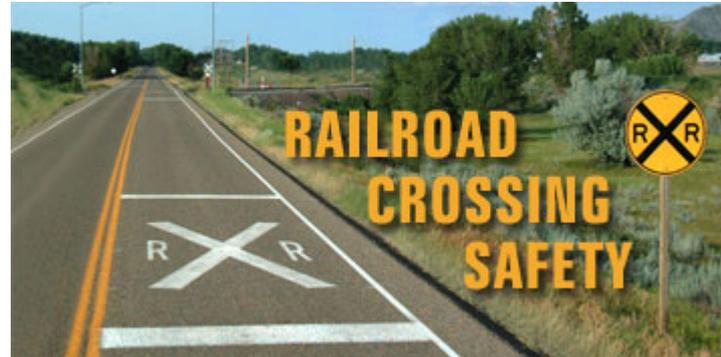


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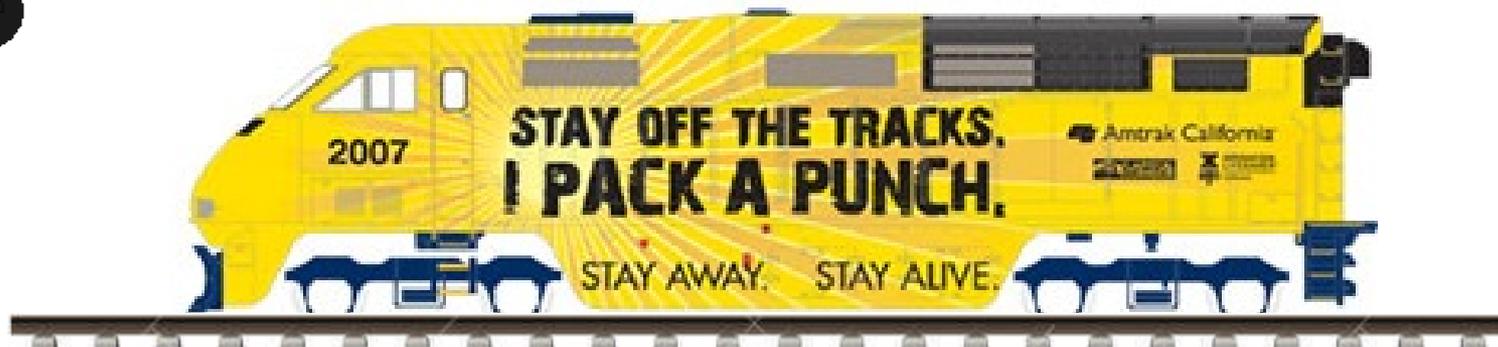


Office of Rail Safety

Safety and Enforcement Division

California Public Utilities Commission

April 7, 2016



**Portions of this presentation provided by Transpo, Industries, Inc.*



Highway-Rail Crossing Safety Issues

Problem Statement:

- Improving safety at railroad / rail transit grade crossings has challenges, one being to the need to coordinate rail crossing design and technological advancements with:
 - Highway / street design
 - Operating within constraints of stakeholder budgets
 - Obtaining cooperation among the various stakeholders.

Statistics for California Highway-Rail At-Grade Public Crossings:

- Highway-rail at-grade public crossings are the most deadly locations that the California Public Utilities Commission (CPUC) regulates.
- There were 83 vehicle-train accidents at California public highway-rail crossings in 2015, resulting in 7 deaths and 31 injuries.
- There were 43 pedestrian accidents at such crossings in 2015; resulting in 23 deaths and 7 injuries.

Integrated Pavement Markings and Signage Improvements for At-Grade Crossings



Integration of pavement markings and Manual on Uniform Traffic Control Devices (MUTCD)-consistent signage upgrades represents a relatively inexpensive approach to enhancing crossing safety.

Example: The approaches of this Florida grade crossing have a total of seven railroad (RR) crossing signs and two areas of RR crossing pavement markings.

A 2014 Federal Department of Transportation (DOT) study found that vehicles were driven more safely in the vicinity of a crossing after visual upgrades were made in pavement markings and signage.



DEGAROUTE Area Marking



US DOT 2014 Report



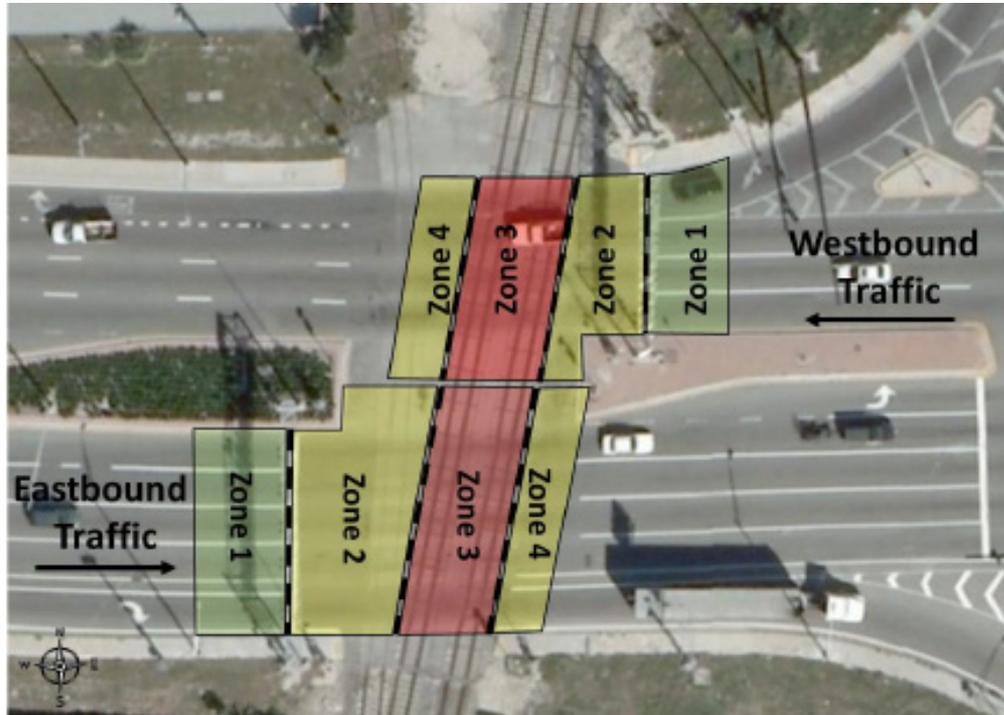
Effect of Dynamic Envelope Pavement Markings on Vehicle Driver Behavior at a Highway-Rail Grade Crossing

US DOT Report #: DOT-VNTSC-FRA-13-05; US DOT/FRA Report #: DOT/FRA/ORD-14/04

- The study evaluated the effectiveness of colored pavement markings applied in the Dynamic Envelope and signage of an at-grade-railroad crossing by examining:
- Driver stopping behavior, and;
- Corrective actions drivers took before and after application of pavement markings and signage.
- The study utilized a Zone system to identify four potential hazard areas where cars stop in front of and behind railroad crossings.
- The study concluded that the changes in pavement markings and signage resulted in an increase in driver safe stopping behavior.
- The study was primarily geared toward driver, rather than pedestrian, behavior.



What Stopping Behavior Is Safe?



Commercial Blvd & FECR crossing. Picture and graphic from Page 19, Figure 14, DOT Report: DOT/FRA/ORD-14/04

Zone 1 (not dangerous): A motorist who stops in Zone 1 has stopped before the stop line where the gate descends during an activation. Motorists stopping in this zone are behaving safely.

Zone 2 (moderately dangerous): A motorist who stops in Zone 2 has stopped after the stop line, but before the dynamic envelope. Motorists stopping in Zone 2 would be stuck inside of a descended gate but not struck by a train.

Zone 3 – Dynamic Envelope Zone (very dangerous): A motorist who stops in Zone 3 has stopped in the most dangerous part of the crossing—the dynamic envelope zone. In this zone, a train and vehicle would collide.

Zone 4 (moderately dangerous): A motorist who stops in Zone 4 has stopped past but adjacent to the dynamic envelope zone. Motorists stopping in Zone 4 would not be struck by a train.

Driver Behavior



- The crossing was filmed for over 80 hours before, and 80 hours after the installation of pavement markings and improved signage.
- Over 6,000 vehicles and associated stopping and corrective behaviors were observed in each phase (12,000 total).
- Driver stopping behavior was observed before and after improvements.
- Driver corrective behavior was observed before and after improvements.

Findings of DOT Study



- Initial results show a positive effect on driver behavior after installation of pavement markings and signage.
- There was a 9% increase in vehicles stopped in safest position (Zone 1).
- After installation there was a 45% decrease in vehicles stopping on the tracks (Zone 3).
- Descending violations (when motorists continue under a gate arm while it is descending but not yet horizontal) were reduced by 50%. There were no horizontal violations (when motorists drive around or through a gate arm) that occurred during the time of this study. They were prohibited by the length of the gate arms.
- There was a 36% decrease in vehicles stopping in Zone 4, slight decrease in Zone 2.
- There was effectively no-change in the actions taken by drivers who found themselves in the marked area, they initiated the same types of actions (back-up, change lanes).
- The study's executive summary cautions that only one crossing has been studied.

“The results of this study provide initial evidence that dynamic envelope pavement markings with signage can produce an increase in safe stopping behaviors”

-Federal Railroad Administration

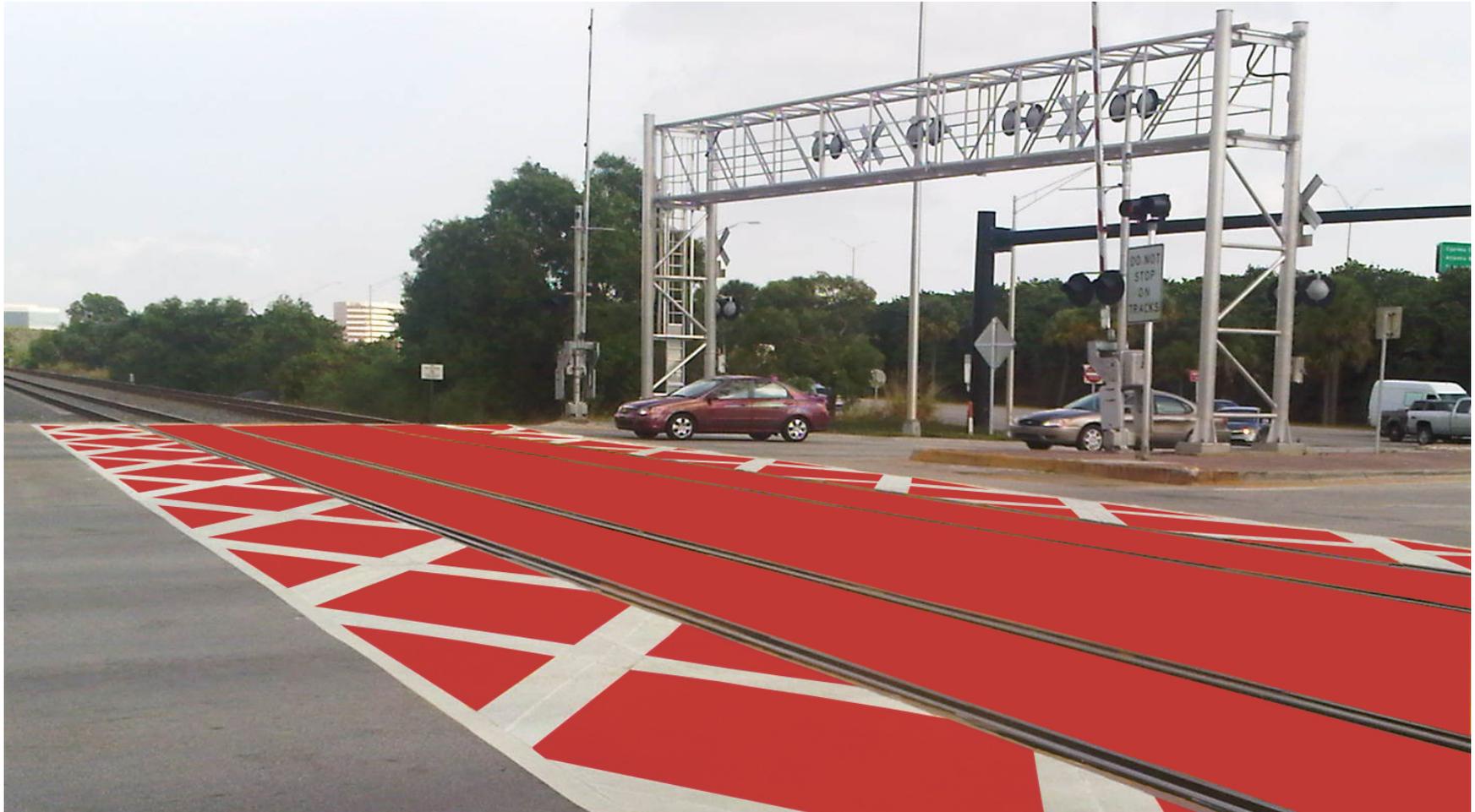
“The installation of the pavement markings elicited significant change in behavior”

-Federal Railroad Administration

A Cost-Efficient Proposal for Safety: Integrated Pavement Markings and Signage Improvements for At-Grade Crossings



Example: Commercial Blvd & Florida East Coast Railway (FECR), Ft Lauderdale, FL



Railroad Crossing utilizing "Color-Safe® Pavement Marking for Dynamic Envelope

**Photo property of Transpo Industries, Inc..*

BODAN® Highway-Rail Grade Crossing Surface



Examples of "BODAN" concrete system in "RED" with train and driver views.

NYC MTA Highway-Rail Grade Crossing Evaluation of Pavement Markings



Excerpts from:

Highway-Rail Grade Crossing Review

Prepared by CTC, Inc., for Metro-North Railroad

October 2, 2015 NY, Valhalla

Cleveland St **DOT # 529904J, MP 24.40** River Subdivision

5.9 Pavement Markings

Evaluate the railroad pavement markings in advance of the highway-rail crossing. The railroad crossing pavement marking symbol should be refreshed and evaluated for appropriate placement in accordance with MUTCD Chapter 8, Section 8b.27. The advance railroad warning signs may need to be relocated based on the placement of the railroad pavement marking symbols.

Extend edge lines and double yellow centerline through the crossing.

5.10 Pedestrians

Consider providing designated pedestrian pathways and encourage pedestrians to traverse within the areas allotted.



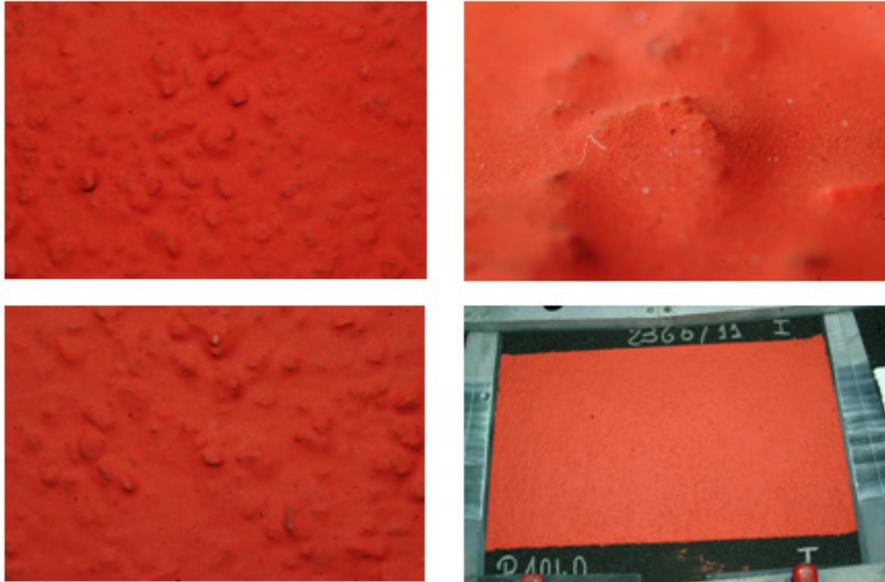
Faded Cleveland Street pavement markings

Turntable Test Acrylic MMA Visual Consistency

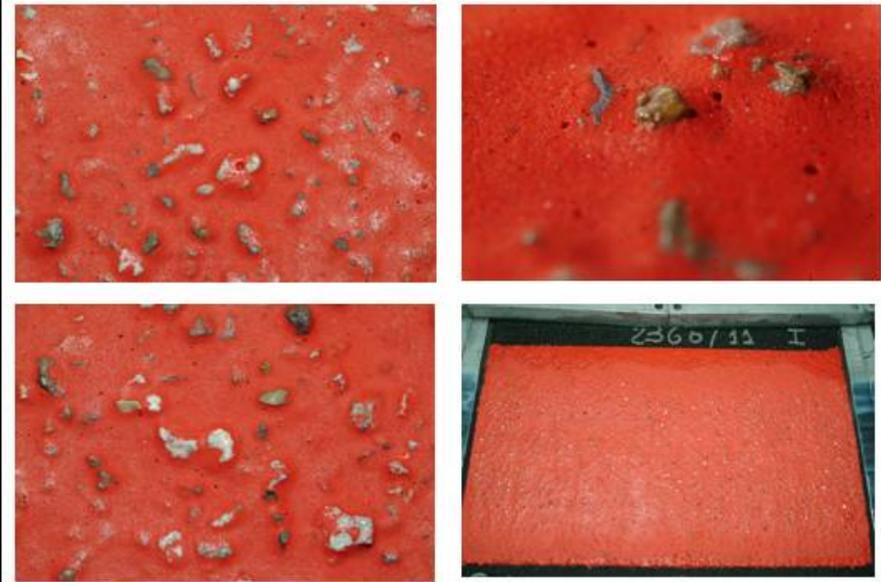


Visual consistency:

Pictures taken at the beginning
(prior to test run)



After 8,000,000 wheel passages





Conclusions

- New ideas in grade crossing safety should be the top priority of all parties (the general public, railroads, state and local agencies).
- These innovative grade crossing dynamic envelope pavement marking designs illustrate a low cost option for improving grade crossing safety.
- A CPUC initiated dynamic envelope pavement marking study would be beneficial.



Caltrain & Future High Speed Rail Crossing
Located at 16th Street and Mississippi Street (I-280 Overpass)
in San Francisco.



Ft Lauderdale pedestrian gate arm and
"Do Not Stop On Tracks" sign with flashing warning device



California Public Utilities Commission



Thank you!

For Additional Information please contact me or visit our webpage:

<http://www.cpuc.ca.gov/rail/>



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