Public Roads

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Managing Speed
by Elizabeth Alicandri and Davey L. Warren

Interagency collaboration could curb speeding and save lives.

The twin challenges of the transportation system are to move traffic safely and efficiently. Although highways and motor vehicles are designed to operate safely at speeds traveled by most motorists, almost one in every three traffic fatalities in the United States is related to speeding, either involving exceeding the posted speed limit or driving too fast for conditions.

Variable speed limits on I-90 across Snoqualmie Pass in Washington are based on winter weather conditions.

In 2000, more than 12,000 lives were lost in speeding-related crashes, and more than 700,000 people were injured. The National Highway Transportation Safety Administration (NHTSA) estimates that speeding-related crashes cost society $28 billion annually. That's $53,243 per minute, or almost $900 per second.

Because speeding is a complex problem involving many factors —personal behavior, vehicle performance, roadway characteristics, and enforcement strategies—the U.S. Department of Transportation (USDOT) organized a multidisciplinary, multiagency team to tackle the problem. The USDOT Speed Management Team includes personnel from the Federal Highway Administration (FHWA), the Federal Motor Carrier Safety Administration (FMCSA), and NHTSA, representing backgrounds ranging from traffic engineering and enforcement to psychology and marketing.

According to Earl Hardy, a highway safety specialist and the speed management team coleader for NHTSA, approaching the problem of

speeding in a coordinated fashion enables the team to develop the best solutions to combat speeding more effectively.

He says, "Through collaboration, we can approach the speeding issue holistically, gathering and analyzing data, setting appropriate speed limits, improving engineering and enforcement technologies, developing innovative strategies for speed enforcement, and educating practitioners, policymakers, and the public about effective solutions."

Public Policy and Outreach

From a public policy standpoint, an effective speed management policy needs to overcome a variety of obstacles in public perception. One of the most common speeding issues brought to the attention of policymakers is that citizens are concerned about other drivers speeding through their neighborhoods, yet most citizens have no idea what goes into setting appropriate speed limits.

Traffic engineers and law enforcement officials need to educate citizens on what speed limits can (and cannot) do in terms of improving safety on roadways. Posting a lower speed limit sign, for example, may help neighborhood residents feel safer, but it will not necessarily slow traffic. In fact, according to research conducted by FHWA in 1997, raising and lowering speed limits as much as 32 kilometers per hour, km/h (20 miles per hour, mph) has little or no effect on prevailing speeds.

Political pressures also factor into speed management policy. Elected officials must answer to constituents who are reluctant to see more speeding tickets issued in their communities or concerned about the use of unconventional police vehicles. In addition, citizens raise the privacy issue with regard to the use of photo radar to enforce speeding, calling for less government intrusion into people's lives. For photo radar enforcement to be acceptable to communities, officials need to focus attention on safety, rather than revenue enhancement.

Portable variable speed limit signs with bright white LEDs, like these in Maryland, conform to the same color convention as standard highway signs and are highly visible.

Engineering

Appropriately engineered speed limits are an essential element in highway safety. For speed limits to be effective, however, they must appear reasonable to most drivers and correctly reflect the maximum safe speed for prevailing conditions. Otherwise the legal system misallocates resources dealing with motorists who are technically violating the law but not engaged in any high-risk behavior. Thus, a prerequisite to an effective speed management program is the establishment of realistic speed limits that are consistent with the

road environment.

FHWA's *Manual on Uniform Traffic Control Devices* recommends that speed limits be set at the 85th percentile speed, or the speed at or below which 85 percent of all the vehicles travel when passing a given point on the road. Only 15 percent of vehicles are traveling above the 85th percentile speed—or speeding.

Setting speed limits based solely on the 85th percentile speed, however, does not account for other factors like roadside development, pedestrian activity, or accident experience. FHWA is developing a software program —USLIMITS—that will help safety engineers systematically and consistently account for these other factors in determining appropriate speed limits. Practitioners are beta testing USLIMITS to evaluate the reasonableness of the recommended speeds, and FHWA expects to release the software in early 2003.

Friendly reminders like this turtle sign respond to citizen concerns about speeding traffic on residential streets.

Research indicates that the risk of crash involvement is lowest for motorists traveling near the average speed of traffic and is significantly higher for the fastest 2 to 5 percent. Setting speed limits at the 85th percentile speed of traffic, allowing for a tolerance of no more than 8 km/h (5 mph), would focus enforcement and adjudication on the occasional violators and high-risk drivers.

From the highway perspective, speed management begins with geometric design, which encompasses the driver and the vehicle. Design elements and roadside safety features alert drivers to the need to change speed and provide the basic cues that help drivers achieve a safe and comfortable speed.

Where communities desire lower speed limits, traffic-calming measures such as speed humps and curb extensions that narrow the road can help reduce speeds to the desired limit. Before implementing traffic-calming devices, however, designers should consult citizens and emergency service providers to ensure that such measures do not raise other safety issues.

Assessing the safety impact of setting differential speed limits for cars and trucks is one of many activities that the USDOT speed management team is carrying out.

Setting speeds in work zones is an ongoing issue. The lack of credibility of work zone speed limits is due to many factors, the most important of which is the fact that at different times of the day—based on traffic volume, lighting, weather, and other conditions—the appropriate safe speed changes, but the speed limit does not. When no roadwork is taking place, drivers often ignore reduced speed limits set to protect workers. Variable speed limits that change based on traffic conditions and the nature of the roadwork represent a promising technique to restore the credibility of speed limits in work zones.

Enforcement

Despite misconceptions among the driving public, police officers do not enforce speed limits simply because they want to write tickets. Enforcement is used to deter drivers from exceeding the posted speed limit. Three elements are critical to the deterrence process: (1) the behavior must be definable, understandable, and detectable by motorists, police, and the courts; (2) the effectiveness of deterrence depends on the perceived risk of apprehension—for the risk to be credible, drivers must believe that they have a good chance of being apprehended; and (3) the effectiveness of deterrence depends on the swiftness, certainty, and severity of the punishment.

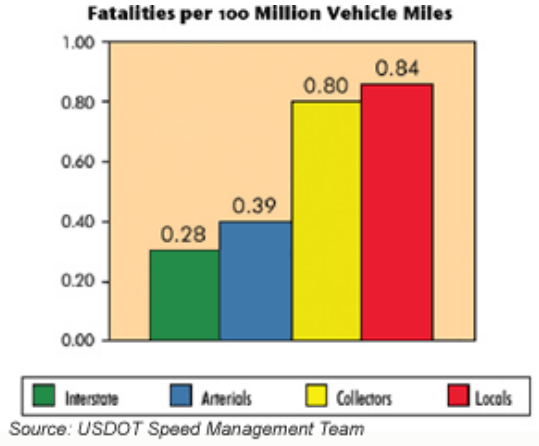
Engineering decisions also can affect enforcement activity. For example, efforts to install high-occupancy vehicle lanes or add lanes to increase capacity effectively eliminate the areas traditionally used for law enforcement activities (i.e., the right and left shoulders). In States with prima facie speed limits, the challenge from the enforcement and adjudication perspective is that law enforcement officers have to be prepared to prove that the speed was unreasonable and imprudent for road conditions regardless of the posted speed limit.

Roads and Speed Limits

Speeding-related crashes are not just a problem on high-speed roadways. Although higher speed crashes are more likely to result in a fatality or serious injury, almost half the speeding-related fatalities occur on lower-speed roads.

Local roads, providing access to residential areas, businesses, and farms, make up the majority of road miles in the United States. Most have posted speed limits ranging from 32 to 72 km/h (20 to 45 mph). Collector roads balance access with mobility, helping drivers get from local roads to larger roads, and they usually have posted speed limits between 56 and 88 km/h (35 and 55 mph). Arterials carry almost half the Nation's vehicle miles and include important roads that connect urban areas, but exclude interstate roadways. Access usually is limited on arterials, as their major purpose is to get people between destinations, and the posted speeds are usually between 80 and 113 km/h (50 and 70 mph). The highest class of roadway in the United States is the interstate system, which carries the highest speeds, generally between 88 and 121 km/h (55 and 75 mph) over long distances. Interstates account for less than 14 percent of all speeding-related crashes.

One important measure of the safety of a road system is the rate of fatalities on a per-mile-driven basis. As drivers log more miles on a particular part of the system, they increase their risk of a crash by simply being on the road. Low-speed local roads have the highest fatality rate, while high-speed interstate roads have the lowest fatality rate. In fact, the speeding-related fatality rate for local roads is three times higher than the rate for interstates. The difference in fatality rate by road class reflects differences in road design and use. Interstates are designed for long, fast travel, providing drivers with few interruptions and clear views of the roadways. Local roads, on the other hand, can have sharp curves and hills that restrict the driver's view, and they are expected to accommodate a broad variety of users, including bicyclists and pedestrians.



Speeding-Related Fatality Rate by Road Classification (1999)

Judiciary

For the sake of traffic safety and the justice system overall, the legal system must appear to be fair. To ensure compliance with speed limits, a balance must be achieved between enforcing penalties that actually deter speed violators and issuing punishments that represent only a minor economic inconvenience to the speeder, such as a small fine or dismissal upon completion of certain conditions. Fines or classes that drivers equate with a mere economic inconvenience have proved ineffective at deterring speed violators. On the other hand, fines and punishments considered too severe will not stand public scrutiny, especially if posted speed limits are not seen as fair and reasonable.

Judges dismiss speeding violations for many reasons, including inaccurate paperwork, offense cited under the wrong statute, plea bargain, officer not present for the trial, or the prosecutor's failure to meet the burden of proof. In States with prima facie limits, if the prosecutor proves that the motorist was exceeding the legal speed limit, then that is prima facie evidence that the driver was traveling at an unreasonable and unsafe speed. The driver has the burden to prove to the court that the speed was reasonable and safe. With absolute speed limits, whether the travel speed was reasonable and safe is irrelevant. Recommendations have been made to improve enforcement and adjudication by abolishing or reducing laws that permit the withholding of points in favor of license suspensions and/or higher fines.

Managing speed through measures such as appropriate speed limits and strict enforcement is an essential element of highway safety.

Speed Management Workshops

In 2000, the USDOT Speed Management Team initiated a series of workshops and demonstration projects designed to bring together critical players in the speed management arena to discuss the issues that each profession faces and develop coordinated action plans. The workshops focus on the issues of setting rational speed limits and their enforcement. Central to these flagship activities is restoring credibility in speed setting through coordinated efforts in engineering, enforcement, and education.

Plenary sessions kick off each workshop with speakers sharing insights from each of the four critical areas in speed management —public policy and outreach, engineering, enforcement, and adjudication. The goal of the workshops is to expose participants to the array of issues that play into speed management strategies.

"Through the speed management workshops, we provide participants with the knowledge and skills that enable them to return to their local communities and develop speed management plans tailored to meet their specific needs," NHTSA's Earl Hardy says.

The Web-based software tool, USLIMITS, assists engineers in setting reasonable, safe, and consistent speed limits, generating a recommended speed limit after the user inputs specific design criteria.

Lessons Learned

After the plenary sessions, participants in the USDOT workshops break into working groups to develop action plans outlining how to attack the speeding problem in their States. Among the most common issues raised during the workshops is the need to overcome institutional and jurisdictional barriers so that speed limits and enforcement strategies are seen as consistent by the public. Other issues include linking design speed and operating speeds more effectively; encouraging engineers and enforcement personnel to communicate and coordinate activities; and improving communication with the public on the importance of setting and enforcing safe speed limits.

The groups are specifically designed to ensure good cross sections of engineering, education, and enforcement personnel. Major Kathryn Doutt, director of the Bureau of Patrol of the Pennsylvania State Police, participated in the first speed management workshop in Washington, DC, in 2000. She joined several colleagues and representatives from State departments of transportation (DOTs), special interest groups, college researchers, psychologists, and others. Doutt applauds the value of sharing multidisciplinary perspectives.

"Engineers and policymakers need to get input from the police community, or they'll be missing a big piece of the picture," she says. "I was surprised to learn that many of the stakeholders thought that enforcement was the only way to change behavior; yet the input of enforcement officials had not been sought previously. Other things, like road design and realistic speed limits, are equally important, as are driver attitudes."

Variable speed limit signs, like this one in a work zone, use sensors to monitor traffic flow and adjust local speed limits accordingly.

Demonstration Projects

Speed management workshops encourage traffic safety personnel to collaborate in identifying and implementing coordinated solutions to control speeding. At the same time, FHWA's speed management demonstration projects provide a structure and funding for those solutions.

Demonstration projects are underway in four States: Connecticut, Louisiana, Massachusetts, and Mississippi. In each case, researchers identify an extended length of road or a group of roads as the demonstration area and a similar road to serve as the control or comparison area. In the demonstration area, traffic safety personnel perform extensive speed studies for a minimum of 24 hours to determine the speed profiles on the roadways and then use the information to determine an appropriate speed for the road segments, relying heavily on the 85th percentile speed.

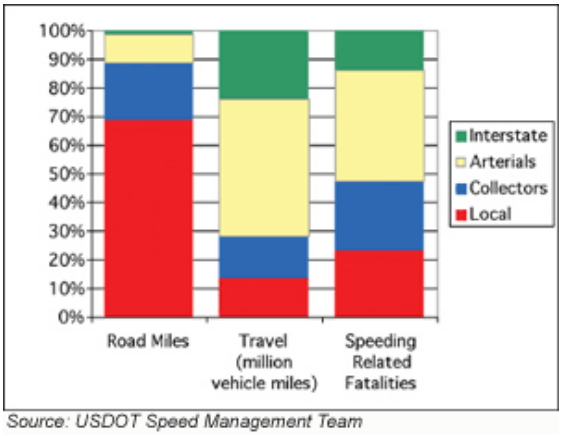
Massachusetts, like many States, is struggling with speed-related crashes. In 2000, speeding was a factor in 36 percent of traffic fatalities. The Governor's Highway Safety Bureau has conducted many Speedwatch programs—a combination of education and enforcement—to increase compliance with posted speed limits. According to Thomas McGovern, deputy director of the Governor's Highway Safety Bureau, the demonstration project advances current programming by considering the engineering of speed management.

"One of our primary objectives is to examine how speed limits are set and revise that process to better reflect the 85th percentile speeds of traffic and the design of roadways," McGovern says. "The more tools we have at our disposal to apply to the problem, the more likely we are to solve it."

As new speed limits are determined, traffic safety personnel implement two distinct outreach campaigns. The first, to the public, informs community members that new speed limits will be established and strictly enforced. The other outreach campaign targets the judiciary—judges and lawyers—to emphasize that law enforcement personnel will have low tolerances for speeding and will not be shy about issuing violations.

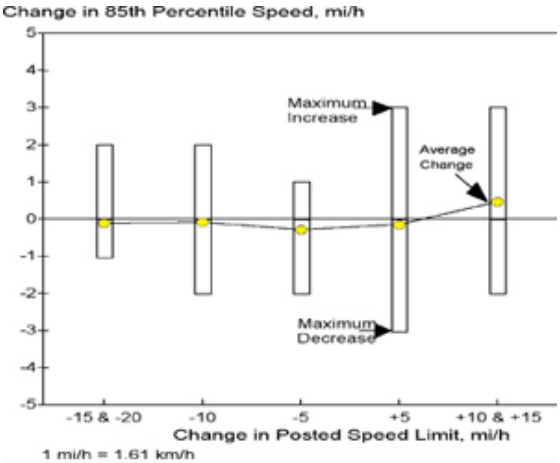
After the new speed limits are in place, the enforcement community kicks in with a strict enforcement campaign. Because the new speed limits are based on the actions of the majority of drivers, law enforcement officials can focus on the most flagrant violators. Throughout the campaign, traffic safety personnel gather speed, crash, program awareness, and other data from the demonstration and comparison sites to evaluate the effectiveness of the project and provide information for future strategies for setting speed limits.

With demonstration projects like this, plus ongoing workshops to develop solutions, speeders *will* slow down—and lives *will* definitely be saved.



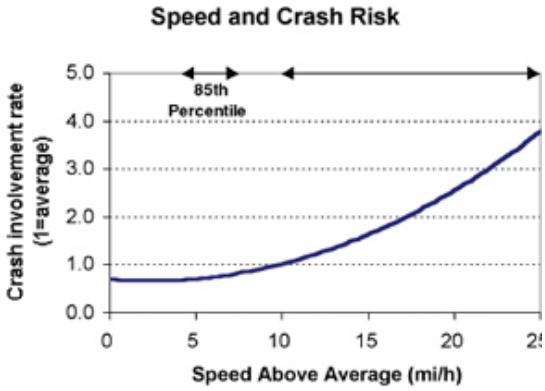
Source: USDOT Speed Management Team

The chart shows total road miles, travel (in million vehicle miles), and speeding-realted fatalities by road function for interstate, arterial, collector, and local roads. (1999)



Source: FHWA

As illustrated in this chart, raising and lowering speed limits as much as 32 km/h (20 mph) has little or no effect on prevailing speeds.



Source: FHWA

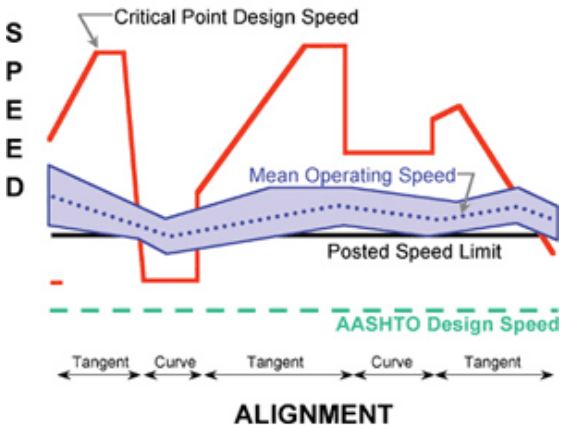
The graph shows that motorists traveling below the 85th percentile speed have below-average crash rates. Setting the speed limit near the 85th percentile speed and allowing a small tolerance would target enforcement at the most dangerous speeds—those more than 16 km/h (10 mph) above the average speed.

Design Speed

In highway design, engineers typically select a minimum design speed for coordinating the geometric design elements. That design speed depends on the type of facility and its function, and it establishes the minimum sharpness of the curves and sight distances. AASHTO's *A Policy on Geometric Design for Highways and Streets* encourages designers to select values greater than the minimum. The design speed concept, therefore, leads to roads with critical point design speeds (inferred from the actual design) greater than the minimum design speed and operating speeds that vary widely along the alignment. Since the underlying criteria and assumptions in the design speed concept are based on long-standing comfort and worst-case conditions, such as braking on wet pavement, the comfort of a blindfolded passenger in a 1930s vehicle, and the reaction times of impaired drivers, it should not be surprising to find that the speeds of many motorists driving under normal conditions safely exceed the minimum design speed.

The incorporation of a feedback loop in the design process that would check for expected operating speeds has been proposed by leading researchers as one way to help designers achieve consistent speeds along the road and designs that are compatible with desired operating speeds. Speed prediction models are available from FHWA at www.tfhrc.gov/safety/ihsdm/pdfs/99-171.pdf for two-lane highways and work is underway at TFHRC to develop models for urban streets.

Although not a determining factor in setting speed limits, the critical point design speed may be used to identify potential hazards associated with some highway design features such as sharp curves or hidden intersections not readily apparent to unfamiliar drivers. Appropriate warning signs in conjunction with an advisory speed should be posted at these locations.



Source: FHWA

The minimum design speed concept, as illustrated conceptually in the figure, can lead to streets and

highways where critical speeds inferred from actual sight distance and curvature exceed the AASHTO design speed throughout the alignment. Geometric roadway designs such as this encourage operating speeds higher than intended, and the variation in speed along the road increases accident risk.

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