

# DESIGN GUIDE for PUBLIC STREET IMPROVEMENTS

October 1993

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# section 1: INTRODUCTION

## PURPOSE



The Bureau of Transportation Engineering and Development (BTED) has developed this *Design Guide for Public Street Improvements* to help the consulting engineer (Design Engineer) prepare construction drawings for public street improvements in the City of Portland.

The *Design Guide* provides guidelines for producing construction drawings that include adequate design information, conform to City requirements, and have a uniform format. Use of the guide is expected to improve communications between the Design Engineer and the City concerning the plan review process and the required technical details. Construction drawings developed in accordance with the *Design Guide* will require fewer "redline" corrections and reduce plan review time by the City. This in turn should help minimize engineering and plan review costs for the Design Engineer and the developer.

## CONTENT AND ORGANIZATION

The *Design Guide* contains the following sections in addition to this Introduction:

- ▶ **section 2: Roles and Responsibilities**, identifies the various participants involved in the plan review process for public street improvements.
- ▶ **section 3: Initiation of Public Street Improvement Projects**, summarizes how public street improvement projects originate. This is not intended as a comprehensive description of the public improvement process. That information can be found in the *City of Portland Development Manual*. (See **References** section.) The *Development Manual* also provides information about sewer and water main improvement

projects, which follow a similar but separate process from street improvement projects. (This *Design Guide* contains guidelines for only those portions of the stormwater drainage and water supply system that must be included in the street improvement construction drawings.)

- ▶ **section 4: Plan Review Process**, describes the plan review process, including all work tasks that are necessary to convert conceptual street improvement plans into detailed engineering construction drawings.
- ▶ **section 5: Traffic Design Criteria**, provides criteria related to traffic operations. These criteria affect many aspects of the project design.
- ▶ **section 6: Street Design Criteria**, identifies the format and technical details that must be provided in construction plans. The City considers it important to follow these design criteria to ensure that the public streets will safely serve their intended purpose and will be economical to maintain. The criteria do not, however, represent a complete reference on any specific topic; the Design Engineer must refer to other sources (see **References** section) and exercise professional judgment in designing the project. The criteria are not intended to restrict the Design Engineer's creativity. The Design Engineer may produce plans that reflect unique circumstances or design solutions, as long as they represent sound engineering design and satisfy the standards of the City.
- ▶ **section 7: Construction Cost Estimates**, discusses the requirements for preparing preliminary and final construction cost estimates.
- ▶ The **Glossary** defines selected terms that are contained in the *Design Guide* and commonly used in the Design Engineer's work.
- ▶ The **References** section identifies other reference sources that may be useful to the Design Engineer.



### REVISIONS TO THE *DESIGN GUIDE*

BTED will periodically update the *Design Guide* to reflect any changes in policies or procedures. BTED also encourages users of the *Design Guide* to suggest needed corrections or improvements. A preaddressed **comment sheet** is included in the back. BTED will send any revisions to everyone who has received a copy of the *Design Guide*.



## section 2: ROLES AND RESPONSIBILITIES



The **Bureau of Transportation Engineering and Development (BTED)** acts as the lead agency for the **Portland Office of Transportation (PDOT)** in implementing public street improvements.

The **City Engineer** is the manager of BTED and serves as the City's officer (as provided in the City Charter and appointed by City Council) for all work in the public right-of-way.

The **Plan Review Engineer** is the BTED engineer who manages the plan review process for street improvements. The Plan Review Engineer is the Design Engineer's primary contact during the development of construction plans. Since public street improvements also affect other bureaus and utilities, the Plan Review Engineer facilitates the review and coordination of project plans with these bureaus and utilities. The Plan Review Engineer is in BTED's **Permit Engineering Section**.

The **Design Engineer** is the consulting engineer employed by a developer to design street improvements. The Design Engineer must be a registered professional engineer in the State of Oregon.

In preparing construction plans, the Design Engineer's overall responsibilities include:

- Survey
- Drafting
- Technical content of engineering
- Changes in design
- Correction of errors and omissions

The Design Engineer's specific tasks during the plan review process are described in Section 4.

Improvements in the public right-of-way also have an impact on other private properties in the immediate area. At the discretion of the City Engineer, the developer may be required

to contact neighboring property owners to discuss the nature and scope of the project, neighborhood impacts, and the proposed construction schedule. The developer may ask the Design Engineer to help arrange for and conduct these meetings.

The **Bureau of Traffic Management (BTM)** specifies the traffic design criteria for street improvements, as discussed in Section 5.

**Utilities** that have facilities in the project area must be consulted to ensure coordination with the street improvements design, as discussed in Section 6.

The **Bureau of Environmental Services (BES)** administers public improvement projects for sanitary sewer and storm drainage facilities, which follow a separate plan review process. However, a small portion of the stormwater system is included with the street improvements designed and constructed under the jurisdiction of BTED. The Stormwater Drainage subsection in Section 6 identifies the information the Design Engineer must include in the street improvement plans and the required coordination with BES.

The **Water Bureau** administers public improvement projects for water mains, which follow a separate plan review process. Only minimal information relating to the water system is included in street improvement plans. This information and required coordination with the Water Bureau are discussed in the Water Supply subsection in Section 6.

The **City Forester** participates in all projects that involve street trees, as discussed in Section 6.

Exhibit 2-1 lists contact names and telephone numbers for City of Portland bureaus, utilities, and water districts.

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**CITY OF PORTLAND BUREAUS**

- **ENVIRONMENTAL SERVICES - Sewer Design**  
City-wide: Bill Baechler, 823-7103
  
- **PARKS - Forestry Division (by district)**  
Southwest and Northwest: Vincent Salomone, 823-4011  
Northeast: Joe Hintz, 823-4025  
Southeast: Craig Jensen, 823-4018  
North: Gary Hill, 823-4002  
City Forester: Alex Wynstra, 823-4489
  
- **TRAFFIC MANAGEMENT**  
**Street Lighting**  
City-wide: Bill Johnson, 823-5218  
  
**Traffic Signals - (by district)**  
North and Northeast: John Bustraan, 823-5176  
Southeast and Northeast (east of 82nd Ave.): Dave Hatch, 823-5174  
Northwest and Southwest: Jack Mason, 823-5182  
  
**District Operations - (by district)**  
North and Northwest: Mike Coleman, 823-5227  
Southwest: Lewis Wardrip, 823-5187  
Southeast and Northeast: Earl Reed, 823-5225
  
- **TRANSPORTATION ENGINEERING AND DEVELOPMENT**  
**Plan Review Engineers - (by assignment)**  
Carol Durand: 823-7154  
Jerry Markesino: 823-7057  
Larry Nordholm: 823-7036  
  
**Right-of-Way Acquisition Section**  
Kathryn Hall: 823-7085
  
- **WATER WORKS**  
City-wide: Hill Hampton, 823-7485 or Tom Chambers, 823-7477

**UTILITY COMPANIES**

- **UTILITIES NOTIFICATION CENTER (one call): 246-6699**
  
- **AT & T**  
Rick Benjamin, 639-6647
  
- **CHEVRON PIPELINE COMPANY**  
1-509-547-2545

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**UTILITY COMPANIES** (continued)

- **COLUMBIA CABLE TELEVISION** (Hayden Island Only)  
Judy Peters, 1-206-254-3228
- **GENERAL TELEPHONE**  
Jim Zerfing, 667-9780
- **NORTHWEST NATURAL GAS**  
New Construction Contact: Jim Stoelting, 226-4211, ext 2357  
Conversion Contact: 226-4211 (ask for Marketing)
- **PACIFIC TELECOM CABLE**  
Bob Kramer, 1-206-696-0983
- **PARAGON CABLE TELEVISION**  
(East side of Willamette River, except Hayden Island)  
Joe Valadez, 667-9390, ext 228
- **PORTLAND GENERAL ELECTRIC** - (All areas except PP & L service area)  
Service and Design Coordinators: Stephanie Choate or Sue Cowan, 464-7750
- **PACIFIC POWER & LIGHT** (North of the Banfield Freeway and east of I-5,  
except Hayden Island)  
Shelli Curry, Service Clerk: 280-2705 or  
Jim McPherran, Service Extension Supervisor: 280-2702
- **TCI CABLEVISION** (West side of Willamette River)  
Linda Petersen, 243-7497
- **U.S. SPRINT**  
Gary Anderson, 1-206-483-1331
- **U.S. WEST COMMUNICATIONS**  
Newly platted subdivisions: Jackie Lollar, 242-8626  
All others: 242-4777.  
Specify the project area and request contact with subarea design engineer.
- **WESTERN UNION**  
David Arnold, 1-206-253-7000

**WATER DISTRICTS**

- **GILBERT WATER DISTRICT**  
761-3770
- **CITY OF GRESHAM**  
Dale Anderson, 669-2426

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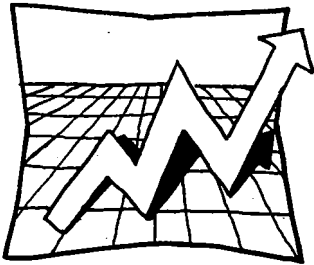
**WATER DISTRICTS** (continued)

- **HAZELWOOD WATER DISTRICT**  
Wayne Brian, 255-2706
- **PALATINE HILL WATER DISTRICT**  
Bill Roach, 636-8420
- **POWELL VALLEY ROAD WATER DISTRICT**  
Calvin Welch, 761-3770
- **ROCKWOOD WATER DISTRICT**  
Mike Baker, 665-4179
- **TUALATIN VALLEY WATER DISTRICT**  
642-1511
- **VALLEY VIEW WATER DISTRICT**  
Marilyn Stevenson, 292-8526





# section 3: INITIATION OF PUBLIC STREET IMPROVEMENT PROJECTS



Public street improvements generally originate as part of the City's development review process. Anyone developing property in the City of Portland may be required to make public improvements (streets, sanitary sewers, storm drainage facilities, or water mains) as a condition of development approval. The need for public street improvements is identified in one of the following ways:

► **The developer applies for a land use/zoning review.**

The City's Subdivision Code (Title 34) and Planning Code (Title 33) require land use/zoning reviews for projects that change the zoning or land use classification, create or alter lot lines, or involve development in geographic areas with design district or environmental designations.

The Portland Office of Transportation (PDOT) participates in these reviews to determine how the development will affect traffic, parking, and use of the streets and public rights-of-way. PDOT identifies public improvements needed both to support the development and to minimize potential negative impacts resulting from additional demand on public facilities. The required improvements may include, but are not limited to:

- New street construction
- Frontage improvements
- Sidewalks
- Street lights
- Traffic signals
- Signing
- Pavement markings

▶ **The developer applies for a building permit.**

Some developments are not subject to a land use/zoning review, but do require a building permit. In this case, PDOT reviews the building permit application and identifies public street improvements that are needed to serve the development.

▶ **The developer applies for a public improvement permit.**

Occasionally, a developer or property owner may want to implement street improvements that do not require a land use review or building permit, but are in the public right-of-way. (For example, replacing the sidewalk in front of a building or changing the material type.) PDOT reviews the public improvement permit application and either approves it or designates required revisions.

A comprehensive discussion of the development review process can be found in the *City of Portland Development Manual*. (See **References** section.) The *Development Manual* also provides information about sewer and water main improvement projects, which follow a similar but separate process from street improvement projects.

# section 4: **PLAN REVIEW PROCESS**

Street improvements evolve from conceptual plans to final engineered construction plans through the plan review process. Three distinct phases are included in the process:

▶ **phase 1: Project Development**

During project development, the Design Engineer works with the City to convert the conceptual plan into an engineering format. The Design Engineer completes all aspects of the construction plans and submits them to the City for approval.

▶ **phase 2: Engineering Plan Review**

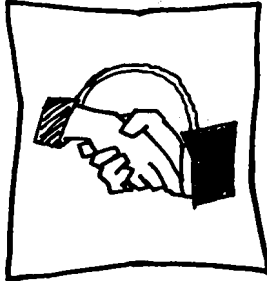
During engineering plan review, all affected City bureaus and utilities provide a comprehensive evaluation of the proposed construction plans. This phase includes the majority of work needed to resolve conflicts and develop a final set of plans suitable for construction.

▶ **phase 3: Approval of Plans and Specifications;  
Final Construction Cost Estimate; and  
Final Permit Fee Estimate**

During this administrative phase, the City prepares the final set of construction documents, the final construction cost estimate, and the final permit fee estimate. The project is then ready to proceed to construction.

The steps involved in each of these phases are identified below.

phase 1:  
**PROJECT  
DEVELOPMENT**



### **1. Predesign Meeting**

Before the start of detailed engineering work, the Plan Review Engineer arranges a predesign meeting with the developer and the Design Engineer. Staff from BTED and other bureaus that collaborate in the project design and construction (Traffic Management, Water, and Environmental Services) are invited to the meeting to respond to questions from the developer and Design Engineer.

The City provides the technical parameters of design and informs the developer and Design Engineer of the plan review process and its expected duration. City mylar sheets are provided so the Design Engineer can begin preparing detailed engineering drawings. Design Engineers who use CAD systems can obtain a disk for drawing the standard City drawing frame. The disk will contain files in the generic .DXF format and in the AutoCad .DWG format.

### **2. Preliminary Construction Cost Estimate**

The Plan Review Engineer prepares a preliminary construction cost estimate, based upon two sources of information:

- The quantities of work and materials estimate supplied by the Design Engineer.
- The construction industry's current unit bid prices, as experienced by the City on construction contracts for each particular type of work.

Section 7 discusses construction cost estimates in more detail and includes a construction cost estimate form (Exhibit 7-1) and definitions (Exhibit 7-2).

### **3. Preliminary Permit Fee Estimate**

Following the predesign meeting, the Plan Review Engineer develops a preliminary permit fee estimate. This consists of the following two parts:

- I. **Engineering expenses**—all City staff costs related to:
  - A. Project development and plan review
  - B. Construction engineering
    - Right-of-way acquisition
    - Construction inspection
    - Material testing
    - Street light inspection and testing
    - Traffic management field engineering
  
- II. **Agency construction costs**—work provided by the City, including such items as:
  - Installation of permanent signs and barricades
  - Pavement markings
  - Minor sewer and water main adjustments

The City Code requires the permittee to deposit 20 percent of the engineering expenses portion of this estimate before the beginning of plan review. This permit fee deposit is placed in a trust account with the City Treasurer. Withdrawals from the trust account are made periodically to reimburse the City for services provided.

Exhibit 4-1 shows the form used for the preliminary permit fee estimate.

#### **4. City Traffic Engineer's Report**

The Design Engineer must obtain an approved City Traffic Engineer's report from the Traffic Engineer (in the Bureau of Traffic Management - District Operations) for all projects designed on collector and arterial streets. This report defines the appropriate traffic criteria for the street to be designed. The specific traffic criteria dictate key requirements that affect vertical and horizontal alignment. Section 5 contains additional information about this report.

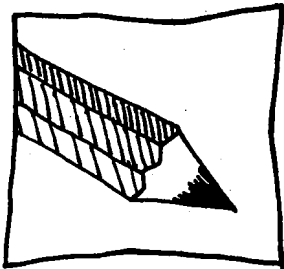
## 5. Construction Plans

The Design Engineer undertakes the project engineering tasks necessary to develop a complete set of construction plans. The Design Engineer is responsible for the complete design of all improvements and coordination with affected utilities. **Meetings with these affected utilities are essential to the completion of the design work.**

The Design Engineer designs and coordinates, at a minimum, the following elements:

- Design of all street and drainage facilities
- Pavement sections
- Street lights
- Street trees
- Driveways
- Sidewalks
- Retaining walls
- Traffic controls
- Construction erosion controls
- All needed utilities, including sewer and water facilities

## phase 2: ENGINEERING PLAN REVIEW



## 6. Initial Plan Acceptance

The Design Engineer submits reproducible construction drawings to the Plan Review Engineer, who screens them for acceptability. If the plans lack fundamental engineering information, preventing a thorough review, they will be returned to the Design Engineer within 3 workdays of the initial submittal. The minimum acceptability criteria are listed in Exhibit 4-2.

In addition to the construction drawings, the Design Engineer may be required to submit supporting engineering information to complete the plan review. This may include:

- Survey notes
- Driveway profiles
- Pavement design analysis

- Design calculations for all structures (always required)
- City Traffic Engineer's report
- Soils report
- Plat

## **7. Initial Plan Review**

A 15-workday initial review period begins when the plans are accepted.

BTED's plan review involves a technical evaluation of the proposed street improvements, related public improvements, and utility relocation/construction work. The plan review includes:

- Checking for compliance with the conditions identified during the land use or building permit review
- Verifying the platted rights-of-way and their relationship to the street design
- Evaluating vertical and horizontal alignments
- Evaluating the proposed pavement design
- Checking for compliance with standard plans and specifications
- Coordinating with other bureaus and agencies relating to design conflicts

The Plan Review Engineer duplicates the plans and forwards them to appropriate City bureaus and utility companies for review, usually concurrent with the BTED review. The reviewing parties (listed in Exhibit 4-3) are requested to comment on the impacts of the proposed design on their respective facilities.

The Plan Review Engineer consolidates any conflicts, errors, and omissions identified by the reviewers. The Plan Review Engineer provides the comments made by

all parties to the Design Engineer at the design conference.

## 8. Design Conference

The Plan Review Engineer arranges a conference with the Design Engineer to review all redlined items. During this conference, the Design Engineer may obtain clarification of each redlined item. At the conclusion of this meeting, the redlined plans and original drawings are given to the Design Engineer.

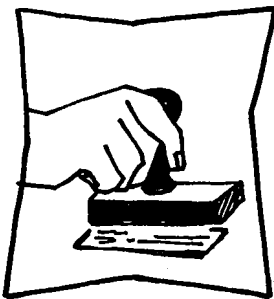
## 9. Revisions

The Design Engineer addresses each redline issue. Most items involve minor errors or omissions. The Design Engineer is encouraged to ask the appropriate City bureaus and utilities for clarification when the intent of a redlined item is unclear. Contested items may be discussed directly with the appropriate City bureau or utility. The City Engineer is the final authority in resolving disputed utility locations and other issues.

## 10. Additional Reviews

Occasionally, additional reviews are necessary to address problems that develop during design. The City completes each additional review within 5 workdays. On all resubmittals, the Design Engineer returns the previously redlined plans with the revised original drawings.

### phase 3: APPROVALS AND ESTIMATES



## 11. Plan Approval

The construction plans are formally approved and signed by the City Engineer. The Plan Review Engineer copies the plans and special specifications, and assembles them with the cost estimates (see steps 12 and 13, below) into construction document packages. These documents become an enclosure to the public improvement permit issued by the City.

Special specifications modify the *Standard Construction Specifications* of July 1, 1987 (revised April 1993), by



adding or deleting certain pieces of information. They may also be used to set specific requirements for each project.

## **12. Final Construction Cost Estimate**

The Plan Review Engineer prepares a final construction cost estimate to determine the permittee's performance guarantee requirement. This amount is based on two sources of information:

- The quantities of work and materials estimate supplied by the Design Engineer.
- The construction industry's current unit bid prices, as experienced by the City on construction contracts for each particular type of work.

Section 7 discusses construction cost estimates in more detail and includes a construction cost estimate form (Exhibit 7-1) and definitions (Exhibit 7-2).

## **13. Final Permit Fee Estimate**

The Plan Review Engineer updates the preliminary permit fee estimate (step 3, above) to reflect actual expenses incurred, plus a new estimate of future service costs. The 20 percent deposit obtained at the beginning of the project is credited against the total estimated fee, leaving a balance to be paid when the permit is issued.

The final permit fee estimate contains two parts:

### **I. Engineering Expenses**

- A. Project development and plan review (actual costs of services to date, plus an estimate of future services to be provided during construction)
- B. Construction engineering:
  - Right-of-way acquisition
  - Construction inspection
  - Material testing

- Street light inspection and testing
- Traffic management field engineering

Construction engineering services are based on an estimate of time and materials. The actual cost will vary, depending on the contractor's ability to complete the work expeditiously.

**II. Agency Construction Costs**

Agency construction costs relate to special work provided by City bureaus or City contractors.

- The Bureau of Maintenance removes, replaces, and installs permanent signs, barricades, pavement markings, and all parking meters.
- The Water Bureau relocates existing facilities and installs new services.
- The Bureau of Environmental Services, through the Maintenance Bureau, makes minor adjustments to existing sewer facilities.
- In certain locations, PGE installs street lights and bills the City for this service.

The City requires reimbursement from the permittee for all of these City-incurred, construction-related expenses as part of the permit fee.

When construction is complete and all costs are known, the Plan Review Engineer makes an accounting of billable expenses. If the permittee owes additional fees to the City, these fees must be paid before the City accepts the work and issues a certificate of completion. Any excess fees collected by the City are refunded to the permittee.

Exhibits 4-4(A) and 4-4(B) are a form and an example of the final permit fee estimate.

**PRELIMINARY PERMIT FEE ESTIMATE - CONSULTANT DESIGN**

JOB# \_\_\_\_\_ PROJECT \_\_\_\_\_

CONSULTANT: \_\_\_\_\_ PHONE: \_\_\_\_\_

**I. ENGINEERING EXPENSES**

**A. Project Development and Plan Review**

- 1. Permit Engineering ( PER ) - Plan Review \$ \_\_\_\_\_
- 2. R / W - Acquisition Services \$ \_\_\_\_\_
- 3. Traffic Management - Plan Review \$ \_\_\_\_\_
- 4. Printing/Distribution \$ \_\_\_\_\_

**Total Project Development and Plan Review \$ \_\_\_\_\_**

**B. Construction Engineering**

- 1. PER - Construction Engineering \$ \_\_\_\_\_
- 2. Construction Inspection \$ \_\_\_\_\_
- 3. Material Testing Expenses \$ \_\_\_\_\_
- 4. Traffic Management - District Operations \$ \_\_\_\_\_
- 5. Traffic Management - Parking Control \$ \_\_\_\_\_
- 6. Street Lighting - Inspection Fee \$ \_\_\_\_\_
- 7. Other \_\_\_\_\_ \$ \_\_\_\_\_
- 8. Other \_\_\_\_\_ \$ \_\_\_\_\_

**Total Construction Engineering \$ \_\_\_\_\_**

**II. AGENCY CONSTRUCTION COSTS**

- A. Maintenance Bureau \$ \_\_\_\_\_
- B. PGE Street Light Installation \$ \_\_\_\_\_
- C. Other \_\_\_\_\_ \$ \_\_\_\_\_

**Total Agency Construction Costs \$ \_\_\_\_\_**

=====

**TOTAL PRELIMINARY PERMIT FEE ESTIMATE**

I-A Total Project Development and Plan Review \$ \_\_\_\_\_

I-B Total Construction Engineering \$ \_\_\_\_\_

II Total Agency Construction Costs \$ \_\_\_\_\_

**TOTAL PERMIT FEE \$ \_\_\_\_\_**

**PERMIT FEE DEPOSIT (I-A + I-B) x 20% = \$ \_\_\_\_\_**

Prepared By: \_\_\_\_\_ Date: \_\_\_\_\_

Approved By: \_\_\_\_\_ Date: \_\_\_\_\_

**STREET PLAN CHECK FOR MINIMUM ACCEPTABILITY**

JOB # \_\_\_\_\_ PROJECT: \_\_\_\_\_

- Plan and profile on City construction plan frames
- Lettering legible and at least 0.10 inch high
- Vicinity map
- Streets identified by name; adjacent properties identified by lot/block, legal, or tax lot
- Street lighting design shown
- Structural details (retaining walls, bridges, box culverts, etc.). Design calculations must accompany plans.
- Existing streetscape amenities and underground facilities
- Typical sections
- Appropriate horizontal and vertical scales
- Centerline stationing used
- Profile of gutter lines
- Vertical curve data (BVC, VCPI, EVC, MO, low point, etc.)
- Horizontal curve data (PC, PT, delta angle, length)
- Inlets and inlet leads
- Registered Professional Engineer seal and signature

**NOTE:** This checklist is intended as a general guide to accept or reject plans for a first review. For a more complete listing of plan requirements, refer to the City of Portland's *Design Guide for Public Street Improvements*.

**CODES:**    ✓ = Acceptable or Not Applicable to this project  
              ✗ = Not Acceptable

<p><b>CITY ACCEPTED</b> BY: _____ DATE: _____</p>
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After the City accepts the initial set of construction plans from the Design Engineer for review, the Plan Review Engineer prints and distributes copies of the plan set to the appropriate City bureaus and utility companies for their review. After these field check plans are returned by the other bureaus and utilities, they are forwarded to the Design Engineer. Potential plan review agencies include:

### **City Bureaus**

- Buildings
- Environmental Services
- Maintenance
- Parks - Forestry Division
- Planning
  
- Traffic Management
  - Street Lighting*
  - Traffic Operations*
  - Signal Operations*
  - On-Street Parking*
  
- Transportation Engineering
  - Plan Review Engineer*
  - Construction Inspection*
  - Utility Coordinator*
  - Right-of-Way Acquisition Agent*
  
- Water Works (or the appropriate water district)

### **Utility Companies**

- AT & T
- Chevron Pipeline Company
- Columbia Cable (Hayden Island)
- Electric Lightwave
- General Telephone
- Northwest Natural Gas
- Pacific Northwest Bell
- Pacific Power & Light
- Pacific Telecom
- Paragon Cable Television (Eastside)
- Portland General Electric
- Sprint
- TCI Cablevision (Westside)
- Western Union

### **Other Agencies**

- Tri-Met

**FINAL PERMIT FEE ESTIMATE - CONSULTANT DESIGN**

JOB# \_\_\_\_\_ PROJECT \_\_\_\_\_

**I. ENGINEERING EXPENSES**

- A. Project Development and Plan Review**
  - 1. Past Charges - all sources \$ \_\_\_\_\_
  - 2. Current Charges - all sources \$ \_\_\_\_\_
  - 3. Future Charges \$ \_\_\_\_\_
  - Total Project Development and Plan Review \$ \_\_\_\_\_**
  
- B. Construction Engineering**
  - 1. PER - Construction Engineering Fee \$ \_\_\_\_\_
  - 2. Construction Inspection \$ \_\_\_\_\_
  - 3. Material Testing Expenses \$ \_\_\_\_\_
  - 4. Traffic Management - District Operations \$ \_\_\_\_\_
  - 5. Traffic Management - Parking Control \$ \_\_\_\_\_
  - 6. Street Lighting - Inspection Fee \$ \_\_\_\_\_
  - 7. Other \_\_\_\_\_ \$ \_\_\_\_\_
  - 8. Other \_\_\_\_\_ \$ \_\_\_\_\_
  - Total Construction Engineering \$ \_\_\_\_\_**

**II. AGENCY CONSTRUCTION COSTS**

- A. Maintenance Bureau \$ \_\_\_\_\_
- B. PGE Street Light Installation \$ \_\_\_\_\_
- C. Other \_\_\_\_\_ \$ \_\_\_\_\_
- Total Agency Construction Costs \$ \_\_\_\_\_**

**FINAL PERMIT FEE ESTIMATE SUMMARY**

- I-A Total Project Development and Plan Review \$ \_\_\_\_\_
- I-B Total Construction Engineering \$ \_\_\_\_\_
- Subtotal - Engineering Expenses \$ \_\_\_\_\_**
  
- Net Engineering Charge to Permittee**  
( \_\_\_\_\_ % of direct charges - Code 17.24.025) \$ \_\_\_\_\_
  
- II. Total Agency Construction Costs \$ \_\_\_\_\_
- TOTAL PERMIT FEE \$ \_\_\_\_\_**
- Less Permit Fee Deposit \$ \_\_\_\_\_
- BALANCE DUE \$ \_\_\_\_\_**

Prepared By: \_\_\_\_\_ DATE: \_\_\_\_\_

Approved By: \_\_\_\_\_ DATE: \_\_\_\_\_

**FINAL PERMIT FEE ESTIMATE - CONSULTANT DESIGN (EXAMPLE)**

JOB# 9909 PROJECT SW Example Project Place

**I. ENGINEERING EXPENSES**

<b>A. Project Development and Plan Review</b>	
1. Past Charges - all sources	\$ 1,200
2. Current Charges - all sources	\$ 200
3. Future Charges	\$ 100
<b>Total Project Development and Plan Review</b>	<b>\$ 1,500</b>
<b>B. Construction Engineering</b>	
1. PER - Construction Engineering Fee	\$ 300
2. Construction Inspection	\$ 5,000
3. Material Testing Expenses	\$ 700
4. Traffic Management - District Operations	\$ 100
5. Street Lighting - Inspection Fee	\$ 200
<b>Total Construction Engineering</b>	<b>\$ 6,300</b>

**II. AGENCY CONSTRUCTION COSTS**

A. Maintenance Bureau	\$ 500
B. PGE Street Light Installation	\$ 0
C. Other - Water Bureau: move fire hydrant	\$ 600
<b>Total Agency Construction Costs</b>	<b>\$ 1,100</b>

**FINAL PERMIT FEE ESTIMATE SUMMARY**

I-A	Total Project Development and Plan Review	\$ 1,500
I-B	Total Construction Engineering	\$ 6,300
	<b>Subtotal - Engineering Expenses</b>	<b>\$ 7,800</b>
	<b>Net Engineering Charge to Permittee (100% of direct charges - Code 17.24.025 )</b>	<b>\$ 7,800</b>
II.	Total Agency Construction Costs	\$ 1,100
	<b>TOTAL PERMIT FEE</b>	<b>\$ 8,900</b>
	Less Permit Fee Deposit	\$ 1,600
	<b>BALANCE DUE</b>	<b>\$ 7,300</b>

Prepared By: \_\_\_\_\_ DATE: \_\_\_\_\_

Approved By: \_\_\_\_\_ DATE: \_\_\_\_\_





# section 5: TRAFFIC DESIGN CRITERIA

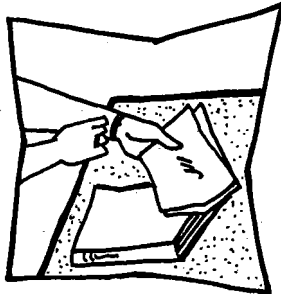
## INTRODUCTION

This section contains the traffic design criteria for improvements in the public right-of-way. It includes guidelines that are under the jurisdiction of the Bureau of Traffic Management (BTM). They relate to: driveway access, design speed, street grades, design vehicles / intersection geometry, guardrail design, street lighting, traffic signals, and other areas concerning the management of traffic. These criteria are based upon a variety of technical references, including but not limited to:

- City of Portland *Standard Construction Specifications*
- City of Portland Municipal Code
- ODOT *Standard Specifications for Highway Construction*
- All applicable AASHTO guidelines

The criteria in this section clarify and supplement the design practice found in other sources. This section does not represent a complete reference on any specific topic. The Design Engineer must refer to the other sources and exercise professional judgement in the design of the project.

## City Traffic Engineer's Report



The City Traffic Engineer's Report specifies for the Design Engineer the traffic criteria for the completed public improvement project.

### REFERENCES

*City of Portland Comprehensive Plan - Transportation Element*,  
(most current version)

### DESIGN CONSIDERATIONS

The criteria for traffic operations affect many aspects of the project design. Before beginning design work on arterial or collector streets, obtain a City Traffic Engineer's report that specifies the criteria of the street to be improved. (The Traffic Engineers are listed in Exhibit 2-1 under Traffic Management - District Operations.) A sample City Traffic Engineer's report and a definition of terms are included as Exhibits 5-1 and 5-2.

The Traffic Engineer, using all readily available information, will specify the criteria that will result in acceptable traffic operations in the area of the improvement project. The specified criteria will generally include: design speed; design vehicle; number, type, and width of travel lanes; type, length, and width of turn lanes; and other criteria relating to safe and efficient traffic operations.

If all traffic operations information is not readily available, the Design Engineer may be required to conduct special traffic engineering studies. The Traffic Engineer will work closely with the developer and the Design Engineer to determine the specific areas of investigation needed. The Design Engineer must be a licensed Professional Engineer in the State of Oregon with expertise in the field of traffic engineering.

The information contained in the rest of Section 5 provides the basis for the criteria in the Traffic Engineer's report.

**TRAFFIC ENGINEER'S REPORT**

Job # \_\_\_\_\_ Project: \_\_\_\_\_

Prepared By: \_\_\_\_\_ Phone # 823- \_\_\_\_\_ Date: \_\_\_\_\_

**DESIGN CRITERIA for planned street improvement**

Street Name: \_\_\_\_\_

Street Use Classifications: Traffic - \_\_\_\_\_ Transit - \_\_\_\_\_

Truck Routes - \_\_\_\_\_ Bikeways - \_\_\_\_\_ Pedestrianways - \_\_\_\_\_

Design Speed: \_\_\_\_\_ MPH Maximum Design Grade: \_\_\_\_\_ %

Design Vehicle: SU-30 \_\_\_\_\_ B-40 \_\_\_\_\_ WB-40 \_\_\_\_\_ WB-50 \_\_\_\_\_ Other \_\_\_\_\_

**STREET CROSS-SECTION: include lane configurations, sidewalks, and right-of-way width  
(Sketch Scale 1"= 10' or 20')**

**REMARKS: (include other criteria and additional needed studies)** \_\_\_\_\_

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

**DESIGN CRITERIA** for Intersection Design

Cross-Street Name: \_\_\_\_\_

Street Use Classifications: Traffic - \_\_\_\_\_ Transit - \_\_\_\_\_

Truck Routes - \_\_\_\_\_ Bikeways - \_\_\_\_\_ Pedestrianways - \_\_\_\_\_

Design Speed: \_\_\_\_\_ MPH Maximum Design Grade: \_\_\_\_\_

**CROSS-SECTION OF THE APPROACH:** Include lane configurations, sidewalks, and right-of-way width (Sketch Scale 1"= 10' or 20')

**INTERSECTION DESIGN VEHICLE:**

FROM (street / direction)	TO (street / direction)	DESIGN VEHICLE
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____

**REMARKS:** (include other criteria and additional needed studies) \_\_\_\_\_

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

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**Street Use Classification:** The designated street classification according to the Transportation Element of the *City of Portland Comprehensive Plan* (formerly known as the "Arterial Streets Classification Policy").

**Design Speed:** The maximum safe speed that can be maintained on a street under optimal conditions and as governed by the design features of the street.

**Right-of-Way:** The land area dedicated for transportation purposes.

**Street Width:** The width of the pavement, between the curbs, used for traffic lanes, parking lanes, preferential lanes, emergency refuge, and other transportation purposes.

**Design Grade:** The maximum design grade, in percent, to be used for each particular street classification (local, collector, and arterial).

**Travel Lanes:** The number and design width of the travel lanes in each direction. Includes preferential lanes (i.e., bike, bus, carpool, etc).

**Turn Lanes:** The number, width, and turning direction of all turn lanes in the street area.

**Parking Lane:** The street width, along the curb, that is reserved for on-street parking.

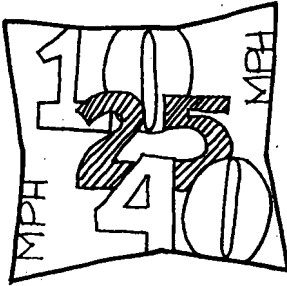
**Bike Lane:** A preferential lane that is striped and designated for bicycle use.

**Design Vehicle:** The selected motor vehicle of a designated type, whose weight, dimensions, and operating characteristics are to be considered in specifying curb radii, horizontal alignment, channelization, and other features.

**ADT:** The average daily traffic (ADT) volume, based upon periodic measurements made by the Bureau of Traffic Management.

**Truck Traffic:** The truck volume component of the ADT, expressed as a percent of the ADT.

## Design Speed



The design speed for a street improvement project of relatively small scope will be determined based on the design and operating characteristics of contiguous street sections. On larger projects where entire segments of new roadways are to be built, the design speed selected should be consistent with the Traffic Speeds Policy of the *City of Portland Comprehensive Plan - Transportation Element* (see below). The Traffic Engineer must either specify or approve the design speed selected for all new streets.

### TRAFFIC SPEEDS POLICY

*It is the intent of this policy to accommodate traffic speeds that are safe and reasonable from the perspective of motorists, bicyclists, pedestrians, and other street users.*

- a. *It is recognized that a combination of driver perception, traffic volume, street design, posted speed limits, and enforcement levels determine the prevalent speed of traffic on any given street. All factors must be carefully coordinated in order to safely and successfully increase or decrease the speed of traffic on any given street.*
- b. *The recommended speed should be reflective of land uses adjacent to the street. The higher end of the range is appropriate for auto-oriented land uses of limited access roadways. The lower end of the range is recommended for streets with residential or lower intensity commercial uses.*
- c. *However, the authority for the designation of speed limits on streets within the City rests with the State Speed Control Board. The intention of this policy is to maintain, by street design, operation, and the posting of recommended speed limits, the following traffic speeds on streets within the City:*

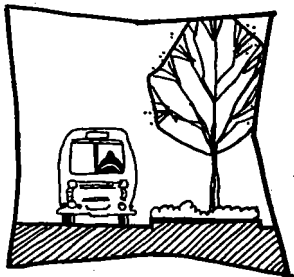
<i>Regional Trafficways</i>	<i>40-55 mph</i>
<i>Major City Traffic Streets</i>	<i>30-45 mph</i>
<i>District Collector Streets</i>	<i>20-40 mph</i>

**SECTION 5: TRAFFIC DESIGN CRITERIA**

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<i>Neighborhood Collector Streets</i>	<i>20-35 mph</i>
<i>Local Service Streets</i>	<i>20-25 mph</i>
<i>Near Schools and Parks (Near Elementary Schools - during school hours)</i>	<i>20 mph</i>
<i>In Neighborhood Commercial Districts</i>	<i>20 mph</i>

## Design Vehicle



The design vehicle will influence the width of the traveled way and the curb return geometry in intersection areas. The choice of the design vehicle is based on street classifications and land use. Lane configurations, designated on-street parking, existing land development, traffic signals, and other existing conditions will directly affect the possible geometric design solutions at intersections. Occasionally, a simple curve radius may satisfy the turn movement needs of the designated design vehicle. More frequently, however, a large radius curve with taper sections or a three-centered compound curve section will be the best design alternative.

### DESIGN FOR TRUCKS

Truck route classifications for City streets can be found in the *City of Portland Comprehensive Plan - Transportation Element* (formerly known as the *Arterial Streets Classification Policy*, or ASCP). These truck classifications include: truck district, regional truck route, major truck route, minor truck route, and local service street. General guidelines for design treatment are described in the *Transportation Element*. Suggested design vehicles for truck routes are described below:

- **Truck District** – For all street classifications in a truck district, use a WB-50 as the typical design vehicle. Where industrial land uses create a relatively high number of "large" truck trips, a WB-70 may be a more prudent design vehicle.
- **Regional Truck Route** -- These are typically higher-classed City traffic streets and state highways. Where City guidelines are applicable, use a WB-50 as the design vehicle.
- **Major and Minor Truck Routes** -- For all major and minor truck routes, use a WB-40 design vehicle.

### DESIGN FOR TRANSIT

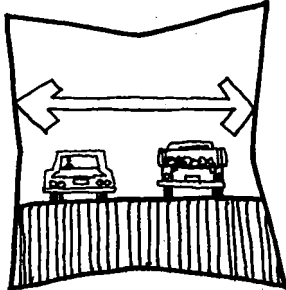


### DESIGN FOR TRANSIT

Transit street classifications are also specified in the *Transportation Element*. They include: regional transitways, major City transit streets, and minor transit streets.

- **All Transit Street Classifications** – Use the B-40 design vehicle.

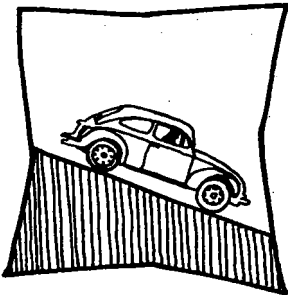
## Right-of-Way and Street Widths



Right-of-way and street widths are established by the City based on the *Comprehensive Plan* designation of abutting property, the type of street, operational characteristics, and on-street parking provisions.

Refer to City Code, Title 34, Figure 1, for specific information on right-of-way and roadway widths.

## Street Grades



Street grades are designated to fit the topography, ensure proper drainage, and promote traffic safety. Based on their use classifications, design street grades should be specified at or below the following maximums:

### Maximum Grades

- Local Service Streets
 

Desirable	15 percent
Maximum - Asphalt Pavement	18 percent
Maximum - Concrete Pavement	22 percent
  
- Neighborhood Collector Streets
 

Desirable	8 percent
Maximum	12 percent

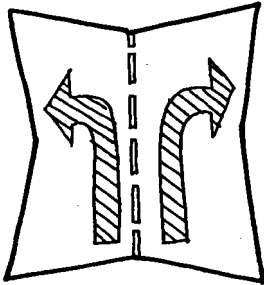
### DESIGN CONSIDERATIONS

On neighborhood collector streets, limit the use of a continuous maximum grade to 500 feet or less. The Traffic Engineer may allow exceptions to the maximum grade to accommodate severe topography.

For signalized intersections, keep the longitudinal grade of all travel lanes through the intersection at or below 6 percent. For unsignalized intersections, keep the longitudinal grade on stop-controlled approaches to the intersection below 8 percent for an approach distance of 50 feet.

Carry the grade line of the "major" street through the intersection. Warp the "minor" cross-street to fit. Avoid combinations of grade lines that make vehicle control difficult.

## Turn Lanes



The Traffic Engineer's report may require the construction of turn lanes to provide for speed change or left-turn storage.

### LEFT-TURN LANE DESIGN

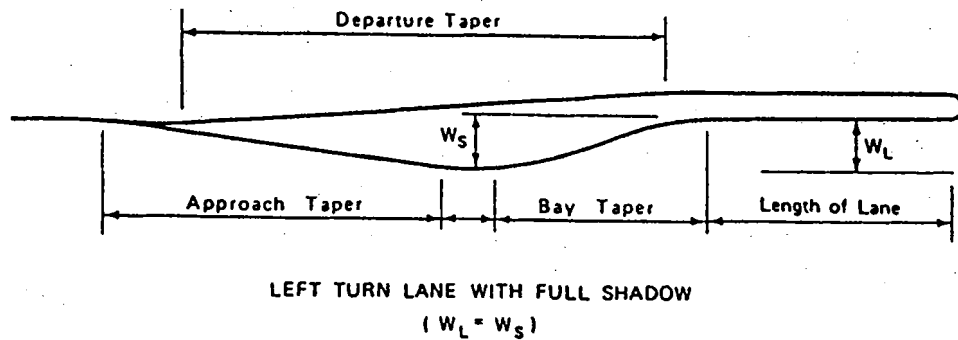
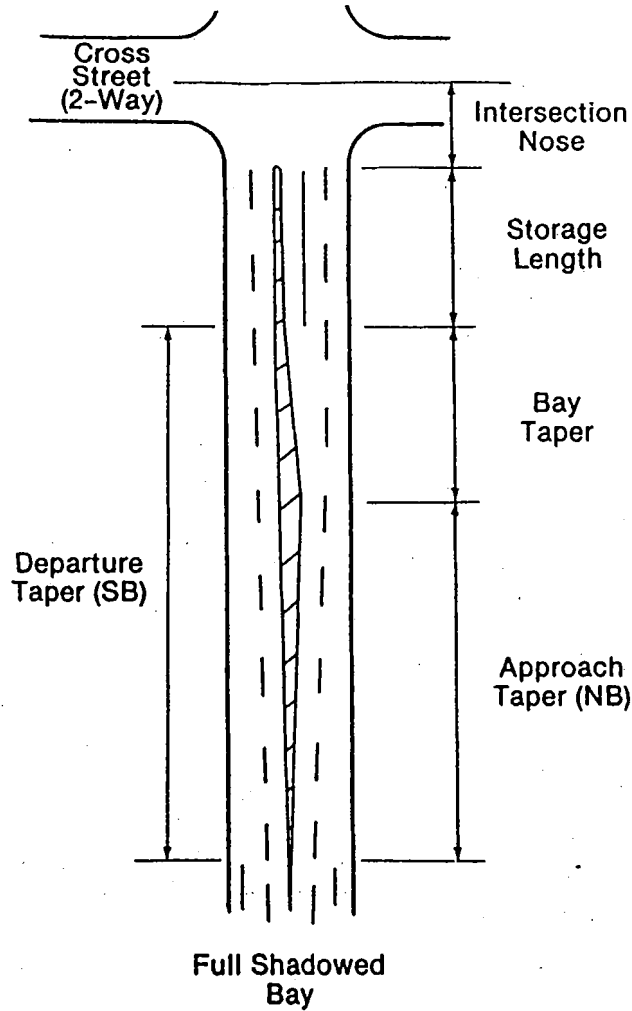
At signalized intersections, warrants for left-turn lanes are based on turning volumes, opposing traffic volumes, accident experience, and available capacity. The need for a left-turn lane is normally determined by the Traffic Engineer.

Elements of left-turn lane design are shown in Exhibits 5-3 and 5-4. Design values for approach taper, bay tapers, and lane taper lengths are shown in Exhibits 5-3 through 5-5. Storage requirements are a function of turning volumes and signal cycle lengths, and are shown on Exhibit 5-6.

For new construction, use a full shadowed bay design and the storage length specified by Exhibit 5-6. Where left-turn lanes are added to existing roadways, use the bay design, full or partial shadowed, that matches the adjacent intersections. Reduced storage lengths may be acceptable in situations where the desired length cannot be reasonably accommodated.

### RIGHT-TURN LANE DESIGN

The Traffic Engineer may require the use of right-turn acceleration and deceleration lanes on streets with either high volumes or high speeds. Speed change lanes facilitate safe completion of the turning movements and reduce the potential for rear-end collisions. Design elements for speed change lanes are shown in Exhibit 5-7.



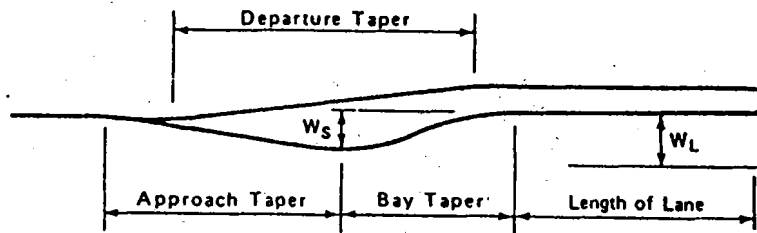
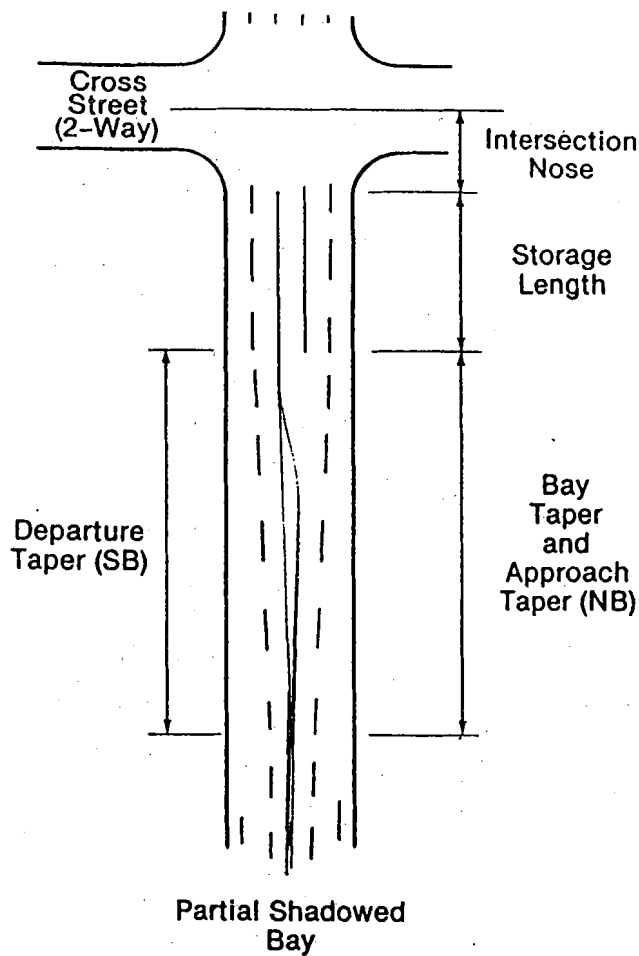
Bay Taper Length = 60' or 90' for Business and Urban areas and 120' for high speed locations.

Approach Taper =  $WS^2/60$  Desirable

Where S = Off Peak 85th Percentile Speed (In urban areas where space is restricted, "S" may be reduced to 10 or 20 MPH).

W = Width of Lateral Traffic Shift in Feet.

**EXHIBIT 5-3**  
**FULL SHADOWED BAY**



LEFT TURN LANE WITH PARTIAL SHADOW  
(  $W_L > W_S$  )

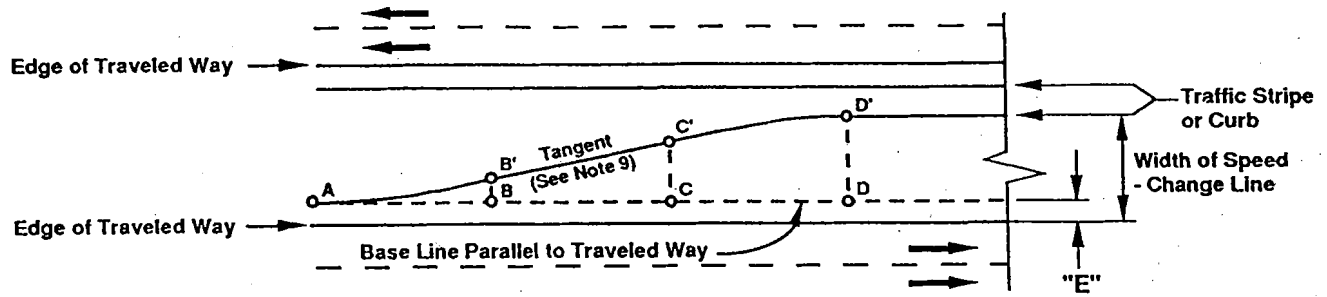
Bay Taper Length = 60' or 90' for Business and Urban areas and 120' for high speed locations.

Approach Taper =  $WS^2/60$  Desirable

Where S = Off Peak 85th Percentile Speed (In urban areas where space is restricted, "S" may be reduced to 10 or 20 MPH).

W = Width of Lateral Traffic Shift in Feet.

**EXHIBIT 5-4**  
**PARTIAL SHADOWED BAY**



LENGTH OF TAPER - FEET			OFFSET DISTANCE		
60	90	120	DD' = 10'	DD' = 11'	DD' = 12'
Distance from Point "A"					
			0	0	0
5	7.5	10	0.16	0.17	0.19
10	15.0	20	0.62	0.69	0.75
15	22.5	30	1.41	1.55	1.69
20	30.0	40	2.50	2.75	3.00
B'	30	45.0	5.00	5.50	6.00
	40	60.0	7.50	8.25	9.00
C'	45	67.5	8.59	9.45	10.31
	50	75.0	9.38	10.31	11.25
	55	82.5	9.84	10.83	11.81
	60	90.0	10.00	11.00	12.00

AD = Length of Taper  
 AB = BC = CD = 1/3 AD  
 AB' & C' D' are Parabolic Curves

**NOTES:**

1. The table gives offsets from a base line parallel to the edge of traveled way at intervals measured from point "A". Add "E" for measurement from edge of traveled way.
2. Where edge of traveled way is a curve, neither base line nor taper between B & C will be a tangent. Use proportional offsets from B & C.
3. The offset "E" is usually 1'-2' along the edge of traveled way where there is a curbed median. Where the median is painted there is no offset.

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**Required Vehicle Storage  
(number of vehicles)**

Peak hour left-turn movements	60 - second cycle	120 - second cycle
100	4	7
200	7	12
300	9	16
400	12	20
500	14	24
600	16	28
700	18	32
800	20	36

(1 vehicle = 20 feet)



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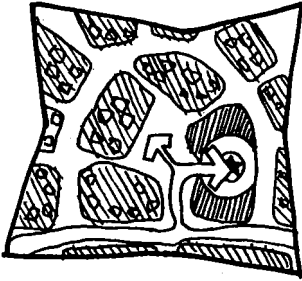
**Length of Speed Change Lanes  
(feet)**

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<b>DESIGN OF POSTED SPEED (MPH)</b>	<b><u>STOP CONDITION</u></b>		<b><u>15 MPH TURN</u></b>	
	<b>ACCEL</b>	<b>DECEL</b>	<b>ACCEL</b>	<b>DECEL</b>
<b>25</b>	<b>100</b>	<b>200</b>	<b>90</b>	<b>150</b>
<b>30</b>	<b>190</b>	<b>235</b>	<b>190</b>	<b>185</b>
<b>35</b>	<b>270</b>	<b>275</b>	<b>240</b>	<b>235</b>
<b>40</b>	<b>380</b>	<b>315</b>	<b>320</b>	<b>295</b>
<b>45</b>	<b>550</b>	<b>375</b>	<b>480</b>	<b>350</b>

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## **Access**



Access design ensures that the location and width of streets and driveways will provide for safe operations and minimal disruption of traffic flow.

### **DESIGN REFERENCES**

City of Portland Municipal Code, Title 16: Vehicles and Traffic.

City of Portland Municipal Code, Chapter 17.28: Sidewalks, Curbs and Driveways.

(See also Section 6 - Driveways, in this Design Guide.)

### **DESIGN CONSIDERATIONS**

Access refers to the design and location of the connection between the public right-of-way and a street or driveway. Access is controlled in order to balance safety and traffic operations in the public street with the access needs of adjacent properties. A concrete driveway is the standard form of access to the public right-of-way from private property. High-volume access points from commercial developments may require the installation of a signalized commercial street intersection.

The Traffic Engineer will consider the following in reviewing the proposed access:

- Land use
- Design vehicle and site needs
- Type of access requested (driveway or intersection)
- Street classification
- Street operational characteristics
- Level of improvement on the adjacent street
- Distance from existing or proposed traffic control devices
- Distance from intersections or other features that increase the potential for vehicle conflicts
- Potential exposure for pedestrians and bicyclists
- Sight distance (public streets)
- Existing policies

In general, the higher the street classification, the fewer the number of access points that are allowed.

Nonresidential developments should orient access away from local residential streets where there is an option.

Intersections should be spaced at least 200 feet apart if unsignalized and 1/2 mile apart if signalized.

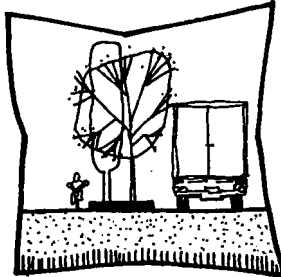
Driveways should be located as far away as possible from intersections or other features that may increase potential conflicts. (Left-turn pockets are an example.)

In areas of high-density housing, such as "row houses," shared driveways are encouraged. Multiple unshared driveways that have minimal separation between them are discouraged.

For driveways, there are no adopted criteria for sight distance. However, the City may require relocation of a driveway for safety reasons, including sight distance. If the applicant wishes to pursue the original location, the City may require the applicant to conduct engineering studies regarding sight distance to justify the requested location.

Where gates or other mechanical devices for controlling or monitoring access will be installed across a driveway (at parking garage entrances, for example), the City may require the applicant to conduct an engineering study regarding the impacts of traffic queuing.

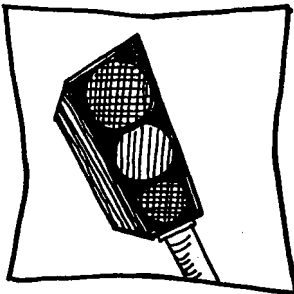
## **Islands and Medians**



Traffic islands and medians are features used to channelize traffic. They are designated as painted or raised.

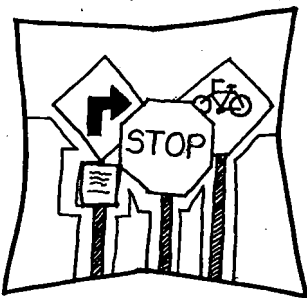
Use raised islands or medians to provide refuge for pedestrians, protect traffic control devices, or prohibit undesirable traffic movements. Design in accordance with AASHTO guidelines. The desirable minimum width for curbed medians is 4 feet. Where the street width is constrained, a minimum width of 2 feet may be accepted.

## **Traffic Signals**



New traffic signals and signal remodels are normally designed by the Bureau of Traffic Management. There are special circumstances under which the permittee may desire to have the signal design performed by a qualified consulting traffic engineer. When this situation occurs, the Signal System Manager is available to meet with the Design Engineer and define the specific design requirements for the intersection.

## **Traffic Signs**



Traffic signs are specified and assigned a position location by the Traffic Engineer during the first review of the construction plans. The permittee is responsible for installing all new or relocated sign posts according to City specifications. Signs are installed by City maintenance crews as an agency construction expense of the permit fee.

## Parking Signs and Meters

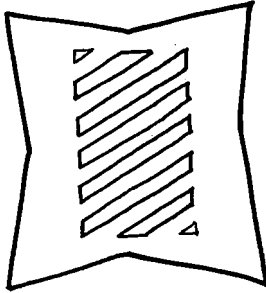


Parking signs are specified and assigned a position location by the City's District Parking Field Representative during the first review of the construction plans. The permittee is responsible for installing all new or relocated sign posts according to City specifications. On the sign posts placed by the permittee, the City installs the sign legends as an agency construction expense of the permit fee.

Parking meter locations are specified by the District Parking Field Representative during the first review of the construction plans. The installation and/or removal of the parking meters and posts may only be performed by City crews under a work order from the District Parking Field Representative. This work is an agency construction expense of the permit fee.

Curb paint and tape that designate parking spaces are specified by the District Parking Field Representative during the first review of the construction plans. Installation is performed by City crews as an agency construction expense of the permit fee.

## **Pavement Markings**



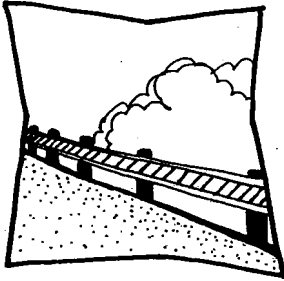
For projects on collector/arterial streets, include a Pavement Markings Plan with the construction plans. Include design information for the placement of temporary traffic control striping and permanent pavement markings. This plan will be used to replace all permanent pavement marking within the project area. It will also be used by the contractor to install temporary traffic controls in the street work zone. Contact the Traffic Engineer early in the design phase for assistance in developing the plan.

Show existing and proposed markings and clearly designate markings to be removed. Provide dimensions at all horizontal break points to define transitions.

Generally, all permanent pavement markings will be installed by City maintenance crews as an agency construction expense of the permit fee. Before the City places pavement markings, the contractor is responsible for field locating permanent markings according to the City's special specifications for the project.

The permittee's contractor is responsible for installing temporary markings where street improvements are opened to traffic before permanent markings are installed.

## Guardrail



In some areas, it may be necessary to install guardrails to improve safe operations on the street.

### **BACKGROUND**

Guardrail is installed to reduce the severity of run-off-the-road accidents. This is accomplished by deflecting a vehicle away from embankment slopes or fixed objects and dissipating the energy of the errant vehicle. However, guardrail will reduce accident severity only for those conditions where striking the guardrail is less severe than going down an embankment or striking a fixed object. Guardrail should be installed only where it is clear that safety will be improved. Guardrail installations are subject to approval by the Bureau of Traffic Management.

### **STANDARD PLAN REFERENCES**

- 3-20, Guardrail - Types and Assembly Details
- 3-21, Guardrail - General Details
- 3-22, Guardrail - Post Details

**Materials** for guardrail installation shall conform to the following sections in the City's Standard Construction Specifications:

- Metal beam rail - Section 608.2.02A.
- Guardrail posts and blockouts - Section 608.2.02B.
- Hardware (ie. bolts, nuts, etc.) - Section 608.2.02C.

**Construction** of guardrail shall conform to Section 608.3.03 of the City's Standard Construction Specifications. The breakaway cable terminal end treatment shall conform to ODOT Standard Drawing No. 2126D until the plan for this end treatment is added to the City standards.

### **NEEDS ASSESSMENT**

Before guardrail is considered, assess the roadside hazards to determine the appropriate treatment.

Consider the treatment of hazards in the following order:

1. Remove the hazard or redesign it so it can be safely traversed.
2. Relocate the hazard to a point where it is less likely to be struck.
3. Reduce the impact severity of the hazard by using an appropriate breakaway device.
4. Redirect a vehicle by shielding the hazard with a longitudinal traffic barrier and/or crash cushion.
5. Delineate the hazard if the above alternatives are not appropriate.

Removing or relocating hazards or flattening slopes is substantially superior to the hazard of impacting guardrail. Some obstructions that must be within the clear zone may be mitigated by using breakaway features, such as breakaway joints in wood poles or slip bases in metal poles. Guardrail should be viewed as the last resort.

Guardrail is placed to mitigate the detrimental effects of a vehicle leaving the roadway only when hitting the guardrail is expected to be less hazardous than the effect of leaving the unprotected roadway. Roadway guardrail is not intended to protect private or public property. Objects with high social or economic value, such as playgrounds or monuments, may be granted an administrative exception.

### **WARRANTS**

The warrants for guardrail installation are based on three main criteria: A) clear zone, B) embankment, and C) accident history.

#### **A) Clear Zone**

The clear zone is defined as the area adjacent to the roadway where an errant vehicle may come to a stop without the threat of hitting a hazardous object. Clear zone distance is based on design travel speed, expected traffic volume, and slope of the ground



adjacent to the roadway. Exhibit 5-8, Clear Zone Distances, is a table provided by AASHTO that gives the clear zone distances (in feet) from the edge of the travelled way (i.e. fog line, edge of the pavement, or curb). There should be no hazardous objects within the clear zone distance. This distance gets larger for higher speeds, higher volumes, and steeper slopes. For example, an errant vehicle travelling at a higher speed is likely to go farther off the road in order to come to a stop than a slower-moving vehicle. Similarly, the steeper the slope, the farther the vehicle is expected to travel. On slopes steeper than 4:1, the vehicle is expected to proceed to the bottom of the slope regardless of the width of the slope. On slopes steeper than 3:1, the vehicle is expected to roll over. On non-recoverable slopes (4:1 or steeper), design the area within 10 feet of the bottom of the slope to be obstruction free.

Consider the following in assessing the clear zone:

- ✓ Roadside cut sections in bedrock are considered a hazard if the rock face is irregular and likely to snag a car.
- ✓ Roadside obstructions include: trees more than 4 inches in diameter; wood poles or posts (having a section area greater than 24 square inches without breakaway features); fixed objects sticking up out of the ground more than 4 inches; drainage items, including pipe ends; open water 2 feet deep or more; and any substantial constructed or natural structure.
- ✓ Where roadside ditches are present, see Exhibit 5-9, Preferred Ditch Sections. Keep the area near the bottom of the ditch free of obstructions because there is a tendency for a vehicle to be channelled along the ditch bottom.

#### **B) Embankment**

If no hazardous objects are within the clear zone and slopes are steeper than 3:1, use the charts shown in Exhibit 5-10, Embankment Criteria, to determine whether guardrail is warranted on an embankment. These charts

are based on average daily traffic, speed, embankment height, and embankment slope. The area above the curve represents conditions that warrant guardrail or other mitigating action.

**C) Accident History**

For locations that are under consideration for guardrail installations, research available accident history data to determine if an identifiable accident pattern exists. Depending on the average daily traffic, two or three similar accidents (such as running off the inside or outside of a curve) occurring over a number of years may define a pattern that warrants mitigation. Accident records may be obtained from the Bureau of Traffic Management.

**GUARDRAIL DESIGN CRITERIA**

Refer to Chapter 5 of the *1989 AASHTO Roadside Design Guide* for specific criteria on guardrail placement. When making a decision about the installation of guardrail, consider the following:

- Locate guardrail far enough in front of an obstruction so that upon impact, it will not deflect into the hazard. This distance is typically 2-3 feet for W-beam guardrail with strong posts.
- If existing guardrail within the project does not satisfy current guardrail warrants, direct the contractor to remove such guardrail by showing the removal work on the construction plans.
- For existing guardrail sections and ends that do not meet current standards, specify appropriate upgrading.
- Locate guardrail as far from traffic as possible, slopes and obstructions permitting. This allows the largest recovery area possible for the motorist and will reduce the hazard and frequency of guardrail impacts.

- Bury the guardrail end at standard height in a cut slope, or fasten it to a bridge railing or other similar object. A less desirable end treatment is to flair the guardrail as far away from the traffic as possible. The least satisfactory method is to use a breakaway cable terminal (BCT) end treatment.

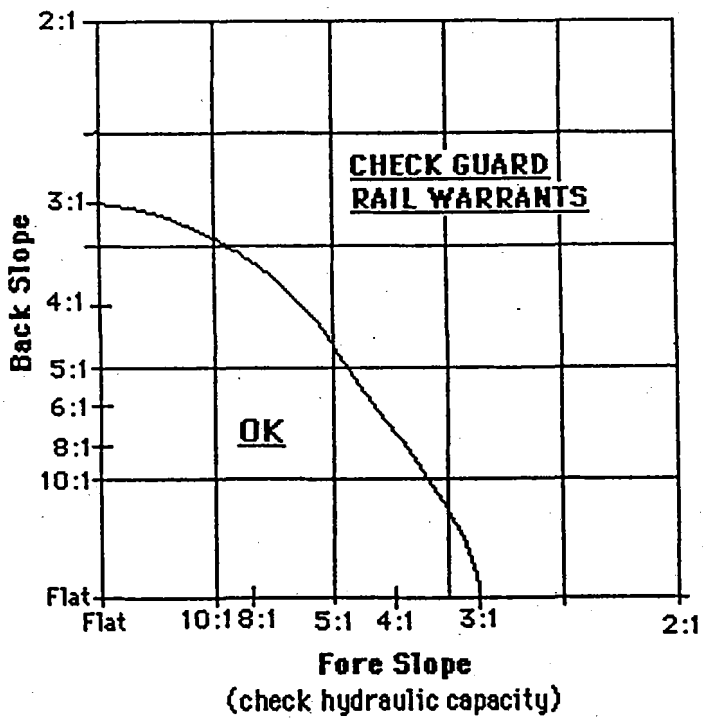
Speed*	Design ADT	Fill Slopes***			Cut Slopes****		
		<6:1	5:1-4:1	3:1	3:1	4:1-5:1	<6:1
40 mph or less	<750	7-10	7-10	**	7-10	7-10	7-10
	750-1500	10-12	12-14	**	10-12	10-12	10-12
	1500-1600	12-14	14-16	**	12-14	12-14	12-14
	>6000	14-16	16-18	**	14-16	14-16	14-16
45-50 mph	<750	10-12	12-14	**	8-10	8-10	10-12
	750-1500	12-14	16-20	**	10-12	12-14	14-16
	1500-6000	16-18	0-26	**	12-14	14-16	16-18
	>6000	18-20	24-28	**	14-16	18-20	20-22

\* AASHTO uses "design speed". Design speed is more applicable to new design and defines some minimum criteria such as grades, curvature, pavement, and shoulder widths. Frequently, roadways are designed so that only one or two of the minimum design criteria apply. Design speed is frequently unknown and not applicable to city streets. Speed limit is most applicable.

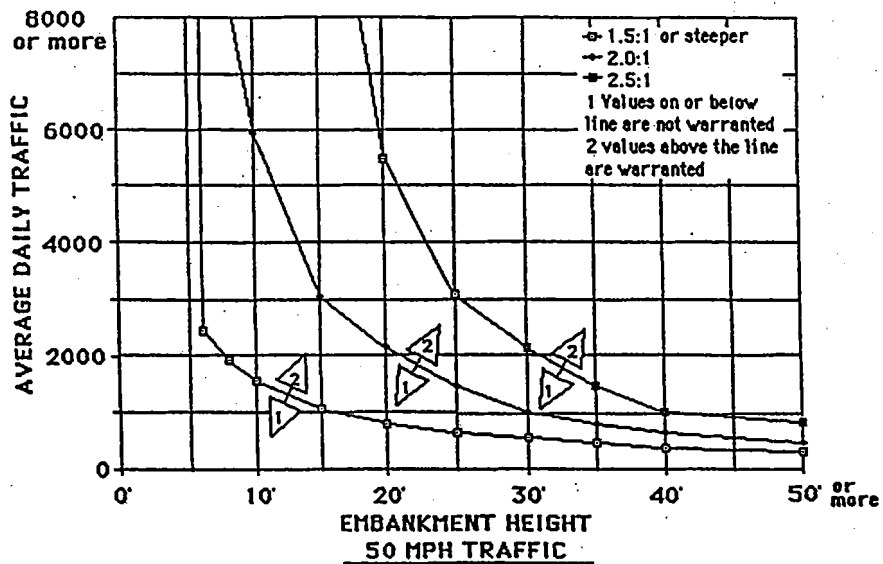
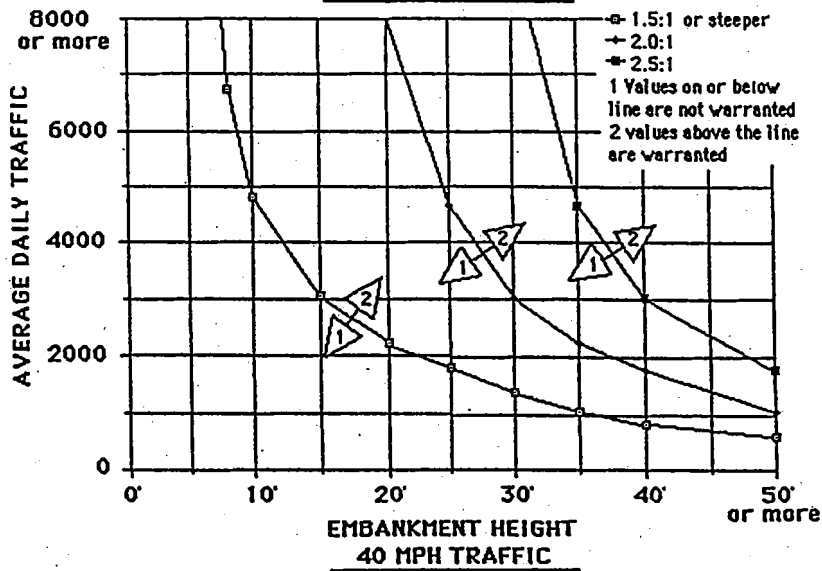
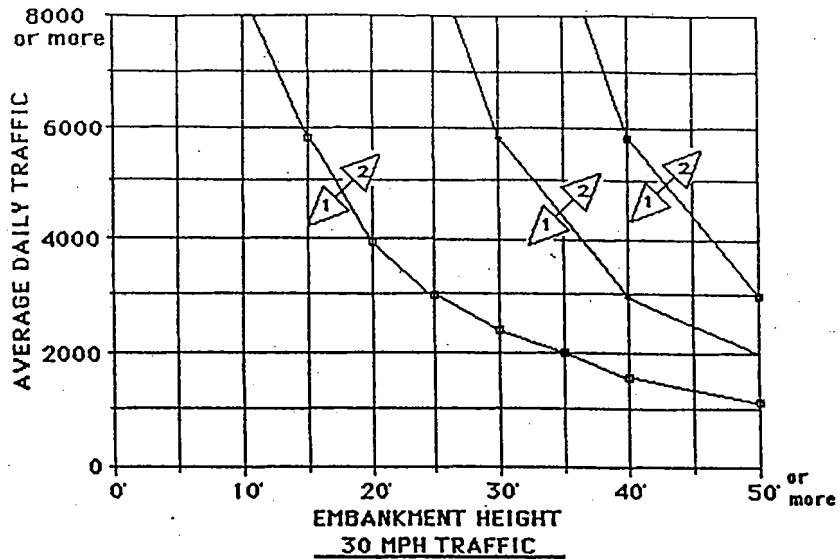
\*\* Obstructions should not occur on or near the bottom of slopes steeper than 4:1, because the driver is unlikely to be able to recover or control the vehicle on such slopes.

\*\*\* All distance represent horizontal distance from the edge of pavement.

**EXHIBIT 5-8  
CLEAR ZONE DISTANCES**

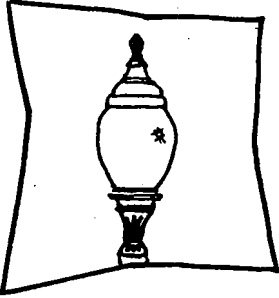


**EXHIBIT 5-9**  
**PREFERRED DITCH SECTIONS**



**EXHIBIT 5-10**  
**EMBANKMENT CRITERIA**

## Street Lights



It is important to design and install street lighting to City standards so the City will accept the system and agree to own, operate, and maintain it upon completion of construction.

### PLAN REFERENCES

*Special Specifications for Subdivisions and Permit Projects.*  
Bureau of Traffic Management, Street Lighting Division,  
July, 1990.

### DESIGN CRITERIA

- **Predesign Meeting** – Participate in a predesign meeting with the Street Lighting Division staff of the Bureau of Traffic Management before beginning design work on any street lighting systems. Specific criteria for street light design will be provided by the City.
- **Utility Construction Plan** – Design all street lighting systems on separate construction drawing mylars. Other "wire" utilities may be included on these design sheets.
- **Construction Drawing Format** – The general construction drawing format used for the street improvement design (See Section 6) also applies to street lighting design. For lighting construction plans, show all of the following: right-of-way, centerlines, lot lines, curbs, pavement edges, existing lights relevant to the project design, proposed lights, proposed panels, proposed service points, wiring diagram, panel schematics, legend, trees, driveways, and any other details necessary to provide a complete design. (See Exhibit 5-11.)
- **Key Locations** – Position street lights at the following key locations:
  - Intersections: on radius line at PC/PT location

- Cul-de-sacs: at the entry throat
- Dead-ends: near the end of the street, spaced so that the maximum street area can be lit
- Horizontal Curves: at the beginning and ending of each curve
- **Spacing** – On straight alignments, adjust pole spacing, within photometric limitations, to position the lights on projected property line locations. Locate all components of the street light system in the public right-of-way.
- **Tree Separation** – Provide for a minimum separation of 25 feet between trees and street light poles. Where new trees are to be installed, selected tree species may allow for a decrease in the minimum tree/pole separation distance. Obtain approval from the Street Lighting Division before design.
- **Driveway Conflicts** – Locate street light poles 5 feet or further from the wing of any style driveway.
- **Sidewalk Conflicts** – On streets that have only one sidewalk, locate the street lights on the side of the street with no sidewalk where possible.
- **Local Residential Street Lights** – Typical street lighting will include the following:
  - Lamp: 100 watt, high-pressure sodium (HPS)
  - Fixtures: "cobra head" or "shoe box" style/cutoff fixture
  - Mounting height: 30 feet
  - Pole spacing: 120 to 180 feet, depending on block length, curves, and lot sizes
- **Arterial Street Lights** – Typical street lighting will include the following:
  - Lamp: 150 to 400 watt, high-pressure sodium (HPS)



- Fixtures: GE "cobra head" or "shoe box" style
- Mounting height: 35 to 40 feet
- Pole spacing: 180 to 215 feet, depending on street width and the City's lighting standard requirements

Obtain specific criteria from the Street Lighting Division before beginning final design.

- **Photometric Design Calculations** – Supply all calculations and photometric data necessary to evaluate a proposed lighting system to verify compliance with Street Lighting Division guidelines.
- **Poles** – Street lights are installed on metal or fiberglass poles. Poles are supported with concrete footings. All systems have underground wiring. In certain cases where five or fewer lights are needed, wood utility poles and underground circuitry may be allowed. Contact the Street Lighting Division before beginning design work on a wood pole system.
- **Control Panels** – Specify U.L.-approved control panels in the street lighting system. The panels shall be freestanding on a concrete base or attached to a street light pole. Minimum size for freestanding base-mounted panels is 43" high x 12" wide x 8.5" deep. Pole-mounted panel size can be 24" high x 12" wide x 8" deep or 12" high by 8" wide by 6" deep as needed, depending on system load. Specify seam-welded, 14-gauge stainless steel construction. Include in the panel circuitry an hour meter, a test switch, and appropriately sized circuit breakers and contactors. Use a master photo cell to control the system.
- **Luminaire Fixtures** – For residential areas, specify either "cobra head" type fixtures (G.E. M 250A-2) or square "shoe box" type fixtures similar to those manufactured by American Electric (series 53/54). Fixtures shall be painted bronze. Use only high-pressure sodium vapor lamps. All 100/150-watt fixtures shall operate at 120 volts, with the lamps operating at 55 volts. For arterial streets and in commercial areas, use G.E. 400A2, 200-watt and larger

fixtures that operate at 240 volts, with the lamps designed to operate at 100 volts.

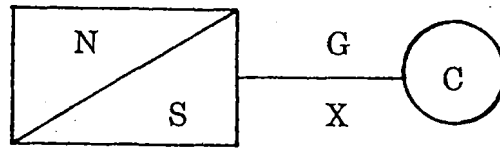
### DESIGN CONSIDERATIONS

The developer is responsible for all design, coordination, and verification of service with the power company; construction; and fees charged by the power company.

### COMMON TROUBLE POINTS

- **Service points:** Failure to identify power supply location with local electric utility company.
- **Design graphics:** Failure to use standard graphics and schematics.
- **Layout:** Failure to consider key street light location requirements.

- **Wire and Conduit Sizing**



N = Number of Conductors

S = Size of Conductors

G = Groundwire

X = Size of Groundwire

C = Conduit Size

- **Symbols**

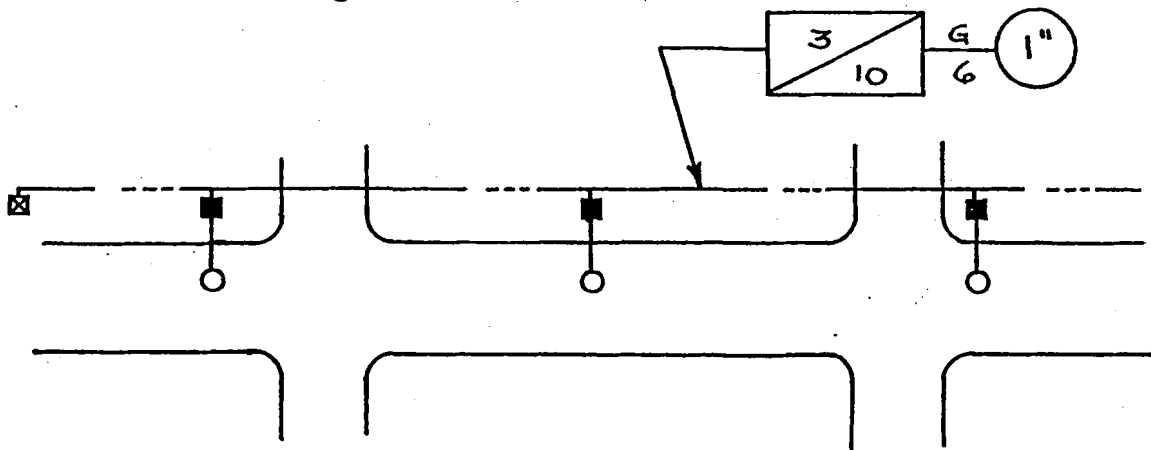
☒ = Panel

■—○ = Cobra-head Street Light

■—□ = Shoe-box Street Light

◊ = Twin Ornamental

⊗ = Single Ornamental



**Example Plan View**



# section 6: STREET DESIGN CRITERIA

## INTRODUCTION

The design criteria for each project have both general and specific requirements. The general requirements are based on a variety of technical references, including but not limited to:

- City of Portland *Standard Construction Specifications* (including Standard Plans)
- City of Portland Municipal Code
- ODOT *Standard Specifications for Highway Construction*
- All applicable AASHTO guidelines

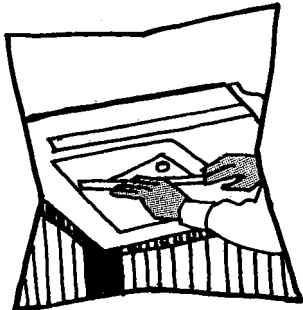
A full listing of technical references is included in the **References** section of this *Design Guide*.

The specific requirements may be based upon the initial land use action, the building permit, the City Traffic Engineer's report (Section 5), and/or other conditions designated by the City Engineer.

The design criteria identified in this section clarify and supplement the requirements provided by these other sources. However, they do not represent a complete reference on any specific topic. The Design Engineer must refer to the other sources and exercise professional judgment in designing the project.

The City considers it important to follow the design criteria in this manual to ensure that the public streets will safely serve their intended purpose and will be economical to maintain. The criteria reflect current practice, identify essential technical details, and promote consistency in order to facilitate the plan review process. However, they are not intended to restrict the Design Engineer's creativity. The Design Engineer may produce plans that reflect unique circumstances or design solutions, as long as they represent sound engineering design and satisfy the standards of the City.

## Construction Drawing Format



### PURPOSE

To provide the Design Engineer with guidelines for the initial plan setup.

### STANDARD PLAN REFERENCES

Not applicable.

### DESIGN CRITERIA

- **City Plan Frames** – Submit plans on 22" x 34" mylar sheets provided by the City of Portland. Both PLAN and PLAN/PROFILE sheets are available. Machine-generated drawings on City base frames are also acceptable. Disks for drawing the standard frame are available from the City. The disk will contain files in the generic .DXF format and in the AutoCad .DWG format.
- **Vicinity Map** – Include a vicinity map on the first sheet of the construction plan set and show the location of the project with respect to the nearest major street intersection. Use a scale that approximates 1" = 600'. The vicinity map need not occupy a space greater than 5 x 5 inches.
- **North Arrow** -- Show a north arrow on each plan view sheet and adjacent to any other drawing that is not oriented the same as other drawings on the sheet.
- **Vertical Scale** – Use a vertical scale that clearly illustrates changes in vertical alignment. Acceptable scales are 1" = 1', 2', 4', 5', or 10'.
- **Horizontal Scale** -- For each plan view, use a horizontal scale large enough to make all notations easy to read. Acceptable scales are 1"= 10', 20', or 30'. The 20 scale normally provides sufficient room for all details and is preferred for use during construction. Show the scale in a "scale-bar" format to facilitate use of the plans after

photocopy reductions are made.

- **Letter Height** -- Use a letter height of 0.10 of an inch (10 point) or larger. Computer-drafted plans, Leroy, and neat hand lettering are acceptable.
- **Benchmark** -- In the General Notes section of the construction plans, identify the location and elevation of the City benchmark used to reference the project. If temporary benchmarks are used, identify the reference, its location, and its elevation in relation to the nearest City benchmark.
- **Professional Engineer Seal** -- On each sheet, show the seal and signature of the Registered Professional Engineer responsible for preparing the construction drawings.
- **Legend** -- Define the meaning of all symbols, symbolic line weights, and screens. List and explain all abbreviations used.

### DESIGN CONSIDERATIONS

Use general and specific notes on each sheet to sufficiently clarify work items for construction. Notes may be used to direct the contractor to take specific actions relating to work methods and coordination. Exhibit 6-1 lists examples of commonly used notes that may be used.

Show the appropriate quarter section and City job number, assigned by the Plan Review Engineer, in the blocks provided.

### COMMON TROUBLE POINTS

**Vicinity Map:** Selected scale is too small to provide accurate project location.

**Vertical Scale:** Selected scale does not readily show change in vertical alignment.

**Horizontal Scale:** Selected scale is too small to show needed

details.

**Letter Height:** If too small on full-size plans, characters become impossible to read on half-size, reduced plans.

**Legend:** Symbols used on plans are not shown in the legend, or symbols used on plans disagree with symbols in the legend.



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## COMMONLY USED GENERAL NOTES

### GENERAL

1. Excavators must comply with all provisions of ORS 757.541 to 757.571 including notification of all owners of underground facilities at least 48 business day hours, but not more than 10 business days, before commencing an excavation. See list of Potential Underground Facility Owners on this sheet.
2. All construction and materials shall conform to these plans and the applicable requirements of the JULY, 1987 edition of the City of Portland STANDARD CONSTRUCTION SPECIFICATIONS (revised April 1993).
3. Notify Street Construction Inspection Department 2 business days before commencing work (823-7012).
4. Elevations are based on City of Portland datum from Bench Mark No. \_\_\_\_\_, elevation = \_\_\_\_\_, located at \_\_\_\_\_.
5. Storm and sanitary sewers are being constructed under Job # \_\_\_\_\_, as approved by the Bureau of Environmental Services.
6. Water mains and services are being constructed under Job # \_\_\_\_\_, as approved by the Water Bureau.

### STREET PAVEMENT

7. Stationing is based upon street centerline unless otherwise specified.
8. Adjust all manhole lids and valve boxes to finished street grade.
9. Exact limits of skinpatching shall be determined by City inspector. Skinpatch with Class "C" asphalt concrete.
10. Sawcut straight matchlines to create a butt joint between the existing pavement and new pavement.
11. Pave with 2" AC "C" mix on 3" AC "B" mix on compacted 8" aggregate base OR match existing pavement if it has a thicker asphalt section.

### CURBS/SIDEWALKS/DRIVEWAYS

12. Construct combination curb and sidewalk per Standard Plan No. 3-140.
13. Construct curb and curb endings per Standard Plan No. 3-130.
14. Construct curb with keyway per Standard Plan No. 3-141. Sidewalk section to be constructed at later date under separate permit.
15. All future driveways shall be constructed per Standard Plan No. 3-105 under separate permits.

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### **CURBS/SIDEWALKS/DRIVEWAYS (continued)**

16. Construct commercial driveways per Standard Plan No. 3-107 at centerline station locations shown on plans.
17. Construct residential driveways per Standard Plan No. 3-105 at centerline station locations shown on plans.
18. Use 3,000 psi/6.1 sack mix concrete for all sidewalks, curbs, and driveways per Standard Specification 602.3.02 B.

### **INLETS AND LEADS**

19. Construct inlets per Standard Plan Nos. 4-30, 4-34, and 4-36.
20. Construct double inlet (end-to-end) per Standard Plan Nos. 4-31-1, 4-34, and 4-36.
21. Construct double inlet (side-by-side) per Standard Plan Nos. 4-31-2, 4-35, and 4-39.
22. All C.S.P. shall be ASTM C-14, Class 3 with Class 'C' bedding and backfill per Standard Plan Nos. 4-01 and 4-02.

### **TRAFFIC ITEMS AND STREET LIGHTS**

23. All signing, pavement striping and markings, and permanent barricades to be installed, removed, and/or reinstalled by the Bureau of Maintenance and charged to permittee. Notify district traffic engineer: \_\_\_\_\_, phone no. \_\_\_\_\_, at least \_\_\_\_\_ days prior to having the work started.
24. Construct street lighting per SPECIAL SPECIFICATIONS FOR SUBDIVISIONS AND PERMIT PROJECTS, dated July 1, 1990 (Bureau of Traffic Management).
25. PGE will install \_\_\_\_ - 150 watt, FG, "cobra head" style luminaires with 8-foot mast arms on their relocated wood poles. All street light equipment to be furnished by City and all costs to be borne by permittee. Contractor must contact Bill Johnson of Street Lighting (823-5218) to initiate street light work order between City and PGE.

### **TREES**

26. TREE ROOT INSPECTION REQUIRED !! Contact the Forestry Division of the Parks Bureau at 823-4489 prior to any excavation adjacent to trees. A tree inspection must be made before cutting any roots.

### **EROSION CONTROL**

27. Construction of all erosion control measures shall be in accordance with OAR 340-41-55 and the City of Portland EROSION CONTROL PLANS TECHNICAL GUIDANCE HANDBOOK dated January, 1991 (or most current version).

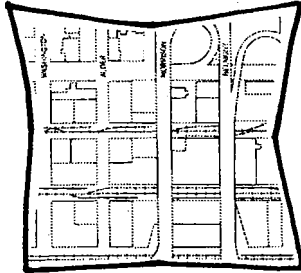
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**EROSION CONTROL (continued)**

28. Approval of this erosion/sedimentation control (ESC) plan does not constitute an approval of any other proposed project design elements.
29. The Contractor is responsible for the implementation of this erosion/sedimentation control (ESC) plan and the construction, maintenance, replacement, and upgrading of the erosion control measures until all construction is completed, the vegetation/landscaping is established, and both are accepted by the City.
30. Clearly mark with survey flagging the clearing limits of the construction site shown on this plan before beginning earthwork. During construction, maintain the marked clearing limits and do not disturb the areas outside the construction site.
31. The ESC measures shown on this plan are the minimum requirements for the anticipated site conditions. During construction, inspect these measures daily and upgrade them to ensure that sediment-laden water does not leave the construction site.
32. Install a "gravel construction entrance" at each point of entry to the construction site according to Figure 3-1A of the EROSION CONTROL PLANS TECHNICAL GUIDANCE HANDBOOK.

## Horizontal Alignment: Plan View



### PURPOSE

To ensure that a sufficient amount of horizontal design information is provided to the contractor, surveyor, and inspector for construction of the project.

### STANDARD PLAN REFERENCES

3-7-1, Curb Offset

### DESIGN CRITERIA

- **Base Map** – Create the base map for the construction plans using the right-of-way lines and the adjacent private property lines. Label the width of the right-of-way and the width of the proposed street improvement. Refer to City Code, Title 34, Figure 1, for specific information on right-of-way and roadway widths.
- **Property Descriptions** – Identify each property by its subdivision name, lot number, and block number or the tax lot number if the property is not formally platted. Label the frontage dimension, adjacent to the right-of-way, of each property on the plan view. Identify all existing and proposed easements on the plan view.
- **Stationing** – Use the standard engineering stationing convention to control the horizontal alignment of the project. Label a station reference on the plan view at least every 50 feet. Mark whole stations with their full station reference (for example: 2+00, 3+00, 4+00), and use "tick marks" as half station references. Identify "begin project" and "end project" station reference.
- **Project Alignment** – Align the centerline of the proposed street improvements on the centerline of the right-of-way. The improvements may be shifted right or left of the right-of-way centerline if topographic or encroachment conditions dictate. Obtain City Engineer approval before proceeding with a design that uses an

offset between the right-of-way and the street centerlines.

- **Sight Distance** – Observe and incorporate AASHTO guidelines for safe stopping sight distance in combination with design speed and vertical alignment. On local service streets, use an inside curb radius of 100 feet or larger.
- **Survey Control References** – Show alignment information for the centerline, the right-of-way lines, and gutter lines (curb faces). For each horizontal curve, show its radius, delta angle, curve length, and references to PC and PT stations. In some situations, a table containing this information should be used to reduce confusion. (See Exhibit 6-2.)

Show the centerline station and offset reference for all PCs, PTs, PCCs, and PRCs (for example: PC 2+54.07, 16' Rt.).

Show centerline stationing and equation points of all intersecting streets (for example: 10+34.56 NW Elm Street = 0+00 NW 47th Ave.).

- **Matchlines** -- Use matchlines to show continuation of the plan view on a succeeding sheet. Identify the matchline by station (for example, label as: 5+34.02 Matchline, See Sheet 3). Design information beyond the matchline is discouraged.
- **Drainage** – Identify the drainage surface flow direction in all street gutters with symbolic flow arrows. Show drainage facilities both on and below the surface of the project.
- **Existing Streetscape Amenities** – Show all existing streetscape amenities within and adjacent to the right-of-way that may be affected by the improvement project. These include: trees, landscaping, structures, driveways, sidewalks, temporary roadways, other existing improvements, and all traffic signs, signals, and pavement markings. (At the discretion of the City Engineer, part or all of this requirement may be waived

for newly platted residential subdivisions.)

- **Trees** -- Removal and placement of all trees in the right-of-way are subject to approval by the City Forester. See additional requirements in the Street Trees subsection.
- **Existing Utilities** -- Show all existing underground utilities and power pole locations. Identify current and proposed utility pole locations/relocations. See additional requirements in the Utilities subsection.
- **Sidewalk Ramps** -- Specify all sidewalk curb ramp locations with the appropriate Standard Plan reference. See the Sidewalks subsection for further details.
- **Driveways** -- Show all proposed driveways. See additional requirements in the Driveways subsection.
- **Future Improvements** -- Extend the horizontal alignment design of streets that will be built in the future. Show at least 100 feet of design information, compatible with the projection of the right-of-way.
- **Horizontal Transitions** -- For horizontal transitions of the curb that do not involve a traffic lane reduction, use a 6:1 taper as shown in Standard Plan 3-7-1, or a combination of reverse curves with radii equal to or larger than 20 feet.
- **Traffic Lane Transitions** -- For traffic lane reduction transitions, design the lane taper length ( L ) as follows:

A. 
$$L = \frac{W \times S^2}{60} \quad \text{for } S = \text{less than 45 mph}$$

B. 
$$L = W \times S \quad \text{for } S = 45 \text{ mph or greater}$$

**Where:**  $L$  = minimum taper length in feet

$S$  = design speed in mph

$W$  = width, in feet, of the traffic lane being eliminated.

## DESIGN CONSIDERATIONS

Existing landscape improvements made by property owners in the public right-of-way are very important to them. Carefully consider the impacts of street construction on these improvements, and be sensitive to property owners' concerns when determining the disposition of the improvements. Indicate by "save" or "remove" all landscaping installed by property owners within the project construction area.

When meeting existing paved streets, specify the approximate limits of skin patching needed to achieve a new design cross-slope.

To help the contractor understand a transition from one typical cross-section to another, show the pavement crown line transition on the plan view.

Street improvement plans include construction of the drainage system from the inlet or catch basin to the manhole. Storm sewer construction plans, approved by the Bureau of Environmental Services, include the construction of all manholes and mainline sewers.

Sidewalk ramps for disabled persons are governed by specific design standards required by the Americans with Disabilities Act. Major sidewalk alterations are often needed to retrofit an existing corner with a curb ramp. Carefully examine each location and specify sufficient horizontal and vertical control to construct these ramps.

## COMMON TROUBLE POINTS

**Property Descriptions:** Properties not fully defined.

**Sight Distance:** Safe stopping sight distance, specified by AASHTO guidelines, not considered.

**Survey Control:** Insufficient information to allow the plans to serve as a single source document for constructing the project.

**Drainage:** Incomplete graphical representation of the entire storm drainage system. Inclusion of mainline sewer

construction on the street improvement plans.

**Existing Streetscape Amenities:** Incomplete graphical representation of existing conditions. Failure to consider design alternatives that minimize the impact on trees and landscaping.

**Existing Utilities:** Incomplete design and coordination work relating to the relocation of utilities.

**Future Improvements:** Failure to consider future road extensions, which unnecessarily complicates future land use actions and construction projects.



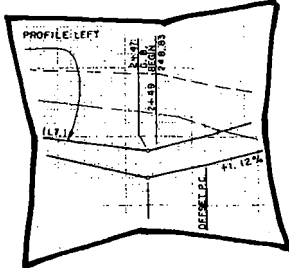
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**CURVE DATA**

<b>CURVE NUMBER</b>	<b>#1</b>	<b>#2</b>	<b>#3</b>
<b>DESCRIPTION</b>	CENTERLN		
<b>PC STATION</b>	1+30.50		
<b>PC ELEVATION</b>	592.37		
<b>PT STATION</b>	2+29.25		
<b>PT ELEVATION</b>	601.50		
<b>RADIUS</b>	250		
<b>LENGTH</b>	98.75		
<b>DELTA ANGLE</b>	22.6318		
<b>CHORD LENGTH</b>	98.11		
<b>CHORD BEARING</b>	N27 52 05W		

## Vertical Alignment: Profile View



### PURPOSE

To ensure that a sufficient amount of vertical design information is provided to the contractor, surveyor, and inspector for construction of the project.

### STANDARD PLAN REFERENCES

- 3-131, 30" Combination Curbs and Gutter
- 3-132, 24" Combination Curbs and Gutter

### DESIGN CRITERIA

- **City Datum** -- Tie vertical control to nearest existing City-established and maintained benchmark.
- **Maximum Pavement Slope** -- When designing the vertical alignment, observe AASHTO guidelines for safe stopping sight distance in combination with design speed and horizontal alignment. On local service streets, the maximum pavement slope for asphalt concrete is 18 percent and the maximum pavement slope for Portland Cement concrete is 22 percent. (See also the Street Grades subsection in Section 5.)
- **Minimum Pavement Slope** -- Minimum longitudinal gutter grade for a standard curb and asphalt pavement is 0.5 percent. For gutter grades between 0.5 percent and 0.3 percent, use the combination concrete curb/gutter section shown under Standard Plan 3-131 or 3-132.
- **Gutter Grades** -- Use the GUTTER LINE as the basis for the vertical alignment. Where the LEFT and RIGHT gutter line profiles are not identical, show separate profile information for each.
- **Property Line Grades** -- Show proposed final left and right property line profiles. During the initial plan review, the Plan Review Engineer may request additional

cross-sections to evaluate conflicts with existing improved properties.

- **Vertical Curves/Grade Breaks** -- Use a vertical curve design for longitudinal grade changes greater than 2.5 percent (algebraic difference). Use a vertical curve length that will produce a middle ordinate (MO) of 0.20 feet or greater. For grade changes less than 2.5 percent, grade breaks are preferred.

Minimum crest vertical curve lengths for local streets are shown in Exhibit 6-3. For collector and arterial streets, refer to AASHTO guidelines for vertical curve design.

- **Cul-de-Sac Profile** -- For each cul-de-sac, show a gutterline runout, as a separate profile. Use a separate stationing reference system along the gutterline that can be tied back to the centerline system at the beginning and ending points of the cul-de-sac. See additional requirements in the Cul-de-Sacs subsection.
- **Survey Control References** -- Show engineering station, horizontal offset, and elevation of all of the following:
  - ✓ Begin vertical curve (BVC)
  - ✓ End vertical curve (EVC)
  - ✓ Vertical curve point of intersection (VCPI), VC length, and middle ordinate (MO)
  - ✓ High point of a crest vertical curve or low point of a sag vertical curve
  - ✓ Changes in horizontal alignment - PCs, PTs, PRCs, and PCCs
  - ✓ Grade breaks, low points (inlets), high points
- **Curb Returns - Straight Grade** -- Specify gutter elevations at each quarter point along all curb returns. Maximum grade break in a curb return is 12 percent (algebraic difference). In some situations, a table containing all

curb return data would be beneficial. (See Exhibit 6-4.)

- **Curb Returns - Vertical Curve** -- Show the gutter elevations on a separate profile detail. Specify the BVC, EVC, PI of the curve, PRVC, and curve length.

### DESIGN CONSIDERATIONS

Consider the vertical alignment of all existing and proposed underground utilities in the project area. Maintain recommended "cover" over existing utilities. Where "cover" conflicts occur, contact the appropriate utility and develop plans for relocation.

Design storage platform areas at all intersections for exiting vehicle traffic that will queue at the intersection. This platform or landing area for exiting vehicles should be at least 50 feet long and have a slope of 8 percent or flatter.

In the case of phased development or future street extensions over currently unimproved land, extend the design profile for streets to be constructed in the future. Show at least 100 feet of design information, compatible with the topography for the future extension.

Design all street grades, intersections, and super-elevation transitions to minimize the concentrated flow of stormwater over the pavement.

### COMMON TROUBLE POINTS

**Property Line Grades:** Insufficient information. Failure to evaluate possible conflicts with existing improved properties, necessitating design revisions. These revisions may include realigning the project or adding retaining walls, or may require negotiating for slope easements or right-of-way donations after the project is under construction.

**Survey Control:** Insufficient information for the construction plans to serve as a "stand-alone" document.

**Gutter Grades:** Incorrect design that uses "top-of-curb."

**Vertical Curves:** Excessive use of vertical curves when a simpler grade break design is preferred. Use of vertical curve lengths too short to meet safe stopping sight distance criteria.

**Utilities:** Failure to consider utility relocation expense and difficulties. Failure to maintain minimum underground utility cover requirements.

**Intersections:** Inadequate sight distance. Excessive vertical grade changes.

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<u>Δ GRADE (%)</u>	<u>LENGTH (FEET)</u>
3	50
4	60
5	80
6	100
7	125
8	150
9	170
10	190
11	210
12	230
13	250
14	275
15	290
16	300

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**Δ Grade: algebraic difference between the two grades**

**(L= 20.46 ΔG - 17.24)**

**Design Speed: 20-25 mph**

**Source: This exhibit is a composite from two sources: AASHTO, *A Policy on Geometric Design of Highways and Streets*, Figure III-42, 1990, and ASCE, *Residential Streets*, 2nd Edition, 1990.**

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**EXHIBIT 6-3**  
**MINIMUM CREST VERTICAL CURVE LENGTH**  
**FOR LOCAL STREETS**

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**CURB RETURN DATA**

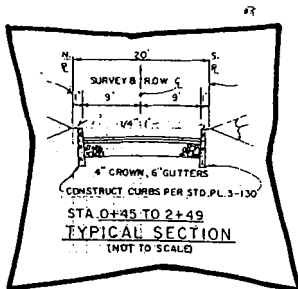
<b>RETURN NUMBER</b>	<b>C-1</b>	<b>C-2</b>	<b>C-3</b>
<b>PC STATION</b>	1+30.6 (Glisan)		
<b>PT STATION</b>	0+31.42 (33rd)		
<b>RADIUS</b>	20		
<b>LENGTH</b>	31.42		
<b>DELTA ANGLE</b>	90.00		
<b>PC ELEVATION</b>	605.43		
<b>1/4 Δ ELEVATION</b>	605.23		
<b>1/2 Δ ELEVATION</b>	605.03		
<b>3/4 Δ ELEVATION</b>	604.83		
<b>PT ELEVATION</b>	604.63		

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**EXHIBIT 6-4**  
**CURB RETURN DATA**  
**(EXAMPLE FORMAT)**

## Street Sections



### PURPOSE

To ensure that a sufficient amount of information is shown on the typical sections to clarify the construction details.

### STANDARD PLAN REFERENCES

- 3-150, Local Traffic Street
- 3-150A, Local Queuing Street
- 3-151, Neighborhood Collector Street
- 3-152, Arterial Street
- 3-153, Commercial Street
- 3-157, Alley Section
- 3-158, High-quarter Section
- 3-169, Limited Frontage Improvement

### DESIGN CRITERIA

- **Pavement Cross-Slope** – Range between 2 and 6 percent.
- **Sidewalk Cross-Slope** – 2 percent (1/4 inch per foot). (See Sidewalks subsection for more detail.)
- **Berm Cross-Slope** – Minimum 1 foot wide beyond the outside edge of sidewalk, or 3 feet wide behind curb if no sidewalk is present. Specify cross-slope at 2 percent or 1/4 inch per foot.
- **Backslopes** – Maximum cut slopes and fill slopes: 50 percent (2 horizontal to 1 vertical). Minimum: 2 percent (1/4 inch per foot).
- **Typical Section** – Show the following for each typical roadway section used (see Exhibit 6-5):
  - ✓ Right-of-way width and centerline location.
  - ✓ Orientation of the section. Identify the outside right-of-way lines as right/left, north/south, or



east/west (as viewed in ascending station order).

- ✓ Street width referenced to the centerline, pavement crown height above gutterline, and crown location.
  - ✓ Pavement class and thickness of layers.
  - ✓ Curb location, type, and exposure from gutter to top of curb.
  - ✓ Sidewalk location, width, and cross-slope.
  - ✓ Berm width and slope, and cut/fill slopes and ratios.
  - ✓ Utility locations.
  - ✓ Street tree locations.
- **Station Range** – Identify the station range that applies to each typical section.

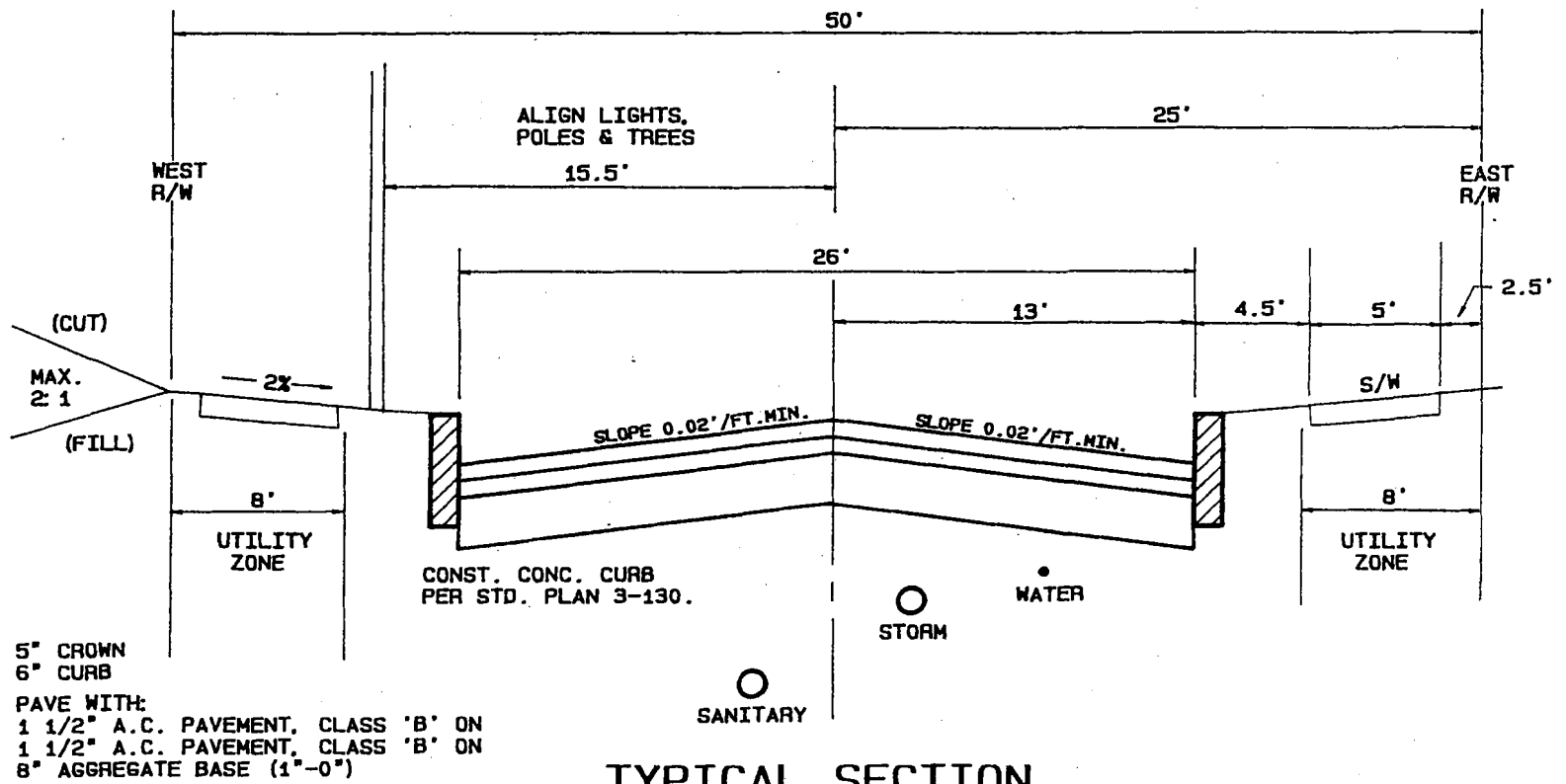
### **DESIGN CONSIDERATIONS**

Backslopes can be varied if supported by a soils report from a licensed geologist.

### **COMMON TROUBLE POINTS**

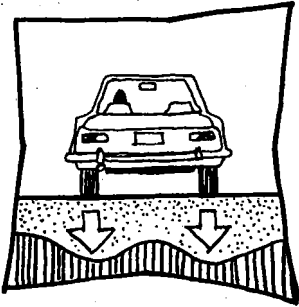
**Roadway Typical Sections:** Insufficient number of sections; failure to specify construction station limits where the typical section is applicable.

EXHIBIT 6-5  
TYPICAL SECTION



**TYPICAL SECTION**  
(NT6)  
STA. 1+45 TO STA. 2+90

## Pavement Design: Structural Section



### PURPOSE

To ensure that the street pavement is correctly designed for economical construction and low-cost maintenance for the entire pavement design life.

### STANDARD PLAN REFERENCES

- 3-150, Local Traffic Street
- 3-150A, Local Queuing Street
- 3-151, Neighborhood Collector Street
- 3-152, Arterial Street
- 3-153, Commercial Street
- 3-169, Limited Frontage Improvement

### DESIGN CRITERIA

- **Street Pavements** – The following street pavements are typical: full-depth asphalt concrete, asphalt concrete with crushed rock base, asphalt concrete with treated base, and Portland Cement concrete. Treated subgrades in the pavement section are also acceptable.
- **Soil Tests** – Conduct two soil tests for projects that have 500 feet or less of new street. An additional soil test is required for each additional 500-foot section. For asphalt pavements, conduct soil testing to determine the design subgrade resilient modulus ( $M_r$ ) within the top 2 feet of the proposed subgrade elevation.
- **Design Life** – 20 years.
- **Design Procedure - Asphalt Pavements** – The design procedures contained in the following references are preferred. (See the **References** section for full citations.)

*AASHTO Guide for Design of Pavement Structures, 1986.* American Association of State Highway and Transportation Officials.

*Thickness Design - Asphalt Pavements for Highways and Streets.* The Asphalt Institute, September 1981.

- **Design Procedure - Concrete Pavements** -- The design procedures contained in the following references are preferred. (See the **References** section for full citations.)

*AASHTO Guide for Design of Pavement Structures, 1986.*

*Thickness Design for Concrete Highway and Street Pavements.* Portland Cement Association, 1984.

- **Minimum Thickness** -- The minimum thickness designs specified in the standard plans are only a point of reference. All projects are subject to a specific thickness design based upon existing soil conditions and the projected 20-year traffic volume.
- **Local Service Streets, Asphalt Pavement** -- Specify Type "C" surface course with a minimum thickness of 1.5 inches. Specify the base course of asphalt concrete as Type "B" with a minimum thickness of 1.5 inches.
- **Arterials and Collectors, Asphalt Pavement** -- Specify Type "B" wearing surface with a minimum thickness of 1.5 inches. Specify the base course of asphalt concrete as Type "B" with the appropriate calculated design thickness.
- **Treated Base Materials** -- For asphalt pavement sections that include either a cement treated base (CTB) or an asphalt treated base (ATB), specify a finish surface pavement of not less than 3 inches of asphalt concrete.

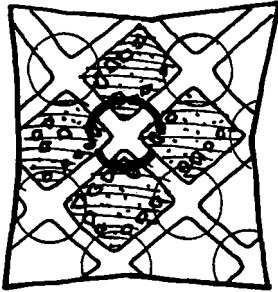
## DESIGN CONSIDERATIONS

Where a fluctuating water table may rise to within 3 feet of the surface, consider using subsurface drainage systems or a permeable base rock to keep water out of the pavement structure.

**COMMON TROUBLE POINTS**

***Traffic Projections:*** Incomplete or inaccurate forecasting of truck volumes in the design life.

## Intersections



### PURPOSE

To ensure that key construction information regarding intersection alignment, offset, curb radii, sidewalk curb ramps, and curb returns is provided on the construction plans.

### STANDARD PLAN REFERENCES

- 3-120, Twin Curb Ramp
- 3-122, Diagonal Curb Ramp - Existing Corner
- 3-123, Diagonal Curb Ramp - New Corner
- 3-124, Radial Wing Curb Ramp

### DESIGN CRITERIA

- **Alignment** – Design intersecting streets as near to right angles as practical. Under certain conditions, an acute angle of not less than 80 degrees will be acceptable. (City Code 34.60.010 (C))
- **Intersection Offset** – When forming a "T" intersection, offset the intersection at least 200 feet from the next nearest intersection (as referenced by street centerlines). (City Code 34.60.010 (B))
- **Radii** – Specify curb radii of 20 feet. Intersections involving streets other than local residential streets will need curb radii greater than 20 feet to accommodate the design traffic turning movements. Refer to the City Traffic Engineer's report (see Section 5) for the appropriate design vehicle.
- **Maximum Grade - Signalized Intersection** – For all travel lanes, specify longitudinal grades of not more than 6 percent.
- **Landings** – Design vehicle storage platform areas, or landings, on all approach legs to an intersection. Specify the landing area at 50 feet or longer, with an approach slope flatter than 8 percent.

- **Sidewalk Curb Ramps** -- Specify sidewalk curb ramps at all corners of an intersection. See the Sidewalks subsection for further details.
- **Curb Returns - Straight Grade** -- Where a straight grade is used between the PC and the PT, specify gutter elevations at each quarter point along the face of the curb (for example: PC = 40.00', 1/4 $\Delta$  = 39.50', 1/2 $\Delta$  = 39.00', 3/4 $\Delta$  = 38.50', PT = 38.00').
- **Curb Returns - Vertical Curves** -- Where vertical curves are used between the PC and the PT, show the gutter elevations on a separate profile detail. Specify the BVC, EVC, PI of the curve, PRVC, curve length, and at least five elevation reference points.
- **Curb Returns - Horizontal Alignment** -- Specify the following for each return:
  - ✓ Radius at the face of curb
  - ✓ Delta angle
  - ✓ Curve length
  - ✓ PC and PT reference to centerline stationing

### DESIGN CONSIDERATIONS

Carry the grade line of the "major" street through the intersection. Warp the grade of the "minor" to fit. Avoid the use of grade line combinations that will make vehicle control difficult.

Curb radii vary, depending on the types of streets at the intersection. Recommended ranges are as follows:

- Local/local: Use 15- to 20-foot radii
- Local/collector: Use 25- to 30-foot radii
- Collector/arterial: Specify, depending on the "design vehicle" used in the City Traffic Engineer's Report.

Pedestrian Districts: Radii less than 15 feet may be used with the Traffic Engineer's approval.

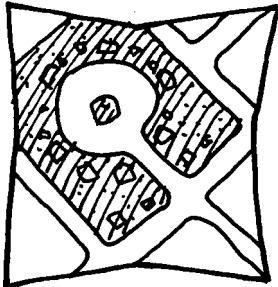
**COMMON TROUBLE POINTS**

Failure to identify the right-of-way width, street width, and horizontal alignment of all streets intersecting the project.

**Landings:** Failure to add this safety measure to the street design.



## Cul-de-Sacs



### PURPOSE

To ensure that key cul-de-sac construction information concerning radii, profiles, high point designation, and cross-slopes is included in the project design.

### STANDARD PLAN REFERENCES

- 3-133, Mountable Curb
- 3-154, Residential Cul-de-Sac
- 3-155, Industrial Cul-de-Sac
- 3-156, Fire Department Turnaround

### DESIGN CRITERIA

- **Radius - Residential Streets** -- Use a curb face radius of 35 feet. Use a transition radius of 25 feet between the normal street and the cul-de-sac bulb.
- **Radius - Commercial Streets** -- Use a minimum curb face radius of 50 feet. Use a transition radius of 35 feet between the normal street and the cul-de-sac bulb.
- **Profile** -- Show a gutterline runout, as a separate profile, for each cul-de-sac. Specify a new engineering station reference along the gutter that is mathematically tied to the centerline engineering station reference at the beginning and at the end (for example: 6+75.43 NW Elm St. 14' Rt = 0+00 cul-de-sac # 2). Include all key vertical and horizontal points on this profile (for example: PRC 0+32.03, G = 453.40).
- **High Point** -- Identify the station location and elevation of the high point of the cul-de-sac pavement.
- **Cross-Slope** -- Design the cross-slope in the bulb, normal to the circular travel path of a vehicle, at 8 percent or flatter.

- **Curbs** – Use a "mountable curb" in the bulb section of 70-foot-diameter residential cul-de-sacs. For all larger cul-de-sacs, use standard barrier curbs.

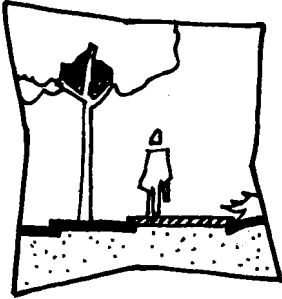
**DESIGN CONSIDERATIONS**

No additional considerations.

**COMMON TROUBLE POINTS**

***Excessive Cross-Slopes:*** Failure to consider the circular path of the vehicle as it negotiates the cul-de-sac bulb.

## Sidewalks



### PURPOSE

To ensure that a sufficient amount of design information is provided to help the contractor construct the improvements that will safely serve pedestrian traffic.

### STANDARD PLAN REFERENCES

- 3-119, Midblock Curb Ramp
- 3-120, Twin Curb Ramp
- 3-122, Diagonal Curb Ramp - Existing Corner
- 3-123, Diagonal Curb Ramp - New Corner
- 3-124, Radial Wing Curb Ramp
- 3-125, Scoring Details
- 3-140, Combination Curb and Sidewalk
- 3-141, Keyed Combination Curb and Sidewalk

### DESIGN CRITERIA

- **Width** -- Minimum width is 6 feet for sidewalks adjacent to arterial and collector streets and in the Central Business District, and 5 feet on all other streets. Certain "design districts" may have special width requirements. For combination curb and sidewalk, net sidewalk width is measured from the back of the curb. (The Central Business District is the area bounded by the Willamette River on the east, I-405 on the west and south, and N.W. Glisan on the north.)
- **Drainage** -- Specify sidewalk cross-slopes at 2 percent, draining toward the street.
- **Warp** -- To meet doorways and transitions with existing improvements, portions of sidewalks may be warped with cross-slopes that vary between 1 and 5 percent, provided that an accessible route 36" wide, with a cross-slope of 2 percent or flatter, is maintained within the sidewalk area.
- **Ramps** -- Include curb ramps at all intersections.
- **Material** -- Portland Cement concrete, 3,000 psi minimum.

## DESIGN CONSIDERATIONS

The minimum sidewalk width, as stated above, is intended to specify the minimum net usable width for pedestrians. Keep this net usable width clear of all obstructions, such as utility poles, utility pole guy wires, fire hydrants, mailboxes, trees, and tree grates.

Where a future sidewalk will be constructed adjacent to new street curb, specify a keyed curb. ( See Standard Plan 3-141.)

For all sidewalks that will be built as a subsequent project, mark "Future Sidewalk" on the plan view of the construction plans.

Installation of sidewalks in residential subdivisions, required as part of a land use action, may be deferred, provided that a deed restriction/covenant is executed to guarantee that the sidewalks will be constructed in conjunction with the building of houses.

Combination curb and sidewalk sections that are poured monolithically are often more economical than separate curb and sidewalk pours.

Specify sidewalk curb ramps in accordance with referenced Standard Plans. These plans meet the requirements of the Americans with Disabilities Act (ADA).

Include a minimum 1-foot-wide berm area on the outside of the sidewalk with the same cross-slope as the sidewalk. Transition the berm to meet existing topographic conditions, with slopes flatter than 2:1.

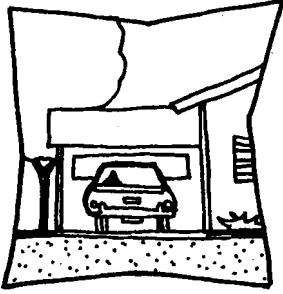
## COMMON TROUBLE POINTS

**Curb Ramps:** Insufficient attention to grade transitions from the sidewalk to the ramp. Obstacles in the curb ramp wing areas.

**Cross-Slopes:** Slopes in excess of 2 percent, which violate the intended design criteria stated in the Americans with Disabilities Act (ADA).

**Minimum Usable Width:** Obstacles in the pedestrian walk area.

## Driveways



### PURPOSE

To ensure that important construction information relating to the location and design of driveways is included in the construction plans. (See also the Access subsection in Section 5.)

### STANDARD PLAN REFERENCES

- 3-102, Alley Crosswalk and Driveway
- 3-103, Residential Driveway (Vintage)
- 3-104, Residential/Commercial Driveway
- 3-105, Residential Driveway (Modern)
- 3-107, Commercial Driveway
- 3-108, Truck Driveway
- 3-109, Signalized Intersection Driveway
- 3-135, Driveway Placement at Existing Dropped Curb
- 3-136, Curb Knockout Detail
- 3-138, Driveway Connection

### DESIGN CRITERIA

- **Location** – For the centerline of each driveway, identify the street centerline station reference and offset. Specify the throat width and the Standard Plan reference. (Sample note: 2 + 20.55, 16' Rt., Const 20' Driveway, Std. Plan 3-105.)
- **Width** – Refer to City Code, Title 17.28.110, for minimum and maximum driveway widths.
- **Drainage** – Design all driveways with positive drainage to the street. Broken back driveways (those with a grade break between the gutter and the property line) are allowed if the high point of the grade break is at least 3 inches above the gutter line.
- **Dropped Curbs** – Curb cuts, or dropped curbs, are not acceptable. Specify the construction of complete driveway aprons only.

- **Driveway Connections** -- Desirable driveway connection slope is 10 percent or flatter. See Standard Plan 3-138 for pavement thickness.
- **Intersection Conflicts** -- At street intersections, locate driveways 25' or further from the lot corner where the two streets intersect.

### **DESIGN CONSIDERATIONS**

Keep the driveway apron and wings free of obstructions. These include street lights, street trees, utility poles, utility pole guy wires, mail boxes, and signage.

Sight distance is important for safe operations across a driveway. Consider horizontal and vertical obstructions in choosing driveway locations. Driveway locations are subject to review by the Traffic Engineer in some situations (City Code 17.28.110).

If stormwater runoff from a parking lot drains across a driveway and into the street, the Bureau of Environmental Services limits the impermeable parking lot surface area that can be drained to 2,000 square feet.

Exercise care in the vertical design of driveways and driveway aprons. Severe grade breaks will limit the use of the driveway by many types of vehicles. If requested by the Plan Review Engineer, provide a separate plan and profile design for existing and proposed driveways. Using scaled grid paper, draft the profile of both outside edges of the existing driveway to a 1" = 1' scale. The profile will be checked with the City's "worst case" design vehicle template for satisfactory vehicle clearances.

If non-standard driveways are needed to accommodate existing horizontal or vertical constrictions, show these unique driveways with separate design details.

### **COMMON TROUBLE POINTS**

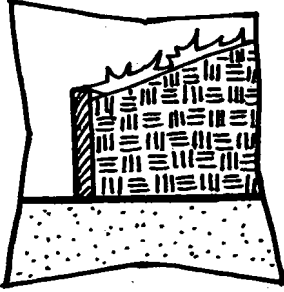
**Location:** Insufficient separation from nearest intersection.

Failure to obtain Traffic Engineer's recommendations.

**Grade:** Excessive grade break between street surface and driveway.

**Clearance:** Obstructions in wings or adjacent areas that obstruct sight distance.

## Structures, Retaining Walls, and Backslopes



### PURPOSE

To ensure that the construction plans include key construction information that will provide for the design of structures and minimize the impacts of cut and fill activities.

### STANDARD PLAN REFERENCES

Not applicable.

### DESIGN CRITERIA

- **Structural Calculations** – For the initial plan review, submit all relevant structural calculations for all proposed structures (walls, box culverts, bridges, etc.). Include calculations for a global stability check if appropriate for retaining wall structures. Also include the following:
  - ✓ Geotechnical report with all recommendations for design values used
  - ✓ All backup information used in performing the design (type of structure, type of backfill, design pressures, safety factors, etc.)
- **Design Loads** – Use HS 25 truck loading for all bridges and culverts in accordance with the latest edition of the *Standard Specifications for Highway Bridges* (AASHTO, as modified by the Oregon Department of Transportation Bridge Design Section).
- **Design Pressures** – Design retaining walls in accordance with the latest edition of the *Standard Specifications for Highway Bridges*. For ordinary gravity-type retaining structures with granular, free-draining wall backfill, use



Rankine's formula with a minimum equivalent fluid pressure of  $30H$ . Where the wall supports a roadway, and traffic loads are within a distance equal to  $1/2$  the wall height ( $H$ ), design the structure with an additional 2'-0" live load surcharge. Other retaining wall types require different procedures to determine the design earth pressure.

- **Retaining Wall Materials** -- For all retaining structures within the public right-of-way that will be maintained by the City, specify only the following materials:

- ✓ Cast-in-place concrete
- ✓ Precast concrete
- ✓ Masonry
- ✓ Galvanized steel bins filled with granular backfill
- ✓ Wire baskets filled with rocks
- ✓ Mechanically stabilized earth (using galvanized steel straps, plastic geogrids, geotextiles, etc.) with concrete, steel, or masonry facing
- ✓ Fitted stone or other durable material

**Do not use timber retaining structures.**

- **Fill Slopes** -- Show the toe of fill or "catch" line on the plan view. Design fill slopes at 2 H: 1 V or flatter. Under certain conditions, and when supported by a soils report, compacted fills may be made at 1.5 H: 1 V.
- **Cut Slopes** -- Show the "top of cut" line on the plan view. Design cut slopes at 2 H: 1 V or flatter. Under certain conditions, and when supported by a soils report, clayey soils may be cut to a maximum of 1 H: 1 V.
- **Curb Berms** -- Behind all curb sections where there will not be a sidewalk, include a 3-foot or wider berm to support the curb. Specify a maximum 2 percent slope on the berm so it will drain to the street. Begin

backslope adjustments beyond the berm area.

- **Sidewalk Berms** -- Behind all sidewalk sections, include a 1-foot or wider berm area with a maximum 2 percent slope draining in the direction of the street. Begin backslope adjustments beyond the berm area.
- **Sidewalk Handrails** -- Include handrails to protect pedestrians when there is a vertical drop of 30 inches or greater at the back of sidewalk.
- **Construction Easements** -- Where the cut or the fill section extends from the roadway section onto private property, a "Consent to Construct Slope" agreement with the current property owner is required. The City can assist in obtaining these agreements. Contact the Right-of-Way Acquisition Section of the Bureau of Transportation Engineering. (See Exhibit 2-1 for contact person.)

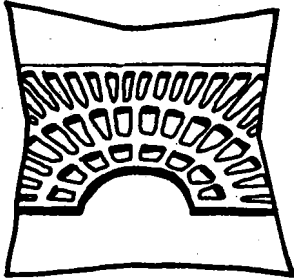
## DESIGN CONSIDERATIONS

Cuts and fills that extend onto private property (especially developed property) are a very sensitive issue. Provide cross-sections that clearly show how the cut or fill affects existing structures, fences, landscaping, drainage patterns, driveways, and other improvements. Consider design alternatives to mitigate the impacts on adjacent properties.

## COMMON TROUBLE POINTS

**Construction Easements:** Failure to completely analyze the impact of cuts and fills on private property adjacent to the public improvements. Failure of developers to secure construction easements, which grant permission to alter slopes, on a timely basis.

## Tree Wells in Public Sidewalks



### PURPOSE

To ensure that tree wells are designed and constructed in a manner that will promote tree growth, minimize future slab damage caused by tree roots, and provide adequate pedestrian passage on adjacent sidewalks.

### STANDARD PLAN REFERENCES

3-162, Tree Well Installation

### DESIGN CRITERIA

- **Minimum Clearance** -- All public sidewalks must provide for comfortable pedestrian passage by maintaining a minimum clear width of 5 feet. On arterial and commercial streets and all streets within the Central Business District, the minimum clear width is 6 feet. This minimum dimension is measured from the back of the curb to the outside edge of the sidewalk. If a tree well is installed, the minimum clear width is measured from the outside edge of the tree well to the outside edge of the sidewalk.
- **Insufficient Right-of-Way** -- If the public right-of-way has insufficient width behind the curb to accommodate both the sidewalk and the tree well, the abutting property owner may donate additional right-of-way or designate a permanent sidewalk easement. The sidewalk may then be constructed in this unobstructed additional area.
- **Tree Well Dimensions** -- Design sidewalk tree wells to be 4' x 4' or larger. Modification to 3' x 5' may be acceptable where needed to provide minimum sidewalk width. Approval by the City Forester is required for all wells smaller than 4' x 4'. Specify the engineering station location of the center of each tree well on the

construction plans.

- **Tree Grates** – Specify the installation of cast iron tree grates in the downtown area. Use only grates that can be altered to provide for growth of the tree trunk. Where tree grates are to be used to add to the usable sidewalk area, specify grates that meet requirements of the Americans with Disabilities Act. The grate opening dimension is limited to 1/2 inch in the direction parallel to pedestrian travel.
- **New Trees - Species Approval** – City Forester approval is required. See the Street Trees subsection.

### DESIGN CONSIDERATIONS

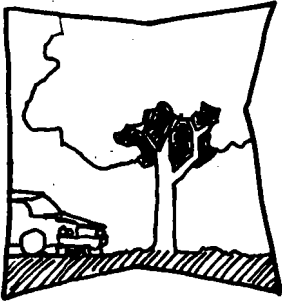
Consider the long-term maintenance responsibility for trees and tree grates that rests with the abutting property owner. Maintenance includes, but is not limited to, tree watering, tree fertilizer applications, tree limb removal for horizontal and vertical clearances, tree grate modifications to accommodate trunk growth, sidewalk concrete repairs, and litter removal in the tree grate area.

### COMMON TROUBLE POINTS

**Minimum Clearance:** Sidewalk clearances not considered in design.

**Tree Grate Support:** Insufficient construction details provided for grate frame installation in concrete sidewalk.

## Street Trees



### PURPOSE

To ensure that the construction plans provide for the protection of existing trees, removal of trees that are incompatible with planned improvements, and planting of new trees that are in harmony with other trees and improvements in the right-of-way.

### STANDARD PLAN REFERENCES

Not applicable.

### DESIGN CRITERIA

- **Tree Inventory** – Locate and identify the diameter and species of all existing trees with a diameter of 6 inches or greater in the construction impact zone. Consider the construction impact zone as the full width of the right-of-way and the bordering 15 feet outside each right-of-way line. Specify the diameter of these trees as measured 4.5 feet above the ground (diameter at breast height, or DBH). Measure the "drip line" for each tree, since this gives an approximate indication of the extent of the tree root system. Show this data on the construction plans.
- **City Forester Design Review** – Review the project design and proposed tree protection/removal plan with the City Forester. The City Forester may suggest design changes or construction practices that will protect the trees designated to be saved.
- **Root Exploration** – If directed by the City Forester or the City Engineer, conduct exploratory root excavations to determine the extent of impact a tree may be subjected to during construction.
- **City Forester's Written Report** – Obtain from the City Forester a written report with findings and recommendations relating to trees to be removed, trees

to be saved, required design changes, and construction practices that will protect trees to be saved.

- **Remove Tree** – Identify each tree to be removed by the contractor and mark **REMOVE** on the construction plans.
- **Save Tree** -- Identify each tree to be saved during construction and mark **SAVE** on the construction plans. Where trees are to be saved, include the following construction note on the plans:

***Tree root inspection required! Contact the Forestry Division of the Parks Bureau at 823-4489 prior to any excavation adjacent to trees. A tree inspection must be made before cutting any roots.***

- **New Trees - Species Approval** -- Obtain tree species approval from the City Forester for any trees that will be planted in the public right-of-way.
- **Street Light Clearance** – Provide a minimum separation of 25 feet between trees and street light poles. With some tree species, a decrease in the minimum tree/pole separation distance may be allowed. Obtain approvals from both the City Forester and the Street Lighting Division before design.
- **Water Main Clearance** – For new tree installations, maintain a minimum separation of 5 feet between new trees and existing water mains (center tree to center main). For each new tree planted within 10 feet of an existing main, install a root barrier. Specify the installation of a 4' x 8' galvanized steel sheet in a vertical position between the pipe and the root ball (vertical = 4', horizontal = 8').
- **Intersection Clearance** – For new tree installations, maintain a minimum separation of 25 feet between a tree and the curb line of the intersection.
- **Other Clearances** -- For new tree installations, maintain a minimum separation of 5 feet between a tree and any of the following items: driveway wings, fire hydrants, water meter boxes, and utility poles.

- **Biobarriers** – For new landscape plantings, the Design Engineer has the discretion to specify the use of root control fabrics.

### **DESIGN CONSIDERATIONS**

All trees in the public right-of-way are valuable assets to the citizens of Portland. Exercise extreme care in all design proposals to save and enhance these resources. Design street improvements so the contractor, exercising reasonable care, can construct the project without destroying trees that are designated to be saved.

Roadway alignment, fill slopes, excavations, soil compaction from construction equipment, and utility trenching may adversely impact existing trees. Evaluate the impacts on each existing tree and make an initial proposal on the disposition of each tree in the project construction impact zone. When in doubt, consult the arborist on your design team.

During the plan review phase of the project, the City Forester will be given a field check plan set. He will be asked to verify the disposition of trees in the construction impact zone according to his previously written report and agreements relating to the design of the street improvement.

#### ***Trees on Adjacent Properties***

The following procedures are followed if trees need to be removed or severely trimmed that are in the right-of-way, adjacent to the project site, and front on private property not controlled by the developer.

- 1) The developer (or developer's designee) meets with or provides written notification to affected neighboring property owners. The purpose of the meeting or written notification is to inform the property owners of the effects the street improvements will have on trees fronting their property. If requested by the developer, the City Forester accompanies the developer or designee to any meetings with property owners.

- 2) The developer or designee asks the affected property owners to sign an "Acknowledgement of Tree(s) or Shrub(s) to be Removed" form before removing trees that are in conflict with the proposed street improvement. (See Exhibit 6-6.) If the signatures cannot be obtained, the developer documents discussions and/or written communications with the affected neighboring property owners. Each meeting or letter is documented, with copies provided for the City's project files.

***Construction Work***

The following procedures are followed when trees on the project are designated as **SAVE**.

- 1) Before construction, the developer conducts a preconstruction conference with all affected parties: Design Engineer, contractor, utility companies, and City staff. The City Forester and the City's construction inspector discuss tree protection procedures with the contractor and the utility companies.
- 2) During construction, the developer's contractor arranges for the City Forester and the construction inspector to be present on the construction site whenever work activities threaten any trees that are designated to be protected.

***Deferred Installation***

Installation of street trees in residential subdivisions, required as part of a land use action, may be deferred provided that a deed restriction/covenant is executed to require tree planting in conjunction with the construction of houses.

**COMMON TROUBLE POINTS**

***Construction Damage:*** Construction activities that occur too close to existing trees, which can damage or eventually kill them. Proper protective actions need to be taken to protect existing trees. (See Exhibit 6-7.)

***Future Improvements:*** Failure to consider sidewalks and other improvements during initial design, resulting in tree removals in the future.





<u>Impact to Tree</u>	<u>Construction Activity</u>	<u>Methods / Treatments to Minimize Damage</u>
Branch and trunk damage	Injury from equipment	Fence trees to enclose low branches and protect trunk. Report all damage promptly so arborist can treat appropriately.
	Pruning for vertical clearance for building, traffic, and construction equipment	Prune to minimum height required prior to construction. Consider minimum height requirements of construction equipment and emergency vehicles over roads. All pruning should be performed by a certified arborist, not by construction personnel.
	Felling trees in construction area	Require that trees being removed be felled away from, rather than into, tree protection zones.
Root damage or loss	Stripping site or organic surface soil	Restrict stripping topsoil around trees. Any woody vegetation to be removed adjacent to trees to remain should be cut at ground level and not pulled out by equipment, or root injury to remaining trees may result.
	Digging into topsoil layer and killing roots while loading piles of soil, sand, gravel, etc.	Store outside fenced protection zones and away from root zones. Place plastic tarp, straw, plywood or geotextile material beneath pile.
	Lowering grade, scarifying, preparing subgrade for fills, structures	Use retaining walls with discontinuous footings to maintain natural grade as far as possible from trees. Excavate to finish grade by hand and cut exposed roots with a saw to avoid root wrenching and shattering by equipment, or cut with root pruning equipment. Soil beyond cut face can be removed by equipment sitting outside the dripline of the tree.

Source: *A Technical Guide to Community and Urban Forestry in Washington, Oregon and California*, World Forestry Center, Portland, OR, September 1989, as modified by *Tree City USA Bulletin No. 20*, National Arbor Day Foundation.

**EXHIBIT 6-7**  
**TREE PROTECTION TECHNIQUES**

<u>Impact to Tree</u>	<u>Construction Activity</u>	<u>Methods / Treatments to Minimize Damage</u>
Root damage or loss	Subgrade preparation for pavement	Use paving materials requiring a minimum amount of excavation (e.g., reinforced concrete instead of asphalt). Design traffic patterns to avoid heavy loads adjacent to trees (heavy load-bearing pavements require thicker base material and subgrade compaction). Specify minimum subgrade compaction under pavement within root zone. Install aeration pipes if necessary.
	Excavation for footings, walls, foundations	Design walls/structures with discontinuous footings and pier foundations. Excavate by hand near major roots. Avoid slab foundations, use post-and-beam footings.
	Trenching for utilities, drainage	Coordinate utility trench locations with utility contractors. Consolidate utility trenches. Excavate trenches by hand in areas with roots larger than one inch diameter. Tunnel under woody roots rather than cutting them. Curve trenches rather than using straight lines.
Unfavorable conditions for root growth; chronic stress from reduced root systems	Compacted soils	Fence trees to keep traffic and storage out of root area. In areas of engineered fills, specify minimum compaction (usually 85%) if fill will not support a structure. Provide a storage yard and traffic areas for construction activity well away from trees. Protect soil surface from traffic compaction with 12" to 14" of wood chip mulch. Following construction, vertical mulch compacted areas. Install aeration vents.
	Spills, waste disposal (e.g., paint, oil, fuel)	Post notices on fences prohibiting dumping and disposal of waste around trees. Require immediate cleanup of accidental spills.
	Concrete wash-out and waste dumping	Designate wash-out areas. Dig pit and remove after construction, if necessary.
	Soil sterilants (herbicides) applied under pavement	Use herbicides safe for use around existing vegetation and follow directions on the label.

**EXHIBIT 6-7**  
**TREE PROTECTION TECHNIQUES - continued**

<u>Impact to Tree</u>	<u>Construction Activity</u>	<u>Methods / Treatments to Minimize Damage</u>
Unfavorable conditions for root growth;...	Impervious surface over soil surface	Utilize pervious paving materials (e.g., interlocking blocks set on sand). Install aeration vents in impervious paving.
Inadequate soil moisture	Rechannelization of stream flow; redirecting runoff; lowering water table; lower grade	In some cases it may be possible to design systems to allow low flows through normal stream alignments and provide bypass into storm drains for peak flow conditions. Provide supplemental irrigation in similar volumes and seasonal distribution as would normally occur.
Excess soil moisture	Underground flow backup; raising water table	Fills placed across drainage courses must have culverts placed at the bottom of the low flow so that water is not backed up before rising to the elevation of the culvert. Study the geotechnical report for ground water characteristics to see that walls and fills will not intercept underground flow.
	Lack of surface drainage away from tree	Where surface grades are to be modified, make sure that water will flow away from the trunk, i.e., that the trunk is not at the lowest point. If the tree is placed in a well, drainage must be provided from the bottom of the well.
	Irrigation of exotic landscapes	Some species cannot tolerate frequent irrigation required to maintain lawns, flowers, and other shallow-rooted plants. Use free form mulch areas or avoid landscaping under those trees, or utilize plants that do not require irrigation.
Increased exposure	Thinning stands, removal of undergrowth	Save groups or clusters of trees when working with species that perform poorly in the open or as single trees. Maintain the natural undergrowth.
	Excessive pruning	Prune sparingly, especially in stands of shade-tolerant species. Remember, leaves manufacture the food needed for root growth and recovery from shock.

**EXHIBIT 6-7**  
**TREE PROTECTION TECHNIQUES - continued**

## **Erosion Control**



### **PURPOSE**

To ensure that the construction plans include measures to prevent disturbed soil from leaving the construction site where the eroded materials could clog streets, storm drains, culverts, and stream channels; cause private property damage; or become a source of water pollution.

### **REFERENCES**

City of Portland Municipal Code, Title 17.38.050: *Erosion Control Required*

*Erosion Control Plans Technical Guidance Handbook*, City of Portland, January 1991 (or most current version)

City of Portland *Standard Construction Specifications*, Section 209

### **DESIGN CRITERIA**

- **Erosion Control Plan** -- Develop an erosion control plan as an integral part of the construction plans. Where the erosion control plan is extensive and includes a considerable number of special notes and symbols that compete with construction data, create a separate erosion control sheet(s) for the plan set. Label the sheet(s) "Erosion Control Plan."

### **DESIGN CONSIDERATIONS**

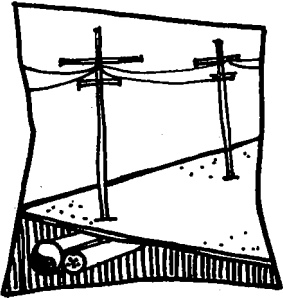
Because of the complexity of erosion control, the City has developed the separate handbook referenced above. Use of this handbook is essential.

For even a simple project, such as a frontage improvement on an existing paved street, erosion control will require the contractor to protect the nearest downstream inlet or catch basin.

## COMMON TROUBLE POINTS

***Erosion Control Measures:*** Measures specified by the designer are not sensitive to the topography of the project site.

## Utilities



### PURPOSE

To ensure that the Design Engineer coordinates the design of the street improvements with other users of the public right-of-way; to ensure a sufficient amount of design information is provided on the construction plans so the street improvements can be efficiently constructed and not jeopardize utilities in the right-of-way. (See the following two subsections for more information concerning stormwater drainage and water supply.)

### STANDARD PLAN REFERENCES

- 3-60, Underground Utility Locations
- 3-61, Underground Utility Locations

### DESIGN CRITERIA

- **Utility Locate** -- Request an underground utility locate from the Utility Notification Center (246-6699). During the design survey for the project, record the marked locations, and document the locations of all marked utilities on the base map of the construction plans.
- **Existing Aboveground Utilities** -- Show the location of all existing facilities that are visible above ground, such as utility poles, guy wires and anchors, telephone closures, water and gas valves, manholes, fire hydrants, street light handholes, traffic control boxes, and irrigation system vaults.
- **Existing Underground Utilities** -- Show the location of all buried facilities, such as cables, ducts, pipes, and vaults.
- **Utility Coordination** -- Meet with each utility company that has existing or proposed plant and facilities in the right-of-way. Coordinate the alignment of all utilities on the project. Resolve all design and construction issues with the affected utilities before submitting the street construction plans to the City for review. Show the proposed final location of all utilities on the construction plans. Utility contacts are identified in Exhibit 2-1.

- **Utility Construction Plan** – Where the amount of utility design information will clutter the street construction plans, transfer all utility construction information to separate sheets. Label these sheets as utility construction plans and show all subsurface items, including, but not limited to, water mains, sewers, power, telephone, television cables, gas lines, and street lights.
- **Common Trench** – When possible, use a common trench for power, telephone, television cables, street light wiring, traffic control wires, and gas mains.
- **Clear Zone for Poles** – Maintain a minimum clear zone of 36 inches between the back of curb and nearest underground utility. This clear zone will allow the placement of utility poles between the curb and the buried utilities.
- **Responsible Party** – When a utility company will be performing work within the road contractor's work area, specifically identify who is to perform the utility relocation work. Name the utility company, and give a contact person and phone number for the contractor to call. Do not use the term "By Others."
- **Advisory Note to Excavators** – State law requires excavators to take certain actions to protect buried utilities. The following construction note is required on at least the first sheet of the construction plans:

***Excavators must comply with all provisions of ORS 757.541 to 757.571, including notification of all owners of underground facilities at least 48 business day hours, but not more than 10 business days, before commencing an excavation.***

## DESIGN CONSIDERATIONS

Construction of public street improvements directly impacts all utilities that use the public right-of-way. Further, after new pavement is placed in the street, the City will not allow cutting of this new pavement for at least 2 years (City Code Chapter 17.24.100(b)). Consequently, the Design Engineer must coordinate his project with all utilities that have facilities in the



project area, giving them the opportunity to relocate existing or construct new plant and facilities before final paving.

Owners of private property on the project who are not fully served with available utility services can be adversely impacted by the above pavement cutting moratorium. The developer's utility coordinator should send letters to all owners of vacant properties to inform them of the 2-year pavement cutting moratorium. The property owners can then make arrangements, if desired, to have utility services installed on their property before street construction begins.

Consider tree locations, street light pole bases, vaults, fire hydrants, and other utilities when designing the common trench alignment. Specify the appropriate cover over each utility.

The power company is the key to coordinating power, street lighting, telephone, and cable television. The telephone and cable television companies will wait until they have seen the power company's construction plans before designing their own plans. They will try to use the power company's trench as much as possible; for aerial utilities, they will try to use the power company's poles.

When power poles are relocated and existing wires are transferred to new poles, the utilities relocate from the top of the pole down to the lowest utility on the pole. Each utility may cut the old pole off just above the next lower utility to allow them to lift the wires over the pole to attach to the new pole. The old poles are usually removed by the last utility on the pole.

In underground utility areas, all cable television companies will install conduits for future service if they are notified in time to coordinate their work with other utilities and if there is an open trench they can use.

### COMMON TROUBLE POINTS

***Aerial Trespass:*** Positioning poles too close to property lines, which may cause the pole mast arm and wires to extend outside the right-of-way.

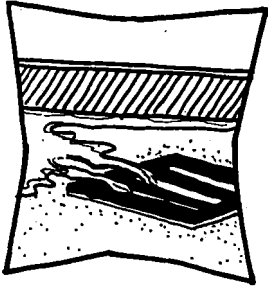
***Guy Wire and Anchor:*** Conflicts with surface improvements, such as sidewalks and driveways.

***Pole Placement:*** Conflicts with the use of pedestrian sidewalks because of insufficient lateral clearance. Conflicts with existing and future driveways.

***Coordination:*** Insufficient contact with utility companies during the project design phase. This can delay the issuance of a construction permit, create conflicts with the project design, and/or necessitate redesign work during construction.

## Stormwater Drainage

### PURPOSE



To ensure that the Design Engineer coordinates the storm drainage facility design with the Bureau of Environmental Services; to ensure a sufficient amount of design information is provided on the construction plans so the improvements can be efficiently constructed and inspected.

### STANDARD PLAN REFERENCES

- 4-01, Typical Trench Sections - Backfill & Surfacing
- 4-02, Pipe Bedding
- 4-10, Precast Sump
- 4-11, Sedimentation Manhole
- 4-30, Concrete Inlet
- 4-30-1, Adjust Concrete Inlet
- 4-30-2, Inlet Location at Curb Return
- 4-31-1, Concrete Double Inlet - End-to-end
- 4-31-2, Concrete Double Inlet
- 4-32-1, Curb Inlet
- 4-32-2, Combination Curb Inlet
- 4-32-3, Curb / Gutter Inlet
- 4-32-4, Double Curb / Gutter Inlet
- 4-33-1, Concrete Field Inlet
- 4-33-2, 48 inch Precast Field Inlet
- 4-34, Inlet Frame
- 4-35, Double Inlet Frame
- 4-36, Inlet Grating
- 4-37, Inlet Grating with Bicycle Protection
- 4-38, Longitudinal Inlet Grating with Bicycle Protection
- 4-39, Inlet Grating
- 4-40, Rain Drain to Gutter

### OTHER REFERENCES

*Sewer Design Manual*, City of Portland, Bureau of Environmental Services, 1991 (or most current version)

The Bureau of Environmental Services (BES) has overall responsibility for stormwater drainage. However, a small portion of the stormwater system is included with street construction work designed and constructed under the jurisdiction of BTED. BTED's portion includes inlets, catch basins, and lead pipes to the storm sewer system and occasionally sump systems. Mainline sewers and manholes are designed and constructed under the jurisdiction of BES.

### **DESIGN CRITERIA**

- **Inlets and Catch Basins (Location)** – Place inlets at all low points in streets, at intersections to collect stormwater before it crosses the pedestrian crosswalk, at points where changes in the street configuration would cause gutter flow to cross a street, and at intervals on continuous grades that will limit the width of flow in the gutter to 6 feet from the face of curb. Specify the station location of each inlet.
- **Inlets and Catch Basins (Type and Size)** -- Consult the *Sewer Design Manual* to select the inlet that will best fit the drainage condition. On the plan view, identify the Standard Plan reference of each type of inlet or catch basin to be used at each location. Verify with BES to determine the need for sump type inlets (catch basins).
- **Lead Pipe** – Typically, specify the use of non-reinforced concrete sewer pipe that conforms with ASTM C-14, Class 2 or Class 3. It is commonly known simply as "Class 2 Pipe" or "Class 3 Pipe" and is referenced under 402.2.02A of the *Standard Construction Specifications*. Specify the inlet lead pipe size, depending upon the inlet being used. A standard concrete inlet, defined by Standard Plan 4-30, allows a minimum pipe size of 8 inches. All other inlet types use a 10-inch or larger pipe. Design pipe slope should be 2 percent or steeper. Position the inlet lead pipe in a straight line both vertically and horizontally so in-line bends are not necessary. Specify the length of pipe to be installed between the inlet and the receiving manhole. Specify the invert elevations of the lead pipe at the inlet and at the manhole.

- **Pipe Bedding** – Specify bedding material to be used in accordance with Standard Plan 4-02. Typically, Class C pipe bedding is used for all inlet lead pipes.
- **Connections** – Design each inlet lead to connect directly to a storm sewer manhole, culvert, or to a discharge point in a watercourse. In-line taps to existing sewer pipes or culvert pipes may be made when the receiving pipe is larger than 24 inches and the inlet lead pipe is less than one-half the diameter of the receiving pipe. The preferred connection point is at a manhole in the storm sewer system.

Specify the invert elevation of the inlet lead pipe in the manhole structure at not greater than 8 feet below the manhole rim.

For manholes that have invert elevations of less than 8 feet below the rim, specify the lead pipe invert elevation at 14 inches above the bottom of the manhole.

Ensure adequate cover above the type of inlet lead pipe used (steel, concrete, or plastic) to prevent a pipe failure from traffic loads.

- **Sewer Pipes** – Show all mainline sewer systems, existing and proposed, in the "background" of the plan view of all street construction plans.
- **Job Number** – When storm and/or sanitary sewers are being constructed on the project, identify the storm sewer location in the right-of-way and reference the Bureau of Environmental Services JOB NUMBER.

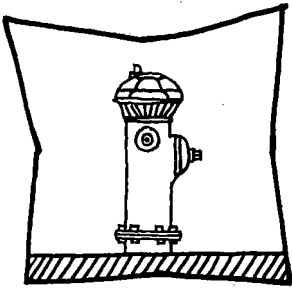
### **DESIGN CONSIDERATIONS**

Refer to the *BES Sewer Design Manual* for storm and sanitary sewer design work.

### **COMMON TROUBLE POINTS**

At the low point in a sag vertical curve, a double inlet is normally necessary since the inlet receives flow from both gutter directions.

## Water Supply



### PURPOSE

To ensure that the Design Engineer coordinates the design of the street improvements with the Portland Bureau of Water Works or the local water district; to ensure a sufficient amount of design information is provided on the construction plans so the street improvements can be efficiently constructed and inspected and not jeopardize the water system.

### REFERENCES

City of Portland *Standard Construction Specifications*, Division 5.

### DESIGN CRITERIA

The following information should be shown on the construction plans to help coordinate the construction of streets, sewers, and other utilities:

- **Hydrants** – Show the location of all existing and proposed fire hydrants on the plan view of the street construction plans. Position hydrants where they will not obstruct sidewalk usage.
- **Valve and Meter Boxes** – Show the location of all existing and proposed valve and meter boxes on the plan view of the street construction plans. In the "Construction Notes" of the plans, instruct the contractor to adjust all valve and meter boxes to finished grade.
- **Water Mains** – Show all water supply mains, existing and proposed, in the "background" of the plan view of all street construction plans. On the typical section views, show the vertical and horizontal location of all existing and proposed water supply mains.

**DESIGN PROCESS  
Portland Bureau of Water Works (BWW)**

For the majority of Portland, the Bureau of Water Works (BWW) has overall responsibility for water supply. When water systems are designed in concert with street improvements, the following process is used.

On existing dedicated public rights-of-way within BWW's service area, City staff design and construct the water system.

In new subdivisions, the developer has the option of having the water system designed by the City or a consulting engineer. The public water system is designed in concert with the street improvements. Construction of the system may be performed by the developer's contractor.

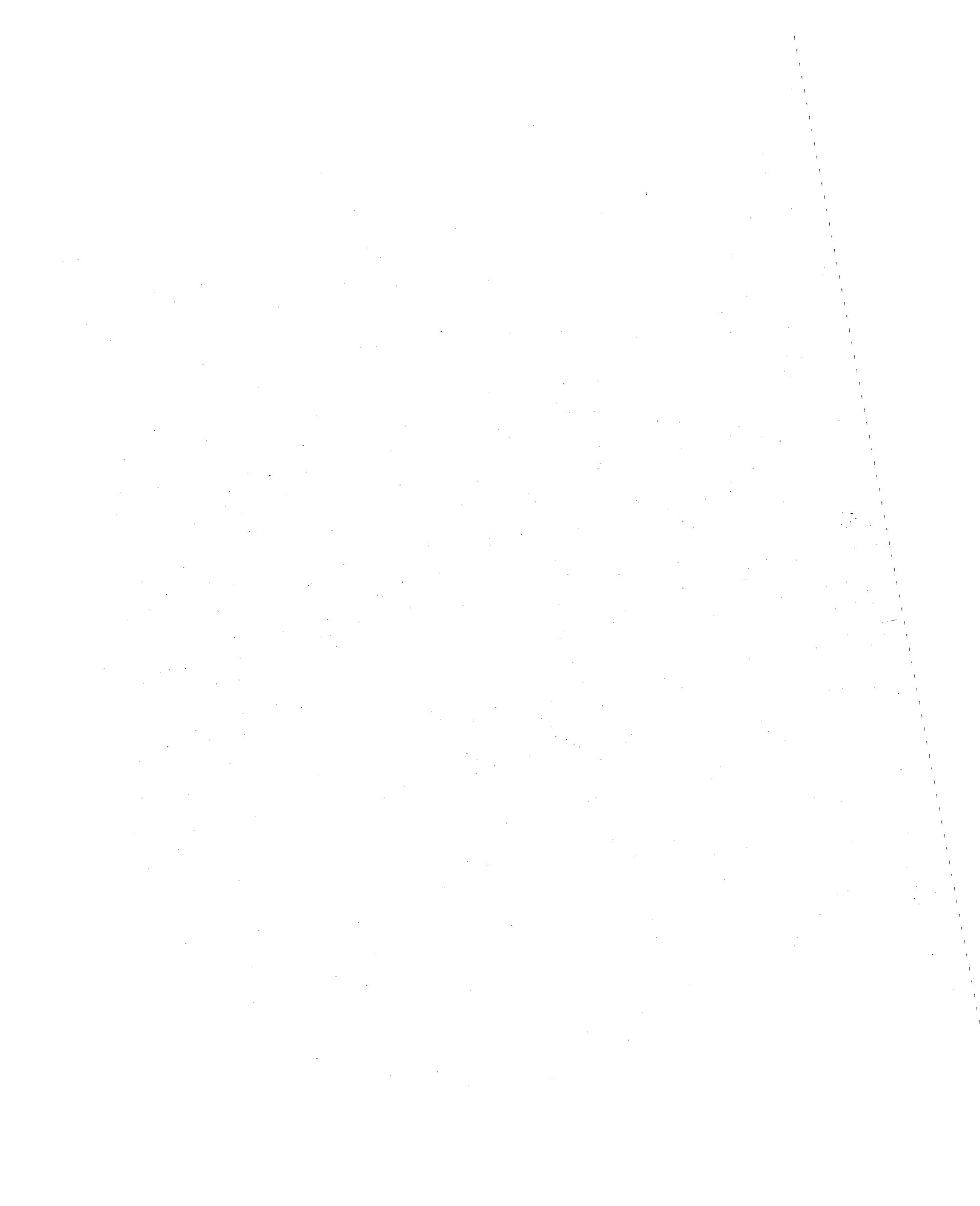
The consulting engineer must participate in a predesign meeting with BWW engineers before beginning design work on any water system. BWW provides specific criteria for the design of the water system.

BWW reviews and approves construction plans. A fee is charged for the plan review based on the extent and complexity of the project.

BES inspects construction of the water system to ensure that the materials and construction techniques conform to accepted standards. A fee is charged for inspection service, based upon actual staff time spent on the project. When the water system has been tested and accepted, BWW connects it to the existing mains at the expense of the developer.

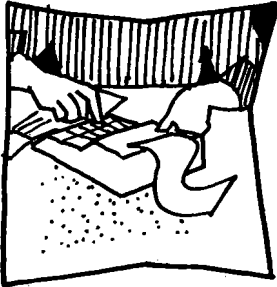
**DESIGN PROCESS  
Private water districts**

The consulting engineer follows the design and construction guidelines of the appropriate private water district.





# section 7: CONSTRUCTION COST ESTIMATES



On projects built by developers, the City uses the construction cost estimate to establish a performance guarantee amount. The construction cost estimate is developed jointly by the developer's Design Engineer and the City's Plan Review Engineer. The Design Engineer determines the types and quantities of work to be completed on the project. The Plan Review Engineer verifies the quantities and assigns unit costs so the value of the project can be determined. The total value of the construction work plus a 10 percent contingency factor constitutes the amount of the performance guarantee.

The performance guarantee is calculated twice on each project:

- 1) On the conceptual plans before design work begins
- 2) At the end of final design before the project proceeds to construction

The permittee must supply the performance guarantee before work can begin in the public right-of-way. Where public improvements will immediately follow construction on private property, the performance guarantee must be made before the building permit will be issued.

The Design Engineer is responsible for providing the following information:

- **Work Quantities:** Perform a quantities takeoff for all units of work on the project. Post this information in the "quantity" column of the construction cost estimate form. (See Exhibits 7-1 and 7-2.)
- **Calculations:** Submit calculations and data used to develop each work quantity value.

**COMMON TROUBLE POINTS:**

- **Pipe Bedding:** The trench fill volume consists of pipe bedding, pipe void, and trench backfill to subgrade. Consider all three items in calculating these volumes.
- **Sewer Pipe Length:** Calculate only the length of pipe from the inlet to the manhole or discharge point. Mainline sewer work is covered by an improvement permit issued by the Bureau of Environmental Services.

**OFFICE OF TRANSPORTATION  
BUREAU OF TRANSPORTATION ENGINEERING AND DEVELOPMENT**

**CONSTRUCTION COST ESTIMATE  
PRELIMINARY/FINAL**

**Job #** \_\_\_\_\_ **Project** \_\_\_\_\_

<u>ITEM</u>	<u>TYPE OF WORK &amp; MATERIAL</u>	<u>QUANTITY</u>	<u>UNIT PRICE</u>	<u>TOTAL</u>
_____	Clearing & Grubbing	_____	LS	_____
_____	Excavation, Common	_____	CY	_____
_____	Excavation, Concrete	_____	CY	_____
_____	Excavation, Common Trench	_____	CY	_____
_____	Granular Trench Backfill Material	_____	CY	_____
_____	Embankment, Common	_____	CY	_____
_____	Embankment, Select Granular	_____	CY	_____
_____	Cut AC Pavement	_____	LF	_____
_____	Sawcut Concrete	_____	LF	_____
_____	_____	_____	_____	_____
_____	Concrete Sidewalk, 4" Thick	_____	SY	_____
_____	Concrete Driveway, 6" Thick	_____	SY	_____
_____	Curb, Concrete	_____	LF	_____
_____	Concrete Dwy. Conn. (Std. Pl. 3-138)	_____	SY	_____
_____	Asphalt Dwy. Conn. (Std. Pl. 3-138)	_____	SY	_____
_____	Aggregate Dwy. Conn., 6" Thick	_____	SY	_____
_____	_____	_____	_____	_____
_____	Aggregate Base, _____" Thick (3/4"-0)	_____	SY	_____
_____	Aggregate Base, _____" Thick (1"-0)	_____	SY	_____
_____	AC Pavement, Class B, _____" Thick	_____	SY	_____
_____	AC Pavement, Class C, _____" Thick	_____	SY	_____
_____	AC Skinpatch	_____	SY	_____
_____	AC Overlay (Thickness Varies)	_____	TN	_____
_____	_____	_____	_____	_____
_____	8" CSP with Class C Bedding	_____	LF	_____
_____	10" CSP with Class C Bedding	_____	LF	_____
_____	12" CSP with Class C Bedding	_____	LF	_____
_____	1/16" Bend, _____" CSP	_____	EA	_____
_____	Remove Inlet	_____	EA	_____
_____	Fill Abandoned Inlets	_____	EA	_____
_____	Seal & Abandon Inlet Lead	_____	EA	_____
_____	Inlet, Single	_____	EA	_____
_____	Inlet, Double	_____	EA	_____
_____	Inlet, Field or Ditch	_____	EA	_____
_____	Inlet, Curb Opening Type	_____	EA	_____
_____	Adjust Inlet	_____	EA	_____
_____	Adjust MH or Sump	_____	EA	_____
_____	_____	_____	_____	_____
_____	Install Street Lighting System	_____	LS	_____
_____	Install Standard Guardrail	_____	LF	_____

**FINAL CONSTRUCTION COST ESTIMATE** \$ \_\_\_\_\_

**PERFORMANCE GUARANTEE AMOUNT (110%)** \$ \_\_\_\_\_

**AGENCY CONSTRUCTION COST**

<u>ITEM</u>	<u>TYPE OF WORK &amp; MATERIAL</u>	<u>QUANTITY</u>	<u>UNIT PRICE</u>	<u>TOTAL</u>
_____	Install Type II Barricades	_____	LF _____	_____
_____	Install Type III Barricades	_____	LF _____	_____
_____	Remove Existing Street Traffic Signs	_____	EA _____	_____
_____	Install Traffic Signs and Posts	_____	EA _____	_____
_____	Install Traffic Signs on existing Post/Pole	_____	EA _____	_____
_____	Pavement Traffic Striping & Markings	_____	LS _____	_____
_____	PGE - Install Street Light	_____	EA _____	_____
_____	_____	_____	_____	_____

**FINAL ESTIMATE OF AGENCY CONSTRUCTION COSTS \$ \_\_\_\_\_**

**Design Consultant:** \_\_\_\_\_

**Prepared by** \_\_\_\_\_ **Date** \_\_\_\_\_

**Checked by** \_\_\_\_\_ **Date** \_\_\_\_\_

***Agency construction costs include the work performed by the Maintenance Bureau as directed by the City Traffic Engineer, with the cost of work included in the permit fee. Work performed by PGE to install City street lights on existing power poles is also included in the permit fee.***

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***The majority of the types of work and material and their unit quantities are self-explanatory. The definitions below add some clarification and provide reference to the Standard Construction Specifications (SCS).***

**Clearing & Grubbing:** Submit a monetary estimate for this item only. City will verify this item based upon the complexity of the project. See Section 203, SCS.

**Excavation, Common:** Applies to all excavation material EXCEPT concrete, rock, and trench. See Section 204, SCS.

**Excavation, Concrete:** Portland Cement concrete with and without rebar. See Section 204, SCS.

**Excavation, Trench:** Material removed from sewer lateral trenches. See Section 204, SCS.

**Granular Trench Backfill:** Imported granular material for trench backfill: sand, bank-run, river-run, or crushed. Include only that volume above the pipe bedding. See Section 204 and Standard Plan 4-02, SCS.

**Embankment, Common:** Typically, compacted native fill material. See Section 204, SCS.

**Embankment, Select:** Imported granular material for structural fills and special embankments.

**Concrete Driveway:** Include the entire driveway, wings, and throat in this bid item. Curb length in the wing area is accounted for in the concrete curb work item. Curb length in the driveway throat is incidental to the driveway.

**Concrete Curb:** Include the entire length of curb except for the curb constructed in each driveway throat.

**CSP (Concrete Sewer Pipe):** Include the length of sewer lateral from the inlet or catch basin to the manhole. When the City assigns a unit price, it will include the cost of placing the pipe and the pipe bedding.

**Agency Construction Costs:** Do not fill out these items. City staff will develop the construction cost for these items.



# glossary

**Berm:** The finished ground surface behind the curb that is graded to drain to the street on a slope of 1/4 inch per foot (2 percent).

**Bureau of Transportation Engineering and Development (BTED):** The lead agency for the Portland Office of Transportation in implementing public street improvements.

**BVC:** Begin Vertical Curve. On the vertical plane, the point where a straight grade ends and a vertical curve begins.

**Central Business District:** The area bounded by the Willamette River on the east, I-405 on the west and south, and N.W. Glisan on the north.

**City Datum:** The vertical control system used by the City of Portland, established from mean sea level at Astoria in 1896 (Ordinance No. 9667). This datum is exactly 1.375 feet above the datum used by the U.S. Geological Survey (USGS), Multnomah County, and the Oregon Department of Transportation (ODOT). City Hall elevation is 78.835 feet above mean sea level.

**City Engineer:** The manager of BTED. The City Engineer also serves as the City's officer (as provided in the City Charter and appointed by City Council) for all work in the public right-of-way.

**City Forester:** The City Forester participates in all projects that involve street trees, to ensure that construction plans and procedures comply with City requirements for street tree protection and removal. The City Forester is in the Forestry Division of the Bureau of Parks and Recreation.

**Contractor:** The person or organization responsible for performing the construction work and identified as such in the construction documents.

**Design Engineer:** The consulting engineer employed by a developer to design street improvements. The Design Engineer must be a registered professional engineer in the State of Oregon.

**Developer:** Any person who is proposing to develop property in the City of Portland. The developer participates in the City's development review process, and may be required to make public improvements (streets, sanitary sewers, storm drainage facilities, or water mains) as a condition of development approval.

**Drop Curb:** Any location in the concrete curb that has a curb face exposure of less than 6 inches, intended to accommodate a future driveway apron. Drop curb sections are no longer acceptable.

**EVC:** End Vertical Curve. On the vertical plane, the point where a vertical curve ends and a straight grade begins.

**Grade Break:** On the vertical plane, the point where two straight grades intersect. Grade breaks are preferred to vertical curve sections when the algebraic difference between the two longitudinal grades is 2.5 percent or less.

**MO:** Middle Ordinate. On a vertical curve, the vertical distance between the vertical curve point of intersection (VCPI) and the pavement surface.

**PC:** Point of Curvature. On the horizontal plane, the point where a tangent section ends and a curved section begins.

**PCC:** Point of Compound Curvature. On the horizontal plane, the point where the radius used to form a curve changes to a longer or shorter radius length.

**PI:** Point of Intersection. On the horizontal plane, the point where two straight lines meet. This is also called an angle point.



**Permit Engineering Section:** The section within the Bureau of Transportation Engineering and Development that is responsible for the public improvement permit process for street improvements.

**Plan Review Engineer:** The designee of the City Engineer who manages the public improvement permit process for street improvements. The Plan Review Engineer is in the Permit Engineering Section of BTED.

**PRC:** Point of Reverse Curvature. On the horizontal plane, the point where two separate horizontal curve sections meet.

**PRVC:** Point of Reverse Vertical Curvature. On the vertical plane, the point where two separate vertical curve sections meet.

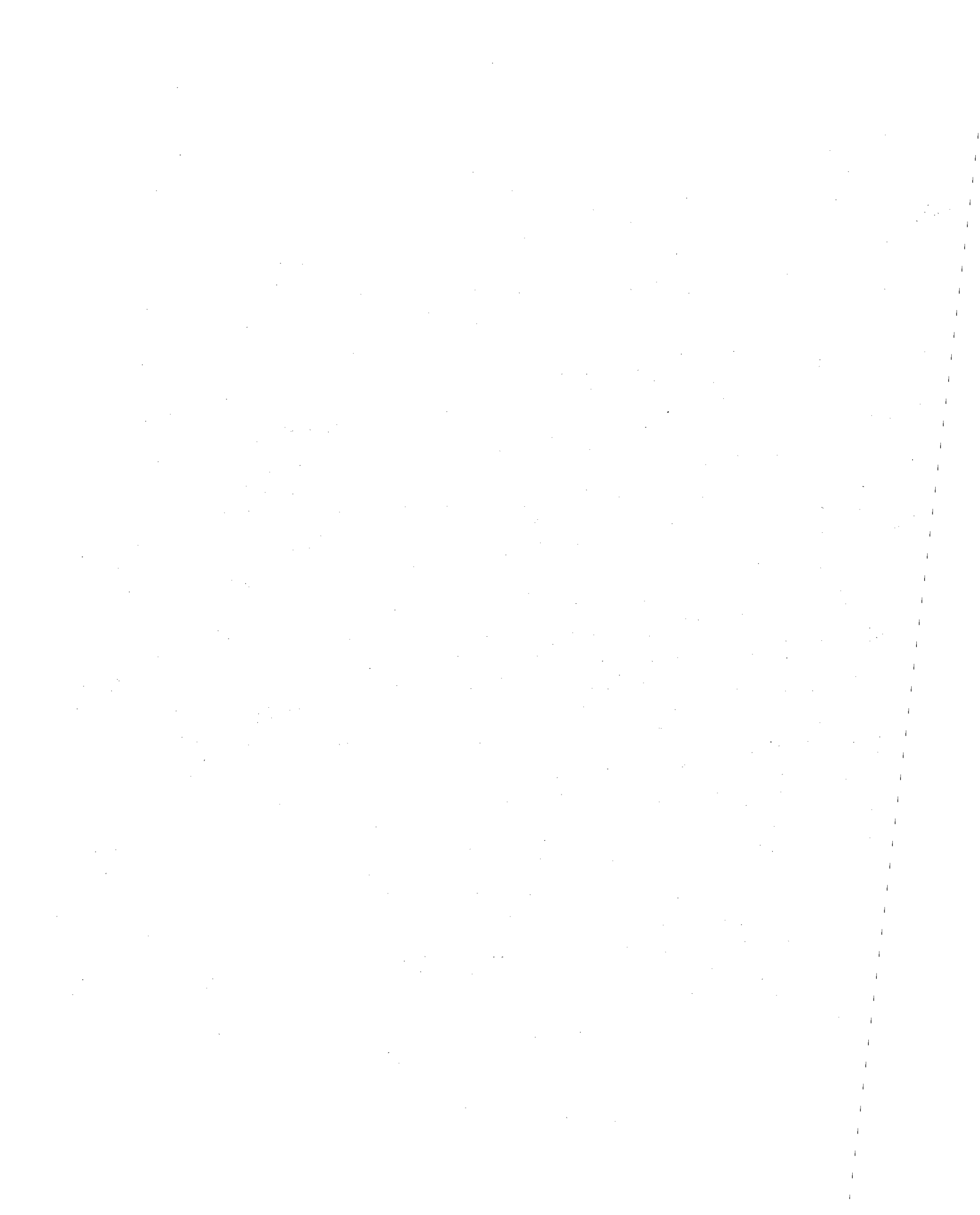
**PT:** Point of Tangency. On the horizontal plane, the point where a curved section ends and a tangent section begins.

**Standard Construction Specifications:** A document containing the City of Portland's standard specifications for construction within the City.

**Standard Plans:** Standard plans that are included in the Standard Construction Specifications.

**Traffic Engineer:** The engineer within the Bureau of Traffic Management who provides traffic criteria for street improvement projects.

**VCPI:** Vertical Curve Point of Intersection. The midpoint of a vertical curve where the projected straight grades intersect.



# references

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## **WE WELCOME YOUR COMMENTS**

The Bureau of Transportation Engineering and Development will periodically update the *Design Guide* to reflect any changes in policies or procedures. We also encourage users of the *Design Guide* to suggest needed corrections or improvements. If you have any comments, please note them below, fold the sheet to show the address on the back, and mail it to us.

**Is the *Design Guide* generally helpful? Why or why not?**

**Is information organized so it is easy to find? Do you have any suggestions for improving the organization?**

**Did you find any of the information to be incorrect, contradictory with other parts of the *Design Guide*, or inconsistent with other information you have obtained from the City? If so, what?**

**What additional information would you like to have included in the *Design Guide*?**

**Do you have any other suggestions for improving the *Design Guide*?**

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