## D-1. Urban Street Overview.

## Streets and Urban Design

We have looked at streets as part of a larger, more complex transportation system. Similarly, the way streets work is also the result of many interactions between a street and adjacent activities, and the way a particular site's layout and design accommodate those activities.

This complex set of interactions—some of which are very site-specific and some of which are determined by economic factors—significantly affects how a street works. Identifying and understanding these factors is important as your neighborhood planning efforts focus on making streets that work. In fact, a number of land use issues and urban design choices that you consider as part of your neighborhood plan are very powerful tools for making streets that work.

### The transportation and land use linkage

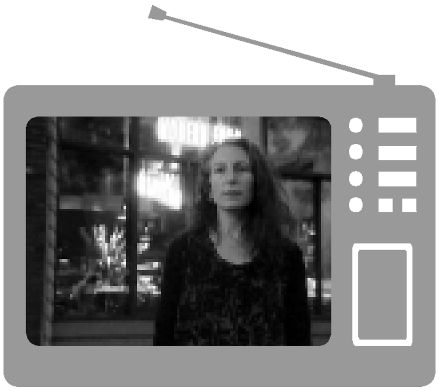
By their very nature, some land uses lend themselves to certain kinds of street activity and transportation choices. For example, a car wash will be a magnet for automobile access. It will also create an environment that is generally convenient for driving to and from, but not pleasant for walking by or for a bus stop. However, fast food restaurants and banks can be very auto-oriented (drive–up only), or they can accommodate a variety of transportation choices, or be completely pedestrian–dependent (like walk–up cash machines and espresso carts).

These various mixes of access (called "mode splits," to describe the split between various modes of transportation) have important effects on the street. Consider the impacts of a busy car wash or drive-up restaurant on a neighborhood commercial street. In addition to the noise and/or smells, there may be cars crossing the sidewalk (creating safety hazards for pedestrians) or lining up on the street (blocking the flow of traffic or access to on–street parking).

On the other hand, consider the impacts of a busy sidewalk espresso cart: it will attract lots of pedestrians and bicyclists, and customers lining up may make a boisterous evening ambiance. In these examples, the activities are very closely tied to the patterns of transportation choice. They affect the character of the streets on which they are located. In this regard, the City's Land Use Code is an important tool for determining what happens along our streets and how streets work.

### Did you know?

Federal law requires every state and metropolitan area to have a pedestrian and bicycle plan. Read the publication "Pedestrian and Bicycle Provisions Under ISTEA," available by calling (800) 760-6272.



**"At the Broadway Market... the interaction between inside and outside has made a great difference in the quality of community and the neighborhood here."**

**Laurrien Gilman, Gravity Bar owner**

### Shaping the street environment

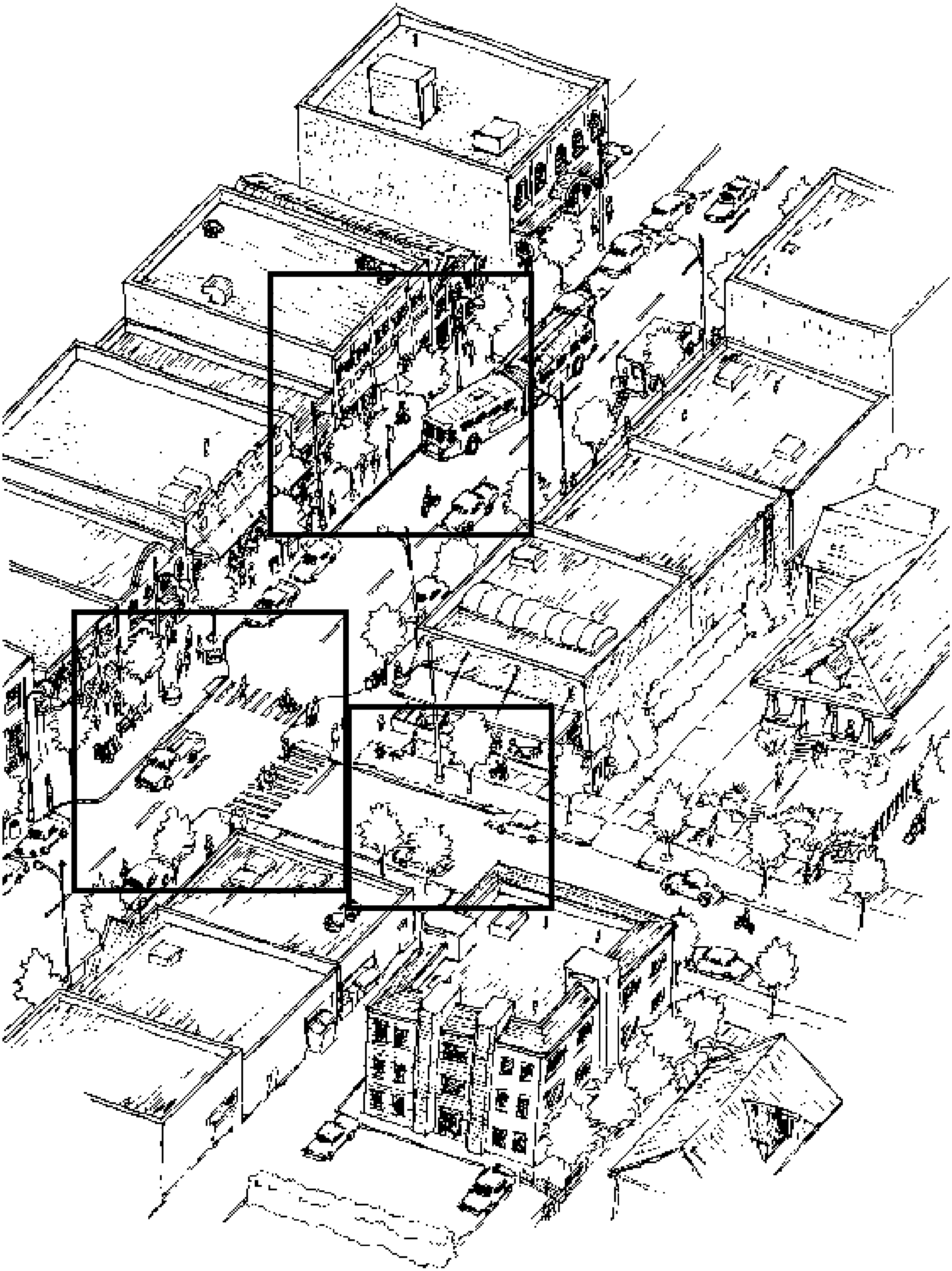
The street environment is literally shaped by the location and design of buildings adjacent to it. These are controlled by the Land Use Code. Buildings with blank faces onto the street will be unpleasant to walk along, while those that are built right up to the sidewalk and have windows, entrances, and awnings will be inviting to pedestrians. On the other hand, buildings that have signs readable at driving speeds, are separated from the sidewalk by **driveways** or open parking lots for automobiles are designed for drive–by traffic and create an automobile–oriented street environment.

The density of residences and/or employment in an area is also an important factor in what happens on streets. Above a minimum threshold of residential density, transit service is viable. Moreover, a “critical mass” of neighborhood activity can sustain a variety of retail shops that are accessible on foot or bicycle, and can contribute to public safety through the “eyes on the street” of residents, shoppers, and visitors.

The overall activity patterns of an area are very important to understanding the roles that streets play in creating a livable city. Areas with a diverse mix of residences, shops, restaurants, and other destinations open into the evening hours will indicate the overall importance of pedestrian activity and transit service. In contrast, the streets in a quiet, low–density residential area may be best suited to accommodating local traffic and deliveries. The neighborhood planning work you do with this book will be based on these kinds of distinctions.

## Look it up!

“Pedestrians and Zoning” and “Design Review” on page 88.



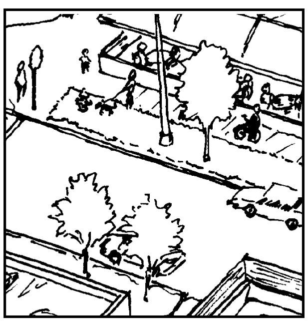
# What’s in a Street—the Big Picture

## The anatomy of a street

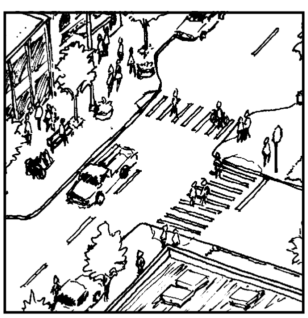
Like people, each street has an anatomy of parts, and each part has its function. **Curbs**, for example, perform many functions. They define the edge of the roadway, improve pedestrian safety by separating pedestrians from motor vehicles, and channel excess runoff water to storm drains. Street lights help increase our ability to see and be seen after dark and in doing so, increase safety. Signs orient us to our location and warn us about upcoming obstacles or changing conditions. Utilities and sewers, though out of sight, are equally important to the smooth function of streets.

But, as these pages show, there is more to a street than its parts. The following drawings demonstrate the role of streets in creating neighborhood identity, and outline the responsibilities of individuals and agencies in the care and maintenance of streets.

## Taking a closer look



The street **right–of–way** is the term used to describe the publicly–owned area between property lines. It can include a variety of elements, such as lanes for vehicle travel, parking, bicycling, walking areas, **street furniture**, bus stops, **utility poles**, **planting strips** with landscaping and trees, and signs.



The **intersection** of two streets is often the area where drivers, pedestrians, and bicyclists meet and navigate the same space. **Traffic control devices** such as stop signs or traffic signals help define who has the right–of–way. **Crosswalks** and **curb ramps** help define the pedestrian crossing area, and make crossings easier.

Lots of activity happens on the **sidewalks** and unpaved shoulders within the street right–of–way. This drawing illustrates a street with restaurants and shops, many of which extend onto the sidewalk with cafes, signs, or awnings. **Effective sidewalk width** is the area of the walkway clear of any obstructions, street furniture, or utility poles. A sidewalk area that is 10' or 12' wide may have an effective width that is significantly narrower, due to bus stop shelters, newspaper racks, signs, and trees taking up some of the space.

## D-2. Roadway Typical Sections

**STANDARDS FOR LOCAL STREETS**
**(Single Family Residential Areas)**

Function

A. Local streets provide direct access to adjacent property.

B. All traffic carried by local streets should have an origin or a destination within the neighborhood.

Right-of-Way Width

In single family residential areas (RS-1, RS-2, RS-3, RS-4, and R-O and R-1 Districts in Denver Zoning Ordinance) - 50'

Number of Moving Lanes

Generally two.

Access Conditions

Intersections at grade with direct access to abutting property.

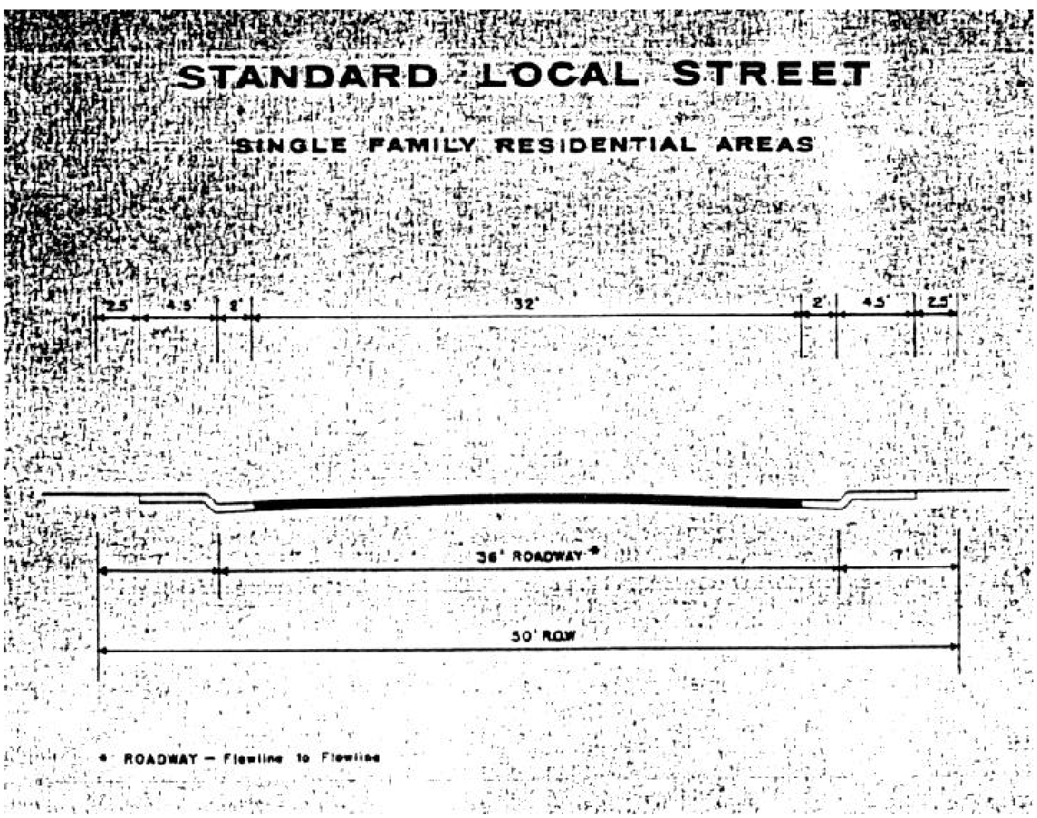
Traffic Characteristics

Traffic and access requirements in these areas may require special design consideration by the City Engineer and the City Traffic Engineer.

Planning Characteristics

A. Local streets should be designed to discourage through traffic from moving through these areas.

B. These streets should intersect arterial street, as infrequently as possible and only in reasonable locations.



**STANDARDS FOR**
**LOCAL STREETS**

(**Multiple Family, Residential, Business and Industrial Areas**)

Function

A. Local streets provide direct access to adjacent property.

B. All traffic carried by local streets should have an origin or a destination within the immediate area.

Right-of-Way Width

In multiple family residential areas (R-2, R-2-A, R-3, R-3-X, R-4 and R-5 Districts in Denver Zoning Ordinance) and for streets abutting a business district (B-1, B-A-1, B-2, B-A-2, B-3, B-A-3, and occasionally B-4 Districts in the Denver Zoning Ordinance) - 60'

In industrial areas (I-P, I-0, I-1, and I-2 Districts in the Denver Zoning Ordinance) 60'.

Number of Moving Lanes

Two to four.

Traffic Characteristics

Usually direct access to residential properties by way of curb cuts or drive over curbs. Parking normally allowed on both sides of the street.

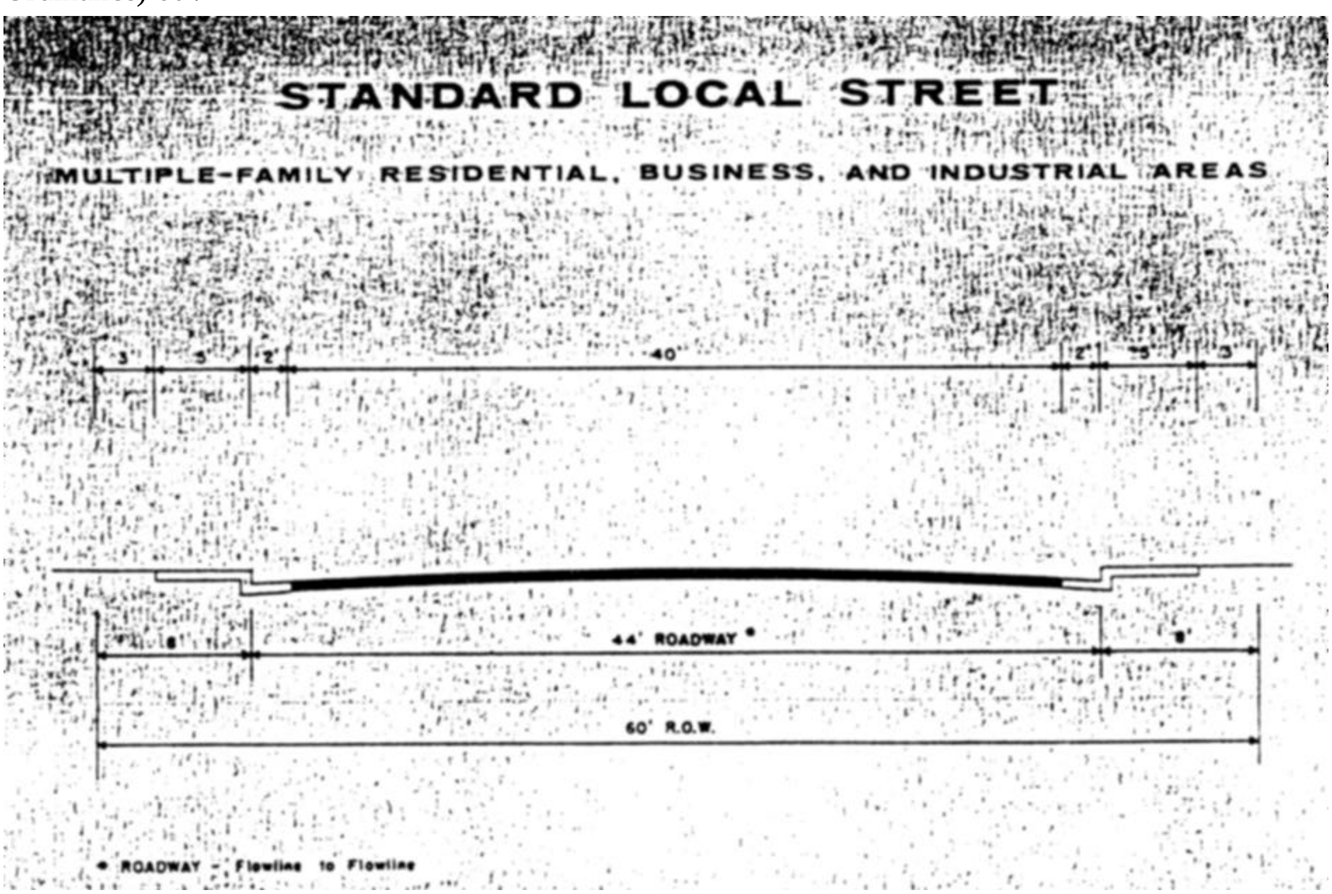
Access Conditions

Intersections at grade with direct access to abutting property permitted.

Planning Characteristics

A. Local streets should be designed to discourage through traffic from moving through the neighborhood

B. Local streets should not intersect arterial streets.



**STANDARDS FOR COLLECTOR STREETS**

Function

A. Collector streets collect and distribute traffic between arterial and local streets.

B. Collector streets serve as main connectors within communities, linking one neighborhood with another or one industrial district with another.

C. All traffic carried by collector streets should have an origin or a destination within the community

Right-of-Way Width

70'

Number of Moving Lanes

Two to Four

Access Conditions

Intersections at grade with direct access to abutting property permitted.

Traffic Characteristics

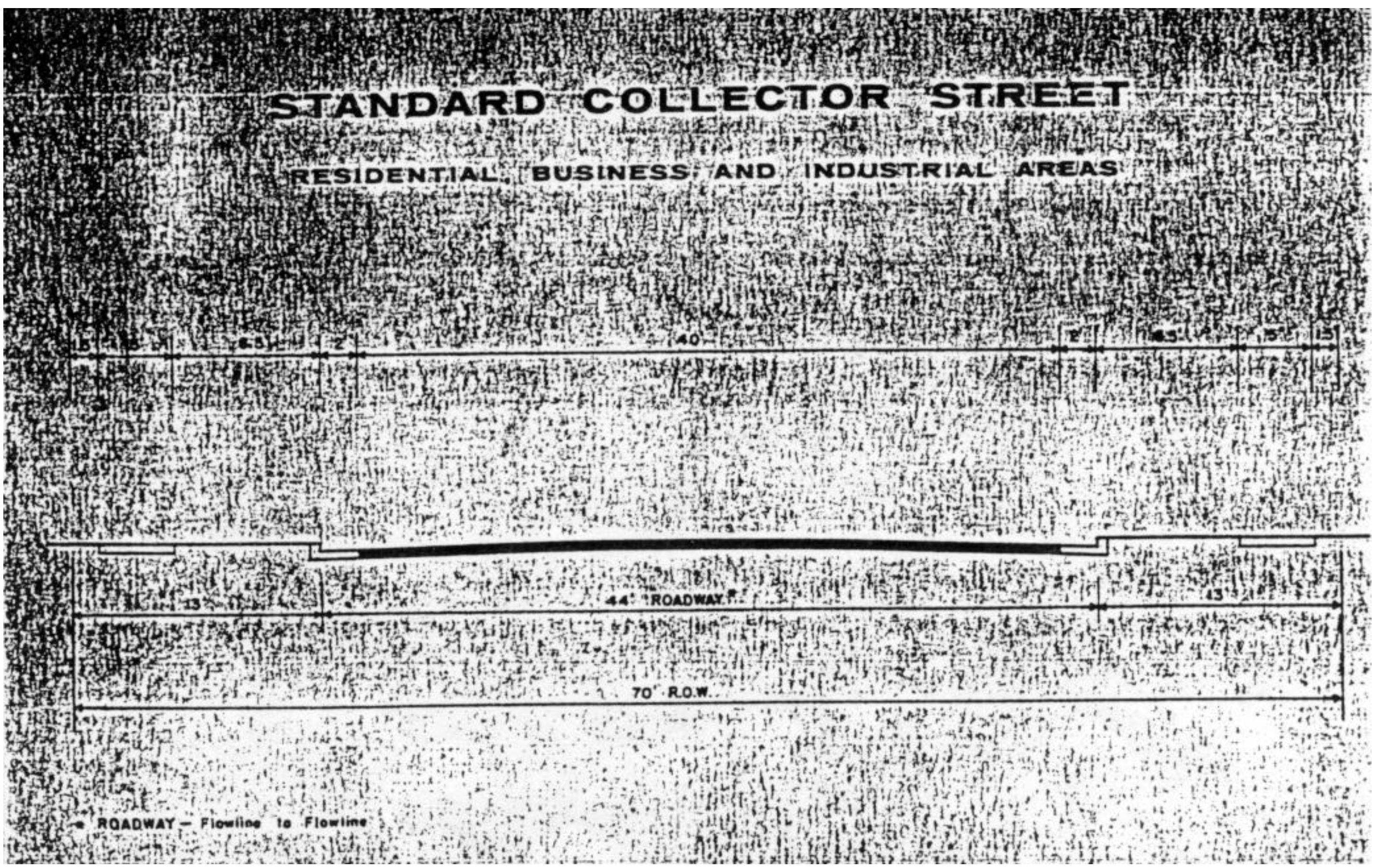
Regulation of traffic between collector streets and other types of streets accomplished by normal traffic engineering devices.

Planning Characteristics

A. Collector streets should have continuity throughout a neighborhood or industrial district but need not extend beyond the neighborhood or industrial district.

B. Intersections with arterial streets should be at least one-quarter mile apart.

C. Sidewalks should be set back from the street.



**STANDARDS FOR ARTERIAL STREETS**

Function

Arterial streets permit rapid and relatively unimpeded traffic movement throughout the City, connecting major land use elements as communities with one another.

Right-of-Way Width

Two-way operation: 120'

Number of Moving Lanes
Four to Six.

Access Conditions

A. Intersections will generally be at grade.

B. Intersections with collector streets should normally be located at one-quarter mile intervals.

C. Access from collector streets should be permitted only when the access can be controlled by traffic control devices. Normally, residential properties will not be allowed direct access to the street, nor should they face on the roadway unless separated from it by a frontage road.

Traffic Characteristics

A. Movement of traffic will be controlled by signals and channelization.

B. Parking may be prohibited.

C. Normally designed as two separate roadways separated by a median.

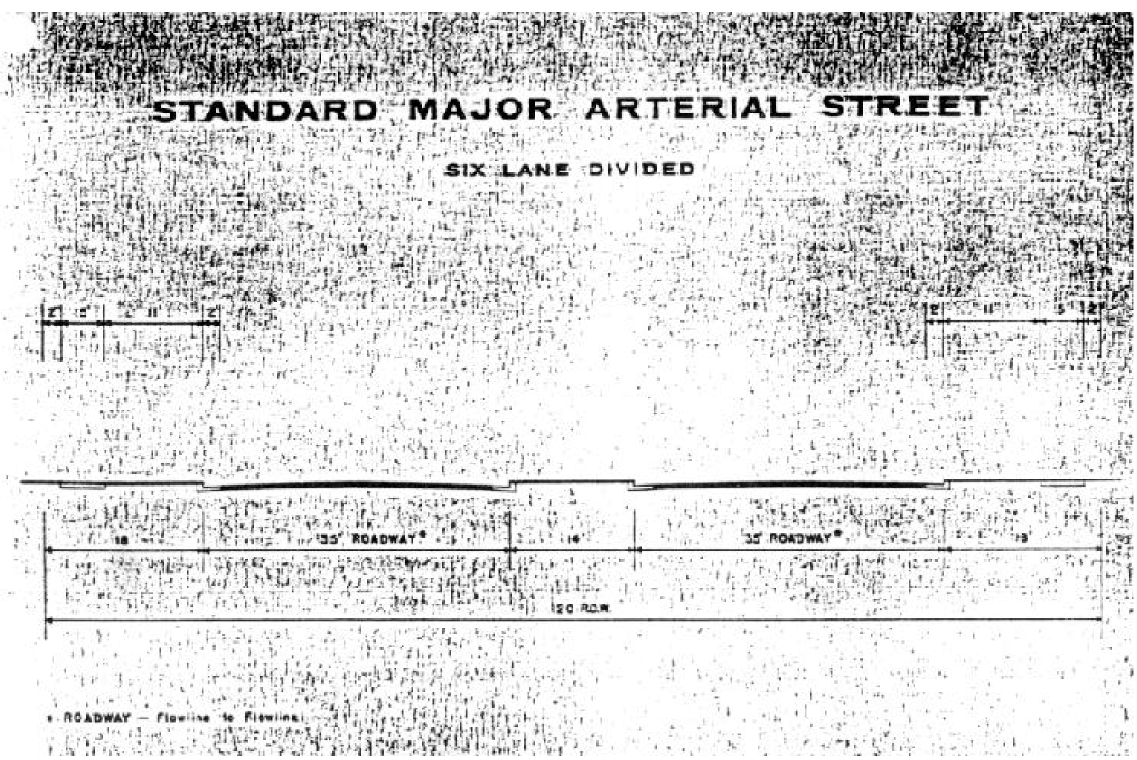
Planning Characteristics

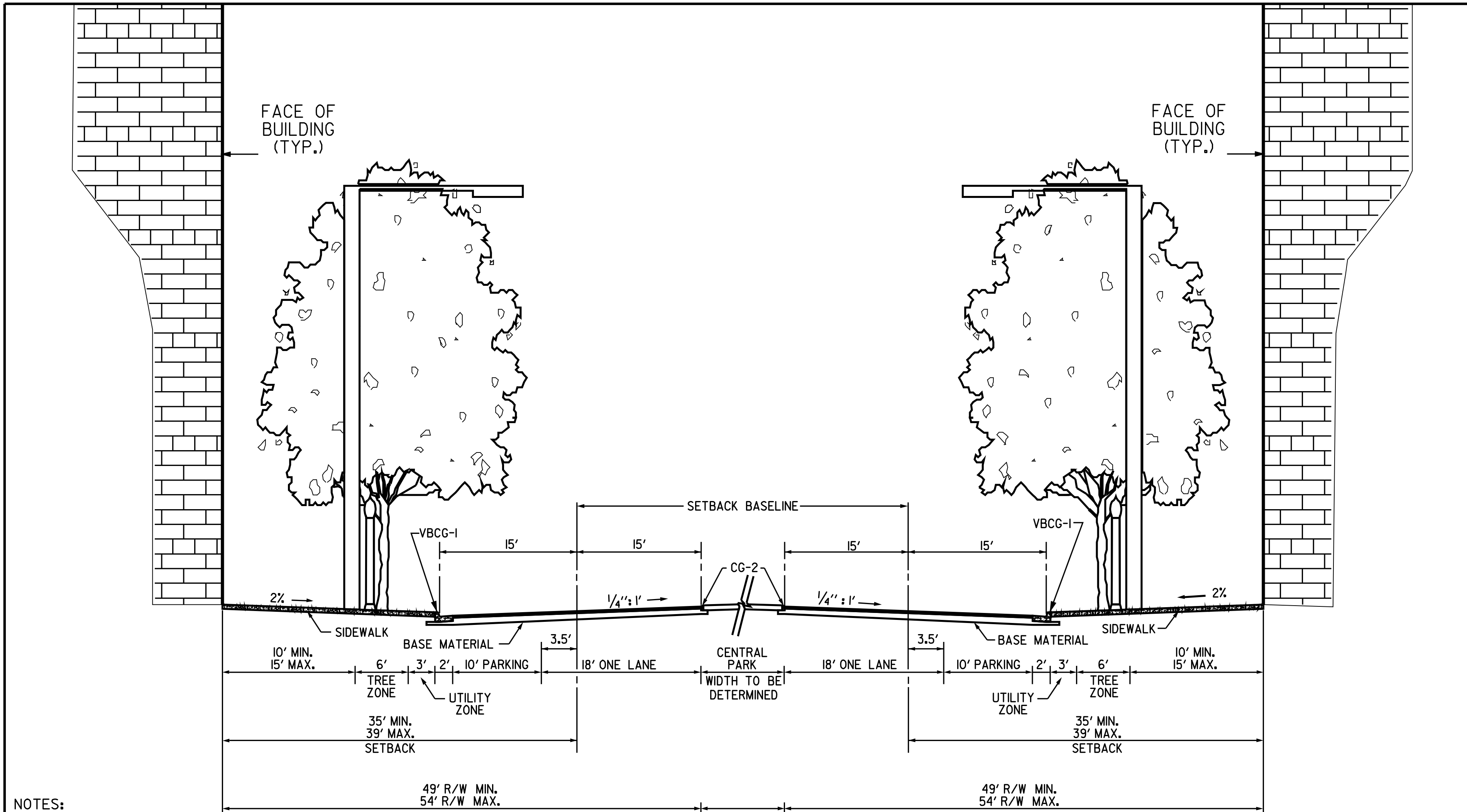
A. Arterial streets should be spaced approximately one mile apart and should traverse the entire city.

B. Arterial streets should not bisect neighborhoods but should act as boundaries between them.

C. Sidewalks should be set back from the street.

D. The median should be landscaped wherever practicable






NOTES:

1) STREET LIGHT DESIGN IS REQUIRED TO DETERMINE POLE HEIGHT, ARM LENGTH, LIGHT TYPE, AND WATTAGE.

2) DETAILS TO BE APPROVED AS AGREED UPON FOR INCLUSION INTO THE CBD CORE DESIGN CRITERIA FOR SIGN POSTS, CONCRETE PAVER UNITS, TREES, STREET LIGHTS, TREE GRATES, ETC.

3) LIGHTING WILL BE UNIFORM AND IDENTIFIED IN THE DESIGN CRITERIA.

**FOR B-3A ZONING IN CENTRAL BUSINESS DISTRICT**

*N.T.S.*

MINIMUM POLE SETTING DEPTH

| LENGTH OF POLE | CONDITIONS | | |
|---|---|---|---|
| | SOLID ROCK | FIRM SOIL | POOR SOIL |
| 30' | 3'-6" | 5'-0" | 5'-6" |
| 35' | 4'-0" | 5'-6" | 6'-0" |
| 40' | 4'-0" | 5'-6" | 6'-0" |

Intersection Typical Sections and Designs will be required with projects showing the placement and locations of right turn lanes, left turn lanes (possibly dual), sidewalks, landscaping and all utilities, including : street lights, traffic control, water, sewer, gas, power, telephone, television, storm drainage, etc.

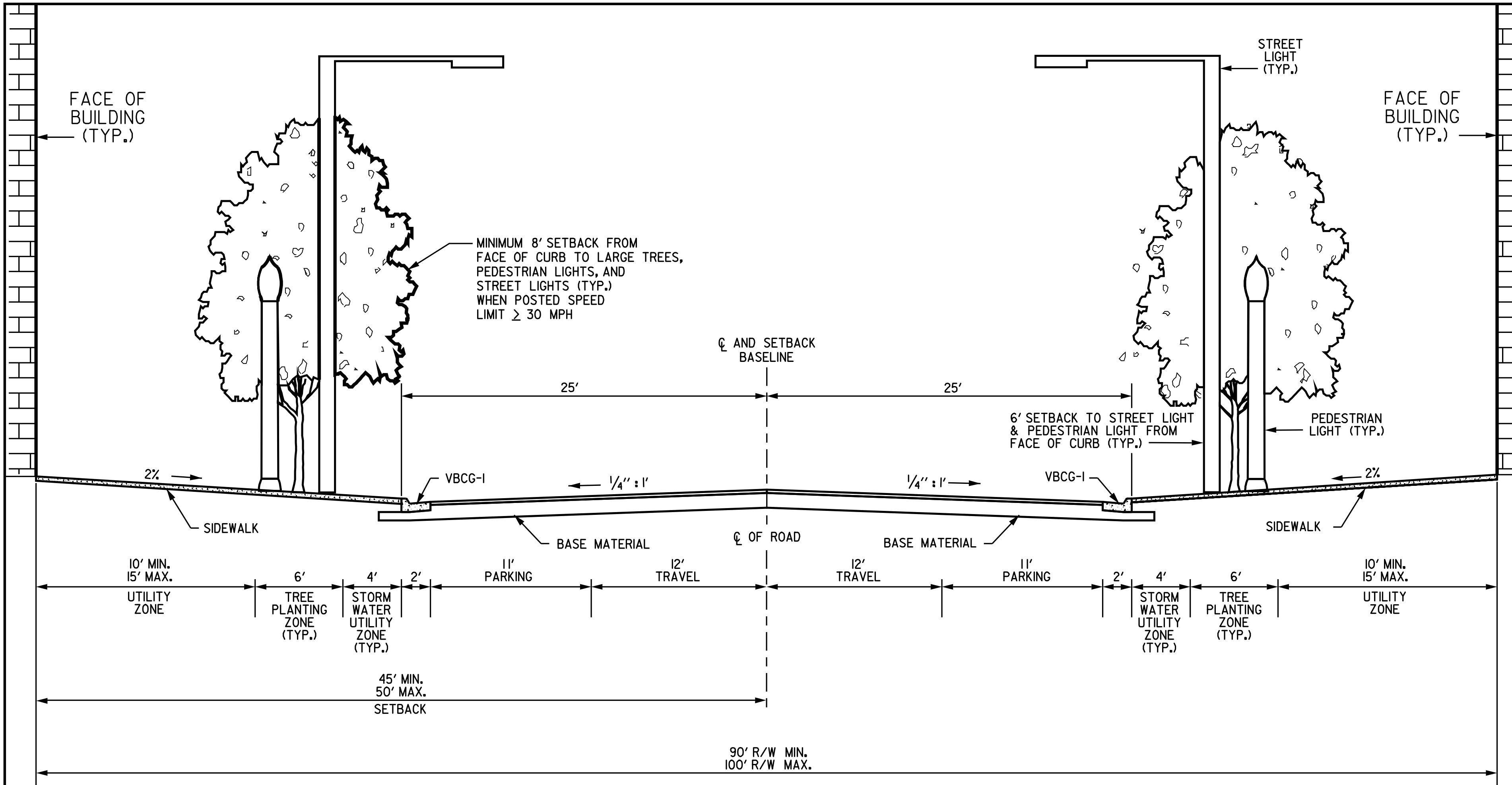
(N.T.S.)

REV. 5/04

CITY OF VIRGINIA BEACH
STANDARD

TYPICAL SECTION FOR
LOCAL ONE WAY (CBD CORE AREA)

PUBLIC WORKS | A-25




NOTES:

1) STREET LIGHT DESIGN IS REQUIRED TO DETERMINE POLE HEIGHT, ARM LENGTH, LIGHT TYPE, AND WATTAGE.

2) DETAILS TO BE APPROVED AS AGREED UPON FOR INCLUSION INTO THE CBD CORE DESIGN CRITERIA FOR SIGN POSTS, CONCRETE PAVER UNITS, TREES, STREET LIGHTS, TREE GRATES, ETC.

3) LIGHTING WILL BE UNIFORM AND IDENTIFIED IN THE DESIGN CRITERIA.

***FOR B-3A ZONING IN CENTRAL BUSINESS DISTRICT***

*N.T.S.*

| MINIMUM POLE SETTING DEPTH | | | |
|---|---|---|---|
| LENGTH OF POLE | CONDITIONS | | |
| | SOLID ROCK | FIRM SOIL | POOR SOIL |
| 30' | 3'-6" | 5'-0" | 5'-6" |
| 35' | 4'-0" | 5'-6" | 6'-0" |
| 40' | 4'-0" | 5'-6" | 6'-0" |

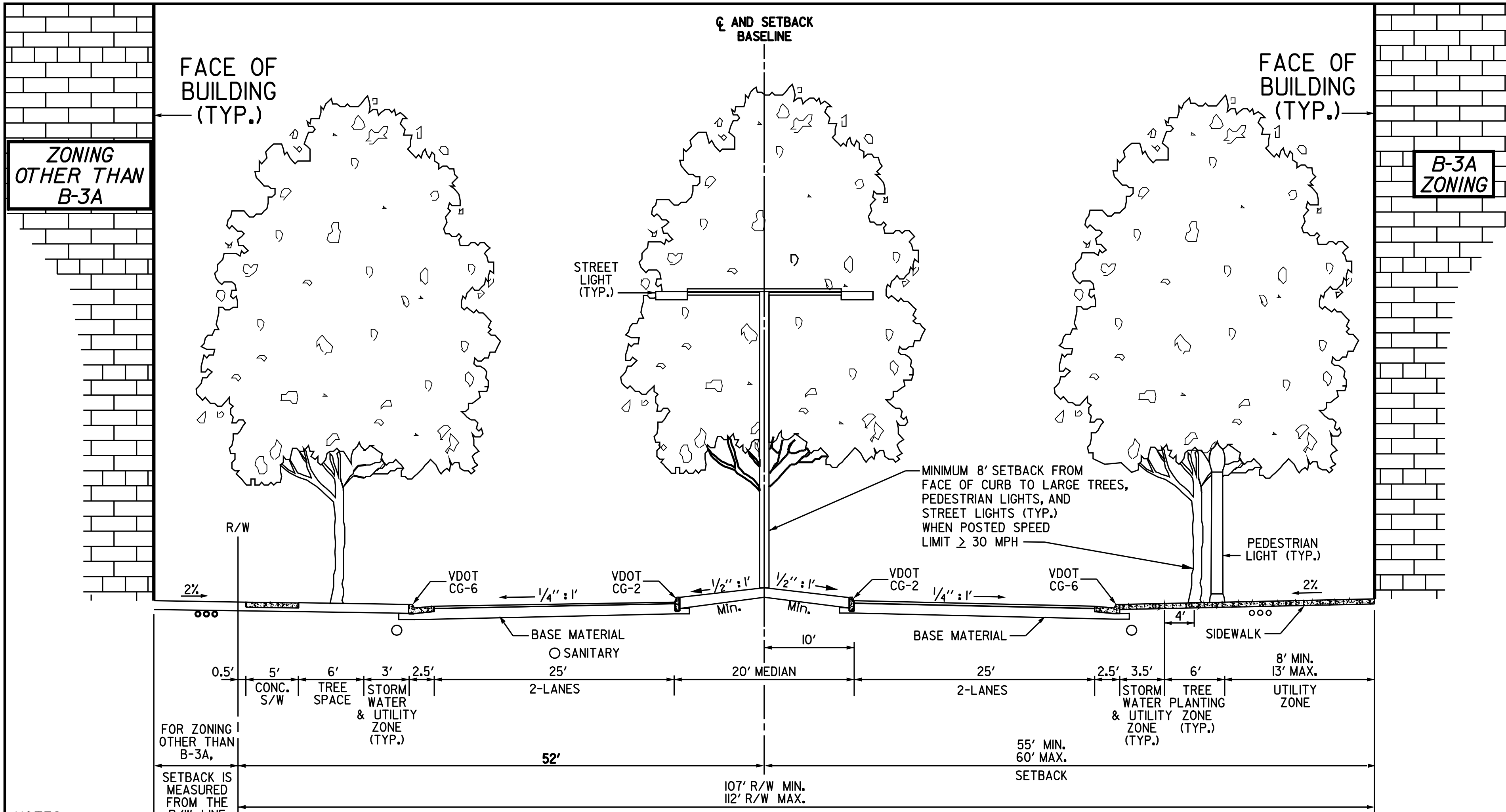
Intersection Typical Sections and Designs will be required with projects showing the placement and locations of right turn lanes, left turn lanes (possibly dual), sidewalks, landscaping and all utilities, including : street lights, traffic control, water, sewer, gas, power, telephone, television, storm drainage, etc.

*(N.T.S.)*
REV. 5/04

***CITY OF VIRGINIA BEACH***
*STANDARD*

*TYPICAL SECTION FOR LOCAL TWO WAY (CBD CORE AREA)*

PUBLIC WORKS | *A-26*




NOTES:

1) STREET LIGHT DESIGN IS REQUIRED TO DETERMINE POLE HEIGHT, ARM LENGTH, LIGHT TYPE, AND WATTAGE.

2) DETAILS TO BE APPROVED AS AGREED UPON FOR INCLUSION INTO THE CBD CORE DESIGN CRITERIA FOR SIGN POSTS, CONCRETE PAVER UNITS, TREES, STREET LIGHTS, TREE GRATES, ETC.

3) LIGHTING WILL BE UNIFORM AND IDENTIFIED IN THE DESIGN CRITERIA.

**FOR B-3A**
**OPPOSITE OTHER ZONING IN CENTRAL BUSINESS DISTRICT**

*N.T.S.*

MINIMUM POLE SETTING DEPTH

| LENGTH OF POLE | CONDITIONS | | |
|---|---|---|---|
| | SOLID ROCK | FIRM SOIL | POOR SOIL |
| 30' | 3'-6" | 5'-0" | 5'-6" |
| 35' | 4'-0" | 5'-6" | 6'-0" |
| 40' | 4'-0" | 5'-6" | 6'-0" |

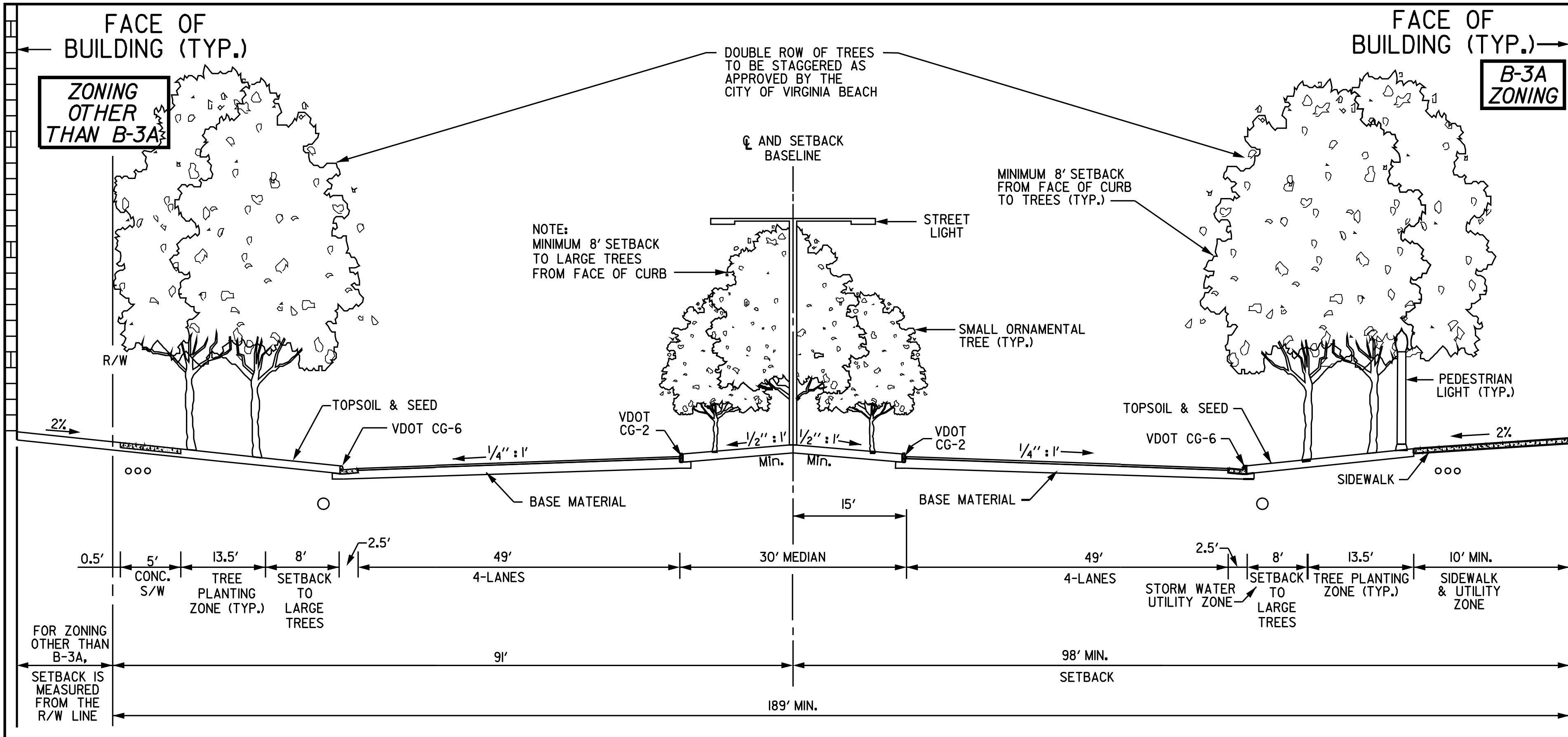
Intersection Typical Sections and Designs will be required with projects showing the placement and locations of right turn lanes, left turn lanes (possibly dual), sidewalks, landscaping and all utilities, including : street lights, traffic control, water, sewer, gas, power, telephone, television, storm drainage, etc.

(N.T.S.)
REV. 5/04

CITY OF VIRGINIA BEACH
STANDARD

TYPICAL SECTION FOR
CORE AREA COLLECTOR STREET

PUBLIC WORKS | A-27




NOTES:

1) STREET LIGHT DESIGN IS REQUIRED TO DETERMINE POLE HEIGHT, ARM LENGTH, LIGHT TYPE, AND WATTAGE.

2) DETAILS TO BE APPROVED AS AGREED UPON FOR INCLUSION INTO THE CBD CORE DESIGN CRITERIA FOR SIGN POSTS, CONCRETE PAVER UNITS, TREES, STREET LIGHTS, TREE GRATES, ETC.

3) LIGHTING WILL BE UNIFORM AND IDENTIFIED IN THE DESIGN CRITERIA.

4) MINIMUM 8' SETBACK FOR ALL TREES MEASURED FROM FACE OF CURB.

**FOR B-3A OPPOSITE OTHER ZONING IN CENTRAL BUSINESS DISTRICT**

N.T.S.

MINIMUM POLE SETTING DEPTH

| LENGTH OF POLE | CONDITIONS | | |
|---|---|---|---|
| | SOLID ROCK | FIRM SOIL | POOR SOIL |
| 30' | 3'-6" | 5'-0" | 5'-6" |
| 35' | 4'-0" | 5'-6" | 6'-0" |
| 40' | 4'-0" | 5'-6" | 6'-0" |

Intersection Typical Sections and Designs will be required with projects showing the placement and locations of right turn lanes, left turn lanes (possibly dual), sidewalks, landscaping and all utilities, including : street lights, traffic control, water, sewer, gas, power, telephone, television, storm drainage, etc.

(N.T.S.)
REV. 5/04

CITY OF VIRGINIA BEACH
STANDARD

TYPICAL SECTION FOR ARTERIAL (CBD CORE AREA)

PUBLIC WORKS | A-28

## D-3. Bicycle and Pedestrian Facilities

# CHAPTER 28

# BICYCLE FACILITIES

## 28.1 General

This chapter sets forth the minimum criteria to be used in the design of all bike lanes, bike paths, or other bicycles facilities within the District's ROWs or easements.

## 28.2 References

Listed below are the references to be used in developing bicycle facilities:

- **Current AASHTO, Guide for the Development of Bicycle Facilities,** as published by the American Association of State Highway and Transportation Officials. This reference was the main reference in this chapter.
- American Traffic Safety Services Association (ATSSA)
- Institute of Transportation Engineers (ITE)
- Manual on Uniform Traffic Control Devices (MUTCD) Part 9
- DCMR 18-DC Traffic Laws
- DDOT Bicycle Design Guidelines
- DDOT Web Site HTTP://www.DDOT.DCGOV
  a) Bicycle Master Plan
  b) Bicycle Advisory Council
  c) Program Manager

While all of the above references should be utilized, the final design considerations shall be approved by the DDOT Bicycle Program Manager.

## 28.3 ADA Requirements

All designs for off-street bicycle paths are considered shared-use paths and shall conform to **ADA** requirements.

## 28.4 General

The bicycle has become an important element for consideration in the highway design process. Most bicycle travel takes place on the highway system, as it presently exists. Therefore, enhancement of an existing route's safety and capacity for bicycle traffic can be achieved through low-cost measures such as those indicated below:

- Paved shoulders (at least 4 ft.)
- A wide outside traffic lane if no shoulders exist (12 ft. to 15 ft.)
- Bicycle-safe drainage grates
- At-grade manhole covers
- A smooth, clean riding surface
- Bicycle sensitive loop and microwave traffic signal detectors

At certain locations, the existing highway system may be further supplemented by providing specifically designed bikeways for either exclusive or nonexclusive bicycle use. To provide adequately for a bikeway facility, the designer should be familiar with bicycle dimensions, operating characteristics, and requirements. The development and design of bikeway facilities should reflect the criteria presented in the **AASHTO publication "Guide for Development of Bicycle Facilities" third edition.**

### 28.4.1 Permitted Bicycle Travel Areas

Bicycles are permitted on all roadways in the District of Columbia except where expressly prohibited through appropriate administrative action and subsequent installation at signs.

### 28.4.2 Maintenance Responsibility

Maintenance and operation responsibility for new bike paths in the public access easement will be determined during the site/subdivision plan approval process. Public access/bike path easements shall be conveyed to the District. The easement width shall be clearly indicated on the site plan or construction plans.

### 28.4.3 Appurtenances Avoided

Manholes, utility poles or other appurtenances or obstructions, should not be located in bike lanes or bike paths, if possible.

## 28.5 On-Street Bike Facilities Design Requirements

### 28.5.1 On-Street Bike Routes

Certain streets are designated in the District Bicycle Plan as on-street bicycle routes. These routes are on streets with lower traffic volumes and speeds or wide outside lanes, and they are marked with bicycle route signs. Some streets within new developments or re-developments must also contain additional roadway width for bike lanes.

Sight distance is the distance necessary for a vehicle operator to perform expected functions and be able to do so without causing a hazard for the driver or other vehicle operator for the specific design speed of the street. Vehicles shall perform moves without causing other vehicles to slow from the average running speed. In no case shall the distance be less than the stopping sight distance. This includes visibility at intersections and driveways as well as around curves and roadside encroachments. Stopping sight distance is calculated according to the **AASHTO Green Book**. Object height is 6 in. above road surface and viewer's height is 3.50 ft. above road surface.

Where an object off the pavement restricts sight distance, the minimum radius of curvature is determined by the stopping sight distance exists at all property lines except in the sight-distance easements that may be required to preserve the needed sight distance.

Stopping sight distance on horizontal curves is based upon lateral clearance from the inner edge of pavement to sight obstruction, for various radii of inner edge of pavement and design speeds. The position of the driver's eye and the object sighted shall be assumed to be 6 ft. from the inner edge of pavement, with the sight distance being measured along this arc. Stopping sight distances are given in Table 30-E.

Table 30-E:
Stopping and Passing Sight Distance

| DESIGN SPEED (MPH) | STOPPING SIGHT DISTANCE (FT.) | PASSING SIGHT DISTANCE (FT.) |
|---|---|---|
| 20 | 125 | 800 |
| 25 | 150 | 1000 |
| 30 | 200 | 1100 |
| 35 | 250 | 1300 |
| 40 | 275 | 1500 |
| 45 | 325 | 1650 |
| 50 | 400 | 1800 |

NOTE: From **AASHTO Green Book** Table III-1, Table III-5 and Table VII-3

On Arterials and Collectors, the corner sight distance shall provide for vehicles to enter traffic and accelerate to the average running speed. All sight-distance triangles must be shown on the street plan/profile plans. All sight distances must be within the public ROW or a sight distance easement. If the line of sight crosses onto private property, a "Sight Distance Easement" shall be indicated on the plat to meet the required sight distance. The District shall obtain from the property owner the

# CHAPTER 29

# PEDESTRIAN AND AMERICAN DISABILITIES ACT (ADA) FACILITIES

## 29.1 General

This chapter sets forth the minimum criteria to be used in the design of all sidewalks, curb ramps, and other pedestrian facilities within the right-of-way (ROW), or other public easements.

## 29.2 AASHTO Reference

**"A Policy on Geometric Design of Highways and Streets",** as published by AASHTO, the American Association of State Highway and Transportation Officials, was used as a reference within this chapter.

## 29.3 ADA Requirements

All pedestrian facilities shall be designed in accordance with **ADA** regulations and the requirements of these Standards, whichever is safer for pedestrians, and also meet Traffic Safety Division's (DDOT) requirements.

**Overview of ADA:** "No qualified individual with a disability shall, by reason of such disability, be excluded prom participation in or be denied the benefits of the services, programs or activities of a public entity."

**Non-discrimination on the Basis of Disability in State and Local Government [28 CFR 35.104] Definitions:** "Disability means, with respect to an individual, a physical or mental impairment that substantially limits one or more of the major life activities of such individual; a record of such an impairment; or being regarded as having an impairment." "Facility means all or any portion of buildings, structures, sites, complexes, equipment, rolling stock or other conveyances, roads, walks passageways, parking lots or other real or personal property, including the site where the building, property, structure, or equipment is located." "Public entity means (1) Any State or local government; (2) Any department, agency, special purpose district, or other instrumentality of a state or States or local government." "State means each of several States, the District of Columbia, …"

## 29.4 Sidewalks

### 29.4.1 General Layout and Design Criteria

All public sidewalks shall comply with the requirements of the ADA Accessibility Guidelines, which includes without limitations, sidewalk widths, grades, locations, markings, surface treatments, and curb ramps.

The Public Space Permits and Record Branch maintains a **Designated Street Distribution** (card file) for each street within the District of Columbia. This Designation Street Distribution contains information for each street and these designated widths are the minimum requirements each street must meet. The overall designated public space street width is called the street's right-of-way. Located within this right-of-way is the designated width for the roadway, sidewalks, and/or parking located on both sides of the street.

Whenever there are any changes or improvements made within the public space area of each street, these designated widths must be maintained. These designated street widths may vary from block to block.

These sidewalk width designations are important when installing curb lay-bys for vehicles and circular driveways, as there is a required minimum, which must be met for pedestrian's safety before the Traffic Safety Division will allow vehicles to encroach within the designated sidewalk widths. (**Definition:** a lay-by is a paved area beside a main road where vehicles can stop temporarily)

When there is no designated sidewalk width, then the minimum sidewalk width adjacent to the installation of a lay-by will be 10 ft. This will allow for the typical vehicle door's opening (3'-8") and a minimum 6 ft. clear path for the pedestrians to walk by. This minimum 10 ft. width allows a disabled person room to maneuver when entering and exiting a vehicle in a safe manner, without impeding the other pedestrians walking along the sidewalk.

Whenever any changes are made within the public space right-of-way of a street, a written justification is required stating what part of the street's right-of-way is being changed and the reason for this change. The Traffic Services Administration requires all affecting agencies within the District of Columbia to state their comments about the subject changes. They also require the agencies to concur in writing whether they are in agreement or not in agreement via a formal consent form. Any proposed change of the street's right-of-way is subject to approval by the Director, Department of Transportation (DDOT).

### 29.4.1.1 Sidewalk Widths

- Minimum Sidewalk Widths at Bus Stops – Minimum sidewalk with at bus stops shall be 6 ft., a traffic safety requirement.
- Minimum Sidewalk Width - Minimum sidewalk width shall be 6 ft.
- Additional Sidewalk Width - The District Project Manager may require additional width for activity areas and routes leading to these areas. The final sidewalk width shall be determined through additional study of higher pedestrian traffic areas.

Most persons will avoid the area less than 30 in. away from the edge of the roadway and 18 – 30 in. from a building façade. Additionally, the presence of street furniture and other features will also reduce the effective width of a pathway for pedestrians. The minimum pathway must be no less than 36 in. However, if the existing sidewalk width is less than 36 inches, "passing pads" measuring 60" x 60" must be constructed every 200 ft. to allow disabled persons to pass one another. Crossing driveways and alleys are considered "passing pads".

### 29.4.1.2 Sidewalk Both Sides of Street

All new street designs shall include sidewalks on both sides of the street. All projects should consider the need for a sidewalk. Sidewalks should be included in projects if the pedestrian volume warrants a sidewalk or if the street is on a typical walkway to schools. For existing streets, the community should be consulted when the project consists of installing a new permanent sidewalk or replacing a temporary sidewalk with a permanent sidewalk.

### 29.4.1.3 Slope

- Cross Slope – Maintain 2 percent (maximum) or ¼ in. per ft. sidewalk cross slope towards the roadway. Maximum cross slope for sidewalks shall be 3 percent only as directed, since 3 percent does **NOT** meet ADA requirements.
- Longitudinal Slope - Longitudinal slope shall be consistent with the street slopes but should not exceed 8 percent. Maximum longitudinal slopes are limited to 8 percent in all new development construction.
- ADA Requirements for Steeper Longitudinal Slopes - Sidewalks detached from the curb, with greater than 5 percent longitudinal slope, shall be constructed to meet ADA requirements.

At sidewalk grade changes leading to retail businesses detectable warning strips are needed at both the top and the bottom of stairways. Truncated domes are also used in hazardous locations when a walking surface and vehicular driveways and/or alleys cross or adjoin and are not separated by curbs or other elements, and on all ramp locations.

## 29.10 Pedestrian Refuge Areas

Provide a pedestrian refuge of at least 6 ft. long in the direction of pedestrian travel when driveway width is 25 ft. and over. A pedestrian refuge area shall be created in the median to increase pedestrian safety. The vehicle turning radii must be taken into account with the specific design of islands. The District requires delineation of the pedestrian crossing by using a different surface material or texture in the roadway; this guides the sight-impaired to the refuge area.

## 29.11 Multi-Use Paths

Where a single, multi-use path is used to serve both pedestrians and bicyclists, the minimum path width shall be 10 ft.

## 29.12 Pedestrian Minimum Clear Path

The minimum clear path around utility structures, street furniture and other encroachments shall be greater or equal to the sidewalk width. The minimum width is 36 inches.

## 29.13 Bus Shelters

### 29.13.1 Location

The Washington Metropolitan Area Transit Authority (WMATA) shall determine the location of the bus shelter. The Project Manager will contact the Department's Mass Transit Division for coordination.

The Traffic Safety Division requires a minimum clear 8 ft. long sidewalk parallel to the curb of the street and adjacent to the front doors of the bus. This area must be free of any obstacles and it must have a minimum 6 ft. sidewalk depth to allow the bus handicap kneeler to operate for receiving wheelchair users. An 8 ft. minimum clear zone area is required at all bus stops. Shelters can no longer be put within this area and should not block the existing sidewalk width for pedestrians using the sidewalk but not boarding a bus.

## 29.7 Pedestrian Crossings

Crosswalks will be required at all signalized intersections, school areas, and high pedestrian areas. Crosswalks may be required at mid-block crossings in neighborhoods, activity centers, trail or path crossings and school crossings when approved by the Traffic Services Administration. Local streets longer than 600 ft. may require additional accesses, which should be spaced approximately 300 ft. apart. If mid-block ramps are used, pavement markings and signing in accordance with the **Traffic Control** chapter of this manual shall be provided.

The crosswalks should line up with the curb ramp. The entire curb ramp must be located within the crosswalk, including side flares. The crosswalk lines shall be perpendicular to the centerline of the roadway except in intersections that are skewed. The crosswalks shall be positioned in accordance with the Traffic Services Administration's requirements. The crosswalks will be designed with brick or stamped concrete in historic and business districts when directed by the Project Manager. All sidewalks that cross over driveways and alleys shall be designed in accordance with ADA Standards. Sidewalk grades are to be maintained at driveways. There shall not be crosswalks in cross-pans. Definition: The crosspan is the swale portion of a driveway apron that carries water from one side to the other.

## 29.8 Hearing Impairments

Individuals with hearing impairments may encounter barriers that center around spoken information and audible warning communication, as vision is relied upon for information needs. Danger may occur when alarms such as automobile horns or fire alarms are not accompanied by flashing lights or other visual cues. Clear signage is important to persons with hearing impairments when verbal communication is not possible.

## 29.9 Tactile Warning Strips (Detectable Warnings): A Traffic Safety Division Requirement

Differences in paving materials can provide tactile cues to aid negotiation and identify hazards. Truncated domes are a detectable warning device used on walkway surfaces and curb ramps to warn visually impaired persons of abrupt grade changes and hazardous vehicular areas. Detectable warning strips are used at potentially dangerous exits such as corners and mid-block crossings, water fountains, and other obstructions to warn visually impaired persons of abrupt grade changes.

### 29.13.7 Shelters on Highways

Approval for installations of all bus shelters proposed in the District Rights-of-Way shall be obtained from DDOT, Office of Mass Transit, prior to any construction of the shelters.

## 29.14 Bus Stops

The Washington Metropolitan Area Transit Authority (WMATA) shall determine the location of the bus stops. The Project Manager will contact the Department's Mass Transit Division for coordination.

### 29.14.1 Bus Stop Spacing Requirements

The bus stop locations must have 120 ft. of clear distance between the last parking area and the curb line of the intersecting street. This clear distance provides for 50 ft. of taper, 40 ft. of bus stop, 5 ft. of clear distance to the crosswalk and 25 ft. to the curb line. The length of a bus stop serving 40 ft. and a 60 ft. long buses shall have a minimum length of 170 ft. starting at the bus stop sign to the curb line of the intersecting street. For mid block stops, there must be a clear distance of 153 ft. from parking space to parking space. The District requires a minimum of 110 ft. between bus stop signs.

### 29.14.2 Bus Pad Requirements

For Bus Pad locations, the Consultant should coordinate with WMATA. The minimum pad size shall be 10 ft. (wide) by 40 ft.(long). A mid block pad will be 10 ft. (wide) by 80 ft. (long). The pad shall be a minimum of 12 in. thick concrete in composite roadways with 10 inches of plain Portland Cement Concrete (PCC) base. The thickness of the bus pad in 10-inch reinforced concrete pavement will be 10 inches of reinforced concrete.

### 29.14.3 Parking Meters

The Project Manager will contact the Department's Mass Transit concerning parking meters impacting construction prior to the start of construction.

## 29.15 Sidewalk Cafes Located Within Public Space (Traffic Safety Division Requirement)

- Between the curb of the street and the edge line of the sidewalk café boundary, there must be a minimum 10 ft. of clear sidewalk provided for pedestrians passing along the sidewalk.
- No individual tree boxes can be located within this sidewalk area between the curb of the street and the edge line of the sidewalk café area, unless the 10 ft. clearance is met.
- Accessibility for wheelchairs users implies, adequate dimensioning of café aisles (4 ft. between tables), and spaces for routes leading to ramps and doorways, if stairs are blocking the way.
- If the cafes are not wheelchair accessible when located within the public space, permits will automatically be denied.
- Chain and/or Rope Barriers Surrounding Edge Line of Sidewalk Café:
    - Chain and/or rope barriers can be hazardous to pedestrians, especially visually impaired persons within the sidewalk areas. These barriers are difficult to see, especially when lower than 32 in. in height and at night. Visually impaired persons, who use a cane, are more easily able to detect chains and ropes when located at a height of 27 in. or less. Discretion should be used when designing chain or rope barriers, and a means should be devised to increase their detection, especially dark areas.
    - The bases of the poles and/or posts for the chain/rope barriers must not protrude within the clear sidewalk area. They must be located within the boundaries of the sidewalk café.

line of sight. For calculating both stopping and passing sight distances, the height of the driver's eye above the pavement surface shall be considered as 3.5 ft. For stopping sight distance calculations, the height of object shall be considered as 6 in. above the pavement surface. For passing sight distance calculations, the height of object shall be considered as 3.5 ft. above the pavement surface.

On tangents, the obstruction that limits the driver's sight distance is the road surface at some point on a crest vertical curve. On horizontal curves, the obstruction that limits the driver's sight distance may be the road surface at some point on a crest vertical curve. It may be some physical feature outside of the traveled way, such as a longitudinal barrier, a bridge-approach fill slope, a tree, foliage, or the back-slope of a cut section. Accordingly, all highway construction plans should be checked in both the vertical and horizontal plane for sight distance obstructions.

Table 30-D shows the standards for passing and stopping sight distance related to design speed.

Table 30-D:
Sight Distance for Design

| | SIGHT DISTANCE IN FT. | | |
|---|---|---|---|
| Design Speed (Mph) | Stopping Desirable | Stopping Minimum | Passing Minimum* |
| 25 | 150 | 150 | --- |
| 30 | 200 | 200 | 1100 |
| 35 | 250 | 225 | 1315 |
| 40 | 325 | 275 | 1500 |
| 45 | 400 | 325 | 1650 |
| 50 | 475 | 400 | 1800 |
| 55 | 550 | 450 | 1950 |
| 60 | 650 | 525 | 2100 |
| 70 | 850 | 625 | 2500 |

*Not applicable to multi-lane highways

The passing sight distance for upgrades should be greater than minimum.
To enhance safety on new construction projects where the design speed is 70 Mph, it is recommended that a minimum stopping sight distance of 725 ft. be used, which provides for an average running speed of 65 Mph. The stopping sight distances shown in Table 30-D should be increased when sustained downgrades are steeper than 3 percent. Increases in the stopping sight distances on downgrades are indicated in the **AASHTO Green Book**.

# CHAPTER 30

# ROADWAY

## 30.1 General

All design criteria in this manual are minimums, and these design criteria do not eliminate the responsibility of the designer to exceed these minimum standards where good engineering practice dictates. All materials and workmanship shall conform to these Standards and to the District of Columbia, current **Standard Specifications for Highway and Structures.**

## 30.2 AASHTO Policy

**AASHTO, A current Policy on Geometric Design of Highways and Streets,** the **Highway Capacity Manual,** was used as a reference within this chapter.

## 30.3 ADA Requirements

All designs for roadways shall conform to **ADA** requirements.

## 30.4 Functional Classification

### 30.4.1 General

Highway classification refers to a process by which roadways are classified into a set of sub-systems based on the way each roadway is used. Central to this process is an understanding that travel rarely involves movement along a single roadway. Rather, each trip or sub-trip initiates at a land use, proceeds through a sequence of streets, roads and highways, and terminates at a second land use.

The highway classification process is required by federal law. Each state must assign roadways into different classes in accordance with standards and procedures established by the Federal Highway Administration.

### 30.4.2 Functional Highway Systems in Urbanized Areas

DDOT has adopted a ***Functional Street Classification Plan*** based on traffic volumes, land use, and expected growth. The four functional highway systems identified are:

- Urban principal arterials (streets)
- Minor arterials (streets)
- Collectors (streets)

- Local streets

Each classification has design criteria that maintains and protects the primary purpose of the roadway.

## 30.5 Design Controls

### 30.5.1 General

The location and geometric design of highways is affected by numerous factors and controlling features; these may be considered in two broad categories. They are, Primary Controls (Highway Classification, Topography and Physical Features and Traffic) and Secondary Controls (Design Speed, Design Vehicle and Capacity).

### 30.5.2 Traffic Volume

For planning and design purposes, the demand of traffic is generally expressed in terms of the design-hourly volume (DHV), predicated on the design year. The design year for new construction and reconstruction is to be 20 years beyond the anticipated date of construction and 10 years beyond the anticipated date of construction for resurfacing, restoration or rehabilitation projects and Plans, Specifications, and Estimate (PS&E) are complete for bids.

### 30.5.3 Design Speed

Except for local streets where speed controls are frequently included intentionally, every effort should be made for a practical design speed to attain a desired degree of safety, mobility, and efficiency. The existing streets will be upgraded for a minimum speed as listed in the table 30-A. Once selected, all pertinent features of the highway should be in correlation to obtain a balanced design.

The design speed (Mph) as it relates to the posted speed (Mph) is shown in Table 30-A (see next page).

Table 30-A:
Design Speed vs. Posted Speed

| Posted Speed | Design Speed Existing Highway | Proposed Design Speed Reconstruction Streets, Highways, or Alignments |
|---|---|---|
| 20 Mph | 25 Mph | 30 Mph |
| 25 Mph | 30 Mph | 35 Mph |
| 30 Mph | 35 Mph | 40 Mph |
| 35 Mph | 40 Mph | 45 Mph |
| 40 Mph | 45 Mph | 50 Mph |
| 45 Mph | 50 Mph | 55 Mph |
| 50 Mph | 55 Mph | 60 Mph |
| 55 Mph | 60 Mph | 65 Mph |

## 30.5.4 Desired Design Speed for New Streets

New streets/highways shall be designed for a minimum speed as listed in Table 30-B:

Table 30-B

| DESCRIPTION | DESIGN SPEED |
|---|---|
| Local | 35 |
| Collector | 35 |
| Minor arterials | 40 |
| Urban principal arterials | 45 |
| Expressways | 65 |

Generally, for freeways and the Interstate system, the design speed shall be 70 Mph. When it is not practical to attain the desired speed in urban areas, the Interstate highway or freeway design speed shall not be less than 55 Mph.

Design speeds shall be selected in minimum increments of 5 Mph.
While it may be necessary to vary the design speed along certain highway sections for economic reasons, a uniform design speed should be maintained. Where a change in design speed is necessary, the maximum change should not exceed 10 Mph.

For roadways where it is not possible or feasible to maintain a 10 mph design speed over the posted speed limit, the designer shall maintain the greatest design speed possible but in no case shall it be less than the posted speed limit.

### 30.5.5 Highway Capacity

To determine the capacity for a particular highway design, the designer shall refer to the most recent edition of the Highway Capacity Manual (**HCM)** for guidance.

## 30.6 Basic Geometric Design Elements

### 30.6.1 General

Geometric highway design pertains to the visible features of the highway. It may be considered as the tailoring of the highway to the terrain, to the controls of the land usage, and to the type of traffic anticipated.

This section covers design criteria and guidelines on the geometric design elements that must be considered in the location and the design of the various types of highways (Refer to Table 30-C). Included are criteria and guidelines on sight distances, horizontal and vertical alignment, and other features common to the several types of roadways and highways.

In applying these criteria and guidelines, it is important to follow the basic principle that consistency in design standards is of major importance on any section of road. The highway should offer no surprises to the driver in terms of geometrics. Problem locations are generally where minimum design standards are introduced on a section of highway where otherwise higher standards should have been applied. The ideal highway design is one with uniformly high standards applied consistently along a section of highway, particularly on major highways designed to serve large volumes of traffic at high operating speeds.

The geometry of the new roadways must allow for the easy operation, maneuvering, turning, parking, standing, or emergency stopping of all types of running vehicles, including emergency vehicles. Determine if bus and/or truck operations are involved and if the buses can make the necessary turns.

For additional information and criteria relative to geometric design elements, refer to the **AASHTO Green Book**.

Table 30-C:
Geometric Design Elements

| Geometric Design Elements | New or Reconstruction Projects |
|---|---|
| Typical Lane Width | 10’ minimum |
| Typical usable shoulder width or parking lane | 8 ft. to 10 ft. |
| Typical cross slope for driving lanes | 1.0 to 4 percent* |
| Maximum degree of horizontal curve | 5 degrees |
| Maximum superelevation | 6 percent |
| Horizontal clearance to obstructions normally provided | 2.0’ |
| Maximum percent grade | 8 percent (new development) |
| Minimum stopping sight distance | 300’ |
| Minimum roadway width on structures less than 200 ft. long | 24’ |
| Typical structural capacity | HS-25 |

NOTE: Minimum clearance over roadways in the District is 14’ – 6”. Minimum vertical clearances of roadways under structures are given in the **Structures** chapter within this manual.

* The parking lane, which may be used as a through lane at times, may have a cross slope of 4.0 percent in order to meet grades and elevations and on Local streets the parking lane may have a maximum

## 30.6.2 Sight Distances

Sight distance represents the continuous length ahead, along a roadway, that an object of specified height is continuously visible to the driver. For the safe and efficient operation of a vehicle on a highway, proper sight distance should be provided to enable drivers traveling at or near the design speed to control the operation of their vehicles to avoid striking an unexpected object or to stop before reaching a stationary object in their path.

The criteria for measuring sight distance are dependent on the height of the driver's eye above the pavement surface, the specified object height above the pavement surface, and the height of sight obstructions within the line of sight. For calculating both stopping and passing sight distances, the height of the driver's eye above the pavement surface shall be considered as 3.5 ft. For stopping sight distance calculations, the height of object shall be considered as 6 in. above the pavement surface. For passing sight distance calculations, the height of object shall be considered as 3.5 ft. above the pavement surface.

On tangents, the obstruction that limits the driver's sight distance is the road surface at some point on a crest vertical curve. On horizontal curves, the obstruction that limits the driver's sight distance may be the road surface at some point on a crest vertical curve. It may be some physical feature outside of the traveled way, such as a longitudinal barrier, a bridge-approach fill slope, a tree, foliage, or the back-slope of a cut section. Accordingly, all highway construction plans should be checked in both the vertical and horizontal plane for sight distance obstructions.

Table 30-D shows the standards for passing and stopping sight distance related to design speed.

Table 30-D:
Sight Distance for Design

| | SIGHT DISTANCE IN FT. | | |
|---|---|---|---|
| Design Speed (Mph) | Stopping Desirable | Stopping Minimum | Passing Minimum* |
| 25 | 150 | 150 | --- |
| 30 | 200 | 200 | 1100 |
| 35 | 250 | 225 | 1315 |
| 40 | 325 | 275 | 1500 |
| 45 | 400 | 325 | 1650 |
| 50 | 475 | 400 | 1800 |
| 55 | 550 | 450 | 1950 |
| 60 | 650 | 525 | 2100 |
| 70 | 850 | 625 | 2500 |

*Not applicable to multi-lane highways

The passing sight distance for upgrades should be greater than minimum. To enhance safety on new construction projects where the design speed is 70 Mph, it is recommended that a minimum stopping sight distance of 725 ft. be used, which provides for an average running speed of 65 Mph. The stopping sight distances shown in Table 30-D should be increased when sustained downgrades are steeper than 3 percent. Increases in the stopping sight distances on downgrades are indicated in the **AASHTO Green Book**.

required easement or ROW to be dedicated to the District. In any event, the District shall try and work with the property owner to establish an unobstructed sight distance triangle.

Any object within the sight triangle more than 30 in. above the flow-line elevation of the adjacent street shall constitute a sight obstruction, and shall be removed or lowered. Such objects include, but are not limited to, berms, buildings, and parked vehicles parked on private property, cut slopes, hedges, trees, bushes, utility cabinets or tall crops. Since parked vehicles are under the control of the District, parked vehicles shall not be considered an obstruction for design purposes. The city may limit parking to protect visibility. The sight distance shall be measured to the centerline of the closest through-lane in both directions.
In no case shall any permanent object encroach into the line-of-sight of any part of the sight-distance triangle. Street trees required by the District are an exception to this requirement. Trees are permitted if pruned up to 8 ft.

## 30.7 Horizontal Alignment

### 30.7.1 General

In the design of horizontal curves, it is necessary to establish the proper relationship between design speed, curvature, and superelevation. Horizontal alignment must afford at least the minimum stopping sight distance for the design speed at all points on the roadway.

The major considerations in horizontal alignment design are: safety, grade, and type of facility, design speed, topography, and construction cost. In design, safety is always considered, either directly or indirectly. Topography largely controls both curve radius and design speed. The design speed, in turn, controls sight distance, but sight distance must be considered concurrently with topography because it often demands a larger radius than the design speed. All these factors must be balanced to produce an alignment that is safe, economical, in harmony with the natural contour of the land and, at the same time, adequate for the design classification of the roadway or highway.

To avoid the appearance of inconsistent distribution, the horizontal alignment should be coordinated carefully with the profile design.

### 30.7.2 Superelevation

Superelevation is predicated on design speed and all highways shall be superelevated according to their speeds rather than using a superelevation for a single radius for all design speeds.

A 6 percent maximum superelevation rate shall be used on urban freeways. A 4 percent maximum superelevation rate may be used on high-speed (greater than 40 Mph) urban highways to minimize conflicts with adjacent development and intersecting streets. Low speed (40 Mph or less) urban streets can use a 4 percent or 6 percent maximum superelevation rate.

Values for superelevation for urban freeways shall be in accordance with Table 30-F.

Table 30-F:
Values of Superelevation for Urban Freeways

| RADIUS (FT.) | SUPERELEVATION (PERCENT) FOR DESIGN SPEEDS OF | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 30 MPH | 35 MPH | 40 MPH | 45 MPH | 50 MPH | 55 MPH | 60 MPH | 70 MPH |
| 275 | 6.0 | | | | | | | |
| 300 | 6.0 | | | | | | | |
| 400 | 5.6 | 6.0 | | | | | | |
| 500 | 5.1 | 5.7 | | | | | | |
| 600 | 4.7 | 5.4 | 5.9 | | | | | |
| 700 | 4.4 | 5.1 | 5.7 | 6.0 | | | | |
| 800 | 4.1 | 4.8 | 5.4 | 5.9 | | | | |
| 900 | 3.9 | 4.5 | 5.1 | 5.7 | 6.0 | | | |
| 1000 | 3.7 | 4.3 | 4.9 | 5.5 | 5.9 | | | |
| 1200 | 3.3 | 3.9 | 4.5 | 5.0 | 5.5 | 5.9 | | |
| 1400 | 2.9 | 3.6 | 4.1 | 4.7 | 5.2 | 5.7 | 6.0 | |
| 1600 | 2.7 | 3.3 | 3.8 | 4.4 | 4.9 | 5.4 | 5.9 | |
| 1800 | 2.4 | 3.0 | 3.6 | 4.1 | 4.6 | 5.1 | 5.6 | |
| 2000 | 2.2 | 2.8 | 3.3 | 3.8 | 4.3 | 4.9 | 5.4 | 6.0 |
| 2500 | 1.8 | 2.3 | 2.8 | 3.3 | 3.8 | 4.3 | 4.8 | 5.8 |
| 3000 | 1.6 | 2.0 | 2.4 | 3.0 | 3.4 | 3.9 | 4.3 | 5.3 |
| 3500 | 1.5 | 1.8 | 2.1 | 2.6 | 3.0 | 3.5 | 4.0 | 4.9 |
| 4000 | NC | 1.5 | 1.9 | 2.3 | 2.7 | 3.1 | 3.6 | 4.4 |
| 4500 | | NC | 1.7 | 2.1 | 2.5 | 2.9 | 3.3 | 4.1 |
| 5000 | | | 1.6 | 1.9 | 2.2 | 2.6 | 3.0 | 3.7 |
| 6000 | | | NC | 1.6 | 1.9 | 2.2 | 2.6 | 3.2 |
| 7000 | | | | NC | 1.7 | 2.0 | 2.3 | 2.8 |
| 8000 | | | | | 1.5 | 1.7 | 2.0 | 2.5 |
| 9000 | | | | | NC | 1.6 | 1.8 | 2.3 |
| 10000 | | | | | | NC | 1.7 | 2.1 |
| 12000 | | | | | | | NC | 1.7 |
| 14000 | | | | | | | | 1.5 |

| | |
|---|---|
| 16000 | NC |
| 18000 | |
| 19000 | |

NC=Normal Crown

No Superelevation Required When Radius (Ft.) is Greater Than:

| | 30 MPH | 35 MPH | 40 MPH | 45 MPH | 50 MPH | 55 MPH | 60 MPH | 70 MPH |
|---|---|---|---|---|---|---|---|---|
| 6% Max. | 3153 | 4133 | 5247 | 6497 | 7883 | 9423 | 11111 | 14046 |

NOTE: Superelevation Rates Less Than 1.5 percent Shall Not Be Used

Values for superelevation for urban highways shall be in accordance with Table 30-G.

Table 30-G:
Values of Superelevation for Urban Highways

| SUPERELEVATION (PERCENT) FOR DESIGN SPEEDS OF | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 30 MPH | | 35 M.P.H | | 40 MPH | | 45 MPH | 50 MPH | 55 MPH | 60 MPH |
| RAD. (FT.) | 4% max | 6% max | 4% max | 6% max | 4% max | 6% max | 4% max | 4% max | 4% max | 4% max |
| 215 | | 6.0 | | | | | | | | |
| 250 | | 2.0 | | | | | | | | |
| 275 | | NC | | | | | | | | |
| 300 | 4.0 | | | | | | | | | |
| 325 | 4.0 | | | 5.6 | | | | | | |
| 350 | 3.9 | | | 3.8 | | | | | | |
| 400 | 3.8 | | | NC | | | | | | |
| 450 | 3.7 | | 4.0 | | | 6.0 | | | | |
| 500 | 3.6 | | 3.9 | | | 3.6 | | | | |
| 600 | 3.4 | | 3.8 | | 4.0 | NC | | | | |
| 700 | 3.2 | | 3.6 | | 3.9 | | | | | |
| 800 | 3.0 | | 3.4 | | 3.8 | | 4.0 | | | |
| 900 | 2.9 | | 3.2 | | 3.6 | | 3.9 | | | |
| 1000 | 2.7 | | 3.1 | | 3.5 | | 3.8 | 4.0 | | |
| 1200 | 2.5 | | 2.9 | | 3.2 | | 3.6 | 3.9 | 4.0 | |
| 1400 | 2.4 | | 2.7 | | 3.0 | | 3.4 | 3.7 | 3.9 | |
| 1600 | 2.2 | | 2.6 | | 2.9 | | 3.2 | 3.5 | 3.8 | |
| 1800 | 2.1 | | 2.4 | | 2.7 | | 3.0 | 3.3 | 3.7 | 4.0 |
| 2000 | 2.0 | | 2.3 | | 2.6 | | 2.9 | 3.2 | 3.5 | 3.8 |
| 2400 | 1.7 | | 2.1 | | 2.4 | | 2.7 | 2.9 | 3.3 | 3.6 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 2800 | 1.5 | 1.9 | 2.2 | 2.5 | 2.7 | 3.0 | 3.4 |
| 3200 | NC | 1.7 | 2.0 | 2.3 | 2.6 | 2.9 | 3.2 |
| 3600 | | 1.6 | 1.9 | 2.2 | 2.4 | 2.7 | 3.0 |
| 4000 | | NC | 1.7 | 2.0 | 2.3 | 2.6 | 2.8 |
| 4500 | | | 1.6 | 1.9 | 2.1 | 2.4 | 2.7 |
| 5000 | | | NC | 1.7 | 2.0 | 2.3 | 2.5 |
| 6000 | | | | 1.5 | 1.7 | 2.0 | 2.3 |
| 7000 | | | | NC | 1.5 | 1.8 | 2.0 |
| 8000 | | | | | NC | 1.6 | 1.8 |
| 9000 | | | | | | 1.5 | 1.7 |
| 10000 | | | | | | NC | 1.5 |
| 12000 | | | | | | | NC |
| 14000 | | | | | | | |

The minimum superelevation to be used is 1.5 percent on flat radius curves requiring superelevation ranging from 1.5 percent to 2 percent. The superelevation should be increased by 0.5 percent in each successive pair of lanes on the low side of the superelevation when more than two lanes are superelevated in the same direction. Superelevation shall not normally be used on local or other roadway classifications with a design speed of 40 Mph or less.

#### 30.7.2.1 Maximum Curvature for Normal Crown Road

Table 30-H is referenced from **AASHTO Table III-13**, and provides Maximum Curvature for Normal Crown Section:

Table 30-H:
Maximum Curvature for Normal Crown Section

| | | | | **SIDE FRICTION FACTOR, F, WITH ADVERSE CROWN** | |
|---|---|---|---|---|---|
| Design Speed (MPH) | Avg. Running Speed (MPH) | Max. Curve Degrees | Min. Curve Radius (ft) | At Design Speed | At Running Speed |
| 20 | 20 | 3°23’ | 1,700 | .031 | .031 |
| 30 | 28 | 1°43’ | 3,340 | .033 | .031 |
| 40 | 36 | 1°02’ | 5,550 | .034 | .031 |
| 50 | 44 | 0°41’ | 8,320 | .035 | .031 |
| 55 | 48 | 0°35’ | 9,930 | .035 | .031 |
| 60 | 52 | 0°29’ | 11,690 | .035 | .030 |
| 65 | 55 | 0°26’ | 13,140 | .035 | .030 |
| 70 | 58 | 0°23’ | 14,690 | .037 | .030 |

#### 30.7.2.2 Superelevation Transition

The superelevation transition generally consists of the superelevation runoff (length of roadway needed to accomplish the change in cross slope from a normal crown section to a fully superelevated section or vice versa). Defining or establishing superelevation runoff shall be in accordance with **AASHTO Green Book.**

### 30.7.3 Curvature

The changes in direction along a highway are accounted for by simple curves or compound curves. Excessive curvature or poor combinations of curvature generates accidents, limits capacity, causes economic losses in time and operating costs, and detracts from a pleasing appearance. Broken-back curves should be avoided.
Street curvature shall meet the minimum specifications shown in Table 30-I.

Table 30-I:
Minimum Horizontal Street Curve Specifications

| DESIGN CRITERIA | LOCAL STREET | COLLECTOR STREET | ARTERIAL STREET |
|---|---|---|---|
| Minimum Design Speed | 20 mph | 35 mph | 40 mph |
| Minimum Centerline Radius | 100 ft | 300 ft | 500 ft |
| Minimum Reverse Curve Tangent | 50 ft | 100 ft | 200 ft |
| Minimum Intersection Approach Tangent | 100 ft | 200 ft | 300 ft |

For additional information and criteria relative to horizontal alignment, refer to the **AASHTO Green Book**, current edition.

## 30.8 Vertical Alignment

### 30.8.1 General

The profile line is a reference line by which the elevation of the pavement and other features of the highway are established. It is controlled mainly by topography, type of highway, horizontal alignment, safety, sight distance, construction costs, cultural development, drainage, and pleasing appearance. The performance of heavy vehicles on a grade must also be considered. All portions of the profile line must meet sight distance requirements for the design speed of the road.

In flat terrain, the elevation of the profile line is often controlled by drainage considerations. In rolling terrain, some undulation in the profile line is often advantageous, both from the standpoint of truck operation and construction economy. This should be done with appearance in mind (i.e., a profile on tangent alignment exhibiting a series of humps visible for some distance ahead should be avoided whenever possible). In rolling terrain, however, the profile usually is closely dependent upon physical controls. In considering alternative profiles, economic comparisons should be made.

### 30.8.2 Position with Respect to Cross Section

The profile line should generally coincide with the axis of rotation for superelevation. Its relation to the cross section should be as follows:

- Undivided Highways -The profile line should coincide with the highway centerline.
- Ramps and Freeway-to-Freeway Connections - The profile line may be positioned at either edge of pavement, or centerline of ramp if multi-lane.
- Divided Highways - The profile line may be positioned at either the centerline of the median or at the median edge of pavement. The former case is appropriate for paved medians 30 ft. wide or less. The latter case is appropriate when:
  - The median edges of pavement of the two roadways are at equal elevation.
  - The two roadways are at different elevations.

### 30.8.3 Permissible Roadway Grades

The minimum allowable grade for roadways or alleys is 0.5 percent. The minimum allowable grade for bubbles or cul-de-sacs within the bulb is 1 percent. The maximum allowable grade for any roadway is shown in Table 30-J.

Table 30-J:

Maximum Allowable Grades

| DESCRIP-TION | DESIGN SPEED | MAXI-MUM GRADE | K VALUE CREST | RANGES SAG | MIN. CREST | V.C.L. SAG |
|---|---|---|---|---|---|---|
| Local | 35 | 8 | 35-50 | 40-50 | 50 | 50 |
| Minor Collector | 35 | 7 | 35-50 | 40-50 | 50 | 50 |
| Major Collector | 40 | 7 | 55-65 | 55-65 | 50 | 50 |
| Minor Arterial | 45 | 6 | 70-105 | 65-85 | 70 | 60 |
| Principal Arterial | 55 | 6 | 115-220 | 90-125 | 110 | 90 |
| Freeway | 60 | 5 | 160-300 | 105-155 | 150 | 100 |

**Note:** The maximum grade may be modified on a case by case basis in areas where steep hills and grades are the norm and the indicated rates may be impossible to attain.

### 30.8.4 Permissible Intersection Grades

The maximum permissible intersection approach grade (min. 50 ft.) should be 4 percent. For signalized intersection approaches, grades should not exceed 2 percent within 50 ft. of intersection. Exceptions will be on a case by case basis.

### 30.8.5 Vertical Curves

Properly designed vertical curves should provide adequate sight distance, safety, comfortable driving, good drainage, and pleasing appearance. Vertical curves shall be designed in accordance with the **AASHTO Green Book**.

Vertical curves are not required where an algebraic difference in grade is less than 0.35 percent. Vertical curves that have a level point and flat sections near their crest or sag should be evaluated for drainage. Values of K=167 or greater should be checked for drainage. All vertical curves shall be labeled in the profile with the station of the vertical point of intersection (VPIS), the elevation (PVIE), the length of vertical curve (VCL), K=(L/A) and the middle ordinate (m).

## 30.9 Combination of Horizontal and Vertical Alignment

To avoid the possibility of introducing serious hazards, coordination is required between horizontal and vertical alignment. Particular care must be exercised to maintain proper sight distance. Where grade line and horizontal alignment will permit, it is desirable to superimpose vertical curves on horizontal curves. This reduces the number of sight distance restrictions and makes changes in the profile less apparent (particularly in rolling terrain). Care should be taken, however, not to introduce a sharp horizontal curve near a pronounced crest or grade sag (this is particularly hazardous at night).

In cases where curves sharper than 7 degrees are located on steep grades, it is considered good design to flatten the grade slightly throughout the length of the curve. Horizontal curvature and profile grade should be made as flat as possible at highway intersections.

On divided highways, variation in the width of medians, the use of separate profiles, and horizontal alignment should be considered to achieve the design and operational advantages of one-way roadways.

NOTE: Changes in noise level should be evaluated where noise receptors are present.

## 30.10 Lane Transition

Design standards of the various features of the transition between roadways of different widths should be consistent with the design standards of the superior roadway. The transition should be made on a tangent section whenever possible and should avoid locations with horizontal and vertical sight distance restrictions. Whenever feasible, the entire transition should be visible to the driver of a vehicle approaching the narrower section. The design should be such that at-grade intersections within the transition are avoided.

The information below shows the minimum required taper length based upon the design speed of the roadway. In all cases, a taper length longer than the minimum should be provided where possible. When tapering the transition drops, a lane should be on the right so that traffic merges to the left.

For design speed greater than 40 MPH:

$$L = V\,W$$

For design speed equal to or less than 40 MPH:

$$L = V \times V \times W / 60$$

Where V = Design Speed (MPH)
W = Lane Width Reduction (FT)
L = Taper Length (FT)

## 30.11 Major Cross Section Elements

### 30.11.1 General

The major cross section elements considered in the design of streets and highways include the pavement surface type, cross slope, lane widths, shoulders, roadside or border, curbs, sidewalks, driveways, and medians. NOTE: For additional information and criteria relative to major cross section items, refer to the **AASHTO Green Book**.

### 30.11.2 Standard Roadway Elements Width:

Minimum requirements are listed in Table 30-K below for new street construction, however every effort should be made to upgrade the existing streets to bring them to the current Department standard as much as practical.

Table 30-K:
Standard Roadway Elements Widths

| ROADWAY | THE STANDARD WIDTH BASED ON DDOT GUIDELINE |
|---|---|
| The Minimum ROW for One-way travel Road | 55’ with 10’ setback both sides |
| The Minimum ROW for Two-way Travel Road | 75’ with 10’ setback both sides |
| Two-way Street, one lane each, with Parking both sides | 36’ Paved Surface Width (Prefer 38’) |
| Two-way Street one lane each with one side parking | 32’ Paved Surface Width (Prefer 34’) |
| One-way Street one lane with two side parking | 30’ Paved Surface Width |
| One-way Street one lane with one side parking | 22’ Paved Surface Width |
| Driving Lane | 10’ to 12’ Paved Surface Width |
| Driving Lane having Buses | 11’ Paved Surface Width |
| Driving Lane, with parking | 18’ Paved Surface Width* |
| Driving Lane, with Parking and Have Buses | 19’ Paved Surface Width |
| Parking Lane | 8’ Paved Surface Width |
| Bicycle Lane one way | 5’ Paved Surface Width |

| | |
|---|---|
| Bicycle Lane two ways | 8’ Paved Surface Width |
| Shared Use Path (Two-Way) | 10’ - 12’ Paved Surface Width (14’ if heavy use) |
| Sidewalk Pavement | 6’ Paved Surface Width** |
| Sidewalk including 4-foot tree space | 10’ Surface Width** |
| Middle of Road median | 4’ Minimum Surface Width |
| Shoulder Width | 10’ Surface Width |

*Driving and parking lane width together = 19 ft. (11 ft. adjacent maneuvering lane). 8 ft. is the standard width for parallel parking and requires a minimum 11 ft. adjacent maneuvering lane, without going over the adjacent travel lane and/or double yellow lines. When the parallel parking lane is narrower than the standard 8 ft. wide parallel lane, than it requires another foot added to the adjacent maneuvering lane. For example, if the parallel parking lane is 7 ft. wide, than the adjacent maneuvering lane must be 12 ft. wide.

**Each street in the District has a designated sidewalk width for public space. The minimum designated width is 10 ft., which includes a 6 ft. sidewalk and 4 ft. tree space. However, each street within the District of Columbia has a designated sidewalk width for each street, and if a particular street has a higher designated minimum width than 10 ft. minimum width then higher width will become the minimum width for that street and it must be met. If there is no designated sidewalk width, then the minimum 10 ft. designated sidewalk width must be used. (Note: The sidewalk width usually includes the tree space).

## 30.13 Lane Widths

Lane widths have a great influence on driving safety and comfort. On freeways the predominant lane width is 12 ft. Although lane widths of 12 ft. are desirable, there are circumstances that necessitate the use of lanes less than 12 ft. on city streets. In urban areas, the use of 11 ft. wide lanes is acceptable. 10 ft. wide lanes have been provided in the past at certain locations where ROW and existing development became stringent controls and where truck volumes were limited. However, 10 ft. wide lanes would not be proposed today for new street construction. 10 ft. lanes may also be used adjacent to bicycle lanes if bus and truck traffic is not substantial. To help accommodate a bicycle, the outside (curb) lane should be wider than the inside lane(s), 14 ft. where possible. For example, a 50 ft. wide street with 4 lanes of traffic should have 14 ft. outside lanes and 12 ft. inside lanes.

Where alternate bike access is provided, the outside lane width should be 1 ft. wider than the adjacent thru-lane width. When rehabilitating or reconstructing existing highways with lane widths of 10 ft. or less, the existing lanes should be widened to either an 11 ft. lane, minimum, or 12 ft. lane, that is desirable. Currently, there are only two minor arterial streets that have 9 ft. wide lanes. They are: E Street, NW, between 5$^{th}$ Street and 13$^{th}$ Street and H Street, NW between 5$^{th}$ and 13$^{th}$ Streets.

## 30.14 Roadway-Rail Grade Crossings

All roadway/rail crossings should be coordinated with the railroad to provide a consistent surface and traffic control. To properly accommodate bicyclists, at grade roadway/rail crossings should be at right angle to the rails. If the crossing is less than 45 degrees, an additional paved shoulder should be provided to permit the bicyclist to cross the track at a safer angle. Refer to the **AASHTO Guide for the Development of Bicycle Facilities** for additional information.

The railroad company will provide the design and special provisions for inclusion in the contract plans. The District will provide funds for construction of the Roadway-Rail Grade Crossing with participation of FHWA.

## D-5.  Right of Way Improvements

## Chapter 3

### Right-of-Way Improvement Requirements

### 3.1.2 New Streets

#### Street Right-of-Way and Roadway

New streets created through the platting process or otherwise dedicated shall meet the improvement requirements specified below. The creation of new streets requires dedication of property to the City of Seattle for street purposes.

#### 3.1.2a New Streets, Required Widths - Arterials

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Street right-of-way and roadway widths for new arterials vary depending on the pavement width needed to serve projected traffic volumes and parking needs. The width required for new arterial streets shall be determined by the Seattle Department of Transportation. For more information, contact Street Use.

#### 3.1.2b New Streets, Required Widths - Non Arterials

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Minimum street right-of-way and roadway widths required for new non-arterial streets. Street right-of-way widths for new non-arterial streets in Downtown or zoned Seattle Mixed shall be determined by the Seattle Department of Transportation. For more information, please contact Street Use.

**Right-of-Way and Roadway Widths for New Non Arterial Streets**

| Land Use Zone Categories* | Right-of-Way Width | Roadway Width |
|---|---|---|
| SF, LDT, L1, NC1 | 50 feet | 25 feet |
| L2, L3, L4, NC2 | 56 feet | 32 feet |
| MR, HR, NC3 | 60 feet | 36 feet |
| C1, C2, IB, IC | 60 feet | 40 feet |
| IG1, IG2 | 66 feet | 40 feet |

* If a project is on a block which is split into more than one land use zone category, the zone category with the most frontage determines the minimum width required. If the land use categories have equal frontage, the one with the greater width requirement shall be used to determine the minimum width.

## D-6. Traffic Analysis

# Appendix H
# Policy Governing Traffic Impact Studies

## H.1 Purpose

The purpose of this policy is to set forth general guidelines concerning the content, procedures and method of technical analysis for traffic impact studies (TIS). The purpose of a traffic impact study is to identify the nature and magnitude of traffic impacts created by certain proposed land uses as compared to the traffic impacts under existing conditions, and to identify ways that the applicant can mitigate those differential impacts upon the roadway system.

## H.2 Applicability

This policy will have applicability whenever a TIS is done in conjunction with a proposed development. It will have particular applicability when the TIS is done on a voluntary basis as part of a conditional zoning application filed in conformance with the City's Comprehensive Plan.

### H.2.1 Need For a Traffic Impact Study

A TIS will be required where any of the following apply:

1) Under circumstances where the Comprehensive Plan prescribes the use of a traffic impact study before a rezoning is granted;

2) Any development that would potentially generate 150 or more trips during the peak period of the generator, according to the rates or equations published in the latest edition of the Institute of Transportation Engineers (ITE) <u>Trip Generation Manual</u> and <u>Trip Generation Handbook, an ITE Proposed Recommended Practice</u>;

3) Any rezoning request, whether conditioned or otherwise, that does not conform to the Comprehensive Plan.

4) When required by City Code for a conditional zoning.

5) At the discretion of the City of Virginia Beach Traffic Engineer.

### H.2.2 Multi-Development

The City of Virginia Beach may require a group of developers to jointly perform a traffic impact study on a section of roadway where many independent developments are planned. The results of this study will be the basis for determining improvements and levels of participation by each developer.

### H.2.3 Exceptions

When a proposed developments traffic impact to City roadway facilities can be clearly anticipated without a study and the City and the developer are able to negotiate appropriate roadway improvements to be proffered by the developer, the TIS may be waived by the City Traffic Engineer.

### H.2.4 Updating an Existing TIS

A TIS that has been previously submitted and approved by the City is required to be updated by the developer when the amount and/or character of traffic on the existing study area roadway facilities is significantly different from an earlier study. Generally a TIS requires updating every two years, however, the City Traffic Engineer may require an update prior to the two-year date at his/her discretion.

## H.3 Conduct of the Study

If a TIS is required, the developer will be responsible for performing and submitting a formal TIS. The applicant shall choose a consultant qualified by professional credentials, including registration as a Professional Engineer in Virginia, and experience to conduct the study in a satisfactory manner. The applicant shall contract directly with that consultant to perform the TIS.

The TIS must be prepared in accordance with the guidance included in this Traffic Impact Studies Policy document. A general outline for information to be included in a TIS and format for the report is included as Appendix A of this Policy. This outline includes minimum requirements for a TIS and additional information and analyses may be required, as determined by the City Traffic Engineer.

It shall be the consultant's responsibility to arrange a pre-study meeting with representatives of the City's Traffic Engineering Bureau and the Department of Planning to identify the necessary background information, assumptions, forecast year(s), time periods to be analyzed and the radius of influence that needs to be studied.

Following the pre-study meeting, the study preparer should submit a memorandum of understanding confirming the scope of the TIS, to include the following:

1) Study area boundaries.

2) Issues to be addressed in the study.

3) Assumptions including time period(s) to be studied, forecast year(s), and methods of analysis.

4) Data sources - both existing data and data to be collected, to include counts and the current signal timings at existing signals.

5) Report contents.

6) Other pertinent issues discussed in the initial meeting.

The City will evaluate the memorandum of understanding and once approved by the City Traffic Engineer, the applicant may proceed with the TIS per the approved scope.

# H.4 Purpose of the Study

The TIS shall identify those improvements to the roadway system (including but not limited to turn lanes, through lanes, signal operation and signalization) necessary to maintain the functioning of the road system to the same level of service prior to development. Where it is not possible to maintain the existing level of service (LOS), a design LOS of "C" shall be used. The Planning Department and Traffic Engineering staff shall review the study. The City Traffic Engineer shall grant final acceptance of the study. For a conditional zoning application, in order to be deemed in conformance to the Comprehensive Plan, it should include proffers of those improvements identified by the study, once approved, in accordance with ***Section 123.1-491.2:1 of the Code of Virginia***.

# H.5 Detailed Study Criteria

## H.5.1 Boundaries of the Traffic Impact Study

The study area for a TIS should extend far enough, within reason, to contain all roadway segments and intersections that will be significantly affected by the traffic volumes generated by the proposed development. As a minimum, the TIS will include all site access point intersections with public roadways, all public roadway segments adjacent to the site and the first signalized intersection on the roadways serving the site. Beyond this minimum, the City and the developer will jointly determine any additional areas to be included in the study based upon site-specific issues. The City Traffic Engineer will give final approval of the TIS study area boundaries.

## H.5.2 Traffic Counts

Existing traffic counts, both average daily trips (ADT) for roadway segments and turning movement counts conducted at study area intersections, shall be based on data from counts collected or secured by the Consultant that are no older than twelve (12) months. If such counts are unavailable, counts shall be performed by the consultant and prepared under the direction of a professional engineer registered in Virginia with expertise in traffic engineering. The following issues apply to the collection of traffic counts for use in the preparation of a TIS:

1) ADT counts should be collected in one-hour increments or smaller and should be directional.

2) Peak hour turn movement counts should be collected on a Tuesday, Wednesday, or Thursday in a non-holiday week and the counts should be collected in fair weather conditions. All peak period turn movement counts should be collected and tabulated in 15-minute increments.

3) Turning movement counts at study area intersections must be conducted in the AM peak period (7 a.m.- 9 a.m.) and PM peak period (4 p.m.- 6 p.m.) Other turning movement counts may be required, as is discussed in the Peak Hours section below.

4) All traffic counts shall be collected simultaneously.

5) All raw traffic data must be included in the Appendix of the report. Electronic traffic count files shall also be included with the TIS submittal.

6) Seasonal adjustment factors should be applied if available from the City.

7) Existing peak hour factors should be determined by approach for each peak period studied.

### H.5.3 Peak Period Hours

In general, the TIS must include an AM peak period analysis (7 am to 9 am) and PM peak period analysis (4 pm to 6 pm). Other peak periods (11:30 a.m.- 1:30 p.m., weekend, and specific development peak hours) may also be required to be analyzed to determine the magnitude of the traffic impacts generated by a proposed development. A determination of required peak periods to be included in each TIS will be made at the pre-study meeting.

### H.5.4 Traffic Analysis Scenarios

The following scenarios must be analyzed as part of a TIS. These scenarios represent the minimum and additional scenarios may be required for specific developments depending on the type of development and roadway specific issues, such as development phasing and roadway improvement projects in the study area. Future year will generally be ten years or the buildout year for the project. For large developments generating more than 250 peak hour trips, the design year will be determined at the pre-study meeting.

1) Existing Conditions – Use existing traffic volumes and roadway configurations.

2) Future Conditions Without Development – Use forecasted future year traffic volumes, including any approved developments that may affect study area roadways, and roadway configurations with any programmed roadway Capital Improvements Projects.

3) Future Conditions With Development – Use forecasted future year background traffic volumes and traffic generated by the development and assigned to study area roadways and intersections.

4) Future Conditions With Development and Proposed Improvements – Use forecasted future conditions with development traffic and any proposed roadway improvements.

## H.5.5 Background Traffic Growth

The background growth in traffic should be established in consultation with City staff through one of the following methods:

1) Roadway growth factors from the regional travel demand forecast model.

2) Historic traffic growth.

4) Corridor transportation studies, if available.

Development of historic traffic growth trends should be based on traffic counts obtained over a number of years, with any unusual data removed from the analysis. Historic growth trends may be available through the City's traffic count program.

Engineering judgment should guide which of the methods listed above should be used to establish a background growth rate for study area roadways. Often straight lined growth from the travel demand model is not appropriate since volumes on certain roadways may rise, fall, and rise again as roads are widened and new facilities are added. Therefore, the timing of such planned improvements should also be considered when determining a growth rate over a given time period.

The TIS report must clearly indicate the methods and assumptions used to develop the background growth rate and the future year background traffic volumes.

## H.5.6 Trip Generation

Total traffic generated by the proposed development shall be computed using the best available equations or rates published in the latest edition of the Institute of Transportation Engineers (ITE) Trip Generation Manual, unless documentation is supplied and approved by the City Traffic Engineer justifying the use of different rates. If a rezoning is proposed without detailed understanding of the proposed land use(s), the highest possible traffic generation situation shall be analyzed.

1) Trip Generation Rates - The methodologies described in the ITE Trip Generation Handbook should be used to determine the most applicable rates or equations. When the land use with a limited number of studies to support the trip generation rates, the consultant should use engineering judgment in the use of the rates and must indicate in the report how these rates were used or modified.

2) Multi-Use Developments/Internal Trips- According to the latest edition of Trip Generation Handbook, an ITE Proposed Recommended Practice, a multi-use development is typically a single real-estate project that consists of two or more ITE land use classifications between which trips can be make without using the off-site road system. Note that any major street running through the development is not considered off-site. Determination of internal trip reduction for multi-use developments should be consistent with the methodologies described in Chapter 7 of the above document.

3) Pass-By Trips- Determination of pass-by trips should be consistent with the methodology presented in the latest edition of Trip Generation Handbook, an ITE Proposed Recommended Practice. It is important to note that pass-by trip reductions are only applicable to evaluation of traffic operations at intersections remote from the site; pass-by trips must be included in the analysis of access point/public roadway intersections.

## H.5.7 Trip Distribution

Trip distribution refers to the direction a vehicle will take to enter or exit the proposed development site and can vary depending on:

1) Type of proposed development

2) Similar land uses in the vicinity

3) Size of the proposed development

4) Conditions on the roadway network in the vicinity of the site.

5) Demographics of the area

All these items and any other relevant information should be considered when developing trip distribution for each of the time periods. As with all technical analysis steps, the basic method and assumptions used in this work must be clearly stated in order that the reviewer can replicate the results reported.

## H.5.8 Evaluation of Impacts of Site Generated Traffic

For all traffic analysis scenarios required for a TIS, peak hour LOS and volume/capacity analyses are required as a minimum level of traffic analysis. Summaries of these analyses are to be reported in a tabular format.

Under the City's policy, if the proposed development is shown to not change the LOS of study area intersections or roadway segments, no roadway improvements will be required. However, if the LOS is affected by the addition of proposed development traffic, the developer will be responsible for proposing roadway improvements that will restore study area intersections and roadways to the existing LOS. These improvements may include the addition or extension of traffic lanes, turn lanes, acceleration and deceleration lanes, traffic signal improvements, access controls, turn restrictions and new traffic signals.

Additional traffic analyses may be required to be included in a TIS to assess the impacts of the proposed development. A queue length analysis is required to be performed when intersection turn or thru movement LOS are adversely affected by the impacts of site traffic. Also, the queue analysis is required when the possibility exists that queues will block thru lanes or upstream intersections. Roadway improvements will be required to mitigate any negative queuing effects caused by the proposed development.

## H.5.9 Analysis Methodologies

The traffic analysis methodologies listed below for the different facility types are used by the City in its analyses and are acceptable for use in a TIS prepared for the City. Other analysis methods may be accepted, however the consultant preparing the TIS must receive prior approval of the proposed alternate methodologies.

1) Two-lane roadways- HCM*, operational analysis

2) Multi-lane roadways- HCM*, operational analysis

3) Signalized intersections- HCM*, Highway Capacity Software, Synchro**, operational analysis

4) Unsignalized intersections- HCM*, Highway Capacity Software, Synchro**, operational analysis

5) Signal warrants- Manual on Uniform Traffic Control Devices (MUTCD), latest edition.

6) Signal progression- Transyt-7F, Synchro

7) Pedestrian Facilities- HCM, MUTCD

8) Turn lane warrants- City of Virginia Beach Standards and Specifications, latest revision.

* Highway Capacity Manual, latest edition.
** Use the HCM analysis report option if Synchro is used.

The following additional guidance is provided for use in signalized and unsignalized intersection analysis:

1) Existing signal timings and phasing shall be used for existing conditions analysis. The City will provide this information on request.

2) Modifications to existing timings and phasing may be proposed in the TIS as a proposed improvement, however the modifications must include an analysis of the effects of these modifications on the applicable traffic signal system.

3) Existing field measured peak hour factors should be used. The use of modified peak hour factors must be justified in the TIS.

4) A minimum green time of 10 seconds must be used for individual movements.

5) Synchro produces unrealistic queue lengths when volume to capacity ratios exceeds 0.95. In these instances, other methods will be required to determine queue lengths.

## 1.6 Design Exceptions

### 1.6.1 Project Design Exceptions

Design Exceptions shall be submitted via letter to the Federal Highway Administration (FHWA) D.C. Division Office when substandard features or design exceptions exist on the project. The design exception letter must discuss the AASHTO Green Book standard that applies, what it would cost to attain the full standard and a discussion of the effect that the substandard design is anticipated to have upon safety in the future. When possible, the Program Manager should avoid design exceptions. The Program Managers/Project Manager will discuss the need of design exceptions with the Chief Transportation Engineer before a letter is sent to the FHWA. All design exceptions should be identified as a part of the preliminary design review and approved prior to the final design review. The Project Manager should discuss the design exception requests with FHWA to determine necessary approvals and possibility of project delays.

The FHWA should receive an invitation to the preliminary design review meeting when a design exception is anticipated on a Federal aid project. A list of design exceptions can be found in Part II – Policy and Standards, of this manual.

NOTE: Design exceptions apply to federal aid projects only.

### 1.6.2 FHWA Approval

For projects with Federal aid, a formal submittal for exceptions to design standards must be submitted to FHWA for approval prior to the 65% design review. The submittal must include justification for design exceptions and mitigation measures where field conditions, lack of ROW, etc., require the construction of facilities, which do not meet minimum standards.

### 1.6.3 Substandard Design Features

The Project Manager shall identify substandard design features along with the rationale for the exception (mitigation measures, accident data, and cost analysis for any sub-standard feature must be explained) on the Project Design Exceptions Form.

## D-7. Design Exception Process