1955 AMERICAN LEAGUE ROOKIE OF THE YEAR

• Herb Score
• Cleveland Indians
• Won/Lost: 16-10
• ERA: 2.85
• SO: 245 (an MLB record that stood for 29 years)
Making their debut in 1955….

Steve Jobs

Whoopi Goldberg

Debra Winger

Bill Gates
1955: A COMPLETELY REDESIGNED CHEVY...
OVER 1 SOLD….APRIL 15, 1955

The first McDonald’s opens in Des Plaines, IL.
1955: SEAT BELTS INTRODUCED

A revolutionary safety device that has saved untold lives.
1955: THE 1ST RUMBLE STRIP INSTALLATION

Wish you were here... on the New Jersey Garden State Parkway!
MITIGATING A KILLER ENGINEERING SOLUTIONS FOR DISTRACTED DRIVING

TIM COX
COX TRANSPORTATION SAFETY
MAY 31, 2017
FHWA LIST OF PROVEN SAFETY COUNTER MEASURES:

1. Road Safety Audits

2. Rumble Strips and Rumble Stripes

3. Median Barriers

4. Safety Edge

5. Roundabouts

6. Left and Right Turn Lanes at Stop- Controlled Intersections

7. Yellow Change Intervals

8. Medians and Pedestrian Refuge Areas in Urban and Suburban Areas

9. Walkways

RUMBLE STRIP APPLICATIONS

- Shoulder (SRS)
- Centerline (CLRS)
- Transverse (TRS)
- Temporary Transverse (TTRS)
Shoulder Rumble Strip (SRS) Application

Figure 2. Typical shoulder rumble strip installation.
Shoulder Rumble Strips (SRS) have proven Effective:

- 13% crash reduction on rural two-lane highways.
- 16% crash reduction on rural multi-lane divided highways.
- 38% crash reduction in run-off-road on freeways.
Centerline Rumble Strip (CLRS) Application

Figure 3. Typical centerline rumble strip installation.
Centerline Rumble Strips (CLRS) have proven Effective:

- 25% Reduction
  - Head-on Crashes
  - Opposite Direction Crashes
- 15% Reduction
  - Rural 2-lane roads
Transverse Rumble Strip (TRS) Application

Figure 5. Typical transverse rumble strip installation.
TRANSVERSE RUMBLE STRIPS

PERMANENT

TEMPORARY
US 50, Kansas May-June, 2004

1 Highway

9 Deaths

6 Weeks
2004 - Peabody, KS

- 22 mile asphalt paving project
- May 10
  - 2 fatalities
  - 2 injuries
- June 28
  - 2 fatalities
  - 2 injuries
- June 29
  - 5 fatalities
  - 2 injuries
TEMPORARY PORTABLE RUMBLE STRIP - TPRS

- Kansas DOT required
  - Alert drivers
  - Temporary
  - Portable
  - Stable

- Portable Rumble Strip
  - ¾ inch high, 11 feet long, 110 lbs.
  - No adhesive or nails
  - Easily deployed
  - Stays in place
RESEARCH: SOUND AND VIBRATION

Sound:
• TPRS = milled-in rumble strips

Vibration:
• TPRS = milled-in rumble strips

University of Kansas Study, Lawrence KS, May, 2009
RESEARCH – DRIVER REACTION

- Tested in 7 Work Zones
- 10-13 mph speed reductions
- Conclusion: will improve safety in Work Zones

Ohio University Study, Athens OH, USA, 2010
RESEARCH – MOVEMENT UNDER BRAKING

Michigan Highway Patrol

DRIVES DOWN DISTRACTED DRIVING
Highways England – September 2014

- Surface
  - Runway on airport
  - Drenched by fire engines

- 1st pass – patrol car @ 135 MPH
- 2nd pass – motorcycle @ 154 MPH
- 3rd pass – motorcycle @ 175 MPH
RESEARCH – MOVEMENT UNDER HIGH WIND

US Federal Aviation Administration

- Problem – distracted pilots enter closed taxiways / runways
- Location – Lafayette, Indiana Airport
- Air sweeper blowing @ 300 MPH
US 50 – Success!

Summer 2011

- 5 months
- **Zero** fatalities
- **Zero** crashes
- Difference - TPRS
TPRS AROUND THE WORLD
TPRS BEST PRACTICE: ARRAY DESIGN

Spacing between Strips
Up to 40 MPH 10' Spacing on Center
41-55 MPH 15' Spacing on Center
56+ MPH 20' Spacing on Center

15C12: Traffic Control for Lane Closure with Flagging Operation
TPRS BEST PRACTICE: ROAD CONDITIONS

- Free of debris
- Curvature
  - Horizontal
  - Vertical
- Surface type
  - Asphalt & Concrete – OK
- Surface Temperature
  - From 0°F to 180°F [-17°C to 80°C]
TPRS BEST PRACTICE DEPLOYMENT

- Protect the workers
  - TMA – truck mounted attenuator
  - Mobile Barrier
- Transport
  - CRIB
  - Retrieval
- Senn Device
CASE STUDIES OF TPRS

- I-35 Central Texas Expansion
- Penn Turnpike Commission
- CETRI
CASE 1 – I-35 CENTRAL TEXAS EXPANSION
End-of-Queue Warning System
Last Year’s Report...

- Examined end-of-queue (EOQ) + portable rumble strip system (PRS) effects
- Looked at nights when both devices deployed (queues were expected)
- Results indicated a 44% reduction in crashes that would have otherwise occurred
- Crashes occurring were less severe
Types of Crashes

- Severe Crashes:
  - Without EOQ: 41%
  - With EOQ: 36%

- Rear-End Crashes:
  - Without EOQ: 58%
  - With EOQ: 36%
Crash Severity

% of Crashes Involving Fatalities or Injuries

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<tr>
<th></th>
<th>No Queuing</th>
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<tr>
<td>No Safety Treatments</td>
<td>31.0%</td>
<td>50.0%</td>
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<tr>
<td>With Safety Treatments</td>
<td>28.6%</td>
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Countermeasure Effects When Queuing is Present...

Both countermeasures have a statistically significant effect.

Reductions in Expected Crashes

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<tr>
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</table>
Average Crash Cost Savings with EOQ System

$6,300. Per Night, Per Installation
Case Study 2: 
PA Turnpike Commission Study

Goals of Study:

• Improve both work-zone and worker safety
• Determine if TPRS would increase driver awareness
• Improve merging
• Improve speed compliance
CASE STUDY 2 - PA TURNPIKE: RESULTS

With TPRS arrays in place:

- **Speed**
  - 8% average decrease
  - 4% 85th percentile decrease
- **Merge distance before lane closure**
  - Base line – 90 M
  - TPRS + Trooper – 180 M
  - TPRS only – 210 M
Effect of TPRS on work zone safety

- Observe driver behavior
  - Change in braking
  - Change in speed
  - Avoidance
- Compare layouts of 2 arrays with 1 array
CTRE - RESULTS

[Caveat – limited funding meant smaller data sets]

Observations

- With TPRS – without TPRS
  - Vehicle speeds: 10% reduction
  - Driver braking: 25% increase
- 2 arrays compared to 1 array
  - 33% speed reduction
“Rumble strips … the weight and design keep them from being moved significantly, even at high speeds.”

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USER QUOTES

Shelly & Sands, INC. “…Traffic slowed down entering the work zone. ...drivers looked up from their cell phones.”

Maryland State Highway Administration “Motorists hit the rumble strips and immediately slow down ... the flagger could hear approaching vehicles…”

Colorado DOT “Cars hit the strips and were alerted, most slowed. Not an ideal site due to super elevation, but movement was manageable …”

Marathon County, Wisconsin “… our crews experienced a safer work area due to the reduced speeds …”
THANK YOU
REFERENCES

- CTRE Iowa State University: http://www.intrans.iastate.edu/research/documents/research-reports/temp_rumble_strips_in_work_zone_flagging_ops_w_cvr.pdf
- Closed Course Test and Analysis of Vibration and Sound Generated by Temporary Rumble Strips for Short Term Work Zones”, - Steven D. Schrock, University of Kansas, Transportation Research Board Annual Meeting, 2010, www.trb.org
- Contact Bill Jamieson for these reports:
  - Best Practices for use of TPRS
  - Pennsylvania Turnpike Pilot Project - TPRS