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Multimodal Planning: Pedestrian and Bicycle Components

In This Issue…

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Overview

Multimodal planning and design is an important aspect of roadway design since it aims to transform a transportation network that favors personal motorized vehicles into one that serves all modes and promotes methods of travel that are more cost-effective, efficient, healthier, and safer. Pedestrian accommodations are a major focus of the multimodal planning process and are part of a larger multimodal grouping. This includes pedestrians and bicycles, and the appropriate facility to complete the street for multimodal design. Sidewalks are a very common example of accommodating another mode. Other examples include bike lanes on roadways, multimodal trails, and how these facilities intersect roadways. From a military-specific standpoint, it also includes how these facilities transition from off-installation to on-installation infrastructure. Inadequate and non-continuous pedestrian accommodations can lead to devastating consequences as highlighted below.

According to U.S. DOT 2018 crash data for U.S.:

- 6,283 pedestrian fatalities
- Most pedestrian fatalities occur at **non-intersection** locations (74%) and **at night** (76%)
- Children 14 and younger accounted for 17% of pedestrian fatalities
- 48% of pedestrian fatalities involved alcohol for the pedestrian and/or driver
- 81% of pedestrian fatalities occurred in urban areas

https://crashstats.nhtsa.dot.gov/Api/Public/ViewPublication/812850

With increased societal emphasis on fitness in recent years through the popularity of personal fitness tracking devices and the fact that the general population on military installations is involved with physical fitness training, there is great demand for proper pedestrian and bicycle accommodations. Therefore, it is important and appropriate for military installations to accommodate alternate modes to the greatest extent possible to meet this demand.

Multimodal planning considers diverse transportation options (such as automobile, walking, cycling, and transit) and also considers how the non-vehicular modes relate to vehicular traffic. Although transit has a pedestrian component based on certain design aspects of a bus stop, transit is not the focus of this bulletin. This bulletin focuses on the pedestrian and bicycle components, and how to plan for this infrastructure on a military installation.

It should also be noted that all pedestrian facilities on federal land must be built to be compliant with the Architectural Barriers Act (ABA), which can significantly impact the design. For more information, see SDDCTEA's Bulletin 12-01 - Accessibility Compliance for Military Installations on the SDDCTEA website.

Pedestrian Planning

Non-motorized vehicles should be a major factor in planning for transportation systems. These systems must be logical and organized and not just a patchwork of poorly connected sections. Poorly connected systems tend to be in older areas that were built before today's emphasis on pedestrians and bicycles. They could also be in corridors with constrained widths, where, in the case of non-installation roadways, the roadway itself uses all of the public land available. While land ownership is not an issue on military installations, other land uses or utilities may occupy the land up to the roadway, leaving no width available for a sidewalk.

Pedestrian and bicycle features can be located in a variety of areas. Sidewalks are generally located adjacent to roadways. It is preferred that sidewalks be separated from the roadway by a grass strip, but this is not necessary. Sidewalks intersect roadways by transitioning to curb ramps. Crosswalks are used to cross roadways and also intersect curb ramps.

Sidewalks are intended for use by pedestrians. This includes people walking to a business, place of employment, home, or other facility. It could include fitness walking, pedestrian commuters, or pedestrians walking for any other reason.

Bicycles are considered vehicles in most jurisdictions where local or state laws require bicyclists to use vehicular travel lanes versus sidewalks. Note that children are often exempt and can ride their bicycles on the sidewalks. Bicycle lanes are often provided adjacent to travel lanes where demand exists and sufficient room is available. If bicycle lanes are not provided, bicycles will travel either in the travel lane or on the shoulder. If on-street parking is present on the shoulder, this can be hazardous for bicycles since this can force them to move from the shoulder and share the travel lane with motorized vehicles.

Shared-use paths are designed for use by both pedestrians and bicyclists and generally travel through parks, along rivers, and recreational areas. They can also be located parallel to roadways or highways and are typically used for recreational purposes but can also serve as commuting routes for pedestrians and bicyclists.

Though land outside the roadway may not be available, there are situations where the roadway itself provides more capacity (for vehicular traffic) than is needed to meet the current traffic demand. This excess capacity could be due to a variety of reasons; including elimination or relocation of businesses or residences, change in mission, etc. Nonetheless, a simple roadway reconfiguration known as a 'Road Diet' (also called a lane reduction) would offer enhanced safety and mobility for all road users, while accommodating a variety of transportation modes. A classic Road Diet typically involves converting an existing four-lane undivided roadway to a three-lane section (with a center two-way left-turn lane) with bicycle lanes on each side. There is often no notable decrease in intersection capacity since under the four-lane condition, the left travel lane would serve as a defacto left-turn lane at busier intersections.

Sidewalks

In general, sidewalks should be located along all roadways in residential areas, central business districts, near schools, and any location where pedestrians would be present. In the civilian world, it is common for municipalities to pass codes requiring developers to build sidewalk as properties get redeveloped. This is helpful as a way to get sidewalk added along corridors, but the disadvantage is that it takes many years for all properties along a corridor to get redeveloped. Another disadvantage is that this methodology results in gaps in the sidewalk system along the corridor, i.e. roadway sections with sidewalk and sections without sidewalk. These missing sidewalk links and sidewalks to nowhere, as illustrated below, are not ideal for pedestrians. To avoid this problem, it is recommended that military installations take a systematic approach and upgrade an entire corridor or section of an installation, either in conjunction with redevelopment or as a stand-alone project.

Undesirable Sidewalk to Nowhere

A worn path is an indicator for the need for a sidewalk, and the presence of such should be considered when determining new sidewalk locations within a project.

Worn Path Indicates the Need for Sidewalk

Crosswalks

A crosswalk is the connection of two sidewalks and provides a designated pedestrian crossing across a roadway. Crosswalks serve the purpose of collecting pedestrians into one location to minimize points of pedestrian-vehicular conflict.

Crosswalks should not be used where sight distance is not adequate. Additionally, crosswalks should not be installed across uncontrolled roadways where vehicular speeds exceed 40 mph, unless additional measures are taken to reduce the speed and/or provide active warning of pedestrian presence. Generally, crosswalks should be marked in the following locations:

- ☑ All intersections with stop, yield, or signal traffic control and only to connect a sidewalk system.
- ☑ All locations where a school crossing guard is normally stationed to assist children in crossing the street; and
- ☑ May be considered at uncontrolled (no stop, yield or signals) intersections and midblock crossings satisfying the minimum vehicular and pedestrian volumes and meeting the minimum safety standards..

Crosswalks are essentially implied at intersections, even when not marked. The most likely location for a pedestrian to cross is at an intersection.

The use of marked mid-block crosswalks is highly debated on military installations. Some proponents argue that marked mid-block crosswalks enhance safety while others argue that they give pedestrians a false sense of security. While certain treatments can enhance safety at mid-block crosswalks, they can be prone to vehicular conflicts resulting from speeds and volume. It is preferable to have a crosswalk at a controlled intersection versus at an uncontrolled mid-block location. Marking mid-block crosswalks at every location where pedestrians cross results in disrespect of crosswalks, including those that truly are warranted.

The mere presence of a small number of pedestrians crossing does not require a marked crosswalk. Pedestrians can always cross the road at unmarked locations cautiously.

Crosswalks should not be located closer than 300 feet from a controlled (i.e., signal/stop/yield control) intersection. A pedestrian should walk to the controlled

intersection, where traffic would stop and the pedestrian could cross at the controlled location. The distance could be reduced to 200 feet if recommended in an engineering study.

Ideally, sidewalk infrastructure should be built to minimize the need for crosswalks. Locate sidewalks on both sides of the roadway so pedestrians walking the roadway have sufficient infrastructure to use until they come to a crosswalk. Sidewalks should travel along the full length of a roadway as opposed to ending midblock, so as to locate crosswalks at intersections versus at midblock locations. Also, parking lots to buildings should be located on the same side of the roadway as the building they serve to eliminate the need for a crossing.

The figure on the following page shows examples of sidewalk routes for parking lots located across a street from the building it serves. The bottom example illustrates proper placement of the sidewalk from the parking lot in order to direct people to cross at the adjacent signalized intersection, and also shows the main doorway of the building located nearest the intersection. These features combined encourage people to cross at the signal versus at a midblock crossing.

Linking to External Networks

Joining a pedestrian network internal to a military installation to the external roadway network can often require special treatment. If the pedestrian network both on and off the installation is complete, some form of access control for pedestrian traffic is required.

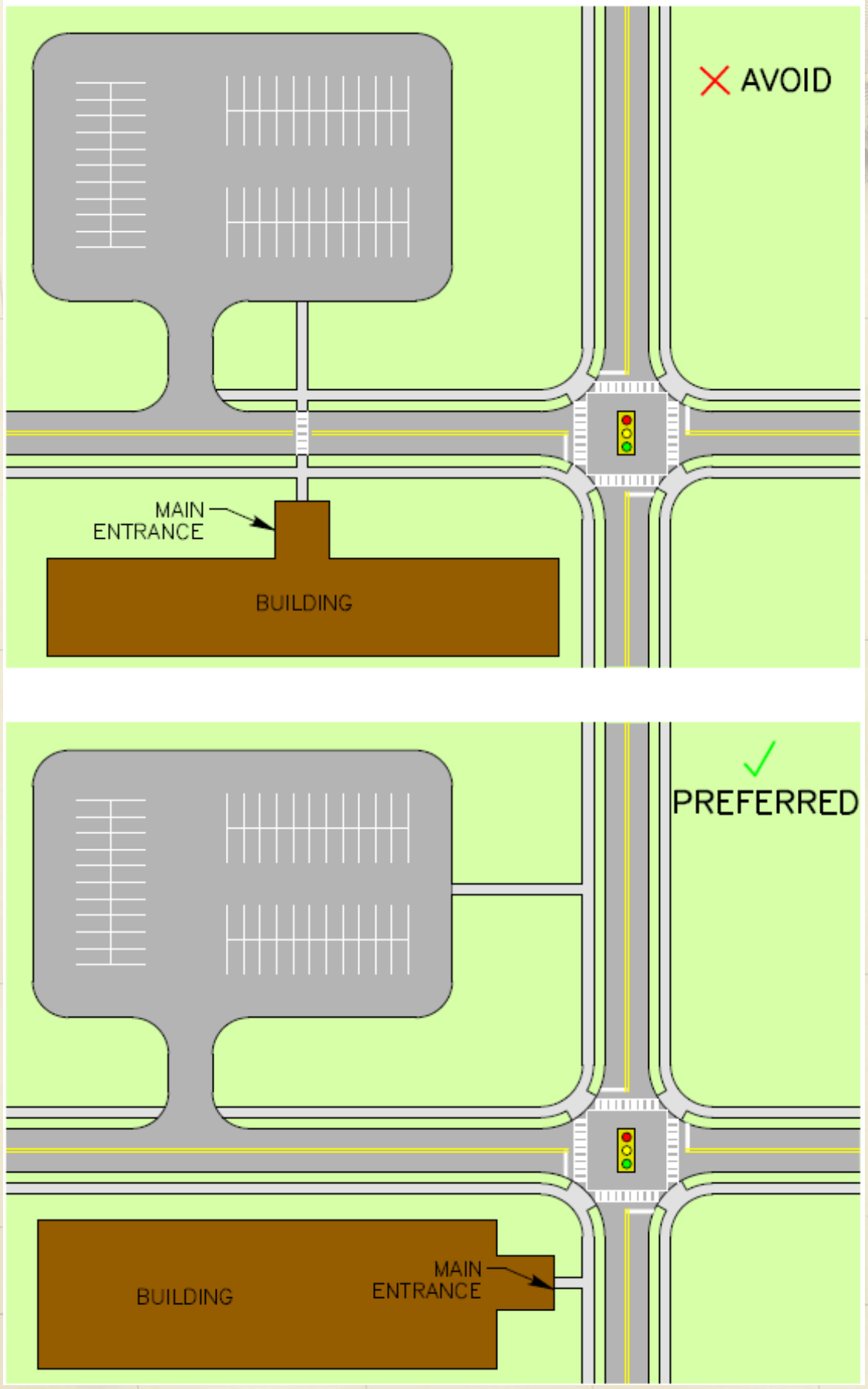
There are three methods to connect to an off-installation sidewalk network.

- ☑ Vehicular entry control facility (ECF) with no exclusive pedestrian accommodations for access control
- ☑ Vehicular ECF with pedestrian checkpoint
- ☑ Pedestrian-only gate

A vehicular ECF with no exclusive pedestrian accommodations is often located where pedestrian volumes are light to non-existent, or at older ECFs not designed to current-day standards for pedestrian accommodations. This type of ECF may have a sidewalk through the entire ECF for pedestrians to use, but it is not always the case. If no sidewalk is present, pedestrians would walk on the shoulder of the roadway leading to and from the gate. Guards that normally process vehicles at the gate would check pedestrians' credentials as they approach the gate. This type of treatment is acceptable where pedestrian volumes are low. The disadvantages to this type of gate include guards halting vehicular processing to process pedestrians, and the potential for guards or pedestrians crossing traffic lanes at the ECF. Guards halting traffic delays vehicular traffic. If this occurs during peak hours when the ECF is busiest, it contributes to congestion and queues at the ECF. Guards or pedestrians crossing traffic lanes is not desirable. Even though crossings would occur at the stopping point for vehicular traffic, most drivers are attentive to the guard's instructions, the roadway ahead, or stowing away their identification after being processed. This creates potential for a driver to proceed as the pedestrian or guard is crossing. Crossings as such are also undesirable because they often lack specific ABA accommodations.

ECF without Pedestrian Accommodations

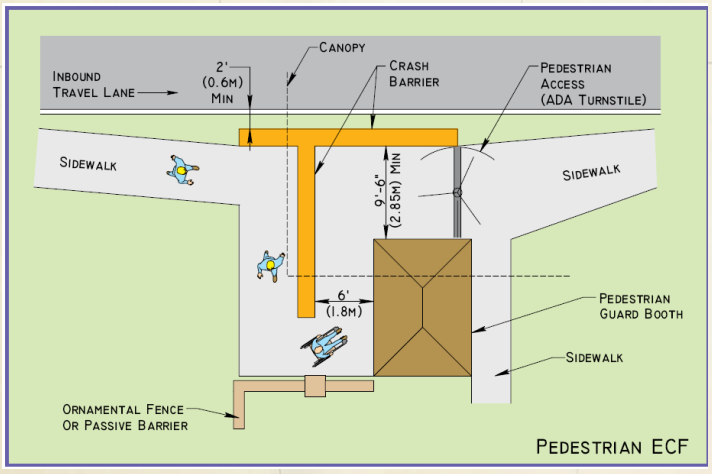
Sidewalk adjacent to a Vehicular ECF



Example of Sidewalk and Crosswalk Placement to Avoid Midblock Crosswalk

A vehicular ECF with a pedestrian checkpoint should be provided when peak hour pedestrian volumes exceed 10 pedestrians per 15-minute interval during the peak hour. This gate would have sidewalk leading to and from the gate. The checkpoint itself would have a manned pedestrian guard booth to verify identification, and an ABA-compliant turnstile for accepted entry. If it is not accessible to wheelchair users, a separate swing gate must be provided for ABA compliance.

An alternative would be to use a card-reader system for identification verification in lieu of a manned checkpoint. With this type of system, the pedestrian would use proper identification for the system. Depending on the system, if it relies on the validity of the actual card versus comparing it to the person carrying the card, there could be some vulnerabilities. A vehicular ECF with a pedestrian gate is preferred for pedestrians since they are removed from the vehicular traffic stream. Prior to entering the ECF area, and after leaving it, pedestrians would use sidewalks adjacent to the regular roadway.



ECF Pedestrian Turnstile Layout

Pedestrian-only gates are often used where there is pedestrian demand to enter the installation in locations different from vehicular traffic. Examples could include:

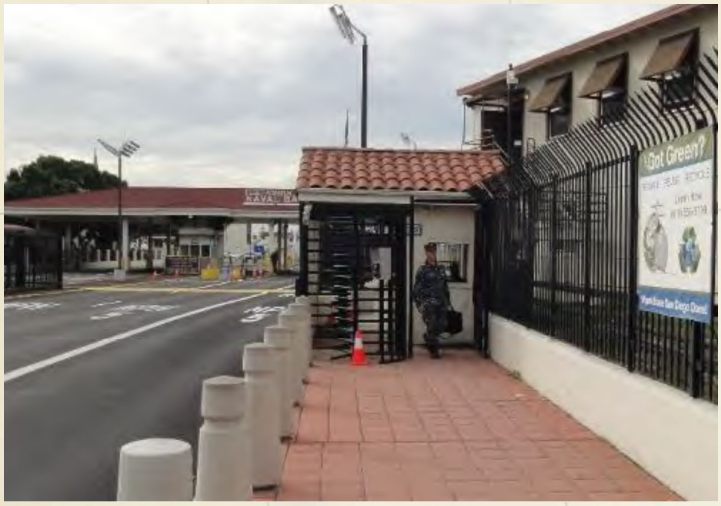
- ☑ Connections between local schools and on-installation housing areas
- ☑ Areas where major walkways enter the installation
- ☑ External transit stops serving installations
- ☑ Built-up urban areas on and off base where vehicular ECFs are located elsewhere such as a rural area where more land is available for a proper ECF layout
- ☑ Secure locations not allowing vehicles.

In cases like this, the pedestrian checkpoint ideally would be similar to the pedestrian checkpoint portion of a vehicular ECF with a pedestrian gate. The location could be either manned or unmanned depending on security desired. A less developed version of this ECF could be a guard stationed in a vehicle at the gate during hours it is opened. A fully automated version is a possibility if the installation's security approves of the technology used. Pedestrian-only gates may be appropriate in locations on installations that are different from vehicular ECFs out of convenience of location. Pedestrians often prefer to use the shortest distance to arrive at their destination, whereas vehicles may be more willing to veer from the most direct path.

Pedestrian-only ECFs can be appropriate in the following locations:

- ☑ Built-up areas of installations, combined with built-up areas outside of the installation. These may have once had vehicular ECFs, but no room is available to accommodate today's ECF requirements.
- ☑ Connections between external schools with internal housing areas, where it may not be desired to have the traffic from a vehicular ECF.
- ☑ Near external transit stops. Transit stops often have high volumes of pedestrians, and if a public stop is located outside the installation, many people could want to access the installation during short specific periods of time. If a pedestrian access point was adjacent to a vehicular ECF where the pedestrian had to walk along the entire vehicular ECF corridor, the convenience of the external transit stop would be lost by requiring people to walk such long distances.
- ☑ Locations where a facility is secure and vehicles are not vetted: i.e., the parking lot for the facility is public. An advantage of this type of access control is that the primary security requirements apply only to the building. The cost associated with a vehicular access control point is eliminated as it is not needed.

Pedestrian-only ECF (turnstile) at transit stop



Pedestrian Checkpoint at a Vehicular ECF

Bicycle Planning

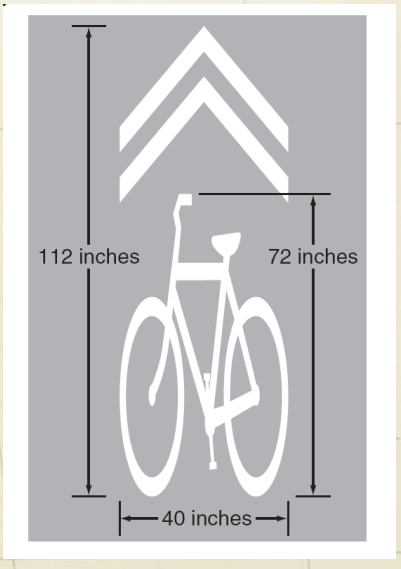
Bicycles should be given consideration on installations. In general, bicyclists are considered to be mature adults versus children. Children on bicycles often use sidewalks, perhaps with family members walking. Bicycles riden by adults are considered vehicles and must follow appropriate vehicle codes.

Bicycle accommodations can include the following:

- ☑ No special accommodations
- ☑ Share the Road system
- ☑ Marked bike lanes
- ☑ Separate bicycle facilities

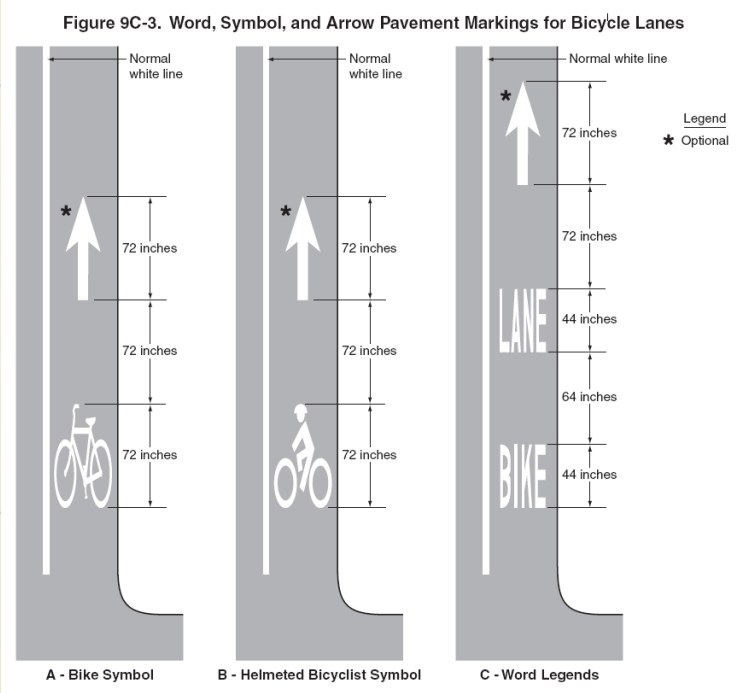
If bicycles have no special accommodations, they travel either in the travel lane or on the shoulder. If bicycle volumes are relatively low, this is adequate. There can be conflicts when bicycles are using the vehicular travel lane. Slower bicycles can delay automobiles. Automobiles can in turn pass bicycles. Depending on the nature of the specific driver, they may pass by accepting shorter gaps in oncoming traffic or in areas with insufficient sight distance. Drivers might also pass at an insufficient width from the bicycle. This can risk the safety of drivers and the bicyclist.

A Share the Road system promotes awareness of bicycle traffic using the roadway. Signs are installed which are intended to convey the message to drivers that bicycle traffic is present. Additionally, pavement marking arrows with a bicycle legend are installed in the travel lane to further highlight the presence of bikes. Bicycle traffic is not removed from the roadway, so the potential for unsafe passing remains.



R4-11 BICYCLES MAY USE FULL LANE SIGN and Shared Lane Marking (from *Manual on Uniform Traffic Control Devices [MUTCD]* Section 9)

Marked bicycle lanes accommodate bicycles by providing a specific width of the roadway for use by bicycles. This could be a four-foot or wider section adjacent to the travel lane. Providing dedicated width for bicycle travel removes much of the conflict associated with vehicles and bicycles using the same lane. When the bike lane is adjacent to the travel lane, there may still be potential for conflict at intersections and driveways.



Pavement Markings for Bicycle Lanes

(from *MUTCD* Figure 9C-3)

Bicycle lanes may possibly be formed by reassigning the capacity of a roadway. As discussed on page 2, 'Road Diet' is a technique used to change the capacity of a roadway by reducing the number of travel lanes and adding bicycle lanes.

Separate bicycle facilities include either exclusive bicycle trails or multimodal trails. These would be located where sufficient area is available, such as running parallel to rivers, roadways, or along abandoned railroad grades. These provide the best separation from traffic since traffic conflict would be limited to intersections. The disadvantage is that the trail requires significant land along a corridor free from obstructions.

Bicycles through ECFs

Bicycles can enter ECFs through travel lanes, similar to vehicles. When they enter an ECF, the vehicular guards check their credentials. If the approach roadway has adequate shoulders, bicyclists would use the shoulder approaching the ECF, then merge into traffic at the actual checkpoint.

If bicycles use pedestrian gates, the bicycle must fit through the infrastructure. The ideal pedestrian gate uses a turnstile to grant access to the pedestrian, which is not accessible to bicycles. If a swing gate is provided for ABA compliance, bicyclists could use this swing gate for access. Whether commuter style bicycles are allowed to use a pedestrian gate is a function of local policy. It may be permissible for bicyclists to walk their bicycle through the gate.

Pedestrian and Bicycle Study

A pedestrian and bicycle study can identify opportunities for upgrades to pedestrian and bicycle infrastructure. There are two aspects to a study: demand study and an asset management study.

Demand Study

There are multiple objectives for performing pedestrian and bicycle studies including: determining the volume of people walking and biking within specific areas; identifying the location for sidewalks, crosswalks, bike lanes, and trails; determining if traffic signals are warranted; implementing safety improvements; and calculating crash rates. Consideration for the safety of non-motorized travel within the installation is of utmost importance. These studies can help improve pedestrian and bicycle travel conditions and reduce the barriers to travel in order to successfully integrate all modes of the installation's transportation network. Four common types of studies that monitor the behavior or performance of the pedestrian and bicyclist include:

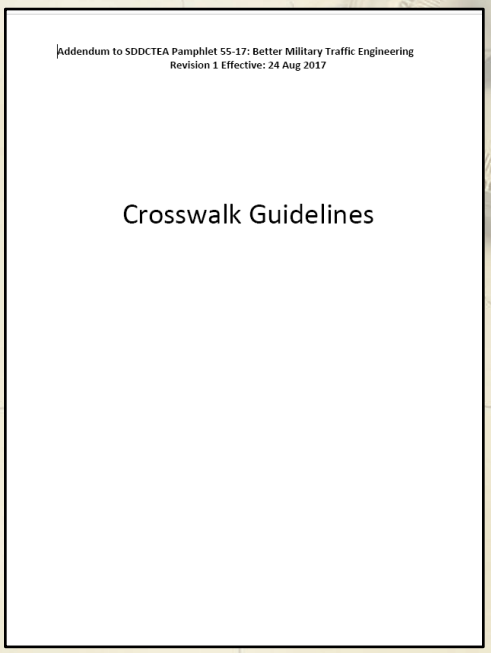
- ☑ Volume studies
- ☑ Travel speed studies
- ☑ Gap studies
- ☑ Origin-Destination studies

Uses for pedestrian and bicycle counts:

- ☑ Track changes in non-motorized activity over time
- ☑ Evaluate the effects of new infrastructure on pedestrian and bicycle activity
- ☑ Identify and prioritize high-priority locations for pedestrian and bicycle facility improvements
- ☑ Determine pedestrian and bicycle safety improvements
- ☑ Provide data for crash analysis
- ☑ Determine appropriate roadway signing and pavement markings
- ☑ Perform pedestrian signal warrants
- ☑ Evaluate uncontrolled crosswalk warrants
- ☑ Determine signal timing
- ☑ Design sidewalks, crosswalks, bike lanes, and trails
- ☑ Evaluate before-and-after volumes after a new facility is opened
- ☑ Perform safety analysis of a facility or area
- ☑ Identify the before-and-after safety effects of upgrading a facility

Walking and bicycling as a means of travel within the installation is important to alleviate vehicle congestion and improve air quality. Additionally, it provides increased health benefits for the users.

The pedestrian demand, at crossing locations, is needed to determine whether a crosswalk should be installed at an uncontrolled location or if it should be located at a stop controlled or signalized intersection. Crosswalks at uncontrolled locations should only be installed where they meet the traffic warrants and safety standards as published in the SDDCTEA Pamphlet 55-17 (See Reference List at end of this bulletin for a link to this pamphlet). Consideration for placement and associated enhancements is dictated by the roadway and pedestrian traffic volumes, as well as roadway speed and number of lanes.



SDDCTEA's *Crosswalk Guidelines*

Providing a safe and efficient infrastructure for bicycles within the installation is encouraged. A bicycle count will identify locations of high volume and frequency of bicycle movement. It can help to identify major bike routes within the installation or suggest the need for safety improvements such as a separate bike lane or trail to minimize conflicts with vehicles. Bicycle movement data may be collected with the same methods as pedestrian travel counts, through manual observation at a location of interest, specifically an intersection. However, since bicyclists often share the road with vehicles and follow motor vehicle rules, reducing the areas of conflict between bicyclists and vehicles is important.

Types of safety improvements that may be considered within the installation for improved bicycle travel include:

- ☑ Designated separate bike lanes
- ☑ Shared bike lanes
- ☑ Shared-use paths
- ☑ Widened roadway shoulders
- ☑ Improved roadway shoulder surface
- ☑ Inlet grates that use a bicycle-safe design
- ☑ Bicycle signing and pavement markings
- ☑ Sight distance improvements
- ☑ Bike routing designations
- ☑ Bike racks

Additional information and guidelines regarding type and application of bicycle improvements and treatments can be found at the FHWA website:

http://www.fhwa.dot.gov/environment/bicycle_pedestrian/guidance/.

Recommendations and implementation of bicycle improvements is at the discretion of the installation. SDDCTEA staff is available for additional direction and assistance in determining improvements that accommodate bicycle travel.

Asset Management Study

An asset management study can assess existing pedestrian and bicycle infrastructure for condition, compliance with standards, size, and overall needs of the installation. Under this type of study, several different items would be assessed.

- ☑ Sidewalk placement and continuity - Placement and continuity would verify that sidewalks are located where appropriate, and identify any gaps where sidewalk would be needed. It would also identify worn paths showing demand where sidewalk should be installed.
- ☑ Americans with Disabilties Act (ADA)/ABA facilities - ADA/ABA compliance is required. The study would verify that all relevant aspects of the pedestrian network would meet ADA/ABA standards. This includes sidewalk width, curb ramp slopes, use of detectable warning surfaces, or pedestrian pushbutton placement.
- ☑ Lighting - Crosswalks should be illuminated. Locations where lighting is provided should have appropriate levels of luminance. A light meter should be used to take crosswalk light readings at night to measure the amount of illumination in a crosswalk.
- ☑ Crosswalks - This would include crosswalk condition, marking style, and any required signing.
- ☑ Pedestrian signals - This would include an assessment of pedestrian signal heads and pushbuttons at traffic signals. It would also include other types of pedestrian signals, such as flashing warning devices or hybrid beacons used at crosswalks.
- ☑ Bicycle accommodations - This would include the use, location and condition of bicycle lanes.
- ☑ Shared-use paths - This would include the use, location and condition of shared-use paths.

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for pamphlets, bulletins and studies

Reference List

- ☑ TEA Home: http://www.sddc.army.mil/sites/tea
- ☑ SDDCTEA Pamphlet 55-15: *Traffic and Safety Engineering for Better Entry Control Facilities*: https://www.sddc.army.mil/sites/TEA/Functions/SpecialAssistant/TrafficEngineeringBranch/Pages/default.aspx, 2019
- ☑ SDDCTEA Pamphlet 55-17: *Better Military Traffic Engineering*: https://www.sddc.army.mil/sites/TEA/Functions/SpecialAssistant/TrafficEngineeringBranch/Pages/default.aspx, 2016
- ☑ Addendum to SDDCTEA Pamphlet 55-17: Better Military Traffic Engineering – Crosswalk Guidelines https://www.sddc.army.mil/sites/TEA/Functions/SpecialAssistant/TrafficEngineeringBranch/Pamphlets/SDDCTEA_Pamphlet_55-17%20Addendum.pdf
- ☑ Federal Highway Administration: *Manual on Uniform Traffic Control Devices*, 2009. https://mutcd.fhwa.dot.gov/?vm=r
- ☑ AASHTO Policy for the Geometric Design of Highways and Streets, 2011
- ☑ Proposed Guidelines for Pedestrian Facilities in the Public Right-of-Way: https://www.access-board.gov/guidelines-and-standards/streets-sidewalks/public-rights-of-way/proposed-rights-of-way-guidelines, 2011