CHAPTER 3
LOCAL URBAN ROAD SYSTEM

3.0 INTRODUCTION

As in Chapter 2 for the local rural road system, the local urban road system also utilizes the concepts of land use context, functional classification and roadway typologies described in Chapter 1, Section 1.1. The differences in the nature and intensity of development in rural and urban areas warrant corresponding differences in rural system characteristics relative to the correspondingly named urban system characteristics. The hierarchy of functional classification systems for the urban area system is the same as for the rural area system. These systems for the entire urban area system and their associated service characteristics are presented in Figure 3.1.

There are three general functional classifications established for the local urban road system: (1) Arterials, (2) Collectors and (3) Local Roads. Municipalities may own roads that fall under any or all of these three general functional classifications.

The Arterial classification usually consists of extensions of rural arterials or the State highway system network into and through the urban area. They may carry major traffic movements entering and leaving the area. The principal function of an arterial is to provide traffic service to major movements rather than to land service. They may carry local routes and provide intra-community continuity, but they should not penetrate the residential neighborhood. Most urban State highway system networks function as arterials and, depending on the extent of the network within the urban area, many small urban areas may not generate sufficient internal travel to warrant arterial service for local highways.

The Collector classification includes those highways that collect traffic from local roads and distribute them into the arterial systems or their ultimate destination and vice versa. Collectors may penetrate neighborhood developments and they may carry through traffic.

The Local Roads classification provides direct access to abutting land and also permits connections to the higher order classification systems. Abutting land may be used for residential, commercial or other purposes. The localized nature of traffic movement rather than the type of land development is the criterion. Traffic volumes are low and service to through traffic movement is usually deliberately discouraged by design or regulations.

3.1 ROADWAY TYPOLOGIES

The roadway's typology is based on a project's:

- Land Use Context (i.e., suburban neighborhood, suburban corridor, suburban center, town/village neighborhood, town/village center, and urban core)

- Functional Classification (i.e., arterial roadway, collector roadway, or local road)

Once the roadway typology is determined, the appropriate design criteria can be selected. For additional guidance, refer to Chapter 1, Section 1.1; Chapter 2, Section 2.4; and Appendix A.
**FIGURE 3.1**
**FUNCTIONAL CLASSIFICATION SYSTEM**
**SERVICE CHARACTERISTICS**

<table>
<thead>
<tr>
<th>URBAN AREA SYSTEM</th>
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<tr>
<td>INTERSTATE AND OTHER</td>
<td></td>
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<tr>
<td>LIMITED ACCESS FREEWAYS</td>
<td>1. Provides limited access facilities.</td>
</tr>
<tr>
<td></td>
<td>2. Serves major centers of activity and carries high proportion of area travel even though it constitutes a relatively small percentage of the total roadway network.</td>
</tr>
<tr>
<td>ARTERIALS</td>
<td>3. Integrated both internally and between major rural connections.</td>
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<tr>
<td>PRINCIPAL ARTERIALS</td>
<td>4. Carries most trips entering and leaving the area and serves intra area travel.</td>
</tr>
<tr>
<td>MINOR ARTERIALS</td>
<td>5. Provides continuity for rural arterials.</td>
</tr>
<tr>
<td>COLLECTORS</td>
<td>6. Spacing related to trip-end density characteristics.</td>
</tr>
<tr>
<td>LOCAL ROADS</td>
<td>7. Spacing normally not more than 2 km (1 mi).</td>
</tr>
</tbody>
</table>

1. Interconnects with and augments principal arterials.
2. Accommodates trips of moderate length.
3. Distributes travel to areas smaller than identified with higher systems.
4. Places emphasis on land access and offers lower traffic mobility.
5. Provides both land access services and traffic circulation.
6. Distributes trips from arterials through residential neighborhoods to ultimate destination.
7. Collects traffic from local streets and channels to arterials.
8. Comprises all facilities not in one of the higher systems.
9. Permits direct access to abutting lands and connects to higher systems.
10. Discourages through-traffic movement.
3.2 DESIGN AND CROSS SECTION ELEMENTS

This section presents the guidelines and concepts that should be considered when designing features of the local urban road system.

A. Alignment. Alignment in the local urban road system for residential areas should closely fit with the existing topography to minimize the need for cuts and fills without sacrificing safety. Also, the alignment of local streets in residential areas should be arranged to discourage through traffic. Street alignment in commercial and industrial areas should be commensurate with the topography but should be as direct as possible. Vertical curvature also impacts operating speeds.

A tighter curve radius effectively reduces design speeds and operating speeds. The minimum radii required for the various design speeds are discussed in the Department's Publication 13M, Design Manual, Part 2, *Highway Design*, Chapter 2, Section 2.6.

B. Sight Distance. For local roads and collectors in the local urban road system, the design for passing sight distance is seldom applicable. For additional information relative to sight distance, refer to Chapter 2, Section 2.1.C.

C. Superelevation. Superelevation, in specific locations, may be advantageous for local street traffic operations. However, in built-up areas, the combination of wide pavement areas, proximity of adjacent development, control of cross slope, profile for drainage, frequency of cross streets and other urban features often combine to preclude the use of superelevation. Usually, superelevation is not provided on local streets in residential and commercial areas. It may be considered on local streets in industrial areas to facilitate operation. For additional information relative to superelevation, including the minimum and maximum cross slopes, refer to Chapter 2, Section 2.4; Appendix A; and the Department's Publication 13M, Design Manual, Part 2, *Highway Design*, Chapter 2, Section 2.13.

D. Grades. It is desirable to provide grades as level as practical that are consistent with the surrounding terrain. To facilitate proper drainage, the acceptable minimum grade used should be 0.30% and the desirable minimum grade should be 0.50%. Grades should not exceed 4% since higher values become critical for drainage design. Where grades steeper than 4% are necessary, special care should be taken to prevent erosion on slopes and open drainage facilities. For commercial and industrial areas, gradient design should be less than 8% and should desirably be less than 5%. In curbed areas, the desirable minimum grade used should be 0.30%.

On arterials that are operating near capacity with large numbers of trucks, flat grades should be considered to avoid speed reductions. Also, steep grades may result in vehicle operation problems, particularly during adverse weather conditions, at intersections. It is desirable to provide the flattest grades practical while providing at least minimum gradients to ensure adequate longitudinal drainage. The grades required for the various design speeds are discussed in the Department's Publication 13M, Design Manual, Part 2, *Highway Design*, Chapter 2, Section 2.7.

E. Pavement Design. Refer to Chapter 2, Section 2.1.F.

F. Guide Rail. Refer to Chapter 2, Section 2.1.G.

G. Medians. A median is the portion of a highway separating opposing directions of the traveled way. Other purposes include serving as a refuge for pedestrians crossing the street, storing or restricting left-turn vehicles, managing access, and providing an attractive landscaping or streetscaping treatment. Sources of criteria for warrants, turn lanes, and storage in medians are identified in the Department's Publication 46, *Traffic Engineering Manual*, Chapter 11, Section 11.1.7.

Medians may be nontraversable. Examples include F-shaped concrete median barrier, raised with curbing, flush grass or guide rails. F-shaped concrete median barrier is an option when retrofitting arterial roadways with restricted right-of-way. Raised medians with curbs are useful for facilitating pedestrian crossings. Although grass medians are classified as nontraversable, they may be crossed sometimes by wayward vehicles. To reduce the possibility of crossover crashes in grass medians, installation of barrier or positive protection (e.g., guide rail, high-tension cable barrier) may be considered.
Medians may also be traversable. These are typically painted or flush medians that do not discourage vehicles from entering or crossing. This type of median is discouraged because vehicles can freely make left turns from the left lane, and following vehicles may make sudden lane shifts to the right.

The nontraversable median is the preferred median type. Due at least in part to its efficiency in reducing conflicting maneuvers at driveways, it has the lowest crash rate.

Among nontraversable medians, the raised median with curbing is preferred due to its ability to encourage safe pedestrian crossings on higher order roadways. However, the installation of physical islands at locations of regular pedestrian crossings can serve to make this median type pedestrian friendly.

Raised medians can enhance the appearance of a corridor by hosting trees or other vegetation as part of a boulevard treatment. An attractive brick or textured concrete surface is another option.

Raised medians are desirable to aid pedestrian crossings on roadways over 18 m (60 ft) in width. It should be noted, however, that on higher speed roadways of restricted widths, the F-shaped concrete median barrier is often preferred to the raised median with curbing. Each site should be analyzed on a case-by-case basis to determine how to safely accommodate pedestrians.

Under certain conditions, traversable type medians may be preferable to nontraversable medians. These conditions include the following: lightly developed areas that will not be considered for access management; intersections where approach speeds are relatively high; areas where there is little pedestrian traffic; areas where fixed-source lighting is not provided; median or corner islands where signals, signs, or luminaire supports are not needed; areas requiring significant snow plowing; and areas where extensive development exists along a street and may demand left-turn lanes into many entrances.

Recommended widths of medians are provided in the Matrices of Design Values found in Appendix A. Medians installed to serve as pedestrian refuges should ideally be 2.4 m (8 ft) in width, with 1.8 m (6 ft) the recommended minimum (measurements of physical medians are from face-of-curb to face-of-curb). Median widths of 3.6 m to 5.4 m (12 ft to 18 ft) can accommodate left-turn bays. Medians of 18.0 m (60 ft) in width or more should only be used for regular traffic operations in rural areas, or to provide landscaping treatments and/or parks in suburban and urban contexts.

If a proposed median will prevent access to a commercial driveway, a project can incorporate median breaks, U-turn jughandles, or flush textured pavement medians.

A median barrier may be desirable with fast-moving traffic since a barrier provides a positive separation of traffic and discourages indiscriminate pedestrian crossings. Median barrier shall be used as determined by the Department's Publication 13M, Design Manual, Part 2, *Highway Design*, Chapter 12.

Accessibility, based on the Americans with Disabilities Act (ADA), must be considered at all medians where public access is allowed. Refer to the Department's Publication 13M, Design Manual, Part 2, *Highway Design*, Chapter 6 for ADA issues related to pedestrian accessibility.

### 3.3 DESIGN CONTROLS

This section presents the guidelines and concepts that should be considered when designing control features of the local urban road system.

**A. Design Traffic Volumes.** In suburban neighborhoods or town/village neighborhoods, roads are typically designed with a two-lane cross section, and factors other than traffic volumes often control their design features. However, minor changes in traffic volumes can become a local concern, and design solutions should consider this need.

For other land uses in suburban and urban areas (suburban corridor, suburban center, town/village center, and urban core), traffic volumes are a major factor and should be considered in design, especially when serving industrial or commercial areas.
Chapter 3 - Local Urban Road System

New highways or improvements to existing highways should not usually be based on current traffic volumes alone, but should consider future traffic volumes expected to use the facility. A period of 20 years should be used as the basis for design. For reconstruction or rehabilitation projects, estimating traffic volumes for a 20-year design period may not be appropriate because of the uncertainties of predicting traffic and funding constraints. A shorter design period (5 to 10 years) may be developed for such projects. Because of the higher directional characteristics in traffic movements during morning and evening peak hours, the traffic volumes during both of these periods should receive special consideration.

B. Design Speed. Refer to Chapter 2, Section 2.2.B.

C. Number of Lanes. The term "capacity" is used to express the maximum number of vehicles that can pass a given point during a specified period under prevailing roadway, traffic, and control conditions.

The number of lanes required to move traffic at desirable operating speeds is dependent on numerous factors such as traffic volumes, number of trucks, turning movements (at intersections and midblock areas), grades, parking requirements, right-of-way availability, signal timing, etc. Although service volumes can vary widely depending on the influence of these factors during peak traffic flow, each lane should provide operating speeds under conditions normally encountered in the local urban road system. When the traffic volumes exceed these levels, a highway capacity analysis, using the HCM, should be evaluated to determine the proper number of lanes required. To accommodate turning vehicles, the pavement may be widened through intersections by the addition of one or two lanes to maintain through-traffic movement. The added lane should extend a minimum of 45 m to 75 m (150 ft to 250 ft) through the intersection to maintain a smooth flow of traffic. In certain areas where there are several midblock left turns, an additional continuous two-way, left-turn lane in the center of the roadway may be provided. The width of roadway (pavement width plus shoulder width each side) for moving traffic on the local urban road system shall be as indicated in the design criteria in Chapter 2, Section 2.4.

D. Right-of-Way. Refer to Chapter 2, Section 2.2.D.

E. Structures. The design requirements for bridges on the local urban road system are basically the same as presented in Chapter 2, Section 2.2.E for bridges on the local rural road system. The design criteria in Chapter 2, Section 2.4 are applicable.

For urban areas, two major items for consideration are sidewalks and parking or turning lanes. Generally, approach sidewalks shall be carried across the bridge and shall be protected by a sidewalk safety barrier. When parking or turning lanes are required, approval by the Bureau of Design is required.

F. Intersection Design. The design and operation of intersections within the local urban road system have a more significant effect on traffic flow and safety than any other part of the system. Improperly functioning intersections can prevent the efficient movement of traffic throughout the entire urban area regardless of the adequacy of design of other highway sections.

Important design considerations for intersections fall into two major categories: the geometric design of the intersection including a capacity analysis and the location and type of traffic control devices. The number and locations of approach roadways and their angles of intersection represent major controls for the intersection geometric pattern. The location of islands (channelization) for control of vehicle movements and the types of traffic control devices should be considered.

Since the major proportion of accidents in urban areas occur at intersections, they should be designed with adequate intersection sight distance as indicated in the Department's Publication 13M, Design Manual, Part 2, Highway Design, Chapter 2, Section 2.17.F. To maintain the minimum required sight distances, restrictions to the location of building lines, fences and landscaping may be needed. The intersection area should be kept free of obstacles and designed with a relatively flat grade. The maximum grade on the approach leg should not exceed 5% where practical. The intersecting legs should meet at approximately a 90° angle. The alignment design should be adjusted to avoid an angle of intersection of less than 60°.

At street intersections, there are two distinct radii that need to be considered – the effective turning radius of the turning vehicle and the radius of the curb return (see the 2004 AASHTO Green Book, Chapter 5, Exhibit 5-10). The
effective turning radius is the minimum radius appropriate for turning from the right-hand travel lane on the
approach street to the appropriate lane of the receiving street. This radius is determined by the selection of a design
vehicle appropriate for the streets being designed and the lane on the receiving street into which that design vehicle
will turn.

A curb radius of 7.5 m to 9.0 m (25 ft to 30 ft) will accommodate most turns on community collector roadways, and
community arterials, particularly roads with less than 5% traffic in buses and heavy trucks. A curb radius of 7.5 m
(25 ft) and a parking lane will permit a single-unit truck to turn without encroachment. Radii of 10.5 m to 12.0 m
(35 ft to 40 ft) are adequate at most intersections on arterial streets where a WB-15 (WB-50) truck is the design
vehicle. A radius of 15 m (50 ft) or larger may be considered for intersections on arterials if congestion and the
percentage of larger vehicles are significant, and if there is little pedestrian activity. Additional guidance is provided

A roundabout may also be a feasible alternative if it meets the guidelines published by the Federal Highway
Administration and the Department's Publication 414, Guide to Roundabouts.

For additional sources of information and criteria relative to intersection design, refer to the 2004 AASHTO Green
Book and the MUTCD.

G. Traffic Control Devices. Refer to Chapter 2, Section 2.2.G.

H. Utilities. Refer to Chapter 2, Section 2.2.H.

I. Erosion Control. Refer to Chapter 2, Section 2.2.I.

J. Curbs. Curbs serve any or all of the following purposes: drainage control, roadway edge delineation, right-
of-way reduction, aesthetics, delineation of pedestrian walkways, reduction of maintenance operations and
assistance in orderly roadside development.

Streets in the local urban road system are normally designed with curbs to allow greater use of available width and
for control of drainage, protection of pedestrians and delineation. The Department's standard curb height is 200 mm
(8 in). Even though the Department's standard curb height is 200 mm (8 in), these standards are a guideline, which
enables the highway designer to have a range of flexibility. The 2004 AASHTO Green Book, Chapter 4, provides
guidance to the designer by illustrating commonly used configurations for vertical curbs and sloping curbs.
Sufficient flexibility is permitted to encourage independent designs tailored to a particular situation.

Curbs are used extensively on all types of low-speed urban highways. The upper limit for low-speed design is
considered to be 70 km/h (45 mph). As stated in Chapter 2, Section 2.2.J, caution should be exercised in the use of
curbs on highways with design speeds ≥ 80 km/h (50 mph).

The Department's standards for curbs are for new construction. However, where reconstruction is required,
modification to the Department's standards may be appropriate. For example, in the Department's Publication 72M,
Roadway Construction Standards, Drawing RC-67M for curb ramps and sidewalks, construction details may be
modified to adapt dimensions to existing curb heights where the curb is less than the standard 200 mm (8 in) height.

There are circumstances where 150 mm (6 in) curbs may be warranted, and these circumstances are reviewed on a
case-by-case basis. Curbs with heights of 150 mm (6 in) could be used adjacent to parking lanes, to meet existing
sidewalks or to fit in with the surrounding topography. As noted in the Department's Publication 72M, Roadway
Construction Standards, Drawing RC-64M, where curbs are installed adjacent to parking lanes, a 150 mm (6 in)
high curb can be utilized with approval from the local municipality.

Vertical curbs with heights of 150 mm (6 in) or more adjacent to the traveled way, should be offset by 0.3 m to
0.6 m (1 ft to 2 ft). Where there is combination curb and gutter construction, the gutter pan width, which is normally
0.3 m to 0.6 m (1 ft to 2 ft), may provide the offset distance.

On divided streets, the type of median curb should be compatible with the width of the median and the type of
turning movement control to be provided. Where midblock left-turn movements are permitted and the median width
is less than 3.0 m (10 ft), a well-delineated flush or rounded median separator is effective to channelize traffic and to
avoid excessive travel distances and concentrations of turns at intersections. Where wider traversable medians are appropriate, they may be either flush or bordered with low curbs 25 mm to 50 mm (1 in to 2 in) high. On some wide medians, where cross-median movements are undesirable, a vertical curb should be used on the median side of the traveled way. A median barrier should be used where positive separation of opposing traffic is essential and there is no need for pedestrian crossings. For additional information relative to curbs, refer to the 2004 AASHTO Green Book, Chapters 4, 5, 6 and 7; and to the Department's Publication 13M, Design Manual, Part 2, Highway Design, Chapters 6, 7 and 12.

3.4 GENERAL DESIGN CONSIDERATIONS

In addition to the design and cross section elements presented in Section 3.2 and the design controls presented in Section 3.3, there are other elements that affect or are affected by geometric design for the local urban road system.

A. Bikeway Facilities. Refer to Chapter 2, Section 2.3.A.

B. Driveways. Refer to Chapter 2, Section 2.3.B.

C. Mailboxes. Refer to Chapter 2, Section 2.3.C.

D. Railroad-Highway Grade Crossings. Refer to Chapter 2, Section 2.3.D.

E. Pedestrian Facilities. Since pedestrians represent a segment of every roadway environment, attention should be given to their presence in rural as well as in urban areas. The urban pedestrian, being far more prevalent, more often influences roadway design features than the rural pedestrian does. Pedestrian facilities may include sidewalks, crosswalks, traffic control features, curb ramps (provides pedestrian access over a curb) and ramps meeting ADA requirements. When designing highways with substantial pedestrian-vehicular conflicts, the following are some measures that could be considered to help reduce these conflicts and may increase the efficient operation of the roadway: (1) eliminate left and/or right turns; (2) prohibit free-flow right-turn movements; (3) prohibit right turn on red; (4) convert from two-way to one-way street operation; (5) provide separate signal phases for pedestrians; (6) eliminate selected crosswalks; and (7) provide for pedestrian grade separations.

Pedestrian facilities should be provided where pedestrian volumes, traffic volumes, intersection capacity and other conditions favor their use. They may be warranted where there are heavy peak pedestrian movements such as at business districts, factories, schools or athletic fields, in combination with moderate-to-heavy vehicular traffic or where abnormal conditions or inconvenience to pedestrians would otherwise result.

There are a number of design facilities that should be considered in projects which will accommodate pedestrians. In special situations, some of these facilities can be used as countermeasures to reduce the potential for pedestrian accidents. These facilities include but are not limited to:

- Sidewalks
- Grade separations (overpasses and underpasses)
- Refuge islands
- Pedestrian barriers
- Installation of pedestrian signals and pedestrian push buttons
- Prohibition of pedestrians (on Interstate highways)
- Widening of shoulders (in rural areas)
- Improvements or installation of lighting
- Installation of special signing and pavement markings
- Prohibition of vehicle parking
- Designation of one-way streets

For additional information and criteria relative to the design requirements and construction practices for pedestrian facilities, refer to the Department's Publication 13M, Design Manual, Part 2, Highway Design, Chapter 6; the Department's Publication 10A, Design Manual, Part 1A, Transportation Engineering Procedures, Appendix J; the Department's Publication 46, Traffic Engineering Manual; and the 2004 AASHTO Green Book, Chapters 4, 5, 6 and
7. For additional information concerning general considerations and physical characteristics of pedestrians and physically disabled pedestrian characteristics, refer to the 2004 AASHTO Green Book, Chapter 2.

F. Cul-De-Sacs and Turnarounds. A cul-de-sac represents a local street open at one end only with a special turning area at the closed end. This turning area desirably should be circular with a radius appropriate to the vehicle types expected.

The cul-de-sac commonly used represents a circular pavement symmetrical about the centerline of the street and may contain a central island. Although this design operates satisfactorily and has a pleasing appearance, better vehicle operation is achieved if the design is offset so that the entrance-half of the pavement is in line with the approach-half of the street. Where the radius used is less than 15 m (50 ft), the central island should be bordered by sloping curbs to permit an occasional oversized vehicle to maneuver.

Where the approach pavement width is at least 10 m (30 ft), the cul-de-sac can accommodate passenger cars, and a single unit truck can turn by backing only once. A radius of approximately 12 m (40 ft) shall enable truck tractor-semitrailer combinations to turn around by maneuvering back and forth.

A municipality may adopt a road or street with a cul-de-sac as a public highway. For the municipality to be eligible for Liquid Fuel Funds, the municipality is to follow the Department's Publication 9, *Liquid Fuels Handbook*. The *Liquid Fuels Handbook* states that all dead-end roads must be at least 76 m (250 ft) in length measured from the last intersection and be provided with a cul-de-sac having a radius of at least 12 m (40 ft).

For additional information concerning cul-de-sac and turnaround design guidelines and geometric features, refer to the 2004 AASHTO Green Book, Chapter 5.

G. Alleys. Alleys provide for access to the side or rear of individual land parcels. They are characterized by a narrow right-of-way and range in width from 5 m to 6 m (16 ft to 20 ft) in residential areas and up to 10 m (30 ft) in industrial areas.

Alleys should be aligned parallel to or concentric with the street property lines and should be situated in such a manner that both ends are connected either to streets or to other alleys. Alleys should have grades established to meet, as closely as possible, the existing grades of the abutting land parcels. The longitudinal grade should not be less than 0.2%.

Alleys should be provided with a central V gutter which directs runoff to a catch basin in the alley itself or to the connecting street gutter system.

H. Outer Separations and Border Areas. The area between the traveled way of a through traffic roadway and a frontage road or street is referred to as the "outer separation". These areas function as buffers for noise abatement in sensitive areas and provide space for shoulders, sideslopes, drainage, access-control fencing and possibly retaining walls and ramps in urban areas. The outer separation should be as wide as economically practical so local traffic shall have less influence on through traffic and should lend itself to landscape treatment that shall enhance the appearance of both the highway and adjoining property. Where ramp connections are provided between the through roadway and the frontage road, the outer separation should be wider than typical with the needed width dependent on the design requirements of the ramp termini. Where two-way frontage roads are provided, desirably the outer separation should be sufficiently wide to minimize the effects of the approaching traffic, particularly the nuisance of headlight glare at night.

The cross section and treatment of an outer separation depend largely upon its width and the type of arterial and frontage road. Preferably, the strip should drain away from the through pavement either to a curb and gutter at the frontage road or to a swale within the strip. Typical cross sections of outer separations are presented in the 2004 AASHTO Green Book, Chapter 4, Exhibit 4-13.

Where no frontage roads or local streets function as frontage roads, the area between the roadway of the main lanes and the right-of-way line is referred to as the border area. The border area between the roadway and the right-of-way line should be wide enough to serve several purposes including provision of a buffer space between pedestrians and vehicular traffic, sidewalk space, snow storage, an area for replacement of underground and above ground utilities such as traffic signals, parking meters and fire hydrants and an area for maintainable aesthetic features such
as grass or other landscaping. The border width should be a minimum of 1.5 m (5 ft) with a desirable width of 2.4 m to 3.6 m (8 ft to 12 ft) or wider. Every effort should be made to provide wide borders not only to serve functional needs but also as a matter of aesthetics, safety and reducing the nuisance of traffic to adjacent development.

I. Parking Lanes. A roadway network should be designed and developed to provide for the safe and efficient movement of vehicles operating on the system. Although vehicle movement is the primary function of the roadway network, certain segments may also provide on-street parking.

Within certain urban areas, existing and developing land uses necessitate the consideration of on-street parking so that the proposed street or highway improvement shall be compatible with the land use. On-street parking generally decreases through traffic capacity, impedes traffic flow and increases crash potential. Therefore, it is desirable to prohibit parking on arterial streets unless the available through-traffic lanes can accommodate the traffic volumes or adequate off-street parking facilities are not available or feasible. On urban arterial street reconstruction projects or on projects where additional right-of-way is being acquired to upgrade an existing route to arterial status, parking should be eliminated whenever practical to increase capacity and safety. However, the impact on abutting land uses should be carefully considered since the loss of existing on-street parking can affect the economic well-being of the abutting property.

The type of on-street parking selected should depend on the specific function and width of the street, the adjacent land use, traffic volumes and existing and anticipated traffic operations. When a proposed roadway design is to include on-street parking, parallel parking should be considered. Angle or diagonal parking may also be considered. However, this method presents special problems due to varying lengths of vehicles and sight distance problems associated with vans and recreational vehicles. The extra length of these vehicles may interfere with the traveled way. The principal problem of diagonal or angle parking, in comparison to parallel parking, is the lack of adequate visibility for the driver during the back-out maneuver. Diagonal or angle parking should only be considered in special cases and designed in accordance with the Department's Publication 212, *Official Traffic Control Devices*.

For parking lane widths, refer to Chapter 2, Section 2.4 and to Appendix A.

Pavement markings are recommended to identify parking space limits. The markings encourage a more orderly and efficient use of parking spaces where turnover is substantial and also tend to prevent or deter encroachment on fire hydrant zones, bus stops, loading zones, approaches to corners, clearance space for islands and other zones where parking is prohibited. Refer to the *MUTCD* for typical parking-space markings.

For additional information and general considerations for the design of parking lanes, refer to the 2004 AASHTO Green Book, Chapters 4, 6 and 7.

J. Mass Transit Facilities. Wherever there is a demand for highways to serve automobile traffic, there is likewise a demand for public transportation. The requirements for public transit and their compatibility with other highway traffic, bicycle traffic and pedestrian movement should be considered in the development and design of highways. Ensure that interference between the modes of transportation is minimized through careful planning, design and traffic control measures. Mass transit facilities may include bus stops and bus turnouts, park and ride facilities, rail transit and high-occupancy vehicle (HOV) facilities. For additional information concerning the location and design of these mass transit facilities, refer to the Department's Publication 13M, Design Manual, Part 2, *Highway Design*, Chapter 19 and the 2004 AASHTO Green Book, Chapters 4, 7 and 8.

K. Lighting. Refer to Chapter 2, Section 2.3.E.

L. Landscape Development. Landscape development should be provided for aesthetic and erosion control purposes in keeping with the character of the highway and its environment. Programs include the following general areas of improvement: (1) preservation of existing vegetation, (2) transplanting of existing vegetation where practical, (3) planting of new vegetation, (4) selective clearing and thinning and (5) regeneration of natural plant species and material.
The objectives in planting or the retention and preservation of natural growth on roadsides are closely related. In essence, they are to provide (1) vegetation that shall be an aid to aesthetics and safety, (2) vegetation that shall aid in lowering construction and maintenance costs and (3) vegetation that shall create interest, usefulness and beauty for the pleasure and satisfaction of the traveling public.

Care should be exercised to ensure the guidelines for sight distances and clearance to obstructions are observed especially at intersections. Landscaping should also consider maintenance problems and costs, future sidewalks, utilities, additional lanes and possible bicycle facilities. All landscape development shall conform to the general principles established in the Department's Publication 13M, Design Manual, Part 2, *Highway Design*, Chapter 8 and the additional sources of reference listed therein for all functional classification systems.

**M. Traffic Calming.** Traffic calming is defined as the combination of mainly physical measures in reducing the negative effects of motor vehicle use, altering driver behavior, and improving conditions for non-motorized street users. Publication 383, *Pennsylvania's Traffic Calming Handbook*, provides guidance for the Department when considering the use of traffic calming measures on State roadways in Pennsylvania. This handbook is also intended to provide municipalities with information in helping them establish a traffic calming program for roadways within their jurisdiction.

Traffic calming measures are mainly used to address speeding and high cut-through traffic volumes on neighborhood streets. These issues can create an atmosphere in which non-motorists are intimidated, or even endangered, by motorized traffic. Additionally, high cut-through volumes become an increased concern when larger commercial vehicles are involved. Along with the additional amount of traffic generated within the neighborhood, cut-through motorists are often perceived as driving faster than local motorists. By addressing high speeds and cut-through volumes, traffic calming can increase both the real and perceived safety of pedestrians and bicyclists, and improve the quality of life within the neighborhood.

The role of physical measures in traffic calming has been emphasized because they are "self-policing". This means that traffic calming measures, such as speed humps, have the ability to slow motor vehicles in the absence of enforcement. On the other hand, traffic control devices, such as turn prohibition signs, weight limits, and one-way streets, depend upon the level of police enforcement and the willingness of motorists to comply with the posted restrictions to be effective. Therefore, the use of traffic calming measures can often lead to a more certain accomplishment of the neighborhood's goals.

**3.5 DESIGN CRITERIA**

The applicable design criteria presented in *Chapter 2, Section 2.4* shall be used for the local urban road system.

**3.6 TYPICAL ROADWAY CROSS SECTIONS**

The applicable Typical Roadway Cross Section details presented in *Chapter 2, Section 2.5* shall be used in the design of typical sections for the local urban road system.