

Work zone safety:

MAKING THE WORK ZONE LESS OF A WAR ZONE



Clear zone provides positive protection via portable concrete barriers on U.S. 101 in Novato, CA.

Photo: Tom Kuennen

Even though highway work zone fatalities have been on a big decline for the past 10 years, the highway work zone remains a dangerous place, for workers and for motorists.

Despite what highway users may think, work zones are much more lethal to motorists than to construction workers. Following a peak of 165 workers killed in work zone accidents in 2005, construction worker deaths declined to 106 in 2010. But in 2010 nearly five times as many motorists were killed in work zone accidents than were workers (586 total deaths, including workers and motorists).



Road Science sponsored by Volvo.

While work zone flaggers face drivers in the front lines, behind them in the work zone, construction workers are at greater risk of injury or death from workplace accidents, rather than from errant motorists.

Even so, each year more than 20,000 workers are injured in road construction work zones, according to data provided by the Federal Highway Administration's Work Zone Safety and Mobility Program. Between 2003-2008, these injuries were caused by:

- Contact with objects or equipment (35 percent)
- Slips, trips, or falls (20 percent)
- Overexertion (15 percent)
- Transportation incidents (12 percent), and
- Exposure to harmful substances or environments (5 percent).

Fatalities at road construction sites typically account for 1.5 to 3 percent of all workplace fatalities

annually, FHWA reports.

It's estimated that road users encounter an active work zone on average one out of every 100 miles driven on the national highway system, according to a 2014 Transportation Research Board paper*, "Approximately one injury work zone crash occurred at every 14 minutes in 2010," the report says.

Do work zones actually contribute to an increase in accidents? Intuitively the answer is yes, but a literature search did not affirm proof. To answer this, the TRB researchers developed an integrated data set based on 60 long-term work zones, and analyzed the characteristics of work zone crashes. Their preliminary analysis results show that the

* *Estimating the Impact of Work Zones on Highway Safety*, by Ozgur Ozturk, graduate assistant, Rutgers Intelligent Transportation Systems (RITS) Laboratory, and Kaan Ozbay, Ph.D., and Hong Yang, Ph.D., NYU Polytechnic School of Engineering.

Products like ROSA (Remote Operated Safety Attendant) are known as automated flagger assistance devices and keep flaggers out of harm's way.



Photo: Roundspring Technologies, Inc.

The New York State DOT requires portable high mast lighting for all night work; although it's a costly solution, it creates exceptional visibility in work zones.

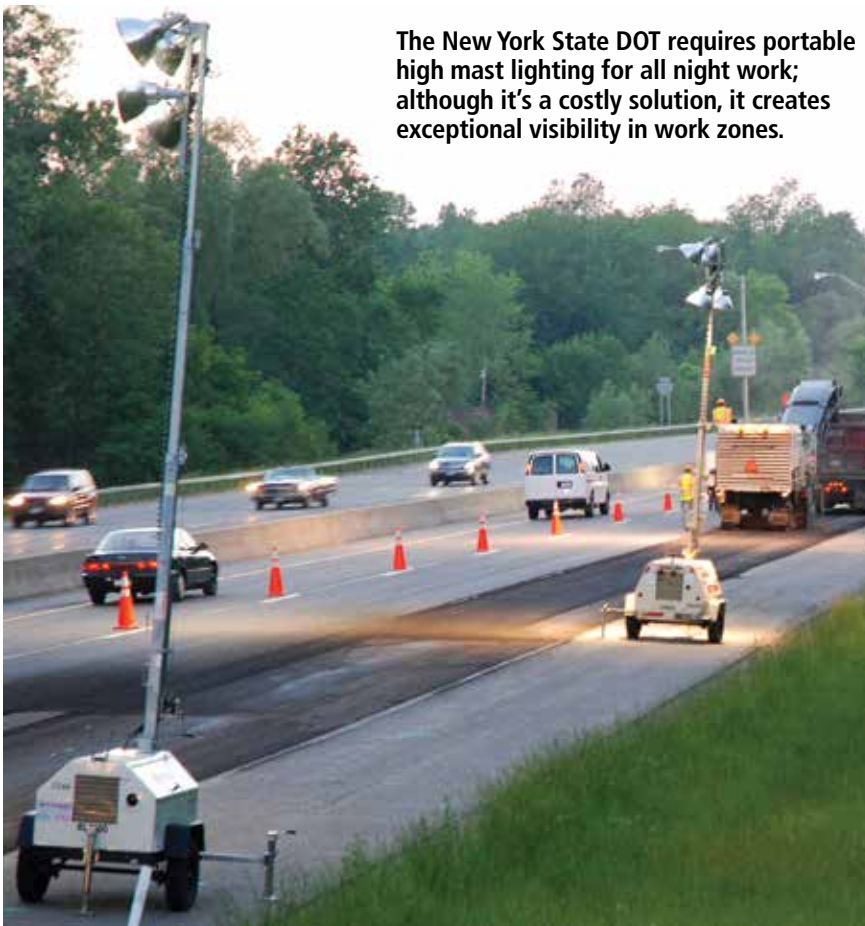


Photo: Tom Kuennen

crash rate increased by 24.4 percent under work zone conditions compared to non-work zones.

Danger in every direction

Danger lurks in every direction within the work zone, and to survive, contractors and road agencies must identify the variables.

Highway workers are at risk of injury from passing traffic, from construction equipment operating inside the work zone, and in supporting ancillary areas that support construction, like portable plants. Construction vehicles operating inside the work zones, as well as entering and leaving, also pose dangers.

These hazards are known to workers. According to a just-released, February 2015 Australian report*, workers' top hazards included:

- Speeding vehicles (the most common work zone hazard)
- Driver aggression towards road workers
- Working in wet weather, at night and close to traffic.

According to the report, effective measures in improving work zone safety included active police enforcement and improved driver education. Also, worker perceptions of threats varied according to their exposure to hazards.

Innovation to the rescue?

Now innovative devices that make work zones safer continue to be improved or introduced, and many are focused on flaggers.

For example, ROSA, the Remote Operated Safety Attendant, is a flagger's tool used to control traffic from the "safe zone," away from imminent danger, verbal abuse and adverse weather conditions. It was devel-

* *Common Hazards and their Mitigating Measures in Work Zones: A Qualitative Study of Worker Perceptions* by Ashim Kumar Debnath, Ross Blackman and Narelle Haworth, Centre for Accident Research and Road Safety, Queensland University of Technology.

oped by Roundspring Technologies and received the first place American Traffic Safety Services Association Innovation Award for 2013.

Products like ROSA are known as automated flagger assistance devices (AFADs), and are designed to be operated remotely by a flagger positioned outside of the travel lanes.

“There are two types of AFADs,” says Melisa D. Finley, Texas Transportation Institute in a 2013 paper.* “One type uses a remote-controlled stop and slow sign to alternate the right-of-way; the other uses remote-controlled red and yellow lenses to alternate the right-of-way,” she says. “A gate arm [such as used for railroad crossings] is required only with the latter.”

Although AFADs may have increased the safety of flaggers, there were concerns that motorists may misunderstand them and proceed before safe to do so. Finley’s research found that the violation rate for the stop-slow AFAD without a gate arm is the highest, and is significantly higher than the violation rate for the red-yellow lens AFAD (which requires a gate arm). Some motorists still violate AFADs, especially when there is a visible line of vehicles going in the same direction as the stopped motorist.

Some contractors make their own devices. Cold-milling of asphalt requires a moving work zone, and for night work one contractor has configured small carts with four pneumatic tires and sign mast (“slow” sign mounted), illuminated by balloon lights powered by a generator on the carts. Flaggers pull their portable flagger stations along as the work zones migrate forward.

“It solves the problem of mobility,” said Dan Darden, vice president of construction, Gallagher Asphalt,

* *Field Evaluation of Automated Flagger Assistance Devices in Work Zones on Two-Lane Roads* by Melisa D. Finley, P.E., Texas Transportation Institute at Texas A&M University.



Photo: Tom Kuennen

No clear zone here: Bicyclists complicate work zone safety.

Thornton, Illinois. “If it were a permanent station, you’d have to have a vehicle sitting there hooked up to a trailer or truck hitch, so it could be pulled down the road in the moving zone. With this cart, the flagger can pull it just like a wagon, and put her lunch pail and rain gear in there.”

The illumination is required by DOT requirements. “Under Illinois DOT specifications, flaggers have to be lighted at night,” Darden told *Equipment World*. Gallagher has been using its shop-fabricated portable stations for about six years, he said. “The flaggers like it,” he added. “The stations are very easy to pull, and keep the flagger from having to

climb in and out of a truck, pulling up or backing up.”

‘Clear zone’ positive protection

For more substantial work over longer periods, highway workers have benefited greatly from working in “clear zones” created by positive protection from drivers. Typically this takes the form of a line of concrete “jersey” barriers – anchored or not – which isolate workers from traffic. In an attempt to forestall “gawker” accidents on brutal southern California freeways, actual work zone walls have been constructed of concrete barriers and plywood risers that completely screen workers from

motorists, and vice versa,

FHWA's rules specify each state highway agency's work zone safety and mobility plan include a description for positive protection in work zones, and implementation guidelines for federal funded highway projects.

A 2012 TRB survey* found eight state highway agencies were in the process of updating their safety and mobility plan, specifically addressing positive protection in work zones, while 15 agencies had posted

** Work Zone Positive Protection Policy Guidance: Synthesis of Devices and State of Practice* by Steven Schrock, Eric Fitzsimmons, Tomás Lindheimer, University of Kansas-Lawrence; Ming-Heng Wang, Kainan University, Taiwan, and Yong Bai, North Dakota State University, 2014 Transportation Research Board.

revised safety and mobility plans on public areas of their websites.

According to the survey, many state highway agencies have dedicated manuals to address work zone positive protection, including Colorado, Hawaii and North Carolina. In addition, Arkansas, New Hampshire, and Virginia have extensive positive protection guidance, and some state agencies have even recommended the use of proprietary devices in certain conditions.

The authors recommended these devices:

- **Portable concrete barriers**, or "Jersey" barriers, for use on all roadways. Typically they are placed with truck cranes or even backhoes. Deflection of barrier

on impact is up to 3 feet, but pinning barriers to pavement lessens deflection.

- **Ballast-filled portable barriers.** These are large polyethylene containers typically filled with either sand or water, interlocked to form a longitudinal barrier or channelizer barrier that can either redirect or provide guidance for vehicles through temporary work zones. They're recommended for use on low-speed (45 mph or lower) roadways only. Their high deflection requires a large longitudinal buffer area behind the barrier. New-design ballast-filled barriers are available for high-speed roads.



Balloon lights provide optimum illumination for night paving.

- **Steel barriers.** These separate the work area from open traffic and are recommended for use on all roadways. If anchored, deflection of barrier is usually less than 3 feet upon vehicle impact.
- **Moveable barriers.** These also separate the work area from open traffic, and are can be used on all paved roadways. They're ideal for dynamic or moving work areas that require shielding for varying widths. Initial cost and on-going operation costs are higher than other barrier types.
- **Truck mounted attenuators.** These common products provide a portable cushion to shield mobile or short-term work areas, and are recommended for mobile operations and smaller work areas where a truck can be used as a shield. Roll-forward distance is necessary to allow system to perform as intended.

- **Vehicle arresting systems.** These cable/net systems capture an errant vehicle prior to entering the work area. They're deployed at the entrance of work areas where a flare cannot be created using a longitudinal barrier system. Arresting systems require attachment to a longitudinal barrier, and a backup arresting net in case one vehicle is captured.

Leveraging ITS technology

ITS – for intelligent transportation systems – use a broad range of communications-based information and electronics technologies, such as sensors and other components in the field to collect traffic information like volume, speed and video of traffic. Wireless and wired communications transmit the data, which software processes and analyzes, after which it's



Photo: Tom Kueinen

Highway workers are at greater risk of injury or death from in-zone construction accidents, like backup run-overs, than from errant drivers; night work enhances risk.

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transferred to end users such as DOTs and motorists.

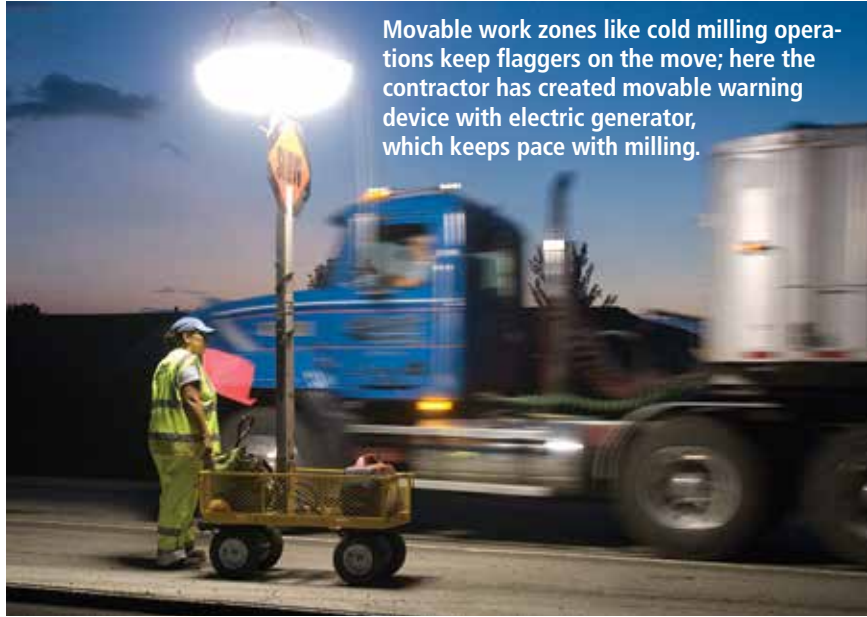
Work zone ITS devices – such as portable changeable message signs – may relay real-time traffic conditions, such as travel delays through a work zone, or recommend diversion routes. They may also be used

to provide immediate warnings, such as stopped traffic ahead.

Arizona and South Carolina are using these message signs to alternate a speed message with a monetary fine message. According to a recent report,* by using this approach on Arizona 89 in Prescott,

the Arizona DOT reduced by half the number of speeders driving 15 mph or more over the limit. **EW**

* *Reduction of Speed in Work Zones Using ITS DMS Instant Feedback to Drivers: Vehicle Speed Versus Traffic Fine* by Craig A. Roberts, Ph.D., P.E., and Edward J. Smaglik, Ph.D., P.E., Northern Arizona University.



Movable work zones like cold milling operations keep flaggers on the move; here the contractor has created movable warning device with electric generator, which keeps pace with milling.

Photo: Tom Kuennien

Work Zone Fatalities: Top 10 states

State	Total Fatalities
1 Texas	104
2 Florida	69
3 California	51
4 Illinois	30
5 Georgia	23
6 Ohio	20
7 Oklahoma	19
8 Virginia	17
9 Pennsylvania	16
T-10 AR, CO, TN	14

Released in January, 2015, this information by the National Work Zone Safety Information Clearinghouse shows the latest data tally (using 2013 figures) of deaths in construction work zone crashes, broken down by state. The group pulls the data from the National Highway Traffic Safety Administration.

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