
Median Design

Course No: C04-041

Credit: 4 PDH

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I. Introduction

II. Access Management Classification

- A. History**
- B. Definition of Terms**
- C. Access Classification and Standards for Controlled Access Facilities**
- D. Types of Median Openings**
- E. Measurements**

III. Medians

- A. Median Opening Conflict Points**
- B. Recommended Queue Storage**
- C. Flexibility**
- D. Retrofit to Restrictive Median**
- E. Access vs. Thru Movement**

IV. Roadway Design Elements

- A. Median Design**
- B. Perception Reaction Time /Distance**
- C. Taper**
- D. Design speed**
- E. Entry Speed**
- F. Median Opening Design Example**

V. Median Design Elements

- A. Median End Treatments**
- B. Median Opening Length**
- C. Right Turns and Left Turns on Divided Roadway**
- D. Two Step Maneuver**

VI. Sight Distance

- A. Sight Distance Concepts**
- B. Sight Distance for U-Turns**
- C. Sight distance for Left Turn into Side Street**
- D. Left Turn Offset**

VII. Median Width

- A. Anatomy of Median Width**
- B. Minimum Traffic Separator Width at Intersections**
- C. Pedestrian Considerations at Traffic Separators**
- D. Seeing Traffic Separators at Intersections**

VIII. Median Signing

IX. Signal Spacing

X. Freeway Ramp Terminal

XI. Special U-Turn Considerations

- A. AASHTO Guidance on Width and U-Turns**
- B. U-Turns Using a Flare**

XII. Turning Vehicle Destination

- A. Placement of Driveways**
- B. Throat Length**

XIII. Summary

I. Introduction

Properly implemented median management will result in improvement to traffic operations, minimize adverse environmental impacts, and increase highway safety. As traffic flow is improved, delay and vehicle emissions are reduced. In addition, roadway capacity and fuel economy are increased and accidents are less numerous and less severe.

The benefits to medians include:

- Safety – Fewer/less severe accidents; less auto/pedestrian conflicts
- Efficiency – Higher levels of services; less stop and go traffic
- Aesthetics – More room for landscaping and pedestrians; more attractive corridors

A. History

The 1988 State Highway System Access Management Act (Florida Statute 335-18) mandated that Florida's access management strategy be based on the following:

- Rule 14-96 was adopted to implement the State Highway System Access Management Act for the regulation and control of vehicular access and connection points of ingress to, and egress from, the State Highway System. This rule chapter describes the connection permit application process and procedures, a voluntary pre-application process, and requirements for modification or closure of connections to the State Highway System. This rule chapter was also adopted to promote close cooperation with local governments in their site planning decisions that increase the safe traffic operations of the State Highway System.
- Rule 14-97 adopted an access classification system and standards to implement the State Highway System Access Management Act of 1988 for the regulation and control of vehicular ingress to, and egress from, the State Highway System. The implementation of the classification system and standard is intended to protect public safety and general welfare, provide for the mobility of people and goods and preserve the functional integrity of the State Highway System. All segments of the State Highway System shall be assigned an access classification and standard. The standards shall be the basis for connection permitting and the planning and development of Department construction plans.

B. Definition of Terms

Area Type means one of four specific land categories reflecting certain land use and intensity characteristics used in specifying the interchange spacing standards for limited access facilities.

Connection means a driveway, street, turn out or other means of providing for the right of access to or from controlled access facilities on the State Highway System. Two one-way connections to a property may constitute a single connection.

Controlled Access Facility means a transportation facility to which access is regulated through the use of a permitting process by the governmental entity having jurisdiction over the facility. Owners or occupants of abutting lands and other persons have a right of access to and from such facility at such points only and in such a manner as may be determined by the permitting authorities.

Directional Median Opening means an opening in a restrictive median that provides to u-turn only, and/or left-turn in movements. Directional median openings to two opposing left or “u-turn” movements along one segment of road are considered one directional median opening.

Full Median Opening means an opening in a restrictive median designed to allow all turning movements to take place from both the state highway and the adjacent connection.

Intersection means an at-grade connection or crossing of a local road or another state highway with a state highway.

Limited Access Facility means a street or highway especially designed for through traffic and over, from, or to which owners or occupants or abutting land or other persons have no right or easement of access, light, air, or view by reason of the fact that their property abuts such limited access facility or for any other reason.

Minimum Median Opening Spacing means the minimum allowable spacing between openings in a restrictive median to allow for crossing the opposing traffic lanes to access property or for crossing the median to travel in the opposite direct (u-turn). The minimum spacing or distance is a measure from centerline to centerline of the openings along the traveled way.

Minimum Signal Spacing means the minimum spacing or distance in miles between adjacent traffic signals on a controlled access facility measured from centerline to centerline of the signalized intersections along the traveled way.

Non-Restrictive Median means a median or painted centerline that does not provide a physical barrier between center traffic turning lanes or traffic lanes traveling in opposite directions. This includes highways with continuous center turn lanes and undivided highways.

Restrictive Median means the portion of a divided highway or divided driveway physically separating vehicular traffic traveling in opposite directions. Restrictive median include physical barriers that prohibit movement of traffic across the median such as a concrete barrier, a raised concrete curb and/or island, and a grassed or a swaled median.

State Highway System (SHS) means the network of limited access and controlled access highways that have been functionally classified and which are under the jurisdiction of the state.

III. Access Management Classification

The State Highway Access Management Act required the Department to assign an access classification to every segment of the State Highway System. In order to accomplish this task, the Department worked with local governments to classify the State Highway System into the six (6) Arterial classifications (Classes 2-7) described in Administrative Rule 14-97. Freeways are all Classification 1. They are not going to be addressed in this document because they do not have median openings.

A. Access Classification and Standards for Controlled Access Facilities

Access Class	Facility Design Features	Minimum Connection Spacing	Minimum Median Opening Spacing		Minimum Signal Spacing
	Median Treatment	>45mph/=45mph or less (feet)	Directional (feet)	Full (miles)	(miles)
2	Restrictive with Service roads	1320/660	1320	0.5	0.5
3	Restrictive	660/440	1320	0.5	0.5
4	Non-Restrictive	660/440	N/A	N/A	0.5
5	Restrictive	440/245	660	0.5/0.25	0.5/0.25
6	Non-Restrictive	440/245	N/A	N/A	0.25
7	Both Median Types	125	330	0.125	0.25

Note:

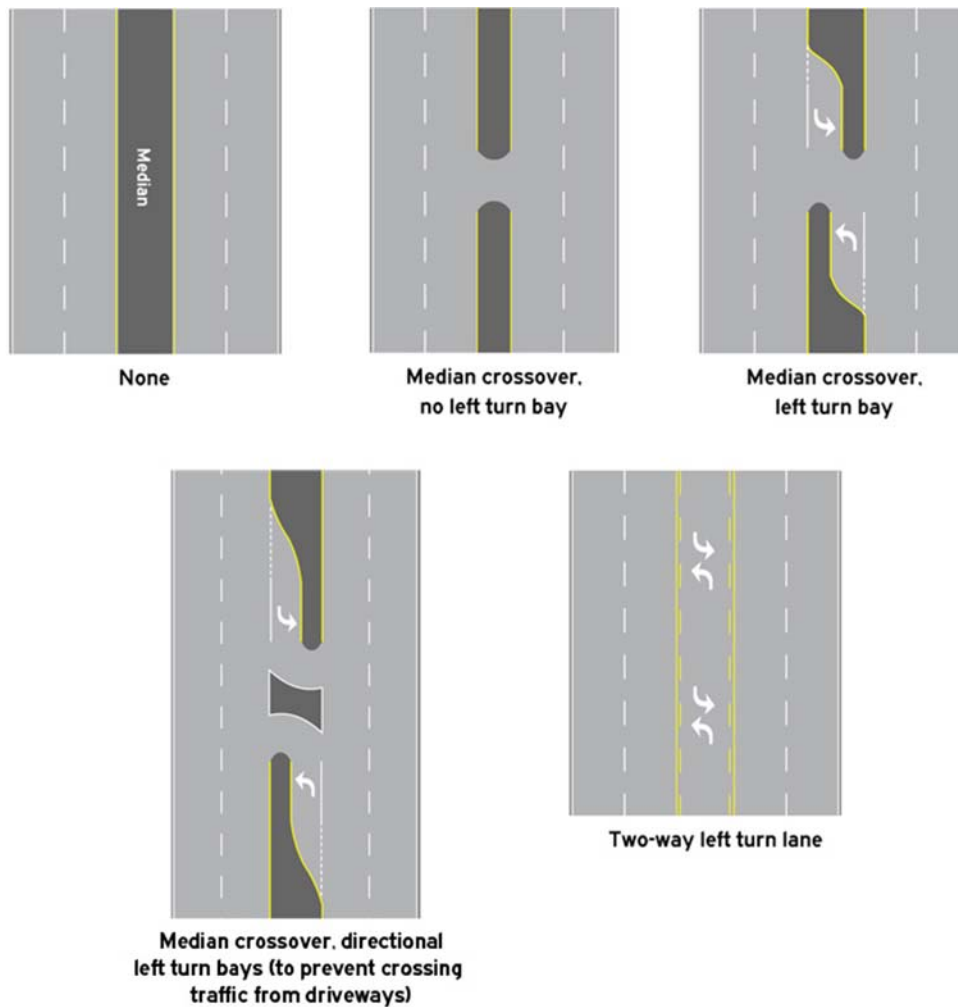
- Section 14-97.003 and 14-97.004, FAC, contain supplementary and more detailed instructions for the use of these standards. These minimum spacings may not be adequate if auxiliary lanes and storage are required.
- Single properties with frontages exceeding the minimum spacing criteria may not receive permits for the maximum number of possible connections.

All controlled access facilities on the State Highway System shall be assigned to one of the Access Management Classes 2 through 7. The assignment of a classification to a specific segment of the State Highway System shall be the responsibility of the Department. The designation shall be made in cooperation with the appropriate governmental entities. This classification decision shall take into consideration the potential for the desired access management classification and standard to be achieved based on existing land use, probability of land use change, adopted future roadway improvements and on the ultimate cross section of the roadway identified in adopted plans. The assignment of a classification shall specifically take into consideration the following factors:

- a. The current and potential functional classification of the road;
- b. Existing and projected future traffic volumes;
- c. Existing and projected state, local and Metropolitan Planning Organization transportation plans and needs (including a consideration of new or improve parallel facilities);
- d. Drainage requirements;
- e. The character of the lands adjoining the highway (existing and projected);
- f. Local land use plans, zoning and land development regulations as set forth in adopted comprehensive plans
- g. The type and volume of traffic requiring access;
- h. Other operational aspects of access, including corridor accident history;
- i. The availability of reasonable access to a state highway by way of county roads or city streets as an alternative to a connection to the state highway;
- j. The cumulative effect of existing and projected connections on the State Highway System's ability to provide for the safe and efficient movement of people and goods within the state.

B. Types of Medians Openings

Roadway median openings can consist of no median opening, median crossover without left turn bay, median crossover with left turn bay, directional median crossover and two-way left turn lanes as shown in the following illustrations.



No median opening is the most restrictive because it does not allow any turning movements to or from the adjacent driveways.

Median crossover without left turn bay is one of the least restrictive because it allows all turning movements. Left turning movements to and from adjacent driveway connections are permitted. It is important to note that this type of median opening is dangerous because it does not allow a vehicle to “store” in a designated left turn lane for the movement. The left turn movement must

be made from the through lane. If opposing traffic does not allow the movement to be made, the left turning vehicle must remain stopped in the through lane.

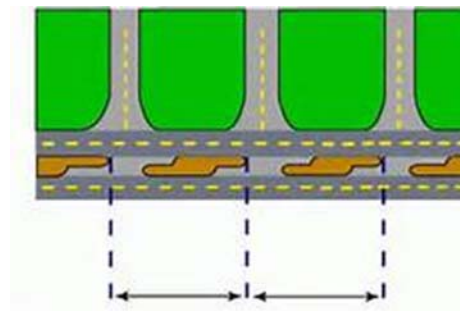
Median crossover with a left turn bay is a restrictive and non-restrictive opening since it allows all left turn movements to and from the adjacent driveways. It is safer because it does provide a lane to “store” the left turning vehicles into the adjacent driveways.

Directional median opening crossover is more restrictive since it prohibits left turns out of the adjacent driveways. It only allows left turns into the adjacent driveways.

Two-way left turn lane is one of the least restrictive because it allows all turning movements. Left turning movements to and from adjacent driveway connections are permitted. This type of design does provide a lane to “store” the left turning vehicle. However, it is possible for two opposing left turning vehicles to attempt to occupy this center lane. This poses a dangerous situation with a potential head-on collision.

C. Measurements

The distance between median openings is measured from the tip of one median opening to the tip of the next median opening along the traveled way. The following is an illustration of the distance between median openings.



III. Medians

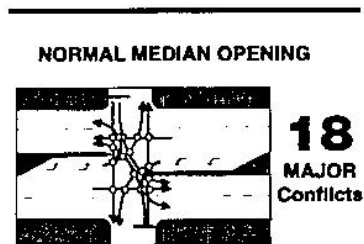
Restrictive medians and well designed median openings are some of the most important features in a safe and efficient highway system. The design and placement of these medians and openings are an integral part of the Access Management practice.

Full median openings should only be placed at locations which are uniformly spaced along the highway to assure efficient traffic operation. If these locations are properly signalized, traffic can progress at an efficient and uniform operational speed.

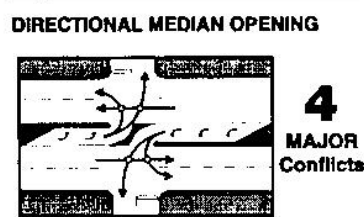
Restrictive medians help in both low and high traffic situations, but where traffic is high, the benefits are greater.

A. Median Opening Conflict Points

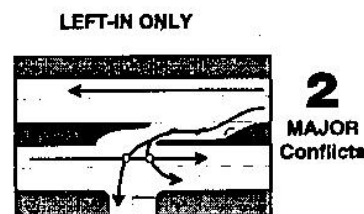
Safety plays a major role in the installation of median openings. The more turning movements allowed at a median opening, the more major conflict points there will be. As seen in the illustrations below, a normal full median opening has 18 major conflict points while the restrictive median openings have 0 to 4 major conflicts. Restrictive median openings can reduce the number of crashes due to the reduction in the number of conflict points.



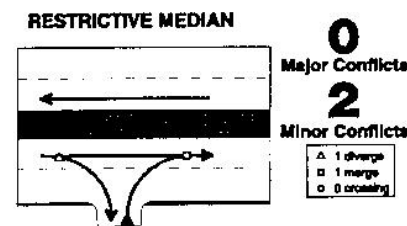
A typical median opening that allows all turns has 18 major conflict points.



One way to limit the number of conflicts is through the design of median openings. This is a "directional" median opening serving a side street, a design which greatly reduces the conflict points by limiting the number of allowed turning movements.



By providing a restrictive median along arterial roads, we can assure that the number of conflict points is kept to the minimum. Through use of restrictive medians, almost every driveway along the corridor essentially becomes a right-in and right-out driveway with only two conflict points.



B. Recommended Queue Storage

A critical measure for good median opening design is left turn queue storage. Projections of queues that are site specific should be used to determine storage length at all major intersections. Due to the variable nature of left turn demand, actual turn volumes should be reviewed in many cases. Designs should also be conservative enough to handle some of the uncertainty in demand.

Where left turn volume is unknown and expected to be minor:

- Urban/suburban minimum = 4 cars or 100 feet (assuming a 25-foot vehicle and gap length)
- Rural minimum = 2 cars or 50 feet (assuming a 25-foot vehicle and gap length)

C. Flexibility

Meeting the median opening spacing standards of Rule 14-97 can pose a practical problem. Therefore, the Department created a process to analyze deviations from the standards found in the rule.

The process allows Project Managers a 10% deviation from the standards for directional median openings and gives complete flexibility to Project Manager on decisions involving connections as long as they meet minimum traffic engineering standards for storage, deceleration, sight distance and maneuverability. All deviations greater than this must go to a District Median Opening Review Committee for further study and recommendation.

There are three essential principles that should be used when considering deviations from median opening and signal spacing standards:

- Traffic safety
- Traffic efficiency
- Functional integrity

Safety of the total transportation system is paramount and should not be compromised. The traffic efficiency and highway function of each road on the State Highway System are also

important and will be given various levels of priority depending on the classification according to Chapter 14-97.

Deviations from the standards relating to median placement should show an overriding benefit in safety or traffic operations or be shown not to degrade traffic safety, traffic efficiency, or highway functional integrity. Deviation from the standards shall be made under the direct supervision of a Department Professional Engineer knowledgeable in access management and traffic operations.

Requests for deviation from median opening standards must:

- provide documentation of unique or special conditions based upon established engineering principles that make strict application of the spacing standards impractical or unsafe; and
- provide documentation how the deviation would affect the traffic efficiency and safety of the transportation facility; and
- be signed and sealed by a Professional Engineer knowledgeable in traffic engineering; or
- be clearly beneficial or justifiable to the District Access Management Review Committee.

Conditions that may be viewed *favorably* in evaluating a proposed median opening deviation include:

- opportunities to alleviate significant traffic congestion at existing or planned signalized intersections
- opportunities to accommodate a joint access serving two or more traffic generators.
- existence of un-relocatable control points such as bridges, waterways, parks, historic or archaeological areas, cemeteries and unique natural features
- where strict application of the median opening standards in 14-97.003(1) Figure 2, would result in a safety, maneuvering or traffic operational problem
- where directional opening would replace existing full service median opening

Conditions that may be viewed *unfavorably* in evaluating a proposed median opening deviation include:

- Florida Intrastate Highway System facilities

- Access Class 2 or 3
- Full median openings and signal spacings
- Median openings in a high accident corridor or location
- Situations where circulations can be provided through other alternatives

A deviation shall not be considered under any of the following conditions:

- Sight distance for the proposed traffic movements would jeopardize safety
- Where the provision of the median opening would cause any safety hazard
- The hardship is self-created by the landowner or business
- Any other deviation that would negatively impact safety
- The deviation would degrade the efficiency of the system

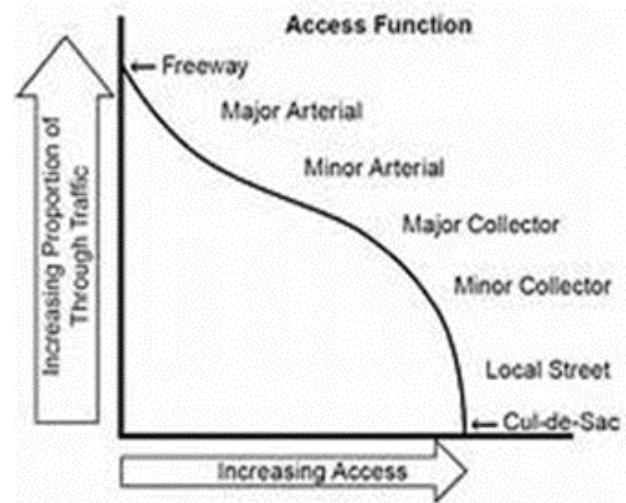
D. Retrofit to Restrictive Median

Existing 5 lane sections on the Federal Interstate Highway System (FIHS) and all those over 28,000 daily traffic should be given the highest priority for retrofit. All 7 lane sections should be given a high priority for retrofit.

E. Access vs. Thru Movement

Highway functional classification means classifying highways with respect to the amount of access or movement they are to provide and then designing and managing each facility to perform that function.

It should be noted that as the amount of through traffic increases, the access to property decreases (e.g., freeway). Also, as the amount of thru traffic decreases, the access to property increases (e.g., local street). Increasing access decreases the proportion of through traffic while decreasing access increases the proportion of through traffic.

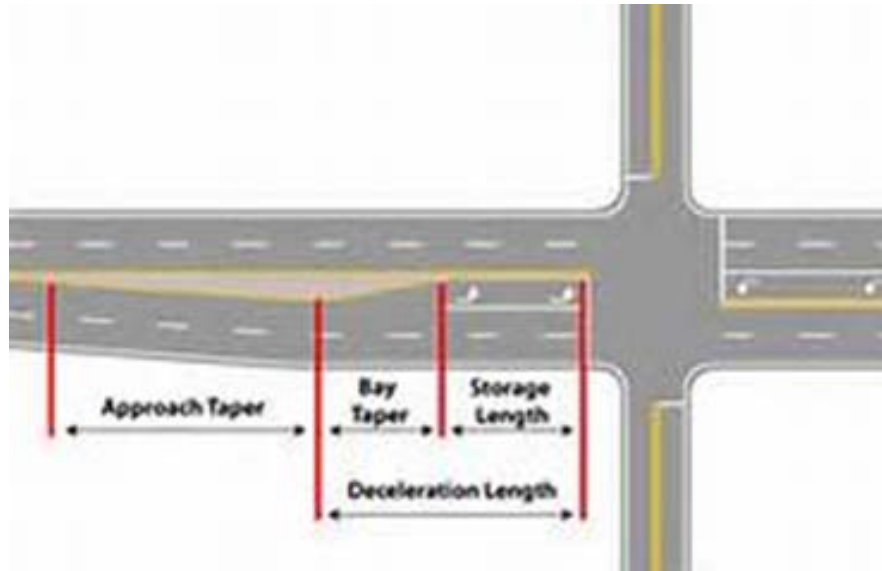


IV. Roadway Design Elements

A. Median Design

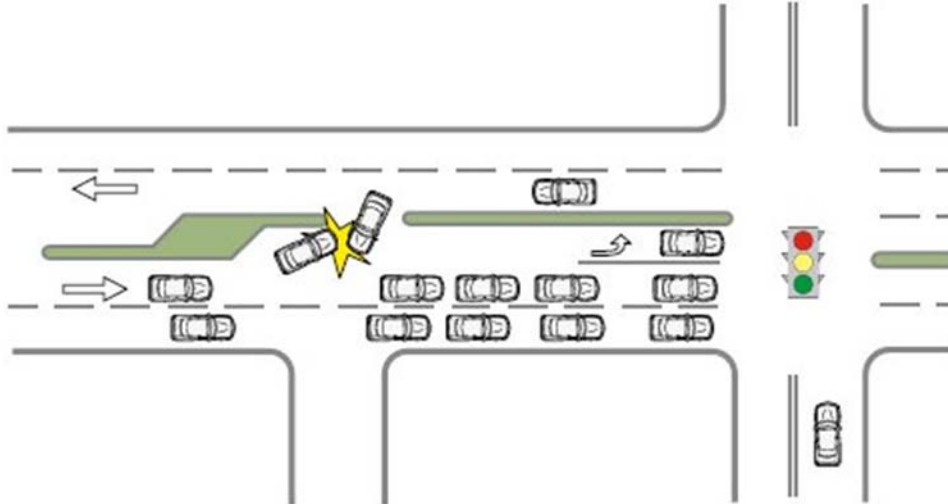
Minimum standards for the distance needed to properly slow a vehicle down, and bring the vehicle to the storage portion of the median opening are found in FDOT 'Design Standard' Index #301. This distance is measured from the beginning of the taper to the end of the queue storage portions.

The unsignalized median opening is essentially an intersection. Properly designed it will have an auxiliary lane allowing the left turning vehicles to decelerate without interfering with the through movement of the leftmost through lane. Because the through lane is where the fastest traffic is, this means that the potential of high speed crashes is the greatest there. Before any design of this area can be done, it is important to know what speed, maneuvering distances and storage requirements you should design for.



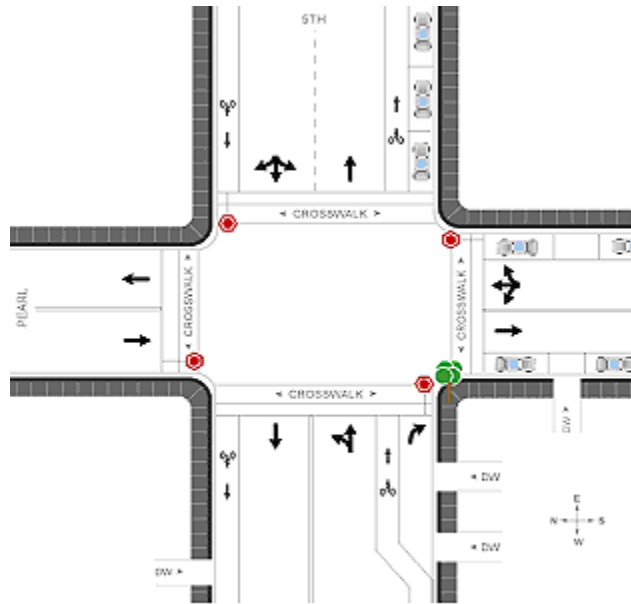
Left Turn Break Prohibition

A median opening within the physical length of a left-turn bay as illustrated below is potentially dangerous. Such an opening violates driver expectancy. A channelizing device should be placed at this median opening to prevent the left turn from the direction without the auxiliary lane.



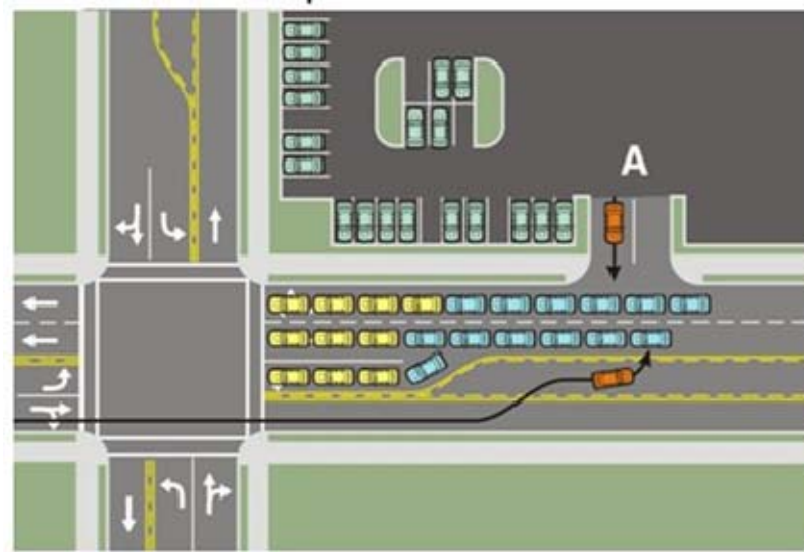
Left Turn across Right Turn Lane or Intersection Queue

Avoid openings across right turn lanes due to the danger of queues building up across the opening area. The problem here is that when these queues build, “good Samaritans” might allow the left turner through only to crash with a vehicle moving freely in the separate right turn lane.



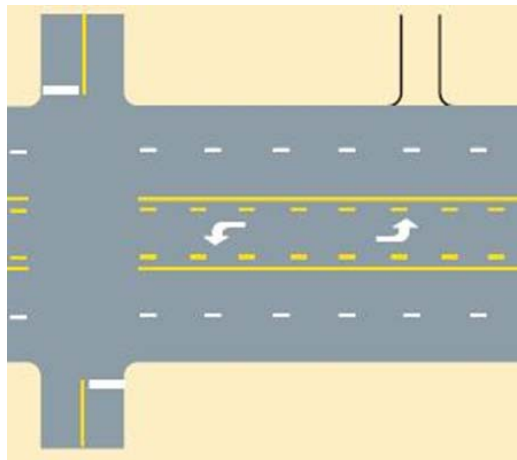
Intersection Queue

When the queue in the through traffic lane spills past the left-turn bay, turning vehicles are trapped in the queue. The left-turning vehicles are not able to move into the turn bay until the queue advances. Dual left turn lanes are more prone to this problem.



Two-Way Left Turn Lanes (TWLTL)

Two-way left turn lanes (TWLTL) have more conflict points than directional median openings. However, they provide unlimited access to driveway connections. The benefits and risks should be weighed carefully before choosing this option.



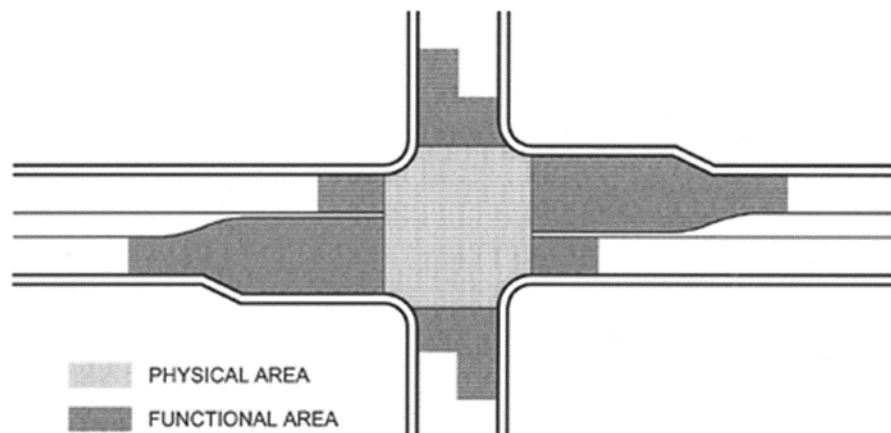
B. Perception Reaction Time/Distance

The perceptions-reaction time required by the driver varies. For motorists who frequently use the street this may be as little as one second or less. However, unfamiliar drivers may not be in the proper lane to execute the desired maneuver and may require three or more seconds.

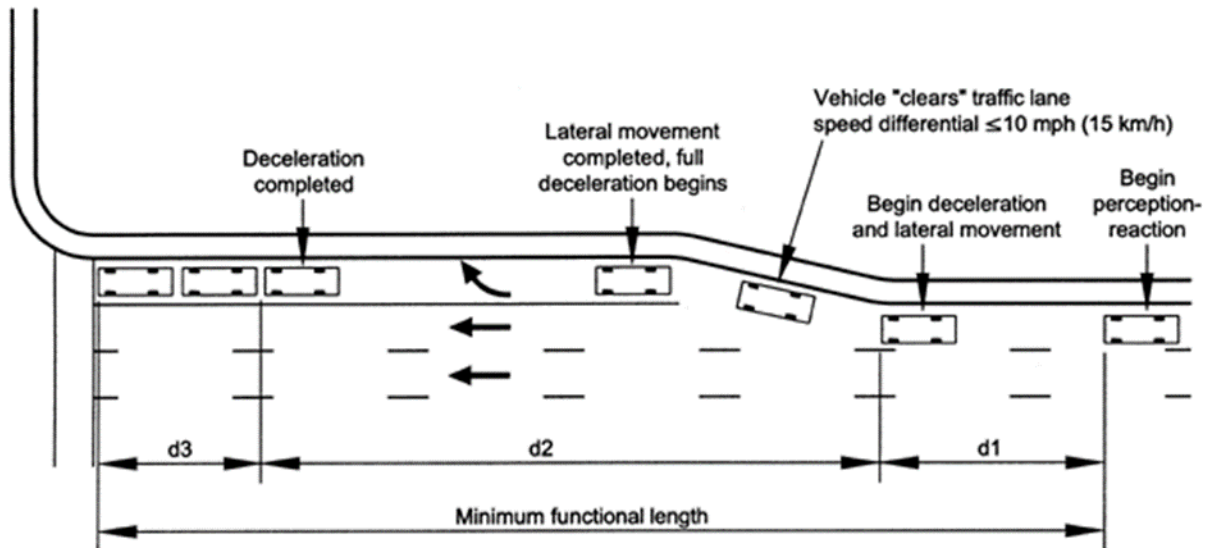
Median openings should not be located in the perception-reaction area of a signalized intersection. The functional area consists of distance traveled during perception reaction time, plus deceleration distance, plus queue storage.

Reaction Time and Distance				
Areas	Sec.	35mph	45mph	55mph
Rural	2.5	130 feet	165 feet	200 feet
Suburban	2	100 feet	130 feet	160 feet
Urban	1.5	75 feet	100 feet	120 feet

The following illustration shows the physical area and functional area of an intersection. The perception reaction time begins at the end of the functional area.



The following illustration shows where the perception reaction time begins and where deceleration occurs.



C. Taper

The taper is the portion of the median opening that begins the transition to the turn lane. FDOT 'Design Standard' Index #301 contains the standards for this feature. The preferred taper length for a single left/right turn lane is 50 feet. The preferred taper length for a dual left/right turn lane is 100 feet. The following table and illustrations show the turn lane requirements per the FDOT 'Design Standards' Index 301.

Turn Lanes – Curbed and Uncurbed Medians								
			Urban Conditions			Rural Conditions		
Design Speed (MPH)	Entry Speed (MPH)	Clearance Distance L1	Brake to Stop Distance L2	Total Decel Distance L	Clearance Distance L3	Brake to Stop Distance L2	Total Decel Distance L	Clearance Distance L3
35	25	70'	75'	145'	110'	----	----	----
40	30	80'	75'	155'	120'	----	----	----
45	35	85'	100'	185'	135'	----	----	----
50	40/44	105'	135'	240'	160'	185'	290'	160'
55	48	125'	----	----	----	225'	350'	195'
60	52	145'	----	----	----	260'	405'	230'
65	55	170'	----	----	----	290'	460'	270'

The illustrations for the single left and dual left turn lanes are found in the FDOT "Design Standards" Index 301.

D. Design Speed

The design speed is the speed used to make critical decisions on the roadway design feature. AASHTO's 'A Policy on Geometric Design of Highways and Streets' 5th Edition (Green Book) defines the design speed as:

“Design speed is the maximum safe speed that can be maintained over a specified section of highway when conditions are so favorable that the design features of the highway govern.”

The AASHTO 'Green Book' also makes the following statements regarding the design speed.

“Once selected, all of the pertinent features of the highway should be related to the design speed to obtain a balanced design. Above-minimum design values should be used where feasible”

Design Speed (mph)	Entry Speed (mph)	Total Deceleration Distance “L” (feet)
35	25	145
45	35	185
50 Urban	40	240
50 Rural	44	320
50 Rural	48	385

E. Entry Speed

When considering medians and median openings, the greatest use of design speed is for determining the length of right and left turn lanes. A reading of the FDOT “Design Standard” Index #301 will show that design speed or the related entry speed are the basis for determining the minimum length of the turn lane for deceleration and stopping behind the turn lane queue.

Total Deceleration Distance is important in the design of a turn lane. The turn bay should be designed so that a turning vehicle will develop a speed differential (through vehicle speed – entry speed of turning vehicle) of 10 mph or less at the point it clears the through traffic lane. The length of the bay should allow the vehicle to come to a comfortable stop prior to reaching the end of the expected queue in the turn lane.

If the turn lane is too short, or queued vehicles take up too much of the deceleration distance, there will be excessive deceleration in the through lane. This creates a high crash hazard as seen in research.

F. Median Opening Design Example

The spacing of median opening will be the sum of the following factors for both directions of the roadway. Note that the deceleration distance includes the taper length.

- Deceleration
- Queue Storage
- Turn Radius (usually 60 feet)
- Perception/Reaction distance or Full Width of Median (The length of the median that is not a part of the turn lanes or the taper. These sections provide for visibility, buffer and landscaping opportunity.)

Example: Design speed 45 mph suburban location

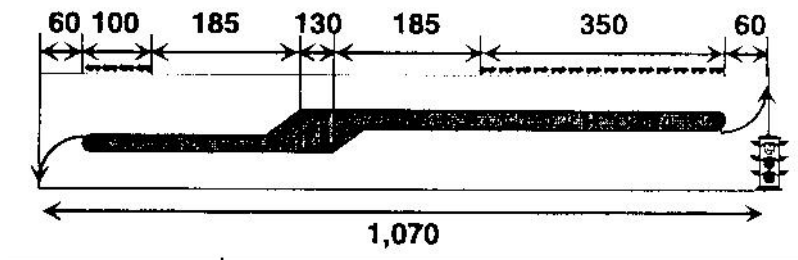
Left turn queue storage: (Signalized) = 350 feet

Deceleration = 185 feet

Left Turn Queue Storage: (Unsignalized) = 100 feet

Full Width Median = 130 feet

Turn Radii = 60 feet



V. Median Design Elements

A. Median End Treatments

The median end design for an urban arterial should be designed for a passenger vehicle while assuring it can accommodate a larger design vehicle.

Different median ends can be used. Alternative designs are semicircular, symmetrical, bullet nose, asymmetrical bullet nose and half-bullet nose

The only way in which left-turn vehicles can be removed from a through traffic lane is to install a left-turn bay. The lane should be of sufficient length to allow for adequate maneuver distance plus queue storage. The total length of the left-turn deceleration lane, including the taper, should be sufficient to allow the turning vehicle to decelerate from the speed of through traffic to a stop plus queue storage.

The only openings that should be provided without turn lanes would be for official or emergency use only.

B. Median Opening Length

Median opening length is governed by:

- Turn radii
- Side street geometrics
- Median (traffic separator) width
- Intersection skews
- Intersection legs

C. Right Turns and Left Turns on Divided Roadways

The FDOT 'Design Standard' Index #546 specifies the sight distances for right and left turns at intersections on multi-lane roads with medians. These should be considered minimums.

D. Two-Step Maneuver

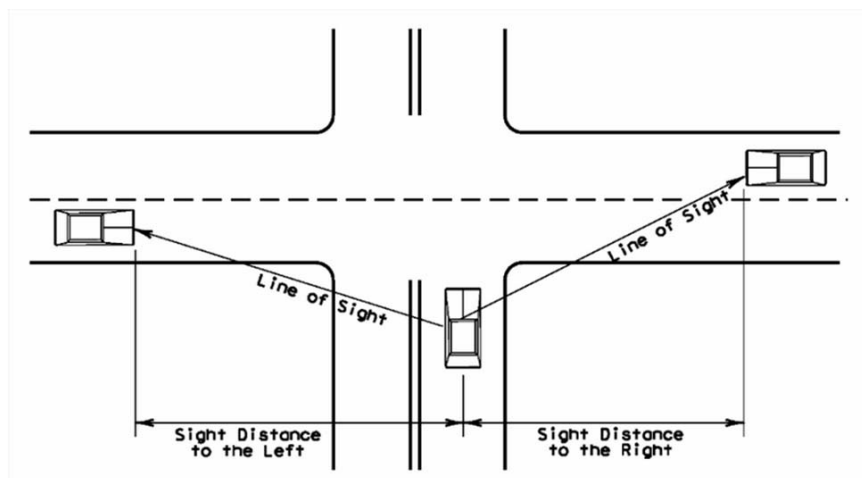
For divided highways with medians (the median is wider than the length of the design vehicle plus front and rear clearance), the maneuvers can be performed as two operations. The stopped vehicle must first have adequate sight distance to depart from a stopped position and cross traffic approaching from the left. The crossing vehicle may then stop in the median prior to performing the second operation. The second move requires the necessary sight distance for vehicles to depart from the median, to turn left into the cross road, and accelerate without being overtaken by vehicles approaching from the right.

VI. Sight Distance

A. Sight Distance Concepts

Highways must be designed to provide sufficient sight distance so that drivers can control and safely operate their vehicles. The following sight distances are of concern on median and median opening decisions, both urban and rural.

- Stopping sight distance: the distance necessary for the driver to safely bring a vehicle to a stop.
- Intersection sight distance: The distance necessary for drivers to safely approach and pass through an intersection.
- Height of eye: In determining sight distance, the height of the eye of the person who must stop or pass through the intersection is assumed to be 3.5 feet above the highway surface. This assumption has a significant bearing on such issues such as the placement of landscaping which might obstruct the view of the vehicle at the assumed height.
- Height of object: AASHTO assumes the height of an object for stopping sight distance to be 4.25 feet. A height of 2.0 feet above the pavement surface should be used as the height of an object for intersection sight distance. This will allow the driver to view the headlights of an oncoming passenger car at night.



Sight distance at intersection of roads

B. Sight Distance for U-Turns

U-Turns are more complicated than simple turning or crossing maneuvers. Sight distances for u-turns were calculated for automobiles with the following assumptions:

- “P” vehicle (Passenger vehicle)
- 2.0 seconds reaction time
- Extra time spent in the u-turn maneuver
- Begin acceleration from 0 mph only at the end of the u-turn movement
- Use of speed/distance/and acceleration figures from AASHTO ‘Green Book’
- 50 feet clearance factor

Sight Distance for U-Turn at Unsignalized Median Opening	
Speed (mph)	Sight Distance (feet)
35	520
40	640
45	830
50	1,040
55	1,250
60	1,540

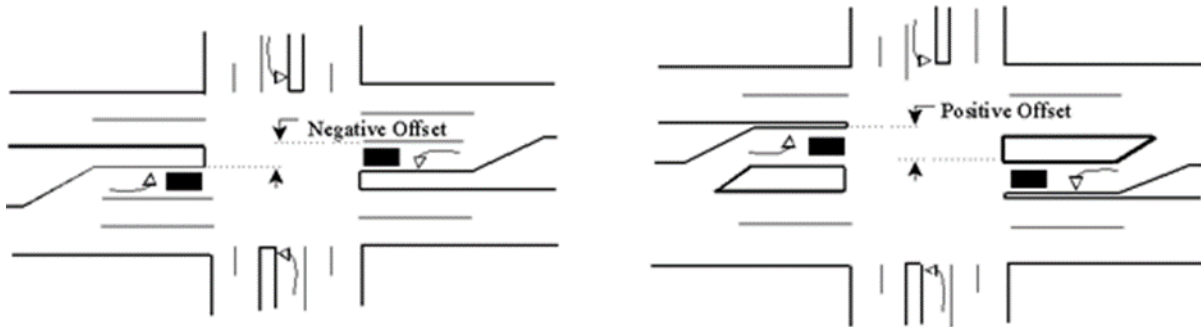
C. Sight Distance for Left Turn into Side Street

After calculating the sight distances for this left turn in maneuver it becomes clear that in most cases the right turn sign distance from the side street would control the sight distance of this area. If the area has enough sight distance to allow a right turn vehicle from the side street, the sight distance should be sufficient for the left turn egress vehicle.

D. Left Turn Offset

Vehicles turning left from opposing left turn lanes restrict each other's sight distance unless the lanes are sufficiently offset. Offset is defined as the lateral distance between the left edge of a left turn lane and the right edge of an opposing left turn.

When the right edge of the opposing left turn is to the left of the left edge of the left turn lane, the offset is negative as shown in the illustration below. If it is to the right, it is a positive offset as indicated in the illustration below. Desirable offsets should all be positive with a recommended minimum 2 foot offset when the opposing left turn vehicle is a passenger car and a recommended minimum 4 foot offset when the opposing left turn vehicle is a truck.



VII. Median Width

The appropriate median width is a function of the purpose that the median is to serve in a particular application. Applications on roadways having at-grade intersections that affect median width include the following:

- Separate opposing traffic streams
- Pedestrian refuge
- Left-turn to side street
- Left-turn out of side street
- Crossing vehicles
- U-turns
- Aesthetics and maintenance

A. Anatomy of Median Width

Median width in most urban situations is made to accommodate turning lanes and a separator. The width of both the lane and the separator are critical to the operations of the median opening.

Minimum and Recommended Widths are as follows:

Summary of Standards and Recommendations		
Minimum	Plans Preparation Manual (Reconstruction Projects) = 40 mph and less	15.5 feet
Minimum	Plans Preparation Manual (Reconstruction Projects) 45 mph	19.5 feet
Minimum	Plans Preparation Manual less than 55 mph	22 feet
Guidance from Plans Preparation Manual	When Greater than 55 mph	40 feet
Recommended	4 lane highways with medians expecting significant u-turns and directional median openings with excellent positive guidance	30 feet for single left turns and 42 feet for dual lefts
Recommended	6 lane highways with medians expecting significant u-turns and directional median openings with excellent positive guidance	22 feet for single left turns and 34 feet for dual lefts

A median width of 30 feet is the most desirable width due to the following:

- Greater flexibility in the choice of lane widths and separation width at double left-turn, full median openings.
- Additional width for landscaping the overlapping “traffic separators” at directional median openings.
- Permits separate vertical and/or horizontal alignment of the two roadways.

For more information on turn lane width, see FDOT ‘Plans Preparation Manual’ Table 2.2.1.

B. Minimum Traffic Separator Width at Intersections

The minimum width of a median traffic separator “nose” has commonly been 4 feet. Where the right-of-way is limited, 2 feet and even as little as 18 inches has been used. The AASHTO ‘Green Book’ indicates that “... *the minimum narrow median width of 4 feet is recommended and is preferably 6 to 8 feet wide.*”

C. Pedestrian Considerations at Traffic Separators

Pedestrian refuge minimum for common practice is to use a minimum of 4-foot separator between the left-turn lane and the opposing traffic lane. The minimum width for pedestrian refuge is 6 feet. Where more than occasional pedestrians may be present, the median width should be at least 8.5 feet and preferable at 10 feet.

D. Seeing Traffic Separators at Intersections

Very narrow median noses are very difficult to see, especially at night and in inclement weather. Reflectorized paint is of little help as it rapidly becomes dirty and loses its reflectivity. Reflectorized traffic buttons and/or reflectorized pylons help but lack the “bulk” to provide good “target value.”

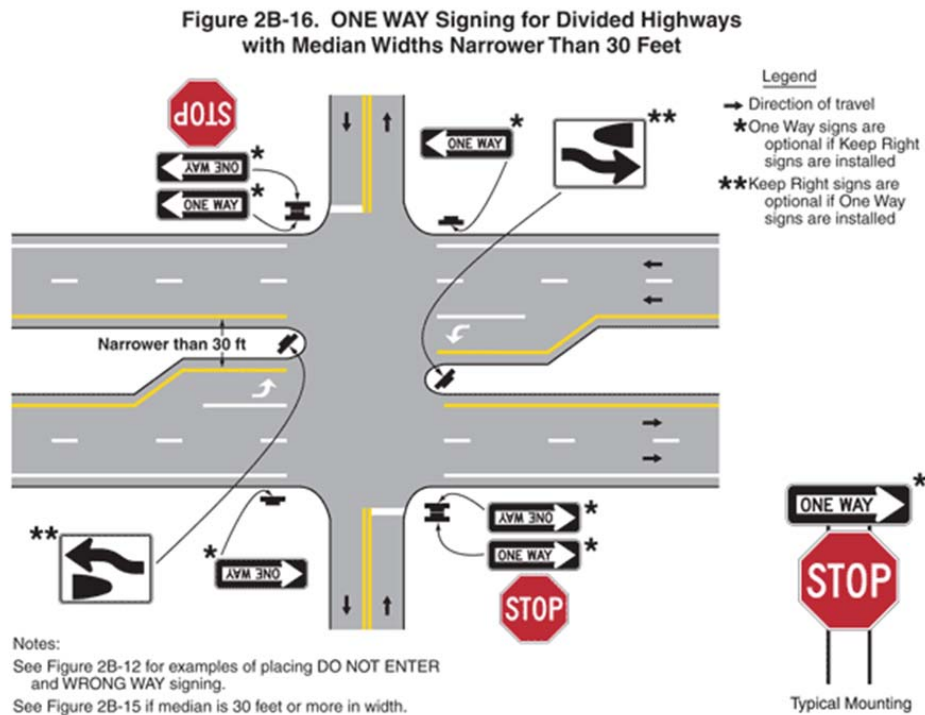
Carefully selected, landscaping is the only effective way to provide excellent visibility of the median and median openings. A minimum traffic separator width of 6 feet and preferable 8.5

feet is needed for the median nose to be of sufficient width back-to-back with curbs to provide adequate area for vegetation.

Landscaping of the median nose to provide visibility is especially important where long left-turn lanes are used. Obviously the choice of vegetation and the landscaping design must ensure that sight distance is not obstructed.

VIII. Median Signing

The Manual on Uniform Traffic Control Devices (MUTCD) contains guidance on the type and placement of signs and traffic control devices at median opening areas. The following illustration (MUTCD, Figure 2B-16) is for signing on a median with a width narrower than 30 feet.



IX. Signal Spacing

The access management classification system defines the spacing of signals to be $\frac{1}{2}$ mile. The $\frac{1}{2}$ mile spacing between signals is optimal because it provides space for:

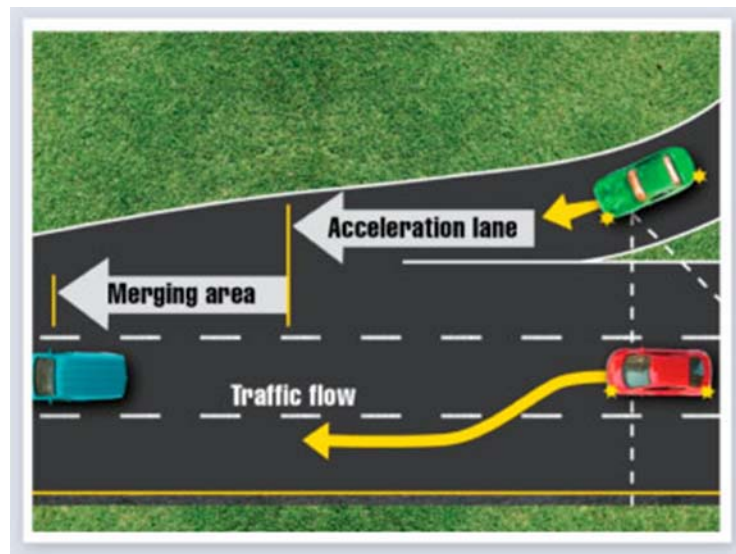
- Safety
- Operations
- Flexibility
- Signal Progression
- Aesthetics.

The distance also accommodates two sets of directional median openings.

X. Freeway Ramp Terminal

Careful design consideration should be given to the distance between the freeway ramp terminal to the first median opening. Observations indicate that drivers tend to make erratic maneuvers when there is a limited separation between the gore area of the off-ramp and the median opening.

Desirable conditions would permit a driver to accelerate, merge into the outside traffic lane and select an acceptable gap in order to merge into the inside lane as illustrated.



XI. Special U-Turn Considerations

A. AASHTO Guidance on Width and U-Turns

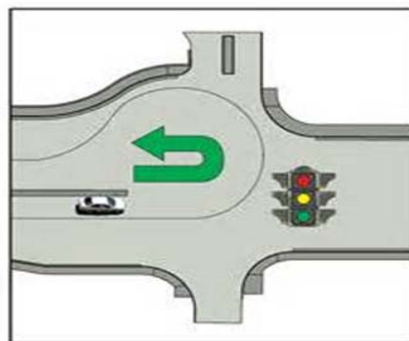
The AASHTO ‘Green Book’ contains some guidance on the relation between median width and u-turn movements. Unfortunately, the figure in the AASHTO ‘Green Book’ shows the u-turn movements made from the inside (left) lane. This is contrary to the basic principle of having left turns made in auxiliary lanes rather than through lanes.

In order to make the width sufficient for a Passenger Car (P) to make a u-turn from the turn lane to the outer lane, it would require 30 feet. If you cannot provide 30 feet, then the car will encroach on to the shoulder. This is acceptable as long as this encroachment has been built into the design.

When designing for 6 lane highways, 20 feet of median width will usually provide sufficient space for the u-turn for the passenger car (P) vehicle.

B. U-Turns Using a Flare

The design P-vehicle can make a u-turn on an undivided roadway without a traffic separator by “flaring” the receiving roadway or where a far-side bus stop is used; the u-turn can be accommodated as shown in the following illustrations.



XII. Turing Vehicle Destination

As a vehicle turns left from a median opening and crosses the highway, it enters the driveway and side street. The design of this entrance is critical to the safety and operation of the median opening. The three major areas of concern for access management issues are:

- Geometric Design of Driveways
- Placement of driveway in relation to the median opening and neighboring streets.
- Throat Length (the distance the driveway should extend before the first conflict).

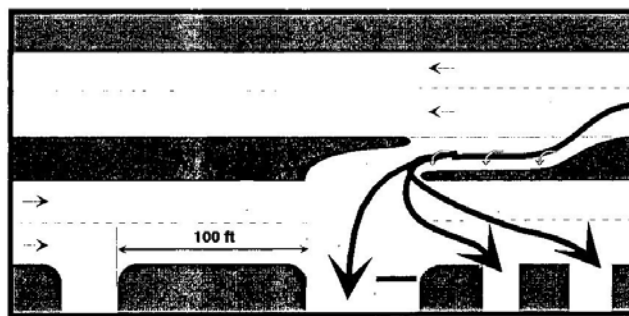
The geometric design of all access connections should allow drivers to complete the ingress maneuver (enter the abutting side street or property) with minimum effect on vehicles in the through traffic lane.

- Proximity to other access connections and median openings
- Curb return radius and throat width
- Throat length (distance before the first conflict)
- Queue storage
- Traffic control

The combinations of curb return radius and throat width should allow drivers to enter and exit an access connection quickly and with minimal interference with through traffic. A narrower entry width can be used on connections that have larger radii.

A. Placement of Driveways

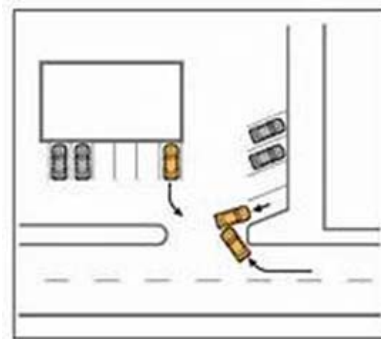
Access connections should be located directly opposite or downstream from a median opening as illustrated. Driveway access should be located more than 100 ft upstream from the median opening to prevent wrong way maneuvers as seen in the following illustration.



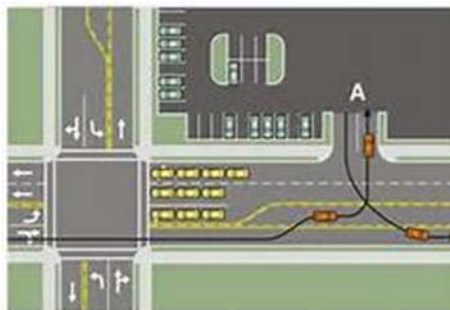
B. Throat Length

The throat length must be of sufficient length to enable the intersection at the access connection and abutting highway, and the on-site circulation to function without interference with each other. Drivers entering the site should first clear the intersection of the highway and access connection before encountering the intersection of the access connection and on-site circulations.

The following illustration shows inadequate throat length. The inbound vehicle conflicts with another vehicle on site.



The following illustration shows adequate throat length. There is sufficient distance between the entrance of the driveway and the first potential crossing movement.



XIII. Summary

Median design benefits were outlined including safety, efficiency and aesthetics. There was a definition of terms used in median design. Access Management Classifications were discussed as they relate to median design.

The types of medians were shown from most restrictive to least restrictive. Conflict points associated with the various types of median openings were covered. Access vs. through movement was shown.

Median design issues were outlined including approach taper, deceleration distance and storage length. Design speed and entry speed also play a factor in turn lanes. Perception-reaction time as it relates to turn lane design was discussed.

Sight distance issues were discussed. Negative and positive left turn offsets were defined. A positive offset is preferred because it gives the left turning driver greater visibility of oncoming traffic. The placement of driveways as it relates to median openings was also covered.

This course should equip an engineer with the necessary information to properly design median openings for roadway plans.