

## **Pedestrian Crosswalk Signals at Roundabouts: Where are they Applicable?**

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### **BACKGROUND**

The proposed American Disability Act (ADA) Guidelines have recommended that traffic signals be located at all roundabout crosswalks to improve pedestrian safety and to allow for the crossing of the visually impaired. There are many roundabout locations that may warrant a pedestrian signal and this paper shows some recent examples of successful installations and one roundabout location where the pedestrian signal was subsequently removed. Midblock crossing signal warrants are described in the USA and the UK. Many engineers and planners feel that the decision of whether to install pedestrian crosswalk signals at a roundabout should be based on engineering judgment and warrants and should not be mandated by a blanket policy.

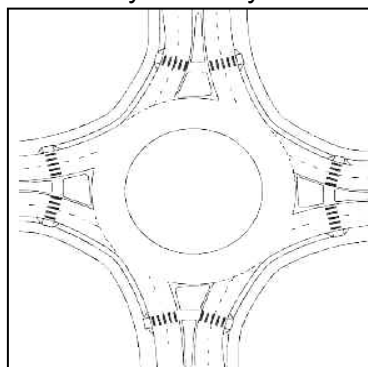
This paper includes:

- Introduction to modern roundabouts;
- US Access Board proposed guidelines at roundabouts;
- Pedestrian signal thresholds/warrants in Great Britain and the USA;
- Examples of roundabouts with pedestrian crosswalk signals;
- Mid-block crossings at roundabouts; and
- Insurance Institute for Highway Safety response to requiring crosswalk signals at roundabouts.

### **MODERN ROUNDABOUTS**

There are an estimated 50,000 modern roundabouts worldwide, and more than 700 have been constructed in the United States since 1990. Many jurisdictions are now considering roundabouts to improve vehicle safety, increase roadway capacity and efficiency, reduce vehicular delay and emissions, and to identify community gateways.

A typical modern roundabout (Figure below) is an unsignalized intersection with a circular central island and a circulatory roadway around the island. Vehicles entering the roundabout yield to vehicles already on the circulatory roadway. A dashed yield line for vehicles marks the outside edge of the circulating roadway at each entering street and defines the boundary of the circulatory roadway.



Roundabouts have raised splitter islands at each approach that separate the entry and exit lanes of a street. These splitter islands are designed to deflect traffic and thus reduce vehicle speed. Splitter islands also provide a pedestrian refuge between the inbound and outbound traffic lanes.

Engineers use a variety of design techniques, mostly geometric, to slow vehicles as they approach, circulate, and exit a roundabout. Design practices from Europe and in Australia continue to

influence U.S. engineers as they refine design approaches for application in urban, suburban, and rural areas.

Studies conducted in western Europe -- where roundabouts are common -- and in the U.S. have found that crashes at roundabouts are less severe than vehicular crashes at more traditional intersections. The reduction in serious vehicular crashes is the most compelling reason cited by transportation engineers for the installation of roundabouts. Roundabouts increase vehicular safety for two main reasons: 1) they reduce or eliminate the risk arising at signalized intersections when motorists misjudge gaps in oncoming traffic and turn across the path of an approaching vehicle; and 2) they eliminate the crashes that occur when vehicles are hit broadside by vehicles on the opposing street that have run a red light or stop/yield sign.

The roundabout community anticipates that roundabouts will be built in the United States annually by the hundreds in the coming years and by the thousands annually, duplicating the trends first in Britain and Australia during the 1970s and 1980s and now being repeated throughout western Europe. For example, France went from 12,000 roundabouts in 1990 to over 23,000 roundabouts today. Most have been built since the mid-1970s. In 2001, there were 23,000 roundabouts in France resulting in 1,329 injury accidents, but only 86 involving pedestrians.

## **US ACCESS BOARD**

The U.S. Access Board is a Federal agency that develops accessibility guidelines for buildings and facilities covered by the ADA and other laws. In 1999, the Board established a committee to make recommendations on accessibility guidelines for public rights-of-way. The members of the committee represented Federal agencies, traffic engineering organizations, State and local government transportation and public works agencies, traffic consultants, standard-setting organizations, and disability organizations. On January 10, 2001, the committee submitted its report to the Board recommending a new national set of *guidelines* for accessible sidewalks, street crossings, and related pedestrian facilities including access to roundabouts.

<http://www.access-board.gov/rowdraft.htm>

The report recommends:

- pedestrian channelization by means of landscaping, railings, bollards with chains and similar devices where pedestrian crossings are prohibited;
- cues (locator tones, detectable warnings, other) to identify crossing locations;
- longer crossing times at signals (3.0 ft./sec walking speed);
- pedestrian-activated signals at roundabout; and
- Audible Pedestrian Signals (APS) at existing traffic signals.



The Access Board is considering Committee recommendations as it adapts current ADA standards for more effective use in the public right-of-way. A draft *guideline* proposing pedestrian signals at all roundabout crossings was published in June 2002. Roundabouts seemed to be lumped together with free right-turns at all types of intersections.

Many engineers and planners designing roundabouts feel that what the US Access Board is asking for in new roundabouts (the "guaranteed gap" for

visually impaired pedestrians) is more stringent than what the visually impaired pedestrians are provided in typical signalized intersections, even in signalized intersections with audible signals. As long as there isn't a protected pedestrian phase (which is the case for most intersections), pedestrians are in conflict with turning vehicles. Visually impaired pedestrians cannot detect turning vehicles at a signalized intersection. In fact it may be more difficult for a visually impaired person to detect a turning vehicle at a signalized intersection, than it is to detect an exiting vehicle at a roundabout.

Many engineers ask why pedestrian signals are required for roundabout intersections when they are not required at all other intersections (All-way STOP, and uncontrolled intersections with marked crosswalks). There are many roundabout locations that may warrant a pedestrian signal and this paper shows some recent examples of successful installations and one roundabout location where the pedestrian signal was subsequently removed. Note that each of these locations met existing pedestrian crosswalk signal warrants established for signalized pedestrian signals in Australia and the USA. In the Clearwater Beach example, although a pedestrian signal was clearly warranted, it was later removed. It was found that this crosswalk was located far enough away from the circle to operate effectively without a pedestrian crosswalk signal.

## **PEDESTRIAN CROSSWALKS AT ROUNDABOUTS**

Pedestrian crosswalks at roundabouts are provided to increase pedestrian safety and convenience without incurring excessive delays to traffic. These objectives will only be achieved if crosswalks are sited to attract the maximum number of pedestrians who would otherwise cross the street at random, and also to give drivers adequate opportunity to recognize them in time to stop safely. The common practice is to situate the crosswalk at least one car away from the roundabout entry line for single-lane roundabouts (25-ft.) and two or more car lengths away (45-50 ft.) from the entry line for dual-lane roundabouts. A refuge island with a minimum 10-ft. width is provided in the splitter island so that pedestrians are required to cross only one traffic stream at a time.

## **PEDESTRIAN CROSSWALK SIGNAL WARRANTS IN THE USA**

The pedestrian signal warrants discussed here are for two types of pedestrian crosswalk signals:

1. Standard traffic signal with Green-Yellow-Red signals activated by a pedestrian pushbutton.
2. Flashing Yellow beacon or in-pavement flashers or a combination of the two activated by a pedestrian pushbutton. When the beacon is activated, vehicles must stop and let pedestrians cross the street. When the pedestrians have passed, the vehicles may proceed.

The *Manual on Uniform Traffic Control Devices* (MUTCD) pedestrian crossing warrant criteria require fairly high pedestrian crossing volumes for extended periods of time. The MUTCD requires a minimum pedestrian volume of 100 or more pedestrians for four hours or 190 or more

pedestrians for one hour. It is typically difficult to meet these warrant criteria. Other studies have recommended the following minimum pedestrian crossing volumes:

- The FHWA's *Pedestrian Signalization Alternatives Study* recommended minimum pedestrian crossing volumes of 60 pedestrians per hour for four hours, 90 per hour for two hours, or 110 per hour for one hour. The volume requirement may be halved for elderly or handicapped pedestrians.
- The Ottawa-Carleton DOT pedestrian flashing crosswalk warrant criteria requires a minimum of 200 pedestrians crossing in an eight hour period, with a minimum range of 200 to 400 pedestrians on roadways with 12 hour traffic volumes ranging from 4,000 to 15,000 respectively. Each elderly or young pedestrian is counted as two pedestrians in the volume calculation.
- Boulder Colorado's warrant criteria are applicable to roadways with speed limits less than 40 mph. They require a minimum of 100 pedestrian crossings per hour for any one hour or 50 pedestrians per hour for any four hours. The pedestrian crossing volume includes all pedestrians crossing the major street at the crossing location. Each elderly or young pedestrian is counted as two pedestrians in the volume calculation. Multi-use paths which cross an arterial are exempt from the pedestrian crossing criteria.

## **GREAT BRITAIN'S PEDESTRIAN SIGNAL THRESHOLDS AT ROUNDABOUTS**

There is a traffic threshold for installing a signalized crosswalk at roundabouts in Great Britain.

**$PV^2$**

**$P$**  = Pedestrians volumes per hour (average of peak 4 hours),

**$V$**  = entering vehicles per hour (average of peak 4 hours),

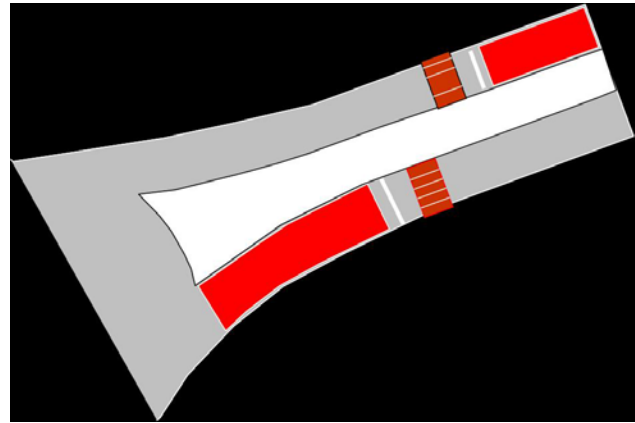
If  **$PV^2 > 10^8$**  then a signalized crossing is warranted.

At a roundabout with a splitter Island there are two crosswalks so each has to satisfy the warrant criteria. The pedestrians cross both of them so  $P$  is the same, but  $V$  will be different, the entry flows on one and the exit flows on the other.

- When pedestrian volumes are significant they can hamper the roundabout capacity on a un-signalized crosswalk as single pedestrians stop the traffic.
- Signalized crosswalks can be set to give a good split for both vehicle traffic and pedestrians. Crossing the pedestrians in groups is more visible also.
- With signalized crosswalks drivers tend to watch the signals rather than the pedestrians just like at normal traffic signals.

The United Kingdom (UK) has not had the same issues with the visually impaired and roundabouts that is a concern in the USA. The UK has higher pedestrian volumes than in the USA so most UK urban roundabouts have signalized crosswalks if they are warranted. With high pedestrian volumes and high vehicle volumes, the pedestrians tend to dominate an unsignalized crosswalk and create severe congestion, so nearly all are signalized with the timings split so that neither traffic or pedestrians are delayed significantly.

However, an important difference is that UK signalized crosswalks are split into two crosswalks - one to the median/splitter and one from it. This greatly reduces vehicle red time. They are offset to avoid pedestrian aspect 'see through' and to stop children or cycles running or riding straight across when the first is on the pedestrian walk phase and the second is on the vehicles phase. They have audible pedestrian cross beepers with a faster beep during the DON'T WALK phase to clear pedestrians from the crosswalk. Tactile paving that the visually impaired can feel with their feet. This is arranged in a T shape to indicate the direction of the crossing.



As the cost of adding signalized crosswalks is about \$100,000 per typical roundabout, they could be installed for the visually impaired, where not otherwise warranted, if there was two funding sources. One for roundabouts and warranted signalized crosswalks. A separate fund for signalized crosswalks for the visually impaired that are not warranted for other reasons. The latter money would not be included in the roundabout economics when comparison is made with other intersection alternatives. (1)

**UNIVERSITY OF UTAH, SALT LAKE CITY, UTAH**



The author was involved in the analysis and design of a roundabout at the University of Utah that included light-rail crossing through the center and a pedestrian crosswalk signal on one of the three legs. See photos below. The crosswalk signal creates serious backups into the roundabout during peak traffic flows that impact one exit of the roundabout. The crosswalk is a mid-block location approximately 150 ft. from the exit of the roundabout.

The same roundabout at right shown from above includes only one pedestrian crosswalk signal where the light rail train is crossing.

Notice that traffic is stopped at the roundabout waiting for the light rail train to pass by. The signal is pushbutton activated and Red-Yellow-Green. This pedestrian crosswalk signal causes brief congestion back into the roundabout during peak hour traffic.



**UNC CHARLOTTE, CHARLOTTE, NORTH CAROLINA**



The University of North Carolina is currently constructing a roundabout on their campus ring road that includes a pedestrian crosswalk signals. Although there are three mid-block crosswalks near the roundabout only one was found to warrant installation of a pedestrian crossing signal. The intersection is shown at left.

There are approximately 600 pedestrians crossing this crosswalk at UNC Charlotte during peak hours. The signal is pushbutton operated Red-Yellow-Green with APS signals for blind pedestrians.

The signalized roundabout crosswalk is located at the far right of the picture shown to the right. The storage space for exiting vehicles is approximately 50 ft. between the edge of the circle to the edge of the crosswalk. The pedestrian crosswalk signal is desired to stop the large number of pedestrians occasionally to allow the vehicle traffic to exit the intersection.



**CLEARWATER BEACH, FLORIDA**



The Clearwater Beach roundabout has been in operation for at least three years and is famous for the high amount of vehicle and pedestrian traffic during spring break periods. (58,000 vehicles per day and up to 6,000 pedestrian crossings per day) The original design included a signalized pedestrian crosswalk shown on the leg at the upper right by Crabby Bill's Restaurant. The crosswalk on the leg on the lower right was relocated farther from the circle and operates well without a pedestrian crosswalk signal.

The pedestrian crosswalk signal shown at right (looking away from Crabby Bill's Restaurant) was found to cause congestion inside the roundabout and was removed. Pedestrians at times are so numerous that they tend to dominate the vehicle traffic on this leg of the roundabout.



***HOMEBUSH BAY, SYDNEY, AUSTRALIA***



The roundabout interchange with flyover at Homebush Bay replaced an at-grade roundabout at the same location before the M5 Motorway and Flyover were constructed. Because of several hundred pedestrians crossing this location during the 2000 Summer Olympics from a nearby train station the pedestrian crosswalk signal was clearly warranted.

The pedestrian crosswalk signal at right for the on ramp traffic is a two light Red-Yellow configuration. When the pedestrian button is pushed the signal flashes Yellow and then changes to solid Red during the crossing phase. When the signal is activated an advance flashing warning sign is also activated for traffic in the bypass lane.



**ALPINE CITY, UTAH**



The Alpine City Main Street roundabout is located near an elementary and a middle school. Children use the new roundabout as part of their safe route to school route. During school crossing times there is a crossing guard helping students across the

intersection. When the crossing guard is present the Yellow lights shown are in constant flashing operation. During off-peak times pedestrians may push a button which activates the crosswalks flashers for a long enough period of time to allow the pedestrians to cross the street safely at the roundabout. This signal does not meet MUTCD warrants but is considered an experimental application.

**WMU PEDESTRIAN UNDERPASS, KALAMAZOO, MICHIGAN**

The Department of Blindness and Low Vision Studies at Western Michigan University offers graduate students preparation for becoming orientation and mobility specialists, rehabilitation teachers, teachers of visually impaired children, and rehabilitation counselors. A roundabout was constructed in Summer 2004 at the western entry into campus that includes a pedestrian underpass that routes pedestrians under the roundabout. Unfortunately, not every City or development has the funds to provide this separation between vehicles and pedestrians.



WMU Rbt Pedestrian Underpass to Left



WMU Pedestrian Underpass (*The CSM Group*)



## **AUDITORY CUES FOR PEDESTRIANS AT ROUNDABOUTS**

Roundabout designers are considering the idea of using auditory cues at roundabouts (single-lane and double-lane). This solution, which uses a series of rumble strips near the crosswalk, seems to show great promise. However, further work in pavement materials will be needed to ensure snow plow compatibility in winter climates.

Michael Wallwork is one practitioner of roundabout design who is testing this treatment -- providing audible cues about the approach of exiting vehicles. It's an idea first broached by Lukas Franck of *The Seeing Eye* in Morristown, NJ, where the earliest installation of this type was piloted on a driveway. FHWA will soon start on a test of a similar approach, using a small sample of cane-users to see if it has merit for future development. (2)

## **MID-BLOCK CROSSINGS AT ROUNDABOUTS**

Many consider that roundabout pedestrian crossings are mid-block crossings because they're not right at the intersection. They aren't what we normally think of when we think of typical mid-block crossings and don't suffer the woes associated with mid-block crossings. Further, the modern roundabout pedestrian crossings go through the splitter islands, which are part of the intersections as they are an essential part of the geometrics, and the pedestrian crossings are likewise an essential part of the intersection.

Many people consider two-way stop control intersections to be "mid-block" crossings from the point of view of the mainline traffic or people crossing the mainline there. From a visually impaired pedestrian's view, the issue there is similar to roundabouts - no traffic surges or road noise to indicate when to walk. From a general pedestrian safety angle a two-way stop control intersection can be quite dangerous and not particularly usable for pedestrians crossing the mainline. Roundabouts can improve this situation by slowing traffic, possibly even improving the sound cues on the mainline (braking and accelerating more like a 4-way stop or signal) and at the same time reducing risk on the cross street.

On the other hand, since two stop signs are typically changed to yield signs in a roundabout application, the crossings on the side road become more mid-block like. The biggest difference is that the roundabout crosswalk is clearly safer for pedestrians than a true mid-block crossing because of the lower prevailing speeds. Although safer, the U.S. Access Board recommendations for crossings at roundabouts imply that they are less usable for people who are blind than traditional intersection crossings or true mid-block crossings. If that's true, then there is something unique about the crossings that put them somewhere in-between traditional intersection and mid-block (traffic on a circulating roadway). The crossings then are more like mid-block from any perspective. (3)

The definition of whether a crosswalk at a roundabout is part of the intersection or is mid-block may vary depending on the state's vehicle code. For most states, the crosswalk at a roundabout would legally be included within the intersection because it more or less fits within the extension of the approach sidewalks. The preferred practice of setting back the crosswalks at a roundabout puts them outside this range and thus creates an ambiguity. This ambiguity would likely be translated as "mid-block" and thus would require signs and pavement markings that the state normally requires for mid-block crossings.

Oregon has amended its vehicle code to explicitly define a roundabout as a single intersection (as opposed to 3 or 4 T-intersections) and has explicitly included the crosswalks as part of the intersection to eliminate this ambiguity. Other states have looked at this issue as well, but most have not acted legislatively to this point. Therefore, for most states, until they amend their vehicle codes or have some official opinion made by their attorney general, roundabout crosswalks should probably be interpreted and treated as mid-block. (4)

## **ADA REQUIREMENTS: COMPARISON WITH ALL-WAY STOP INTERSECTIONS**

The Access Board indicates that the absence of stopped traffic presents a problem for pedestrians with vision impairments in crossing streets. It is true that traffic signals at conventional intersections establish a stop-and-go pattern that can assist blind and visually impaired pedestrians in crossing busy streets by producing audible cues about vehicle movements. However, a large majority of U.S. intersections are not controlled by traffic signals.

Most intersections are governed by one-way or two-way STOP sign control, which only require vehicles traveling on minor intersection approaches to stop. At most stop sign-controlled intersections, vehicles traveling on major intersection approaches are not required to stop, and at such locations travel speeds often can exceed 40-50 mph. So clearly, the absence of stopped traffic, while potentially problematic for pedestrians with vision impairments, is a frequently encountered condition. Like countless other crossings where traffic does not stop, blind pedestrians primarily rely on hearing to identify gaps in traffic.

The draft guidelines also suggest that crossing at a roundabout requires a pedestrian to visually select a safe gap between cars that may not stop. This statement is inaccurate as well as insulting to pedestrians who are blind. With proper training, blind pedestrians use their hearing to identify and select gaps in traffic at a wide range of unsignalized crossings where traffic may not stop. Even the Access Board-sponsored research by Guth et al. (2002) reported that blind individuals can cross single-lane roundabouts with relatively little difficulty and with few "risky" judgments (and more than half of U.S. roundabouts are single-lane, as reported by Jacquemart (1998)).

The Access Board claims that people who are blind or visually impaired are unable to make eye contact with drivers making it impossible to "claim the intersection." Blind pedestrians obviously are unable to make eye contact with drivers, regardless of the type of intersection traffic control. However, because roundabouts produce low travel speeds, short crossing distances, and eliminate turning vehicles, pedestrian crossings at roundabouts should be safer for blind pedestrians relative to many other unsignalized crossings. White Cane Laws, which require drivers to yield the right-of-way, further enable blind pedestrians to claim the intersection at roundabout crossings despite the inability to make eye contact.

## **INSURANCE INSTITUTE OF HIGHWAY SAFETY COMMENTS**

Brude and Larsson (2000) analyzed pedestrian crash data at 72 roundabouts in Sweden and concluded that roundabouts pose no problems for pedestrians compared with conventional signal control intersections. For single-lane roundabouts, the observed numbers of pedestrian crashes were 3-4 times lower than for comparable signalized intersections, controlling for pedestrian volumes and traffic flow. (5)

Jordan (1985) examined pedestrian crash patterns at roundabouts in Victoria, Australia for the 4-year period 1980-83. A total of 35 pedestrian crashes were reported (average 9 crashes per year) at approximately 800 roundabouts. The author characterized this as an extremely low rate of pedestrian crashes and concluded that "concern for pedestrian safety at roundabouts, while well intentioned, is unfounded." (6)

Tumber (1997) conducted a review of pedestrian safety at roundabouts, also in Australia. The study focused on roundabouts constructed on arterial roads within the Melbourne metropolitan area during 1987-94. During this period, 64 pedestrian crashes were reported at approximately 400 roundabouts, for an average crash rate of 0.02 crashes per roundabout per year. The severity of pedestrian crashes (as indicated by the proportion of injuries classified as either serious or fatal) also was lower for roundabouts than for intersections with other forms of traffic control. (7)

The safety of blind pedestrians at roundabouts has been questioned by some advocates of the visually impaired, but direct evaluations of crash data are not available. In an indirect evaluation of the issue, Guth et al. (2002) collected data regarding the ability of blind pedestrians to use their hearing to distinguish "crossable" gaps in traffic at roundabouts from gaps that were considered by the authors too short to afford a safe crossing. This work was supported by the Access Board. Three study sites in Maryland included a low-volume, single-lane roundabout; a large, urban, high-volume, two-lane roundabout; and an urban, intermediate-volume, two-lane roundabout. Six blind and four sighted pedestrians observed traffic at roundabout crosswalks and indicated by pressing a button whenever they believed they could complete a crossing before the arrival of the next vehicle.

Despite the finding by Guth et al. (2002) that blind pedestrians can adequately judge gaps at single-lane roundabouts with little difficulty and as well as sighted individuals, the Access Board is proposing guidelines that would require signalization of pedestrian crosswalks at all roundabouts on the basis that the safety of blind pedestrians mandates such devices. This proposed requirement would apply even in rural settings where pedestrian activity is infrequent and where blind pedestrians may be nonexistent. However, traffic signals appear to be unnecessary at single-lane roundabouts and, if mandated, actually could be detrimental to highway safety. It is likely that the arbitrary addition of traffic signals to well designed roundabouts could increase the risk of injury crashes due to disruptions in traffic flow. Also, substantial costs associated with installation and maintenance of traffic signals might discourage some communities from constructing roundabouts. Even for high-volume, two-lane roundabouts, the Guth et al. field study does not make a compelling case for traffic signals because of weaknesses in the research methodology. Blind pedestrians were driven to roundabouts and then observed after minimal exposure to these unfamiliar locations. This is unrealistic because blind pedestrians typically do not wander into such areas without a guide to provide initial orientation. Guth et al. merely provides evidence of the perception of risk, not actual risk. The blind pedestrians may have been more willing to press a button when they believed they could complete a crossing than to begin crossing, thus inflating the numbers of "risky" judgments. Also, comparable data were not collected for intersections controlled by traffic signals or stop signs. (8)

Compared with conventional intersections, roundabouts can provide improved access and safety for blind pedestrians as well as sighted individuals because of specific roundabout design and operational characteristics. First and foremost, traffic speeds within roundabouts are very low -- typically 15-20 mph -- compared with considerably higher traffic speeds at most traffic signal and stop sign-controlled intersections. Pedestrian refuge islands at roundabouts provide

for short crossing distances. Also, roundabouts are relatively simple intersections that eliminate left turns, right turns, and the associated turning-vehicle conflicts common at conventional intersections. By comparison, conventional intersections are characterized by higher traffic speeds, longer crossing distances, and are more complex due to two-way traffic flow and frequent vehicle turning movements. Preusser et al. (2002) reported that 25 percent of motor vehicle-pedestrian collisions in Washington D.C. involve turning vehicles. (9)

The combination of low traffic speeds, short crossing distances, and absence of turning vehicles in conjunction with White Cane Laws - laws in 47 states that require drivers to yield the right-of-way to a person carrying a white cane or accompanied by a guide dog --- provide safe crosswalks for blind pedestrian at many roundabouts. Additional measures that could enhance safety include textured pavement in conjunction with ramps to help lead blind pedestrians to crosswalks, raised crosswalks that can further slow entering and exiting traffic, and pedestrian yield signs in both directions of the crossing that require drivers to stop for pedestrians waiting on the crosswalk. Also, specific training can be developed and provided to help the visually impaired perceive gaps in traffic and to give drivers cues to stop.

Signalizing roundabout crossings can be justified when the combined volumes of pedestrians and vehicles are high or at locations with complex geometry such as high-volume school zones. In Australia and Europe, the vast majority of roundabouts are unsignalized, but some roundabouts in urban areas do have pedestrian signals. Rather than adopting the Access Board's recommendation to require signalization on pedestrian crosswalks at all roundabouts, regardless of need or justification, the Institute for Highway Safety supports the Australian and European practice of installing pedestrian signals at appropriate locations based on objective criteria. (10)

The Institute opposes provisions of the draft guidelines that would require installation of traffic signals on pedestrian crosswalks at all roundabouts. The Access Board has provided no scientific evidence in support of this proposed requirement and, furthermore, it is likely that the arbitrary addition of traffic signals to well-designed roundabouts could increase the risk of motor vehicle crashes, in particular rear-end collisions, due to disruptions in traffic flow. Substantial costs associated with installation and maintenance of traffic signals might discourage some communities from constructing roundabouts or installing pedestrian crossings. Compared with conventional intersections, roundabout design and operational characteristics can provide improved access and safety for blind as well as sighted pedestrians, and additional measures can be taken to further improve the safety of blind pedestrians at unsignalized roundabout crossings such as textured pavement, raised crosswalks (speed tables), and increased lighting.

Rather than adopting the Access Board's recommendation to mandate signalization on pedestrian crosswalks at all roundabouts -- regardless of need or justification -- the Institute supports the practice of installing pedestrian signals at appropriate locations where needed, based on objective criteria. (11)

## **PROPOSED RULE BY US ACCESS BOARD IMPACTING ROUNDABOUTS**

The Americans with Disabilities Act (ADA) recognizes and protects the civil rights of people with disabilities and is modeled after earlier landmark laws prohibiting discrimination on the basis of race and gender. To ensure that buildings and facilities are accessible to and usable by people with disabilities, the ADA establishes accessibility requirements for State and local government facilities, places of public accommodation, and commercial facilities. Under the ADA, the Access

Board has developed and continues to maintain design guidelines for accessible buildings and facilities known as the ADA Accessibility Guidelines (ADAAG). ADAAG covers a wide variety of facilities and establishes minimum requirements for new construction and alterations.

*Pedestrian Signal Phase Timing (1105.3)*

The draft guidelines would require pedestrian signal phase timing to be calculated according to a walking speed of 3.0 feet per second. Industry practice generally recommends calculations based on a speed ranging from 3.5 to 4.0 feet per second, though some jurisdictions are reportedly considering a rate of 2.5 feet per second. The advisory committee recommended using a crossing speed of 3.5 feet per second or less. The Board believes that a rate of 3.0 feet per second will accommodate a broader range of pedestrians and offer greater access.

*Roundabouts (1105.6)*

A growing trend in roadway design favors continuous-flow roundabouts over traditional signalized intersections. While their design varies widely, roundabouts typically feature a circulatory roadway around a central island. Entering traffic yields to vehicles already in the circle. Increasingly popular in the U.S. because they add vehicle capacity and reduce delay, roundabouts are a common feature in Europe and Australia. Because crossing at a roundabout requires a pedestrian to visually select a safe gap between cars that may not stop, accessibility has been problematic. While roundabouts may be an asset to traffic planners in controlling and slowing the flow of traffic at intersections without using traffic signals, the absence of stopped traffic presents a problem for pedestrians with vision impairments in crossing streets. Pedestrians report that vehicles at roundabouts, as well as at other unsignalized crossings, often do not yield for pedestrians. Persons with vision impairments and pedestrians who may hesitate at such crossings are at a particular disadvantage.

To provide safer crossing at roundabouts, the draft guidelines would require pedestrian activated crossing signals at each roundabout crosswalk, including those at splitter islands. (The draft guidelines would ensure that such signals are usable by persons with vision impairments under requirements in [section 1106](#) discussed below.) Although roundabouts are typically used to avoid signalization, the Board is not aware of alternatives that would allow safe passage for pedestrians with disabilities. Aside from accessibility, the use of roundabouts in areas of high pedestrian use has been questioned by some in the industry.

Requiring the signal to be pedestrian activated may help limit the impact on traffic flow. Signal technologies are available that can further minimize the impact, such as devices that halt traffic only while a pedestrian is in the crosswalk. The Board seeks information on alternative design strategies and available technologies that can improve access at roundabouts for persons with disabilities, particularly those with vision impairments.

Barriers or similarly distinct elements are needed to prevent blind persons from inadvertently crossing a roundabout roadway in unsafe locations. The draft guidelines would require a continuous barrier along the street side of the sidewalk where pedestrian crossing is prohibited. If a railing is used, it must have a bottom rail no higher than 15 inches. This dimension would allow use of a standard roadside guardrail while providing sufficient cane detectability.

*Turn Lanes at Intersections (1105.7)*

The draft guidelines also include a requirement for a pedestrian activated signal at each segment of a crosswalk that crosses right or left turn slip lanes.

### **Accessible Pedestrian Signal Systems ([1102.8](#), [1106](#))**

At signalized intersections, people with vision impairments typically rely on the noise of traffic alongside them as a cue to begin crossing. The effectiveness of this technique is compromised by various factors, including increasingly quiet cars, permitted right turns on red, pedestrian activated signals, and wide streets. Further, low traffic volumes may make it difficult to discern signal phase changes. Technologies are available that enable audible and vibrating signals to be incorporated into pedestrian signal systems, which are those systems that provide signals expressly for pedestrians, such as "walk" signs. The draft guidelines would require pedestrian signal systems, where provided, to provide both audible and vibrating indications of the "walk" interval. Typically, a small box, with a directional arrow, emits an audible tone or voice message and vibrates when the walk interval begins.

Increasingly, signals activated by pedestrians, usually by means of a push button, are being installed. The draft guidelines would require push buttons, where provided, to be equipped with a locator tone integrated into the signaling device to indicate that pedestrian activation is necessary and to identify the location of the push button.

The Board is proposing to apply these requirements where pedestrian signal systems are provided at pedestrian crossings. The advisory committee had recommended limiting their application only where certain types of pedestrian signal systems are provided, such as those that are pedestrian activated. The Board believes that access should be required at all crossings equipped with pedestrian signals to ensure a consistent level of accessibility within a pedestrian network. Compliant products are available. A project the Board sponsored on accessible pedestrian signals provides a synthesis on current technology in accessible pedestrian signals, including a listing of devices and manufacturers in the U.S. and abroad, and a matrix comparing the features of each device. The project report, "[Accessible Pedestrian Signals](#)" provides information on several different types of devices on the market, including audible, vibrating, and receiver-based infrared systems. Audible systems are now available that feature discreet tones which automatically adjust to the ambient noise level. These systems have replaced older products that had raised concerns about noise pollution. (12)

### **SUMMARY**

- ⊕ The safety benefits of roundabouts to vehicle traffic and pedestrian traffic are considerable and because of this they will continue to be constructed in the USA.
- ⊕ Pedestrian crosswalks are not always warranted at roundabout intersections but where they are allowed they should be considered as midblock crossings.
- ⊕ A City may apply established midblock pedestrian traffic signal warrants that utilize pedestrian/vehicle volume thresholds to decide whether pedestrian crossings should be signalized at or near a roundabout.
- ⊕ Several examples are outlined where pedestrian signals were applicable and one case where they were not applicable at modern roundabouts.
- ⊕ Traffic signals appear to be unnecessary at single-lane roundabouts and, if mandated, actually could be detrimental to highway safety. It is likely that the arbitrary addition of traffic signals to well designed roundabouts could increase the risk of injury crashes due to disruptions in traffic flow.
- ⊕ The costs associated with installation and maintenance of traffic signals might discourage some communities from constructing roundabouts.

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