

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). California Department of Transportation (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 traveling 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 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).

The researchers procured and assembled 5 camera systems with an electronics box, a solar panel and two cameras each. They transported 3 of them to District 11 on January 11, 2022 and supervised installation at Jefferson overcrossing on January 11 and at Las Flores overcrossing on January 12 by Caltrans' subcontractors. The researchers painted reference markings on the freeway to calibrate the machine vision algorithm and downloaded and tested initial video data. The other camera system was installed at La Costa Overcrossing on March 16, 2022.

The researchers wrote software to download video from the cameras and determine the volume, speed and lane position of vehicles. They measured color and retro-reflectivity of sample areas on the freeway and on the Caltrans maintenance yard in District 11. Operation of the spectrometer and retro-reflectometer was demonstrated to Caltrans' construction inspection engineer and an engineer working for the contractor who will be able to make subsequent periodic measurements.

Work planned for next quarter:

The researchers plan to install the remaining two camera systems at Cassidy and Palomar Airport Rd overcrossings. 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. Color and retro-reflectivity of samples will continue at 2-month intervals.



Image 2: Reflectometer to measure retro-reflectivity

IMAGES



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



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

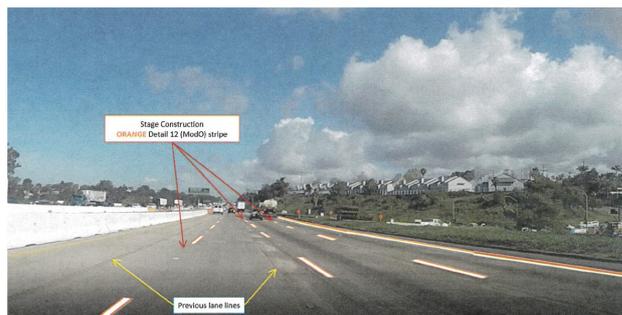


Image 7: Caltrans District 11 proposed orange temporary work zone pavement delineation pattern – alternative 2

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