District Work Zone Review

• St. Louis – June 11-14, 2018

• Central – July 16-18, 2018

• Northeast – August 27-29, 2018
History

- 1996 – Work Zone Reviews
- Focus on Safety and Mobility
- 2003 – WZ Safety and Mobility Policy
- 2004 – 30 Fatalities
- MoDOT Recognized Practice
Fatal and Serious Injury Crashes

- 56% due to aggressive and distracted driving
- Rear-end crashes most predominant of two or more vehicles
- 62% occurred in urban areas
- 66% occurred in divided roadways
- 56% occurred on ideal geometry (level with no curves)
11 Fatalities on State System
1 Fatality on Non-State System
(2018)
1,446 Crashes on State System
747 Crashes on Non-State System
(2017)
Work Zone Delays Greater than 10 Minutes

- Number of Delays:
  - 2015: 400
  - 2016: 436
  - 2017: 743
  - 2018 YTD: 778
  - 2018: 180

- Cumulative Hours of Congestion:
  - 2015: 272
  - 2016: 279
  - 2017: 434
  - 2018 YTD: 205
  - 2018: 111

- Work Zones Monitored:
  - 2015: 743
  - 2016: 778
  - 2017: 180

2018 Target:
- 180 Hours of Congestion
The Grading Scale

• A = Excellent;
• B = Good to Very Good;
• C = Acceptable;
• D = Below Average;
• F = Unacceptable;
  - With +/- for grades B, C & D
Areas Inspected

- Signing
- Channelizers
- Barricades
- Traffic Barriers
- Crash Cushions
- CMS/Arrow Panels
- Flaggers
- Workers & Work Site

- Roadway Conditions
- Entrance/Exit Ramps
- Tapers
- Lighting
- Pavement Marking
- Truck/Equipment Crossings
- Traffic Management
Facts

• Reviewed 84 work zones
• Types of work zones reviewed included:
  – Construction;
  – Maintenance;
  – Maintenance On-call; and
  – Permit
  – LPA
Signs may be seen in early spring but by summer it could be obscured by vegetation.
Sign legs are up in air and concern if hit by a vehicle because not crash tested.

Utility sign is blocking sidewalk.

Left lane sign blocking EXIT sign.
Is the area used by pedestrian a shoulder or sidewalk, but it is used by pedestrians. Further down an actual shoulder is available.
Both “shoulder” and sidewalk were closed how will the pedestrians be able to get down the sidewalk/road?
Ballasting

For skid mounted signs, ballasting should be limited to one sand bag height on the sign legs. The crossbar should be no higher than 12-inches (one sandbag over the crossbar is acceptable).
Channelizing Devices

<table>
<thead>
<tr>
<th></th>
<th>Channelizing Devices</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>2</td>
</tr>
<tr>
<td>B</td>
<td>19</td>
</tr>
<tr>
<td>C</td>
<td>7</td>
</tr>
<tr>
<td>D</td>
<td>3</td>
</tr>
<tr>
<td>F</td>
<td>2</td>
</tr>
</tbody>
</table>
Channelizers (DIBs) are in good condition and taper is set-up properly.
Channelizers were poor quality. Edge drop did not have a slope and needed channelizers in placed.
Barricades

A: 3  B: 4  C: 4  D: 8  F: 5
Need another type 3 barricade.
Project is left wide open, which traveling public could enter a possible dangerous situation.

Vehicles parked in front of the closed barricades.
Top picture is a proper closed road. Below picture is a soft closure to allow deliveries that were coming at an interval of 10 min. Then after deliveries were complete the closure was fully closed.
Workers & Work Site

<table>
<thead>
<tr>
<th></th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>10</td>
<td>23</td>
<td>4</td>
<td>11</td>
<td>12</td>
</tr>
</tbody>
</table>

Workers & Work Site
For daytime activity, flaggers shall wear a high visibility hard hat; safety glasses; a Performance Class 2 top or a Performance Class 2 top; and safety footwear.

For daytime activity, workers shall wear a hard hat; safety glasses; a Performance Class 2 top or a Performance Class 2 top; and safety footwear.

For nighttime activity, flaggers shall wear a high visibility hard hat; safety glasses; a Performance Class 3 top and Class 1 bottom; or a Performance Class 2 top and Class 1 bottom; and safety footwear.

For nighttime activity, workers shall wear a hard hat; safety glasses; a Performance Class 3 top or a Performance Class 2 top; and safety footwear.

Daytime Flagger PPE

Nighttime Flagger PPE

Daytime Worker PPE

Nighttime Worker PPE
Workers varied not having proper class of apparel vest/shirt, hard hat, protective eye ware, and proper footwear.
Should not ride behind a pull paver from site to site, just when laying material.

Parking a non-crash worthy vehicle in front of a crash worthy sand barrel array.
Stationary & Mobile Flagging Operations
3, 2 or 1 Cone Procedures

Flagger Station Location
- Setup in order to be visible to oncoming traffic (500' Day & 1000' Night)
- Setup a min 30' from flagger symbol sign & no further than 1 mile
- Setup at least 300’ from the traffic control devices that delineate the work space and/or work vehicles
- Flagger stations should be located such that an oncoming vehicle has additional space to stop without entering the work space, the flagger must identify an escape route

Mobile & Short Duration Operations
- When lane width is less than 12 feet, 2 cones is recommended during Short Duration and 1 cone must be used during Mobile Operations

Step 1: Stopping Traffic
- Setup cone(s) as shown and return to shoulder
- Remain facing traffic, with STOP visible
- Keep visual contact with drivers of stopping vehicles
- Keep left hand raised with palm facing down, signaling to stop

Step 2: Traffic has Stopped
- Once traffic has stopped, move out towards the center of the lane
- Keep the Stop/Slow Paddle in your right hand and position it out towards the center line, be sure not to cross the line with the Stop/Slow Paddle
- Keep visual contact with drivers of stopped vehicles
- Keep left hand raised with palm facing down, signaling to stop, until traffic has stopped

Step 3: Preparing to Release Traffic
- Once you have confirmed opposing traffic is clear, make your way back to the shoulder taking the cone (as shown) with you:
- Be sure to keep STOP visible to the stopped traffic
- Based on the type of operation, lane width and number of cones used, you may need to move multiple cones

Step 4: Releasing Traffic
- Once on the shoulder, rotate the Stop/Slow Paddle to SLOW and release traffic
- Direct traffic by signaling with your arm while waving vehicles through

These photos represent the open lane of the work zone. The flagger at the opposite end controlling traffic of the closed lane (the lane work is actually taking place) would not move the cones. Instead, you would direct traffic to drive around the cones. There may be instances when you have to move the cone to allow traffic to pass, such as when traffic has stopped too close to the cone or to accommodate a OWOO load. A minimum of 1 cone or trim-line channelizer must be used. Additional channelizers may be used at the discretion of the District Maintenance Engineer, Safety & Health Manager, Superintendent and/or Supervisor.

Contact your Safety & Health Manager and/or Work Zone Coordinator with any questions.
Flagging Reminders

100 feet from work vehicles

Escape Route

Maintain Eye Contact

Proper Procedures & Safety Apparel

10 feet behind the cone
Do the flaggers appear in charged and safely position?
Is this flagger in proper position?

Is this flagger in charge and in a location with a safe escapable path?
Where is this flaggers escape route? Open lane of traffic or hit the soft rocks after diving over the guardrail.
3-2-1 Cone and PPE Field Procedures

Good

Poor

Good

Poor
New Ideas for Alerting Traveling Public of Flaggers and Workers
### Rumble Strips

#### Figure: 616.6.87.2 Rumble Strip Placement on a Divided Highway

<table>
<thead>
<tr>
<th>SPEED</th>
<th>SIGN SPACING (ft)</th>
<th>TAPE LENGTH (ft)</th>
<th>OPTIONAL CHANNELIZER SPACING (ft)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Permanent</td>
<td>Unidivided</td>
<td>Divided</td>
</tr>
<tr>
<td>Permanent</td>
<td>Posted (mph)</td>
<td>(5)</td>
<td>(8)</td>
</tr>
<tr>
<td>0-45</td>
<td>-</td>
<td>200</td>
<td>70</td>
</tr>
<tr>
<td>40-65</td>
<td>-</td>
<td>600</td>
<td>150</td>
</tr>
<tr>
<td>60-70</td>
<td>-</td>
<td>1000</td>
<td>165</td>
</tr>
<tr>
<td></td>
<td>5A - 1000</td>
<td>5B - 1500</td>
<td>SC - 2540</td>
</tr>
</tbody>
</table>

1. Shoulder taper length based on 10 ft. (standard shoulder width) offset.
2. Lane taper length based on 12 ft. (standard lane width) offset.

#### Notes:

- See EPG 616.6.87 Temporary Rumble Strips for rumble strip guidance and locations.
- Review appropriate typical applications for signs, sign spacing, taper length, buffer length, channelizer spacing, TMA's, AWRS, flags, etc.
- Temporary rumble strips shall be orange in color.
- Long-term rumble strips shall consist of 5 strips separated at 2-4 ft. centers or manufacturer's recommendation.
- Short-term rumble strips shall consist of 3 strips.

#### Short-Term Rumble Strips

<table>
<thead>
<tr>
<th>Speed (MPH)</th>
<th>Distance (ft)</th>
<th>Spacing (ft)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 - 45</td>
<td>120</td>
<td>10</td>
</tr>
<tr>
<td>50 - 65</td>
<td>160</td>
<td>15</td>
</tr>
<tr>
<td>60 - 70</td>
<td>200</td>
<td>20</td>
</tr>
</tbody>
</table>

**Spacing Example (2) —**

Two or four sets of rumble strips may be used simultaneously covering locations (3) & (4). If only two sets are used, the preferred placement is at location (3).

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**Legend**

- Work Area
- Channelizer
- Sign
- Arrow Board
- Advanced Warning Rail System
- Long-term or Short-term Rumble Strips
Work Zone Intrusion Alert Systems

Traffic Guard Worker Alert System

Traffic Guard Portable Speed Bump
TMA Flagger
1) RFP has been accepted.

2) MoDOT’s two protective vehicle/TMA’s are being updated with the technology in Florida.

3) Study will proceed next year.

**Autonomous TMA**
Audible Alert
CMS sign can be used to advertise upcoming projects. An innovation challenge showing what a fine may be if caught speeding.
Make sure your message is exactly what you want to tell the public.
How to let traveling public of up coming slow/stop traffic?
Dynamic Late Merge System (Zipper Merge)

<table>
<thead>
<tr>
<th>SPEED (mph)</th>
<th>SIGN SPACING (ft)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normal Posted</td>
<td>Unidivided</td>
</tr>
<tr>
<td>0-35</td>
<td>200</td>
</tr>
<tr>
<td>40-45</td>
<td>300</td>
</tr>
<tr>
<td>50-55</td>
<td>500</td>
</tr>
<tr>
<td>60-70</td>
<td>1000</td>
</tr>
</tbody>
</table>

Notes:
The typical application is not drawn to scale.
The Changeable Message Signs and Non-intrusive Detectors shall be spaced along the route as needed for proper systems operations.
Static signs may be used as a supplement for CMS boards.
The static sign provides a continuous reinforcing message to the traveling public.
Static signs may be located beyond and within the anticipated queue length.

DURING BACKUPS USE BOTH LANES
TAKE TURNS AT MERGE
96" x 48" (Letters 5" E Modified)

TAKE TURNS AT MERGE
36" x 24" (Letters 4.5" C)

TAKE TURNS
30" x 24" (Letters 6" C)

SLOW TRAFFIC AHEAD
USE BOTH LANES

STOPPED TRAFFIC AHEAD
USE BOTH LANES

CMS located beyond the estimated queue length at the time when system activation will occur.

CMS located 100' ahead (upstream) of the Merge sign.

CMS located beyond the estimated queue length at the time when system activation will occur.
The use of Law Enforcement
Rumble strips to get attention.
Law Enforcement to get attention.
Red/Blue light to get attention at night, be careful of brightness.
Innovation Winner

JAWS Debris Remover

Person can remove debris while protected inside a vehicle.
Work Zone Simulation Training

Figure 1. (a) Virtual Reality Headset and Immersion in a work zone scenario, (b) Example of poor signage in the work zone scenario
Daytime scenario
Nighttime scenario with eye tracker
Resources

Quality Standards for Temporary Traffic Control Devices

July 2013

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Questions?
As part of MoDOT’s continuing effort to improve the safety of their workforce and motorists, MoDOT has developed a pilot to study the effectiveness of work zone intrusion alert systems.

These systems are designed to alert workers of unauthorized entry of vehicles entering into the work zone.

These systems will also alert workers of internal conflicts that may happen within the work area when equipment encroaches too closely to workers.