Freeway Geometric Design for Active Traffic Management in Europe

International Scan Findings and Recommendations

December 9, 2010 1:00 PM - 2:30 PM EST
International Technology Scanning Program

- Evaluates innovative foreign technologies and practices that could significantly benefit U.S. transportation systems
  - More than 80 international scans since 1991

- Sponsored by AASHTO, FHWA, and NCHRP

- Scan reports accessible via FHWA Office of International Programs
  - www.international.fhwa.dot.gov
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Purpose of Scan

- To examine the design practices used with active traffic management techniques in other countries to improve the safety and operational performance of congested freeway facilities.

England

The Netherlands
Countries Visited

- Spain (Valencia)
- Germany (Hessen, Rhineland/Pfalz)
- Netherlands (Den Hague, Delft)
- United Kingdom (Birmingham)
Managed Motorways

- Suite of complementary techniques applied to provide better safety and travel time reliability on motorway sections
- Techniques integrate roadway design with operational strategies

The Netherlands
(source: presentation to scan team)
Managed Motorway Strategies

Variable speed limits
Speed harmonization
Line (lane) control
Queue detection & warning systems
Traffic delay warnings
Alternative route information
Traffic surveillance and monitoring
Incident management
Enforcement (mobile and/or automated)
Shoulder running
Emergency refuge areas
Overtaking (passing) bans
Ramp metering
Hard Shoulder Running (HSR)

- 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 journey time reliability.

The Netherlands

England
Functionality of Shoulders

Modern perspectives on shoulder functionality

- Fewer vehicle breakdowns than when motorways were first constructed
- Discouraged use of inside shoulder for breakdowns

England, driving on left

The Netherlands
Germany: Sign Legend
Also Used in Netherlands

Use Hard Shoulder
End Hard Shoulder Use
Leave Hard Shoulder

Germany (Source: Lemke, 4th International Symposium)

The Netherlands
(Source: Scan Team)
England: Sign Legends on Entrance Ramp

Shoulder running allowed

Blank gray background: shoulder running not allowed

(Source: England Highway Agency)
England: Potential Sign Legends for Entrance Ramp

Shoulder Closed Downstream

Shoulder Running On

(Source: presentation to scan team)
England: Potential Sign Legend for Exit Ramp

Shoulder Closed thru Junction

Shoulder Open thru Junction

(Source: presentation to scan team)
Pavement Markings

**England**, note solid lane line separating shoulder (closed to shoulder running) and travel lane (source: scan team)

**The Netherlands**, note 9:3 spacing on Plus Lane markings compared to 3:9 spacing for markings on other lanes (source: Google Earth)
Pavement Markings for Shoulder Running through Junctions

England, At exit ramp

Netherlands, Downstream of entrance ramp
Allocation Cross Section

- Variety of practices noted for reallocating cross section to provide additional lane
- Narrowed lane widths between 2.75 and 3.50 m (9.0 to 11.5 ft) discussed
- In some locations, lane widths varied
  - Narrower widths in the inside lanes (typically include truck no-passing restriction)

(Source: Lemke, 4th Geometric Design International Symposium)
Variable Speed Limit

- Each of the countries visited had a general practice of reducing the speed limits within sections having permanent or temporary shoulder running

Germany
(Source: Hessen, Germany website)
Speed Harmonization

- Introduce via variable (reduced) speed limit
- Improve flow of traffic
- Warn vehicle approaching back of queue

Algorithm
- Uses data from surveillance (loops or cameras)
- Automatically reduces speed based on real-time traffic conditions

- Need to communicate reason for speed reduction
- “Go slower to get there faster”
Variable Message Signs

- Each of the countries visited also used variable message signs

(source: presentation to scan team)

England
Speeds in mph
(source: scan team)
Emergency Refuge Areas

- Emergency refuge area added when shoulder is used (either temporarily or permanently)
- Spacing of the refuge areas varied by facility and country

England (source: scan team)
Traffic Surveillance & Incident Management

Traffic Monitoring, Response and Management Centers

Surveillance Cameras

Service Patrols

In-Pavement Loop Detectors

(source: scan team)
Automated Speed Enforcement

England

The Netherlands

(source: scan team)
Line (Lane) Control
Line (Lane) Control
Line (Lane) Control
Interchange Lane Control

The Netherlands

(source: presentation to scan team)
Ramp Metering

The Netherlands
Performance Measures

- Improve travel time reliability
- Decrease congestion
- Improve safety

![Duration of Congestion in Hessen (hr)](chart)

- **traffic**
- **accidents**
- **roadworks**
- **breakdowns**
Increased flows and reduced journey times suggests that 4 Lane Variable Speed Limits (4LVSL) is delivering real benefits.

The graph to the left indicates the situation AFTER 4LVSL.
Planning

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

- Hazard Index
  - England
Lessons Learned

- The management and design approaches for a freeway corridor will differ as it ____ (evolves, matures, progresses)
- Project will only be successful if public perceives it to be successful (despite what data may say)
- Education of drivers and stakeholders is key
Key Observations

- **Managed Motorways work**
  - Dynamically managing the use of the freeway cross section has great potential advantages for improving safety and mobility
  - Potential for great benefit in USA
  - Applicable to all metro areas and high volume corridors
Key Observations

- European countries have addressed safety concerns
- England, Germany, and Netherland have identify improvements in safety

The Netherlands, 3 yr before data, 2 yr after data
Key Observations

- **Paradigm shift** in design policies and practices for actively managed freeway facilities
  - Risk based and performance based design decision making
  - Dynamic vs. static approaches to design
Key Observations

- **Synergistic relationship** of traffic management concepts
- Integrated and dynamic approaches that may evolve as needs and demands change (a continuum of freeway management)
Key Observations

- Collaboration of design with operations & enforcement
Key Needs for Implementation

- Champion at the highest level
- Overcoming “we never did this before” syndrome
- Institutionalizing and culture change
- Funding the continuing operations
Scan Team Implementation Plan

- Dissemination of Scan Findings and Recommendations
- Efforts to Gather Further Details on Key Issues
- Research Recommendations
- Developing Supplemental Design Guidance
Dissemination of Scan Findings and Recommendations

- Summary Report
- Presentations
- Disseminate Results of US Active Traffic Management Pilot Projects
  - US Demonstration Showcase
    - Seattle - I-5, SR-520, I-90
    - Minneapolis - I-35W
Efforts to Gather Further Details on Key Issues

- Coordination of Managed Freeway Geometric Design Practices with On-going Efforts for the Active Traffic Management Guidebook
- Potential Application of United Kingdom’s (UK) Risk-Based Design Approaches and Hazard Log Index for US Practices
- Public Education and Stakeholder Involvement Needed for Success
Research Needs

- Hazard index approach developed by U.K. Highways Agency applicable?

<table>
<thead>
<tr>
<th>Severity Classification</th>
<th>Interpretation</th>
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<tbody>
<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>
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<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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Research Needs

- Signing and markings for U.S. applications

The Netherlands
Research Needs

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

- Research is needed to understand the extent to which European design standards are modified to implement ATM, and the considerations for making those design decisions.
- Research is also needed to support updates of geometric design guidelines in the US for modification of the highway cross-section for ATM (specifically in regard to:
  - Lane width
  - Lane widening on horizontal curves
  - Sight distance on horizontal curves
  - Lateral offset and/or clear zone
  - Ramp terminal design
  - Location and design of emergency refuge

(Source: Lemke, 4th Geometric Design International Symposium)
Questions?