U.S.Department of Transportation
Federal Highway Administration

Embedded LEDs in Signs

Purpose

Embedded Light Emitting Diodes (LED) in sign faces improve safety at intersections by enhancing driver awareness of traffic-control signs.

Alternative Names

Solar-powered LED road signs, flashing LED-enhanced solar-powered traffic signs, LED-enhanced signs.

Operation

LEDs can be embedded in standard highway warning and regulatory signs to outline either the sign itself or the words and symbols on the sign. The LEDs may be set to flash or operate in steady mode. LEDs may be illuminated 24 hours a day, or be activated by vehicles or pedestrians. Due to the low power requirements of LEDs, signs with embedded LEDs can typically be powered using stand-alone solar panel units.

This treatment is applicable for regulatory and warning signs at unsignalized intersections with the intended purpose of improving the visual conspicuity of the signs. Typical locations where LED-embedded signs can be implemented include:

- Locations with sight visibility limitations (horizontal curves, dusk/dawn glare, etc.);
- Locations with documented problems of drivers failing to recognize an intersection; and
- At STOP signs – this treatment may help to increase the rate of vehicles stopping and to avoid drivers failing to detect the STOP sign.

Potential Benefits

In general, embedded LED units are used to:

- Improve driver compliance with regulatory signs through improved conspicuity; and
- Enhance visibility and recognition of regulatory and warning signs to drivers, especially under low-light or low-visibility conditions.

Agency Experience

A study on safety effects of LEDs embedded in STOP signs, conducted by the Texas Transportation Institute in 2004, found:

- A 28.9 percent reduction in the number of vehicles not fully stopping; and
- A 52.9 percent reduction in the number of vehicles moving through the intersection without significantly slowing.

Gates, T.J., Carlson, P.J., and Hawkins, H.G., Jr., "Field Evaluations of Warning and Regulatory Signs with Enhanced Conspicuity Properties."

This summary is one in a series describing Innovative Intersection Safety Treatments. The summaries identify newer technologies and techniques to improve intersection safety developed since NCHRP Report 500, Volumes 5 and 12, were published in 2003 and 2004, respectively. These treatments show promise for improving safety but comprehensive effectiveness evaluations are not yet available.

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Figure 1: Example of stop sign with embedded LEDs and solar unit.

Figure 2: LEDs are embedded in the symbols and lettering on this truck warning sign.

Figure 3: Example of pedestrian crossing warning sign with embedded LEDs and solar unit.

A similar study, conducted by the Virginia Transportation Research Council in 2007, found:

- A statistically significant decrease in vehicle approach speeds ranging from 1.9 to 3.4 miles per hour (mph) with an average of 2.7 mph (a 7 percent decrease) indicated that LED STOP signs positively affected driver behavior.
- Speed decreases tended to be greater during the night than during the day.

E. D. Arnold, Jr., and K. E. Lantz, Jr., "Evaluation of Best Practices in Traffic Operations and Safety: Phase 1: Flashing LED Stop Signs and Optical Speed Bars."

LED lights have been used in signs in Florida and Wisconsin and have been evaluated in STOP signs in Virginia and Texas. Naval Station Mayport in Florida installed a pedestrian walk sign with embedded LEDs.

Implementation Considerations

- Due to low power usage, solar applications make the use of this treatment flexible enough for nearly any location.
- LEDs may be set to flash 24 hours a day or be vehicle or pedestrian activated.

Manual on Uniform Traffic Control Devices (MUTCD) Specifications

- If used, the LEDs shall be the same color as the sign legend, border, or background. If flashed, all LED units on an installation shall flash simultaneously at a rate of more than 50 and less than 60 times per minute. The uniformity of the sign shall be maintained without any decrease in visibility, legibility, or driver comprehension during either daytime or nighttime conditions. *MUTCD, Section 2A.08.*
- MUTCD, Section 2A.08 contains further information that should be consulted when installing a sign with embedded LEDs.
- Lighting elements for illuminated signs (e.g. LED-embedded signs) should be replaced on a regular maintenance schedule. *MUTCD, Section 2A.22.*

Costs

During the course of the 2007 Virginia Transportation Research Council study, the costs for 48-inch, 36-inch, and 30-inch signs embedded with LEDs were estimated at $1,860, $1,640, and $1,600, respectively. This included the cost of the solar power supply, but did not include an additional $175 for post and anchor or the cost of installation.

Learn More

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http://www.virginiadot.org/vtrc/main/online_reports/pdf/07-r34.pdf

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