MISSOURI DEPARTMENT OF TRANSPORTATION
ACCESS MANAGEMENT
GUIDELINES

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1.0 INTRODUCTION AND DEFINITIONS

Problem statement

As development occurs and vehicle traffic increases, many roadways deteriorate into highly congested routes that experience unacceptable delays and crashes. This deterioration can be due in part to improperly spaced and designed intersections and driveways. These intersections and driveways cause crashes and conflicts to through traffic. Roadways serve a dual purpose of providing a means of transport between one place and another and providing access to adjacent property. Access management is intended to balance the roadways' role of serving through traffic with the role of providing access to property.

Once the safety and efficient operation of a roadway is lost, it is difficult and expensive to restore. Adding lanes to an existing route does not completely solve the problem. Relocating the route causes loss of public investment in the roadway, and loss of private investment in adjacent property. Yet it can be difficult to get support from affected communities, business owners, and the public, for access management as a strategy to improve a roadway experiencing problems with safety and delay.

Purpose

Access management involves the proper planning and design of points of access to the public roadway system. These points of access include interchanges, public road intersections, and driveways. Sound access management can have a positive impact on roadway safety and the ability of roadways to carry traffic efficiently and safely. Failure to properly manage access can result in safety and operational problems, negatively impact adjacent property owners, and cause a loss of the public's investment in the roadway system.

The access management guidelines contained in this document are intended to provide for the appropriate design and provision of access to facilities operated by the Missouri Department of Transportation(MoDOT), while allowing for flexibility where necessary. The guidelines apply to long-range planning, project planning and design, right-of way acquisition, redesign of existing highway corridors, and driveway permitting. The purpose of the guidelines is to improve the safety and efficiency of traffic moving on and off of public roadway facilities, while balancing the need for access to adjacent property. These guidelines are also offered to municipalities and other entities involved with establishing and maintaining access to the Missouri highway system.

Background

The goals established for the development of access management guidelines for the Missouri Department of Transportation include the following:

- Improve roadway safety
- Improve traffic operations
- Protect the taxpayers' investment in roadways
- Create better conditions for non-automobile modes

A roadway classification system that balances movement of traffic with access to properties was developed as a first step to defining access management guidelines. Guidelines were then developed for the intersections and interchanges, driveways, and other pertinent issues related to these classifications of roadway. Where possible, national studies and other state's experience with comprehensive access management were used. Guidelines for intersections and interchanges include:

- interchange spacing
- clearance of functional areas for interchanges
- spacing for public road intersections
- spacing of traffic signals

Driveway guidelines include the following:

- Driveway spacing and density
- Corner clearance and clearance of functional areas of public road intersections
- Sight distance minimums
- Driveway geometric design
- Angle of intersection and approach radii
- Driveway width, throat length, and grade
- Guidelines for surfacing and curbs

MoDOT will work with cities, counties, and affected property owners to manage access through shared access, and access from local roadways. Guidelines for the use of two-way left-turn lanes (TWLTLs), three-lane roadways, and raised medians, warrants for auxiliary turn lanes, frontage and backage roads, recommended practices for local land use planning agencies, and consideration of non-automobile modes in managing access are included.

The stakeholders involved in the development of the plan saw the need for development of department wide guidelines. Existing procedures have led to parallel standards used by the separate business units, creating confusion both within the department and with our outside customers. The guidelines will encourage uniformity within the department and provide property owners and developers with a clear expectation of the requirements involved with gaining access to the MoDOT system. Some local government entities in Missouri have chosen to adopt their own access management classification systems and standards for use on their roadway system.

Benefits of Access Management

The proven benefits of access management include increased safety for motorists and pedestrians, decreased delay (through better operation), decreased emissions, and aesthetic improvements.

Safer Roadways

National studies show that as many as 68% of all crashes are access related. As demonstrated in other states, implementation of a comprehensive plan will significantly reduce access related crashes. Studies have shown that crash rates can drop as much as 50 % on routes where access management techniques have been implemented.

The safety benefits of access management impact other modes of transportation as well. The reduction of vehicular conflicts creates a similar conflict reduction for pedestrians and bicyclists and decreased exposure to vehicular movements. This translates to a roadway environment that is conducive to pedestrian and bicycle activity.

Improved Operations

Managing access can provide significant improvement to roadway capacity and operational benefits. These improvements to roadway capacity can be documented by analysis using the Highway Capacity Manual (HCM). An example analysis of a four-lane roadway at level of service D, concludes that the same roadway can accommodate nearly 10,000 more vehicles per day by incorporation of access management techniques. Another example analysis demonstrates the effects of one particular element of access management, traffic signal spacing. The capacity of a six-lane roadway with traffic signals spaced at ¼ mile increments is no greater than a four-lane roadway with traffic signals spaced at ½ mile increments.

See Section 5.0 for discussion of alternate analysis procedures.

Environmental Benefits

The operational improvements gained by access management techniques have environmental benefits. Reduced delay results in improved fuel economy and reduced emissions on well-managed roadways.

Improved Roadway aesthetics

Techniques such as increased driveway spacing and median treatments provide additional areas for green space and landscaping. These areas can create an improved climate for commercial and residential areas.

Expected Impacts of the Proposed Access Management Plan

Business community/property impacts

On routes where access is not managed, increased congestion can lead to decreased traffic volumes as motorists avoid the routes to escape the delay. Lower traffic volumes can result in a drop in business revenues and property values. Thriving business corridors can experience an economic decline associated with traffic congestion.

On routes where access is managed, certain types of businesses located in the mid-block that depend on convenience for passer-by traffic may experience a negative impact, but studies done in other states indicate that the majority of businesses located on roadways with properly managed access experience increased sales and property values. Overall, the market area of businesses will increase on well-managed routes, due to reduced congestion.

The possible reduction in access points will be perceived as a negative impact by adjoining property owners, in particular commercial property owners. A reduction in the

total number of access points has not been shown to have a detrimental effect on business. With regard to a possible reduction in left turning opportunities, national studies show mixed results on the effect of the use of restrictive medians to limit left turns. Any negative impacts are directly related to the specific type of business and are not demonstrated in the results of all case studies. The proposed plan is designed to minimize the detrimental effects of restricting left turns while maximizing the operational advantages.

Increased Life Span of Roadways

Vergil Stover and Bud Koepke, two national experts in the field of access management, reflect the observation of most engineers and planners when they stated: "The failure to manage access is the major cause of highway obsolescence". Many roadways in Missouri have deteriorated operationally from inadequate access management. This deterioration eventually drives MoDOT to construct bypasses in order to relieve the congestion. If a bypass is not an alternative for improvement, the motorists and the property owners have no other choice than to live with the operational problems. The proposed comprehensive plan allows for cost effective use of the taxpayer investment by ensuring the maximum available capacity for a given roadway improvement.

Right of Way Costs

An increased investment will be necessary for additional right of way and access limitations. This increased investment will be offset by additional capacity and greater longevity of the roadway. The most visible changes will include:

1. An increased footprint for freeway interchanges.
2. An expansion of access limitations on minor arterial roadways. Current standards require access limitations in the area immediately surrounding public street intersections. The proposed guidelines will require the purchase of access limitations along the entire right of way.
3. Defined spacing guidelines for driveways will reduce the number of access points available to some properties, while increasing the number available to other properties.

Less Direct Access for Motorists

The reduction of conflict points proposed by the plan will also reduce the number of left turn opportunities on some routes resulting in less direct access to some properties. The plan minimizes the impact through the use of various design features (U-turn phases at signals, roundabouts, etc)

Implementation

Access Management retrofit projects

To address problems with safety and traffic operations on those highly developed and congested arterial routes on the state highway system, an evaluation of improvement alternatives should include the application of access management techniques. In the process of determining project scope, if an access management retrofit can be shown to provide cost effectiveness, improvements to safety, capacity, and traffic operations

beyond that of other project alternatives, the access management alternative should be pursued. Where access is being managed on an existing roadway (a "retrofit project"), MoDOT will strive to incorporate the Access Management guidelines. However, it may not be possible to incorporate and attain all of the access management guidelines in retrofit projects due to existing development, economic, physical, and other constraints. Through public involvement and cooperation with local governments, MoDOT staff will work to provide a reasonable solution under the existing conditions.

Inclusion of the Access Management guidelines in projects with new roadway alignments

All corridors that are improved through a MoDOT project need to continue to operate efficiently and safely for many years to protect taxpayer investment in the roadway. The incorporation of Access Management into these projects will provide for proper placement and design of accesses, so that additional development does not cause them to deteriorate into highly congested routes that experience excessive delay and safety problems.

The Project Development Manual contains the minimum acceptable criteria that can be implemented without approval from headquarters. On both retrofit and new roadway alignment projects, collaboration with General Headquarters Design and documentation in the Scoping Process will be required when the Access Management guidelines are not attained on the project. For statewide consistency on projects and permits, the State Traffic Engineer will provide a recommendation as part this collaboration process. The Director of Project Development will resolve any differences between Design and Operations. An evaluation process will be conducted to determine the department's success in implementing the Access Management guidelines on projects.

Permitting Procedures

When a request for access is received, the district staff will work with the property owner to determine whether applicable spacing guidelines can be met. If they cannot, collaboration with Headquarters must occur and other options such as side road access and shared access will be pursued. For requests on normal access right of way, if no workable alternative exists, a permit can be pursued with documentation required as to why the guidelines were not met. For requests on limited access right of way, if no workable alternative exists and the request is compliant with the Commission's policy for Changes in Access on Limited Access Right of Way, the appropriate agreement (and subsequent permit) may be pursued with documentation required as to why the guidelines were not met. Requests that are not compliant with the Commission's Policy for Changes in Access on Limited Access Right of Way must be forwarded to the State Traffic Engineer for review (for further information, see the Permitting Processes Manual).

For larger developments, if it is determined that the access point requested will meet the guidelines for spacing, a traffic study will be required to determine what roadway improvements will be required. To ensure that operations on our roadway are not negatively impacted by the additional access, the developer will provide the roadway improvements. The policy of the Missouri Highways and Transportation Commission and MoDOT should be in all cases to discourage the proliferation of access points and conflict points within the State highway system.

Cooperation with city and county planning and zoning authorities

Successful access management involves a partnership between MoDOT and local land use planning officials. Implementation of the Access Management plan will include face-to-face informational meetings between District staffs and local authorities. Districts should work to establish mutually beneficial and cooperative relationships with city and county stakeholders. This relationship should allow MoDOT to provide input into the plat and zoning review process to assure that sound access management principles are implemented. A cooperative relationship can help to successfully manage on-site circulation and lot frontages. Access to local side streets and cross access easements necessary to maintain proper access spacing can also be accomplished. While MoDOT has no authority to manage on-site issues that occur beyond the MoDOT right of way, these on-site issues can influence the operation of our roadway.

Legal Authority For Access Management In Missouri

The Missouri Department of Transportation (MoDOT) operates under the supervision of the state transportation commission.

Article IV, Section 29 (Highways and Transportation) of the Missouri Constitution states:

> " The highways and transportation commission shall have authority over all state transportation programs and facilities as provided by law, including, but not limited to, bridges, highways, aviation, railroads, mass transportation, ports, and waterborne commerce, and shall have authority to limit access to, from and across state highways where the public interest and safety may require."

Compensation to property owners is governed by Article I, Section 26 of the Missouri Constitution. That section states that:

> "Private property shall not be taken or damaged for public use without just compensation. Such compensation shall be ascertained by a jury or Board of Commissioners of not less than three freeholders, in such manner as may be provided by law; and until the same shall be paid to the owner, or into court for the owner, the property shall not be disturbed of the proprietary rights of the owner therein divested."

The Commission has the authority to restrict access, but it may have to pay for the exercise of that power. The principal limitation on the exercise of police power to limit access is that any limitation must be reasonable.

Permit Exceptions to Access Management Guidelines

For access granted through permitting procedures that do not meet the Access Management guidelines, appropriate documentation will be required. For permits involving sight distance, clearance of the functional area of an interchanges, signal spacing, collaboration with Headquarters Traffic is strongly suggested.

A system will be put in place to track permits statewide and an evaluation process will be conducted to determine the level of success in implementing the Access Management guidelines through permitting.

Definitions of Terms

AASHTO – The American Association of State Highway and Transportation Officials.

Access – The ability to enter or leave a business, residence or land parcel from a public roadway via a connecting driveway. In real estate law, the term "access" denotes the right vested in an owner of land that adjoins a highway or other road to go and return from his/her own land to the highway without obstruction.

Access Management – The design of driveways, intersections, interchanges, and other access features of roadways so as to maintain safety and operational performance of roadways.

Access Management Program – The whole of all actions taken by a governing council, board, or agency to maintain the safety and traffic carrying capacity of its roadways.

Annual Average Daily Traffic (AADT) – The annual average two-way daily traffic volume on a route. AADT represents the total traffic on a road per year, divided by 365. For the purposes of access management on MoDOT routes, all AADT figures should come from MoDOT data collection (past or current traffic), a Metropolitan Planning Organization (MPO) urban transportation model, or the MoDOT statewide traffic model (forecast traffic).

Arterial – A road intended primarily to serve through traffic and where access is carefully managed.

At Grade – Where two or more facilities meet in the same plane of elevation.

Auxiliary Lane – A lane adjoining a roadway that is used for acceleration, deceleration, or storage of vehicles.

Backage Road – A local road that is used to provide alternative access to a road with higher functional classification; backage roads typically run parallel with the main route and provide access at the back of a line of adjacent properties.

Collector – Roads intended to move traffic from local roads to secondary or principal arterials.

Commercial – Property developed for the purpose of retail, wholesale, or industrial activities, and that typically generate higher numbers of trips and traffic volumes than do residential properties.

Conflict – A traffic-related event that causes evasive action by a driver to avoid a collision.

Conflict Point – Any point where the paths of two through or turning vehicles diverge, merge, or cross and create the potential for conflicts.

Congestion – A condition resulting from more vehicles trying to use a given road during a specific period of time than the road is designed to handle with what are considered acceptable levels of delay or inconvenience.

Corner Clearance – The distance between the edge of an intersection between a public road and the closest edge of the first driveway.

Corridor – A major roadway designed for relatively uninterrupted, high-volume mobility between regions.

Crash Rate – The number of vehicular collisions occurring on a facility divided by traffic volume during a selected time period.

Cross Access – A service drive that provides access between two or more abutting sites so that the driver need not enter the public street system to move between them.

Deceleration Lane – A speed-change lane that enables a vehicle to leave the through-traffic lane and decelerate to stop or make a slow speed turn.

Directional Median – A (typically) raised median used to channel traffic in a particular direction. For example, a directional median may allow only right turns at a particular location.

Design Traffic Volume – The traffic volume that a roadway or driveway was designed to accommodate and against which its performance is evaluated.

Downstream – The next feature (e.g., a driveway) in the same direction as the traffic flow.

Driveway – A (typically) private roadway or entrance used to access residential, commercial, or other property from an abutting public roadway.

Driveway Density – The number of driveways divided by the length of a particular roadway.

Driveway Width – The width of a driveway measured from one side to the other at the point of tangency.

Easement – A grant of one or more property rights by a property owner. For example, one property owner may allow a neighbor to access public roads across his/her property.

Entering Sight Distance – The distance of minimum visibility needed for a passenger vehicle to safely enter a roadway and accelerate without unduly slowing through traffic.

Expressway – A major roadway designed for relatively uninterrupted, high-volume mobility between regions, access to which is limited and often includes a mixture of intersections (at grade) and interchanges (grade separated).

Facility – A transportation asset designed to facilitate the movement of traffic, including roadways, intersections, auxiliary lanes, frontage roads, backage roads, bike paths, etc.

FHWA – The Federal Highway Administration of the U.S. Department of Transportation.

Flag Lot – A lot not meeting minimum frontage requirements where access to a public road is provided by a narrow strip of land carrying a private driveway.

Freeway - A major roadway designed for relatively uninterrupted, high-volume mobility between areas, access to which is limited to grade-separated interchanges only. Interstates are freeways.

Frontage – The length of a property that directly abuts a highway.

Frontage Road – A local road that is used to provide alternative access to property from a road with higher functional classification; frontage roads typically run parallel to the mainline road and provide access at the front of a line of adjacent properties.

Functional Area – The area surrounding an interchange or intersection that includes the space needed for drivers to make decisions, accelerate, decelerate, weave, maneuver, and queue for turns and stop situations. The functional area should be kept as clear as possible of driveways and median openings where left turns are allowed.

Functional Classification System – A system used to categorize the design and operational standards of roadways according to their purpose in moving vehicles; higher functional classification implies higher traffic capacity and speeds and typically longer traveling distances.

Functional Integrity – Incorporation of appropriate access management guidelines and controls that allow a roadway to maintain its classified purpose.

Geometric Design Standards – The acceptable physical measurements that allow a facility to maintain functional integrity.

Grade Separated – Two or more facilities that intersect in separate planes of elevation.

Highest and Best Use – The probable and legal use of vacant land or improved property that is physically possible, appropriately supported, and financially feasible, which results in the highest property value.

Highway – A public way that every person has a right to use. The two critical aspects of a highway are the right of common enjoyment and the duty of public maintenance**.** In this document, a highway generally refers to a roadway under MoDOT jurisdiction that plays some role in moving through traffic.

Highway Capacity – The maximum number of vehicles a highway can handle during a particular amount of time and at a given level of service.

Highway System – All public highways and roads, including controlled access highways, freeways, expressways, other arterials, collectors, and local streets.

Interchange – A grade-separated facility that provides for movement between two or more roadways.

Internal Circulation – Traffic flow that occurs inside a private property.

Internal Site Design – The layout of a private property, including building placement, parking lots, service drives, and driveways.

Intersection – An at-grade facility that provides mobility between two or more roadways.

Interstate – A federally designated roadway system for relatively uninterrupted, high-volume mobility between states.

Jersey Barrier – A special variety of very high raised median that is used to separate opposing flows of traffic on high-speed urban interstates and freeways.

Joint (or Shared) Access – A private access facility used by two or more adjacent sites.

Just Compensation – The measure of damages in condemnation that represents the difference between the fair market value of the property immediately before a taking (a change in access that altered the value) and the value of the property in the after condition.

Land Use – The particular application for which a portion of land is employed, for instance, commercial use.

Lane – The portion of a roadway used in the movement of a single line of vehicles.

Left-Turn Lane – A lane used for acceleration, deceleration, or storage of vehicles conducting left-turning (cross traffic) maneuvers.

Level of Service – The factor that rates the performance of a roadway by comparing operating conditions to ideal conditions; "A" is the best, "F" is the worst.

Local Land Use Authority – Governmental entities such as cities and counties have authority to plan, zone, and control the subdivision of land on properties outside the right-of-way. Such authority is often critical to an effective program of roadway access management.

Local Service Street – A road whose primary purpose is to provide access between abutting properties and roads of higher functional classification.

Median – A barrier that separates opposing flows of traffic. Raised medians (with curbs and a paved or landscaped area in the center) are generally used in urban areas. Raised medians should not be confused with the more obtrusive Jersey Barriers. Flush medians (with no curbs and a grass-covered area in the center) are generally used in rural areas. Medians can be both functional and attractive.

Mid-Block Crossing – A crossing that is provided so that pedestrians can conveniently and safely cross a roadway in the middle of a block or segment of roadway.

Minor Arterial – A road whose primary purpose is to provide access between collectors and roadways of higher functional classification; these roads mainly provide local mobility and some access to land.

MoDOT – The Missouri Department of Transportation.

NCHRP – The National Cooperative Highway Research Program, a program that sponsors research on highway safety, operations, standards, and other topics.

Peak Hour Traffic – The number of vehicles passing over a section of roadway during its most active 60-minute period each day.

Police Power – The general power vested in the legislature to make reasonable laws, statutes, and ordinances where not in conflict with the Constitution that secure or promote the health, safety, welfare, and prosperity of the public.

Principal Arterial – A road whose primary purpose is to provide long-distance mobility between areas as well as connections between roads of lower functional classification, particularly minor arterials and collectors.

Queue Storage – A lane used to temporarily hold traffic that is waiting to make a turn or proceed through a location controlled by a traffic control device such as a stop sign or traffic signal.

Raised Median – The elevated section of a divided road that separates opposing traffic flows.

Residential – Property developed for the purpose of family, multi-unit, or other housing quarters, and that typically generates a lower number of trips and a lower volume of traffic than do commercial properties.

Right-In, Right-Out – A driveway or median where left turns are prohibited either by physical or regulatory means. In general, regulatory approaches to preventing left turns are ineffective.

Right-of-Way – Land reserved, used, or slated for use for a highway, street, alley, walkway, drainage facility, or other public purpose related to transportation.

Road – For the purposes of this document, a transportation facility extending from one community to another.

Roadway – The part of a public transportation facility intended for use by through traffic.

Roadway Classification System – See "Functional Classification System"

Rural – A geographic area that is not in an urbanized Area, municipality, or similarly densely developed area and which is not likely to be so in the next 20 years.

Service Road – A local road that is used to provide alternative access to a road with higher functional classification; service roads may include internal circulation systems, frontage roads, or backage roads.

Shared Driveway – A single, private driveway serving two or more lots.

Side Friction – Driver delays and conflicts caused by vehicles entering and exiting driveways.

Sight Distance – The distance visible to the driver of a passenger vehicle measured along the normal travel path of a roadway to a specified height above the roadway when the view is unobstructed to oncoming traffic.

Speed Differential – The difference in travel speed between through traffic and traffic entering or exiting a roadway. Large speed differentials can contribute to delay, congestion, and rear-end collisions.

Stopping Sight Distance – The minimum distance required for a vehicle traveling on a roadway to come to a complete stop upon the driver seeing a potential conflict; it includes driver reaction and braking time and is measured on a wet pavement.

Storage Length – The length of a lane of roadway used to temporarily accumulate traffic that is waiting to proceed through a traffic control device or other stop or yield situation.

Street – For the purposes of this document, roads or public ways that are contained within a city, town, or village.

Strip Development – A linear pattern of roadside commercial development that often creates a large number of driveways and conflict points along a roadway.

Subdivision – A tract of land that is divided into multiple lots, often along an existing or proposed street, highway, easement, or right-of-way.

Taper – The transitional area of a roadway where it becomes wider or narrower.

Thoroughfare Plan Map – A long range traffic circulation map that identifies the right-of-way widths for each roadway and serves as an official listing of rights-of-way to be reserved.

Throat Length – The distance between an intersecting roadway and where the internal circulation of a commercial driveway or parking lot begins; it provides queue storage mainly for traffic exiting a development.

Traffic Flow – The actual amount of traffic movement.

Traffic Impact Study – A report that compares relative roadway conditions with and without a proposed development; it may include an analysis of mitigation measures.

Transition – The area of a roadway where a change in traffic patterns occurs, including acceleration, deceleration, and turning activities.

Trip Generation – The estimated volume of entering and exiting traffic caused by a particular development.

Turning Radius – The radius of an arc that approximates the turning path of a vehicle.

Two-Way Left-Turning Lane (TWLTL) – A lane located between opposing traffic flows, which provides a transition area for left-turning (cross traffic) vehicles.

Uncontrolled Access – A situation that results in the incremental development of an uncontrolled number, spacing, and/or design of access facilities; an access management program is intended to constrain uncontrolled access.

Upstream – Against the direction of the traffic flow.

Urban – Within a current census urbanized area or municipal boundary or an area with similar density characteristics or forecast to be of an urban character within the next 20 years.

Vehicle Trip – A vehicle moving from a point of origin to a point of destination.

Warrant – The standardized condition under which traffic management techniques are justified.

Weaving – Crossing of traffic streams moving in the same general direction through merging and diverging, for instance, near an interchange or intersection.

2.0 ROADWAY CLASSIFICATION SYSTEM

Roadways serve a dual purpose of providing a means of transport between one place and another and providing access to adjacent property. Access management is intended to balance the roadways' role of serving through traffic with the role of providing access to property.

Highways should be carefully classified based on their intended function so that access can be managed in an appropriate way. Highways that are intended to mainly serve through traffic (e.g., interstates, freeways, and principal arterials) should play a limited role in terms of direct property access. These are routes where the Highway and Transportation Commission purchases rights of access from landowners and allows for access only at those points where it is appropriate. Access management on these routes should be stricter than on other routes such as collectors and local roads and streets. These collector routes may carry some through traffic; however, the main purpose of collectors is to provide direct access to property.

The following classification system is used throughout this document to establish a functional hierarchy of roadways. It was developed based on the existing MoDOT functional classification system. Each roadway under MoDOT jurisdiction is classified according to this system. Routes classified as interstate/freeway or principal arterial are intended to carry long-distance, high-speed travel and will have a high level of access control. Routes classified as minor arterials and collectors will make up the bulk of the miles of the system, serve more local destination traffic, and have a lower level of access control.

Urban/ Rural
Interstate/Freeway
Principal Arterial
Minor Arterial
Collector

- Some of the guidelines for the Principal Arterial classification will be a range of values. The high end of this range should be applied to Principal Arterial routes that are intended to serve long-distance trips at relatively high speeds.
- The "collector" classification includes both major collectors and minor collectors.
- Urban: Any area forecasted as urban within 20 years, or future urban highways should be planned as such in terms of access management.
- A rural designation means that the highway is *not* within a current or 20-year forecast urban area.

The Missouri Department of Transportation does not have jurisdiction for local roads and streets; cities and counties in Missouri control such routes. Routes on the MoDOT system that serve a local road or street function should be transferred to a local jurisdiction.

3.0 GUIDELINES FOR DETERMINING URBAN AND RURAL SEGMENTS

Breaks between urban and rural designations will be established on a regular basis by MoDOT district staff for access management purposes. In general, this should be done according to the definitions of urban/rural currently used in MoDOT's planning process, except that each break between urban and rural must occur at a readily identifiable physical feature such as a bridge, creek, river, or public road intersection.

Urban areas will be set to take into account that the urban area around metropolitan areas will grow substantially beyond the current urban boundary over the next 15–20 years. Most Metropolitan Planning Organizations (MPOs) forecast and establish a 20-year planning boundary for long-range transportation planning purposes. This boundary should be adopted as the future urban boundary for access management purposes.

Outside Urban Areas

In some places, traffic density may be a more important consideration than population density. Such areas might be described as "commercial communities" located in what are now rural areas. Examples of this type of development would be strip commercial centers located along major routes outside of city boundaries. Reasonable guidelines for identifying "rural commercial communities" are individual commercial developments that generate at least 250 trips per hour (2,500 trips per day) or clusters of commercial development that generate at least 4,000 trips per hour (4,000 trips per day) along a mile of road. (This equates to 200 trips per hour for a one half mile of road.)

Other rural areas that appear likely to develop at urban densities (either in terms of population or traffic/trip generation) over the next 15 to 20 years should be considered as *urban* for access management purposes.

Minimum Length For An Urban Designation

In order to preserve continuity on the Missouri highway system, urban designations for access management purposes should be *at least* one-half mile in length or more. Frequent transitions in designations along routes between urban and rural should be avoided wherever possible.

Urban-Rural Designation Process

The planning and traffic staff in each district should determine the urban and rural boundary points along each route for access management purposes. This should be done in consultation with appropriate MPO, regional planning, and local government representatives. Adjacent districts must coordinate urban and rural designations near their boundaries.

As noted above, each break between urban and rural must occur at a readily identifiable physical feature such as a bridge, creek, river, or public road intersection.

Urban and rural designations for access management purposes may be expected to change over time, depending on development trends and changes in the highway network. Urban and rural break points should be reviewed by district planning personnel at least every two years.

4.0 LIST OF GUIDELINES

The following table provides a listing and rationale for the guidelines included in this document.

Access Management Guideline	What It Means	Why It Is Important
Classification System		
Access management roadway classification system.	Access management guidelines should vary by the functional roadway type; the system classification should be mapped.	Allows access management guidelines to properly fit the functional role of the highway, street, or road—the higher function, the less direct access is allowed.
Interchanges/ Intersections		
Distance between interchanges on interstates and other freeways.	The minimum distance allowed between two interchanges.	Avoids intense weaving situations that create congestion and increase crash rates.
Clearance of functional areas of interchanges.	The minimum distance between an at-grade intersection or driveway and an interchange.	Preserves safety and traffic flow at and near interchanges.
Freeway/expressway transition.	The minimum transition distance between freeway interchange and at-grade intersection on a principal arterial that changes from a freeway to an expressway.	Helps drivers make a safe transition when a roadway changes in terms of its access management features.
Distance between major at-grade intersections.	The minimum distance or spacing between types of roadways (e.g., between two major arterials).	Preserves traffic flow and ensures that a functional hierarchy of roads is maintained.
Distance between traffic signals.	The minimum and desirable spacing between signals.	Ensures efficient traffic flow on signalized arterials. Too many signals placed too close together will disrupt traffic flow.

Access Management Guideline	What It Means	Why It Is Important
Driveways		
Driveway spacing and density.	The amount of distance between driveways and the number of driveways per unit of frontage. These guidelines should vary with the roadway classification, the expected land use, and the speed limit for the road.	Short spacing between driveways and high driveway densities generate conflict points that in turn lead to higher crash rates and more traffic congestion.
Corner clearance and clearance of the functional areas of intersections.	The minimum distance allowed between an intersection and the first driveway.	Insufficient corner clearance is a major cause of access-related crashes.
Sight distance standards.	The sight distance conditions under which a driveway should not be allowed.	A driveway opening where there is insufficient sight distance is inherently dangerous.
Driveway geometric guidelines.	The width, turning radius, throat length, approach angle, grade, and surfacing requirements for driveways. These can vary by the expected land use served by the driveway and the roadway classification.	Insufficient driveway geometrics lead to slow driveway entrance and exit speeds. This leads to conflicts between turning and through traffic. Driveway geometric design can help or hinder pedestrians and bicyclists.

Access Management Guideline	What It Means	Why It Is Important
Other Access Features		
Median opening.	Where openings in medians will and will not be allowed.	Too many median openings or closely spaced median openings detract from the proper functioning of a median.
Guideline on using two-way left-turn lane (TWLTL).	When TWLTLs should be used and when raised medians should be used instead.	TWLTLs are far less controversial than raised medians; however TWLTLs do not function well once a certain traffic volume range has been reached.
Auxiliary lanes (dedicated left- and right-turning lane guidelines.)	The traffic conditions under which turning lanes should be provided to serve a commercial or industrial driveway.	Some high volume driveways should have dedicated left- or right- turn lanes to reduce conflicts with through traffic. This is particularly true on high-speed routes.
Frontage and backage road spacing.	How far away frontage and backage roads should be placed from the mainline.	Frontage and backage roads that are placed too close to mainlines may create more conflicts than they solve.
Guideline for using three-lane TWLTL cross-section.	A three-lane road may perform better than a four-lane undivided roadway under the right circumstances.	Three-lane roads are a relatively new concept that may be an economical solution to some access problems.

5.0 ANALYSIS OF RETROFIT APPLICATIONS

Where access is being managed on an existing roadway (a “retrofit project”), it may not be possible to incorporate and attain all of the access management criteria due to economic, physical or other constraints. In such cases where the access management criteria cannot be met, a detailed analysis should be performed to determine the optimum solution. This solution should strive to improve safety and operations along the roadway, and maintain uninterrupted flow on the transportation system.

While HCM procedures can provide quick and reliable results for predicting whether or not a facility will be operating at or below capacity, they are generally limited in their ability to evaluate systems effects, queues and the effects of queues, and over saturated conditions. Additionally, there are several gaps in the HCM procedures, such as roadways with the following:

- closely spaced traffic signals
- two-way left turn lanes
- roundabouts
- tight diamond interchanges
- freeway weaves
- other unique scenarios

In cases where HCM procedures will not adequately analyze the roadway improvements, a microsimulation analysis may be appropriate. The VISSIM software package has been identified as the most capable of analyzing the limitations and gaps of the HCM. In regards to roundabouts, the HCM may be used as a primary check of a roundabout’s capacity, but additional operational analyses should use either the SIDRA or VISSIM software package.

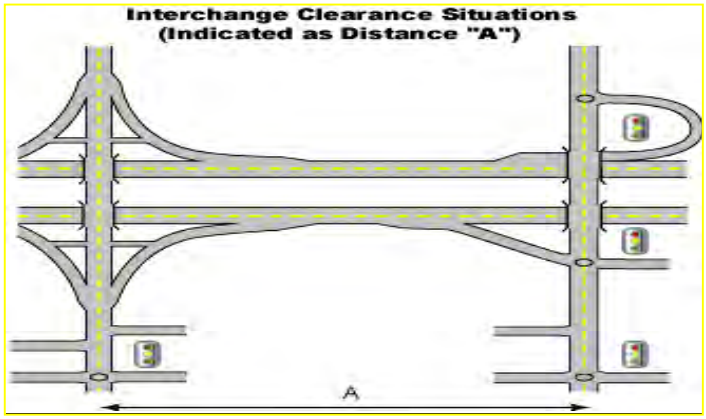
6.0 MINIMUM SPACING BETWEEN INTERCHANGES

What This Guideline Means

This guideline governs the minimum spacing between grade-separated interchanges on high-speed roads that are intended to mainly serve long distance travel. Spacing of interchanges is needed to preserve smooth traffic flow and to allow for safe and efficient weaving or changing of lanes for traffic that is entering and exiting. Generally, speeds are higher in rural areas; therefore, interchanges must be spaced farther apart there than in urban areas.

All interchange spacing decisions will be subject to operational and level of traffic service analysis for traffic. Connectivity, speed, and safety will also be considered. In highly dense urban central city areas, the configuration of the local street system may require a closer interchange spacing to maintain connections and mobility. Shorter spacing may be considered when the analysis indicates this is prudent and necessary. Measurements are made between the centers of interchanges as shown below.

Diagram



Minimum Guideline

Roadway Classification	In Current and Projected Urban Areas	In Rural Areas
Interstate/Freeway	2 miles	5 miles
Principal Arterial	2 miles	5 miles
Minor Arterial	Generally not applicable	Generally not applicable
Collector	Generally not applicable	Generally not applicable

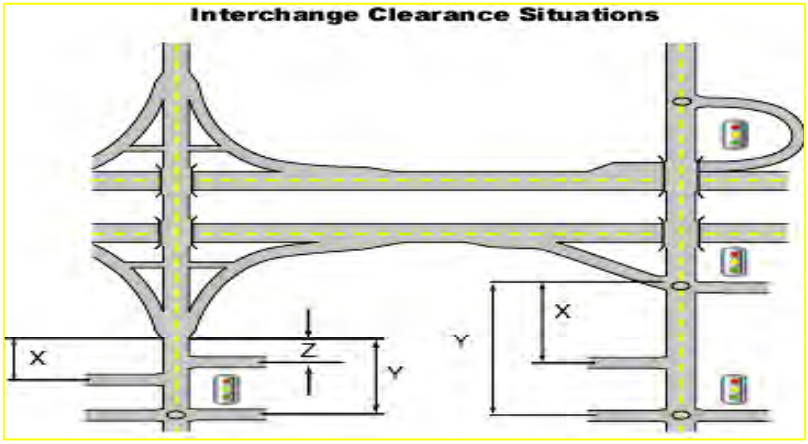
7.0 CLEARANCE OF FUNCTIONAL AREAS OF INTERCHANGES

What This Guideline Means

This guideline applies to areas where grade-separated facilities (e.g. interstates and other freeways) interchange with surface streets, highways, and roads. In such cases, adequate areas need to be provided for traffic to make the transition from a road with a very high level of access control to a different road with at-grade access points. The functional area of the interchange is the area in which merging and diverging of traffic takes place. Drivers must travel along an exit ramp, find acceptable gaps, change lanes (weave), and merge within this distance.

In order to provide a safe distance for this activity to occur, a spacing of about 1,320 feet needs to be provided from the end of the off ramp to the first private driveway on the left-hand side, median opening, or intersection with a public road in urban areas. (This is measured from the point of intersection of the ramp baseline and roadway centerline.) These guidelines also apply to on-ramps. When only right turns into or out of driveways or public roads are involved, a shorter clearance area (750 feet) may be used.

Diagram



X = Minimum distance from baseline off-ramp to first right-in, right-out driveway/public road intersection.

Y = Minimum distance from baseline off-ramp to first major public road intersection, full median opening, or left-turn opportunity.

Z = Minimum distance from last right-in, right-out opportunity to baseline on-ramp.

Minimum Guidelines for Interchange Area Clearance

Type of Area	Minimum Distance from Off-Ramp to First Right-In, Right-Out Driveway (X)	Minimum Distance to First Major Public Road Intersection, Full Median Opening, Or Left-Turn Opportunity (Y)*	Minimum Distance from Last Right-In, Right-Out Driveway to On-Ramp (Z)
Urban	750 feet	1,320 feet	750 feet
Rural	750 feet	1,320 feet	750 feet

*No left turns should be allowed in this section of roadway. The public road intersection is likely to become a signalized intersection as the interchange area develops. Right –in, right –out driveways configuration must include a non-traversable median.

Note: All ramp measurements are taken to or from baseline ramp.

Any proposal for a clearance of less than the minimum guidelines contained in the above table will require a study of alternatives to ensure safety and traffic flow. All reasonable alternatives, including relocating the interchange to a different location should be considered. Other alternatives to be examined may include installation of raised medians or alternative access ways such as frontage and backage roads.

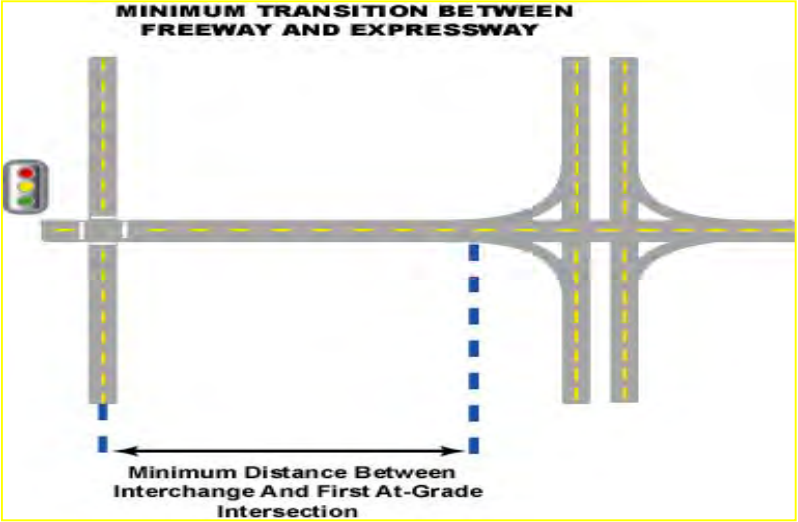
8.0 FREEWAY AND EXPRESSWAY TRANSITION

What This Guideline Means

Some principal arterials will consist of a mixture of freeway (with grade-separated interchanges and no driveway accesses) and expressways (with at-grade public road intersections and driveways). The transition between freeway and expressway must be made carefully so drivers are well aware that a change in the access character of the roadway has occurred. This guideline will not apply to minor arterials or collectors.

The following guideline represents the minimum distance that should exist between the taper of the final ramp on a freeway cross section to the first at-grade intersection (and potentially the first traffic signal) on an expressway cross section on the same facility.

Diagram



Minimum Guideline

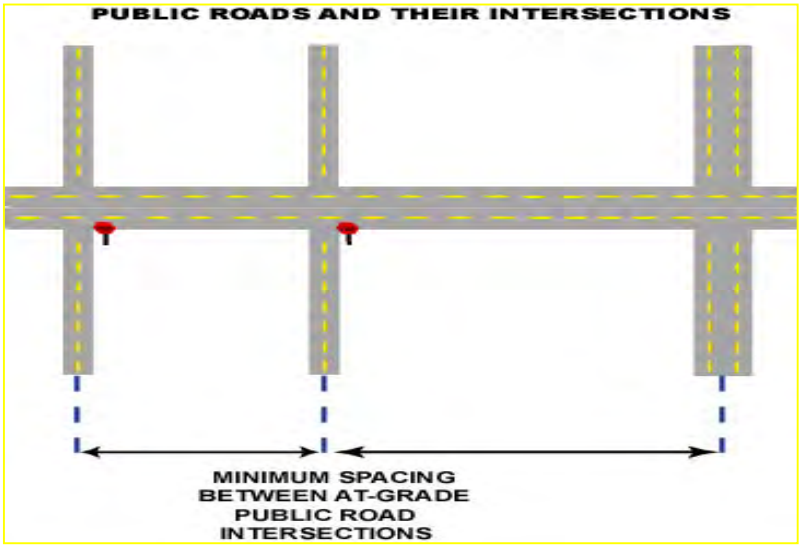
Roadway Classification	In Current and Projected Urban Areas	In Rural Areas
Interstate/Freeway	No at-grade intersections are allowed (no expressway cross sections)	No at-grade intersections are allowed (no expressway cross sections)
Principal Arterial	½ mile (2,640 feet)	1 mile (5,280 feet)

9.0 AT-GRADE INTERSECTIONS SPACING

What This Guideline Means

This guideline governs the minimum distance or spacing between types of public roadways and their intersections. This guideline provides for a hierarchy of roads and maintains adequate spacing between roads that are intended to mainly serve through traffic. Interstates, freeways, and the three types of arterials are mainly intended to serve through traffic and therefore are spaced the farthest apart. Collectors provide some service to through traffic but also provide direct access to property; therefore, they can be placed closer together.

Diagram



Minimum Guideline

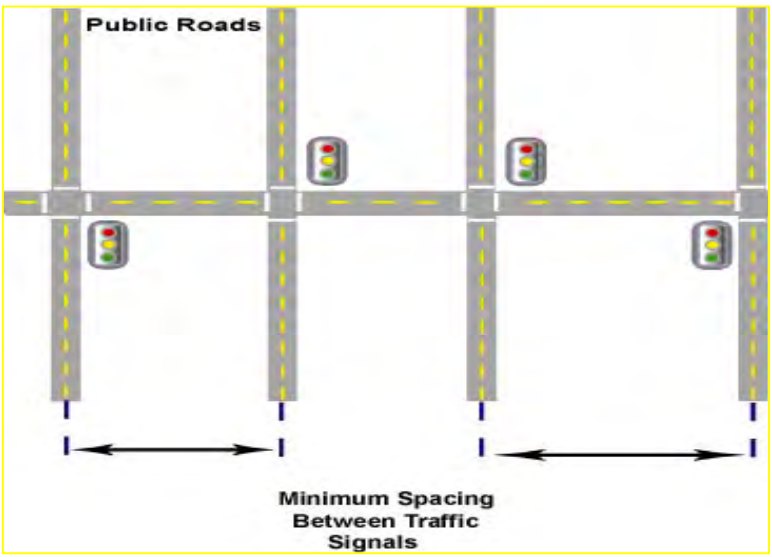
Roadway Classification	In Current and Projected Urban Areas	In Rural Areas
Interstate/Freeway	No at grade intersections are allowed	No at grade intersections are allowed
Principal Arterial	½ mile (2,640 feet)	1 mile (5,280 feet)
Minor Arterial	¼ mile (1,320 feet)	½ mile (2,640 feet)
Collector	660 feet(desirable)	1,320 feet(desirable)

10.0 TRAFFIC SIGNALS SPACING

What This Guideline Means

This guideline governs the distance between signalized at-grade intersections on public roadways. Minimum spacing is mainly intended to preserve efficient traffic flow and progression on urban arterial roadways; for instance, a quarter- or half-mile spacing allows traffic signals to be effectively interconnected and synchronized. Adequate spacing will also tend to reduce rear-end collisions and "stop and go" driving that increases congestion, delay, and air pollution. In urban areas, these guidelines were developed to allow for smooth operations given a 90-second total traffic signal cycle length.

Diagram



Minimum Guideline

Roadway Classification	In Current and Projected Urban Areas	In Rural Areas
Interstate/Freeway	Traffic signals not allowed	Traffic signals not allowed
Principal Arterial	½ mile (2,640 feet)	*
Minor Arterial	½ mile (2,640 feet)	*
Collector	¼ mile (1,320 feet) (desirable)	*

* Rural traffic signals are generally isolated signals rather than signals placed in a progression along a route. Signals should be placed at least one mile (5,280 feet) apart because of high operating speeds in rural areas.

11.0 MEDIAN OPENING SPACING

What This Guideline Means

Openings in raised medians should only be provided to accommodate turning traffic in locations where this can be safely done. When openings are provided, an adequate spacing between them is required to allow for weaving of traffic so as to preserve traffic flow and provide for safe lane changes and turns.

A full opening allows turns to be made in both directions; a directional opening allows turns to be made in only one direction. An example of a directional median would be one that allows left turns into a driveway but does not allow left turns to be made out.

Median openings *shall not* be allowed under the following circumstances:

- On interstates or other freeways
- Within the functional area of an interchange
- Within the functional area of an intersection between two public roads
- At locations that have high accident rates
- Where an opening would be unsafe because of inadequate sight distance

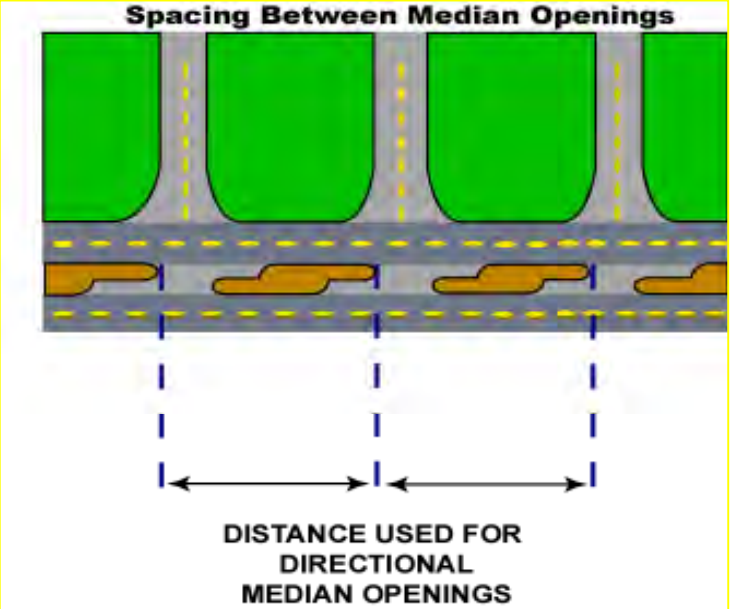
Under conditions of inadequate sight distance, median openings *shall not* be allowed.

Queue storage for median openings should be a minimum of 40 feet (two guideline car lengths) in rural areas and 60 feet (three guideline car lengths) in urban areas. Traffic studies should support the required length of queue storage for major traffic generators such as a shopping mall or industrial plant.

Accommodating Safe U-Turns

In cases where left turns are restricted by lack of median openings, care must be taken to allow for U-turns to be made in a safe manner. U-turns can be safely accommodated through a variety of means, including signal phasing and timing, widening, and including physical design features such as turning lanes and “jug handles.” Where U-turns cannot be made safely, they should be explicitly prohibited. U-turn opportunities should be designed with a typical design vehicle type in mind, generally a guideline passenger car.

Diagram



Minimum Guideline

Roadway Classification	In Current and Projected Urban Areas	In Rural Areas
Interstate/Freeway	No median openings allowed	No median openings allowed
Principal Arterial	1,320 to 2,640 feet 1,320 to 660 feet (directional)	2,640 feet (full) when posted speed is over 45 mph 1,320 feet (full) when posted speed is under 45 mph
Minor Arterial	1,320 feet (full) 660 feet (directional)	1,320 feet (full) at all speeds
Collector	Medians generally not used	Medians generally not used

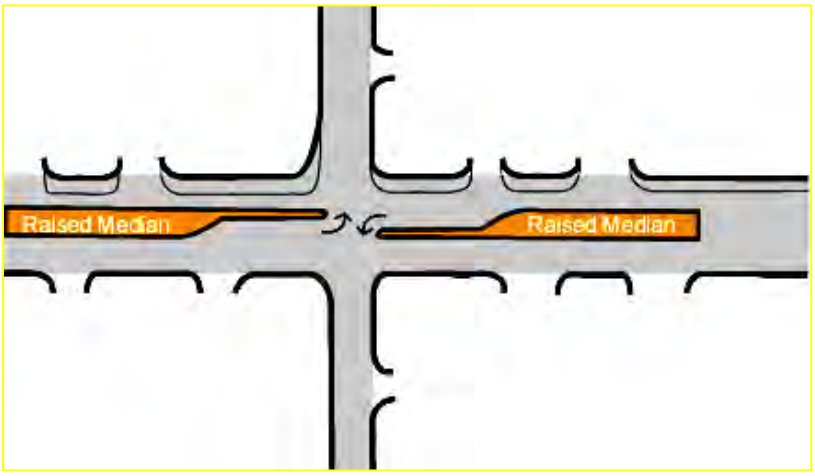
12.0 RAISED MEDIANS

What This Guideline Means

Raised medians are the most effective access management strategy on high-volume urban routes. They are 25 or more percent safer than multi-lane undivided sections and 15 percent safer than two-way left-turn lane cross sections in such high traffic situations.

In general, use of raised medians is recommended where current and projected traffic volume is greater than 28,000 average annual daily traffic (AADT). Raised medians are especially recommended in corridors where the traffic volume is high, the density of commercial driveways is high (over 24 per mile in both directions), and other access management strategies such as driveway consolidation and corner clearance are not practical. Raised medians should be used on arterial facilities with three or more through traffic lanes in each direction.

Diagram



Guideline

Roadway Classification	In Current and Projected Urban Areas	In Rural Areas
Interstate/Freeway	Not applicable	Not applicable
Principal Arterial	Use a raised median when current and projected traffic exceeds 28,000 AADT	Use flush median instead
Minor Arterial	Use a raised median when current and projected traffic exceeds 28,000 AADT	Use flush median instead
Collector	Generally not applicable due to low traffic volumes	Generally not applicable due to low traffic volumes

13.0 AUXILIARY ACCELERATION AND TURNING LANES

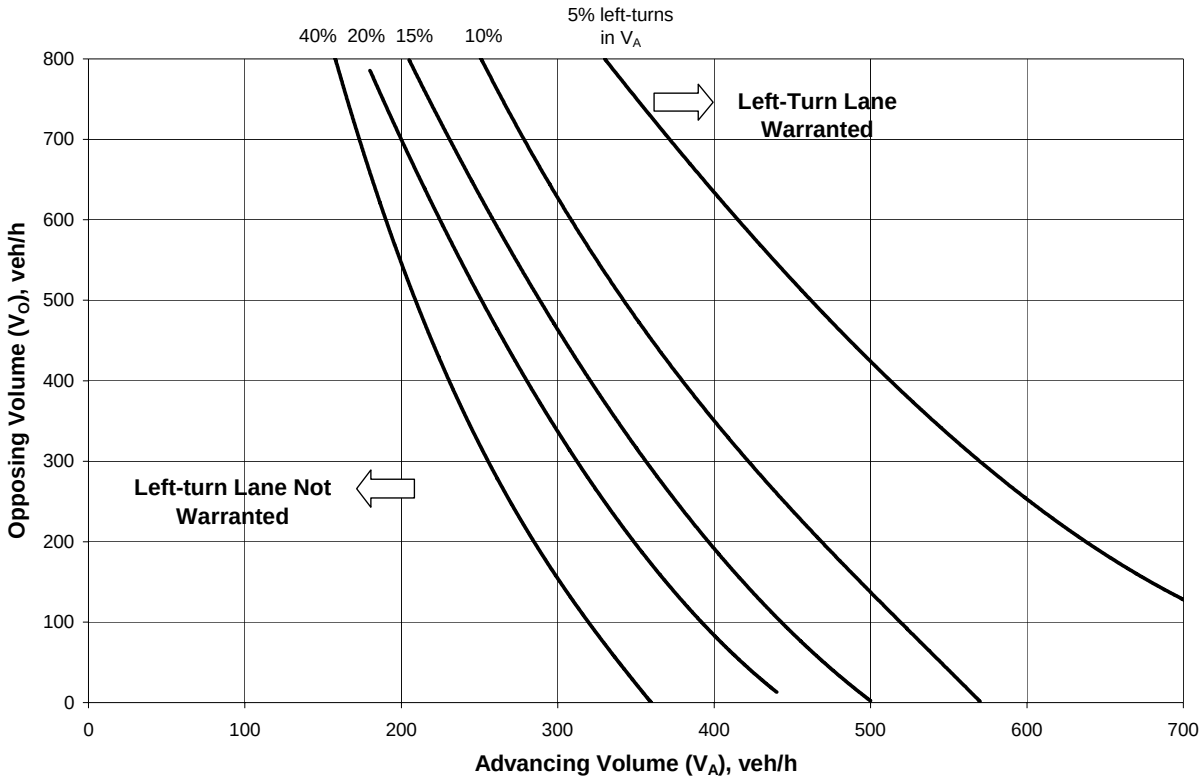
What This Guideline Means

Dedicated left- and right-turn lanes should be provided in situations where traffic volumes and speeds are relatively high and conflicts are likely to develop at public road intersections and private driveways between through and turning traffic. Auxiliary lanes are an asset in promoting safety and improved traffic flow in such situations. The use and design of any auxiliary lanes should always be guided by a traffic study. Some major applications for and considerations for the design of auxiliary lanes are as follows:

- Installing a right-turn acceleration lane. These lanes allow entering vehicles (those that have turned right from a driveway or minor public road onto the major route) to accelerate before entering the through-traffic flow. Such acceleration lanes may be appropriate when the average daily traffic on the major route with a posted speed of 35 miles per hour or more exceeds 10,000 and there are at least 75 right-turn egress movements from a driveway or minor public road. Such lanes may also be warranted where crash experience indicates a problem with right-turning, entering vehicles. The right-turn acceleration lane should be of a sufficient length to allow safe and efficient merge maneuvers. The design length, tapers, and other features of right-turn acceleration lanes should always be guided by a traffic study.

- Installing auxiliary left-turn lanes. Such lanes, installed in the roadway center, are intended to remove turning vehicles from the through traffic flow. This should reduce the frequency of rear-end collisions at locations where there is considerable left-turn ingress activity, such as major driveways and minor public road intersections. Left-turn lane warrants are shown in the figures below. To use the figures, peak hour traffic counts, including directional splits, will be required, which may be obtained from Traffic Staff. In addition, the ITE Trip Generation Manual may be used as an estimate for peak hour traffic counts. For design year analyses, appropriate growth rates will be required, which may be obtained from Planning Staff.

- The use and design of auxiliary left-turn lanes should always be guided by a traffic study. In general, auxiliary left-turn lanes must be long enough to accommodate a safe deceleration distance and to provide adequate storage of a queue for expected peak hour turning traffic. MoDOT's Project Development Manual (PDM) should be consulted for appropriate storage and deceleration lengths.

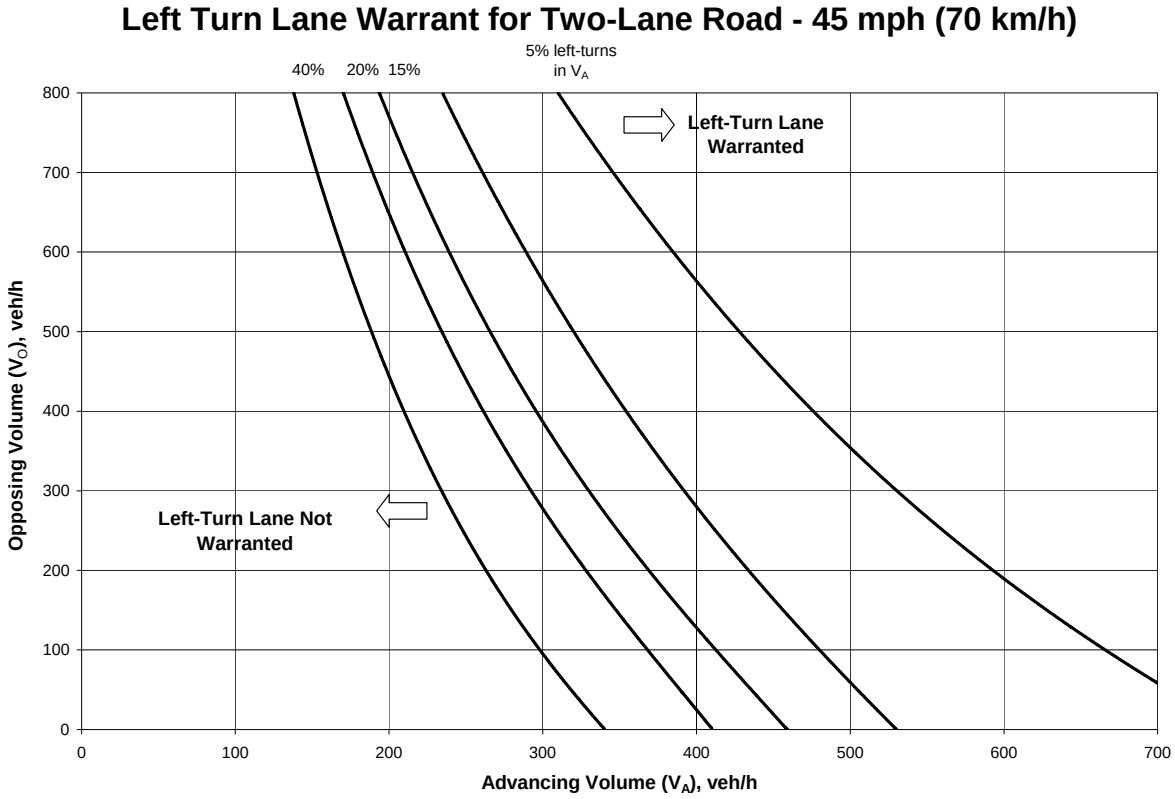


The following data are required:

1. Opposing Volume (veh/hr) - V_O - The opposing volume should include only the right-turn and through movements in the opposite direction of the left turning vehicle.
2. Advancing Volume (veh/hr) - V_A - The advancing volume should include the right-turn, left-turn and through movements in the same direction as the left turning vehicle.
3. Operating Speed (mph) - The greater of design or posted speed.
4. Percentage of left turns in V_A

Left turn lane is not warranted for left turn volume less than 10 vph. However, criteria other than volume, such as crash experience, may be used to justify a left turn lane.

The appropriate trend line is identified on the basis of the percentage of left-turns in the advancing volume, rounded up to the nearest percentage trend line. If the advancing and opposing volume combination intersects above or to the right of this trend line, a left-turn lane is warranted.



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3. Operating Speed (mph) - The greater of design or posted speed.
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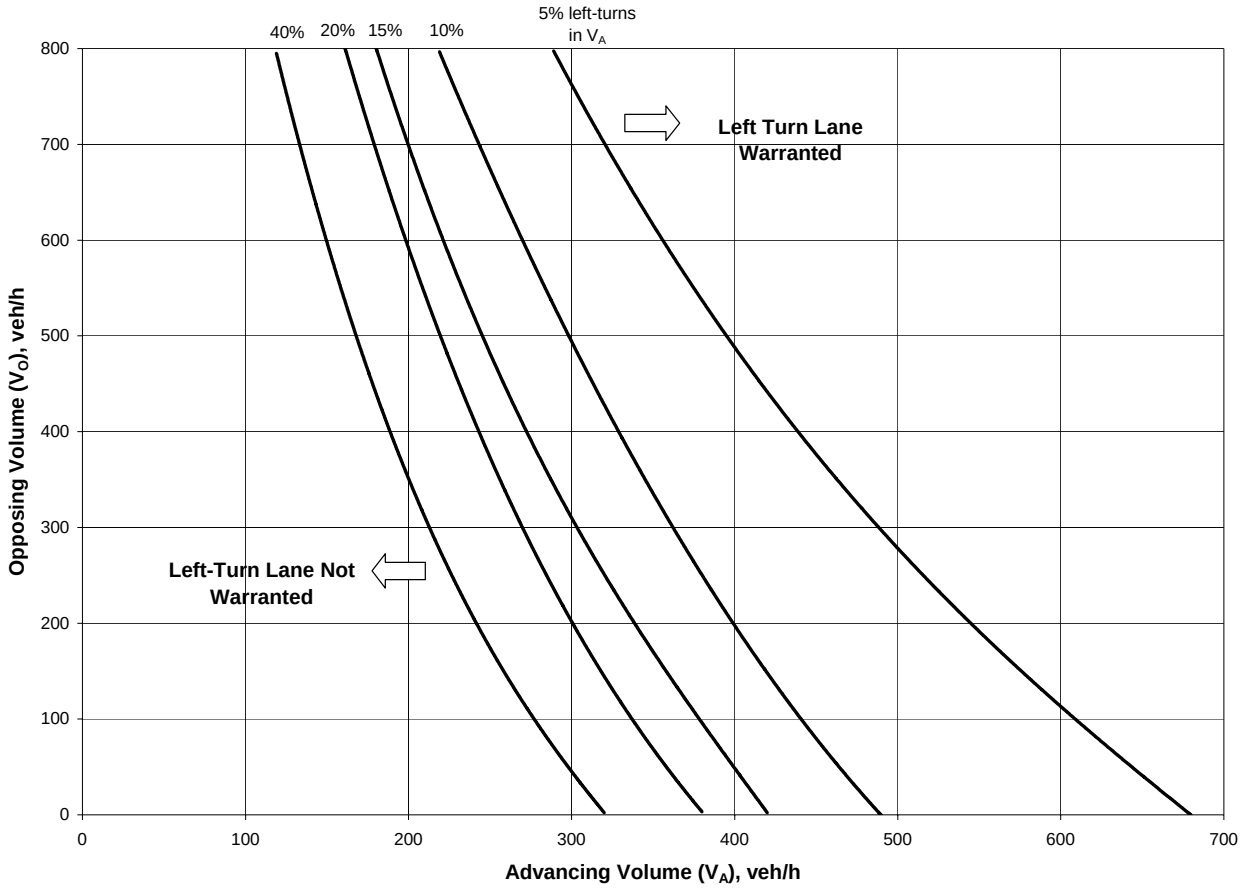

The following data are required:

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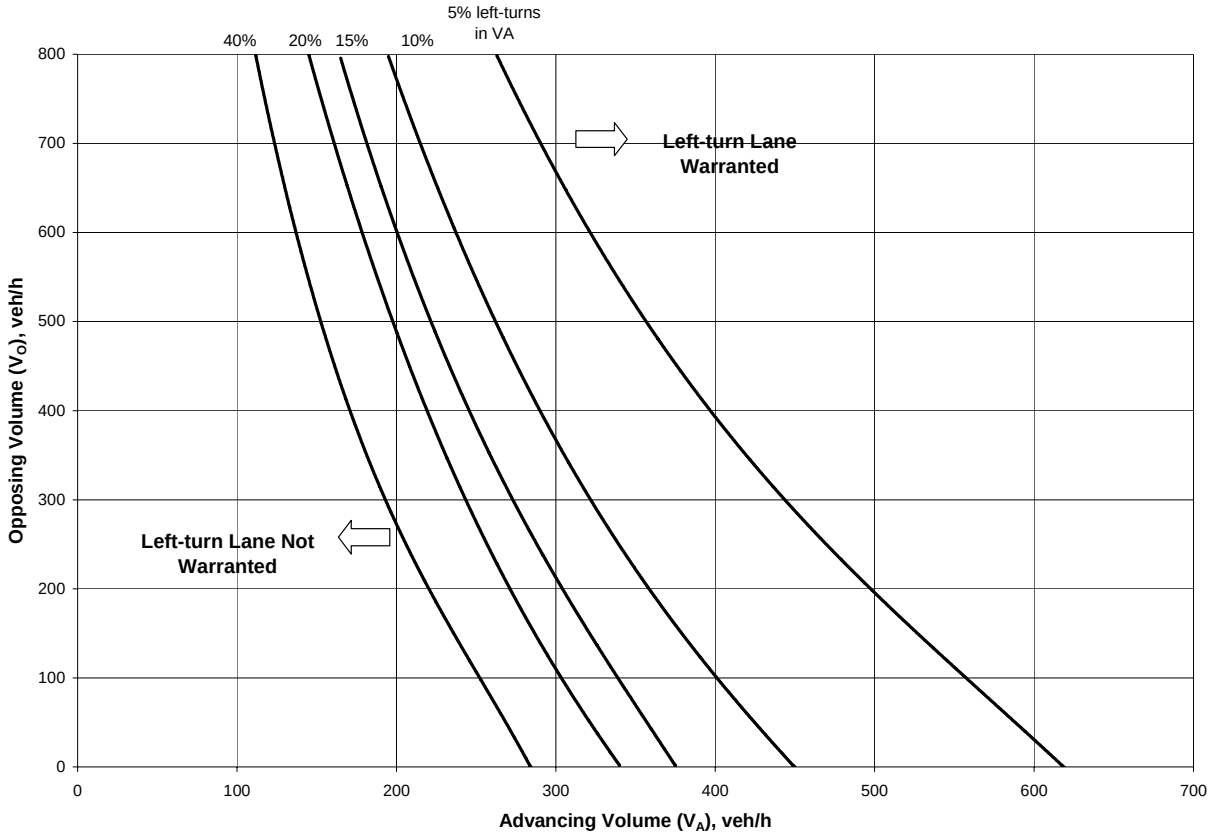
2. Advancing Volume (veh/hr) - V_A - The advancing volume should include the right-turn, left-turn and through movements in the same direction as the left turning vehicle.
3. Operating Speed (mph) - The greater of design or posted speed.
4. Percentage of left turns in V_A

Left turn lane is not warranted for left turn volume less than 10 vph. However, criteria other than volume, such as crash experience, may be used to justify a left turn lane.

The appropriate trend line is identified on the basis of the percentage of left-turns in the advancing volume, rounded up to the nearest percentage trend line. If the advancing and opposing volume combination intersects above or to the right of this trend line, a left-turn lane is warranted.

Left Turn Lane Warrant for Two-Lane Road - 55 mph (90 km/h)

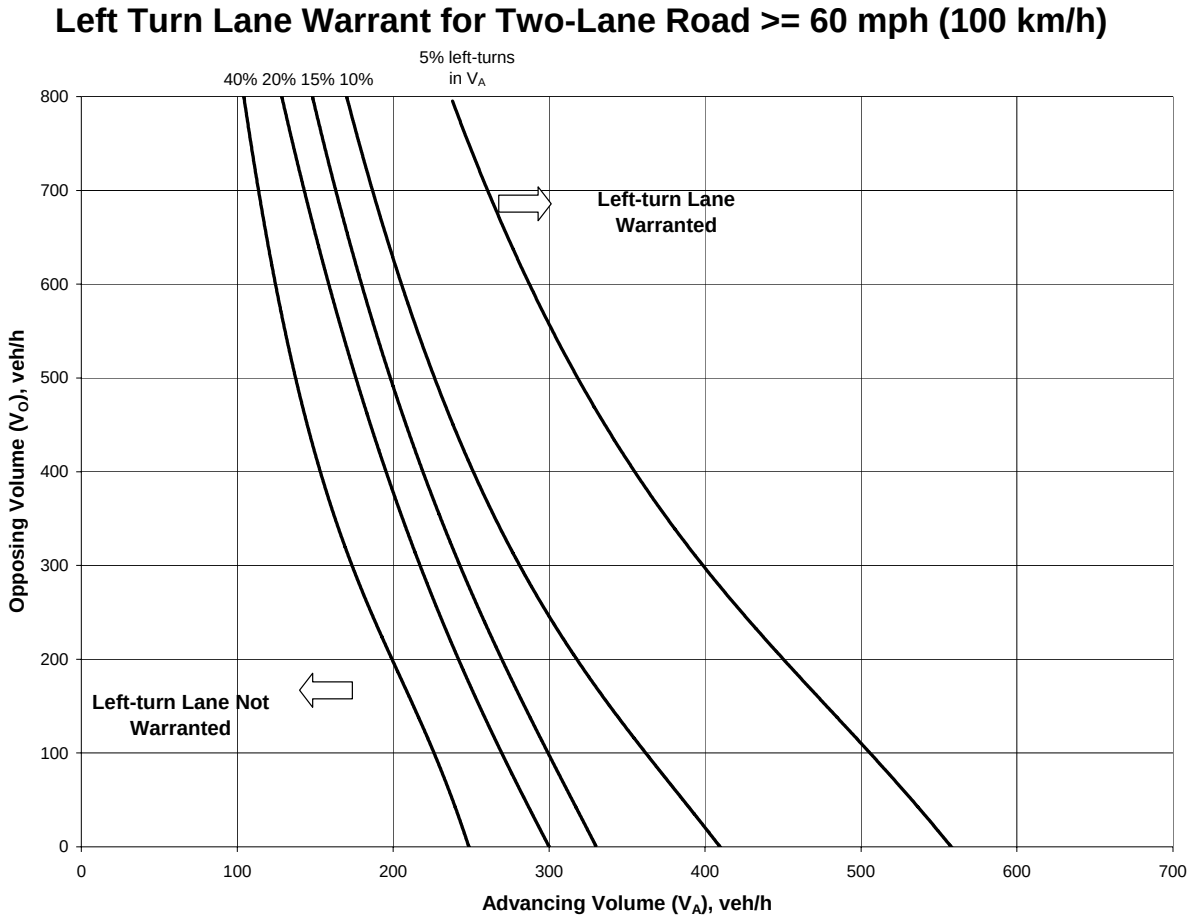


The following data are required:

1. Opposing Volume (veh/hr) - V_O - The opposing volume should include only the right-turn and through movements in the opposite direction of the left turning vehicle.
2. Advancing Volume (veh/hr) - V_A - The advancing volume should include the right-turn, left-turn and through movements in the same direction as the left turning vehicle.
3. Operating Speed (mph) - The greater of design or posted speed.
4. Percentage of left turns in V_A

Left turn lane is not warranted for left turn volume less than 10 vph. However, criteria other than volume, such as crash experience, may be used to justify a left turn lane.

The appropriate trend line is identified on the basis of the percentage of left-turns in the advancing volume, rounded up to the nearest percentage trend line. If the advancing and opposing volume combination intersects above or to the right of this trend line, a left-turn lane is warranted.



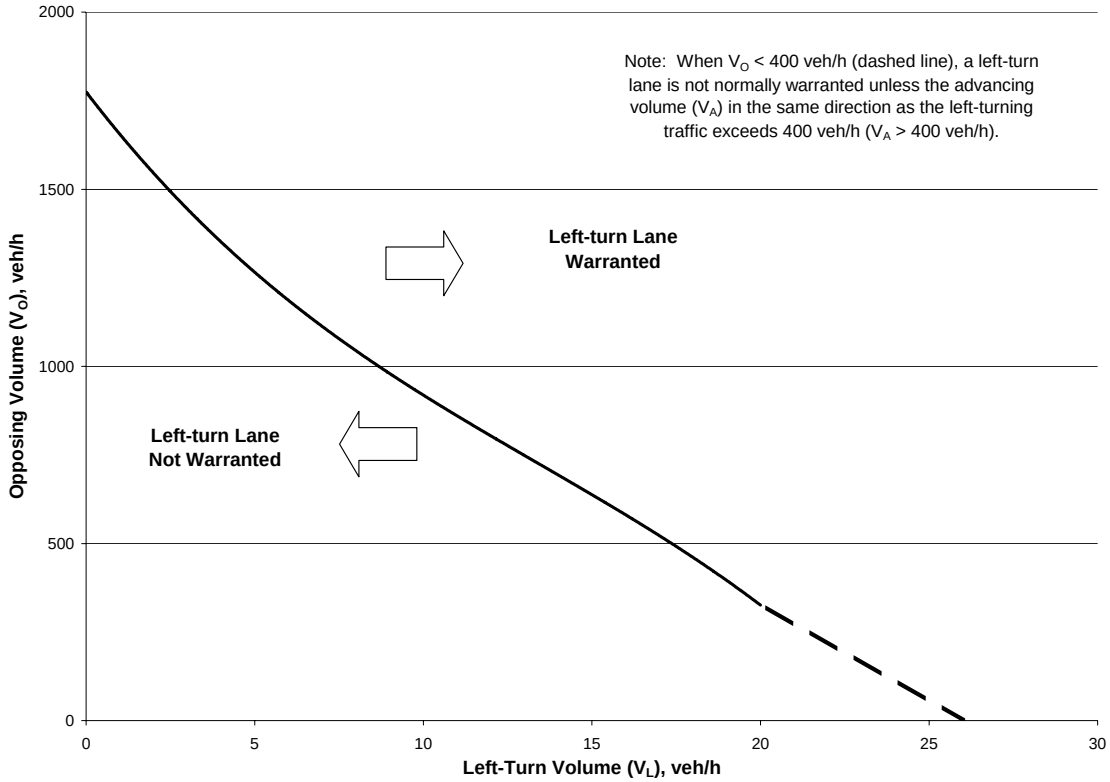
The following data are required:

1. Opposing Volume (veh/hr) - V_O - The opposing volume should include only the right-turn and through movements in the opposite direction of the left turning vehicle.
2. Advancing Volume (veh/hr) - V_A - The advancing volume should include the right-turn, left-turn and through movements in the same direction as the left turning vehicle.
3. Operating Speed (mph) - The greater of design or posted speed.
4. Percentage of left turns in V_A

Left turn lane is not warranted for left turn volume less than 10 vph. However, criteria other than volume, such as crash experience, may be used to justify a left turn lane.

The appropriate trend line is identified on the basis of the percentage of left-turns in the advancing volume, rounded up to the nearest percentage trend line. If the advancing and opposing volume combination intersects above or to the right of this trend line, a left-turn lane is warranted.

Left Turn Lane Warrant for Four-Lane Undivided Roadway



The following data are required:

1. Opposing Volume (veh/hr) - V_O - The opposing volume should include only the right-turn and through movements in the opposite direction of the left turning vehicle.
2. Left-Turn Volume – V_L

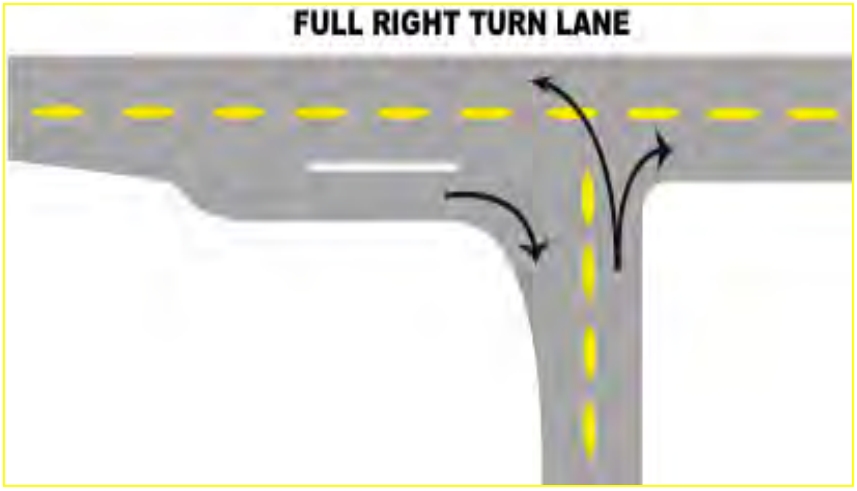
If the opposing and left-turn volume combination intersects above or to the right of the trend line, a left-turn lane is warranted.

- Installing auxiliary right-turn lanes. The use of dedicated right-turn lanes should also always be guided by a traffic study. In general, dedicated right-turn lanes should be provided in both rural and urban areas on two lane routes as shown in the figures below. Right-turn lane warrants are shown in the figures below. To use the figures, peak hour traffic counts, including directional splits, will be required, which may be obtained from Traffic Staff. In addition, the ITE Trip Generation Manual may be used as an estimate for peak hour traffic counts. For design year analyses, appropriate growth rates will be required, which may be obtained from Planning Staff.

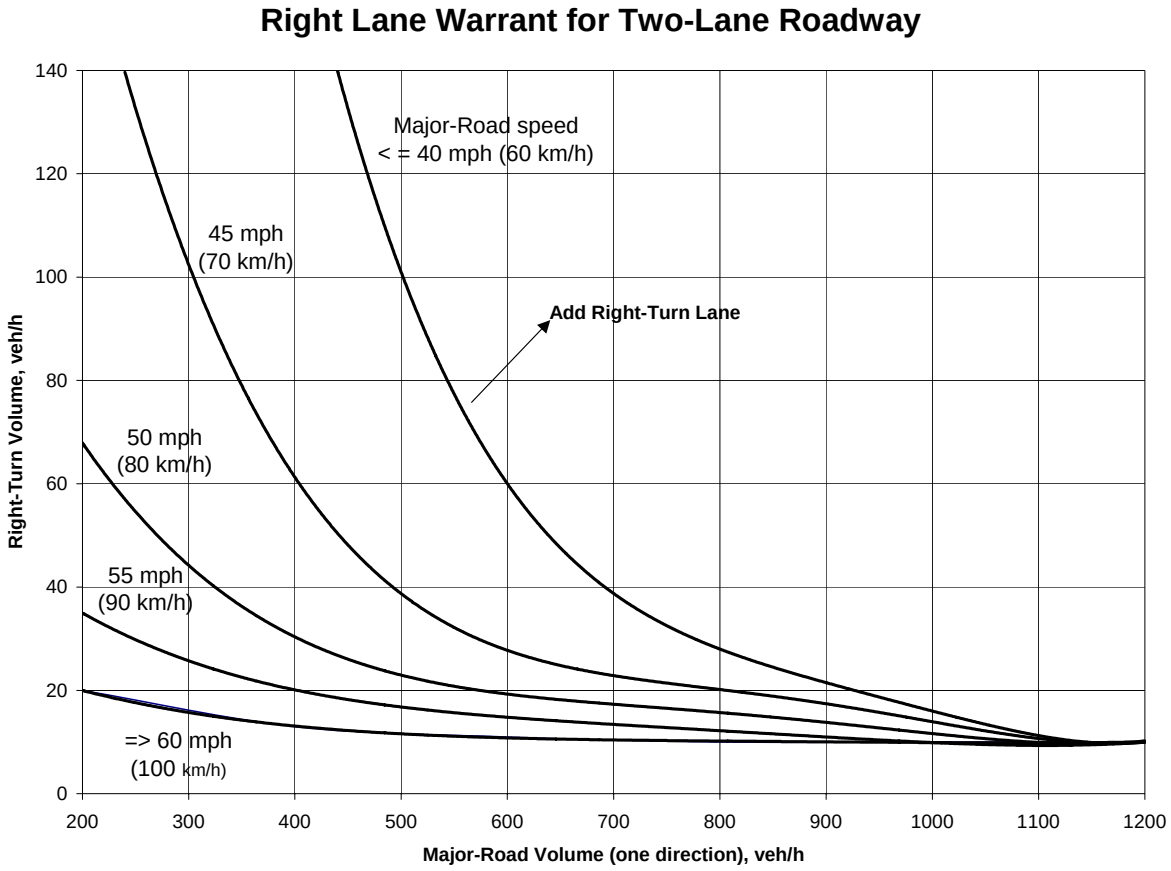
Dedicated right turn lanes should also be strongly considered in situations where:

- Poor internal site design and circulation leads to backups on the mainline. Auto-oriented businesses with short drive-through lanes or poorly-designed parking lots would be prime examples of this situation.
- The peak hour turning traffic activity is unusually high (e.g. greater than 10 percent of the daily total.)
- Operating speeds on the mainline route are very high (greater than 60 miles per hour) and right turns would generally not be expected by drivers.
- The driveway or minor public road intersection is difficult for drivers to see.
- The driveway entrance is gated or otherwise must be entered very slowly.
- Right turning traffic consists of an unusually high number of trailers or other large vehicles.
- The intersection or driveway angle is highly skewed.
- Rear end collision experience is unusually high at a location.

Diagram



As with any auxiliary turning lane, dedicated right-turn lanes should be designed based on the results of a traffic study.

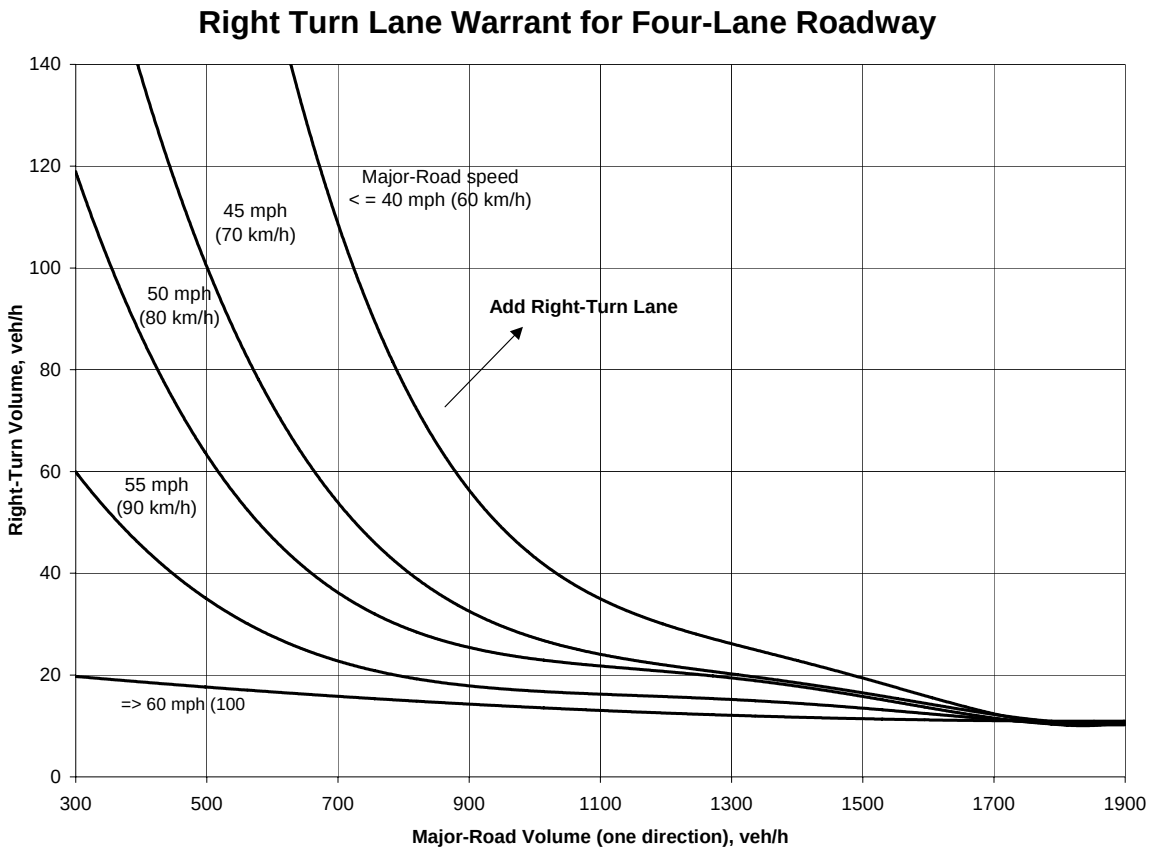


The following data are required:

1. Advancing Volume (veh/hr) - The advancing volume should include the right-turn, left-turn and through movements in the same direction as the right turning vehicle.
2. Right Turning Volume (veh/hr) - The right turning volume is the number of advancing vehicles turning right.
3. Operating Speed (mph) - The greater of design or posted speed.

Note: Right turn lane is not warranted for right turn volume less than 10 vph

If the combination of major-road approach volume and right-turn volume intersects above or to the right of the speed trend line corresponding the major road operating speed, then a right-turn lane is warranted.



The following data are required:

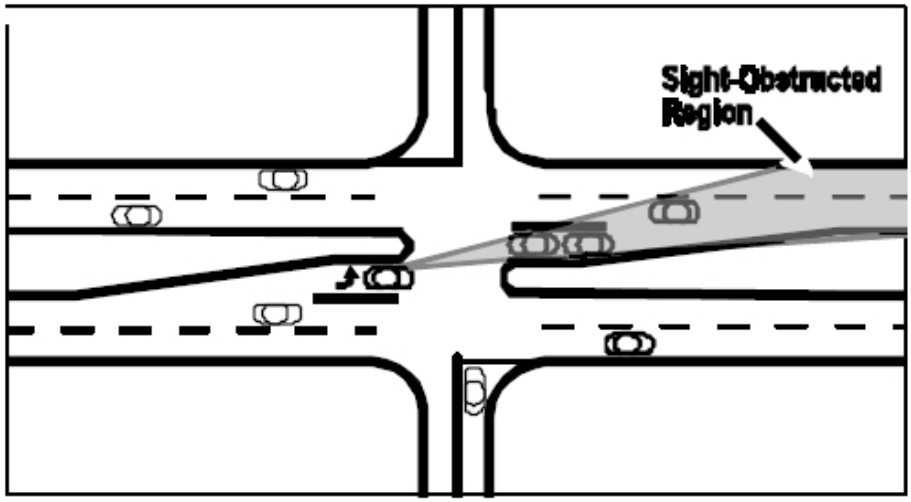
1. Advancing Volume (veh/hr) - The advancing volume should include the right-turn, left-turn and through movements in the same direction as the right turning vehicle.
2. Right Turning Volume (veh/hr) - The right turning volume is the number of advancing vehicles turning right.
3. Operating Speed (mph) - The greater of design or posted speed.

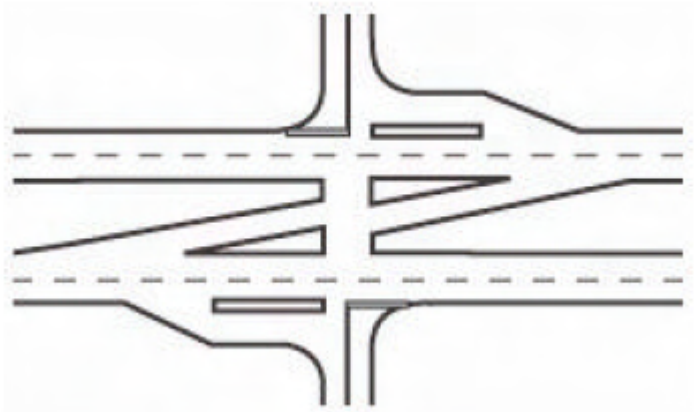
Note: Right turn lane not warranted for right turn volume less than 10 vph

If the combination of major-road approach volume and right-turn volume intersects above or to the right of the speed trend line corresponding the major road operating speed, then a right-turn lane is warranted.

- **Offset Right- and Left- Turn Lanes**

Vehicles in the right-turn lane tend to obstruct the vision of drivers waiting at the stop bar of the minor roadway. One way to reduce the obstruction of the minor roadway drivers' view is to offset the right-hand turning bay to the right. Similarly, vehicles in the opposing left-turn lane block the views of left-turning vehicles from the opposite direction, as shown in the figure below. An example intersection with offset right- and left-turn lanes is shown below. Offsetting left-turn lanes to the left as far as practical improves the visibility of opposing traffic. By improving the visibility of opposing traffic, drivers can more effectively use available gaps. Offsetting right-turn lanes to the right gives drivers on the minor approach (at the stop bar) an unobstructed view of oncoming traffic in the near expressway lanes, which allows for more effective use of gaps.



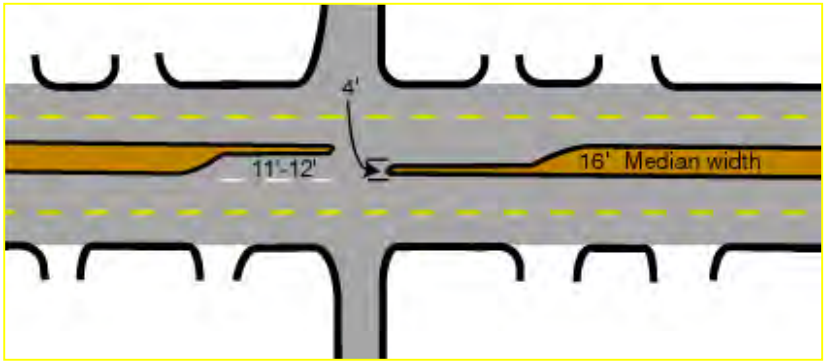


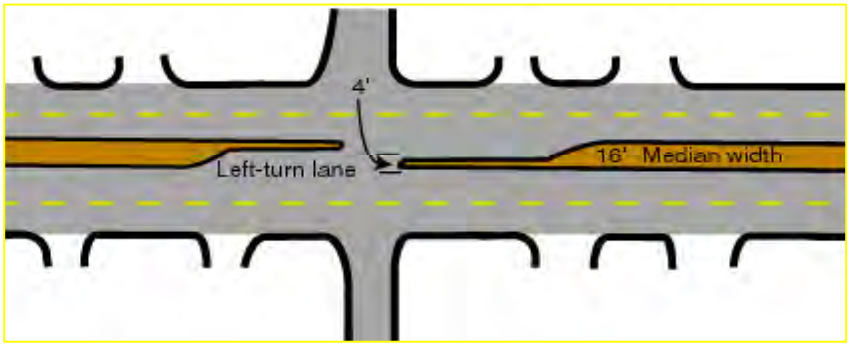
Rural Expressway Intersection Synthesis of Practice and Crash Analysis
Center for Transportation Research and Education – October 2004

Consideration should be given to offset right- and left-turn lanes lane in locations with high mainline operating speeds, large percentage of turning trucks, unique sight distance issues, or crash experience where investigation of crash diagrams indicates a safety benefit may be obtained from an offset turn lane. Care should be taken when implementing offset auxiliary turn lanes to ensue the horizontal geometry of the roadway does not negate the line-of-sight improvement.

Width of Auxiliary Acceleration and Turn Lanes

Any auxiliary turning lanes such as dedicated right-turn, left-turn, and acceleration lanes should always be at least 11 feet wide. Twelve feet is a desirable width, not including the gutter. The following diagram shows several typical left-turn lane designs.





14.0 TWO-WAY LEFT-TURN LANES ("Five-Lane" Facilities)

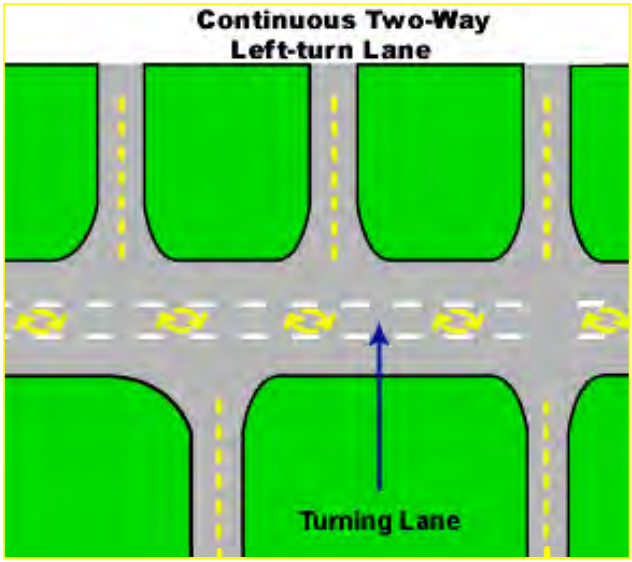
What This Guideline Means

Two-way left-turn lanes may be effective as an access management tool when used in conjunction with other techniques such as driveway consolidation and corner clearance. TWLTL cross sections work best in situations where traffic volume and the density of driveways is relatively low, and the proportion of left-turning vehicles is relatively high. It is recommended that they only be considered in places where commercial driveways make up a substantial portion of total driveways and where the percentage of vehicles turning left at peak hour is at least 20 percent.

Their use should be avoided on retrofit projects where the commercial driveway density is above the driveway spacing guideline. Research indicates that when commercial driveway density is over 24 per mile (12 per mile in each direction), crash rates increase significantly. This roughly equates to an average driveway spacing of 440 feet. TWLTL configurations should generally be avoided unless driveway density can be kept at that level or below, or other viable alternatives do not exist.

TWLTL configurations should not be used along high traffic volume (over 28,000 AADT) urban routes; in such situations raised medians are 25 or more percent safer than multilane undivided sections and 15 percent safer than TWLTL cross sections. TWLTL configurations should never be used on facilities with more than four through-traffic lanes, e.g., to create a "seven lane" facility. Crash experience with such large roadway cross sections is poor.

Diagram



Guideline

Roadway Classification	In Current and Projected Urban Areas	In Rural Areas
Interstate/Freeway	Not applicable	Not applicable
Principal Arterial	May be used when appropriate if AADT in design year is less than 28,000; otherwise use a raised median	Do not use
Minor Arterial	May be used when appropriate if AADT in design year is less than 28,000; otherwise use a raised median	Do not use
Collector	May be used when appropriate if AADT in design year is less than 28,000; otherwise use a raised median	Do not use

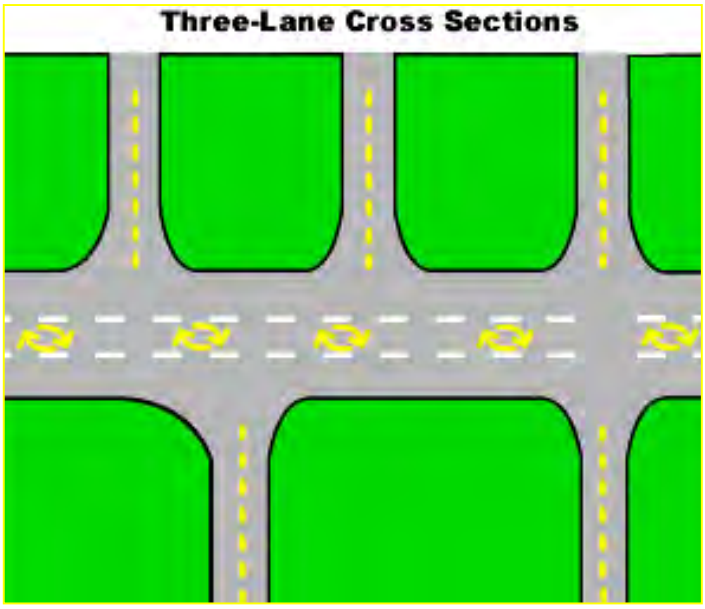
15.0 THREE-LANE CROSS SECTIONS

What This Guideline Means

Three-lane cross sections (two through lanes with a TWLTL in the center) are a possible access management tool in certain situations. Such roadways are about 25 percent safer than an undivided four-lane road and can provide comparable capacity provided that intersections are well designed. They work best in situations where traffic volumes are moderate and where the proportion of vehicles turning left is high. The use of TWLTL's should be discouraged in rural areas, as their use in high speed, low volume situations can lead to increase in head on crashes. They should also be avoided in urban areas where the design year traffic is expected to grow beyond 17,500 AADT. TWLTL's are best used in situations where driveway density is low to moderate (e.g., below 24 commercial driveways per mile, which equates to a spacing of about 440 feet between driveways). They should be strongly considered in multifamily residential areas or mixed land use areas, especially on urban minor arterials and collectors.

This guideline does not refer to third lanes used as passing, turning, or climbing lanes in rural areas.

Diagram



Guidelines

Roadway Classification	In Current and Projected Urban Areas	In Rural Areas
Interstate/Freeway	Not applicable	Not applicable
Principal Arterial	May be used when appropriate and where AADT in design year is less than 17,500	Not applicable
Minor Arterial	May be used when appropriate and where AADT in design year is less than 17,500	Should not be used
Collector	May be used when appropriate and where AADT in design year is less than 17,500	Should not be used

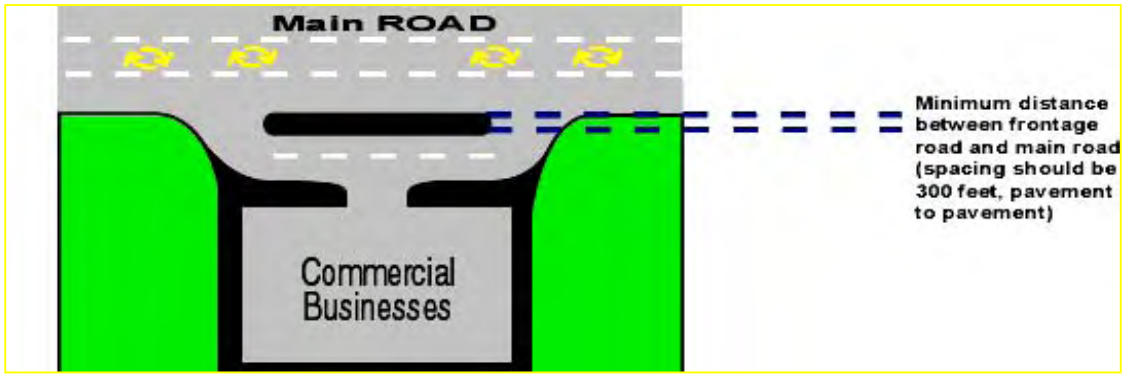
16.0 FRONTAGE AND BACKAGE ROADS

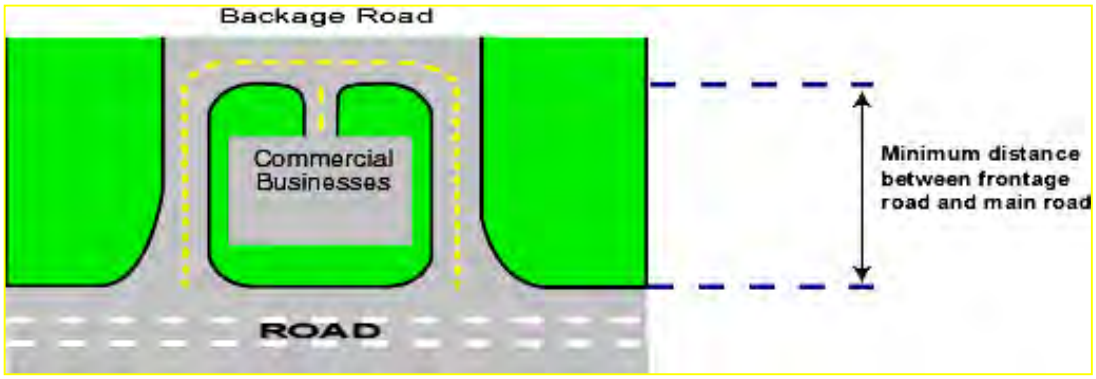
What This Guideline Means

Frontage and backage roads provide alternative access to property and help remove turning traffic from the through traffic on a mainline route. When such roads are used, direct access is not provided to property from the mainline road. A frontage road provides alternative access at the front of properties while a backage road provides alternative access at the rear of properties. These types of roads are most often used to provide alternative access to commercial businesses and developments.

Frontage and backage roads can dramatically improve safety and operations. However, a common mistake involves placing frontage or backage roads in very close proximity to the mainline. Placing frontage roads very close to mainline roads can actually create additional opportunities for delay, congestion, and crashes because insufficient storage ("throat length") is provided for entering and exiting vehicles. When this happens, the access problem the frontage or backage road was designed to address is relocated rather than cured.

Diagrams





Minimum Guideline

Frontage and backage roads should be spaced a minimum 300 feet from the mainline route they provide alternative access for. Measurements should be taken from pavement edge to pavement edge. In effect, this 300-foot minimum spacing will tend to promote the use of backage roads rather than frontage roads.

17.0 DRIVEWAY SPACING

What This Guideline Means

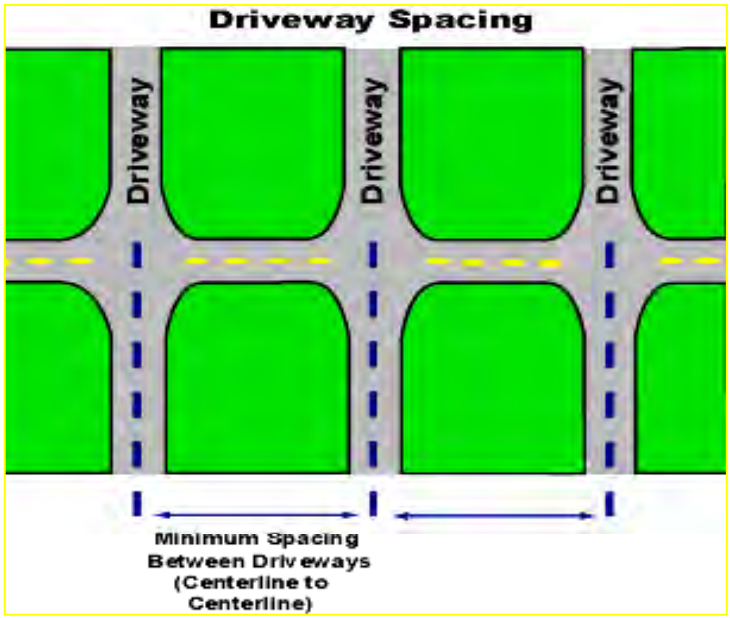
This guideline governs the minimum recommended spacing between private driveways necessary to preserve both safety and traffic flow. Spacing between driveways must be longer on higher speed routes in rural areas than in urban areas. In urban areas, these guidelines allow for about one driveway per city block face on principal arterials and minor arterials, and two driveways per block face on collectors.

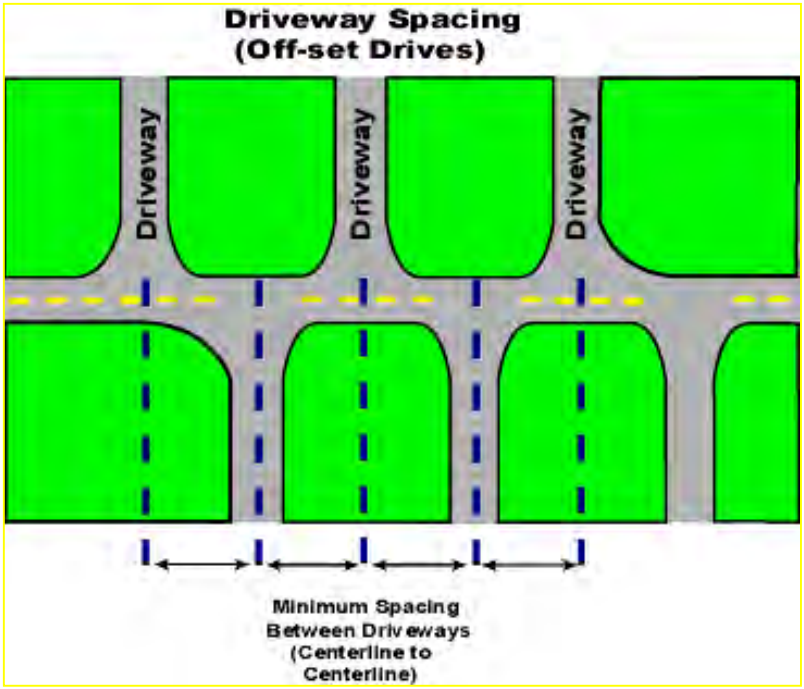
In order to preserve spacing, direct access should be moved to local streets (not arterials) where possible. In particular, access for corner lots should be moved to a lower traffic side street whenever possible. Access can often be better accomplished on major streets through such means as frontage and backage roads, joint access, cross access, and shared driveways. This guideline only applies where sight distance allows. Driveways should *not* be allowed where sight distance is inadequate even if the driveway spacing guideline would allow them.

Driveway accesses should be provided on local and collector streets ("side streets") rather than arterials wherever possible. Driveways should also be lined up across the public roadway from each other whenever possible. When driveways are not lined up, the minimum spacing should be measured from the closest driveway on either side of the road, except where a non-traversable (e.g., raised) median exists.

On urban routes where non-traversable medians exist, shorter driveway spacing may be acceptable for right-in, right-out driveways only.

Diagrams





Minimum Guideline

Roadway Classification	In Current and Projected Urban Areas	In Rural Areas
Interstate/Freeway	No driveways are allowed	No driveways are allowed
Principal Arterial	440 to 660 feet	660 to 1,320 feet *
Minor Arterial	330 feet	440 feet *
Collectors	220 feet (desirable)	330 feet (desirable) *

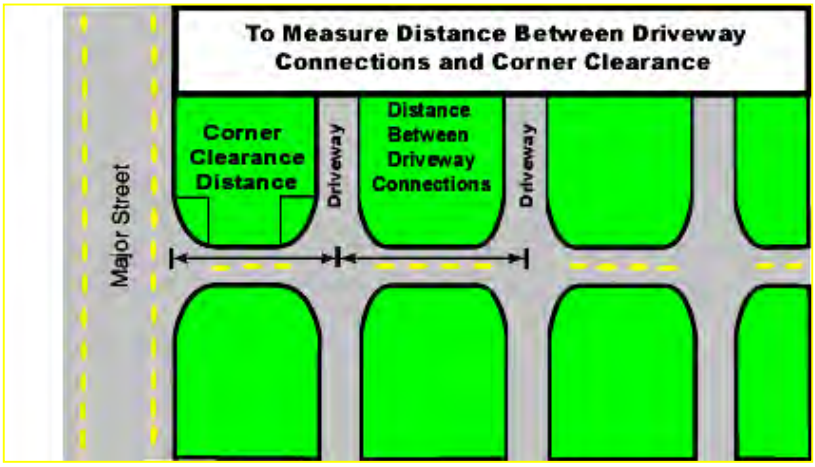
* The urban guideline may be applied in developed areas that are not urban, for example, cities with populations under 5,000. On collectors in cities with population under 5,000, the recommended minimum guideline is 220 feet (same as the urban guideline).

18.0 DRIVEWAY CORNER CLEARANCE

What This Guideline Means

Corner clearance represents the distance between the corner of the intersection of two public roadways and the next private driveway. It is important to provide enough distance between the corner and the first driveway to effectively separate conflict points and to allow drivers enough time to make safe maneuvers. When corners are not adequately cleared, high crash rates tend to occur. Delays and traffic congestion also result when corners are not adequately cleared. These guidelines correspond to the minimum driveway spacing guidelines for the same roadway classification. *This guideline only applies where the minimum sight distance guideline allows.*

Diagram



Minimum Guideline

Roadway Classification	In Current and Projected Urban Areas	In Rural Areas
Interstate/Freeway	No driveways are allowed	No driveways are allowed
Principal Arterial	440 to 660 feet	660 to 1,320 feet *
Minor Arterial	330 feet	440 feet *
Collector	220 feet(desirable)	330 feet(desirable) *

* The urban guideline may be applied in developed areas that are not urban, for example, cities with populations under 5,000. On collectors in cities with population under 5,000, the recommended minimum guideline is 220 feet (same as the urban guideline).

19.0 SPACING / CLEARANCE FOR RIGHT-IN, RIGHT-OUT DRIVEWAYS

What This Guideline Means

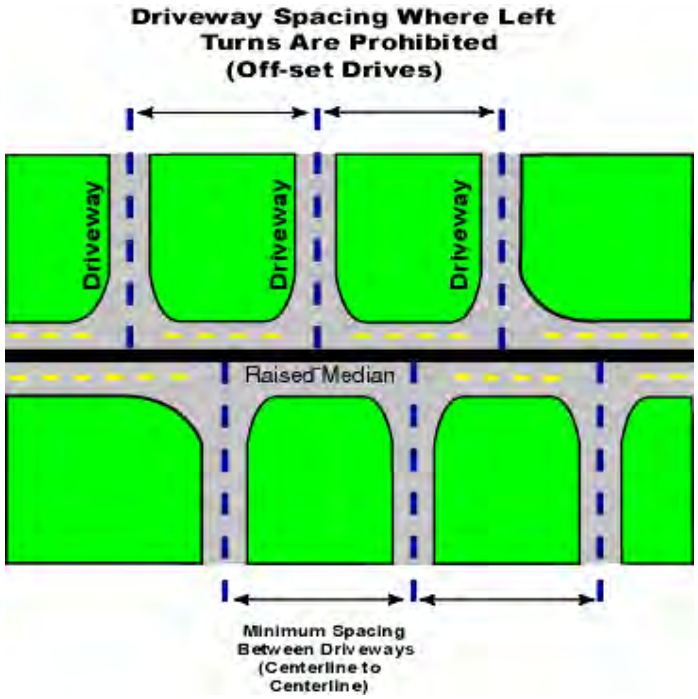
This guideline governs the minimum recommended spacing and corner clearance for driveways along roadways in urban areas that have a non-traversable median and speed limits at or below 45 miles per hour. A non-traversable median restricts left-turn movements into and out of driveways. Adequate spacing between driveways and corner clearance are both necessary to preserve safety and traffic flow. Spacing between driveways must be greater on higher speed routes and in rural areas than in urban areas because of higher posted speed limits.

Research and experience in other states indicates that on urban routes *where non-traversable medians exist*, shorter driveway spacing and corner clearance upstream from an intersection is acceptable for right-in, right-out driveways. This guideline provides for double the number of right-in, right-out driveway access points that are allowed when left turns into and out of driveways are permitted. It also allows for a shorter clearance distance from corners to the last driveway upstream from the corner. For safety reasons, the minimum downstream corner clearance should stay the same as in situations in which there is no non-traversable median present. This shorter guideline for right-in right-out driveways *should not* be used where a non-traversable median does not exist (e.g., where there is a continuous left-turn lane.) It should also not be used in rural areas, where higher operating speeds prevail, for safety reasons.

Experience has shown that a shorter guideline for right-in, right-out drives will only work well where there is a significant physical barrier that prevents left turns (e.g., a non-traversable median). Regulatory restrictions on left turns (e.g., “No Left Turn” signs) are not effective in preventing left turns. Neither are small traffic directors located at driveway entrances.

In order to preserve spacing, direct access should be moved to local streets (not arterials and collectors) where possible. Access can be better accomplished on major streets through such means as frontage and backage roads, joint access, cross access, and shared driveways. These guidelines only apply where sight distance allows. *Driveways should not be allowed where sight distance is inadequate even if the spacing guideline would allow them.*

Diagram



Minimum Guidelines, in Urban Areas *

Roadway Classification	Minimum Spacing between Right-In, Right-Out Driveways on Roadway with a Restrictive Median	Upstream Corner Clearance for Right-In, Right-Out Driveways on Roadway with a Restrictive Median**
Interstate/Freeway	No driveways are allowed	No driveways are allowed
Principal Arterial	220 to 330 feet	220 to 330 feet
Minor Arterial	165 feet	165 feet
Collectors	110 feet (desirable)	110 feet (desirable)

* The urban guideline may be applied in rural but developed areas that are not urban, for example, cities with populations under 5,000. On collectors in cities with population under 5,000, the recommended minimum guideline is 110 feet (same as the urban guideline).

** Downstream corner clearance guidelines should not be modified from the main corner clearance guideline even when a non-traversable median exists.

20.0 DRIVEWAY GEOMETRICS

The design of driveways is critical in access management in that it affects the speed of traffic turning into and out of driveways. This in turn affects the speed differential between through traffic and turning traffic. Large speed differentials are created when driveways are inadequately designed. Large speed differentials are associated with higher crash rates and diminished traffic operations.

The following standards are adapted from the Institute for Transportation Engineers (ITE) latest recommended practice for driveway design with modifications by the Access Management Technical Committee. The existing ITE guidelines are from 1974 and are currently undergoing substantial revision; this should result in standards that resemble those on these pages. Driveway designs should always be based on the results of a study of the traffic likely to use them; these guidelines are presented to illustrate good practices for driveway designs.

Lining Up Driveways Across Roadways

Driveways should be as closely lined up with driveways across roadways without non-traversable medians to the maximum extent possible even if less spacing between driveways is the result.

Angle of Intersection to the Public Roadway

- Driveways that serve two-way traffic should have angles of intersection with the public road of 90 degrees or very near 90 degrees. The minimum acceptable angle for driveways that serve two-way traffic is 70 degrees.

- Driveways that serve one-way traffic may have an acute angular placement of from 60 to 90 degrees.

Right-Turn (Approach) Radius

Approach radii should be large enough to allow entering vehicles to do so at a reasonable rate of speed. The following are suggested as minimum approach radii and are measured from the edge of the driving surface of the roadway. Any maximum approach radius is allowable for driveways.

Minimum Right-Turn Radius for Driveways	Urban Areas (At or below 45 mph Posted Speed)	Rural Areas (Greater than 45 mph Posted Speed)
Residential Driveways	10 feet	25 feet
Commercial Driveways	25 feet	50 feet
Industrial Driveways	Design to handle typical large truck that uses the driveway	Design to handle typical large truck that uses the driveway

Inside radii should be determined on a case by case basis given driveway angle, traffic volume, and other relevant factors. Sites that generate substantial large truck traffic need inside larger radii to accommodate the wheel path of the turning trucks.

Driveway Width

No driveways should have widths less than 20 feet. Driveways of greater than 54 feet should be strongly discouraged unless they contain a raised median to separate traffic lanes. Driveways that serve one-way traffic should be from 20 to 30 feet wide. Driveway widths should be measured from the face of curb to the face of curb at the point of tangency. Any medians contained in the driveway are above and beyond the minimum widths in the table. Minimum acceptable and maximum acceptable widths for various levels of traffic and directions of access are shown in the table below:

Driveway Traffic Category	Average Daily Traffic Using Driveway	Peak Hour Traffic Using Driveway	With Two-Way Access		With One-Way Access	
			Minimum Width	Maximum Width	Minimum Width	Maximum Width
Residential	0 – 100	0 – 10	20 feet	30 feet	NA	NA
Low Volume Commercial/Industrial	< 1500	< 150	28 feet**	42 feet***	20 feet*	20 feet*
Medium Volume Commercial/Industrial	1,500 – 4,000	150 – 400	42 feet***	54 feet****	20 feet*	30 feet**
High Volume Commercial/Industrial	> 4000	> 400	42 feet***	To be determined through a traffic study	Generally not applicable	Generally not applicable

* One-lane driveways.

** Driveway striped for two lanes.
*** Driveway striped for three lanes.
**** Driveway striped for four lanes.

All commercial and industrial driveways should be curbed on approach.

Driveways and Accommodation of Pedestrians

In current and future urban places, all driveways must adequately accommodate pedestrians using sidewalks or paths. The minimum practical width should be used to accommodate pedestrians, and the driveway should be designed to provide the shortest practical path across the driveway for pedestrian movements. Where four or more driveway lanes are created, they should be designed so that the pedestrians have a refuge from entering and exiting traffic. A safe boundary should always be created between pedestrian and motor vehicle traffic.

Driveways and Accommodation of Bicycles

Where a new driveway crosses a bicycle facility (such as a dedicated bike path or an on-street bike lane), the driveway should be designed so as to accommodate the safe crossing of bicyclists. Likewise, when a new bicycle facility is built that crosses existing driveways, the bicycle facility should be designed with safe crossings in mind.

Tapers

The minimum distance between the entrance and exit tapers of adjacent driveways must be at least 50 feet. If they are not, the tapers should be eliminated and the shoulder paved to form a turn lane.

Driveway Throat Length

The throat length is the distance between the street and the parking lot served by a driveway. An adequate throat length helps to keep traffic conflicts within a parking lot to a minimum and frees up space on the driveway for incoming and outbound traffic. The following throat-length guidelines are suggested:

- For low traffic volume commercial and industrial driveways (below 150 peak hour vehicles in both directions), the minimum desirable driveway throat length is 20 feet (about one 20-foot car length).

- For medium traffic volume commercial and industrial driveways (150 – 400 peak hour vehicles in both directions), the minimum desirable driveway throat length is 60 feet (about three 20-foot car lengths).

- For high-volume driveways (over 400 peak hour vehicles in both directions) such as a shopping center entrance, the adequate throat length should always be determined by the results of a traffic study.

Vertical Geometrics (Driveway Grade Change)

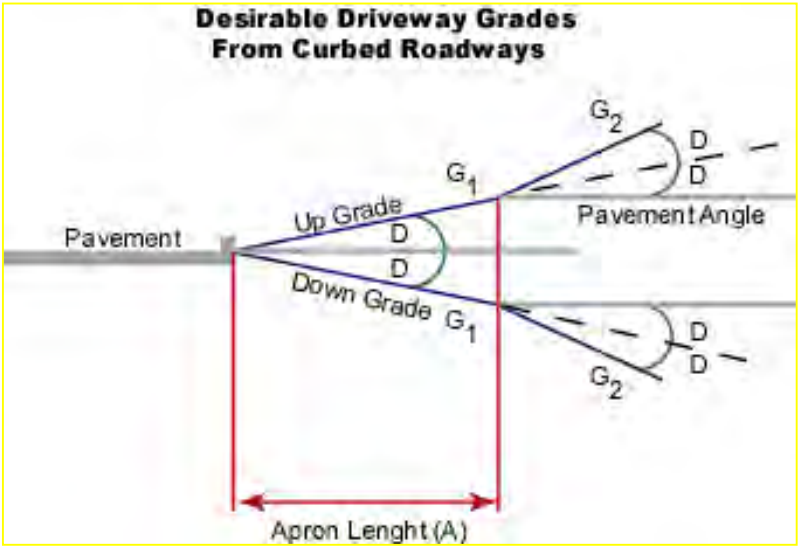
Access driveways on arterial roadways should always be designed to allow vehicles to proceed into or out of the driveway at a speed that will prevent large speed differentials between turning and through traffic. Required apron lengths, desirable grade changes and maximum allowable grade changes are shown in the table below. The apron is a relatively flat area where the driveway meets the public roadway. These guidelines apply to all types of driveways, including for residential, commercial and industrial uses. Driveways should always have a minimum grade change between ½ to 1 percent to provide for adequate drainage. Either an upgrade or downgrade is permissible.

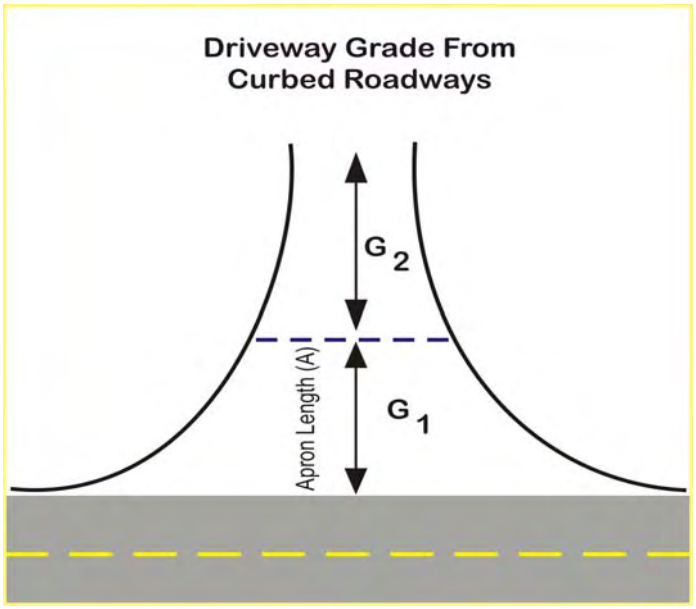
Desirable grades and maximum allowable grades are shown in the following table. Driveways should have a minimum grade of ±1% for drainage.

Roadway Classification	Required Minimum Apron Length ("A" in the Diagram)	Desirable Grade Change, ("D" in the Diagram) Urban	Maximum Grade Change Allowed, Urban	Desirable Grade Change, ("D" in the Diagram) Rural	Maximum Grade Change Allowed, Rural
Interstate/Freeway	NA	NA	NA	NA	NA
Principal Arterial	25-30 feet	2%-3%	3%-4%	1%-2%	2%-3%
Minor Arterial	20 feet	4%	5%	3%	4%
Collector	15 feet	5%	6%	4%	5%

Notes: NA: No driveways are allowed on this classification.
The Apron Length is shown as "A" and grade change as "D" on the diagram below.
The grade may change along the course of the driveway, as indicated by G_1 and G_2. In such cases, it is very important to ensure that the minimum apron length is maintained.

Diagrams





Driveway Surfacing
Required driveway surfaces depend on the roadway they are entering:

Roadway Classification	In Current and Projected Urban Areas	In Rural Areas
Interstate/Freeway	No driveways are allowed	No driveways are allowed
Principal Arterial	Paved	Paved, except for residences, farm field, and forest lot entrances
Minor Arterial	Paved	Paved, except for residences, farm field, and forest lot accesses
Collectors	Paved	Unpaved driveways are acceptable

In general, the minimum pavement depth for a commercial or industrial driveway should be eight-inch deep portland cement concrete (PCC) or its equivalent in asphalt (a ten-inch deep Type-A asphalt mix with an eight-inch base course and a two-inch surface course). On residential driveways, a lesser pavement depth of seven inches for portland cement or nine inches of asphalt (7-inch base and 2-inch surface course) is acceptable. Having paved driveways is most critical on principal arterial routes to keep the speed differential between through and turning traffic as low as possible. As noted before, all commercial and industrial driveways should be curbed on approach.

21.0 PARKING ON FACILITIES

What This Guideline Means

This guideline suggests when parking may be allowed on facilities. In general, parking should not be allowed on highway facilities that are primarily intended to serve through-traffic movement. This includes such facilities as interstates, other freeways, and arterials. On-facility parking should not generally be allowed along collectors in rural areas since these roadways allow for high travel speeds. On facilities such as urban collectors, parking may be allowed if an engineering study indicates that it is safe to do so and that the parking will not unduly hinder traffic operations.

Only parallel parking should be allowed. No angle parking should be permitted on any of the types of facilities listed in the table below. Angle parking may, however, be appropriate if the goal is to provide something other than smooth traffic flow or safety. For instance in a small town, promotion of a "walkable community" may be encouraged by providing angle parking in the central business district.

It should be noted that there is currently no statutory prohibition in Missouri regarding parking on the highway right-of-way. Motorists are permitted to stop momentarily to pick up passengers or discharge cargo. Local governments do have the ability to prohibit or restrict parking within their jurisdiction.

Recommended Guideline

Roadway Classification	In Current and Projected Urban Areas	In Rural Areas
Interstate/Freeway	No parking	No parking
Principal Arterial	No parking	No parking
Minor Arterial	Parking should be studied but may be allowed when warranted to serve and when it can be provided safely	No parking*
Collectors	Parking should be studied but may be allowed when warranted to serve and when it can be provided safely	No parking*

* The urban guideline may be applied on minor arterials and collectors in developed areas that are not urban, for example, cities with populations under 5,000.

22.0 OTHER MODES

Other complementary corridor management features that are not access management features per se, such as bicycle and pedestrian accommodation and public transit pull-ins are included here. MoDOT has developed a General Pedestrian and Bicycle Guide that should be used to determine what should be done to accommodate those modes when access is managed. The section of this handbook that discusses driveway geometrics has the largest bearing on pedestrians and bicyclists. In addition, access management treatments such as reducing driveway density and adding raised medians and mid-block crossings will have a positive impact on safety and convenience for pedestrians and bicyclists.

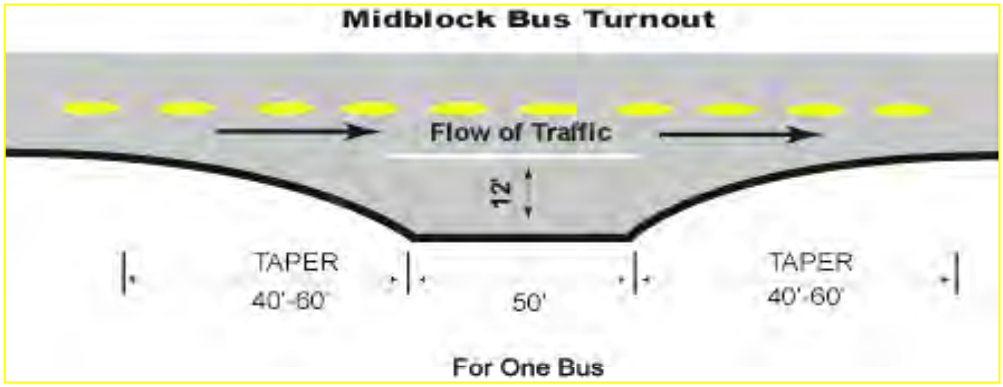
Managing access can also have a positive impact on the operation of public transit vehicles since they will be able to operate more efficiently and safely when they use arterial and collector routes.

What This Guideline Means

In urban areas and future urban areas, access management projects should accommodate public transit vehicles through the use of such design features as bus pull-outs as shown in the table below.

Mid-block bus pull-outs should be a minimum of 50 feet in length, and 12 feet in width and have an additional 40 – 60 foot taper in each direction. These guidelines do not apply in future urban areas.

Diagram



Guideline For Public Transit Accommodation

Roadway Classification	Public Transit Buses
Interstate/Freeway	Use of these facilities recommended for express bus routes only
Principal Arterial	Use of these facilities recommended for express bus routes only
Minor Arterial	Include bus pull-outs in design as appropriate
Collectors	Generally no applicable due to low traffic volumes