



Caltrans Division of Research,
Innovation and System Information

Research

Notes

Construction

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Project Title:
Orange Temporary Pavement
Delineation in Construction Zones

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Orange Temporary Pavement Delineation in Construction Zones

Evaluating the effectiveness of orange pavement delineation in construction zones by measuring driver lane position before and after installation

WHAT IS THE NEED?

Highway workers working in construction zones are injured and killed every year by errant drivers. Orange temporary pavement delineation has been used around the world as a method of increasing driver awareness and improving safety in construction zones. European countries, Canada, and New Zealand have implemented this striping with positive results. Testing in three U.S. states has indicated that it can reduce driver confusion and improve worker safety, but it has not been tested in California yet. It is anticipated that orange delineation will increase its visibility to motorists, their awareness of being in a work zone and the likelihood of them driving at reasonable speeds. This research will also provide an opportunity to test benefits of orange striping for Connected and Automated Vehicles (CAV). Caltrans sees this research as an opportunity to improve the safety along the state highway system for both drivers and workers.

WHAT ARE WE DOING?

This project will assess the influence of orange pavement delineation in a work zone in Caltrans District 11 in the Interstate 5 (I-5) North Coast Corridor (NCC) Construction Project in San Diego County (about 14 miles one-way). Construction Units 1, 2, and 3 of the I-5 NCC Projects are using standard temporary white striping. For Unit 4, striping with orange contrast will be implemented from Palomar Airport Road to State Route 78 (about 4.1 miles in each direction, northbound and southbound). It is planned to have two alternative orange striping patterns for lane lines, right edge line, lane drop, and gores in the southbound direction and northbound direction. The different units allow the researchers to compare driver behavior and evaluate the effectiveness of the orange temporary delineation compared to standard temporary white striping.



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Driver behavior will be observed by temporary installations of closed-circuit television (CCTV) cameras to measure vehicle speed, lateral position in lanes and number of lane departures. Visibility and durability of the orange delineation paint will be measured in terms of chromaticity and retro-reflectivity values when first installed and at approximately 2-month intervals afterwards over one year. The influence of the orange striping on the number and severity of traffic incidents will be observed according to available data from the California Highway Patrol (CHP) by comparing reports from Units 1, 2, or 3 (using white delineation) with Unit 4 (using orange delineation). Driver perception of, and preference for, orange versus white delineation will be measured by a website survey through a partnership with a Caltrans District 11 public relations consultant.

WHAT IS OUR GOAL?

Evaluate the effectiveness of orange pavement delineation in a work zone by comparing driver behavior in zones with white and orange delineation. Measure the influence of orange delineation on motorists' lane position and speed.

WHAT IS THE BENEFIT?

The results of this project will allow Caltrans to make an informed decision about whether to use orange striping for temporary work zone delineation. If proven effective, subsequent statewide implementation of orange work zone delineation could save the lives and property of road-side construction workers and the travelling public.

WHAT IS THE PROGRESS TO DATE?

The kick-off meeting was held on April 8, 2021, and an on-site project meeting was held on June 15, 2021 in the field office in Cardiff, CA. The researchers surveyed the current (white delineation) and future (orange delineation) work zones and made recordings with a GoPro8-Dashboard camera.

The researchers continued designing and prototyping the closed-circuit television (CCTV) camera system. They discussed and refined appropriate camera mounting locations with District 11 engineers. Mounting on vertical fence posts on specific bridges and overcrossings was approved by Caltrans' Offices of Structure Construction. The researchers are exploring two main software-based approaches for analyzing the video data.

The researchers ordered, received and tested the reflectometer to measure retro-reflectivity and nighttime chromaticity and the spectrometer to measure daytime chromaticity. They reviewed literature on retro-reflectivity, nighttime chromaticity, and daytime chromaticity of pavement markings. They received training on the BYK Gardner spectrometer by the manufacturer on August 26, 2021. They also attended a webinar on Sept. 9, 2021 about Color Systems for Solid and Effect Colors and a webinar about Color difference equations for solid and effect colors on Sept. 15, 2021, both held by BYK Gardner. They developed initial protocols for measuring striping quality with the reflectometer and spectrometer.

The researchers acquired a Light Detection and Ranging (LiDAR) sensor.

The researchers developed a draft web-based survey with Southwest Strategies, the Caltrans District 11 public relations consultant.

The researchers submitted the first 6-month report to the Federal Highway Administration (FHWA).

Work planned for next quarter:

The researchers will assemble two CCTV camera systems for two locations with temporary white striping and install them in conjunction with District 11's electrical subcontractor. They plan to eventually install 8 more systems at 5 locations with temporary orange striping once it is in place. The researchers will start collecting video data from each camera system as soon as they are

installed. They plan to install a LiDAR somewhere within the temporary orange striping work zone. Southwest Strategies will post a survey about driver perception of, and preference for, orange versus white delineation on the I-5 North Coast Corridor ("NCC") project website, and the researchers plan to include some of the results in their final report.

The researchers plan to measure striping quality soon after the orange striping is installed. They will likely have access to only the lane lines between lanes 1 and 2 during a night closure for K-rail installation. The researchers will train Caltrans staff and/or the work zone contractor to subsequently collect data at regular intervals until they join the data collection effort again after 6 months.

IMAGES



Image 1: I-5 North Coast Corridor (NCC) construction project area



Image 2: Reflectometer to measure retro-reflectivity



Image 3: Spectrometer to measure daytime chromaticity

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Image 4: Kentucky DOT orange temporary work zone pavement delineation



Image 5: Wisconsin DOT orange temporary work zone pavement delineation

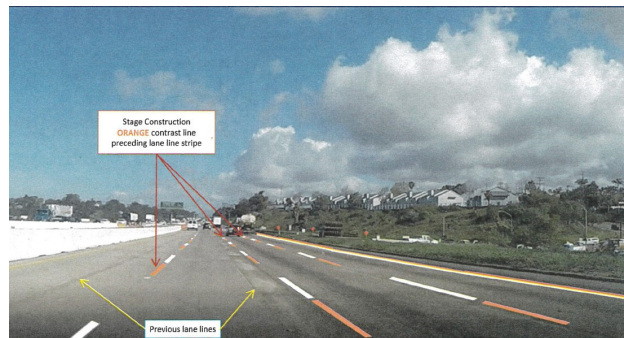


Image 6: Caltrans District 11 proposed orange temporary work zone pavement delineation pattern – alternative 1

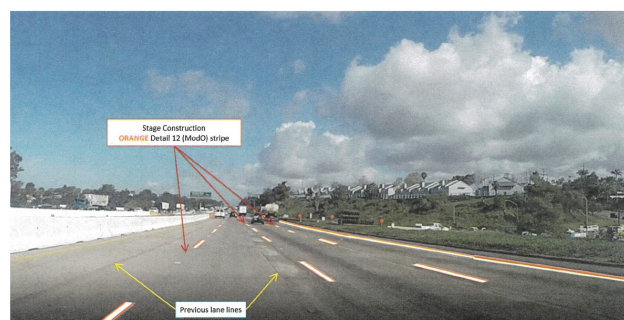


Image 7: Caltrans District 11 proposed orange temporary work zone pavement delineation pattern – alternative 2