4-07.1 URBAN IMPROVEMENTS. Most urban street and highway improvements are identified as follows:

- Needed improvements to existing arterial facilities are shown through traffic studies of street and highway facilities exhibiting inadequate capacity, high accident rates or fatalities.
- The district engineer may request from the Office of Transportation Management Systems to obtain origin and destination studies in cities with a population of 5000 or more, if the communities are in need of traffic relief and if the cities are willing to cooperate in the study and participate in the cost of the improvements.
- Where new large private developments are constructed, such as office, apartment, commercial, or manufacturing complexes. Improvements to existing streets and highways may be required.

4-07.2 POLICY. The policy of the department with regard to urban highway improvements is as follows:

- Urban highway improvements are considered only within the urban limits of cities with a population of 5000 or more.
- The department locates, constructs or reconstructs routes selected by the city and the department as urban extensions of the federal aid system.
- The department assumes the responsibility of making surveys, preparing plans, acquiring right of way, and supervising construction of the urban routes.
- The developer, city or county is willing to cooperate in obtaining needed highway improvements and to participate in the cost.

4-07.3 TYPES OF URBAN HIGHWAYS. There are three general classes of urban highways, i.e., minor arterial streets, principal arterial streets and freeways. Minor arterial streets have intersections at grade and direct access to abutting property. Principal arterial streets have partial control of access where principal cross streets are connected at grade. Freeways have full control of access, where access to the freeway is provided only at interchanges. This subsection of the manual is divided into three parts -- Minor Arterial Streets, Principal Arterial Streets and Freeways. Under each, certain design criteria are specified for use in development of plans. These criteria are considered as a minimum and if practical are exceeded.

4-07.3 (1) MINOR ARTERIAL STREETS. This is an arterial highway with intersections at grade and, in general, provides direct access to all abutting property. There is usually no control of access, but connections to private driveways, alleys, and commercial driveways are kept at a minimum.

4-07.3 (1) (a) MEDIANS. Medians are desirable but not essential. Usually painted medians are used on arterial streets. See Subsection 4-04.5.

4-07.3 (1) (b) PARKING LANES. Parking lanes are not provided along major streets. On cross streets where parking is permitted, curb parking should be prohibited by agreement with the city for a distance of 100 ft. [30 m] on both sides of the cross street from the near curb of the intersection with the arterial street. This is to provide adequate sight distance from vehicles approaching the intersection and to provide turning clearance for vehicles turning into the cross street.

4-07.3 (1) (c) INTERSECTIONS. At grade intersections are designed for vehicle turning radii given in Subsection 4-05.4. Islands and channelization are used in accordance with the criteria in Section 4-05. At signalized intersections protected left-turn lanes are provided, if warranted.

4-07.3 (1) (d) LANE DESIGN. Widths of traffic lanes are shown on Figure 4-07.1. The minimum width for left and right turning lanes is 10 ft. [3.0 m]. Lane capacities are determined in accordance with the Highway Capacity Manual.

4-07.3 (1) (e) BICYCLE/PEDESTRIAN FACILITIES. The designer should establish the need for bicycle/pedestrian facilities are necessary according to the guidelines provided in Subsection 4-09.25.

4-07.3 (1) (f) DESIGN CRITERIA. Basic design criteria for arterial streets are given on Figure 4-07.1.

4-07.3 (1) (g) TYPICAL SECTIONS. A guide for typical sections for minor arterial streets is given on Figure 4-07.2.

4-07.3 (1) (h) TWO-WAY LEFT-TURN LANES. Traffic congestion often occurs along arterial streets through locations of strip commercial development, where there is left turn demand to approaches along both sides of the street. One of the key benefits of two-way left-turn lanes (TWLTLs) includes the removal of turning vehicles from the through traffic lanes, thereby reducing travel time and delay by 40 to 60 percent. Two-way left-turn lanes are far less controversial than raised medians, and can be an effective traffic management tool when used under the right circumstances, however they have limitations.

Two-way left-turn lanes do not function well once certain traffic volumes or recommended driveway spacing limits have been exceeded. In areas of high traffic volumes, i.e. AADT is greater than 28,000, raised medians are at least 25 percent safer than multilane undivided sections and 15 percent safer than TWLTLs. Two-way left-turn lanes should only be considered in places where commercial driveways make up a substantial portion of total driveways, overall driveway density is managed, and where the percentage of vehicles turning left at peak hour is at least 20 percent.

Two-way left-turn lane configurations should not be used in areas that are expected to remain rural in the foreseeable future or on roadways with posted speeds in excess of 45 mph [70 km/h]. In no case should one attempt to create a two-way left-turn lane on routes with more than two through-traffic lanes in each direction to create a "seven lane" facility.

Criteria for use and design of TWLTLs on MoDOT's system include the following:

Roadway/ Traffic Conditions	Two-Way Left-Turn Lanes (Five-Lane Facilities)	Two-Way Left-Turn Lanes (Three-Lane Facilities)
AADT	May be used where AADT in the design year is less than 28,000; otherwise use a raised median	May be used where AADT in the design year is less than 17,500
Driveway Spacing	May be used when driveway spacing is 12 or less per mile in each direction (Average spacing of 440 feet)	May be used when driveway spacing is 12 or less per mile in each direction (Average spacing of 440 feet)

Where continuous two-way left turn lanes are considered, several elements of the design must be reviewed. Higher travel speeds combined with rolling terrain can create serious safety problems if a two-way left-turn lane is used. The number of movements made in the lane can become too large, resulting in an increase in accidents or near accidents. Consequently, the speed, traffic volume and topography must be analyzed prior to installation of this type of control.

In addition, the following elements must be included within the design of the TWLTL - the median lane width should be at least 14 ft. [4.2 m], and a minimum of 400 ft. [120 m] of stopping sight distance should be provided within the limits of the continuous two-way left-turn lane.

Roads that may be candidates for TWLTLs should be evaluated to determine whether accidents are a significant factor, and if, alternatively, access management strategies could be implemented to reduce accidents. All core team members should be involved in the evaluation process, and alternatives weighed against the "Purpose and Need." If a TWLTL is the best solution for existing conditions, supporting information addressing safety concerns must be included in the conceptual plan submittal.

Designing or implementing a TWLTL on a roadway that does not warrant the use of this type of facility will require a design exception. Lane markings for 3 lane and 5 lane roadways shall be in accordance with the MUTCD.

4-07.3 (2) PRINCIPAL ARTERIAL STREETS. This type facility is practically free from roadside interferences, and the crossing or approaches of traffic from less important streets is eliminated. The right of access from approaches and less important cross streets is controlled either by the acquisition of limited-access right of way or by the construction of frontage roads.

4-07.3 (2) (a) MEDIANS. See Subsection 4-04.5.

4-07.3 (2) (b) OUTER ROADWAYS. Outer roadways are specified where required to provide access to adjacent property and to minimize the number of access points connecting to the main roadway. See Subsection 4-04.6. Outer roadways maybe designed for one way traffic, if practical.

Adequate outer separation between the edge of pavement of the main roadway and the edge of pavement of the outer roadway must be provided. Clear zone should be provided within the outer separation for the main roadway. Minimum outer separation consists of the shoulders of the main roadway and the frontage road plus a physical barrier.

The location of the intersection of the outer roadway and the cross road should be in compliance with our policy covering access control at diamond interchanges.

See Subsection 4-04.6(7) for design standards for outer roadways.

4-07.3 (2) (c) PARKING LANES. Parking lanes are not to be provided. Shoulders are usually constructed with high-type pavement to provide space for stalled vehicles in emergencies.

4-07.3 (2) (d) INTERSECTIONS. Interchanges or at-grade intersections are provided at important cross streets. The grade intersections may be channelized, and additional lanes may be provided for turning movements, if necessary. If warranted protected left-turn lanes are provided for traffic leaving the arterial streets. The criteria for determining the length of left-turn lanes is given in Section 4-05 and Chapter VIII. The design of intersections includes signalization if warranted or provision for traffic signals if warranted by design year traffic. Provisions for traffic signals might include geometrics, right of way and conduit.

4-07.3 (2) (e) LANE CAPACITIES. Capacity is determined in accordance with the Highway Capacity Manual.

4-07.3 (2) (f) DESIGN CRITERIA. Basic design criteria for arterial streets at grade are given in Figure 4-07.1.

4-07.3 (2) (g) TYPICAL SECTIONS. A guide for typical sections for arterial streets is given in Figures 4-07.2 and 4-07.3

4-07.3 (3) FREEWAYS. A freeway is the highest type principal arterial highway, with full control of access. Access is restricted to and from the freeway at interchanges which are usually constructed at major cross streets. Grade separations are provided for other major streets which are needed for local community circulation.

4-07.3 (3) (a) GRADE SEPARATION. In addition to fitting a grade separation structure into the topography, the major considerations are economics, major traffic movements and the handling of traffic during construction. Generally, overpass structures are better suited for crossing over railroads, high volume arterials and at

diamond interchange locations. While an underpass of minor roads is better where traffic handling problems are less and there is greater savings in construction cost.

4-07.3 (3) (b) WARRANTS FOR GRADE SEPARATION STRUCTURES. Grade separations are considered by one or more of the following factors:

- The route is an interstate or fully controlled access freeway.
- To eliminate a hazard conflict.
- An at-grade intersection lacks the capacity to handle the traffic volumes.
- An existing local road or street cannot feasibly be terminated outside the right of way limits.
- Separation is needed to eliminate railroad highway hazard conflict.

4-07.3 (3) (c) RAMPS AND TERMINALS. Design considerations for ramps are included in Section 4-06. Design considerations for terminals are included in Section 4-05.

4-07.3 (3) (d) MEDIANS. A depressed physical separation or barrier is provided in the median between opposing traffic lanes. For median barrier warrants consult Subsection 4-04.5.

4-07.3 (3) (e) LANE DESIGN AND CAPACITIES. Freeway lane widths are normally 12 ft. [3.6 m]. Other information on lane design is included in Section 4-06. Lane capacities are determined in accordance with the Highway Capacity Manual.

4-07.3 (3) (f) SHOULDERS. Stabilized shoulders are provided along the freeway. Outside shoulders are 12 ft. [3.6 m] in width. Inside shoulders, 12 ft. [3.6 m] wide constructed next to the median, are provided on freeways with six or more lanes. See Subsection 6-04.2 for shoulder details.

4-07.3 (3) (g) VERTICAL ALIGNMENT CONTROLS. Urban freeway facilities are designed with grades and stopping sight distance based on the same vertical alignment controls as principal arterials which are shown on Figure 4-04.1. Desirably the vertical alignment provides good visibility of ramp terminals at interchange locations, in areas of vehicle weaving or lane changing and ahead of freeway lane drops.

4-07.3 (3) (h) HORIZONTAL ALIGNMENT CONTROL. Alignment controls are shown on Figure 4-04.1. Horizontal alignment on multi-lane freeway facilities should be held as flat as possible for safe traffic maneuverability in changing lanes, interpretation of signing and visibility of maintenance operations. Sharp reverse alignment is to be avoided. The horizontal and vertical alignment needs to be properly coordinated to promote uniform vehicle speeds, to optimize the utility and safety of the roadway. If possible, vertical and horizontal curvature are superimposed on each other. Sharp horizontal curvature should not be made on pronounced crest vertical curves. Also sharp horizontal curvature should not be introduced at or near short sag vertical curves.

4-07.3 (3) (i) DESIGN CRITERIA. General design criteria for freeways are given on Figure 4-04.1 under principal arterials.

4-07.3 (3) (j) TYPICAL SECTIONS. A typical section for 6-lane freeways is given on Figure 4-07.4