Access Location, Spacing, Turn Lanes, and Medians

This section addresses access location, spacing, turn lane and median needs, including TRB Principles of Access Management 5-9:

A. Preserve the Functional Area of Intersections and Interchanges (Principle 5)

AASHTO states, "Ideally, driveways should not be located within the functional area of an intersection or in the influence area of an adjacent driveway. The functional area extends both upstream and downstream from the physical intersection area and includes the longitudinal limits of auxiliary lanes."

1. **Upstream Functional Distance:** The upstream functional distance of the intersection can be further defined as the approach distance to an intersection that is required for the driver to change speeds in order to complete a movement, such as entering an auxiliary lane or slowing down for a turn or signal. The upstream functional distance includes the sum of:

   d_1, distance traveled during driver's perception - reaction time

   d_2, deceleration distance while the driver maneuvers to a stop

   d_3, queue storage length required (50 foot minimum)

Table 5L-3.01: Distance Traveled During Driver's Perception-reaction, (d_1)

Speed (mph)	Rural (feet)	Urban/ Suburban (feet)
20	75	45
30	110	65
40	145	90
50	185	110
60	220	135
70	255	155

Source: TRB Access Management Manual

Table 5L-3.02: Desirable Maneuver Distances, (d_2)

Speed (mph)	Distance (feet)
20	70
30	160
40	275
50	425
60	605
70	820

Source: TRB Access Management Manual

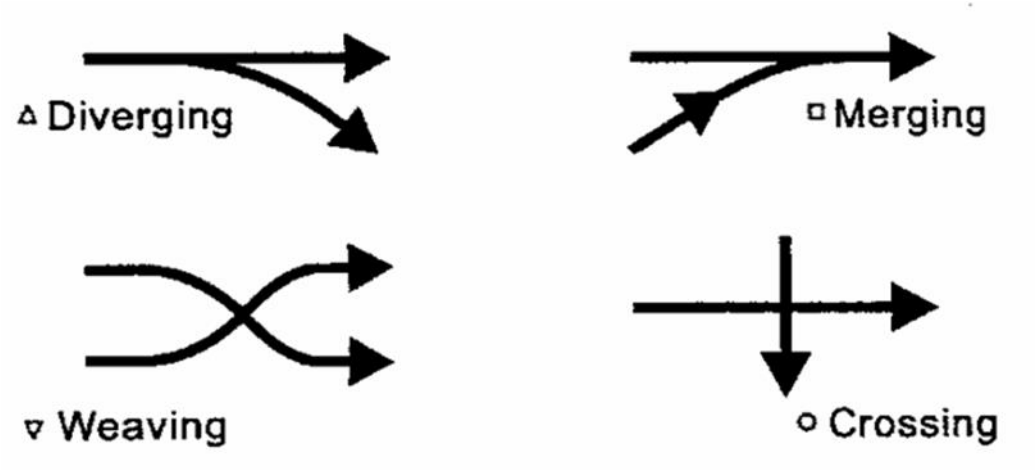
For example, at an urban intersection approach with a 30 mph speed and minimal queuing, the upstream functional distance would be 275 feet (65 feet + 160 feet + 50 feet).

2. **Downstream Functional Distance:** The downstream functional distance from an intersection should be based on upstream functional distance for the proposed adjacent access point. Minimum separation should be no less than the AASHTO stopping sight distance.

B. Limit the Number of Conflict Points (Principle 6)

Traffic conflicts occur where the paths of traffic movements cross. Eliminating or reducing conflict points will simplify the driving task, contributing to improved traffic operations and fewer collisions.

Figure 5L-3.01: Types of Vehicular Conflicts



C. Separate Conflict Areas (Principle 7)

Separating conflict areas allows drivers to address one potential set of conflicts at a time. The higher the speed, the longer the distance a vehicle will travel during a given perception-reaction time. Also, drivers need more time to react to complex conflict areas. Hence minimum separation distances are a function of both the speed of traffic on a given section of roadway and the complexity of the decision with which the driver may be presented. The complexity of the problem, in turn, increases with both the number and type of conflicts and the volume of traffic.

Various methods that can be utilized to separate conflict areas include the following:

- Minimum access spacing
- Minimum corner clearance
- Minimum property line clearance
- Limit the number of accesses per property
- Designate the access for each property

Figure 5L-3.02: Two Lane Undivided Roadway (Single Entrance)

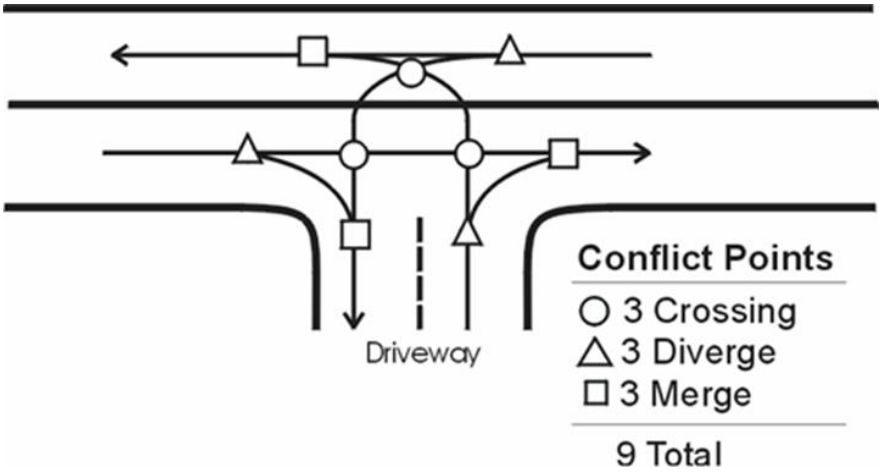
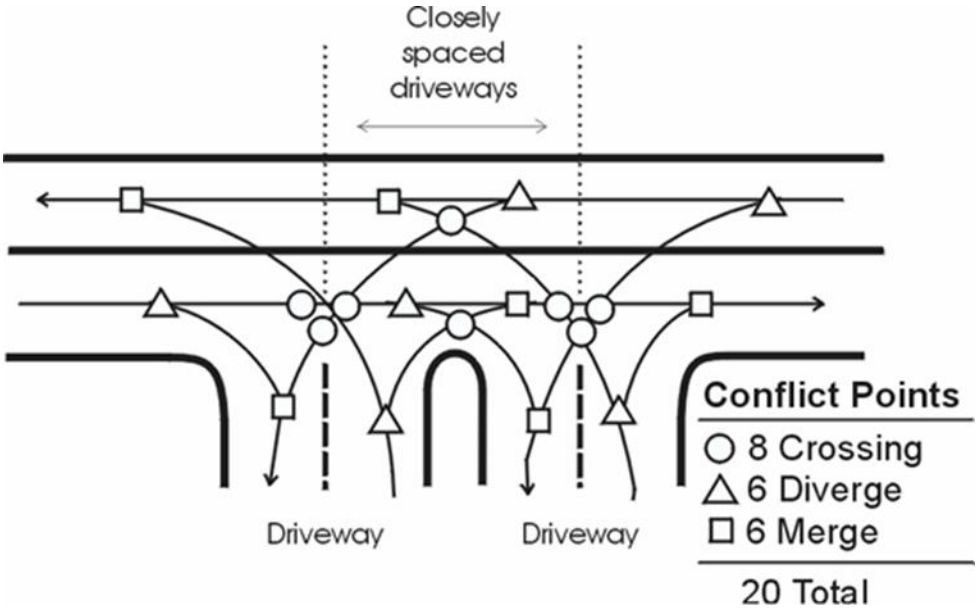


Figure 5L-3.03: Two Lane Undivided Roadway (Closely Spaced Entrances)



1. **Driveway Density:** The number of driveways per block or per mile significantly affects the safety of the corridor. Crash rates increase very quickly as the number of access points increases on arterial and collector roadways.

Table 5L-3.03: Crash Rates (crashes per million vehicle miles traveled) vs. Access Point Density

Access Points per Mile	Approximate Accesses per 500 feet	Representative Crash Rate for an Undivided Roadway	Increase in Crashes Associated with More Access Density
Under 20	Under 2	3.8	----
20 to 40	2 to 4	7.3	+92%
40 to 60	4 to 6	9.4	+147%
Over 60	Over 6	10.6	+179%

Source: National Cooperative Highway Research Program Report 420.

2. **Access Spacing for Major Arterials:** Provide separation between access connections so that drivers can assess potential conflict locations one-at-a-time. Applicable spacing criteria may include:
   - Functional area (Section 5L-2)
   - AASHTO stopping sight distance
   - Preventing right turn overlap (see below)
   - Other criteria as established by the Jurisdiction

   Right turn overlap occurs when a through vehicle must monitor two egress right turning vehicles at once while still performing other driving tasks. By separating access points a proper distance, the overlap does not occur, and the through driver has only one egress right turning vehicle to monitor. Recommended minimum access spacings to avoid right turn overlap shown in Table 5L-3.04 are comparable to AASHTO stopping sight distances.

Table 5L-3.04: Minimum Access Spacing to Prevent Right Turn Overlap

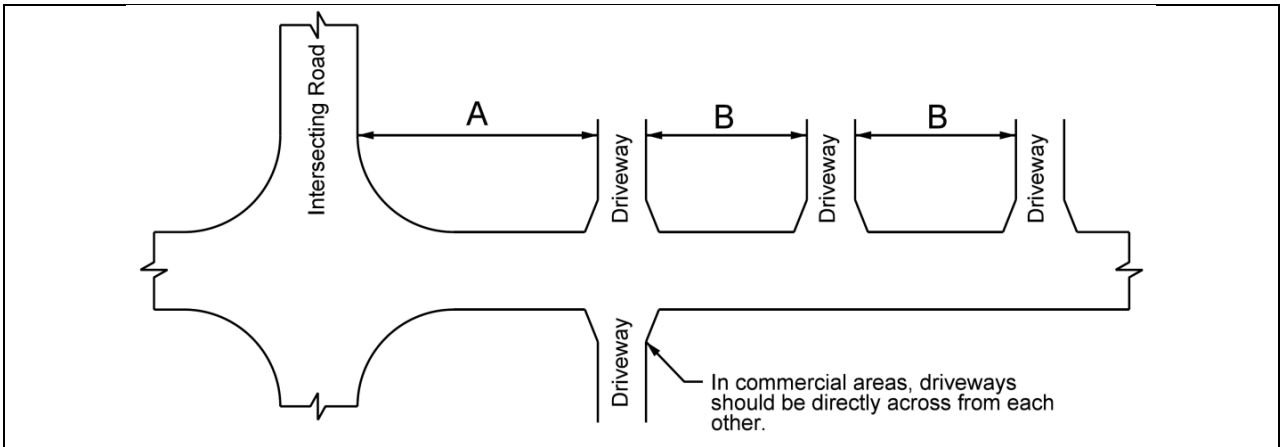
Speed (mph)	Recommended Minimum (feet)[1]
25	120
30	185
35	245
40	300
45	350

[1] Intersection clearance should be the same as driveway spacings or at least as long as stopping sight distance.

Source: Transportation Research Board Record 644, 1977.

3. **Access Spacing for Minor Arterials, Collectors, and Local Streets in Urban/Suburban Areas:** For minor arterials and major collectors, direct access from individual properties should be avoided wherever possible. Property access should be provided from minor collectors, local streets, frontage roads and backage roads. Major arterial access spacing criteria should be used for minor arterials and major collectors when possible.

Table 5L-3.05: Minimum Distance between Driveways or from Intersecting Streets



	Minor Arterial			Collector			Local		
	Res. Area	***C/ I Area***	***Ag Area***	***Res. Area[3]***	***C/I Area***	***Ag Area***	***Res. Area[3]***	***C/I Area***	***Ag Area***
A. Minimum intersection clearance[1]	145’	170’	300’	100’	100’	300’	75’	75’	150’
B. Minimum driveway spacing[2]	100’	200’	300’	75’	100’	300’	---[4]	---[4]	150’

Res = Residential, C/I = Commercial/Industrial

[1] Values are measured from the back of the curb, intersecting road to the adjacent driveway near edge.

[2] Values are measured between driveway edges.

[3] One access drive allowed per lot. Depending on lot size, an additional drive may be allowed upon approval of the Jurisdiction.

[4] See Jurisdictional Engineer for local requirements.

4. **Access Spacing for State Primary Roads:** In rural areas, travel speeds are usually 55 mile per hour and above. This means that driveway spacing in rural areas must be longer to provide for a safe driving environment. On state highways, spacing is also longer because the routes are primarily designed to carry through traffic rather than to serve as property access routes. The more important a route is for through traffic and commerce, the longer the spacing between driveways. The following table shows the State of Iowa's standards for its highway system.

Table 5L-3.06: Iowa DOT Access Control - Minimum Spacings

State Highway Priority	Minimum Spacing Between Driveways	Number of Driveways Per Mile
Priority I (Full Access Control)	Interchanges at roads	N/A
Priority II (Four Lane Divided)	2,640' (minimum)[1] 5,280' (preferred)[1]	2 2
Priority III	1,000' rural (minimum)[1] 1,320' rural (preferred)[1]	4 4
Priority IV(a) Priority IV(b)	600' rural (≥ 45 mph) 300' urban (≤ 40 mph)	8 16
Priority V (Access Right Acquired Between 1956 to 1966)	1 access per 1,000' of frontage not exceeding 2,000'	2 to 5
Priority VI	Safety and need	Varies

[1] Access allowed only at interchanges and selected at-grade locations

5. **Access Spacing for County Roads:** On county roads, the spacing standard should also depend on the nature of the road, e.g. how important the road is for through traffic. Even on the lowest functional levels, some sort of driveway spacing standard is important for traffic safety.

Table 5L-3.07: County Road Minimum Access Spacings

County Road Route Type	Minimum Spacing Between Driveways	Number of Driveways Per Mile
Minor arterials	600'	9
Collectors	300'	18
Local traffic service	150'	36

6. **Additional Access Spacing Considerations:**
   - At a minimum, the upstream corner clearance should be longer than the longest expected queue at the adjacent intersection.
   - High speed, high volume roadways need longer corner clearances whereas the corner clearance on a local street can be much shorter.
   - Residential streets - driveways on corner lots should be located on the lesser street and near the property line most distant from the intersection.
   - Typically, all elements of an access drive, including the radii should be within a property frontage.
   - At a minimum, all driveway geometrics should be along the frontage of the property served by the driveway.
   - On major roadways, the corner clearance should be at least as long as the stopping sight distance so that vehicles turning corners can make safe stops when encountering entering traffic.
   - Encourage owners of adjacent properties to construct joint-use driveways in lieu of separate driveways.
   - Encourage a property owner to replace two or more driveways with a single driveway (or fewer driveways).
   - For adjacent properties, locate joint access on the property line. Reciprocal easements must be executed.

D. Remove Turning Traffic from Through-traffic Lanes (Principle 8)

All driveway and intersection geometrics require that turns be made at very slow speeds and hence result in high speed differentials. Providing auxiliary lanes (left-turn and right-turn bays) is the most effective means of limiting the speed differential. This is especially important on high volume and high speed roadways.

The several methods by which turning vehicles can be removed from through traffic lanes are:

- Install isolated left-turn bay
- Install a nontraversable median with left-turn bays
- Install right-turn deceleration bay
- Install right-turn lane
- Install a continuous two-way left-turn lane (TWLTL)

1. **Turn Lane Warrants for Urban/Suburban Areas (Unsignalized):** Providing left and/or right turn lanes can significantly improve the operation and safety of an intersection. They allow turning vehicles to exit the through traffic lane with reduced speed differential and provide queue storage without interference with through traffic. Rear-end and side-swipe collisions are greatly reduced. Capacity is increased and delay decreased.

   General information regarding improvements for intersections, including guidelines for including left and right turn lanes, can be found in NCHRP Report 457. More specific information and warrants for installation of left turn lanes is presented in NCHRP Report 745.

   In general, the decision to provide turn lanes should be based on safety rather than just capacity. Where practical, left turn lanes should be provided at median openings on divided roads, regardless of projected traffic volumes.

2. **Rural Turn Lane Warrants and Right Turn Deceleration Length (Unsignalized):** See Iowa Department of Transportation's Design Manual, Chapter 6 - Geometric Design.

3. **Three Lanes with TWLTL:** Three lane roadway designs can be effectively used in situations where there are low to moderate levels of through traffic, yet there are concerns about conflict points and crashes caused by left-turning traffic. The upper limit for using a three lane design is about 17,000 vehicles per day of traffic. Three lane designs are ideal where right-of-way width is limited due to existing land development or other constraints. Three lane roads can either be designed that way originally or can be created by widening an existing two lane route or by modifying an existing four lane undivided route.

4. **Five lanes with TWLTL:** When the average daily traffic (ADT) on a street exceeds about 17,000 vehicles per day, four lane roadways with raised medians or five lane roadways with TWLTL are more appropriate designs. The limit for five lane roadway (with TWLTL) is approximately 24,000 ADT. TWLTL should generally not be used in situations where there are more than four total through lanes.

E. Use Nontraversable Medians to Manage Left Turn Movements (Principle 9)

The majority of access-related crashes involve left turns. Providing nontraversable medians limits and defines locations of left turns, thereby improving safety. Full access median openings that allow left turns from all directions are best provided at signalized intersections and unsignalized junctions of arterial and collector streets. Providing median closures or partial access medians at other intersections and access points reduces the number and types of conflicts.

1. **Median Closures:** Median openings should be considered for closure where:
   - A safety or operational problem is evident and an appropriate retrofit cannot be made.
   - Median width is less than 11 feet, thereby not allowing for construction of left turn lanes.
   - The left-turn bay of a nearby signalized intersection needs to be extended.
   - A pattern of left-turn crashes is evident.
   - Heavy pedestrian use is predicted or crashes involving pedestrians have occurred at the intersection.

   Implementation of a median closure involves providing a section of median of the same design as existing on either side of the opening. The following should be considered during design:
   - Tree lines, building lines, and lighting may head drivers into believing the median can be crossed.
   - Visual cues should be provided to clearly inform drivers that the opening has been closed.
   - The need for visual cues is especially critical during nighttime hours where a four way intersection previously existed or there are access drives directly opposite each other.
   - Minimum 4 feet median width face-to-face of curbs is recommended.
   - Select and locate landscaping materials to delineate the median while considering potential sight distance obstructions.

Figure 5L-3.04: Two Lane Roadway Conflict Points at Typical Three Way Intersection or Driveway

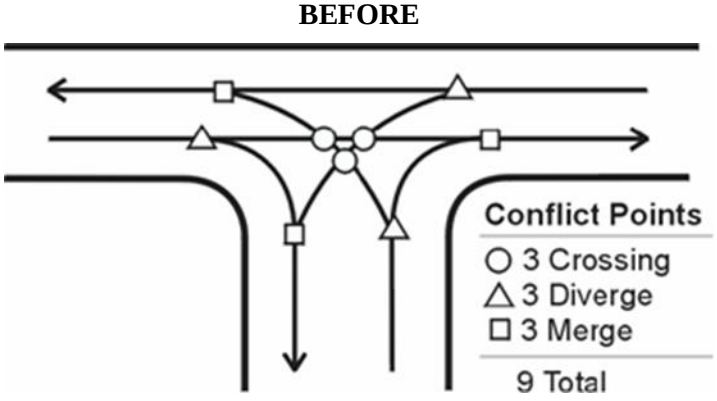


Figure 5L-3.05: Two Lane Roadway with Raised Median Closure (right-in/right-out only access)

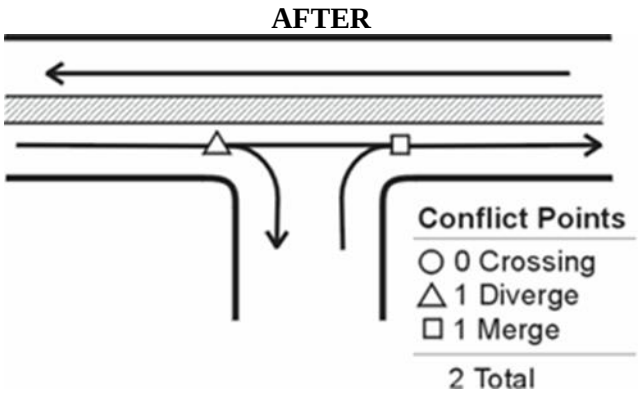
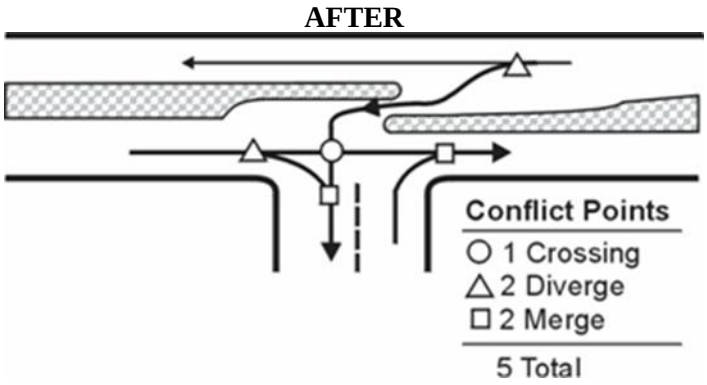


Figure 5L-3.06: Two Lane Roadway with Raised Median (left turn ingress allowed into driveway)



2. Raised Medians vs. Two Way Left Turn Lanes:

- Because they are the most restrictive access management treatment, constructing raised center medians along arterials is often very controversial among business and property owners. Two way left turn lanes (TWLTL) are usually much less controversial. Business persons and property owners feel that installation of raised medians will have a large, negative impact on their customers, sales, and property values. Therefore, TWLTL are often suggested as compromise solutions.
- Arterial roadways with raised medians are statistically safer and operate better than any other configuration. Research indicates that raised median roadways are significantly safer than undivided roadways in urban areas. When traffic volume on an arterial roadway is projected to exceed about 24,000 average annual daily traffic (AADT) during the next 20 years, including a raised median is prudent.
- In general, TWLTL projects function well when traffic levels are moderate, when the percentage of vehicles turning as opposed to traveling through is high, and when the density of commercial driveways is low. TWLTL will function very well on most arterials where AADT is in the range of 10,000 to 24,000 AADT (five lane TWLTL).
- TWLTL projects can also work very well in places where the number of driveways per block or mile is high, but the land use is such that not many turning movements are generated per hour. An example would be an arterial street passing through a predominately residential area.

- TWLTL are much less effective in situations where commercial driveway densities are high and these driveways are spaced close together. In such a situation, the number of conflict points is high, and this will be reflected in crash experience. Research from many states indicates that raised median roadways are always safer than TWLTL roadways. If TWLTL are considered, driveway density and driveway spacing must be managed very aggressively.

Table 5L-3.08: Crash Rates (crashes per million vehicle miles traveled) vs. Median Type

Access Points Per Mile	Undivided (Painted Centerline) Crash Rate	TWLTL Crash Rate	Raised Median Crash Rate	Rate Reduction Raised Median Versus TWLTL
Less than 20	3.8	3.4	2.9	-0.5 (15%)
20 to 40	7.3	5.9	5.1	-0.8 (14%)
40 to 60	9.4	7.4	6.5	-0.9 (12%)
Over 60	10.6	9.2	8.2	-1.0 (11%)

Source: National Cooperative Highway Research Program Report 420

F. References

Transportation Research Board - National Cooperative Highway Research Program (NCHRP). *NCHRP Report 420: Impacts of Access Management Techniques*. National Academy Press. Washington, DC. 1999.

Transportation Research Board - National Cooperative Highway Research Program (NCHRP). *NCHRP Report 644: Guidelines for Conducting a Disparity and Availability Study for Federal DBE Program*. National Academy Press. Washington, DC. 1977.