TRAFFIC AND SAFETY INFORMATIONAL SERIES FREQUENTLY ASKED QUESTIONS

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TRAFFIC AND SAFETY INFORMATIONAL SERIES FREQUENTLY ASKED QUESTION #1

WON'T A "CHILDREN AT PLAY" SIGN HELP PROTECT OUR CHILDREN?

The *Manual on Uniform Traffic Control Devices* (MUTCD) regulates the design, use, and placement of signs and markings in the United States. According to the MUTCD, the "Children at Play" sign is considered a warning sign with a word message. This sign is sometimes used instead of the nationally recognized "Playground" sign (see Figure 1).

Requests for "Children at Play" signs are based on the belief that these types of signs will alert drivers to the presence of children and increase safety. The purpose of any warning sign is to inform drivers of conditions that they are likely to consistently encounter. However, drivers begin to ignore warning signs when this is not true.

"CHILDREN AT PLAY" AND "PLAYGROUND" SIGNS

Warning signs should be uniformly designed and often communicate their message most efficiently through the use of symbols. Warning signs that are not consistently uniform can confuse drivers. The "Children at Play" sign, for example, has several variations. These include "Slow – Children" and "Caution – Children at Play."

The MUTCD recommends that all nonuniform signs within a jurisdiction be removed. In their place, a uniform set of signs (word or symbol) should be used throughout the jurisdiction.

A sign with a message similar to that of the "Children at Play" sign, but in symbol form, has been approved for use in the MUTCD. This sign, which presents a "Playground" symbol, is shown in Figure 1. The MUTCD provides the option for this sign to be used to give advanced warning of a children's playground adjacent to the road. Therefore, the MUTCD's guidance on the installation of this type of sign is for a very specific location.

FIGURE 1 Playground sign.

Reference: Manual on Uniform Traffic Control Devices.

OVERUSE OR MISUSE OF WARNING SIGNS

The overuse or misuse of any warning sign (including "Children at Play" signs) is a major concern. The MUTCD indicates that "the use of warning signs should be kept to a minimum, as the unnecessary use of warning signs tends to breed disrespect for all signs" (MUTCD Section 2C.02). For example, if a large number of "Children at Play" or "Playground" signs are installed in a given area, the signs would become ineffective because drivers would see them constantly without any apparent hazard and eventually begin to ignore them. This would, of course, defeat the purpose of installing these types of signs, even in places where they are actually needed.

PLACING SIGNS DOES NOT SLOW VEHICLES

In general, the speeds people choose to drive along a roadway are primarily determined by the roadway's characteristics and environment and by the level of comfort and safety the driver perceives. No documented studies on the attention value and crash or speed impacts of "Children at Play" warning signs have been performed as of 2020.

However, a 2012 study of "Playground" warning signs conducted at three sites in Minnesota found that the signs produced no effect on mean vehicle speeds at one site and decreased mean vehicle speeds by 0.9 and 1.5 mph at the other two sites. The magnitudes of these vehicle speed differences, although statistically significant, are not considered significant in any practical sense. The researchers concluded that if this type of sign, which is installed next to playgrounds or similar areas, did not reduce vehicle speeds at any practical level, then warning signs with a more general message (e.g., "Children at Play") would be likely to have a similar or even less noticeable impact.

TRAFFIC AND SAFETY INFORMATIONAL SERIES FREQUENTLY ASKED QUESTION #1

Won't a "Children at Play" Sign Help Protect Our Children?

We often get requests from parents for "Children at Play" signs to be installed in their neighborhoods. Parents hope that the signs will encourage drivers to slow down and drive cautiously. The concern for the safety of children is very important and is shared by highway and street officials. Unfortunately, "Children at Play" signs may not be the best solution. Here's why:

Placing signs does not slow vehicles

The speeds people choose to drive along a roadway are generally determined by the roadway's characteristics and environment and by the level of comfort and safety the driver perceives. In many cases, "Children at Play" or "Playground" (i.e., a sign with children on a teeter-totter) signs are placed along local neighborhood roadways; the users of these roadways are local residents and typically are aware of children in the neighborhood. The characteristics and environments of many local residential roadways also usually produce relatively low speeds. In this type of environment, a reduction in general vehicle speeds through the placement of a "Children at Play" or "Playground" sign should not be expected, especially when the hazard is not consistently clear to the driver.

Signs are used to warn of consistent, not occasional, conditions

A 2012 study of "Playground" warning signs conducted at three sites in Minnesota found that the signs produced no effect on mean vehicle speeds at one site and decreased mean vehicle speeds by 0.9 and 1.5 mph at the other two sites. The magnitudes of these vehicle speed differences, although statistically significant, are not considered significant in any practical sense. The researchers concluded that if this type of sign, which is installed next to playgrounds or similar areas, did not reduce vehicle speeds at any practical level, then warning signs with a more general message (e.g., "Children at Play") would be likely to have a similar or even less noticeable impact.

With or without signs, education and awareness can be important

Even when "Children at Play" signs are used, it may not be a good idea to let your guard down or be lulled into a false sense of safety. Children can benefit from keeping in mind that the street is not a place to play and that drivers may not necessarily be watching out for them.

For more information

For more information, please contact _____.

TRAFFIC AND SAFETY INFORMATIONAL SERIES FREQUENTLY ASKED QUESTION #2

HOW MANY BULLET HOLES DOES IT TAKE TO KILL A SIGN? (SIGN VANDALISM)

Sign vandalism is a serious problem in Iowa. In fact, it is believed that one in ten signs is vandalized each year, with signs installed along roadways with low traffic volumes accounting for about 80 percent of the signs vandalized. Overall, the annual cost of sign vandalism in the United States is about $414,300,000. A number of steps have been taken to reduce the amount of sign vandalism, but no single action has worked completely.

Signs are important: they regulate the actions of drivers, warn drivers of hazards, and inform drivers of important locations. Signs are placed and/or designed to fulfill a need, command attention and respect, convey a clear and legible message, and provide drivers with enough time to respond appropriately. A sign damaged by vandalism cannot perform any of these functions effectively; a damaged sign may not command attention and respect or convey a clear and legible message. In short, sign vandalism can have serious consequences.

TYPES OF SIGN VANDALSIM

There are many kinds of sign vandalism. While some people believe that shooting signs (see Figure 1) is the most common type of vandalism, a study by the Iowa Department of Transportation found that only about 11 percent of vandalized signs are shot by a gun. Broken/knocked down signs and stolen signs are the first and second most common types of vandalism, respectively, and gun-damaged signs are the third. Other kinds of vandalism include painting or marring the face of a sign, pulling out a sign, and bending a sign. All of these can produce serious safety problems and should be mitigated as soon as possible.

FIGURE 1 Sign vandalized by gun.

FACTORS FOR REPLACING OR FIXING VANDALIZED SIGNS

Vandalized signs provide a poor impression of the surrounding community. Moreover, studies have shown that neglecting to replace or fix vandalized signs can lead to more severe vandalism. Vandalized signs should therefore be repaired or replaced as soon as possible.

REPLACEMENT OF VANDALIZED SIGNS

A vandalized sign may no longer be effective and can deprive motorists of critical information, which could result in a collision. Critical signs include regulatory signs such as stop signs, yield signs, speed limit signs, and “Do Not Enter” signs. A missing or illegible warning sign, which is designed to caution motorists of potential danger, may also lead to a collision. Warning signs include signs that alert motorists to approaching intersections, curves, turns, and stop signs or signals. Guide signs that direct motorists to points of interest are also important because they produce a less confusing driving environment and allow the driver’s attention to be directed toward the roadway.

Regardless of sign type, a sign technician must determine whether the sign should be replaced or repaired immediately based on field judgement. Aside from the need to continue providing critical information to drivers, other considerations for replacement may include repair costs and the remaining service life of the sign face. Regardless of the decision made, a vandalized sign that provides critical regulatory or warning information should not be taken down without a replacement sign put in its place.

COUNTERMEASURES FOR SIGN VANDALISM

For a description of techniques to combat sign vandalism, consult the *Manual on Countermeasures for Sign Vandalism* (U.S. Department of Transportation, Federal Highway Administration).

TRAFFIC AND SAFETY INFORMATIONAL SERIES FREQUENTLY ASKED QUESTION #2

How Many Bullet Holes Does It Take to Kill a Sign? (Sign Vandalism)

Sign vandalism is a serious problem. In Iowa, 1 in 10 signs is vandalized each year. Sign vandalism is illegal, it costs US taxpayers about $414,300,000 annually, and it can confuse motorists and result in deadly crashes.

What is sign vandalism?

Sign vandalism includes the following:

- knocking down signs
- stealing signs
- shooting signs with a gun
- painting or marring signs
- bending signs or signposts

Repairing/replacing vandalized signs

It is important that vandalized signs be repaired or replaced as soon as possible because missing or damaged signs are a safety hazard. If a sign is damaged or removed, motorists could be deprived of important information, resulting in a collision. Moreover, neglecting to replace or fix damaged signs quickly can lead to even more severe vandalism.

Critical or regulatory signs (for example, speed limit signs and stop, yield, and “Do Not Enter” signs) should be repaired or replaced as a first priority. The second priority should be to replace or repair warning signs (for example, signs that alert motorists to potentially dangerous intersections and curves). The third priority should be to repair or replace guide signs (for example, signs that direct motorists to points of interest).

The general public can help by reporting damaged or missing signs to the proper authorities.

For more information

For more information, please contact _____.

TRAFFIC AND SAFETY INFORMATIONAL SERIES FREQUENTLY ASKED QUESTION #3

WON'T A LOWER SPEED LIMIT LOWER TRAVEL SPEEDS AND THE NUMBER OF ACCIDENTS?

SAFETY AND SPEED

Speed has an impact on the severity of a collision, but in many cases it is not the primary cause of the collision. In fact, research into this subject has not found a direct relationship between speed and the number of crashes on a particular type of roadway. The Interstate highway system generally has a low crash rate but serves vehicles at very high speeds.

Crashes or collisions along a roadway are often caused by a combination of vehicles traveling at different speeds. The probability of a vehicle being involved in a collision increases if it is traveling faster or slower than the average traffic flow (see Figure 1). Vehicles that collide at higher speeds experience an increase in fatalities (see Table 1).

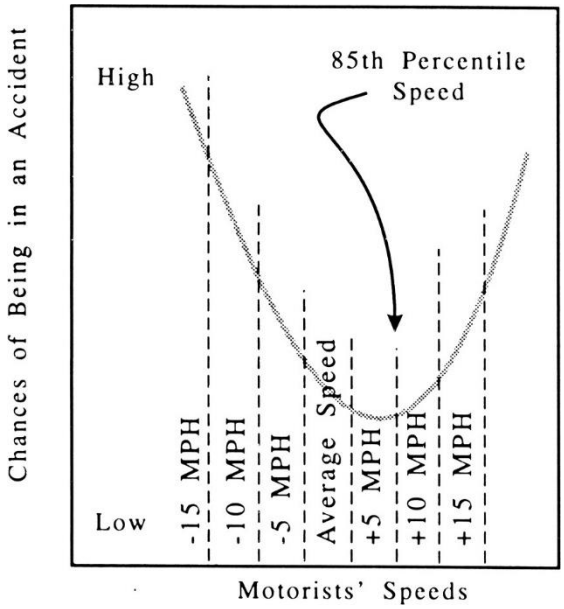


FIGURE 1 Crash rates and vehicle speed.

Reference: Speed Zoning on Iowa Highways, Iowa Department of Transportation.

TABLE 1 Vehicle speed and fatalities

	Average Annual Number of Fatal Crashes	Average Annual Number of Fatalities
Rural Interstate System		
1981–1986	17	21
1988–1993	26	31
1994–1997	24	31
Rural Primary System		
1981–1986	141	168
1988–1993	143	175
1994–1997	143	173

Notes: Interstate speed limits were raised from 55 to 65 mph in 1987. The 1996 and 1997 crash and fatality information is based on preliminary data.
Reference: *Update Report on Speed Limits in Iowa*, Iowa Department of Transportation.

SETTING A SPEED LIMIT

Drivers generally select their vehicle speed based on the roadway environment and characteristics and by the level of comfort and safety the driver perceives. This is why the 85th percentile speed of the vehicles already using a roadway (i.e., the speed at or below which 85 percent of vehicles travel) is one of the most important factors in the determination of a posted speed limit. Research indicates that roadways with posted speed limits at or near their 85th percentile vehicle speed will experience fewer collisions than roadways with speed limits above or below this level.

A speed limit that is posted too low (i.e., lower than what the majority of vehicles already travel) usually does not increase the safety of the roadway. As mentioned above, a driver generally selects a speed based on the roadway environment/characteristics and personal comfort, safety, and risk levels. For this reason, it is unlikely that a driver will reduce the speed of his or her vehicle unless there is an obvious need, and a posted speed limit that is unreasonably low will typically be ignored. This combination of speeds typically produces an increase in collision rates (see Figure 1), and the situation also produces an overall lack of respect for the concept of speed limit regulations (even when correctly posted).

Factors other than the 85th percentile speed of a roadway that are taken into account when determining a posted speed limit include surrounding land use, pedestrian/parking activity, road surface conditions, roadway geometry, and the collision history of a roadway. In some cases, the consideration of these factors can lead to a posted speed limit other than the 85th percentile speed of the roadway. For example, a posted speed limit may be reduced when entering a school zone that may not be apparent to the driver.

TRAFFIC AND SAFETY INFORMATIONAL SERIES FREQUENTLY ASKED QUESTION #3

Won't a Lower Speed Limit Lower Travel Speeds and the Number of Accidents?

People often believe that posting lower speed limits will force drivers to slow down and will result in fewer traffic crashes. Unfortunately, this is not always true. Here's why:

Slow does not mean safe

Although crashes at high speeds can result in more severe injuries, research has found that higher speed limits do not necessarily result in more crashes. The Interstate highway system, for example, has the highest speed limits and yet has a very low crash rate when compared with other types of roadways.

The speed drivers actually travel is often the safest speed

One principle that helps determine a speed limit is that the safest situation on a roadway is when all the vehicles are traveling about the same speed. When a speed limit is set unreasonably low, some drivers tend to ignore the signs. Other drivers will try to obey the posted speed limit. The result is that the roadway is carrying both fast-moving and slow-moving vehicles, which is the perfect recipe for a crash. Strange as it may seem, it is safer for all drivers to be traveling at the same high or low speed than for some drivers to be driving fast and some driving slowly. Therefore, speeds are usually set based on what most people actually drive.

Other factors

Other factors are also considered in setting speed limits. These include roadway surface conditions, pedestrian and parking activity, and the record of crashes at the location. These factors, however, must be balanced against the hazard of having vehicles on the same roadway travel at very different speeds.

For more information

For more information, please contact _____.

TRAFFIC AND SAFETY INFORMATIONAL SERIES FREQUENTLY ASKED QUESTION #4

WHY CAN'T I HAVE SEVERAL DRIVEWAYS TO MY PROPERTY WHEREVER I WANT THEM?

State, city, and county governments in Iowa are legally responsible for providing and managing roadway access to roadside properties. Property owners (especially commercial property owners) generally like to have several driveways at the most convenient locations. However, too many or improperly designed access points can lead to operational and safety concerns along roadways when vehicles attempt to enter or exit driveways. Roadways with access that is not properly managed can experience lower safety and increased traffic congestion.

Access management regulations must balance the public need for safe and efficient movement and the landowner's private property right to sufficient access. The existence of driveways along a roadway does impact the safety and operation of traffic. Vehicles entering and exiting a driveway move more slowly than through traffic. A roadway with numerous driveways and/or inadequate driveway spacing has an increased number of vehicle stops and starts (i.e., conflicts). This produces a lower level of operations and safety than along roadways with restricted or regulated driveway access. A roadway with a small number of access points per mile is over three times as safe as one with a greater access density (see Table 1).

TABLE 1 Relationship between access density and traffic safety

Access Points per Mile	Crash Rate per Million Vehicles	Relative Level of Crashes
0 to 10	2.22	1
10 to 30	3.34	1.5
30 to 50	4.74	2.1
Over 50	7.38	3.3

BRW, Inc., study for the Minnesota Department of Transportation, August 1998.

A limitation on the number of driveways per property allows drivers more time and distance (i.e., reduces confusion) to complete driving maneuvers. In other words, the potential for vehicle conflicts and collisions is reduced. Recommended guidelines for driveway spacing are shown in Table 2. These guidelines are based on operating speed, roadway type, and the amount of traffic.

TABLE 2 General guidelines for unsignalized access spacing

Condition	Spacing Guidelines (feet)
Operating speed	
30 mph	100 to 200
45 mph	300 to 550
Type of facility	
Major arterial (e.g., most numbered state and federal highways)	300 to 500
Minor arterial (e.g., urban streets)	100 to 300
Collector (e.g., roadway connecting local streets to arterials)	100 to 200

Transportation Research Board, *Transportation Research Circular*, No. 456, March 1999.

TECHNIQUES USED TO REDUCE THE IMPACT OF ACCESS POINTS

New projects or roadway improvements should be designed to reduce the number of conflict points associated with traffic entering or exiting roadside development. Driveways should be designed to minimize the disruption turning vehicles have on the efficiency of traffic flow. Access management plans for a specific roadway can include the following:

- reducing the overall number of driveways per block or mile,
- maintaining a greater minimum distance between driveways,
- sharing driveways between properties to limit the number of conflicts, and
- requiring adequate sight distance (see below).

Access management can improve driving conditions and the safety for all motorists. Providing proper access to properties and properly designing intersections maintains safety and promotes a smooth traffic flow. Some results of successful access management include

- the separation of vehicle conflict areas,
- a reduction of interference between through and turning traffic, and
- the better maintenance of consistent speeds along major roadways.

HOW SIGHT DISTANCE IMPACTS THE LOCATION OF DRIVEWAYS

Sight distance, the length of roadway visible to a driver, must be provided at driveways for the safety of both through and turning traffic. Drivers using the roadway or entering and exiting a driveway use the sight distance provided to verify that the area is clear. Providing adequate sight distance to/from a driveway produces a safer environment because it allows drivers to adequately adjust to potential conflicts and operating impacts. Required sight distances allow vehicles to enter the roadway with only a small adjustment by the traffic along the main roadway. The requirements for driveway (or intersection) sight distance may be found in *A Policy on Geometric Design of Highways and Streets* (American Association of State and Highway Transportation Officials).

TRAFFIC AND SAFETY INFORMATIONAL SERIES FREQUENTLY ASKED QUESTION #4

Why Can't I Have Several Driveways to My Property Wherever I Want Them?

Many people who own commercial property want more driveways to make it convenient for motorists to access their businesses. They may not have considered the negative safety-related impacts of having extra driveways.

More driveways sometimes result in more crashes

Studies have shown that as the number of driveways along a street increases, so does the number of crashes. Vehicles entering and exiting a driveway cause the rest of traffic—the through traffic—to slow down and sometimes stop. On a street with many driveways, traffic has to slow and stop often to accommodate vehicles pulling in and out of the driveways. This kind of traffic movement can result in more crashes. Reducing the number of driveways and/or creating shared driveways are ways to make traffic flow more smoothly and to reduce the number of crashes.

The location of driveways is important too

In addition to the number of driveways, the placement of driveways is important. They should be located a safe distance from intersections and where drivers who are entering or exiting the driveway can see clearly for an adequate distance in both directions.

Limiting driveways doesn't equal bad business

In recent Iowa case studies, businesses along streets with a limited number of well designed driveways had similar or better retail sales than businesses on streets with more driveways. Motorists generally try to avoid streets where they have to regularly slow down or stop for vehicles that are pulling in and out of driveways. These case study projects are located in Ames, Spencer, Fairfield, Clive, and Ankeny. The retail sales evaluation results for these locations are discussed in the *Iowa Access Management Awareness Phase II Report* (available from the Center for Transportation Research and Education at Iowa State University).

For more information

For more information, please contact _____.

TRAFFIC AND SAFETY INFORMATIONAL SERIES FREQUENTLY ASKED QUESTION #5

WHY AREN'T THERE BETTER AND LONGER LASTING STRIPES ON THE ROAD?

Pavement markings guide traffic and inform drivers. The harsh environmental conditions that pavement markings are exposed to, however, make it difficult for any marking material to last a significant length of time. For this reason, the deterioration of pavement markings is a common and expensive problem.

TYPES OF MATERIALS USED

Pavement marking materials are generally either highly durable non-paint-based materials or paint-based materials (sometimes characterized as nondurable). Some common types of materials are listed below.

Highly durable non-paint-based materials:

- Grooved-in tape
- Hot-applied thermoplastic
- Cold-applied thermoplastic
- Epoxy
- Polyester stripping
- Methyl methacrylate
- Reflective raised pavement markings

Nondurable paint-based materials:

- Latex-based paint
- Water-based paint
- Rubber-based paint
- Oil-based paint

The marking materials listed above have different life expectancies.

LIFE EXPECTANCY OF COMMONLY USED MATERIALS

Latex-based paint, for example, can last from six months to one year under normal road conditions. Water-based paint is also expected to last up to one year, and in some cases two years, under normal conditions. Thermoplastic, on the other hand, is a more durable material, and in many areas it can last several years. In Iowa, however, this material is not widely used because snowplows have a tendency to remove it. Epoxy is used in Iowa and is considered an extremely durable striping material. It can last from three to five years, depending on the amount of snowplow use and traffic volumes along a roadway.

Placing longer-lived materials, such as thermoplastic or tape, into grooves in the pavement surface can further enhance the durability and lifespan of these materials. Such grooved-in markings have been used throughout Iowa in different settings and can last for five years or more, depending on the roadway's

traffic volumes, surface conditions, and other characteristics. However, grooved-in markings can be expensive to purchase and apply.

FACTORS INFLUENCING PAVEMENT MARKING LIFE EXPECTANCY

Several factors determine how long pavement marking materials may last on a roadway.

Pavement Type and Surface Condition. The pavement type and surface condition of a roadway determine not only the amount and type of marking material needed but also how long the markings are likely to last. The surface condition also affects the visibility of the materials. For example, an open-graded roadway surface (e.g., an asphalt concrete) requires either thick layers of paint or hot-applied thermoplastic for markings to be visible. In another example, if a roadway needs restriping but will likely need to be resurfaced in the near future, a less expensive paint application should probably be used as a temporary measure before the surface is repaved.

Traffic Volume. Traffic volumes impact the type of pavement marking materials selected and the frequency of application. On roadways with high traffic volumes, the pavement markings do not last as long as those on roadways with low traffic volumes. Therefore, a roadway with high traffic volumes is commonly marked with materials such as raised markers (in areas without snowplowing), hot-applied thermoplastic, grooved-in markings, or epoxy thermoplastic. However, on roadways with low traffic volumes, it is more common to use less expensive and nondurable paint-based products. The lower traffic volumes allow the paint to last an acceptable amount of time, although the service life is still typically under three years.

Traffic Composition. The type of traffic on a roadway impacts the durability of pavement markings. Trucks, buses, and other heavy vehicles and equipment contribute more to pavement marking wear than typical passenger cars.

Season Materials Are Applied. The weather or season when pavement markings are applied impacts their durability. For example, thermoplastics applied to a pavement surface during cold weather may not last as long as those applied during the summer. The same is true for painted pavement markings.

Thickness of Pavement Marking. The durability or lifespan of a pavement marking depends on how much of the material is applied. For obvious reasons, a thicker layer of paint will likely result in longer lasting markings, though thick applications of a material tend to increase costs.

Snow Maintenance. Snowplows increase the wear on pavement markings, and some materials, such as thermoplastic, may peel off the pavement entirely during snowplow passes. Only pavement markings that can withstand the blade of a snowplow should be applied in areas that see snow maintenance activity.

Retroreflectivity. Glass beads scattered across wet paint or reflective materials incorporated into preformed markings (i.e., tapes) make pavement markings retroreflective at night. Over time, however, the retroreflective qualities of the markings deteriorate due to traffic, weathering, and other factors. While grooving in markings can slow this wear to an extent, dirt and abrasion inevitably diminish the retroreflectivity of markings at night and necessitate repainting. Markings may need to be repainted with increasing frequency depending on the minimum levels for pavement marking retroreflectivity that are established in future editions of the *Manual on Uniform Traffic Control Devices* (MUTCD).

TRAFFIC AND SAFETY INFORMATIONAL SERIES FREQUENTLY ASKED QUESTION #5

Why Aren't There Better and Longer Lasting Stripes on the Road?

To some motorists, it may seem like pavement markings—for example, the stripes on the road that divide traffic lanes—are reapplied frequently. Highway agency personnel can also become frustrated with having to apply and reapply those markings.

No single material or application technique is best for providing long lasting pavement markings. Instead, many factors impact the design of pavement markings and the decisions regarding the materials and application methods used at each location.

Durability and cost of materials

When deciding what material to use for pavement markings, durability and cost are evaluated on a case-by-case basis. Pavement marking materials are generally either paint based or non-paint based. Paint-based markings are nondurable, lasting from six months to two years, and are relatively inexpensive. Non-paint-based markings are durable, generally lasting longer than paint-based markings, but are more expensive than paint-based markings. An example of a non-paint-based marking material used in Iowa is epoxy.

Pavement type and condition

The type of pavement surface must also be considered when choosing pavement markings. For example, asphalt concrete surfaces require either hot-applied thermoplastics or heavy applications of paint-based markings for the markings to be visible. For streets in good condition, more durable pavement markings are generally used. However, for streets in poor condition that may be resurfaced soon, a less expensive paint-based material is usually used.

Weather and season

Marking materials applied during the summer generally last longer than those applied during cold weather. Moreover, some non-paint-based markings are not widely used in Iowa because snowplows have a tendency to remove them.

Amount and composition of traffic

The more traffic on a street, the more quickly the pavement markings deteriorate, with trucks and other heavy vehicles typically wearing pavement markings more quickly than passenger cars. However, over time even common use leads to wear, and even the most durable pavement markings will likely need to be repaired or reapplied at some point.

For more information

For more information, please contact _____.

TRAFFIC AND SAFETY INFORMATIONAL SERIES FREQUENTLY ASKED QUESTION #6

WHY CAN'T I PLACE A BUSINESS-RELATED DIRECTIONAL SIGN WITHIN THE ROADWAY RIGHT-OF-WAY?

Unless carefully regulated, signs along a roadway can be hazardous. According to data from the Insurance Institute for Highway Safety, each year about 15 percent of all fixed-object collisions that result in a fatality involve a vehicle colliding with a sign, light support, or utility pole. For this and other reasons, one objective of agencies is to minimize the number of signs in a roadway's right-of-way.

SIGNS ALLOWED IN THE ROADWAY RIGHT-OF-WAY

Only signs that fulfill an essential need are typically allowed in the roadway right-of-way. The only signs that the *Manual on Uniform Traffic Control Devices* (MUTCD) allows within a roadway's right-of-way that also include business logos are referred to as "service" or "logo" signs. These signs direct motorists to essential services (e.g., gas, food, lodging, or camping). They are generally installed along freeways and expressways (typically preceding a roadway exit or junction) but must be officially authorized and properly designed and placed.

Authorized signs are uniform in their placement and design but also have posts that are designed to reduce the impact of collisions (i.e., crashworthy). Numerous studies have been conducted to determine the sign and sign support designs that best protect drivers in the event of a vehicle collision. Signs must be authorized to be placed in the right-of-way to ensure that they meet the design requirements based on these studies.

All signs in the roadway right-of-way must meet the design and placement requirements of the MUTCD and the specifications of any local (i.e., state, county, or city) roadway agency. (See Iowa Code Section 319.12 for more detail.) In addition, all signs and sign supports within a roadway's right-of-way should follow the guidelines documented in the American Association of State Highway and Transportation Officials' *Roadside Design Guide*.

Among other things, signs need to be a certain distance from the roadway and have posts designed with certain breakpoints in case of a collision. Signs and signposts not installed by a governmental agency typically do not meet these requirements and should be removed as quickly as possible.

AUTHORIZATION FOR SERVICE OR LOGO SIGN PLACEMENT

The placement of a sign within the roadway right-of-way must be authorized by the entity that owns and/or maintains the roadway and has the jurisdiction to regulate, guide, and warn traffic. Any unauthorized signs in a roadway's right-of-way can produce an unsafe situation and should be removed.

The MUTCD provides guidance regarding the location, number, and characteristics of all signs within a roadway's right-of-way. The manual's requirements for proper sign placement, design, and spacing seek to avoid the possibility of contributing to sign clutter or a driver missing an essential sign. In most cases, if a business-related directional sign were placed within a roadway's right-of-way for every business in a particular area, the MUTCD requirements could not be met and an unsafe situation would result.

The location and design of service and logo signs depend on the requirements in the MUTCD. In addition, once a highway agency decides to allow service or logo signs within its roadway right-of-way, the following must also be decided:

- What type of businesses will be eligible
- How far a business can be from its sign
- How sign logos and legends will be designed
- How logos will be removed and/or covered for seasonal businesses
- Whether service signs can be used in non-rural areas
- How much each business must pay for the permits, installation, annual maintenance, and other costs of the logo signs

The MUTCD requirements for the factors listed above should be considered the minimum standards by a local highway agency when it determines its service or logo sign policy. For example, the MUTCD requires that food services advertised on these signs must serve three meals per day, have a telephone, and be open six days a week. These requirements can be accepted as-is by the local highway agency or made more stringent.

CONSEQUENCES OF UNAUTHORIZED SIGNS IN THE RIGHT-OF-WAY

The roadway right-of-way is reserved for officially authorized regulatory, warning, and directional or guide signs. Any other signs should be removed and/or relocated to preserve traffic safety and operations.

The unauthorized placement of nonstandard signs and signposts in the roadway right-of-way introduces a safety hazard to drivers. When an individual erects an unauthorized sign within a roadway's right-of-way, the proper supports and/or signing material are not typically used, which increases the risk of an injury or fatality during a collision. Additionally, a collision involving an unauthorized sign can entail a number of liability issues for both the individual who erected the sign and the local jurisdiction.

A good reference for sign regulation in Iowa is the Iowa Department of Transportation publication entitled *Guide to Iowa Outdoor Advertising Sign Regulations*.

TRAFFIC AND SAFETY INFORMATIONAL SERIES
FREQUENTLY ASKED QUESTION #6

Why Can't I Place a Business-Related Sign within the Roadway Right-of-Way?

Many businesses rely on the use of signs to direct customers to their place of business. It is therefore understandable why some business owners would like to have their business signs posted along the road.

However, for the safety of all motorists, the number, type, and placement of signs along the road are regulated, and all signs placed in the roadway right-of-way must be officially authorized. While business owners are not permitted to place their own signs, authorized signs include "service" or "logo" signs that help direct motorists to area businesses.

Signs, signposts, and the placement of signs are regulated in the right-of-way

Because nonstandard signs and the unauthorized placement of signs can be hazardous to motorists, standards have been established to increase the safety and effectiveness of the signs that are placed. Only signs with breakaway signposts are authorized because the use of non-breakaway poles can increase the severity of crashes. The distance of signs from the roadway and the spacing between signs are also regulated to reduce the number and severity of crashes. See Code of Iowa Section 319.12 for more detail.

The dangers of too many signs

An excessive number of signs along the roadway increases the possibility that drivers will miss important warning, regulatory, or directional messages. If a business-related directional sign were placed within the roadway right-of-way for every business in an area, the large number of signs might decrease the usefulness any given sign—be it a warning sign or a sign for an area business—sometimes with severe consequences.

Signs that are safe and useful

For the reasons above, only signs that fulfill an essential need are typically authorized within a roadway's right-of-way. Service or logo signs that direct motorists to essential services—hospitals, gas, food, lodging, camping, and the like—are allowed in some cases if properly designed and placed. These signs are generally installed along freeways and expressways and can also include business logos and tourist-oriented directional signs.

For more information

For more information, please contact _____.

TRAFFIC AND SAFETY INFORMATIONAL SERIES FREQUENTLY ASKED QUESTION #7

WHAT FACTORS ARE CONSIDERED WHEN LOCATING, CONTROLLING, AND/OR MARKING PEDESTRIAN CROSSINGS?

INTERSECTIONS AND PEDESTRIAN CROSSINGS

Intersections are places of concentrated activity and conflicts between pedestrians and motorists. In fact, many suburban intersections can present difficulties for pedestrians because their configuration, size, and signal phasing and timing are often designed to efficiently serve motor vehicles rather than pedestrian traffic.

PEDESTRIAN CROSSING LOCATIONS

The locations of pedestrian crossings are determined by the volumes and patterns of existing or expected pedestrian trips. The most common locations for marked or unmarked pedestrian crossings are at intersections with traffic control (e.g., stop signs or traffic signals). However, if a significant number of pedestrians cross at midblock, marked crossings may also be designated at these locations.

PEDESTRIAN CROSSING CONTROL

Many pedestrian crossings are uncontrolled but are located at intersections controlled by stop signs or signals. There are, however, locations where the installation of a dedicated signal at a pedestrian crossing may be necessary to separate the conflicting flows of pedestrian and motor vehicle traffic and improve safety. For example, a signal such as a high-intensity activated crosswalk (HAWK) beacon might be added at a midblock pedestrian crossing. However, the installation of such devices can be expensive, and an engineering study needs to be performed to determine whether a signal is warranted.

The timing of the pedestrian signal with respect to the surrounding signals and the method of pedestrian actuation must also be considered. When a pedestrian crossing is at a regular intersection, pedestrian movements are often served at the same time as similar vehicle movements. However, more recent developments in pedestrian signal timing, such as leading pedestrian intervals, provide pedestrians with a dedicated amount of time to begin their crossing and establish themselves in the crosswalk before vehicular traffic is released.

PEDESTRIAN CROSSING MARKING AND SIGNING

Marking

In general, pavement markings at pedestrian crossings are meant to guide pedestrians across the roadway. Markings are especially important if there is any confusion about where pedestrians should cross. The markings at a crossing also serve as a cue (possibly along with some signing) to motorists that the crossing exists.

The marking and signing of pedestrian crossings are regulated by the requirements in the *Manual on Uniform Traffic Control Devices* (MUTCD). The MUTCD states that at locations controlled by traffic signals or on approaches controlled by stop or yield signs, crosswalk lines should be installed where engineering judgment indicates they are needed to direct pedestrians to the proper crossing path(s). An engineering study should be performed before a marked crosswalk is installed at a location away from a

traffic control signal or on an approach controlled by a stop or yield sign. Typically, a crossing is marked and/or signed when there is a high volume of crossing traffic (both motor vehicles and pedestrians). This can occur at crossings at regular intersections, in downtown areas, near schools, and even at midblock locations.

When crosswalk lines are used, they shall consist of solid white lines that mark the crosswalk. They shall not be less than 6 inches or greater than 24 inches in width. The width of the crossing should not be less than six feet, and it should extend the full width of the roadway pavement. At locations where additional visibility and attention is necessary, a zebra marking technique consisting of white diagonal lines at a 45-degree angle to the line of the crosswalk may be used. These diagonal marking lines should be about 12 to 24 inches wide and have a spacing of 12 to 60 inches between lines.

Signing

The marking of pedestrian crossings is sometimes supplemented by signing. Advance crossing signs are used to warn drivers of unexpected pedestrian crossing locations. For example, crossings that are not located at intersections (i.e., midblock crossings) are unexpected and require the installation of an advance crossing sign. The advance crossing sign for pedestrians is shown in Figure 1. The distance to the crossing or an "Ahead" supplemental plaque (MUTCD W16-9P) may also be indicated on the same post as the advance crossing sign. In addition, where the crossing occurs at a specific point, the advance crossing sign can be supplemented by a downward arrow plaque (MUTCD W16-7P). These types of signs should be placed at the crossing location and often are used in urban areas and/or at marked crossings. Different advance crossing assembles are used at locations where school children cross (MUTCD S1-1 and various supplemental plaques). The advance crossing sign for schools is shown in Figure 2.

FIGURE 1 Pedestrian advance crossing sign (W11-2).

Reference: Manual on Uniform Traffic Control Devices.

FIGURE 2 School advance crossing sign (S1-1).

Reference: Manual on Uniform Traffic Control Devices.

TRAFFIC AND SAFETY INFORMATIONAL SERIES
FREQUENTLY ASKED QUESTION #7

What Factors Are Considered When Locating, Controlling, and/or Marking Pedestrian Crossings?

At intersections, motorists and pedestrians sometimes compete for the same space. Because intersections are primarily designed to serve motor vehicles, they can be unsafe for pedestrians. The proper location, marking, and signing of pedestrian crossings is therefore very important for pedestrian safety.

Where is a good place for a crossing?

Pedestrian crossing locations are determined by the amount of existing or expected pedestrian traffic. The most common location for a marked or unmarked pedestrian crossing is at an intersection with a stop sign or traffic signal. However, if a significant number of pedestrians cross at midblock, marked crossings can also be designated at these locations.

When are crosswalk stripes painted?

Typically, crosswalk stripes consisting of solid white lines on both sides of the pedestrian path are painted at crossings with a high volume of vehicle and pedestrian traffic. Painted crosswalk stripes are especially important at locations where pedestrians may be uncertain about where they should cross. These markings can also serve as a signal (possibly along with some signing) to motorists that a crossing is present. Where a crossing requires additional visibility or attention, hatched zebra markings may be added that consist of white diagonal lines painted at a 45-degree angle to the line of the crosswalk.

When are crossing signs needed?

Advance crossing signs, which picture a person walking, are used to warn drivers of unexpected crossing locations. A school advance crossing sign is used at locations where school children cross.

Advance crossing sign

School advance crossing sign

When are crossings controlled by traffic signals?

Some locations may require a dedicated signal to help direct the flow of pedestrian and motor vehicle traffic and improve safety. For example, a signal such as a high-intensity activated crosswalk (HAWK) beacon might be added at a midblock pedestrian crossing. An engineering study should be used to determine whether a signal is warranted at a particular location.

For more information

For more information, please contact _____.

TRAFFIC AND SAFETY INFORMATIONAL SERIES FREQUENTLY ASKED QUESTION #8

WHY ISN'T THERE A "SCHOOL BUS STOP AHEAD" SIGN EVERYWHERE A BUS STOPS?

Signs improve the safety of a roadway by warning of hazards and assisting with the orderly and predictable movement of traffic. Before a sign can be placed along a roadway, it must meet four requirements:

1. The sign should fulfill a need. This need should be identified by a field study or other information, such as crash history data.
2. The sign should draw attention. The purpose of a sign is defeated if roadway users do not notice it.
3. The sign should have a clear message that all roadway users can understand.
4. The sign should be placed properly so that roadway users have enough time to perceive and respond to its message.

The specific location, number, and characteristics of signs placed within a roadway's right-of-way must meet the requirements of the *Manual on Uniform Traffic Control Devices* (MUTCD). In addition, the placement of a sign within a roadway's right-of-way must be authorized by the jurisdiction that owns and/or maintains the roadway.

PLACEMENT OF "SCHOOL BUS STOP AHEAD" SIGNS

According to the MUTCD, a "School Bus Stop Ahead" sign (see Figure 1) should be installed in advance of locations where a school bus, when stopping to pick up or discharge passengers, is not visible to road users for an adequate distance and where there is no opportunity to relocate the school bus stop to provide adequate sight distance.

FIGURE 1 "School Bus Stop Ahead" sign (MUTCD S3-1).

Reference: Manual on Uniform Traffic Control Devices

Typically, a specific school bus stop location is investigated as a candidate for a "School Bus Stop Ahead" sign if a request is filed with the government entity that has signing authority along that particular roadway. If the sight distance before the school bus stop is inadequate, an alternate bus stop location should first be considered as the safest option. If the terrain or roadway features do not allow an alternative bus stop location, a "School Bus Stop Ahead" sign should be installed.

OVERUSE AND MISUSE OF "SCHOOL BUS STOP AHEAD" SIGNS

The placement of unnecessary "School Bus Stop Ahead" signs reduces the overall effectiveness of these signs. The purpose of these signs is to warn drivers of unexpected hazards, such as a bus stopped in the roadway and/or passengers crossing the road. If these signs were placed at every school bus stop location, even locations where the bus and its passengers are visible from an adequate distance, drivers would begin to believe that caution is only needed if a bus is visible near a "School Bus Stop Ahead" sign. In reality, however, a bus may be over a hill or around a curve. Moreover, if drivers begin to see these signs at numerous locations, especially where they are not needed, they may begin to experience signing fatigue and ignore the signs completely.

The overuse and misuse of "School Bus Stop Ahead" signs can thus render the signs ineffective, even those signs placed where they are really needed, that is, where drivers cannot see a stopped school bus. These signs must be used consistently and prudently to ensure their effectiveness.

TRAFFIC AND SAFETY INFORMATIONAL SERIES FREQUENTLY ASKED QUESTION #8

Why Isn't There a "School Bus Stop Ahead" Sign Everywhere a Bus Stops?

Parents sometimes request the installation of "School Bus Stop Ahead" signs at their children's bus stop. While the safety of children is very important, placing a "School Bus Stop Ahead" sign is not necessarily the best solution to make children safer. In fact, misusing or overusing these signs can sometimes lead to the signs being misinterpreted or ignored. Here's why:

When warning signs are overused, they are sometimes ignored

If a "School Bus Stop Ahead" sign were used at every school bus stop, the sheer number of these signs on the roadway might lead drivers to begin ignoring these signs or to miss other important signs.

Warning signs are effective when they warn of unexpected hazards

The purpose of the "School Bus Stop Ahead" sign is to warn drivers of unexpected hazards, such as a stopped bus around a curve or over a hill. The sign is helpful in advance of a school bus stop if the bus, its flashing lights, or its passengers are not visible to drivers for an adequate sight distance. However, most school bus stops are located in places where drivers can clearly see the stopped bus, rendering a sign unnecessary. Before a "School Bus Stop Ahead" sign is installed, alternate locations should be considered for bus stops where sight distance may be a problem.

With or without "School Bus Stop Ahead" signs, education can be important

Even at school bus stops where a "School Bus Stop Ahead" sign has been installed, parents and children should not be lulled into a false sense of security. Children should keep in mind that they must be careful when crossing the street and that drivers may not necessarily be watching out for them.

For more information

For more information, please contact _____.

TRAFFIC AND SAFETY INFORMATIONAL SERIES FREQUENTLY ASKED QUESTION #9

WHY CAN'T SPEED BUMPS BE USED ON ALL STREETS TO SLOW TRAFFIC?

Speed "humps" are the most widely used traffic calming device in the United States. They are one response to citizen concerns about speeding and cut-through traffic in residential areas. The primary objective of speed humps, and other traffic calming measures in general, is to improve the environment and safety of a roadway by physically controlling vehicle speeds. Another consequence of speed humps can also be a reduction in the amount of cut-through traffic.

Excessive vehicle speeds and/or traffic volumes are common neighborhood complaints. These roadway characteristics are typically viewed as a disruption to the peace, safety, and quality of life of the neighborhood.

SPEED HUMP AND SPEED BUMP

Speed "humps" are not the same as speed "bumps". The primary objective of these two devices is to control the speed of vehicles, but they have different designs and allowable uses. A schematic of their differences is shown in Figure 1.

Speed Bump *Speed Hump*

FIGURE 1 Schematic differences between a speed bump and speed hump.

Speed humps are raised pavement areas across a roadway. They are typically parabolic, circular, or sinusoidal in shape and are a gentle version of the speed bump (see Figure 1). National guidelines have set the maximum height of speed humps at three to four inches (although 3.5 inches is now commonly accepted as the maximum height) and a maximum length at 12 feet (although 14 foot and longer are now becoming more common). Speed humps create a gentle vehicle rocking motion at low speeds but can jolt a vehicle at higher speeds. They are typically designed to reduce the speed of vehicles to about 15 mph.

The design of speed humps has evolved from extensive research and testing to achieve the specified speed reduction goal without imposing a high level of safety risks. When designed and installed properly, speed humps can be effective at lowering vehicle speeds and possibly reducing speed-related collisions. Speed humps can also be installed in a series to reduce speeds along an extended section of street.

Speed bumps, on the other hand, have a more abrupt design. They consist of a portion of raised pavement, but because of their abruptness their use is very restricted. In fact, most speed bumps are found in parking lots and or along private roadways. Their height is typically between three and six inches, and they are usually only one to three feet long. Speed bumps produce substantial driver discomfort, damage to the vehicle suspension, and/or loss of control if encountered at too high a speed.

This is one reason speed bumps are not used on public roadways. In general, vehicles must slow to about 5 mph or less for a speed bump (compared to 15 mph for a speed hump).

SPEED HUMP APPLICATION

Streets are classified according to the type of service they generally provide. *Arterial* streets are used for mobility purposes and are typically used by through vehicles (on longer trips) at higher speeds. On arterial streets, such as highways and major urban streets, speed humps are typically considered impractical because these roadways are meant to serve a mobility purpose. *Collector* roadways typically link arterials to the local roadway system. They normally experience moderate to low speeds. Typically, speed humps are not automatically recommended for collector streets but may be allowed in some jurisdictions. The decision to implement a speed hump on a collector street is usually made on a case by case basis after an engineering study of the roadway. *Local* streets primarily provide access to land uses and are expected to serve a small number of relatively short low-speed vehicle trips. Speed humps are used on these types of roadways when the neighborhood and the city believe that lower vehicle speeds and/or through traffic are needed, and this belief is supported by the results of an engineering investigation.

In addition to the type of roadway, there are other factors that should also be considered before the installation (and design) of a speed hump. Winter maintenance (e.g., snowplows) and emergency response vehicles need to have the ability to efficiently clear and respond to an emergency along a roadway.

Studies have shown that the response time of emergency vehicles does increases (depending on the vehicle type) for each speed hump. This is one reason some cities do not all the installation of speed humps along specified emergency vehicle response routes. The installation of speed humps and other traffic calming devices can also require additional maneuvering and/or a reduction in speed during winter maintenance activities. The result can be reduced efficiency. The installation of speed humps must also be supplemented with signs and/or pavement markings to warn motorists of their presence and to indicate suitable driver behavior.

For more information on traffic calming, speed humps, and their impact consult *Traffic Calming State of the Practice*. This document is published by the Institute of Transportation Engineers.

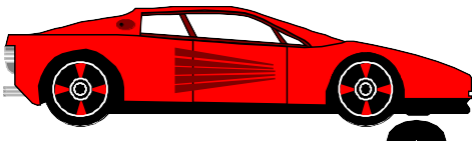
TRAFFIC AND SAFETY INFORMATIONAL SERIES
FREQUENTLY ASKED QUESTION #9

Why Can't Speed Bumps Be Used on All Streets to Slow Traffic?

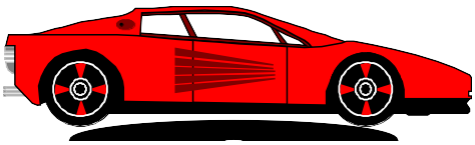
When traffic goes too fast on a street, people sometimes suggest we install speed bumps to slow vehicles down. Speed bumps are usually not an effective solution to speeding on public roadways. Speed *humps*, on the other hand, are used in some locations.

What is the difference between speed bumps and speed humps?

Speed bumps and speed humps are both used to slow vehicles, but they have different designs and are used in different places.



Speed Bump



Speed Hump

Speed bumps are made of an abruptly raised portion of pavement. Most speed bumps are found in parking lots and along private roadways. Speed bumps can produce substantial driver discomfort/injury, damage to vehicle suspension, and/or loss of control if encountered at too high a speed. These are some of the reasons why speed bumps are not used on public roadways.

A speed hump, on the other hand, is a much more gently raised portion of pavement. Speed humps are much longer than speed bumps and not nearly as steep. Speed humps create a gentle vehicle rocking motion at low speeds, but they can jolt a vehicle at higher speeds.

Factors that determine the use of speed humps

There are many factors that are considered when deciding whether to install a speed hump at a particular location.

The use of speed humps typically lowers vehicle speeds to about 15 mph. Speed humps are installed on some local roads and other low speed limit roadways. Speed humps may be used on local streets when it is determined that lower vehicle speeds and less through traffic are needed. Speed humps are not used on roadways that are intended for high-speed and high- volume traffic.

Speed humps can make the work of winter maintenance vehicles more difficult and can slow emergency vehicle response speeds. These factors should also be considered in deciding the location of speed humps.

For more information

For more information, please contact _____.

TRAFFIC AND SAFETY INFORMATIONAL SERIES FREQUENTLY ASKED QUESTION #10

HOW ARE POSTED SPEED LIMITS AND THE LOCATIONS OF SPEED LIMIT SIGNS DETERMINED?

DETERMINATION OF THE POSTED SPEED LIMIT

In Iowa, several jurisdictions (e.g., the state, counties, and cities) have the authority to establish speed limits on roadways. City and county agencies may establish posted speed limits of up to 55 mph, and the Iowa Department of Transportation (DOT) may establish speed limits of up to 70 mph.

The actual posted speed limit on a particular roadway, however, is typically established based on the results of a traffic engineering study. In general, these investigations analyze existing roadway conditions, crash data, and/or the prevailing speed of most drivers. The following factors are typically considered:

- The 85th percentile speed (determined by a speed study)
- Roadway type and surface characteristics
- Roadside development
- The safe speed for curves or hazardous locations
- Parking practices and pedestrian activity
- Crash history

In many cases, the primary determining factor is the 85th percentile speed of the vehicles already using a particular segment of roadway. This is the speed at or below which 85 percent of vehicles travel on a given roadway (see Figure 1 for a typical distribution of speeds on a roadway). This speed is generally considered reasonable and safe.

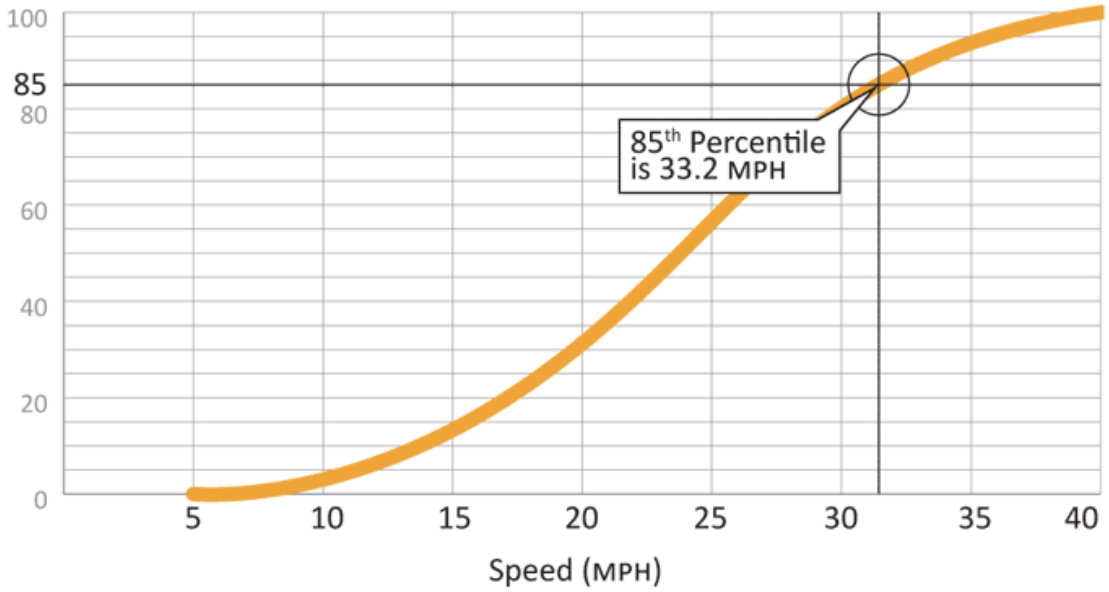


FIGURE 1 Typical distribution of vehicle speeds.

Reference: Speed Management: A Manual for Local Rural Road Owners, Federal Highway Administration.

The 85th percentile speed is primarily based on most drivers' sense of comfort and safety along a roadway segment and the characteristics and overall environment of the roadway. Therefore, setting a speed limit at or near the 85th percentile speed is desirable because the overall objective should be to set a speed limit most drivers will obey. If the speed limit is set too low, some drivers will obey it while others (possibly the majority) will ignore it. This situation will actually decrease the overall safety of the roadway because it will result in a large range of vehicle speeds. A speed limit that is set too high can produce a similar situation. The safest situation is when every vehicle (or at least the majority of vehicles) on the roadway travel at the same speed.

The speed limit sign for a roadway segment displays either what is considered to be a reasonable speed (i.e., the posted speed limit, as determined by the results of an engineering study into the factors listed above) or the statutory speed (established by the state legislature for specific types of roadways) for the segment during typical driving conditions. Speeds are displayed in increments of 5 mph.

LOCATION OF THE SPEED LIMIT SIGN

There is no standard spacing for speed limit signs along roadway segments. The only requirement in the *Manual on Uniform Traffic Control Devices* (MUTCD) is that speed limit signs be located at the points of change from one speed limit to another, beyond major intersections, and at other locations where it is necessary to remind road users of the applicable speed limit. Speed limit signs are also generally placed to the right of the roadway, but supplemental signs may be placed to the left along one-way roadways because the view of the driver in the left lane may be obstructed to the right.

SPEED RESTRICTIONS IN THE IOWA CODE

There are also legislative restrictions on speed limits in Iowa. In the Iowa Code, speed limits are restricted to 20 mph in any business district, 25 mph in any residential or school district, 45 mph in any suburban district, 55 mph on rural highways, 65 mph on selected multilane highways, and 70 mph on Interstate highways.

A general application of these restrictions, however, can produce unreasonable situations in which drivers tend to ignore the speed limits. The local governmental entities in control of a particular roadway segment can therefore increase the speed limits required in the Iowa Code when the results of an engineering and traffic study indicate that a higher speed limit is more reasonable and safer. However, local authorities in Iowa do not have the ability to authorize speed limits greater than 55 mph.

The Iowa DOT may establish speed limits higher than 55 mph on roadways under its jurisdiction, but such roads must first be analyzed by the Iowa Department of Transportation to confirm that the higher speed is warranted.

TRAFFIC AND SAFETY INFORMATIONAL SERIES FREQUENTLY ASKED QUESTION #10

How Are Posted Speed Limits and the Locations of Speed Limit Signs Determined?

Speed limits are generally set at the speed that most drivers travel on a particular roadway. This speed is considered to be reasonable and safe. Signs are posted at locations where drivers may need to be alerted to the speed limit.

Speed limits are set by the speed drivers actually travel

A key principle that helps determine a speed limit is that the safest situation on a roadway is when all vehicles are traveling approximately the same speed. When a speed limit is set unreasonably low, some drivers will tend to ignore it while other drivers will try to obey it. The result is that the roadway will carry both fast-moving and slow-moving vehicles, which may lead to a crash. Strange as it may seem, it is safer for all drivers to travel at the same high or low speed than for some drivers to drive fast and some to drive slowly.

Therefore, speeds are usually set based on the speed that most people drive on a particular roadway.

Other factors

Iowa drivers are expected to know that the speed limit is 20 mph in business districts, 25 mph in residential and school districts, 45 mph in suburban districts, and 55 mph on highways unless otherwise posted. The speed limit of any given segment of roadway may be increased from these standards if the results of an engineering and traffic study indicate that a higher speed limit would be more reasonable and safer.

Other factors may also be considered in setting speed limits, including roadway surface conditions, roadside development, pedestrian and parking activity, and the crash history at the location.

Speed limits are posted where they will alert or remind drivers of the speed limit

Speed limit signs must be located at points of change from one speed limit to another, beyond major intersections, and at other locations where it is necessary to remind road users of the applicable speed limit.

For more information

For more information, please contact _____.

TRAFFIC AND SAFETY INFORMATIONAL SERIES FREQUENTLY ASKED QUESTION #11

COULD TRAFFIC SIGNALS BE TIMED SO I RECEIVE A GREEN LIGHT AT EVERY INTERSECTION?

Traffic signals cannot be timed so that everyone receives a green light all of the time, and there are several reasons a minor street typically receives a shorter green light than a major street. Signal timing depends on the many different types of and uses for signals and certain guidelines for their placement.

Table 1 shows the speeds that allow a vehicle to progress along a roadway for various signal spacings and cycle lengths (the amount of time each movement receives). The addition of a new signal (possibly due to new development) will alter the signal spacing and may lower or negate the possibility that a vehicle can progress along the roadway without stopping at a traffic signal. The progression of vehicles along a roadway must be reconsidered whenever the characteristics of the roadway or its traffic control change.

TABLE 1 Maximum progressive vehicle speeds for various cycle lengths and intersection spacings

Traffic Signal Cycle Length (seconds)	Maximum Progressive Speed (mph)			
	0.125-mile Intersection Spacing	0.25-mile Intersection Spacing	0.5-mile Intersection Spacing	1.0-mile Intersection Spacing
60	15	30	—	—
90	10	22	45	—
120	7.5	15	30	60

Adapted from *System Considerations for Urban Arterial Streets*, Institute of Transportation Engineers, 1969.

WHY IS THE GREEN TIME SO MUCH SHORTER FOR MINOR STREETS?

This question can easily be answered by considering the definitions of arterial (i.e., major) and collector (i.e., minor) roadways. By definition, an arterial is a main thoroughfare that carries the majority of the traffic volume through an area, while a collector is a street that carries the minority of the traffic volume and provides a route to access the arterial.

Because the arterial street carries the largest traffic volumes, the signal plan should provide the majority of the green time to the arterial intersection approaches. This signal timing minimizes the delay for the traffic on the arterial but sometimes causes longer delays for the traffic on the minor streets. If signals are timed correctly and the appropriate type of signal controller is used, a minimum total delay (for major and minor street traffic) should be achieved.

WHAT IS THE DIFFERENCE BETWEEN PRETIMED AND ACTUATED SIGNALS?

Pretimed Signals

Pretimed signals have a preset cycle length for specified times of the day or for the entire day. Unlike actuated signals, a pretimed signal cannot adjust to traffic flow. Therefore, the optimum cycle lengths for these intersections must be determined. Factors considered in designing a cycle length include the

number of phases, the largest number of vehicles that can be served by a green light, and the number of lanes having right-of-way, just to name a few. Pedestrians are also a major consideration, and their presence (with corresponding crossing times) could increase the side-street green times and consequent cycle lengths at an intersection.

Actuated Signals

Actuated signals can vary their cycle length (i.e., vary the length of the green time given to each movement) to adapt to the traffic flow that uses the intersection. Detectors sense vehicles that approach the intersection and send that information to a signal controller. The controller then adjusts the length of the green time for the current traffic conditions. There are two types of actuated signals: fully actuated and semi-actuated.

Fully actuated signals are found at intersections that exhibit large fluctuations in traffic volumes from all of the approaches throughout the day. These signals have a set minimum and maximum green time. If no opposing vehicles are stopped at the intersection, the moving traffic will receive additional green time. The minimum green time is often set equal to the time required for a pedestrian to safely cross the intersection.

Semi-actuated signals have detectors only on the minor street approaches to an intersection. These types of signals are often found at the intersections of arterials and minor, low-volume roadways. The arterial has a green light until a vehicle is detected on the minor street. When the traffic volume is high on the side streets (during peak travel times) the semi-actuated signal acts as a pretimed signal.

HOW IS THE DECISION TO PLACE A TRAFFIC SIGNAL MADE?

Traffic engineers cannot simply install traffic signals where they are not warranted. Traffic signals are expensive, and incorrect placement can actually be harmful to safety and mobility. Refer to the *Manual on Uniform Traffic Control Devices* (MUTCD) for information on the nine warrants for the placement of traffic signals. A traffic signal should not be placed if one or more of these warrants has not been met.

There are some general objectives in placing a traffic signal. Good engineering judgment must be used in order to balance these objectives. According to the MUTCD, traffic engineers should assess five potential advantages when allocating the right-of-way to traffic:

1. Provide for the orderly movement of traffic
2. Increase the traffic-handling capacity of the intersection
3. Reduce the frequency and severity of certain crash types
4. Provide for continuous or nearly continuous movement of traffic along a given route under favorable conditions
5. Interrupt heavy traffic to permit other traffic and pedestrians to cross

TRAFFIC AND SAFETY INFORMATIONAL SERIES FREQUENTLY ASKED QUESTION #11

Could Traffic Signals Be Timed So I Receive a Green Light at Every Intersection?

Because of the complexity of most transportation systems, it would be nearly impossible to orchestrate traffic patterns and traffic signal timing so that everyone could receive green lights at every intersection. The following are some of the factors that determine when traffic signals change and explain why drivers can't always get green lights.

Green times vary for minor and major streets

Because major streets carry the largest traffic volumes, traffic signals give the majority of the green time to the traffic on these streets. This usually minimizes the delay for the majority of the traffic crossing an intersection. However, the smaller volume of traffic on the minor street may sometimes experience longer delays as a result. Achieving the minimum *total* delay is the goal.

Many traffic signals are timed on an individual basis

Many traffic signals, especially those at isolated intersections, are designed on an individual basis to change at cycles that are best suited for that particular intersection. The timing for these traffic signals is controlled either by a preset schedule (pretimed signals) or current traffic conditions (actuated signals).

Pretimed signals have preset cycle lengths (that is, the length of the green light is a fixed time interval), either for specified times of the day or for the entire day. These signals do not adjust to the traffic flow. Therefore, the optimum cycle lengths for a particular flow pattern at the intersection must be determined so that the ideal signal timing can be set. One of the many factors that determine how long a green light lasts is whether there is a pedestrian crossing at the intersection.

Actuated signals, in contrast, vary their cycle lengths based on the traffic flow. When a vehicle approaches an intersection with an actuated signal, the vehicle is detected and the information is sent to a signal controller. The controller then adjusts the length of the green light so that it is optimal for the current traffic conditions.

Some traffic signals are timed as a system

Many signals, especially when closely spaced, are also timed as a coordinated system so that some vehicles can receive a green light at each intersection while traveling a segment of roadway.

The goal is to reduce total delay

In general, traffic signals are timed to reduce the delay for the most vehicles and help traffic flow more smoothly.

For more information

For more information, please contact _____.

TRAFFIC AND SAFETY INFORMATIONAL SERIES FREQUENTLY ASKED QUESTION #12

HOW ARE PEDESTRIAN SIGNALS TIMED TO ACCOMMODATE PEDESTRIANS?

Crossing a signalized intersection can be dangerous for pedestrians. It is important for an intersection with regular pedestrian traffic to have clearly visible signals that tell pedestrians when they should and should not cross the intersection. Pedestrian signals are especially necessary when pedestrians cannot see the green signal for the vehicles travelling in the same direction. In addition to the safety challenges that pedestrians introduce, the presence of pedestrians can greatly affect traffic signal timing. Understanding how pedestrian signals work is very important to pedestrian safety.

WHAT DO THE PHASES OF THE PEDESTRIAN SIGNALS MEAN?

When the "Walk" symbol (and optional countdown indication) is illuminated, a pedestrian may *start* walking across the intersection. The pedestrian should still check for potential conflicts with turning vehicles.

When the "Don't Walk" symbol is *flashing* (and the optional countdown timer, if present, continues to run), it is *not safe* for a pedestrian *to start* crossing. However, a pedestrian who is already crossing when the symbol starts to flash should have sufficient time to safely finish.

When the "Don't Walk" symbol is constantly illuminated (and the optional countdown indication is blank), it is *not safe* for a pedestrian to be in the crosswalk.

WHY DOES THE WALK SYMBOL STAY ON FOR ONLY A FEW SECONDS?

A common misconception that pedestrians have is that they should not be in the crosswalk when the "Walk" symbol changes to a flashing "Don't Walk" symbol (including any countdown indication). When the "Walk" symbol changes, some pedestrians already in the crosswalk actually turn around and go back to where they started! Pedestrians should realize that the only time that they should not be in the crosswalk is when the "Don't Walk" symbol is illuminated *constantly*. However, pedestrians *should not start* crossing if the "Don't Walk" symbol (including any countdown indication) is flashing.

Most "Walk" phases last only about four to seven seconds and are normally referred to as the minimum start-up time for pedestrians. For pedestrians who have begun crossing during the "Walk" phase, the flashing "Don't Walk" or countdown phase should provide enough time to safely cross the intersection.

HOW IS PEDESTRIAN CROSSING TIME RELATED TO PEDESTRIAN SIGNAL TIMING?

Transportation professionals use a simple equation to determine how much time is needed for a pedestrian to safely cross an intersection:

G_P = (4 to 7) + (W/4.0),

where G_P is the minimum pedestrian crossing time needed in seconds. In general, the "Walk" symbol is illuminated for four to seven seconds (depending on the level of pedestrian flow). The flashing "Don't Walk" symbol is illuminated for (W / 4.0) seconds, where W is the distance in feet from the curb to the center of the farthest lane on the roadway and the value of 4.0 (in feet per second) is the walking speed typically assumed for pedestrians. (A range of 3.5 to 4.0 feet per second is reasonable based on guidance and options from the *Manual on Uniform Traffic Control Devices* [MUTCD].)

There are also other methods for timing pedestrian signals. A common alternative to the previous approach is to install a pedestrian push-button detector. When the button is pushed, the traffic signal controller provides a minimum crossing time for pedestrians during the next available concurrent vehicle green phase. In the presence of pedestrians, the green time might be increased beyond what is needed for the vehicles during that phase and the percentage of the cycle allocated to the other phases decreased proportionally. In locations where it is assumed that pedestrians cross an intersection in two trips, pedestrian signal timing is based on the use of a median island. In locations with high volumes of pedestrians and conflicting turning vehicles, a leading pedestrian interval (LPI) may be used to reduce conflicts. This approach provides pedestrians with a walk indication three to seven seconds before vehicles are given a green signal to allow pedestrians to establish their presence in the crosswalk.

WHAT DETERMINES THE PLACEMENT OF A PEDESTRIAN SIGNAL?

The safety of pedestrians crossing an intersection is very important. The MUTCD outlines several guidelines that address pedestrian safety at signalized intersections. The following are some of the basic conditions that stipulate the placement of a pedestrian signal:

- When warrants for pedestrian volume or school crossing require the installation of a traffic signal
- When an exclusive interval is provided or made available for pedestrian crossing
- At established school crossings at any signalized location
- When multiphase indications may confuse pedestrians
- When it is necessary to assist pedestrians in deciding when to begin crossing the roadway
- When traffic pattern indicators are not visible to pedestrians (e.g., one-way streets)
- When pedestrians cross only part of a street at a time (to or from a median island)

TRAFFIC AND SAFETY INFORMATIONAL SERIES
FREQUENTLY ASKED QUESTION #12

How Are Pedestrian Signals Timed to Accommodate Pedestrians?

Crossing the street, particularly at a busy intersection, can be dangerous for pedestrians. Pedestrian signals are designed to make it clear to pedestrians when they should and should not cross.

Meanings of pedestrian-related signals

When the "**Walk" symbol (and optional countdown indication) is illuminated**, the pedestrian may *start* walking across the intersection. The pedestrian should still check for potential conflicts with turning vehicles.

When the **"Don't Walk" symbol is *flashing*** (and the optional countdown timer, if present, continues to run), it is *not safe* for a pedestrian *to start* crossing. However, a pedestrian who is already crossing when the symbol starts to flash should have sufficient time to safely finish.

When the **"Don't Walk" symbol is constantly illuminated** (and the optional countdown indication is blank), it is *not safe* for a pedestrian to be in the crosswalk.

Supplementing the use of pedestrian signals with caution

Even with the help of pedestrian signals, pedestrians should use caution and look for traffic in all directions before crossing.

For more information

For more information, please contact _____.

TRAFFIC AND SAFETY INFORMATIONAL SERIES FREQUENTLY ASKED QUESTION #13

WHY CAN'T STOP SIGNS BE PLACED AT INTERSECTIONS TO REDUCE SPEEDING ALONG MY STREET?

A common complaint from people in residential areas is that vehicles constantly speed by the fronts of their houses, potentially threatening the safety of the neighborhood's children. These residents frequently request the erection of additional stop signs on their streets to reduce traffic speeds. Adding stop signs, however, usually does not solve the problem of speeding in residential areas.

WHY CAN'T ANOTHER STOP SIGN BE INSTALLED?

A stop sign is an inconvenience to motorists, and stop signs that are not warranted are frequently violated. Therefore, a stop sign should only be placed at an intersection if one or more of the warrants listed in the *Manual on Uniform Traffic Control Devices* (MUTCD) is met (see below). Before the warrants for a stop sign are even considered, however, less restrictive measures (such as a yield sign) are usually considered. In certain cases, the use of less restrictive measures or no control at all accommodates traffic demands safely and effectively.

WARRANTS FOR A STOP SIGN

A stop sign may be warranted at an intersection where one or more of the following conditions exists:

- A less important road intersects a main road and application of the regular right-of-way rule is hazardous.
- A street is entering a through highway or street.
- The intersection is in a signalized area but is itself unsignalized.
- High traffic volumes, a restricted view, and/or a problematic crash history at the intersection indicates the need for control by a stop sign.

If a full stop is not found to be warranted at an intersection, a yield sign can be considered instead.

In addition to evaluating intersections for the installation of new stop signs, existing stop sign installations should be reviewed periodically to determine whether the use of less restrictive control or no control at all could accommodate the existing and projected traffic flow safely and effectively.

WHERE SHOULD A STOP SIGN BE INSTALLED?

A stop sign should be installed/located where vehicles are to stop or as near to that point as possible. The sign may be supplemented with a stop line and/or the word STOP on the pavement. A yield sign is erected in the same manner. Where there is a marked crosswalk, the stop or yield sign should be erected approximately four feet in advance of the crosswalk line.

When only one stop or yield sign is used on an intersection approach, the sign should be placed on the right side of the roadway. Based on engineering judgement, a second stop or yield sign may be added on the left side of the roadway to increase conspicuity. For example, a second sign may be necessary at wide intersections or other locations where additional emphasis of the stop or yield condition is

necessary. Additionally, if two lanes of traffic are present on an approach, at least one stop sign should be visible to each lane of traffic.

CAN STOP SIGNS CONTROL SPEED?

Many studies have shown that stop signs are not an effective means of controlling or reducing midblock speeds, and Section 2B.04 of the MUTCD specifically notes that stop signs should not be used for speed control. In fact, the overuse of stop signs may cause drivers to act carelessly in the presence of the stop signs that are installed. In stop sign observance studies, approximately half of all motorists typically come to a rolling stop and 25 percent do not stop at all. A study conducted by Beaubien (1989) also showed that placing stop signs along a street may actually increase the peak speed of vehicles because motorists tend to increase their speed between stop signs to regain the time "lost" at the stop signs. Moreover, stop signs can give pedestrians a false sense of safety if it is assumed that all vehicles will come to a complete stop at the proper location.

WHAT CAN BE DONE INSTEAD OF INSTALLING A NEW STOP SIGN?

There are many alternatives to installing a new stop sign. For example, a concept called *traffic calming*, the combination of physical traffic controls and community support, might be a good alternative for some communities. Traffic calming measures can be installed as part of an areawide traffic management plan or on a single street and involve local law enforcement, emergency and maintenance officials, engineers, and the community. One traffic calming measure that could be applied in the short or long term to address speeding is the use of speed feedback signs. The effectiveness of these devices varies by location, application, and duration, with urban, non-school zone deployments producing reductions in mean speeds of 1 to 8 mph.

Some communities also start inter-neighborhood programs to address the problems of speeding and traffic safety in their neighborhoods. In many cases, the problem is largely attributable to drivers that live in these same neighborhoods, and simply raising awareness of the issue may prompt these drivers to adjust their driving behaviors and decrease their speeds.

Though measures can be taken, unfortunately there is no definitive solution to the problem of drivers speeding through residential areas. It is important for residents to be aware of the issue.

REFERENCE

Beaubien, R. 1989. Controlling Speeds on Residential Streets. *ITE Journal*, Vol. 59, No. 4, pp. 37–39.

TRAFFIC AND SAFETY INFORMATIONAL SERIES FREQUENTLY ASKED QUESTION #13

Why Can't Stop Signs Be Placed at Intersections to Reduce Speeding along My Street?

A common and very understandable complaint from people in residential areas is that vehicles are speeding through their neighborhoods. These residents often ask that more stop signs be installed to address the problem. However, adding stop signs may not be the best solution. In fact, doing so can sometimes make the problem worse.

Stop signs don't always slow traffic

Though it may seem counterintuitive, installing stop signs may not result in reduced traffic speeds. Studies have shown that stop signs are not effective at controlling drivers' speeds between intersections. In fact, motorists sometimes drive even faster between stop signs to make up for time "lost" while stopped, which actually increases peak speeds and potentially makes neighborhoods more dangerous.

Installing stop signs can sometimes do more harm than good

Too many stop signs may discourage good driving habits. Studies have shown that if stop signs are overused within an area or are located where they do not seem necessary, some drivers may become careless about obeying them. This can be especially dangerous for pedestrians and bicyclists, who may have a false sense of safety from the presence of stop signs.

Other solutions

Fortunately, there are other ways to encourage traffic to slow down, such as the use of traffic calming measures. Sometimes even a simple neighborhood awareness program about the dangers of speeding can be effective.

For more information

For more information, please contact _____.

TRAFFIC AND SAFETY INFORMATIONAL SERIES FREQUENTLY ASKED QUESTION #14

WHY CAN'T A MULTIWAY STOP SIGN BE PLACED TO REDUCE ACCIDENTS AT AN INTERSECTION?

Crash analysis is very complicated and usually identifies multiple causes for the crash history at a given intersection. A multiway stop sign is not always the best option for addressing these causes and reducing intersection crashes. Stop signs delay drivers, who often become impatient and whose impatience may cause crashes. Intersections with multiway stop signs are not inherently dangerous, but the multiway stop control must be warranted, and other, less restrictive options should be considered before a multiway stop sign is installed.

WHAT IS REQUIRED FOR THE INSTALLATION OF MULTIWAY STOP CONTROL?

Multiway stop control is an inconvenience to all drivers using the intersection. For this reason, three warrants for its use have been developed, as listed in the *Manual on Uniform Traffic Control Devices* (MUTCD). Multiway stop control may be considered at an intersection if any of the following conditions are present:

1. Traffic signals are justified, and a multiway stop sign is an interim measure that can be installed quickly to control traffic while arrangements are made for the signal installation.
2. Five or more crashes have occurred over a 12-month period that are correctable by a multiway stop sign. Such accidents include right- and left-turn collisions as well as right-angle collisions.
3. The intersection meets the following criteria for minimum traffic volumes: (a) The vehicular volume entering the intersection from the major street approaches averages at least 300 vehicles per hour for any eight hours of an average day; and (b) the combined vehicular, pedestrian, and bicycle volume from the minor street approaches averages at least 200 units per hour for the same eight hours, with an average delay to minor street vehicular traffic of at least 30 seconds per vehicle during the highest hour; but (c) if the 85th percentile approach speed of the major street traffic exceeds 40 mph, the minimum vehicular volume warrants are 70 percent of the above requirements.

A multiway stop sign should only be installed when traffic volumes on the intersecting roadways are approximately equal. However, if volumes are particularly high, a traffic signal may be more appropriate (for traffic signal warrants, see Traffic and Safety Informational Series Frequently Asked Question #15, What Is the Harm in Installing an Unwarranted Traffic Control Device?). Investigating the warrants listed above for a multiway stop sign requires an extensive traffic engineering study to determine whether installation of multiway stop control is appropriate.

WON'T CRASHES BE REDUCED IF A MULTIWAY STOP SIGN IS INSTALLED?

One of the warrants for multiway stop control is crash related. If an intersection meets this requirement (see above) and the traffic volumes on each approach are approximately equal, multiway stop control may be warranted for safety purposes. However, the overall results of the traffic engineering study and the professional judgement of the engineer should also be considered. Research has shown that under certain conditions, other traffic control measures may be more effective and safer than a multiway stop

sign. For example, improving intersection visibility by clearing sight triangles of obstructions can be effective in reducing crashes. Other options are discussed below.

WHAT CAN BE DONE OTHER THAN ADDING A MULTIWAY STOP SIGN?

A thorough analysis of the unique traffic, safety, and geometric characteristics of a given intersection is required to evaluate the validity of certain traffic control measures at that location. While a multiway stop sign is needed in certain situations, less restrictive countermeasures may be safer and more effective in other situations. The following are some of the alternatives that can be considered:

- Install warning signs and/or flashing beacons along the major roadway to warn users approaching the intersection.
- Relocate the stop line(s) to improve sight distance and visibility at the intersection.
- Install a flashing beacon at the intersection to supplement the existing stop signs and increase conspicuity.
- Add one or more lanes on a minor roadway approach to reduce the number of vehicles per lane on the approach.
- Install roadway lighting to reduce the frequency of crashes at night.
- Restrict one or more turning movements.
- Limit the number of driveways in close proximity to the intersection; unexpected and conflicting movements from these driveways could cause vehicles on the roadway to suddenly stop or swerve, resulting in crashes.

The ultimate goal of any countermeasure is to provide a safe intersection for vehicles, pedestrians, and bicyclists.

TRAFFIC AND SAFETY INFORMATIONAL SERIES FREQUENTLY ASKED QUESTION #14

Why Can't a Multiway Stop Sign Be Placed to Reduce Accidents at an Intersection?

It may seem like installing a multiway stop sign at a particular intersection would slow drivers down and make the streets safer, but additional stop signs do not necessarily increase safety. In fact, the overuse of stop signs can sometimes lead drivers to ignore them, especially when the signs are installed at locations where they are not really needed. Therefore, traffic engineers make careful decisions concerning the use of multiway stop signs. Some of the factors they consider are described below.

Too many stop signs can lead to ineffectiveness

Studies have shown that when stop signs are placed at intersections where they are not really needed, some motorists become careless about obeying them. Moreover, the overuse of multiway stop signs can contribute to the number of frustrated, impatient, and, consequently, reckless drivers on the streets.

Multiway stop signs are installed only where they are needed

To make travel as efficient and safe as possible, multiway stop signs are usually installed only where conditions warrant their use. Multiway stop signs are often installed at the intersection of two roadways that contain similar traffic volumes, and that intersection must meet at least one of the following conditions:

- A traffic signal is going to be installed and the intersection needs a temporary solution to control traffic.
- At least five crashes have occurred at the intersection within a 12-month period that could have been prevented by stop signs.
- The intersection sees relatively high volumes of vehicle and possibly pedestrian and/or bicycle traffic.

Other alternatives may provide just as much safety

Before a multiway stop sign is installed, other, less restrictive solutions should be considered, such as the following:

- Relocate the stop line(s) to improve visibility at the intersection.
- Limit the number of driveways in close proximity to the intersection; unexpected movements to/from these driveways sometimes cause drivers to suddenly stop or swerve, resulting in crashes.
- Install flashing beacons before or at the intersection to provide advance warning to drivers or to supplement existing stop signs, respectively.
- Install roadway lighting to reduce the frequency of crashes at night.

For more information

For more information, please contact _____.

TRAFFIC AND SAFETY INFORMATIONAL SERIES FREQUENTLY ASKED QUESTION #15

WHAT IS THE HARM IN INSTALLING AN UNWARRANTED TRAFFIC CONTROL DEVICE?

Installing traffic control devices such as stop signs or traffic signals where they are not needed can significantly disrupt traffic flow and increase intersection delay for drivers. The induced delay increases travel time and frustrates drivers, and the additional starts and stops result in increased fuel consumption and the consequent production of vehicle emissions.

WHAT IS THE HARM IN INSTALLING A STOP SIGN?

A two-way stop sign assigns the right-of-way at an intersection. Because a stop sign causes substantial inconvenience to motorists, it should be used only where warranted. The *Manual on Uniform Traffic Control Devices* (MUTCD) states that a two-way stop sign may be warranted at an intersection where one or more the following conditions exists:

1. A less important road intersects a main road and application of the normal right-of-way rule would not be expected to provide reasonable compliance with the law.
2. A street is entering a through highway or street.
3. The intersection is in a signalized area but is itself unsignalized.
4. A combination of high entering traffic volumes, a restricted view, or a problematic crash history indicates a need for control by a stop sign.

The amount of delay created by a two-way stop sign at a given intersection depends on the traffic flows on both the major and minor streets. The gaps in the traffic stream on the major street must be sufficient to allow the stopped traffic on the minor street to execute the desired through, right-turn, or left-turn movements through the intersection. The term “critical headway” is often used to describe the median gap accepted by drivers for specific turning maneuvers and roadway characteristics. According to the 2010 *Highway Capacity Manual*, typical critical headways are 6.2 to 7.1 seconds for right turns from a minor roadway and 6.4 to 7.5 seconds for left turns from a minor roadway. Left-turn movements take longer than right-turn movements, and left-turning drivers must cross more traffic streams than right-turning drivers. The delay for vehicles on the minor street is also determined by the vehicle arrival rate on the minor street, which is related to how long drivers must wait in the queue to get to the stop line.

The delay times at stop-controlled approaches can become excessive if the traffic flow on either the major or minor street is high. However, the advantage of a two-way stop is that the major flows do not have to stop and thus incur almost no delay at the intersection (i.e., the majority of the traffic does not have to stop).

Multiway stop control is often controversial because it can sometimes confuse motorists and cause more average delay than other types of traffic control. A multiway stop sign should only be used where the traffic volumes on all approaches to the intersection are approximately equal and relatively low. However, a multiway stop sign can be quite useful in unusual situations where two-way stop control has not solved the observed safety problems but where signalization is not yet warranted.

WHAT IS THE HARM IN INSTALLING A TRAFFIC SIGNAL?

Justifying the installation of a traffic signal requires considerable data collection and analysis. The following data must be collected and analyzed:

- Traffic volumes by approach and movement during 12 hours of an average day
- Pedestrian counts in crosswalks
- Information on nearby facilities and activity centers that serve the young, elderly, and/or disabled
- Posted or statutory speed limits or the 85th percentile speeds on the uncontrolled approaches
- Collision diagrams of recent crashes
- Condition diagram of the intersection

The MUTCD lists nine warrants for the placement of traffic signals, as summarized below (please refer to Chapter 4C of the MUTCD for details):

1. Eight-hour vehicular volume. The volume of intersecting traffic is sufficiently high to consider installing a traffic control signal, or the traffic volume on a major street is so heavy that traffic on a minor intersecting street suffers excessive delay or conflict in entering or crossing the major street.
2. Four-hour vehicular volume. The volume of intersecting traffic is sufficiently high to consider installing a traffic control signal.
3. Peak hour volume. Traffic conditions are such that for a minimum of one hour of an average day, the minor street traffic suffers undue delay when entering or crossing the major street.
4. Pedestrian volume. Traffic volume on a major street is so heavy that pedestrians experience excessive delay in crossing the major street.
5. School crossing. The frequency and adequacy of gaps in the traffic flow are insufficient for schoolchildren crossing the major street.
6. Coordinated signal system. The installation of a traffic signal as part of a coordinated signal system at an unsignalized intersection would provide progressive movement and maintain vehicle platooning.
7. Crash experience. Other alternatives do not decrease crashes, and the severity and frequency of crashes are correctable by use of a traffic signal.
8. Roadway network. A signal installation would encourage traffic flow concentration and organization on the roadway network.
9. Intersection near a grade crossing. An intersection approach controlled by a stop or yield sign is in close proximity to a railroad grade crossing.

If none of these warrants are met, a traffic signal should not be installed. In addition, the fulfillment of a warrant or warrants does not in itself justify the installation of a signal.

Installing a traffic signal at a low-volume intersection can significantly increase delays and crashes. The length of delay is directly related to a number of factors. For example, one factor is cycle length, which is influenced by traffic volumes and the need to safely accommodate pedestrian crossing times. As noted above, the increase in delay and stops then translates into higher fuel consumption, increased travel times, and higher point source emissions. Additionally, although traffic signals can reduce the total number of crashes at an intersection, research has shown that certain types of crashes (e.g., rear-end collisions) may actually increase after a signal is installed. For this reason, the type and number of crashes at an intersection should be considered before the installation of a traffic signal.

Traffic signals can represent a positive public investment when justified, but they are costly. A modern traffic signal can cost between $250,000 and $500,000 to install. In addition, the electrical power consumed in operating a signalized intersection 24 hours a day can cost an average of about $1,500 per year.

It is important to carefully consider whether a traffic control device is needed before rushing to make an implementation decision. The costs and benefits must be carefully evaluated, and a careful analysis and engineering study must be completed.

TRAFFIC AND SAFETY INFORMATIONAL SERIES FREQUENTLY ASKED QUESTION #15

What Is the Harm in Installing an Unwarranted Traffic Control Device?

Installing traffic control devices such as stop signs or traffic signals along a roadway does not necessarily slow drivers down or increase safety. In fact, the overuse of stop signs and traffic signals can sometimes lead drivers to ignore or disobey them, especially when traffic control devices are installed at locations where they are not really needed.

Too many stop signs can lead to ineffectiveness

Studies have shown that when stop signs are placed at intersections where they do not appear to be needed, motorists may become careless about obeying them.

Too many traffic signals can negatively impact traffic flow

Installing traffic signals where they are not needed can create traffic congestion, increase travel time and vehicle emissions, and frustrate drivers, who may drive impatiently as a result.

Other options can provide safety

To make travel efficient and safe and to help ensure the proper observance of stop signs and traffic signals, traffic control devices are usually installed only where they are absolutely necessary. In many cases, other, less restrictive solutions such as yield signs may provide sufficient safety without any detriment to traffic flow.

For more information

For more information, please contact _____.

TRAFFIC AND SAFETY INFORMATIONAL SERIES FREQUENTLY ASKED QUESTION #16

WOULDN'T INSTALLING A TRAFFIC SIGNAL REDUCE THE NUMBER OF CRASHES AT AN INTERSECTION?

A traffic signal is not always the best option for reducing crashes at an intersection. In fact, the incorrect installation or placement of a traffic signal can actually result in additional crashes at the intersection.

Crash analysis is very complicated and usually identifies multiple causes for the crash history at a given intersection. For this reason, the solution to a safety problem at a particular intersection is not always obvious, and the placement of any type of traffic control device to address the identified causes must be considered carefully.

WHAT ARE THE WARRANTS FOR A TRAFFIC SIGNAL?

A traffic control signal should not be installed unless one or more of the nine traffic signal warrants presented in the *Manual on Uniform Traffic Control Devices* (MUTCD) is met. A complete listing of these warrants is included in the answer to Traffic and Safety Informational Series Frequently Asked Question #15, What Is the Harm in Installing an Unwarranted Traffic Control Device? Among other things, these warrants are related to vehicular and pedestrian volumes at the intersection, the intersection's crash history, and the presence of a school or railroad crossing.

However, fulfillment of one or more of these warrants does not in itself justify the installation of a traffic signal. A comprehensive engineering study should also be performed to determine whether a traffic signal would improve the overall safety and/or operation of the intersection. If the study indicates otherwise, a traffic signal should not be installed, even if one or more of the warrants is met.

WHAT CONTRIBUTES TO INTERSECTION CRASHES?

According to the U.S. Department of Transportation's 1994 *Technical Report on Intersection Crossing Path Crashes,* approximately one-third of all intersection crossing path crashes occur at intersections controlled with traffic signals. However, most of the crashes related to traffic signals are rear-end collisions.

The National Highway Traffic Safety Administration and Insurance Institute for Highway Safety have published several fact sheets about crashes in general that contain information relevant to understanding intersection crashes. The major contributors to crashes are summarized below:

- *Young drivers* are major contributors to fatal crashes in Iowa. In 2019, although 16- and 17-year-old drivers only represented 2.8 percent of Iowa's licensed drivers, they were involved in 11 percent of all fatalities resulting from crashes.
- *Alcohol* is a major contributing factor to traffic fatalities. In 2019, alcohol-related crashes were responsible for 103 fatalities, roughly one-quarter of all fatalities resulting from crashes.
- *Speeding* is another major contributing factor to fatal crashes in Iowa. When a vehicle is traveling at a faster speed, a much greater distance is required to make the same driving decisions than when a vehicle is traveling at a slower speed. Speeding was a factor in 21 percent of fatal crashes in Iowa in 2019.

- *Red light running* results in a large number of crashes at signalized intersections. For example, red light running crashes were responsible for 143,000 injuries and 846 deaths in the United States in 2019.

WHAT CAN BE DONE TO REDUCE INTERSECTION CRASHES?

An intersection crash analysis can be undertaken with the goal of developing countermeasures to reduce crashes. However, it is important to keep in mind that each intersection has its own unique characteristics that must be studied and analyzed in detail. The traffic engineer conducting the analysis should observe the site and use proper analysis techniques and his or her background and experience to identify solutions.

Signalization may not eliminate the crash concerns at an intersection; it may simply change the type of crashes that occur or shift them to another location. A traffic signal (especially an unwarranted signal) can cause excessive delay, and violation of the signal by frustrated drivers can contribute to additional crashes or result in a diversion of traffic to parallel residential streets.

The evaluation of an intersection and its characteristics may indicate that measures other than a traffic signal could improve safety adequately and less intrusively. Some countermeasures that might be considered for crash reduction have been identified by the Institute of Transportation Studies in the 16th edition of the *Fundamentals of Traffic Engineering*:

- Prohibit a turning movement
- Provide dedicated/channelized turn lanes
- Install or improve warning signs
- Improve roadway lighting
- Provide a stop sign
- Install or improve pedestrian crosswalks
- Improve skid resistance for wet-weather crashes
- Correct the roadway alignment

WHAT ABOUT INSTALLING A TRAFFIC SIGNAL?

Traffic signals, when warranted, can produce a more orderly movement of traffic, increased intersection capacity, a reduction in certain types of crashes (especially right-angle crashes), nearly continuous movement along a route (via signal coordination), and interruptions in traffic to permit other traffic or pedestrians to cross. However, improperly installed or unwarranted traffic signals can produce excessive delay, disobedience of the signal indications, increased use of minor roadways to avoid signals, and an increase in certain types of crashes (especially rear-end collisions).

Installation of a traffic signal (or multiway stop control) must be preceded by a thorough engineering study to determine whether the location meets minimum signalization warrants. A traffic signal should only be installed if the intersection meets one or more of the nine warrants in the MUTCD for signal installation (for these warrants, see the answer to Traffic and Safety Informational Series Frequently Asked Question #15, What Is the Harm in Installing an Unwarranted Traffic Control Device?).

Only one traffic signal warrant is related to an intersection’s crash history. This warrant requires that remedies less restrictive than a traffic signal be considered first, that there be at least five reportable crashes in a year that could be corrected by a traffic signal, and that certain minimum volume levels be met.

TRAFFIC AND SAFETY INFORMATIONAL SERIES FREQUENTLY ASKED QUESTION #16

Wouldn't Installing a Traffic Signal Reduce the Number of Crashes at an Intersection?

Installing a traffic signal does not necessarily increase safety at an intersection. In fact, especially when the traffic signal does not appear to be needed, some drivers may begin to ignore it, run yellow lights, or increase speeds in an attempt to avoid delays.

Therefore, local transportation officials make careful decisions concerning the use of traffic signals. Some of the factors they consider are described below.

Too many traffic signals can negatively impact traffic flow

Installing traffic signals where they are not needed can create traffic congestion, increase travel time, and frustrate drivers, who may drive impatiently and make inappropriate decisions as a result.

Traffic signals are installed only where they are needed

To make travel efficient and safe and to help ensure the proper observance of traffic signals, signals are usually installed only where they are absolutely necessary. At least one of nine conditions must be met for a traffic signal to be installed. These conditions include high vehicle and/or pedestrian volumes, a record of severe but correctable crashes, and school crossings where the gaps in the traffic flow are insufficient for children to cross safely.

Other solutions may improve safety as effectively

Many crashes at intersections are not caused by the lack of a traffic signal. Rather, inexperienced drivers, drunk drivers, and speeding are often the cause. Therefore, traffic signals do not always improve safety at an intersection.

Other solutions that might be considered include providing turning lanes, installing warning signs, improving roadway lighting, and/or installing a pedestrian crosswalk.

For more information

For more information, please contact _____.

TRAFFIC AND SAFETY INFORMATIONAL SERIES FREQUENTLY ASKED QUESTION #17

WHAT ARE THE RECOMMENDED SAFE DRIVING PRACTICES AT RAILROAD CROSSINGS?

RECOMMENDATIONS FROM OPERATION LIFESAVER

Operation Lifesaver, a nationwide public education program dedicated to reducing crashes at rail crossings, recommends the following driving tips (https://www.oli.org):

- The only safe and legal place to cross railroad tracks is at designated crossings.
- Always obey warning signs and signals, and always look for a train before proceeding.
- Ensure you can clearly see down the tracks in both directions before proceeding.
- Do not get trapped on a crossing. Before crossing, be sure there is space on the other side to completely clear the tracks.
- Leave at least 15 feet between the front and rear of your vehicle and the nearest rail.
- Always expect a train.
- Trains may be closer and traveling faster than they appear and can run on any track at any time.
- Avoid crossing while lights are flashing or gates are down. It is illegal and dangerous to go around lowered gates.
- Never try to beat a train.
- If your vehicle gets stuck or stalls at a crossing, get everyone out and far away immediately.
- To report a problem or emergency, call the number on the blue and white Emergency Notification System (ENS) sign on the crossbuck and share the crossing ID number with the dispatcher. (Call 911 if no sign is present.)
- Be aware that trains cannot stop quickly. It takes over a mile to stop a train once the emergency brakes are applied. When a train engineer can see you, it is too late for the train to avoid a collision with you or your vehicle.

These tips represent safe driving procedures for at-grade crossings between railroad tracks and public or private roadways. The consequences of not following these procedures can be significant. Some at-grade railroad crossing statistics are discussed below.

AT-GRADE RAILROAD CROSSING STATISTICS

Transportation agencies (railroad and highway) install a series of controls at at-grade railroad crossings. Unfortunately, studies based on observations of rural roadway/railroad crossings have shown that these controls are sometimes ignored. A study by Shinar and Raz in 1982 observed drivers on rural roads at different at-grade railroad crossings with a variety of control strategies. It was found that all drivers stopped when lights were flashing, but 40 percent then crossed the tracks while the lights were still flashing. A study by Meeker and Barr in 1989 found that 67 percent of drivers actually crossed the railroad tracks in front of an approaching train. A more recent study by Meeker in 1997 supported these findings, showing that 67 percent of all drivers crossed the tracks when only flashing lights were used, but 38 percent of drivers also drove around lowered crossing gates.

The consequences of making a mistake at an at-grade railroad/highway crossing can be fatal if a train/vehicle crash occurs. In 2020, 33 crashes occurred at at-grade railroad/highway crossings in Iowa.

These crashes did not result in any fatalities but did produce 9 personal injuries. In the United States, 170 fatalities occurred at at-grade railroad/highway crossings in 2020. Overall, approximately 34 percent of these fatalities occurred in rural areas. Note that these statistics summarize crashes that occurred at at-grade railroad/highway crossings with and without active traffic control. The study results mentioned in the previous paragraph may, in part, explain these numbers.

AT-GRADE RAILROAD/ROADWAY CROSSING CONTROLS

There are generally two types of at-grade railroad/roadway crossing controls: passive and active.

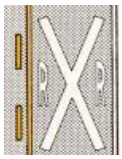
Passive Control Devices

Passive control devices consist of signs and pavement markings designed to identify at-grade railroad crossings and direct driver and pedestrian attention to them. Drivers and pedestrians can then take the appropriate actions. Passive controls can include the following:

Advance warning signs are placed in advance of the grade crossing at a distance that varies with the posted speed or the 85th percentile of the approaching traffic (see Section 2C.05 of the *Manual on Uniform Traffic Control Devices*).

A *railroad crossing sign*, commonly referred to as a crossbuck sign, is normally located at the crossing no closer than 15 feet measured perpendicular from the nearest rail and 6 to 12 feet from the edge of the shoulder or traveled way. At multiple-track crossings, the number of tracks shall be shown with a supplemental plaque.

A *stop or yield sign* is installed in conjunction with the crossbuck sign, either as part of the crossbuck assembly or as a separate sign/post. The yield sign is the default installation, unless an engineering study finds that a stop sign is needed.

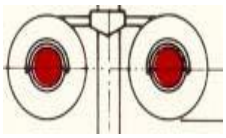


Pavement markings are placed on the approach lanes of the roadway in advance of an at-grade railroad crossing where signals or gates are used or where the posted or statutory speed limit for traffic is 40 mph or greater.

"Do Not Stop on Tracks" signs and stop signs can be used where detailed engineering studies determine that there is a need.

Active Control Devices

Active control devices at at-grade railroad/roadway crossings inform motorists of the presence of trains at or approaching the crossing through the use of flashing lights and gates. Active controls can include the following:



Horizontally mounted *alternate flashing lights* are used to warn motorists of the presence of a train. Where the speed of trains is 20 mph or greater, the lights must flash for a minimum of 20 seconds before the train arrives at the crossing. Bells or other audible warning devices may also be used to provide additional warning.

A *descending gate arm* that extends across the approaching lanes of traffic can be used to block traffic at the crossing. Gates are used in addition to flashing lights. The gate arm shall start its downward motion not less than 3 seconds after the flashing lights start to operate, reach its horizontal position at least 5 seconds before the arrival of rail traffic, and remain in the down position as long as the rail traffic occupies the grade crossing.

The active control devices described above are also usually combined with any or all of the passive devices described previously, excluding the stop/yield signs.

Different gate designs may be used. Dual gates block traffic only in the approach lanes in both directions. Four-quadrant gates, on the other hand, block traffic in both directions on both sides of the tracks. This design prevents vehicles from driving around the gates, which can occur with a dual gate design. Four-quadrant gate designs, however, can trap vehicles on the crossing. For this reason, the lowering of the downstream gates lags the upstream gates by a specified delay to allow vehicles to clear the tracks if necessary.

REFERENCES

Shinar, D., and S. Raz. 1982. Driver Response to Different Railroad Crossing Protection Systems. *Ergonomics*, Vol. 25, pp. 801–808.

Meeker, F. L., and R. A. Barr. 1989. An Observational Study of Driver Behavior at a Protected Railroad Grade Crossing as Trains Approach. *Accident Analysis and Prevention*, Vol. 21, No. 3, pp. 255–262.

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TRAFFIC AND SAFETY INFORMATIONAL SERIES FREQUENTLY ASKED QUESTION #17

What Are the Recommended Safe Driving Practices at Railroad Crossings?

Signs, signals, and gates are installed at railroad crossings for safety. Unfortunately, these controls are sometimes not obeyed, and the consequence may be a fatal crash. A 1997 study of rural railroad crossings showed that 67 percent of drivers crossed the tracks in front of a train even when warning lights were flashing, and 38 percent of drivers drove around lowered crossing gates. In 2020, 33 crashes occurred at highway-railroad crossings in Iowa, resulting in 9 personal injuries.

Understanding the signs and signals at railroad crossings

Drivers can help reduce the number of crashes and fatalities at railroad crossings by obeying the law and by recognizing the signs, signals, and gates described below:

Advance warning signs are placed in advance of a railroad crossing and alert drivers to the crossing.

Railroad crossing (or *crossbuck*) *signs* identify the crossing location for motorists and are located at the crossing no closer than 15 feet measured perpendicular from the nearest rail and 6 to 12 feet from the edge of the shoulder or traveled way.

Alternate flashing lights are used to warn motorists that a train is present or approaching. Drivers should stop and wait until the lights stop flashing before looking in both directions and then proceeding.

A *descending gate arm* that extends across the approaching lanes of traffic blocks traffic at the crossing.

Advance warning sign

Railroad crossing (crossbuck) sign

Other tips for safe driving at railroad crossings

Operation Lifesaver, a nationwide public education program dedicated to reducing crashes at rail crossings, gives some tips for drivers at railroad crossings (https://www.oli.org):

- The only safe and legal place to cross railroad tracks is at designated crossings.
- Always obey warning signs and signals and look for a train before proceeding.
- It is illegal and dangerous to go around illegal and dangerous to go around lowered gates.
- Always expect a train.
- If your vehicle gets stuck or stalls at a crossing, get everyone out and far away immediately.
- To report a problem or emergency, call the number on the blue and white Emergency Notification System (ENS) sign on the crossbuck and share the crossing ID number with the dispatcher. (Call 911 if no sign is present.)

For more information

For more information, please contact _____.

TRAFFIC AND SAFETY INFORMATIONAL SERIES FREQUENTLY ASKED QUESTION #18

HOW ARE THE LOCATIONS OF TRAFFIC SIGNS DECIDED?

Traffic signs cannot be randomly placed along a roadway. Although the aesthetics of a traffic sign can sometimes be undesirable, these signs are often necessary to provide information intended to keep roadways safe and to prevent driver or pedestrian confusion.

According to the *Manual on Uniform Traffic Control Devices* (MUTCD), the general rule on sign placement is to locate signs on the right-hand side of the roadway, where drivers will be looking for them. Overhead signs may be necessary on expressways or roadways where sufficient roadside space is not available. In certain cases, signs are placed on median islands or on the left-hand side of the road. Signs should also be placed so that they remain visible (e.g., away from trees and other obstructions) both during the day and at night. The spacing between signs is determined by the vehicle speeds at a given site and is chosen to give drivers adequate time to read and understand the signs and make appropriate driving decisions.

WHO DECIDES WHERE A TRAFFIC SIGN WILL BE PLACED?

Only a public agency or an official having jurisdiction over a roadway can place traffic signs for the purpose of regulating, warning, or guiding traffic, and a large amount of thought can go into their placement. In many cases, the use and/or location of traffic signs is warranted by the physical conditions at a given site and field studies. For example, signs are often essential at specific places to introduce or reinforce information (e.g., speed limits) or to provide warning where hazards are not self-evident. However, local officials do not want to use signs excessively. Too many signs are expensive, can confuse motorists, and can reduce the effectiveness of the signs that are warranted and necessary. Too many signs can also produce a situation where drivers begin to ignore signs even where they are needed.

Traffic signs are only placed in the publicly owned roadway right-of-way. The width of the right-of-way can vary by location. For a number of reasons, portions of the right-of-way are often maintained by adjacent private property owners. This area is publicly owned, however, and can be used for roadway signing purposes if required.

WHAT ARE THE DIFFERENT TYPES OF TRAFFIC SIGNS?

Several hundred signs are used along public roadways. These signs must be located within the publicly owned right-of-way of these roadways, and the exact placement of these signs must follow the requirements contained in the MUTCD. In general, there are three categories of signs:

Regulatory signs usually have a black legend on a white background. They convey information about specific traffic regulations that the driver must obey.

Warning signs usually have a black legend on a yellow background. These diamond-shaped signs are used to warn drivers of impending hazards that might not be readily apparent.

Guide signs usually have a white legend on a green, blue, or brown background. These signs provide directional guidance to drivers.

These three categories of traffic signs are described in more detail below.

Regulatory Signs

Regulatory signs fall into six general categories based on the type of regulation they convey:

1. *Right-of-way signs* include stop signs and yield signs. These are used at at-grade intersections and crossings.
2. S*peed signs* include a variety of signs used to post legal speed limits. These include the typical speed limit signs; truck, night, and minimum speed limit signs; and signs alerting drivers to changes in speed regulations. These signs are located as needed (to remind drivers of the speed limit) and according to MUTCD requirements.
3. *Movement signs* include a wide variety of signs affecting specific vehicle maneuvers. These signs provide information on permissible and prohibited movements and include turn signs, alignment signs, exclusion signs (e.g., "Do Not Enter"), and one-way signs.
4. *Parking signs* are mostly found in urban and suburban areas. These signs are used for curb control and parking.
5. *Pedestrian signs* include both legend and symbol signs such as "Use Crosswalk" and "Walk on Left Facing Traffic."
6. The *miscellaneous remaining signs* include all regulatory signs that do not fit into any of the other categories. Some examples include "Keep Off Median," "Stop Here on Red," and road closure signs.

Warning Signs

Warning signs are primarily intended for drivers who are unfamiliar with a particular roadway or its hazards. These signs must be posted far enough in advance of a hazard that the driver can see the sign and then respond to the warning before reaching the hazard. The MUTCD describes how these signs should be located and identifies three categories of warning signs:

1. *Roadway-related signs* indicate changes in horizontal alignment, vertical alignment, cross section, roadway surface conditions, and weather-related hazards.
2. *Traffic-related signs* include advance traffic control, traffic flow, intersection, vehicular and nonvehicular traffic, and new traffic pattern signs.
3. *Other supplemental plaques* include location, high-occupancy vehicle lane, distance, directional arrow, street name, intersection, "Share the Road," and photo enforcement signs.

Guide Signs

Guide signs are important to drivers who are unfamiliar with a particular roadway, in that a confused driver can be a dangerous driver. Some of the most common guide signs are as follows:

1. *Route signs* are those signs placed along a roadway to inform drivers of the route they are travelling on. The MUTCD indicates that "all numbered highway routes shall be identified by route signs and auxiliary signs."

2. *Destination signs* are used to display the distance to critical destinations along the route. At major junctions, diagrammatic guide signs may be used.
3. *Specific service guide signs* provide directions to a variety of motorist services. These services typically include food, lodging, fuel, and camping.
4. *Recreational and cultural interest area signs* include directions to historic, recreational, and cultural areas of interest.
5. *Milepost signs* are the small signs that indicate the mileage along a designated route. These useful signs allow drivers to estimate their progress along a route or locate their vehicle if it should stall. As an augmentation to mileposts on some facilities, intermediate reference location signs showing the tenth of the mile with a decimal point may be installed at intervals of one tenth of a mile or at some other regular spacing.

TRAFFIC AND SAFETY INFORMATIONAL SERIES FREQUENTLY ASKED QUESTION #18

How Are the Locations of Traffic Signs Decided?

People sometimes wonder why traffic signs are placed at certain locations and not at others. Once a sign is determined to be necessary, many factors go into the decision of where the sign will be located. Some of the principles that determine the most effective location for a sign are described below.

The type of sign determines where it will be placed

Traffic signs fall into three categories, and the signs in each category are placed according to a different set of criteria. The most effective location for a *regulatory sign* (such as a speed limit sign or stop sign) is determined by local officials based on the characteristics of the roadway and the type of information the sign conveys. A *warning sign* (such as a "Narrow Roadway" or "Railroad Crossing Ahead" sign) is posted far enough in advance of a hazard that drivers can see the sign and then respond before reaching the hazard. A *guide sign* (such as a milepost sign or a sign that directs motorists to area services) is placed where appropriate.

Drivers expect to see signs on the right side of the road

Most signs are located on the right side of the road, where drivers are used to seeing most signs and will be looking for them. Overhead signs may be necessary on expressways or roadways where sufficient space is not available or where additional signage is needed.

Sign spacing is based on how much time drivers need to read and react to signs

The spacing between signs is determined by the vehicle speeds at a given site and is chosen to give drivers adequate enough time to read and understand the signs and make appropriate driving decisions. Too much information presented to a driver too quickly can be confusing and may result in unsafe decisions and/or actions.

Sign placement follows certain general principles

Traffic signs are placed only in the public right-of-way of a roadway and should be located where drivers will expect to see them.

For more information

For more information, please contact _____.

TRAFFIC AND SAFETY INFORMATIONAL SERIES FREQUENTLY ASKED QUESTION #19

HOW DOES A COUNTY MAKE DECISIONS ABOUT DUST CONTROL ON GRAVEL ROADWAYS?

Road dust consists of fine particles small enough that they feel like powder when rubbed between the fingers. This dust can be an annoyance to residents along unpaved roadways, especially in rural areas, and can be a safety hazard if it reduces visibility at intersections and curves. Additionally, when large quantities of these fine particles are lost to a roadway in the form of dust, the roadway begins to deteriorate, with washboarding, ruts, potholes, and other problems developing.

Fugitive dust is a term defined by Section 567-20.2(455B) of the Iowa Code as any airborne solid particulate matter emitted from any source other than a flue or stack. The Iowa Administrative Code further specifies that fugitive dust does not include dust generated by farming operations and dust generated by ordinary travel on unpaved roads.

In Iowa, gravel roadways are typically maintained by a county secondary roads department and a county engineer. Dust palliatives (i.e., dust control materials) may be applied to reduce dust by either wetting the roadway surface or providing a surface coat to reduce the effects of tire/surface interactions. A dust palliative is any material (e.g., water, calcium chloride, magnesium chloride, lignin sulfate, asphalt binder [MC-70], or other products such as sugar beet extract [Molex]) used to control dust on unpaved roadways. Waste oil is no longer allowed as a dust control agent because it may contain polychlorinated biphenyl (PCBs), dioxin, or other contaminants.

WHAT ARE THE POLICIES ON DUST CONTROL?

Many Iowa counties have approved dust control policies that specify procedures for public dust control applications and a permitting process for private application of dust palliatives. These policies may specify the conditions under which a county may apply dust palliatives for reasons of safety.

The application of dust control materials can be expensive, and counties typically cannot afford widespread county-financed dust control applications. Applying dust control materials, in fact, might absorb the entire secondary road budget. Therefore, counties do allow the general public (with proper permits) to apply dust control agents on unpaved county roads next to their property. As required by the Section 319.14 of the Iowa Code, a permit must be acquired from the appropriate county or counties, usually through the county engineer’s office.

WHAT ARE THE GUIDELINES ON DUST CONTROL MEASURES?

The minimum length of dust control application varies from county to county, but it is usually between 150 and 300 feet. For a given section of roadway, two dust control applications are often recommended to ensure that the treatment lasts a full season.

Permit deadline dates for dust control applications may also be part of an approved dust control policy. For a roadway on the border of two counties, both counties will often be required to approve the dust control permit. The county or counties may require the resident to mark the location of application with flags so that the segment can be identified, the roadway crowned, and the necessary rock material added.

Some dust control applications and permits may require grading. Permittees may be required to repair any potholes or other deterioration at their own expense.

WHAT MATERIALS ARE ACCEPTABLE FOR USE IN DUST CONTROL?

A list of approved dust control materials and specifications should be obtained from the county within which the roadway of interest is located. The vendor of the material used may be required to provide a laboratory analysis of the material to the county, and contractors that apply dust control materials may have to meet certain qualifications. Some examples of dust control materials a county could approve include the following:

- **Calcium chloride**. Calcium chloride absorbs water vapor from the air and water from the roadbed. This process allows traffic to compact the roadway. Calcium chloride is usually sprayed as a water solution with a specified percentage of the chemical. The county may also specify application widths and rates.
- **Magnesium chloride**. Magnesium chloride is a chemical similar to calcium chloride, but it is applied at different percentage and rate specifications.
- **Lignin sulfate (tree sap)**. Lignan sulfate is sprayed on the roadway surface and then mixed with the top few inches of the roadway surface. Remixing may be required. Specifications may also require the unmixed form of lignin sulfate to have a certain percentage of solids and residual sugars. Application widths and rates may also be specified.
- **MC-70**. MC-70 is a road oil or bitumen product. Federal regulations prohibit using bituminous products mixed with petroleum distillates. However, this product meets current Iowa Department of Transportation (Iowa DOT) specifications. It is blotted with sand or limestone chips immediately after application to clean up any excess pooling.

FACTORS CONSIDERED FOR DUST CONTROL

Individual counties may have a traffic safety program in place to treat some fraction of the county's roadways with dust control materials. Such programs require that a minimum average daily traffic (ADT) level must be met (e.g., 200 to 250 ADT), coupled with an average traffic speed. Iowa DOT traffic volume estimates may be used in identifying treatment locations, or special traffic counts may be collected by the county engineer. Counts are usually taken during a 7- to 10-day time period to avoid the effect of special events or repeated travel by drivers trying to inflate the traffic count.

Dust control may also be applied for specific traffic safety reasons at intersections, bridges, curves, hills with limited sight distance, driveways, or other locations specified by the county engineer. Residents may also extend these treated areas at their own expense.

County-funded dust control measures may also be applied on park and recreational roadways, roadways leading to a quarry, and construction detours and haul roadways. Established or implied detours with high levels of traffic may also be treated in compliance with local, state, or federal requirements.

HOW MUCH DOES DUST CONTROL ACTUALLY COST?

The current cost for a dual application of calcium chloride on a 400-foot by 24-foot section of roadway by a private contractor is $300 to $475. The cost per application for different dust control materials can vary. Calcium chloride, for example, is about $0.75 per linear foot for a 20-foot wide application. For an MC-70 application of the same area, however, the cost would be about $3.00 per linear foot. A full seal coat with a rock base can be as much as $8.00 per linear foot. In other words, the cost to treat all of the unpaved roads in a county could total several million dollars per year per county.

TRAFFIC AND SAFETY INFORMATIONAL SERIES FREQUENTLY ASKED QUESTION #19

How Does a County Make Decisions about Dust Control on Gravel Roadways?

As anyone who lives near or travels on a gravel roadway knows, dust can be an annoyance. It can irritate the eyes and can make it hard to breathe. Heavy dust can also be a safety hazard if it reduces visibility at roadway intersections and curves. Additionally, dust means the loss of roadway material, which can lead to road deterioration in the form of washboarding, ruts, and potholes.

How the state defines the problem

Road dust on unpaved roads consists of fine particles that feel like powder when rubbed between the fingers. Most dust control strategies are aimed at reducing "fugitive dust," which consists of airborne particles but not those emitted from a flue or stack and not those generated from farming operations or *ordinary travel on unpaved roads*.

What are typical county policies on dust control?

Many Iowa counties have approved dust control policies that specify procedures for public dust control applications and a permitting process for private application of dust control materials. Talk to the local county engineer for the specific policy and procedures followed in a particular county.

What materials are used to control dust?

Each county maintains a list of approved dust control materials and application procedures. Waste oil is no longer used to control dust because it may contain contaminants that are harmful to the environment. However, many other dust control materials can be used, such as calcium chloride, magnesium chloride, and lignin sulfate. These dust control materials are usually applied by coating the roadway surface to reduce interactions between the surface and the tires traveling over it.

The cost of dust control

The specific cost of dust control varies with the type of material used. The cost to treat all of the unpaved roads in a typical Iowa county could total several million dollars per year.

Because the application of dust control materials can be expensive, counties cannot afford to apply dust control materials on every unpaved road. As a solution, counties sometimes allow the general public (with proper permits) to apply dust control materials on unpaved county roads next to their property. Permits must be acquired from the appropriate county or counties, usually through the county engineer's office. Permittees may be required to meet certain specifications related to the application of dust control materials.

For more information

For more information, please contact _____.

TRAFFIC AND SAFETY INFORMATIONAL SERIES FREQUENTLY ASKED QUESTION #20

WHEN ARE STOP SIGNS AND TRAFFIC SIGNALS APPROPRIATE FOR INTERSECTIONS?

Traffic control devices are intended to safely assist and guide drivers. Some people may believe that various types of traffic problems would be solved by the addition of a stop sign or traffic signal. Some would even like a traffic signal or a stop sign to be placed at every intersection. However, in some circumstances the absence of a stop sign or traffic signal actually provides for a safer situation.

According to on the *Manual on Uniform Traffic Control Devices* (MUTCD), traffic control devices should meet five basic requirements:

- Fulfill a need
- Command attention
- Convey a clear, simple meaning
- Command respect of road users
- Give adequate time for a proper response

WHAT IS THE APPROPRIATE USE AND PLACEMENT OF A STOP SIGN?

A stop sign is a regulatory sign used to stop traffic at a certain location. It consists of a red octagon with a white border and large white letters that read “STOP” (Figure 1). At multiway stop intersections where all approaches are required to stop, a small plate is placed below the stop sign to inform drivers of the all-way stop condition.

FIGURE 1 Stop sign

Because stop signs inconvenience drivers, they should only be used where they are strictly warranted. The MUTCD states that a stop sign may be warranted where one or more the following conditions exists:

1. A less important road intersects a main road and application of the normal right-of-way rule would not be expected to provide reasonable compliance with the law.
2. A street is entering a through highway or street.
3. The intersection is in a signalized area but is itself unsignalized.
4. A combination of high entering traffic volumes, a restricted view, or a problematic crash history indicates the need for control by a stop sign.

Conversely, the use of a stop sign should be avoided in certain locations. Before the use of a stop sign is considered, a less restrictive method, such as the use of a yield sign, should first be considered.

WHAT DETERMINES THE PLACEMENT OF A MULTIWAY STOP SIGN?

A multiway stop sign may improve safety at an intersection. Normally, multiway stop control is used at the intersection of two roads that contain similar traffic volumes. Three-way stop control is used at intersections that have only three approaches (e.g., a T-intersection). According to the MUTCD, the warrants for placing a multiway stop sign are as follows:

1. Traffic signals are justified, and a multiway stop sign is an interim measure that can be installed quickly to control traffic while arrangements are made for the signal installation.
2. Five or more crashes have occurred over a 12-month period that are correctable by a multiway stop sign. Such accidents include right- and left-turn collisions as well as right-angle collisions.
3. The intersection meets the following criteria for minimum traffic volumes: (a) The vehicular volume entering the intersection from the major street approaches averages at least 300 vehicles per hour for any eight hours of an average day; and (b) the combined vehicular, pedestrian, and bicycle volume from the minor street approaches averages at least 200 units per hour for the same eight hours, with an average delay to minor street vehicular traffic of at least 30 seconds per vehicle during the highest hour; but (c) if the 85th percentile approach speed of the major street traffic exceeds 40 mph, the minimum vehicular volume warrants are 70 percent of the above requirements.

WHAT DETERMINES THE PLACEMENT OF A TRAFFIC SIGNAL?

The warrants for the placement of traffic signals are found in the MUTCD. For traffic signal warrants, refer to Traffic and Safety Informational Series Frequently Asked Question #15, What Is the Harm in Installing an Unwarranted Traffic Control Device?

WHY CAN'T A TRAFFIC SIGNAL BE PLACED AT EVERY SCHOOL CROSSING?

The fifth MUTCD warrant for traffic signalization (Section 4C.06) explains traffic signal placement with regard to school crossings. If a traffic study shows that the frequency and adequacy of gaps in the traffic flow are insufficient to allow schoolchildren to cross safely, then a traffic control signal may be warranted. When a traffic control signal is installed entirely because of this warrant, the MUTCD notes the following:

- If installed at an intersection or major driveway location, the signal should also control the minor street or driveway traffic, should be traffic actuated, and should include pedestrian detection.
- If installed at a non-intersection crossing, the signal should be installed at least 100 feet from side streets or driveways that are controlled by stop or yield signs and should be pedestrian actuated.
- If the signal is installed at a non-intersection crossing, at least one of the signal faces should be over the traveled way for each approach, parking and other sight obstructions should be prohibited for at least 100 feet in advance of and at least 20 feet beyond the crosswalk, or site accommodations should be made through curb extensions or other techniques to provide adequate sight distance.
- If installed within a signal system, the signal should be coordinated with others in the vicinity.

When the gaps in the traffic flow at a school crossing are sufficient for schoolchildren to cross safely, the addition of a traffic control device may not be necessary. A crossing guard or a school crossing sign at the crosswalk with warning signs on the approaches can also help control traffic during peak traffic flow times.

TRAFFIC AND SAFETY INFORMATIONAL SERIES FREQUENTLY ASKED QUESTION #20

When Are Stop Signs and Traffic Signals Appropriate for Intersections?

Installing traffic control devices such as stop signs or traffic signals does not necessarily slow drivers down or increase safety at intersections. In fact, the overuse of traffic control devices can sometimes lead drivers to disobey or ignore them, especially when they are installed where they are not needed.

Therefore, local transportation officials make careful decisions concerning the use of stop signs and traffic signals. Some of the factors they consider are described below.

Too many stop signs can lead to ineffectiveness

Studies have shown that when stop signs are placed at intersections where they are not really needed, motorists may become careless about obeying them. Moreover, the overuse of multiway stop signs can contribute to the number of frustrated, impatient, and, consequently, reckless drivers on the streets.

The use of signs and signals should be restricted to locations where they will be effective

To make travel efficient and safe and to help ensure the proper observance of stop signs and traffic signals, traffic control devices are installed only where they (1) fulfill a need, (2) convey a clear, simple meaning, (3) command attention and respect, and (4) give adequate time for drivers to respond.

A location must meet one or more of the following the conditions for a stop sign to be warranted:

1. A less important road intersects a main road and application of the normal right-of-way rule would not be expected to provide reasonable compliance with the law.
2. A street is entering a through highway or street.
3. The intersection is in a signalized area but is itself unsignalized.
4. A combination of high entering traffic volumes, a restricted view, or a problematic crash history indicates the need for control by a stop sign.

Multiway stop signs are often used at the intersection of two roadways that contain similar traffic volumes. The location must meet at least one of the following conditions:

- Traffic signals are justified, and a multiway stop sign is an interim measure that can be installed quickly to control traffic while arrangements are made for the signal installation.
- Five or more crashes have occurred over a 12-month period that are correctable by a multiway stop sign. Such accidents include right- and left-turn collisions as well as right-angle collisions.
- The intersection meets one of three minimum traffic volume criteria listed in Section 2B.07 of the Manual on Uniform Traffic Control Devices (MUTCD).

At least one of nine conditions must be met for a traffic signal to be installed. These conditions include high vehicle and/or pedestrian volumes, a record of severe but correctable crashes, and school crossings where the gaps in the traffic flow are insufficient for schoolchildren to cross safely.

For more information

For more information, please contact _____.

TRAFFIC AND SAFETY INFORMATIONAL SERIES FREQUENTLY ASKED QUESTION #21

HOW CAN CONVERTING A FOUR-LANE STREET TO A THREE-LANE STREET IMPROVE SAFETY WITHOUT INCREASING CONGESTION?

Operational and safety problems along a roadway can develop as traffic increases. The original design of the roadway may not be adequate or match current traffic patterns, and conflicts between turning and through vehicles may become significant. Recently, it has been found that some four-lane undivided roadways can be improved if converted to a three-lane cross section (see Figure 1). If feasible, this type of conversion can improve safety and have minimal impacts on congestion or traffic operations.

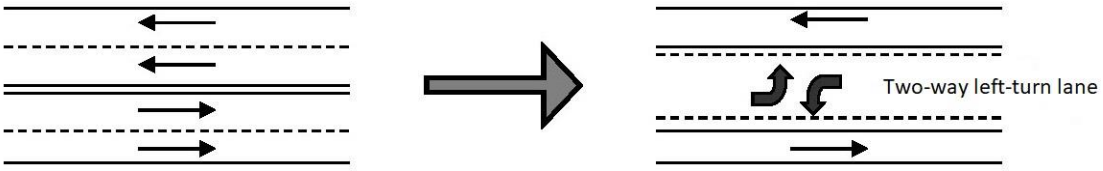


FIGURE 1 Four-lane undivided roadway conversion to a three-lane roadway.

HOW IS SAFETY IMPROVED?

The National Cooperative Highway Research Program (NCHRP) has released several reports that address the safety benefits of adding two-way-left-turn lanes (TWLTLs) or raised medians to previously undivided roadways. Model results show that that addition of a TWLTL results in a lower crash rate than those along an undivided roadway (see Table 1).

TABLE 1 Average annual crashes per mile per year predicted by various models

Average Daily Traffic (ADT)	Predicted Crashes on an Undivided Roadway	Predicted Crashes on a Roadway with TWLTL
10,000	48	39
20,000	126	60
30,000	190	92
40,000	253	112

Source: *Converting Four-Lane Undivided Roadways to a Three-Lane Cross Section: Factors to Consider*. Center for Transportation Research and Education, Iowa State University, 1999.

Based on past research and several case study results (see the following section), it was expected that in certain instances a roadway with a three-lane cross section may have a lower crash rate than the existing four-lane undivided roadway. In addition, data from Minnesota indicate that three-lane roadways have a crash rate 27 percent lower than four-lane undivided roadways. Safety improvements from this type of conversion are typically a result of a reduction in speed variability, a decrease in the number of conflict points, and improved sight distance for drivers turning left.

The three-lane cross section removes left-turn vehicles from the through lanes, and this reduces the number of conflicts between them and the through traffic (in comparison to a four-lane undivided roadway). The number of lanes that need to be crossed by left-turn and minor street vehicles also

decreases. These improvements usually decrease the probability of rear-end, sideswipe, and/or angle crashes along a roadway. The overall decrease in decision complexity helps all drivers but is especially preferable for areas with large populations of older drivers.

The conversion of urban four-lane undivided roadways to three lanes may also improve pedestrian and bicycle safety. Four-lane undivided urban roadways do not usually serve pedestrians and bicyclists very well. Converting a four-lane undivided roadway to a three-lane cross section can allow the provision of a bicycle lane, and surveys from past conversions show that pedestrians, bicyclists, and adjacent landowners typically prefer the three-lane cross-section environment. The somewhat slower and more consistent speeds of the three-lane roadway are more desirable.

CASE STUDY ANALYSIS RESULTS

Several cities in Iowa have completed or are considering the conversion of urban four-lane undivided roadways to a three-lane cross section. This type of conversion has also been completed throughout the United States. Two cities in Iowa, Storm Lake and Muscatine, have had a positive experience with a four-lane undivided a three-lane cross section cross section. There has generally been a positive public response, and city officials are pleased with the resulting traffic flow and increased safety. When safety is an issue, the Iowa Department of Transportation believes that the feasibility of this type of conversion should be evaluated.

Table 2 summarizes the results and anecdotal conclusions from several Iowa case study conversions. There is a general indication that the conversion of a four-lane undivided roadway to a three-lane cross section can improve the safety of a roadway without dramatically decreasing the level of service provided. These types of results, however, are only produced when the conversion is feasible and applied at the appropriate locations.

TABLE 2 Iowa case study analysis results

Location	Approx. Average Daily Traffic	Safety	Operations
Storm Lake, Flindt Drive	8,500	Improved	No notable decrease
Muscatine, Clay Street	8,400	Improved	Not available
Sioux Center, US 75	14,500 (changed?)	Not available	Expected average arterial speed decrease of 2.6 mph
Iowa Falls, US 65	8,700	Not available	Expected intersection delay per vehicle increase of 0.5 seconds

Source: *Converting Four-Lane Undivided Roadways to a Three-Lane Cross Section: Factors to Consider*. Center for Transportation Research and Education, Iowa State University, 1999.

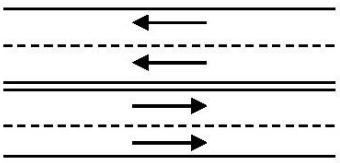
TRAFFIC AND SAFETY INFORMATIONAL SERIES FREQUENTLY ASKED QUESTION #21

How Can Converting a Four-Lane Street to a Three-Lane Street Improve Safety Without Increasing Congestion?

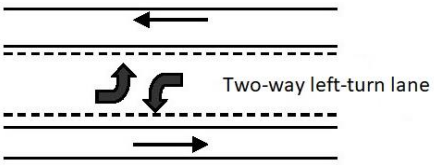
Four-lane undivided roadways are known for their lack of safety. One reason for this is that the left lanes (the inner lanes) tend to carry both through traffic and drivers who need to slow down and possibly stop to turn left.

The alternatives

There are alternatives to four-lane undivided roadways that are safer—and that may not sacrifice speed or cause congestion. For example, four-lane roadways can be converted into three-lane roadways whose middle lane is a two-way left-turn lane. This conversion removes left-turning vehicles from the through lanes, which helps traffic flow more smoothly. The number of lanes that need to be crossed by left-turning and cross-street vehicles also decreases.



Four-lane undivided roadway



Three-lane roadway

How is safety improved?

Changing from four-lane undivided roadways to three-lane roadways can result in a reduction in the range of speeds being driven, a decrease in traffic disruption, and improved visibility for drivers turning left. Speeding is also reduced. These improvements decrease the probability of crashes along the roadway. Data from a study in Minnesota indicate that three-lane roads have a crash rate 27 percent lower than four- lane undivided roadways.

What about speed and traffic flow?

Three-lane roadways are not necessarily more congested than four-lane roadways. If designed properly and implemented in the right locations, any decrease in average speed can be minimal. Delays at intersections may increase, but proper signal timing can minimize the impact.

What is being done

Two cities in Iowa, Storm Lake and Muscatine, have had positive experiences with three- lane roadways that have been converted from four-lane undivided roads. Other cities in Iowa and cities in 12 other states have also implemented this strategy. The public response has been positive, and city officials are pleased with the resulting traffic flow and increased safety.

For more information

For more information, please contact _____.

TRAFFIC AND SAFETY INFORMATIONAL SERIES FREQUENTLY ASKED QUESTION #22

HOW ARE THE LOCATIONS OF LIGHT POLES DECIDED?

The US Department of Transportation *Roadway Lighting Handbook* identifies five objectives for roadway lighting:

- Supplementing vehicle headlights
- Improving the ability of a driver to see roadway features and objects on or near the roadway
- Delineating the roadway ahead
- Providing the driver with a better view of the overall roadway environment
- Reducing driver apprehension about using the roadway

Roadway lighting should be implemented if it can accomplish one or more of these objectives, but cost and safety must also be considered. Light poles added to the roadway environment could become hazards if they are not located, installed, and maintained properly.

THE BENEFITS OF ROADWAY LIGHTING

A Federal Highway Administration study reported that nighttime crash rates are nearly five times higher than daytime crash rates. Fortunately, a study by Probst, Krafczyk, and Brandt found that roadway lighting can significantly reduce the number of nighttime crashes at a particular location.

Many nighttime crashes occur at intersections. The complex decision making and conflicts that occur at these locations produce an environment where crashes are more likely to occur and where roadway lighting is needed the most. In urban areas, the number and proximity of intersections is one of the reasons there is continuous lighting. In rural areas, however, the cost and small amount of traffic do not allow continuous roadway lighting, and a reduction in nighttime crashes depends on adequate vehicle headlights and an efficient and focused program for lighting at significant intersections.

WHERE ARE LIGHT POLES PLACED?

A roadway clear zone is the "[u]nobstructed, relatively flat area provided beyond the edge of the traveled way for the recovery of errant vehicles." The recovery area should be clear of all permanent objects such as trees, non-breakaway sign supports, utility poles, and other fixed objects. The suggested clear zone for a roadway depends upon the vehicle speed, volume of the roadway, and the roadway embankment slope. They range from approximately 10 feet for low-speed roadways to 30 feet for high-speed and high–traffic volume roadways (e.g., a paved rural highway). In fact, "[s]tudies have indicated that on high- speed highways, a width of nine meters [30 feet] or more from the edge of the traveled way permits about 80 percent of the vehicles leaving a roadway out of control to recover." Overall, **it is generally recommended that a roadside recovery area be as wide as possible, and the suggested width of a clear zone in rural areas almost always requires a breakaway support for any light poles**.

WHAT CAN BE DONE TO MAKE LIGHT POLES LESS HAZARDOUS?

Safety is the primary reason that light poles are placed away from the roadway (i.e., outside the clear zone). However, in some situations, roadside devices (such as light poles) have to be placed nearer to the

roadway. For example, in an urban area there may be no space to place the light pole outside the clear zone. Light poles placed within a clear zone represent a hazard to the traveling public, and their supports must be made to quickly break away or yield when hit by a vehicle.

These breakaway supports are designed to reduce the severity of a vehicle impact with the light pole. If there are pedestrians in the area of the light pole (and speeds are 45 mph or less), however, the use of a breakaway light pole support is not recommended. The breakaway pole may become more of a hazard to the pedestrian than the traveling public.

Although it is not typically possible or required, it is preferable that a light pole have a breakaway support and be outside the roadway clear zone. A pole designed and located in this manner would be less likely to be hit and would also result in a less severe impact if it were hit.

TRAFFIC AND SAFETY INFORMATIONAL SERIES FREQUENTLY ASKED QUESTION #22

How Are the Locations of Light Poles Decided?

Residents in rural areas sometimes wonder why there are so few streetlights and why the light poles aren't closer to the road. In some cases, roadway lighting may help reduce the number of nighttime crashes, but light poles can also become hazards themselves if not designed and installed properly. Many factors go into determining whether additional lights should be added and how far they should be from the road.

More activity, more lights

There are usually more streetlights in urban areas than in rural areas. Some of the reasons for this are that urban areas have more pedestrians and traffic, and a higher concentration of homes and driveways. Urban areas also have more intersections, and intersections are where many nighttime crashes occur.

The cost of installing continuous lighting on every rural road is prohibitive. However, it may be useful for there to be lighting at some of the more significant rural intersections.

Light poles cannot be in the clear zone

Light poles with non-breakaway supports cannot be located close to rural roads because the roads are required to have a clear zone, an unobstructed, relatively flat area beyond the edge of the traveled way where vehicles that run off the road can recover. For safety reasons, it is preferable not to have trees, non-breakaway signs, and poles in this area.

For more information

For more information, please contact _____.

TRAFFIC AND SAFETY INFORMATIONAL SERIES FREQUENTLY ASKED QUESTION #23

HOW DOES A COUNTY MAKE DECISIONS ABOUT PAVING GRAVEL ROADWAYS?

IOWA POLICY ON PAVING GRAVEL ROADS

According to Iowa state law, the decision to pave a gravel roadway within a county must be made by the county board of supervisors and the county engineer. A number of factors are considered in the decision to pave a roadway, and in 1982 the Association of County Engineers and the Association of Boards of Supervisors created a point system for these factors to establish whether and when a county roadway might be paved. The factors considered in this point system include

- roadway type,
- vehicles per day,
- proximity to other paved roadways, and
- amount of truck traffic.

A gravel roadway weakens as more traffic uses it. For this reason, the type, number, and weight of vehicles on a gravel roadway influence its overall useful life. The point system for paving a roadway includes the type and amount of traffic using the roadway. Typically, the paving of a particular roadway is more likely to be justified as average daily traffic volumes increase. In addition to the point system, county officials may also take into account the willingness of local property owners to contribute financially to the paving project.

ROADWAY MANAGEMENT SYSTEM

One tool that some counties use to help make a paving decision is a roadway management system. A roadway management system allows a county to assess the condition of its roadways and make more efficient financial decisions about roadway improvements. The goal is to improve the overall county roadway system by considering all of them in a systematic manner.

Improvements to a particular roadway are analyzed by considering maintenance costs, riding surface, and the additional expense related to other roadways within the county. The following steps are typically included in a roadway management system. These steps are outlined in *When to Pave a Gravel Road* from the Local Transportation Information Center of the Iowa State University Extension.

1. *Inventory the county roadways*. Survey the mileage and condition of the system roadways.
2. *Assess the condition of the roadways*. Use consistent survey techniques from year to year to analyze the pavement.
3. *Select a roadway management strategy*. Use appropriate treatments to repair problem areas.
4. Determine present needs: estimate the cost of repair and establish long range goals and objectives.
5. *Establish priorities*. Use preventive maintenance to keep roadways in proper shape and reconstruct roadways in very poor condition.

Using a roadway management system allows a county to spend their limited funds more wisely by determining the most cost-effective and long-term improvements and maintenance for the roadway system. The system can help make more appropriate and cost effective paving decisions.

OTHER METHODS TO PREVENT OR CORRECT PROBLEMS WITH GRAVEL ROADWAYS (BESIDES PAVING)

Gravel roadways can experience many problems. A number of problems, however, can be improved or prevented without the introduction of a paved surface. Four of the most common problems encountered with gravel roadways, along with a possible solution, are briefly described in Table 1.

TABLE 1 Causes and solutions to problems with gravel roadways

Problem	Description	Reason for Concern	Possible Solution
Corrugation	Ripples/ridges on roadway	Wears on vehicles and impairs driver control of steering and breaking	Commercial binders
Loss of material	Losing material from the surface (loose gravel)	Weakens surface and replacement cost	Dust palliative to make particles heavier or use of a motor grader to remix the gravel
Rutting	Wheel paths deform the roadway	Cause severe break up of road surface, improper drainage and traps vehicle tires	Improve drainage and add/stabilize the gravel
Potholes	Bowl- shaped depressions on gravel surfaces	Vehicle wear, and they can hold water which damages the roadway	Clean out and add new gravel; add stabilizers or dust suppressants and keep overweight vehicles off the roadway

Source: *Problems Associated with Gravel Roads*. Federal Highway Administration, May 1998.

SOME IMPORTANT REFERENCES ABOUT GRAVEL ROADS

- *When to Pave a Gravel Road*. Local Transportation Information Center of the Iowa State University Extension.
- *Problems Associated with Gravel Roads*. Federal Highway Administration, May 1998.

TRAFFIC AND SAFETY INFORMATIONAL SERIES FREQUENTLY ASKED QUESTION #23

How Does a County Make Decisions about Paving Gravel Roadways?

You may wonder why some gravel roads get paved and why some remain gravel. County engineers follow a plan and consider many factors when deciding which roadways to pave and which to maintain as gravel roadways.

The assessment and decision plan

Because no county can afford to pave every gravel roadway, the county must form and follow a plan for how to evaluate and take care of its roadways. This plan, often called a "roadway management system," allows a county to assess the condition of its roadways and make efficient financial decisions about roadway improvements. The following steps are typically included in a roadway management system:

1. Make an inventory of the number and mileage of county roadways.
2. Assess the condition of the roadways.
3. Decide the best method of repairing problem areas.
4. Establish long-range goals and objectives.
5. Establish priorities: use preventive maintenance to keep roadways in proper shape and reconstruct roadways in very poor condition.

Using a roadway management system allows a county to spend its limited funds more wisely by determining the most cost-effective and long-term improvements and maintenance for their roads.

Factors that determine when to pave

When determining whether to pave and when, counties consider many factors. These factors may include the following:

- Roadway type.
- How many vehicles drive on the road per day. A gravel roadway weakens as more traffic uses it. Typically, the paving of a particular roadway is more likely to be justified as average daily traffic volume increases.
- The type of traffic that uses the road. The type and weight of vehicles on a gravel roadway also influence its overall useful life. The heavier the vehicles, the shorter the life, making paving more justified.

These and other factors go into every difficult decision of whether to maintain a gravel roadway as is or whether to pave it.

Keeping gravel roads in good repair

Many problems with gravel roads can be remedied with methods other than paving. For example, for loss of gravel from the road, a motor grader could be used to remix the gravel or dust-control materials could be applied. These and other methods may be used to keeping the gravel roads in your area in good repair.

For more information

For more information, please contact _____.

TRAFFIC AND SAFETY INFORMATIONAL SERIES FREQUENTLY ASKED QUESTION #24

WHY AREN'T CROSSING GUARDS PRESENT AT ALL SCHOOL CROSSINGS?

The primary objective at a school pedestrian crossing is the protection of children. The chances of meeting this objective increase if the school children and drivers can easily interpret, understand, and follow the traffic control devices (e.g., signs) in the area of the crossing. This understanding is accomplished by keeping the signing and/or traffic control within school zones consistent throughout a particular jurisdiction. Adult crossing guards are used at some school crossings in order to supply adequate crossing breaks in the traffic flow, but this type of traffic control can be expensive and the need must be closely evaluated.

HOW ARE SCHOOL CROSSING LOCATIONS DETERMINED?

A properly designed route to school should not require the use of adult crossing guards. However, this depends on the location of the school, the roadway network, and the location of the child's home. A safe travel route must be selected for young pedestrians going to and from school, and the roadway crossings along that route should be at locations that have adequate and existing traffic control to guide the child. In some cases, the route selected (which might include a designated school crossing) may require children to travel a longer distance. Crossings along a school route are determined by the existing traffic control, sidewalk availability, the number and age of children using the crossing, and the total extra walking distance required. If necessary, better traffic control along the route may be needed at the crossings. These improvements can include better signs, flashing lights, pavement markings, traffic signals, crossing guards, pedestrian walkways, and altering the slope of a roadway.

EVALUATING THE NEED FOR A CROSSING GUARD

For a number of reasons, the use of an adult crossing guard must be closely evaluated. The city of Arlington, Texas, for example, uses a hazard index to assess the need for adult crossing guards.

This process allows the requests for crossing guards to be prioritized for the entire city. Alternatives to adult crossing guards are also investigated. The hazard index was discussed in "Crossing Guard Analysis" (*ITE Journal*, July 1989) and includes the following factors:

- traffic volume
- street width
- traffic speed
- sight distance
- safe stopping distance
- number of children
- age of children

Arlington has used this method to allocate available resources and maximize the benefits of adult crossing guards that are used. The approach allows the city to place crossing guards at the most appropriate and effective locations. The factors are considered by the city when a school crossing guard is requested at a particular location. In some cases, the implementation of a school crossing guard is

appropriate, and in other cases alternative improvements are more feasible. The factors listed above could be used to assist in this type of decision making.

WHAT CAN BE DONE INSTEAD OF USING A CROSSING GUARD?

A crossing guard at a school crossing is not always appropriate or feasible. The following table includes some solutions (including school guards) to the deficiencies often found along a route used by school children to walk to school.

TABLE 1 Examples of some solutions for deficiencies to a school walking route

Typical Crossing Deficiency	Solutions to Consider
High traffic volume	Interrupt traffic flow; relocate designated route
High pedestrian volumes at crossings	Revise walk route; widen crossing; provide crossing guards
High vehicle speeds	Install warning signs; provide school zone speed limit
Frequent crashes	Provide public education; redesignate walk route; bus students; increase level of control and enforcement
Child perception deficiencies	Provide public education and student training
Children with disabilities	Provide special education or transportation; provide crossing guards or controls
Driver (or child) violation of warning devices	Increase enforcement; provide public (or student) education; review and modify placement of warning devices

Adapted from *School Trip Safety Program Guidelines*. Institute of Transportation Engineers (ITE), January 1985

TRAFFIC AND SAFETY INFORMATIONAL SERIES FREQUENTLY ASKED QUESTION #24

Why Aren't Crossing Guards Present at All School Crossings?

We sometimes get requests from parents for crossing guards at school crossings. The concern for the safety of children is very important. However, the addition of adult crossing guards at school crossings would not necessarily make the crossings safer.

Many factors determine where crossing guards are used

Some locations justify the use of adult crossing guards. Many factors—for example, traffic volume, street width, traffic speed, visibility, number of children, and age of children—may be considered when determining where to use crossing guards.

Often existing safety systems work

Before requesting the addition of crossing guards at school crossings in your area, consider the existing methods of traffic control in the area. Often the stop signs, traffic signals, and school signs that already exist near school crossings do a reasonable job of informing drivers. Drivers respond best to a uniform use of signs and signals; when new forms of traffic control (including crossing guards) are added, sometimes confusion rather than caution is introduced.

With or without crossing guards, education and awareness can be important

Even with crossing guards, the education of drivers and pedestrians of the possible conflicts may be necessary. Children can benefit from keeping in mind that they should be careful when crossing the street and that not all drivers are necessarily watching out for them. Drivers need to be aware of the possibility of pedestrians in the area.

For more information

For more information, please contact _____.

TRAFFIC AND SAFETY INFORMATIONAL SERIES FREQUENTLY ASKED QUESTION #25

WON'T A FLASHING YELLOW LIGHT DRAW MORE ATTENTION TO A SIGN?

A flashing beacon is a blinking light that is often used to draw attention to particular intersections and other situations where drivers need to be warned of unexpected or hazardous conditions. It is a common belief, but not always true, that the addition of a flashing yellow light will reduce the speed of vehicles using the roadway. In addition, flashing lights may initially draw attention to a particular situation but lose some of their attention value over time. Flashing yellow lights are a type of flashing beacon.

WHEN SHOULD FLASHING LIGHTS BE USED?

If a driver needs to be alerted to an area that requires greater than normal care, flashing lights could be installed. The lights can be installed immediately at an intersection or in combination with the intersection advance warning signs. However, flashing beacons should only be used to warn drivers of unusual conditions that are not readily apparent. These situations could include intersections on high-speed roadways, obstructions in the roadway, special roadway conditions, narrow bridges, or other conditions hidden from the driver.

It is important that a flashing yellow light be warranted before it is installed. If too many unwarranted yellow flashing lights are installed (e.g., they are installed at locations that are not unusual or unexpected), the beacons that are truly necessary may start to be ignored. When this happens, the effectiveness of all the flashing lights is reduced, and crashes can result.

The *Manual on Uniform Traffic Control Devices* (MUTCD) allows four types of flashing beacons to be installed:

1. Intersection control beacon. This type of flashing light is used at intersections controlling two or more directions of travel. These beacons are intended for use at intersections where traffic or physical conditions do not justify conventional traffic signals, but where high crash rates indicate a special hazard.
2. Warning beacon (hazard identification beacon). The warning beacon is only used to supplement a warning or regulatory sign. Warning beacons may be applied to warn of an obstruction in or adjacent to the roadway at midblock crosswalks, to supplement advanced warning signs, or at intersections where a warning is required.
3. Speed limit sign beacon. A flashing speed limit sign beacon is to be used where a fixed or variable speed limit sign is used. This beacon may be used where appropriate to show that the posted speed limit is in effect.
4. Stop Sign Beacon. A stop sign may be supplemented with a stop sign beacon if further attention is necessary to identify a hazard. This type of flashing lights can be very effective where an intersection is located just beyond a curve that is hidden from a vehicle's view.

RESEARCH SHOWS THAT FLASHING LIGHTS MAY NOT BE EFFECTIVE

There has been some research into the effectiveness of flashing lights. A study by Cynecki and Sparks in the *Institute of Transportation Engineers Journal* was performed to determine whether flashers were

successful in reducing illegal vehicle movements, primarily running red lights. This study found that speeds and violation rates of red lights actually increased after flashing beacons were added to advance warning signs at two school crossings. The study concluded that it is an incorrect assumption that flashing lights control what drivers view as safe behavior. In general, the actual presence of children was found to have the most substantial impact on vehicle speeds. It was also found that a flashing light blends into the existing scenery the longer it operates. This produces a situation in which the flashing light loses its value. Overall, the authors of the study believe that flashing lights are most applicable in a high-speed rural environment with unusual geometry characteristics, at locations with frequent pedestrian crossings, and along roadways with a large number of unfamiliar drivers.

Another study that discussed the effectiveness of flashing beacons at intersections appeared in *Transportation Research Record* in January 1977. This study found that intersection control beacons had the greatest effect on the fastest vehicles and less of an impact on vehicles traveling at or near the average vehicle speed along the roadway. In addition, an analysis of the speed data revealed no significant change in the average speed at an intersection when a flashing beacon was added to a “Stop Ahead” sign. There was, however, a significant reduction in the amount that the speeds varied among vehicles.

TRAFFIC AND SAFETY INFORMATIONAL SERIES FREQUENTLY ASKED QUESTION #25

Won’t a Flashing Yellow Light Draw More Attention to a Sign?

We sometimes get requests for a flashing light to be added to a sign. It is believed that this would draw drivers’ attention to a sign and encourage them to slow down. You may be surprised to learn that this is not always true. Traffic engineers study and evaluate what locations would benefit from flashing lights and at what locations flashing lights would be a detriment. Here are some of their findings:

Flashing lights are used to alert drivers to conditions that are unusual and/or unforeseeable

Flashing lights should be used to warn drivers of unusual conditions that are not readily apparent and that require more than normal care—for example, when there is an obstruction in the roadway ahead or a narrow bridge around a curve. Some flashing lights are effective in high-speed rural environments where the roadway suddenly changes, at locations where pedestrians frequently cross, and along roadways that experience a large number of drivers who are unfamiliar with the roadway. If conditions are not unusual or unforeseeable, flashing lights may not be necessary or make the roadway any safer.

When flashing lights are overused, they may become ineffective

The effectiveness of flashing lights at any given location decreases with time. Studies have shown that when flashing lights are used too often, some drivers stop paying attention to them. Drivers may even start to ignore important signs that aren’t supplemented by flashing lights.

Existing signs are often adequate

Unless conditions are unusual and/or unforeseeable, existing unlighted signs are often effective in conveying their message to drivers.

For more information

For more information, please contact _____.