910 PEDESTRIAN CROSSWALKS

910.1 INTRODUCTION

By legal definition, there are three or more crosswalks at every intersection whether marked or unmarked. A marked crosswalk is defined as any portion of a roadway at an intersection or elsewhere distinctly indicated for pedestrian crossing by lines or other approved markings on the pavement surface. A marked crosswalk should be installed at an intersection where an unmarked crosswalk would not be clearly discernable due to peculiar geometrics or other physical characteristics.

When warranted and located properly, a marked pedestrian crosswalk may achieve the following results:

- Act, in a limited manner, as a warning device and reminder to motorists that pedestrian conflicts can be expected.
- Point out to the pedestrian an optimum crossing path.
- Limit pedestrian crossings to specific locations.
- Aid in enforcing pedestrian crossing regulations.

Unwarranted or poorly located marked crosswalks may have the following effects:

- Result in unnecessary installation and maintenance costs.
- Cause a greater number of rear-end and associated collisions due to pedestrians not waiting for adequate gaps in traffic.

Marked crosswalks are a useful traffic control device but should not be installed unless the anticipated benefits outweigh the associated risks.

A marked mid-block crosswalk may be installed if it meets the crosswalk warrants and satisfies the following conditions:

A. The length of the block between intersections should be at least 1000 feet;

B. There should be a high pedestrian volume generator nearby; and

C. There should be a reasonable demand by the pedestrians to cross within a concentrated area at least 400 feet from the nearest intersection.

The following warrants are based on a point system evaluation incorporating gap time, pedestrian volumes, vehicle approach speed, and general conditions. Crash history and the investigating engineer's opinion have been eliminated to encourage maximum objectivity in determining crosswalk needs.

No crosswalks shall be installed at an unsignalized location unless the driver has an unrestricted view of the pavement surface at the proposed crosswalk site for distances as shown in Table 910-1:

Table 910-1. Stopping Sight Distance

Posted Approach Speed (mph)	Sight Distance (feet)
20	125
25	150
30	200
35	250
40	325
45	400

All roadways having a raised or painted median at least six feet wide for curbed sections and ten feet wide for uncurbed sections shall be considered as two separate roadways. Roadways having two-way left turn lanes may be considered as two separate roadways when, in the judgment of the engineer, it is appropriate.

Higher-visibility markings and/or supplementing markings with signing and/or active devices should be considered at unsignalized locations where speed limits exceed 35 mph.

In general, at signalized intersections in urban areas, marked crosswalks are provided across all legs of the intersection. A crosswalk may be omitted across one or more legs of a signalized intersection if an engineering evaluation shows that the omission of the crosswalk provides operational benefits that outweigh the negative impact to pedestrians. If a crosswalk is omitted across an approach at a signalized intersection, then regulatory signs prohibiting pedestrian crossing and/or physical barriers should be placed to reinforce the elimination of the crosswalk across that leg.

910.2 PEDESTRIAN CROSSWALK WARRANTS

	Warrant	Maximum Points
A.	Gap Time Warrant	10
B.	Pedestrian Volume Warrant	10
C.	Approach Speed Warrant	5
D.	General Conditions Warrant	8
	Maximum Total Points	**33**

The minimum warrant for the installation of a marked crosswalk at an unsignalized location is satisfied when 16 or more points are accrued, one of which shall be for pedestrian volumes. A Crosswalk Warrant Evaluation Form is provided in Exhibit 910-A.

A. Gap Time Warrant

Point assignment is based on the one-hour period during the day when the vehicle-pedestrian conflicts are at maximum and, thus, gap availability would be most apt to be critical.

Average Gaps Per 5-Minute Period	Points
0 - 0.99	10
1 - 1.99	8
2 - 2.99	6
3 - 3.99	4
4 - 4.99	2
5 or over	0
Maximum	**10**

B. Pedestrian Volume Warrant

Points are assigned in accordance with the total number of times that individual or groups of pedestrians cross the street under study during the hour of maximum vehicle-pedestrian conflict. For unsignalized locations, this includes activity in both crosswalks at an intersection. Crosswalks shall not be installed where ten or fewer crossings are made by individual or groups of pedestrians during the study period.

Total Crossings	Points
over 100	10
91 - 100	8
61 - 90	6
31 - 60	4
11 - 30	2
0 - 10	0
Maximum	**10**

A Pedestrian Volume and Usable Gap Time Form is provided in Exhibit 910-B.

C. Approach Speed Warrant

Points are assigned in accordance with the vehicular approach speed from both directions of travel as determined through engineering speed studies or the posted speed limit. No crosswalks at unsignalized locations shall be installed on roadways having posted speeds in excess of 45 mph.

Approach Speed	Points
under 20 mph	1
20 to 28 mph	3
29 to 37 mph	5
38 to 45 mph	1
over 45 mph	0
Maximum	**5**

D. General Conditions Warrant

Points are assigned only if a marked crosswalk would:

		Points
(1)	Clarify and define pedestrian routes across complex intersections	2
(2)	Channelize pedestrians into a significantly shorter path	2
(3)	Position pedestrians to be seen better by motorists	2
(4)	Position pedestrians to expose them to fewer vehicles	2
	Maximum	**8**

910.3 FORMULAS

A. $$\text{Pedestrian Crossing Time} = \frac{\text{Street Width Curb to Curb}}{\text{Walking Speed}}$$

In which the walking speed may be considered as:
1. 3.0 feet per second for locations where use by very young, elderly, and/or handicapped pedestrians predominates, or
2. 3.5 feet per second for locations with typical pedestrians.

B. $$\text{Average Number of Gaps per 5-Minute Period} = \frac{\text{Total Usable Gap Time in Seconds}}{\text{Pedestrian Crossing Time} \times 12}$$

910.4 SURVEY METHODS AND FIELD FORMS

A. Survey Methods

1. Personnel Requirements: One person.
2. Duration of Survey: One hour during the period of maximum conflict between vehicles and pedestrians (when gap availability is most apt to be critical). When the period of maximum conflict is unknown, a longer survey may be required to capture the maximum conflict period.
3. Equipment: Stop watch and field data forms.
4. Type of Survey:
   a. Pedestrian count within the crosswalk area during the one-hour study period.
   b. Usable gap time count during the same study period. Each gap time that is equal to or exceeds the calculated pedestrian crossing time is defined as a usable gap time and is entered on the field data form as such.
   c. Speed samples should be obtained.

B. Use of the Crosswalk Warrant Field Form

1. Compute the pedestrian crossing time and enter the figure (in seconds) in the appropriate space.
2. Begin the usable gap time recording by entering on the field data sheet the length (in seconds) of those gap times equal to or exceeding the calculated pedestrian crossing time.
3. Total the usable gap times in seconds, and compute the average number of gaps per 5-minute period.
4. Record the one-hour pedestrian volume, the approach speed, and the existing general conditions.
5. Evaluate the individual warrants, assign points as merited, and tabulate to determine if a marked crosswalk installation is justified.

The location and marking of pedestrian crosswalks shall be approved by the Regional Traffic Engineer.

Exhibit 910-A. Crosswalk Warrant Evaluation Form

ARIZONA DEPARTMENT OF TRANSPORTATION
INTERMODAL TRANSPORTATION DIVISION
TRAFFIC ENGINEERING GROUP

Crosswalk Warrant Evaluation

ROUTE:_____ MP:_____ INTERSECTION:_____

COMMUNITY:_____ DATE:_____ TIME:_____

DISTRICT:_____ COUNTY:_____

INVESTIGATED BY:_____ PROJECT NUMBER:_____

PEDESTRIAN CROSSING TIME

Width of Street
_____ = _____ = _____
Walking Rate

AVERAGE NUMBER OF GAPS PER FIVE MINUTE PERIOD

Total Usable Gap Time in Seconds
_____ = _____ = _____
Pedestrian Crossing Time x 12

APPROACH SPEED

Posted:_____mph Actual Approach Speed or Speed Limit:_____mph

GENERAL CONDITIONS

CONDITION	PTS	MAX	CONDITION	PTS	MAX
1		2	3		2
2		2	4		2

WARRANTS	POINTS	MAXIMUM POINTS
Gap Time		10
Pedestrian Volume		10
Approach Speed		5
General Conditions		8
Include sketches/comments on separate sheets		

Exhibit 910-B. Pedestrian Volume and Usable Gap Time Evaluation Form

PEDESTRIAN VOLUME AND USABLE GAP TIME

Time	Usable Gap Time	Time	Usable Gap Time	Time	Usable Gap Time	Time	Usable Gap Time	Time	Usable Gap Time	Time	Usable Gap Time

PEDESTRIAN COUNT DIVIDED INTO 5 MINUTE INTERVALS

1	2	3	4	5	6	7	8	9	10	11	12

Remarks: