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TOP 10 ROAD SAFETY ISSUES

In This Issue…

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Overview

Traffic Engineering Agency (TEA) has conducted numerous traffic engineering and safety studies on military installations throughout the world. Types of studies include comprehensive studies, entry control facility (ECF) studies, pedestrian studies, crash location enhancement studies, traffic safety audits, sign management studies, traffic signal operational audits, and traffic impact studies. Through the course of these studies, TEA witnessed several recurring issues on military installations. Though these issues may differ in magnitude at one location versus another, they are generally observed at the same frequency. Based upon observations only and not recorded crash data, it seems the majority of installations have at least one of these common issues. Therefore, due to their frequency, TEA is taking a proactive approach and highlighting these issues. The list below identifies the top ten safety deficiencies as documented in these studies:

- ☑ Missing ALL WAY Sign Plaques
- ☑ Faded and Non-retroreflective Signs
- ☑ Inappropriate Speed Limits
- ☑ Missing or Inadequate Street Name Signs
- ☑ Unwarranted Midblock Crosswalks
- ☑ Intersection Crosswalks in Advance of the Stop Line
- ☑ Missing or Incompliant Traffic Signal Pedestrian Accommodations
- ☑ Inappropriate Traffic Signal Operation
- ☑ Incorrect Use of Lane Closure Devices at ECFs
- ☑ Roadside Hazards

Each of these deficiencies is described in the following pages.

TEA is available to assist installations with studying any of these items and developing recommendations for mitigation.

Missing ALL WAY Sign Plaques

The Manual on Uniform Traffic Control Devices (MUTCD) requires an ALL WAY plaque be mounted below each STOP sign at intersections where all approaches stop. There are two commonly occurring issues associated with this requirement: simply lacking the plaque at an all way stop controlled intersection and using an obsolete plaque indicating the number of legs which stop. Prior to the current 2009 MUTCD edition, plaques indicating the corresponding number of approach legs were allowed. Under that permission, it was not prohibited to post 2-WAY plaques beneath the STOP signs at a two-way stop-controlled intersection. Since most plaques were used at all way stop controlled intersections, they were misinterpreted when used at two-way stop-controlled intersections. Drivers would see the sign, not necessarily read or misinterpret it, and upon expecting the conflicting approaches to also stop, would proceed into the path of an oncoming vehicle.

Per the MUTCD, the size of the ALL WAY placard is 18” x 6” when used with a 30” x 30” or 36” x 36” STOP sign, or 30” x 12” when used with a 48” x 48” STOP sign.

R1-1 &
R1-3P

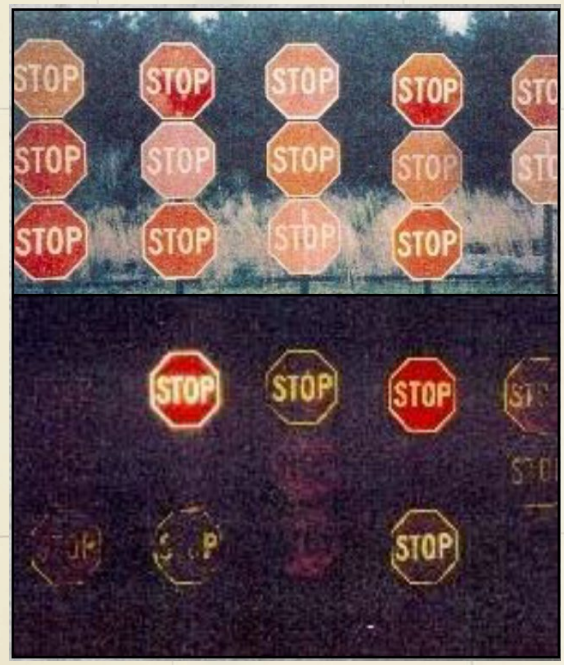
Use of an Obsolete 3-Way Plaque (File Photo)

Faded and Non-retroreflective Signs

Faded signs are a frequent safety problem on military installations. Faded signs lack a recognizable message, thereby not providing motorists with information critical to the driving task. This lack of critical information can have dangerous consequences for motorists. The cost of replacing a sign is considerably less than the consequences of a crash and drivers should not have to rely upon guessing or sign shape to interpret its message.

Faded Signs (File Photos)

Along with the need for daytime visibility, retroreflective signing is critical for nighttime visibility. Signing with inadequate retroreflectivity lacks nighttime visibility while a faded sign lacks daytime visibility. Type III or better sheeting material is recommended by TEA since lesser grade sheeting barely meets the MUTCD retroreflectivity requirements. Just because a sign is visible by day does not mean it has adequate nighttime retroreflectivity.



Daytime Versus Nighttime Sign Comparison

Signs have an expected life of about 15 years on average. Environmental factors, particularly sun exposure can reduce this time. Signs should be replaced at the end of this lifetime, or when they have reached the end of their service life. Along with replacing the sign panel, verify that the sign is mounted properly on a breakaway support and located properly for its intended purpose.

Inappropriate Speed Limits

Inappropriately applied speed limits commonly occur on military installations. Speed limits that are too low for a roadway are more common than speed limits too high for a roadway.

Most motorists select a speed that will allow them to arrive to their destination in the shortest time possible but without endangering themselves and others. As drivers, we select our speed by considering the roadway width and alignment, presence of intersections and driveways, roadside conditions, parked vehicles, pedestrian traffic, mix and density of vehicular traffic, weather, and other conditions. The posted speed limit is the numerical speed limit noted on regulatory signs placed along the roadway to which it applies. All states have a law that requires the driver to operate a motor vehicle at a speed that is reasonable and prudent for existing conditions, regardless of the presence of a posted speed limit.

Improperly posted speed limit signs can lead to speed differences between vehicles, thereby increasing crash potential. And the greater the speed differences, the greater the damage when vehicles collide with one another. In a perfect world, drivers would travel at exactly the same speed at any given location.

Research shows that the safest speed limit approximates the 85th-percentile speed, which is the speed that 85 percent of the free-flowing vehicles are traveling at or below. In reality, it is necessary to round the speed limit to the nearest 5-mph multiple at or below the 85th-percentile speed. Using speed limits that are not divisible by 5-mph is not appropriate.

Drivers tend to travel at speeds they are comfortable with. This comfort is based on the physical features of the roadway, such as lane width, curvature, grades, and clear zone. Speed limits lower or higher than what feels appropriate to drivers are generally not heeded. Studies repeatedly show that establishing the speed limit below the 85th-percentile speed increases the number of crashes. The cause of this increase in crashes may be the direct result of a few drivers who actually attempt to obey the speed limit, which in turn frustrates other drivers, causes traffic queues and congestion, and contributes to increased tailgating and passing. Furthermore, setting speed limits lower than the 85th percentile does not encourage compliance with the posted speed limit. The basic reason for a posted speed limit is to encourage speed uniformity and to provide a means to prosecute the few drivers that travel at excessive speeds and jeopardize the safety of others.

Most states have laws in place that identify minimum and maximum speed limits for different types of roadways, such as urban or rural. These laws often require that speed studies be conducted prior to changing a speed limit. A speed study often includes assessing current vehcile speeds, roadway design elements, pedestran and bike activity, and crash history. Design elements to consider include superelevation rate, roadway curvature, clear zone, and sight distance.

Missing or Inadequate Street Name Signs

Street name signs are very important for providing unfamiliar drivers with necessary information as it relates to the name of intersecting roadways. Since military installation roadways are used extensively by newly assigned service members, visiting retirees, and unfamiliar contractors; it is important to provide street name and destination information.

Street Name Sign Located too Far from Intersection to be Visible from Cross Street (File Photo)

At minor intersections, one street name sign facing each approach is permissible; but at major unsignalized intersections and in business or commercial areas, install street name signs on diagonally opposite corners. The signs are normally double-sided so that they can be read in both directions of travel.

Street name signs are usually installed on their own signpost in an intersection quadrant, but they may be placed above a STOP or YIELD sign as long as they remain visible from the cross street. If signs are mounted above a STOP or YIELD sign, it is encouraged to mount the one with the name of the cross street on top so that the unique shape of the STOP or YIELD sign is not compromised. If the sign for the cross street is below, it would be directly above the STOP or YIELD sign. The gap between these signs could be small and appear from a distance as being one elongated sign.

Special hardware is available to mount the sign panels from their bottom edge so that both sides of the sign are clearly visible to approaching drivers.

At signalized intersections, it is recommended to mount street name signs overhead on the signal mast arms or span wire near the signal heads to maximize visibility.

Street name signs should utilize a white, mixed-case legends. The recommended background color is green; however, blue, brown, or black background colors are permissible. Nonetheless, it is desirable to use a consistent color throughout an entire military installation, or at least throughout a unique area within the installation. The recommended minimum letter height for street name signs is shown in the table below, information from MUTCD Table 2D-2.

Minimum Letter Heights for Street Name Signs

Type of Mounting	Type of Street or Highway	Speed Limit	Recommended Minimum Letter Ht	
			Initial Upper Case	Lower Case
Overhead	All types	All speed limits	12 inches	9 inches
Post-mounted	Multi-lane	More than 40 mph	8 inches	6 inches
Post-mounted	Multi-lane	40 mph or less	6 inches	4.5 inches
Post-mounted	2-lane	All speed limits	6 inches*	4.5 inches*

*On local two-lane streets with speed limits of 25 mph or less, 4-inch initial upper-case letters with 3-inch lower-case letters may be used.

Since large signs can result from using these letter heights, sign borders may be eliminated to reduce their size.

Overhead Street Name Signs (File Photo)

D3-1

Street Name Sign (D3-1), from MUTCD

Unwarranted Midblock Crosswalks

It is very common for midblock crosswalks to be installed where crossing demand is minimal, or old crosswalks to be maintained where pedestrian crossing demand no longer exists. Midblock crosswalks are sometimes located near a controlled intersection where pedestrians can be reasonably expected to walk to that controlled intersection instead. The overuse of unwarranted crosswalks (at midblock and uncontrolled locations) reduces their effectiveness and reduces the respect they must command by drivers at locations where they are truly needed and warranted. Uncontrolled refers to the absence of traffic control (yield, stop or signals) on the approach to a crosswalk.

Crosswalks should not be used where speeds exceed 45 mph at unsignalized intersections, and where sight distance is inadequate. Generally, marked crosswalks should be considered when one of the following conditions exist:

- ☑ Signalized intersections with pedestrian signal heads;
- ☑ All locations where a school crossing guard is normally stationed to assist children in crossing the street; and
- ☑ All intersections and mid-block crossings satisfying minimum vehicle and pedestrian volume guidelines.

Most state laws recognize crossings at intersections as legal crosswalks whether they are marked or unmarked; however, for midblock crossings they are only defined as a legal crosswalk when marked.

Although the majority of pedestrian crossings occur at intersections, 73% of pedestrian fatalities occur at midblock crossings. An engineering study should be performed before installing crosswalks at these midblock and other uncontrolled locations (intersections).

For a proposed crosswalk at a midblock location or on an uncontrolled approach to an intersection, the following two criteria shall be satisfied in conjunction with the proposed marked crosswalk:

- ☑ The crosswalk shall provide adequate sight distance; to include vertical, horizontal, and intersection stopping sight distance.
- ☑ The crosswalk shall not cross any part of an auxiliary lane and its transition. Auxiliary lanes include left turn, right turn, acceleration, and deceleration lanes. Two-way left-turn lanes are not considered auxiliary lanes.

Locations being considered for a crosswalk (midblock or an uncontrolled approach to an intersection) should have a minimum level of traffic and pedestrian volumes. All of the following four criteria should be satisfied prior to marking:

- ☑ Location of midblock crossing should be a minimum of 300 feet (200 feet with an engineering study) from any controlled intersection (all-way signal/stop/yield control or pedestrian overpass).
- ☑ Pedestrian crossing volumes should meet one of the following conditions:
  - 20 pedestrians in an hour, or
  - 15 elderly, disabled and/or children in an hour, or
  - 60 pedestrians total for the highest consecutive pedestrian 4-hour period.

  Pedestrian counts should only include pedestrians crossing within 100 feet either side of the proposed crosswalk location in an attempt to capture only potential users of the proposed crosswalk.
- ☑ The two-way traffic volume should meet the minimum of 1500 vehicles for the average daily traffic (ADT) or 150 vehicles in the pedestrian count hour.
- ☑ The current pedestrian crossing is not due to a correctable gap in the sidewalk system.

After determination is made that a crosswalk is warranted, TEA's Addendum to SDDCTEA Pamphlet 55-17, *Crosswalk Warrant and Guidelines* provides enhancements that should be added when implemented.

Uncontrolled Crosswalk Treatment Example (File Photo)

Intersection Crosswalks in Advance of the Stop Line

Sidewalks or physical training trails often run parallel to roadways. They are often offset from the roadway, with perhaps 20 to 30 feet separating the sidewalk or trail from the roadway. This creates a desirable separation between pedestrians using the trail and vehicles on the roadway. With the correct distance, pedestrians are well outside the roadway clear zone resulting in significant safety benefits. It makes pedestrians feel comfortable, reduces roadway noise with distance, and provides greenspace which can be used for landscaping, trees, benches or other aesthetic treatments. In northern climates when snow is plowed from the roadway, this additional width will keep the plowed snow from ending up on the sidewalk or trail.

A significant disadvantage of this separation is that when the sidewalk or trail approaches an intersection or cross street, there is a tendency to maintain the offset between the roadway and the sidewalk or trail where the crosswalk crosses the intersecting street. This results in a crosswalk being located prior to the required stopping point for traffic at the intersection, and therefore, pedestrians crossing at an uncontrolled location.

This is a significant safety issue. Not only are pedestrians crossing at an uncontrolled location, but they are also at risk from traffic turning off the adjacent roadway and onto the roadway they are crossing. The pedestrian crossing location may be outside the driver's cone of vision as they turn. With a relatively short distance to the crosswalk, the driver may accelerate before seeing a pedestrian, making that pedestrian prone to being struck by the vehicle. This is further amplified when the pedestrian can't be seen because they are crossing behind a vehicle that is stopped at the stop line.

Crosswalk in advance of Stop Line (File Photo)

The crosswalk in the above photo is especially problematic because the Stop Here for Pedestrians sign is an incorrect attempt to provide traffic control for the crosswalk but makes the STOP sign message at the intersection ambiguous. Is a stop at the intersection necessary if there is no pedestrian in the crosswalk?

Ideally, mitigation for this condition is to simply relocate the sidewalk approaching the intersection. It is possible to simply relocate the stop line in advance of the crosswalk as long as the ending location is not too far from the roadway. If the distance is significant, drivers tend to stop at the location they believe is appropriate for seeing traffic at the intersection.

The graphic below shows an example of the preferred treatment where the sidewalk connection is relocated closer to the intersection, allowing the crosswalk to be in advance of the stop line.

Sidewalk Relocation Closer to Intersection
Image Source: Installation aerial imagery

Missing or Incompliant Traffic Signal Pedestrian Accommodations

The primary function of intersection traffic signals is to assign the right of way to opposing traffic movements to maximize efficiency of travel. As the majority of traffic is vehicular traffic, many agencies exclude pedestrian accommodations in signal design since pedestrians are not a major component of the overall intersection volumes. Hence, TEA has observed many traffic signals constructed without pedestrian accommodations. If accommodations are present, many times they are malfunctioning due to poor maintenance.

As pedestrians have an equal right to access and to use the roadway, the design of a signalized intersection should include accommodations for this mode of travel. When there is evidence of even light pedestrian demand along a roadway, there will likely be some pedestrian demand through the intersections - - pedestrians are expected at intersections so motorists are more aware of their presence. Crosswalks located at signalized intersections do not need to meet minimum pedestrian crossing warrants, as they would with crossings at uncontrolled locations. It is preferred to have pedestrians cross at intersections. When an intersection is signalized, it is generally safer for pedestrians since vehicular traffic is controlled and pedestrians can cross with signal indications. The WALK and DONT WALK indications are critical in providing pedestrians with guidance for when to cross, as well as providing adequate time for their crossing of the road when activated.

When designing a new signal, the cost of pedestrian accommodations is typically limited to the cost of pedestrian signal heads and pushbuttons, along with wiring leading from these to the signal controller. Occasionally, with certain geometric conditions, special poles are needed for pushbuttons and signal heads apart from the poles used for the mast arms. The cost of mast arms or strain poles for span wires is significant, as is the controller and cabinet assembly. In comparison, the cost for pedestrian accommodations is minimal and a minor cost overall. However, as with any component, they must be maintained and kept in working order. A nonfunctional pushbutton can be replaced quite easily; and, with LEDs common for signal indications, the lifespan of the signal indications is long.

It is also to the drivers' advantage to have functional and properly timed pedestrian accommodations. Calculated minimum pedestrian crossing times must be provided at signals, which varies by intersection width. If the required time for the vehicular phases is less than the required time for pedestrians to cross, the complete pedestrian time is only provided when the pushbutton is actuated. Therefore, with no pedestrian demand, no unnecessary extra green time is provided, and the signal operates more efficiently for traffic conditions.

Crosswalk at Signal Lacking Pedestrian Accommodations (File Photo)

Inappropriate Traffic Signal Operation

The lay person may see a traffic signal cycling regularly between green, yellow, and red and think that the signal is operating correctly. In reality, there are many aspects of a signal's operation that are necessary for efficient operations. Some of these aspects relate to design, and others relate to maintenance and operation. Common deficiencies that effect signal efficiency are listed below.

- ☑ Incorrect Timings. Traffic signals with incorrect timings are a common problem on military installations. Items that have potential to influence the required timing for signal intervals include:

- Population changes or new building construction that influences traffic demand, resulting in changes to intersection traffic volumes.
- A newly constructed entry control facility which adds considerably more traffic to the roadway or changes travel patterns.
- Pedestrian demand.
- Changes in posted speed limits.

☑ Signal Controller Settings. There are several timing and operational settings in a controller that can be very influential to the operation of an intersection. Some of these include passage time, time before reduce, time to reduce, maximum or minimum recall, fixed force off or on, locking or nonlocking detection, or maximum or minimum coordination. Different settings are appropriate with different conditions. A simple incorrect setting can significantly reduce the efficiency of a signal and cause traffic to queue.

☑ Malfunctioning Detection. When detection is not functioning properly a constant call for the phase is sent to the controller, resulting in a phase being on unnecessarily. Loops embedded in the pavement can malfunction as pavement ruts or deteriorates, which requires the loop to be replaced. Video detection can get dirty with road dirt or even spider nests. It is not as reliable during certain weather conditions such as snow and fog. Video detectors must be cleaned at least annually for proper performance.

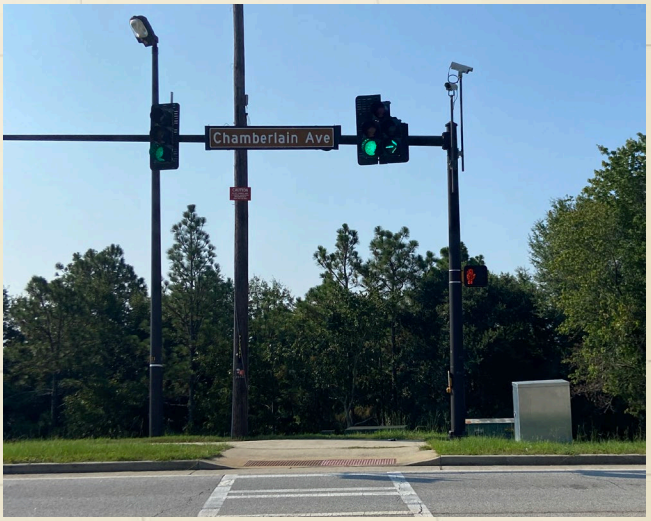
☑ Incorrect left-turn phasing. Left-turn phasing must be carefully evaluated. There are three types of phasing: permitted, where left-turns proceed but yield to the opposing through movement which also proceeds; protected-permitted, where there is a green left-turn arrow for a protected portion of the phase, followed by the permitted phase described above for the other phase portion; and protected only, where traffic may only proceed with the green left-turn arrow. Considerations influencing the appropriate phasing type include traffic volumes, intersection widths, crash experience and sight distance.

☑ Old Equipment. Traffic signal technology has evolved significantly over the last 20 or so years. LED indications used in lieu of incandescent indications is the norm and modern controllers have more capabilities than legacy controllers once had. Detection capabilities are far greater than they once were. For example, radar detection technology detects continuously with actual vehicle position over longer distances. Also, software is available to monitor real-time traffic for traffic responsive signal coordination.

☑ Poor Maintenance. Signals must be properly maintained to operate properly. Signal indications not functioning, such as burned-out indications, are a clear sign of the need for maintenance. Signal wires dangling from the span wire or mast arm, signal attachment hardware becoming loose, or signal equipment in need of repair after being hit by a vehicle are all clear signs of maintenance needs.

☑ Nonfunctional Interconnect. When a roadway corridor has multiple signals, the signals should be interconnected and operating in coordination such that green times at subsequent signals are offset based on the speed limit of the roadway, which minimizes the need for motorists to stop at subsequent signals. This requires that the signals be operating in sync, which requires interconnection. Forms of interconnection include:

- Copper cable (wired connection)
- Fiber optic cable (wired connection)
- Radio communication (wireless communication via transmitters, receivers, and repeaters mounted on all signals)
- GPS time-based coordination (wireless coordination via synchronized time clocks)



Traffic Signal with Broken Backplates and Heads out of Alignment (File Photo)

Incorrect Use of Lane Closure Devices at ECFs

Entry control facilities (ECFs) are sized to have sufficient inbound ID check lanes that can accommodate morning peak period traffic. After the morning peak period, the full capacity is typically no longer needed and lanes can be closed. It is common for chicanes to be used to close one lane of a two-lane roadway through ECFs. The benefit is that doing so adds curvature that forces traffic to slow as it travels through the ECF approach; however, these chicanes are often incorrectly installed. Barriers or other blunt ends used for closures may lack delineation and provide little guidance to the motorist.

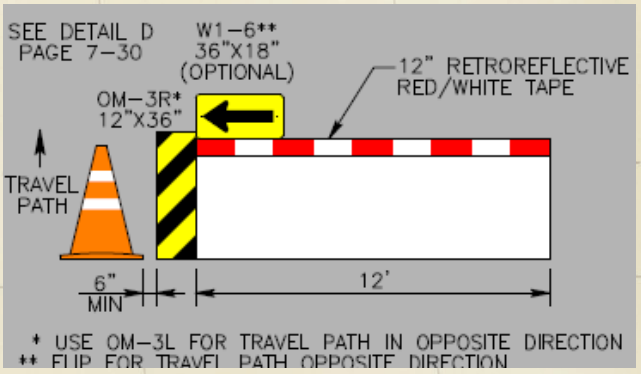
Concrete Barriers (Top) and Bollards (Bottom) [File Photos]

TEA discourages the use of blunt objects in roadways to close lanes because of the risk to motorists. Recognizing the security needs, if used, chicanes must have adequate spacing and delineation.

In an attempt to increase roadway safety when using an in-roadway system, TEA has tested and found that an 8-inch high precast section of curb will disable vehicles traveling at 25 mph or more. The 8-inch curb design is presented in SDDCTEA Pamphlet 55-15. It has been safety tested and is intended to be used as an in-roadway barrier to create chicanes, replacing the detrimental bollards, crash gates and the common Type F concrete barriers.

A research and physical testing study performed by TEA determined the appropriate chicane layout and spacing based on roadway width and threat vehicle design speeds, for chicane designs with or without accommodating trucks. For designs without trucks, consider the need for all vehicles that may need to use the gate, including school buses and emergency vehicles. Section 4.2.2 of SDDCTEA Pamphlet 55-15 shows the recommended barrier spacing. This aggressive chicane is intended for use with three barriers. The standard chicane should be used with four barriers. When selecting design speed, consider the space available for chicane placement, as well as the actual speed desired.

If used, chicanes require proper traffic control to alert motorists of the condition. Proper delineation of barrier placements is critical to increase traffic safety and avoid operational conflicts. Red and white retroreflective markings (such as tape) must be installed on the barrier to improve delineation, though the specific type of material used will vary by type of barrier. In addition, chicanes need appropriate advance warning signs, and the travel paths through the chicane must be delineated using traffic cones and the adjacent edge of the barrier delineated with a black and yellow object marker (or tape, depending on barrier type).



Barrier Delineation Detail excerpt from SDDCTEA Pamphlet 55-15. See 55-15 for complete detail.

Roadside Hazards

Installation roadways often contain roadside hazards. A roadside hazard is defined as a fixed object that can potentially harm the driver if struck. Common hazards can include utility poles, trees, concrete barriers, bollards and culvert headwalls. A clear zone is the total roadside border area from the edge of the travel way that is available for safe use by errant drivers. Providing adequate clear zones can enhance roadway safety by providing motorists with certain levels of expectation. The required clear zone distance is a function of the design speed of the adjacent roadway, the average daily traffic volumes, and roadside geometry (i.e., side slope).

Fixed objects should not be located within the roadway clear zone. Roadway barriers should only be used when the consequences of running off the road are more severe than the consequences of hitting the barrier. Many of TEA's studies have often observed instances where bollards are used to protect other fixed objects, such as fire hydrants, gas mains, or raised junction boxes located next to the roadway. The bollards worsen the crash severity of the hazard.

There are five options to mitigate roadway hazards, in order of preference:

- ☑ Remove the hazard
- ☑ Relocate the hazard outside of the roadway clear zone
- ☑ Reduce the impact severity, such as with a breakaway support
- ☑ Shield the hazard with a traffic barrier, such as a guardrail
- ☑ Delineate the hazard with an object marker.

It is preferred to remove hazards completely. It is easy to run utilities along roadway corridors since width is often available, but they can be hazards if not done properly. Poles for overhead utilities should be located outside the clear zone. If this cannot be achieved, then consideration should be given to burying the utilities; junction boxes should be completely underground; and gas and water mains should be underground or at least positioned outside the clear zone. Drainage structures should be a traversable design and flat with the ground versus the older headwall style that extends above the ground.

Barriers such as guardrail can be used to shield an object, but only if what is being protected cannot be removed. Barriers are hazards themselves, so they should not be used if other options are available. Barrier can be avoided if an embankment can be regraded to flatten the slope, if trees can be removed, or if utility poles can be removed. Signposts and luminaire supports should be breakaway such that they yield if struck.

In urban environments, meeting clear zone requirements is often not possible due to the limited right of way for roadside features since urban areas are generally more developed and use curbing. Urban environments are characterized by sidewalks beginning at the face of the curb, enclosed drainage, numerous fixed objects (e.g., signs, utility poles, luminaire supports, fire hydrants, etc.), and frequent traffic stops. The AASHTO Roadside Design Guide provides recommended values for enhanced lateral offset from fixed object hazards of 4 to 6 feet but absolutely no less than 1.5 feet from the face of curbing. This minimum lateral offset distance is intended only to provide sufficient clearance for the overhang of a truck to avoid striking an object and should not be misconstrued as satisfying the clear roadside concept.

Bollards Protecting Light Pole are Additional Fixed Objects (File Photo)

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