking lots with shuttles to encourage carpooling.

"MoDOT worked to develop a mentality that we are all in this together," says Hassinger. "If everyone did what they could to help the situation, St. Louis would be able to handle this."

The 2006 meetings with the emergency responders and traffic engineers developed into a twice monthly maintenance-of-traffic meeting. The contractor hosted these meetings at the construction project office to share the upcoming schedule and discuss the details of every work zone closure and how to handle traffic.

Meetings averaged 30 people representing the hospitals, police, and fire from the six municipalities closest to the project. Staff from the city and county highway departments and city public works attended as well. The group shared concerns about safety in the work zone, discussed signal timing adjustments on alternate routes, and, most important, worked to develop detour routes for every closure, whether a ramp or an overpass, major interchange, or full interstate closure.

Public Information: We Can Do This

In addition to regional mobility, hospital and emergency access, and alternate routes to and from public and private schools, the outreach had to address the concerns of large and small businesses and employers, regional attractions, and commuters and shoppers. MoDOT shared the public information responsibilities with two staff members from an engineering and architectural firm to distribute information about the big picture, schedule, regional mobility, and coping information. MoDOT also required the contractor to have full-time public information staff. The contractor worked with a subcontractor communications firm to communicate the project's progress,

Dan Galvin, Granite Construction Inc.

These finishers are providing a smooth surface on freshly poured concrete for the new I–64 driving lanes.

traffic issues, and daily construction updates. The MoDOT/contractor team approach facilitated a seamless flow of information. Five public relations professionals were colocated at the project office to develop and implement the extensive outreach.

Between 2007 and 2009, the public information team delivered more than 300 speeches to employers, business associations, neighborhood associations and townhalls, schools, chambers of commerce, and other groups, reaching approximately 30,000 customers.

The project Web site, www.thenewi64.org, contained daily, weekly, and monthly updates on construction activities that would affect traffic, and customers could sign up for regular emails with project updates. The site posted photos, maps, drawings, flyers, and other information to reflect progress and evolving hot topics. Depending on the time of year, the site received from 40,000 to 100,000 visits per month. The project team answered thousands of emails the same day they were received.

With the highway closed for construction, the public could not see the progress on a daily basis, so MoDOT used the Web site as a window for viewing the work. The agency installed five cameras at key intersections and took a photo every 10 to 15 minutes. Site users could click on the current photo, any past photo, or a time lapse of photos to date. Two of the cameras remained in the same location for the duration of the project. The other three moved from the west half to the east half. The photos were the site's most popular feature.

Starting in November 2007, the public information managers with MoDOT and the contractor cohosted a weekly 1-hour chat room on the Web site of the *St. Louis Post-Dispatch*, the newspaper's first-ever nonstaff chat room. The "I-64 Live" chat room became the newspaper's second busiest, exceeded only by its sports chat room. On average, the team answered 25 to 50 questions every Wednesday for 2 years. The newspaper printed excerpts every Monday so the conversations could be read by subscribers as well. The chat room was so successful that the newspaper continued it beyond the completion of the I-64 project. It is now called "The Road Crew" and is hosted weekly by MoDOT, the city, and St. Louis County with more than 50 questions each week about regional road issues.

The public information team engaged the media on a weekly and sometimes daily basis. Due to the project's controversial nature, the St. Louis news media exhibited interest in the project from day one. The lead-up to the January 2, 2008, closure included countdowns on the local news for 1 month.

The Closure: Would St. Louis Come to a Halt?

On January 2, 2008, all lanes of I-64 for 5 miles would be closed for 1 year. Apprehension mounted in the public and media as the closure drew near.

"A lot of people were uncertain about the process," says St. Louis County Executive Charlie Dooley. "Uncertain about what it meant to them as far as going home and going to work. How do you go about getting around a major metropolitan area when the major corridor is closed off? [But] people started realizing we could do this if we did it together."

MoDOT treated the I-64 closure as a planned incident and followed the U.S. Department of Homeland Security's National Incident Management System protocol. The agency organized a new I-64 closure command team to ensure that MoDOT and its partners would be knowledgeable about the condition and operations of the region's transportation system and be able to actively manage travel time reliability and communicate with the public. MoDOT gathered preclosure travel times on the alternate interstates and major arterials. The agency's goal during the closure was to have travel times no more than 50 percent greater than those preclosure conditions.

Traffic engineers from MoDOT, the contractor, county, and city

Dan Galvin, Granite Construction Inc.

Paving crews are pouring the new concrete lanes of westbound I–64 near the I–170 interchange.

Dan Galvin, Granite Construction Inc.

Crews set girders for one of 30 bridges on the I–64 project. The closed roadway created a safer working environment for both workers and drivers.

developed a network of teams to monitor the major routes, watch for bottlenecks, and make improvements. MoDOT installed computer sensors to collect data and organized teams to drive the routes to verify the travel time information. They monitored traffic and travel times from 5 a.m. to 9 a.m. and from 3 p.m. to 7 p.m. during the morning and evening rush hours. After the teams reported the information, the command team shared it publicly at a news conference at 11 a.m. and 9 p.m. to ensure timeliness. The command team later debriefed the teams that traveled the routes and brainstormed solutions to be implemented prior to the next rush period. Due to driver confusion with some of the restriping on the alternate routes, the striping was touched up and markings added, including interstate shields on some new exit lanes on the detour routes.

During the first days of the closure, media Web sites covered the news conferences live. The public responded through the media, and the command team then made changes based on those responses. In some of the most affected areas, only 25 percent of surveyed motorists said their commute time had increased by 15 minutes, while many others reported it was better or unchanged from before the closure. The same survey indicated that 91 to 95 percent felt they were well informed about the closure.

"The closure command process is the real lasting benefit of the I-64 project," says Hassinger. "It showed us that we can proactively monitor roads and address issues and solve problems if we work together. The relationships we built with our regional partners will benefit the region long after [the reconstruction of] I-64."

Measurable Results

Prior to the 2008 closure, headlines screamed "Apocalypse Now!" and "Traffic Nightmare!" Some publications even went so far as to name the upcoming closure "Carmageddon." The headlines immediately after the January 2008 closure read

MoDOT

Federal Highway Administrator Victor Mendez, Missouri Governor Jay Nixon, and a host of other Federal, State, and local officials, along with MoDOT and contractor representatives, celebrated the early completion of I–64 at this December 6, 2009, ribbon cutting.

"Region's Traffic Nightmare a No-Show" and "Preparation Pays Off." The communication effort and traffic planning had paid off.

The region's traffic continued to flow even better in some areas than before the closure. Under normal conditions, the interstates and arterial roadways had predictable travel times, and incremental changes in signal timing on key arterials fine-tuned the trouble spots. The command team identified, evaluated, and solved problems—often within hours of first notice. Motorists used the traffic information resources to find recommended alternate routes. Businesses offered flexible schedules to their employees and location or delivery options to their customers. Surveys, mobility studies, and tests showed that freeway travel times in the region were similar to the previous year, a strong verification of the team's success.

One month after the closure, MoDOT received a complimentary letter cosigned by the region's top three business associations. The St. Louis Regional Chamber & Growth Association, Regional Business Council, and Civic Progress wrote: "In addition to excellent engineering and construction work, the outstanding communication from you and your staff, the resources made available to workers in the area via news media, the Web, and direct communications with local businesses—all have ensured a smoother, easier transition for commuters."

Dooley points out, "[The project] showed us for the first time that when we work together, we can change the game. We can make a difference. And that's what we are here for, to make a difference, to move our community forward with economic development, great jobs, and opportunities. That's what infrastructure does."

In February of 2008, 2009, and 2010, MoDOT used a consultant to mail surveys to residents in more than two dozen ZIP Codes along the project route and in areas well to the east and west. The purpose was to measure public opinion of the information outreach and the overall project. Each year's results showed improvement in the public reaction.

In general, St. Louis residents showed extremely high levels of satisfaction. In the February 2010 survey mailed after the highway reopened, a large majority of respondents (95.1 percent) supported the decision to close the highway for 2 years as opposed to taking 6 to 8 years to complete the project using lane closures. Overall, 94.6 percent of the community was satisfied with how the project was handled.

"The traveling public, the citizens, as well as government leaders are now more confident in going into the next project," says St. Louis Mayor Francis Slay.

Several thousand runners and walkers turned out for a 3-mile (5-kilometer) run on the new I–64 for the opening ceremonies. In total, an estimated 20,000 people participated in the opening festivities the day before the highway opened to traffic.

MoDOT

Exceeded All Project Goals

The I–64 project reopened nearly a month early in December 2009. The project has won numerous local, State, and national awards for innovative procurement, cooperative regional partnerships and traffic handling, and outstanding public outreach.

"We built this project under budget and ahead of schedule, which for a half-billion-dollar job is just amazing," says Keith. "But not only that, the community support was fabulous. The traffic handling was not an issue, once we got started. We created a positive for the engineering community with a new way to approach complex design-build projects. When you put all that together, this is a positive for MoDOT and a positive for the St. Louis community."

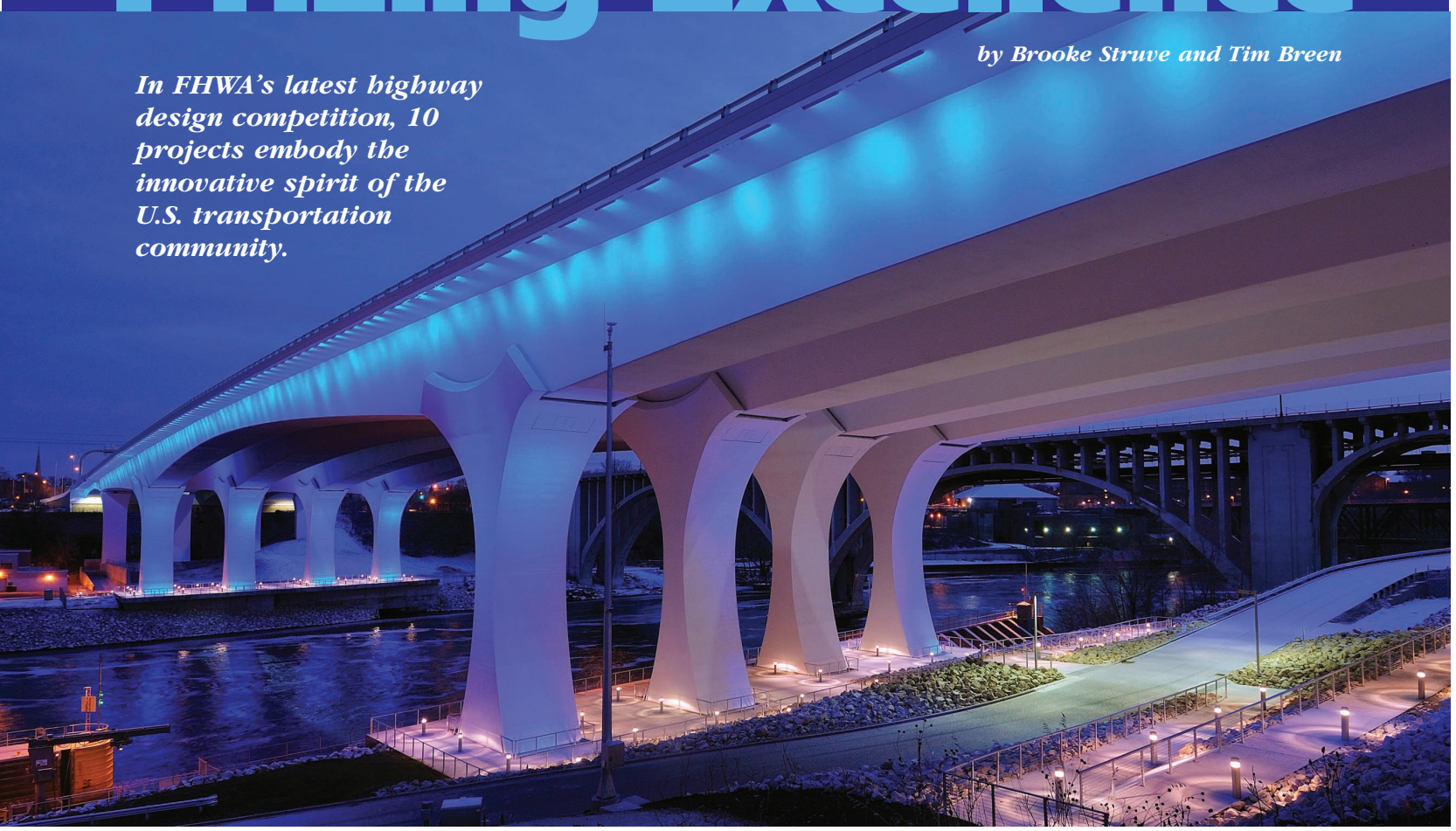
Linda Wilson is community relations manager at MoDOT's St. Louis office. She has managed public relations for MoDOT for more than 19 years. Wilson has a bachelor's degree in journalism from the University of Missouri. In 2010 her work on I–64 received awards for Communicator of the Year from the National Association of Government Communicators, Communicator of the Year from the St. Louis Community Service Public Relations Council, and Missouri State Employee of the Month.

For more information, contact Linda Wilson at 314-453-5063 or linda.wilson@modot.mo.gov. Also see www.ops.fhwa.dot.gov/wz/resources/final_rule/modotcasestudy.htm.

Prizing Excellence

by Brooke Struve and Tim Breen

In FHWA's latest highway design competition, 10 projects embody the innovative spirit of the U.S. transportation community.



From streets that are the arteries of a community to bridges built overnight, the U.S. transportation industry designs and constructs cutting-edge projects that are sensitive to their communities and the environment. To recognize the efforts of State departments of transportation (DOTs) to address problems such as highway safety, congestion, funding scarcity, and environmental impacts, the Federal Highway Administration (FHWA) presents its Excellence in Highway Design Biennial Awards every 2 years.

(Above) The Minneapolis, MN, community helped select the aesthetic features for the new I–35W Bridge, one of many practices lauded by judges in FHWA's Excellence in Highway Design Biennial Awards competition. As seen in this night shot, lighting accentuates the curves of the 70-foot (21.3-meter)-tall piers. *Photo: FIGG.*

The awards date to 1967, when Secretary of Transportation Alan Boyd, inspired by Lady Bird Johnson's crusade to beautify the Nation's highways, announced a competition called The Highway and Its Environment. The Excellence in Highway Design Biennial Awards succeeded that original competition in 1984. To date, FHWA has highlighted hundreds of projects involving highways, bridges, bicyclist and pedestrian paths, and roadside facilities that reflect the best of the highway community's innovation and creativity.

FHWA announced the 2010 awards for excellence and honorable mention in 10 broad categories at the American Association of State Highway and Transportation Officials' annual meeting in Biloxi, MS, held October 28–November 1. A panel of 11 judges—9 from private engineering firms and 2 from State DOTs—selected the winners. The 10 excellence award winners follow by category.

Urban Highways: Freeways And Expressways

In Milwaukee, WI, the Marquette Interchange reconstruction was a major undertaking, involving 12 miles (19.3 kilometers) of urban freeways (I–43, I–94, and I–794), 50 ramps, and more than 180 structures. Despite the project's size, the Wisconsin Department of Transportation (WisDOT) completed the reconstruction on time and under budget, and developed state-of-the-art processes along the way.

Before groundbreaking, the interchange was carrying more than twice its designed traffic volume. Then and now, the interchange carries more than 300,000 vehicles through downtown Milwaukee every day—nearly half of Wisconsin's commercial and tourist traffic. The site had long been one of the State's most hazardous

freeway sections, averaging more than three crashes per day. Reconstruction was vital but daunting, made more so by the need to keep vehicles moving during the work.

WisDOT developed a 4-year, $810 million reconstruction plan that accounted for various challenges. For instance, the interchange geometry was complex due to ramps required to access downtown destinations and utilities scattered throughout the interchange. A tight urban footprint resulted in stacked roadways, braided ramps, and depressed sections.

Planners gave the new interchange a 75-year design life, and the project team placed a premium on value engineering. Designing around the utilities rather than moving them saved $100 million. Disposing of more than 100,000 cubic yards (76,455 cubic meters) of contaminated soil on an adjacent brownfield redevelopment saved more than $5 million. The designers improved safety by moving all exit and entrance ramps to the right side of the freeway, increasing weaving distances and clear zones and improving access to local streets, all while staying within the existing project footprint.

WisDOT also made a commitment to political leaders, businesses, and motorists to keep downtown Milwaukee open for business. The agency staged work around the existing interchange to maintain two traffic lanes in each cardinal direction throughout construction. The complex staging plan enabled construction to continue even during the harsh Wisconsin winters.

The agency likewise took innovative approaches to maintaining traffic flow. For instance, the construction team built an asphalt roadway 2 years in advance of the ramp it would connect to and buried it in the dirt. Workers dug the roadway up in the middle of 1 night, connected it to a newly built ramp, and let traffic flow the next day. In addition, the design team formulated a lane rental program, which charged the contractor a fee for closing off and using lanes based on the estimated cost of delay or inconvenience to road users. Lane rental programs have become Wisconsin's standard for freeway construction projects, encouraging contractors to minimize road user impacts during construction.

A sweeping public involvement program helped keep motorists informed and traffic moving safely. A key component was ongoing communication between the project office and community, including notices of alternate routes and ramp closings and openings. The project's Web site featured a patented routing tool to help motorists navigate work zones and plan their commutes. Testament to the excellent traffic management plan, the average crash rate for the interchange dropped 20 percent *during* reconstruction.

"This is a safer design, a better looking design, and it incorporates historic and artistic components," said Governor Jim Doyle at the project's opening in August 2008. "This is really the best transportation project we've ever done—not only the biggest but the best in the State of Wisconsin."

Indeed, WisDOT delivered a state-of-the-art facility that is now considered one of Milwaukee's most iconic structures. The price tag came to $795 million, $15 million under budget. And the project was finished 3 months ahead of the 48-month schedule.

Urban Highways: Surface Streets

In the 1960s, the New York State Department of Transportation (NYSDOT) converted a 1.5-mile (2.4-kilometer) section of Route 376/Raymond Avenue into a concrete, four-lane arterial. Serving Poughkeepsie's downtown Arlington District, which includes residences, businesses, and Vassar College, the roadway had eight signalized intersections and intermittent parking lanes (not continuous through the corridor) and sidewalks.

HNTB Corporation

Reconstruction of Milwaukee's massive Marquette Interchange, shown here from above, has transformed the flow of traffic in southeastern Wisconsin, increasing safety and mobility for thousands of travelers every day.

In time, high traffic volume began to take a toll on the concrete pavement of Raymond Avenue. The surface lost much of its friction, making it more slippery and conducive to crashes. Other safety problems included a lack of turning lanes at the intersections, combined with significant turning volumes, which caused drivers to weave through traffic to avoid turning vehicles and increased the

NYSDOT

The addition of roundabouts such as the one seen in the background, reduction from four lanes to two, and addition of parking lanes and a median have calmed traffic on Route 376/Raymond Avenue through the commercial district of Poughkeepsie, NY.

likelihood of crashes. The corridor also posed dangers to pedestrians. The sidewalks were not continuous, and crosswalks were located only at the signalized intersections, which were far apart. Many pedestrians crossed four lanes of traffic outside the protected crosswalks.

NYSDOT's goals for the reconstruction were to improve Arlington by providing a traditional "Main Street" with vehicle, bicycle, and pedestrian features, all operating together safely. The project would reduce vehicle travel delays and improve pedestrian access from Vassar and nearby homes to the downtown business district. NYSDOT would employ context sensitive design and involve all stakeholders to ensure the project was in harmony with the community and its scenic, aesthetic, and historic resources.

The agency's first order of business was to replace three signalized intersections with roundabouts, which generally are safer than conventional intersections. The roundabouts increased traffic movement through the corridor with fewer interruptions, but still at safe speeds. Because they handle traffic more efficiently, roundabouts reduce energy consumption and improve air quality. The placement of the roundabouts also increased the overall width of the sidewalks, enabling local businesses to provide more gathering spaces and outdoor dining.

In addition, NYSDOT put Raymond Avenue on a "road diet," reducing the travel lanes from four to two. The previous design encouraged vehicle speeds that neared 50 miles per hour, mi/h (80.5 kilometers per hour, km/h). Students and faculty at Vassar and an elementary school found the area difficult and dangerous to navigate, and business owners wanted to attract more foot traffic.

The thinner road helped reduce vehicle speeds and increase pedestrian safety. NYSDOT dedicated the old, outer lanes to parking to handle business traffic. Cobblestone imprint strips better delineate the parking lanes adjacent to the roadway and encourage vehicles to park closer to the curb, which creates more space for bicycles to share the street. The diet also had the effect of bringing back Raymond Avenue's original historical context.

NYSDOT installed raised medians to delineate traffic lanes and for pedestrian refuge in crossing zones. Some medians contain traversable curbing for emergency vehicles to access. The agency planted other medians with trees to enhance the visual appeal along the corridor and reduce the urban heat island effect.

A traffic operations study, performed after construction of two of three roundabouts, found the improvements are working. For instance, average vehicle speeds decreased by 9 mi/h (14.5 km/h) in each direction, approach delay at the roundabout intersections decreased by 56 percent, and total number of crashes decreased by 51 percent. However, backups at the remaining signalized intersection that was later replaced by the third roundabout, caused travel time through the corridor to increase by 7 percent during peak traffic."NYSDOT could have just resurfaced the road but instead chose to create a community for living," says Daniel Baah, PE, a principal project manager at CH2M HILL and one of the awards judges.

Rural Highways: Freeways

In Inyo County, CA, the Blackrock Four-Lane Project on U.S. 395 converted 14.3 miles (23 kilometers) of two-lane highway into four-lane expressway with a 100-foot (30.5-meter) median. "The project is extraordinary because of the remarkable collaborative effort of all the participants required to plan, fund, design, and construct a successful highway project in a rural area with important scenic values," says contest judge Leo Scott, PE, vice president of Gray-Bowen and Company, Inc.

The four-lane divided expressway will reduce or eliminate head-on collisions, the most common type of fatal crash on rural highways, thereby improving safety. The two lanes in each direction allow faster moving traffic to pass slow-moving trucks and recreational vehicles (RVs) safely, reducing seasonal congestion caused by travel to Mammoth Lakes, Yosemite National Park, and Lake Tahoe. Also, rerouting traffic for maintenance or incident management is possible without temporary closures.

During construction, the California Department of Transportation (Caltrans) used innovative engineering techniques that helped make the project a showcase. For example, the agency created a digital terrain model (DTM) of the new roadbed, which crews used along with a global positioning system and automated machine guidance software to direct the construction machinery with improved precision, speed, and accuracy. The technology also reduced the number of personnel

needed, increased productivity, and saved up to 40 percent in fuel.

In an effort to preserve the local environment, Caltrans gathered the seeds of native shrubs and grasses during clearing and applied them to disturbed areas. The revegetation created a sustainable roadside landscape that will require no irrigation and will blend in naturally with the rest of the landscape.

Rather than grade the entire median, Caltrans preserved scenic sections to maintain the area's visual character. Natural lava rocks provide physical separation of travel directions and minimize associated headlight glare to oncoming traffic.

Because the project was on an officially designated State scenic highway, Caltrans paid special attention to reducing visual impacts during construction, such as by storing material and plant equipment at a single location. Having materials nearby also reduced hauling needs and the production of greenhouse gas emissions.

Rural Highways: Highways

On the northern shore of Lake Superior, Minnesota State Trunk Highway 1 (TH 1) snakes through Superior National Forest, among abundant wildlife, lakes, rivers, and wetlands.

"Travelers think of TH 1 as an emotional experience known not only for its scenic and natural character and North Woods intimacy, but also for its many hairpin curves," says Mike Robinson, district engineer for northeastern Minnesota with the Minnesota Department of Transportation (Mn/DOT).

Indeed, TH 1—which is a commercial lifeline to remote communities and cultural resources—had 46 speed advisory signs to warn drivers of sharp curves and sags. Poor drainage often caused water to run across the highway. While overall corridor crash rates were average, a 15-mile (24.1-kilometer) stretch was more dangerous.

In 2001, Mn/DOT, the USDA Forest Service, and Lake County began collaboration on a redesign of the 15-mile length of highway. For the first time, the Forest Service used its Forest Highways Program funds for State highway reconstruction in Minnesota.

From the start, the core of the project was to improve the substandard geometry and road structure with a frost-free roadbed for 10-ton (9.1-metric-ton) commercial traffic; improve the pavement, riding surface, hydraulic structures, and drainage; replace bridges over two rivers; and provide passing opportunities. A public involvement plan by an interdisciplinary, multiagency project team and a local public advisory committee forged a compromise. Although some interests wanted a straighter, flatter, faster arterial—with speeds up to 70 mi/h (112.7 km/h)—and others wanted almost no change and a speed limit of 30 mi/h (48.3 km/h), they settled on a two-lane route with a design speed of 40 mi/h (64.4 km/h).

"The circumstances surrounding the design and reconstruction of this segment of Highway 1 made it seem the most impossible situation we had encountered," says Mike Tardy, Mn/DOT's assistant district engineer. "I don't know if I can convey how perfectly the project development played out and how perfect the design parameters wound up fitting the situations."

The 40-mi/h design enabled the roadway to follow the historically significant alignment while straightening curves only where necessary. That kept forest clearing and environmental impacts to a minimum. The State Historic Preservation Office was able to make a finding of no adverse impact to properties eligible for the National Register of Historic Places.

Also in keeping with the context and design speed, the roadway was to have 10-ton capacity, 12-foot (3.7-meter)-wide lanes, 5-foot (1.5-meter) paved shoulders (with an extra foot of reinforced gravel shoulder), and a minimum 10-foot (3-meter) clear vehicle recovery area. Additional project features included steeper fill and cut slopes to minimize forest and wetland impacts, restricted rock blasting to avoid wildlife denning and nesting seasons, wildlife undercrossings, offset blasting of outcrops for a more natural appearance of rock faces, and native plant restoration.

The first phase involved replacement of the Stony River Bridge, where the ruins of an early 1900s sluiceway remained. The design team crafted a bridge that spanned the river without disturbing the sluiceway, fit the terrain better, included wildlife underpasses on both sides of the river, and was higher and wider to better accommodate boaters and anglers. Postreconstruction data show a 71 percent reduction in average annual crashes.

"Road design has to be about more than numbers in a design manual geared toward giving you a good

Caltrans

Before the redesign made Inyo County's U.S. 395 into two travel lanes in each direction, motorists often found themselves stuck behind slower vehicles 66.2 percent of the time. The two lanes going in the opposite direction are visible in the background.

John Bray, Mn/DOT

Mn/DOT

Seen from above, the reconstructed TH 1 alignment lies lightly on the land as it winds around lakes and hills in Superior National Forest. (Inset) The project is sensitive to the needs of wildlife, such as this moose on the edge of the road.

product in typical circumstances, because there will be circumstances where those numbers will do you a disservice—and TH 1 is one of those cases," says Robinson. "TH 1 is now becoming the road it naturally wants to be."

Structures Costing $10 Million or More

On August 1, 2007, the collapse of the I–35W Bridge in Minneapolis, MN, was front-page news. But not only did Mn/DOT and its partners complete the replacement in remarkable time, they incorporated state-of-the-art features and used cutting-edge construction techniques in the process.

In addition to a timetable of only 11 months from start to completion, the project had to address many challenges. These included removal, investigative, and cleanup operations associated with the collapsed bridge; contamination from past industrial uses, including a Superfund site; roadway approaches that did not meet current capacity and geometric design standards; and stakeholders with divergent views on bridge design. The project also had to accommodate historic properties, lock and dam operations, public parks, protected roads, railroad tracks, and utilities under the bridge.

The new structure features twin concrete spans, each 1,223 feet (372.8 meters) long with a 504-foot (153.6-meter)-long precast segmental main span over the Mississippi River. The bridge employs high-strength, high-performance concrete with an estimated 100-year lifespan.

Mn/DOT placed most of the concrete during the winter, requiring special mix designs to maintain proper temperatures. Crews added heated water and aggregate to the mix to maintain temperature during delivery, and heated sheds around the casting beds kept a constant temperature in the casting yard.

Mn/DOT used a new type of cement to build two 30-foot (9.1-meter)-tall curved gateway structures at each end of the bridge, marking the river crossing. The cement cleans the air and itself by photocatalytic reaction with the atmosphere. Also, low-energy, low-maintenance light-emitting diode (LED) lights were used on the deck's 10-lane highway. This was the first use of LEDs on a major interstate thoroughfare in the United States.

Mn/DOT used "smart bridge" systems that monitored the temperature of the concrete during curing to ensure high quality. Over the bridge's service life, information collected from the 323 installed sensors will help enhance bridge inspections, maintain efficient and safe traffic flow, and provide infrastructure security. The sensors measure the bridge's response to loads in real time to alert officials if a problem could occur. Information gathered from the sensors will provide valuable feedback for future bridges.

Looking forward, Mn/DOT designed the I–35W bridge to be adaptable throughout its lifespan. The bridge has space for light rail, bus, or high-occupancy vehicle lanes, and is designed to carry a pedestrian bridge slung below it.

Mn/DOT and its partners worked to keep the community informed about progress, employing a Web site and webcam to share news. Every Saturday morning, project representatives led tours adjacent to the construction site. The tours became highly

popular, with thousands attending over the course of the project.

The new I–35W bridge opened to traffic on September 18, 2008—3 months early and little more than a year after the collapse.

Structures Costing Less Than $10 Million

In Utah, contractors replaced four bridges in 37 hours, a feat that actually had them doing more work than originally planned so they could protect motorists and save taxpayers' money.

The project was part of the Utah Department of Transportation's (UDOT) ambitious plan to replace 12 bridges in 2 months near Salt Lake City, including four bridge decks at the I–80/Mountain Dell and I–80/Lambs Canyon interchanges. UDOT advertised the work as a design-build project and specified maintenance of traffic to keep three lanes of I–80 open to traffic in each direction, except for a 16-hour closure during nonpeak times for each bridge deck.

The contractors proposed replacing the superstructure for all four bridges using self-propelled modular transporters (SPMTs). "Originally it was just going to be a deck replacement," says Mark Parry, UDOT's project manager. "As we looked at different possibilities, the contractors found it was cheaper to replace the entire structure." Thus, the project also replaced the bridge girders, which will greatly improve the life expectancy of the structures and save taxpayers an estimated $1.3 million.

Through negotiations, UDOT agreed to allow one 24-hour, weekend closure for each direction of I–80, reducing the original 64 hours of closure to just 48 hours. Ultimately, the contractors replaced the bridges in a record 37 hours over two weekends, beating the allowed closure time by 11 hours. They replaced the eastbound bridges in 16 hours.

FIGG

The 504-foot (153.6-meter) main span of the new I–35W bridge, shown here during construction, crosses the Mississippi River as a modern interpretation of historic arch bridges along the river.

Building bridges offsite and using SPMTs to move them into place is an accelerated bridge construction technology. Other UDOT projects using SPMTs have built bridges on temporary abutments positioned at the eventual lifting points. The SPMTs then lift the bridge at pick points located away from the bearings. But that puts the deck and parapets into tension and can cause cracking throughout the elements during the move.

The I–80 project took that innovation to the next level. Temporary abutments supported the preconstructed bridges at the pick points. With the temporary abutments, the superstructure could accommodate the loading until the time when the bridge was placed in service with highway loads. Thus, the lifting and moving put no additional stress on the bridge decks, which became precompressed elements by being placed into final position under compression with the parapets.

This method required significantly more planning and engineering, but it reduced the time needed for one set of SPMTs to move multiple bridges and limited the moving distance to the final locations. The innovative design is expected to increase the life of the bridge deck and parapets.

The project set other precedents as well. For the first time in Utah, the contractor *chose* to use SPMTs to remove or replace a bridge. (In all previous projects, UDOT had mandated use of SPMTs.) The project also entailed the State's first total closure of a major interstate trucking route for replacement of a bridge superstructure and was the first time that approaches were replaced along with the bridges. (Previously, approaches were replaced later during separate closures.)

Stanley Consultants

For the bridge replacement project near Salt Lake City, crews used SPMTs to move the existing bridges out of the way and put the new bridges in place.

Caltrans

A bicyclist cruises down State Route 36 near Susanville, CA. Additive bidding enabled Caltrans to improve the route beyond just adding the bike lane.

Work zone safety and the desire to minimize traffic delays were driving factors behind using the SPMTs. The technique reduces the amount of time workers are exposed to moving traffic. No lost-time construction incidents occurred during the I–80 bridge replacements. The project also improved motorist safety by eliminating movement through and below work zones.

The project maintained traffic on I–80, a critical national east-west route, at all times, with only two brief detours, which had little impact on local businesses. UDOT estimates the speed of the project saved 190,000 hours of delays and $2.5 million in related costs.

Intermodal Transportation Facilities

More and more transportation stakeholders are embracing complete streets, the principle that roadways should accommodate all travelers, bicyclists and pedestrians included. That principle became the guiding tenet in Susanville, CA, 10 years ago, when the Lassen County Transportation Commission first partnered with Caltrans to add a bike lane to State Route 36. The Town Hill project had to overcome financial hurdles, but the agencies completed it in October 2009—and validated an innovative contracting vehicle in the process.

"The partnership between Caltrans and the local agency is a testament to success through use of innovative ideas and solutions, and is proof that this project was much more than just a bike lane," says Dan Dennis, president of Dennis Corporation, who was a contest judge.

When implementing the bike lane, the agencies created a wide shoulder that can accommodate snow storage, disabled vehicle parking, and rockfall catchment. They also moved a pulloff where drivers can place chains on their tires out of downtown to ease traffic congestion, moved an intersection to a safer location, and added a left-turn lane.

The most noticeable improvement was a large rock earthwork cut. Previously, a portion of S.R. 36 was intimidating to travel, as it appeared boulders might come crashing down at any time. As part of the Town Hill project, crews cut back the slope and stabilized it. The contractor used an innovative technique to recycle the rock, crushing it for use on other projects rather than trucking the boulders offsite for disposal.

The Town Hill project used an innovative bidding program that had been implemented on only four other Caltrans projects. "Additive bidding" allows contractors to submit alternative bids for additional improvements. This provision in turn enables Caltrans to include the improvements if they fit within a project's budget. The approach was successful, and Caltrans was able to include a pavement overlay of the highway as an additive bid item.

"The overlay was sorely needed, but because of budgetary restrictions, it never would have been included without this bidding program," says John Bulinski, Caltrans District 2 director. Because of the success of this project and others, Caltrans is preparing a pilot program to allow additive bidding on future projects.

Traveler Services

The Bass Mountain Wireless Hub serves I–5 as it enters the Cascade Mountains near Redding, CA. The project consists of communications infrastructure that enables drivers to access accurate, timely information on highway conditions. For motorists, it can mean the difference between spending the night in a warm motel room or on the snowy roadside.

The interstate is a key north-south transportation corridor that links the entire west coast. Closures of the route over the Cascades are common in winter. The impact on travel and freight movement has ripple effects throughout the corridor.

Completed in May 2009, the Bass Mountain Wireless Hub is a mountaintop facility with modern wireless technology, the critical communication path connecting roadside field elements (such as cameras, weather stations, message signs, highway advisory radios) to the Caltrans District 2 Traffic Management Center (TMC). The TMC uses data from a variety of sources, including images from closed-circuit television cameras and meteorological and pavement condition information from Road Weather Information System stations, to formulate timely messages for motorists.

The wireless hub performs better and more reliably than traditional digital telephone lines, dramatically improving image and data collection along I–5 and leading to better traffic management based on more accurate information, especially during winter operations. The project also saved Caltrans money, as the wireless connections to the roadside equipment and TMC do not incur monthly service costs.

Further, the project improved coordination and accuracy of information transfer between field maintenance personnel and the TMC, which communicates messages through highway advisory radio and changeable message signs. In addition, the roadside images

and data are available to the public on the Web for trip planning. This has developed into an essential public service as measured by Web site activity, with more than 7 million hits during one recent winter month for the seven northeastern California counties of District 2.

The associated wireless system uses license-free microwave equipment. Caltrans designed and built point-to-point interconnections from the mountaintop back to the TMC in Redding, from the site to another mountain site 13 miles (20.9 kilometers) north, and to several roadside TMS elements along I–5. The agency designed the transmission system for high reliability, and already it has exceeded expectations, as evidenced by the data collected.

Caltrans had to be innovative as well in transporting a prefabricated radio vault on an access trail to the mountaintop. The agency worked with a vault manufacturer to "panelize" an existing design, then developed a complete transportation and installation sequence to verify that the precast panels could be moved up the trail. Crews used a specially designed steerable trailer, pulled by a bulldozer, to transport the panels in 15,000-pound (6,804-kilogram) loads up steep slopes and switchbacks. On the mountaintop, a tracked excavator lifted the panels into place, and a crew then assembled them as a normal precast structure.

At the mountaintop, the project minimized tree removal by careful siting and selection of the microwave paths. The facility's exterior finish is earth tone to blend with the natural environment, and it is nestled in the existing trees and unnoticeable from I–5 or the surrounding area.

The building has an expected lifespan of 50 years and the wireless communications equipment 20 years. The procedures and designs developed for the project are applicable to any rural area in California or areas with similar topography.

Project Management

The James A. Farley Memorial Bridge opened to traffic in 1922 as a steel-deck, arch-truss bridge with five spans totaling 360 feet (109.7 meters) long. The bridge carries Route 9W, a commuter and trade route in Stony Point, NY, over a creek. In 1970, NYSDOT rehabilitated the bridge, but by 2005 it had deteriorated again and was carrying triple the traffic.

The agency had to complete design of a 400-foot (121.9-meter)-long, three-span bridge on high piers over Cedar Pond Brook's 100-foot (30.5-meter) gorge in 2.5 months. The tight timeframe was to design the bridge as quickly as possible, get the project out to bid, and maximize the construction season, thereby allowing the bridge to be built and concrete deck to be poured before the cold weather set in. (The normal design period would have been 6 months.) To ensure success, NYSDOT had to determine the highest schedule risks and develop a plan to eliminate those issues, which included design, acquisition of right-of-way (ROW) and steel for the bridge superstructure, utility relocation, and preparation of detour routes.

Ultimately, the agency found the solutions in a series of innovative contracts: an accelerated contract to construct the bridge with full closure and detour, a contract when ROW would be available for demolishing buildings and completing highway work, an advance steel contract, and a traditional bridge replacement contract.

By reassigning personnel, NYSDOT began the design work in September 2008 and completed the plans, specifications, and estimate phase by that December. NYSDOT's real estate team cleared the necessary ROW within 3.5 months from when maps were prepared. Refocused personnel resources, as well as preliminary legal and property valuation work initiated in anticipation of a later bridge replacement schedule, enabled the team to clear the ROW within the compressed time schedule.

Due to the long lead time for making structural steel and bearings, the standard approach of having the general contractor acquire the steel was not possible. Instead, NYSDOT used separate contracts: an advance steel contract and the traditional bridge replacement contract. But first the department obtained FHWA's approval to use Federal funds for this innovative separate purchase of steel.

Utility relocation presented another issue. Relocation normally occurs in the early stages of a project to enable the contractor to prepare the site, but this procedure would not work for the Farley Bridge. The detour route had to be available at the start of the contract, but utility poles blocked the proposed detour and needed to be moved first.

Caltrans

A crew assembles the vault that now safeguards the Bass Mountain Wireless Hub near Redding, CA.

Honorable Mentions

Although the following nine projects did not win Excellence in Highway Design awards, they each displayed such innovation, effectiveness, value, or other merit that they earned honorable mentions.

Urban Highways: Freeways and Expressways. The Missouri Department of Transportation constructed the first diverging diamond interchange in the United States (see "The Double Crossover Diamond" in the November/December 2010 issue of PUBLIC ROADS). The innovative geometry alleviates congestion on the busy Kansas Expressway, took less time and money to build than a conventional design, and is expected to reduce crashes.

Urban Highways: Surface Streets. NYSDOT built the Slingerlands Bypass Extension on State Route 85 in Bethlehem to address mobility and congestion, while also supporting development. The 1.5-mile (2.4-kilometer) extension of the four-lane divided highway creates a gateway to the community and connects residential, business, and recreational areas with a pedestrian network.

Rural Highways: Freeways. California's Sherwin Summit Rehabilitation Project on U.S. 395 in Inyo County rehabilitated pavement, widened shoulders and medians, improved culverts and drainage, modified chain-up areas, and relocated utilities, all without disturbing the renowned rock outcrops of the volcanic tablelands.

Rural Highways: Highways. FHWA's Central Federal Lands Highway Division, the U.S. Army, and the Hawaii Department of Transportation combined efforts to build the Saddle Road project on State Route 200. The road crosses the Big Island of Hawaii and links Hilo with the residential and resort areas of the Kona and Kohala Coast. The project removes conflicts between military training and the traveling public.

Structures Costing $10 Million or More. In the Gay Street Bridge project on State Route 113 in Phoenixville, the Pennsylvania Department of Transportation replaced the 12-span concrete arch bridge with a 973-foot (297-meter) steel structure. The replacement provides greater load capacity and maintains safe pedestrian, vehicle, and emergency traffic to downtown. The new bridge maintains the site's role as a prominent fixture of the Phoenixville Historic District.

Structures Costing Less Than $10 Million. NYSDOT rehabilitated an architecturally and historically significant bridge over Crum Elbow Creek on State Route 9 in Hyde Park. The Vanderbilt family built the original bridge in 1898, and it is an excellent example of turn-of-the-century stone masonry construction of an arch bridge.

Traveler Services. Mn/DOT rehabilitated the Split Rock Lighthouse Overlook in Beaver Bay Township, MN. The project restored the historic wayside along Minnesota State Trunk Highway 61, Lake Superior's North Shore Scenic Drive All-American Road.

Project Management. Unprecedented rainfall caused Wisconsin's Lake Delton to spill over a low-lying section of the shore and State Trunk Highway A, interrupting service on this critical transportation and utility corridor. The project team redefined "fast-track services"—preparing design and contract documents in 3 months instead of the typical 24 and completing construction support within 11 months of the lake draining—and adopted innovative and cost-effective engineering solutions to meet the constantly changing hydrologic, geologic, regulatory, legal, and funding requirements.

Program and Project Development. The San Diego Association of Governments' (SANDAG) TransNet program, which uses a half-cent-per-dollar sales tax to fund transportation improvements, seeks to expand mobility around San Diego and involves three interstates, two State routes, and light rail. TransNet's sheer magnitude obviated the conventional management approach, and a SANDAG assessment concluded that a single corridor manager would enable the program to achieve its goals.

NYSDOT tapped its own regional maintenance forces to prepare the site and worked with the utility company to move the poles in time.

The detour routes needed to be ready for traffic within 2 weeks of the contract award date. Again, the tight timetable did not allow the normal process of having the general contractor prepare the detours. Instead, NYSDOT used other ongoing contracts and its own resources to prepare the routes. For instance, its Standby Emergency Highway Work Order Contract enabled the addition of shoulders, guide railing, and pavement, as well as fabrication and installation of all detour signs; its Traffic Signal Job Order Contract enabled installation of a permanent traffic signal at an intersection; and its Traffic Signal Unit installed a temporary traffic signal at another intersection.

Because NYSDOT needed to ensure sufficient motivation for the contractor to meet the tight construction schedule, the agency opted for an incentive-disincentive clause. The contractor had 229 calendar days from award to opening of the bridge to two lanes of traffic. The contract included an incentive of $30,000 for each day, up to a maximum of 30 days, that the bridge was open before the deadline. The contractor organized its construction operations to achieve the maximum incentive of $900,000 for early completion.

On October 26, 2009, the grandnephews of James A. Farley, along with a longtime Stony Point resident who witnessed the dedication of the original bridge, drove a vintage fire truck over the new James A. Farley Memorial Bridge to inaugurate it.

Program and Project Development

Agencies across the country strive to deliver transportation projects on time and on budget. State legislatures and the public expect transportation facilities to be delivered at projected costs and in the timeframes promised.

In recent years, Mn/DOT came to recognize that more accurate cost estimates could help build and maintain public trust. To address this issue, the agency created the Cost Estimation Process Improvement and Organizational Integration Project. By October 2008, the project had resulted in a process to create better estimates during all phases of project development up to contract letting, and for better cost management based on the National Cooperative Highway Research Program's *Guidance for Cost Estimation and Management for Highway Projects During Planning, Programming, and Preconstruction* (NCHRP 574 Report).

The agency's new cost estimation and management vision is a department-wide priority for estimating, managing, and controlling costs. The program includes policies and procedures supported by a technical reference manual and training for employees. The department now is beginning to require total project cost estimates (TPCEs) to include costs related to engineering, ROW, construction (typically the contractor bid for construction), and related items (utilities, municipal agreements, environmental mitigation items, and hazardous materials).

Five sets of guidelines support the new paradigm. Under the Project Cost Estimation Policy, estimates are to be in the form of TPCEs and will

require management approval at certain gates during the project development process. Under the Uncertainty, Risk, and Contingency Policy, TPCEs will identify risks for the unknown elements and apply contingency strategies. Throughout the development process, as more is known about the project and risk is retired, the contingency steps also will be modified.

Under the Cost Estimate Communications Policy, all projects will complete a one-page project summary sheet that includes TPCE and schedule, project risks, and contact information. Mn/DOT anticipates using the sheets to manage cost expectations with the State Legislature, key stakeholders, and the public.

Under the Project Cost Management Policy, each project will have a scoping document, approved by management, with a TPCE before entering the State Transportation Improvement Program (STIP). The TPCE at the end of scoping will be called the baseline cost estimate. The agency will manage costs against the baseline, and use of contingency strategies requires approval by the program manager.

Under the Program Management Policy, Mn/DOT will manage projects to their approved scopes. If a cost estimate differs from the baseline, the agency's Transportation Program Investment Committee will have to approve it.

NYSDOT

Workers prepare the piers that will support the new triple-span Farley Bridge in Stony Point, NY.

In addition to the cost-estimating improvements, Mn/DOT revised its project scoping process to be more consistent and focused. Scoping now emphasizes finding opportunities for context sensitive solutions, mitigating impacts on businesses, and establishing earlier collaboration with internal and external stakeholders.

The outcome of the scoping process is a report describing the project and comprehensively documenting decisions on which elements will be included. To demonstrate accountability, the district engineer or a designee must sign the completed scoping report.

In 2008 the State Legislature provided a 10-year, $2.5 billion bonding program primarily to upgrade Minnesota's bridges. To ensure delivery on time and on budget, Mn/DOT is applying the new cost estimation/management vision to the bridge program and to all projects in the 2010–2013 STIP. To date, all the bridge projects and 94 percent of the STIP projects have approved scoping reports, TPCEs, and project summary sheets.

"This entire effort is really about changing a culture within Mn/DOT to be more responsive to stakeholder needs," says Michael Barnes, the agency's division director of engineering services. "There is work that will continue into the future, but Mn/DOT has started a journey that will lead to greater project success and improved public trust and confidence."

Continuing the Legacy

FHWA will present the next Excellence in Highway Design Biennial Awards in 2012. The competition will again be open to U.S. highway projects that were completed since the previous award cycle. Project owners will be able to submit nominations online, and a panel of judges selected from across the transportation community will evaluate the entries. FHWA will provide details as they become available at www.fhwa.dot.gov/eihd/index.cfm.

David Gonzalez, Mn/DOT

Mn/DOT is using its new cost-estimating approach to better organize and speed delivery of its bridge projects, including current reconstruction of the Hastings Bridge, which is slated to open to traffic in May 2013 with the longest freestanding main arch in North America.

Brooke Struve is a program manager for the Office of Program Administration in FHWA's Office of Infrastructure. She promotes best practices in the design discipline across the agency and provides technical support for interstate access, geometric design, and accessible design for disabled pedestrians. She earned a bachelor's degree in civil engineering from Brigham Young University.

Tim Breen is a contributing editor for PUBLIC ROADS.

For more information, visit www.fhwa.dot.gov/eihd/index.cfm or contact Brooke Struve at 202-366-1317 or brooke.struve@dot.gov.

Along the Road

Along the Road is the place to look for information about current and upcoming activities, developments, trends, and items of general interest to the highway community. This information comes from U.S. Department of Transportation (USDOT) sources unless otherwise indicated. Your suggestions and input are welcome. Let's meet along the road.

Policy and Legislation

NHTSA, EPA Propose National Standards for Trucks and Buses

The U.S. Environmental Protection Agency (EPA) and the National Highway Traffic Safety Administration (NHTSA) are proposing the first national standards to improve the fuel efficiency of heavy-duty trucks and buses and reduce their associated greenhouse gas (GHG) emissions. The standards would reduce GHG emissions by nearly 250 million metric tons and save 500 million barrels of oil over the lives of the vehicles produced within the program's first 5 years.

The standards would cover three categories of heavy trucks: combination tractors, heavy-duty pickups and vans, and vocational vehicles (such as delivery trucks and school buses). For combination tractors, the agencies are proposing engine and vehicle standards that begin in the 2014 model year and achieve up to a 20 percent reduction in carbon dioxide (CO_2) emissions and fuel consumption by the 2018 model year. For heavy-duty pickup trucks and vans, the agencies are proposing separate gasoline and diesel truck standards starting in the 2014 model year and achieving up to a 10 percent reduction for gasoline vehicles and 15 percent reduction for diesel vehicles by the 2018 model year. Lastly, for vocational vehicles, the agencies are proposing engine and vehicle standards starting in the 2014 model year that would achieve up to a 10 percent reduction in fuel consumption and CO_2 emissions by the 2018 model year.

Overall, EPA and NHTSA estimate that the program will provide $41 billion in net benefits, including fuel savings and emissions reductions, over the lifetime of model year 2014 to 2018 vehicles. The innovative technologies such as aerodynamic improvements, tire rolling resistance, and engine and transmission upgrades fostered by this program also will yield economic benefits, enhance energy security, and improve air quality.

For more information, visit www.epa.gov/otaq/climate/regulations.htm or www.nhtsa.gov/fuel-economy.

Public Information and Information Exchange

USDOT Launches Distracted Driving Video Series

In November 2010, USDOT launched "Faces of Distracted Driving," an online video series showing the consequences of using cell phones while driving. The series features people from across the country who have been injured or lost loved ones in distracted driving crashes. The videos are part of USDOT efforts to raise public awareness about the dangers of distracted driving and to support victims.

At its launch, the series contained three videos, each featuring a family member of a victim of distracted driving. In one video, a mother talks about how her 13-year-old daughter died when a truck driver talking on his cell phone crashed into the back of the school bus in which she was a passenger. In another video, a woman shares how her 58-year-old mother died when a distracted driver struck her as she walked beside a road. The third video features a father talking about how his 16-year-old daughter died when she lost control of her vehicle, crossed the centerline, and hit a pickup truck because she was texting while driving.

In an introductory video, Secretary of Transportation Ray LaHood says, "Our 'Faces of Distracted Driving' Web series shares the stories of these people, whose lives have been forever changed because of texting or talking behind the wheel." In 2009, nearly 5,500 people died and half a million were injured in crashes involving a distracted driver.

For more information, visit www.distraction.gov/faces.

Montana Encourages Drivers to Use Cell Phone Pull Outs

In an effort to discourage cell phone use while driving, the Montana Department of Transportation (MDT) recently started posting signs on existing highway pull outs—designated areas where drivers can pull off the highway—where cell phone service is available. MDT hopes the signs will encourage drivers to use the pull outs and resist the urge to use their phones while driving.

The signs are installed along the roadside prior to pull outs with verified cell phone service, and simply state, "Cell Phone Pull Out ¼ Mile." Since the first installation in July 2010, MDT has installed 18 signs in western Montana. MDT plans to expand the number of pull outs across the State to increase awareness and help prevent cell phone use while driving.

Posting signs at pull outs is inexpensive and has potential for reducing crashes. Since the pull outs already exist, MDT crews simply verify cell phone coverage and then install the signs, making this a low-cost safety solution.

MDT

Rhode Island Opens Multimodal Hub

In October 2010, Rhode Island opened the T.F. Green Airport InterLink, one of the State's largest transportation projects. Designed to improve convenience for travelers such as airport users and commuters, the facility connects travelers going by plane, train, bus, and car.

The InterLink connects travelers with several options for getting where they need to go, including a consolidated rental car facility serving both the airport and commuter trains traveling between Boston, MA, Providence, RI, and Warwick, RI. The facility also provides for the area's first-ever connection between commuter rail service and the airport, bus service, and rental cars.

The project's 1,200-foot (366-meter)-long Skywalk spans the airport's upper level, connects to the airport terminal at the third floor, and joins to the rental car and commuter parking garage. The Skywalk uses

Rhode Island Airport Corporation

The Skywalk, shown here, is part of the new InterLink facility at T.F. Green Airport.

high-efficiency glass, heating and ventilation, and light fixtures to help keep energy costs low. The six-level garage has 2,600 parking spaces and a three-level platform for fueling, washing, and vacuuming rental cars. Precasting its nearly 3,500 concrete pieces in Connecticut and assembling them onsite reduced construction time and improved the garage's overall quality.

For more information on the project, see "Small State, Big Vision" in the March/April 2010 issue of PUBLIC ROADS.

Complete Streets Partners with CDC

The National Complete Streets Coalition is serving as a technical assistance provider for the Centers for Disease Control and Prevention's (CDC) Communities Putting Prevention to Work program. The program fights tobacco use and obesity using a three-step approach that includes policy, systems, and environmental change.

The project, started in late 2010, reaches 52 communities across the country. In communities interested in pursuing Complete Streets policies, the coalition will work to help them draft policies and then guide them through policy adoption. After adoption, the coalition will educate the communities about changing their systems and procedures to take into account the needs of people walking, bicycling, and taking public transportation for all future transportation projects. Finally, when the policies and systems are in place, they are expected to lead to systemwide environmental changes such as routinely incorporating sidewalks, bike lanes, safer crossings, and other features that make nonmotorized travel safer and more convenient.

The program's ultimate goal is to reduce chronic diseases related to obesity and tobacco use by making changes to policies and the built environment to encourage healthier choices such as walking and bicycling.

National Complete Streets Coalition

Internet Watch

by Alicia Sindlinger

Improving Roads at the Local Level

For nearly three decades, the Federal Highway Administration's (FHWA) Local Technical Assistance Program (LTAP) has been helping local agencies build, maintain, and operate their roads and bridges. The LTAP and Tribal Technical Assistance Program (TTAP) network assists more than 38,000 cities and towns, rural and urban counties, and tribal governments by delivering targeted road-related materials, training, and technical assistance. But like many government programs today, LTAP and TTAP are striving to provide more services with limited financial resources.

To help stretch every dollar, LTAP and TTAP are focusing on sharing information through more economical, online technologies and strategies such as their shared Web site, podcasts, electronic newsletters, and social media. The central hub of these efforts is a recently updated Web site, accessible at www.ltap.org. The updated site launched in August 2010 with a new design, navigation, and features such as a photo gallery, discussion forums, podcasts, and an improved "secure" area accessible only to LTAP/TTAP center staff.

"Pushing higher quality information to the Web site was an obvious choice for making knowledge-sharing simpler and easier for LTAP/TTAP centers," says Cameron Ishaq, a strategy and management consultant for FHWA's Office of Technical Services. "Centers and their local agency customers can visit the site to find information, share materials and resources, or simply ask questions of their peers. It's a critical part of our overall strategy to find new ways to accelerate information exchange and stay ahead of the need factor."

Decentralizing Information

In addition to stretching dollars, the new Web site furthers another priority: decentralizing information. Fifty-eight LTAP/TTAP centers—one in each State and Puerto Rico, and seven regional centers that serve tribal governments—support the needs of local communities across the Nation. In the past, most resources and information were housed at a centralized location and distributed to centers only upon request. Through the Web site and other online outlets, the network now can distribute information easily on a continuous basis to the centers and transportation agencies across the country.

"Decentralizing information is key to providing centers, and ultimately transportation agencies, with the knowledge they need be successful given our limited resources," says Ishaq. "With the resources at their fingertips, centers don't have to redo or recreate from scratch something someone else has already done. This saves time, energy, and money that then can be put toward new efforts and capabilities."

An important component of decentralizing information is the new "Centers Only Area" of the Web site. Center staff can log onto a secure section of the site to access mandatory assessment reports, track and archive

reports, upload materials and resources to share, and find best practices and ideas from other centers.

Navigating the New Site

At first glance, site users will notice the new graphics and navigation. Front and center on the home page is a feature rotator that displays links to news, events, and materials. Users also can navigate easily to other pages on the site from navigation bars across the top and right-hand side of the home page. The page also includes four smaller feature boxes for one-click access to a resource database, photo gallery, discussion forum, and "LTAP/TTAP Interchange," which is an audio newsletter.

One of the most frequently accessed new features is the resource database that contains more than 2,600 resources from across the local roads community, including training materials and videos, tips from the field, and presentations. Site users can search the database by keyword, resource type, technical category, or contributing organization. From the secure area of the site, LTAP/TTAP centers can share their own materials by uploading to the database.

Also new is the discussion forum, where site administrators and users can collaborate, ask questions, and exchange ideas. Some discussion threads are open to all site users, while others are for specific groups, such as center staff or directors. The discussion forum replaced a limited-function listserv and allows for easier management of discussion threads.

"When planning for the new site, we tried to anticipate future needs and build capabilities [into the site] that not only can accommodate the present state of LTAP/TTAP but also grow with the program," says Ishaq.

For more information on the Web site, contact Lisa McCluskey at 202-289-4434 or lmccluskey@artba.org. For more information on the LTAP/TTAP programs, contact Jeff Zaharewicz, LTAP/TTAP program manager with FHWA, at jeffrey.zaharewicz@dot.gov.

Alicia Sindlinger is a contributing editor for PUBLIC ROADS.

by Lilly Pinto

Enforcing Freight Regulations

The freight industry is responsible for moving the items the Nation depends on every day—food, clothing, household wares—in a quick, reliable, and economical manner. In 2008, the U.S. transportation industry moved an average of 58.9 million tons (53.4 million metric tons) per day. The highway infrastructure on which the majority of these goods are moved represents a sizeable investment of Federal, State, and local funds. Federal commercial motor vehicle size and weight requirements help to manage highway assets by requiring that commercial vehicles operate at sizes and weights highways can support.

The National Highway Institute's (NHI) Principles of Effective Commercial Motor Vehicle (CMV) Size and Weight Enforcement (FHWA-NHI-139004) is designed to help transportation professionals who are responsible for enforcing size and weight regulations obtain necessary training. This course provides "continuity and uniformity of the enforcement of size and weight regulations by law enforcement, which can help shape industry expectations of goods movement," says Tony Furst, director of the Federal Highway Administration's (FHWA) Office of Freight Management and Operations. "No one likes surprises that can cause loss of time and money."

Effective Enforcement Course

Federal commercial motor vehicle size and weight (VSW) regulations describe the length, width, and weight limitations of commercial vehicles operating on the Nation's interstates and highways. The Principles of Effective CMV Size and Weight Enforcement course is a 2-day training designed to provide an advanced, indepth understanding of Federal commercial motor VSW regulations and how States oversee the regulations through enforcement programs.

www.Shutterstock.com, Adam Bies

Enforcing vehicle size and weight helps to protect the Nation's roads and bridges. Shown here, a commercial truck carries freight across the New River Gorge Bridge in Fayetteville, WV.

During the training, participants complete various exercises that help to demonstrate what should be included in a State commercial motor VSW enforcement plan and how to evaluate the plan. The exercises also address the critical relationship between size and weight enforcement and the condition of pavements and bridges.

The training is geared toward transportation professionals responsible for overseeing the asset management of highway infrastructure, the development and review of annual planning for VSW enforcement and Federal certification, and commercial motor VSW enforcement. Those who would benefit the most from the training include FHWA division office staff, employees from State and local transportation agencies with responsibility for overseeing commercial vehicle operations, personnel from State and local law enforcement agencies, Federal Motor Carrier Safety Administration field office personnel, trucking company managers, trucking association officials, law enforcement associations, and training staff from State transportation agencies.

According to Furst, "The training reinforces the idea that when Federal and State departments of transportation and enforcement agencies understand their roles and responsibilities, the agencies can work together with better efficiency to help preserve State assets."

Additional Freight Course Scheduled in 2011

In addition to preserving infrastructure, transportation professionals are concerned about the environmental impact of freight transportation. To this end, NHI designed its Linking Freight to Planning and the Environment (FHWA-NHI-139005) course to inform participants of the impacts of freight transportation on the environment. In this 2-day course, transportation, environmental, and freight planners and engineers can learn to integrate environmental considerations more effectively into public sector freight planning and project development.

Course participants receive an overview of the transportation planning and programming process as it relates to freight's impact on the environment, and then identify the transportation needs and deficiencies in their State or region. Participants then develop an improvement plan and project implementation process to address the needs.

Upon course completion, participants should be able to identify strategies that balance statewide, regional, and metropolitan freight mobility needs with community and environmental goals. NHI is holding sessions of the Linking Freight to Planning and the Environment course between April and June 2011 at its headquarters in Arlington, VA.

For more information on these and other courses related to freight management, please visit the NHI Web site at www.nhi.fhwa.dot.gov.

Lilly Pinto is a contractor for NHI.

Communication Product Updates

Compiled by Zachary Ellis of FHWA's Office of Corporate Research, Technology, and Innovation Management

Below are brief descriptions of communications products recently developed by the Federal Highway Administration's (FHWA) Office of Research, Development, and Technology. All of the reports are or will soon be available from the National Technical Information Service (NTIS). In some cases, limited copies of the communications products are available from FHWA's Research and Technology (R&T) Product Distribution Center (PDC).

When ordering from NTIS, include the NTIS publication number (PB number) and the publication title. You also may visit the NTIS Web site at www.ntis.gov to order publications online. Call NTIS for current prices. For customers outside the United States, Canada, and Mexico, the cost is usually double the listed price. Address requests to:

National Technical Information Service
5285 Port Royal Road
Springfield, VA 22161
Telephone: 703–605–6000
Toll-free number: 800–553–NTIS (6847)
Web site: www.ntis.gov

Requests for items available from the R&T Product Distribution Center should be addressed to:

R&T Product Distribution Center
Szanca Solutions/FHWA PDC
13710 Dunnings Highway
Claysburg, PA 16625
Telephone: 814–239–1160
Fax: 814–239–2156
Email: report.center@dot.gov

For more information on R&T communications products available from FHWA, visit FHWA's Web site at www.fhwa.dot.gov, the National Transportation Library's Web site at http://ntl.bts.gov, or the OneDOT information network at http://dotlibrary.dot.gov.

Factors Contributing to Pedestrian and Bicycle Crashes on Rural Highways (Summary Report) Publication No. FHWA-HRT-10-052

Approximately 25 percent of fatal and injury crashes nationwide involving pedestrians and bicyclists occur on rural highways. The goals of this study, *Factors Contributing to Pedestrian and Bicycle Crashes on Rural Highways*, were to examine the differences between pedestrian and bicyclist crashes in urban and rural settings in North Carolina and identify problem areas (specific crash types and locations) on rural highways that are of high priority for safety treatments. This summary report discusses prior research, compares rural and urban crashes, explores factors in rural crashes, and offers conclusions.

Researchers found that rural crashes in North Carolina were typified by higher fatality rates, higher vehicle speeds, less roadway lighting, unpaved shoulders, and more nonintersection locations than urban crashes in the State. An examination of crashes by road class showed that rural, two-lane roads had the greatest need for safety improvements because of their high crash frequencies and crash rates per vehicle mile traveled.

For rural two-lane roads, the study identified 11 problem areas involving pedestrians, such as walking along roadways, and 5 bicyclist problem areas, such as turning or merging into the path of drivers midblock. Potential countermeasures to reduce pedestrian crashes in rural areas include improving roadway lighting, educating pedestrians and drivers, and adding sidewalks and paved shoulders. Potential countermeasures to reduce bicyclist crashes in rural areas include providing marked pavement space for bicyclists, adding paved shoulders, and improving roadway lighting.

The document is available at www.fhwa.dot.gov/publications/research/safety/10052/index.cfm. Printed copies are available from the PDC.

Investigating Congestion and Solutions: Experiments on Congestion Conditions And Pricing Initiatives (Fact Sheet) Publication No. FHWA-HRT-10-061

When and why drivers choose a priced or tolled facility over an untolled but congested parallel route is the subject of a 3-year project under FHWA's Exploratory Advanced Research (EAR) Program. Experiments on Driving under Uncertain Congestion Conditions and the Effects on Traffic Networks from Congestion Pricing Initiatives examined how drivers' risk preferences influence their choices of route and travel departure times. This fact sheet discusses evaluation of driver behavior, field and simulation experiments, and expectations from the remainder of the project.

Because congestion conditions are uncertain and differ across routes and departure times, researchers are using estimated decision models—defined using criteria such as travel time, purpose, and the personal value of the trip—as well as various costs and benefits related to arrival times. The researchers are testing several congestion pricing schemes and collecting data on driver decisions through field tests and simulated conditions.

The research team already has completed the design of the field and simulation experiments, which will be coordinated with agencies in the three metropolitan areas where data collection will occur—Atlanta, GA, Miami, FL, and Orlando, FL. Preliminary tests of the procedures are underway, and full-scale pilot experiments are scheduled to be completed in 2012. The

outcomes of the study will be a set of prediction models for traffic planners and a manual for conducting similar congestion pricing experiments.

The document is available at www.fhwa.dot.gov/advancedresearch/pubs/10061/index.cfm. Printed copies are available from the PDC.

Driving Simulation Forward: Making Driving Simulators More Useful For Behavioral Research (Fact Sheet) Publication No. FHWA-HRT-10-060

Highway and traffic engineers often have difficulty considering how complex driver behavior will influence their designs. However, failing to calculate the impacts can cost lives and, if roadways must be rebuilt, millions of dollars. The aim of Making Driving Simulators More Useful for Behavioral Research, an EAR project, is to make driving simulators more reliable tools for highway engineers. This fact sheet discusses the state of simulation, the technical approach of driving simulators, simulation challenges, and future efforts.

The project team asserts that although existing simulators are valuable tools for research and highway design, they are underutilized because of concerns about the sometimes weak relationship between simulator data and onroad data. Researchers also cite concerns about the reliability of simulator data, given that different simulators often produce differing results for similar scenarios and design situations.

This 32-month project, launched in 2009, aims to provide a systematic, design-centered approach to matching simulator data to onroad data and correlating data between simulators. The team's goal is to make simulators more practical and useful by creating a system to help researchers select simulator features (such as a motion base and wide visual field) that will best predict onroad performance for their particular research questions.

The document is available at www.fhwa.dot.gov/advancedresearch/pubs/10060/index.cfm. Printed copies are available at the PDC.

Beyond Traffic Signals: A Paradigm Shift, Intersection Control for Autonomous Vehicles (Fact Sheet) Publication No. FHWA-HRT-10-023

Traffic congestion costs the Nation billions of dollars each year in wasted fuel and lost productivity. Traditional traffic control systems cannot keep pace with this growing problem, but systems that work with self-driving vehicles may afford a more radical approach. FHWA's Intersection Control for Autonomous Vehicles, an EAR project, is pursuing a new way to keep traffic moving. This fact sheet discusses the promise of autonomous vehicles, the concept of "reserving" space and time to pass through an intersection, and future efforts.

The intersection control system proposed in this EAR study promises to process traffic more efficiently than is possible with traffic lights and stop signs and without compromising safety. The system's development is guided by a set of criteria that includes the use of current or near-term sensor technologies, the adoption of a standardized communication protocol, and the ability to deploy the new technology incrementally. These criteria allow expansion to other intersections and adaptation to increasing numbers of autonomous vehicles. Absolute collision prevention, even under conditions of communications failures, and high levels of efficiency are primary goals for the system.

The project proposes innovations in five areas: traffic signal timing, intersection collision avoidance, autonomous traffic infrastructure, autonomous driving, and multiagent systems. The project's major tasks are developing a detailed vehicle-infrastructure communication protocol and developing and testing prototype agent-control algorithms.

The document is available at www.fhwa.dot.gov/advancedresearch/pubs/10023/index.cfm. Printed copies are available from the PDC.

Modeling Driver Characteristics: Driver Behavior in Traffic (Fact Sheet) Publication No. FHWA-HRT-10-070

Existing traffic analysis and simulation tools cannot effectively model drivers' ability to recognize and respond to situational and environmental factors. FHWA's Driver Behavior in Traffic, an EAR project, is attempting to characterize driver behavior using naturalistic driving data and agent-based modeling techniques. This fact sheet includes background on driver behavior, how to capture driver behavior, the research's learning approach, and future work.

Current literature detailing the characterization of driver behavior is limited. The majority of traffic modeling and parameter calibration (adjusting a factor such as average vehicle speed to reflect real-world data) research assumes similar driving conditions and behavioral sets for all drivers. Typically, differences in drivers' actions are represented merely by drawing samples from statistical distributions assigned to each driver type (such as sex and age). This approach does not capture or predict individual driver reactions to various situational and environmental factors.

At the conclusion of this project, FHWA will develop agents (models programmed into traffic simulators) to mimic realistic driver behavior in various driving scenarios. After the research team verifies and validates the agents, an abstraction of learned "driving rules" will be embedded in a microscopic traffic simulation tool. This study also could lead to future research to develop new generations of traffic simulation tools that can capture driver behavior in complex traffic situations accurately.

Printed copies of the fact sheet are available from the PDC.

Conferences/Special Events Calendar

Date	Conference	Sponsors	Location	Contact
May 8–12, 2011	13th National Transportation Planning Applications Conference	Transportation Research Board (TRB)	Reno, NV	Robert Schiffer 850-219-6388 rschiffer@camsys.com www.trb-appcon.org
May 14–19, 2011	13th National Scenic and Historic Trails Conference	Partnership for the National Trails System	Abingdon, VA	Julia Glad 414-617-2525 PNTSCommunications@gmail.com www.pnts.org
May 18–20, 2011	Building Bridges 2011 International Annual Conference	Women's Transportation Seminar (WTS)	San Francisco, CA	Jane Bierstedt 925-930-7100 j.bierstedt@fehrandpeers.com www.wtsinternational.org
May 18–20, 2011	4th International Transportation Systems Performance Measurement Conference	TRB	Irvine, CA	Martine Micozzi 202-334-3177 mmicozzi@nas.edu www.cvent.com/EVENTS/Info/Summary.aspx?e=13eb81c7-0a18-41e2-94cf-cdef79d4b888
June 5–7, 2011	TMCA Annual Conference & Exposition	Transportation Marketing & Communications Association (TMCA)	San Diego, CA	Colleen Reasoner 609-799-4900 info@TMCAtoday.org www.tmcatoday.org/Events/Events.asp
June 5–8, 2011	International Bridge Conference®	Engineers' Society of Western Pennsylvania	Pittsburgh, PA	Conor McGarvey 412-261-0710, ext. 11 c.mcgarvey@eswp.com www.eswp.com/bridge
June 6–8, 2011	17th International Conference on Urban Transport and the Environment	Wessex Institute of Technology Transactions on the Built Environment	Pisa, Italy	Claire Shiell +44 (0) 238 0293223 cshiell@wessex.ac.uk www.wessex.ac.uk/11-conferences/urbantransport-2011.html
June 12–15, 2011	SLA 2011 Annual Conference & INFO-EXPO	Special Libraries Association (SLA)	Philadelphia, PA	SLA Events 703-647-4949 www.sla.org/philly2011
June 14–17, 2011	1st International Conference on Access Management	Hellenic Association of Rural and Surveying Engineers, TRB, Technical Chamber of Greece, Greek Ministry of Infrastructure, Transport and Networks	Athens, Greece	Maria Arvaniti (+30) 210 7414728 maria.arvaniti@erasmus.gr www.accessmanagement2011.gr
July 18–20, 2011	19th International Symposium on Transportation and Traffic Theory (ISTTT19)	University of California, Berkeley Institute of Transportation Studies	Berkeley, CA	ISTTT19 Secretary secretary@isttt19.org www.isttt19.org

Don Jones for FHWA

Putting Safety First

2011 National Roadway Safety Awards

The biennial awards recognize agencies and organizations that have made significant and verifiable improvements to safety on U.S. highways in three key areas:

- Infrastructure
- Operations
- Program Planning, Development, and Evaluation

Highway safety projects are judged on effectiveness, innovation, and efficient use of resources.

For 2011 application forms, instructions, and a list of previous winners, visit **www.roadwaysafety.org** or **http://safety.fhwa.dot.gov.** The deadline to submit applications is May 1, 2011.

Submit your nomination today!

Roadway Safety FOUNDATION

U.S.Department of Transportation
Federal Highway Administration

U.S. Department
of Transportation
Federal Highway Administration
Attn: HRTM
1200 New Jersey Avenue, SE
Washington, DC 20590

Official Business
Penalty for Private Use $300

PERIODICALS
POSTAGE & FEES PAID
FEDERAL HIGHWAY ADMINISTRATION
ISSN NO. 033-3735
USPS NO. 516-690

FHWA-HRT-11-003
HRTM-20/3-11(5M200)E