ENHANCING PASSIVE CROSSING SAFETY WITH SOLAR TECHNOLOGY

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ABSTRACT

Trespassing at passive railway crossings accounts for approximately half of the annual deaths at highway-rail intersections in the US. (1) Marked by crossbucks or advance warning signs, passive crossings rely on drivers and pedestrians to notice and properly respond to signage. Rural areas where winding roads and environmental conditions can most compromise a driver's ability to see and respond to signage are often the areas where the cost of installing active warning devices cannot be justified. For this reason, there is increased emphasis on finding effective, low-cost warning signals to improve safety at low-volume grade crossings throughout the United States. (1)

Solar-powered flashing beacons offer an ideal solution for these applications. Operating free of the electrical grid, solar power removes geographical barriers to installing important safety enhancements. Solar technology requires no trenching or cabling, and compact solar flashing beacons install easily onto existing sign posts. Significant improvements in solar technology mean that modern solar equipment functions reliably in virtually any environment. While it is important to understand the limitations of solar when deciding upon the validity of the technology for individual applications, solar power can all but remove the conventional barriers to implementing enhanced safety measures at passive crossings. In addition, solar technology can improve an agency's bottom line and help to demonstrate a commitment to eco-friendly infrastructure improvements.

With the ability to enhance safety at low-volume grade crossings easily and cost-effectively solar technology may offer the effective, low-cost device that agencies have been searching for.
PASSIVE RAILWAY CROSSINGS - A SAFETY HAZARD

While active train crossings assist drivers in safe navigation, passive railway crossings rely entirely upon driver knowledge, awareness and discretion for appropriate and safe crossing procedures. Marked with signs ranging from crossbucks to stop signs, passive crossing markings require that drivers recognize and respond appropriately to the signage in place. Drivers must also be able to easily see the crossings and the corresponding signs for marking to be effective.

This combination of variables has the potential to create significant hazards at passive railway crossings. Research has shown that drivers often do not respond appropriately to passive crossing signage: tending to make rolling stops, or no stops when confronted with a stop sign. (1) Crossbucks also create a hazard for drivers who often understand the sign to mean that railroad tracks are present, rather than indicating the possibility of an oncoming train. (2)

The increasing percentage of aging drivers creates a further concern, with many older drivers experiencing a loss of visual acuity and contrast sensitivity that affects their ability to detect critical elements such as crossbuck or warning symbols. (3) Diminished capacities related to age can also preclude the detection of a train at a crossing until impact is imminent, especially at night. (3)

While passive crossings comprise only 67% of all grade crossings in the United States, they are responsible for nearly 50% of the annual railway/roadway crossing deaths. A large number of these deaths occur during nighttime conditions when visibility is a factor. (1) Indeed, passive crossings present a major safety concern and continue to be the focus of widespread rail safety campaigns such as Operation Lifesaver, a program that encourages rail safety through education across Canada and the United States. (4)
IMPROVING SAFETY AT PASSIVE CROSSINGS

Certainly education plays a large part in improving the safety of passive crossings; however, with an increasing population of aging drivers, and taking into account the limits of retro-reflective signs in night and low-visibility conditions, driver education should not be the sole focus of safety improvements.

Many passive crossings are passive for a reason. Often they are present in areas of low train and/or traffic volume: for example, on rural roads. In remote and rural locations power may present challenges, with the electrical grid being difficult or impossible to access. This difficulty directly affects the ease and feasibility of installing active warning systems.

In addition, with the cost of converting a passive crossing to an active crossing estimated between $200,000 and $400,000 per intersection, installing active warning signals can prove to be cost prohibitive for agencies. (1)

Nevertheless, research shows that markings such as flashing lights and illumination at passive crossings significantly improve driver behavior, recognition and visibility. (3) Drivers’ braking response is improved when signage is marked with flashing lights, while conspicuity and compliance to signs also shows significant improvements with the presence of flashing lights. (1, 3) In addition, flashing lights increase peripheral recognition for drivers, an important finding for the aging driver population. (5) Properly directed illumination at crossings has also been shown to significantly reduce crash statistics at passive highway-rail grade crossings, particularly during hours of darkness. (3)
The problems of budgetary restraints and electrical grid access aside, there can be little doubt that for agencies seeking to improve the safety of passive crossings, research supports the addition of flashing lights and/or general illumination as an effective improvement. (Table 1)

ALTERNATIVE SOLUTIONS AS A METHOD OF ADDRESSING OPERATIONAL CHALLENGES

Unfortunately, the need for flashing lights and/or general illumination does not, in and of itself, override the presence of budget limitations and the difficulty of electrical grid access in remote locations. To navigate these challenges, agencies must look to alternative solutions.

Gaining attention and acceptance for a variety of applications, solar technology can provide an agency with an effective, versatile and reliable alternative solution for improving safety at passive crossings. By its very nature, solar-powered technology eliminates the concerns associated with electrical grid access. Solar-powered lighting requires no trenching or cabling, and provides compact, stand-alone illumination to virtually any location.

By avoiding extensive installation procedures, solar technology eliminates many of the costs associated with establishing safety improvements such as hard-wired flashing lights and area illumination. Solar flashing beacons can be installed onto existing signposts with little more than a screwdriver and wrench and can be integrated with wireless technology to function as an advance warning system. Solar area illumination can be installed in any location that can benefit from additional lighting and can be programmed with intelligent operating profiles that allow for illumination levels to match times of greatest traffic volume.

In addition, current solar power technology has the capacity to significantly reduce maintenance cycles and associated expenses. With the integration of intelligent energy management systems, leading edge solar solutions are able to dynamically adjust light output to match the level of solar
charging available. This ensures that energy is conserved appropriately during times of low solar charging such as low light and winter conditions, making solutions remarkably reliable. Incorporating LED technology, solar LED solutions provide for lengthy product life often functioning without scheduled maintenance for five years or more.

With no connection to the electrical grid, solar technology is also immune to electrical grid failures, allowing for safety equipment to function at all times.

Solar technology also eliminates the cost associated with ongoing electrical bills. Naturally self-sustaining, solar technology has no electricity requirements and as an added benefit, generates no greenhouse gases. Beyond the flexibility of application and ongoing cost benefits, the eco-friendly benefit of installing solar technology allows an agency to leverage its public profile with the implementation of sustainable, green solutions.

**REMOVING BARRIERS TO IMPROVING SAFETY**

With safety at passive crossings continuing to be a real concern for agencies, there is a need to look beyond current solutions. Alternative energy resources are gaining increased attention and acceptance, and solar technology is leading the way in a variety of applications.

For railway agencies seeking to improve safety at passive crossings, solar technology provides an attractive and viable solution. Cost-effective, reliable and flexible, solar-powered flashing beacons and solar-powered area illumination offer passive crossing improvements that research has proven to be effective.

With the introduction of solar technology, agencies can significantly improve the safety of passive crossings while avoiding logistical challenges that have prevented the implementation of safety measures in the past.
REFERENCES


Table 1: Transport Canada, Passive Crossing Safety Countermeasure Type, Effectiveness, Cost and References

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<th>Countermeasure</th>
<th>Effectiveness</th>
<th>Cost</th>
<th>Reference(s)</th>
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<tr>
<td>Stop Signs at Passive Crossings</td>
<td>Unknown</td>
<td>$1.2 to $2 K (U.S.)</td>
<td>NTSB (1998a)</td>
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<td>Intersection Lighting</td>
<td>52% Reduction in Nighttime Accidents over No Lighting</td>
<td>Unknown</td>
<td>Walker &amp; Roberts (1975)</td>
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<td>84% Reduction in Injuries over Crossbucks;</td>
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<td></td>
<td>83% Reduction in Deaths over Crossbucks</td>
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Countermeasures are listed by approximate date of introduction. The effectiveness of a countermeasure is expressed as a function of the percentage reduction in accidents and other violations over some previous treatment. Cost is expressed in U.S. dollars for the most recent reference.
### TABLES AND FIGURES

**Table 1**: Transport Canada, Passive Crossing Safety Countermeasure Type, Effectiveness, Cost and References. Une analyse des facteurs humains dans les accidents aux passages à niveau au Canada (TP 13938F). Undated. [http://www.tc.gc.ca/TDC/summary/13900/13938f.htm](http://www.tc.gc.ca/TDC/summary/13900/13938f.htm)

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