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Identification and Evaluation of the Cost-Effectiveness of Highway Design Features to Reduce Nonrecurrent Congestion

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Project Objectives

**Identify the full range** of possible roadway design features to improve travel time reliability and reduce delays due to nonrecurrent congestion.

**Assess** their costs and operational / safety effectiveness.

**Provide recommendations** for their use and eventual incorporation into design guides.
Project Scope

Evaluation and assessment of design treatments that:

- Address at least one of the primary causes of nonrecurrent congestion
  Traffic incidents
  Work zones
  Demand fluctuations
  Special events
  Traffic control devices
  Weather

- Directly or indirectly involve geometric design

Inclusion of all facility types of potential interest

Freeways | arterials
Roadway segments | intersections
Signalized | unsignalized
What is a Design Treatment?

- **Design treatment:**
  - A highway design feature

- **Directly-design related treatments:**
  - Implemented through physical changes in the highway design that have a direct influence on traffic flow

- **Indirectly-design related treatments:**
  - Not intrinsically highway design features, but have secondary implications related to highway design
Directly Design-Related Treatments

- Median crossovers
- Moveable traffic barriers
- Controlled/gated turnarounds
- Movable cable median barrier
- Mountable/traversable medians
- Extra-height median barrier
- Portable incident screens
- Shoulder-use lanes
- Shoulder improvements for vehicle breakdown and storage
- Alternating shoulder
- Vehicle turnouts
- Bus turnouts
- Crash investigation sites
- Emergency access between interchanges
- Ramp widening
- Ramp closure
- Ramp terminal traffic control
- Ramp turn restrictions
- Improvements to detour routes
- Temporary bridges
- Runaway truck ramps
- Reduced construction duration
- Improved work site access
- Snow fences
- Anti-icing systems
Indirectly Design-Related Treatments

Contraflow lanes for emergency evacuation
Contraflow lanes for work zones
HOV/HOT lanes
Dual facilities
Reversible lanes
Work zone express lanes
Traffic signal preemption
Queue jump lanes
Traffic signalization improvements
Signal timing systems
Reversible traffic control devices
Ramp metering/flow signals
Temporary traffic signals
Variable speed limit
Electronic toll collection
Over-height vehicle detection systems
Reference location signs
Roadside call boxes
Fog detection
Road Weather Information System
Avalanche warning system
Flood warning system
Wind warning system
Phase II

- Objective:
  - To assess design treatments for reduction of delay due to nonrecurrent congestion

- Traffic operational assessment

- Safety assessment

- Benefit-cost analysis
Traffic Operational Assessment

Hybrid Approach

- Development of spreadsheet-based analysis tools to apply models from SHRP 2 Project L03

- VISSIM simulation modeling to estimate delay reduction due to design treatments
What Project L03 Gave Us

Prediction Functions for **TTI and Reliability** based on Operational Variables

**Cumulative Frequency**

- 10%  
- 50%  
- 80%  
- 95%  
- 99%

**Travel Time Index (TTI)**

- 1.0  
- 2.0  
- 3.0  
- 4.0  
- 5.0

**TTI_{n\%} (●) as a function of:**

- \((d/c_{crit})\) Critical demand/capacity ratio
- \((LHL)\) Lane-hours lost due to incidents and work zones
- \((R_{0.05''})\) Hours of rainfall exceeding 0.05 inches

**Freeways in large, urban areas**

**Peak periods**
Project L07’s Hybrid Operational Analysis Approach

Custom Analysis Tool | Microsimulation Support

- Establish base reliability/delay conditions for an analysis segment
- Estimate the effects of design treatments based on either:
  - Reduction in LHL
  - Increase in $d/c_{crit}$
Project L07’s Hybrid Operational Analysis Approach

- Estimate the delay impacts of various design treatments over a range of conditions (volumes, incident duration, capacity reductions, and treatment-specific effects).
- Incorporate results into the spreadsheet analysis tool to widen the range of situations covered.

Freeways in rural and small/medium urban areas
All freeways during off-peak periods
Safety Assessment

- Determine relationship between safety and various levels of congestion
- Three years of traffic operational data (5-min volume and speed data)
- Crash data from FHWA’s Highway Safety Information System (HSIS)
Phase III
Design Guidebook

- Treatment assessment for each treatment
- Treatment selection procedure
- Treatment selection tool
- Full implementation guidance
Questions?