Special issue: urban crashes

STATUS REPORT

INSURANCE INSTITUTE FOR HIGHWAY SAFETY

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BEEP, SMASH, THUD

Traffic engineering methods to reduce urban crashes

The classic vexation of urban driving is a gridlocked city street. Not much better are suburban roads with more and more traffic that moves faster than in the city. Both routes breed collisions.

Fatal crashes occur more often on rural roads, but most crashes of all severities occur in urban areas. Population- and vehicle-based crash rates are higher in cities and suburbs than in rural areas. Insurance claims for vehicle damage go up as vehicle density per square mile increases. Three of every four pedestrian deaths occur on city streets.

TRAFFIC SIGNAL TIMING, VISIBILITY

"Relatively simple engineering solutions exist to address urban crashes, but these methods don't always get proper attention," Institute President Brian O'Neill points out. "We ought to be looking at them because physical changes to the roadway environment can improve safety for vehicle occupants and pedestrians alike."

Four crash types — running traffic controls, rear-end, left turn, and running off the road — account for more than 75 percent of all urban injury crashes (see *Status Report*, Vol. 28, No. 2, Feb. 6, 1993). Pedestrian crashes constitute a relatively small percentage of the crash total, but they often result in serious injuries.

"We understand the dynamics of urban crashes and what it takes to prevent many of them," says Richard Retting, Institute senior transportation engineer. "A range of measures starting with traffic signal timing and visibility improvements can help."

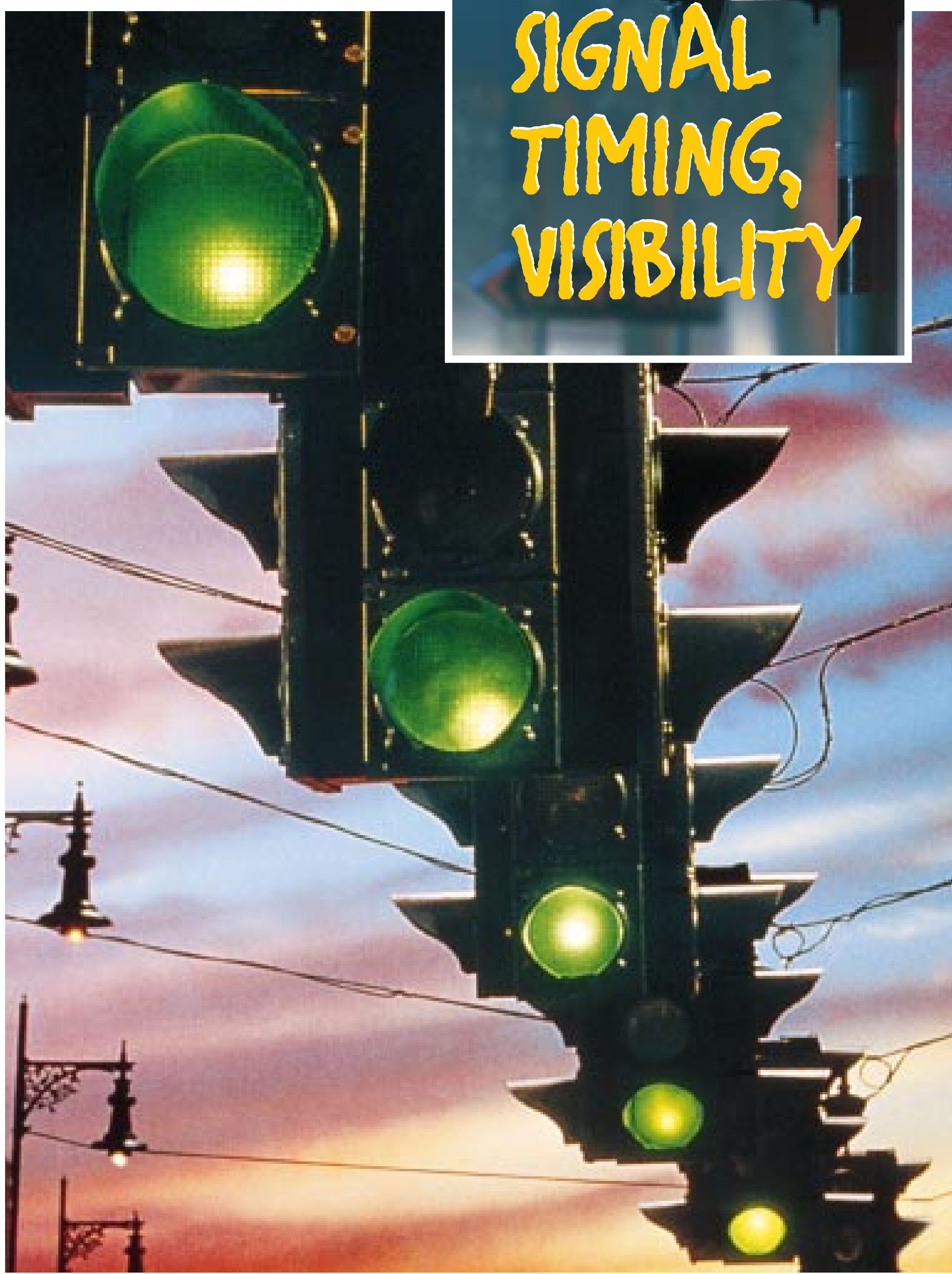
This special *Status Report* points to traffic engineering approaches — some relatively simple, others more comprehensive — to reduce urban crashes. References to the studies on which these approaches are based appear on page 7.

Traffic signal timing: Some rear-end collisions could be prevented by improving the timing of traffic signals to reduce vehicle stops. Considerable advances have been made in designing and implementing computer-based signal control systems (GAO, 1994). More specific and less expensive timing measures also can help. These include automatic methods that would reduce unnecessary traffic delays.

Another measure is to ensure adequate signal clearance intervals (yellow light plus brief red-in-all-directions that separate conflicting traffic flows). Inadequate clearances increase the proportion of drivers who enter intersections without enough time to go through before the light turns red. Research indicates that small increases in the duration of the yellow and all-red could eliminate many cross-traffic conflicts (Zador et al., 1985; Retting and Greene, 1995). However, no universal practice exists for selecting the duration of intervals.

Signals, lanes for turning left: Crashes involving left-turning vehicles don't occur as often as other major crash types, but they're associated with high injury rates. The majority of these crashes occur at urban intersections equipped with traffic signals.

Installing signal displays to permit left turns only when the opposing traffic is stopped reduces crashes at intersections (Upchurch, 1991). Adding separate lanes for turning vehicles has been found to reduce both left-turn and rear-end crashes (McCoy and Malone, 1989).



Traffic signal visibility: Enhanced signal visibility cuts down on inadvertent red light running. Converting signals to high intensity displays is reported to reduce daytime crashes, especially crossroad collisions (Greater London Road Safety Unit, 1974). Installing an additional signal head was cited as an effective countermeasure at some sites (Polanis, 1992).

Making time for pedestrians to cross: About 37 percent of all pedestrian injury crashes and 20 percent of fatal crashes occur at intersections. A relatively simple and inexpensive countermeasure is a three-second leading pedestrian signal interval. This allows pedestrians to enter a crosswalk before the drivers of turning vehicles see a green light, thus reducing conflicts and making it easier for the pedestrians to cross (Van Houten, Retting et al., 1997).

Other low-cost interventions to help pedestrians at intersections include signs, pavement markings, and taped voices warning pedestrians to look for turning vehicles (Retting et al., 1996; Van Houten, Malenfant et al., 1997).

Traffic signal removal: When there's a safety problem on urban streets, a common response is to add a signal light. But this doesn't necessarily solve the problem. Retting points out that "the opposite approach is needed in some cases. Removing the lights at intersections with low traffic volumes actually enhances safety in many situations."

A signal removal program in Philadelphia shows the benefits (Persaud et al., 1997). From 1978 to 1992, more than 400 signal lights were replaced with four-way stop signs at mainly low volume intersections involving one-way streets. The result was an estimated crash reduction of about 24 percent.

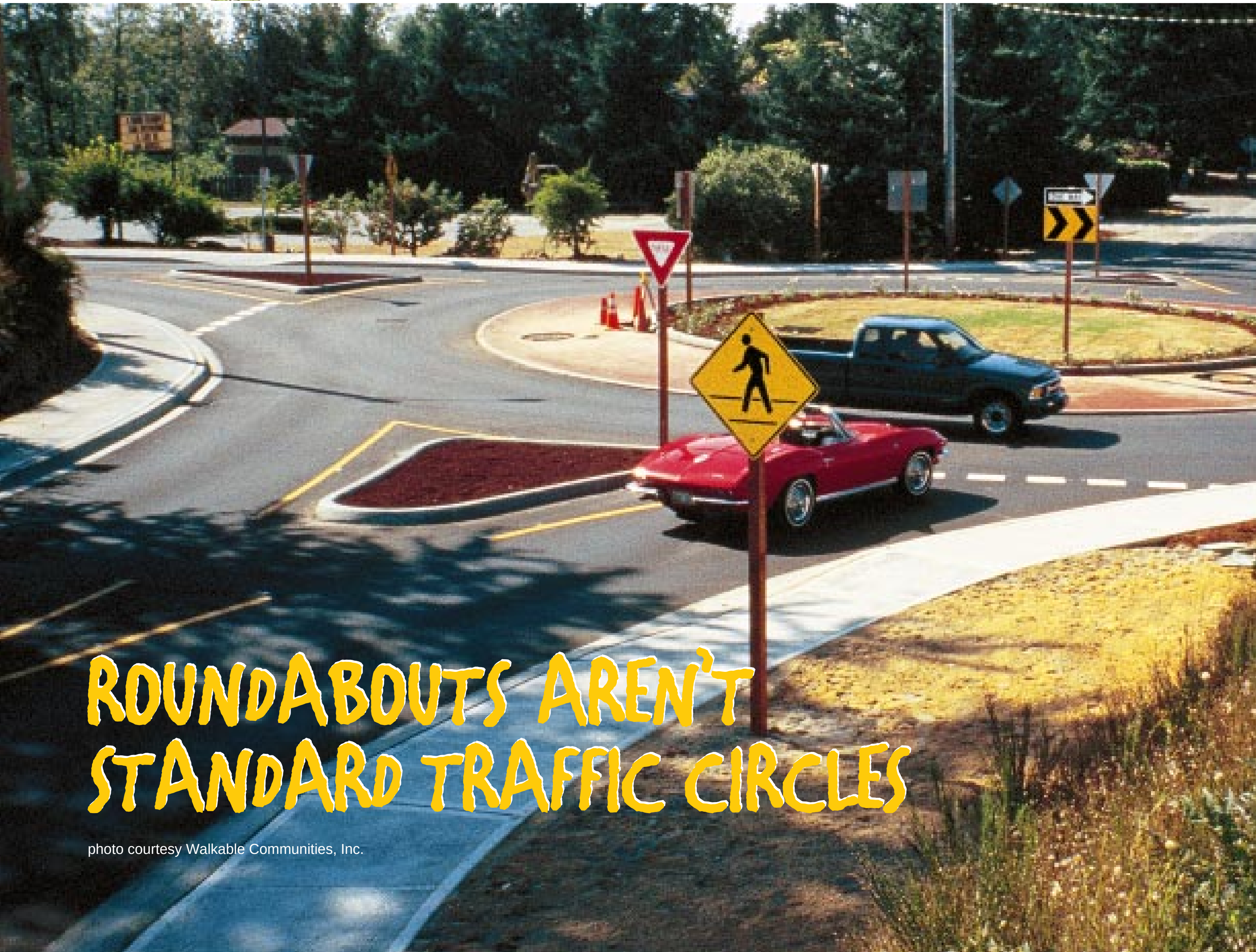
Both day and night, there were significant reductions in all crash types including right-angle and turning, rear-end, pedestrian, and fixed-object. Reductions in crashes with severe injuries were substantially larger than for crashes involving only minor injuries.

Four-way stop signs: Converting intersections with two-way stop signs into four-way stops has been shown to reduce crashes by 40 to 60 percent — injury crashes by 50 to 80 percent. Further evaluation of the safety effects of all-way stops found an expected crash reduction of 47 percent, with right-angle and injury crashes each dropping by about 70 percent (Hauer, 1985; Lovell and Hauer, 1986). "So we need to give more consideration to multiway stop signs," Retting says, "especially in residential neighborhoods and at intersections with low traffic volumes."

Roundabouts: Converting conventional intersections into roundabouts has proven highly effective throughout western Europe. For example, installing roundabouts at 181 intersections in the Netherlands reduced crashes by 47 percent and injuries by 71 percent (Schoon and van Minnen, 1994).

Just make sure you don't confuse roundabouts with the older style traffic circles that dot U.S. cities. "The U.S. version often has lights or stop signs, so it functions as an overly complicated intersection," Retting explains. "Traffic may enter conventional circles at high speeds because the approaching roads are straight."

In contrast, the yield-at-entry and deflected entry of roundabouts force drivers to reduce speeds during approach, entry, and movement within the circle. This represents an improvement compared with not only old style traffic circles but also



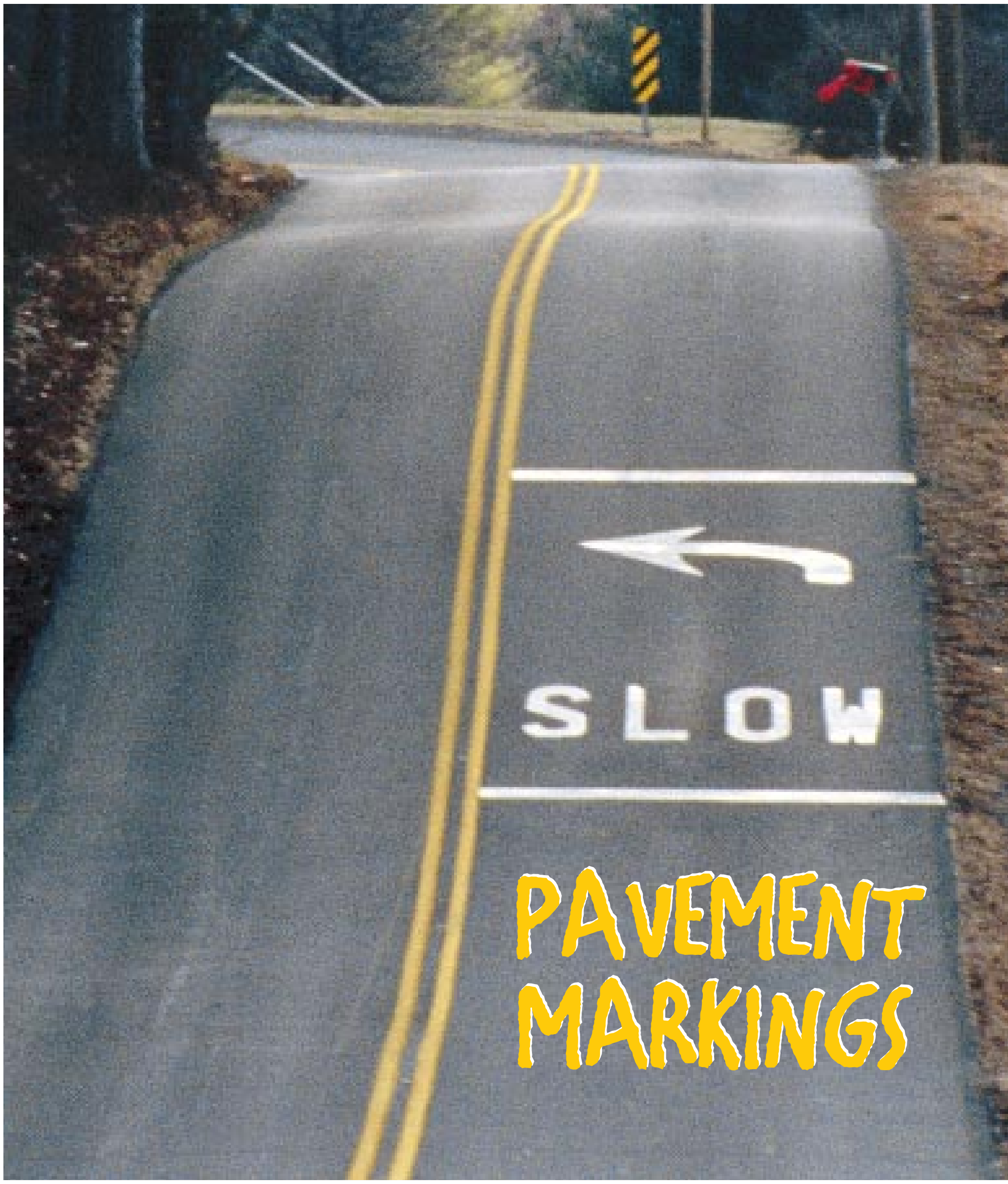
ROUNDABOUTS AREN'T STANDARD TRAFFIC CIRCLES

photo courtesy Walkable Communities, Inc.

traditional intersections where drivers often speed up during green or yellow lights to 'beat the red' and get across quickly. The modern roundabout virtually eliminates right-angle and left-turn conflicts and reduces rear-end crashes.

The first U.S. roundabout was built in Las Vegas in 1990. The designer, Leif Ourston, says public response to this and subsequent roundabouts is enthusiastic.

Pavement markings: Crashes on curved roads occur more frequently — and they're more severe — than crashes on straight roads. Certain kinds of crashes including collisions with fixed objects, head-on collisions, and rollovers occur disproportionately on curves. Excessive speed is a significant contributor.



Researchers examined the effects of special pavement markings designed to reduce speeds at locations with sharp curves. The markings consisted of white lines, the word "SLOW," and an arrow warning of the curve. Results indicate reductions in speeds — especially excessive speeds — in the vicinity of the curve (Retting and Farmer, 1997). The greatest speed reductions occurred late at night.

Experimental pavement markings added to curved freeway exit ramps narrowed the width of the lanes. The result was a reduction in the proportion of cars exceeding posted ramp speed advisories by at least 10 mph. The proportion of large trucks exceeding the advisories by at least 5 mph also was reduced.

Traffic calming: This term describes a range of physical measures to slow vehicles and discourage cut-through traffic on neighborhood streets. Measures include multiway stops, speed humps, rumble strips, paving stones or other rough surfaces instead of asphalt, and narrowing of streets with features like on-street parking, plantings, and wider sidewalks.

Four projects in Vancouver, Canada, show the benefits of such measures. An average 40 percent reduction in crash fre-

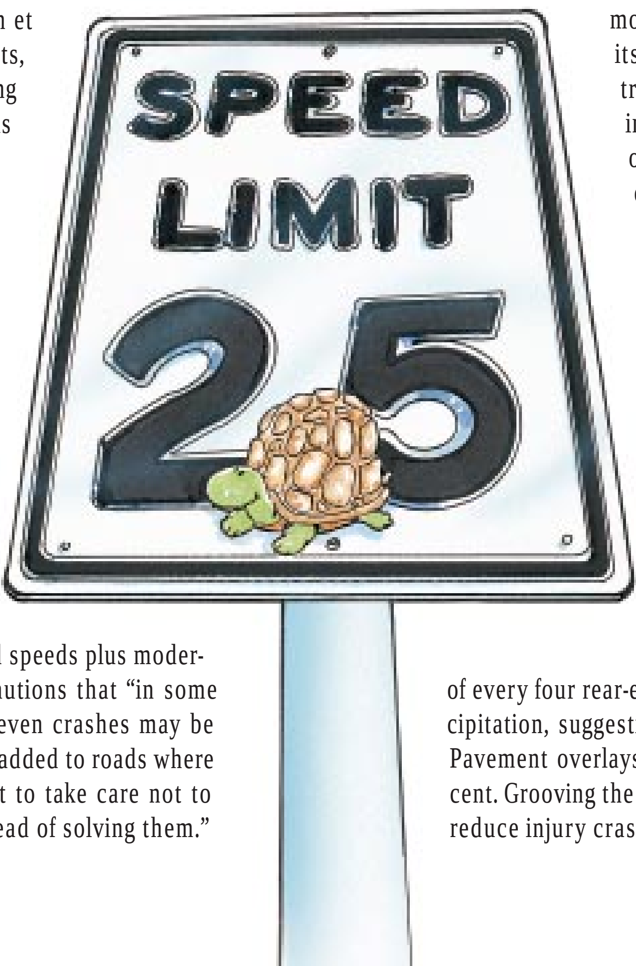
TRAFFIC CALMING

photo courtesy Walkable Communities, Inc.

quency and 38 percent reduction in the annual cost of insurance claims (Zein et al., 1997) followed from closing streets, designating one-way streets, installing stop signs, and expanding sidewalks to make streets narrower.

The study also reviewed 85 traffic calming programs in North America, Europe, and Australia. Fifteen cases with more than five pre-calming crashes per year were analyzed separately, and in this group the decrease in crash frequency ranged from 8 to 95 percent.

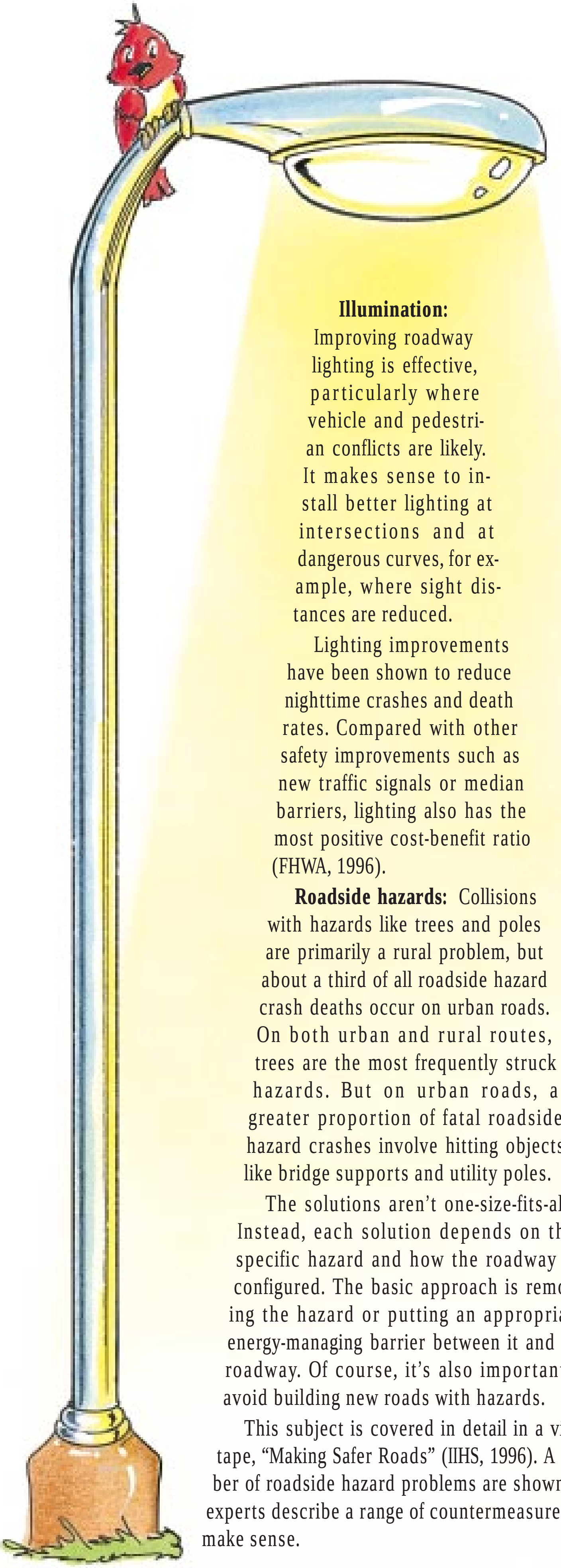
Worldwide research on the effects of traffic calming are summarized in a special edition of *Accident Analysis and Prevention* (1992). The studies show reductions in traffic volume and speeds plus moderate crash reductions. But Retting cautions that "in some cases traffic volume, speeding, and even crashes may be shifted to other residential streets or added to roads where congestion already reigns. We've got to take care not to end up shifting traffic problems instead of solving them."



Speed limits: In terms of impact on motor vehicle deaths, "setting speed limits is one of the most important things traffic engineers do," Retting notes. "It's important to set appropriate limits not only on high-speed rural roads but also on freeways, major streets, and side streets in urban areas."

For example, when freeway and interstate speed limits are raised, both mean speeds and proportions of vehicles going at high speeds increase (Retting and Greene, 1997). These increases translate into more deaths. In the last 9 months of 1996, an estimated 500 deaths were attributable to posting higher speed limits on urban as well as rural roads in 12 states (Farmer et al., 1997).

Skid-resistant pavement: One of every four rear-end crashes occurs in rain or other precipitation, suggesting skid-resistant pavement may help. Pavement overlays can reduce injury crashes by 19 percent. Grooving the pavement to cut down on skidding can reduce injury crashes by 15 percent (FHWA, 1996).



Illumination: Improving roadway lighting is effective, particularly where vehicle and pedestrian conflicts are likely. It makes sense to install better lighting at intersections and at dangerous curves, for example, where sight distances are reduced.

Lighting improvements have been shown to reduce nighttime crashes and death rates. Compared with other safety improvements such as new traffic signals or median barriers, lighting also has the most positive cost-benefit ratio (FHWA, 1996).

Roadside hazards: Collisions with hazards like trees and poles are primarily a rural problem, but about a third of all roadside hazard crash deaths occur on urban roads. On both urban and rural routes, trees are the most frequently struck hazards. But on urban roads, a greater proportion of fatal roadside hazard crashes involve hitting objects like bridge supports and utility poles.

The solutions aren't one-size-fits-all. Instead, each solution depends on the specific hazard and how the roadway is configured. The basic approach is removing the hazard or putting an appropriate energy-managing barrier between it and the roadway. Of course, it's also important to avoid building new roads with hazards.

This subject is covered in detail in a videotape, "Making Safer Roads" (IIHS, 1996). A number of roadside hazard problems are shown, and experts describe a range of countermeasures that make sense.

Where we learned it: studies on which this report is based

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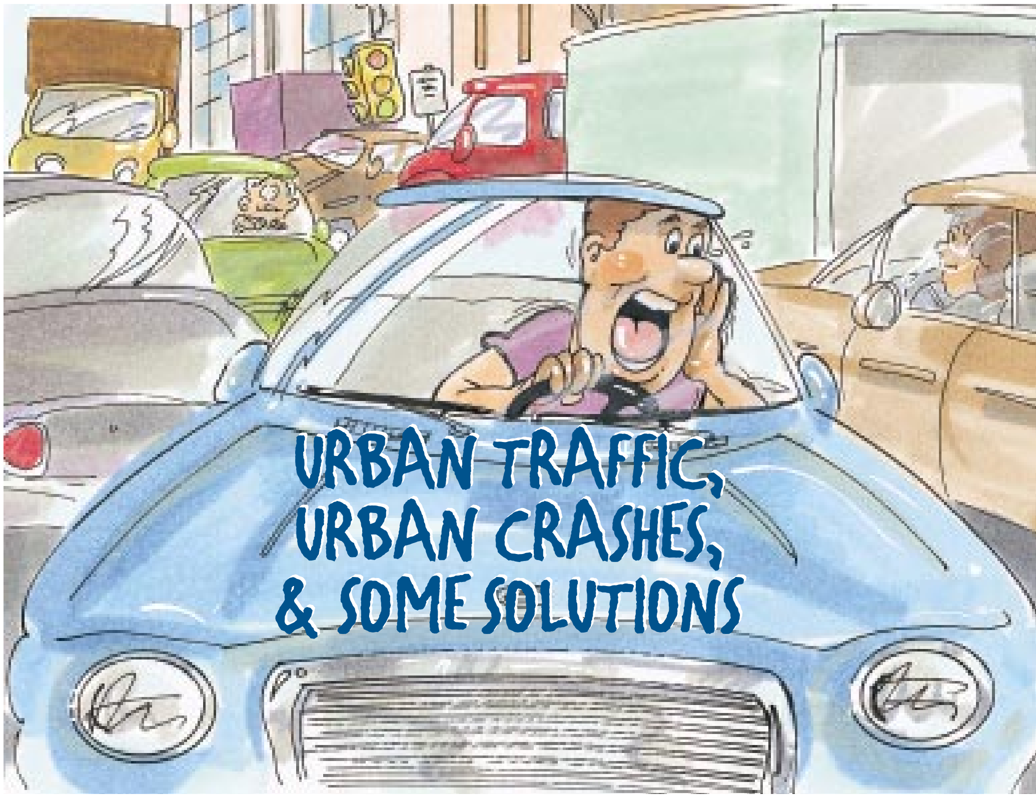
This special issue focuses on traffic engineering methods to reduce urban crashes. Other special issues have focused on the following subjects:



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