SAFETY IMPACT

of Traffic Control Intervention at Work Zones

The combination of work zones and passing traffic can be hazardous. Busy environments with moving vehicles and limited space make drivers, pedestrians, and especially workers, all vulnerable. This study tested the introduction of new, highly reflective materials to improve work zone layout visibility for drivers. What resulted were significant reductions in speeds and an improvement in overall speed limit compliance.

Research indicates that collisions in work zones are not only on the rise [1] but that there are more fatalities in work zone crashes than those that occur elsewhere [2]. Multiple factors compromise work zone safety, but two significant issues recur. The first and most important is excessive speed, especially when work zones are located on highways or freeways where the speed limit is over 60 km/h [3]. The second is clarity of roadway layout and traffic control measures around work zones. This may be impeded by confusing layout patterns, reduced visibility due to inclement weather, or inadequately designed marking materials.

To address the impact of these factors on work zone safety, research suggests that speed should be reduced *before* the work zone and layouts should be clearly and logically presented with old road markings effectively masked and new road markings made highly visible. Authorities at all levels, including the City of Edmonton, Alberta, Canada, have implemented Vision Zero policies with the aim of reducing traffic-related fatalities and serious injury but must consider lower-cost strategies and technologies that can be implemented in work zones that still reduce speeds in lieu of

expensive, labour-intensive enforcement. Dynamic message signs, mobile barrier systems, reduced speed limits, and orange pavement markings, have all been applied in practice (Table 1). However, since collision numbers remain consistently high, further research on these and other measures is required to pinpoint effective means of reducing speed, increasing driver awareness, and ultimately saving lives.

This study was designed to address both speed and roadway layout as key factors in traffic control and safety management through the application of 3M™ road marking and other traffic intervention materials, including 3M™ Stamark™ Wet Reflective Removable Tape Series 710, 3M™ Stamark™ Removable Black Line Mask 715, 3M™ Diamond Grade Flexible Work Zone Sheeting Series 3910, and 3M™ Linear Delineation System Series 340. The aim was to test whether the use of these 3M products for lane and barrier marking could help to reduce speed in work zone traffic flow areas, thereby reducing the possibilities for collisions and increasing workers' safety.

Working with City of Edmonton Traffic Operations in the Summer of 2019, the University of Alberta research team identified three construction sites that would be in operation for a minimum of three weeks with a consistent layout as test site locations. Each of the construction zones chosen was then divided into three test sites. Two of the sites were designated for traffic control interventions, and one was to remain a control site at which speed monitoring occurred, but no new traffic control materials were added. The City's Traffic Monitoring team installed Black Cat radar cameras to record vehicle speeds for the duration of the testing periods, and video cameras were installed to record any collisions or near-misses that may occur in the work zone test sites.

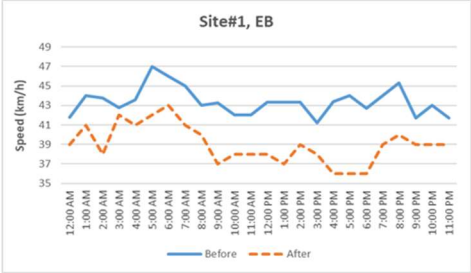
Alternative	Road Type	Avg Speed Reduction
Changeable Message Sign	Rural Freeway	0-7 mph
	Rural Freeway	3-5 mph
	Urban Freeway	0-2 mph
	Urban Arterial	3 mph
Drone Radar	Rural Freeway	0-2 mph
	Rural Highway	0-3 mph
Rumble Strips	Two-Lane Highway	2 mph
	Two-Lane Highway	1-2 mph
Transverse Pavement Markings	Two-Lane Highway	0 mph
Narrowed Lanes	Urban Freeway	0-3 mph
	Rural Freeway	3-8 mph
	Rural Freeway	2-5 mph
	Urban Freeway	0 mph
	Two-Lane Highway	4-8 mph
	Urban Arterial	2-4 mph

Table 1. Summary of alternative enforcement types to reduce speed

The UofA team chose a before and after study design to run over a three-week period. The radar cameras were used to test vehicle speed for week one when no intervention materials had been applied to the work zones. In addition, video recordings during the week were analyzed for driver behaviour and any collisions or near-misses. Average speeds were recorded in all three test sites and in all three construction zones, totalling nine sites.

Test results indicated that speeds at work zones dropped on average between 4.7 km/h to 11.6 km/h after the interventions

After the first week, the recorded data was gathered and processed, ready for analysis at the end of the testing period. During the following week, the 3M traffic control intervention materials were applied to the six test sites, while the three control sites were left untouched. With these in place, testing began at the start of the third week. Speeds of through traffic and vehicle behaviour were recorded in all nine test sites, including the six test and three control sites, using the same equipment, methods, and timings as in week 1. Once testing was complete, workers on site were surveyed regarding their impressions of the intervention materials' effect on driver behaviour when passing through the work zones.



Before and After Average Speed Results from Test Site #1, Eastbound

The before and after test results indicated that speeds at the work zones did significantly reduce after the interventions, dropping an average of between 4.7 km/h to 11.6 km/h in the respective test sites, while no observable drop occurred in the control sites. In addition, driver compliance with indicated speed limits showed an increase. These speed reductions and speed compliance were particularly notable during working hours, which accords with the Vision Zero aim of increasing worker safety around work zones. Furthermore, workers surveyed expressed an elevated sense of their own safety and effectiveness of the intervention materials.

References

1. NHTSA (2016). 2015 Motor Vehicle Crashes: Overview. Traffic Safety Facts Research Note 2016, National Highway Traffic Safety Administration, 1-9.

2. FHWA (2015). Facts and Statistics – Work Zone Safety. Washington, DC: U.S. Department of Transportation, Federal Highway Administration.

3. Harb, R., Radwan, E., Yan, X., Pande, A., & Abdel-Aty, M. (2008). Freeway Work-Zone Crash Analysis and Risk Identification Using Multiple and Conditional Logistic Regression. *Journal of Transportation Engineering*, 134(5), 203-214.

Centre for Smart Transportation

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In Progress

The full results and analysis form part of a research paper currently under review for publication.