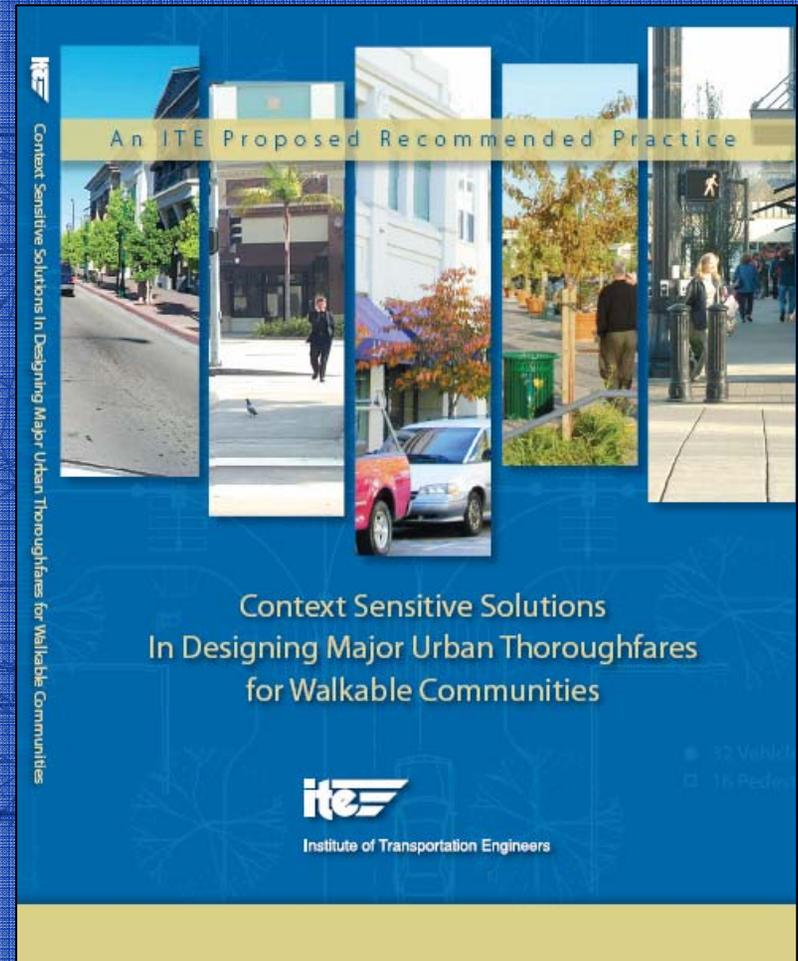


# Context Sensitive Solutions in Designing Major Urban Thoroughfares for Walkable Communities

An ITE Proposed  
Recommended  
Practice



# Segment 1

## Overview

# Communities and Practitioners

## Want:

- Flexibility
- Compatibility with adjacent land uses
- Balanced land use/transportation functions
- Safe and attractive streets
- Multimodal facilities
- Streets that are quality public space

# Project Objectives

- Establish CSS principles for design
- Integrate CSS in planning and project development
- Define compatibility and tradeoffs
- Develop guidance and design parameters for:
  - Thoroughfare design process
  - Identifying context
  - Roadside, travel way and intersections

# Project Sponsors

- Federal Highway Administration
- Environmental Protection Agency
- A joint effort:
  - Institute of Transportation Engineers
  - Congress for the New Urbanism



U.S. Department of Transportation  
**Federal Highway  
Administration**



# Technical and Steering Committees

- Traffic and design engineers
- Transportation planners
- Land use planners
- Architects
- Urban designers
- Landscape architects
- Transit planners
- Organization Reps (APWA, AASHTO)
- Over 60 reviewers and balloters

# Report Overview

- Aid context sensitive design
- CSS principles for planning and project development
  - Network
  - Corridor
  - Project
- Create a design framework
- Present criteria and guidance
- Consistent with established guidance

# Focus of the Proposed RP

- “Major”:
  - arterials and collectors
- “Urban”:
  - Walkable suburbs, town and city centers
  - mix of land uses
  - Efficient, attractive choices
    - Walking
    - Biking
    - Transit



Photo: Skidmore, Owings, and Merrill LLP

# Tenets of CSS

- Balance
  - Safety
  - Mobility
  - Community objectives
  - Environment
- Multimodal
- Involve public, stakeholders
- Interdisciplinary teams
- Flexibility in design
- Incorporate aesthetics



Source: Minnesota Department of Transportation

# CSS: Bringing Place and Thoroughfare Design Together



E14th Corridor - San Leandro, CA Source: Community, Design + Architecture

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# CSS: Bringing Place and Thoroughfare Design Together



E14th Corridor - San Leandro, CA Source: Community, Design + Architecture

# Contents of the Proposed RP

- Introduction
  - Overview
- Planning
  - Network and corridor planning
  - Design framework
- Design
  - Principles, criteria, guidelines
    - Roadside
    - Traveled way
    - Intersections
  - Design in constrained rights-of-way
  - Flexibility
  - Examples



**“Fact Sheet” Series**

# Intended Users

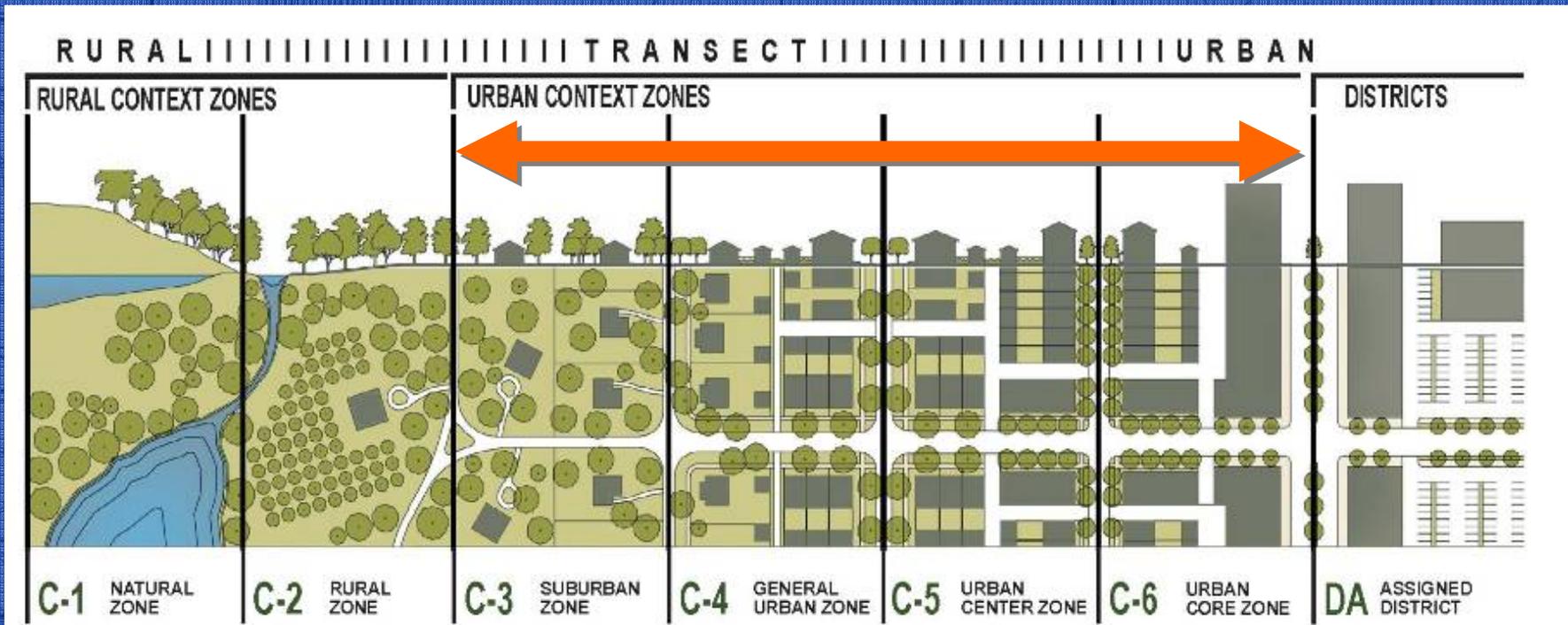
- Transportation/civil engineers
- Transportation planners
- Land use planners
- Design professionals
  - Architects, urban designers, landscape
- Stakeholders
  - Elected officials, agencies, developers, citizens

# CSS Design Framework

- Context zones:
  - Suburbs to downtowns
- Street classification:
  - Functional class
    - Arterial
    - collector
  - Thoroughfare type
    - Boulevard
    - Avenue
    - Street
- Compatibility



# Context Zones – An Organizing System for Thoroughfare Design



Source: Duany Plater-Zyberk and Company

# The Concept of Context Zones

Suburban



General Urban



Urban Center



Urban Core



Source: Duany Plater-Zyberk and Company

Context Sensitive Solutions in Designing Major Urban Thoroughfares for Walkable Communities



# CSS vs. Conventional Thoroughfare Design Approach

Conventional	CSS Approach
<p>Context:</p> <ul style="list-style-type: none"><li>Urban</li><li>Rural</li></ul>	<p>Urban Context:</p> <ul style="list-style-type: none"><li>Suburban</li><li>General Urban</li><li>Urban Center</li><li>Urban Core</li></ul>
<p>Design criteria based primarily on:</p> <ul style="list-style-type: none"><li>Functional class</li><li>Design speed</li><li>Travel demand forecasts</li><li>Level of service objectives</li></ul>	<p>Design criteria based primarily on:</p> <ul style="list-style-type: none"><li>Community objectives</li><li>Thoroughfare type</li><li>Functional class</li><li>Adjacent land use</li></ul>

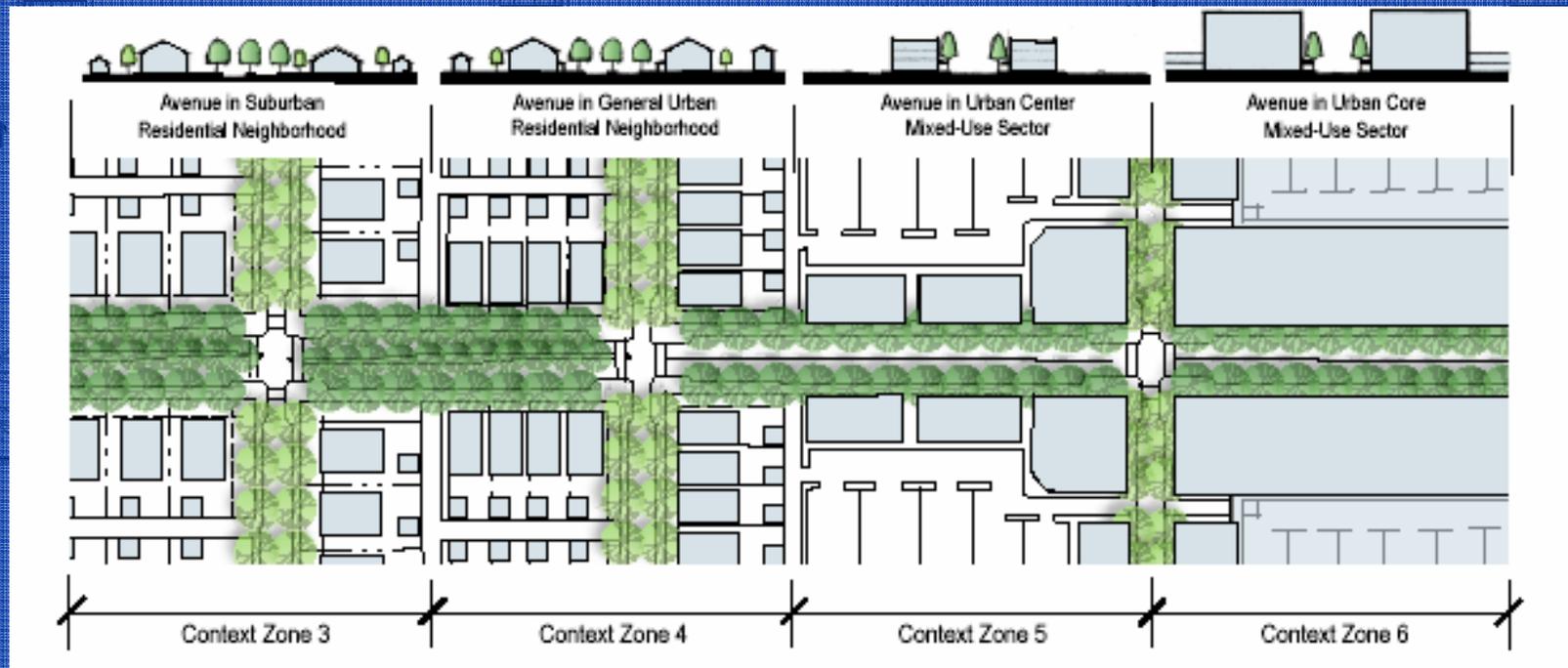
# Features That Create Context

- Land use
- Site design
- Building design
- Landscape design
- Natural features
- Character of public space



# Thoroughfare Design Changes as Context Changes

*The thoroughfare both responds to and contributes to shaping the context and defining the place*



# Context Zone Descriptions

Context Zone	Distinguishing Characteristics	General Character	Building Placement	Frontage Types	Typical Building Height	Type of Public Open Space
C-3 Suburban	Primarily single family residential with walkable development pattern and pedestrian facilities, dominant landscape character	Detached buildings with landscaped yards	Varying front and side yard setbacks	Lawns, porches, fences, naturalistic tree planting	1 to 2 story with some 3 story	Parks, greenbelts
C-4 General Urban	Mix of housing types including attached units, with a range of commercial and civic activity at the neighborhood and community scale	Predominantly detached buildings, balance between landscape and buildings, presence of pedestrians	Shallow to medium front and side yard setback	Porches, fences	2 to 3 story with some variation and few taller workplace buildings	Parks, greenbelts
C-5 Urban Center	Attached housing types such as townhouses and apartments mixed with retail, workplace, and civic activities at the community or sub-regional scale.	Predominantly attached buildings landscaping within the public right of way substantial pedestrian activity	Small or no setbacks, buildings oriented to street with placement and character defining a street wall	Stoops, dooryards, storefronts, arcaded walkways	3 to 5 story with some variation	Parks, plazas, and squares, boulevard median landscaping
C-6 Urban Core	Highest-intensity areas in sub-region or region, with high-density residential and workplace uses, entertainment, civic, and cultural uses	Attached buildings forming sense of enclosure and continuous street wall landscaping within the public right of way, highest pedestrian and transit activity	Small or no setbacks, building oriented to street, placed at front property line	Stoops, dooryards, forecourts, storefronts, arcaded walkways	4+ story with a few shorter buildings	Parks, plazas, and squares, boulevard median landscaping

# Thoroughfare Types

- Three classifications:
  - Boulevard
  - Avenue
  - Street
- Basis for:
  - Physical configuration
  - Design criteria
  - Design speed

# Functional Classification in Thoroughfare Design

- Function and role in the network
  - Continuity
  - Trip purpose and length
  - Level of land access
  - Type of freight
  - Types of public transit
- Design controls
  - Design speed for sight distance
  - Horizontal and vertical curvature

# Thoroughfare Type in Thoroughfare Design

- Design criteria
  - Target speed (desirable operating speed)
- Physical configuration
  - With surrounding context
- Dimensions for:
  - Roadside
  - Traveled way
  - Intersections

# Thoroughfare Type Establishes Design Criteria

## ARTERIAL THOROUGHFARES

Context	Suburban (C-3)				General Urban (C-4)			
	Residential		Commercial		Residential		Commercial	
	Boulevard	Avenue	Boulevard	Avenue	Boulevard	Avenue	Boulevard	Avenue
Building Orientation (entrance orientation)	front, side	front, side	front, side	front, side	front	front	front	front
Maximum Setback [1]	20'	20'	5'	5'	15'	15'	0'	0'
Off-Street Parking Access/Location	rear, side	rear, side	rear, side	rear, side	rear, side	rear, side	rear, side	rear, side
<b>Roadside</b>								
Recommended Roadside Width [2]	14.5'	12.5'	16'	15'	16.5'	12.5'	19'	16'
Pedestrian Buffers (planting strip exclusive of travel way width) [2]	8' planting strip	6-8' planting strip	7' tree well	6' tree well	8' planting strip	6-8' planting strip	7' tree well	6' tree well
Street Lighting	For all arterial thoroughfares in all context zones, intersection safety lighting, basic street lighting, and pedestrian-s (Design Guidelines) and Chapter 10 (Intersection Design Guidel							
<b>Traveled Way</b>								
Target Speed (mph)	35	25-30	35	35	35	25-30	35	25-30 [3]
Design Speed	Design speed should be a maximum of 5 mph over the operating speed. Design speed is used as a control for certa horizontal and vertical curvature.							
Number of Through Lanes [4]	4-6	2-4	4-6	2-4	4-6	2-4	4-6	2-4
Lane Width [5]	10-11'	10-11'	10-12'	10-11'	10-11'	10-11'	10-12'	10-11'
Parallel On-Street Parking Width [6]	7'	7'	8'	8'	7'	7'	8'	8'
Min. Combined Parking/Bike Lane Width	13'	13'	13'	13'	13'	13'	13'	13'
Horizontal Radius (per AASHTO) [7]	762'	510'	762'	762'	762'	510'	762'	510'

# Design Controls in CSS

- Target Speed
  - Desirable operating speed
  - Mobility for motor vehicles
  - Safety for vehicles, pedestrians and bicyclists
  - Usually posted speed limit
- Design Speed
  - Governs geometric features
    - Minimum intersection sight distance
    - Minimum sight distance on horizontal and vertical curves
    - Horizontal and vertical curvature
  - Design speed - 5 mph over target speed

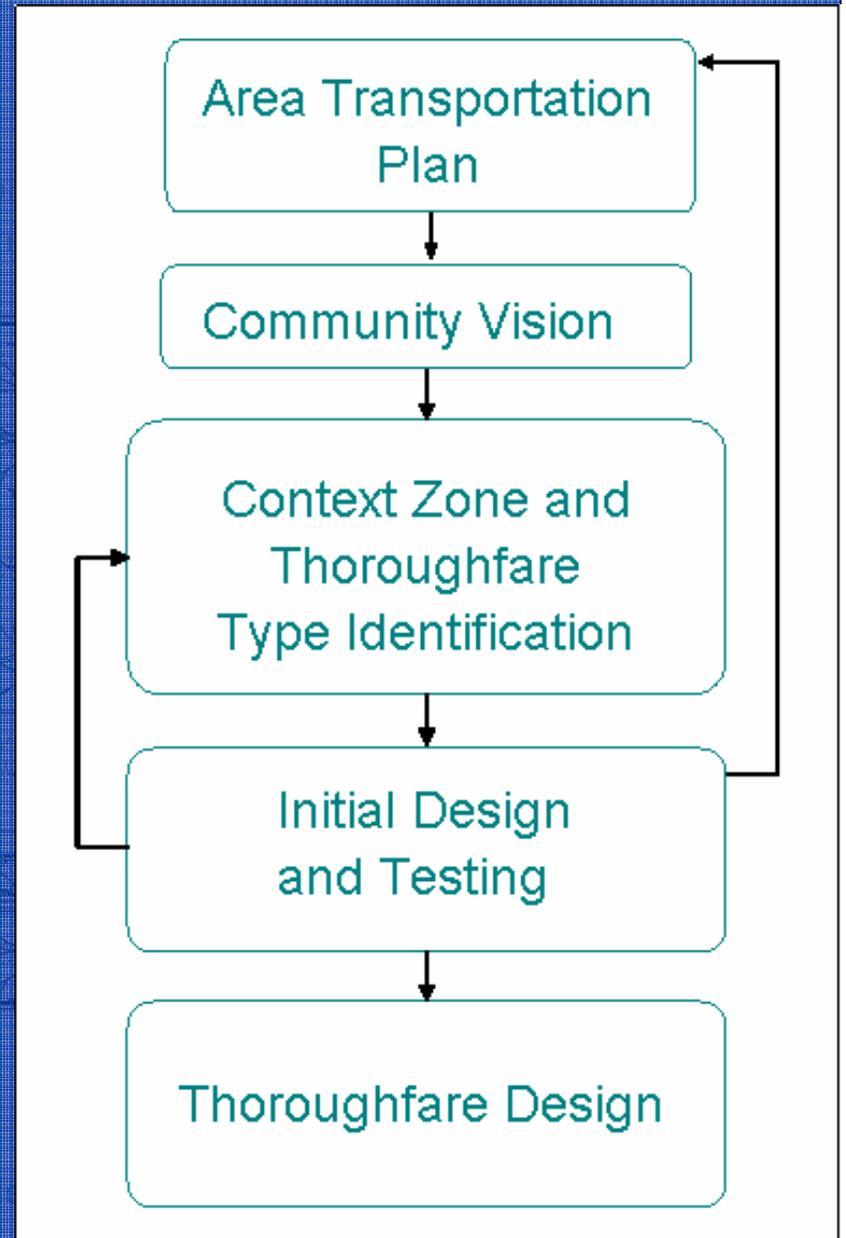


# Speed and Capacity of Urban Streets

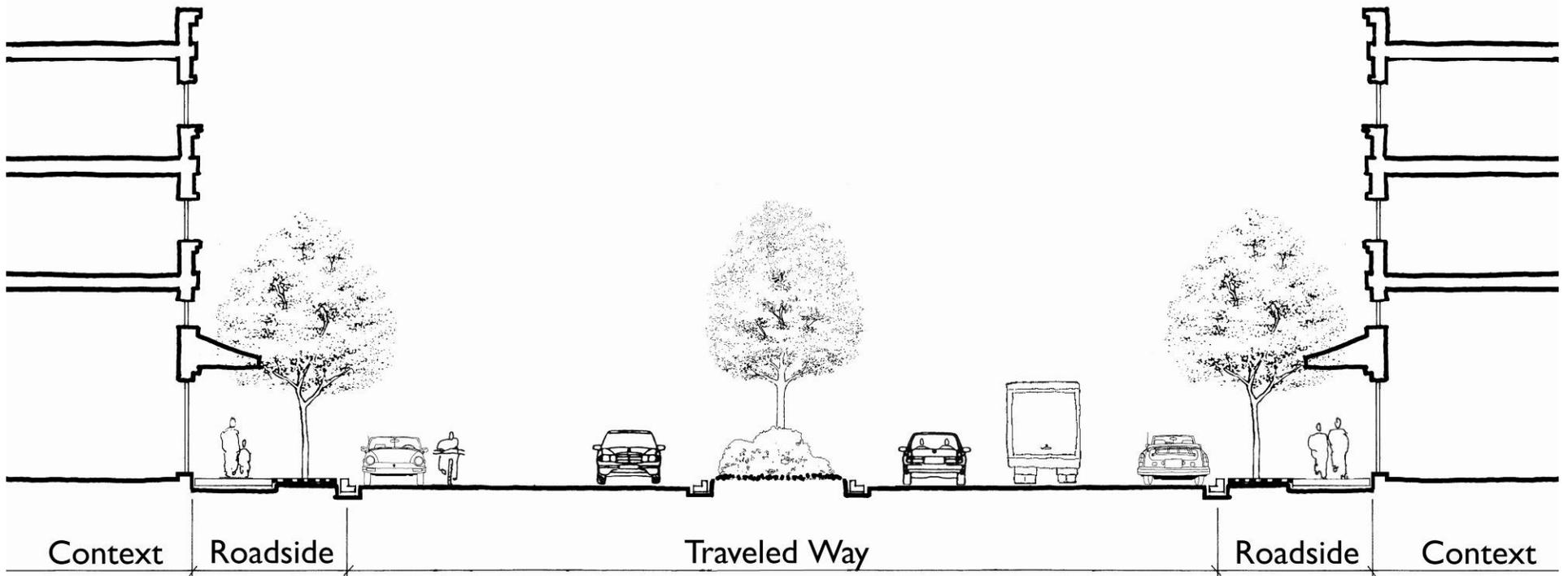
- Adequate LOS with operating speeds at 25 to 35 mph
- Address capacity issues with:
  - Network capacity
  - Synchronized signal timing
  - Access management
  - Turn lanes
- Address safety:
  - Case-by-case basis

# CSS Design Process

- 1: Plan
- 2: Vision
- 3: Compatibility
- 4: Initial concept/testing
- 5: Design



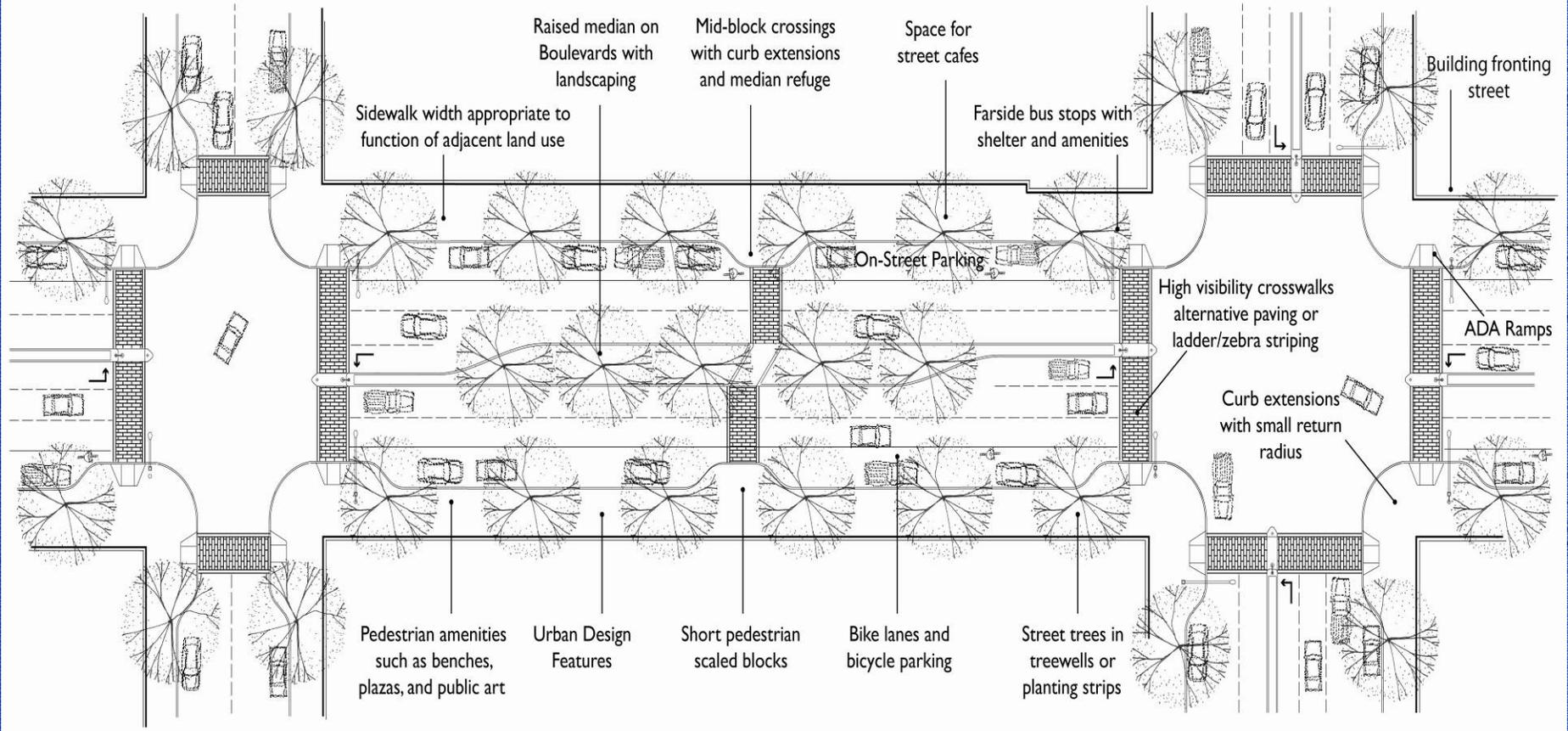
# Thoroughfare Components



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# CSS Elements in Urban Contexts

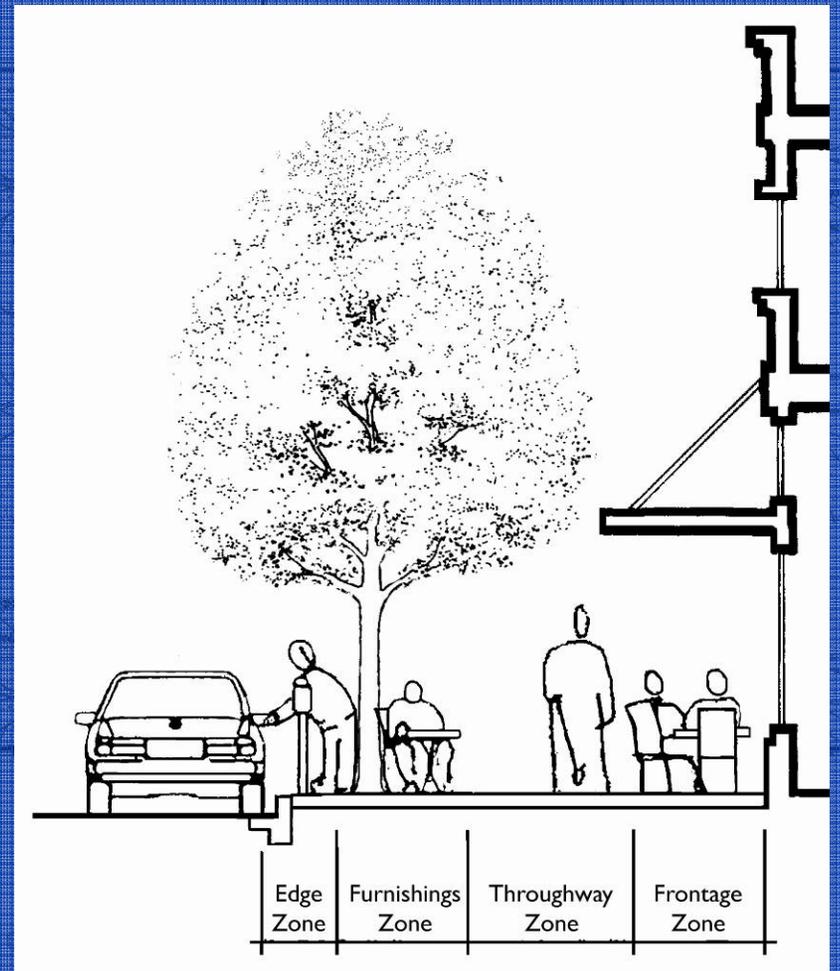


Context Sensitive Solutions in Designing Major Urban Thoroughfares for Walkable Communities



# Roadside Design

- Roadside zones:
  - Edge Zone
  - Furnishings Zone
  - Throughway Zone (ADA)
  - Frontage Zone
- Function and dimensions vary by context zone and adjacent land use



# Roadside Design

- Roadside zones on a C-4 Avenue



Not Context Sensitive



Context Sensitive

# Roadside Design Topics

- Roadside zones
- Public places
- Placement of roadside facilities
- Public art
- Sidewalk width and function
- Pedestrian buffers
- Sidewalk/driveway/alley crossings
- Street furniture
- Utilities
- Landscaping/street trees



Sidewalk Zone [1]		C-6 and C-5		C-4 w/ Predominantly Commercial Ground Floor Use		C-4 w/ Predominantly Residential Frontage		
Boulevard	Edge	1.5 feet 2.5 feet at diagonal parking		1.5 feet 2.5 feet at diagonal parking		0.5 feet		
	Furnishings	7 feet (trees in tree wells)		7 feet (trees in tree wells)		8 feet (landscape strip w/ trees and grasses or groundcovers)		
	Throughway	10 feet		8 feet		8 feet		
	Frontage	3 feet		2.5 feet		0 feet along lawn and groundcover 1 foot along low walls, fences, and hedges 1.5 feet along facades, tall walls, and fences		
Boulevard Without Parking	Edge	THIS THOROUGHFARE TYPE NOT APPLICABLE TO THE PREDOMINANTLY COMMERCIAL GROUND FLOOR LAND USES FOUND IN C-4 THROUGH C-6 CONTEXT ZONES						0.5 feet
	Furnishings							10 feet (landscape strip w/ trees and groundcovers or low shrubs)
	Throughway							8 feet
	Frontage							0 feet along lawn and groundcover 1 foot along low walls, fences, and hedges 1.5 feet along facades, tall walls, and fences
Avenue	Edge	1.5 feet 2.5 feet at diagonal parking		1.5 feet 2.5 feet at diagonal parking		0.5 feet		
	Furnishings	With Parking	6 feet trees in tree wells		6 feet (trees in tree wells)		8 feet (landscape strip w/ trees and grasses or groundcovers)	
		Without Parking	8 feet with buffer landscaping		8 feet with buffer landscaping		8 feet with buffer landscaping	
	Throughway	9 feet		6 feet		6 feet		
	Frontage	3 feet		2.5 feet		0 feet along lawn and groundcover 1 foot along low walls, fences, and hedges 1.5 feet along facades, tall walls, and fences		
Street	Edge	1.5 feet 2.5 feet at diagonal parking		1.5 feet 2.5 feet at diagonal parking		0.5 feet		
	Furnishings	6 feet (trees in tree wells)		6 feet (trees in tree wells)		5 feet (landscape strip w/ trees and grasses or groundcovers)		
	Throughway	6 feet		6 feet		6 feet		
	Frontage	2.5 feet		2.5 feet		0 feet along lawn and groundcover 1 foot along low walls, fences, and hedges 1.5 feet along facades, tall walls, and fences		

21.5 foot (recommended)

12 foot (constrained)

19 foot (recommended)

12 foot (constrained)

16.5 foot (recommended)

18.5 foot (Recommended)

14.5 foot (recommended)

11.5 foot (recommended)

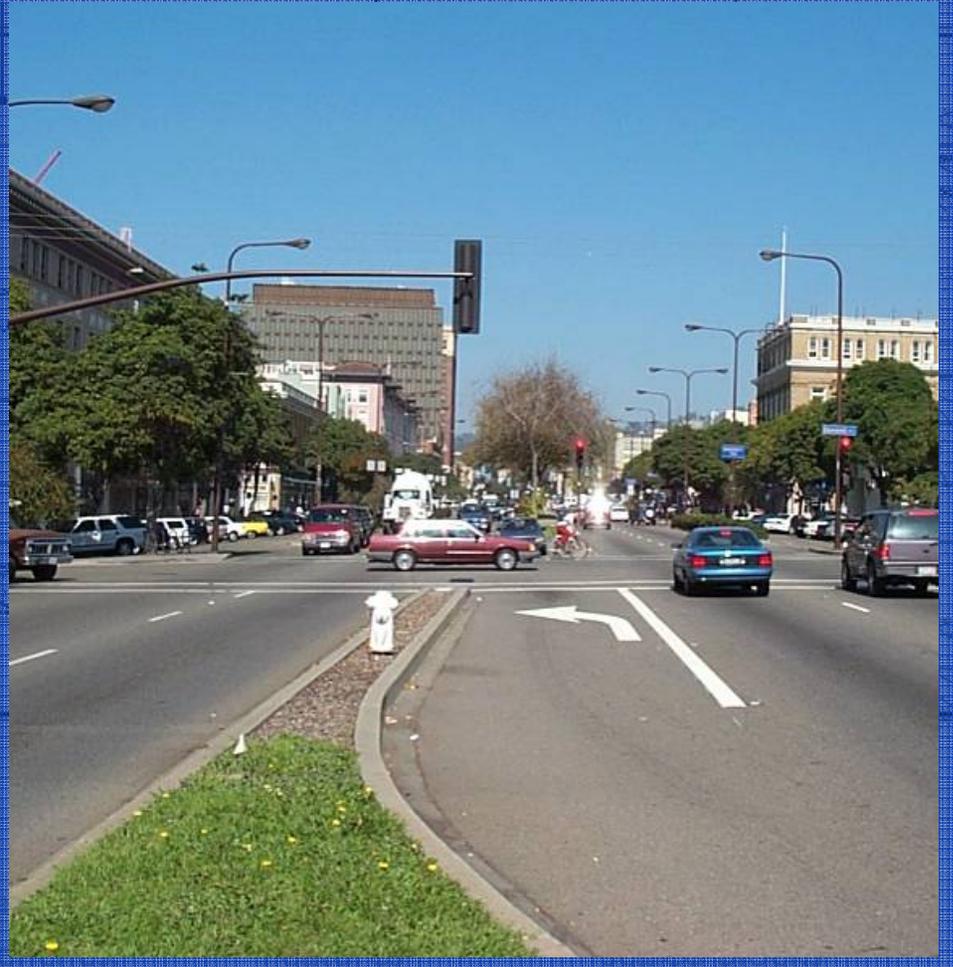
# Traveled Way Design Topics

- Cross-sections
- Access management
- Transition principles
- Lane width
- Medians
- Bicycle facilities
- On-street parking
- Mid-block crosswalks
- Pedestrian refuge islands
- Mid-block bus stops
- Snow removal



# Intersection Design Topics

- General principles
- Intersection sight distance
- Managing modal conflicts
- General intersection layout
- Curb return radii
- Channelized right turns
- Modern roundabouts
- Crosswalks
- Curb extensions
- Bicycle lane treatment
- Bus stops at intersections

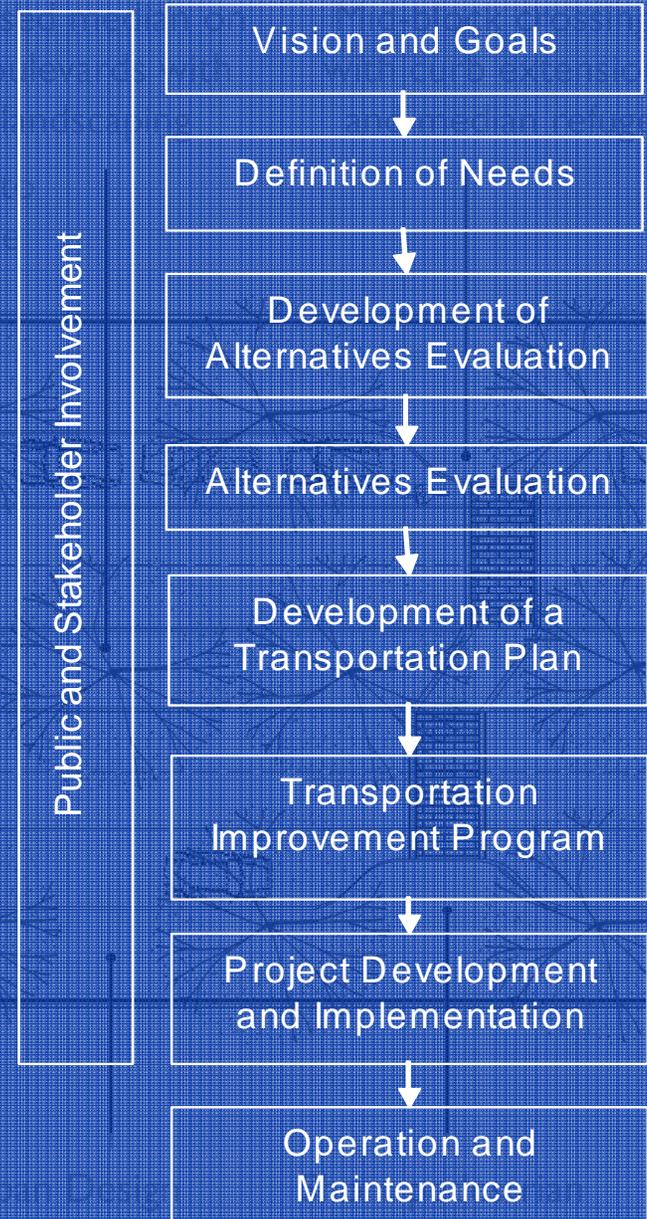


# Segment 2

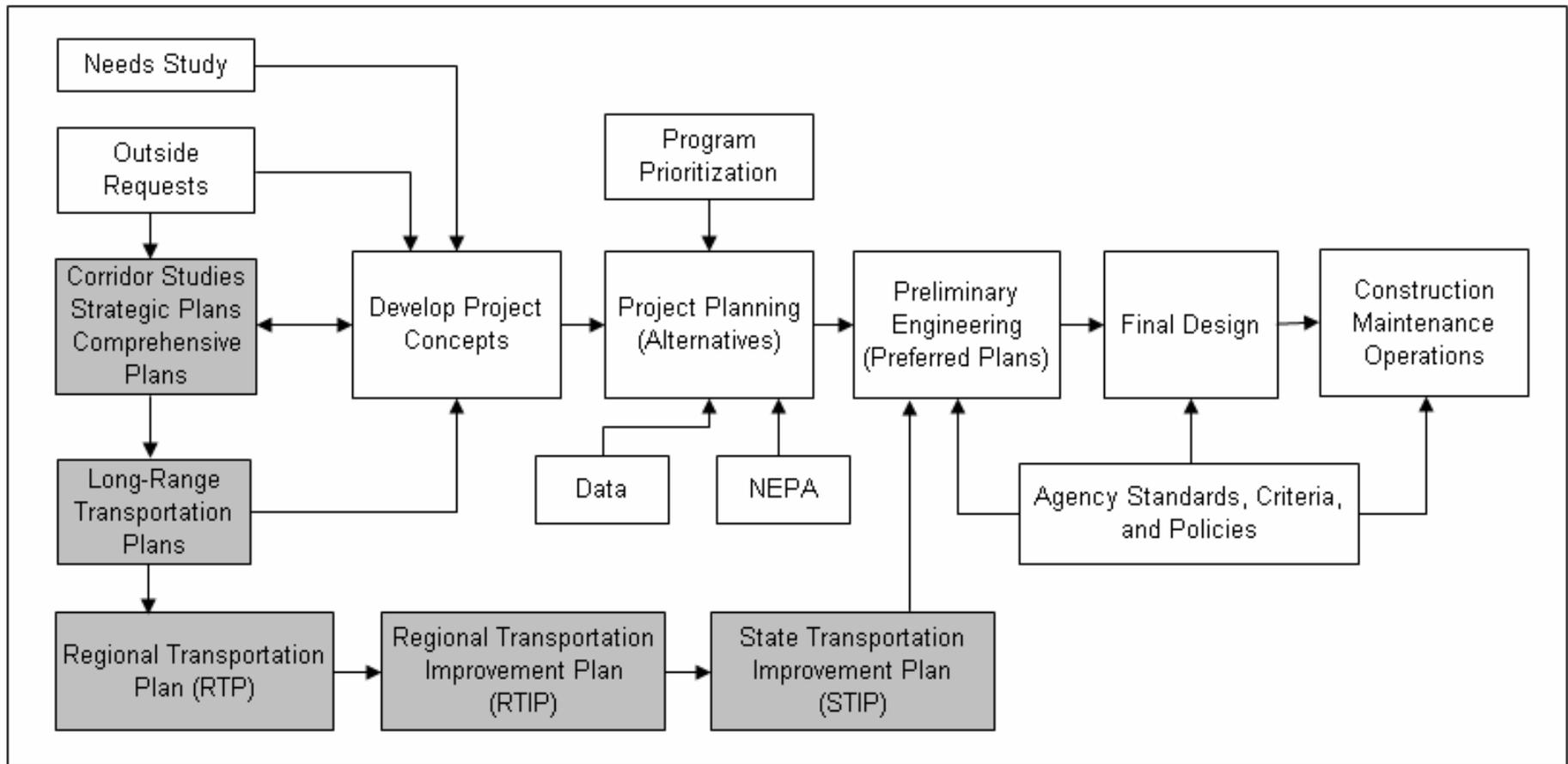
## CSS in Transportation Planning

# CSS in Transportation Planning

- CSS outcomes
  - Long range vision
  - Stakeholder education
  - Full range of alternatives
  - Enhancements
  - Clear assessment of tradeoffs
  - Public trust in agency
  - Innovative solutions

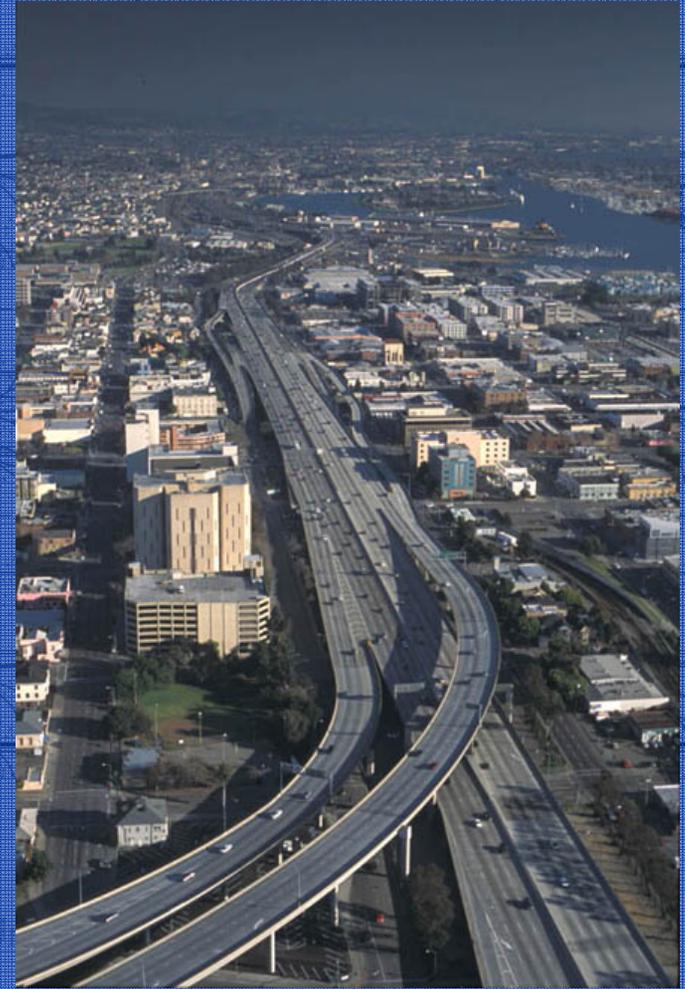


# Transportation Planning Process

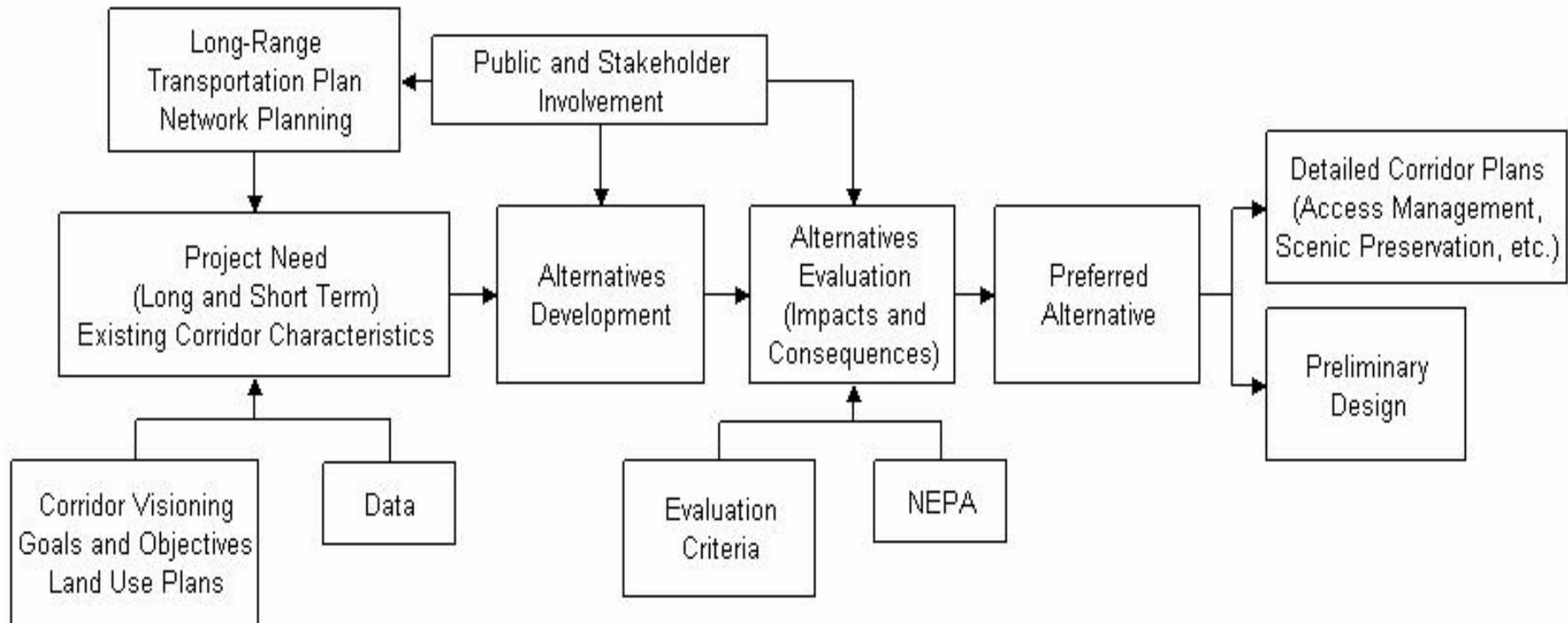


# CSS in Corridor Planning

- Fills gap between:
  - Long-range transportation plan
  - Project development
- Comprehensively address
  - Transportation needs
  - Physical improvements
  - Operational and management strategies
  - Land use/transportation linkage
  - Community issues/concerns



# Corridor Planning Process



# CSS in Network Planning and Design

- Network planning:
  - Framework for integrating CSS in thoroughfare design
  - Expedites project development
  - Resolves thoroughfare design challenges
  - Addresses regional, sub-regional and community issues

# Network Design Principles

- Integrate multimodal plans:
  - Land use
  - Transportation
  - Urban form
- Connectivity
  - Establish high level of connectivity
  - Support desired development patterns
  - Ensure intermodal connections
  - Avoid channeling traffic to limited number of arterials
  - Preserve capacity with access management

# Network Design Guidelines

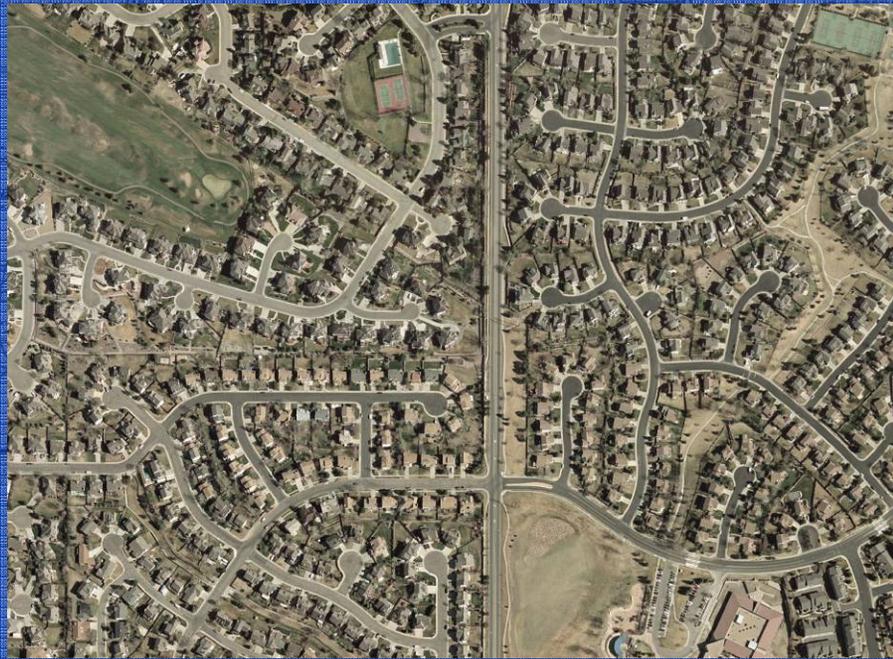
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Pedestrian amenities such as benches Urban Design Features Short pedestrian greenways

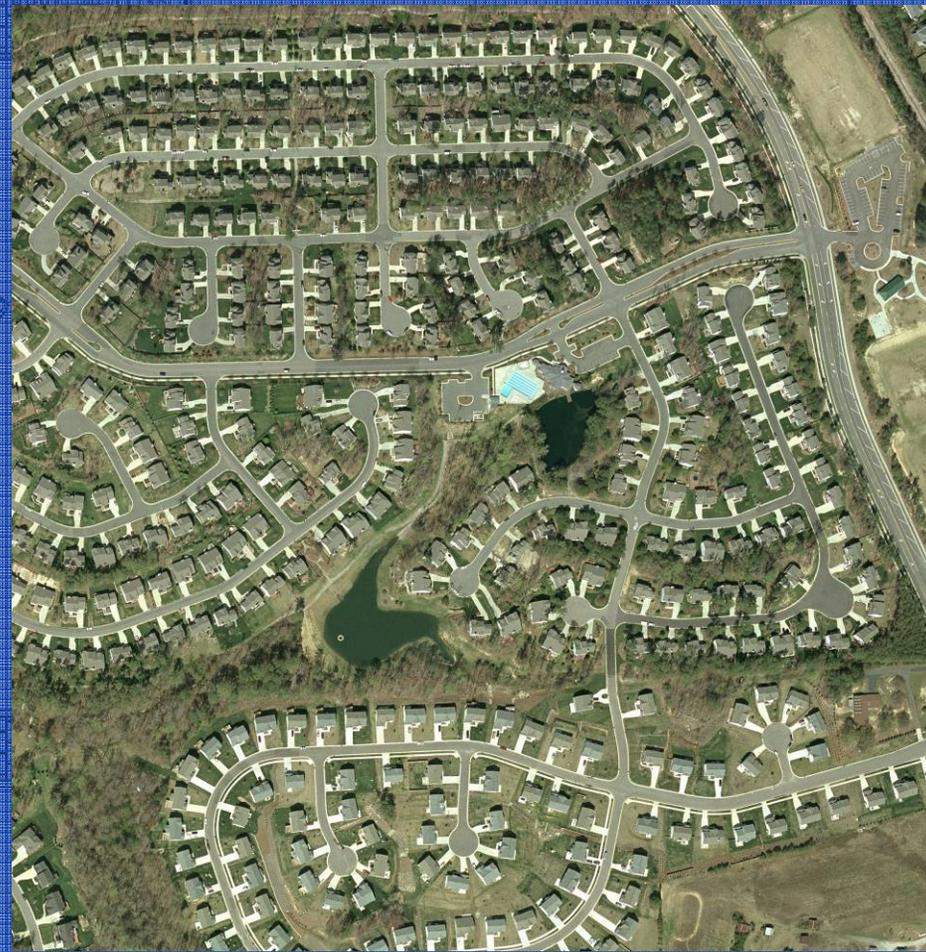
# Network Types

Conventional  
Dendritic Network

Traditional Grid  
Network



# Hybrid Network

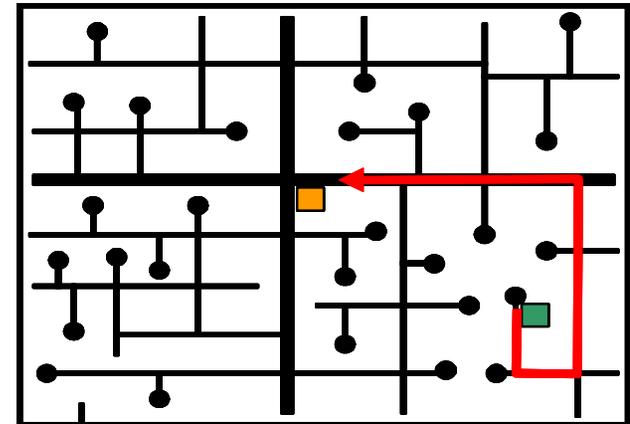


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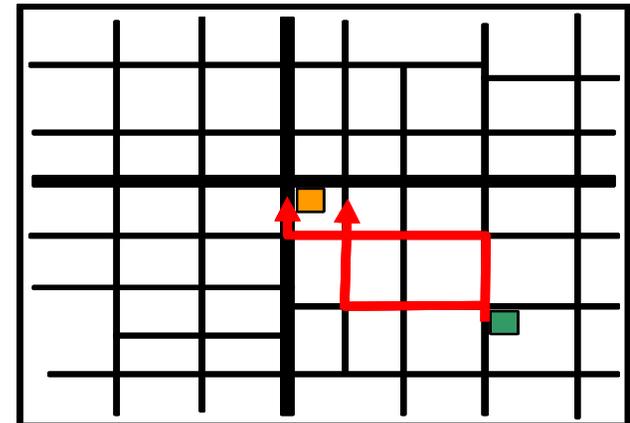


# Benefits of Connectivity

- Disperses traffic
- Reduces impacts on collectors
- Direct routes
- Lower vehicle miles of travel
- Encourages walking and biking
- Transit-friendly
- Block structure provides development flexibility
- Limits width and number of lanes on major thoroughfares



A) Conventional suburban hierarchical network



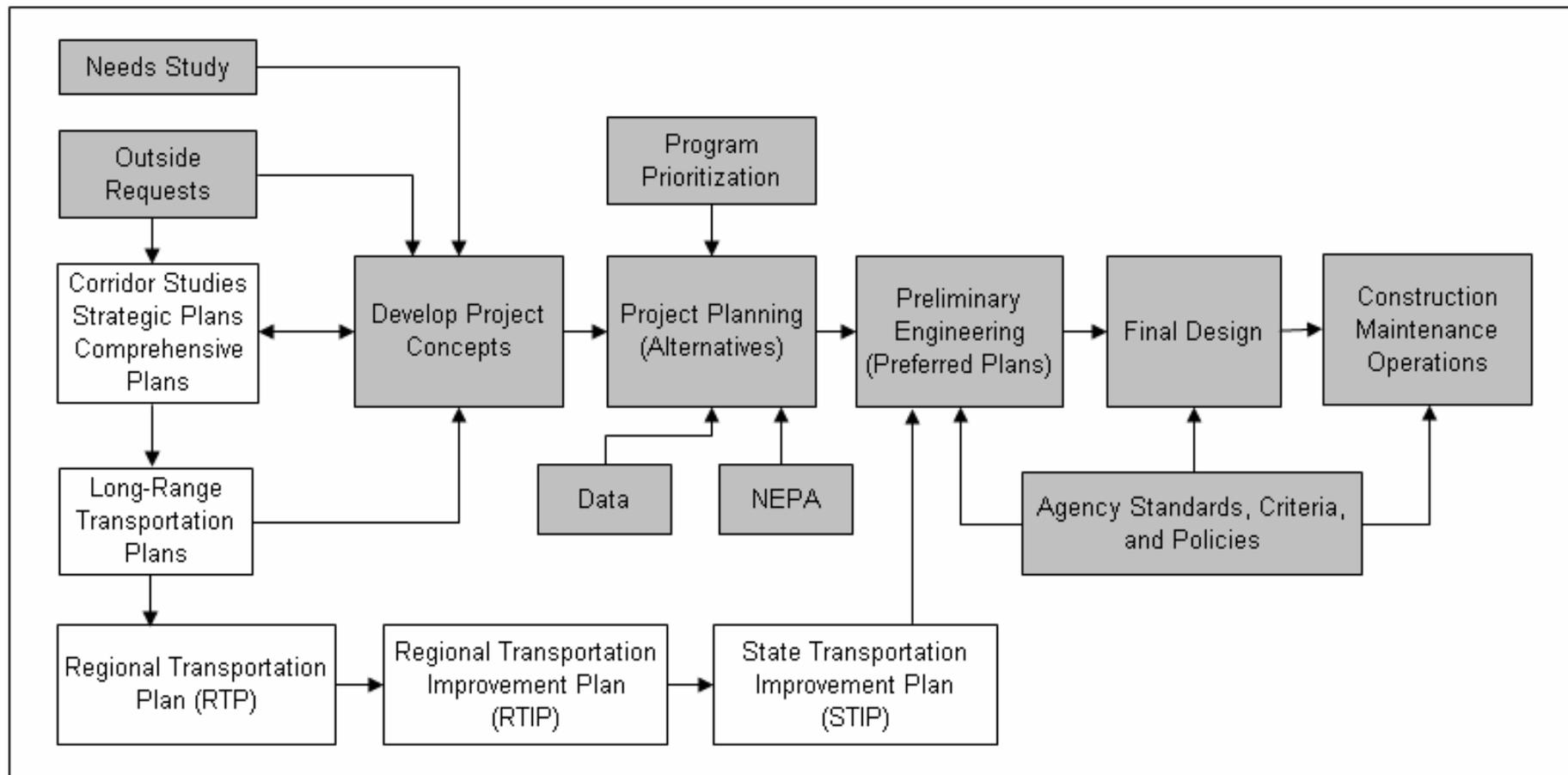
B) Traditional urban connected network

# CSS in Project Development

Context Sensitive Solutions in Designing Major Urban Thoroughfares for Walkable Communities



# Project Development Process



# Segment 3

## CSS Design Framework

# Placemaking

- Community-based approach to the development and revitalization of cities and neighborhoods
- Placemaking:
  - Unique places with lasting value
  - Compact, mixed-use
  - Pedestrian and transit oriented
  - Strong civic character
  - Contributes to economic development

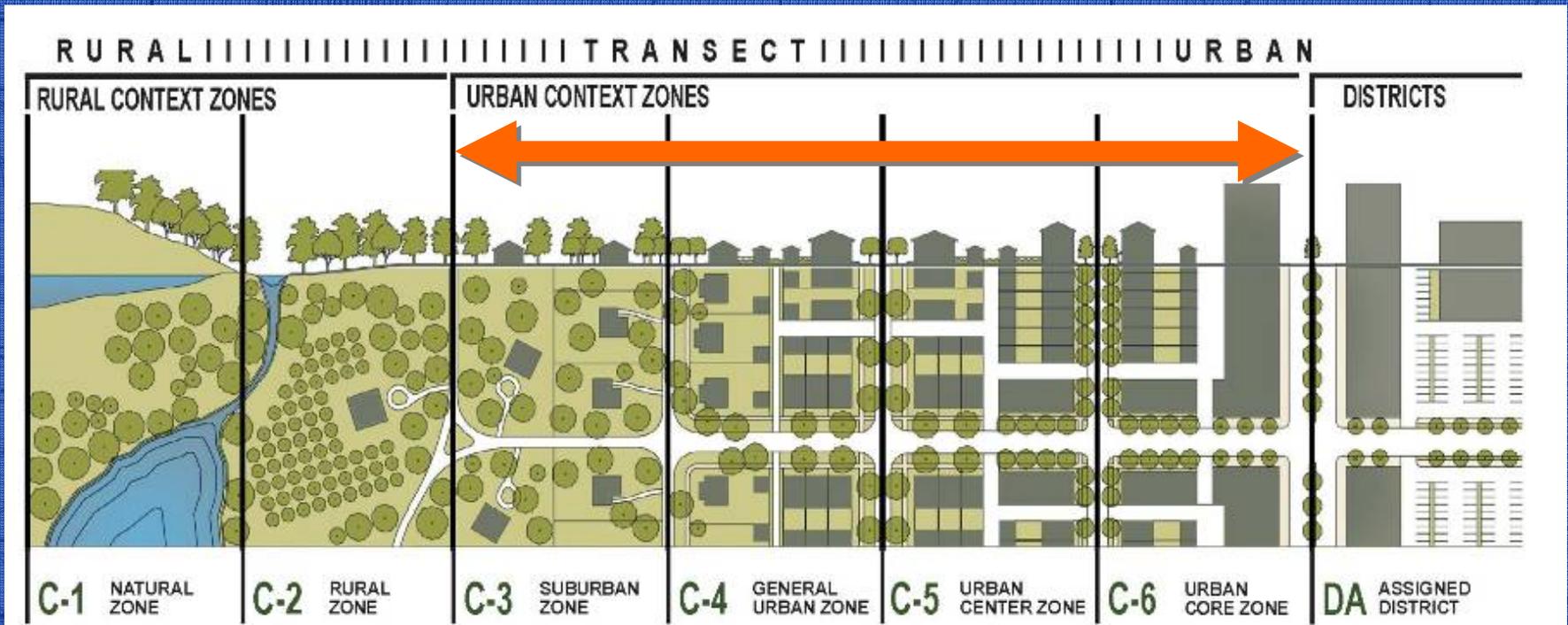


# CSS Design Framework

- Context zones:
  - Suburbs to downtowns
- Street classification:
  - Functional class
    - Arterial
    - collector
  - Thoroughfare type
    - Boulevard
    - Avenue
    - Street
- Compatibility



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Source: Duany Plater-Zyberk and Company

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General Urban



Urban Center



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# Features That Create Context

- **Land use**
  - Defines urban activity
  - Major factor in design criteria
- **Site design**
  - Arrangement of buildings, circulation, parking and landscape
  - Vehicle or pedestrian-orientation
- **Building design**
  - Height, massing shape context
  - Create enclosure/pedestrian interest



# Land Use

- Major factor in thoroughfare design
- Influences:
  - Travel demand
  - Activity in roadside
  - Width of roadside
  - On-street parking
  - Target speed
  - Freight and transit



# Site Design

	Auto Oriented	Pedestrian Oriented
Building Orientation and Setback	<ul style="list-style-type: none"> <li>– Set well back into private property</li> <li>– Oriented to parking or landscape</li> </ul>	<ul style="list-style-type: none"> <li>– Oriented to, and adjacent to street</li> <li>– Direct pedestrian entrance on street</li> <li>– Integrated with street using stoops, arcades, cafes</li> </ul>
Parking Type and Orientation	<ul style="list-style-type: none"> <li>– Surface lot between buildings and street</li> </ul>	<ul style="list-style-type: none"> <li>– Under or behind building access by alleys</li> <li>– Structured</li> <li>– On-street</li> </ul>
Block Length	<ul style="list-style-type: none"> <li>- Large blocks, often with no public throughway</li> <li>- Superblocks</li> </ul>	<ul style="list-style-type: none"> <li>- Short blocks</li> <li>- High connected network</li> </ul>

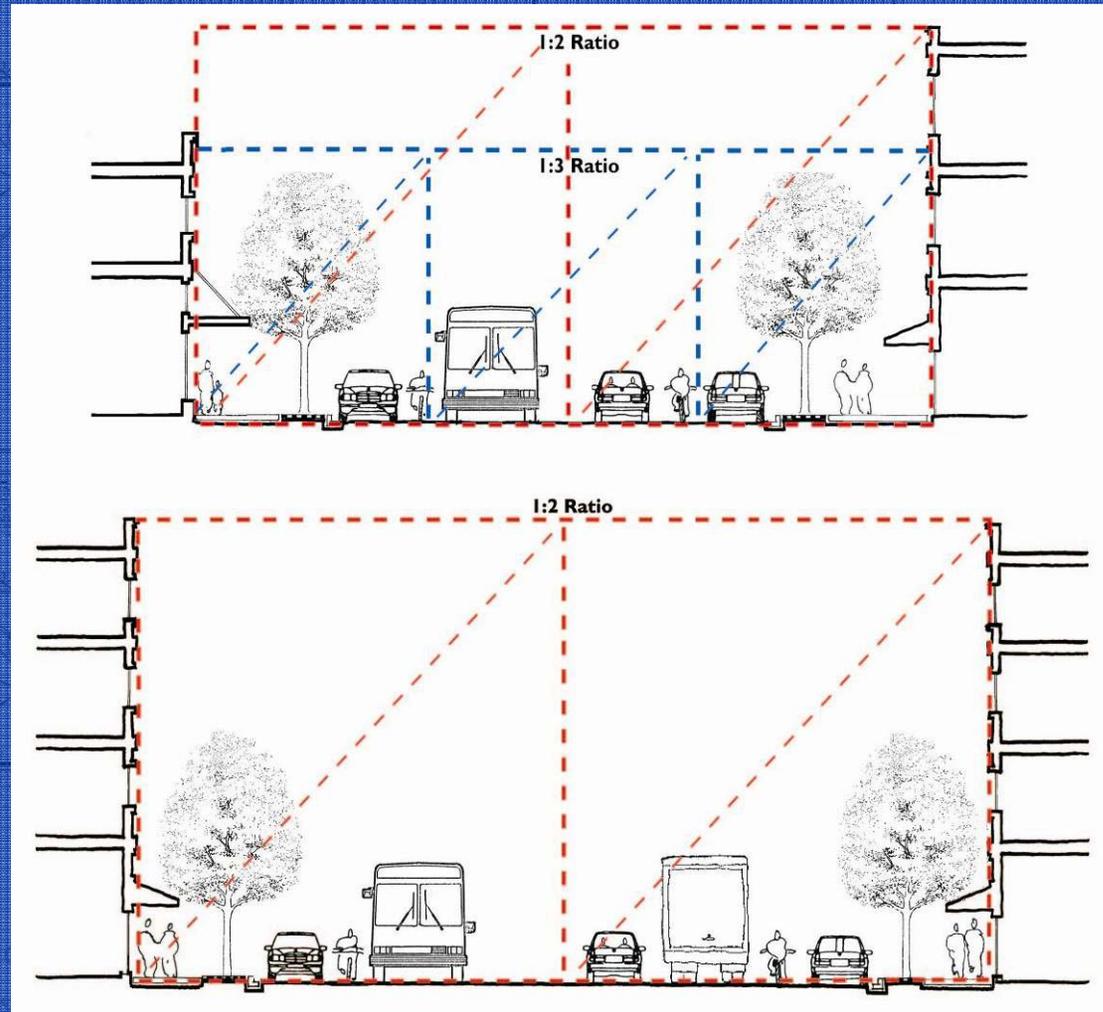
# Building Design

- Significant contributor to context defined by:
  - Height and thoroughfare enclosure
  - Width
  - Scale and variety
  - Entries



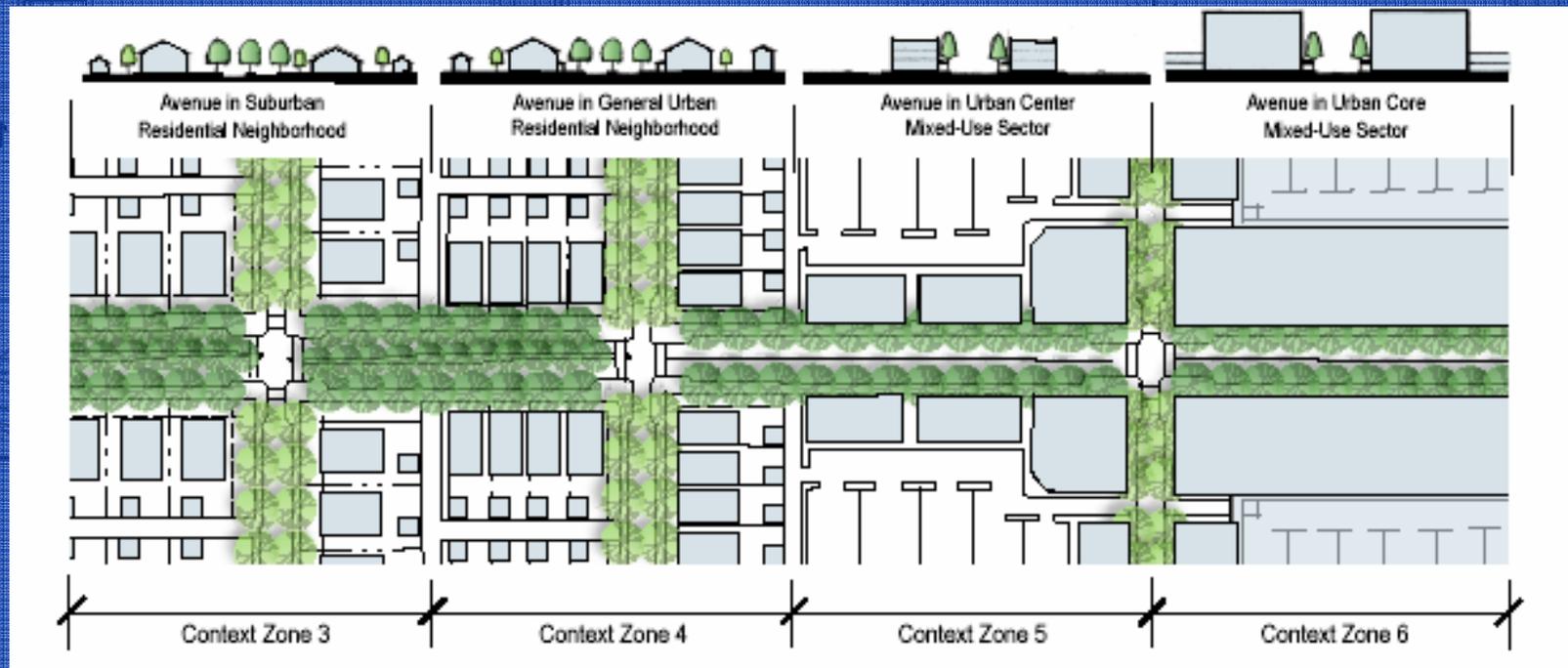
# Street Enclosure

- Building height to thoroughfare width ratios:
  - 1:4 suburban
  - 1:2-1:3 urban
- Pedestrians first perceive enclosure at a 1:4 ratio



# CSS Tenet –Thoroughfare Design Changes as Context Changes

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# Thoroughfare Types

- Three classifications:
  - Boulevard
  - Avenue
  - Street
- Basis for:
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  - Design criteria
  - Design speed

# Functional Classification in Thoroughfare Design

- Function and role in the network
  - Continuity
  - Trip purpose and length
  - Level of land access
  - Type of freight
  - Types of public transit
- Design controls
  - Design speed for sight distance
  - Horizontal and vertical curvature

# Relationship between Thoroughfare Type and Functional Class

Functional Classification	Thoroughfare Types						
	FREEWAY/EXPRESSWAY/ PARKWAY	RURAL HIGHWAY	BOULEVARD	AVENUE	STREET	RURAL ROAD	ALLEY/REAR LANE
PRINCIPAL ARTERIAL	Black	Black	Black	Black	Black	Grey	Grey
MINOR ARTERIAL	Grey	Black	Black	Black	Black	Grey	Grey
COLLECTOR	Grey	Grey	White	Black	Black	Black	Grey
LOCAL	Grey	Grey	White	White	Black	Black	Black

# Thoroughfare Type in Design

- Design criteria
  - Target speed (desirable operating speed)
- Physical configuration
  - With surrounding context
- Dimensions for:
  - Roadside
  - Traveled way
  - Intersections

# Thoroughfare Type Characteristics

Urban Thoroughfare Type	Number of Through Lanes	Design Speed (mph)	Operating Speed (mph)	Intersection Spacing [1]	Transit Service Emphasis	Median	Driveway Access	Curb Parking	Pedestrian Facilities [2]	Bicycle Facilities	Freight Mvmt. [3]
FREEWAY	4 to 6+	50-70	45-65	1 to 2 miles	Express	Required	No	No	No	Optional Separated Pathway	Regional Truck Route
EXPRESSWAY/PARKWAY	4 to 6	50-60	45-55	1/2 to 1 mile	Express	Required	No	No	Optional Separated Pathway	Optional Separated Pathway	Regional Truck Route
BOULEVARD	4 to 6	35-40	30-35	660 to 1,320 feet	Express and Local	Required	Limited	Optional	Sidewalk	Bike Lanes or Parallel Route	Regional Truck Route
MULTIWAY BOULEVARD	4 to 6	30-40 (20 in access roadway)	25-35	660 to 1,320 feet (400 to 660 feet for access lanes)	Express and Local	Required	Yes from access lane	Yes on access roadway	Sidewalk		Regional Route/Local deliveries only on access roadway
AVENUE	2 to 4	30-35	25-30	300 to 660 mile	Local	Optional	Yes	Yes	Sidewalk		Local Truck Route
STREET	2	30	25	300 to 600 feet	Local	Optional	Yes	Yes	Sidewalk		Local Deliveries Only
ALLEY/REAR LANE	1	10	5	Not Applicable	None	No	Yes	No	Shared	Shared	Local Deliveries Only

# Vehicle Mobility Priority Thoroughfares

- Serves areas where vehicle mobility is high priority
- Auto-oriented land uses
- Target speeds up to 45 mph
- Number of lanes: typically 4 to 6, up to 8
- Narrow sidewalks, but pedestrian buffer important

# Boulevard

- Divided arterial (4+ lanes)
- Target speed (35 mph or less)
- Through and local traffic
- Serve longer trips
- Access management
- Major transit corridor
- Primary freight route
- Emergency response route
- Limited curb parking





# Multi-way Boulevard

- Characterized by:
  - Central roadway for through traffic
  - Parallel roadways access abutting property, parking, and pedestrian and bicycle facilities
  - Parallel roadways separated from the through lanes by curbed islands
- Require significant right-of-way
- Special treatment of intersections

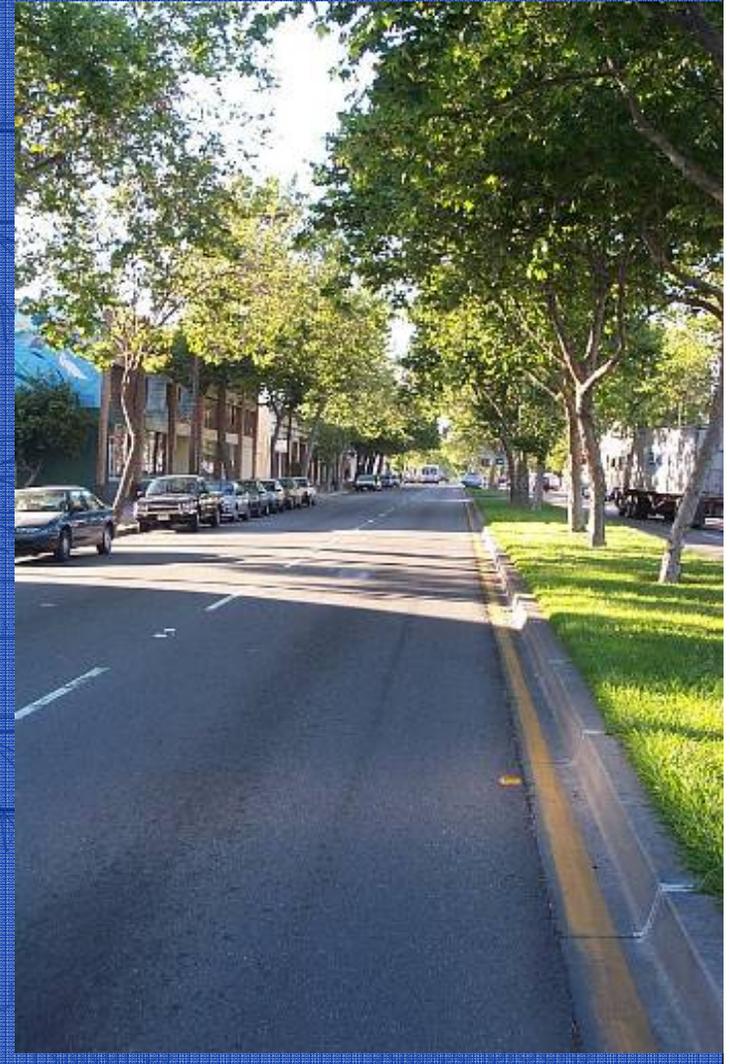






# Avenue

- Arterial or collector (4 lanes max)
- Target speed (30 to 35 mph)
- Land access
- Primary ped and bike route
- Local transit route
- Freight - local deliveries
- Optional raised landscaped median
- Curb parking





**Context Sensitive Solutions in Designing Major Urban Thoroughfares for Walkable Communities**



# Street

- Collector or local street (2 lanes)
- Target speed (25 mph)
- Land access primary function
- Designed to:
  - Connect residential neighborhoods
  - Connect neighborhoods with commercial districts
  - Connect local streets to arterials
- May be commercial main street
- Emphasizes curbside parking
- Freight restricted to local deliveries



Context Sensitive Solutions in Designing Major Urban Thoroughfares for Walkable Communities



# Thoroughfare Examples

- Street in urban center context



# Thoroughfare Examples

- Boulevard in general urban context



# Thoroughfare Examples

- Boulevard in urban core context



# Thoroughfare Examples

- Avenue  
in  
suburban  
context



# Thoroughfare Examples

- Avenue in urban center context



# Changing Thoroughfare & Context

- Arterial Street
- C-3: Suburban



Source: TJPDC, VDoT, City of Charlottesville, & Albemarle Co.  
CD+A, Meyer, Mohaddes, & Urban Advantage

Existing Conditions

Context Sensitive Solutions in Designing Major Urban Thoroughfares for Walkable Communities



# Changing Thoroughfare & Context

- Boulevard Thoroughfare
- C-4: General Urban



Source: TJPDC, VDoT, City of Charlottesville, & Albemarle Co.  
CD+A, Meyer, Mohaddes, & Urban Advantage

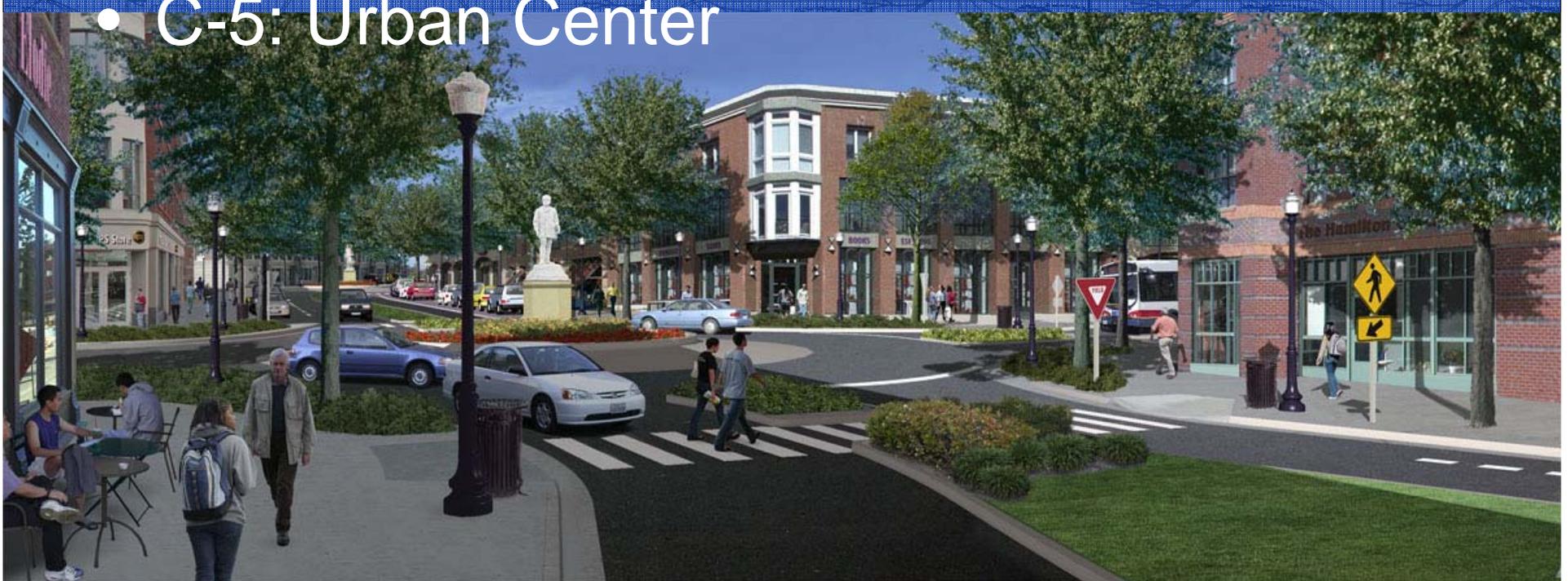
Alternative Future with Initial Network

Context Sensitive Solutions in Designing Major Urban Thoroughfares for Walkable Communities



# Changing Thoroughfare & Context

- Avenue Thoroughfare
- C-5: Urban Center



Source: TJPDC, VDoT, City of Charlottesville, & Albemarle Co.  
CD+A, Meyer, Mohaddes, & Urban Advantage

Alternative Future with Potential "Full" Network

Context Sensitive Solutions in Designing Major Urban Thoroughfares for Walkable Communities



# Segment 4

## Design Controls and Thoroughfare Design

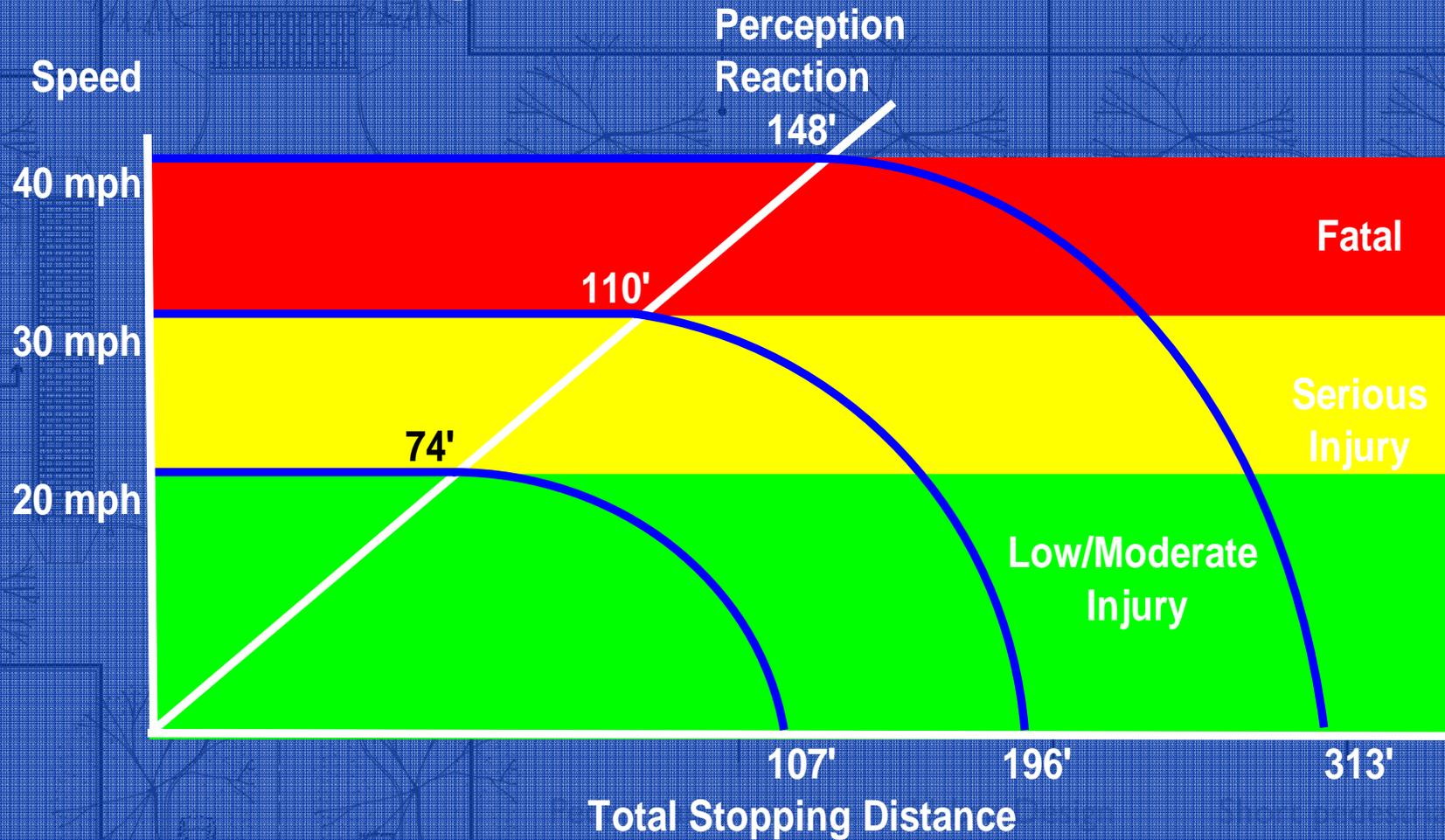
# Design Controls in CSS

- Design control – guide selection of design criteria
  - Speed
  - Design vehicle
  - Functional class
  - Location
  - Sight distance
  - Horizontal / vertical alignment
  - Access management
  - Pedestrians and bicyclists

# Speed Definitions

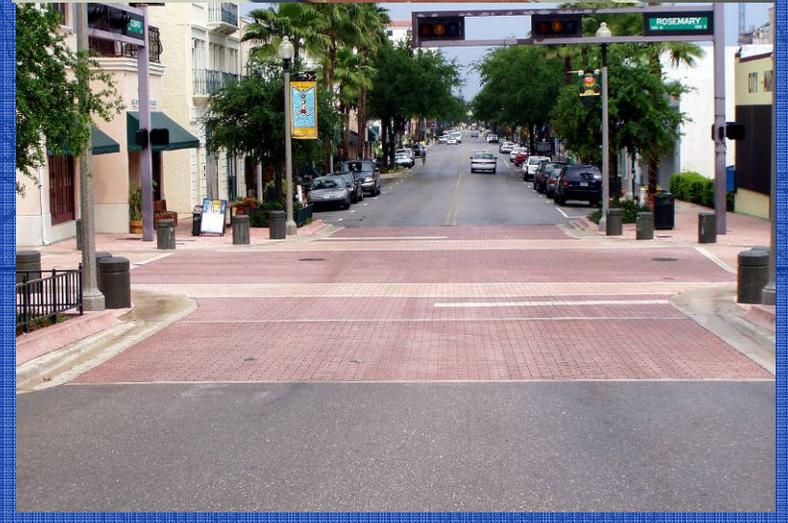
- Target speed
  - Desirable operating speed in specific context
  - Range: 25 to 35 mph
  - Balances
    - Vehicle mobility
    - Safe environment
  - Usually posted speed limit
- Design speed
  - Governs certain geometric features
  - In CSS – 5 mph over target speed

# Speed/Accident Severity Relationship



# Design Factors that Influence Target Speed (Urban Areas)

- Narrow lanes
- Minimal offset
- No superelevation
- No shoulders
- On-street parking
- Smaller curb return radii
- Design of right turn lanes
- Spacing of signalized intersections
- Synchronization to desired speed
- Paving materials



# Design vs. Control Vehicle

- Design Vehicle

- Accommodated without encroachment
- Turns with considerable frequency
- High volumes in opposing lanes
- Example: bus

- Control Vehicle

- Encroachment allowed
- Turns infrequently
- Example: emergency vehicle



# CSS vs. Conventional Thoroughfare Design Approach

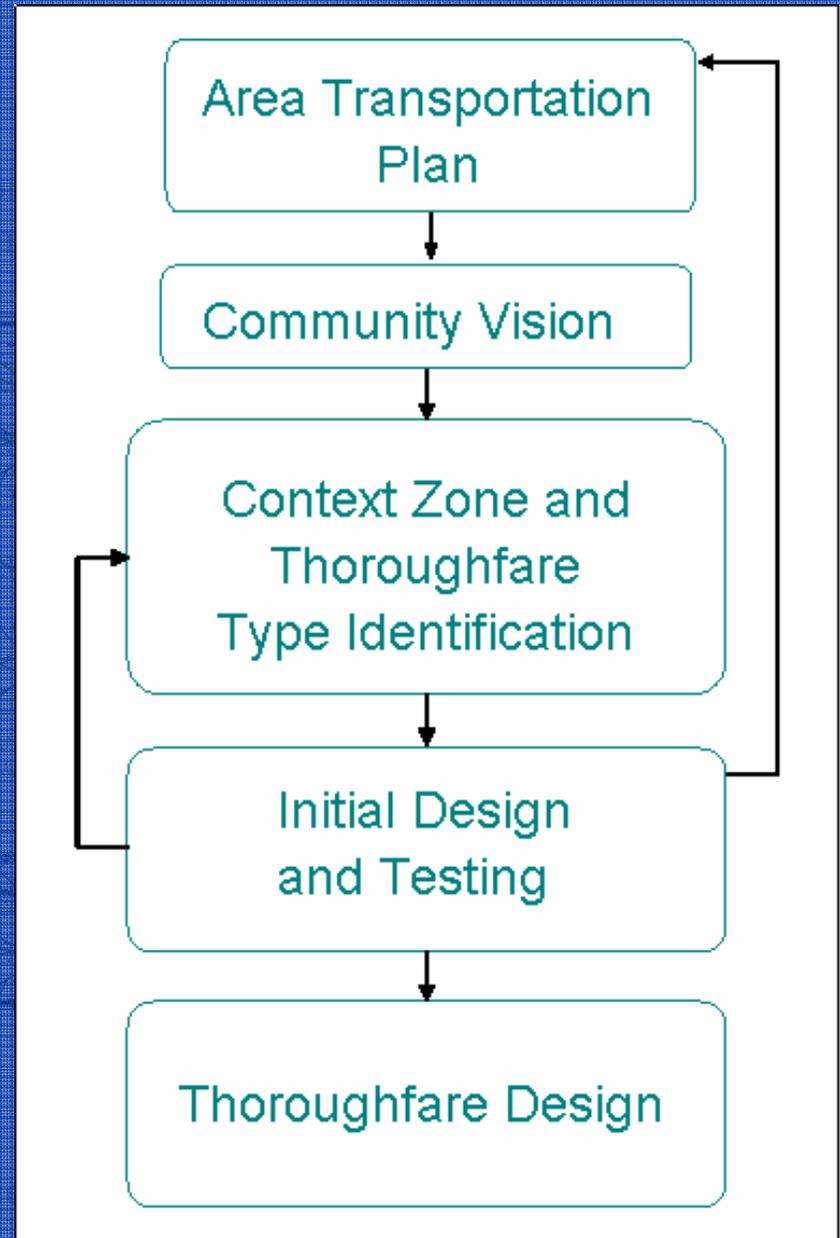
Conventional	CSS Approach
<p data-bbox="201 526 436 581">Context:</p> <ul data-bbox="369 613 512 734" style="list-style-type: none"><li data-bbox="369 613 512 662">Urban</li><li data-bbox="369 688 495 734">Rural</li></ul>	<p data-bbox="1104 526 1528 581">Urban Context:</p> <ul data-bbox="1272 613 1621 889" style="list-style-type: none"><li data-bbox="1272 613 1503 662">Suburban</li><li data-bbox="1272 688 1621 734">General Urban</li><li data-bbox="1272 760 1591 808">Urban Center</li><li data-bbox="1272 834 1549 883">Urban Core</li></ul>
<p data-bbox="180 925 1033 1055">Design criteria based primarily on:</p> <ul data-bbox="369 1088 991 1364" style="list-style-type: none"><li data-bbox="369 1088 747 1136">Functional class</li><li data-bbox="369 1162 697 1211">Design speed</li><li data-bbox="369 1237 949 1286">Travel demand forecasts</li><li data-bbox="369 1312 991 1360">Level of service objectives</li></ul>	<p data-bbox="1083 925 1936 1055">Design criteria based primarily on:</p> <ul data-bbox="1272 1088 1789 1364" style="list-style-type: none"><li data-bbox="1272 1088 1789 1136">Community objectives</li><li data-bbox="1272 1162 1705 1211">Thoroughfare type</li><li data-bbox="1272 1237 1654 1286">Functional class</li><li data-bbox="1272 1312 1696 1360">Adjacent land use</li></ul>

# Speed and Capacity of Urban Streets

- Adequate LOS with operating speeds at 25 to 35 mph
- Address capacity issues with:
  - Network capacity
  - Synchronized signal timing
  - Access management
  - Turn lanes
- Address safety:
  - Case-by-case basis

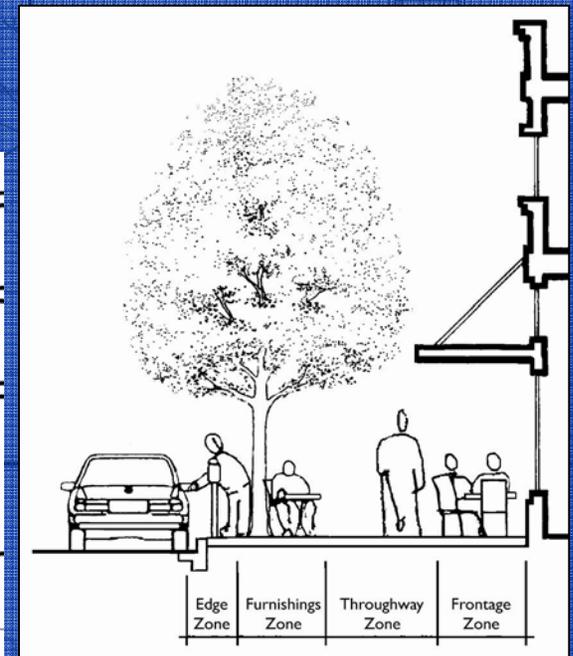
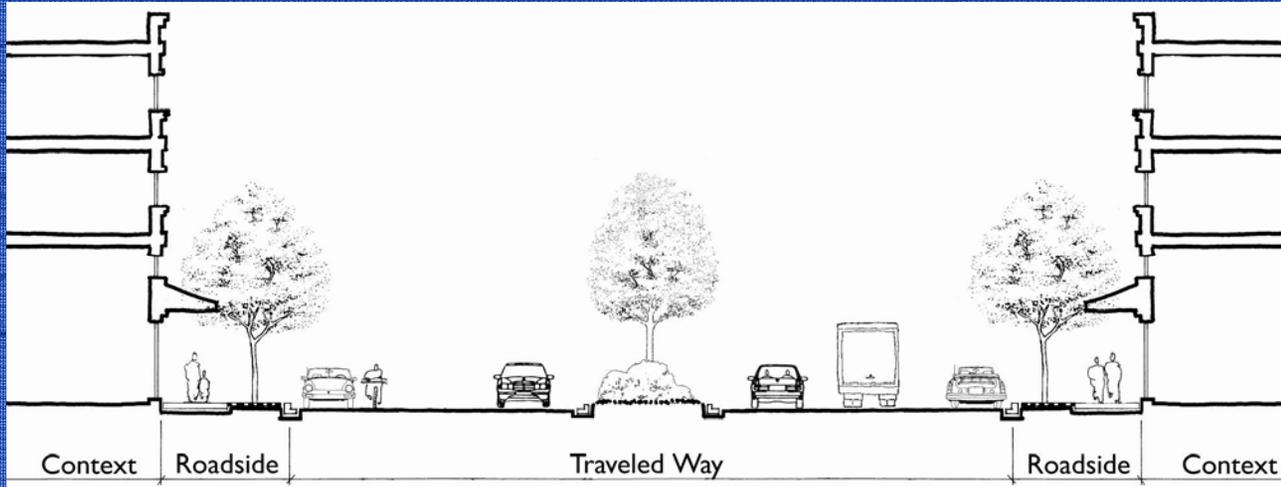
# CSS Design Process

- 1: Plan
- 2: Vision
- 3: Compatibility
- 4: Initial concept/testing
- 5: Design



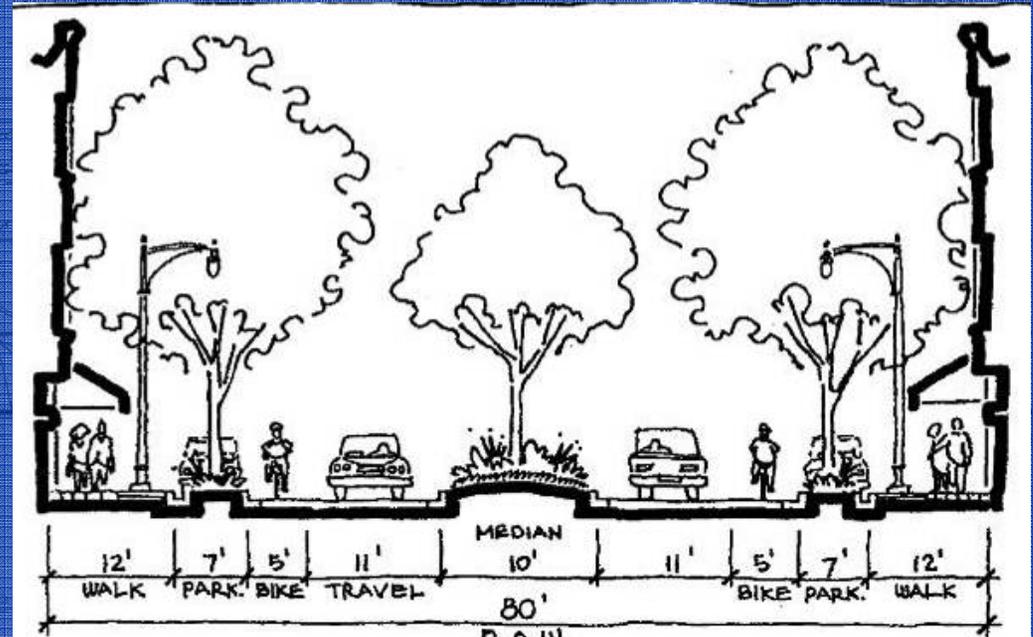
# Thoroughfare Components

## Roadside



# Considerations in Cross-Section Design

- Local objectives
- Stakeholder priorities
- Adjacent activities
- Functional class
- Context zone and thoroughfare type
- Modal requirements
- Other conditions
  - Right-of-way
  - Traffic volumes
  - Vehicle mix



# Stages in Cross-Section Design

## 1. Establish general parameters based on:

- Context zone
- Thoroughfare type
- Tables 6.2-6.3

## 2. Determine number of lanes based on:

- Community objectives
- Thoroughfare type
- Long-range transportation plan
- Corridor/network capacity analysis
- Maximum 6 lanes in walkable urban areas

# Stages in Cross-Section Design

3. Determine design and control vehicle
4. Identify transit, freight, and bicycle requirements
  - Establish dimensions
5. Develop ideal cross-section - compare to R/W
  - Acquire R/W or narrow design elements, or
  - Widen high priority elements to match R/W
  - Avoid combining minimal widths

# Design in Constrained Right-of-Way

- Prioritize design elements
- Develop sections
  - Optimal – unconstrained
  - Predominant – all priority elements
  - Functional minimum – many priority elements
  - Absolute minimum – highest priority only
- R/W width less than absolute minimum
  - Acquire R/W incrementally
  - Change thoroughfare type

# Transitions

- Geometric transitions (use AASHTO)
  - Change in thoroughfare width
  - Lateral shifts
  - Lane drops
- Context, visual, operational, environmental transition
  - Speed zone transition
  - Visual cues
    - Urban design, land uses, building design, gateways
  - Change width of thoroughfare

# Design Parameters

- Tables 6.2 (Arterials) & 6.3 (Collectors)
  - General parameters for Walkable Thoroughfares
    - Context
    - Roadside
    - Traveled way
    - Intersections
- Tables 11.2 (Arterials) & 11.3 (Collectors)
  - General parameters for Vehicle Mobility Priority Thoroughfares

**Table 6.2 General Parameters for Arterial Thoroughfares**

Context	Suburban (C-3)				General Urban (C-4)				Urban Center/Core (C-5/6)			
	Residential		Commercial		Residential		Commercial		Residential		Commercial	
	Boulevard	Avenue	Boulevard	Avenue	Boulevard	Avenue	Boulevard	Avenue	Boulevard	Avenue	Boulevard	Avenue
Building Orientation (entrance orientation)	front, side	front, side	front, side	front, side	front	front	front	front	front	front	front	front
Maximum Setback [1]	20 ft.	20 ft.	5 ft.	5 ft.	15 ft.	15 ft.	0 ft.	0 ft.	10 ft.	10 ft.	0 ft.	0 ft.
Off-Street Parking Access/Location	rear, side	rear, side	rear, side	rear, side	rear, side	rear, side	rear, side	rear, side	rear	rear	rear	rear
<b>Roadside</b>												
Recommended Roadside Width [2]	14.5 ft.	12.5 ft.	16 ft.	15 ft.	16.5 ft.	12.5 ft.	19 ft.	16 ft.	21.5 ft.	19.5 ft.	21.5 ft.	19.5 ft.
Pedestrian Buffers (planting strip exclusive of travel way width) [2]	8 ft. planting strip	6-8 ft. planting strip	7 ft. tree well	6 ft. tree well	8 ft. planting strip	6-8 ft. planting strip	7 ft. tree well	6 ft. tree well	7 ft. tree well	6 ft. tree well	7 ft. tree well	6 ft. tree well
Street Lighting	For all arterial thoroughfares in all context zones, intersection safety lighting, basic street lighting and pedestrian-scaled lighting is recommended. See Chapter 8 (Roadside Design Guidelines) and Chapter 10 (Intersection Design Guidelines).											
<b>Traveled Way</b>												
Target Speed (mph)	35	25-30	35	35	35	25-30	35	25-30 [3]	35	25-30	30	25-30 [3]
Design Speed	Design speed should be a maximum of 5 mph over the operating speed. Design speed is used as a control for certain geometric design elements including sight distance and horizontal and vertical curvature.											
Number of Through Lanes [4]	4-6	2-4	4-6	2-4	4-6	2-4	4-6	2-4	4-6	2-4	4-6	2-4
Lane Width [5]	10-11 ft.	10-11 ft.	10-12 ft.	10-11 ft.	10-11 ft.	10-11 ft.	10-12 ft.	10-11 ft.	10-11 ft.	10-11 ft.	10-11 ft.	10-11 ft.
Parallel On-Street Parking Width [6]	7 ft.	7 ft.	8 ft.	8 ft.	7 ft.	7 ft.	8 ft.	8 ft.	7 ft.	7 ft.	8 ft.	8 ft.
Min. Combined Parking/Bike Lane Width	13 ft.	13 ft.	13 ft.	13 ft.	13 ft.	13 ft.	13 ft.	13 ft.	13 ft.	13 ft.	13 ft.	13 ft.
Horizontal Radius (per AASHTO) [7]	762 ft.	510 ft.	762 ft.	762 ft.	762 ft.	510 ft.	762 ft.	510 ft.	762 ft.	510 ft.	510 ft.	510 ft.
Vertical Alignment	Use AASHTO minimums as a target, but consider combinations of horizontal and vertical per AASHTO Green Book.											
Medians (which will accommodate single left-turn lanes at intersections) [8]	14-16 ft.	Optional 14 ft.	14-16 ft.	Optional 14 ft.	14-16 ft.	Optional 14 ft.	14-16 ft.	Optional 14 ft.	14-16 ft.	Optional 14 ft.	14-16 ft.	Optional 14 ft.
Bike Lanes (min./preferred width)	5 ft./6 ft.	5 ft./6 ft.	5 ft./6 ft.	5 ft./6 ft.	5 ft./6 ft.	5 ft./6 ft.	5 ft./6 ft.	5 ft./6 ft.	5 ft./6 ft.	5 ft./6 ft.	5 ft./6 ft.	5 ft./6 ft.
Access Management [9]	Moderate	Low	High	Moderate	Moderate	Low	High	Low	Moderate	Low	High	Low
Typical Traffic Volume Range (vpd)	20,000-35,000	15,000-25,000	20,000-50,000	10,000-35,000	10,000-30,000	10,000-20,000	15,000-40,000	5,000-30,000	15,000-30,000	10,000-20,000	15,000-40,000	5,000-30,000
<b>Intersections</b>												
Roundabout	Consider urban single-lane roundabouts at intersections on arterial avenues with less than 20,000 entering vehicles per day, and urban double-lane roundabouts at intersections on Boulevards and Avenues with less than 40,000 entering vehicles per day.											
Curb Return Radii	Refer to Chapter 10 (Intersection Design Guidelines) for details											

**Table 11.2 General Parameters for Vehicle Mobility Priority Arterials**

Parameter	Design Characteristics										
	Strip Commercial/Shopping Center		Business Park/ Campus Office		Industrial		Single-Use Residential Not Fronting On Thoroughfare		Passive Park, Nature Preserve, Intentional Buffer Area		
<b>Traveled Way</b>											
Typical ADT	20,000+	<25,000	20,000+	<25,000	25,000+	<25,000	20,000+	<20,000	10,000+	<10,000	
Thoroughfare type	Boulevard	Avenue	Boulevard	Avenue	Boulevard	Avenue	Boulevard	Avenue	Boulevard	Avenue	
Off-street parking access	Limited from thoroughfare; side street	Limited from thoroughfare; side street	Limited from thoroughfare; side street	Limited from thoroughfare; side street	Limited from thoroughfare; side street	Limited from thoroughfare; side street	From side street only	Limited from thoroughfare; side street	From side street only	Limited from thoroughfare; side street	
Operating speed (mph) (design speed = 5 mph higher)	35 to 40	35	45	35 to 40	45	35 to 40	35 to 40	30 to 35	45	40	
Number of through lanes	4 to 6 typical; 6 to 8 where parallel capacity not available	2 to 4	4 to 6 typical; 6 to 8 where parallel capacity not available	2 to 4	4 to 6 typical; 6 to 8 where parallel capacity not available	2 to 4	4 to 6 typical; 6 to 8 where parallel capacity not available	2 to 4	4 to 6 typical; 6 to 8 where parallel capacity not available	2 to 4	
Lane width	11 to 12 ft.	11 to 12 ft.	11 to 12 ft.	11 to 12 ft.	12 ft.+	12 ft.+	11 to 12 ft.	11 to 12 ft.	11 to 12 ft.	11 to 12 ft.	
On-street parking	Depends on need	Depends on need	None	None	None	None	None	None	None	None	
Median [1]	16 to 18 ft.	Optional 14 to 18 ft.	16 to 18 ft.	Optional 14 to 18 ft.	16 to 22 ft.	None	16 to 18 ft.	Optional 14 to 18 ft.	16 to 18 ft.	Optional 14 to 18 ft.	
Access management [2]	High	Moderate	Moderate	Low	Moderate	Low	High	Low	Moderate	Moderate	
Bike Lanes	6 ft. bike lane when needed for bicycle network connectivity; Optional 6 ft. lane where there are nearby parallel facilities										
<b>Roadside</b>											
Minimum/desirable roadside width (incl. 1 ft. clearance behind sidewalk)	6 ft./14 ft.	6 ft./14 ft.	6 ft./14 ft.	6 ft./14 ft.	6 ft./14 ft.	6 ft./14 ft.	6 ft./12 ft.	6 ft./12 ft.	6 ft./14 ft.	6 ft./14 ft.	
Pedestrian buffers/planting strip width	0 to 8 ft.	0 to 8 ft.	0 to 8 ft.	0 to 8 ft.	0 to 8 ft.	0 to 8 ft.	0 to 6 ft. [3]	0 to 6 ft. [3]	0 to 8 ft.	0 to 8 ft.	
Min. sidewalk width	5 ft.	5 ft.	5 ft.	5 ft.	5 ft.	5 ft.	5 ft.	5 ft.	5 ft.	5 ft.	
Street lighting	Safety lighting recommended throughout segment and at intersections										
<b>Intersections</b>											
Traffic signal control	Prioritize signal progression, traffic movement efficiency, transit routes; safely accommodate pedestrian crossings with multi-stage crossings if necessary where medians are provided with adequate pedestrian refuge width (min. 8 ft.).										
Curb radii	30 ft. to 50 ft. or 3-center curves; larger with heavy right turns or truck volumes and corner islands						30 ft.	30 ft.	30-50 ft. or 3-center curves; larger with heavy right-turns or truck volumes and corner islands		
Roundabouts	Optional at low and medium volume intersections where sufficient roundabout capacity can be developed.										

# Segment 5

## Roadside Design

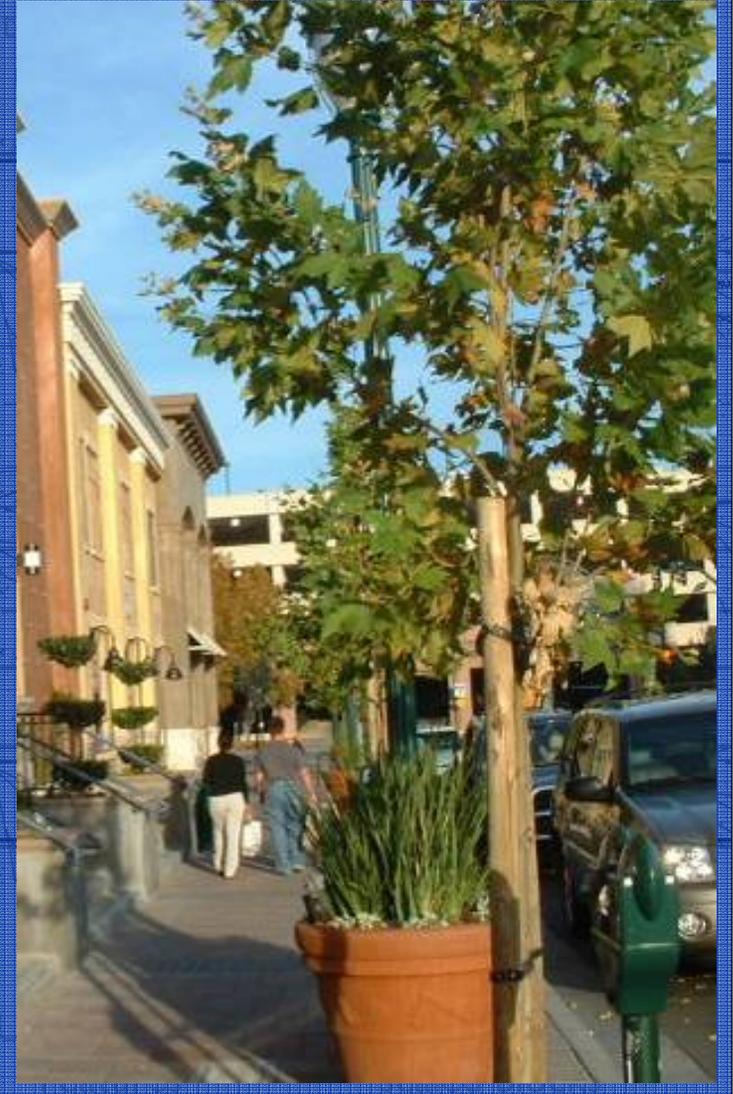
# Roadside Defined

- From property line to face of curb
- Accommodates street activity
  - Mobility
  - Business
  - Social
- Public space



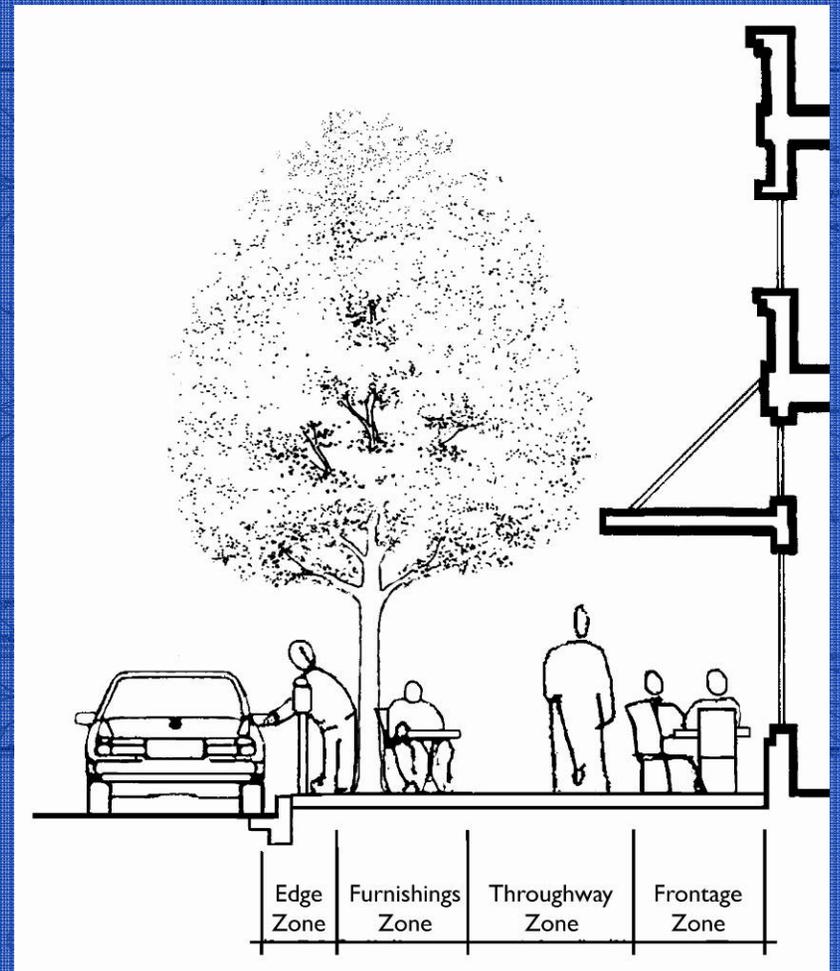
# The Urban Roadside – Uses and Activities

- Movement of pedestrians
- Access to buildings/property
- Utilities/appurtenances
- Transit stops
- Landscaping
- Urban design/public art
- Sidewalk cafes
- Business functions
- Civic spaces (plazas, seating)



# Roadside Components

- Roadside zones:
  - Edge Zone
  - Furnishings Zone
  - Throughway Zone (ADA)
  - Frontage Zone
- Function and dimensions vary by context zone and adjacent land use



Sidewalk Zone [1]		C-6 and C-5		C-4 w/ Predominantly Commercial Ground Floor Use		C-4 w/ Predominantly Residential Frontage		
Boulevard	Edge	1.5 feet 2.5 feet at diagonal parking		1.5 feet 2.5 feet at diagonal parking		0.5 feet		
	Furnishings	7 feet (trees in tree wells)		7 feet (trees in tree wells)		8 feet (landscape strip w/ trees and grasses or groundcovers)		
	Throughway	10 feet		8 feet		8 feet		
	Frontage	3 feet		2.5 feet		0 feet along lawn and groundcover 1 foot along low walls, fences, and hedges 1.5 feet along facades, tall walls, and fences		
Boulevard Without Parking	Edge	THIS THOROUGHFARE TYPE NOT APPLICABLE TO THE PREDOMINANTLY COMMERCIAL GROUND FLOOR LAND USES FOUND IN C-4 THROUGH C-6 CONTEXT ZONES						0.5 feet
	Furnishings							10 feet (landscape strip w/ trees and groundcovers or low shrubs)
	Throughway							8 feet
	Frontage							0 feet along lawn and groundcover 1 foot along low walls, fences, and hedges 1.5 feet along facades, tall walls, and fences
Avenue	Edge	1.5 feet 2.5 feet at diagonal parking		1.5 feet 2.5 feet at diagonal parking		0.5 feet		
	Furnishings	With Parking	6 feet trees in tree wells		6 feet (trees in tree wells)		8 feet (landscape strip w/ trees and grasses or groundcovers)	
		Without Parking	8 feet with buffer landscaping		8 feet with buffer landscaping		8 feet with buffer landscaping	
	Throughway	9 feet		6 feet		6 feet		
	Frontage	3 feet		2.5 feet		0 feet along lawn and groundcover 1 foot along low walls, fences, and hedges 1.5 feet along facades, tall walls, and fences		
Street	Edge	1.5 feet 2.5 feet at diagonal parking		1.5 feet 2.5 feet at diagonal parking		0.5 feet		
	Furnishings	6 feet (trees in tree wells)		6 feet (trees in tree wells)		5 feet (landscape strip w/ trees and grasses or groundcovers)		
	Throughway	6 feet		6 feet		6 feet		
	Frontage	2.5 feet		2.5 feet		0 feet along lawn and groundcover 1 foot along low walls, fences, and hedges 1.5 feet along facades, tall walls, and fences		

21.5 foot (recommended)  
12 foot (constrained)

19 foot (recommended)  
12 foot (constrained)

16.5 foot (recommended)

18.5 foot (Recommended)

19.5 foot (recommended)  
12.0 foot (constrained)

16 foot (recommended)  
12 foot (constrained)

14.5 foot (recommended)

16 foot (recommended)  
12.0 foot (constrained)

16 foot (recommended)  
12 foot (constrained)

11.5 foot (recommended)

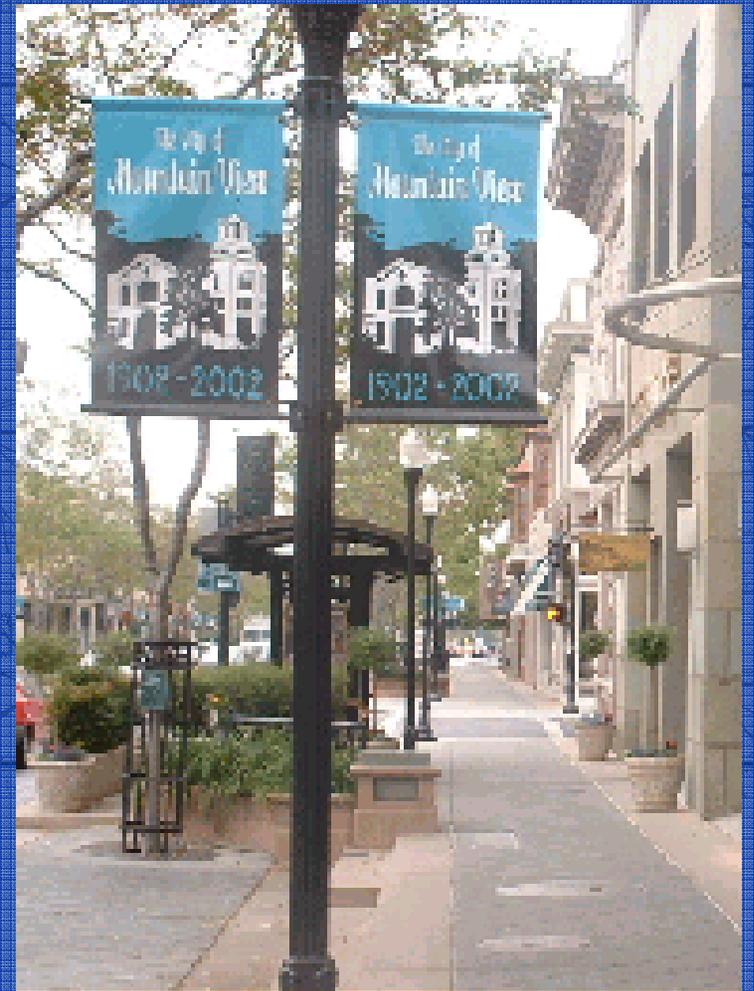
# Edge Zone

- Interface with traveled way
- Functions
  - Vehicle overhang and clearance
  - Door opening area
  - Wheelchair access at transit stops



# Furnishings Zone

- Buffers pedestrians from traveled way
- Functions
  - Accommodates street furniture and utilities
  - Transit stops
  - Lighting
  - Public spaces (seating)
  - Business space (cafes)
  - Landscaping



# Throughway and Frontage Zones

- Throughway zone
  - Clear area for pedestrian travel
  - ADAAG requirements
- Frontage zone
  - Area adjacent to property line
  - “Shy” distance from buildings
  - Business space (cafes, signs)
  - Landscaping
  - Seating
  - Building access



# Clear Zones on Urban Thoroughfares

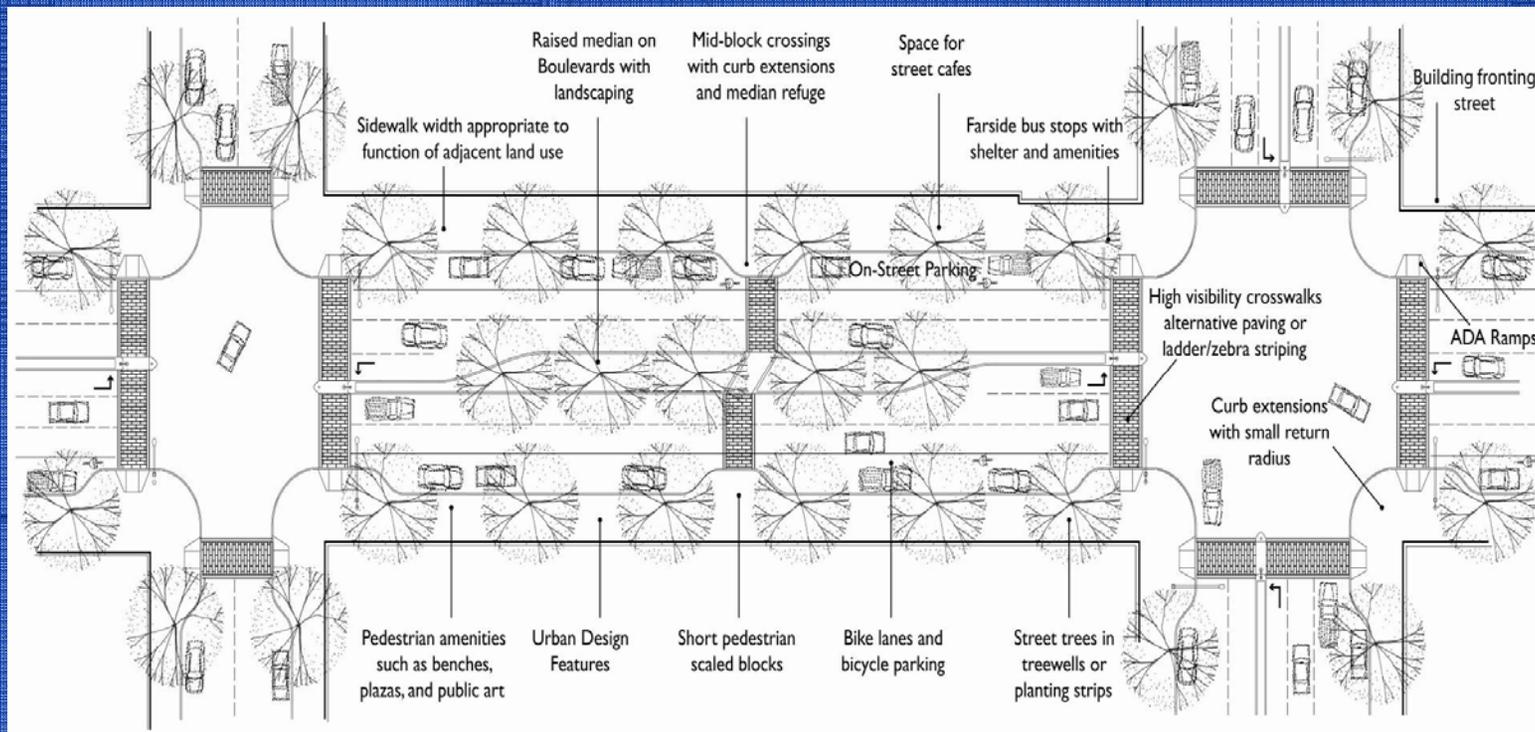
- Defined as an edge zone clear of fixed objects
- Less consequence than rural context
  - Lower speeds
  - Parked vehicles
- Often not practical in urban areas

# Segment 6

## Traveled Way Design

# The Urban Traveled Way

- Central portion of thoroughfare between curbs
- Provides for movement of vehicles
- Interface with roadside via on-street parking



# Traveled Way Elements

- Through travel and turn lanes
- Medians
- Bicycle facilities
- On-street parking
- Midblock crosswalks
- Pedestrian refuge islands
- Transit stops



# Lane Width

- Recommended practice
  - Range of lane widths: 10–11 feet on arterials and collectors
  - 12-feet under special circumstances
  - Based on:
    - Design speed
    - Design vehicle
    - Right-of-way
    - Width of adjacent parking and bicycle lanes



# Medians

- Recommended practice

## Recommended Median Widths on Low Speed Thoroughfares (35 mph or less)

Thoroughfare Type	Minimum Width	Recommended Width
<b>Median for access control</b>		
Arterial Boulevards and Avenues	4 ft.	6 ft.
Collector Avenues and Streets		
<b>Median for pedestrian refuge</b>		
Arterial Boulevards and Avenues	6 ft.	8 ft.
Collector Avenues and Streets		
<b>Median for street trees and lighting</b>		
Arterial Boulevards and Avenues	6 ft.	10 ft.
Collector Avenues and Streets		
<b>Median for single left-turn lane</b>		
Collector Avenues and Streets	10 ft.	14 ft.
Arterial Boulevards and Avenues	12 ft.	16-18 ft.
<b>Median for dual left turn lane</b>		
Arterial Boulevards and Avenues	20 ft.	22 ft.

# Street Trees

- Recommended practice
- In medians
  - Min. median width
    - 6 feet for up to 4" caliper trees
    - 10 feet for larger trees
  - Avoid trees larger than 4" caliper
    - Speed > 45 mph
    - Or use barrier



# Bicycle Lanes

- Recommended practice
  - Combined with on-street parking = 13 feet
  - Without on-street parking = 6 feet



# On-Street Parking

- Recommended practice

## Recommended Parallel Parking Lane Widths

Thoroughfare Type in C-3 through C-6 Context Zones	
Parallel Parking Lane Width (commercial and residential areas)	
Arterial Boulevard (commercial)	8 ft.
Arterial Boulevard (residential)	7 ft.
Parallel Parking Lane Width (residential areas)	
Arterial Avenue	7 ft.
Collector Avenue and Street	7 ft.
Parallel Parking Lane Width (commercial areas)	
Arterial Avenue	8 ft.
Collector Avenue and Street	8 ft.

# Mid-Block Crosswalks

- Recommended practice
  - Locate so crossings are 200-300 feet apart
  - Significant pedestrian demand
  - Criteria
    - 12,000 ADT or less
    - 15,000 ADT with median refuge
    - Speed less than 40 mph
    - Adequate sight distance

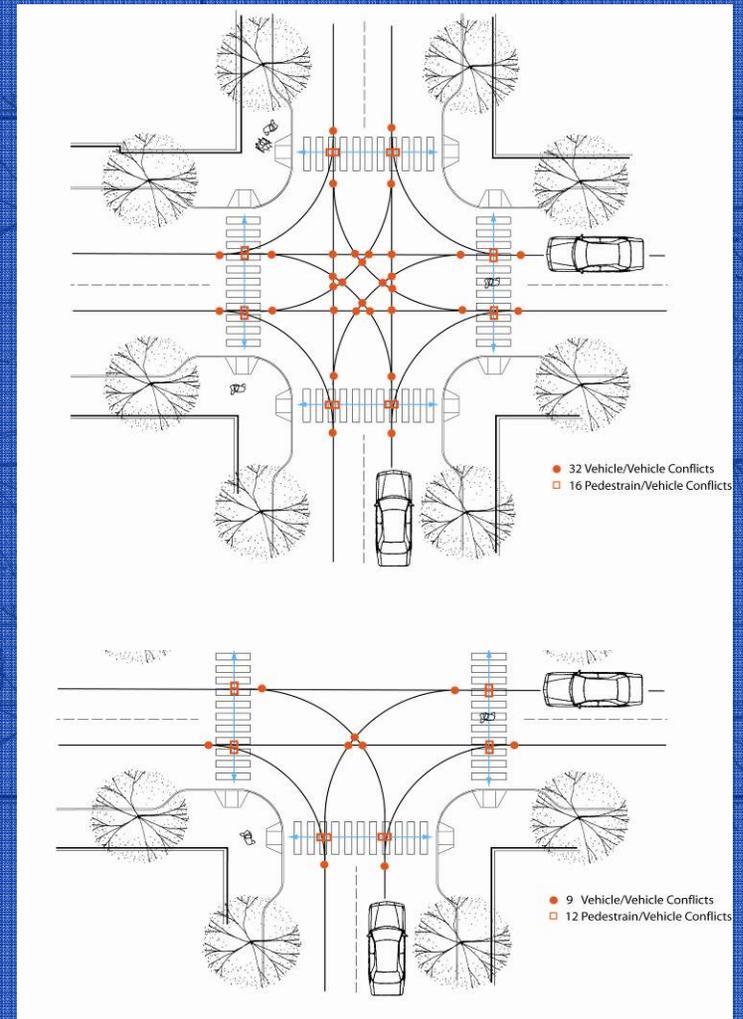


# Segment 7

## Intersection Design

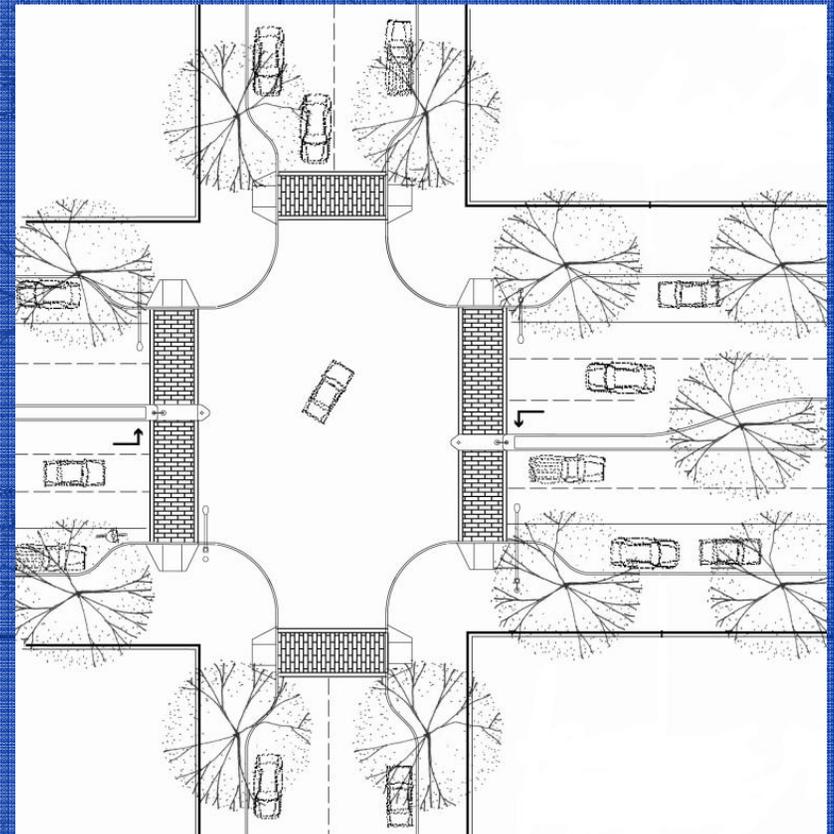
# Urban Intersections

- General principles
  - Minimize conflicts between modes
  - Minimize pedestrian exposure
  - Provide crosswalks on all approaches
  - Minimize curb radii consistent with design/control vehicle
  - Ensure good visibility
  - Balance vehicle LOS with pedestrian convenience and safety



# Urban Intersections

- Design elements
  - Through and turning lanes
  - Intersection sight distance
  - Medians
  - Curb return radii
  - Design vehicle
  - Channelized right turns
  - Modern roundabouts
  - Crosswalks and refuges
  - Curb extensions
  - Bicycle lane treatment
  - Bus stops
  - Traffic signals



# Intersection Design

- Avoid large undefined open spaces

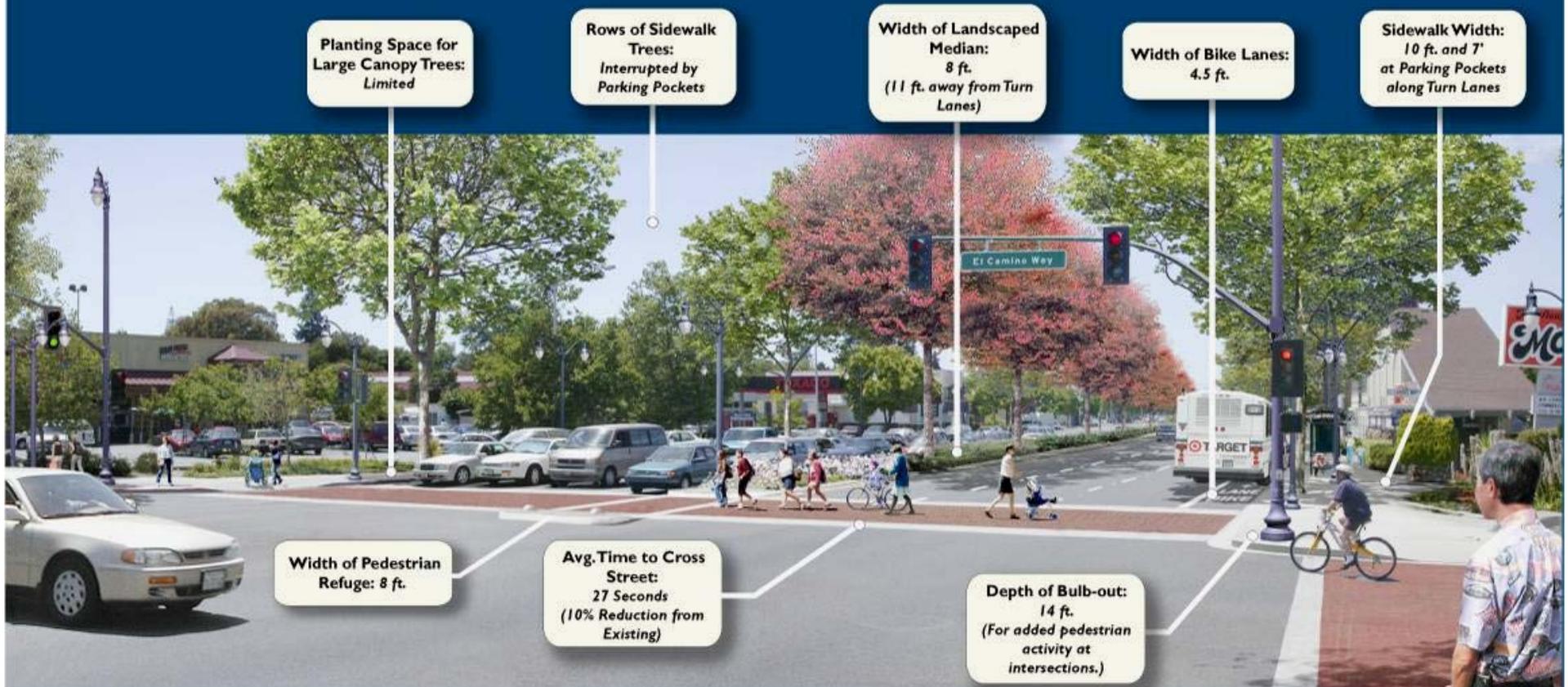


Source: City of Palo Alto  
CD+A, FPA, and Urban Advantage

El Camino Real @ Los Robles – EXISTING CONDITIONS

# Intersection Design

- Creating opportunities to improve context



Source: City of Palo Alto  
CD+A, FPA, and Urban Advantage

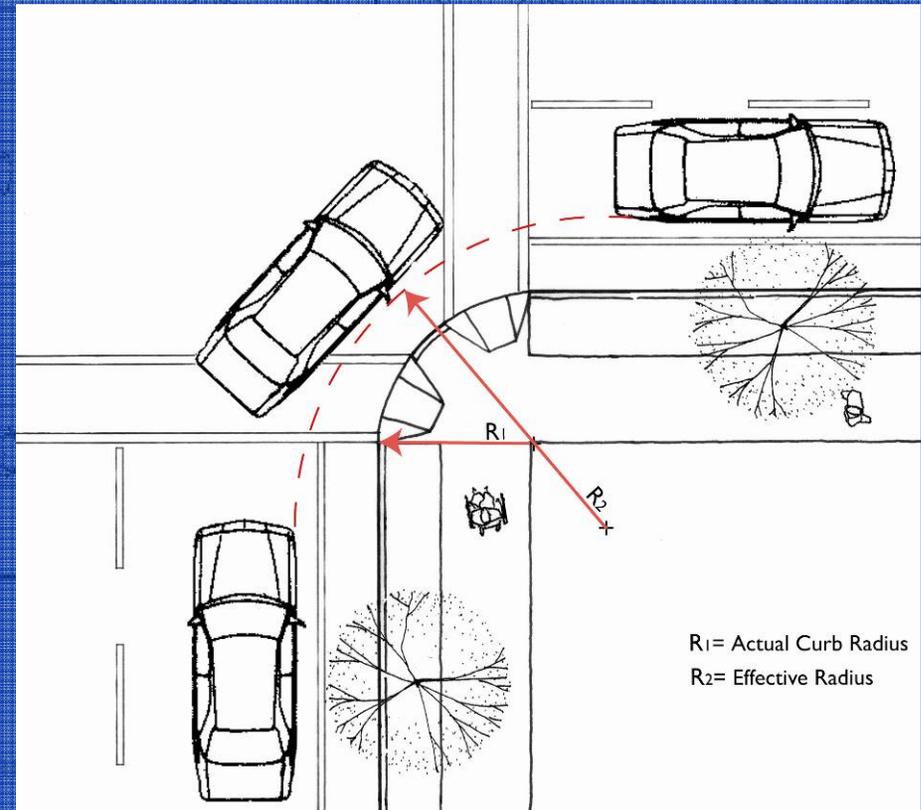
El Camino Real @ Los Robles – PROPOSED IMPROVEMENTS

Context Sensitive Solutions in Designing Major Urban Thoroughfares for Walkable Communities



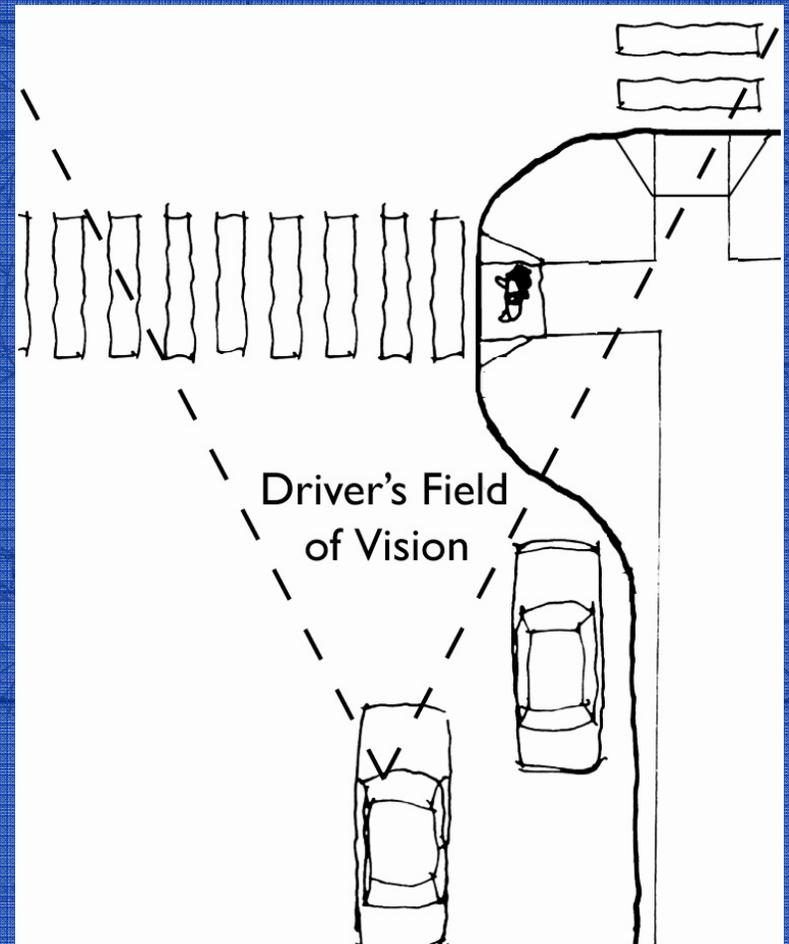
# Curb Return Radii

- Recommended practice
  - Consider
    - Design vehicle
    - Effective width
    - Curb return radii
  - Minimum radius = 5 feet
  - Use 10-15 feet radius
    - High ped volumes
    - Low turning volumes and speed
    - Bike/parking lanes create higher effective radii



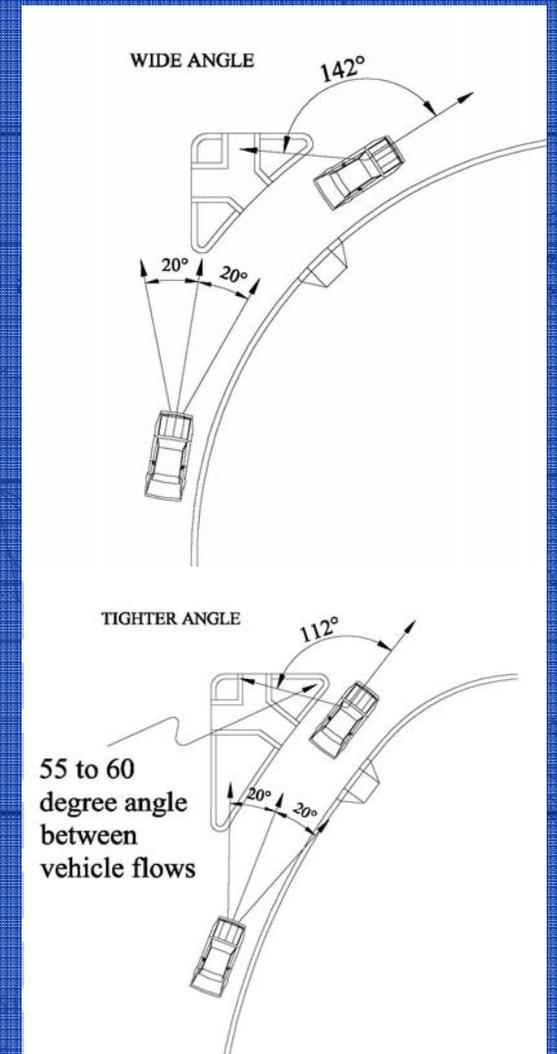
# Curb Extensions

- Improve visibility
- Reduce crossing width
- On streets with parking
- Recommended practice
  - Extend curb line 1 ft. less than parking width
  - Curb return radius for control vehicle
  - Use with bus stops to increase waiting area



# Channelized Right Turns

- Recommended practice
  - Generally discouraged in walkable environments
  - Signalized intersections with high right turns
  - Low pedestrian volumes
  - Where pedestrian volumes high – eliminate or install pedestrian signal
  - Low-angle turn
  - Clear visibility
  - Illumination



# Modern Roundabouts

- Recommended practice

Parameter	Minimum “Mini- Roundabout”	Urban Compact Roundabout	Urban Single-Lane Roundabout	Urban Double-Lane Roundabout
Maximum Entry Speed (mph)	15	15	20	25
Design Vehicle	Bus and Single-unit truck drive over apron	Bus and Single-Unit Truck	WB-50	WB-67 with lane encroachment on truck apron
Inscribed circle diameter (feet)	45 to 80	80 to 100	100 to 130	150 to 180
Maximum number of entering lanes	1	1	1	2
Typical capacity (vehicles per day entering from all approaches)	10,000	15,000	20,000	40,000
<b>Applicability by Thoroughfare Type:</b>				
Boulevard	Not Applicable	Not Applicable	Not Applicable	Applicable
Arterial Avenue	Not Applicable	Not Applicable	Applicable	Applicable
Collector Avenue	Applicable	Not Applicable	Applicable	Not Applicable
Street	Applicable	Applicable	Applicable	Not Applicable

# Modern Roundabouts



Context Sensitive Solutions in Designing Major Urban Thoroughfares for Walkable Communities



# Areas of Controversary

- Design speed vs. target speed
- Lane widths
- Maximum number of moving lanes
- Design vehicle
- Role of level of service
- Clear zones/street trees in urban areas
- Mid-block crosswalks
- Extensive use of bike lanes