



Project Summary Report 1848-S

Project O-1848: Geometric Design Guidelines to Accommodate  
Incident Management Strategies

Authors: Angelia H. Parham, P.E., Mark D. Wooldridge, P.E., David W. Fenno, P.E.,  
Kay Fitzpatrick, P.E., Debbie Jasek, and Stephen E. Ranft

## Design Guidelines to Accommodate Incident Management

Traffic incidents on Texas' urban highways are becoming an increasing source of delay, congestion, safety problems, and poor air quality. Every day, traffic incidents impede mobility on urban, suburban, and rural highways.

In Texas cities during 1992 alone, incidents were the source of more than 450,000 hours of delay, costing the motoring public approximately \$2.45 billion.<sup>1</sup> Additionally, non-recurrent congestion due to an accident, stalled vehicle, or spilled load leads to unexpected delay and magnifies driver frustration. Incident-caused congestion may also lead to secondary accidents by causing unexpected stops or slowdowns.

An effective incident management program can significantly reduce the effects of incidents on freeways. Many incident management strategies depend on some aspect of geometric design; the travel time required for emergency vehicles to reach the site of the incident, for example, is affected by accessibility to the incident.



*Emergency crossovers can facilitate incident response.*

Freeway features such as refuge areas, emergency crossovers, and incident location strategies may enable emergency personnel to respond to incidents in a safer and more timely manner.

### *What We Did . . .*

Researchers reviewed existing literature, administered a survey of those involved in incident management, and made on-site visits to locations that have implemented selected incident management strategies.

A survey was mailed to 158 city and state transportation agencies and fire, police, and

other emergency response agencies in the larger cities within the United States. The survey identified incident management techniques being used successfully, along with the corresponding geometric requirements needed for the techniques to work effectively.

Researchers conducted phone interviews as a follow-up to the written survey. The interviews provided additional information about specific incident management techniques identified in the written responses. Researchers then conducted on-site meetings

<sup>1</sup> Incident Management in the United States: A State-of-the-Practice Review, for Korea Road Traffic Safety Association, final report. Texas Transportation Institute, College Station, Texas, November 1997.



and/or made on-site visits in the following locations: Houston, Texas; Ft. Worth, Texas; Atlanta, Georgia; Charlotte, North Carolina; Winston-Salem, North Carolina; Virginia; Maryland; Chicago, Illinois; Las Vegas, Nevada; Los Angeles, California; and Washington, D.C.

## What We Found . . .

Researchers combined results from these efforts with existing geometric design principles to develop guidelines for accommodating incident management strategies.

### Emergency Crossovers

The presence of emergency crossovers can facilitate incident response by allowing emergency vehicles to bypass traffic queues or to recover from incident location errors.

The guidelines recommend the provision of emergency crossovers in locations with large distances between interchanges.

#### *Emergency crossovers should provide:*

- crossings in rural, suburban, and urban areas where distance between interchanges exceeds 1.5 miles,
- an improved surface,
- powered gates that meet current crash test requirements for breaks in median barriers, and
- a sign saying “Official Vehicles Only.”
- Emergency crossovers should not have to provide advance warning signs.

### Incident Location

Accurately locating incidents is critical for effective incident response. Although partially redundant with other systems, the use of closely spaced reference markers on urban freeways appears to be an effective aid.



*Screening and tall barriers can reduce the negative impact of incidents for opposing traffic.*

#### *The guidelines recommend the following practices:*

- Use reference markers at 0.1 mile spacing on urban freeways.
- Use ramp markers to identify specific ramps.
- Define ramps as roadways for improving accident record accuracy.

#### *Potential redundancies are:*

- freeway monitoring, and
- the 911 locating system currently under investigation.

### Screening/Tall Barriers

Screening and tall barriers reduce the negative impact of incidents on freeway capacity for traffic traveling in the opposing direction. Local experience is the best indicator of areas where screening can be effective.

#### *Our findings suggest that:*

- Tall concrete barriers appear to be the best permanent construction method.
- Glare screens may be placed on top of low concrete barriers in spots where tall concrete barriers cannot be used.

### Refuge Areas/Accident Investigation Sites

Refuge areas include emergency pull-off zones and accident investigation sites. Accident investigation sites are designated and signed areas off the freeway where damaged vehicles can be moved, motorists can exchange information, and police and motorists can complete necessary accident report forms. These sites help minimize disruption to freeway and arterial traffic flow.

Emergency pull-off zones are designated areas that are typically provided along roadway sections with little or no shoulder width. Pull-off zones provide sites for the temporary relocation of damaged or broken-down vehicles or for law enforcement purposes.

The typical layout for an accident investigation site includes a paved parking area that will accommodate a minimum of five vehicles, is easily accessible, is well marked, has sufficient lighting, and is not located in a high crime area. The construction or layout of the site should also take into account the





Refuge areas include emergency pull-off zones and accident investigation sites.

traffic stream of the roadway, such as the amount of truck or commercial vehicle traffic.

Public awareness of refuge areas is crucial for the sites to be part of a successful incident management program. The public must be educated on the availability, purpose, and location of refuge areas, and they must also be informed about legal implications and procedures for moving vehicles to the sites. The guidelines recommend the use of refuge areas with the following suggestions:

- Use refuge areas where the right shoulder does not allow refuge.
- Locate areas adjacent to or within sight of the freeway lanes.
- Make the area large enough to allow easy movement of tow, police, and fire vehicles. An acceptable nominal size is 45 feet (14 m) by 150 feet (46 m).
- Provide for acceleration and deceleration distances on separate entrances and exits to limit the possibility of wrong-way movements.

- Provide 911 telephone access.
- Include a median between the site and the main lanes to provide a separation distance equal to the required horizontal clearance or clear zone.
- Include advance signing.

#### Equipment Storage Sites

Incident equipment storage sites are specially designated areas for the parking of towing and recovery equipment sometimes used near high-incident or other critical facilities. They may store emergency supplies to speed and increase the efficiency of clearing an incident. The guidelines do not recommend their use for TxDOT.

#### Redundancies are:

- pre-loaded DOT trucks/trailers, and
- courtesy patrol operations.

#### Concerns include:

- control of material,
- access rights,
- ROW for site,
- replenishment, and
- aesthetics.

#### Shoulder Lanes

Roadway shoulders are sometimes used as travel lanes to facilitate clearing traffic during incidents or in high-demand situations. The use of shoulder lanes for a short period is appropriate when directed by officers on the scene (using police or emergency flaggers). The guidelines do not recommend their use on a permanent or scheduled basis.

#### Concerns include:

- safety impacts because of the lack of a safe breakdown area,
- lack of acceptable area for enforcement activities,
- increased incident response time due to shoulder blockage, and
- habitual usage could potentially cause problems.

### Researchers Recommend . . .

The researchers recommend using the guidelines for emergency crossovers, incident location, barrier screens, and refuge areas as described in the previous sections. The researchers do not recommend the use of equipment sites or shoulder lanes. The guidelines will help ensure that Texas Department of Transportation (TxDOT) designs for new construction and for roadway rehabilitation recognize the importance of incident management to the safe and efficient operation of the roadway system.



## *For More Details . . .*

The research is documented in Report 1848-1: *Geometric Design Guidelines to Accommodate Incident Management*

Research Supervisor: Mark D. Wooldridge, P.E., Texas Transportation Institute, m-wooldridge@tamu.edu, (979) 845-7321

TxDOT Project Director: Enoch (Bubba) Needham, P.E., TxDOT Austin District, ENeedham@mailgw.dot.state.tx.us, (512) 832-7053

**To obtain copies of the report, contact Dolores Hott, Texas Transportation Institute, Information & Technology Exchange Center, (979) 845-4853, or email d-hott@tamu.edu. See our on-line catalog at <http://tti.tamu.edu>.**

## *TxDOT Implementation Status August 2000*

**By William E. Knowles, P.E., Design Research Engineer**

**Phone: (512) 465-7648 or e-mail wknowle@dot.state.tx.us**

TxDOT believes that the geometric design guidelines developed to accommodate incident management will be a useful design tool for new construction projects and rehabilitation projects. The guidelines are being incorporated into the TxDOT Roadway Design Manual.

The guidelines provide roadway designers with recommendations for the application of emergency crossovers, improved incident location identifiers, screening, refuge areas, and equipment storage areas for incident management. The guidelines do not recommend the application of shoulder lanes for incident management on a permanent or scheduled basis. Temporary use of shoulder lanes for incident management is recommended.

## *YOUR INVOLVEMENT IS WELCOME!*

This research was performed in cooperation with the Texas Department of Transportation (TxDOT) and the U.S. Department of Transportation, Federal Highway Administration (FHWA). The contents of this report reflect the views of the authors, who are responsible for the facts and accuracy of the data presented herein. The contents do not necessarily reflect the official views or policies of TxDOT or the FHWA. This report does not constitute a standard, specification, or regulation, nor is it intended for construction, bidding, or permit purposes. Trade names were used solely for information and not for product endorsement. This report was prepared by Angelia Parham (TX-87,210), Mark Wooldridge (TX-65791), David Fenno (TX-84643), Kay Fitzpatrick (TX-86,762), Debbie Jasek, and Stephen Ranft.