Installations of the pushbutton-integrated style of accessible pedestrian signals (APS) now specified by the MUTCD (4E.09-4E.13) are making it much easier for visually-impaired pedestrians to cross streets safely and confidently. These APS have a loudspeaker integrated into the pedestrian pushbutton, rather than being installed on the pedestrian signal head. They have tactually discriminable arrows aligned in the direction of travel on the associated crosswalk which vibrate during the walk interval. The standard walk indication is a tick or tone sounding at a rate of approximately 8/second.

Where possible, there must be two pushbuttons on corner installations separated by at least 10 feet. If pushbuttons are installed with two devices on one pole (or closer together than 10 feet), the walk indication must be a speech message providing the name of the street to be crossed. When speech messages are required, APS are also required to have a “pushbutton information message” normally actuated by a button press of more than one second, that begins with the word “Wait,” and then provides the name of the street to be crossed.

An important feature of pushbutton-integrated APS is a pushbutton locator tone comprised of a very short tone repeating once a second during the flashing and steady don’t walk intervals. Pushbutton locator tones let approaching pedestrians know they need to push a button to request pedestrian timing and to get a WALK indication. The tones come from the housing of the pushbutton, and thus help pedestrians who are visually impaired to locate the pushbutton.

APS pushbutton locator tones and walk indications are required to respond to ambient sound quieter when there is little traffic and louder when there is more traffic or a noisy vehicle passing. The sound level should be set so locator tones and walk indications are audible six to twelve feet from the pushbutton or to the building line, whichever is closer. This setting is intended to ensure visually-impaired pedestrians will hear the APS as they approach a crossing, but the APS will not be loud enough to be a neighborhood nuisance. For more information about APS, their use by pedestrians who are blind, and detailed installation information, see the information developed as part of National Cooperative Highway Research Program Project 3-62, Guidelines for Accessible Pedestrian Signals at www.apsguide.org.

Adjustment of the sound level is accomplished in different ways on devices by different manufacturers, but it always requires careful listening on the part of the installer, from different directions and distances. This is more art than science as loudness is a subjective judgment and is influenced by wind, nearby reflective surfaces, humidity, and the hearing of the listener. It is further complicated by the fact that the absolute level of the sound varies with passing traffic. Default settings are rarely appropriate.

Even with careful adjustment, however, some people find pushbutton locator tones objectionable. Automated or passive pedestrian detection used to actuate both the walk indications and pushbutton locator tones has the potential to decrease sound pollution and neighborhood objection. (See “Taking the Next Step” by D. Gibson, P. Burton, N. Boudreau, M. Bobinsky, J. Hoben, B. Ling, and B. Bentzen in IMSA Journal, September/October 2013, reprinted from Public Roads March/April 2013, Vol. 76, No. 5.)

The MUTCD 4E.09 says “Accessible pedestrian signal detectors may be pushbuttons or passive detection devices.” The use of passive detection to actuate locator tones is not specifically mentioned. However, in addition to resulting in a quieter environment, the actuation of APS by passive detection may have some benefits for those who use them. It could also have adverse consequences. As mentioned in “Taking the Next Step,” “...additional research is needed to fine-tune the system to optimize it for the needs of visually impaired individuals.” (Gibson et al, p. 46.)

**Possible Benefits to Pedestrians Who are Visually Impaired**

There may be benefits of automated pedestrian detection for pedestrians who are visually impaired. One of the primary clues that visually-impaired travelers use to judge the probable direction of a crosswalk is the direction they were walking as they approached the corner. If they need to deviate during that approach to find and push a button, their initial alignment to cross may be less accurate than when they do not have to deviate from their straight approach to the street. If alignment is more accurate, they are less likely to veer outside the crosswalk as they cross. Auto-
mated pedestrian detection may also mean pedestrians who are visually impaired experience less delay when getting ready to cross.

Possible Adverse Consequences for Pedestrians Who are Visually Impaired

A major concern with automated detection is visually-impaired pedestrians may be less certain that the onset of an audible walk indication is for the crosswalk they intended to cross because they do not have to go to the APS device and push a button. They may be more likely to mistakenly begin to cross with the audible walk indication for a crosswalk that is orthogonal to the one they wish to cross, taking them into the path of moving traffic.

Pedestrians who are visually impaired may feel more confident that they will know which walk indication is for their intended crossing if they have gone to the APS and know exactly where it is. Especially in very noisy situations or for visually-impaired pedestrians who have impaired hearing, including those having common age-related hearing loss, finding the pushbutton and resting the hand on the arrow until it gives the vibratory walk indication assures them that the walk indication they hear is for the crossing they wish to make.

In addition, visually-impaired pedestrians who do not have to push a button to request a pedestrian phase and an audible walk indication, may be less likely to be within the width of the defined crosswalk when they begin to cross, and they may be less sure they are in the correct location to begin crossing. Pushbuttons that are well-located can be a good indication of the location of the crosswalk. However, pushbutton location is still quite inconsistent in the US.

Visually-impaired pedestrians get general directional information from tactile arrows on APS that are correctly aligned with the direction of travel on the associated crosswalk. However, precise alignment with tactile arrows is not possible for most people (Scott et al., 2011).

Nonetheless, it is possible that pedestrians who are visually impaired may align more accurately with tactile arrows, at least at intersections where there is no little or no traffic parallel to the crosswalk, than with other available cues. They may also have more confidence in their alignment based on a tactile arrow than based solely on traffic moving parallel to their intended direction of travel. For this reason, they may wish to locate the APS to check the orientation of the arrow, even though they do not need to push the button to get a walk indication.

Challenges of Installing Automated Pedestrian Detection at Intersections Having APS

The combination of automated pedestrian detection and APS at an intersection results in installation

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challenges that require an understanding of the ways people who are blind or who have low vision travel. Individuals who are blind or who have low vision cross at intersections with which they are not familiar; they are not provided with instruction at every intersection they cross. Special care must be taken in setting detection zones so they include all paths where a pedestrian who is visually impaired may approach or wait to cross at an intersection. There is no “standard” location that can be assumed. The detection zones must be custom set for each corner and each approach.

People who are visually impaired may or may not cross from curb ramps and cannot be assumed to wait on the ramp or on the detectable warning surface (truncated domes). Many individuals prefer to avoid crossing from the ramp, particularly since curb ramps often are directed toward the center of the intersection. Many prefer to walk straight up to a corner and cross from wherever they contact the curb or curb line. Some prefer to travel following the edge of the sidewalk farthest from the street, while others do not intentionally stay close to either edge of a sidewalk. As shown in Figure 1, travel patterns vary depending on the street the pedestrian wants to cross, personal preference, whether the pushbutton is used, and the corner and intersection geometry.

**Detection Zones**

Automated pedestrian detection must not decrease the effectiveness of the information provided by APS. Passive detection zones must be individually set to meet the travel patterns of visually impaired pedestrians. Detection zones for actuating locator tones and/or walk indications must ensure that pedestrians who are visually impaired are detected from all directions of approach, on the full width of the sidewalk, and in all locations at which they may be waiting to cross.

If the automated detection system is used to activate pushbutton locator tones, the detection system must detect approaching pedestrians in sufficient time for locator tones to begin sounding by the time pedestrians are a minimum of six feet from APS pushbuttons so the tones will be audible to most pedestrians a minimum of six feet from the associated APS, as required by MUTCD 4E.12. This means that detection zones for pushbutton locator tones must be relatively large, covering the full width of the sidewalk on both approaches to a corner, as shown in Figure 2.

The walk indication detection zone must cover the entire area

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where pedestrians who are blind may wait to cross. At most corners, there will be some overlap in the location in which pedestrians who are blind will wait to cross in either direction, as can be seen in Figure 1.

Figure 3 shows the approximate area that needs to be covered by the detection zone for actuating the walk indication. The area needs to include the curb line itself, and extend back a minimum of six feet, or to the pushbutton, as pedestrians may wait to cross at varying distances from the curb line and some may wait beside the APS pushbutton. This is likely to be the case when pedestrians rely on the vibrotactile walk indication to be sure they are aware of when the walk indication begins, and to which crossing it applies.

**Need for Careful Evaluation, Extensive Field Testing, and Adjustment**

Careful evaluation is needed to determine whether vehicular and pedestrian volumes make installation of automated pedestrian detection with APS appropriate. At the corner shown, if the pedestrian timing is concurrent with vehicular timing, automated detection zones that are set adequately for APS will frequently actuate the pushbutton locator tones and pedestrian timings for both streets. Where two pushbuttons are on the same pole,

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locator tones and walk indications as well as pedestrian timing for both streets will be actuated by the presence of a single pedestrian. This may have negative impacts on vehicular timing.

Because all pedestrians, not just those who are visually impaired, will actuate the pushbutton locator tones and walk indications when they enter the detection zones, installation of automated pedestrian detection may not result in decreasing the annoyance of the pushbutton locator tones at intersections with high pedestrian usage. In addition, a single pedestrian wishing to cross a minor street may actuate the pedestrian phase for the intersecting major street, resulting in delay for vehicles traveling on the major street when there is no pedestrian wishing to cross.

Getting all parts of a passive detection system with APS to function correctly can be challenging. If, with any approach to a corner from either direction, pushbutton locator tones are not actuated in a timely fashion, pedestrians with visual impairments will not be getting the information they are intended to receive from the APS.

Each installation should be evaluated by approaching each corner from each direction along the center and the extremes of the path of travel that might be taken by a visually-impaired pedestrian, and waiting to cross in the center of the crosswalk as well as at each extreme of the area in which a visually-impaired pedestrian might wait to cross. On each approach, the following functional requirements should be documented.

- Pedestrian’s distance from pushbutton when locator tone begins to sound is no less than six feet
- Number of seconds after entering the walk indication actuation zone before hearing the pushbutton actuation message “Wait” or the pushbutton information message “Wait to cross (street name)” at (street name) is no more than two seconds.
- Audible and vibrotactile walk indications correspond to the timing of the pedestrian signal head display
- APS reverts to the pushbutton locator tone after the walk interval, for the full duration of the pedestrian clearance time
- Where APS provide speech messages, both the pushbutton information message and the speech walk indication are audible and understandable from one APS without interference by the other APS on the same corner

Conclusion

Careful evaluation is needed to determine whether the installation of passive detection will result in a decrease of noise at an intersection without adversely affecting signal timing. It must be correctly installed to provide equal access to pedestrian timing as well as to audible and vibrotactile information about the signal status to pedestrians who are visually impaired. Care must be exercised in installation and adjustment of detection fields of passive pedestrian detection systems to be certain visually impaired pedestrians approaching from both directions at a corner, intending to cross either street, will have access to signal information in time to make accurate crossing decisions.

More research is needed on the effects of passive pedestrian detection on crossing safety and access to signal information for pedestrians who are blind or who have low vision. There has been no research to date on the effect on pedestrians who are visually impaired of passive pedestrian detection combined with APS at intersections at which the pedestrian phase is concurrent with vehicular green.

References


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