

Work Zone Safety Challenges, Trends and Best Practices

| Introduction to Work Zone Safety Planning

Globally, there are over 1 billion cars on the road today. By some estimates, that number is set to double by 2040.¹ As the number of vehicles and miles traveled continues to increase, the need for global investment in roadway infrastructure will increase as well. The G20-backed Global Infrastructure Hub estimates that the world needs to invest \$3.7 trillion in infrastructure annually to keep up with demand. Of that, we need to invest \$900 billion annually in roadway infrastructure.²

Investing in roadway infrastructure provides significant economic benefits to local and national economies. New job creation and reduction in unemployment rates, as well as the influx of budgetary spending, can lead to increased consumer spending. Perhaps more importantly, improving and expanding a country's roadway infrastructure boosts productivity by increasing the efficiency of both businesses and individuals. Infrastructure development leads to improved mobility and safety through more navigable, less congested roads. It becomes easier, more reliable, and less costly for businesses to transport freight from one region to another. Businesses can expand their distribution network and use the cost savings from increased freight efficiency to invest in the business and keep up with new demand. Expanded roadway networks enable individuals to unlock new economic opportunities as they're able to more efficiently travel to and from work. The cost of sitting in traffic congestion, in terms of both time and money, is immense. By some estimates, Americans lose up to 6.9 billion hours and 3.1 billion gallons of fuel every year sitting in traffic jams.³ With more efficient roads, your citizens will be able to reinvest that time and money in new pursuits and opportunities.

As global roadway infrastructure investment continues to grow, the need for work zone safety planning will grow along with it. Anytime a roadway construction or maintenance project is initiated, key stakeholders—including the traffic engineer designing the work zone, the company responsible for traffic control, OEMs producing temporary traffic control devices, and law enforcement agencies—must consider the safety and mobility of drivers, workers, pedestrians and cyclists. By planning for safety and traffic flow in work zones, we can help to maintain public trust, avoid the risk of work zone injuries and fatalities, and guide the success of the roadway project.



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| The Importance of Work Zones

► What is a work zone?

A work zone can be defined as any section of road where work is being performed. The Federal Highway Administration (FHWA) defines a work zone as “**That part of the highway being used or occupied for the conduct of highway work, within which workers, vehicles, equipment, materials, supplies, excavations or other obstructions are present.**” This can include highway construction, maintenance, or utility work. Table 1 provides scenarios that require work zone safety planning.⁴



► Scenarios that require a safe work zone

Type of Work	Considerations and Requirements
Work Outside the Shoulder	<ul style="list-style-type: none"> Distance from shoulder to work space—temporary traffic control not needed if work is 15 feet or more from the traveled way ROAD WORK AHEAD sign needed if work is closer to the road, or if there are distracting conditions Length of work zone—longer work zones present increased exposure, while shorter work zones present greater speed differentials²⁶
Work on the Shoulder with no Encroachment onto Road	<ul style="list-style-type: none"> LEFT or RIGHT SHOULDER WORK or CLOSED sign Channelizing devices to close shoulder Length of work zone—longer work zones present increased exposure, while shorter work zones present greater speed differentials
Work on the Shoulder with Minor Road Encroachment	<ul style="list-style-type: none"> Assess need for lane closure Assess if pedestrian or cyclist pathways are impacted, and reroute if necessary
Median Work	<ul style="list-style-type: none"> Location of work—if work is within 15 feet of traveled way, use temporary traffic control, including advance warning signs and channelizing devices

Table 1: Situations that Require Work Zones



Type of Work	Considerations and Requirements
Work Within the Traveled Roadway	<ul style="list-style-type: none"> • Advance warning signs to alert drivers to route changes • DETOUR signs to reroute traffic around work zone or channelizing devices, flaggers and temporary pavement markings to guide drivers through work zone • Temporary traffic control for intersections, highway exits and highway access points • Conspicuous, frequent, retroreflective signage and temporary traffic control devices to account for traffic flow and work duration • Consideration and guidance for pedestrians and cyclists
Nighttime Work	<ul style="list-style-type: none"> • Retroreflective signage and temporary traffic control for increased nighttime visibility • Lighting devices for supplemental lighting
Short-Duration or Mobile Operations on Shoulder	<ul style="list-style-type: none"> • Alerting traffic—can use arrow displays, vehicle hazard lights, or rotating or strobe lights
Mobile Operations on Multi-Lane Road	<ul style="list-style-type: none"> • Vehicle mounted signs to alert drivers • Rotating lights or strobe lights for shadow and work vehicles

Table 1: Situations that Require Work Zones (cont.)

Anytime road conditions are affected by road work or a roadway incident—including an accident, emergency situation, natural disaster, special event, etc.—traffic engineers should utilize temporary traffic control and develop a work zone safety plan to lay out the use of temporary traffic control devices, flaggers, law enforcement authorities and detours to safely and efficiently guide drivers and pedestrians through or around the area.

Work zones can be particularly dangerous because they present drivers and pedestrians with changing, unfamiliar and unexpected conditions—including sudden speed and lane changes, new routes, unfamiliar signage and distractions. In fact, it's estimated that the U.S. crash rate increases by nearly 25% in work zone conditions,⁵ and workers are put in harm's way through close proximity to moving traffic. In 2016, there were 683 fatal work zone accidents and 765 work zone fatalities in the United States alone. Of those fatalities, 143 were workers. Every year in the United States, there are more than 80,000 work zone accidents causing injuries to more than 40,000 motorists, workers and pedestrians.⁶

As global roadway infrastructure spending increases, so will the number of work zones on our roads. Unless we work together to find a way to make work zones safer and more effective, the number of accidents and fatalities can also be expected to grow.

As a traffic engineer, you're a key stakeholder in the effort to reduce work zone accidents and fatalities. By developing and following consistent guidelines and best practices for safer work zones, together we can work towards reducing and eventually eliminating roadway fatalities around the globe.

Work Zone Safety Benefits:

What are the benefits of a safe work zone?

► Reduced injuries and associated legal and economic risks

The costs of work zone accidents and injuries are high for both workers and motorists. State University of New York at Buffalo Civil, Structural and Environmental Engineering professor Satish B. Mohan estimated that construction and maintenance workers were exposed to around 27,000 first-aid injuries and 26,000 lost-time injuries every year. The total annual cost for these injuries was around \$2.46 billion at the time of the study. Vehicle drivers and passengers, meanwhile, suffered around 700 fatalities and 40,000 injuries annually. The total cost of these fatalities and injuries amounted to around \$6.2 billion per year, with each motorist injury averaging a direct cost of \$3,687. The study found that highway work zone fatalities, per billion dollars spent, “cost at least four times more than in total U.S. construction.”⁷ Mohan conducted his study in 2002, but work zone fatalities and injuries have remained relatively consistent at around 700 deaths and 40,000 injuries per year, respectively.

Calculate the potential impact of one injury

Type in Direct Cost of Injury

Indirect Cost of Injury

Calculation based on [OSHA Indirect cost ratio](#)

Total Cost of Injury

Type in Profit Margin of Business (%)

Revenue Required to Offset Loss

Revenue Required = (Total Cost) / (% Profit Margin / 100)

This worksheet is intended to help raise awareness of the impact of injuries. It is for example only. For more detailed information about average injury costs, visit OSHA’s Safety Pays Program.

[Learn more ►](#)



It's also important to consider the costs of liability in any work zone accident or injury. Anyone who is injured in a work zone, including drivers, passengers, pedestrians, cyclists and workers, can make the claim that the work zone caused or contributed to the injury. If a plaintiff can demonstrate that the work zone was improperly designed, implemented or maintained, then anyone involved in designing, implementing, maintaining or inspecting the work zone can be held responsible as a defendant in a lawsuit. Oftentimes, the government agency or the traffic control company that was contracted to implement the work zone are the primary defendants, but individuals can also be held responsible. In the case of a lawsuit, it's critical to be able to demonstrate that you and your agency followed guidelines and best practices, and developed a comprehensive work zone safety plan that clearly specified the work zone layout and temporary traffic control devices required.⁸



Case Study: Impact of Work Zone on Traffic Accident Characteristics of Kochi

The rapid growth of Kochi, India led to the need for new transportation solutions. In response to increased traffic demands, the central and state governments partnered to develop a rapid transit system called Kochi Metro Rail. The project required long term work zones to ensure traffic safety and mobility during construction.



[Read the full case study](#) that was initiated to determine the economic and safety impacts of the project.

► Toward Zero Deaths

In the United States, traffic safety experts and stakeholders developed an initiative called “Toward Zero Deaths: A National Strategy on Highway Safety” in response to the high number of traffic fatalities on U.S. roads. The goal of this initiative is to reduce, and eventually eliminate, the number of traffic accidents and deaths on U.S. roads by educating the community about traffic safety. The National Strategy provides guidance and best practices on roadway safety, and calls on key stakeholders—including traffic engineers, roadway planners, vehicle manufacturers, OEMs, infrastructure manufacturers, government agencies, safety advocates and others—to work together in pursuit of the goal of eliminating highway accidents. The initiative also serves as a tool and forum to educate the public on the importance of traffic safety and to communicate stakeholder efforts to design safer roads for all.

Globally, governing bodies and traffic safety stakeholders are also pursuing the goal of improving road safety and reducing deaths and injuries caused by traffic accidents. The Division for Sustainable Development Goals (DSDG) in the United Nations Department of Economic and Social Affairs (UNDESA) reports that “in 2013, about 1.25 million people died from road traffic injuries, the leading cause of death among males between 15 and 29 years of age.” The DSDG has set the goal of reducing the number of traffic deaths and injuries by half by 2020. This is an ambitious goal, considering the drastic increase in the number of vehicles sharing the roads. In 2010, the UN General Assembly officially proclaimed the Decade of Action for Road Safety 2011–2020.⁷ Through this effort, the UN is working to save millions of lives by:

- Building road safety management capacity
- Improving the safety of road infrastructure
- Developing the safety of vehicles
- Enhancing the behavior of road users
- Improving post-crash response.

In 1997, Sweden passed Vision Zero as an Act of Parliament. Vision Zero called for an end to deaths and serious injuries on Sweden’s roads. The effort reduced the number of traffic fatalities on Sweden’s roads by half between 1997 and 2015.⁸ Vision Zero principles have since been adopted in Canada, the Netherlands, and the United Kingdom.



► Improved traffic mobility

After safety, a traffic engineer's next step is optimizing traffic flow through or around the work zone. Traffic congestion is a significant problem around the world. As the number of motorists on the roads continues to increase and roadway infrastructure struggles to keep pace, it isn't a problem that will be going away anytime soon.

Work zones that lack careful planning or proper implementation can cause additional traffic congestion on already busy roads. These traffic delays can cause significant frustration for the general public and inefficiency for local businesses. Both can reduce the level of public trust in a roadway project, which could prove detrimental to the success of the project (real and perceived), and impact future budgets. Additionally, traffic congestion can create unsafe situations and inhibit safe mobility for emergency vehicles.

Traffic engineers strive to design work zones that optimize traffic mobility in less-than-ideal conditions—factoring in appropriate traffic speeds (considering both safety and efficiency), lane reductions, the opportunities and impacts of rerouting traffic, and the time of day work will be done to minimize traffic disruption.

Case Study: How Caltrans Maintains Traffic Mobility

The California Department of Transportation (Caltrans) “stipulates that motorists must not be delayed more than 30 minutes above normal recurring delay when work is being performed on the highway.”⁹ To accomplish this goal, they require Transportation Management Plans (TMPs) for every work zone. TMPs lay out strategies for minimizing both traffic delays and the time it takes for work to be completed, accounting for:

- Public awareness campaigns
- Driver information
- Roadway demand management
- Roadway incident management
- Construction best practices
- Alternate route planning
- Full facility closures
- Weekend and weekday closures
- Performance-based traffic handling specifications



Read the [full case study](#) to find out the lessons Caltrans learned from implementing TMPs.

► Improved productivity

In addition to the risks and costs associated with work zone accidents and injuries, traffic congestion caused by work zones can have significant economic impacts on both individual motorists who lose time and waste fuel in traffic delays and on businesses who lose productivity and efficiency due to delayed shipping.

► Reduced costs from travel delay and fuel consumption

A study conducted by the Federal Highway Administration (FHWA) found that the number of vehicle miles traveled on U.S. highways doubled between 1980 and 2010. During that same period, the capacity of U.S. highways only increased by 5%.¹⁰ Roadway congestion is a significant challenge in the United States. The FHWA's study found that the costs of congestion, caused by travel delay and extra fuel use, rose from \$24 billion in 1982 to \$115 billion in 2009¹¹, and the yearly peak delay rose from 18 hours in 1982 to 42 hours in 2014.¹²

U.S. investment in highway infrastructure tripled over that same period. This additional investment, and need for new maintenance, repair, and construction, led to a significant increase in the number of work zones on the roads. The traffic disruptions caused by these additional work zones further exacerbated the rising costs of traffic congestion. According to the FHWA, around 24% of non-recurring freeway delay and 10% of overall roadway congestion is attributable to work zones. In 2014, this translated to around 888 million lost hours and an estimated annual fuel loss of over 310 million gallons.¹²

Case Study: District of Columbia Department of Transportation's (DDOT) Integrated Work Zone Project Management System

In 2007, DDOT started developing a comprehensive web-based Work Zone Project Management System to coordinate the planning and management of their many road work projects. Their goal was to increase work zone safety and minimize the impact on traffic mobility. They focused on four key areas for the system:

- Work Zone Tracking
- Traffic Analysis
- Cumulative Transportation Management Planning (TMP) reporting
- Implementation and Monitoring

 [Read the full case study](#) to learn more about the DDOT Work Zone Project Management System.





► Less disruption of local businesses

Work zones can have a significant impact on local businesses in the work zone area by restricting customer access, parking, and delivery, causing utility disruptions, and changing traffic patterns. Each of these factors could potentially lead to lost customers, lost revenue, or a decrease in property values. Additionally, work zones can have economic impacts on businesses that use the roads affected by the work zone. For example, a study conducted during a rehabilitation project on US-59 in Houston, Texas found that “four retail groups—general merchandise, food stores, automotive outlets and home furnishings—have been adversely affected by the construction on US-59.”¹³

The most important thing you can do is to involve local business owners and stakeholders early in the planning process, and clearly communicate the benefits of the work being done. By meeting with business owners early, you can make sure that their concerns are addressed in order to minimize the impact of the work zone on their business. Some DOT authorities have enacted programs wherein the business community is engaged through regular communications in order to maintain a strong, positive relationship for the duration of the road work project. Some common principles these types of programs follow include:

- Provide opportunities for business representatives to serve on project advisory committees
- Hold public hearings and information meetings to collect early input
- Have conversations with business representatives during project design to gather input on mitigating impacts on traffic, access and parking
- Hold pre-construction meetings with businesses, traffic engineering staff and road work contractor
- Provide special signage if feasible and/or necessary
- Restrict construction to times when businesses are closed
- Restrict construction during community events
- Hold weekly meetings during construction between businesses, contractors, and traffic engineering staff
- Provide ongoing updates during construction

► More efficient emergency evacuations and natural disaster recovery

Natural Disasters, traffic accidents, chemical spills and other emergencies arise with little to no warning. In these situations, it's critical to have a plan for the safe and efficient mobility of drivers, pedestrians, emergency vehicles, officials and work crews. Temporary traffic control plans, along with work zone safety plans, can help you respond to emergency situations by outlining work zone designs, safety procedures and the temporary traffic control signs and devices you'll use to provide positive guidance to motorists and pedestrians as they navigate unpredictable, changing conditions.

As a traffic engineer, you'll be responsible for determining the ideal evacuation routes, communicating your decisions, implementing signage, pavement markings, and other temporary traffic control devices that provide visible, easy-to-understand positive guidance for motorists in high stress situations, and designing work zones that allow for the repair work that needs to be done after a natural disaster or emergency.

Here are a few things you can do to help you prepare for an emergency situation:

- **Have a Plan:** In emergency situations, it's important to be prepared. You may consider preparing work traffic control and work zone safety plans for many different emergency situations so when an emergency arises, you're ready.
- **Follow Work Zone Safety Best Practices:** Emergency situations can present additional unpredictable demands on temporary traffic control, but as much as possible you should follow work zone safety guidelines and best practices.
- **Determine the Safest, Most Efficient Evacuation Routes:** Your primary goal is directing drivers and pedestrians through or around the affected areas as safely and quickly as possible.
- **Work with Local Officials:** You'll want to partner with law enforcement and emergency officials to ensure you have proper authority and enforcement, and to help ensure your plans correspond with emergency response and relief efforts.
- **Communicate:** Throughout an emergency situation, it's important to communicate with the general public. This will help them understand the situation and remain safe. Communication will also help you maintain good public relations. Work with the news media to communicate the existence of and reasons for traffic changes or work zones in emergency situations.

For additional guidance on developing and maintaining a natural disaster or emergency plan, refer to [preparecenter.org](https://www.preparecenter.org), [FEMA guide "Developing and Maintaining Emergency Operations Plans"](#) or [FHWA's "Role of Transportation Management Centers in Emergency Operations Guidebook."](#)

► Reduced deterioration of air quality from vehicle emissions

It's estimated that passenger cars produce 60% of carbon monoxide emissions, 60% of hydrocarbon emissions, and 1/3 of the nitrogen released into the atmosphere.¹⁴ Each of these pollutants is potentially harmful to human health and the environment. Traffic congestion, which is frequently made worse by roadway construction and work zones, further exacerbates the negative impacts of vehicle emissions on air quality by increasing both emissions into the environment and our exposure to those pollutants. This is due to three factors:

1. Congestion lowers a motorist's average speed, increasing travel time and exposure on a per vehicle basis.
2. Lower vehicle speeds can increase the concentration of pollutants from emissions, as vehicle-induced turbulence is dependent on vehicle speed.
3. Congestion often changes driving patterns. Vehicles tend to speed up, slow down, stop and start with greater frequency. This type of driving creates more emissions than normal cruise conditions.¹⁵

To reduce the health and environmental impacts of work zones, it's essential to design work zones that optimize mobility and traffic flow in less-than-ideal conditions.



Work Zone Safety Challenges and Solutions: What are the challenges of work zone safety planning?

Designing and implementing safe and effective work zones is a complex challenge. You need to keep workers, drivers and pedestrians safe in less-than-ideal conditions, including at night and in the rain. Distracted drivers and pedestrians must be alerted to traffic flow disruptions, detours, road hazards, and speed and lane changes as you provide them with positive guidance through unfamiliar routes. You need to partner with a trustworthy, reputable traffic control company that will accurately implement your work zone design. You need to communicate with the general public about work zone planning, project timing, detours and delays so you can maintain positive public perception.

When planning a work zone, you need to consider unforeseen roadway hazards, weather and light conditions, and already congested roads. It can be helpful to keep in mind a few key challenges, trends and regulations for work zone safety.



► Challenge: Securing budget to establish a safe work zone

Before you can start planning for safe and effective work zones, you need to determine the budget you'll be working with, and if necessary advocate for an increased budget to ensure that your work zone will provide both safety and traffic mobility for drivers, workers, pedestrians, and bicyclists as they travel through or around your work zone.

To develop your case for increased budget, you should focus on the importance of safety and mobility. As we covered earlier in this ebook, work zones have a significant impact on the safety of motorists, workers and pedestrians, and improving work zone safety has become a focus for government agencies and organizations around the world. In 2018, the International Road Federation released a Statement of Policy, "[Mandating Safer Work Zones Globally](#)," calling for "coordinated efforts to foster a safety culture on road construction sites, currently responsible for hundreds of thousands of injuries and thousands of deaths worldwide."¹⁶ Looking at the various risks and challenges a work zone presents, it's clear that money should be allocated to ensure that work zones are as safe as possible.

You can also make an economic case for maintaining traffic flow by presenting the economic impact on individuals and businesses of traffic congestions and delays. In the United States, a traffic analysis tool called [QuickZone](#) can be used to estimate the impact of work zones on motorists in terms of both costs and delays.

Solution: Develop a business case.

- 1. Articulate Your Case:** This is your justification for the work zone. Why do you need to design and implement a work zone? Why is safety and traffic mobility important?
- 2. Provide Possible Solutions:** Give your stakeholders a few options for the work zone. This could include a list of potential temporary traffic control companies and their average costs, different project scenarios, scopes and timelines, and the possibility of reallocating money from other budgets to pay for the work zone.
- 3. Outline Benefits:** Provide both quantitative and qualitative evidence of the benefits of safe and efficient work zones.
- 4. Predict the Project Scope and Risk:** Estimate the scope of the project, the timeline, and the steps/actions that will be included in a successful project. Additionally, try to foresee risks that could impact the project.
- 5. Estimate Your Budget:** Based on similar projects, consider the resources you'll need to design and implement a safe and effective work zone for the entire duration of the project.
- 6. Outline Your Project Plan:** Outline your project goals and scope, tasks and milestones, communication plans, key stakeholders, deliverables, schedules and timelines, change management plans and budget estimates.
- 7. Write Your Executive Summary:** Create a one-page summary of everything you've developed in steps 1-6.





A key component of your business case is the estimated budget you'll need to design and implement a safe and effective work zone (decisions often come down to the bottom line, after all). When you're making your business case to receive sufficient budget for your work zone safety plan, make sure to inform stakeholders that in the U.S., the Code of Federal Regulations section 630.1012 stipulates that any road work project requires a Transportation Management Plan (TMO) that includes a Temporary Traffic Control (TTC) Plan and addresses both Transportation Operations (TO) and Public Information (PI), and also requires the plans to include "appropriate pay item provisions for implementing the TMP."¹⁷

Here are a few things to consider when you're estimating your budget:

- Project scope and schedule
- Communication plan and required resources
- Average cost to contract with a reliable traffic control company
- The number of temporary traffic control devices you'll need
 - ▶ The American Traffic Safety Services Association has developed a free application under the FHWA Work Zone Safety Grant. The [Work Zone Safety App](#) can help you estimate the number of devices you'll need, determine work zone layout, set up temporary traffic control areas, and more.
- Systems to ensure compliance with standards, regulations and guidelines
- Risk factors, including project complexity, unexpected circumstances, scope creep, and local regulations

For more insight on creating accurate budget estimates and preventing cost escalation, download the National Cooperative Highway Research Program's "[Guidance for Cost Estimation and Management for Highway Projects During Planning, Programming, and Preconstruction.](#)"

► Challenge: Developing consistent and standardized work zone designs

When you're working to design safer, more efficient work zones, and planning how you'll ensure consistency and standardization on future work zone designs, it's essential to develop a clear, consistent set of specifications that guide the requirements and usage for temporary traffic control devices and reflective materials in work zones.



Solution: Develop consistent specifications for temporary traffic control devices and reflective materials.

Step 1: Understand Best Practices and Standards

Safety and traffic mobility should be your two primary considerations any time you're planning a work zone for roadway construction, maintenance, utility or incident management. The goal is to develop plans that account for the safety of drivers, workers and pedestrians while optimizing traffic flow through or around the work zone, and your plans need to contain a sufficient level of detail to enable the traffic control company to accurately and successfully implement them.

It would be impossible to account for every scenario in this guide, but these best practices will help you design safer, more effective work zones:¹⁸

- Before work starts, develop a detailed, comprehensive traffic control plan that all stakeholders understand. This plan should include specifications for temporary traffic control devices, roadway geometrics, work zone areas, and plans for maintaining traffic flow. The complexity of your plan should be appropriate to the complexity of the project.
- Follow basic roadway safety principles¹⁹ as closely as possible, using roadway geometrics and traffic control devices that are comparable to those used in normal roadway situations. Refer to the World Health Organization's "[Save Lives: A Road Safety Technical Package](#)" for a guide to basic safety principles.
- Inhibit normal traffic flow as little as possible.
- Use clear, positive guidance to direct drivers and pedestrians through or around the work zone.
- Maintain the work zone through the lifecycle of the project, and adjust traffic control plans as necessary, to account for changes or increased roadway hazards.
- Ensure that everyone designing, implementing or working in work zones receives appropriate training.
- Work with local agencies to ensure you have legislative authority to implement and enforce needed traffic and parking regulations.
- Communicate with the public about your work zones and maintain good public relations.



Step 2: Determine Your Application/Areas of Use

The MUTCD states “When the normal function of the roadway, or a private road open to public travel, is suspended, temporary traffic control planning provides for the continuity of the movement of motor vehicle, bicycle, and pedestrian traffic (including accessible passage); transit operations; and access (and accessibility) to property and utilities.”²⁰

It wouldn't be feasible to cover every possible scenario and application for work zone planning. However, it can be helpful to consider the type of environment you're designing a work zone for.

In general, you'll need to plan for work zone safety and develop a temporary traffic control plan in three scenarios:

- 1. Road Construction:** The most common scenario requiring work zone planning. This could include anything from widening a highway to increasing the number of lanes, to building or replacing a bridge or exit ramp, to resurfacing a road.
- 2. Utility Work:** Utility work, such as pothole patching, debris cleanup, street cleaning, sewer maintenance, traffic signal repair, etc. typically requires shorter term work zones (hourly or daily).
- 3. Incident Management, Emergency Evacuation, and Crowd Control:** This scenario could include everything from a natural disaster, to an accident blocking the road, to a hazardous chemical spill closing a highway, to a sporting event creating extra traffic flow in a confined area. Your primary goal is to help traffic move through or around the affected area as efficiently and safely as possible.

To start planning for these scenarios, you need to consider three key factors:

- 1. Work Duration**
- 2. Work Location**
- 3. Type of Road**



1) Work Duration

To plan for the right number and type of temporary traffic control devices your work zone requires, first consider the work duration of the project. There are five categories of work duration:²¹

- **Long-Term Stationary:** If your work zone will occupy a location for more than three days, you need to consider using more visible retroreflective and/or illuminated devices to ensure safety for nighttime traffic. You can use larger channelizing devices to reduce the likelihood that they'll be moved or tipped over while work crews aren't present. Replace inapplicable or confusing pavement markings with temporary pavement markings.
- **Intermediate-Term Stationary:** For work zones that occupy a location from overnight to three days, it might not be practical from a safety or economic standpoint to install temporary pavement markings or barriers. Install retroreflective and/or illuminated devices²² to account for nighttime traffic.
- **Short-Term Stationary:** Work that occupies an area for one to 12 hours is the most common type. In this situation, the work crew will be present to monitor the work zone and a flagger can control traffic flow.
- **Short Duration:** Short duration work takes up to one hour. Use simplified temporary traffic control devices to reduce the worker safety risks associated with installing and removing complex traffic controls, and to reduce the impact on traffic.
- **Mobile:** Mobile work activities move along the road intermittently or continuously. Common mobile operations with intermittent stops include litter cleanup, pothole patching or other utility operations. For these operations, use warning signs, flashing vehicle lights, flags, or channelizing devices. For operations where workers and equipment travel along the road without stopping, the advance warning area moves with the work area. Schedule these types of activities for off-peak traffic times and direct traffic to safely pass the work area.

2) Work Location

The location of the work zone plays a large factor in work zone planning and will help determine the number of temporary traffic control devices you need in your work zone. You'll need more traffic control devices the closer your work zone is to traffic.

These are the standard work locations:²¹

- **Outside of the shoulder edge:** If the work zone is 15 or more feet from the shoulder edge, you may not need to install temporary traffic control devices (depending on the type of road, road geometrics, and vehicle speed). If workers and equipment move closer to the actual road at times, use a general warning sign to alert drivers to their presence.
- **On or near the shoulder edge:** The shoulder edge is considered part of the drivers' "recovery area"²¹, so work zones on the shoulder should be treated as if the work were being done on the road itself, requiring advance warning signs. Use channelizing devices to close the shoulder, direct traffic and help bring visibility to the work space. Use portable barriers to protect workers from traffic.
- **On the median of a divided highway:** Work in the median might require temporary traffic control for traffic in both directions, depending on the situation. Use advance warning signs to alert drivers to the approaching work zone and channelization devices to direct traffic. Narrow medians may require portable barriers to protect workers and prevent crossover accidents.
- **On the normally traveled path:** This is the most dangerous type of work zone and requires maximum protection for workers and advance warning for drivers. For drivers, communicate the work taking place, alert them to hazards, and provide positive guidance to navigate through or around the work zone.

3) Type of Road

It's important to consider the road type and environment when you're planning for work zone safety and traffic mobility. Different types of roads have different temporary traffic control requirements. Refer to the MUTCD, section 6H, for more detailed information and application diagrams for each of these road types.

- **Rural Two-Lane Roads:** Rural two-lane roads have lower traffic demands and higher average speeds requiring longer advance warning areas.
- **Urban Arterial Roads and Other Urban Streets:** Urban work zones typically have higher traffic demands, lower average travel speeds, more frequent intersections and driveways, space limitations, on-street parking, mass transit and bus stops, special events creating variable traffic demands, and multiple projects happening simultaneously.
- **Rural or Urban Multilane Divided and Undivided Highways, Freeways:** High traffic volumes and high speeds, requiring the highest level of temporary traffic control.



Step 3: Understand Methods to Improve Work Zone Safety

Different applications have different safety requirements, depending on work duration and location, traffic flow and speed, application area, and additional hazards on the road.

Depending on your application, you might want to consider enhancing the safety of your work zone by trying one of these standard tactics:²¹

- **Adding additional devices**

- Additional signs
- Flashing arrow displays
- More channelizing devices at closer intervals
- Temporary raised pavement markers
- High-level warning devices
- Portable changeable message signs
- Portable traffic signals
- Portable barriers
- Impact attenuators
- Screens
- Rumble strips

- **Upgrading your temporary traffic control devices**

- Wet continuous retroreflective pavement markings optimized for human drivers and machine vision systems
- Larger, more conspicuous signs
- Durable, highly visible channelizing devices
- Barriers in place of channelizing devices

- **Improved roadway geometrics at detours and crossovers**

- **Increased distances for advance warning areas and tapers**

- **Increased lighting**

- Temporary roadway lighting
- Steady-burn lights used with channelizing devices
- Flashing lights for isolated hazards
- Illuminated signs
- Floodlights

Step 4: Specify Temporary Traffic Control Devices and Materials

A well-designed work zone safety plan can help save time and money by standardizing the temporary traffic control devices you use. The Wisconsin Department of Transportation's "[Manual on Uniform Traffic Control Devices](#)" states that:

Uniformity of devices simplifies the task of the road user because it aids in recognition and understanding, thereby reducing perception/reaction time. Uniformity assists road users, law enforcement officers, and traffic courts by giving everyone the same interpretation. Uniformity assists public highway officials through efficiency in manufacture, installation, maintenance, and administration.²³

To work towards uniformity, start by creating specifications for acceptable temporary traffic control devices and reflective sheeting. It's critical to develop specifications appropriate to your work environment and work zone requirements.

The MUTCD [specification guidelines](#) will help you think about specifying your devices and materials for each of these types of temporary traffic control devices.



Specifying Temporary Traffic Control Devices

Follow these general guidelines and best practices for specifying temporary traffic control devices:²⁴

- **Warning Signs:** Temporary traffic control warning signs should have black symbols/lettering on an orange background. Yellow warning signs are also acceptable. Fluorescent materials are typically noticed and comprehended at greater distances with more accurate color perception than non-fluorescent colored products.²⁵ Signs that motorists need to see at night must use retroreflective materials or be illuminated.
- **Regulatory Signs:** With the exception of STOP, YIELD, DO NOT ENTER, WRONG WAY, and the one-way arrow sign, regulatory signs are rectangular and have black symbols/lettering on a white background.
- **Portable Changeable Message Signs (PCMS):** PCMSs consist of a message sign panel, control system, power source and mounting system. The design of the message sign panel should be appropriate for the application and should be visible from at least a half mile away in both day and night conditions.
- **Arrow Displays:** Arrow displays should be rectangular and finished in non-reflective black.
- **Channelizing Devices:** Channelizing devices need to be highly visible and durable. As a best practice, they should be fluorescent orange to increase visibility and have a smooth, sealed retroreflective surface to ensure visibility in nighttime or rainy conditions. If motorists need to see the devices in the snow, fog, or around large curves, use flashing warning lights to increase conspicuity. Use channelizing devices that are designed to perform predictably if they're hit by a vehicle to prevent fragments from puncturing the vehicle or presenting a danger to workers.
- **Pavement Markings:** Types of temporary pavement markings can include pavement marking tape, paint or epoxy. They need to be highly visible in a range of conditions—including at night and in the rain. Temporary pavement markings should be white or yellow. 3M recommends pavement markings that offer high contrast and continuous wet retroreflectivity to ensure visibility in a range of conditions. Remove or cover the original pavement markings to prevent confusion.
- **Lighting Devices:** Install lighting devices to provide supplemental lighting as needed. Be careful to avoid creating extra glare or visibility problems.
 - **Floodlights:** Used to assist with nighttime work by illuminating flagger stations, equipment crossings, and other areas where workers need extra lighting to see what they're doing.
 - **Flashing Identification Beacons:** A yellow flashing light with a minimum 8 inches diameter. Beacons are used to draw extra attention to special conditions and should operate 24 hours a day.
 - **Steady-Burning Electric Lamps:** Lights used to show drivers the route through and around obstructions, including detours, lane closures, tapers, and other work zone areas where headlights might not be adequate to show the intended path.
 - **Warning Lights:** Used to supplement and draw attention to the retroreflectivity on other temporary traffic control devices.
- **Temporary Traffic Signals:** Should resemble regular traffic signals as closely as possible.
- **Impact Attenuators:** Must be constructed to absorb or redirect vehicle impacts.
- **Portable Barriers:** Can be concrete, steel, or ballast-filled barriers.
- **Rumble Strips:** Raised strips or depressed grooves placed transverse to the direction of traffic. The distance between each strip or groove should become shorter as a driver approaches the hazard.
- **Screens:** Screens should be mounted to reduce headlight glare and gawking, but shouldn't restrict visibility.
- **Opposing Traffic Lane Divider:** Upright orange panels that should be around 12 inches wide x 18 inches high.

For additional details on traffic control device specifications, refer to [section 6F of the MUTCD](#).

Specifying Reflective Sheeting

There are multiple types of reflective sheeting to use on temporary traffic control signs and devices:

- **ASTM Type I (Engineer Grade):** This is the most basic type of reflective sheeting for use on non-critical road signs (parking and way-finding). Usually meets ASTM D4956 Type I standards and lasts 5-7 years, but offers less reflectivity than other types of sheeting.
- **ASTM Type III/IV (High-Intensity Prismatic Sheeting):** High-Intensity reflective sheeting offers higher reflectivity and durability than Engineer Grade. [3M HIP Series 3930 meets and exceeds ASTM D4956 Type IV requirements.](#)
- **ASTM Type XI (DG³-Diamond Grade):** Reflective sheeting uses 100% optical active area full cube corner technology that reflects almost twice the amount of light back towards the driver as High-Intensity Prismatic sheeting. Designed to better reflect light from headlights, DG³ provides higher performance compared to 3M HIP across a range of vehicle types and sign placements.



[Compare HIP vs. DG³](#)

To appropriately specify reflective sheeting for your application and environment, you'll want to consider three primary factors:

- Visibility
- Retroreflectivity
- Durability



Step 5: Establish Enforcement Systems

After you've established your standards and best practices for temporary traffic control plans and your specifications for temporary traffic control devices and reflective materials, the next challenge is enforcing the standards and guidelines you've set.

Enforcing the standards you've set has the potential to greatly improve the safety and traffic mobility of your work zones, but can be challenging. There are several factors that tend to get in the way of compliance:

- Budget constraints
- Underestimating the complexity of the project
- Failure on the part of the traffic control company to accurately implement the plan
- Failing to adjust the plan as roadway conditions change
- Temporary traffic control devices breaking or degrading during the project

You need enforcement systems in place to ensure consistent compliance with the specifications you've established for temporary traffic control devices and materials, the accurate implementation of your temporary traffic control plan, and the following of the best practices and guidelines you've set.



Here are the essential pieces of an enforcement system for temporary traffic control layout, design, devices and materials:

- Enforcement training for all stakeholders. [Find training courses offered by the National Safety Council.](#)
- Comprehensive temporary traffic control plan and work zone safety plan. Most Departments of Transportation offer [resources for developing temporary traffic control plans and work zone safety plans.](#)
- Detailed specifications for temporary traffic control devices and materials.
- Inspection methods and procedures to identify improperly implemented work zones, improperly installed devices, or inadequately maintained devices. Inspections should be performed during work zone set-up and tear-down, after temporary traffic control devices are deployed, on a regular basis throughout the project (including at night and during adverse weather conditions), after work zone modifications, after incidents or crashes, or at any other time required by policies. Inspectors should look for:
 - Work zone layout, function and performance
 - Proper installation/removal of temporary traffic control devices
 - The condition, type and number of temporary traffic control devices
 - Positive guidance throughout the work zone
 - Accommodations for pedestrians and cyclists
 - Presence, position and activity of law enforcement

Find more information on work zone inspections in this [“Safe and Effective Work Zone Inspections”](#) guide.

- Training for work zone inspectors. The American Traffic Safety Services Association offers [Comprehensive Inspection Training.](#)
- Ongoing auditing of device and material specifications and temporary traffic control plans to evaluate and adopt new technologies and best practices. For further guidance on conducting a work zone safety audit, the ATSSA put together the [“Work Zone Road Safety Audit Guidelines and Prompt Lists.”](#)
- Standards for the selection of traffic control companies, including employee training and certifications, quality of devices, and implementation practices.

“We’re constantly out doing safety inspections. Consistency and transparency are key. Of course, we do inspections when we’re setting up the work zone, but we also do daily inspections throughout the day. Really every few hours. And if the work zone is in an area with night traffic, and you have devices that need to be effective at night, then it’s important to do nighttime inspections as well. Our supervisors spend a lot of time at job sites, making sure everything is set up properly and we have the right devices. They do their safety audits on iPads that create pdfs of their reports. The reports are immediately sent back to key stakeholders, so we’re making sure we’re delivering transparency to both the safety of our work zones and our ongoing inspection processes.”

Curtis Eckhoff,
Safety Director,
RoadSafe Traffic Systems

► Challenge: Maximizing visibility and improving traffic mobility to reduce accidents

Work zones are full of hazards, distractions, and obstacles for drivers, pedestrians and bicyclists. Motorists find themselves suddenly confronted by new information, unfamiliar conditions and unexpected changes, and must see, comprehend and react to these inputs in mere seconds.

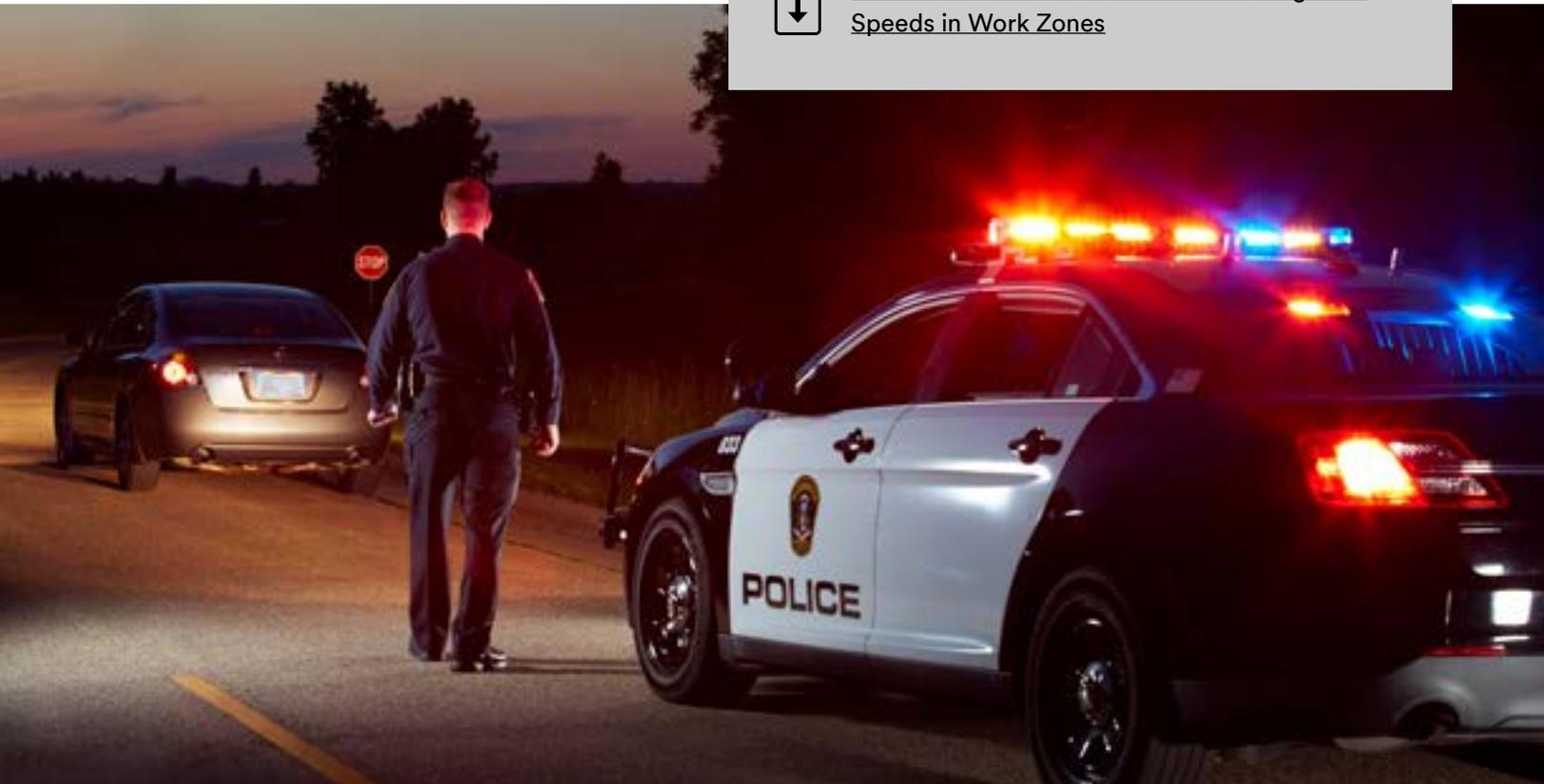
Work zones present challenges to drivers' reaction time, as changes are more sudden and pronounced than in typical driving situations. It's been found that drivers often underestimate the amount of time and distance it will require for them to react to a situation or stop their vehicle.¹¹ Speeding makes this challenge even more pronounced, as speed differentials in work zones can be severe. An Oregon DOT study found that speeding in work zones is a significant concern for highway users.²⁷

In 2014, speeding was a factor in 28% of all injury and fatal work zone accidents.²⁷ Studies have shown that speed limit signs alone have little impact on average vehicle speed.²⁸ There are several things you can do to manage vehicle speed in your work zones, including installing highly visible and conspicuous temporary speed limit signs, requesting a higher level of police enforcement in your work zone, and reducing lane width. Research has shown that narrowed driving lanes give drivers the impression that reduced speed is necessary, making it more likely that they'll follow posted speed limits.²⁹

To help drivers and pedestrians react appropriately to speed and lane changes, congestion, detours, narrow lanes, workers and equipment on the road, and unfamiliar signage and pavement markings, you must provide positive guidance in the form of conspicuous, easy-to-understand temporary traffic control signs and devices.



[FHWA Recommendations for Promoting Safe Speeds in Work Zones](#)



Solution: Specify bright, conspicuous and durable traffic control signs and devices for all weather and daylight conditions.

Visibility

The quality and color of the reflective sheeting used for temporary traffic control signs and devices can improve visibility and driver response times. Bright, conspicuous and highly visible signs and devices can more effectively alert drivers and pedestrians to upcoming work zones and communicate speed changes, lane changes, detours, etc.

Reflective sheeting in the marketplace can be categorized into three groups—Engineer Grade, High Intensity Prismatic, and Diamond Grade. It's important to know that they offer varying levels of brightness and visibility and to understand your work zone's requirements. The advanced full-cube technology in DG³ reflective sheeting can offer nearly twice the efficiency of conventional prismatic sheeting, attracting the attention of drivers sooner to improve response times.

Highly conspicuous fluorescent colors are easier to see at day, dawn and dusk. It's been found that fluorescent orange materials are recognized at greater distances, with more accurate perception of color, than non-fluorescent orange colored products,²⁵ and in one study conducted by the Texas Department of Transportation (TxDOT), drivers commented that orange fluorescent signs appeared brighter than typical road signs.³⁰ Additionally, fluorescent signs are less susceptible to background clutter,³¹ helping to ensure that drivers will notice and comprehend the signs in distracting work zone environments.

Retroreflectivity

Retroreflective materials are designed to return light from a vehicle's headlights back to the driver, making temporary traffic control signs and pavement markings visible at night. This is critical for helping drivers see and react to positive guidance and keeping workers safe during nighttime conditions.

Wet Retroreflectivity

Wet and rainy conditions create additional challenges for sign and pavement marking visibility. When pavement markings and some signs get wet, water interferes with the reflective optics and retroreflectivity breaks down. As a result, the wet sign or pavement marking returns only a small amount of the light from the vehicle's headlights to the driver. This challenge makes many retroreflective materials ineffective in wet conditions. Wet retroreflective materials contain optics with a higher refractive index than traditional retroreflective materials to counteract the effects of water. Using wet retroreflective materials will increase the visibility of your temporary traffic control signs and devices in rainy conditions.

Durability

Temporary traffic control signs and devices can take a beating in work zones. They'll be hit by motorists, be exposed to the grime, dirt and dust of construction environments, and endure rough handling. More durable temporary traffic control signs and devices can help reduce the amount of repair and maintenance work required. This can, in turn, reduce the amount of time that work crews are exposed to the hazards of work zones.

Traffic safety experts recommend that temporary traffic control signs, pavement markings and devices are impact and scratch resistant, engineered to hold up in heat or cold, flex upon impact, use as few components as possible to reduce potential failure points³², have been tested and proven over time, and maintain a high level of brightness throughout their useful life.

► Challenge: Ensuring compliance with regulations

When you design your work zone, you need to consider safety, traffic mobility and the feasibility of implementing your design, taking deadlines, budgets and productivity into consideration. To strike the balance between these three considerations, it's important to understand the regulations and standards for the layout and design of work zones. Regulations and standards can help reduce accidents and traffic congestion by ensuring that the appropriate number and type of temporary traffic control signs and devices are used to provide drivers with positive guidance through or around the work zone and providing enough transition and buffer space to keep workers out of harm's way. Additionally, regulations can help reduce costs by standardizing the work zone design and implementation process.

Solution: Be familiar with current regulations and specify traffic control devices that meet regulated standards in visibility and durability.

In the United States, a few different organizations guide traffic control regulations. On a federal level, the Federal Highway Administration (FHWA) produces the [“Manual on Uniform Traffic Control Devices for Streets and Highways \(MUTCD\).”](#) This manual sets minimum standards and offers guidance to help ensure the uniformity of traffic control devices across the country. In the U.S., failure to comply with the MUTCD can result in the loss of federal funds and increased tort liability. According to the MUTCD, “The responsibility for the design, placement, operation, maintenance, and uniformity of traffic control devices shall rest with the public agency or the official having jurisdiction, or, in the case of private roads open to public travel, with the private owner or private official having jurisdiction.”³³ The Occupational Safety and Health Administration (OSHA) enforces the MUTCD.

On a state level, the American Association of State Highway and Transportation Officials (AASHTO) produces [“A Policy on Geometric Design of Highways and Streets”](#) and the [“Roadside Design Guide.”](#) All of these resources may be helpful for implementing and applying standards and regulations of your own.



Work zones are typically divided into four areas³⁴:

- **Advance Warning Area:** Informs drivers, pedestrians and cyclists of an approaching work zone. The Advance Warning Area could consist of signs (e.g. LANE CLOSED, ROAD WORK AHEAD) or flashing lights on a vehicle before the Transition Area. Rumble strips can also be used to alert drivers to an approaching work zone. The amount of advance warning and the spacing between indicators depends on the rate and speed of traffic on the roadway, but must provide enough warning for drivers to perceive and react to approaching conditions.
- **Transition Area:** The area where motorists, pedestrians, cyclists, etc. are redirected from their normal travel path. The Transition Area often incorporates tapers to gradually redirect traffic, using channelizing devices, arrow displays or temporary pavement markings to provide motorists with positive guidance.
- **Activity Area:** The area where the work is happening, comprised of work space, traffic space and buffer space between workers and traffic. The activity area should include appropriate signage to alert drivers that they are in a work zone, temporary pavement markings if there are lane closures, barriers to protect workers, and lane dividers, lighting devices and screens if necessary.
- **Termination Area:** Returns traffic back to its normal path and indicates the end of the work zone. END ROAD WORK signs indicate the end of the work zone. Channelizing devices, arrow displays and temporary pavement markings can be used to provide drivers with positive guidance.

The OSHA “[Reference Guide to Work Zone Traffic Control](#)” provides specific guidance for temporary traffic control signs and devices for a variety of different road work scenarios.

Typical temporary traffic control devices include³⁵:

- **Signs:** Temporary traffic control signs deliver messages to drivers, pedestrians and cyclists through words or messages. The three types of signs are regulatory (traffic laws or regulations), warning (notify drivers of general or specific road conditions), and guide (directional, length of work, route markings, etc.).
- **Portable Changeable Message Signs (PCMS):** Electronic signs that can display a variety of messages to fit the requirements of the work zone conditions. The messages can be changed through a control system.
- **Arrow Displays:** Provides warning and directional information, in the form of flashing or sequential arrows, to help with merging and traffic control.
- **Channelizing Devices:** Cones, tubular markers, vertical panels, drums, barricades, temporary raised islands, and barriers designed to alert and guide drivers and pedestrians in work zones and help protect workers.
- **Pavement Markings:** Road markings to delineate vehicle lanes and pedestrian paths.
- **Lighting Devices:** Floodlights, hazard identification beacons, steady-burning electric lamps, and warning lights to supplement retroreflective signs, barriers and channelizing devices.
- **Impact Attenuators:** Designed to reduce the impact of accidents by either smoothly decelerating or redirecting errant vehicles.
- **Portable Barriers:** Prevent vehicles from entering work areas or separate two-way traffic.
- **Temporary Traffic Signals:** Used to provide temporary guidance through and around work zones.
- **Rumble Strips:** Rough-textured strips used to warn drivers of unusual or unexpected road conditions.
- **Screens:** Used to conceal distracting work zone activity and contain dust and debris.
- **Opposing Traffic Lane Divider:** Upright orange panel used to divide opposing traffic on a two-lane road.

For more information on appropriate uses and specifications for each type of temporary traffic control device, refer to the [“MUTCD Section 6F. Types of Devices.”](#)

► Challenge: Accurately implementing a work zone plan

Designing a safe and efficient work zone is only one phase of your project. The next challenge is ensuring that it's implemented in the way you intended. It's essential to select a reputable company to implement your plan and manage temporary traffic control throughout the project. The traffic control company you partner with should have a rigorous training plan for their employees, use the most visible, durable, high-quality temporary traffic control signs, pavement markings and devices, and be diligent about accurately implementing your work zone safety plans.

Traffic control companies can experience significant pain points, particularly on roadways that are already heavily congested or in urban areas. Work zones in these types of areas present high traffic flow that can quickly become congested due to bottlenecks caused by lane closures and reduced travel speeds. Additionally, these areas frequently have space limitations, a greater number of intersections and driveway access points, on-street parking, mass transit and bus stops to account for, increased pedestrian and cyclist traffic, special events that can significantly alter traffic flow to the area, and multiple construction projects happening simultaneously.³⁶ According to Curtis Eckhoff, Safety Director for RoadSafe Traffic Systems, driveways, intersections and business entrances pose the largest challenges. These situations can all present unpredictable traffic flow and vehicles moving in multiple directions. Traffic engineers should provide detailed safety plans to account for these scenarios, outlining the use of temporary traffic control devices to maximize safety and mobility.

Additionally, work zone conditions can change quickly, with little warning. When this happens, the traffic engineer and the traffic control company must collaborate to adapt the work zone to new conditions and manage the change process. Eckhoff says that successful change management boils down to two things—preparation and communication. Traffic engineers should carefully map out the work zone and attempt to foresee challenges that may arise throughout the project. Planning ahead for challenges and changes can help mitigate the impact when issues arise. Eckhoff also thinks that it's essential for traffic control companies to be prepared with the right equipment, even going so far as to bring extra temporary traffic control devices and signage to the jobsite. This way, workers can be confident they have everything they need to get the job done, even if conditions change once they get to the jobsite. Additionally, this helps ensure that no one will cut corners when it comes to safety. Once the work zone is set up, it's also critical that project stakeholders and the traffic control company maintain consistent, open communication throughout the project. According to Eckhoff, daily meetings can help the project team assess and react to the need for changes and improves the transparency of the project.

Solution: Select a reputable traffic control company with a proven safety record.

The Role of a Traffic Control Company

The traffic control company is an important partner when you're designing and implementing a work zone. The traffic control company provides trained, certified traffic safety personnel—including flaggers, pavement technicians, traffic control supervisors, and traffic control technicians—as well as the temporary traffic control signs, pavement markings and devices that communicate key information to drivers and pedestrians in your work zone.

For a roadway project to succeed, traffic engineers must balance multiple priorities:

- Ensuring safe, efficient travel for motorists
- Addressing the safety and travel needs of pedestrians
- Providing a safe environment for workers
- Maintaining public trust to help promote future projects
- Avoiding lawsuits

Remember that the MUTCD states that “The responsibility for the design, placement, operation, maintenance, and uniformity of traffic control devices shall rest with the public agency or the official having jurisdiction, or, in the case of private roads open to public travel, with the private owner or private official having jurisdiction.”³⁷ Meeting these goals starts with a work zone safety plan and ends with work zone safety implementation. The traffic control company is your partner in properly implementing a safe, effective work zone.

When you're selecting the traffic control company you're going to partner with, it will be helpful to understand their employee training policies and the types of signs, pavement markings and devices they use.

“The Traffic Control Company provides safe work zone setup and traffic control to help ensure safety for employees as they work in and around traffic, and safety for the public as they travel through or around the work zone.”

Curtis Eckhoff,
Safety Director,
RoadSafe Traffic Systems



With that in mind, here are things to look for when selecting your Traffic Control Company:

Commitment to Safety

The traffic control company you work with should put safety first in everything it does. The company website is a good place to start assessing a traffic control company's commitment to safety. Ideally, they should have a section of their website covering safety and the efforts they make to promote safety for workers, motorists and pedestrians.

After you've found a few traffic control companies that appear to have safety procedures and policies in place, here are some questions you can ask to dig deeper into their commitment to safety:

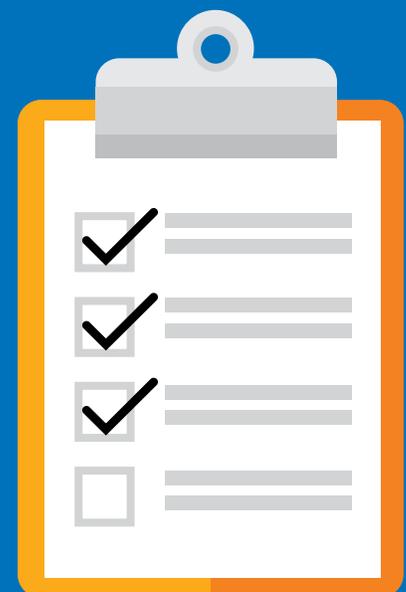
- ✓ Does the company schedule an appropriate number of flaggers, technicians and other workers to get the job done safely?
- ✓ Are the company's workers cautious when they drive to and from a work zone?
- ✓ What is the company's procedure for setting up and tearing down a job site?
- ✓ What are the company's policies and procedures for reporting job site injuries and safety violations?
- ✓ What is the condition and appearance of their vehicles, equipment and traffic control devices?
- ✓ Does the company have a history of work zone accidents?

Case Study: Virginia Department of Transportation (VDOT)—Improving Night Work Zone Traffic Control

Working at night provides both significant advantages and drawbacks. As a positive, night work can reduce traffic congestion on busy roads, reduce worker exposure to traffic, and result in faster project completion. On the other hand, night work presents more hazardous conditions, including reduced visibility and less attentive drivers.

VDOT addressed these concerns by ensuring that their partner traffic control companies used well-maintained, properly-installed signs and channelizing devices and detailed lighting plans. Additionally, they required workers to wear retroreflective safety vests and hard hats to increase worker visibility.

 [Read the Final Report](#) to learn more about VDOT's safety efforts.





“Training is key...for flaggers, for traffic technicians, for supervisors. Every state has different regulations, so your workers really need to have safety training that’s specific to the state they’re working in. This is important for worker safety, for the safety of motorists and pedestrians... and it’s really important for public perception. If you’re using high-quality temporary traffic control devices and your crews are well trained, the public can tell that and you’ll really command their respect.”

Curtis Eckhoff, Safety Director,
RoadSafe Traffic Systems

Employee Training

Make sure you ask about the traffic control company’s training practices. Appropriate training for flaggers, traffic control technicians and traffic control supervisors ensures that they understand work zone safety to reduce the risks of accidents or injuries. Ideally, traffic control company employees will be certified by a governing body in your country or region, and the company will conduct ongoing training to increase their employees’ understanding of safety best practices.

Here are six key subjects traffic control company employees should be trained in:

- Work zone best practices
- Safety best practices
- Accurately implementing temporary traffic control plans
- Safe use of temporary traffic control devices and work zone equipment
- Safely entering, operating, and exiting work zone vehicles
- Work zone safety apparel (high visibility reflective vests, hard hats, goggles, gloves, footwear)

In the U.S., the American Traffic Safety Services Association (ATSSA) is the guiding agency for work zone safety training. The [ATSSA website](#) provides additional guidance on safety training and training plans.

Quality of Temporary Traffic Control Devices

For quality assurance, your traffic control company needs to use temporary traffic control devices that are high-quality, in good condition and, most importantly, meet your country's specifications.

It can be helpful to ask any potential traffic control partner these questions:

- Does the reflective sheeting on your traffic control devices meet specifications?
- What are the specifications of your temporary traffic control devices?
- How often do you inspect your temporary traffic control devices?
- What is your process for repairing and/or replacing temporary traffic control devices?

For more guidance, check out the [ATSSA Quality Guidelines for Temporary Traffic Control Devices and Features](#).

Accurately Implementing Work Zone Safety Plans

Ultimately, your work zone safety plan will only be successful if the reality on the road represents the plan you've designed. It's essential that your traffic control company accurately implements your plan.

To ensure you partner with a traffic control company that is capable of accurately implementing your plans, make sure that the company's supervisors and technicians have the appropriate training and experience to implement work zone safety plans. Meet with the project team to discuss your plans at various stages of the bidding and implementation process to ensure that they clearly understand your work zone safety plan and clear up any questions. Finally, be sure to visit the job site during work zone implementation, and at various stages of the project lifecycle, to check that the work zone is up to your standards.

Meeting Project Deadlines

Delays in temporary traffic control implementation could potentially delay the entire project, creating significant budget, scheduling and public perception challenges for you. This may also lead to frustration and loss of trust for the motorists and pedestrians using the roads. It's critical to the success of your project that your traffic control company meets the deadlines you and they have agreed to.

To ensure that your traffic control company meets project deadlines, create open lines of communication to discuss important milestones and deadlines, potential obstacles or setbacks, and signs of delays so that you can adjust your plans. It can also be helpful to obtain references from the traffic control company, so you can talk with other traffic engineers who have worked with the company and can speak to their ability to meet project deadlines.



Eliminating Waste

To reduce the time and money it takes to implement your work zone safety plan, it's important to work with a traffic control company that follows lean principles. To be lean, a traffic control company should follow these best practices:

- **Standardized Processes:** Ensure consistent quality while reducing duplicate work by standardizing processes. Standardized processes ensure the completion of defined tasks in a set amount of time, simplifying scheduling and ensuring that deadlines are met.
- **Standardized Equipment and Temporary Traffic Control Devices:** There should be a standardized process for procuring equipment and temporary traffic control devices. Clearly specify equipment and temporary traffic control devices to ensure consistent quality and pricing.
- **Eliminate Waste:** The traffic control company should avoid having excess inventory of vehicles, equipment or temporary traffic control devices. Use vehicles and equipment only for specified tasks to prevent both wear and energy waste.

Case Study:

Work Zone Safety and Mobility Issues: A Case Study on Dan Ryan Reconstruction Project

The Dan Ryan Expressway (190/94) around downtown Chicago is the busiest expressway in the region. When the Illinois Department of Transportation (IDOT) initiated a \$1 billion reconstruction project on the aging roadway, they knew that mobility and safety were critical to the success of the project.



[Read the full case study](#) to find out how IDOT used work zone best practices, new technologies, safety inspection policies and worker safety training to ensure a successful reconstruction project.



► Challenge: Managing public perception and satisfaction

Public perception is a critical factor in the success of any road work project. The public needs to know that work zones are safe, that efforts are being made to maintain traffic mobility and that work is being completed efficiently and on schedule.

To manage the public perception of your work zone, communication is key. It's important to educate and inform people affected by work zones—including motorists, community members and local business—so that they understand the need for the project, changes that will affect them, and project timelines.

The Public Perception of Work Zone Safety

The perceived safety of a work zone can be influenced by several factors. Work zones can often be confusing, disorienting and frustrating for drivers and pedestrians. Sudden changes to routes, lanes and speeds, along with unfamiliar signage and an increased number of distractions and hazards, can make it difficult to see and comprehend the signs, devices and markings intended to guide motorists and pedestrians through the work zone. A study conducted by the Oregon DOT found that highway users were concerned about the lack of nighttime visibility in work zones, and were having trouble seeing signs, lane markings, barrier and construction personnel at night.²⁶ The same study also found that drivers were concerned about the visibility of pavement markings and narrow lanes. All of these factors can impact how the public perceives the safety of your work zone.

The Public Perception of Road Work Efficiency

As we explored earlier in this ebook, travel congestion and delays caused by work zones can create significant losses for the general public in terms of both time and money. If the public perceives that road work isn't being completed in an efficient or timely manner, this can lead to frustration with the project and with road work in general. When this happens, the public may stop supporting roadway infrastructure projects, and gain a negative view of politicians who allocate budget to road work.

This is why it's so critical to maintain efficient traffic flow through and around work zones, and to clearly and transparently communicate with the public about the reasons, expectations, changes and timelines for any road work project.

Solution: Communicate clearly and frequently with the community.



It's important to develop a communication plan for the duration of the road construction project. The Maryland Department of Transportation developed a [Communication Plan Template for State Highway Administration projects](#) that you can use as an example.

Here are steps you can take to develop an effective communication plan:

Step 1: Determine who you need to communicate with

- Local businesses
- Motorists, pedestrians and cyclists in the community
- Affected property owners
- Freight/shipping industry impacted by work
- Local schools and colleges
- Local elected officials
- Law enforcement and emergency agencies

Step 2: Determine what you will communicate

- Road/lane closures
- Detours
- Project description and purpose of project
- Construction timeline
- Work zone safety education
- Emergency communications

Step 3: Determine when will you communicate

- Pre-construction communication
- Ongoing communication throughout lifecycle of project
- Communication once project is complete

Step 4: Determine how you will communicate

- Communication channels covered below

Step 5: Measure communication success

- Public surveys or interviews to assess success of communication efforts



Here are some methods you can use to communicate with the public:³⁸

- **Brochures and Mailers:** Create a brochure or mailer that communicates project information, including a project description, project impact, alternate routes, schedules and timelines. You can mail these to community members or have them available at large local employers, rest stops, information centers, etc., around the work zone.
- **Press Releases and Media Alerts:** Communicate with the media and provide them with project information to share with the public.
- **Paid Advertisements:** Buy print, web, radio or television ads to alert the public about the project and provide updates or work zone changes.
- **Public Information Center:** Create a facility located in or near the work zone that provides project information (project models, maps, brochures, etc.)
- **Telephone Hotline:** Provide a call-in telephone hotline that provides traffic and travel information and updates.
- **Project Website:** Build a website that provides project information and updates, lane closures, traffic updates, etc.
- **Public Meetings:** Hold a public meeting to present project information and gather comments, questions or concerns from the community.
- **Community Task Forces:** Involve community stakeholders by creating community task forces to share project information and collect feedback. The community task force could consist of local businesses, neighborhood groups, public officials, involved individuals, or other representatives.
- **Coordinating with Community Groups:** Work with the media, local schools, businesses and emergency services that will be affected by the work zone.
- **Education and Safety Campaigns:** Work to reduce accidents, injuries and fatalities in work zones by using brochures, websites, media campaigns, events and video to educate the public about work zone safety.
- **Highway Signs:** Use highway signs around work zones to increase driver awareness about work zone safety.
- **Rideshare Promotions:** Increase marketing of an existing rideshare program or create a new one.
- **Video and Presentations:** Create videos or online presentations to disseminate project information.



In addition to communication, here are key steps you can take to improve the public perception of the safety of your work zones:

- Initiate work zone safety education programs for drivers and pedestrians
- Follow work zone safety best practices
- Use high-quality temporary traffic control devices that are in good condition
- Take steps to ensure that drivers abide by posted speed limits
- Work with a reputable traffic control company that wears appropriate attire and demonstrates professionalism on the jobsite
- Inspect and adjust your work zone as road conditions change to ensure your work zone remains effective throughout the project

| Preparing for Work Zones of the Future

The vehicles we drive and the roads we drive on are constantly evolving. Vehicle manufacturers, OEMs, Tier 1 and 2 manufacturers, and other automotive and traffic stakeholders are creating new technologies every day to make roads safer and more efficient.

These technological advancements also apply to work zone safety planning. By understanding and taking advantage of the latest trends and advancements in work zone safety, you can design safer work zones while optimizing traffic flow through and around your work zones.

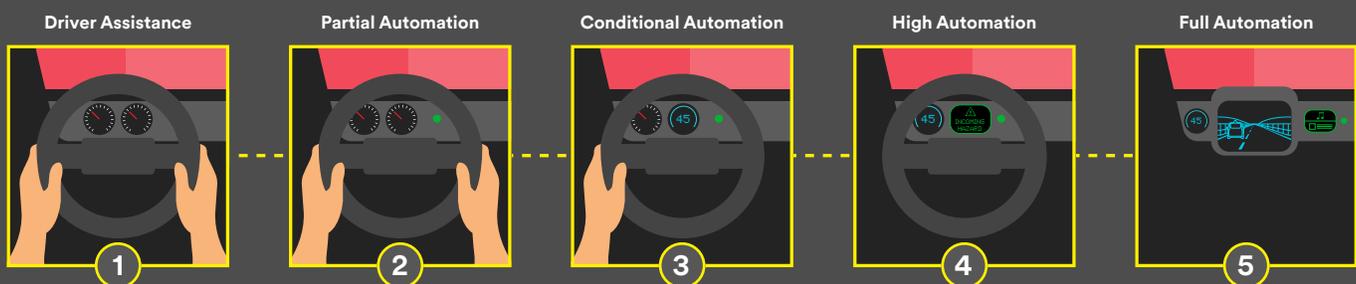
► Automated & Autonomous Vehicles

Most vehicles being sold today have some level of advanced driver assistance systems (ADAS)—ranging from side and rear view cameras to Lane Departure Warning Systems (LDW), Lane Keep Assist Systems (LKS), emergency braking and adaptive cruise control—and several manufacturers are working towards fully connected and autonomous vehicles (CAVs) that don't require any human intervention to operate. As these technologies advance, we'll start seeing autonomous shuttles and robo-taxis providing urban transportation and autonomous semi-trailers platooning down the highways transporting freight.

But the transition from human drivers to ADAS-equipped vehicles to fully autonomous vehicles won't happen overnight. Additionally, the average age of vehicles on the road is 11.6 years³⁹. People are keeping and driving their vehicles longer than ever. Given the size of the investment, economics indicate that the average consumer will not purchase an automated or autonomous vehicle as soon as one becomes available. Further, recent studies indicate that the majority of consumers will need greater confidence in vehicle technology before investing. One recent study found that almost half of consumers surveyed "would never buy a Level 5 (or fully autonomous) vehicle,"⁴⁰ while another study by the American Automobile Association (AAA) found that 73% of American drivers say "they would be too afraid to ride in a fully self-driving vehicle."⁴¹ These factors underscore the likelihood that the transition from human-driven, to automated, to autonomous driving will be gradual. We need to be prepared for people and machines to share the roads, far into the future.

As you plan for work zone safety, you need to consider how these ADAS-equipped and fully autonomous vehicles will interpret, comprehend, and react to the often unpredictable and changing conditions of work zones. Additionally, you'll need to adapt your work zone designs and best practices as human drivers and automated/autonomous vehicles more and more frequently share the roads.

SAE Automation Levels



Vehicles equipped with ADAS and CAVs replace human vision and decision making with advanced machine vision systems. These machine vision systems consist of cameras and sensors that feed digital information to the vehicle's computer, which analyzes that information using complex algorithms. Armed with this information, the vehicle gains situational awareness, interprets its surroundings and makes split-second decisions. For these systems to collect the right information about their surroundings and make appropriate decisions, they rely on consistent, reliable roadway infrastructure. Using temporary traffic control signs, pavement markings and devices that are optimized for machine vision systems can help improve the safety and effectiveness of your work zones.

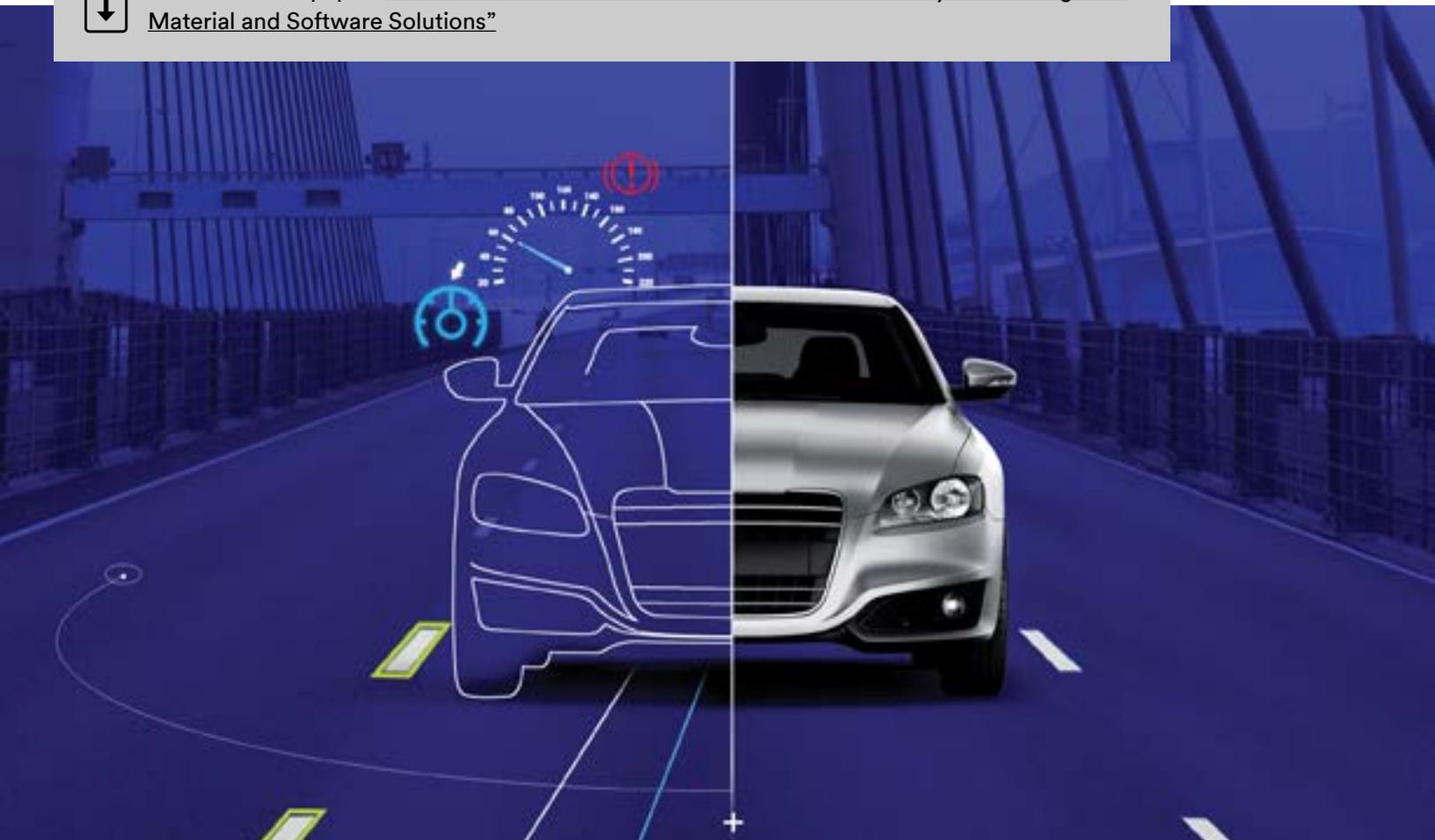
► SMART and Connected Roads

Traffic engineers should implement temporary traffic control signs, pavement markings and devices that are optimized for machine vision to design safe and efficient work zones for CAVs and vehicles equipped with ADAS.

Pavement markings need to be high-visibility, high-contrast, durable and retroreflective to provide clear, consistent visibility and readability for both human drivers and machine vision systems—including in night and rain conditions. To detect pavement markings and ensure lane keeping, machine vision sensor systems look for consistent lane marking edges. Pavement markings that provide high contrast between the road surface and the marking help these systems interpret the marking. Durability is a critical factor because machine vision systems can be confused by other longitudinal markings on the road surface such as cracks, fills and road imperfections. Inconsistent lane markings make lane keeping more difficult by reducing the safety margin against these stray surface features.



Read the Whitepaper: [“Invisible 2D Bar Code to Enable Machine Readability of Road Signs—Material and Software Solutions”](#)



As technology advances, it's also likely that vehicles will increasingly be connected to each other, the road, and transportation infrastructure through the cloud. As this future becomes a closer reality, we'll need to consider how we can use technology such as vehicle or smartphone alerts to send critical warnings, updates and information to motorists as they approach and travel through work zones.

In 2017, 3M cooperated with the Michigan DOT (MDOT) to deploy a 100-day test of 3M™ Connected Roads prototype solutions in a 3.3-mile construction work zone. 3M's infrastructure solutions included 10 signs with embedded 2D barcodes (invisible to the human eye, but detectable by infrared cameras), as well as 5 regular 2D barcodes (visible for both human and machine vision). MDOT also installed 3M™ Stamark™ All Weather Tape to help enhance lane detection by humans and automated vehicles in the zone. In the test area, moving vehicles' infrared camera systems were able to capture and process the embedded 2D barcode signs from distances of up to 100 meters at highway speeds.

[Read the full case study: “‘Motor City’ Detroit Merging Automotive & Infrastructure Innovation with 3M™ Connected Roads I-75 Test Corridor”](#)



► The 3M Advantage for Work Zone Safety

For over 80 years, 3M has been developing infrastructure to improve the safety and mobility of our roads. And we take our commitment to safety seriously. Our ongoing innovation and quality improvements have led to a full portfolio of temporary traffic control devices, signing materials and pavement markings to help you design safe and efficient work zones.

- **3M™ Diamond Grade™ DG³ Sheeting:** This sheeting features full-cube technology for nearly twice the brightness of conventional prismatic sheeting to attract drivers' attention. It's available in bright, highly-conspicuous fluorescent colors to even further increase recognition distance. Within 3M's Diamond Grade sheeting portfolio, we offer 3M™ Diamond Grade™ DG³ Reflective Sign Sheeting for excellent visibility on rigid signs and a range of flexible Diamond Grade sheeting products for barricades, impact-resistant drums, posts, tubes and channelizers, and lightweight, portable signs.
- **Wet Reflective Temporary Pavement Markings:** Stamark™ Wet Reflective Pavement Markings deliver highly-visible lane delineation, even in poor weather and rainy conditions. Simple to apply and remove, these durable pavement markings last through a normal construction season.
- **Fluorescent Technology:** Highly-conspicuous fluorescent materials are easier to see at day, dawn and dusk. It's been found that fluorescent materials are recognized at greater distances, with more accurate perception of color, than non-fluorescent colored products.

See 3M Work Zone Safety products in action. Register for a visit with the 3M Roadshow Truck.

- See product demonstrations
- Get free samples
- Talk with our experts

These products are high-quality, durable and reliable. We design our sheeting and pavement markings to offer performance over the lifecycle of the product, meaning they'll retain luminance and reflectivity over time.



In addition to our highly-visible, durable work zone safety solutions, 3M offers local experts and a global supply chain to help you choose and implement the ideal temporary traffic control devices and materials for your job.

3M Local Subject Matter Experts

Our local teams of application engineers are ready to help you choose and implement the right temporary traffic control devices, signs, pavement markings and materials for your applications. We'll work with you at every stage of the project lifecycle, whether you're just starting to plan your work zone, or if you have implementation questions as your work zone is being set up on the road.

3M Global Supply Chain

Thanks to our global supply chain, we're equipped to help you get the right temporary traffic control devices and materials for your application, no matter what country or region your work zone is in.



Have questions? Ask an expert. ►



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Transportation Safety Division
3M Center, Building 225-4N-14
St. Paul, MN 55144-1000
1.800.553.1380

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