International Scan on Freeway
Geometric Design

Preliminary Findings and
Summary Briefing

Traffic Topics Seminar
June 16, 2011
Overview - Crisis of Congestion: Tax on U.S.

- **Commuting costs:** Each motorist stuck in traffic wastes on average 38 hours and 26 gallons of fuel every year - at a cost of $710* per person annually
- **Quality of life:** Reduced air quality, less time with family and friends
- **Productivity:** Delays to trucks and unreliability of delivery times increase costs for businesses and reduce economic competitiveness

*Texas Transportation Institute, 2007 *Urban Mobility Report*
**Overview - U.S. Congestion is Getting Worse**

*Texas Transportation Institute, *2009 Urban Mobility Report*

<table>
<thead>
<tr>
<th>Metric</th>
<th>1982</th>
<th>2007</th>
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<tbody>
<tr>
<td>Urban areas with Travel Time Index above 1.30</td>
<td>0</td>
<td>19</td>
</tr>
<tr>
<td>Percent peak period travel congested</td>
<td>29%</td>
<td>63%</td>
</tr>
<tr>
<td>Percent of major road system congested</td>
<td>29%</td>
<td>48%</td>
</tr>
<tr>
<td>Hours of day congestion encountered</td>
<td>4.2 hr</td>
<td>7.0 hr</td>
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Peak-Period Congestion on the National Highway System: 2002

Note: Highly congested segments are stop-and-go conditions with volume/service flow ratios greater than 0.95. Congested segments have reduced traffic speeds with volume/service flow ratios between 0.75 and 0.95.

Peak-Period Congestion on the National Highway System: 2035

Note: Highly congested segments are stop-and-go conditions with volume/service flow ratios greater than 0.95. Congested segments have reduced traffic speeds with volume/service flow ratios between 0.75 and 0.95.

National Vision Statement

“Our goal is to effectively use every inch of pavement so that we have the most efficient transportation system possible.”

Victor Mendez
Federal Highway Administrator
September 2009
International Technology Scanning Program

- Evaluates innovative foreign technologies and practices that could significantly benefit U.S. transportation systems
  - More than 80 international scans since 1990

- Sponsored by AASHTO, FHWA, and NCHRP

- Scan reports accessible via FHWA Office of International Programs
  - [www.international.fhwa.dot.gov](http://www.international.fhwa.dot.gov)
International Technology Scanning Program

2006 European Scan on Active Traffic Management
Freeway Geometric Design Scan - Purpose

- To examine the use of innovative geometric design practices and techniques being used in other countries to improve the operational performance of congested freeway facilities, without compromising safety.
Scan Team Members

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• Brooke Struve, Design Program Manager, FHWA

• Barton Thrasher, Assistant State Location and Design Engineer, Virginia Department of Transportation

• Elizabeth Young, Senior Supervising Transportation Planner, Parsons Brinckerhoff
Countries Visited

- Spain (Valencia)
- Germany (Hessen, Rhineland/Pfalz)
- Netherlands (Den Hague, Delft)
- United Kingdom (Birmingham)
Freeway Geometric Design Scan - Major Topic Areas

- Geometric Design
- Performance Measures
- Planning
- Benefits and Lessons Learned
General Findings

- European nations are facing growing traffic and congestion on their freeway networks
  - Spain - actively building new roadways
  - Germany - mature freeway networks with some opportunities for building new or widened facilities
  - Netherlands and England - mature freeway networks with few plans for new motorways
General Findings

- In England, the Netherlands, and Germany, highways agencies are responding to traffic growth by implementing:
  - Managed systems to better utilize the existing roadway footprint
  - Performance-based and risk-based approaches to making highway design choices

Example: Variable Shoulder Use and Variable Speed Limit Sign (The Netherlands)
“Managed Motorways”

- A toolbox of techniques applied to provide better safety and travel time reliability on urban motorway sections

- Managed motorway techniques integrate roadway design with operational strategies
Managed Motorways Toolbox

Variable speed limits
Speed harmonization
Line (lane) control
Queue detection & warning systems

Traffic surveillance and monitoring
Incident management
Enforcement (mobile and/or automated)

Traffic delay warnings
Alternative route information

Shoulder running
Emergency refuge areas
Overtaking (passing) bans
Ramp metering
Preliminary Findings - Design

- English Highways Agency evolving approach to designing improved motorways: rather than start with an ideal standard and step down (i.e. request design exceptions), begin with the absolute minimum for a feature (e.g., lane width) and expand as the conditions will allow.

- Constraints such as right-of-way, social and environmental impacts, and funding levels may dictate what design choices are possible and practical.
Preliminary Findings - Design

- English Highways Agency utilizes performance-based design approaches that first consider the desired goals and objectives of the transportation facility and then establish project design criteria accordingly.

- Assess the risk of using “less than typical” design dimensions based on the operational regime of the managed lanes and the physical characteristics of the eligible vehicles.
Preliminary Findings - Design

A variety of practices were noted for when an existing cross section width is reallocated to provide an additional lane

- Narrowed lane widths between 2.75 and 3.5 m (9.0 to 11.5 ft) were observed
- In some locations, lane widths varied within the cross section with narrower widths in the inside lanes
- These facilities would typically include a truck no-passing restriction that would restrict trucks from the more narrow lanes
Preliminary Findings - Design

Modern perspectives on shoulder functionality

- Fewer vehicle breakdowns than when motorways were first constructed
- Discouraged use of left-side shoulder for break-downs

The Netherlands
Example: Limited Shoulder Width on Motorway (Birmingham, England)
Preliminary Findings - Design

“Hard Shoulder Running”

• Utilizing the hard (paved) shoulder as an additional running lane during peak and congested periods to facilitate greater volumes of traffic, minimize congestion and improve trip time reliability
Example: Temporary Shoulder Use - just beyond entrance ramp (Netherlands)
Preliminary Findings - Design

“Hard Shoulder Running”

• Each of the countries visited had a general practice of **reducing the speed limits** within freeway sections under shoulder running conditions
Example: Shoulder Running and Reduced Speed Limit (Germany)
Example: Shoulder Running and Reduced Speed Limit (Birmingham, England)
Shoulder Running Operational Strategies

- Temporary shoulder usage
  - Between Junctions
  - Through Junctions
- Permanent use of shoulders
Example: Shoulder Running between interchanges only (England)
Example: Shoulder use variable signing (England)

Sign legends approaching the junction (interchange)

Shoulder Closed thru Junction

Shoulder Open thru Junction
Example: Shoulder use variable signing (England)

Sign legends used at entrance ramp merges

Shoulder Closed Downstream

Shoulder Running On (crossing edge line)
Shoulder use variable signing (England)

Variable message sign on entrance ramp showing shoulder running open (left sign) or displaying a blank gray background at other times (right)
Example: Pavement markings for thru junction shoulder running (Birmingham, England)
Preliminary Findings - Design

- When the shoulder can be used as a travel lane - either temporarily or permanently - emergency refuge areas were added
- Spacing varies by facility and country
Preliminary Findings - Design

- The design and operation of managed freeways must be considered simultaneously.

- Design choices should be influenced by the dynamic operating characteristics and the eligible vehicles.
Speed Harmonization

- Introduced through variable (reduced) speed limits
- Improves traffic flow and maximizes through-put
- Warns vehicles approaching the back of congestion queue
- Speed limit set automatically using data from surveillance (loop detectors and/or cameras) detecting changes in traffic conditions

- Communicating the reason for the lower speed along with enforcement is essential for obtaining driver respect
  - “Trust equals compliance”
  - Speed limit needs to be reasonable and the benefits of lower speeds obvious
  - “Going slower to get there faster”
Traffic Surveillance & Incident Management

- Service Patrols
- In-Pavement Loop Detectors
- Surveillance Cameras

Traffic Monitoring, Response and Management Centers
Automated Speed Enforcement

England

The Netherlands
Line (Lane) Control
Line (Lane) Control
Ramp Metering

The Netherlands
Preliminary Findings - Performance Measures

- Performance measures being used:
  - Travel time reliability
  - Decrease in hours of congestion
  - Safety improvement

![Diagram showing duration of congestion in Hessen (hr) from 2001 to 2008. The bars are color-coded to represent traffic, accidents, roadworks, and breakdowns.]
Preliminary Findings - Planning

- National or state policy drives solutions
  - “Congestion Free Hessen 2015”
    - Future technologies
    - Traffic management
    - Mobility services

- Hazard Index
  - England
Preliminary Findings - Lessons Learned

- The management and design approaches for a freeway corridor will differ as it evolves (matures, progresses)
- Dynamically managing the use of the cross section has proven advantages for improving safety and mobility
- Collaborative design process across disciplines - symbiotic nature of freeway design and operations
- Project will only be successful if public perceives it to be successful (despite what data may say)
- Education of drivers and stakeholders is key
Preliminary Implementation Plan

- Synthesis of managed freeway geometric design practices and associated operational and safety performance for both European and US applications
  - Identify the characteristics of circumstances where managed freeway treatments are likely to be successful

- Coordination of design issues with on-going Active Traffic Management research, guidance and US case study efforts currently underway by FHWA Office of Transportation Management
Preliminary Findings - Research Needs

- Driver understanding and information overload concerns for managed lanes on high-volume “complex” freeways

Birmingham, England
Preliminary Findings
Research Needs:

Signing & Markings for US Applications of Shoulder Running
Preliminary Implementation Plan

- U.S. applications for applying the hazard index approach developed by UK Highways Agency
  - perhaps with eventual integration into the AASHTO Highway Safety Manual as appropriate

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<tr>
<th>Severity Classification</th>
<th>Interpretation</th>
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<tr>
<td>Severe</td>
<td>The proportion of collisions that are fatal is expected to be higher than average by at least a factor of 10</td>
</tr>
<tr>
<td>Higher than average</td>
<td>The proportion of fatal collisions is expected to be higher than average by a factor between 3 and 10</td>
</tr>
<tr>
<td>Average</td>
<td>The distribution of collisions (i.e. ratio of damage-only to fatal) is expected to be similar to the motorway average</td>
</tr>
<tr>
<td>Lower than average</td>
<td>The proportion of fatal collisions is expected to be lower than average by a factor between 3 and 10</td>
</tr>
<tr>
<td>Minor</td>
<td>The proportion of collisions that are fatal is expected to be lower than average by at least a factor of 10</td>
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Preliminary Implementation Plan

- Query the AASHTO Technical Committee on Geometric Design for potential future additions to the Green Book, such as general language on managed lanes, emergency refuge areas, etc., as well as potential enhancements to discussion of flexible design practice.
- Assess updating AASHTO Guide for HOV Facilities and broadening to include Active Traffic Management principles.
- Request to FHWA for clarification of federal policy and position on eligibility and use of managed freeway tools.
- Query the FHWA and NCUTCD to determine possible updates needed to the MUTCD for managed freeway applications.
Questions?