U.S.Department of Transportation
Federal Highway Administration

LED Raised Pavement Markers

This summary is one in a series describing Innovative Intersection Safety Treatments. The summaries identify newer technologies and techniques for 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.

Purpose

Light Emitting Diode (LED) pavement markers improve the safety of intersection approaches, as well as pedestrian, bicycle and other crossings. These markers enhance delineation and driver awareness, especially in low visibility conditions.

Alternative Names

Daylight-visible or solar-powered LED raised pavement markers, LED-illuminated pavement markers, solar road markers or studs.

Operation

- Light Emitting Diode (LED) Raised Pavement Markers (RPM) function similarly to standard reflective pavement markers, but have small LEDs located inside of them instead of (or in addition to, retroreflective components).
- LED RPMs have built in sensors that can automatically turn on the LEDs when ambient light drops below a preset level or can be wired to operate as an active treatment in conjunction with vehicle detection.
- LED RPMs are currently powered either by a solar photocell charger in each marker, or by wiring to a power source such as a signal controller.
- LED RPMs should not be operated in flash-mode to comply with the Manual on Uniform Traffic Control Devices (MUTCD).

Potential Benefits

- LED RPMs increase the visibility of intersections during low-visibility conditions (e.g., darkness and inclement weather). Illumination of intersection approaches and crossings helps improve road user recognition of intersection location and features.
- At intersections with vertical or horizontal curves causing limited sight distance for traffic entering the intersection, LED RPMs activated by vehicle detectors can help provide advance notification to drivers of potential vehicle conflicts.
- LED RPMs are more visible than retroreflective RPMs under conditions that reduce the effectiveness of headlights and retroreflective material (e.g., inclement weather).
- At rural intersections, where powered lighting may not be available, the use of solar-powered LED RPMs may provide an alternative safety treatment.

Safe Roads for a Safer Future
Investment in roadway safety saves lives

May 2009
FHWA-SA-09-007

Figure 1: Example LED Raised Pavement Markers.

Figure 2: LED Raised Pavement Marker installed at intersection to guide turning movements.

Learn More:

Carlos Ibarra, Texas Department of Transportation

cibarra@dot.state.tx.us

Ed Rice, Intersection Safety Team Leader
FHWA Office of Safety

202-366-9064

ed.rice@dot.gov

Agency Experience

- LED RPMs have been used in Texas in advance of horizontal curves to notify drivers that they are approaching the curve too quickly. The Texas Department of Transportation has installed LED RPMs on roadway edgelines and centerlines, including near intersections and in conjunction with other treatments such as rumble strips or flashing beacons on the sign posts.
- LED RPMs have been employed in Florida in several locations, and Florida DOT standard drawings provide for LED RPMs at intersections along lane lines and areas of channelization.
- The Oregon DOT conducted performance testing of LED RPM from several different manufacturers. The summary report is available at *http://www.oregon.gov/ODOT/TD/TP_RES/docs/Reports/2007/FHWA-OR-RD-08-07.pdf* and includes results that indicate that many LED RPMs may not meet retroreflectivity and chromaticity standards.
- The known uses of LED RPMs include steady, nighttime only operation, as well as a flashing operation implemented in Texas based on speed detection, which is engaged when vehicles are travelling at excessive speeds. Note that this flashing operation does not comply with the MUTCD, as described below.

Implementation Considerations

- Hardwired LED RPMs have been found to be brighter than the solar-powered models.
- LED RPMs could potentially be implemented anywhere traditional RPMs are currently placed, including lane line delineation, gore areas, or painted channelization.
- An Institute of Traffic Engineers (ITE) study found that snow melts on LED RPMs faster than on the adjacent roadway, allowing snow plow damage to be avoided.

MUTCD Specifications

- Allow light sources, including LEDs, within raised pavement markers to accentuate their visibility, and specifies raised pavement marker design, colors, location, spacing, and usage. *MUTCD, Sections 3B.11 – 3B.13.*
- In-roadway lights (i.e. illuminated markers level with the pavement) are reserved for pedestrian crossings, even though in-roadway lights may be preferred to raised pavement markers from a maintenance standpoint. *MUTCD, Sections 4L.01 – 4L.02.*
- Internally illuminated RPMs used as positioning guides or to supplement or substitute for other markings must operate in a steady (non-flashing) mode. *MUTCD, Section 3B.14.*
- Flashing LED lights in or on the roadway are considered to be an in-roadway version of a traditional flashing beacon warning signal. Therefore, the use of flashing in-roadway lights is currently limited to use for uncontrolled marked crosswalks. At this time, any other use of flashing LED markers must receive official experimentation approval from FHWA per MUTCD Section 1A.10. MUTCD, Section 4L.02.

Costs

- A photocell powered LED RPM unit costs approximately $50 including material and installation costs.
- MUTCD, Sections 3B.11 and 3B.14 provide standards for LED RPM placement. Placement frequency will depend on the specific application.