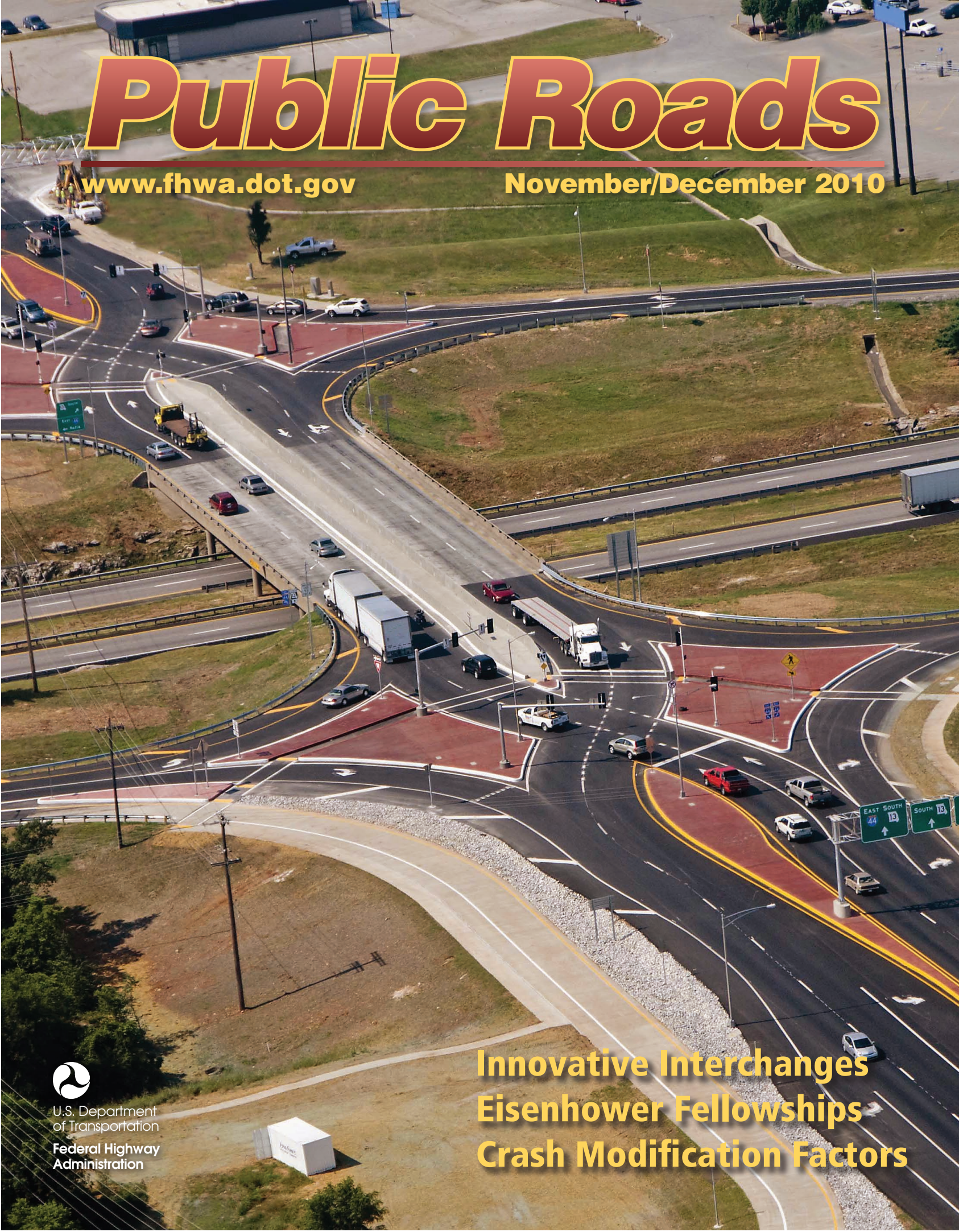
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U.S. Department of Transportation
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Public Roads

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

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Front cover—Shot on July 8, 2009, from a helicopter, this aerial photograph shows the first-ever double crossover diamond (DCD) interchange constructed in the United States, located at I–44 and MO–13 in Springfield, MO. DCDs, used for decades in France, are among a variety of innovative interchange designs the Federal Highway Administration is exploring for use in the United States. For more information, see "The Double Crossover Diamond" on page 2 in this issue of PUBLIC ROADS. *Photo: Cathy Morrison, MoDOT.*

Back cover—As metropolitan areas surrounding Atlanta (shown here) and other cities continue to expand, the United States is witnessing significant growth in interstates and superhighways. Over the past 30 years, recipients of the Dwight David Eisenhower Transportation Fellowship have been at the forefront of advancing research on transportation planning, pavements and infrastructure, congestion mitigation, and highway safety. For more information, see "Workforce Development in Action" on page 12 in this issue of PUBLIC ROADS. *Photo: Shutterstock.com, Jackweichen.*

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Guest Editorial

Improving Transportation Safety Is Priority No. 1

Safety is the top priority of the U.S. Department of Transportation and the Federal Highway Administration (FHWA), which remain deeply committed to reducing fatalities and serious injuries on the Nation's roadways. For about a decade, the annual number of highway fatalities in the United States hovered around 42,000. Then, starting in 2006, the number of fatalities began to drop steadily to its current level of approximately 34,000. Although this downward trend indicates progress, much work remains to be done.

A whole host of strategies will be required for systematic and continuous improvement of highway safety, ranging from targeted funding for safety improvements to consistent advancements in the four Es—engineering, education, enforcement, and emergency response. The FHWA Office of Safety Research & Development (R&D) contributes to these strategies by partnering with the agency's Office of Safety and Resource Center (along with other Federal and State agencies) to identify R&D and technology transfer activities that address high-priority safety concerns. The office is focused on developing products and tools; providing services such as technical guidance, training, and laboratory testing; and identifying new designs and technologies to assist the FHWA division offices and State and local decisionmakers and practitioners.

Researchers in the Office of Safety R&D use data-driven decisionmaking to identify the worst safety problems that could be improved by infrastructure-based interventions, such as the large number of fatalities due to roadway departures. Using research roadmaps, R&D staffers also identify and codify gaps in the knowledge and technology base that need to be filled in order to produce practical solutions. Roadmaps currently exist for nine program areas: human factors, intersections, motorcycles, pedestrians and bicycles, roadway departures, rural and local roads, speed management, visibility, and comprehensive approaches to safety (that is, data tools). The Office of Safety R&D also provides research and support services in the areas of geometric design and visibility. In addition, R&D teams explore a variety of advanced research topics that have the potential to result in transformative changes to the Nation's surface transportation system.

The Office of Safety R&D plays a key role in other major safety R&D programs such as development of the Strategic Highway Research Program 2 (SHRP 2) safety plan. SHRP 2 is addressing the role of driver performance and behavior in traffic safety. The office also oversees the IntelliDrive℠ program that is developing vehicle-to-infrastructure technology and encouraging its deployment.

It's an exciting time to be involved in transportation safety. Clearly, current efforts are resulting in positive change. Continued improvements are likely to rely on a collaborative, multimodal, multidisciplinary, and systemic approach supported by strategic investments of time and money. In the pursuit of priority number one, FHWA and its partners will continue to refine and reinforce the framework to facilitate additional safety gains. One day, zero fatalities will be the norm and not a lofty goal.

Monique R. Evans
Director, Office of Safety Research & Development
Federal Highway Administration

by Joe Bared and Don Saiko

Introducing an innovative interchange for grade-separated crossroads that promises to speed construction, save money, and increase safety.

The Double Crossover Diamond

Here's a riddle. What comes from France and can lead the motorist safely through multiple conflict points? The correct answer is the double crossover diamond (DCD) interchange, also called the diverging diamond.

Many interchanges in mostly urban areas are congested and experiencing high crash frequencies. The conventional diamond interchange constitutes 62 percent of interchange types in the United States.

(Above) This aerial photograph shows the Nation's first DCD interchange, located in Springfield, MO. (Inset) An aerial of the conventional interchange in Springfield prior to construction of the DCD interchange. *Photos: MoDOT.*

Diamond interchanges are grade-separated and require bridge structures that are costly to widen by adding new lanes, if increased traffic capacity is needed. The DCD design is a variation of the diamond interchange that can alleviate all three of these problems (congestion, high crash frequencies, and cost to add traffic capacity).

The DCD design has existed in France for 30 years, according to Michel Labrousse, director, Centre d'Etudes Techniques de l'Equipement Normandie-Centre, who provided records, signal layouts, traffic flow, and crash data from the groundbreaking interchange in Versailles, France. Installations exist also at Seclin and Perreux-sur-Marne. The DCD interchange in Versailles improved the traffic capacity over the previous design, and it has a low crash rate.

Until recently, few U.S. engineers were aware of the DCD and had rejected its unconventional design. This story is reminiscent of U.S. experience with roundabouts, which took about three decades to adopt from Europe and Australia.

Recently, researchers from the Federal Highway Administration's (FHWA) Turner-Fairbank Highway Research Center (TFHRC) have begun to promote the DCD in the United States. Inspired by the findings reported in a paper by Gilbert Chlewicki, "New Interchange and Intersection Designs: The Synchronized Split-Phasing Intersection and the Diverging Diamond Interchange," included in the 2003 *Proceedings of the 2nd Urban Street Symposium*, FHWA researchers began modeling and developing simulations to study how the DCD design might work in the United States. This research culminated in the Missouri Department of Transportation (MoDOT) becoming the first State agency to embrace the new design by opening the first

Performance of DCD Versus Conventional Diamond Interchange

Traffic Scenario	Input Flow (veh/h)	Model Throughput (veh/h)		Delay Time (sec/veh)		Stop Time (sec/veh)		Number of Stops		Max Queue (ft)	
		DCD	Diamond	DCD	Diamond	DCD	Diamond	DCD	Diamond	DCD	Diamond
High 3	6,100	5,800	5,228	62	105	32	55	1.4	2.4	1,191	1,665
High 2	5,600	5,380	5,187	40	91	24	46	0.9	2.3	1,000	1,170
High 1	5,100	4,912	4,869	32	66	20	35	0.8	1.8	482	1,108
Medium	3,200	3,074	3,104	20	26	12	13	0.7	0.9	239	262
Low	1,700	1,631	1,631	17	20	11	11	0.6	0.8	123	120

Source: FHWA.

DCD in the United States on June 21, 2009.

How does the DCD work? The geometric design channelizes vehicular traffic on a grade-separated crossroad from the right side of the road to the left side and then back again at the ramp terminals.

Traffic Flow on the Double Crossover Diamond

What distinguishes the DCD from the conventional diamond interchange is that it combines left-turning traffic with through traffic. This is accomplished by having both left-turn and through vehicles cross over to the opposite sides of the roadway at the ramp terminals. The result is that northbound traffic traveling over the bridge travels on the roadway on the left (between the two ramp terminals), and the southbound traffic also travels on the roadway to the left.

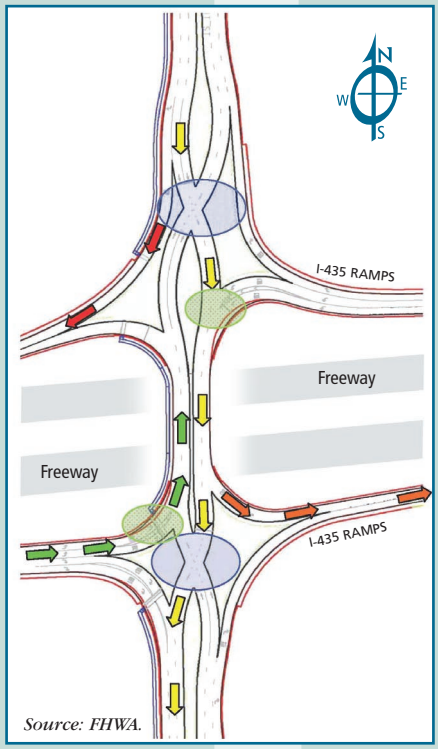
Only two signal phases are needed instead of three or four. In the DCD, the crossover junctions are signalized. However, after the crossed-over vehicles have passed the first ramp terminal, left-turn and through movements proceed without having to stop. With the DCD configuration, traffic engineers set the signal control phasing so that vehicles are required to stop at only one of the signals along the arterial road. This design eliminates the left-turn signal phase from the arterial road and also the need for a ramp to store vehicles waiting to go left.

While one direction of the arterial through traffic is proceeding, one side of the off-ramp traffic turning left from the freeway proceeds on green to queue up between the two ramp terminals. For example, while northbound arterial traffic is proceeding, westbound off-ramp traffic from the freeway turning left (south) is also free to enter and wait between the ramp terminals. The same is true for the eastbound off-ramp traffic. When the off-ramp left turns are signalized, off-ramp traffic is likely to stop twice, once at the ramp signal and another time at the crossover intersection.

Benefits of the DCD Design

The DCD design offers advantages in operational capacity, safety, environment, and cost compared with the conventional diamond interchange.

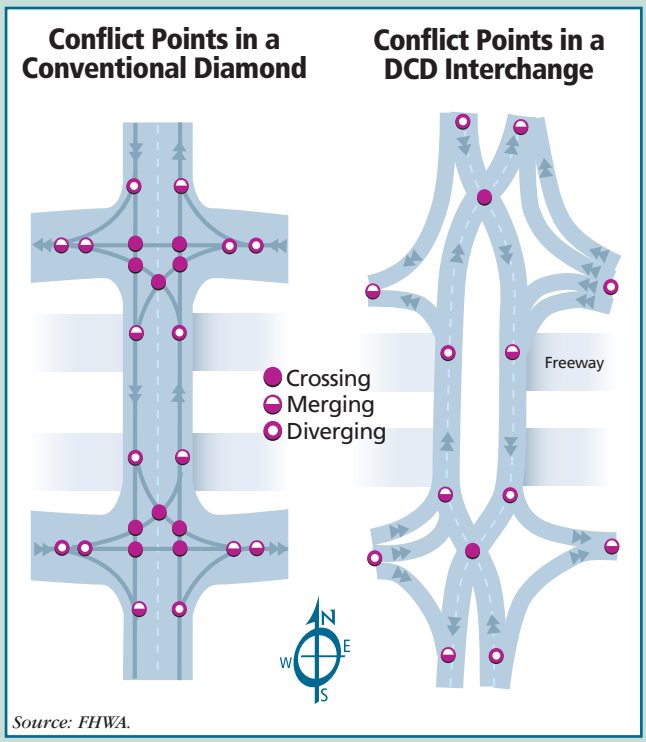
Operational benefits derive from the DCD's ability to combine left-turning traffic with through traffic, thereby eliminating the left-turn-only signal phase of a conventional interchange. The left-turn-only phase is no longer required because both left-turn and through traffic cross over to the left side and at most are required to wait just once at a two-phase signal. This design results in a doubling of throughput of the left-turning arterial traffic and a reduction of total delay when compared with a conventional diamond interchange in high-volume scenarios. At high traffic volumes, the DCD shows about 50 percent less delay in seconds per vehicle than a conventional diamond. Capacity benefits are best when directional traffic is unbalanced because the crossover allows only one movement at a time in comparison to conventional intersections. That means it will be advantageous when the volume of one opposing through movement is greater than the other.



This illustration shows the traffic flows through a DCD interchange. Signal locations are designated by blue and green ellipses. Green arrows show off-ramp traffic turning left from the freeway, stored between the two ramp terminals. Yellow arrows show southbound traffic.

Safety benefits derive from three aspects of the design. First, the DCD has just 14 crossing-path conflicts compared with 26 crossing conflicts in the typical diamond interchange. Safety of the DCD also is enhanced by the reverse curvature preceding the crossover intersections. These curves lead to reduced speeds at the location of the crossing-path conflict points and are expected to lead to fewer crashes.

Another safety benefit is that the DCD increases safety and mobility for pedestrians and bicyclists. Unlike the traditional diamond intersection, through traffic in the DCD often must stop at least once as it traverses the intersection. (The benefit of this design is derived primarily from conditions of unbalanced directional flows. If the traffic is balanced fifty/fifty, the DCD design will not be favorable.) Currently, MoDOT and FHWA are evaluating the safety benefits in terms of crash frequency and conflicts, and data should be available within 2 years. Data on crash reductions are available from the Versailles site, which experienced 11 minor injury crashes in 5 years compared to 23 fatal and injury crashes at a typical U.S. diamond interchange in a similar time period. A typical diamond interchange is a design without frontage roads or



Source: FHWA.

without other intersections in close proximity to the ramp terminals.

Environmental benefits. Environmental benefits can only be roughly estimated as the data have not yet been quantified. Initial benefits are realized at the construction stage. These benefits are derived from the compactness of the design that allows for a smaller footprint and therefore more green space, and lower right-of-way costs. In the case of a retrofit, these gains are even greater because excavation and modification of the existing overpass is avoided since space for the additional lanes required by a conventional design is not needed.

Other environmental benefits of DCDs derive from the operational benefits of reduced vehicle idling and fewer incidents.

Cost benefits. In the case of a retrofit, a recent project to convert an existing interchange into a DCD in Springfield, MO, saved $6.8 million compared to a single point urban interchange or widening of a conventional diamond design. The traditional design would have required the existing bridge to be torn down and a new, wider bridge to be built.

Making It Work In the USA

With so many advantages, it would seem that implementing the DCD in the United States would be straightforward. Certainly, U.S. engineers recognize the design's potential, but questions remain. Would U.S. motorists be comfortable with opposing traffic passing them on the right instead of the left? Might some drivers, particularly less experienced or older drivers, have difficulty navigating such an interchange? And would local leaders be comfortable introducing a new and unfamiliar design that had only limited testing in the United States?

Engineers at TFHRC recognize that answers to such questions are needed before more informed recommendations for implementation in the United States can be made. As a first step, FHWA engineers in 2004 began to explore the geometric and operational aspects of the DCD design. To accomplish this, they developed two types of simulations: microsimulations to facilitate modeling of design and operational characteristics, and a full-scale drivable model to allow direct observation of driver performance.

DCD Traffic Simulation—Micro Models

To start with, FHWA researchers acquired comprehensive data on various operational aspects of the DCD design. Engineers at TFHRC constructed numerous simulations of DCDs and then examined their performance under various operating conditions.

One microsimulation used was VISSIM, a tool for transportation professionals who want to simulate different traffic scenarios (at individual vehicle microscopic levels) before starting implementation. Compared to a conventional interchange, the DCD design showed increases in capacity up to about 30 percent. The greatest advantage was derived when opposing traffic volumes were more unbalanced and left-turning volumes from the arterial and off-ramps were high.

DCD Laboratory Simulation—Driving Model

Once the TFHRC engineers were satisfied with the model predictions of operational characteristics, the next step was to determine a suitable location for a driving simulation and work with local officials to build it. To this end, FHWA held discussions with MoDOT about a Kansas City site that State transportation engineers were designing as a DCD. The MoDOT engineers visited TFHRC to virtually drive through their proposed design in FHWA's highway driving simulator. As a result, they gained confidence in the design's feasibility and also assurance that drivers would indeed be able to navigate safely through this novel intersection design. The driving model also enabled the engineers to make design modifications to the geometry, signals, and signs.

In addition to the Kansas City design, TFHRC modeled a comparable conventional diamond interchange. The main findings from 70 volunteer drivers who participated in the experiment showed that they navigated through the DCD correctly, as they did in a comparable diamond interchange. Mean speeds through the DCD were about 24 miles per hour, mi/h

Service Volumes of Conventional and DCD Interchange Designs

Service Volumes	Northbound Off-Ramp (veh/h/ln)	Southbound Off-Ramp (veh/h/ln)	Eastbound (veh/h/ln)		Westbound (veh/h/ln)	
	L	L	L	T	L	T
Conventional Diamond	390	390	330	600	330	600
Double Crossover (four lanes)	600	600	600(L/T)*	600	600(L/T)*	600
Double Crossover (six lanes)	700	700	600(L/T)*	600	600(L/T)*	600

* (L/T) means that the left-turning traffic, as well as through traffic, uses the lane.
Source: Transportation Research Board.

(39 kilometers per hour, km/h), compared to 34 mi/h (55 km/h) at the conventional diamond. The reduced speed does not reduce capacity.

Missouri Experience

Although MoDOT planned and designed the Kansas City DCD interchange first, the State actually opened the Nation's first DCD at a site in Springfield, MO, in June 2009. The Springfield DCD interchange opened before the Kansas City one because of budgetary situations. MoDOT constructed the Springfield project to alleviate congestion on the heavily traveled Kansas Expressway (Missouri Route 13) at I–44, while providing a pedestrian and bicyclist crossing down the center of the bridge.

MoDOT selected this innovative design because it would be faster to build, cheaper to construct, and safer for motorists and pedestrians. These goals became MoDOT's motto for the project: quicker, cheaper, safer.

Quicker. MoDOT built the project in 6 months instead of 12 to 18 months, mainly because the existing Kansas Expressway bridge over I–44 was rehabilitated and kept in place. A new, much larger bridge would have been needed if a single-point urban interchange had been built instead.

Cheaper. The project cost came in at $3.2 million because the existing bridge was used in place. Reconstructing this interchange as a single-point urban interchange would have raised the cost to about $10 million. MoDOT put the money saved toward other projects.

Safer. During the first 6 months of operation, the DCD reduced crashes by 50 percent between the ramp terminals and by 25 percent between the first intersections north and south of the interchange, compared to the same period in 2008, based on crash data obtained by MoDOT from the city. Most were rear-end crashes, and none were head-on from driving the wrong way. MoDOT accomplished this reduction by eliminating left-turn conflicts and reducing bumper-to-bumper congestion. MoDOT attributes none of the remaining crashes to the DCD design.

The DCD also made this interchange safer by including a 9.5-foot (2.9-meter) walkway down the center of the bridge for pedestrians and bicyclists visiting retail and residential areas to the south and recreational centers (fairgrounds and zoo) to the north. A concrete barrier wall on each side of the walkway separates pedestrians and bicyclists from vehicles. Crosswalks at the signals on each end of the walkway provide a safe way to cross traffic.

Shortly after the interchange opened, MoDOT contracted with a research company to conduct a mail survey to assess customer satisfaction with the DCD project. The contractor mailed surveys to 400 randomly selected Springfield area residents and received 75 responses. Most respondents thought the project made the roadway safer (96.7 percent), more convenient (95.1 percent), less congested (95.2 percent), easier to drive (86.9 percent), and better marked (89.8 percent). They agreed that the DCD was the right transportation solution (89.4 percent).

The relocation of the road next to the fairgrounds and zoo helped to alleviate traffic congestion that used to occur. According to Melinda Arnold, public relations and marketing director at the Dickerson Park Zoo, which is adjacent to the Springfield DCD, "Our experience is that since the DCD opened, there don't seem to be backups during peak travel times."

Sergeant Tom Royal, of the Springfield police department's traffic division, notes that before the DCD opened, the police had to address numerous crashes with vehicles going northbound on Route 13 and making left-hand turns across two lanes of traffic to go west on I–44 at the interchange. Since the DCD interchange opened, "We've seen a drastic reduction in crashes," says Royal. "Crashes took a nosedive, and the reconfiguration has alleviated the traffic congestion."

"The Turner-Fairbank Highway Research Center had a major role in identifying, evaluating, and producing computer simulations; testing design alternatives; and assisting the Missouri Department of Transportation in construction," says Monique Evans, director of FHWA's Office of Safety Research and Development. "For years, the Federal Highway Administration has encouraged innovative and cost-effective intersection designs, and the double crossover diamond interchange is an excellent example."

Joe Bared, Ph.D., P.E., is team leader for Transportation Operations Concepts & Analysis in the FHWA Office of Operations Research and Development. He has worked at FHWA for more than 20 years and managed the program area on intersection/interchange safety and operational effects of design. He managed development of the first roundabout guide in the United States and has promoted intersection/interchange design innovations in a new FHWA publication, *Alternative Intersections/Interchanges: Informational Report* (FHWA-HRT-09-060).

Don Saiko, P.E., is a transportation project manager with MoDOT, where he has worked for 18 years. He supervised the Springfield DCD project. Saiko graduated from the University of Minnesota with a B.S. in civil engineering.

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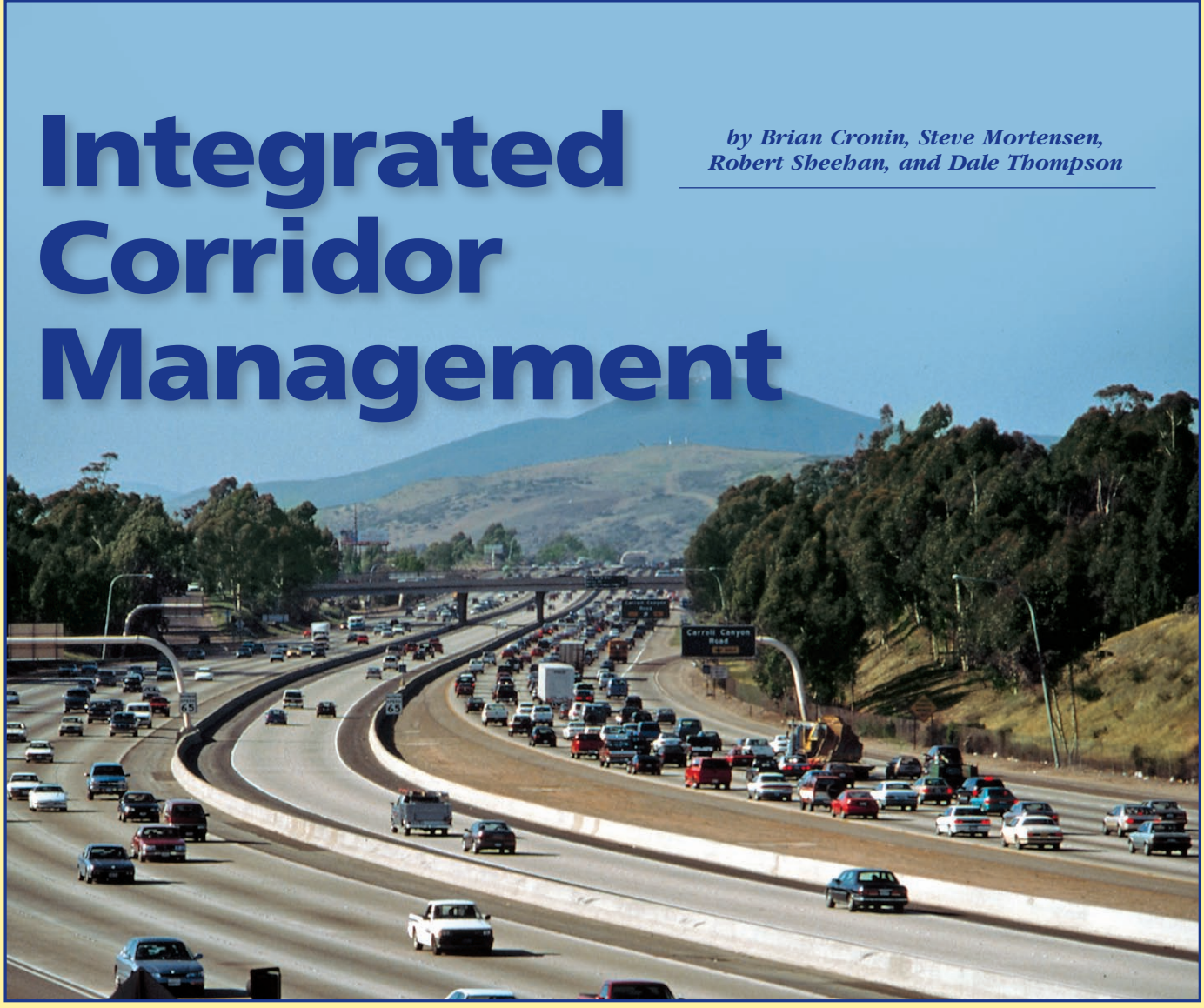
MoDOT

This pedestrian walkway is located in the median of the DCD interchange in Springfield, MO.

Integrated Corridor Management

by Brian Cronin, Steve Mortensen, Robert Sheehan, and Dale Thompson



Analysis, modeling, and simulations of ICM strategies are going forward on three of the Nation's busiest roadways. Coming next—demonstrations.

Although high fuel prices and a struggling economy have reduced the number of vehicles on U.S. roadways, traffic congestion remains a costly problem that will only worsen after the economy improves. The Texas Transportation Institute reports that even with the decline in the congestion curve, Americans lost an estimated 4.2 billion hours of time and wasted 2.8 billion gallons of fuel in 2007 as a result of traffic congestion, which translates to an estimated $87 billion hit to the U.S. economy.

(Above) I–15 in San Diego, CA, a critical transportation corridor, is one of two demonstration sites for research on integrated corridor management. *Photo: Alex Estrella, SANDAG.*

The greatest concentrations of congestion occur along critical transportation corridors, which link residential areas, business centers, sports arenas, and shopping areas. Integrated corridor management (ICM)—the coordination of transportation operations to improve travel management—is a key strategy to address traffic congestion. ICM research involving analysis, modeling, and simulation at a test corridor (I–880 in San Francisco, CA) and preliminary results from three other analysis, modeling, and simulation pioneer sites (Dallas, TX; Minneapolis, MN; and San Diego, CA) indicate that corridors that implement ICM can expect greater travel time reliability and productivity of corridor networks, and reduced fuel consumption and emissions.

The ICM Initiative, which the U.S. Department of Transportation (USDOT) launched in 2006, now is moving from the basic initial research and preliminary studies at pioneer sites to the demonstration phase. "The initiative's end goal is to demonstrate the value of thinking holistically about how to operate a multimodal transportation corridor," says Dr. Robert Bertini, deputy administrator of the Research and Innovative Technology Administration (RITA). "ICM is a key multimodal tool in the transportation management toolbox, and we are equipping transportation professionals across the country to successfully implement ICM in their corridors through knowledge and technology transfer."

What Is ICM?

ICM enables departments of transportation (DOTs) to optimize use of available infrastructure by directing travelers to underutilized capacity in a transportation corridor. Strategies include motorists shifting their trip departure times, routes, or modal choices, or DOTs dynamically adjusting capacity by changing metering rates at entrance ramps or adjusting traffic signal timings to accommodate demand fluctuations. In an ICM corridor, travelers can shift to transportation alternatives—even during the course of their trips—in response to changing traffic conditions.

Multijurisdictional partner agencies manage ICM corridors as collaborative, multimodal systems. At the Federal level, three USDOT agencies—RITA, Federal Highway Administration (FHWA), and Federal Transit Administration (FTA)—are partnering with eight of the Nation's busiest corridors in a multiyear initiative to develop, deploy, and evaluate ICM concepts.

The ICM pioneer sites are located in Oakland and San Diego, CA; Dallas, Houston, and San Antonio, TX; Montgomery County, MD; Seattle, WA; and Minneapolis, MN. All eight sites participated in the ICM Initiative's initial phase, which was completed in 2007 and consisted of developing concepts of operations and system requirements.

A concept of operations describes the "who, what, when, where, why, and how" of an ICM system. It also describes the goals of ICM in a transportation corridor from both the users' and the operators' perspectives, and lays the foundation for subsequent institutional, operational, and technical planning, development, and implementation decisions. The system requirements specifications build on the concepts of operations to provide greater detail about what the ICM system will do.

ICM Analysis, Modeling, And Simulation

The USDOT agencies selected three of the pioneer sites (Dallas, Minneapolis, and San Diego) for further analysis, modeling, and simulation tests of ICM strategies under a variety of conditions. Examples are operating the corridors during planned special events, high traffic congestion, and major incidents.

The tests have four goals. The first objective is to ensure the modeling tools will meet the analysis needs and lead to confidence in the model results. The tests also will enable the researchers to determine whether modeling software available in the marketplace today can be used to perform the analysis necessary for ICM. Third, the tests can help DOTs illustrate potential benefits and refine ICM strategies. Finally, the tests will continue fostering collaboration among ICM's public and private sector champions.

Conducting analysis, modeling, and simulation tests enables corridor partners to identify the most promising strategies and informs decisions for design of ICM systems. For the Dallas pioneer site, for example, Robert Saylor, traffic engineering and operations manager for the Dallas suburb of Richardson, sees a clear benefit in analysis, modeling, and simulation because these tests provide insights and measurable results. "When you think about how to react to congestion or an incident, there are multiple alternatives," he says. "One strategy we are looking at, for example, is deploying an additional DART [Dallas Area Rapid Transit] train, which is a significant investment. Through modeling, we are able to determine whether having another train available on-demand will make enough improvement to make the investment worthwhile."

Koorosh Oylai, DART

The Dallas pioneer site will promote transit options, such as the Dallas Area Rapid Transit (DART) bus and light rail shown here, enabling travelers to switch from driving their own vehicles to taking public transit, depending on real-time conditions.

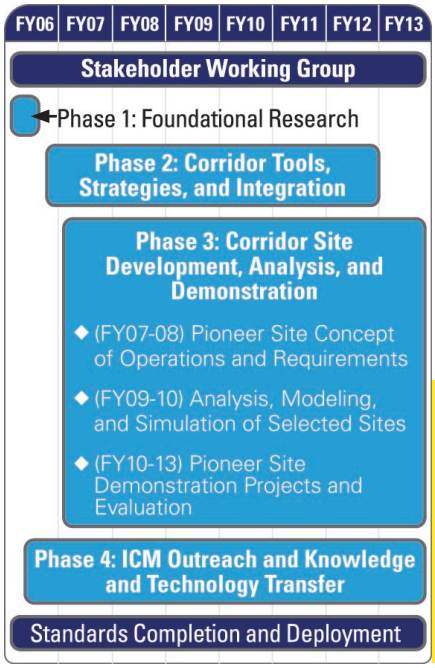
ICM Scenarios Evaluated During Phase I

	Dallas	Minneapolis	San Diego
No Incident	✔		✔
Freeway Incident (Major)	✔	✔	✔
Freeway Incident (Minor)	✔	✔	
Arterial Incident (Major)		✔	✔
Arterial Incident (Minor)		✔	
Special Event		✔	✔
Transit Incident			✔
Weather Conditions		✔	
Disaster Response			✔

Performance Measures

Corridor partners develop performance measures for their ICM objectives. The metrics enable the partners to determine how well the ICM system is working and whether it is accomplishing its goals. The performance measures assess ICM performance in four areas:

- *Safety*: The number and severity of crashes (that is, fatal, injury, and property damage)
- *Mobility*: How well the corridor moves people and freight
- *Reliability*: The relative predictability of the public's travel times
- *Emissions and fuel consumption*: Impacts of ICM strategies on fuel use and emissions



This diagram shows the four phases of the ICM Initiative, starting with Phase 1 in Fiscal Year 2006, Phase 2 from 2007 to 2012, and so on through Phase 4. Currently, the initiative is in Phase 3, to be completed in 2013. *Source: USDOT.*

Benefits of the ICM Methodology

The analysis, modeling, and simulation tests facilitate the selection and application of the most effective ICM strategies. The methodology offers corridor managers the ability to predict which combinations of ICM strategies are likely to be most effective in various conditions.

Analysis, modeling, and simulation also help managers invest in ICM strategies with confidence. Modeling the implications of scenarios in advance enables them to fund the most effective combination of strategies.

In addition, the methodology helps corridor managers continually improve implementation of ICM strategies by updating plans, models, and assumptions based on experience. Managers can integrate the methodology with ICM decision support systems to facilitate predictive, real-time, and scenario-based operational decisionmaking. As defined by R.H. Sprague and H.J. Watson in *Decision Support for Management*, decision support systems are interactive, computer-based systems that help decisionmakers use historical data and models to identify and solve problems.

Preliminary Results

The three pioneer sites selected for analysis, modeling, and simulation testing embody a cross section of corridor characteristics and assets, and have well-developed concepts of operations and systems requirements. The three sites evaluated nine transportation scenarios.

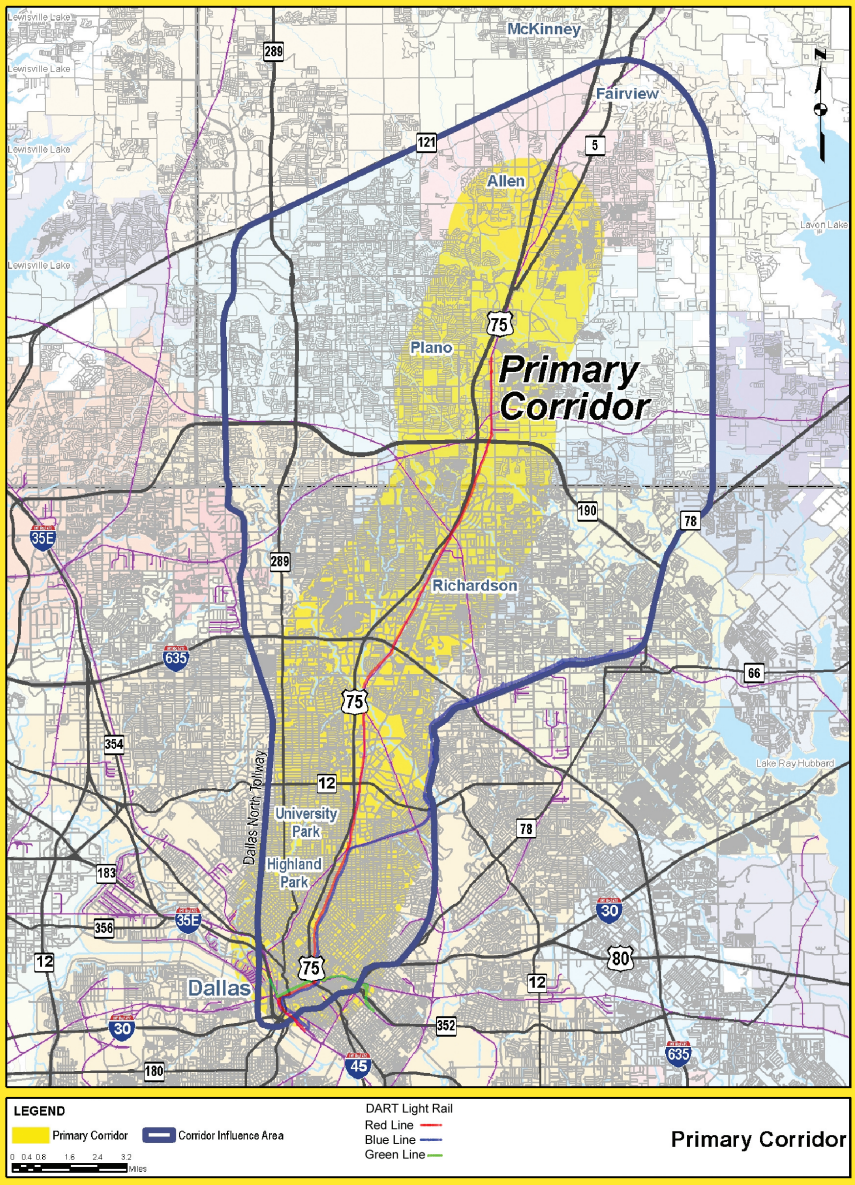
Alex Estrella, senior transportation planner with the San Diego Association of Governments, is tracking results at the San Diego site. Analysis, modeling, and simulation tests are "helping us measure corridor benefits of planned investments, while also highlighting key corridor strategies for helping us manage congestion. One of the critical measures for our corridor—both from operational and user perspectives—is improvement to travel reliability. Our preliminary results indicate that we will be able to achieve significant improvements through combinations of ICM strategies, especially when there is high demand and during nonrecurrent congestion."

Preliminary results from all three analysis, modeling, and simulation pioneer sites show positive trends. For example, preliminary results in San Diego indicate a 12.6 percent improvement in travel time reliability, and in Minneapolis an 11.8 percent improvement in travel time reliability for eastbound trips along I-394. Preliminary results in Dallas also show improvement in travel time reliability and a 10-year net benefit of deploying ICM strategies of $125 million on its ICM corridor.

Lessons Learned

Given that ICM is new and has put new requirements on current modeling and analysis tools, the ICM Initiative needed to first define an ICM modeling methodology and approach, and then select actual corridors implementing logical ICM strategies that then could be modeled. Finally, the initiative had to build local models and model the selected strategies at each of the corridors. In the future, the process is expected to be faster, although sites still will need time to define their strategies, develop modeling and analysis tools, and collect data.

Dallas ICM Pioneer Site (U.S. 75)



Source: Koorosh Olyai, DART.

The following three improvements resulted from the second phase of the ICM research:

Enhancing capabilities necessary to model ICM. The researchers found that the software models used at the pioneer sites did not have the robust capabilities needed to model multimodal assignments and mode shifts in real time, as well as ramp metering, congestion pricing, and dynamically managed lanes. To overcome this hurdle, the USDOT analysis, modeling, and simulation contractor and pioneer site teams worked with universities and vendors of analysis tools to improve the software so it could model these operational strategies. Today, the software developers have either incorporated enhancements to their standard software package or created external modules that provide more functionality for operational and real-time analysis.

Reliable data are key. To develop dependable models, compare ICM strategies, and build a complete picture of the transportation system, reliable data are essential. Gathering information can have its own challenges, such as knowing where to put detectors, having a way to determine when sensors are down, ascertaining what is going on between detectors, and deciding when to accept or reject field data.

The USDOT team conducted a data gap analysis, developed ways to address the gaps, and identified additional data elements needed to evaluate ICM. The team also developed a process for combining different sources to improve the overall quality of the data. To ensure reliability, agencies need to replace defective sensors quickly and be able to change installation and testing standards for their data collection equipment.

Improving model calibration techniques. The analysis, modeling, and simulation methodology is a significant undertaking and, as such, must rely on trusted, well-calibrated models. Through the ICM Initiative, the USDOT team refined the modeling calibration methodologies and criteria. The research raised confidence levels for modeling a "typical day," developed new methods to calibrate the models for an "incident day," and validated transit and park-and-ride numbers so the models can tell the full ICM story.

Demonstration Phase

In December 2009, the three USDOT agencies selected two of the critical transportation corridors for demonstrations, or living laboratories, in the fight against congestion. The two pioneer sites, located in Dallas and San Diego, will build on past findings to provide a firsthand evaluation of real-world impacts. As part of their experience, the demonstration sites will be able to see the impact of technologies to help prevent the dangers of text messaging and other activities behind the wheel that result in distracted driving. In addition, both Dallas and San Diego will be developing decision support systems to help them make real-time decisions about when and how to implement ICM strategies.

Dallas: U.S. 75 Corridor

The U.S. 75 project is a collaborative effort led by Dallas Area Rapid Transit (DART) in collaboration with USDOT; the cities of Dallas, Plano, Richardson, and University Park; the town of Highland Park; North Central Texas Council of Governments; North Texas Tollway Authority; and the Texas Department of Transportation (TxDOT).

U.S. 75 is a north-south radial corridor that serves commuter, commercial, and regional trips, and is the

San Diego Corridor ICM Pioneer Site

Source: Alex Estrella, SANDAG.

primary connector from downtown Dallas to the cities to the north. Weekday mainline traffic volumes reach 250,000 vehicles, with another 30,000 vehicles on the frontage roads. The corridor has 167 miles (269 kilometers) of arterial roadways.

The U.S. 75 corridor currently has two concurrent flow-managed, high-occupancy vehicle (HOV) lanes, light rail, bus service, and park-and-ride lots. The corridor sees recurring congestion and a significant number of freeway incidents. Light rail on the DART red line is running at 75 percent capacity, and arterial streets are near capacity during peak periods and are affected by two choke points at the U.S. 75/Lyndon B. Johnson Freeway (I–635) interchange and U.S. 75/President George Bush Turnpike interchange.

DART will contribute $3 million to the $8.3 million project, which will use a transportation management model to predict travel conditions 30 minutes into the future. Those predictions will facilitate diversion of traffic from U.S. 75 to other routes during freeway incidents and special events. Through wireless and Web-based alerts, travelers will have access to real-time information about traffic, public transit, and expected travel times. Another goal of the Dallas research is to improve incident management through interagency communication and coordinated response.

Specific practices that the Dallas team intends to employ include the following:

1. Provide comparative travel times to the public and operating agencies for the freeway, HOV lanes, frontage roads, arterial streets, and light-rail transit line.
2. Use simulations to predict travel conditions for improved incident response.
3. Implement interdependent response plans among agencies.
4. Divert traffic to strategic arterials with adaptive control that can adjust signal timing in response to real-time traffic demands.
5. Shift travelers to the light-rail system during major incidents on the freeway.

San Diego: I–15 Corridor

The I–15 project is a collaboration led by the San Diego Association of Governments (SANDAG), along with USDOT, the California Department of Transportation, Metropolitan Transit System, North County Transit District, and the cities of San Diego, Poway, and Escondido, in addition to private sector support. The goals are to augment technical management, software and systems development, and cutting-edge innovation.

The interstate is a north-south corridor that runs from S.R. 78 in the north to the S.R. 163 interchange in the south. I–15 is a primary artery for the movement of commuters, goods, and services from inland northern San Diego County to downtown San Diego. Weekday traffic volumes range from 170,000 to 290,000 vehicles on the general purpose lanes. The corridor currently has two reversible high-occupancy toll (HOT) lanes. Approximately 20,000 vehicles use the I–15 express lanes during weekdays, and the corridor experiences recurring congestion.

SANDAG and its partnering agencies will contribute $2.2 million for the $10.9 million project. San Diego will use investments in intelligent transportation systems (ITS) to implement a "smart" transportation management system that combines road sensors, transit management strategies, video, and traveler information to reduce congestion. The smart system will deliver information to commuters via the Internet and message signs, and will

Alex Estrella, SANDAG

These express lanes in San Diego will help control traffic congestion by giving travelers the option to switch to a price-managed lane providing near-free-flow speeds.

Koorosh Olfati, DART

Shown here is the DART light rail transit service, paratransit service (a special public transportation option for senior citizens and persons with disabilities), and high-occupancy vehicle (HOV) lane along the ICM corridor on U.S. 75 in Dallas.

enable managers to adjust traffic signals and ramp meters to direct travelers to HOV and HOT lanes, bus rapid transit, and other options.

Examples of practices the SANDAG team intends to employ include the following:

1. Provide corridor users with the operational condition of all corridor networks and components, such as comparative travel times, parking space availability, incident information, and expected delays.
2. Use a decision support system with real-time simulation, predictive algorithms, and analysis modeling.
3. Establish, improve, and automate joint agency action plans.
4. Identify means of enhancing corridor management across all networks, including shared control of field devices such as lane controls, traveler information messages, and transit priority.

Looking Ahead: Next Steps

The ICM demonstration phase will have three subphases—kickoff, design and deployment, and operations and maintenance—all to be completed between 2010 and 2013. San Diego is scheduled to launch in September 2011, and Dallas will go live in January 2012. In parallel to the demonstration phase, USDOT will be conducting an evaluation of the ICM system to determine whether it will do what it is intended to do: improve situational awareness, enhance response and control, better inform travelers, and improve corridor performance.

Implementation guidance, plans, and results will be available online through the "ICM Knowledgebase" to help other corridors interested in conducting analysis, modeling, and simulation. The Web site will contain resources such as fact-sheets, concepts of operations from the pioneer sites, system requirements documents, and more.

U.S. Transportation Secretary Ray LaHood says, "These communities are leading the way by using state-of-the-art technologies to create a commute that is safer, less congested, and more convenient. America can't simply build our way to a more modern and efficient transportation infrastructure. These projects will show the rest of the Nation that bumper-to-bumper traffic doesn't have to be the status quo."

Brian Cronin is the RITA ITS Joint Program Office (JPO) manager for the ICM Initiative. Cronin is the team leader for ITS research and demonstration for JPO and serves as the technical representative for the Montgomery County and San Antonio pioneer sites.

Steve Mortensen is a senior ITS engineer with the FTA Office of Research, Demonstration and Innovation. Mortensen is the technical representative for the Dallas and Oakland pioneer sites.

Robert (Bob) Sheehan is a transportation specialist with the FHWA Office of Operations. Sheehan is the technical representative for the San Diego pioneer site.

Dale Thompson is a transportation research specialist with the FHWA Office of Operations Research and Development. Thompson is the technical representative for the Houston, Minneapolis, and Seattle pioneer sites.

For more information and to sign up for the two optional Really Simple Syndication (RSS) feeds to be notified when updates are posted to the "What's New" section of the ICM home page and when resources are added to the "ICM Knowledgebase," see www.its.dot.gov/icms/index.htm. To obtain copies of ICM knowledge and technology transfer resources as they become available, please visit the "ICM Knowledgebase" at www.its.dot.gov/icms/knowledgebase.htm. Contact Brian Cronin at 202-366-8841 or brian.cronin@dot.gov, Steve Mortensen at 202-493-0459 or steven.mortensen@dot.gov, Robert Sheehan at 202-366-6817 or robert.sheehan@dot.gov, or Dale Thompson at 202-493-3420 or dale.thompson@dot.gov.

The Dwight David Eisenhower Transportation Fellowship program continues to attract the best and brightest minds to the transportation field.

Workforce Development in Action

by Henry C. Murdaugh and Stephanie Carter

As the transportation field continues to evolve, the industry faces increasingly complex challenges, including rehabilitating an aging infrastructure, keeping pace with advanced technology, adapting to broad organizational changes, and meeting the growing demands of a global economy. To respond to these developments successfully requires a diverse, multidisciplinary, and well-trained workforce.

Over the past 10 years, however, public sector transportation agencies have seen a steady decline in personnel due to myriad factors, including retirements, career changes, and hiring and funding challenges. As a result, an inordinate amount of institutional knowledge has walked out the doors of Federal, State, and local transportation departments. Workforce development, therefore, has become a hot topic at the U.S. Department of Transportation (USDOT). The critical need to attract and retain talented employees has spurred heighten attention and activity across the Department and its related program areas.

Three fundamental questions are at the core of transportation workforce development: How can the transportation field attract qualified and motivated personnel? How can the field enhance the careers of the professionals it already has? And, ultimately, how can it retain talent over the long run? Fortunately, the Federal Highway Administration (FHWA) has one answer for all three: the Dwight David Eisenhower Transportation Fellowship program.

For nearly 30 years, the Eisenhower Transportation Fellowship program has served as a catalyst for transportation workforce development. To date, it has awarded more than 2,000 fellowships in a variety of fields, and more than 80 percent of recipients have gone on to careers in the transportation industry.

"I think the Eisenhower program is one of the most outstanding educational programs that our Federal Government provides for engineering education, especially civil engineering education," says Mark McDonald, assistant professor in the Department of Civil & Environmental Engineering at Vanderbilt University and former recipient of the Eisenhower

(Above) Recipients of the 2010 Eisenhower fellowships convene at the 89th annual meeting of the Transportation Research Board.

Transportation Fellowship. "Although the focus is on transportation, [the program] is clearly broad enough to fund research on many problems of enormous social relevance—managing our crumbling civil infrastructure, providing access to the central business districts of sprawling metropolitan areas, understanding the relationships between transportation and all the other critical social and economic sectors, providing safe and secure transportation in the midst of a global war on terror, ending our country's dependence on foreign oil, improving air and water quality, ensuring that our transportation system is funded in as fair and equitable a way as is possible, and so forth. The research that can be funded can have big policy ramifications, can save lives, or can save money."

Today the Eisenhower Transportation Fellowship program continues to provide funding for students pursuing undergraduate degrees, masters' degrees, or doctorates in transportation-related fields, filling a valuable role in attracting and retaining qualified highway professionals.

Eisenhower Transportation Fellowship Disciplines

Arts and Sciences
Architecture
Chemistry
Communication
Computer Science
Criminal Justice
Environmental Science
Information Systems
Logistics
Mathematics
Physics
Public Administration

Aviation
Aeronautical Studies
Airway Science
Aviation Flight Management Science

Business
Accounting
Business Administration
Business Management
Finance
Economics
Management
Marketing

Education and Human Development
Education
Human Factors
Human Resources
Psychology

Engineering
Chemical Engineering
Civil Engineering
Construction Engineering
Electrical Engineering
Electronic Engineering
Engineering (General)
Environmental Engineering
Geotechnical Engineering
Manufacturing Engineering
Mechanical Engineering
Structural Engineering
Transportation Engineering

Law
Law

Public Policy and Planning
Public Policy & Analysis
Political Science/Government
Urban and Regional Planning
Urban Studies

Transportation
Pavement and Materials
Transportation (General)
Transportation (Infrastructure)
Transportation (Traffic Operations)
Transportation Logistics
Transportation Planning & Management
Transportation Policy
Transportation Studies

Almost 30 Years Strong

The Eisenhower Transportation Fellowship program began as the Grants for Research Fellowships program in 1983. FHWA first announced the grants program to acquaint the academic community with the capabilities of its Turner-Fairbank Highway Research Center (TFHRC) in McLean, VA.

The program had several objectives. One was to create a pool of talented students to help upgrade professional practices associated with delivering the Federal highway program. The program also sought to merge academic study and practical applications for students majoring in transportation fields and to extend and strengthen ties between FHWA and universities offering transportation-related degrees. A fourth objective was to encourage students to pursue careers in highway transportation.

In 1991, the Intermodal Surface Transportation Efficiency Act turned the grants program into the Dwight David Eisenhower Transportation Fellowship program. The Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users, in turn, carried the authorization through 2009. (A continuing resolution extended appropriations through the end of 2010.)

FHWA Deputy Administrator Greg Nadeau spoke to Eisenhower fellows at TRB's 2010 Dwight David Eisenhower Transportation Fellowship Program Research Showcase. He noted that about 85 percent of former Eisenhower Transportation Fellowship recipients are working in transportation and engineering fields.

Types of Eisenhower Fellowships

The **Eisenhower Graduate Fellowship** enables students to pursue masters' or doctoral degrees in transportation-related fields at accredited universities in the United States and its territories.

The **Eisenhower Grants for Research Fellowship** acquaints undergraduate and graduate students with transportation research, development, and technology transfer activities at USDOT facilities.

The **Eisenhower Historically Black Colleges and Universities Fellowship** provides students at those institutions with opportunities to pursue careers in transportation. This fellowship also serves as a feeder for other Eisenhower fellowships.

The **Eisenhower Hispanic Serving Institutions Fellowship** provides students at those institutions with opportunities to pursue careers in transportation. This fellowship also serves as a feeder for other Eisenhower fellowships.

The **Eisenhower Tribal Colleges and Universities Fellowship** provides students at those schools with opportunities to pursue careers in transportation. This fellowship also serves as a feeder for other Eisenhower fellowships.

The **Eisenhower People with Disabilities Fellowship** provides opportunities for individuals with disabilities to pursue careers in transportation. This fellowship also serves as a feeder for other Eisenhower fellowships.

The **Eisenhower Intern Fellowship** provides students with opportunities to perform a wide range of significant transportation-related activities at public and private sector transportation organizations.

The **Eisenhower Community College Fellowship** provides opportunities for community college students to pursue careers in transportation. This fellowship also serves as a feeder for other Eisenhower fellowships.

The mission of the current Eisenhower Transportation Fellowship program remains largely unchanged: to advance transportation workforce development by attracting the brightest minds to the field, enhancing the careers of transportation professionals by encouraging them to pursue advanced degrees, and retaining top talent in the U.S. transportation industry.

"The generosity of the Eisenhower Transportation Fellowship program allowed me to work on my Ph.D. full-time, enabling me to immerse myself in research and complete more tasks faster," says Nelson Gibson, an FHWA research civil engineer at TFHRC. "I am quite grateful for the support from the program, and the added exposure influenced my decision to pursue a career at FHWA."

During TRB's Innovative Doctoral Research Showcase, Robert Campbell from the University of California, Berkeley, top-ranked recipient of the 2010 Eisenhower fellowships, discussed his research on methods for improving compliance with posted traffic signs.

Dr. Robert Bertini, deputy administrator of the Research and Innovative Technology Administration (RITA), received an Eisenhower fellowship while a graduate student at the University of California, Berkeley. "The Eisenhower program not only supported my graduate studies in transportation engineering, but it connected me to students at other universities who are now colleagues and leaders in the transportation field," Bertini says. "In addition, as a professor at Portland State University, I had the opportunity to encourage and supervise Eisenhower fellows who are among the next generation of transportation professionals, faculty members, and leaders."

A Legacy to Build On

The Eisenhower program now consists of eight fellowship categories (the original Grants for Research Fellowships program is now one of the eight). The categories represent the diversity of the current and future transportation workforce, emphasize the interdisciplinary nature of modern transportation, and extend professional expertise beyond the traditional areas of engineering and science.

In 2005, the Eisenhower Transportation Fellowship program created the People with Disabilities Fellowship to place greater emphasis on attracting individuals with disabilities into the transportation field. Then, in 2009, the program initiated the Community College Fellowship. In the United States, more than 40 percent of science and engineering college students attend community colleges, so now the program has a way to tap into this growing audience of talented students to encourage them to pursue career opportunities in transportation.

Of the eight categories, the Graduate Fellowships and Grants for Research Fellowships might be considered the premiere programs because, once the recipients have completed their fellowships, they have research and work experience and are workforce-ready.

"Being a graduate research fellow in the Eisenhower program opened the door for my being employed by FHWA," says Morris Oliver, a transportation specialist in the agency's Office of Safety. "After completing the fellowship, I signed up for a

At the 2009 TRB annual meeting, Jeffrey F. Paniati, executive director of FHWA, addressed the Eisenhower fellowship recipients, underscoring the need to prepare the workforce to lead, manage, and build the transportation system of the future.

temporary position at TFHRC until a position opened on FHWA's 18-month master's training program. I have enjoyed my 21-year career with FHWA and probably would not have considered a career in the Federal Government if I hadn't been selected as an Eisenhower fellow."

Recipients of the Eisenhower Transportation Fellowship have the opportunity to present their research at the Transportation Research Board's (TRB) annual meetings, enabling them to share their work with the broader transportation community. The meetings feature four sessions that highlight achievements of the fellowship program: the Innovative Doctoral Transportation Research Showcase, Eisenhower Transportation Fellowship Program Research Showcase, and two Eisenhower Fellowship Program Poster Sessions. Many awardees present their research at other TRB sessions as well. In 2010 alone, recipients presented at 49 TRB sessions in addition to the traditional four Eisenhower sessions.

Challenge for the Future

The success of the Eisenhower Transportation Fellowship program has hinged on its ability to evolve and meet the changing needs of the transportation industry's workforce. "The kind of work I did was made possible because of the flexibility that the doctoral fellowship offered," says McDonald. "Unrestricted funding to pursue 'outside the box' ideas is not easy to come by. That's the beauty of the Eisenhower doctoral fellowship: It allows motivated graduate students to pursue ideas that may not be at the stage where their advisers can win funding through the National Cooperative Highway Research Program, National Science Foundation, or some other agency, but also may be a little too outside the box for State transportation departments that often need answers in short order for practical problems that they face immediately."

The Eisenhower Transportation Fellowship program now faces a growing challenge, however, partly due to its own success. Although the program has expanded to encompass a broader range of students to meet the needs of the future transportation workforce, funding levels have remained flat over the past 15 years. The static funding level has limited the program's ability to compete for additional qualified students whom the industry so sorely needs.

Today the Eisenhower Transportation Fellowship program encompasses all modes of transportation. Former fellowship recipients have worked or are working for USDOT, in field offices, headquarters, and across multiple modal administrations—including FHWA, Federal Aviation Administration, Federal Railroad Administration, Federal Transit Administration, National Highway Traffic Safety Administration (NHTSA), and RITA. Former recipients are represented at all management levels within the agencies (General Schedule Grade 14 through Senior Executive Service). Many former recipients work in academia as well. The program also can boast that it has third-generation Eisenhower recipients; that is, former recipients in academia have sent their students on to participate in the program, and these students-cum-professors have in turn encouraged some of their students to become Eisenhower fellows.

"Working directly with industry professionals on relevant and timely transportation issues is the best way to learn while doing," says Alrik Svenson, a former recipient and now a research engineer and program manager in NHTSA's Office of Applied Vehicle Safety Research. "The Eisenhower fellowship program puts you in the driver's seat for future career success. The experience and the networking contacts gained through the program last a lifetime."

Henry C. Murdaugh is the FHWA program manager of the Universities and Grants Programs (U&GP) in FHWA's Office of Technical Services, Technology Partnership Programs. He has more than 20 years of grants/contracts and program management experience at the Federal and State levels.

Stephanie Carter is employed by Sevatec, Inc., as a program analyst for U&GP. She oversees all marketing and is an advocate writer for U&GP, organizes the annual National Engineers Week program, and focuses on workforce development for the highway transportation industry.

For more information, contact Henry C. Murdaugh at henry.murdaugh @dot.gov or Stephanie Carter at stephanie.carter@dot.gov. *The authors also wish to acknowledge the U&GP staff: Camron Ranje, team leader and systems analyst, and Gerald Hill, program analyst, for their support of the Eisenhower Transportation Fellowship program.*

THE CMF CLEARINGHOUSE: A Handy Safety Tool

by Katy Jones, Karen Yunk, and Daniel Carter

FHWA has developed an accessible Web-based, one-stop resource for information on crash modification factors.

The Federal Highway Administration (FHWA), State departments of transportation (DOTs), and other stakeholders continue to make progress in reducing highway fatalities across the Nation, with deaths per vehicle mile traveled (VMT) falling every year except 1 over the last 15 years. In 1994 and 1995, for instance, there were 1.73 fatalities per 100 million VMT, but that number dropped to 1.25 deaths per 100 VMT in 2008, according to the National Highway Traffic Safety Administration.

(Above) The CMF Clearinghouse contains more than 2,500 crash modification factors for 700+ countermeasures. Installing a sidewalk (with a CMF of 0.26) like the one shown here improves safety by removing pedestrians from the roadway. State surveys indicate that this can reduce crashes by 74 percent. *Photo: UNC Highway Safety Research Center.*

Continuing to achieve further reductions in traffic fatalities will require even more effective, data-driven investment decisions. Practitioners now have many resources and tools available to help them identify potential safety improvements and decide which ones to implement. One such resource is crash modification factors (CMFs), multiplicative factors used to compute the expected number of crashes that might occur after implementing a given countermeasure at a specific site. The concept is not new, as efforts can be traced back to the 1970s to develop tabular summaries of accident reduction factors, or ARFs, as they were called at that time. Over the years, researchers have developed thousands of CMFs to estimate the expected safety improvement associated with implementation of various countermeasures.

The CMF represents a valuable piece of information for safety professionals. A CMF of less than 1.00 indicates an expected decrease in the number of crashes, while a CMF greater than 1.00 indicates an expected increase in crashes. For example, imagine that an intersection is experiencing 20 angle crashes and 40 rear-end crashes per year. If

The home page of the CMF Clearinghouse features recently added CMFs.

a DOT implements automated red light running enforcement cameras, which have a CMF of 0.67 for angle crashes, the agency might expect to see 13 angle crashes (20 x 0.67 = 13) per year after implementation. If the same countermeasure also has a CMF of 1.45 for rear-end crashes, the DOT might expect to see 58 rear-end crashes (40 x 1.45 = 58) per year. By performing these calculations, engineers can weigh the relative costs and benefits of installing various countermeasures and inform decisionmakers about the solution(s) most likely to improve overall safety at a given location.

Research continuously identifies new CMFs, but they are useful only if easily available to practitioners. Recognizing the growing need for a centralized location to store and provide easy access to the CMFs, FHWA recently launched the Web-based Crash Modification Factors Clearinghouse (www.CMFClearinghouse.org). As of August 2010, the clearinghouse provides access to more than 2,500 CMFs for over 700 countermeasures, as well as guidance to help transportation professionals use CMFs to improve their decisions about road safety. The site also features information on training and cost-benefit analyses.

"The Crash Modification Factors Clearinghouse provides an easy way for practitioners to use the latest knowledge as they make important safety improvement decisions on their roadways," says FHWA Executive Director Jeff Paniati. "It also provides links to other important safety resources, such as the new [American Association of State Highway and Transportation Officials (AASHTO)] *Highway Safety Manual*."

Building the Clearinghouse

In November 2008, FHWA began developing the CMF Clearinghouse. The agency worked with a variety of potential users, such as State DOT personnel and local engineers, to develop the content, design, and functionality of the Web site. Based on this indepth user feedback, FHWA structured the clearinghouse to include several key features. First, the site includes a rating system to inform users of the reliability of CMFs. Second, the site lists both CMFs and crash reduction factors (or CRFs), which are estimates of the *percentage* reduction in crashes. Plus, the site is home to assorted educational materials that are updated regularly. The clearinghouse also coordinates closely with information covered in AASHTO's *Highway Safety Manual*, which is a key document practitioners use to facilitate roadway design and operational decisions based on explicit consideration of their safety consequences.

The initial collection of CMFs in the clearinghouse came from several sources: research conducted to develop AASHTO's *Highway Safety Manual*, FHWA's *Desktop Reference for Crash Reduction Factors*, and studies identified at the

CMFs and CRFs

Crash modification factors (CMFs) and crash reduction factors (CRFs) are both terms used to express the effectiveness of countermeasures installed to improve highway safety. The main difference is that CMFs are used to compute the expected *number* of crashes after implementing certain improvements, while CRFs provide estimates of the *percentage reduction* in crashes. A CRF of 46, for example, represents a 46 percent reduction in crashes at a particular site. CMFs and CRFs are related by a simple mathematical function: CMF = 1 – (CRF/100). Using the previous example, a CRF of 46 would yield a CMF of 0.54. Because both terms are widely used in the field of traffic safety, both are available in the clearinghouse.

In September 2007, FHWA published the *Desktop Reference for Crash Reduction Factors* (FHWA-SA-07-015), the first comprehensive resource on countermeasure effectiveness. FHWA then updated the resource the following year (FHWA-SA-08-011) to reflect the latest research. In addition to including CMFs, FHWA's CMF Clearinghouse includes CRFs because of their widespread use and displays them side by side on the basic search results page and each CMF details page.

iStock

Studies have shown that providing continuous milled-in shoulder rumble strips (with a CMF of 0.21) like those shown here can lead to a 79 percent reduction in crashes.

2009 Transportation Research Board annual meeting. After drawing on existing compilations of CMFs to populate the clearinghouse upfront, FHWA now updates the site quarterly as new CMFs become available.

FHWA identifies additional CMFs for the updates through literature searches and user submissions, and then reviews all potential new CMFs to determine their applicability for the clearinghouse. The review process has two parts. First, a preliminary review identifies and records key information about studies with potential relevance to the clearinghouse. This step records information such as the study title and publication date, countermeasures investigated, study methodology, sample size, and locations used for data collection. Second, a critical review then evaluates each CMF and determines an appropriate quality rating. After FHWA assigns a rating, the CMF goes live on the clearinghouse Web site.

Rating CMF Quality

The CMF Clearinghouse includes all documented CMFs, which can vary widely in quality and reliability depending on the study design, number of sites included in the analysis, and other factors. For this reason, the potential users who were consulted requested that the clearinghouse include a system to indicate the dependability of each CMF. In response, FHWA developed a quality rating system utilizing stars—the more stars, the better the quality of the CMF.

FHWA bases the quality rating on a CMF's performance (that is, the quality of the study that developed the CMF) in five categories: study design, sample size, standard error, potential bias, and data source. The performance in each category is rated as excellent, fair, or poor. For example, a study that employed a statistically rigorous design with a reference group, such as empirical Bayes (a method by which predicted crashes are compared to actual crashes to determine the safety effect of the countermeasure), would receive a rating of excellent for study design. If the study employed a simple before/after design, it would receive a lower rating relative to study design. However, study design is only one category. If the study also had a large sample size or widespread data source, it would receive high scores for those categories. Scores across all five categories are combined to produce the star quality rating for the CMF.

The quality rating system applies criteria that are intended to be as objective as possible, but ratings still entail a degree of subjectivity and judgment. "Users of the clearinghouse should take into account all the information presented for a CMF and should not substitute the star quality rating for sound engineering judgment," says Ray Krammes, technical director, FHWA Office of Safety Research and Development.

Although the star quality rating provides users with an indication of the general reliability of the CMF, one of the best ways to ensure CMFs used by practitioners match the local conditions as closely as possible is for State and local agencies to develop CMFs using local data.

CMFs in the *Highway Safety Manual*

The *Highway Safety Manual* provides tools for highway safety practitioners to develop effective roadway safety management programs and predict estimates of crash frequency and severity. The *Highway Safety Manual* also provides a catalog of crash modification factors (CMFs) for a variety of facility types. Practitioners use CMFs to estimate the change in the number of crashes as a result of implementing a particular countermeasure. CMFs also can be used to select countermeasures and conduct economic appraisals as part of the roadway safety management process or to estimate the expected average crash frequency of a proposed project or design alternative using the predictive methods.

Coordinating With AASHTO's *Highway Safety Manual*

Coordination with the *Highway Safety Manual* was an essential factor in development of the CMF Clearinghouse. In fact, to be consistent with the manual, the predominant term in the clearinghouse is "crash modification factor" rather than "crash reduction factor," which FHWA used in previous related documents.

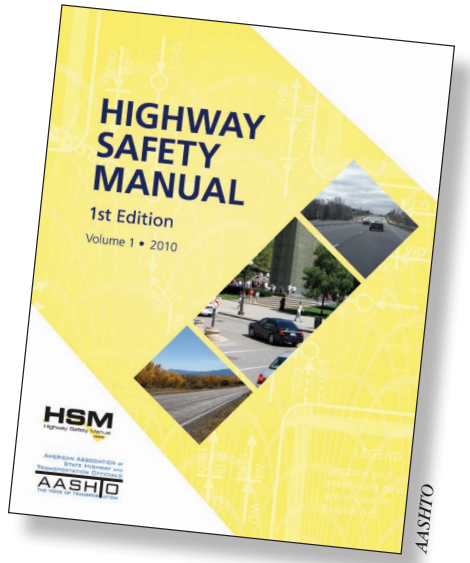
The CMFs in the manual meet strict inclusion criteria, as described in Transportation Research Circular E-C142 *Methodology for*

the Development and Inclusion of Crash Modification Factors in the First Edition of the Highway Safety Manual, whereas FHWA's clearinghouse provides a comprehensive list of all available CMFs. To help users quickly determine whether a CMF is included in the *Highway Safety Manual*, the clearinghouse enables them to search for CMFs in the manual. High-quality CMFs do not exist for every countermeasure, and, therefore, there are many countermeasures for which CMFs do not appear in the *Highway Safety Manual*. In addition, there are many CMFs that were documented after the *Highway Safety Manual* was developed.

"The review process for the CMF Clearinghouse has the added benefit of setting the stage for the next edition of the *Highway Safety Manual*," says Priscilla Tobias, State safety engineer with the Illinois Department of Transportation and chairperson of the AASHTO Subcommittee on Highway Safety Management's Technical Safety Publication Oversight and Coordination Task Force. "*Highway Safety Manual* reviewers will be able to use the information compiled for the clearinghouse to review CMFs and determine whether they meet the manual's inclusion criteria."

The Clearinghouse at Work

Launched in December 2009, the clearinghouse hosted more than 6,300 visits in just its first 8 months. Traffic engineers and other professionals now use the clearinghouse to answer basic questions they face every day, such as, "What is the best safety countermeasure to use?" To find applicable CMFs, users can conduct quick keyword searches from the home page or narrow their queries by countermeasure, crash type, crash severity, and roadway type. The Web site also has an advanced search feature that enables users to search by more detailed parameters, such as intersection type, traffic control, area type, and more.



AASHTO

AASHTO published the first edition of the *Highway Safety Manual* (shown here) in 2010.

State DOTs are promoting the clearinghouse to transportation officials who are conducting benefit-cost analyses. The Iowa Department of Transportation (Iowa DOT), for example, uses the clearinghouse as a resource for local governments that are applying for site-specific safety funding through the State's Traffic Safety Improvement Program. When seeking grants for either new construction or improvement of traffic safety and operations at a specific site or corridor with a crash history, applicants must include benefit-cost analyses. Using worksheets provided by Iowa DOT, local transportation officials calculate the benefit-cost ratio for each potential improvement. Iowa DOT directs applicants to the CMF Clearinghouse as a starting point for these analyses and instructs them to use the CRFs there. "We especially like that in most cases there are factors that are specific to certain crash types and severities," says Tim Simodynes, a safety engineer with Iowa DOT.

The Washington State Department of Transportation (WSDOT) also is using the clearinghouse to provide guidance on benefit-cost analyses. With the complete list of CMFs included in the clearinghouse as a starting point, WSDOT is developing a tailored list of CMFs approved for use by the department and will distribute that list to potential applicants for local safety funding.

"Providing our agency with CMFs from the clearinghouse will enable WSDOT to better scope and prioritize our projects," says Matt Neeley, intelligent transportation

Kyle Arend, Larimer County Engineering, CO

Studies have shown that converting a two-way, stop-controlled intersection to a roundabout (with a CMF of 0.56), such as the one shown here, can reduce crashes by 44 percent.

systems research and planning engineer with WSDOT. "In the past, we haven't had as much information as the clearinghouse provides."

Educational Value

Another purpose of the clearinghouse is to educate transportation professionals about the application of CMFs. The Web site includes an overview of CMFs and a glossary of related terms. Users can read a list of frequently asked questions that address issues such as the difference between CMFs and CRFs, and how to apply multiple CMFs at one location. The site also includes a comprehensive resources section with links to CMF-related publications, countermeasure selection tools, and how to sign up for the *CMF Update*, the clearinghouse's e-newsletter.

The clearinghouse also directs users to two Web-based training courses dealing with CRFs available through the National Highway Institute (NHI): Application of Crash Reduction Factors (FHWA-NHI-380093) and Science of Crash Reduction Factors (FHWA-NHI-380094). The former provides hands-on experience with safety diagnosis and application of CRFs to compare the effectiveness of countermeasures.

According to Kathy DesRoches, director of workforce development at Manchester Community College, New Hampshire hosted a session of the course Application of Crash Reduction Factors in March 2009 as a prerequisite for individuals planning to attend a road safety audit (RSA) course. "By taking the CRF course first," DesRoches says, "participants were better equipped to conduct an RSA because they were more informed about low-cost countermeasures and linking crash patterns with specific countermeasures."

Top Ten Most Viewed CMFs

The following represent the top ten CMFs that received the most views by visitors to the CMF Clearinghouse between December 1, 2009, and August 15, 2010.

1. Installation of flashing beacons at four leg stop-controlled intersections on two lane roads; standard and actuated beacons
2. Design of diamond, trumpet, or cloverleaf interchange with crossroad above freeway
3. Physical channelization of left-turn lane on major road
4. Replacement of 8-inch red signal heads with 12-inch
5. Addition of left-turn lanes to major road approaches at intersections
6. Changing of driveway density from X to Y (driveways/mile for segment)
7. Installation of raised median
8. Installation of continuous milled-in shoulder rumble strips
9. Provision of a median
10. Prohibition of on-street parking

Moving Forward

Now that the clearinghouse is up and running, FHWA will continue to update the database with new CMFs as they become available. FHWA invites users to submit feedback regarding the site's design and content. Past feedback has resulted in improvements to the search mechanism, better explanations of site items, and a clearer layout.

In addition, FHWA encourages transportation professionals to make efforts to develop CMFs within their own agencies by conducting safety evaluation studies using data from their jurisdictions. These evaluation studies can be submitted for possible inclusion in the clearinghouse. By adding to the library of documented CMFs, practitioners can share their own research with other States and assist their colleagues in making data-driven decisions that can help save lives.

One of the goals of the CMF Clearinghouse is to educate practitioners on the proper application of CMFs. Shown here is the opening slide in the NHI course Application of Crash Reduction Factors (FHWA-NHI-380093).

Katy Jones is the manager for research information and education programs at the University of North Carolina Highway Safety Research Center. She has a B.A. degree in journalism and mass communication from the University of North Carolina at Chapel Hill. She also serves as the marketing manager for the Pedestrian and Bicycle Information Center.

Karen Yunk, P.E., is the Highway Safety Improvement Program implementation manager with FHWA's Office of Safety Programs. She has an M.S. degree in civil engineering from Rutgers, the State University of New Jersey.

Daniel Carter, P.E., is an engineering research associate at the University of North Carolina Highway Safety Research Center, where he handles data collection and analysis for safety research projects. He received B.S. and M.S. degrees in civil engineering (transportation) from North Carolina State University.

For more information, contact Katy Jones at 919-843-7007 or jones@hsrc.unc.edu, Karen Yunk at 609-637-4207 or karen.yunk@dot.gov, or Daniel Carter at 919-962-8720 or daniel_carter@unc.edu. To sign up for news about the CMF Clearinghouse, please visit www.CMFClearinghouse.org/signup.

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.

Management and Administration

USDOT Expands Internship Program for Women

In July 2010, USDOT expanded an internship program designed to encourage young women to pursue careers in transportation. The program expanded from 1 to 10 regions of the country, enabling young women from colleges and universities nationwide to participate.

USDOT's Small Business Transportation Resource Centers are administering the program. The centers, located across the country, provide resources, technical assistance, and outreach to all 50 States and U.S. Territories. Each center is responsible for placing qualified female college students in transportation-related internships in its region.

The expanded program is based on a successful pilot with Spelman College in Atlanta, GA, that began in 2009. The program is part of a broader effort by USDOT to create a pipeline of young women entering the transportation workforce. The USDOT program supports an initiative of the White House to ensure that Federal programs and policies take into account the distinct needs and concerns of women and girls.

For more information, visit www.osdbu.dot.gov/WG.

Technical News

CDOT Investigates Re-Use Options For Traction Sand

The Colorado Department of Transportation (CDOT) released a report in June 2010 that explores physical and chemical data on traction sand reclaimed from winter maintenance of the State's mountain roads. The focus of the research was to identify viable alternative, cost-effective uses for used traction sand to minimize disposal in landfills.

According to the report, *Investigation of Re-Use Options for Used Traction Sand* (CDOT-2010-4), street sweepers reclaim approximately 50 percent of the 24,000 tons (21,772 metric tons) of traction sand CDOT applies annually in the mountainous areas of Colorado. The Colorado researchers examined data on reclaimed traction sand and concluded that the sand can be reused without posing a risk to human safety. Findings indicate that an aggregate material that meets many CDOT specifications could be prepared often at a lower cost by combining the reclaimed materials with a coarse aggregate supplement.

For more information, visit www.coloradodot.info /programs/research/pdfs/2010/tractionsand/at _download/file.

CDOT

Felsburg, Holt, & Ullevig

A researcher shovels a sample of reclaimed traction sand from a collection site on Berthoud Pass (U.S. 40) near Winter Park, CO.

Policy and Legislation

FHWA Releases Green Procurement Guide

The Federal Government is one of the largest purchasers in the world, suggesting an obligation and opportunity to be a responsible environmental steward by choosing green products and thus leveraging this purchasing power. At the Federal Highway Administration (FHWA), a new *Green Procurement Guide* encourages personnel involved in acquisition planning to purchase and use green products.

The *Green Procurement Guide* is designed to promote purchasing of designated recycled-content products; energy- and water-efficient products; biobased, environmentally preferable products and services; alternative fuel vehicles and alternative fuels; and non-ozone-depleting substances. The guide also advises purchasers to seek alternatives to products that contain cadmium, lead, mercury, and other priority chemicals identified by the U.S. Environmental Protection Agency. According to the guide, when FHWA personnel review or draft procurement specifications, they should indicate a preference for these types of products and items to the maximum extent practicable.

In addition to environmental benefits, the *Green Procurement Guide* might help FHWA reduce operational costs. For example, buying re-refined motor oil and then sending the used oil to the producer to re-refine it, significantly reduces disposal and waste management costs.

For more information, visit www.fhwa.dot.gov /legsregs/directives/orders/gppg041910.htm#rmbp1.

Public Information and Information Exchange

Small Maryland Town Builds a Green Street

Edmonston, MD, is a small, working-class town situated at sea level within the Anacostia Watershed, just outside Washington, DC. Until recently, the town was plagued with flooding due to an inadequate stormwater management system and increased stormwater runoff from surrounding communities. Edmonston leaders spearheaded an effort to redesign the town's main residential

Town of Edmonston, MD

Decatur Street in Edmonston, MD, after a redesign using practices to manage stormwater and a number of sustainability strategies such as permeable asphalt and bike lanes (at far left).

street to help prevent flooding and make it more sustainable, safe, and attractive.

The focus of the redesign was to prevent flooding and stop runoff from polluting the Anacostia River and ultimately Chesapeake Bay. The redesign employs bioretention cells (raingardens) and permeable pavement (bricks and asphalt that allow water to flow into the ground). The system is designed to capture the first 1.33 inches (3.4 centimeters) of rainfall during a storm, which equates to approximately 90 percent of stormwater during a typical year.

The redesign, completed in fall 2010, also incorporates other sustainable design practices such as restoring the native tree canopy, installing energy-efficient streetlights powered by wind, and making the street and sidewalks more accommodating to pedestrians and bicyclists. The street now boasts wider sidewalks, bike lanes, bumpouts to narrow the road and slow traffic speeds, and access to a regional bike trail network.

The town leadership hopes that other cities along the watershed will see the many benefits of their street redesign and follow their example. To help encourage other cities, town officials have placed the project's engineering and design drawings on the town Web site at www.edmonstonmd.gov. Edmonston Mayor Adam Ortiz says the town is hoping to make a statement and create a ripple effect. "If our little working class town can build a green street, any place can and every place should," says Ortiz.

For more information, visit www.edmonstonmd.gov.

Crash-Test Dummies Added to Smithsonian

USDOT recently donated "Vince and Larry" crash test dummy costumes and related automobile safety items to the Smithsonian Institution. The costumes and objects are now part of the permanent collection of the Smithsonian's National Museum of American History in Washington, DC.

Beginning in 1985, the National Highway Traffic Safety Administration (NHTSA) promoted highway safety through a series of public service announcements (PSAs) starring actors dressed as talking crash-test dummies named Vince and Larry. The PSAs aired on television and radio and also ran in magazines. The campaign, conducted through 1998, used slapstick humor and comical antics to remind people of the importance of wearing their seatbelts.

To mark the 25th anniversary of these award-winning PSAs, NHTSA officially transferred the costumes to the Smithsonian during a ceremony in July 2010. As a result of the crash-test dummy campaign and newer campaigns such as "Click It or Ticket," NHTSA estimates a record 84 percent of Americans now use seatbelts.

NHTSA

FHWA Updates Intersection Resources Library CD-ROM

FHWA recently updated its Intersection Resources Library CD-ROM (FHWA-SA-09-027), a resource that brings together a broad cross section of publications, educational materials, and other media related to intersections. The CD-ROM is available at http://safety.fhwa.dot.gov/intersection/resources/fhwasa09027.

FHWA organized the CD-ROM into five broad topic categories, including traditional signalized intersections, traditional unsignalized intersections, roundabouts, highway/rail grade crossings, and alternative intersection designs such as single-point intersections. The resources are all published by FHWA or its transportation safety partners.

CD-ROM users can hunt for information by keyword search or browse by title, author, or topic. When a user clicks on a resource, an abstract appears that includes the title, author, publisher, year, and description of the resource. From the abstract page, users can download the resource or access it via an external Web link, if available.

The CD-ROM also contains a list of links to related Web sites such as the FHWA Safety Program page and pages of FHWA partners such as the Transportation Research Board. The "Related Sites" list also includes additional training resources such as relevant courses available through the National Highway Institute.

Missouri Coalition Redesigns Highway Safety Web Site

The Missouri Coalition for Roadway Safety, a statewide safety advocate group that aims to create safer roads, recently redesigned its Web site (see www.saveMOlives.com). The site features eye-catching graphics, videos, news and information, and driving tips, as well as advice on how to "Arrive Alive"—also the group's current campaign slogan.

The redesigned site not only looks different, but also the content is more streamlined and organized. The home page highlights the latest news, events, regional

pages, and safe driving information. The site also has a more prominent social media focus, employing quick links to Facebook, Twitter, and a Really Simple Syndication (RSS) newsfeed on the bottom of each page.

According to Leanna Depue, chair of the Missouri Coalition for Roadway Safety's Executive Committee, "We really wanted an updated Web site that would grab people's attention and present our safety information in the best way possible." The coalition's goal is to reduce Missouri road fatalities to 850 or fewer by 2012. The 2009 number stands at 878, a decrease of 31 percent since 2005.

For more information, visit www.saveMOlives.com.

Missouri Department of Transportation

Now Available: Video on Modern Roundabouts

Roundabouts are one-way, circular intersections that eliminate some traffic conflicts, such as left turns across opposing traffic, which sometimes contribute to severe crashes at traditional intersections. FHWA has produced a video, "Modern Roundabouts: A Safer Choice" (FHWA-SA-10-023), that reveals the operational and safety benefits of installing modern roundabout intersections.

The video discusses the benefits of modern roundabouts as compared to stop-controlled and signalized intersections. Benefits include increased safety, improved traffic flow, reduced emissions, lower costs, and community livability. A portion of the video demonstrates how roundabouts are safer for other types of road users such as pedestrians and bicyclists because of slower traffic speeds and elimination of turns across crosswalks, among other reasons.

The video asks the question, "With all of these benefits, why aren't all transportation agencies building modern roundabout intersections?" It then discusses one of the biggest challenges for the installation of roundabouts: public acceptance. According to the video, even individuals who are skeptical of a roundabout before it is implemented usually are convinced after seeing the time savings and safety benefits. As with all new traffic treatments, FHWA recommends thorough public education, effective signing, and pavement markings to educate drivers.

To download the video, visit http://safety.fhwa.dot.gov/intersection/roundabouts/#video. A transcript of the video also is available online.

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Internet Watch

by Alicia Sindlinger

Dashboard Tracks DDOT Projects

When President Barack Obama signed the American Recovery and Reinvestment Act (the Recovery Act) in February 2009, he demanded unparalleled transparency on use of the recovery funds. The District Department of Transportation (DDOT), the department of transportation in Washington, DC, answered this challenge by developing and implementing a Web-based "DDOT Transportation Access Portal" (dTAP) for its initial 15 projects funded by the Recovery Act. The model worked so well, the agency now uses the portal to manage nearly 100 projects.

The dTAP system, available at http://dashboard.ddot.dc.gov, provides project information, including a brief description, budget, scheduling, updates, and links to related documents such as supporting studies. Since the portal's launch in early 2010, District of Columbia residents, business owners, elected officials, DDOT employees, and others looking for information on the agency's transportation program have accessed the site.

"The dTAP system is part of a larger DDOT effort to increase its transparency and ability to communicate with District of Columbia residents," says DDOT Director Gabe Klein. "This system, while launched as a beta program, is already proving to be a powerful tool bringing all processes, people, and technology together in one solution."

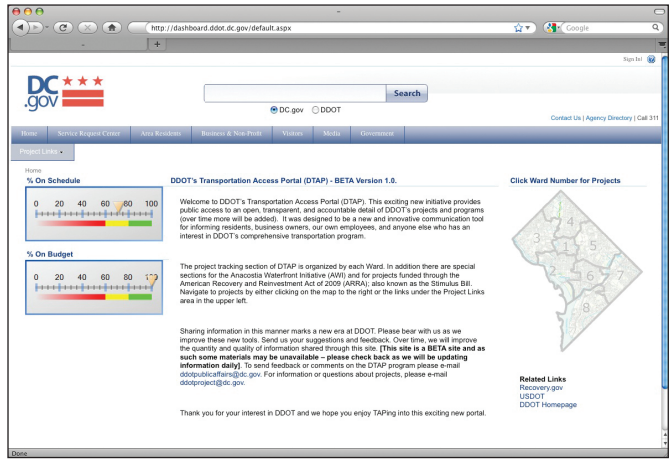
Designing a Multiple-Purpose Solution

Beyond meeting transparency requirements, DDOT had been looking for a way to centrally manage its project load and communicate project information within the agency and with the public. DDOT wanted a solution that balanced its internal needs (for example, project management and monitoring milestones for communications purposes) with the needs of residents.

"DDOT liked the dashboard our neighbors at the Virginia Department of Transportation developed and used that as a model for what we wanted to create for DDOT," says Karyn LeBlanc, director of communications at DDOT. "We modeled our dashboard after the straightforward look that Virginia used and then made adjustments to make it more District-centric."

DDOT Director Klein tasked system designers with four main objectives: (1) increase stakeholder communication to achieve a higher level of responsiveness from the community; (2) increase project management consistency using a standardized toolset and provide a centralized location for project data; (3) create a system to promote transparent budgeting so public dollars are tracked accurately; and (4) establish project management processes and controls to trigger early identification of potential issues and to increase stakeholder involvement.

The project management solution enables DDOT to publish all of its Microsoft® Project plans to Microsoft SharePoint®, a software platform that allows users to access a Web-based user interface through a browser. The dTAP system makes it possible for DDOT and the public to closely monitor project budget and schedule performance.



The home page of the "DDOT Transportation Access Portal."

Accessing Project Details

When visiting the dTAP home page, users will see the total percentage of DDOT projects that are on budget and on schedule prominently displayed in linear scales on the left-hand side. The home page also features a clickable map of the District showing its eight wards (divisions of the city). DDOT structured dTAP by ward to make finding information easier for District residents.

For example, a resident of Ward 1 can find all current projects in his or her neighborhood by clicking on Ward 1 on the map. A new page will load showing the total percentage of projects on budget and on schedule. In addition, the resident will see a list of projects located in Ward 1. Each project listing includes the project name, schedule status, percentage of overdue tasks, start and finish dates, percentage completed, and number of overdue tasks. If the resident is interested in a specific project, he or she can click on that project in the list and more detailed information will appear, such as scheduled meetings and events, project documents, budget, and a map showing the project's exact location.

Since the portal's launch, in addition to increased communication with residents and stakeholders, DDOT has realized benefits such as improved efficiency and reduced costs, greater control over processes to monitor project budget and schedule, improved data integrity and support, and improved project management consistency and standardization. According to LeBlanc, the department is continuing to make changes and improvements, which it hopes to introduce in 2011. Improvements will center on making the interface even more user friendly.

For more information, contact Karyn LeBlanc at 202-671-3490 or karyn.leblanc@dc.gov.

Alicia Sindlinger is a contributing editor for PUBLIC ROADS.

by Lilly Pinto

NHI Redesigns and Enhances Its Web Site

Over the past decade, the National Highway Institute (NHI) has built a considerable portfolio of Web-based trainings and moved all course registration and material purchasing functions online. With its Web site as the hub of these online activities, NHI officials knew that an improved site style and navigation was vital to continuing to deliver high-quality customer service. To draw out what users liked and disliked about the existing Web site, NHI conducted a usability study—targeted research delivered through interviews with NHI customers.

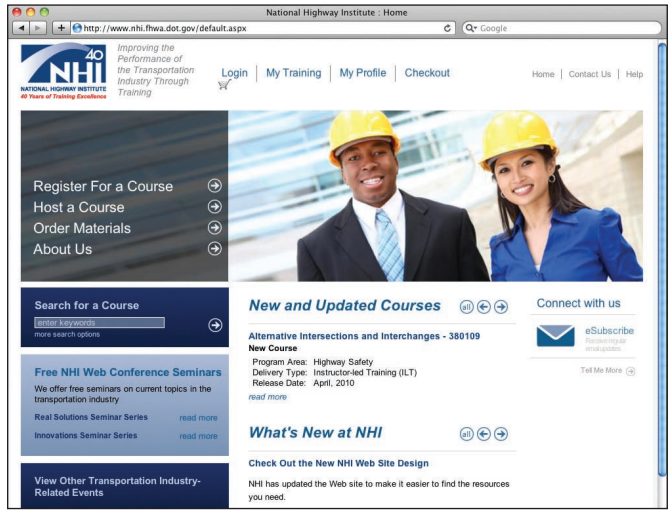
NHI used the findings to prioritize updates to the design, features, functionality, and content of the Web site (www.nhi.fhwa.dot.gov). The redesign process is occurring during multiple phases, with a majority of changes implemented by the end of 2010. Several significant features, such as sign-on functionality and home page and navigation redesign, are intended to improve the user experience, as well as increase Web site capabilities. The new features will make login, scheduling, searching, and completing NHI trainings easier for all users.

"Within the last few years, there has been an increase in the number of customers who felt the Web site lacked important information, or they had trouble finding information due to the site's unclear processes and missing features," says Josh Kersey, a management consultant engaged by NHI to lead the redesign. In addition, Heather Shelsta, NHI's program manager for systems and marketing, says, "Today's Web users expect a higher level of functionality, especially since so many now rely on Web-based training. The redesigned site will meet such demands—and, we hope, exceed them."

Simplified Sign-on and Redesign

The first phase of the update, completed in March 2010, included implementing "My Training," a single sign-on feature. The new feature directly launches Web-based and Web-conference trainings on the site, and enables customers to view a list of scheduled and past Web-based and Web-conference trainings they have taken. "My Training" also allows customers to access and download training documents (for Web-based and Web-conference trainings only), such as personalized certificates for successfully completed courses, unofficial transcripts, and electronic materials ordered from the NHI Store. While logged in, customers also can request an official transcript from the NHI Registrar.

During the second phase, completed in August 2010, NHI launched the home page and navigation redesign. The updates included a new home page with changes to fonts, colors, and images; a new left-side navigation bar and site map at the bottom of each page; navigation options in the center-right of the home page; and a course search box on each page, which enables site users to find courses on any page at any time.



The redesigned home page features improved functionality.

Phase two of the NHI Web site redesign tackled the navigation and style issues of the original Web site, while maintaining all the strengths of the old Web site. For example, NHI retained several previous Web site features in the new design, such as displaying new courses on the home page, providing clear and informative course descriptions, maintaining an easy shopping and checkout process, and emailing updates to site users who sign up.

Overall, the improved design aims to make the NHI site more accessible and easy to read by giving users the information they need upfront. NHI expects that the streamlined content and simple design not only give regular users increased accessibility, but also will attract new users and potential customers.

Continuous Site Evolution

Although the phase one and two enhancements made dramatic changes to the site, NHI plans to make continual improvements over the next few years. The remaining improvements, though less significant than the already implemented changes, were developed based on the usability study. NHI will implement these additional changes gradually.

By the end of 2011, site users can expect to see updates such as Really Simple Syndication (RSS) feeds that enable customers to set preferences to receive email updates on specific NHI subject areas, print and share features, and improvements to the NHI Store to make downloading electronic documents faster and easier.

"Our mission at NHI is to improve the performance of the transportation industry through training, and our Web site is a critical tool for doing this," says Shelsta. "Using customer feedback, we will continue to evolve the Web site, as well as all NHI services, to meet the needs of the transportation community."

For more information, please visit www.nhi.fhwa.dot.gov.

Lilly Pinto is 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:

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

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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.

Interactive Highway Safety Design Model—*Highway Safety Manual* Predictive Method 2010 Release (Version 6.0.0, July 15, 2010)

The 2010 release of the Interactive Highway Safety Design Model (IHSDM)—*Highway Safety Manual* (HSM) Predictive Method (Version 6.0.0, July 15, 2010) is now available for free at www.ihsdm.org. The IHSDM is a suite of software analysis tools for evaluating safety and operational effects of geometric design decisions. The model enables users to check existing or proposed highway designs against relevant design policy values and provides estimates of a design's expected safety and operational performance. The 2010 release replaces all previous IHSDM versions.

The IHSDM 2010 release includes six evaluation modules: crash prediction, policy review, design consistency, intersection review, traffic analysis, and driver/vehicle. The updated Crash Prediction Module (CPM) is an implementation of the American Association of State Highway and Transportation Officials' HSM Part C: Predictive Methods for two-lane rural highways, multilane rural highways, and urban and suburban arterials. The CPM estimates the frequency of crashes expected on a roadway based on its geometric design and traffic characteristics. The crash prediction algorithms consider the effect of a number of roadway segment and intersection variables.

The IHSDM public software Web site (www.ihsdm.org) also provides access to IHSDM user documentation and information on data requirements, technical support, summaries of selected IHSDM user applications and case studies, and IHSDM-related current events.

Simultaneous Structural and Environmental Loading of a UHPC Component (TechBrief) Publication No. FHWA-HRT-10-055


TECHBRIEF

Simultaneous Structural and Environmental Loading of a UHPC Component

FHWA Publication No: FHWA-HRT-10-055

FHWA Contact: Ben Graybeal, HRDI-06, 202-493-3122, benjamin.graybeal@dot.gov

This document is a technical summary of the unpublished Federal Highway Administration (FHWA) report, *Simultaneous Structural and Environmental Loading of an Ultra-High Performance Concrete Component*, available through the National Technical Information Service (NTIS).

NTIS Accession No. of the report covered in this TechBrief: PB2010-110331

Objective

This TechBrief highlights the results of a study aimed at evaluating the inelastic tensile response of ultra-high performance concrete (UHPC) subjected to simultaneous structural and environmental loading.

Introduction

UHPC is an advanced cementitious composite material that has been developed in recent decades. When compared to more conventional concrete materials, UHPC tends to exhibit superior properties such as exceptional durability, high compressive strength, usable tensile strength, and long-term stability.[1,2]

Practical application of concrete in the highway infrastructure frequently subjects cracked sections to simultaneous mechanical and environmental stressors. This experimental investigation focused on the response of a UHPC beam subjected to concurrent inelastic flexural loading and 15 percent sodium chloride (NaCl) solution application. The results provided insight into the sustained robustness of UHPC structural members loaded beyond their tensile cracking strength.

UHPC

Advances in the science of concrete materials led to the development of new cementitious materials, namely UHPC. As a class, these concretes tend to contain high cementitious materials contents, low water-to-cementitious materials ratios,

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Ultra-high performance concrete (UHPC) is an advanced cementitious composite material developed in recent decades. When compared to more conventional concrete materials, UHPC tends to exhibit superior properties such as exceptional durability, high compressive strength, usable tensile strength, and long-term stability. FHWA studied the post-cracking tensile response of UHPC subjected to simultaneous structural and environmental loading. This TechBrief, a summary of the unpublished FHWA report, *Simultaneous Structural and Environmental Loading of an Ultra-High Performance Concrete Component*, provides more information on the study's objective, properties of UHPC, durability of cracked UHPC, test program description, and conclusions.

Practical application of concrete in the highway infrastructure frequently subjects cracked sections to simultaneous mechanical and environmental stressors. This experimental investigation focused on the response of a UHPC beam subjected to concurrent inelastic flexural loading and the application of a 15 percent sodium chloride solution. The study concluded that simultaneous application of structural and environmental loading to a UHPC flexural member did not result in any apparent degradation of the member's flexural capacity.

The document is available at www.fhwa.dot.gov/publications/research/infrastructure/structures/10055/

index.cfm. Printed copies are available from the PDC. Copies of the full, unpublished report are available from NTIS under PB2010-110331.

Development of a Speeding-Related Crash Typology (Summary Report) Publication No. FHWA-HRT-10-039

Seeking more effective ways to reduce speeding-related fatalities, injuries, and crashes, the U.S. Department of Transportation instituted the Speed Management Strategic Initiative. In support of this initiative, FHWA examined recent crash data by developing a speeding-related crash typology. This summary report discusses the literature review FHWA conducted, the analysis methodology used, and the results.

The speeding-related crash typology helped define the crash, vehicle, and driver characteristics that result in a higher probability of speeding-related crashes. The goal was to determine the what, where, when, and who descriptors of speeding-related crashes to provide guidance in the development of new treatments and to better target new and existing treatments to subgroups of drivers and types of roadways (such as two-lane rural) or roadway locations (such as curves).

The study used 2005 data from the two major national crash databases: the National Automotive Sampling System's General Estimates System (GES) and the National Highway Traffic Safety Administration's Fatality Analysis Reporting System (FARS). Researchers also used data from two States: 2002–2004 data from North Carolina and 2003–2005 data from Ohio. Two analysis methodologies were used: (1) single variable table analysis and (2) classification and regression tree (CART). The single variable analysis examined a series of both crash-related and driver- and vehicle-related variables. CART automatically defined which variables or factors are most critical in speeding-related crashes. The study concludes that the current focus on speeding is both well justified and of critical importance in further reducing the cost to society resulting from vehicle crashes in the United States.

The document is available at www.fhwa.dot.gov/publications/research/safety/10039/index.cfm. Printed copies also are available from the PDC.

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Paula Magoulas, Editor-in-Chief

September 28, 2010

Conferences/Special Events Calendar

Date	Conference	Sponsors	Location	Contact
January 9–12, 2011	Louisiana Transportation Conference	Louisiana Transportation Research Center	Baton Rouge, LA	Philip Macaluso 225-935-0140 or 225-303-3115 phillip.macaluso@la.gov www.ltrc.lsu.edu
January 17–21, 2011	World of Concrete Exhibition and Education Program	See show Web site for a list of cosponsoring organizations.	Las Vegas, NV	Jackie James 972-536-6379 jjames@hanleywood.com www.worldofconcrete.com
February 3–5, 2011	10th Annual New Partners for Smart Growth Conference	Local Government Commission	Charlotte, NC	Melissa Harper-Barton 916-448-1198 x327 mbarton@lgc.org www.newpartners.org
February 6–9, 2011	NAPA 56th Annual Meeting	National Asphalt Pavement Association (NAPA)	Orlando, FL	Sandy Palacorolla 888-468-6499 sandy@hotmix.org www.hotmix.org
February 13–17, 2011	ATSSA 41st Annual Convention and Traffic Expo	American Traffic Safety Services Association (ATSSA)	Phoenix, AZ	Melanie McKee 540-368-1701 melanie.mckee@atssa.com www.atssa.com
March 13–16, 2011	Geo-Frontiers 2011: Advances in Geotechnical Engineering	See conference Web site for a list of sponsors.	Dallas, TX	Deb Stender 651-225-6981 dlstender@ifai.com www.geofrontiers11.com
March 16–18, 2011	ICRI Spring Convention: Structural Health Monitoring	International Concrete Repair Institute (ICRI)	Houston, TX	Dale Regnier 847-827-0830 dale.regnier@icri.org www.icri.org
March 27–30, 2011	AAPT Annual Meeting	Association of Asphalt Paving Technologists (AAPT)	Tampa, FL	Eileen Soler 651-293-9188 aaptinfo@gmail.com www.asphalttechnology.org

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XXIV Congreso Mundial de Carreteras

Ciudad de México, del 26 al 30 de septiembre de 2011

XXIV World Road Congress

Mexico City, from September 26th to 30th of 2011

XXIV[e] Congrès Mondial de la Route

Mexico, du 26 au 30 septembre 2011

Para mayor información:
For further information:
Pour en savoir plus:
www.aipcrmexico2011.org

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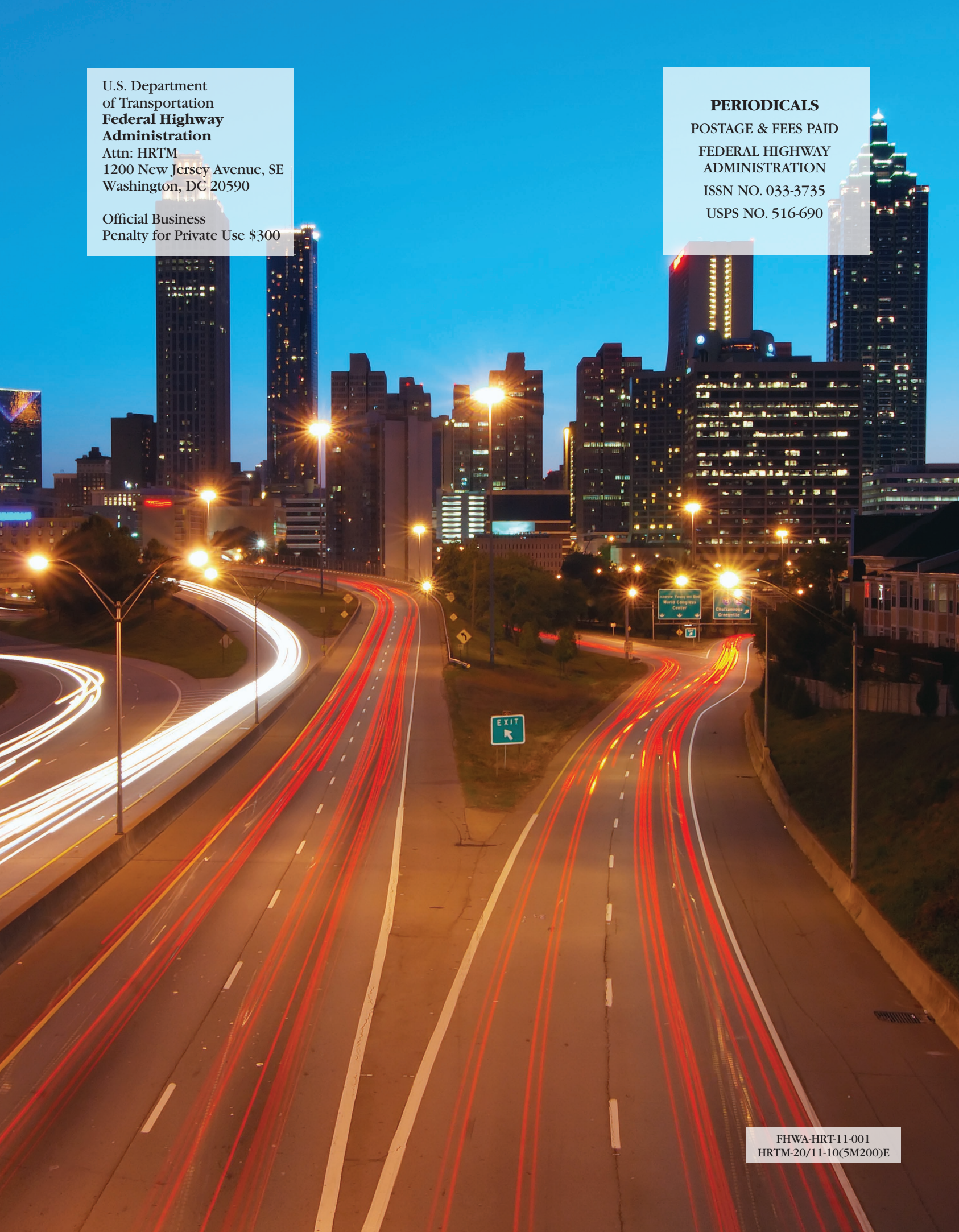

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