

DRAFT Guidance for Accessibility at Signalized Intersections

1) UNDERSTANDING ACCESSIBLE PEDESTRIAN SIGNALS

- a. Accessible pedestrian signals (APS) provide visually impaired users the same message as visually capable users through audible cues
- b. Placed so that users with mobility disabilities can reach and activate pedestrian signal phases
- c. For visual and hearing impaired: indicates when pedestrian signal is activated
- d. Accessible Pedestrian Signals include:
 - i. Push button features
 - 1. Vibrotactile cues
 - 2. Audible cues
 - ii. Countdown timer indicators
- e. APS push button placement is critical for blind or low-vision pedestrians as well as people using wheelchairs and other mobility devices:
 - i. It is important to blind and low-vision pedestrians that APS buttons to be consistently placed at all signalized intersections
 - ii. People using wheelchairs and other mobility devices need to be able to access the APS button from a level surface

2) PEDESTRIAN CROSSING NEEDS AT SIGNALIZED INTERSECTIONS

- a. Connect existing pedestrian facilities with accessible crossings
- b. Cross all 4 legs of the intersection with push buttons and pedestrian refuges (curb ramps and rural pads)
 - i. Connect pedestrians to destinations (existing and anticipated)
 - ii. Provide acceptable level of service (LOS) for pedestrians
 - iii. Exceptions:
 - 1. Coordinate with MnDOT's Traffic engineering unit, Bicycle & Pedestrian unit, and ADA unit in scoping
 - a. If pedestrian crossings are not added, be careful not to strand pedestrians with R9-3 signs (no pedestrian crossing)
 - b. Omitting crossings due to significant impacts to signal operations
 - i. Crossings should be omitted judiciously and infrequently, document analysis
 - 2. Interchanges
 - a. Diamond & Folded Diamond
 - i. No pedestrian facilities
 - 1. Evaluate on case by case basis, see 2)b.iii.1

- ii. Pedestrian facilities along one side
 - 1. Add crossings in line with pedestrian facilities at minimum
- iii. Pedestrian facilities along two sides
 - 1. Add crossings in line with pedestrian facilities at minimum
 - 2. Pedestrian crossings on outside legs of interchange, typical
 - 3. Inside legs may be utilized to avoid excessive conflict points (i.e. double right turn lanes) or connections to transit stops within the interchange
- 3. SPUI, DDI, and other less common interchanges
 - a. Refer to MnDOT Facility Design Guide and Coordinate with MnDOT's Traffic engineering unit, Bicycle & Pedestrian unit, and ADA unit in scoping crossing guidance
- 4. Signalized Restricted Crossing U-Turn (RCUT) Intersections
 - a. Refer to [MnDOT Technical Memorandum No. 20-07-TS-03](#)
- 5. Remote rural signal with no trails, sidewalks, or pedestrian destinations
 - a. 1 mainline crossing minimum, minor approaches may omit APS crossings if minimum vehicle green time meets pedestrian needs
 - b. Adjacent to Railroads, consider railroad preemption needs when determining mainline crossings

3) APS SCOPING REQUIREMENTS

- a. When installing APS, all pedestrian legs of a signalized intersection should be installed at the same time for signal equipment consistency and consistency of the user experience through the intersection
- b. For existing signal systems with APS, any quadrants impacted by the scope of the work needs to be upgraded to meet current curb ramp and APS standards
- c. Evaluate accessibility needs and impacts at the intersection including, but not limited to:
 - i. Signal components
 - 1. Pole and cabinet locations that impede the PAR and MAR shall be included in project scopes for relocation
 - 2. Handhole adjustments and relocations
 - 3. Consider vehicle loop detectors affected by crosswalk realignments
 - ii. Footprint sufficient for both pedestrian facilities and other infrastructure
 - 1. Right-of-way acquisition
 - 2. Curb extensions (also known as bumpouts)
 - 3. Curb radius modifications
 - iii. Drainage structures do not inhibit the PAR through crosswalks and curb ramps
 - 1. Use accessible grates when catch basins are located within PAR or direct path of travel from push button to crosswalk

- a. The most direct path of travel may be over the flare curb ramps skewed with respect to crossing for visually impaired users departing from the push button
 2. Relocate drainage structures when feasible
 3. Curb boxes – remove as needed to meet curb ramp standards
- iv. Intersection Geometrics
 1. Intersection quadrants
 - a. Curb ramps need to be installed or upgraded to meet MnDOT ADA requirements
 - b. Gutter flowlines shall be tabled to 2% or less according to MnDOT Standard Plan 5-297.250 (Pedestrian Curb Ramp Details), sheet 6 of 6.
 2. Crosswalk geometrics
 - a. Crosswalk running slopes shall be 5% max
 - i. Modify the crosswalk/roadway approach as needed to achieve 5% through milling and paving operations or partial reconstruction of the roadway
 - b. Crosswalk cross slope may match roadway profile at signalized intersections
 - i. The crosswalk cross slope should be 2% or less and corrected whenever feasible with the scope of the project (roadway reconstruction for example)
 3. Medians
 - a. Add median refuge with push buttons where footprint is sufficient outside of vehicle turning movements
 - b. Truncate medians to allow straight crosswalk alignments when not usable as a pedestrian refuge
 4. Expand pork chop footprint to accommodate curb ramps, landings, push buttons, signal poles, and handholes
- v. Utility impacts
 1. Relocate or adjust utilities as needed
 2. Utilities may include hydrants, power poles, utility cabinets, lighting, etc.
- vi. Transit stops
- vii. Future developments or network expansion
 1. Incorporate pedestrian infrastructure for crossings to limit rework when future developments are planned or anticipated
 2. Place signal components as not to impede the potential alignment of planned sidewalks or trails

- d. Right-of-way (ROW) footprint needed for pedestrian facilities at signalized intersections
 - i. The footprints listed in this section are minimum dimensions needed for a clear and continuous pedestrian facility, analyze placement of signal poles, cabinets, handholes, and other constraints that may require additional ROW
 - 1. Sidewalk with grass boulevards:
 - a. 15' permanent ROW from outside edge of ramps
 - b. 5' temporary easement from edge of ROW

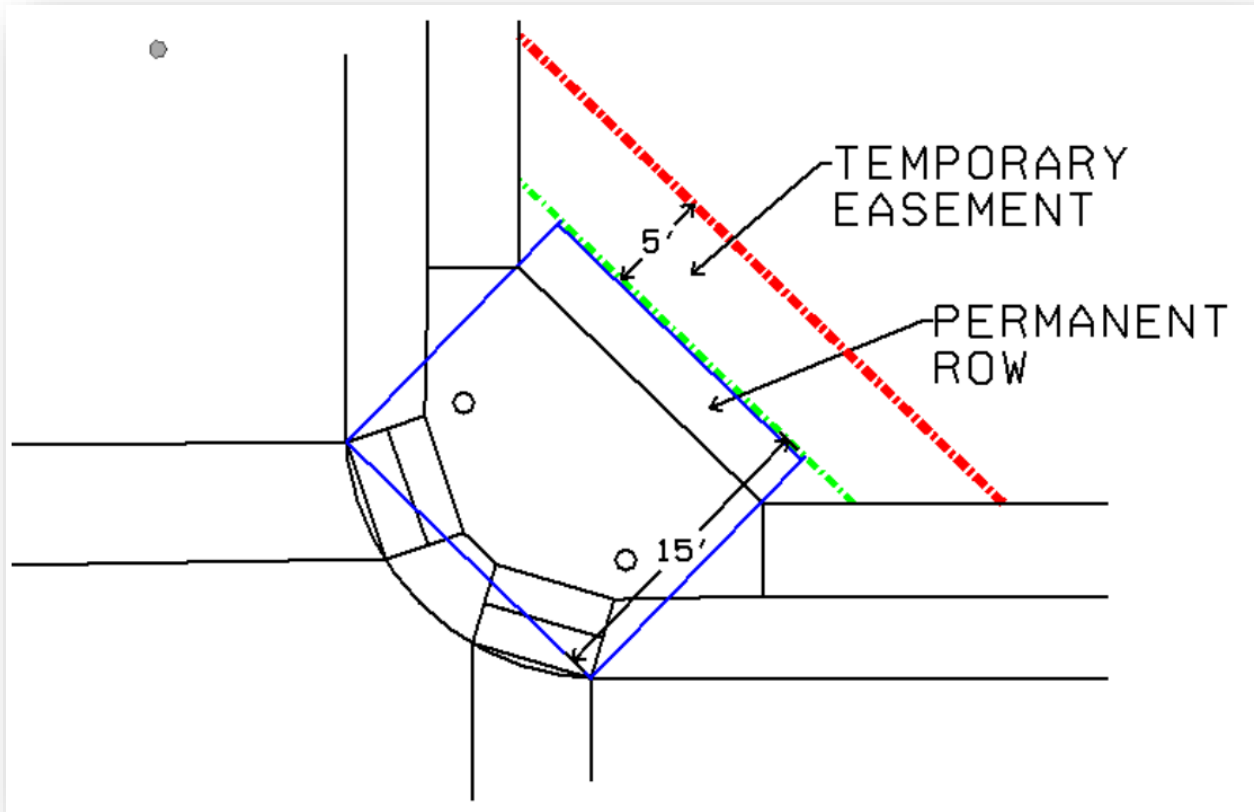


Figure 3)d.i.1

- 2. Sidewalk at back of curb:
 - a. 12' permanent ROW from outside edge of ramps
 - b. 5' temporary easement from edge of ROW

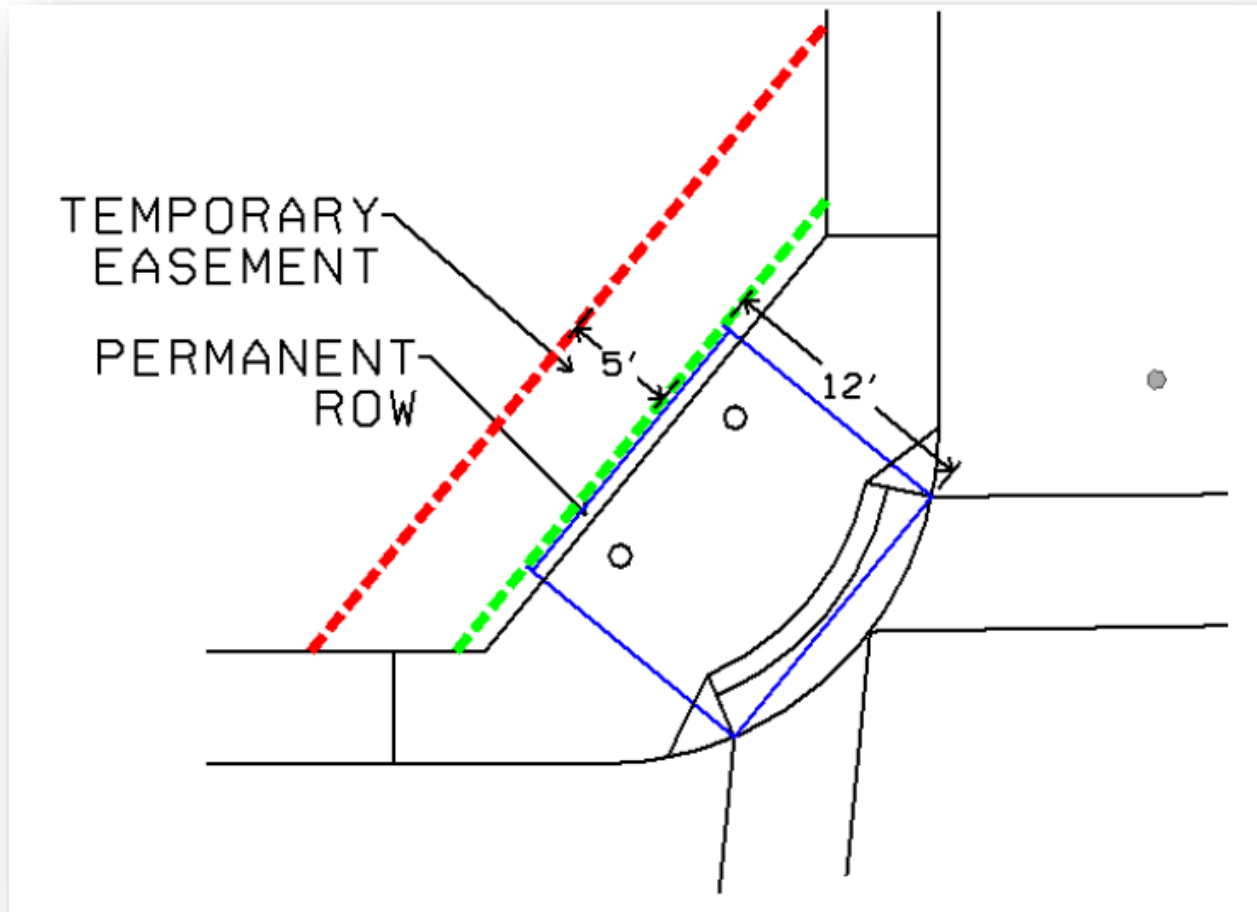


Figure 3)d.i.2

- 3. Larger ROW footprints will be needed for shared use paths
- e. Project scopes impacting signals with pedestrian indications or unmet pedestrian needs
 - i. Signal driven scope
 - 1. New Signals and Signal Replacement
 - a. Full APS implementation required
 - 2. Signal Modifications
 - a. Loop or video detection modifications, interconnect, and indicator upgrades do not require upgrading the signal to APS
 - b. When relocating cabinets, relocating multiple signal poles, or substantial replacement of underground signal components, consider APS upgrades for the entire intersection

3. APS upgrade
 - a. Replace curb ramps with APS signal updates
 - b. Consider pole relocation
 - c. Evaluate impacts to other signal components
- ii. Pavement driven scope including pavement preservation and reconstruction
 1. Curb ramp replacement thresholds have federal requirements driven by pavement impacts (alterations) within the crosswalk limits
 2. MnDOT's policy is to upgrade signals to APS when curb ramps are replaced
 - a. Curb ramp type selection and design are directly related to the APS push button location requirements at signalized intersections
 - b. Performing upgrades to both curb ramps and APS together avoids rework for the following reasons:
 - i. When push buttons are relocated to meet APS criteria, curb ramps need to be redesigned so that the curb ramp geometry enables the APS push button to meet location requirements
 - ii. Rerouting conduits to revise push button locations when upgrading to APS will require rework of any curb ramps, regardless if the curb ramp geometry was adequate for APS
 - c. MnDOT's ADA Transition Plan
 - i. Completing both APS and curb ramp upgrades together removes the signalized intersection quadrants from MnDOT's ADA Transition Plan, which significantly increases progress toward APS implementation goals¹
 - ii. If a reasonable accommodation request for APS is made after the initial curb ramp construction is completed without APS, then the ramps would need to be reconstructed again for APS upgrades
- iii. ADA upgrade scope driven
 1. Upgrade signals to APS and replace curb ramps for all quadrants
 2. Project examples:
 - a. ADA curb ramp replacement at signalized freeway interchange ramps (orphan intersections)
 - b. Curb ramp standalone projects
 - c. Bike & Pedestrian unit driven upgrades and expansion

¹ As of the end of 2020, 65% of MnDOT's signals with pedestrian phases have been upgraded to APS with a goal of substantial completion by 2030.

f. Non-MnDOT Projects

- i. These special criteria are for projects driven by local agencies and developers including State-aid projects, Safe Routes to School (SRTS), Local Partnership Program (LPP) projects, and other permits on MnDOT's right-of-way. This is MnDOT's attempt to work with local agencies within their existing project scopes, these criteria are minimums that shall be met.
 1. Project examples:
 - a. Pavement preservation or reconstruction projects
 - b. New sidewalks and shared use paths connecting to signalized trunk highway intersections
 2. For pavement driven project scopes:
 - a. When half or more of the crosswalks at an intersection are impacted by the project scope, the entire intersection should be upgraded to full APS at all quadrants.
 - b. If less than half the crosswalks at the intersection are impacted by the project, the affected quadrants shall be "APS ready" at minimum
 - i. APS ready is defined as designing and constructing the curb ramps, landings with integral push button station foundations, underground electrical components, and relocation of the solid-state push buttons to new pedestrian push button locations meeting APS placement standards
 - ii. For signals with pedestrian recall, APS ready will include curb ramps, landings with integral push button station foundations, underground electrical components, and caps for conduits flush with landing surface.
 - iii. If all crossing needs at a signalized intersection cannot be met with the scope of the project, construct impacted quadrants APS ready for future crosswalks as described in Section 3)f.i.2.b.i
 3. For projects limited to expansion and improvement of pedestrian facilities (non-roadway driven projects), the work may be limited to the curb ramps and crossings directly affected by the addition or improvement. If the addition of the pedestrian facility changes the crossing needs for the intersection, any crossings not present shall be added.

4) DESIGN CONSIDERATIONS AT SIGNALIZED INTERSECTIONS

- a. Spatial needs at signalized intersection corners are often competing
 - i. Vehicle turning movements
 - 1. This affects the radius and the footprint behind the curb
 - ii. Pedestrian facilities
 - 1. Obstruction free pedestrian access route, curb ramps, landings, APS push buttons
 - iii. Signal components
 - 1. Signal poles, pedestals, push button stations, handholes, cabinets
 - iv. Utilities
 - 1. Power poles, light poles, cabinets, handholes, manholes, catch basins, hydrants, gate valves, vaults, pedestals, etc.
 - v. Maintenance needs
 - 1. See Section 4)b
 - vi. Other
 - 1. Traffic signs, transit stops, shared use paths, separated bicycle facilities, landscaping, parking, waste receptacles, benches, other street furniture, buildings, doorways, outdoor dining, sandwich boards & other encroachments, etc.
- b. Maintenance access routes (MAR)
 - i. MnDOT has established standards for the Maintenance Access Route (MAR) to provide sufficient space for winter maintenance required under the ADA but not reflected in the Access Board's design guidance
 - 1. The MAR is necessary for mechanical removal of snow and ice from the PAR
 - ii. The MAR requires a clear distance between raised obstacles such as push button stations, electrical foundations (signal, lighting, or cabinet), buildings, v-curb, utility poles, sign posts, etc.
 - 1. 6 foot minimum clear distance for sidewalks
 - 2. 8-10 foot minimum clear distance for shared use paths
 - a. The minimum clear distance should match shared use path width
 - iii. Account for the footprint of obstacles such as signal poles, hydrants, and even the push button itself when placing push buttons
 - 1. Standalone push button stations currently use a 7" square breakaway t-base, or 10" diagonal corner to corner
 - iv. The MAR follows the same route as the PAR and may be wider in some locations to account for limitations in maintenance vehicle turning movements
 - 1. A generally continuous PAR alignment is good for pedestrians and it is necessary to for mechanical snow and ice removal
 - 2. Most mechanical snow and ice removal equipment cannot move sideways or make sharp turns

3. Mechanical snow and ice removal equipment include skid steers, pickup trucks with plows, snow blowers, mounted rotary brooms, etc.
- v. At signalized quadrants, the MAR should be a paved surface but does not need to meet the PAR cross slope criteria outside the limits of the PAR
- vi. Consider localized maintenance needs
 1. For example, a shared use path may need different snow and ice removal operations than a commercial district or residential neighborhood
- c. PAR limitations and improvements
 - i. Existing footprints available for pedestrian facilities are often inadequate to accommodate a usable and maintainable pedestrian access route
 - ii. Improve the footprint available using the options below that best meet the needs of the system, including pedestrians, automobiles, freight, utilities, maintenance, etc:
 1. Structures that impact the horizontal or vertical alignment of the PAR and MAR shall be addressed
 2. Widen the sidewalk footprint to utilize the full benefits of the existing right-of-way
 3. Acquire additional right-of-way to meet the needs of pedestrians, vehicle turning movements, signals, utilities, etc.
 4. Reduce the curb radius
 5. Curb extensions (bumpouts)
 6. Relocate existing obstructions within the proposed PAR/MAR
- d. Typical right-of-way (ROW) needs at signalized intersections
 - i. See Section 0
- e. Design effort with APS
 - i. Account for additional time to design curb ramps and push buttons, this is often an iterative process
 1. Curb ramps with APS push buttons take more time to design than traditional curb ramps at non-signalized intersections
 - ii. Push button locations need to be considered WHILE designing curb ramps for effective placement
 1. The geometric designer putting together curb ramps needs to understand the APS criteria and constraints or consult an ADA or Traffic Signal expert when choosing your initial ramp type and locations for the design

5) APS PUSH BUTTON PLACEMENT STANDARDS

- a. Maximum Extent Feasible
 - i. Where MnDOT Standards cannot be fully met, the design engineer will evaluate, document, and recommend a preferred alternative
 - ii. Approval of the preferred alternative will be made by the ADA Unit
 - iii. All facilities not meeting MnDOT Standards will be documented in the ADA Design Memorandum, which is required to be submitted for all projects including ADA improvements on MnDOT's right-of-way
 - iv. When the project manager, design engineer, and the ADA program engineer cannot find consensus on design options, the decision will be elevated to the District ADE and brought to the Assistant Director for the Operations Division
- b. MnMUTCD Derived APS Standards
 - i. Most guidance and "should" criteria in MnMUTCD Section 4E.8 have been made Agency Standards (shall) to provide much needed consistency for visually impaired users
 1. These standards are considered accessibility compliance criteria, see [MnDOT ADA Standards](#)
 - ii. Push buttons shall be placed on the outside edge of crosswalk with respect to center of the intersection
 - iii. Push buttons shall be located adjacent to a landing
 - iv. Push button mounting height shall be 42 inches from the surface of the landing to the center of the push button
 1. May deviate if a reasonable accommodation is requested, consult ADA Unit for further guidance
 - v. 10' minimum separation between push buttons
 1. Separation is measured from face of push buttons
 2. Separation between push buttons is necessary to audibly differentiate between the locator tones of the APS push button unit and the existence of multiple crosswalks
 3. In design, utilize these minimum distances from center to center of signal features to account for the offset from center to the face of push button:
 - a. 11', Push Button Station to Push Button Station
 - b. #', Push Button Station to Pedestal
 - c. #', Pedestal to Pedestal
 - d. #', Signal Pole to Push Button Station
 - e. #', Signal Pole to Pedestal
 - vi. 5' maximum offset from the edge of the crosswalk to the push button
 1. The 5' offset is measured perpendicular to the projected outside edge of the crosswalk
 2. The edge of crosswalk is defined by a line connecting two curb ramps from the point located at back of curb on the outside edge of the curb opening, to the same point on the opposite curb ramp

3. This proximity is necessary for visually impaired users that depart from the push button
 - a. Users that depart from the push button are more likely to encounter interference from vehicles stopped at the signal if the push button is offset more than 5' from the crosswalk
- vii. 1.5' to 10' push button setback from curb
 1. Push button shall be placed between 1.5' to 10' from back of curb in the direction of travel
 - a. MnMUTCD guidance states placement of pushbutton should be 1.5' to 6'
 - b. MnDOT commonly utilizes the MnMUTCD exception of up to 10' for flexibility of pushbutton placement and have adopted it as standard practice
 - i. Placing the pushbutton towards the back edge of sidewalk or trail can improve usability and maintainability when the PAR is near the back of curb
 - c. If there is no curb (rural section), measure push button setback from the edge of domes closest to roadway in the direction of travel
 2. If a standalone pushbutton station is used, place the push button a minimum of 4' perpendicular from back of curb to prevent knockdowns resulting from truck overturning and snowplow operations
 3. Close proximity to the curb is necessary to reduce crossing distances for users that depart from the push button
 - a. Crossing distance should be measured from the departing push button to the receiving curb ramp to calculate signal timing
- c. MnDOT APS Standards Based on Maintainability and Usability
 - i. Maintenance Access Routes (MAR)
 1. 6' minimum clear distance between raised obstacles for sidewalks
 2. 8'-10' minimum clear distance between raised obstacles for shared-use paths (SUP)
 - a. The minimum clear distance should match SUP width
 3. Refer to Section 4)b for more information regarding the MAR
 - ii. 2' minimum setback from the push button to the top of ramp or back edge of landing
 1. Centering the push button on the edge of a 4'x4' landing space improves usability for pedestrians with mobility issues by making it more reachable on a level surface.
 - iii. If compromise is necessary:
 1. MAR takes priority over 2' setback from edge of landing
 2. 0.75' (or 9") is the minimum setback for standalone push button stations due to the radius of the push button station foundation which is integral to the landing

6) APS PUSH BUTTON PLACEMENT GUIDANCE

- a. Placement Guidance Based on Sidewalk Cross Sections:
 - i. Sidewalks with grass boulevards
 - 1. Generally, favor placement near the front edge of sidewalk (towards road)
 - ii. Sidewalks at back of curb
 - 1. Generally, favor placement near the back of walk
 - 2. This includes sidewalks with walkable surface boulevards including pavers, stamped and/or colored concrete
- b. Staggering push buttons by placing one at front and the other at back of sidewalk can be useful to achieve 10' minimum push button separation
- c. If compromise is necessary for 10' separation between push buttons, ensure there is proper documentation of alternatives evaluating the maximum extent feasible.
 - i. Refer to Section 5)a for information regarding max extent feasible
 - ii. If all compliance criteria cannot be met, the first compromise MnDOT is willing to accept would be 8' separation between push buttons utilizing a verbal message as opposed to tones
 - iii. Per MnMUTCD Section 4E.11, Standard: "Where two accessible pedestrian signals are separated by a distance of at least 10 feet, the audible walk indication shall be a percussive tone. Where two accessible pedestrian signals on one corner are not separated by a distance of at least 10 feet, the audible walk indication shall be a speech walk message."
- d. Signal timing is typically determined using a 3.5 ft/s walking rate for the distance from a departure location to point of safety.
 - i. Crossing distance is measured from push button (departure location) to the opposite curb ramp (point of safety) in the direction of travel for determining signal timing.
 - 1. Vibrotactile feature of the push button gives cues to users with both hearing and sight impairments, so these users would typically wait to depart from the push button

7) SIGNAL COMPONENT PLACEMENT FOR ACCESSIBLE DESIGNS

- a. Signal Poles
 - i. Locate new and relocated signal poles outside and away from sidewalks whenever feasible
 - ii. For shared use paths, bicycle standards require 2' clear zones
 - 1. Ideally, separate poles from sidewalk with a buffer space to account for minor adjustments in the field due to potential underground utility conflicts since signal pole foundations are 12' deep or more
 - iii. Push buttons should not be placed on new signal poles
 - 1. Any signal pole adjustments due to utilities or otherwise could impact APS compliance, curb ramp designs, and overall usability if used for push button placement

2. The inherent imprecision of drilling a foundation hole with an auger can make it more difficult to match detailed ramp designs where inches can affect the ability to meet standards
3. Utilizing push button stations for push buttons placement helps mitigate this risk since foundations are only 1' deep
- iv. Existing signal poles may be used for push button placement when it meets curb ramp and APS design criteria
 1. Understanding where the survey shot was taken with respect to the foundation is important for design
- v. Geometric and signal designers should work together early in the design process to determine their preferred signal pole locations
- vi. Adjust the signal pole placement to accommodate both signal and pedestrian accessibility needs
- b. Cabinet Placement
 - i. Locate cabinets so they don't block visibility of pedestrians to vehicles, interfere with the PAR/MAR, or encroach bicycle clear zones
- c. Handholes
 - i. All new handholes shall be placed out of the PAR, preferably outside of the paved sidewalk in grass boulevards or behind the sidewalk when boulevards are walkable surfaces
 - ii. For downtown environments where it is paved from back of curb to the edge of right-of-way, place handholes in the paved boulevard area/furniture zone, if present
 - iii. Show all handholes on the ADA detail sheets

8) CURB RAMP DESIGN FOR APS

- a. Curb ramp design at signalized intersections need to account for numerous different factors, such as
 - i. Vehicle stopping locations; site lines; width, alignment, and type of incoming pedestrian facilities (sidewalks and shared use paths); available footprint for the curb ramps and other infrastructure within the right-of-way (utilities, catch basins, lighting, etc)
- b. Determining curb ramp types and locations is an iterative process, along with determining crosswalk locations, due to the complexity of the different factors involved
- c. Performing a field walk prior to design is essential to evaluate the conditions in the field
 - i. This process improves the overall design and may help reduce the necessary design iterations by better understanding the actual field conditions and observing how the system functions and how each of the numerous factors interact that ultimately influence the success of the design
- d. Ramp types and APS push button placement is completely interdependent
- e. Common configurations
 - i. Perpendicular ramps
 1. 4' long, 6' wide ramp
 2. Place push button 6' from back of curb

3. Maintain 6' minimum PAR/MAR behind push button for sidewalk
- ii. Fan ramp
 1. 3' long ramp, wide enough to cover incoming pedestrian facilities
 2. Place push button 5' or 9.5' from back of curb depending on the incoming PAR alignments and widths
- iii. Depressed corner
 1. This is the most flexible ramp design for APS, however this is one of the least preferred ramp designs since the landing area is all at gutter grade and may have drainage and sedimentation issues
 2. The entire area from the back of curb to the back of walk is a landing, push buttons can be placed anywhere within the landing that meets push button placement criteria
- iv. Directional ramps
 1. Directional curb ramps can make it difficult to achieve push button separation while also meeting setback criteria at signalized intersections
 2. Directional curb ramps meeting at a shared landing make it difficult to achieve 10' minimum push button separation
 3. The directional curb wedge moves the curb ramp and landing further from the intersection, which often results in push button setback in excess of 10' from the back of the adjacent curb
 - a. As PAR and curb ramps become wider, such as trails and wide sidewalks, this problem is often magnified due to larger directional curb wedge setbacks
 4. APS push buttons provide directional cues to visually impaired users, so the value of a directional curb ramp with APS is diminished for visually impaired users
 5. Directional curb ramps can work well with APS if 4'-6' curb extensions (bumpouts) are used
 6. Directional curb ramps with APS may also work better when there is only one pedestrian crossing from the quadrant, such as a freeway on/off-ramp.
 - a. See 3', 4', 9' design in the Curb Ramp Standard Plans
- v. Downtown environments and APS
 1. Curb extensions are important tools in downtown environments with sidewalks at the back of curb and buildings behind sidewalks due to both spatial and vertical constraints
 - a. Curb extensions (bumpouts) may be necessary if there are vertically constrained tie-in elevations at the back of walk, especially once landings are made large enough to work with APS separation criteria

9) CROSSWALK PLACEMENT FOR ACCESSIBILITY

- a. Skewing Crosswalks/Floating Curb Ramp Locations downstream

- i. Skewing crosswalks relative to the centerline of the roadway is acceptable and can be helpful in meeting push button placement criteria, as well as reducing crosswalk distances
 - ii. It is generally better to keep curb ramps closer to the intersection on the upstream side with respect to traffic flow, where traffic stops
 - 1. The farther away from the intersection the curb ramp is placed, the more likely vehicles would pull ahead of the stop bar into the crosswalk, especially right-turning vehicles, who are most prone to creep past the stop bar when waiting for a gap to turn during a red light.
 - 2. This is an obstruction and a safety concern for pedestrians, particularly those who are visually impaired
 - iii. Curb ramps on the “downstream” side of intersection with respect to traffic flow have more flexibility for placement.
 - 1. Moving the curb ramp further away from the intersection has much less of an impact where vehicles are expected to stop on the opposite side of the road
 - a. For example, shifting a ramp 4 ft on the downstream side of the roadway approach would only shift the stopping location 2’ at the center and 0 ft at the opposite side.
 - 2. Shifting curb ramps away from the intersection creates more space to meet push button separation criteria
 - 3. By shifting curb ramps away from the intersection on the downstream side, we can create wider ramps or create more ramp separation
 - iv. When separating two curb ramps, be careful not to create a small “bump” with the curb flares that line up with the center of the approaching sidewalks which can be a trip hazard and maintenance obstacle for snow and ice removal operations
 - 1. Consider a fan ramp or depressed corner for those situations as opposed to two separate ramps
 - v. Once ramp locations have been set, the crosswalk alignment can be determined
 - 1. Define the edge of crosswalk as a line drawn between the outside zero at the back of curb between the curb ramps on both ends of the crosswalk
 - 2. The width of the crosswalk pavement markings shall match the widest approaching PAR width (6’ minimum)
- b. Crosswalks and Medians
- i. Checking turning movements to determine if any medians can be used for a pedestrian refuge by extending or maintaining the median location
 - ii. An APS push button shall be provided in the median if a pedestrian refuge is provided
 - 1. Push buttons shall be adjacent to a landing, check elevations
 - iii. To be considered a pedestrian refuge, the median should be 6’ or greater from back of curb to back of curb, utilize truncated domes, and match the crosswalk width

1. 6 ft wide medians do not provide any space to provide ramps for balancing elevations between gutter flowlines while still providing a landing adjacent to the push button
2. If sidewalk and curb are integral, the truncated domes may be placed along the face of curb so that 2' minimum separation between truncated domes is achieved, as required by PROWAG.
3. Sidewalk with integral curb in medians is not a common practice for MnDOT
 - a. A plan detail should be provided when median with curb and gutter is transitioned to sidewalk with integral curb due to the increased complexity for construction
 - b. Set median widths to accommodate pedestrian needs at the intersections and eliminate the need for minimum design widths and atypical design practices
 - c. In layout development and typical sections, measure dimensions of all pedestrian facilities from back of curb to avoid atypical construction to only achieve the absolute minimum median widths for pedestrian refuge
- iv. If the median cannot be used as a pedestrian refuge due to turning movements or insufficient space within the median:
 1. The median shall be modified or truncated away from the intersection so there is no kink or obstructions in the crosswalk
 - a. Set the nose of the median 1' clear from the crosswalk for design and construction tolerances
 - b. The 1' median setback also ensures the crosswalk pavement is flush when paved at the nose of the median
 2. Crosswalks kinked towards the intersection present safety risks and additional challenges for visually impaired users
 - a. Once a visually impaired user reaches the kink point of the crosswalk, there is very little indication that they need to change direction, introducing the risk that they may project that initial path of travel into the intersection
- v. Occasionally, the crosswalk needs to be kinked away from the intersection to provide a median refuge clear of vehicle turning movements for pedestrian safety.
 1. Providing a median refuge is more critical for high speed roadways, so kinked crosswalks should be considered on high speed roads if it allows for a median refuge to be implemented
 2. Where a crosswalk is kinked these criteria shall be met:
 - a. The kink point shall be in an accessible median refuge
 - b. The kink point shall be directed away from the center of intersection, not toward the intersection
 - c. There shall be 2 push buttons in the median refuge, one for each half of the crosswalk so that visually impaired pedestrians

- may correct their path of travel to align with the next segment of the crosswalk
 - i. One push button in the median is insufficient for a kinked crosswalk, since it can only indicate the alignment for one of the two crosswalk segments
 - d. A stop bar should be used to reinforce the stopping location since the crosswalk is directed further from the intersection when kinked
- c. Best practices for crosswalk wayfinding
 - i. The pavement surface may be delineated along the edge(s) of the crosswalk to improve wayfinding for people who are blind or visually impaired using a white cane
 - 1. For delineation, utilize ground-in pavement marking grooves (without the pavement marking)
 - 2. This is a low-cost option that can be very beneficial, especially on long crosswalks with 4 or more lanes, but should be considered for any and all crossings
 - 3. These grooves have been used to cross the free-right lane of a pork chops where there are no push buttons to indicate the alignment of the crosswalk.

10) GEOMETRICS OF URBAN MEDIANS WITH PEDESTRIAN REFUGE

- a. Elevations are critical to median design
 - i. Begin designing the median by analyzing the difference between gutter flowline elevations
 - ii. The PAR profile will need to match elevations on both sides of the median while meeting ADA standards
 - iii. All medians shall meet level 3 design criteria with elevations provided
 - iv. Output gutter should be utilized through curb ramps when adjacent to superelevated lanes and is a good tool when balancing elevations between gutter flowlines in the median
 - 1. Consider drainage implications of transitioning to output gutter, place catch basins upstream of the curb ramp wherever feasible
- b. Curb ramp length and slopes depend on:
 - i. Width of the median
 - ii. Elevations between gutter flowlines
 - iii. A median cut through may be utilized, but ramps are typically preferred where space is available
- c. Landings are required
 - i. Adjacent to push buttons
 - ii. At the top of steep ramps to meet the ADA standards
- d. Push buttons shall be placed on the outside edge of crosswalk with respect to the center of the intersection (similar to quadrants)
- e. For medians 20 ft wide or less with an inline crosswalk (no kink), utilize 1 push button

11) URBAN MEDIAN ISLANDS (PORK CHOPS)

- a. Elevations are critical to pork chop median design
 - i. Begin designing the median by analyzing the difference between gutter flowline elevations
 - ii. The PAR profile will need to balance elevations across the median
 - iii. All pork chop medians shall meet level 3 design criteria with elevations provided
- b. Pork chop median island geometrics:
 - i. Utilize 4" curbs on the pork chop
 - 1. This reduces the ramp lengths by 2 ft compared with islands using 6" curb
 - ii. Maximize the footprint of the pork chop within roadway standards as feasible
 - 1. Expand the median island into the shoulder, utilizing the minimum reaction distance from the face of curb to the through lane
 - a. 30 mph – 2 ft reaction
 - b. 45+ mph – 4 ft reaction
 - c. Do not block shoulders used by busses
 - iii. A 12' minimum path along the edge of PAR is needed from curb to curb
 - 1. 12' will fit two 4' long ramps and a minimum 4' landing
 - 2. Consideration of the curb flowline elevations surrounding the pork chop median island is critical to the design in meeting curb ramp standards
 - a. Curb ramp lengths will increase as elevations deviate between gutter flowlines across the median island
 - b. Pork chop median islands require level 3 design details
 - 3. Cut-through designs should not be utilized in pork chop median islands with 3 crossings since the ramp "Y" configuration is difficult to maintain for snow and ice removal operations
 - 4. **ADD FIGURE**
 - iv. Curb ramps will almost always be perpendicular ramps on pork chop median islands
 - 1. Directional curb ramps are not recommended for most pork chop median islands due to the limited footprints available
 - a. The dome setback at back of curb is 2% or less and eats into available running space to make up elevation/grade between the through lanes and the free right which is typically lower
 - v. Ramp alignment is important for maximizing landing space and getting push buttons and ramps to work together within APS and curb ramp criteria
 - 1. Curb ramps should typically meet at a shared landing
 - vi. Output gutter is recommended on the free right side of the pork chop median island
 - 1. Output gutter improves the usability by removing a 2 ft inverse grade through the gutter between the curb ramp and the free right which is typically superelevated down away from the median island

- vii. For preservation type projects, consider the existing signal equipment such as handholes and signal poles when sizing pork chop median islands and placing curb ramps
- c. APS push button placement in pork chop median islands
 - i. When the footprint of a median island has been maximized within roadway standards, there are circumstance where achieving the minimum 10 ft push button separation may still be infeasible
 - ii. Where constrained, exceptions to the 10 ft push button separation may be utilized, MnDOT will accept separation of 8 ft, but shall not be less than the PAR and MAR widths

12) RURAL APS DESIGN

- a. Typically crossing a trunk highway is one of the most prominent barriers when using shoulders to travel on local roads and highways
- b. Rural pad design at quadrants:
 - i. Design the entire surface as a landing with radial domes, similar to a depressed corner
 - 1. The surface should slope 1.5% away from the roadway to shed/sheet water off the back, perpetuating the existing rural drainage patterns
 - ii. Detectable warning surfaces (DWS)
 - 1. The DWS should be set back 1' away from the edge of the traveled roadway
 - a. In absence of curb and gutter, the 1 ft offset from the bituminous roadway provides visual contrast since the dark iron/rust colored DWS are placed on a light concrete surface
 - 2. DWS should cover the full width of the rural pad within 3" of each edge
 - iii. Push Button Placement
 - 1. Push buttons should be 6'-8' typical from edge of roadway since vehicle overturning is more prevalent on rural quadrants without curb channelization
 - 2. Design the rural pad/landing and DWS so pedestrians can depart from the push button directly in line with the crosswalk without walking over turf (or dirt, mud, and ruts at the edge of road)
- c. Rural median refuges
 - i. Push buttons should be placed in rural medians whenever 6' or wider
 - 1. If pedestrians have trouble crossing the entire roadway during the pedestrian phase for any reason (starting late, slow walking speed, etc.), being able to initiate a pedestrian phase from the center is a significant safety improvement
 - ii. Push buttons need to be placed adjacent to a landing
 - iii. Push buttons shall be placed on the outside edge of crosswalk with respect to the center of the intersection (similar to quadrants)
 - iv. Detectable warning surfaces (DWS)
 - 1. Minimum of 6' wide

2. Minimum of 2' separation between DWS in the path of travel, 5' preferred
3. Placed 1' from the edge of the traveled roadway
4. Placed outside of left turning movements
- v. The surface behind the push button should be turf to provide a wayfinding tool for visually impaired users, a detectable edge, and a better sense of the limits of the pedestrian refuge
- vi. Check elevation early in design in case paving operations are necessary to keep the median crossing within accessibility standards for running slopes while still achieving a landing at the push button(s) and perpetuating intersection surface drainage
- vii. Drainage considerations are one of the most important details in effectively designing a rural median crossing
 1. Find the existing low point/flow path from the intersection to the existing median ditch, this needs to remain the low point or be modified with paving operations
 2. As water sheds from the intersection to the median, the surface drainage needs to be perpetuated over the walk so a puddle or "bird bath" is not created
 3. 3 critical design constraints:
 - a. Edge of median/roadway PI
 - b. Opposite edge of median/roadway PI
 - c. Median low point receiving drainage from within the intersection

13) PLAN FORMATTING FOR ADA INTERSECTION DETAILS

- a. Intersections with APS need detailed designs for coordination of push buttons and curb ramps
- b. Designs details should always follow Level 2 design criteria unless the quadrant meets Level 3 criteria, i.e. vertical constraints, revised curb alignments, revised curb radii, gutter flowline profile adjustments (tabling), all median pedestrian refuges, and pork chop median islands
- c. 20 scale detail sheets that fit the entire intersection on one continuous plan view
 - i. Exceptions may be made to utilize 30 scale details only for large intersections that cannot fit all curb ramp details on one plan sheet
- d. Right-of-Way limits, existing and proposed
- e. Legend
 - i. Include [MnDOT's Standard ADA Legend for Level 2 and Level 3 designs](#)
- f. Utilities
 - i. Show all surface utilities on the ADA intersection details
 - ii. It is important to understand where these surface utilities are located with respect to the PAR alignment, grade breaks, push buttons, and MAR
- g. Crosswalk pavement markings shall be included where proposed

- i. MnDOT's standard is to provide crosswalk pavement markings for pedestrian crossings at signalized intersections
 - h. Signal components
 - i. Show all APS push buttons, signal poles, cabinets, and hand holes on the intersection detail sheets
 - ii. Signal control point tables
 - 1. Signal component XY's
 - a. Include XY for new signal push buttons, signal poles, pedestals, and cabinets
 - b. When a push button is placed on an existing signal pole (retrofit), you may note "on pole" in the table instead of providing an XY since it's a fixed location
 - 2. Note the distances from the front and back of landing for all push buttons
 - a. Distances should be measured in direction of the path of travel
 - i. Think about how someone in a wheelchair would use the push button and curb ramp to make this more intuitive
 - ii. For ramps (fan, perpendicular, directional), measure in the direction of the ramp running slope
 - 1. Wheeled users will tend to approach the ramp so that both wheels hit the grade break at the same time
 - iii. For depressed corners and parallel ramps, measure from the push button directly towards the outside corner of the DWS at the zero inch curb
 - 1. Wheeled users will tend to take the most direct route since there is not grade break to traverse
 - iii. In the signal plans, include a pole note to provide APS pole mount adaptors or APS pedestal mount adaptor whenever a push button is mounted on either signal pole or pedestal
 - i. Control points for curb ramps and medians
 - i. Level 1 designs do not work for signalized intersections due to the complexity of APS and curb ramp constraints
 - ii. Level 2 designs are the minimum design detail required for intersections with APS
 - 1. 1 control point per curb ramp
 - a. XY on outside edge of ramps placed at the gutter flowline
 - b. For ramps with radial domes, only place the 1 control point, the chord length of dome plates varies slightly by manufacturer and will be closely field fit
 - 2. 1 Control point per median nose (non-refuge medians)
 - a. XY on median noses placed at the end of the median

- iii. Level 3 designs are for any vertically constrained quadrants, modified curb alignment, curb radii, or gutter flowline elevations, and all median refuges and pork chop median islands
 - 1. 3 control points per ramp minimum
 - a. 1 XYZ at each ramp edge placed on the gutter flowline to control ramp cross slope
 - b. 1 XYZ at the top of the curb ramp to control ramp running slope
 - c. Additional XYZ at vertically constrained tie-in locations

14) APS HARDWARE & DETAILS

- a. Standalone APS Push Button Station:
 - i. MnDOT's standard standalone APS push button station uses a breakaway t-base that with an integral foundation to the sidewalk/landing in which 4 holes are drilled and anchor rods are epoxied into
 - ii. The breakaway base make maintenance simpler after knockdowns so the t-base can be replaced without impacting the concrete the foundation or anchor rods
 - 1. This is a major benefit for maintenance in winter conditions, no concrete flatwork necessary to fix
 - iii. The foundation is only 12" deep and has a 9" radius, which is poured integrally with the adjacent landing
 - iv. No joint (tooled, sawcut, or cold poured) shall be within 9" of the center of the push button for structural integrity surrounding the anchor rods
 - 1. When the push button station is surrounded by concrete, flare the landing out 9" at the top of the curb ramp so the push button is outside the envelope of the curb ramp (see twin perpendicular ramps in the detail)
 - 2. When the push button is placed at the edge of concrete walk adjacent to turf, bulb the landing out 9" with a trapezoidal or radial design so the button is kept outside the envelope of the curb ramp alignment (see options in the detail)
 - v. Include the [APS Push Button Station detail](#)
- b. APS push button mounting hardware
 - i. Pedestal push button mounting spacers and pole mount adaptors shall be included for all push buttons on all signal poles
 - ii. Add a pole note in the signal plans where spacers and adaptors are needed for both new signals and retrofit installations
 - iii. Include MnDOT's [Pole Mount Detail](#) as needed for APS retrofit installations
 - iv. Benefits
 - 1. Adaptors minimize the side reach distance to within standards (10" max side reach standard)
 - 2. Adaptors provide flexibility in mounting height and extend below the top of the T-base (42" push button height standard)
 - 3. Push buttons can be mounted at any angle on the round surface of the adaptor, so the face of the push button is in line with the edge of

crosswalk improving directionality from the 8 flat surfaces of MnDOT signal poles

15) CONSTRUCTION OF APS

- a. Signal Pedestal Foundation Standard Plate
 - i. New pedestal foundations shall be flush within a ¼” of the walk
 - ii. Helps meet ADA standards for ¼” maximum vertical deviation within the PAR
 - iii. Construction staging
 - iv. When mounting APS push buttons to pedestal poles, utilize temporary signal poles mounted on concrete weighted donuts during construction so that the pedestal foundations can be poured at the same time as the walk
 - 1. Signals typically are installed and in operation before the curb ramps and other flatwork are started
 - 2. Utilizing the temporary signal poles allows the contractor to be more flexible with staging and use best practices for constructing the pedestal foundations flush with the sidewalk
- b. RECTANGULAR RAPID FLASHING BEACON (RRFB)
 - i. Shall utilize APS push buttons on MnDOT right-of-way
 - ii. Audible message should say “Yellow lights are flashing”
 - iii. The push button shall not use vibrotactile indications or percussive indications
 - iv. Push buttons shall meet all other MnDOT placement criteria as prescribed for APS
- c. POLITICS AND NON-TRADITIONAL ADA SOLUTIONS
 - i. Lighted pedestrian crossing signs on free-right turn lanes