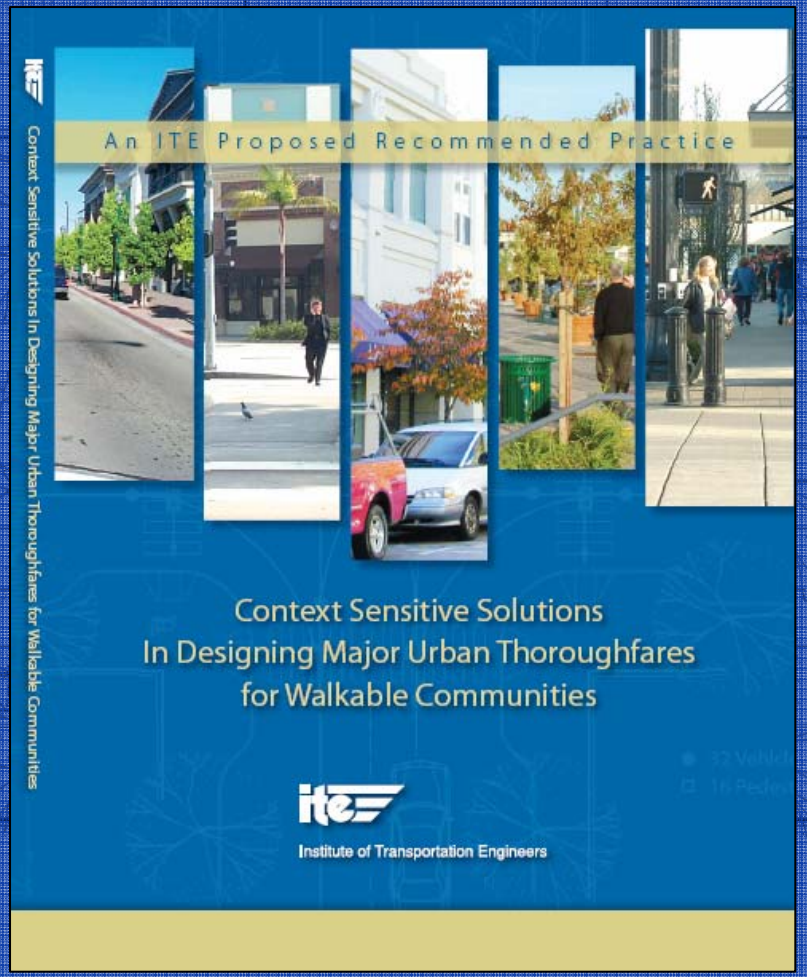
Context Sensitive Solutions in Designing Major Urban Thoroughfares for Walkable Communities

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

U.S. Department of Transportation
Federal Highway Administration

- A joint effort:
  - Institute of Transportation Engineers
  - Congress for the New Urbanism

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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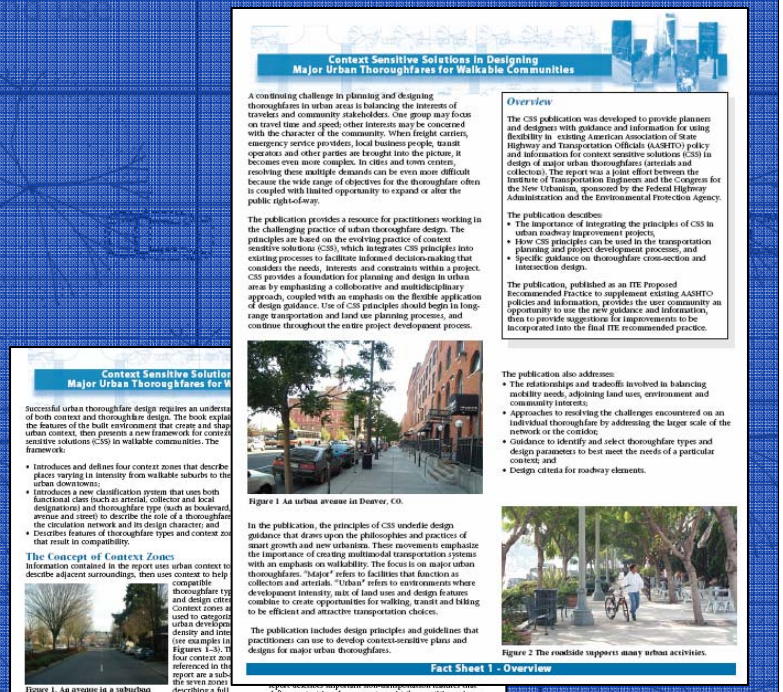
Contents of the Proposed RP

- 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


Context Sensitive Solutions in Designing Major Urban Thoroughfares for Walkable Communities

Overview

Fact Sheet 1 - Overview

Fact Sheet 2 - A Framework for CSS in Urban Thoroughfare Design

"Fact Sheet" Series

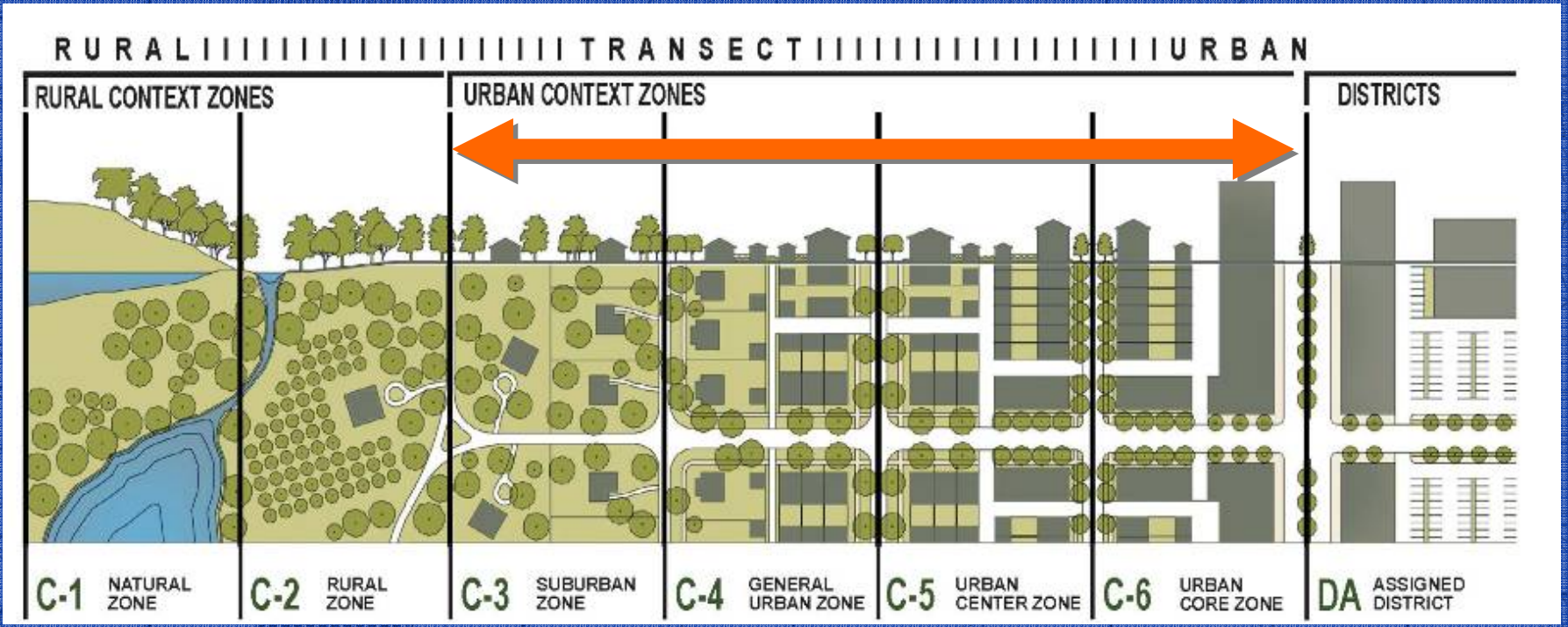
Intended Users

- 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

Source: Duany Plater-Zyberk and Company

CSS vs. Conventional Thoroughfare Design Approach

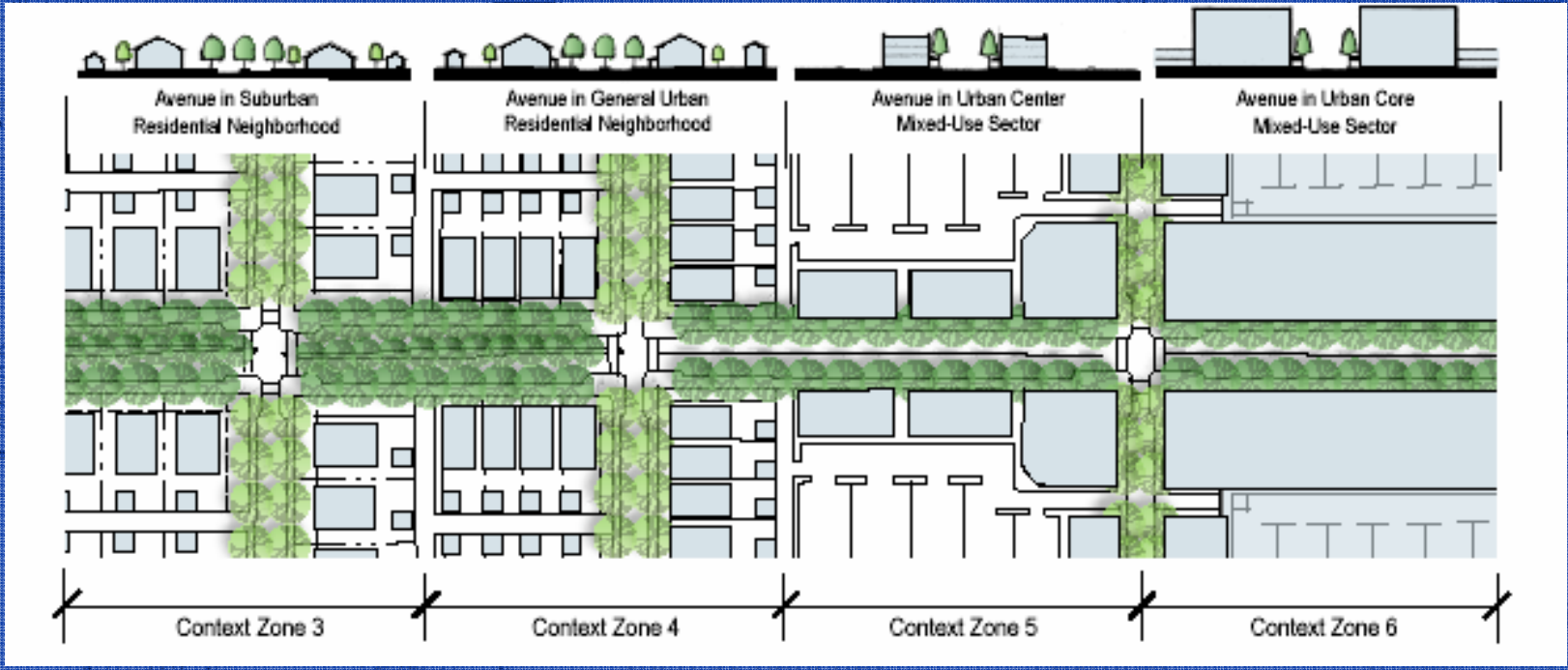
Conventional	CSS Approach
Context: Urban Rural	Urban Context: Suburban General Urban Urban Center Urban Core
Design criteria based primarily on: Functional class Design speed Travel demand forecasts Level of service objectives	Design criteria based primarily on: Community objectives Thoroughfare type Functional class Adjacent land use

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

	Suburban (C-3)				General Urban (C-4)			
	Residential		Commercial		Residential		Commercial	
	Boulevard	Avenue	Boulevard	Avenue	Boulevard	Avenue	Boulevard	Avenue
Context								
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
Roadside								
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							
Traveled Way								
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

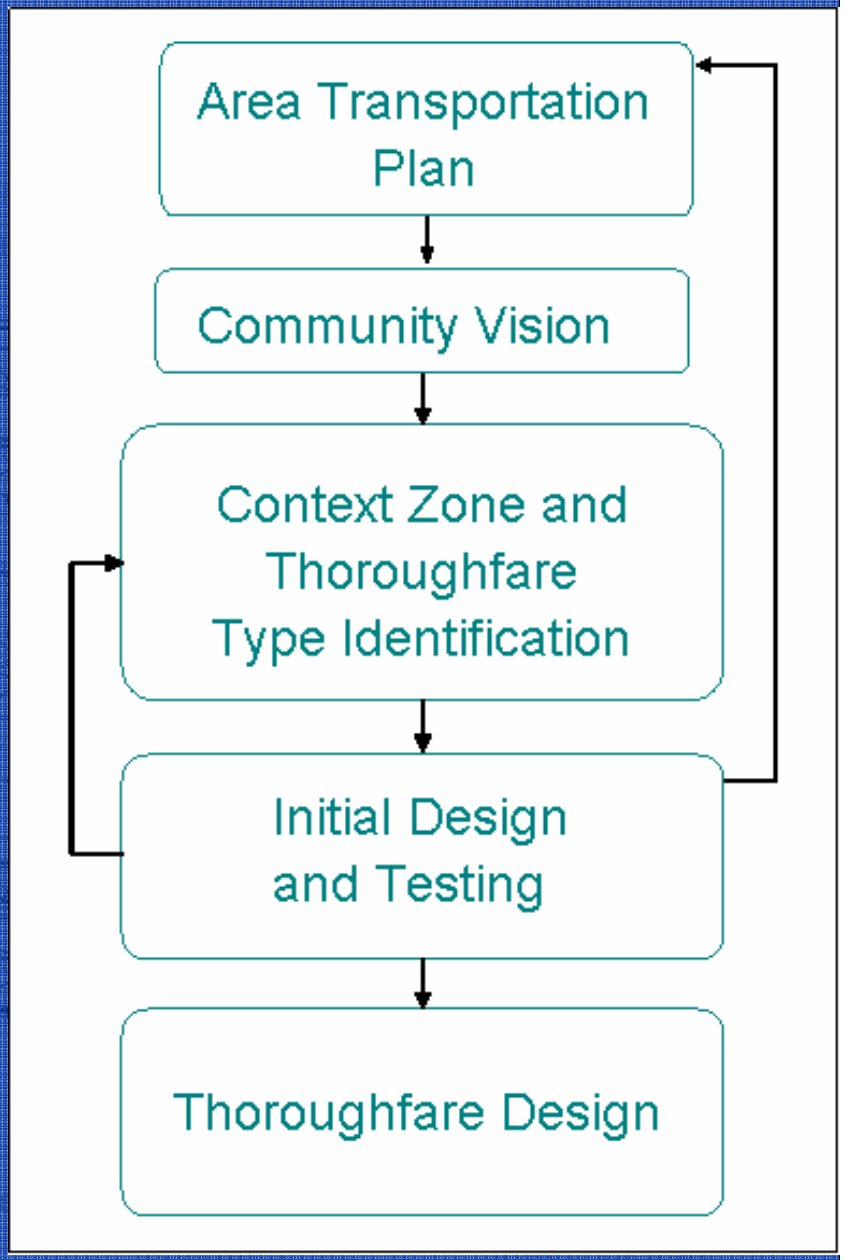
- Target Speed
  - Desirable operating speed
  - Mobility for motor vehicles
  - Safety for vehicles, pedestrians and bicyclists
  - Usually posted speed limit
- Design Speed
  - Governs geometric features
    - Minimum intersection sight distance
    - Minimum sight distance on horizontal and vertical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

Speed and Capacity of Urban Streets

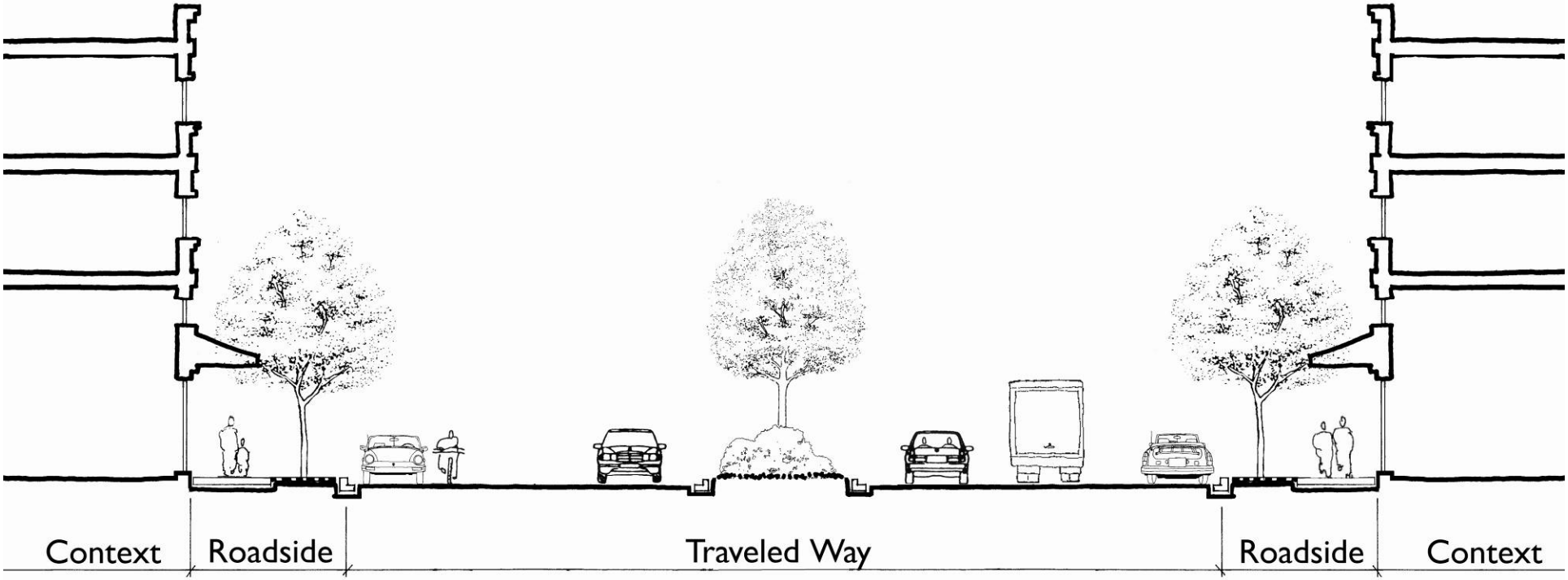
- Adequate LOS with operating speeds at 25 to 35 mph
- Address capacity issues with:
  - Network capacity
  - Synchronized signal timing
  - Access management
  - Turn lanes
- Address safety:
  - Case-by-case basis

CSS Design Process

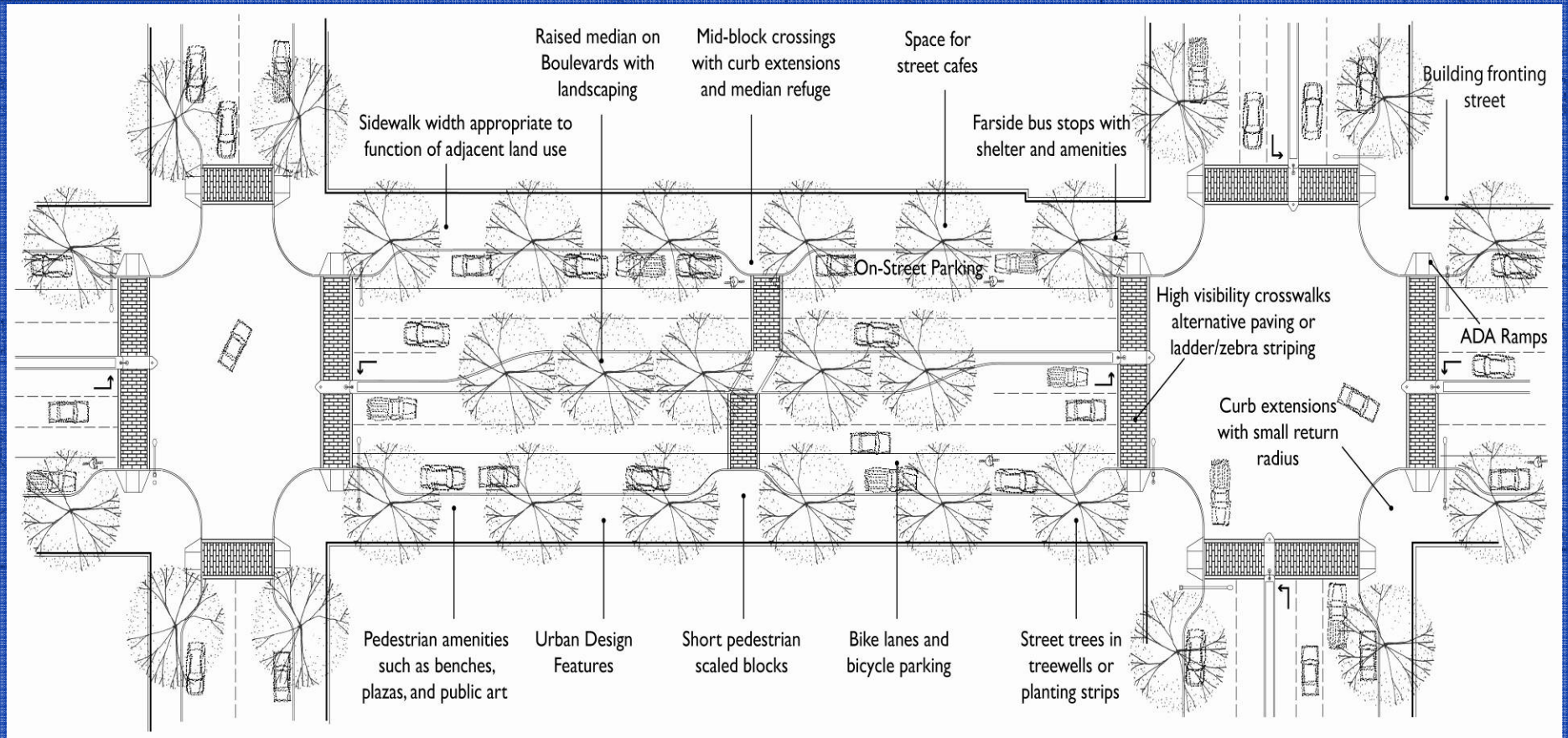
1: Plan
2: Vision
3: Compatibility
4: Initial concept/testing
5: Design



Thoroughfare Components

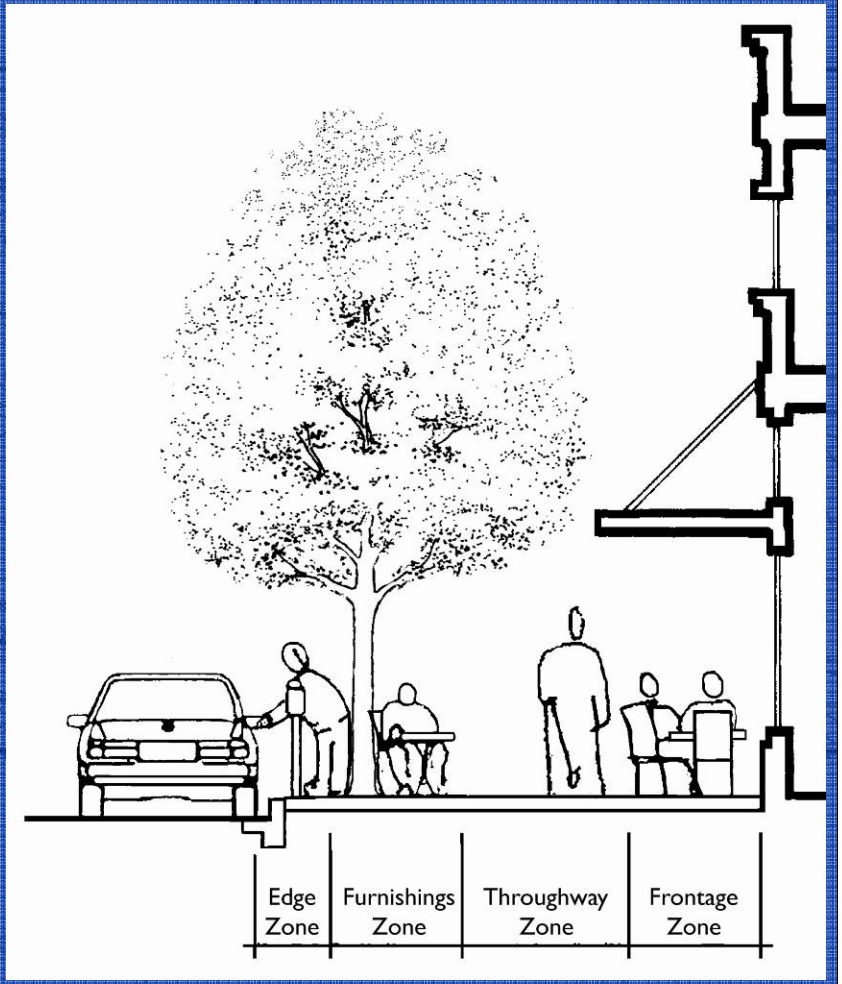


CSS Elements in Urban Contexts



Roadside Design

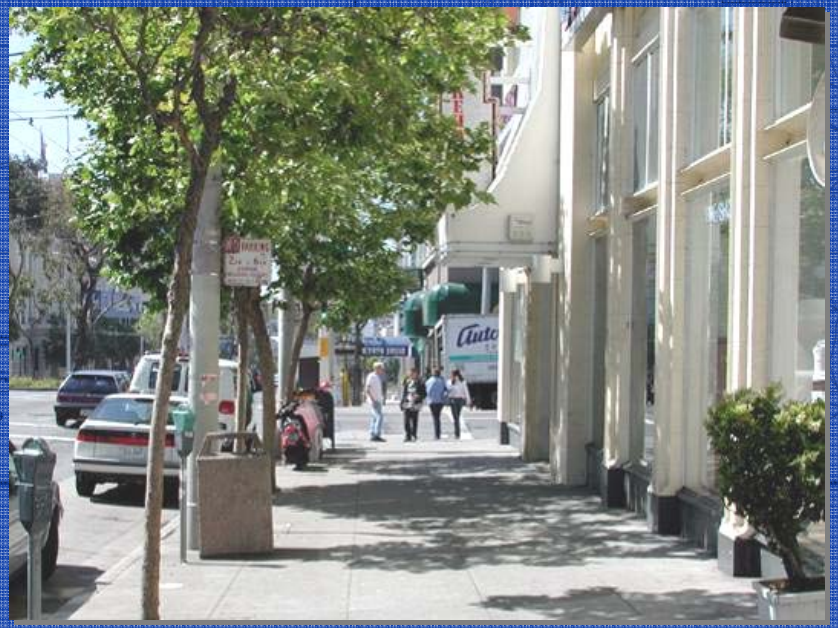
- Roadside zones:
  - Edge Zone
  - Furnishings Zone
  - Throughway Zone (ADA)
  - Frontage Zone
- Function and dimensions vary by context zone and adjacent land use



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	21.5 foot (recommended)	12 foot (constrained)	1.5 feet 2.5 feet at diagonal parking	19 foot (recommended)	12 foot (constrained)	0.5 feet	16.5 foot (recommended)
	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	18.5 foot (Recommended)
	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	19.5 foot (recommended)	12.0 foot (constrained)	1.5 feet 2.5 feet at diagonal parking	16 foot (recommended)	12 foot (constrained)	0.5 feet	14.5 foot (recommended)
	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	16 foot (recommended)	12.0 foot (constrained)	1.5 feet 2.5 feet at diagonal parking	16 foot (recommended)	12 foot (constrained)	0.5 feet	11.5 foot (recommended)
	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	

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

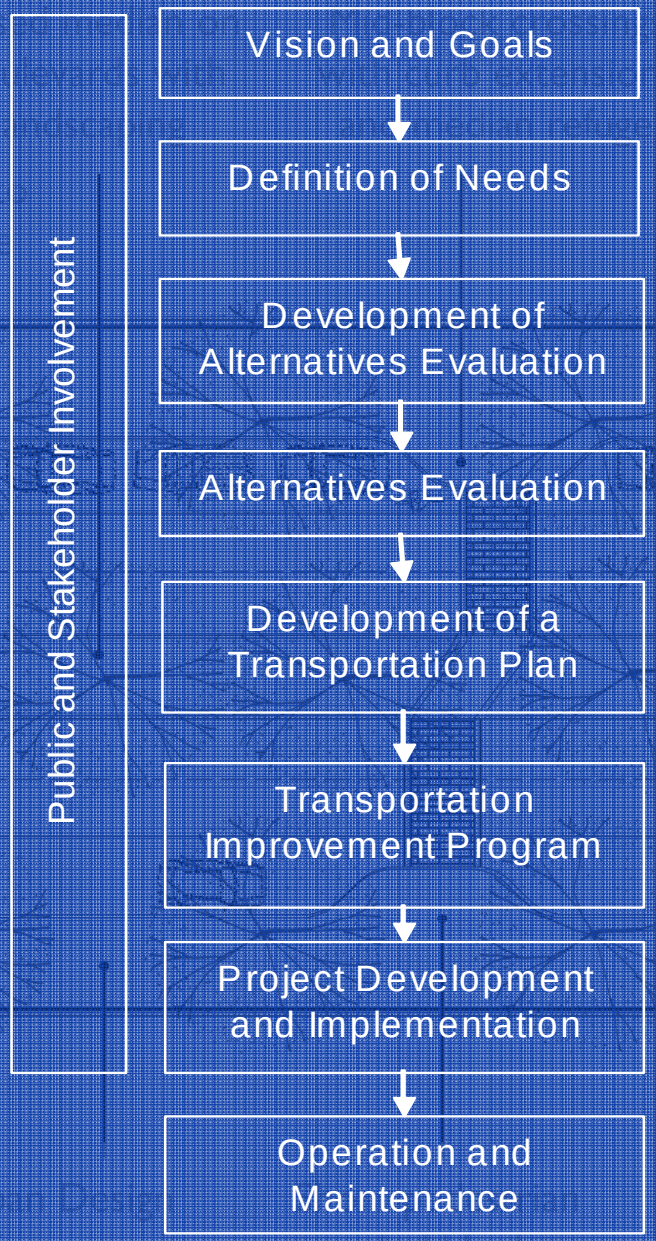
- General principles
- Intersection sight distance
- Managing modal conflicts
- General intersection layout
- Curb return radii
- Channelized right turns
- Modern roundabouts
- Crosswalks
- Curb extensions
- Bicycle lane treatment
- Bus stops at intersections

Segment 2

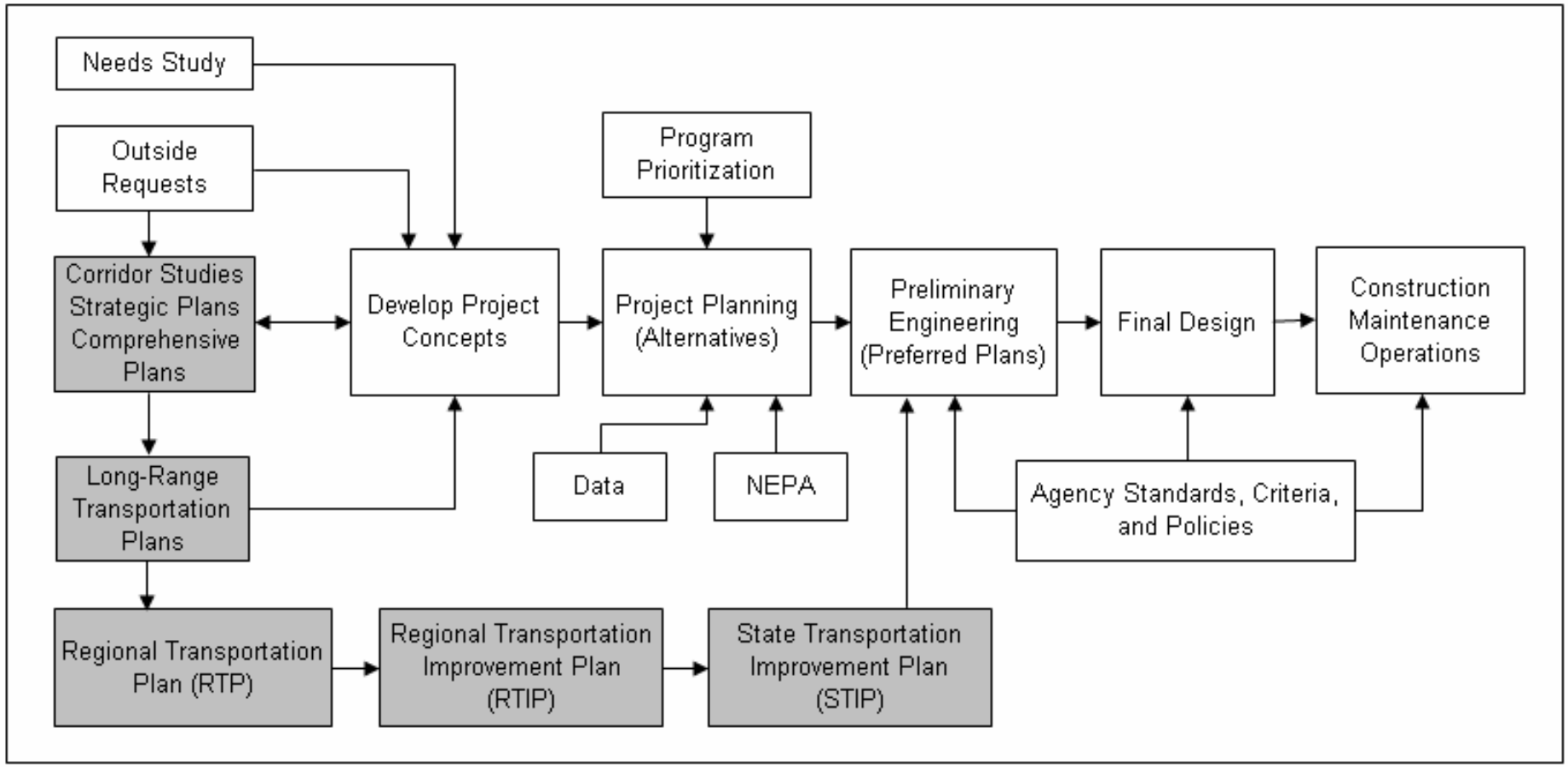
CSS in Transportation Planning

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

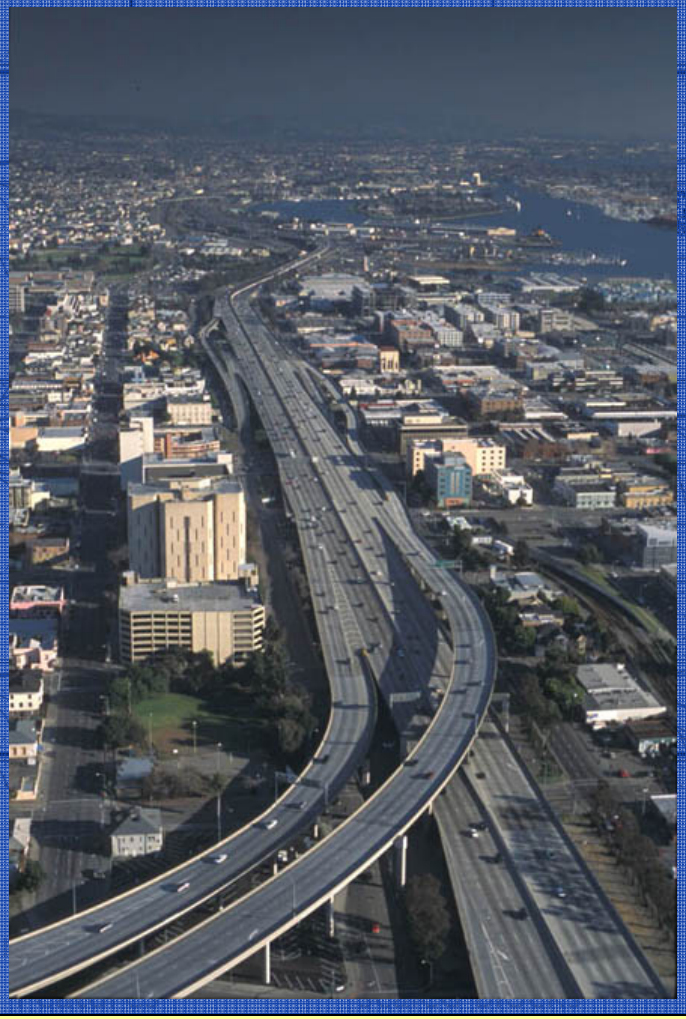


Transportation Planning Process

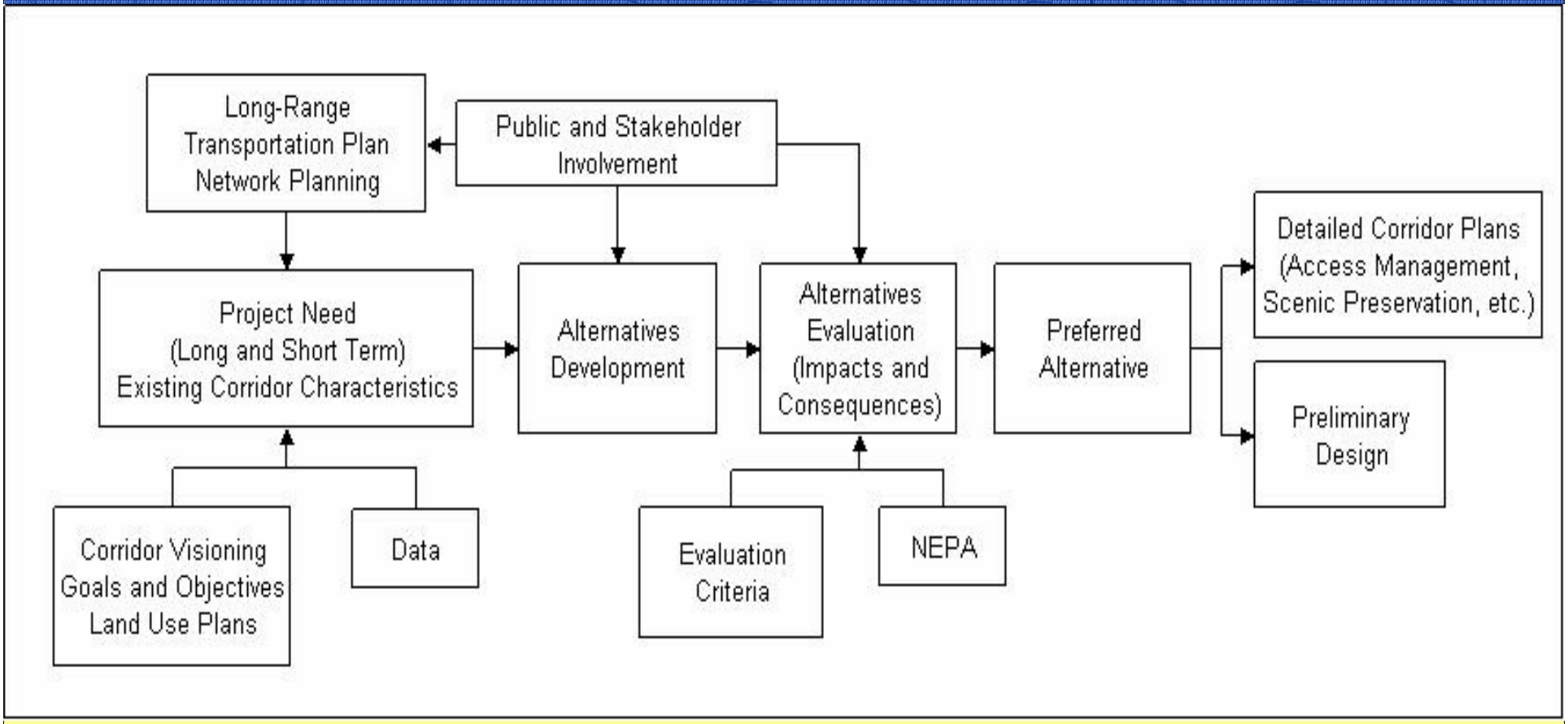


CSS in Corridor Planning

- 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



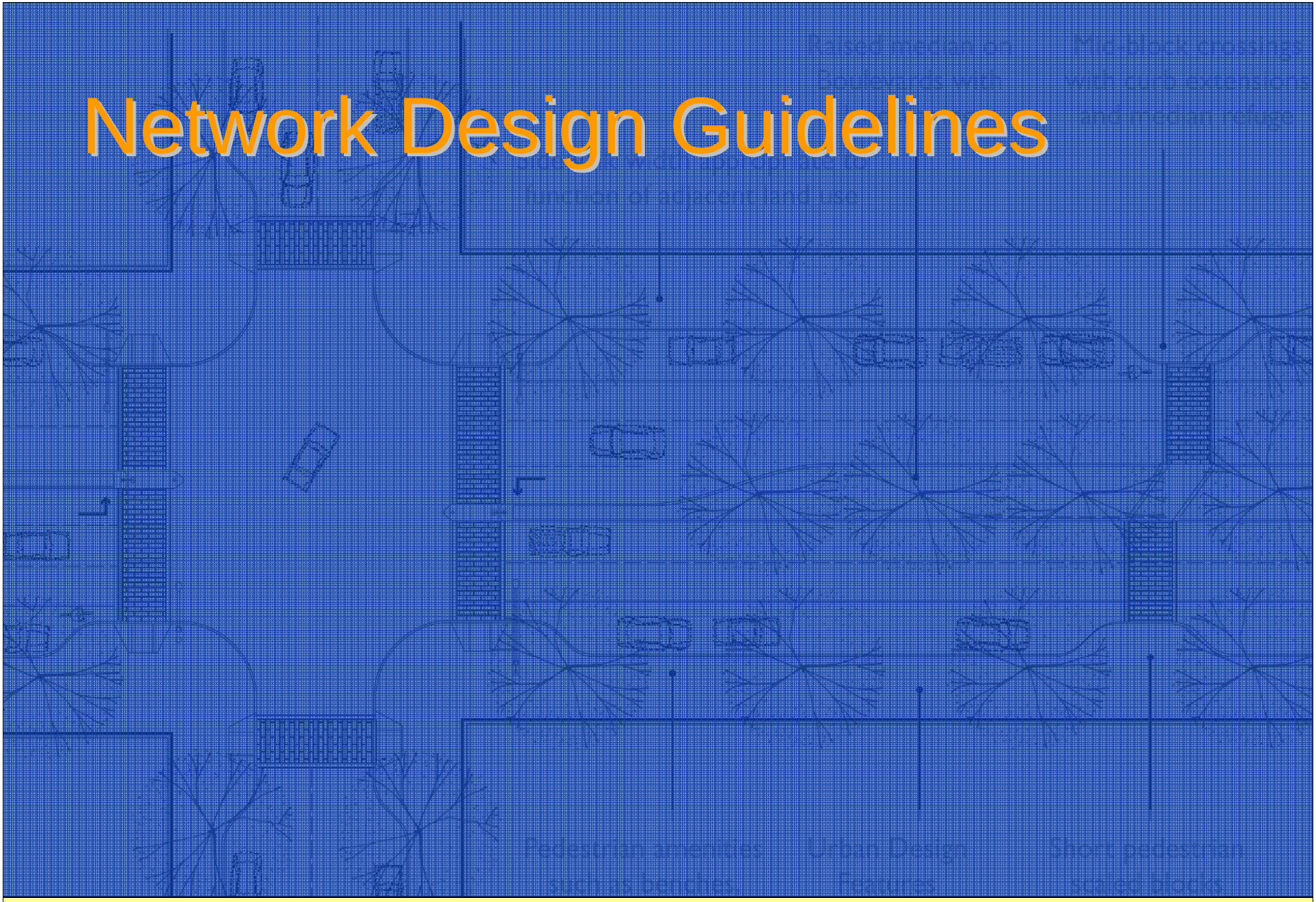
CSS in Network Planning and Design

- 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

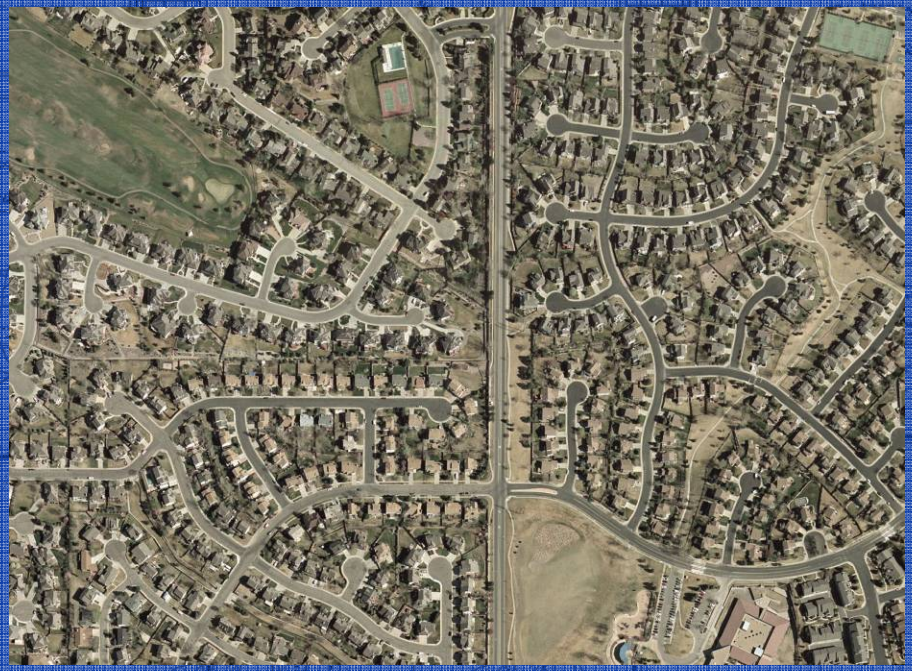
- Integrate multimodal plans:
  - Land use
  - Transportation
  - Urban form
- Connectivity
  - Establish high level of connectivity
  - Support desired development patterns
  - Ensure intermodal connections
  - Avoid channeling traffic to limited number of arterials
  - Preserve capacity with access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

Network Design Guidelines

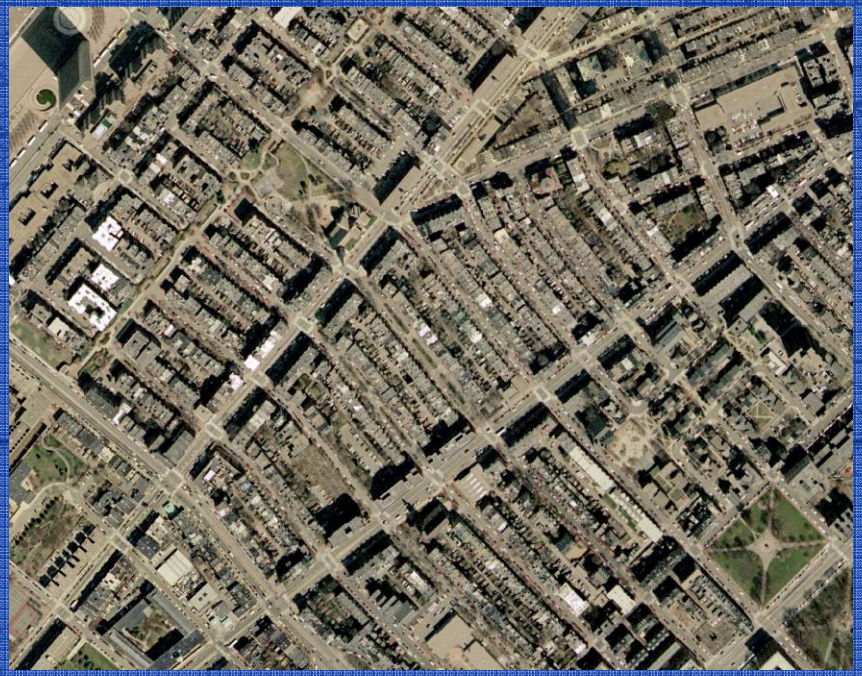


Network Types

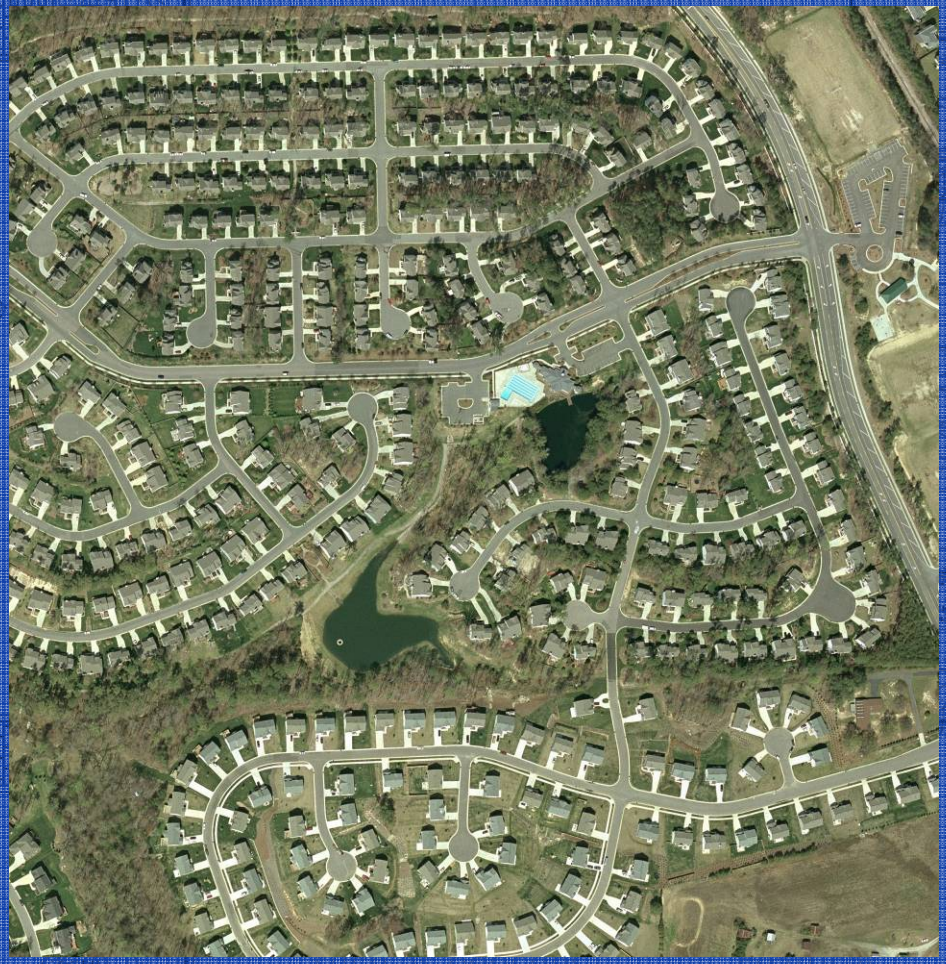
Conventional Dendritic Network



Traditional Grid Network

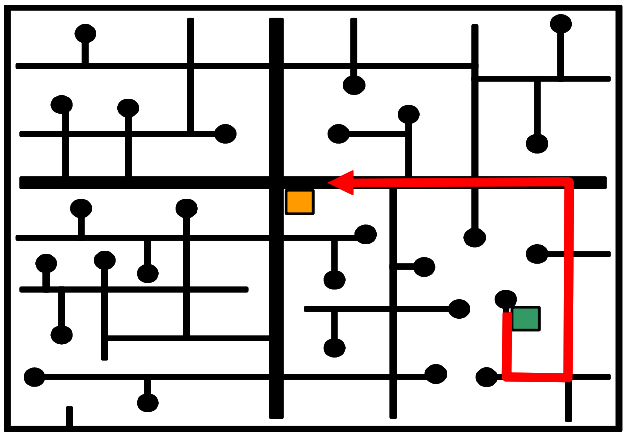


Hybrid Network

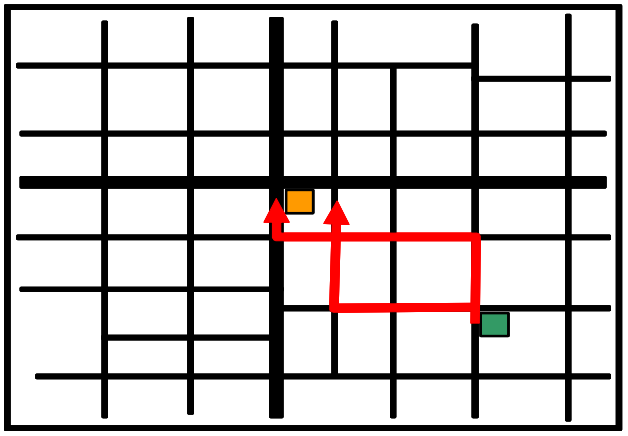


Benefits of Connectivity

- 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

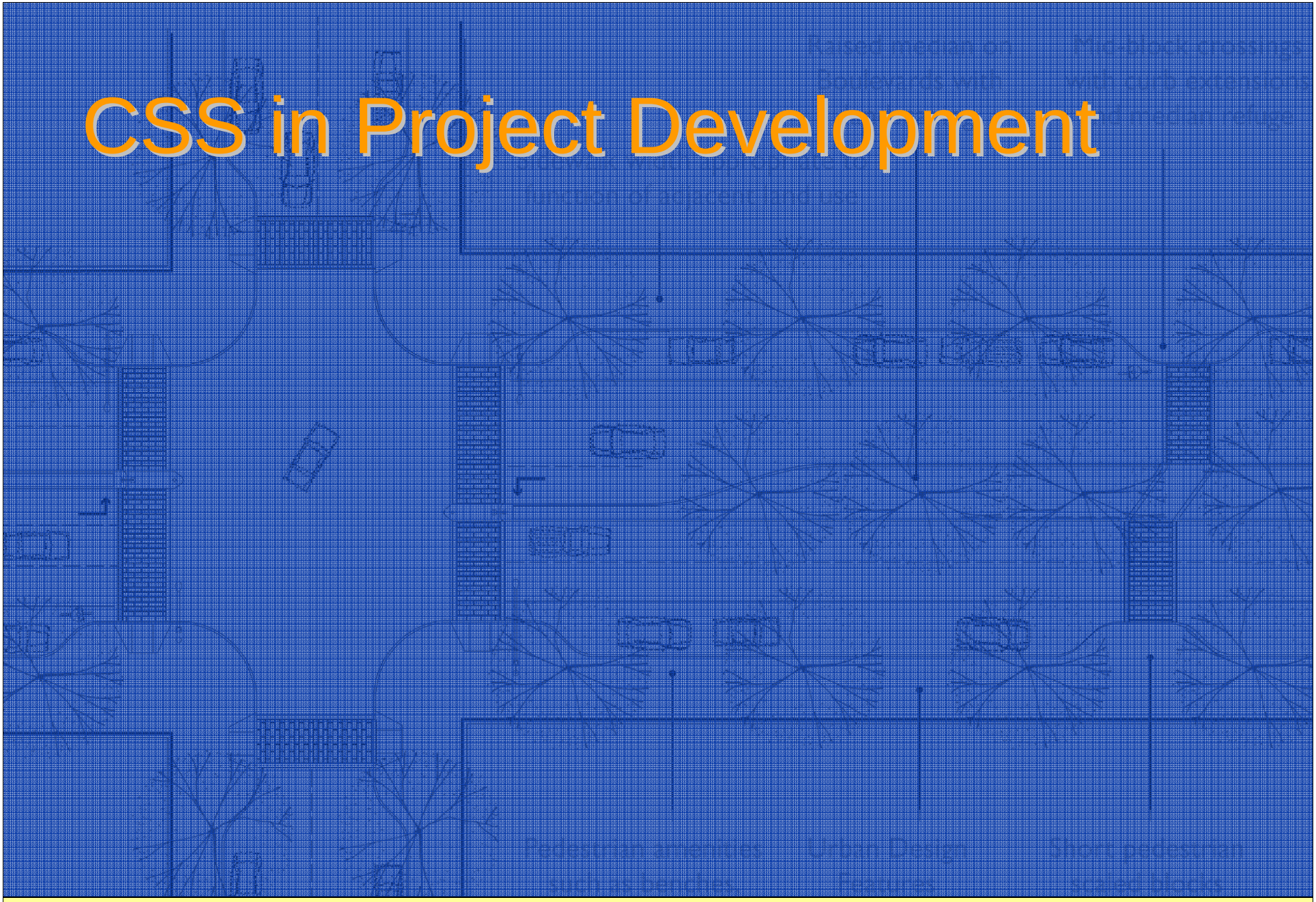


A) Conventional suburban hierarchical network

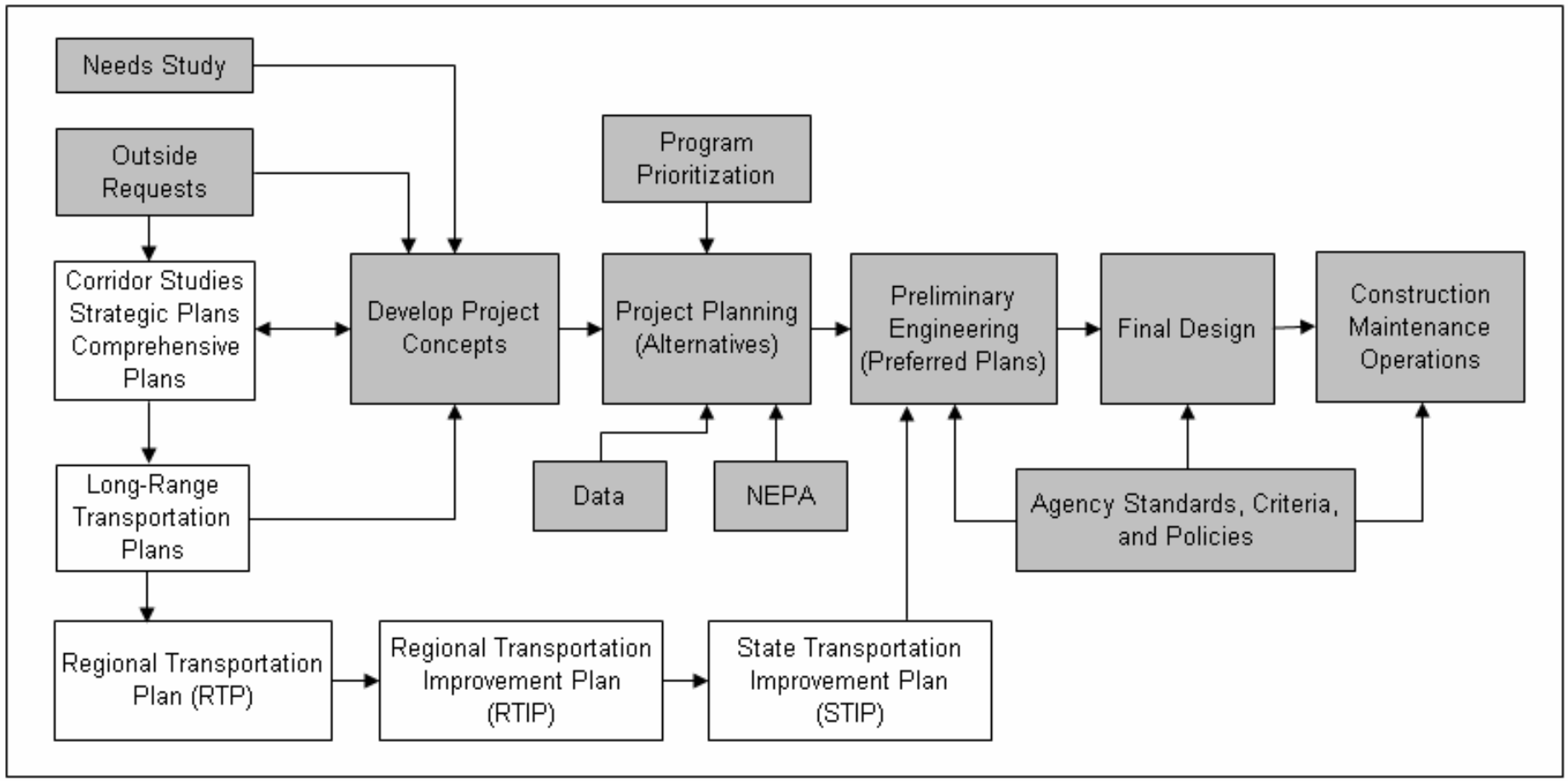


B) Traditional urban connected network

CSS in Project Development



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

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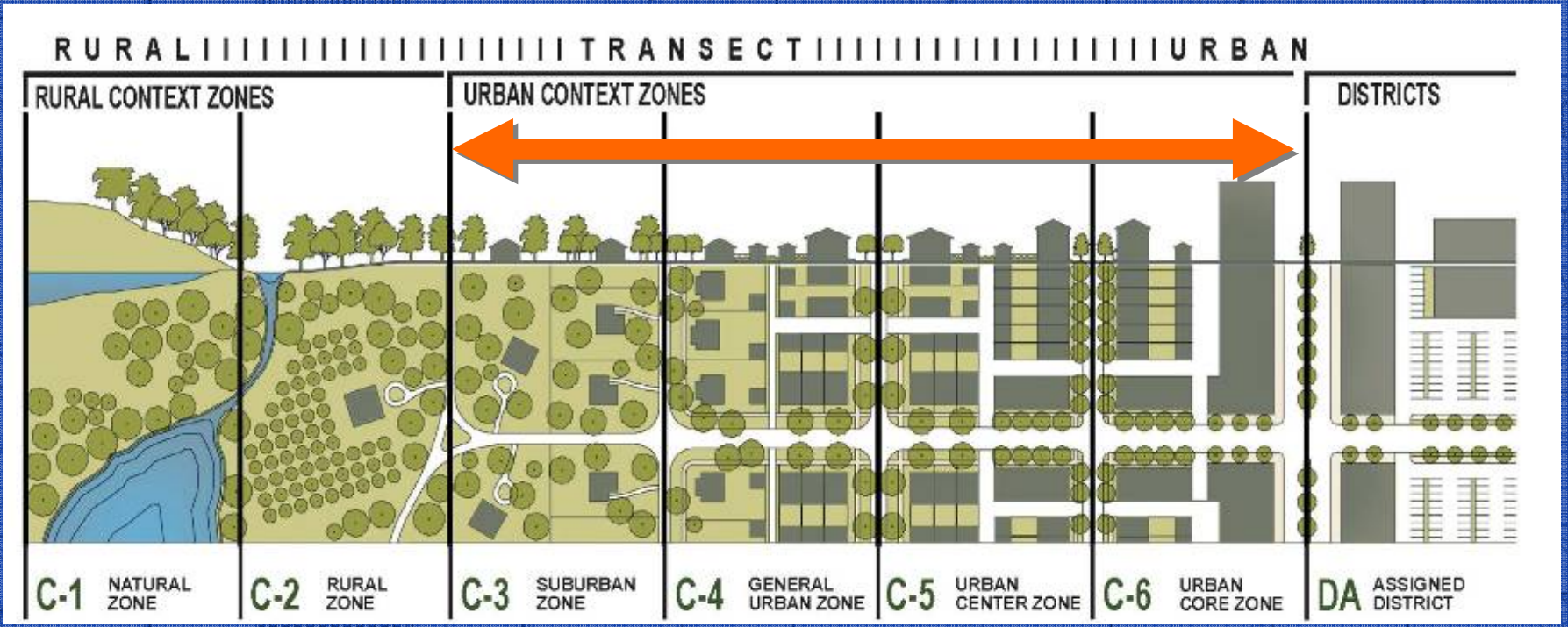

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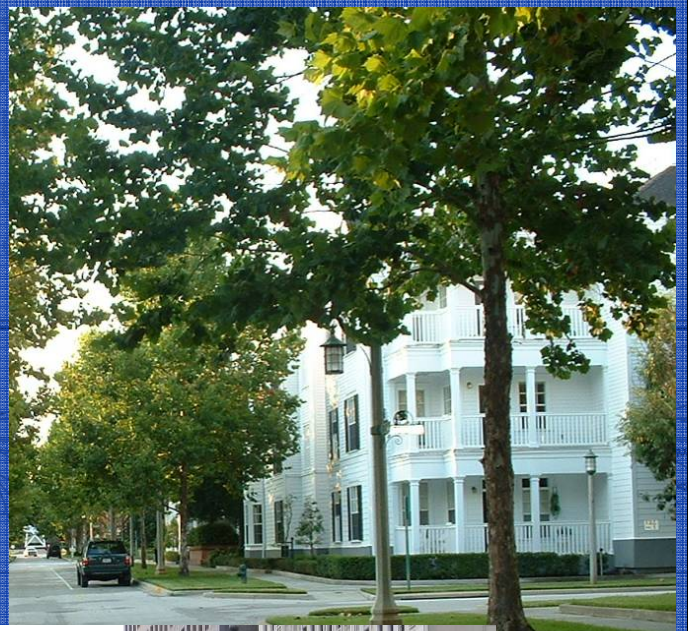
Features That Create Context

- **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

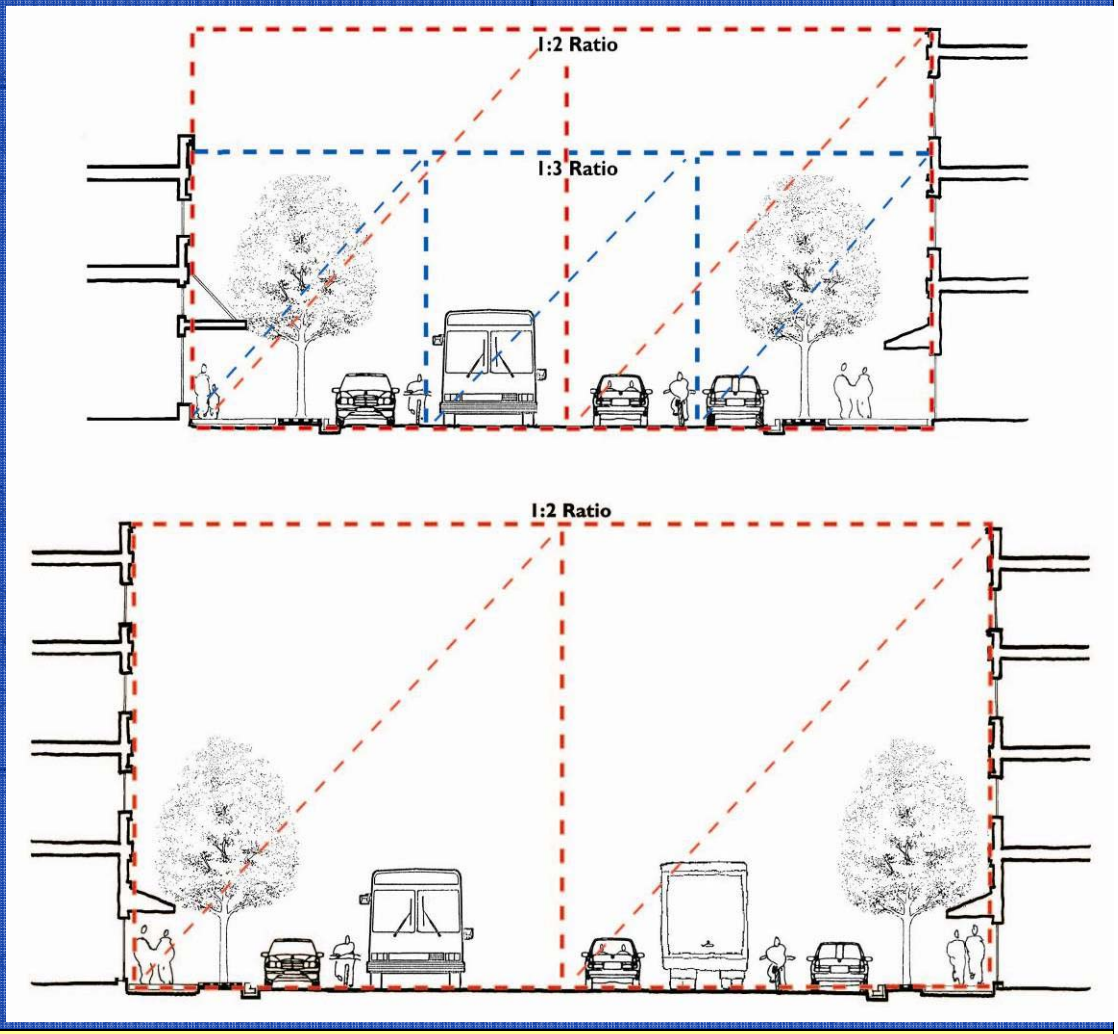
	Auto Oriented	Pedestrian Oriented
Building Orientation and Setback	– Set well back into private property – Oriented to parking or landscape	– Oriented to, and adjacent to street –Direct pedestrian entrance on street – Integrated with street using stoops, arcades, cafes
Parking Type and Orientation	– Surface lot between buildings and street	– Under or behind building access by alleys –Structured –On-street
Block Length	- Large blocks, often with no public throughway - Superblocks	- Short blocks - High connected network

Building Design

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

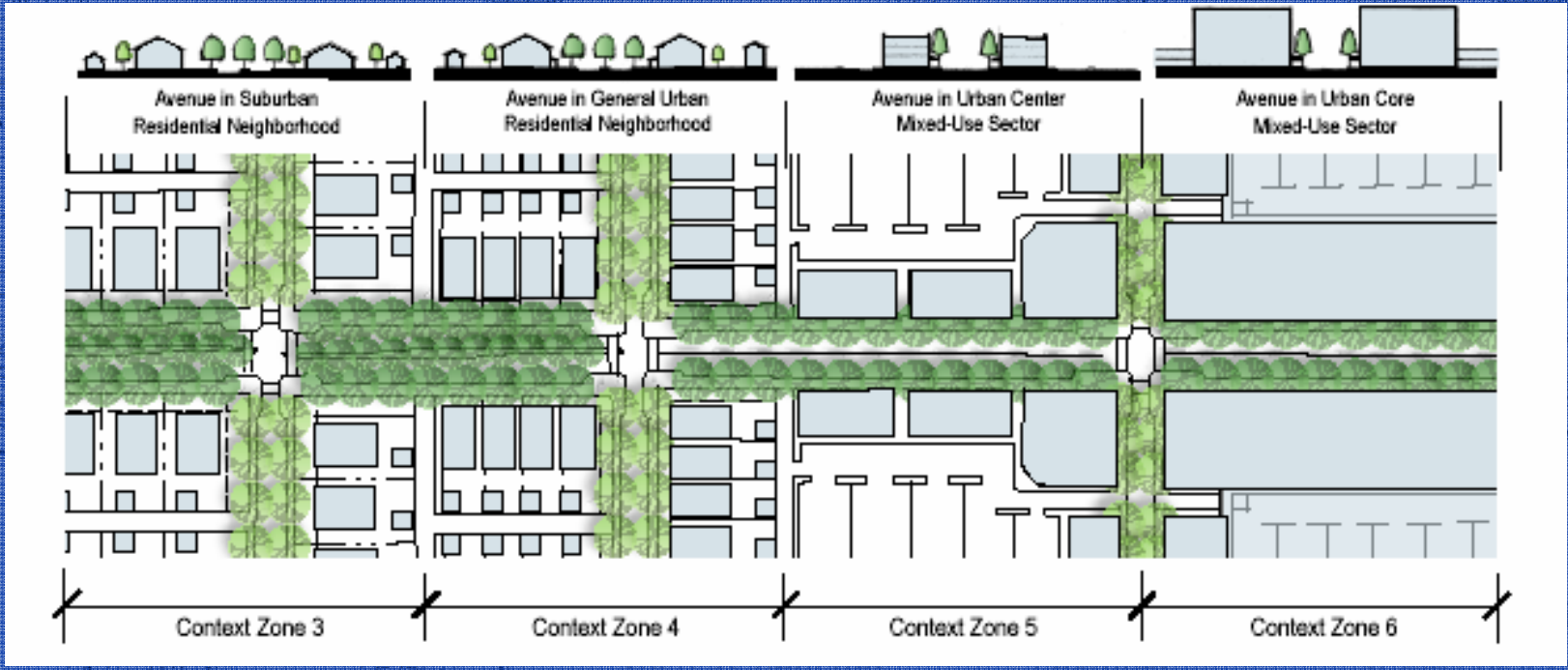
Street Enclosure

- 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

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



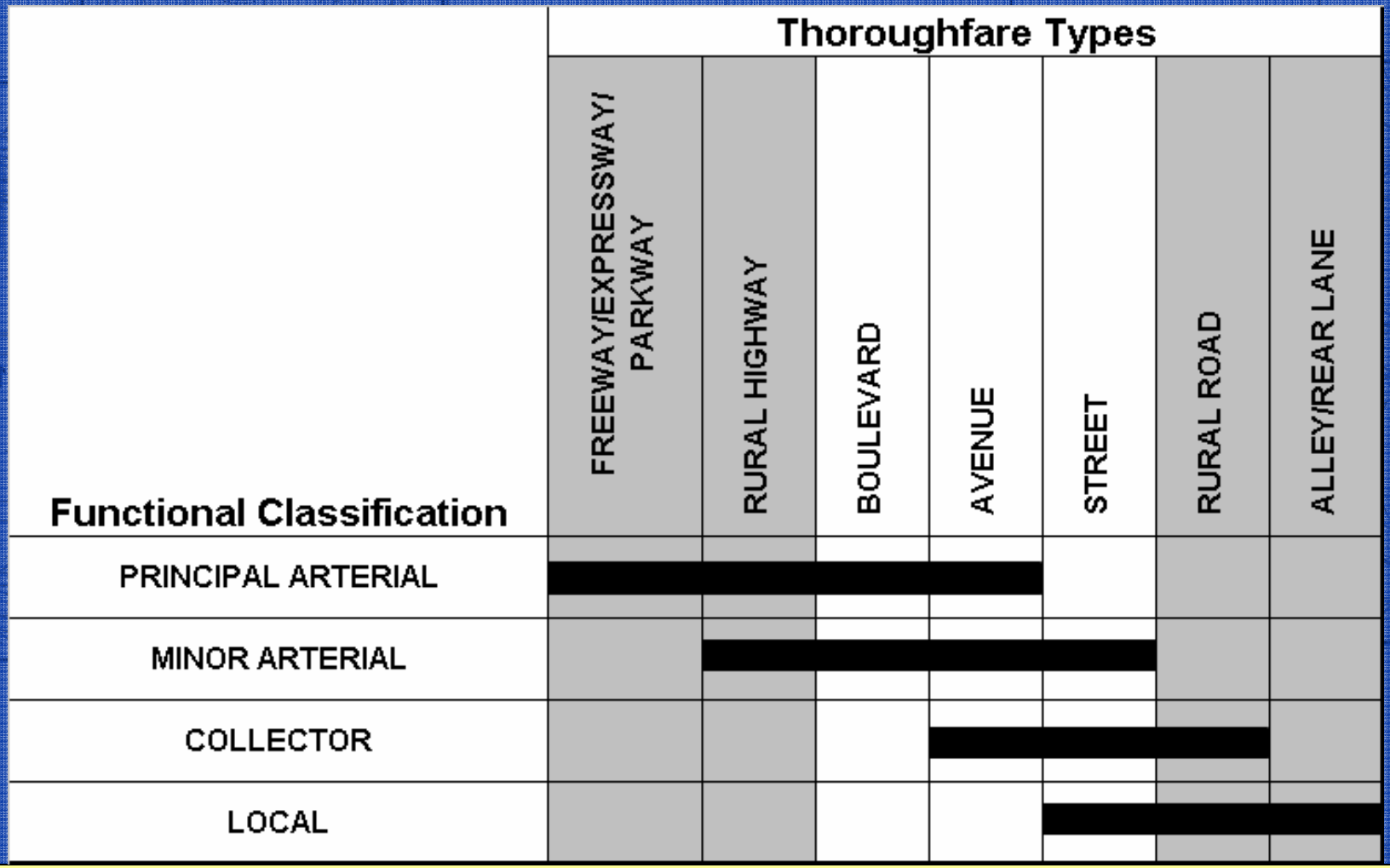
Thoroughfare Types

- 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

Relationship between Thoroughfare Type and Functional Class



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


Townsend
LANE

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


NEED TRANSIT INFO?
CALL
511
CHANNING Way


THE ARTS & COMMERCE DISTRICT

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 curb parking
- Freight restricted to local deliveries

Context Sensitive Solutions in Designing Major Urban Thoroughfares for Walkable Communities

Thoroughfare Examples

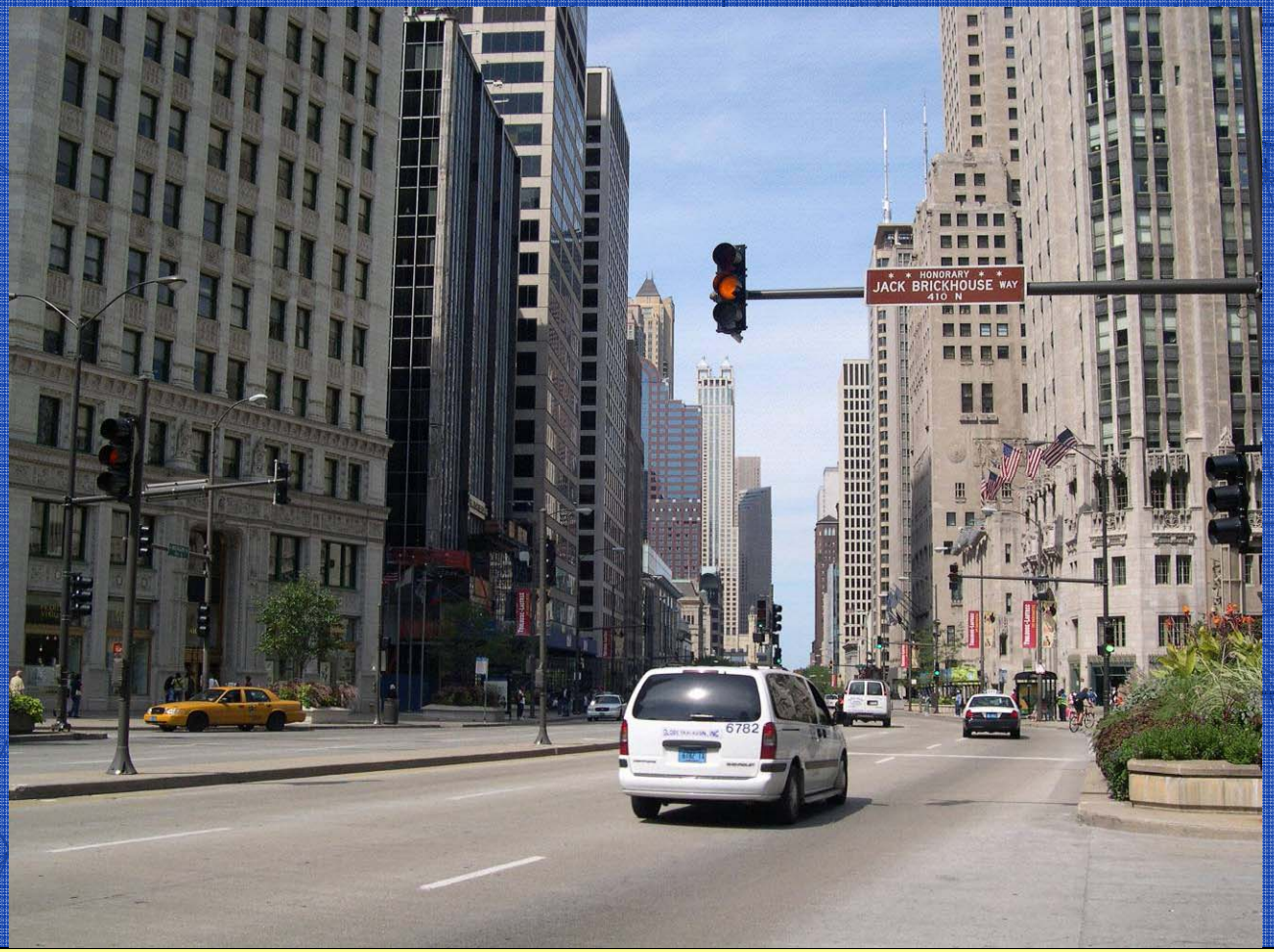
- Street in urban center context

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

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

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

Segment 4

Design Controls and Thoroughfare Design

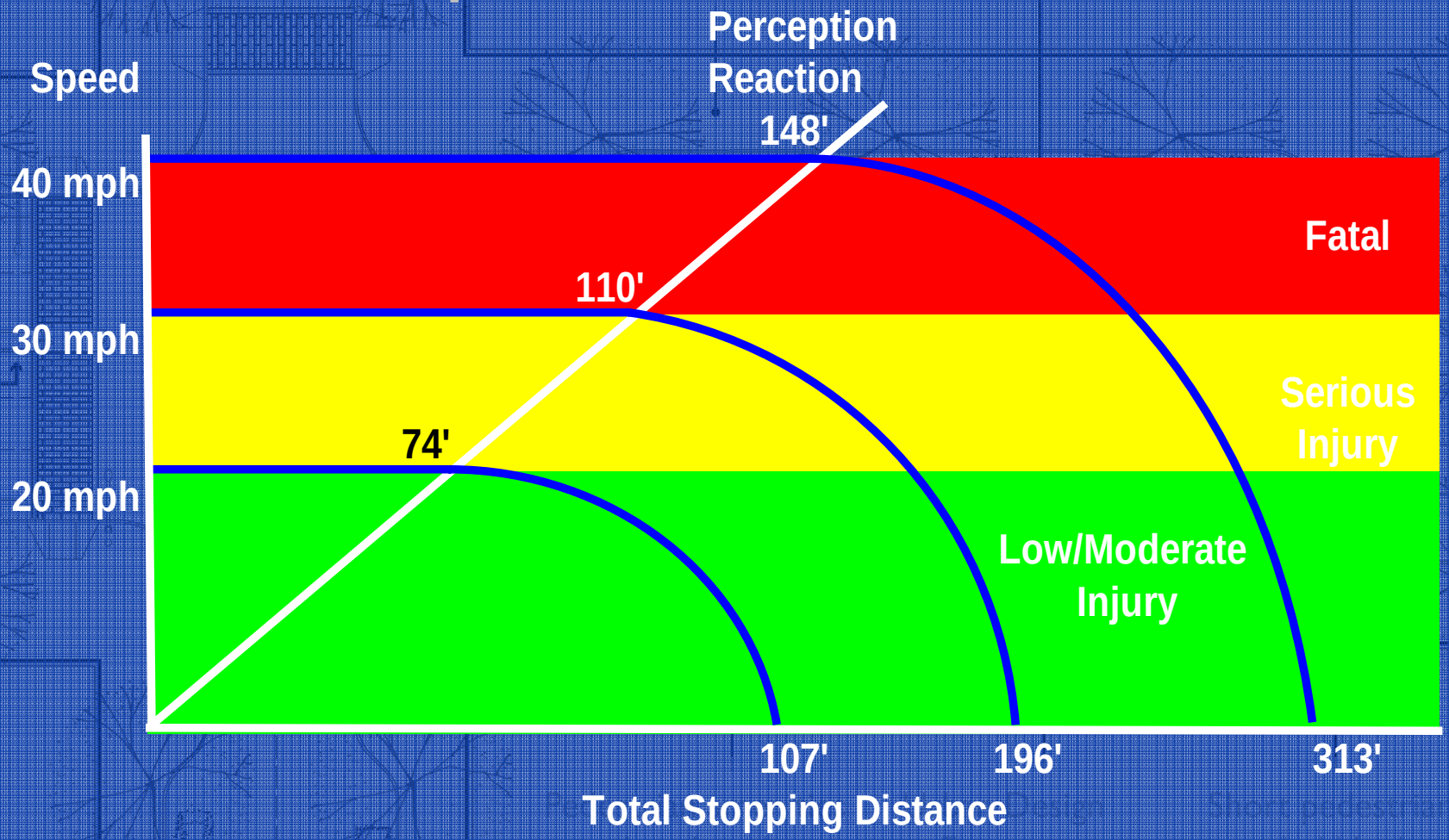
Design Controls in CSS

- 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

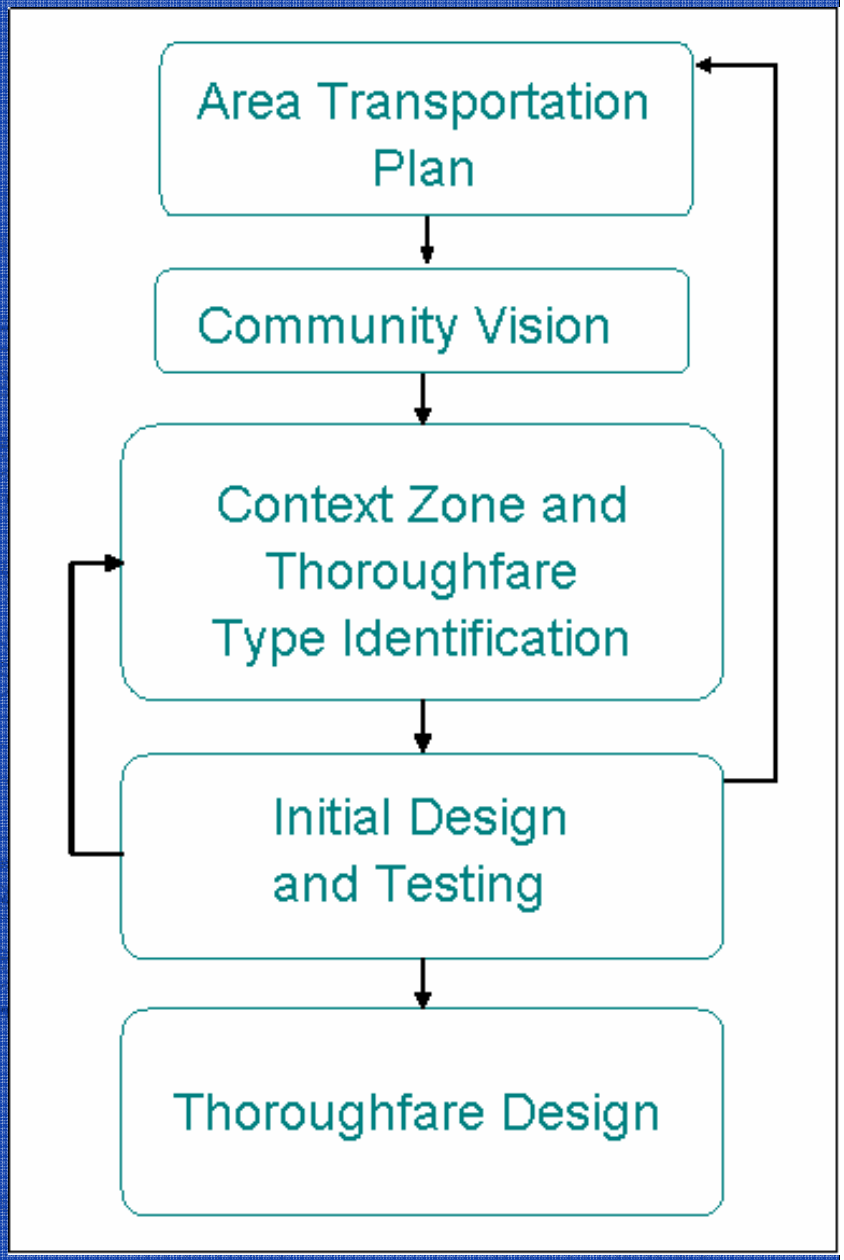
Conventional	CSS Approach
Context: Urban Rural	Urban Context: Suburban General Urban Urban Center Urban Core
Design criteria based primarily on: Functional class Design speed Travel demand forecasts Level of service objectives	Design criteria based primarily on: Community objectives Thoroughfare type Functional class Adjacent land use

Speed and Capacity of Urban Streets

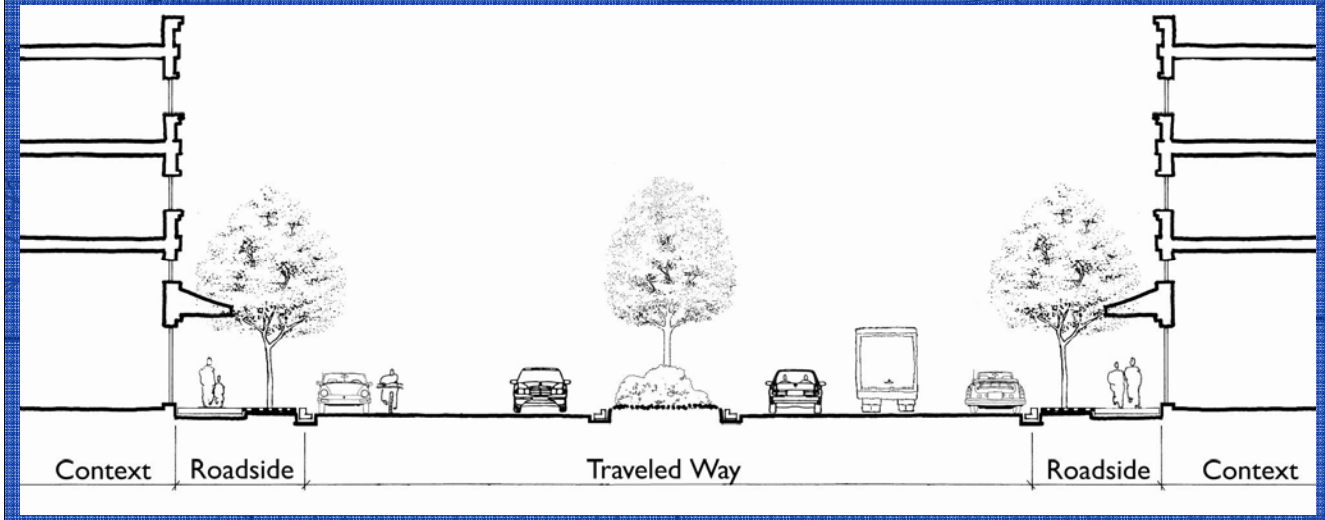
- Adequate LOS with operating speeds at 25 to 35 mph
- Address capacity issues with:
  - Network capacity
  - Synchronized signal timing
  - Access management
  - Turn lanes
- Address safety:
  - Case-by-case basis

CSS Design Process

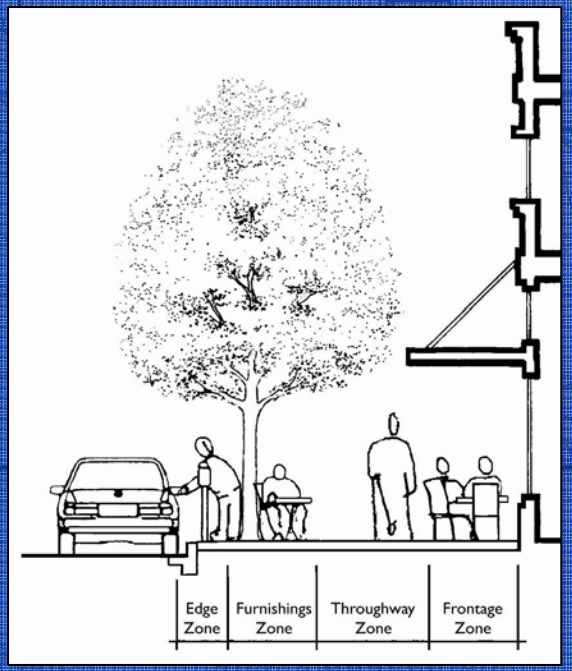
1: Plan
2: Vision
3: Compatibility
4: Initial concept/testing
5: Design



Thoroughfare Components

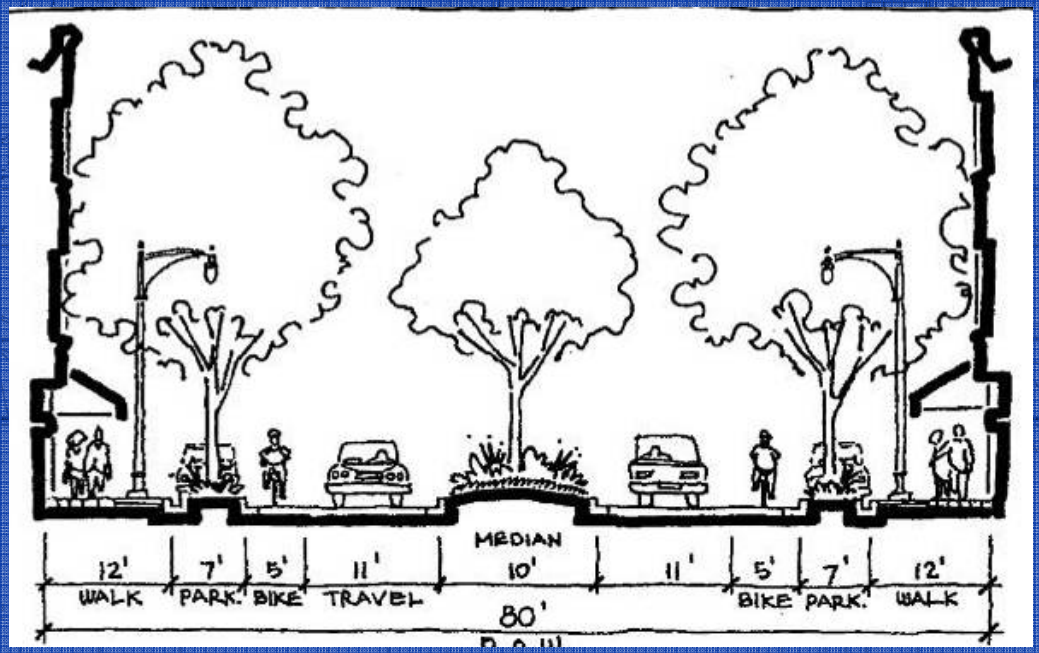


Roadside



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
Roadside												
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).											
Traveled Way												
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
Intersections												
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	
Traveled Way										
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									
Roadside										
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									
Intersections										
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

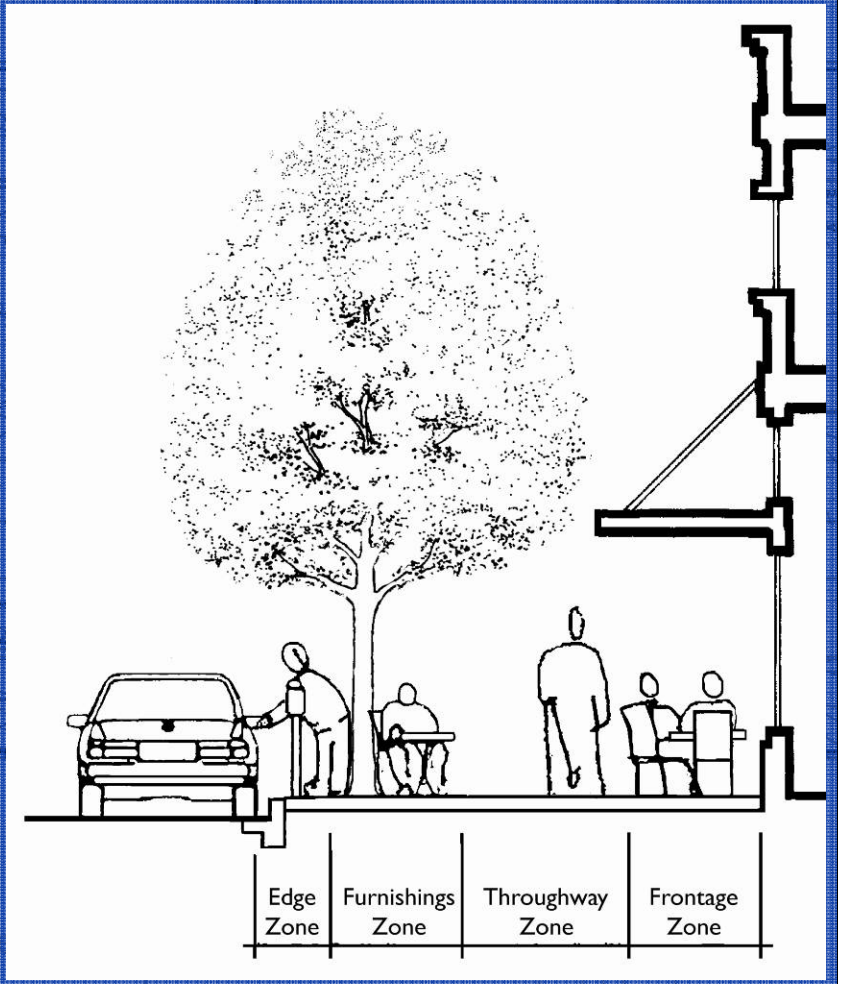
- From property line to face of curb
- Accommodates street activity
  - Mobility
  - Business
  - Social
- Public space

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	21.5 foot (recommended)	12 foot (constrained)	1.5 feet 2.5 feet at diagonal parking	19 foot (recommended)	12 foot (constrained)	0.5 feet	16.5 foot (recommended)
	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	18.5 foot (Recommended)
	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	19.5 foot (recommended)	12.0 foot (constrained)	1.5 feet 2.5 feet at diagonal parking	16 foot (recommended)	12 foot (constrained)	0.5 feet	14.5 foot (recommended)
	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	16 foot (recommended)	12.0 foot (constrained)	1.5 feet 2.5 feet at diagonal parking	16 foot (recommended)	12 foot (constrained)	0.5 feet	11.5 foot (recommended)
	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	

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

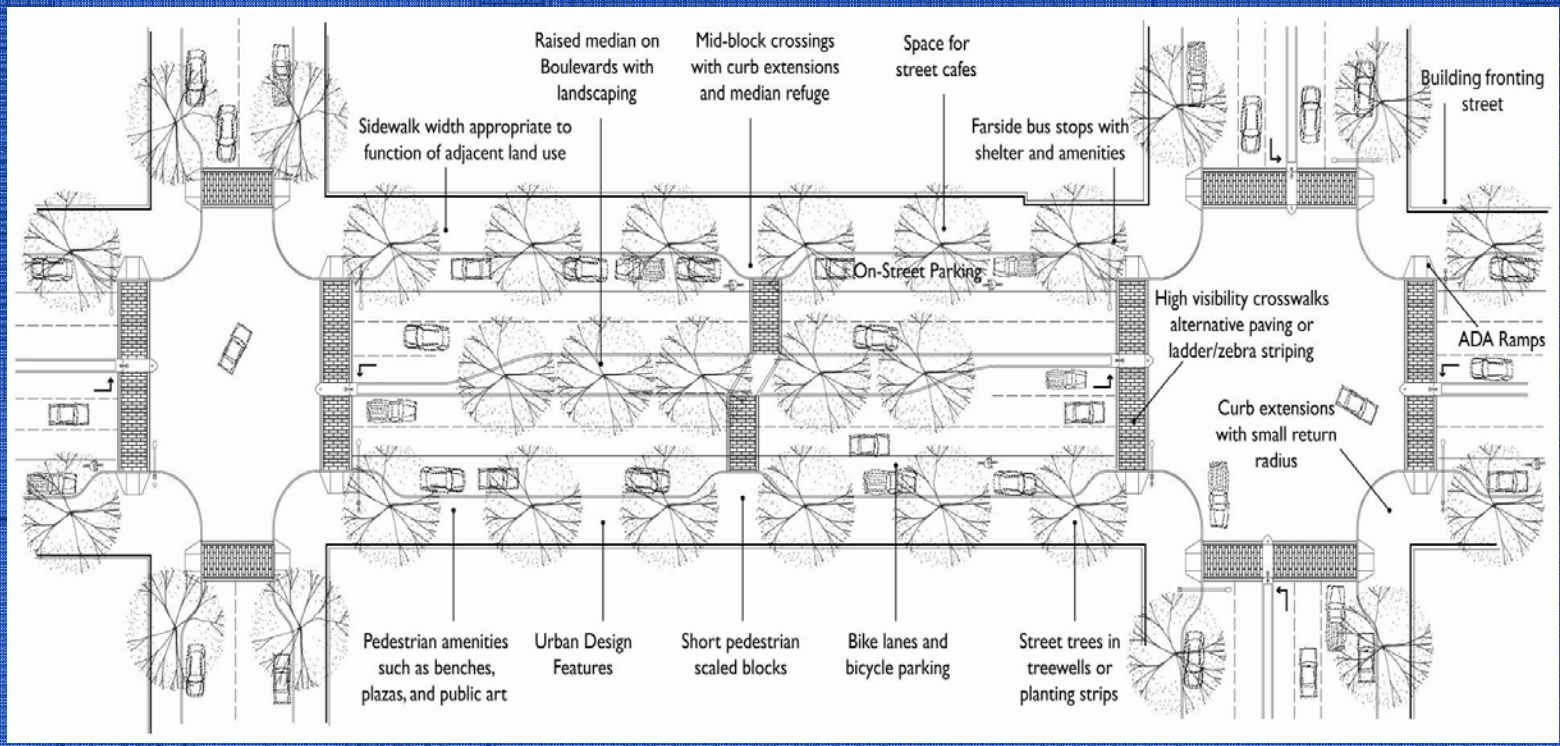
- Defined as an edge zone clear of fixed objects
- Less consequence than rural context
  - Lower speeds
  - Parked vehicles
- Often not practical in urban areas

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
Median for access control		
Arterial Boulevards and Avenues	4 ft.	6 ft.
Collector Avenues and Streets		
Median for pedestrian refuge		
Arterial Boulevards and Avenues	6 ft.	8 ft.
Collector Avenues and Streets		
Median for street trees and lighting		
Arterial Boulevards and Avenues	6 ft.	10 ft.
Collector Avenues and Streets		
Median for single left-turn lane		
Collector Avenues and Streets	10 ft.	14 ft.
Arterial Boulevards and Avenues	12 ft.	16-18 ft.
Median for dual left turn lane		
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

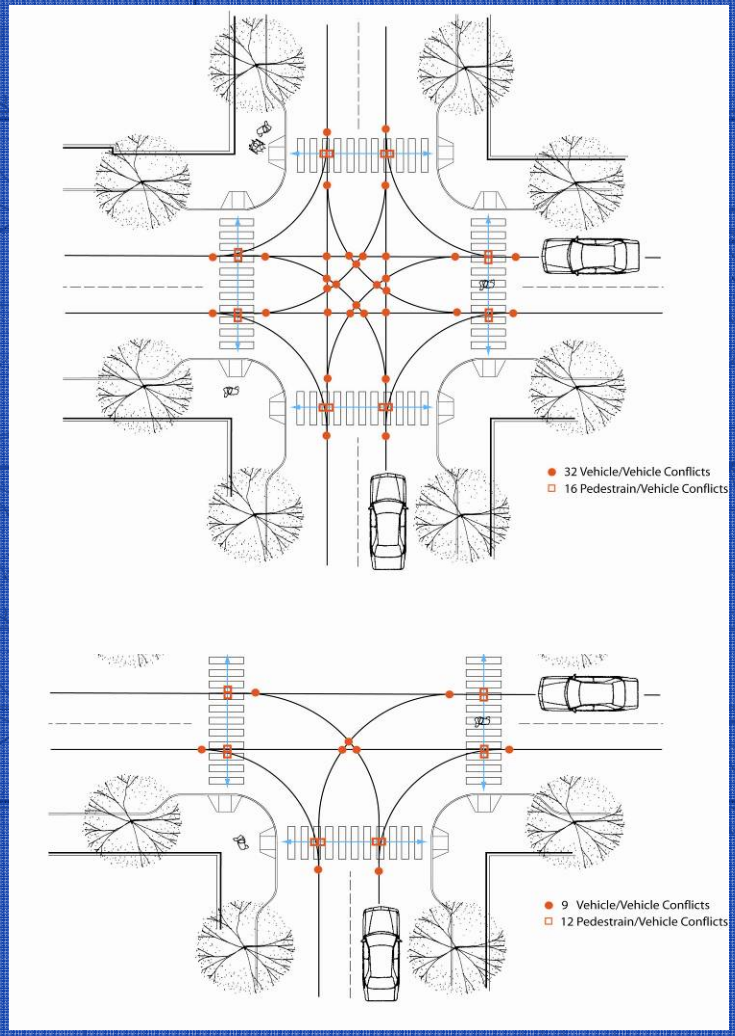
- Recommended practice
  - Locate so crossings are 200-300 feet apart
  - Significant pedestrian demand
  - Criteria
    - 12,000 ADT or less
    - 15,000 ADT with median refuge
    - Speed less than 40 mph
    - Adequate sight distance

Segment 7

Intersection Design

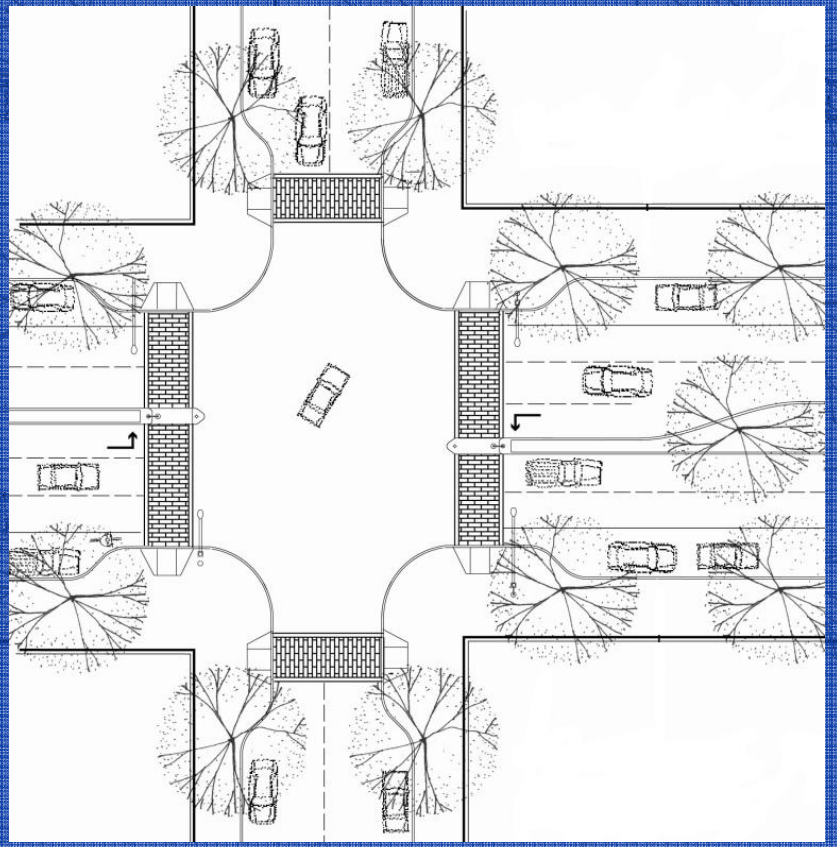
Urban Intersections

- 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

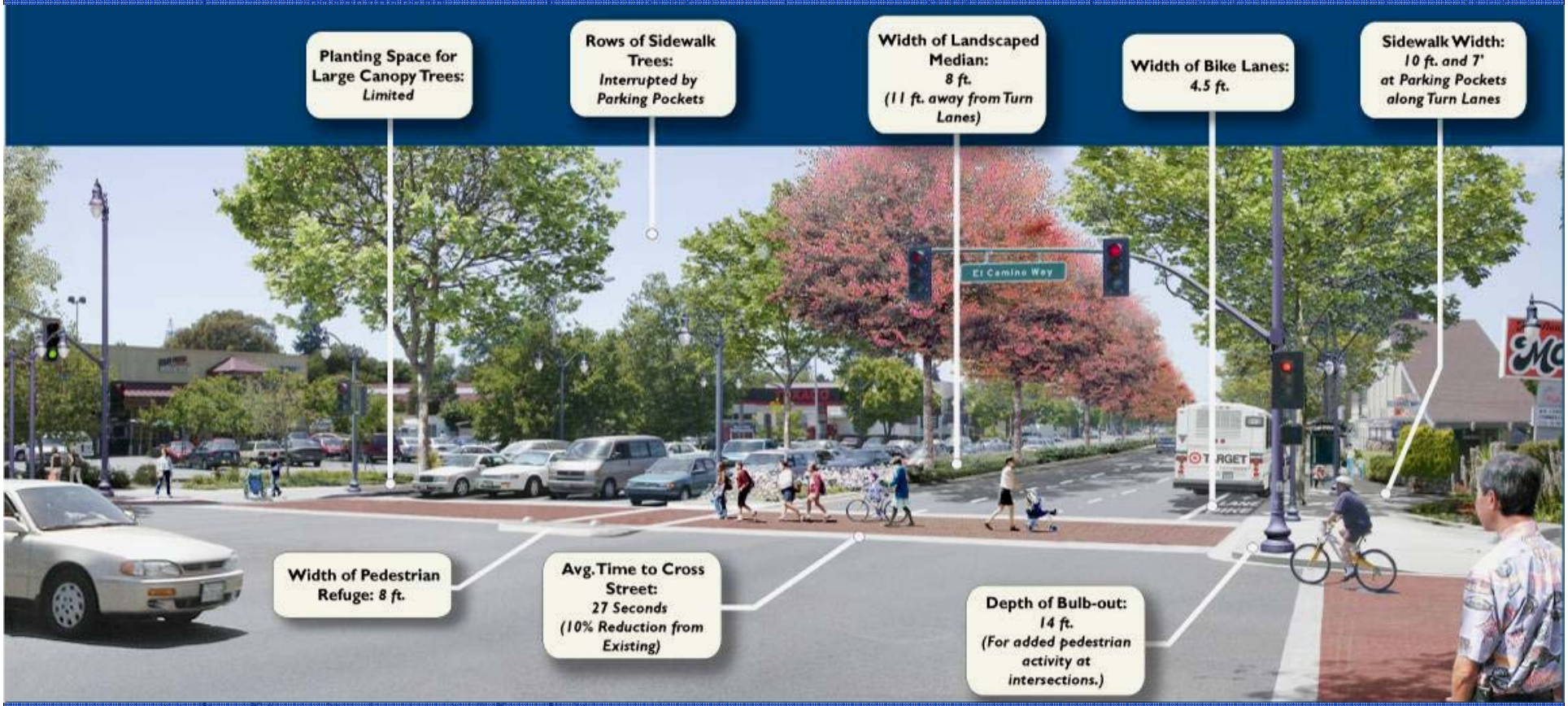
- Avoid large undefined open spaces

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

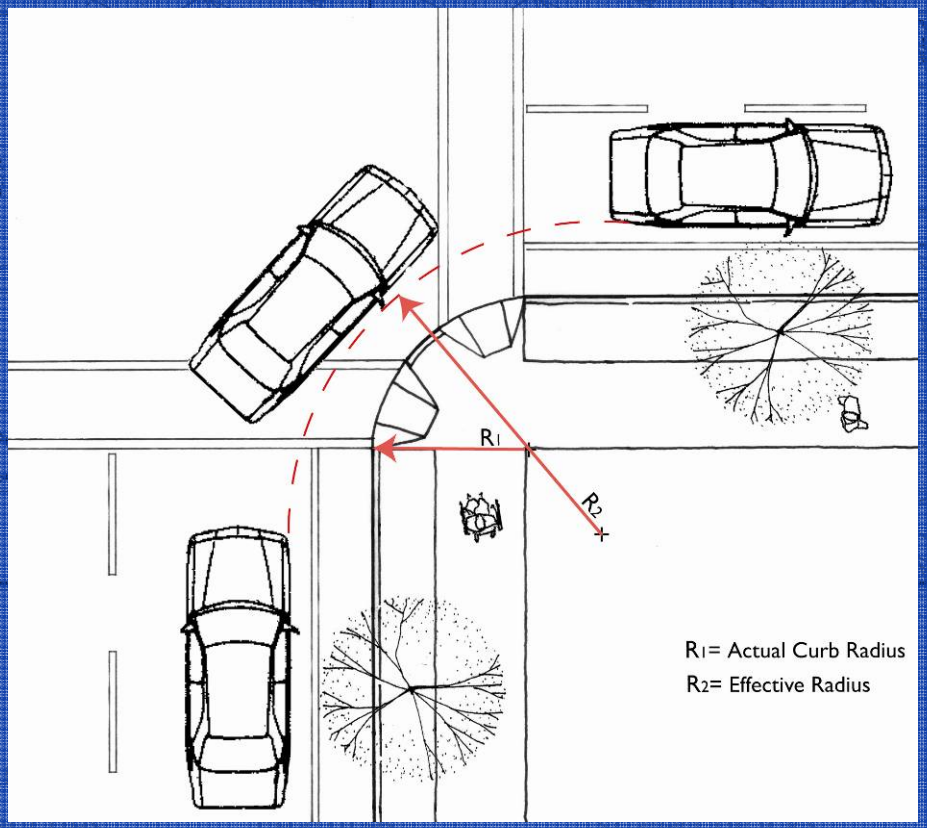


Source: City of Palo Alto
CD+A, FPA, and Urban Advantage

El Camino Real @ Los Robles – PROPOSED IMPROVEMENTS

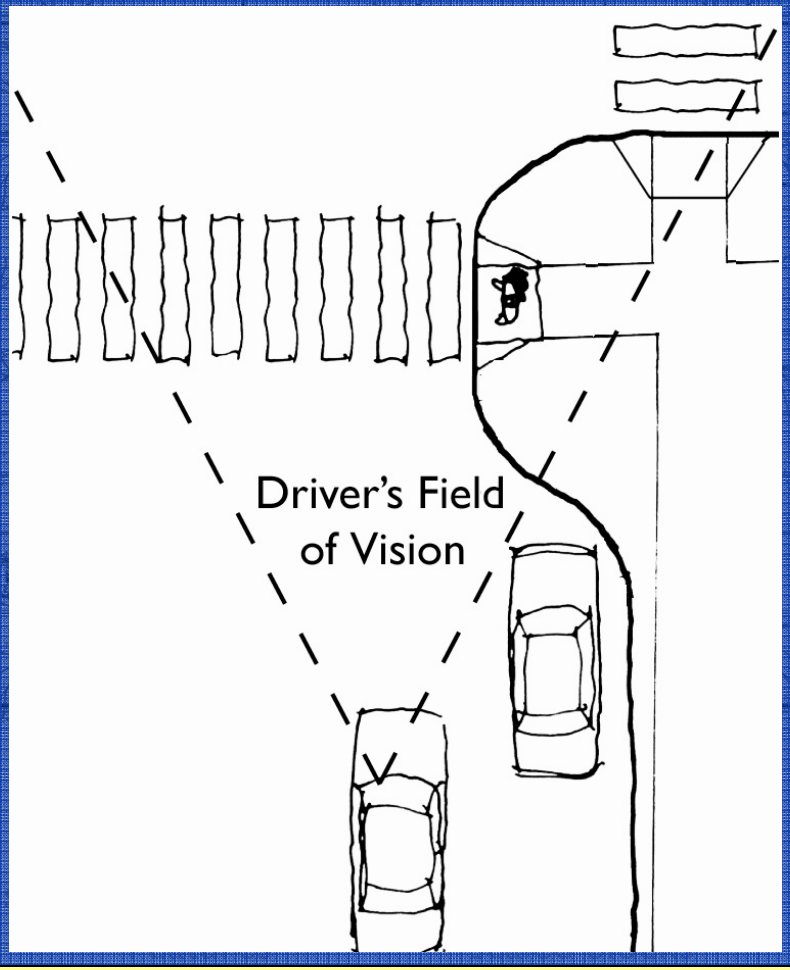
Curb Return Radii

- 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



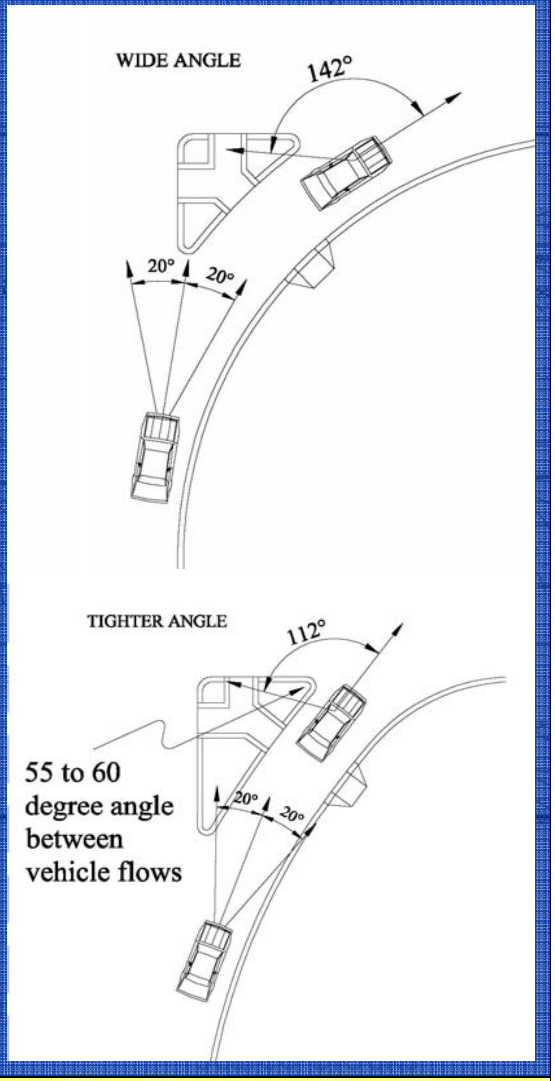
Curb Extensions

- 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
Applicability by Thoroughfare Type:				
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

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