In-Pavement Flashing Crosswalks - State of the Art

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The past four years have seen the development and perfection of a new treatment for uncontrolled marked crosswalks. The device is known by many terms, including "Illuminated Crosswalk;" however, the most commonly known device of this type is generally referred to as an "in-pavement flasher system" (IPF). These devices are mounted in the street pavement adjacent to the outside of the crosswalk markings. They are normally dark, but they are actuated to provide a flashing yellow light while the pedestrian crossing is in use. The photo shows a typical IPF.

IPF systems address concerns that motorists may "tune out" conventional flashing beacons that are operated continuously. Motorists appear to be more apt to notice a device that is currently flashing, if it normally does not flash. Further, motorists may be more likely to properly react to the warning condition if the flashing operation is more closely associated with the condition, not the site.

The City of Fountain Valley, California retained Katz, Okitsu & Associates to review the state-of-the-art for use of IPFs. The study included a survey of existing users to obtain their experiences and opinions. Thirty-five public agencies were identified to use IPF systems when the study was being conducted in the year 2000. This represented about 100 installations, mostly in the states of California and Washington. However, the number of agencies that have installed these systems and the number of locations have continued to increase since the study was completed.

Current Policy on Usage

The most recent version of the Manual of Uniform Traffic Control Devices allows for the use of IPFs at appropriate locations, and it presents guidelines for their usage. California has generally led activities in testing and demonstration of the devices. The California Traffic Control Devices Committee (CTCDC) sponsored an evaluation of performance at a set of initial installations in 1998. The CTCDC has developed guidelines for usage and has generally given local agencies a full authority to install in-pavement flashers. The CTCDC now only requires local agencies to inform the Committee about new installations.

System History and Manufacturers

The experimentation with IPFs began in Santa Rosa, CA in 1993. After a fatal pedestrian accident involving a friend, a private citizen went before the City with the idea for a flashing device to be installed on the pavement surface along the crosswalk lines and facing traffic. This citizen invented the pedestrian crosswalk warning system, now known as the LightGuard System, and founded the company of the same name in 1994.

To date, three commercial vendors supply in-pavement flashers. They are LightGuard Systems, Inc., Santa Rosa, CA, Traffic Safety Corporation, Sacramento, CA (a.k.a. Flight Light), and Astucia UK LTD, England (Intelligent Road Studs). Other traffic control device manufacturers are also currently developing comparable product lines. Pricing can be quite variable, but $20-50,000 per location is an appropriate range, depending upon the amount of site preparation and accessories required.

Site Characteristics

The following information was compiled for 100 locations where these devices are installed.

Average daily traffic ranges from 2,500 to 23,100 vehicles per day.
The number of lanes crossed ranges from 2 to 5 lanes.
About 18% of the roadways have a median.
About 65% of the roadways have a left-turn lane.
About 71% of the sites allow parking on the street.
About 24% of the roadway cross-sections have bike lanes.
About 19% of the crossings are school crossings.
About 59% of the installed in-pavement flashers are activated by push-button.

User Satisfaction

User agencies generally report a high level of satisfaction. These agencies also report that there is a high level of satisfaction by the public. However, support is not 100%. The devices do not guarantee to prevent all pedestrian accidents, and the survey found support to be weakest among agencies that have experienced accidents at sites following implementation of IPFs. One agency indicated that they intend to remove the devices and replace them with a different device. It should be noted also that most of the in-pavement flasher systems surveyed have been installed for three years or less at the time the survey was done.

Support for the use of these devices appears to be generally weaker among agencies and individuals that have not utilized the devices, although these agencies were not formally surveyed for the project.

Agencies also provided information on the primary concerns and objections they have received from the public since installation. The most common concerns are:

People see nothing flashing, so they don't know if the device is working.
Some people don't understand how to use the device.
Persons do not push the actuation button, so the device is not providing benefits.
The device does not stop traffic effectively enough.
The devices should flash red, not yellow, requiring all drivers to stop.

Detection Issues

Detection of the pedestrian is the most common area of criticism by users of the devices. There are two means of activating IPFs, Passive Detection and Push Button. Each method has its advantages and disadvantages, but most agencies that have installed passive detection systems would not recommend its use in future installations, unless improvements to the detection system are made.

Push button detection is done using equipment similar to traffic signal pedestrian push buttons. It is generally more reliable, less expensive, and simpler to maintain than passive detection. It is strongly preferred by maintenance personnel. However, the lights will begin to flash as soon as the button is pushed, regardless of the level of traffic at the time. Aggressive motorists may be unwilling to yield to pedestrians at first, even though the lights are flashing. Motorists driving within coordinated signal systems may also be more unwilling to yield while driving within platoons created by upstream traffic signals. As a result, it is common for the pre-set flash timer to time out before pedestrians can fully cross the street.

Passive Detection has been done using microwave, motion sensors, video detection, or light trip beam. When working properly, passive detection is less disruptive to traffic, as pedestrians typically wait until there is a natural gap in traffic before stepping off the curb and activating the device. This also causes less difficulty in setting the flashing interval duration.

There have been frequent complaints from maintaining agencies that the microwave detection is difficult to operate properly. The systems produce false calls in inclement weather and at other times. They also are more complicated and require maintenance techniques that are
different from the requirements of traffic signals. The most recent installations use gateway bollards with light trip beams. These appear to have fewer problems than the earlier microwave detectors. The agencies reporting the use of bollards with light trip-beams appear to be more satisfied than the users of other detection types.

Effectiveness and Safety Benefits

W-Trans Engineers of Santa Rosa, CA, and the University of North Carolina, Transportation Research Center, have conducted human factor studies. These have found that IPFs improve motorist response to pedestrians within crosswalks. Braking distance prior to crosswalks increases following installation, and the percentage of motorists who yield to pedestrians also increases at typical installations. There were no attempts to measure or quantify safety benefits of the systems prior to the Fountain Valley study, because the number of locations and years of experience was not yet significant to allow a comparison.

The Fountain Valley study attempted to compile accident information from the survey participants to conduct an initial safety assessment. There have been two reported known pedestrian accidents among the locations surveyed in this study since the installation of in-pavement flashers. With over 427 million vehicle crossings since installation, the number of reported accidents is about 80% less than might be expected from uncontrolled marked crosswalks with "average" crosswalk treatments. There have been concerns over increases in rear-end accidents at locations with in-pavement flashers, but this concern has not been quantified. This study presents the first evidence that pedestrian safety at uncontrolled marked crosswalks is better at locations with IPFs than at comparable marked crosswalks with average signing and striping treatments. However, no locations with in-pavement flashers have existed long enough to determine whether this effect will be permanent and long lasting.

Comparison with Alternative Treatments

Other striping and marking techniques may be equally effective at reducing pedestrian accidents at marked crosswalks, including advanced limit lines and actuated overhead flashers. However these passive treatments may not be as effective in producing greater motorist compliance with pedestrian right-of-way. The increase in motorist response is probably the key element in actuated flash systems that may distinguish them from passive treatments.

Final Recommendations

We have recommended the use of IPF systems as a tool to agencies that have established high goals for

pedestrian mobility while preserving or enhancing pedestrian safety. The devices show promise to improve pedestrian safety at certain types of marked crosswalks beyond conventional treatments. We could recommend consideration of this device to any interested community that has appropriate locations for its use. However, potential users should understand that the technology is new, under continuing improvement, and liable to change in the future. Most users appear to be responding to strong City policy mandates, such as "Pedestrians First". Many users may also consider themselves as experimenters or early innovators, knowing that current City goals will be met, but that changes, difficulties, or surprises may emerge at a later date.

Various guidelines and warrants for usage are emerging. However the devices appear to be most effective for use on multi-lane roadways where pedestrian usage is moderate and reasonably expected. They may be most appropriate for undivided roadways in downtown areas, commercial areas, or densely developed areas that do not offer median refuges for crossing pedestrians, since these types of roadways are most problematic for pedestrian safety. The devices do not appear to be as effective at high-speed multi-lane locations, especially where pedestrians are infrequent and rarely expected. They are probably unnecessary at locations across two-lane undivided urban roadways, since yielding and safety are less likely to be problems prior to application.

Where the devices are implemented, trip-beam actuation systems using a bollard gateway should be considered. Although they are currently less reliable, the detection technology is improving and there are considerable benefits for both vehicles and pedestrians. Systems with "passive actuation" are less disruptive to signal coordination, because pedestrians will usually wait for a gap in traffic before entering the roadway. Where push-button actuation is employed, the flashing operation begins immediately, maximizing potential interference with traffic, and making timing of the flash duration difficult. We believe that the use of passive actuation will become the standard approach after it is fully perfected. This will be accomplished only through continued deployment of the passive systems.

The complete Fountain Valley Flashing crosswalks study can be reviewed and downloaded in PDF format by clicking here. There are several other studies and documents at this site, as well as links to similar sites that may be of interest to persons researching pedestrian safety.