WORK ZONE SAFETY RESEARCH AT THE TEXAS TRANSPORTATION INSTITUTE
The mission of TTI is to solve transportation problems through research, to transfer technology, and to develop diverse human resources to meet the transportation challenges of tomorrow.

http://tti.tamu.edu
EXISTING TYPE III BARRICADES
IMPROVED TYPE III BARRICADES

Steel & Wood Construction
IMPROVED TYPE III BARRICADES

Plastic & Wood Construction
“THE GOAL”
TTI’s “OTHER” WORK ZONE SAFETY RESEARCH ACTIVITIES

• Improved Flashing Vehicle Warning Lights
• Effect of Enhanced Fines in Work Zones
• Making Work Zones More Enforcement-Friendly
• Nighttime Lane Closure Lighting System

• Improving Safety at Short-Term Rural Work Zones
• Photometric Requirements for Arrow Panels
• Improving Traffic Control at “Complex” Work Zones
IMPROVED FLASHING VEHICLE WARNING LIGHTS

Given the prevalence of flashing amber warning lights in work zones and elsewhere, should other warning light colors be used (with amber) under certain conditions on construction and maintenance vehicles?
COLOR AFFECTS PERCEPTIONS OF THE HAZARD BEING APPROACHED...
THE DRIVING ACTION BELIEVED TO BE APPROPRIATE...
... AND DRIVING BEHAVIOR

![Average Speed Chart](chart.png)

- Site A
- Site B
- Site C
- Site D
- Site F

Ave Speed, km/hr
... AND DRIVING BEHAVIOR

% of Traffic Activating Brakes

- Site B
- Site D
- Site F
EFFECT OF ENHANCED FINE LEGISLATION IN WORK ZONES

Most states (including Texas) have passed legislation increasing the fines for traffic violations in work zones. Have these laws been effective?
EFFECTS OF ENHANCED FINE LEGISLATION IN TEXAS

Texas WZ Fatal Crashes:
Before (’94-'97) – 92/yr
After (’98-'99) – 111/yr

Sites Where Speeds Decreased: 28%
Sites Where Speeds Increased: 22%
Sites With No Change: 50%

Type of Adjudication:
- Plead Guilty, Paid Fine: 65% Before Law, 54% After Law
- Citation Dismissed: 15% Before Law, 10% After Law
- Took Defensive Driving: 20% Before Law, 36% After Law
MAKING WORK ZONES MORE “ENFORCEMENT-FRIENDLY”

The loss of shoulders and median area during construction eliminates places to conduct enforcement activities. What can be done to reduce these adverse impacts?
ENFORCEMENT-FRIENDLY WORK ZONE DESIGNS

• Limiting work zone lengths

• Providing enforcement pull-out areas
  – How big?
  – How far apart?
  – Under what conditions?
ENFORCEMENT-FRIENDLY TECHNOLOGY

Remote real-time enforcement

- Automated speed enforcement technology
- Wireless communication system
## DOWNSTREAM VEHICLE RECOGNITION

<table>
<thead>
<tr>
<th>Site</th>
<th>Distance Downstream from Camera</th>
<th>% Successfully Identified</th>
</tr>
</thead>
<tbody>
<tr>
<td>Site 1</td>
<td>1 mile</td>
<td>88.0%</td>
</tr>
<tr>
<td>Site 1</td>
<td>1.5 miles</td>
<td>84.0%</td>
</tr>
<tr>
<td>Site 2</td>
<td>0.5 miles</td>
<td>86.7%</td>
</tr>
<tr>
<td>Site 2</td>
<td>1 mile</td>
<td>88.0%</td>
</tr>
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NIGHTTIME LANE CLOSURE WARNING LIGHT SYSTEM

Given the pressure to do more roadwork at night, can we do anything to reduce the chance of vehicles running into the lane closure?
MOST MOTORISTS LIKE THE CONCEPT...

- Steady-Burn Light Background System: 42%
- Steady-Burn Lights: 16%
- No Warning Lights: 22%
- No-Light Background Systems: 20%
THE SYSTEM MAY ENCOURAGE EARLIER LANE CHANGING

<table>
<thead>
<tr>
<th>% Vehicles in Closed Lane 1000' from Taper</th>
<th>With System</th>
<th>Without System</th>
</tr>
</thead>
<tbody>
<tr>
<td>Passenger</td>
<td>23</td>
<td>30</td>
</tr>
<tr>
<td>Truck</td>
<td>7</td>
<td>19</td>
</tr>
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</table>
Short-term work zones are the most unexpected to motorists. How can we improve driver awareness and behavior in these types of locations?
INCREASING CONSPICUITY, DRIVER AWARENESS

- Speed display
- Drone radar
- Variable message sign
- Fluorescent orange signs
- Fluorescent yellow-green vests and hard hats
- Vehicle conspicuity improvements
- Portable rumble strips
- Worker strobe lights
- Safe-T-Spins
“BEST” DEVICES

- Speed display
  - 5 mph reduction in activity area
  - 10-20% fewer vehicles exceeding speed limit

- Yellow-green vests
  - Luminance 2× orange vest
  - Contrast ratio significantly better
PORTABLE TRAFFIC SIGNALS

• Why?
  – Better driver understanding (red means stop, green means go)
  – Eliminate flagger risk
  – No need to rotate flaggers
  – Improve personnel productivity
FACILITATING IMPLEMENTATION OF PORTABLE SIGNALS

<table>
<thead>
<tr>
<th>Lowest Reasonable Speed (mph)</th>
<th>Work Zone Travel Time (sec) by Work Zone Length (feet)</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>250</td>
</tr>
<tr>
<td>15</td>
<td>11</td>
</tr>
<tr>
<td>20</td>
<td>9</td>
</tr>
<tr>
<td>25</td>
<td>7</td>
</tr>
</tbody>
</table>
**FACILITATING IMPLEMENTATION**

- **NOTE:** Warning sign sequence in opposite direction same as below.

- **Portable Traffic Signal** (optional)
- **Standard Pavement Marking** (optional)

- **END ROAD WORK**

- **ONE LANE ROAD AHEAD**

- **ROAD WORK AHEAD**

- **END ROAD WORK**

- **STOP RED**

- **MPH** (optional)

- **40-150 ft or 12-45 meters**

- **30 ft or 9 meters**

- **50 ft or 15 meters**

- **100 ft or 30 meters**

- **40-150 ft or 12-45 meters**

**Transportation Operations Group**
Current criteria requires arrow panels to be visible from 1 mile. How does an agency ensure that effective panels are purchased and are being maintained in the field?
ISSUES BEING EXAMINED

• Minimum daytime and nighttime intensities (on and off-axis)
• Maximum nighttime intensity
• Angularity
• Color
• Photometric testing methods
Work zones on high-volume, urban freeways can require fairly extensive traffic control. This can sometimes overwhelm drivers. What can be done to improve these situations?
FOR MORE INFORMATION…

http://tti.tamu.edu
http://transops.tamu.edu
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