VTRC Work Zone Safety and Queue Management Research

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Virginia Work Zone Safety

- Nationally:
  - 1 work zone fatality every 15 hours
  - 1 work zone injury every 15 minutes
  - 4 of 5 fatalities are drivers

- In 2017, VA work zones had:
  - 2,666 crashes (+9.8%)
  - 1,329 injuries (+12.7%)
  - 12 fatalities
How Do Work Zones Affect Safety?

- VTRC worked on NCHRP 17-61 to identify safety effects and crash countermeasures
- National sample of work zones on freeways/interstates/multi-lane highways
  - NC, VA, OH, TX, UT, WA
  - 8200 mi-months, 7600+ crashes
- Looked at a range of lane closure, lane width, shoulder width, and positive protection conditions
4-Lane Freeways/Interstates

![Graph showing predicted crashes per mile per year vs. AADT (veh/day)]
6-Lane Freeways/Interstates

- 17-61, Work Zone
- 17-61, Normal
- HSM, Urban
- HSM, Rural
Crash Increases in Work Zones

- **4-lane**
- **6-lane**

AADT (Average Annual Daily Traffic)
Congestion Effects of Work Zones

- Work zones were responsible for about 4% of VA Interstate delay in 2016 vs. 7% in 2017
Work Zone
Congestion and Safety

• A 2-yr study of Virginia work zone crashes found that:
  – about 58% of crashes were rear ends
  – Over 76% of rear ends were because of congestion
Smart Work Zones

• VDOT deployed pilot tests of 2 Smart Work Zones in 2017:
  – I-95 SB in Emporia, VA
  – I-95 SB in Fredericksburg
• Installed a number of trailer/post mounted radar sensors to measure traffic speeds
• Queue warning messages were triggered on DMSs when speeds dropped below 40 mph
Long Term Construction

Major Findings

• Systems generally detected congestion appropriately

• Crash frequency impacts:
  – Emporia: crashes during activation were similar to pre-construction crash frequency
  – Fredericksburg: Crashes declined from 7.2 rear ends per month pre-construction to 4.7 per month (-35%)

• System cost ~ $10k per month
Staunton Queue Management Teams

- Two pickup trucks with PCMS and warning lights, cell phones, and radio communications (to the other truck and to TOC)
- Leap-frog operations
  - Truck-1 (Active): 2000 feet from the end-of-queue/taper
    - Display: ROAD WORK AHEAD / SLOW or STOP TRAFFIC
  - Truck-2 (Transitory): 0.5 miles from the end-of-queue/taper
    - Display: ROAD WORK AHEAD / SLOW TRAFFIC AHEAD
  - As the queue reaches Truck-1
    - Truck-1 will re-position itself to 0.5 mile from the end-of-queue
    - Truck-2 becomes Active
  - They will switch their roles
Queue Management in Work Zones

- Staunton District has been using a queue management team (QMT)
  - Appear to be effective in 2 paving projects during 2017 on I-81
  - No fatal crashes when using QMT
  - No high speed rear-end crashes

- VTRC is comparing QMT and smart work zone solutions to no queue management on several I-81 paving jobs
Portable Smart Work Zone

AUTOMATED QUEUE WARNING (AQW) SYSTEM
TYPE 1 Layout (Typical)
Intelligent Portable Changeable Message Sign
PCMS w/Sensor & Modem (3.0-3.5 mi b4 WZ)

AUTOMATED QUEUE WARNING SYSTEM
EQUIPMENT
- 4 Portable Speed-Mac Sensors
- 1 Intelligent PCMS + Doppler

SYSTEM
- Web-Based Remote Queue Warning Server

Portable Traffic Sensors (Speed-Mac)(Qty = 4)
0.1, 0.5, (1.0-1.5) & (2.0-2.5) before Taper

SYSTEM LOGIC:
APPROACH SPEEDS AT SENSOR(S)
SLOW TRAFFIC: Avg Speeds < 45 mph
- CAUTION SLOW TRAFFIC - X MILES AHEAD
STOPPED TRAFFIC: Avg Speeds < 20 mph
- CAUTION STOPPED TRAFFIC - X MILES AHEAD

APPROACH SPEEDS AT PCMS
FREE FLOW:
WORKZONE 3 MILES AHEAD

MAX QUEUE ALERT: Avg Speeds <45 mph
- Send Auto Alert via Email to Project Personnel
- Consider moving PCMS further upstream
- Consider adding another Sensor upstream
(spaced approximately 1.0 mile +/-)

NOTE: Only use on roads with <= 3 lanes
PM8L: PQMS location
# PM8L: PQMS configuration

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Speed Heatmap

2.5 mile queue

Queue buildup in the morning

June 29
Summary

- Tools exist to help predict crash effects of work zones
- Smart work zones have proven to be effective on long-term construction projects
- Currently testing options for paving operations
Questions?

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