Designing Walkable Urban Thoroughfares:

A Context Sensitive Approach

Part 1

10 PDH / 10 CE Hours / 10 AIA LU/HSW

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Designing Walkable Urban Thoroughfares Part 1
Final Exam

1. CSS is also known as _____.
   a. walkable communities
   b. context sensitive solutions
   c. crosswalk society solutions
   d. community objective sciences

2. Pedestrian tolerant-areas _____ accommodate pedestrians but do not support a high level of pedestrian activity and are usually vehicle dominant.
   a. minimally
   b. maximally
   c. moderately
   d. never

3. According to Table 2.1, which tier is responsible for federal policy and regulations for CSS Applications?
   a. Local Agency
   b. Regional/Metropolitan
   c. Statewide
   d. National

4. After developing a vision and goals for a transportation system, what step should be done next?
   a. Operation and Maintenance
   b. Definition of Needs
   c. Alternatives Evaluation
   d. Project Development and Implementation

5. According to Figure 2.3, what should be involved with the Project Planning (Alternatives) step?
   a. Program Prioritization
   b. Data
   c. NEPA
   d. All of the above

6. The typical _____ street network is often characterized by a framework of widely spaced arterial roads with connectivity limited by a system of large blocks, curving streets and a branching hierarchical pattern often terminating in cul-de-sacs.
   a. conventional
   b. arterial
   c. traditional
   d. comparative

7. Major thoroughfare networks should form a grid-like pattern of continuous thoroughfares except as precluded by _____ barriers.
   a. manmade
   b. facility
   c. suburban
   d. topographic

8. The basic form of the thoroughfare system is shaped by the spacing and alignment of arterial thoroughfares. The system of arterials should be continuous and networked in a general _____ form.
   a. rectilinear
   b. triangular
   c. grid-like
   d. parallel

9. _____ means there are provisions for mode of travel that include bicycles and transit
   a. regional coordination
   b. character
   c. multipurpose
   d. multimodal

10. According to Table 4.1, a _____ context zone has the distinguishing characteristics of being agricultural with scattered development.
   a. General urban
   b. Rural
   c. Urban center
   d. Natural

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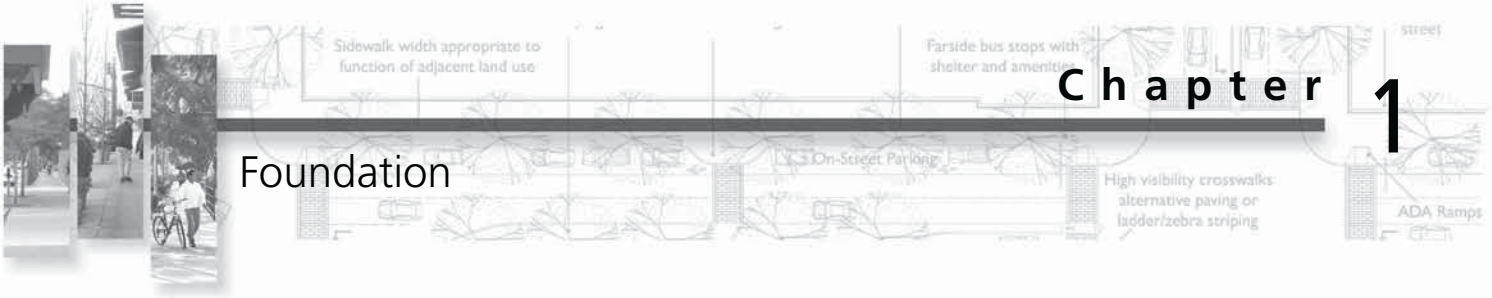
PART 1

Introduction



Chapter 1

Foundation

Purpose of This Report

This report has been developed in response to widespread interest for improving both mobility choices and community character through a commitment to creating and enhancing walkable communities. Many agencies will work toward these goals using the concepts and principles in this report to ensure the users, community and other key factors are considered in the planning and design processes used to develop walkable urban thoroughfares.

Traditionally, through thousands of years of human settlement, urban streets have performed multiple functions. Mobility was one of the functions, but economic and social functions were important as well. Retail and social transactions have occurred along most urban thoroughfares throughout history. It is only in the 20th century that streets were designed to separate the mobility function from the economic and social functions. This report is intended to facilitate the restoration of the complex multiple functions of urban streets. It provides guidance for the design of walkable urban thoroughfares in places that currently support the mode of walking and in places where the community desires to provide a more walkable thoroughfare, and the context to support them in the future.

While the concepts and principles of context sensitive solutions (CSS) are applicable to all types of transportation facilities, this report focuses on applying the concepts and principles in the planning and design of urban thoroughfares—facilities commonly designated by the conventional functional classifications of arterials and collectors. Freeways, expressways and local streets are not covered in this report. The following chapters emphasize thoroughfares in "walkable communities"—compact, pedestrian-scaled villages, neighborhoods, town centers, urban centers, urban cores and other areas where walking, bicycling and transit are encouraged. Practitioners working on places and thoroughfares that do not completely fit within this report's definition of walkable urban thoroughfares may also find this guidance useful in gaining an understanding of the flexibility that is inherent in the "Green Book"—the American Association of State Highway and Transportation Officials' (AASHTO's) *Policy on Geometric Design of Highways and Streets* (AASHTO, 2004a).

Throughout this report, for brevity, the terms "principles of CSS" and "CSS" are used interchangeably.

CSS and This Report

The principles of CSS promote a collaborative, multidisciplinary process that involves all stakeholders in planning and designing transportation facilities that:

- Meet the needs of users and stakeholders;
- Are compatible with their setting and preserve scenic, aesthetic, historic and environmental resources;
- Respect design objectives for safety, efficiency, multimodal mobility, capacity and maintenance; and
- Integrate community objectives and values relating to compatibility, livability, sense of place, urban design, cost and environmental impacts. (FHWA and Atlanta Regional Commission)

Applying the principles of CSS enhances the planning and design process by addressing objectives and considerations not only for the transportation facility but also for the surrounding area and its land uses, developments, economic and other activities and environmental conditions. With a thorough understanding of the CSS principles and design process, the practitioner planning or designing a thoroughfare seeks to integrate community objectives, accommodate all users and make decisions based on an understanding of the trade-offs

that frequently accompany multiple or conflicting needs.

Applying the principles of CSS in the transportation planning or project development process identifies objectives, issues and trade-offs based on stakeholder and community input starting at the regional planning process and continuing through each level of planning and project development (for example, network, corridor and project). This report provides guidance in how CSS principles may be considered and applied in the processes involved with planning and developing roadway improvements for walkable urban thoroughfares.

As documented in *Context-Sensitive Design Around the Country* (TRB 2004), *A Guide to Best Practices for Achieving Context Sensitive Solutions* (TRB 2002) and other sources, the principles of CSS are successfully used in towns and cities as well as in rural areas. Agencies are transforming the current project development process to meet the expectations of all users and stakeholders. Integrating CSS principles into the project development process results in the consideration of a broad range of objectives and an attempt to balance these objectives based on the needs and conditions specific to each project and its context. The use of CSS principles in the project development process is resulting in community interests, user needs and environmental issues being considered early in the development of roadway improvement projects—specifically in defining the project's purpose and need and, as appropriate, in other decisions in each phase of the project.

Objectives of this Report

The objectives of this report are to

1. Identify how CSS principles can be applied in the processes (for example, network, corridor, project development) involved with planning and developing roadway improvement projects on urban thoroughfares for walkable communities;
2. Describe the relationship, compatibility and trade-offs that may be appropriate when balancing the needs of all users, adjoining land uses, environment and community interests when making decisions in the project development process;
3. Describe the principles of CSS and the benefits and importance of these principles in transportation projects;
4. Present guidance on how to identify and select appropriate thoroughfare types and corresponding design parameters to best meet the walkability needs in a particular context; and
5. Provide criteria for specific thoroughfare elements, along with guidance on balancing stakeholder, community and environmental needs and constraints in planning and designing walkable urban thoroughfare projects.

Walkable Communities

Walkable communities are urban places that support walking as an important part of people's daily travel through a complementary relationship between transportation, land use and the urban design character of the place. In walkable communities, walking is a desirable and efficient mode of transportation. Although nearly every human environment can accommodate some degree of walking, walkable communities give additional value and support to make walking an enjoyable experience (see sidebar regarding the "continuum of walkability").

Principles for walkable communities include the following:

1. Accommodating pedestrians, bicycles, transit, freight and motor vehicles within a fine-grained urban circulation network where the allocation of right of way on individual thoroughfares is based on urban context, often determined through the process in this report;
2. Providing a compact and mixed-use environment of urban buildings, public spaces and landscapes that support walking directly through the built environment and indirectly by supporting human and economic activities associated with adjacent and surrounding land uses;
3. Achieving system-wide transportation capacity by using a high level of multimodal network connectivity, serving walkable commu-

nities with appropriately spaced and properly sized pedestrian, bicycle, transit and vehicular components rather than by increasing the vehicular capacity of individual thoroughfares; and

4. Creating a supportive relationship between thoroughfare and context by designing thoroughfares that will change as the surroundings vary in urban character.

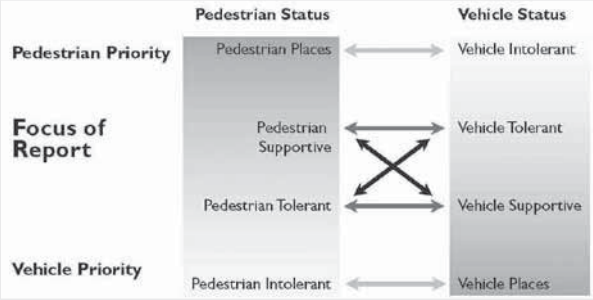
Walkable communities have the following characteristics:

1. A mix of land uses in close proximity to one another;
2. A mix of density including relatively compact developments (both residential and commercial);
3. Building entries that front directly onto the sidewalk without parking between entries and the public right of way;
4. Building, landscape and thoroughfare design that is pedestrian-scale—in other words, that provides architectural and urban design features scaled and detailed to be appreciated by persons who are traveling slowly and observing from the sidewalk at street level;
5. Thoroughfares designed to serve the activities generated by the adjacent context in terms of the mobility, safety, access and place-making functions of the public right of way; and
6. A highly connected, multimodal circulation network, usually with a fine "grain" created by relatively small blocks providing safe, continuous and balanced multimodal facilities that capitalize on compact urban development patterns and densities.

The above principles and characteristics are the qualities found in urban places where development pattern, intensity and design combine to facilitate frequent walking and transit use. In these places, the nonauto modes are attractive and efficient choices for many people, in concert with automobiles and their convenient and accessible parking. An increasing number of communities are recognizing the value of these features and are embracing them in land use, urban design and transportation

Continuum of Walkability

At some level nearly every place in the built environment is walkable. Some places, such as freeways or highways do not allow for pedestrians. At the other extreme, public spaces such as plazas, parks and pedestrian malls are primarily for pedestrians and generally exclude vehicles. Thoroughfares that are in between these two extremes require trade-offs between pedestrian and vehicle priority. The focus of this report is on the thoroughfares that are "pedestrian supportive" as shown in the spectrum of pedestrian and vehicle supportiveness below. Some of the concepts in this report can be used in pedestrian-tolerant areas as well.



Pedestrian priority on urban thoroughfares falls into the following ranges:

- Pedestrian places—mixed-use areas with a significant pedestrian presence, not dominated by, and sometimes prohibiting, vehicles;
- Pedestrian supportive—mixed-use areas with moderate to significant pedestrian presence;
- Pedestrian tolerant—areas that minimally accommodate pedestrians but do not support a high level of pedestrian activity and are usually vehicle dominant; and
- Pedestrian intolerant—areas with little support for walking or that prohibit pedestrians and are vehicle dominant.

Thoroughfares that are pedestrian supportive range from being tolerant to supportive of vehicular access and mobility. The specifics of the community's objectives, transportation needs and priorities are resolved through the CSS process to arrive at the proper thoroughfare design solutions.

Source: Adapted from a system for describing "degrees of walkability" for street environments, Charlier Associates.

plans, often using techniques drawn from planning and design movements such as smart growth and new urbanism.

As the successful design of walkable communities is complex and is not the primary focus of this report, the following references are provided as some of the many sources for useful guidance regarding the overall design of walkable communities:

1. *Promoting Sustainable Transportation Through Site Design: An ITE Recommended Practice,* 2010. This document provides specific guidance regarding the design of sites to create a context that supports walkable urban thoroughfares.
2. *SmartCode v9.2,* (Andres Duany, Sandy Sorlien, and William Wright, 2008). This document is a model development code for walkable communities that is based upon the Transect.

Applicability of this Recommended Practice

This recommended practice provides guidance for designing urban thoroughfares—facilities designated as arterials or collectors—to support walkable communities. Most applications of the design guidance included in this report will often apply in one of the following two circumstances:

1. A thoroughfare project in an existing walkable community where its multimodal character is to be preserved and enhanced; or
2. A thoroughfare project in an area where community goals call for a walkable context, in which case applying this design guidance will shape public investment to advance those goals.

Both circumstances can apply to either new construction or retrofit projects.

Commitment to walkable communities as a goal means that throughout the design process, location will serve as a design control (see Chapter 7). As a result, design decisions will consistently favor those elements and dimensions that are most supportive of walkable community characteristics. Examples of the design-decision processes favoring walkable community outcomes are provided in Chapter 5.

Other development contexts will also benefit from applying the guidance presented in this report. These include places characterized by business parks, residential subdivisions and strip commercial development. In areas such as these, outside of existing and evolving walkable communities, this report can help designers provide benefits including

- Safe and comfortable facilities for pedestrians;
- Attractive streetside areas;
- Appropriate sizing of facilities with respect to pavement width, with associated potential for cost savings in right-of-way acquisition, construction and maintenance;
- Successful integration of transit facilities and operations; and
- Speed management.

In cases where the design guidance is being used in development contexts other than walkable communities (existing or planned), design controls other than location may dominate trade-off decisions.

Relationship to Other Guidance

This report supplements and expands on policies, guides and standards commonly used by state and local transportation, engineering and public works engineers and planners. Those publications include *A Policy on Geometric Design of Highways and Streets* (AASHTO 2004a); *Guide for the Planning, Design and Operation of Pedestrian Facilities* (AASHTO 2004b); *Guide for the Development of Bicycle Facilities* (AASHTO 1999); *Highway Safety Design and Operations Guide* (AASHTO 1997); *Roadside Design Guide* (AASHTO 2002); as well as state department of transportation design policies and manuals, local municipal street design standards, urban design guides and guidances published by other standard-setting organizations. This publication expands on information published by the Federal Highway Administration (FHWA) in *Flexibility in Highway Design* (1997) and the *Manual on Uniform Traffic Control Devices* (2009) and builds upon the considerations in devel-

oping context sensitive solutions described in *A Guide for Achieving Flexibility in Highway Design* (AASHTO 2004c). **This report is intended to illustrate how AASHTO guidance can be applied to roadway improvement projects to make them more compatible with community objectives and context in urban areas.**

The flexibility encouraged in this report is consistent with the policies and intent expressed in the American Association of State Highway and Transportation Officials' (AASHTO) *Policy on Geometric Design of Highways and Streets*. Most of the criteria in this report are based on AASHTO design criteria, and this report shows how the criteria can be applied to create context sensitive designs in places with the qualities of traditional urbanism. This report presents guidance from sources other than AASHTO, citing these sources at the end of each chapter. This report incorporates by reference consistency with guidelines and standards published in the latest version of the *Americans with Disabilities Act Accessibility Guidelines* (ADAAG) as well as the *Public Rights-of-Way Accessibility Guidelines* (PROWAG), which both can be found at www.access-board.gov.

This report augments information found in the above resources by providing guidance on

1. Applying CSS principles in the planning and design of urban thoroughfares;
2. Considering a broader set of factors during the planning and design of walkable urban thoroughfares;
3. Recognizing the importance of context, the role of sites and buildings and how context influences the design of the thoroughfare and vice versa; and
4. Providing an understanding of how thoroughfare design criteria should vary depending on the context through which the thoroughfare passes.

Organization

This report is divided into three parts: introduction, planning and design. There are ten chapters:

- Chapter 1 provides the introduction.
- Chapters 2 through 4 describe how CSS principles are used in the planning and project development processes.
- Chapters 5 through 10 address the thoroughfare design process and specific design criteria.
- The appendices contain definitions of key terms and concepts, as well as a primer on CSS.

Table 1.1 lists the chapters and provides an overview of the material that is addressed in each chapter.

Chapter 6 provides general design parameters and example designs for urban thoroughfares with speeds up to 35 mph in areas with high levels of pedestrian, bicycle and transit activity. Chapter 7 presents general design controls that apply to urban thoroughfare design. Design guidelines in Chapters 8 through 10 focus on the streetside, traveled way and intersection design of lower-speed thoroughfares, but much of this guidance also can be applied to higher-speed facilities.

Who Should Use This Report

This report is for practitioners and stakeholders involved in planning and designing urban thoroughfares for walkable communities. Users are encouraged to consider the principles and guidelines in this report in conjunction with applicable local policies and manuals. **Table 1.2** presents many of the intended users and their responsibilities where CSS principles may be considered. Each user listed in **Table 1.2** represents a different set of stakeholders that bring different perspectives and responsibilities to the transportation planning and project development processes to best meet the needs of all the stakeholders. However, all users may benefit from an understanding of CSS principles and how they might be integrated into their work.

Table 1.1 Contents of This Report

Chapter Title	Material that is Addressed
Part 1: Introduction	
1—Foundation	The background behind this guidance and an overview of the principles of CSS.
Part 2: Planning	
2—Planning and Developing Context Sensitive Urban Thoroughfares	An overview of the transportation planning and project development process and how CSS principles are applied with these processes.
3—Network and Corridor Planning	An overview of thoroughfare network types, characteristics of successful networks and network design guidelines. An overview of the corridor planning process and the role of CSS.
4—A Framework for Walkable Urban Thoroughfare Design	An introduction into the design framework for context sensitive thoroughfare design, context zones, their characteristics and the features that create context and a description of thoroughfare types and their relationship with functional classifications, compatibility with context zones and general design parameters.
Part 3: Design	
5—Thoroughfare Design Process	A process for using this report to design thoroughfares, how to design thoroughfares within constrained rights of way and flexibility in the application of design criteria.
6—Thoroughfare Designs for Walkable Urban Areas	General design parameters for thoroughfare types, variations in the streetside and traveled way under varying conditions and example thoroughfare designs.
7—Design Controls	A discussion of the engineering controls and level of flexibility critical in context sensitive design, including design vehicle, roadway geometrics and design speed.
8—Streetside Design Guidelines	General principles, design considerations and detailed guidance for the design of the elements that comprise the streetside.
9—Traveled Way Design Guidelines	General principles, design considerations and detailed guidance for the design of the elements that comprise the traveled way.
10—Intersection Design Guidelines	General principles, design considerations and detailed guidance for the design of the elements that comprise multimodal intersections.

Table 1.2 Intended Users and Responsibilities

User	Responsibilities
All Users	• Participate in preparing transportation plans; • Help establish community vision and project goals and objectives; and • Help develop and evaluate thoroughfare concepts, alternatives and impacts.
Transportation Planner	• Develops and evaluates long-range transportation plans; • Helps establish community vision and project goals and objectives; • Develops and evaluates thoroughfare concepts, alternatives and impacts; and • Works with public, stakeholders and multidisciplinary teams to integrate transportation and land use planning.
Traffic/Civil Engineer	• Prepares purpose and need for transportation projects; • Develops initial thoroughfare concepts and prepares detailed evaluations of these concepts; • Identifies design controls and parameters, constraints and trade-offs; • Works with public, stakeholders and multidisciplinary teams to resolve design challenges; and • Prepares preliminary and final engineering plans.
Land Use Planner	• Develops long-range land use plans; • Helps establish community vision and goals and objectives for neighborhoods and corridors; • Works with multidisciplinary team to establish and identify context; • Formulates land use policy that affects thoroughfare design; and • Establishes land use regulations (subdivision, zoning and so forth) that guide context.
Design Professional - Architect - Urban Designer - Landscape Architect	• Designs integral elements of the thoroughfare and its surrounding context including buildings, sites and streetscape features; • Works with public, stakeholders and multidisciplinary teams to resolve design challenges; and • Prepares environmental assessments; identifies impacts and mitigation measures.
Stakeholders - Elected Officials - Appointed Commissioners - Developers - Local, Regional and State Agencies - Citizens	• Provide local and regional input and leadership; • Provide funding and financing mechanisms for development of context and thoroughfares; • Have jurisdiction and approval authority over plans and designs; and • Work closely with the general public to achieve community acceptance of projects.

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PART 2

Planning

Chapter 2

Planning and Developing Context Sensitive Urban Thoroughfares

Purpose

This chapter describes, in general terms, the transportation planning and project development processes. It provides a broad overview of each stage of the processes and emphasizes that CSS principles can be applied at each stage. The transportation planning overview in this chapter provides the background for the practitioner to understand the principles and guidance on network and corridor planning presented in Chapter 3. Similarly, the overview of the project development process introduces the stages for planning and designing roadway improvement projects, which supports the information presented in Chapters 4 through 10.

Objectives

This chapter

1. Broadly describes how CSS principles can be integrated into the transportation planning process; and
2. Describes how CSS can be integrated into the project development process and identifies the applicable steps.

CSS in the Transportation Planning Process

Transportation planning is a continuing, comprehensive and collaborative process to encourage the development of a multimodal transportation system to ensure safe and efficient movement of people and goods while balancing environmental and community needs. The process is designed to promote involvement by all levels of government, stakeholders and the general public. The transportation planning process is concentrated at four levels of government: federal, state, metropolitan, or regional, and local agency. **Table 2.1** describes the planning roles and responsibilities at the various government levels and shows how CSS can be applied at each level.

The planning process examines demographic characteristics and travel patterns for a given area, shows how these characteristics will change over a given period of time and evaluates alternative improvements for the transportation system. **Table 2.1** also summarizes how CSS can be applied in each of the planning tiers. The planning tiers are divided into four levels:

1. National—Responsible for legislation and oversight and development of policies and regulations, as well as providing funding for transportation projects at the state, regional and local level.
2. Statewide—Responsible for long- and short-range transportation planning, development of transportation regulations and standards, oversight and development of transportation programs, transportation funding and implementation, and maintenance and operation of the state highway system.
3. Metropolitan or Regional–Responsible for areawide planning, projections and coordination; generally these agencies are metropolitan planning organizations (MPOs) in urbanized areas with more than 50,000 population or cover rural and small city regions outside the MPO areas. MPOs also coordinate metropolitan plan adoption, project selection and allocation of federal and some state funding.
4. Local Agency—Responsible for local planning and project development, operations and maintenance of transportation facilities.

The consideration of CSS principles can allow the different agency planning-level goals and objectives to be reflected in the initial or early development of individual projects and may convey information for use in defining the purpose and need. In addition, CSS considerations in transportation planning can identify issues or decisions facing the region, allowing for consensus and a shared understanding of the major sources of change that affect the future.

Table 2.1 Transportation Planning Tiers and CSS Applications

Tier	Responsibilities	CSS Applications
National	• Authorizing legislation • Federal regulations • Federal policy • Research programs • Highway construction funding	• Interpreting legislation • Federal policy and regulations • Development of CSS and flexible design guidance • Demonstration projects • Research programs addressing design issues
Statewide	**Statewide State DOT Long-Range Planning (10 to 50 Years)** • Strategic plans • Transportation plans • Plans and programs **Programs and System Plans (5 to 10 Years)** • System and corridor planning • Strategic system plans • Regional/agency operational programs and plans • State transportation improvement programs (STIP) • Highway construction funding	• Network design and connectivity plans • Multimodal and CSS policies • Public participation in CSS vision and plan development • Developing CSS and flexible design guidance • State design manual revisions • Context sensitive designs of highways and thoroughfares • Coordination with resource agencies • Demonstration programs • Staff and local agency training • CSS funding partnerships
Regional/Metropolitan	**Regional Long-Range Planning (10 to 50 Years)** • Agency strategic plans • Regional transportation plans • Agency plans and programs **Programs and System Plans (5 to 10 Years)** • System and corridor planning • Strategic system plans • Agency and regional transportation improvement programs (TIPs) • Transportation construction funding, coordination and prioritization	• Network design and connectivity plans • Multimodal and CSS policies • Context sensitive highway and thoroughfare corridor studies • Coordinating among agencies • Staff and local agency training • CSS funding partnerships
Local Agency	• Operations, management strategies and plans • Roadway improvement projects • Planning, design and enhancements • Support services • Capital improvement programs	• Local design manual/standards • Corridor plans • Thoroughfare plans • Multimodal and CSS policies in comprehensive plans • Integrating CSS into project development process (includes public participation)

Source: Adapted from *Freeway Management and Operations Handbook*, Federal Highway Administration

Integrating CSS principles within the transportation planning process assists regions and communities in reaching their transportation goals by encouraging the consideration of land use, transportation and infrastructure needs in an integrated manner. When transportation planning reflects community input and takes into consideration the impacts on both natural and human environments, it also promotes partnerships that lead to "balanced" decision making. Incorporating CSS considerations within transportation planning also produces better environmental results by advancing the ability to identify sensitive environmental resources while facilitating cooperative interagency relationships.

The benefits of integrating CSS in the planning process encourages public support for transportation plans and cooperation among agencies, reduces project delays by minimizing controversy and saves time and funds. CSS also fosters conservation of environmental and community resources. The probable benefits when working collaboratively with stakeholders includes the production of a full range of options, an understanding of trade-offs and consensus on key decisions. This results in information that directly feeds into, and accelerates the project development process.

Without adoption and support of CSS principles by agencies (for example, policies, procedures, standards and programs), it will be challenging and difficult to apply CSS in either a transportation planning process or improvement project. If a regional long-range transportation plan or local corridor plan has not incorporated a process that considers CSS, it may limit the range of options and the best overall solution. For example, changing the functional classification of a roadway to be more compatible with its surroundings should be considered at the level of the long-range transportation plan so that the change can be evaluated within the context of the entire network. Without a large-scale evaluation and adoption of the change in a plan, it will be difficult to change the functional classification at the project development stage, even if conditions justify the change.

Complete Streets

Some communities have adopted "complete streets" laws and policies to ensure that their roads and streets are routinely designed and operated to provide the safest achievable access for all users, including motorists, bicyclists, pedestrians and transit riders. In communities with complete streets policies, the objective is for pedestrians, bicyclists, motorists and transit riders of all ages and abilities to be able to safely move along and across an urban street.

A complete streets policy creates a routine process for providing for all travel modes whenever a street is built, altered, or maintained. Such policies have been adopted at the state level in the United States (Oregon, California, Illinois, South Carolina and Virginia), by MPOs (Central Ohio, California Bay Area) and by local governments (Charlotte, NC; Sacramento, CA; Boulder, CO; and Chicago, IL).

Communities with street projects will benefit greatly from the application of CSS principles. The recommendations of this report can help communities implement complete streets policies.

While context sensitive solutions involve stakeholders in considering a transportation facility in its entire social, environmental and aesthetic context, complete street policies are a reminder that providing for safe travel by users of all modes is the primary function of the corridor. Under complete streets, basic accommodations for bicyclists, pedestrians, transit users and disabled travelers are necessities rather than optional items. All modes and users are important on all thoroughfares.

For more information on complete streets, visit www.completestreets.org.

The process usually involves the steps shown in **Figure 2.1.** The general process is introduced here to demonstrate how each stage provides an opportunity to integrate CSS principles, beginning with the first step in the process—developing a vision, goals and policies. Below is a brief discussion of each step and the possible outcomes when CSS is part of the process.

Vision and Goals: It is at this step that the overall vision and goals for how the transportation system shall be designed, built, operated and maintained is decided. Applying CSS principles, at this level

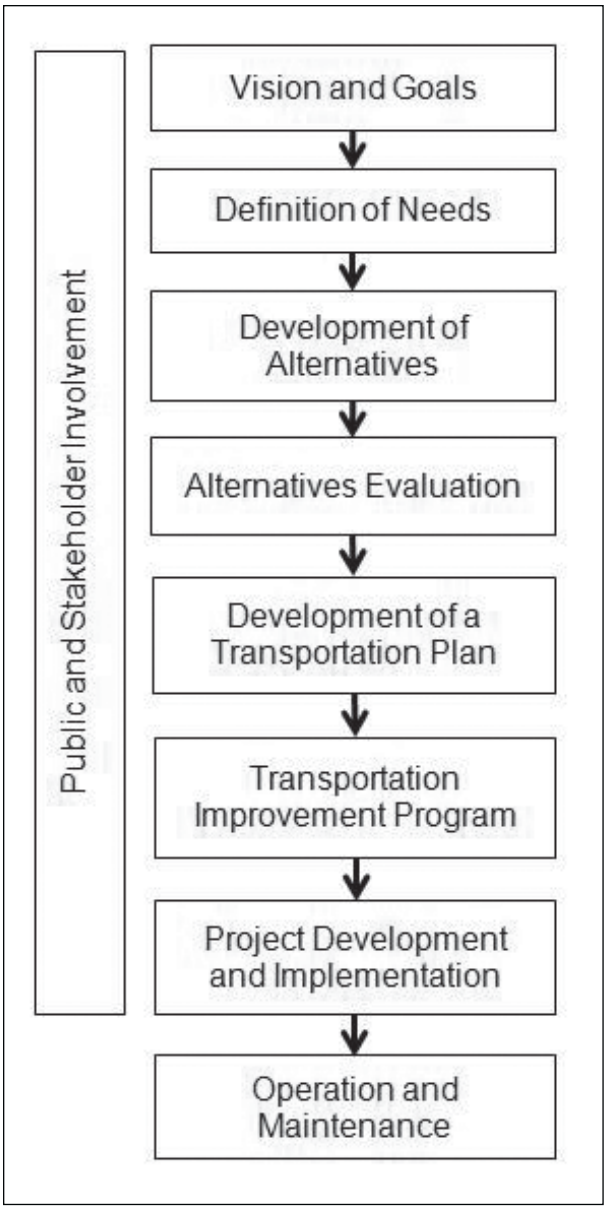

Figure 2.1 Transportation planning process.
Source: Kimley-Horn and Associates, Inc.

helps to integrate the regional, local and neighborhood vision for the physical nature and economic vitality of communities. CSS principles can result in compatibility between the facility and its surroundings so that the two are mutually supportive, whether in urban or rural settings. Possible outcomes of this step include:

- Long-range vision for the community and project;
- Community values and issues;
- Supporting data;
- Community and agency priorities;
- Development of a multidisciplinary team;
- Education of stakeholders regarding issues, process and constraints; and
- An established planning process that identifies decision points and stakeholder roles and responsibilities.

Definition of Needs: A process that incorporates CSS, inclusive of all stakeholders, can help define the needs of the transportation plan or project based on the goals, objectives and visions established earlier. By proactively identifying stakeholder values, issues and concerns, CSS allows development of an inclusive problem/need statement consistent with applicable policies and requirements. The possible outcomes of this step include:

- Acceptance of a problem statement that reflects community and agency perspectives;
- A broad and comprehensive needs statement reflecting community values as well as the transportation need; and
- Evaluation criteria and performance measures.

Development of Alternatives: CSS encourages use of the vision, goals and needs as the basis for developing a full range of options in a collaborative and participatory process, resulting in flexible and innovative solutions. Objectivity in developing the alternatives is critical. What seem at first sight to be infeasible options often can be refined into workable solutions. The possible outcomes of this step include:

- A full range of alternatives that meet the needs statement;
- Avoiding unlikely (straw man) alternatives;
- Opportunities for enhancement and flexibility to modify alternatives;
- Consideration of all modes and all users;
- Consideration of innovative and feasible solutions; and
- Clear, understandable and graphical portrayal of alternatives.

Alternatives Evaluation: CSS encourages objective evaluation of the trade-offs between different alterna-

tives, always relating back to evaluation criteria. As a result, stakeholders will be better able to support and endorse plans and designs. The possible outcomes of this step include:

- Participatory and transparent evaluation process;
- Clear assessment of trade-offs;
- Equal level of assessment for accurate comparison;
- Information to assist decision makers; and
- Clear reasoning behind rejection of alternatives.

Development of a Transportation Plan and Transportation Improvement Program (TIP): CSS principles can be integrated into the development of a long-term transportation network, with a goal of achieving increasingly diverse travel modes and improving the overall operation of the transportation system. As a strategy that enhances safety and encourages all travel modes, CSS projects (transportation enhancements) may draw upon different funding sources than do conventional projects. The possible outcomes of this step include a plan that:

- Reflects the vision and community values and meets the needs statement;
- Identifies opportunities to enhance community resources;
- Encompasses traditional and innovative solutions; and
- Engenders community ownership and endorsement.

Project Development and Implementation: CSS principles can have the most profound effect on this step in the planning and design process as transportation projects are taken from the conceptual stage to implementation. The possible outcomes of this step include:

- Innovative solutions that meet project needs, reflect community values and enhance resources;
- Expedited approval of projects through early and consistent stakeholder involvement;
- Application of design flexibility and documentation of design decisions;
- Continuation of stakeholder input through design and construction; and
- Assurance that commitments made in the planning process are honored through construction.

Public and Stakeholder Involvement: CSS by definition is a process that involves, and attempts to build consensus among, a diverse group of stakeholders. The possible outcomes of this step include:

- Early involvement;
- A variety of traditional and innovative ways to engage the community (e.g., workshops, cha-

Transportation Visioning

Communities determine their own vision for transportation—describing an ideal that reflects their values, concerns and priorities. Below are examples of a transportation vision from two communities.

"Moving people and goods within and across the metropolitan boundaries safely, conveniently and reliably by providing an integrated and accessible transportation system comprised of a balanced range of travel options."

The Livable Metropolis, official plan of the Municipality of Metropolitan Toronto,

"Traffic in the corridors will be calmed to foster a relaxed, accessible, outdoor-oriented, pedestrian-friendly urban village. The issues outlined below expand upon the vision statement and become a set of principles to guide future public and private investment and also create a "measuring stick" by which to evaluate consistency with the vision, and thereby appropriateness, of these future investments:

- Slow the traffic;
- Divert cut-through traffic around Upper Arlington;
- Build safe crosswalks;
- Build sidewalks and bikeways;
- Plant more street trees; and
- Encourage redevelopment that is scaled to encourage/foster street life.

"100-year lifespan vision of Upper Arlington Streets"
Lane Avenue and Tremont Road
Street Planning and Transportation Vision, City of Upper Arlington, Ohio.

rettes, newsletters, focus groups, Web sites, interviews);

- A high level of agency credibility and public trust throughout the involvement process;
- Engagement of underserved and minority communities;
- Equal participation of stakeholders; and
- Education of the public regarding the planning and project development processes, constraints and agency perspectives.

Operations and Maintenance: The transportation planning and project development processes consider the effects of decisions on costs, liability risks and operations and maintenance. Application of CCS principles and design guidance can affect these aspects of project development and need to be carefully considered. Examples include the need to maintain landscaping, the effects of CSS design on utility maintenance and liabilities associated with certain design elements in public places. The possible outcomes of this step include:

- Plans to monitor performance (particularly design exceptions) and receive feedback; and
- Commitment to maintain facilities.

CSS in the Project Development Process

Figure 2.2 combines the basic phases of the transportation planning and project development processes for transportation facilities involving federal funds. This figure illustrates how the transportation planning process relates to the project development process. The figure is intended to show how information for transportation improvements to a thoroughfare developed in the transportation process provides input into the project development process. This type of information includes:

- Multimodal role of thoroughfares within the network;
- Relationship between land uses and the transportation system;
- Travel demand forecasts for various modes of travel;
- Performance measures and criteria used to evaluate individual transportation projects;
- Multimodal performance of the network and individual corridors;
- Specific capital projects and funding sources;
- Goals and policies that provide direction for the development of individual transportation projects; and
- Prioritization of projects.

The information presented in this report requires an understanding of the existing and future context in urban areas. The application of CSS principles also requires one to know the ways to use the design of the thoroughfare itself to provide mutual support between the thoroughfare and existing and planned adjacent land uses and development patterns. While CSS principles should be considered at the highest level of planning and be integrated into the culture of transportation agencies, in project development, CSS principles should be introduced at the earliest stage—the needs study.

Integrating CSS in the project development process significantly influences the development of project concepts. Project concepts should emerge from a full understanding of the relationship between the thoroughfare, adjoining property and character of the broader urban area. Modal emphasis should be established in the early stages of project development, not addressed as an afterthought in preliminary engineering. In the project scoping or planning step, which includes an environmental review, all alternative analyses may incorporate the principles of CSS.

CSS highlights the need for context sensitive performance measures and criteria for selecting the preferred alternative at this stage of project development. The project development process in **Figure 2.2** illustrates where the information in this report can be used in the process. The steps discussed are highlighted in the flowcharts that follow (**Figures 2.3** through **2.6**):

- **Long-Range Transportation Plan:** In this part of the process, the report's network planning and design guidelines (Chapter 3) can be used to help prepare long-range transportation plans and network connectivity supporting context-based thoroughfares. Additionally, the thorough-

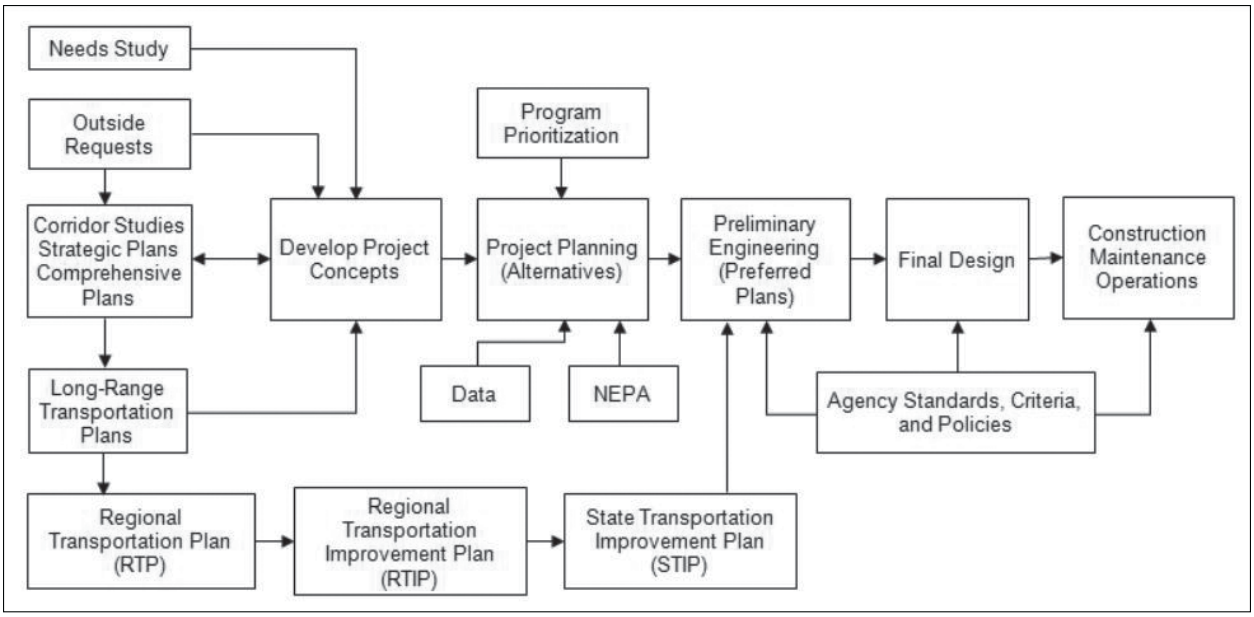

Figure 2.2 Transportation planning and project development processes. Source: Kimley-Horn and Associates, Inc.

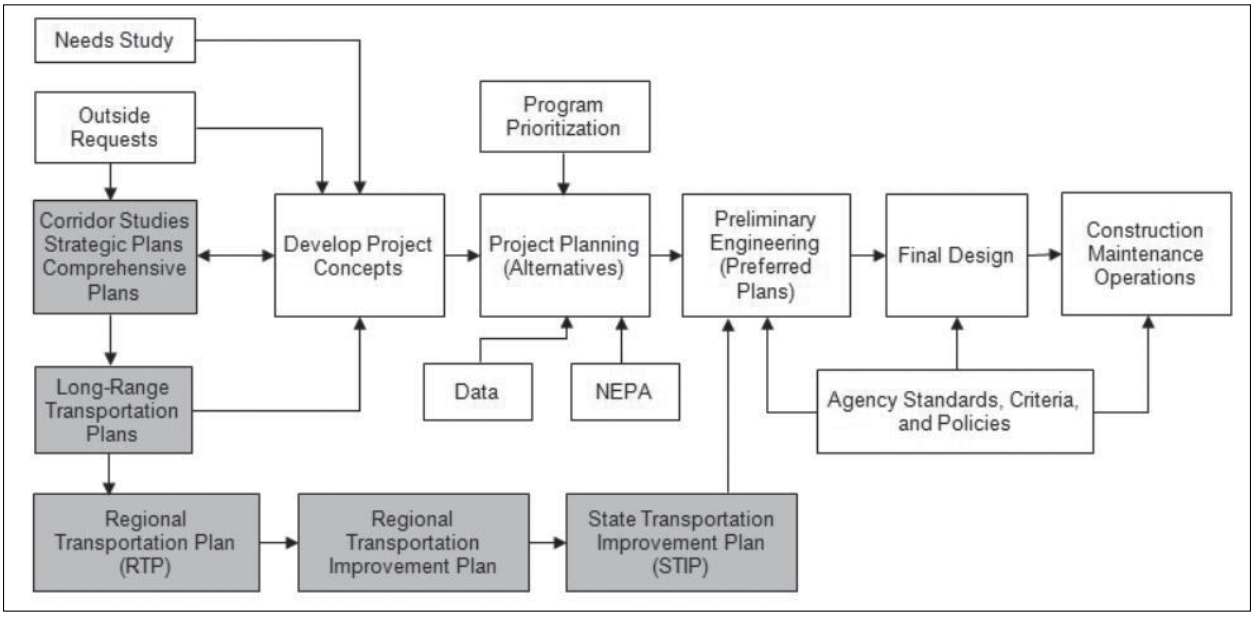

Figure 2.3 Applicable Steps in Planning Process for Long-Range Transportation Plan (shown as highlighted boxes)

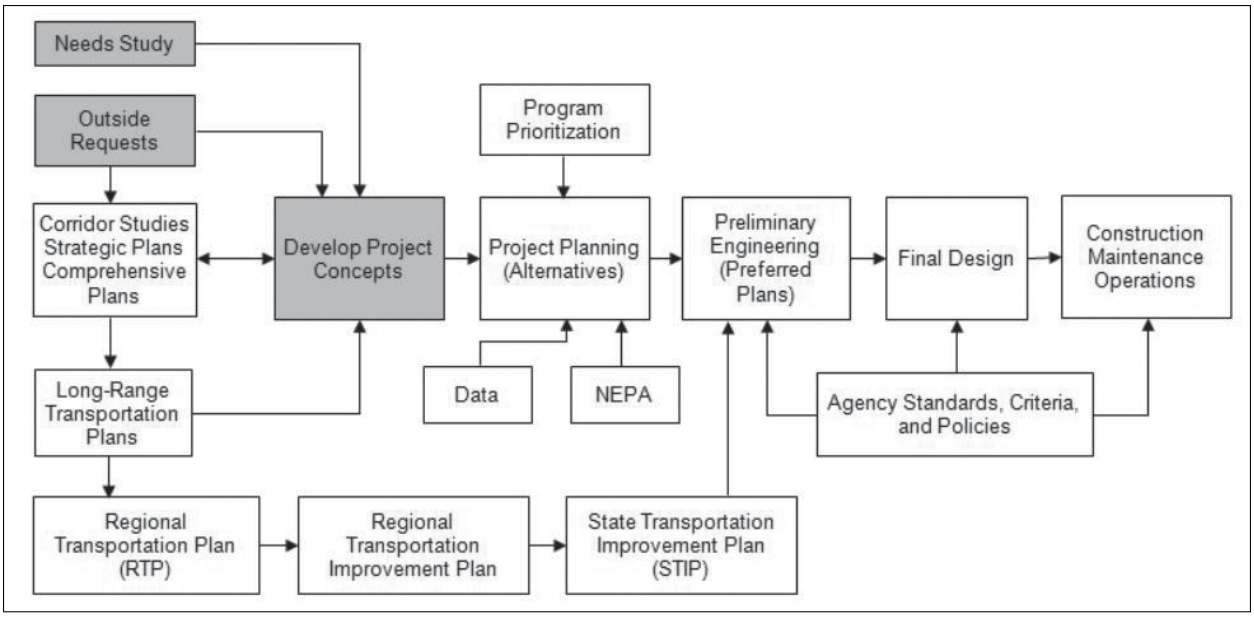

Figure 2.4 Applicable Steps in Planning Process for Needs Study and development of Project Concepts (shown as highlighted boxes)

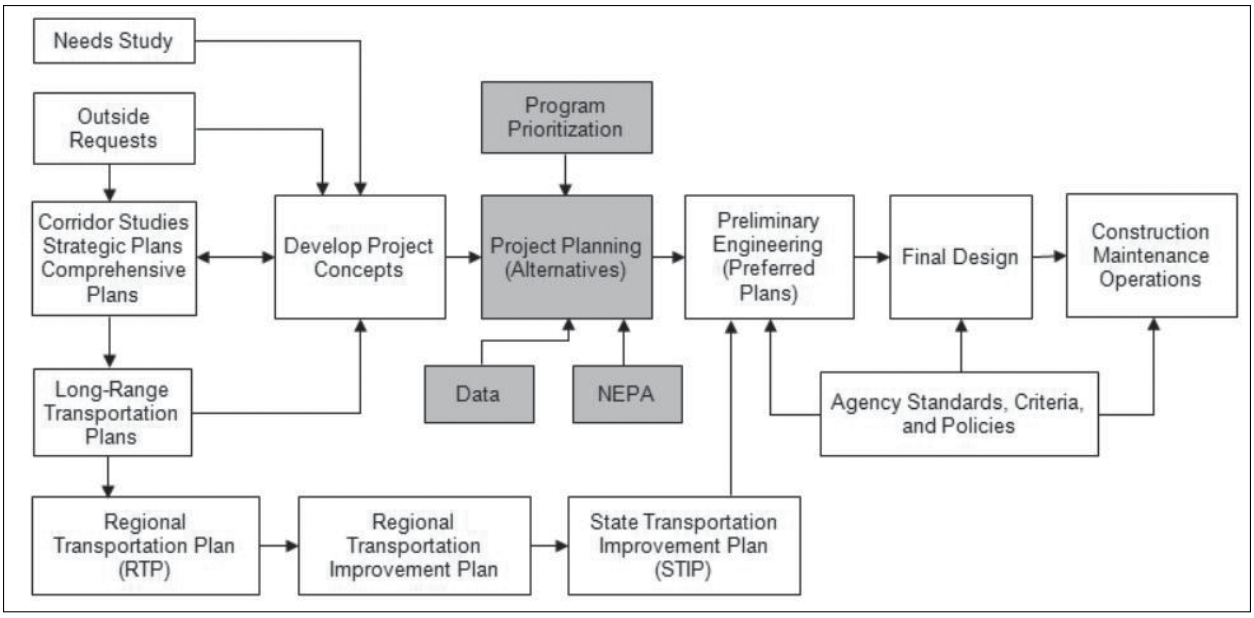

Figure 2.5 Applicable Steps in Planning Process for Project Planning and Alternatives Analysis (shown in highlighted boxes)

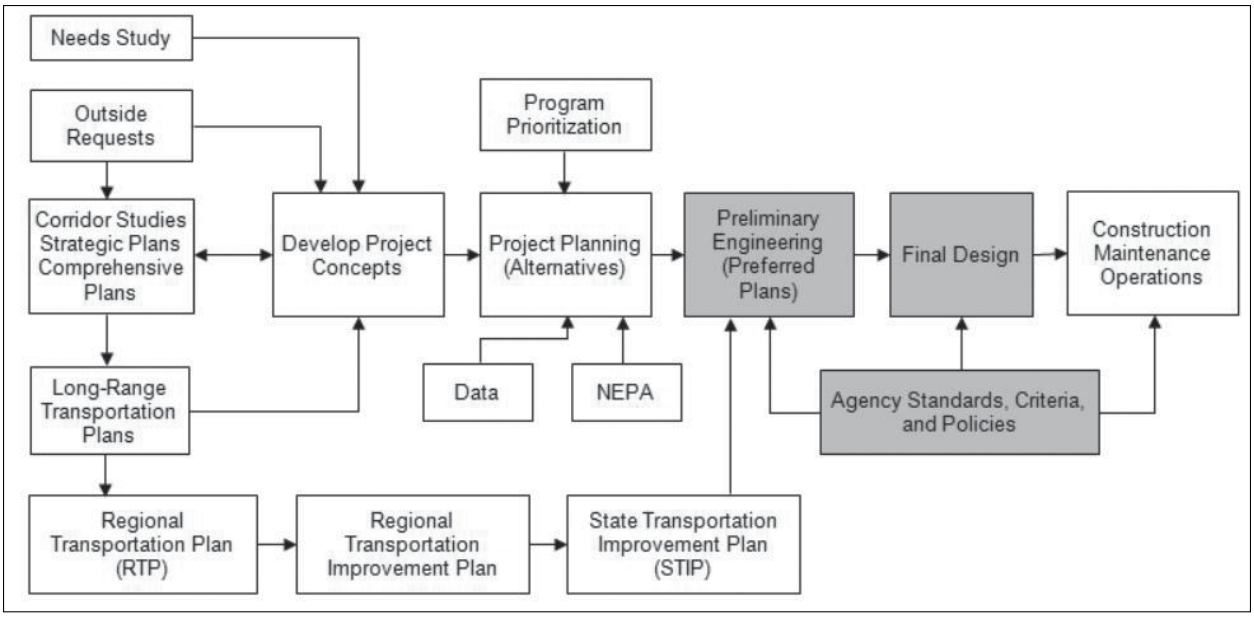

Figure 2.6 Applicable Steps in Planning Process for Preliminary Engineering and Final Design (shown in highlighted boxes)

fare types described in Chapter 4 may be integrated into the development of long-range plans. The long-range transportation planning process provides an opportunity to identify those places where local agency land use and development policies can best support urban CSS, such as pedestrian-scale districts, town center designs and transit corridors. These policy decisions can then be reflected in the development of thoroughfare classifications.

- **Needs Study and Project Concepts:** The fundamentals of urban context sensitive design, the design framework introduced in Chapter 3 and the thoroughfare design process and example thoroughfare designs (Chapters 5 and 6) are important tools in the needs study and development of project concepts. Multidisciplinary team and stakeholder involvement is critical in this early step.

  The project concept will emerge from an understanding of the relationships between thoroughfare types and context zones, along with other unique project circumstances, values, or objectives. Additionally, a thoroughfare's modal emphasis should be clearly identified in the project concept phase. Chapters 3 and 5 provide the tools for corresponding specific thoroughfare types to various contexts and describe how to prioritize design elements and assemble the cross sections based on context and potentially constrained conditions. Data input to the project concept phase of project development should include information relating to land use development patterns and design features that support present conditions and, equally important, the vision for the future context.

- **Project Planning and Alternatives Analysis:** Includes development and evaluation of alternatives and environmental review. The development of alternatives may use the techniques and design criteria presented in this report, including accessibility. Each alternative should incorporate the appropriate design characteristics compatible with the context.

- **Preliminary Engineering and Final Design:** The processes described in Part 3 of this report—thoroughfare design controls and detailed guidelines—are suitable tools for use in the preliminary engineering and final design phases of the project development process. These chapters provide information to establish an initial design for testing, identify trade-offs and prepare a final concept for engineering.

Sources of Additional Information

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Chapter 3

Network and Corridor Planning

Purpose

This chapter describes the interrelationship between the broader transportation network, corridors and individual thoroughfare segments. It presents how the principles of CSS can be used in the planning for urban thoroughfares at the network, region, or corridor levels to support or create walkable places. Understanding this relationship will contribute to the consideration of key issues and community objectives and to the development of a broader set of alternatives and improved flexibility when planning and developing transportation improvement projects.

This chapter provides the network plan context from which transportation projects are selected for further development and design. The chapter is intended to provide background related to network planning, but other documents; such as the upcoming ITE *Planning Urban Roadway Systems* and the CNU Statement of Principles on Transportation Networks contain recommendations on how to prepare such plans.

This report emphasizes the introduction of CSS principles early in the planning process. Network and corridor planning is an early opportunity to integrate community goals into specific urban thoroughfare projects. This helps expedite the project development process by identifying and addressing key issues and community objectives early, rather than for the first time during the planning and design of an individual thoroughfare project. Integrating CSS principles into the network and corridor planning process can:

- Determine how decisions for individual thoroughfare segments affect the corridor and network as a whole;
- Establish objectives, operational concepts, performance measures and thresholds, land uses, access control and functional classification for an entire network or corridor, which can be applied to individual thoroughfare segments in project development; and

The Roles of Network and Corridor Plans

Long Range or Regional Network Plan:

- Links transportation system to other metropolitan functions such as land use, environment, economy and so forth;
- Defines the transportation system for large areas in terms of corridors and guidance for the finer-grained network between corridors;
- Integrates multimodal systems such as highways, streets, freight, transit, bicycle and pedestrian; and
- Develops modal networks such as a thoroughfare plan, rail system, bus system, or bicycle network.

Corridor Plan:

- Links corridor to surrounding metropolitan functions such as land use;
- Coordinates and integrates multiple modes of transportation within the corridor; and
- Establishes the function and operation and design criteria for the individual facilities in the corridor.

Project Development Process:

- Confirms need for facility improvement;
- Develops conceptual, preliminary and final designs;
- Provides analysis of potential environmental impacts and mitigation measures; and
- Establishes costs and implementation program.

- Allow for policy, political and public debate on issues that impact a broader area than an individual thoroughfare segment (e.g., regional, corridor, community).

The early integration of CSS principles will influence desired change systematically rather than a piecemeal process.

Objectives

This chapter

1. Provides CSS principles and considerations for planning and designing transportation networks and corridors;
2. Provides guidelines on how CSS principles can be applied and design issues addressed at the network or corridor planning level;
3. Emphasizes that solutions may be found at the scale of the network and corridor rather than the individual thoroughfare (such as a denser network of streets or parallel facilities that provide equivalent function and capacity to the alternative of widening an individual thoroughfare); and
4. Shows how thoroughfares function within a network and how the CSS approach to improvements of specific segments of a thoroughfare relate to the thoroughfare's role in the network.

The guidelines presented in this chapter apply to both new development and retrofit conditions. Improving an existing situation will depend on the degree of connectivity, flexibility and capacity of the existing network, and the extent the network can be modified to accommodate the desired improvements.

Introduction

Chapter 2 presented a broad overview of the transportation planning and project development processes and described how CSS principles can be applied in each step of the process. This chapter builds on Chapter 2 by describing principles and guidelines that can be used at the network and corridor scales to create or improve urban walkable areas.

Network, or "system," planning sets the strategic direction and framework around which the various components and facilities will eventually be constructed or redeveloped. It is a series of high-level incremental plans leading to the design of individual thoroughfare segments that is consistent with the framework. Network planning defines goals for all modes of transportation and facilities. These long-range plans typically contain:

- A vision for the ultimate transportation system, goals and policies related to each mode of travel;
- Technical information on travel patterns and forecasts;
- A capital program for individual projects as part of the transportation system; and
- An action plan for implementing the plan over time.

The long-range transportation plan should consider the role and function of a multimodal transportation network for an entire region or metropolitan area. Corridors are transportation pathways that provide for the movement of people and goods between and within activity centers. A corridor plan encompasses single or multiple transportation routes or facilities (such as thoroughfares, public transit, railroads, highways, bikeways, trails, or sidewalks), the adjacent land uses and the connecting network of streets.

Corridor planning encompasses a scale that is large enough to consider the context and network, but small enough to be comprehensible by the public. Corridor planning applies multiple strategies to achieve specific land use and transportation objectives along a transportation corridor, combining capital improvements and management strategies into a unified plan for the corridor.[1]

CSS in Network Planning

Oftentimes the challenges encountered creating more walkable urban thoroughfares can be resolved at the scale of the network or the corridor. Network planning:

- Establishes a framework for the transportation system;

1 Corridor planning as defined by the New York State Department of Transportation.

- Distinguishes for individual segments;
  - Functions;
  - Modal emphasis; and
  - Operational features.

Familiar characteristics addressed include:

- Alignment;
- Spacing;
- Functional classification;
- Access control;
- Determination of number of lanes; and
- Designation for major freight and transit routes.

Ideally, network planning takes place at the early stages of regional development and is integrated into a comprehensive planning process that concurrently addresses land use, transportation and environmental resource management. In practice, especially in areas with multiple jurisdictions, network planning is often conducted in a piecemeal manner by multiple agencies with different geographic jurisdictions, missions and powers. For the practitioner planning or designing a thoroughfare segment, considering network design and function can lead to solutions that balance between demands for vehicle throughput and support for adjacent development.

The design process—the subject of this report—needs to recognize the role of a thoroughfare as part of a large-scale, multimodal network. The project development process should consider the regional, subregional and neighborhood functions of the thoroughfare in relation to urban form and character. The design of the individual thoroughfare, therefore, is linked to both its context and the performance of the network. A multimodal network may identify some thoroughfares that emphasize vehicles or trucks, while others emphasize pedestrians and transit.

CSS merges a community's comprehensive corridor objectives with mobility objectives in a manner acceptable to a variety of stakeholders. Two critical common characteristics for desirable thoroughfares are compatibility and support for the corridor context and providing a high degree of multimodal connectivity.

The context may vary along the length of the thoroughfare. The combination of function, context, or other changes may cause the design of the thoroughfare to vary along its length.

Network characteristics have a meaningful impact on urban development patterns. For example, compact, mixed-use areas are dependent on a pattern of highly connected local and major thoroughfares. The high level of connectivity results in short blocks that provide many choices of routes to destinations, support a fine-grained urban lot pattern and provide direct access to many properties. Walkable suburban areas should be similarly supported by a high level of street or path connectivity.

One fundamental tension that is commonly encountered in the application of CSS principles is between the desire of local residents to emphasize character and walkability in thoroughfare design and the desire of transportation agencies to emphasize vehicle capacity or the ability to accommodate projected regional travel demand. The tension between these objectives is best addressed through consideration of the broader network and corridor in conjunction with the individual thoroughfare.

Network characteristics are factors that provide opportunity for CSS. Connectivity, parallel routes and corridor capacity contribute to a transportation system that can accommodate projected demand by dispersing traffic, transit, freight and bicyclists across a system of parallel roadways.

This report addresses urban thoroughfares except limited-access facilities and local streets. However, when considering network design, properly located express thoroughfares—freeways/tollways, expressways and parkways—supplement the urban arterial thoroughfare network by providing high-speed, high-capacity service for longer trips. High vehicular capacity facilities permit other thoroughfares to balance the movement of traffic with other local objectives. If well connected to the larger thoroughfare network, local streets can also provide parallel capacity in the network to accommodate local, shorter trips.

Figure 3.1 Example of a conventional network.
Source: Data available from U.S. Geological Survey, EROS Data Center, Sioux Falls, SD.

Figure 3.2 Example of a traditional network.
Source: Data available from U.S. Geological Survey, EROS Data Center, Sioux Falls, SD.

Effective Network Planning for Walkable Areas

Network planning at the regional scale by regional or metropolitan planning agencies typically includes only highways, arterials and major collector systems. The planning of the finer grid of local residential and commercial streets is typically prepared at the county and/or city scale. As described above, regional network planning establishes the framework for the planning of county- and citywide networks. County- and citywide transportation plans establish a framework for planning and designing the local street system and individual thoroughfares. Finally, site planning and the project development process achieve the highest level of detail. The network types discussed below encompass both regional and local scales, since later discussions on thoroughfare design are influenced by the pattern of fine-grain networks.

Network Types

Most urban areas have a system of arterial streets, some of which may be highways. The most efficient systems have arterials with extended continuity, usually traversing all or much of an urban area except where barriers exist. The most efficient urban networks—which provide enough parallel streets to provide route flexibility and an opportunity for special street functions—have arterials spaced at half a mile or less. The important features of the arterial systems are connectivity and continuity.

Within the arterial street framework is a finer network of thoroughfares. These finer networks are sometimes characterized as either "traditional" or "conventional."

The typical conventional street network is often characterized by a framework of widely spaced arterial roads with connectivity limited by a system of large blocks, curving streets and a branching hierarchical pattern often terminating in cul-de-sacs (**Figure 3.1**). In contrast, traditional networks (**Figure 3.2**) are typically characterized by a less hierarchical pattern of short blocks and straight streets with a high density of intersections.

The prototypical traditional and conventional networks differ in three easily measurable respects: (1) block size, (2) degree of connectivity and route choice and (3) degree of curvature. While the last measure does not significantly affect network performance, differences in block size and connectivity create very different characteristics.

Comparative Advantages

Both network design types have advantages. Advantages of traditional grids include

- Dispersing traffic rather than concentrating it onto a limited number of thoroughfares, thereby reducing the impacts of high traffic volumes on residential collectors;
- More direct routes, which generate fewer vehicle miles of travel (VMT) than conventional suburban networks;

- Reducing travel delay by allowing travelers to choose alternate routes to destinations for convenience, variety, or to avoid construction or other blockages and to increase reliability of the network;
- Facilitating circulation within an area by all travel modes;
- Encouraging walking and biking with direct routing and options to travel along high- or low-volume streets and development patterns that can offer a variety of complementary destinations within close proximity;
- More transit-friendly systems, which offer users relatively direct walking routes to transit stops;
- A smaller block structure where land use can evolve and adapt over time, providing development flexibility;
- A redundancy of the network, which benefits emergency service providers, offering multiple ways to access an emergency site;
- Regularly spaced traffic signals that can be synchronized to provide a consistent speed and more frequent pedestrian crossings; and
- Opportunities for special thoroughfare uses and designs.

In contrast, conventional networks have some advantages over traditional urban grids. Advantages of conventional networks include:

- Concentration of traffic on a few routes—beneficial for auto-centric business needs;
- Reduction of through traffic within neighborhoods that results in lower traffic volumes on local streets (although traffic is higher on streets outside neighborhoods);
- Some very low-volume cul-de-sacs, which may be desirable to many residents;
- Perception of increased neighborhood security and more flexibility to accommodate large developments; and
- Increased adaptability to areas with severe topographic constraints or other barriers.

Both traditional grid and conventional networks have livability impacts that may be considered a benefit or detriment, depending on the context and one's perspective. The impact of traditional grids results from the dispersion of traffic, resulting in some local residential streets experiencing higher traffic volumes than a similar street in a conventional network. The impact of conventional networks is the concentration of traffic, congestion and associated impacts into fewer residential arterials and collectors.

Urban Form and Transportation Networks

Transportation and land use interact with each other. Such relationships can vary by land use type, whether on a regional, community, or localized scale. This section describes this relationship.

Metropolitan planning organizations (MPOs) model travel behavior using area types such as central business district, fringe and rural. The U.S. Census Bureau definitions aid in planning by defining urban areas and dividing them into urbanized areas having more than 50,000 population and urban clusters having less than 50,000 population. Rural areas make up the remainder of the land area. Urbanized areas have structured MPO planning procedures and guide the allocation of federal transportation funding. Comprehensive plans for communities also identify areas as commercial, residential, or office use.

None of these definitions sufficiently describes urban context at a level of detail that relates the context to the transportation system or to thoroughfare design. Designers need to know the intensity of urban development and the desired travel modes that best serve its users. Context intensity gradations—called context zones—distinguish the urban built environment adjacent to and surrounding thoroughfares.

Context zones describe the physical form and character of a place. This includes the mass or intensity of development within a neighborhood or along a thoroughfare. Context zones are typically applied at the neighborhood or community level, but for the purposes of thoroughfare design, context zones are interpreted on a block-by-block basis to re-

spond to specific physical and activity characteristics. Chapter 4 further describes context zones and describes how they are used in designing walkable urban thoroughfares. In planning, understanding the context zones sets the scale for design of the regional transportation network as well as individual transportation facilities.

Planning Urban Transportation Networks

Urban thoroughfare design should be based on a combination of local needs and the role of the thoroughfare in the area or region's transportation network. The thoroughfare network should be planned to support the needs generated by the planned land uses (including intensity) while at the same time being compatible with the characteristics of the resulting neighborhoods and community—areas that may have widely varying needs, features and activity levels. The community may also have a variety of goals associated with specific neighborhoods, areas, or corridors that the thoroughfares (individual and as a network) should support.

The thoroughfare network develops from its existing state and expands in accordance with a community's comprehensive plan (or transportation plan). The density (spacing) of the network, the capacity (lanes, walkway, bicycle, transit), the space for furnishings and other components of the right of way should encourage and support the development pattern, land use type and level of development intensity in accordance with the plan. The total transportation network should function as a system of thoroughfares consisting of vehicular, pedestrian, bicycle and transit facilities that together meet and support the needs of the communities' desired urban form and growth.

Figure 3.3 shows a simplified example of a network of thoroughfares, along with context zones. For illustrative purposes, the network contains a principal street that passes through several different context zones, typical of many major thoroughfares. Also shown are boulevards, avenues and streets in a highly connected network that ultimately connects to the regional highway system. Network capacity, in the form of a dense system of thoroughfares (not necessarily more travel lanes on individual facilities), needs to be greatest in the high-intensity areas.

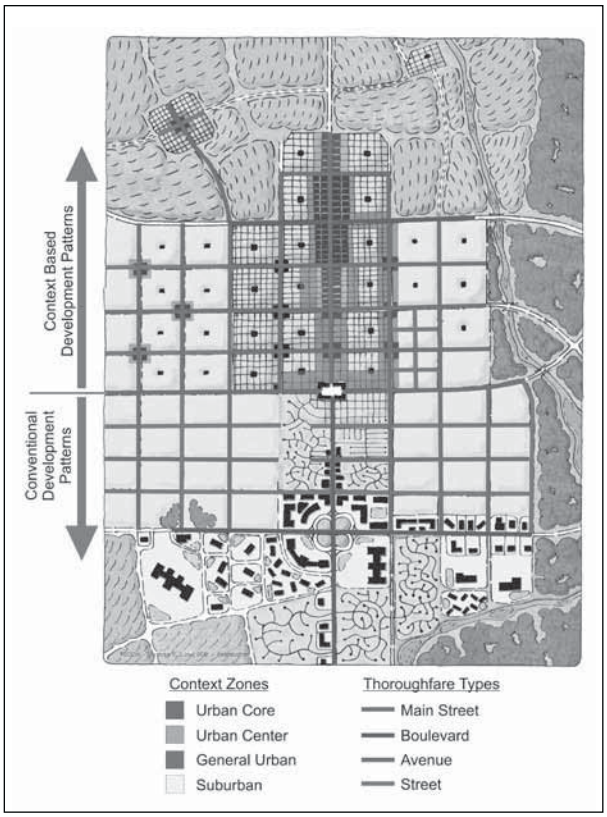

Figure 3.3 Context based development patterns are formed around a highly connected network of walkable thoroughfares. Source: Thomas Low (DPZ) and Digital Media Productions.

The level of capacity in these high-intensity areas will depend on the degree of interaction among local land uses, the amount of multimodal activity generated and the amount of through travel using the network. As further described in Chapter 4, the design of the individual thoroughfare needs to respond, adjust and support the different development and activities associated with changes in context zone.

Network Planning Principles for Walkable Urban Thoroughfares

The following principles describe an approach for planning and designing urban thoroughfare networks that are sensitive to community objectives and context and will help create a more walkable environ-

ment on appropriate facilities in the network. These principles should be considered together to create effective networks.

Planning Multimodal Networks

- Multimodal network planning should be integrated into long-range comprehensive plans that address land use, transportation and urban form.
- Network planning should address mobility and access needs associated with passenger travel, goods movement, utilities placement and emergency services.
- Reserving right of way for the ultimate width of thoroughfares should be based on long-term needs defined by objectives for both community character and mobility.

Indices For Network Connectivity and Accessibility

- **Links and nodes** (index): Roadway (or modal) links divided by the number of nodes (intersections). Ranges from 1.00 (poorest level; all cul-de-sacs) to 2.50 (full grid). Minimum index defining a walkable community is 1.4 to1.6.
- **Intersection ratio:** The ratio of intersections divided by intersections and dead ends, expressed on a scale from zero to 1.0 (US EPA, 2002). An index of more than 0.75 is desirable.
- **Average intersection spacing:** For walkability, a maximum distance of 660 feet; desirable spacing is less than 400 feet.
- **Intersection density:** The number of surface street intersections within a given area, such as a square mile. The more intersections, the greater the degree of connectivity.
- **Blocks per square mile:** For walkability this index should be at least 100.
- **Directness (index):** Actual travel distance divided by direct travel distance. Ideal index is 1.0. For walkability, index should be 1.5 or less.

Sources: Texas Transportation Institute, Adapted from: Donohue, Nick, "Secondary Street Acceptance Requirements," Office of the Secretary of Transportation, Commonwealth of Virginia. Spring 2008. "Smart Growth Index Model," U.S. EPA 2002.

Network planning should be refined and updated to define alignments and to establish the role of thoroughfares as more detailed planning and development occur.

Street Connectivity and Spacing

- Networks should provide a high level of connectivity so that drivers, pedestrians and transit users can choose the most direct routes and access urban properties. Connectivity should support the desired development patterns. Networks should provide intermodal connectivity to easily transfer between modes.
- Intersperse arterial thoroughfares with a system of intermediate collector thoroughfares serving local trips connecting neighborhood and subregional destinations.
- Expand the typical definition of collectors to recognize their role in connecting local origins and destinations in order to distribute trips efficiently, keep short local trips off the arterial system and provide a choice of routes for transit, pedestrians, drivers and bicyclists (**Figure 3.4**).
- Build network capacity and redundancy through a dense, connected network rather than through an emphasis on high levels of vehicle capacity on individual arterial facilities. This approach (more thoroughfares rather than wider thoroughfares) ensures that the network and thoroughfare facilities can support other objectives such as pedestrian activity, multimodal safety and support for adjacent development.
- Highly connected networks may reduce or eliminate the need for additional capacity that results from poorly connected thoroughfares by providing highly connected networks.
- Minimize property access directly onto arterials through design of a connected network of closely spaced arterial and collector thoroughfares and local street connections. With fewer driveway-type interruptions, arterial thoroughfares can perform more efficiently for both vehicles and for pedestrians. Thus, network connectivity can provide a foundation for access management strategies to increase corridor capacity and accessibility.

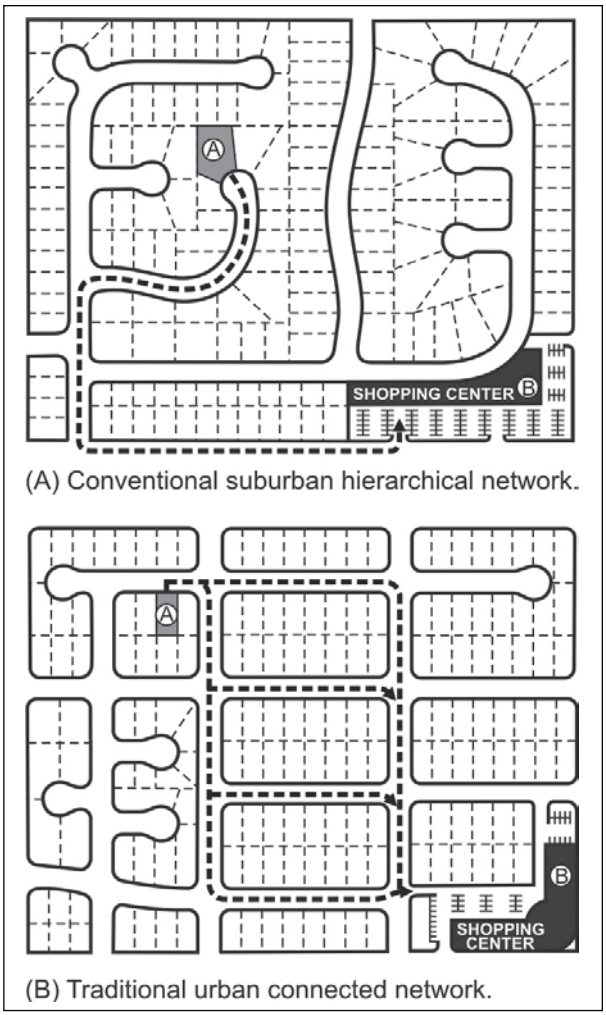

Figure 3.4 The collector in a typical hierarchical network (A) channels traffic from local streets to the arterial street system. A system of parallel connectors (B) provides multiple and direct routes between origins and destinations. Source: Kimley-Horn and Associates, Inc. and Digital Media Productions.

Performance Measures

Performance measures should be selected to describe how well the system will perform in accordance with network objectives. Such measures are often used to compare network plan alternatives or measure performance of a network according to specific objectives. The following may aid in selecting appropriate measures:

- Select transportation performance measures that reflect stakeholder objectives and priorities for the system or facility being planned or designed. Some of these may not be strictly transportation measures but include economic development and other types of measures.
- Use performance measures that recognize all modes.
- Performance goals can vary for different parts of the network as long as direct comparisons are made to the same measures.
- Performance measures could include conventional measures of vehicle congestion, capacity and density, considered at a networkwide or corridorwide level.
- To reflect walkability and compact development, consider measures such as a connectivity index, intersection density measures and pedestrian environment measures.
- Selected performance measures should include measures of safety for all users.

NCHRP Report 446, A Guide to Performance-Based Transportation Planning, provides more information on performance measurement.

Network Design Guidelines

This section provides specific considerations and guidelines for network design. The guidelines provided in this section are applicable for:

1. Greenfield development—establishing, augmenting, or reconfiguring a system of thoroughfares to serve an undeveloped or newly developing area or long-range plans for future development.
2. Reuse and redevelopment—large projects in mature urban areas that permit reconfiguration or changes in the function of adjacent or nearby thoroughfares. In these situations, changes might include the following:
   - Surrounding land uses;
   - Thoroughfare alignment or the addition of new routes or connections;
   - Emphasis in mode or usage (such as exclusive busways, wider sidewalks to serve adjacent economic activities and addition of bike lanes) or accommodating freight movement;
   - Functional classifications; and
   - Modal split allowing reallocation of (network) right of way among modes.

Ten Thoroughfare Network Planning Principles

Major thoroughfare networks should

1. Connect and provide access to and between communities, centers of activity and neighborhoods of all types, as well as recreational and cultural facilities;
2. Form a gridlike pattern of continuous thoroughfares except as precluded by topographic barriers;
3. Conform with and follow natural topographic features and avoid adverse impacts to natural resource areas;
4. Meet spacing and connectivity criteria similar to those presented in this chapter;
5. Be designed to efficiently accommodate emergency vehicles, providing multiple routes to reach any block;
6. Have thoroughfares interconnected with specified distances between intersections to provide choices of routes to reduce travel distances; to promote use of transit, bicycles and walking; and to efficiently accommodate utility needs;
7. Provide signalized crossings to encourage use of walking, bicycles and transit;
8. Be comprehensible to the average traveler;
9. Communicate the intended functions of individual thoroughfares through both design characteristics and appearance; and
10. Develop operating plans to serve all modes and all users, with uses varying on some thoroughfares according to context, needs, objectives and priorities while considering overall network needs.

3. Facility reconstruction—reconstruction of major sections of one or more thoroughfares provides an opportunity to make network changes more compatible with existing context/land uses, such as converting from a two-way thoroughfare to a one-way couplet (or vice versa), realigning a thoroughfare to improve accessibility to surrounding properties and reallocating right of way to better balance design elements among various modes of travel.

General Network Guidelines

- The system of multimodal thoroughfares may be organized by the context zones, functional classifications and thoroughfare types as described in Chapter 4.
- The thoroughfare network should be designed to serve transit, pedestrians and bicycles as well as private and commercial vehicles.
- Transit networks should focus on and take advantage of built or planned transit-oriented and transit-adjacent developments.
- Planning for right of way should consider needs based on multimodal network performance measures that allow capacity and level of service to be considered in conjunction with other measures, both quantitative and qualitative. The CSS process should be open to the selection of decision criteria that balance community character and capacity enhancement or congestion relief.

Street Spacing Guidelines for Walkable Areas

- The basic form of the thoroughfare system is shaped by the spacing and alignment of arterial thoroughfares. The system of arterials should be continuous and networked in a general rectilinear form. In urban areas, arterial spacing may need to be one-half mile or less. In denser urban centers and core areas, arterials may need to be spaced at one-quarter mile or less.
- In more conventional suburban areas that are intended to remain so, arterial spacing of up to one mile may suffice if facilities of up to six lanes are acceptable to the community. The arterial thoroughfares should be supplemented by thoroughfares spaced at most one-half-mile apart. Such areas typically are interspersed with areas of mixed-use and walkable activity, such as commercial districts and activity centers. These centers require more frequent and connected networks of local streets.
- Closer spacing of thoroughfares (one-quarter mile for collectors) may be needed depending on pedestrian activity levels, desired block patterns and

continuity. Natural features, preserved lands, or active agriculture may break up the pattern.

- Sketch planning demand estimation or travel forecasting models should be among the tools used to estimate the spacing and capacity needs for urban thoroughfares within the minimum spacing described above. However, for walkable areas, walkability criteria may require closer spacing.
- The network should include a system of bicycle facilities with parallel routes, with direct connections to major trip generators such as schools, retail districts and parks. Bicycle facilities may include on-street bike lanes, separated paths, or shared lanes on traffic-calmed streets with low motor vehicle volumes.

Local streets should be configured in a fine-grained, multimodal network internal to the neighborhood, with many connections to the system of thoroughfares. Where streets cannot be fully networked, they should be supplemented by pedestrian and/or bike-pedestrian facilities to provide the desired connectivity.

Pedestrian facilities should be spaced so block lengths in less dense areas (suburban or general urban) do not exceed 600 feet (preferably 200 to 400 feet) and relatively direct routes are available. In the densest urban areas (urban centers and urban cores), block length should not exceed 400 feet (preferably 200 to 300 feet) to support higher densities and pedestrian activity.

Urban Corridor Thoroughfare Planning for Walkable Urban Areas

Corridors are transportation pathways that provide for the movement of people and goods between and within activity centers. A corridor encompasses a single transportation route or multiple transportation routes or facilities (such as thoroughfares, public transit, railroads, highways, bikeways and so forth), the adjacent land uses and the connecting network of streets (**Figure 3.5**).

Corridor planning is one of the incremental steps for network planning in the long-range transportation plan to thoroughfare design in the project development stage (see **Figure 3.5**). The purpose of corridor planning is to comprehensively address future transportation needs and recommend a series of physical improvements and operational and management strategies within a corridor. Corridor planning fills the gap between long-range transportation planning and project development. It identifies and provides a link between corridor land-use planning and corridor transportation planning and provides an opportunity to direct future development within the corridor. An important benefit of corridor planning is that it addresses issues prior to reaching the project development stage for transportation improvements within the corridor. Finally, it promotes interagency cooperation and broad stakeholder and public involvement. Corridor plans should address the following: (ID DOT 1998)

Figure 3.5 Corridors include multiple transportation facilities, adjacent land uses and connecting streets. Source: Kimley-Horn and Associates, Inc.

- Long-range vision for the corridor;
- Existing conditions of the transportation system and analysis with regard to the performance objectives;
- Existing and future environmental, land-use and socioeconomic conditions in the corridor area, including a community profile, current and planned land uses, historical and cultural buildings and sites, and key environmental resources and environmental issues;
- Public and stakeholder involvement strategy;
- Purpose, need and the relative importance of corridor needs through project goals and community objectives;
- Expected future multimodal travel demand and performance of existing and programmed transportation improvements;
- Identification of feasible alternatives by evaluating all options and comparing costs, impacts, trade-offs and the degree to which the alternative meets established goals;
- Available and expected funding for transportation improvements in the corridor; and
- Long- and short-range recommendations.

The corridor planning process generally mirrors the transportation planning process in its fundamental steps of a needs study, alternatives development, alternatives evaluation and selection of a preferred alternative, which leads to either the developing a detailed plan or implementing the project development process (preliminary design).

Integrating CSS into urban corridor thoroughfare planning requires stakeholders to consider the economic, social and environmental consequences of alternatives. It defines the short- and long-term needs of the corridor, develops goals and objectives that will achieve the vision of the corridor and evaluates feasible multimodal alternatives.

The outcome of CSS in urban corridor thoroughfare planning goes beyond just street improvements. Corridor planning integrally addresses transportation improvement, land development and redevelopment, economic development, scenic and historic preservation, community character and environmental enhancement. Because urban corridor thoroughfare planning affects a broad spectrum of the community, public and stakeholder involvement is a central element of the process. The basic steps in the planning process include:

- Corridor vision;
- Project needs;
- Alternatives development;
- Alternatives evaluation; and
- Selection of preferred alternative.

In some cases, urban corridor thoroughfare planning may be integral with environmental studies leading to a National Environmental Policy Act document (www.epa.gov/compliance/nepa) or other environmental impact assessment. **Figure 3.6** illustrates the steps in the corridor planning process and identifies the type of input needed at various stages in the process.

The basic steps in the process, and how CSS principles can be integrated, are described below:

- **Corridor Vision:** Similar to any application of CSS principles, the process begins with a vision for the corridor. A vision is a corridorwide expression of how the corridor will be viewed in the future. Goals for the corridor expand on the vision by identifying the achievements that will result from implementing the corridor's plan. Developing objectives and a vision for a corridor can occur as part of a long-range transportation plan or as part of the corridor planning process. Public and stakeholder input and involvement are critical inputs when developing a vision, because the vision needs to reflect the goals and objectives of the community and address more than the transportation function of the corridor. The corridor vision feeds directly into the project needs step.
- **Needs:** As with developing a vision, the needs for the project may be developed in a long-range transportation plan if there is one or may be developed as part of the corridor planning process. The project needs include a problem statement that reflects the needs of all users and also reflect the corridor's existing (and future) context and characteristics. Stakeholder input is necessary to identify values, issues, priorities, goals and objec-

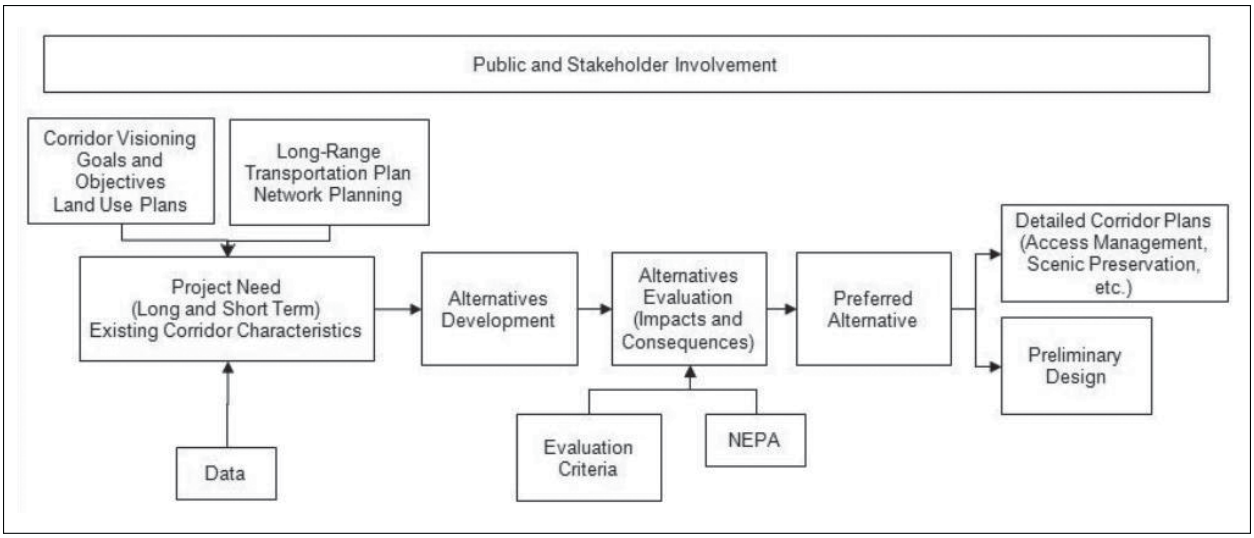

Figure 3.6 The corridor planning process. Source: Kimley-Horn and Associates, Inc.

tives. Much of this same input will help form criteria for assessing alternatives in the next phase.

- **Alternatives Development:** The corridor planning process includes a participatory public process to define and develop alternatives. The alternatives need to address the problem statement identified in the project needs step and also reflect the community vision and objectives. Stakeholder input is necessary to identify values, issues, priorities and criteria for assessing alternatives. The CSS outcome of this step is an inclusive problem statement, a short- and long-range vision for the corridor and goals and objectives that will direct the development of alternatives.

Corridor Vision and Needs

CSS Approach

- Public and stakeholder input
- Corridor and context characteristics
- Identify values and issues

CSS Outcome

- Inclusive problem statement
- Corridor vision
- Goals and objectives

With a CSS approach, the needs may be stated in terms of context, economic, or other community aspects, as well as mobility needs. The CSS outcome of this step is to provide stakeholders and decision makers (bodies that approve the funding and implementation of projects) with a wide range of choices derived from a collaborative and participatory process. The alternatives should be competitive in that they address as many of the goals and objectives as possible. Solutions should be innovative and flexible in the application of design guidance. The solutions should include ways to enhance and meet the needs of the context, activities generated by adjacent and nearby land uses and objectives that are part of the community vision for the corridor.

Alternatives Development

CSS Approach

- Interactive and participatory process
- Alternatives address problem statement and reflect objectives

CSS Outcome

- Broad range of solutions derived from collaboration
- Innovation and flexibility

To the extent not already included in the community vision, consideration should also be given to potential environmental consequences when developing the corridor alternatives. Alternatives may include different alignments and parallel routes, cross-sections, modal combinations, streetside treatments, interaction with adjacent development, streetscape approaches, business and community activity and support infrastructure. The important thing to remember is that the alternatives in CSS are developed to meet the full range of a specific community or neighborhood's objectives.

- **Alternatives Evaluation:** The goal of the alternatives evaluation is to provide an objective and balanced assessment of impacts, trade-offs and benefits of each alternative (**Figure 3.7**). This requires careful selection of, and stakeholder agreement on, evaluation criteria. The criteria need to reflect not just transportation objectives but the community and environmental objectives as well. Examples of evaluation criteria categories and related measures include:

Mobility for All Users: travel demand, roadway capacity, level of service, travel time, connectivity, circulation, access, truck movement, access to multiple travel modes and so forth.

Social and Economic Effects: socioeconomic and cultural environment (historic, cultural and archaeological resources; environmental justice; residential and business displacement/dislocation; socioeconomics and equity; neighborhood integrity and cohesion; economic development; place making qualities; and so forth).

Environmental Effects: positive and negative effects of natural environment (air quality, noise, energy consumption, water quality and quantity, vegetation, wildlife, soils, open space, park lands, ecologically significant areas, drainage/flooding aesthetics and visual quality); and land use (residential patterns, compatible uses, development suitability according to community values and so forth.).

Cost-Effectiveness and Affordability: capital costs, operations and maintenance costs, achievement of benefits commensurate with resource commitment, sufficiency of revenues and so forth.

Alternatives Evaluation

CSS Approach

- Public and stakeholder input
- Evaluation criteria that reflects community, environmental and transportation objectives and concerns

CSS Outcome

- Clear assessment of trade-offs
- Participatory process

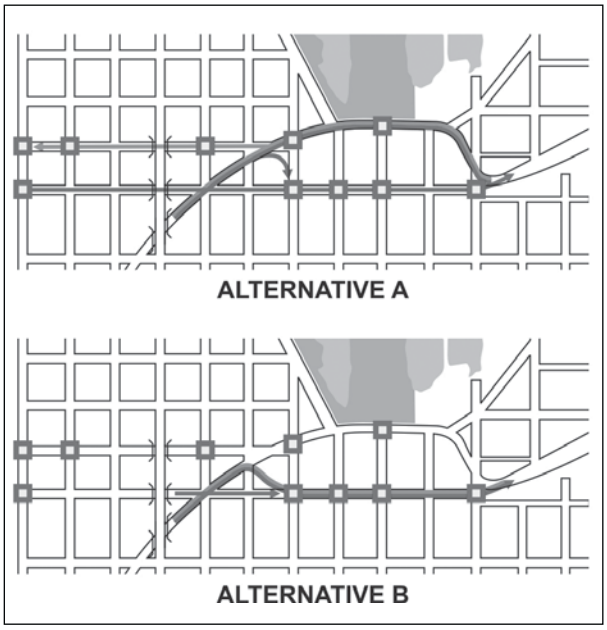

Figure 3.7 Corridor planning involves the consideration of trade-offs between alternatives. In this example of a corridor study, different alignments and reconfiguration of streets are evaluated and compared. Source: City of Seattle, CHM2Hill, South Lake Union Transportation Study, Mercer Corridor Project.

Other Factors: compatibility with local and regional plans and policies, constructability, construction effects and so forth.

The alternatives evaluation step includes a comprehensive evaluation of applicable issues and options using selected criteria such as those described above (such as modal capacity; alignment; design concept; costs; right of way; environmental, social and economic impacts; operations; safety; and so forth). Alternatives can be a combination of capital improvements and management and operations strategies. The outcome of this step is the clear communication of trade-offs to the public, stakeholders and decision makers, developed and discussed in a transparent and participatory process.

- **Selection of Preferred Alternative:** The selection of a preferred alternative is, ideally, a consensus-based process. Consensus building in this step engenders community ownership in the selected alternative and helps achieve a commitment toward implementation of the plan or project. The CSS process uses an array of tools for selecting, refining and building consensus on alternatives. A successful selection of a preferred alternative is one that is compatible with the context(s), reflects the needs of all users and best achieves the objectives and vision established for the corridor.

The selection of a preferred alternative leads to either the development of a detailed corridor plan, such as a thoroughfare plan, access management plan, scenic preservation plan, streetscape plan, or economic vitalization plan. It can also lead to the preliminary design of an individual thoroughfare, network of thoroughfares, or multimodal transportation corridor with parallel thoroughfares, rail, transit, highway and bikeway systems.

Selection of Preferred Alternatives

CSS Approach

- Participatory process, using workshops or charettes to refine concepts
- Consensus building

CSS Outcome

- Alternative fits within the context
- Composite solution for all modes and users
- Preferred alternative that balances across objectives and evaluation criteria

Corridor planning varies in level of effort ranging from large-scale planning efforts for corridors in newly developing areas to small-scale planning of segments of individual thoroughfares within constrained rights of way. The outcome of corridor planning ranges from broad policies to statewide and regional long-range transportation plans to multimodal systems plans, as well as to local thoroughfare plans and individual segment concepts and designs (**Figure 3.8**). CSS plays a role in any type of corridor planning. The remainder of this report focuses on the detailed design of thoroughfares.

CSS Example in Corridor Planning—Developing Evaluation Criteria

SR 179 Corridor Plan

The Arizona Department of Transportation (ADOT) worked with the community of the greater Sedona area in the Coconino National Forest to design and construct improvements to the 9-mile stretch of SR 179. This road carries millions of tourists each year through one of the most pristine and unique areas of the world. The road is also the only route connecting the business and residential communities of the greater Sedona area. While there have been improvements to SR 179, continuing traffic buildup will continue to exacerbate the capacity and safety issues of the road during the next 20 years.

Figure 3.8 Corridor planning results range from broad policies to detailed concepts for corridor segments. Source: Contra Costa County Dept. of Public Works and Whitlock & Weinberger Transportation, Inc.

This example addresses the selection of evaluation criteria for rural scenic segments and urban segments of the corridor. It is an example of a process that integrates CSS principles to work with stakeholders to evaluate corridor alternatives. The evaluation process could be used to evaluate projects in any context.

The goal of the project was to develop a transportation corridor that addressed safety, mobility and the preservation of scenic, aesthetic, historic, environmental and other community values and to reach consensus on the planning, design and construction of SR 179.

The SR 179 project is a good example of a CSS corridor plan involving the public. The collaborative community-based process used an innovative process called the needs-based implementation plan (**Figure 3.9**). This process depended on the community to actively participate and provide input throughout the process.

Developing Evaluation Criteria

A unique aspect of the SR 179 Corridor project was the process used to develop and select the preferred planning concepts, particularly the evaluation criteria. The screening process is illustrated in **Figure 3.10**. The development of evaluation criteria began with working with the community to identify its core values for the corridor. The core values are also components of the vision for the corridor. Core values include in priority order:

- Scenic beauty—preservation of scenic features and viewpoints;
- Public safety—preventing crashes and providing efficient emergency services;
- Environmental preservation—maintaining the natural and physical environment;

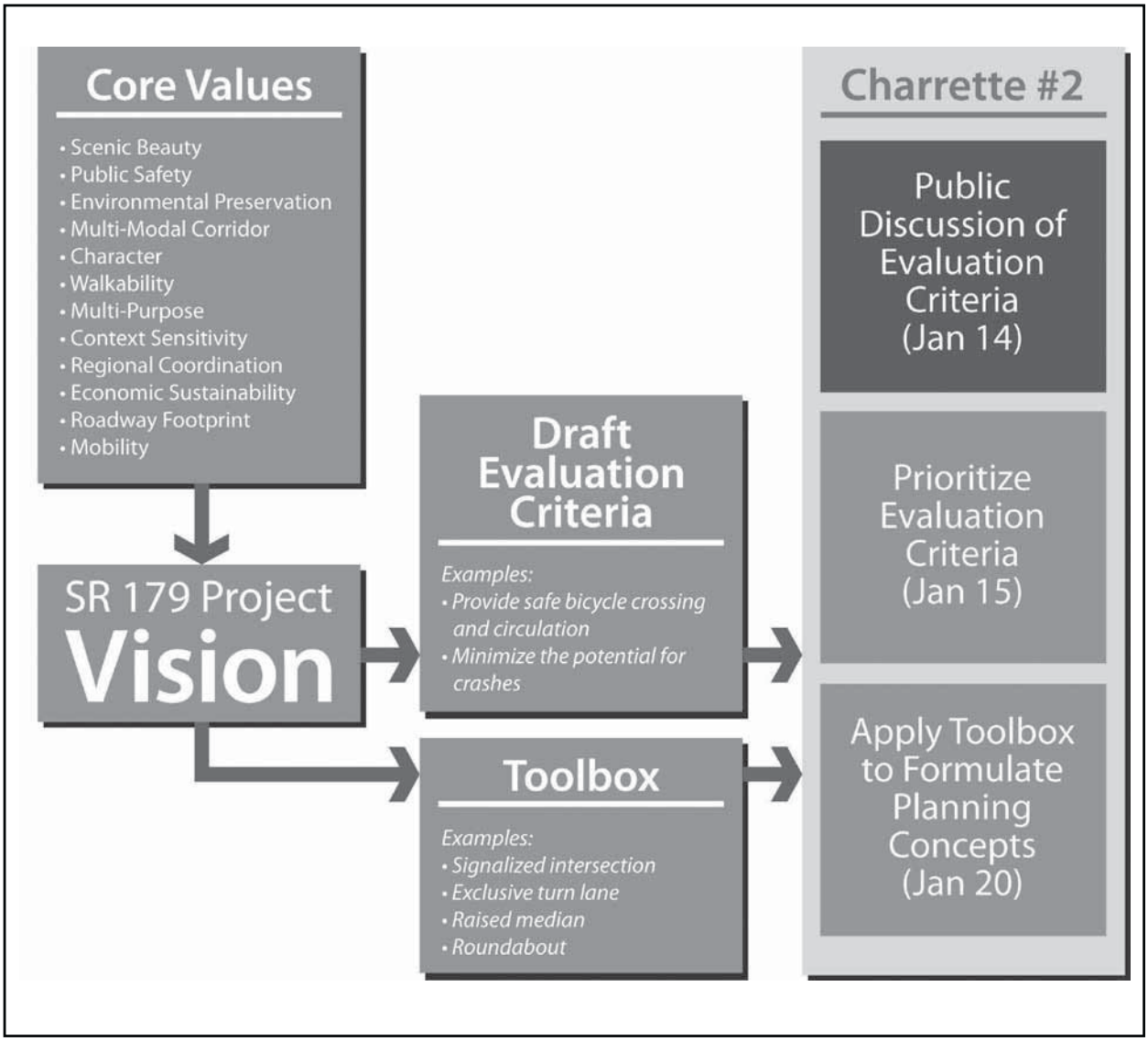

Figure 3.9 The needs-based implementation plan included a community-based process to develop criteria to evaluate corridor alternatives. Source: Arizona Department of Transportation, DMJM+Harris.

- Multimodal—provisions for modes of travel that include bicycles and transit;
- Character—the unique look and feel of the corridor;
- Walkability—ability of pedestrians to circulate in the corridor and reach points within the corridor;
- Multipurpose—a corridor that serves many needs including commuting, shopping, tourism and social trips;
- Context sensitivity—compatibility with the unique context of the SR 179 corridor;
- Regional coordination—a process involving stakeholders throughout the region;
- Economic sustainability—contribution to the economic vitality of the area;
- Roadway footprint—the width and cross-section of the corridor; and
- Mobility—ability to provide efficient and reliable transportation services.

Using the core values as a base, the project team worked with the community to develop, prioritize and build consensus on criteria for evaluating cor-

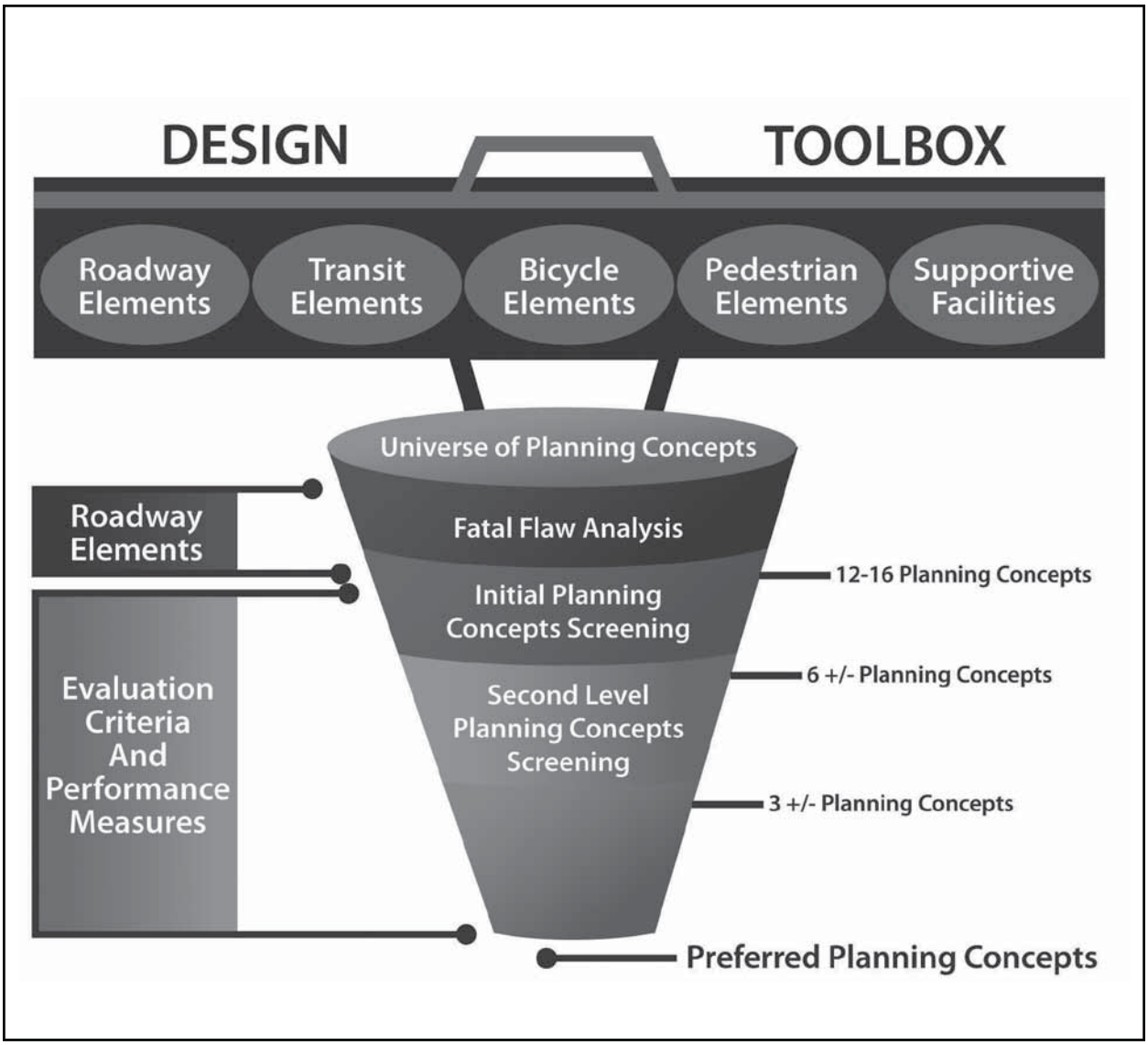

Figure 3.10 The screening process started with a wide range of alternatives and used public participation and evaluation criteria to narrow alternatives to a preferred planning concept. Source: Arizona Department of Transportation, DMJM+Harris.

ridor alternatives. The evaluation criteria and performance measures were used in a screening process to narrow the alternatives to a preferred planning concept for each segment of the corridor. **Figure 3.11** presents a sample of the evaluation criteria and associated performance measures.

An Important Note About Implementation

The benefits of a highly connected, multimodal network developed through a CSS process will not be fully realized unless the complete network is implemented. Complete implementation requires state, county and municipal transportation agencies to preserve and protect right of way, then fund and construct (or have developers construct) the major and local thoroughfare system.

To gain network benefits early and avoid interim oversizing of roads, it is important that as development starts, the network should also be constructed in usable segments. For example, when a parcel at the intersection of two county roads is developed, the local street

Evaluation Criterion	Performance Measures
Retain and enhance the natural appearance of the landscape and the ability to enjoy scenic views from the corridor.	Number of sensitively placed scenic pullouts
	Number of new scenic vistas available
	Appropriate scenic viewing opportunity potential
Provide a distinctive corridor identity and unique experience for the user.	Opportunity for artistic and landscape amenities
	Opportunity to preserve and interpret architectural and cultural themes of the Sedona/Red Rock area
	Opportunity for design creativity to contribute to the corridor identity
Provide safe and attractive wayfinding aids (signage and informational features) for tourists and others who may be relatively unfamiliar with the corridor.	Total number of sites for wayfinding information
	Opportunities for context sensitive wayfinding signage visible from the roadway and pathways
	Opportunities to provide access to new Forest Service Ranger District Office and other connecting facilities
Provide safe vehicular and emergency access to, from and across the corridor.	Number of new safe crossings (signals or roundabouts)
	Number of locations on the mainline with left-turn storage lane or roundabout
	Number of acceleration and deceleration lanes
	Number of "right-in, right-out" ingress/egress locations
	Number of mainline entry locations
Provide safe pedestrian crossings and circulation.	Number of new safe pedestrian crossings
	Opportunities for pedestrian amenities and enhancements at intersections
	Square feet of pathways/sidewalks
	Number of trailheads directly accessible on foot from the corridor
	Number of key destinations in the corridor accessible via a connected pedestrian system

Figure 3.11 Example evaluation criteria and performance measures used in the SR 179 Corridor Plan.
Source: Arizona Department of Transportation, DMJM+Harris.

network planned within the development by the MPO, county, or municipality should also be constructed.

Furthermore, at least one street should be constructed and connected through or around the initial development to ensure alternative routes are available in case of emergency, congestion, or temporary blockage.

If this approach continues as development progresses, this implementation approach will ensure that the network will evolve to completion.

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Chapter 4

A Framework for Walkable Urban Thoroughfare Design

Purpose

This chapter describes a set of tools for use by practitioners planning and designing walkable urban thoroughfares. It describes a design framework to identify and classify context and thoroughfares and describes how the controls of context and thoroughfare type are used in the design process to establish design parameters.

The functional classification system classifies context as either rural or urban. In this report, the definition and description of the conventional urban context is expanded to provide more detailed descriptions of adjacent surroundings and to provide a way to use context as a criterion in the selection of thoroughfare type and design criteria. Context zones are used to classify urban contexts into discrete types, ranging from lower to higher density and intensity of development.

The approach described in this chapter introduces thoroughfare types as a complement to functional classification to provide a broader range of thoroughfare design choices. The use of thoroughfare types restores the former practice of distinguishing streets by their design characteristics in addition to their functional classification.

Objectives

This chapter:

1. Defines context as used in urban thoroughfare design and explains the features of urban areas that create and shape context;
2. Introduces the concept of "context zones" and provides guidance to help practitioners use this tool;
3. Describes the features that create context including land use, site design and urban form, and building design;
4. Describes the different types of thoroughfares and their relationship to functional classifications; and
5. Describes features of thoroughfare types and context zones that result in compatibility.

Introduction

The design of viable, well-functioning urban thoroughfares depends on a clear understanding of the application of CSS principles in designing thoroughfares in the urban environment. Once urban context is understood, the function of each thoroughfare can be established and the design parameters can be selected to achieve a balance between land use and transportation design. This linkage demands special tools. While it is possible to "feel" the character of an urban area, it can be hard to define and describe the specific features that collectively give shape and character to a particular urban setting, whether it is a small town, activity center, main street, or high-density regional downtown.

Not only does context influence the design of thoroughfares, but the design of the thoroughfare itself helps to define and shape the context as much as adjacent land uses and buildings define and shape context. For these reasons, this document recommends a clear focus on context first, followed by detailed transportation planning to support the context in a balanced way.

Conventional thoroughfare design processes emphasize vehicular mobility and the provision of automobile access to adjoining land uses, primarily using functional classification, traffic volume and design speed as the determinants for design parameters. The principles of CSS expand the design process to better integrate thoroughfares with their surroundings. The result in many communities is a new emphasis on urban thoroughfares with features that emphasize multimodal safety and mobility as well as support for the activities of the adjacent land uses. Walkability, a key focus of this document, is better planned with an initial, clear focus on context.

A main tenet of walkable thoroughfare design is encapsulated in the phrase "one size does not fit all," which means the function of a thoroughfare and its design should complement the context that it serves,

and the design of the thoroughfare should change as the existing and planned context changes. This tenet challenges the conventional design process used by many state and municipal agencies, which applies a single roadway cross-section, based on functional classification, to a thoroughfare—regardless of the context. In this report, it is context and the change in context that determines the need to transition from one thoroughfare type to another and also determines the corresponding change in design parameters.

Thoroughfare planning and engineering requires evaluating capacity, connectivity and safety considerations in combination with meeting local objectives for urban character. The selection of appropriate design controls and performance measures, discussed further in Chapter 7, is a key step in developing suitable design solutions. The design scenarios presented in Chapter 6 provide illustrations of how context sensitive objectives can be evaluated under alternative designs and integrated into a preferred alternative.

Features that Create Context

Often, transportation planning and design considers context only in terms of land use (traffic generation) and two elements of site design—parking and access (driveways). The CSS design process for walkable urban thoroughfares expands this understanding of context to include the aspects of building and site design that create support for pedestrian and transit activity and that relate to the design of thoroughfares to result in integrated walkable environments.

Land Use

Land use is a common criterion for characterizing urban development and estimating vehicle trip generation, particularly in single-use, vehicle-dominated locations. The design framework in this report identifies land use as an important contributor to context and a major factor in the selection of design criteria (particularly as these relate to levels of pedestrian activity), assembly of the cross-section components and allocation of the width of the right of way.

In addition to having a fundamental impact on automobile travel demand, variations in adjacent land use affect the width and design of the streetside, the part of the thoroughfare between the curb and edge of right of way including sidewalks. As detailed in Chapter 8, residential uses typically have less need for sidewalk space than similarly scaled mixed-use blocks with ground floor commercial retail uses, where space for window shopping, outdoor dining, newspaper racks and other street appurtenances add to the sidewalk width. Areas that disperse land uses into single-use areas and that rely on hierarchical circulation networks generally result in longer trips, less walking and bicycling and more dependence on motor vehicles. Commercial uses generate higher volumes of pedestrian travel and business activities that use the streetside compared to similarly scaled residential uses. With respect to the traveled way, the part of the thoroughfare between curbs, variations between residential and commercial areas include parking- and travel-lane width. Commercial areas typically have a higher volume of large vehicles such as delivery trucks and buses and have a higher turnover of on-street parking than residential areas. Thus, a predominantly commercial thoroughfare often requires a wider traveled way when compared to a predominantly residential thoroughfare in the same context zone. Commercial areas usually generate more traffic than residential areas, which affects decisions related to the number of lanes, access control and intersection design.

Site Design and Urban Form

The ways in which buildings, circulation, parking and landscape are arranged on a site has an effect on where a thoroughfare and its context fall in the continuum of walkability (see sidebar on the Continuum of Walkability in Chapter 1). The specific elements of site design that contribute to defining urban context include:

- **Building orientation and setback:** In places that have less priority for walking, buildings typically will be less related to the street either by large setbacks into private property or oriented toward a parking lot rather than the street. By contrast, a context with traditional urban character will have buildings oriented toward and often adjacent to the thoroughfare and therefore a higher priority for pedestrian travel. The directness of the pedestrian connection to the building entry from the thoroughfare—and whether the building itself is integrated into the thoroughfare's streetside with stoops, arcades,

cafes, and so forth—distinguishes a context with traditional urban character. In these locations, buildings may form a continuous built edge or street wall (a row of buildings that have no side yards and consistent setback at the thoroughfare edge).

- **Parking type and orientation:** Parking provided in surface lots between buildings and streets defines a vehicle-dominated context with a lower priority for walking. On-street parking, and parking under or behind buildings and accessed by alleys is an urban characteristic. Thoroughfares in these areas should have a higher priority for walking.
- **Block length:** Development patterns with traditional urban characteristics usually have short block lengths with a system of highly connected thoroughfares, local streets and alleys. Vehicle-dominated contexts have larger blocks, less complete street connectivity and usually no alleys; this pattern makes walking distances longer and, therefore, it is likely that fewer people will walk between destinations. Generally, the desirable block length is 200 to 400 feet and should not exceed 600 feet. See Chapter 3 for more on block spacing.

Building Design

The design of buildings is a significant contributor to context and the priority that the context gives to walking. Building height, density and floor-area ratio, architectural elements, mass and scale, relationship to adjacent buildings and thoroughfares, orientation of the entry, and the design and type of ground floor land uses can help shape context and create an environment that is more or less walkable.

Development in contexts that give a lower priority to walking generally are more internally oriented as evidenced by how the buildings sit on their sites (as discussed above) and how the ground floor uses lack supportive relationships with adjacent streetsides and sidewalks. The lack of walkability in these contexts is not correlated with building intensity but with features of building and site design.

Buildings in locations with a traditional urban character that contributes to a walkable community are typically oriented toward the street. Ground floor uses in urban buildings are usually oriented to the pedestrian passing on the adjacent sidewalk (for example, retail, restaurant, services) and incorporate architectural elements that are interesting, attractive and scaled to the pedestrian (**Figure 4.1**). Some aspects of how building design helps define urban context include:

Figure 4.1 Pedestrian-scaled architectural elements. Source: Community, Design + Architecture.

- **Building height and thoroughfare enclosure:** Buildings are the primary feature of urban contexts that create a sense of definition and enclosure on a thoroughfare—an important urban design element that helps create the experience of being in a city and in a place that is comfortable for pedestrians. The threshold when pedestrians first perceive enclosure is a 1:4 ratio of building height to thoroughfare width—typical of low-density environments. In denser urban contexts, height-to-width ratios between 1:3 and 1:2 create an appropriate enclosure on a thoroughfare (**Figure 4.2**). Highly walkable thoroughfares do not require tall buildings. Street trees may be used to provide a similar sense of definition and enclosure in contexts with lower height and less dense buildings.

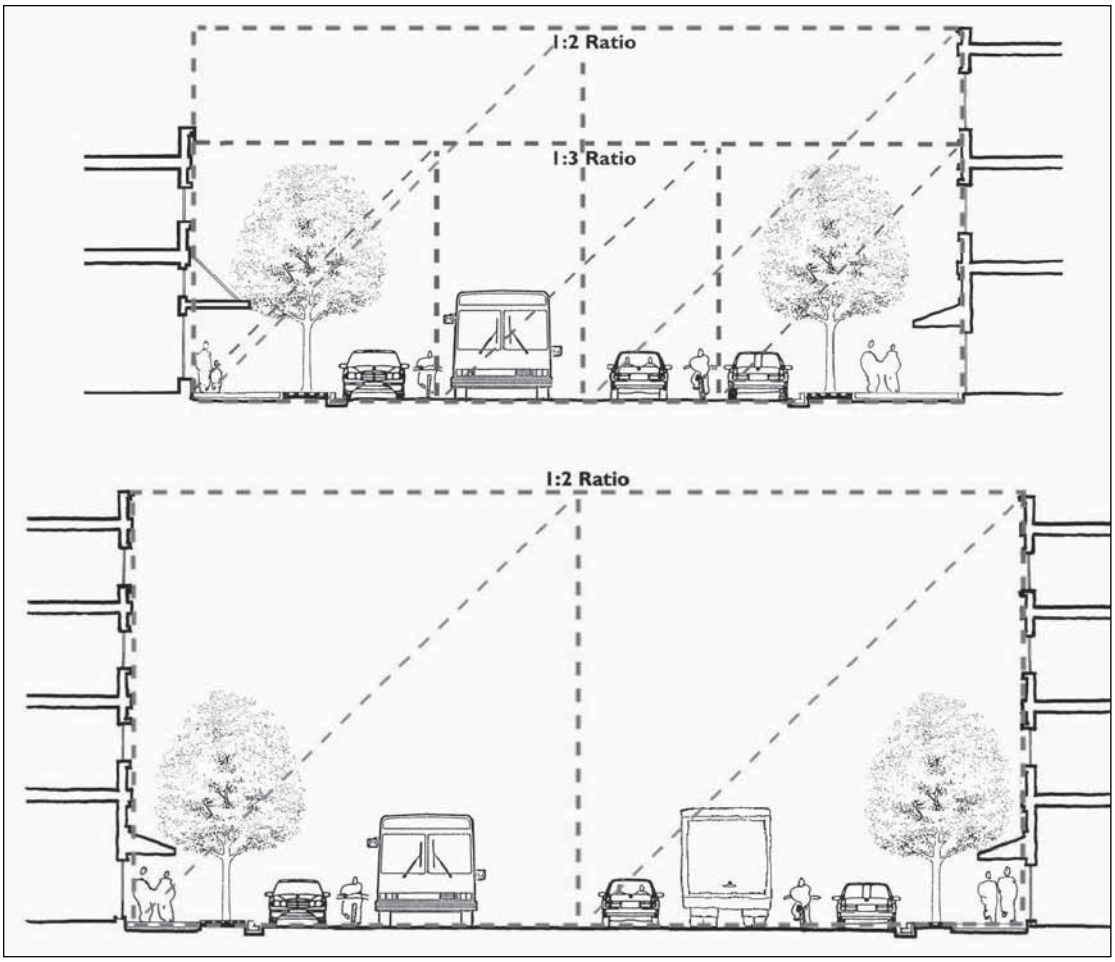

Figure 4.2 Illustration of height to width ratios that create a scale on thoroughfares that is comfortable to people and encourages walking (human scale). Human scale ratios fall between 1:3 and 1:2 as measured from the building fronts. Source: Community, Design + Architecture.

- **Building width:** Building width, like building height, contributes to the sense of enclosure of the thoroughfare. There are three elements of width: (1) the percentage of a building's width fronting the street, which should range from about 70 percent in suburban environments to nearly 100 percent in urban environments; (2) the distance between buildings or building separation, which should range from 0 to 30 feet; and (3) the articulation of buildings (an architectural term that refers to dividing building facades into distinct parts to reduce the appearance of the building's mass adjacent to the sidewalk, identify building entrances and minimize uninviting blank walls) resulting in a scale of building that is comfortable to a person walking adjacent to it and adding architectural diversity and interest (**Figure 4.3**).
- **Building scale and variety:** This helps define the context and character of a thoroughfare and encourages walking by providing visual interest to the thoroughfare. The scale and variety of buildings should help define the scale of the pedestrian environment. Vehicle-oriented building scale maximizes physical and visual accessibility by drivers and auto passengers, contributing to contexts that discourage walking.
- **Building entries:** Building entries are important in making buildings accessible and interesting for pedestrians. To maintain or create traditional urban character, buildings should have frequent entries directly from adjacent

Figure 4.3 The frequency of articulation of a building facade contributes to a scale that is comfortable to pedestrians. Source: Community, Design + Architecture.

thoroughfares to improve connectivity and to break down the scale of the building. Frequent entries from parking lots and secondary thoroughfares should be provided as well.

More information on how building design promotes context sensitivity and sustainability can be found in *Promoting Sustainable Transportation through Site Design*, an ITE recommended practice and in the *SmartCode* (see References for Further Reading at the end of this chapter). All elements of building design provide strong cues for the selection of a thoroughfare design.

Context Zones

Context zones describe the physical form and character of a place. This includes the mass or intensity of development within a neighborhood or along a thoroughfare. Context zones are applied at the community unit level, but for the purposes of thoroughfare design must be interpreted on a block-by-block basis to respond to specific physical and activity characteristics. **Figure 4.4** contains the descriptions of the six context zones. Zones C-3 through C-6 are urban zones that relate to urban thoroughfare design.

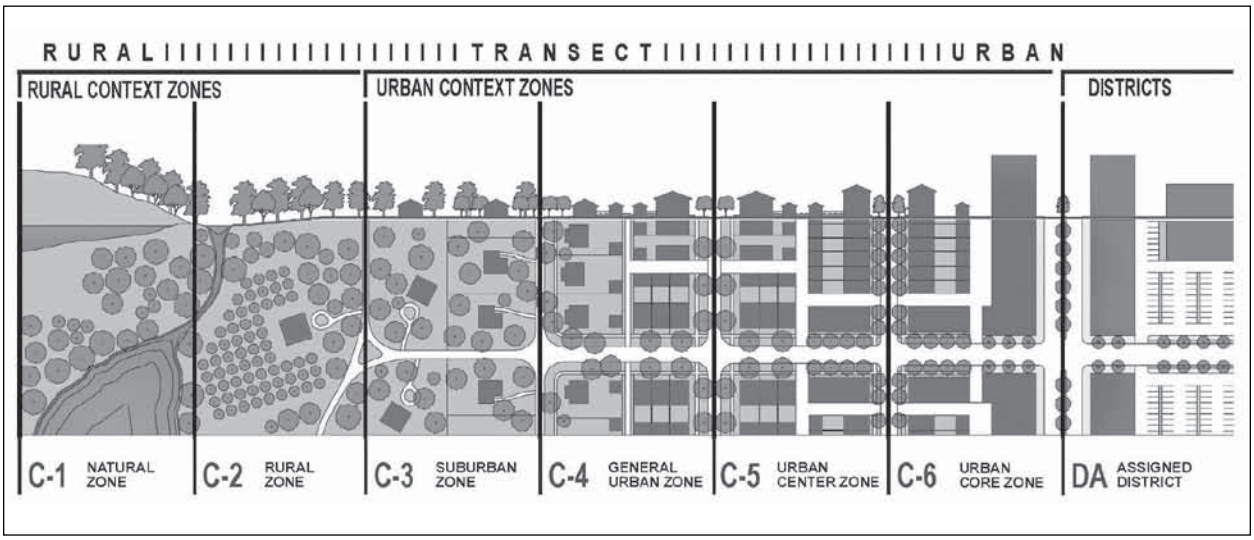

Figure 4.4 Illustration of a gradient of development patterns ranging from rural in Context Zone 1 (C-1), to the most urban in C-6. Source: Duany Plater-Zyberk and Company.

Selecting a Context Zone in Thoroughfare Design

The design process presented in this report uses context zones as a primary consideration in selecting the design parameters of urban thoroughfares. This is a refinement to the "rural" and "urban" classifications that are critical in selecting design criteria in *A Policy on the Geometric Design of Highways and Streets* (AASHTO 2004). Context zones are an important determinant of basic design criteria in traditional urban thoroughfares. This chapter helps the practitioner identify and select context zones as one of the first steps in the design process.

As **Table 4.1** shows, context is defined by multiple parameters, including land use, density and design features. **Table 4.1** presents the full range of context zones, but this report focuses on urban contexts (C-3 through C-6). The "distinguishing characteristics" column in the table, for example, describes the overall relationship between buildings and landscape that contributes to context. In addition to the distinguishing characteristics and general character, four attributes assist the practitioner in identifying a context zone: (1) building placement—how buildings are oriented and set back in relation to the thoroughfare; (2) frontage type—what part of the site or building fronts onto the thoroughfare; (3) typical building height; and (4) type of public open space.

Guidelines for identifying and selecting a context zone include the following:

1. Consider both the existing conditions and the plans for the future, recognizing that thoroughfares often last longer than adjacent buildings.
2. Assess area plans and review general, comprehensive and specific plans, zoning codes and community goals and objectives. These often provide detailed guidance on the vision for the area.
3. Compare the area's predominant land use patterns, building types and land uses to the characteristics presented in **Table 4.1**.
4. Pay particular attention to residential densities and building type, commercial floor-area ratios and building heights.
5. Consider dividing the area into two or more context zones if an area or corridor has a diversity of characteristics that could fall under multiple context zones.
6. Identify current levels of pedestrian and transit activity or estimate future levels based on the type, mix and proximity of land uses. This is a strong indicator of urban context.
7. Consider the area's existing and future characteristics beyond the thoroughfare design, possibly extending consideration to include entire neighborhoods or districts.

Thoroughfare Types

The design process in this report refers to both functional classification and thoroughfare type to classify streets.

The purpose of each classification as used in CSS applications for areas with traditional urban characteristics is described below.

- Functional classification—defines a thoroughfare's function and role in the network, in addition to governing the selection of certain design controls. The practitioner may use functional class to determine:
  - Continuity of the thoroughfare through a region and the types of places it connects (such as major activity centers);
  - Purpose and lengths of trips accommodated by the thoroughfare;
  - Level of land access and level of access management;
  - Type of freight service; and
  - Types of public transit services (for example, bus, bus rapid transit, fixed guideway and so forth).

These factors are used to inform the practitioner's decisions related to both the physical design and operations of the thoroughfare.

Table 4.1 Context Zone Characteristics

Context Zone	Distinguishing Characteristics	General Character	Building Placement	Frontage Types	Typical Building Height	Type of Public Open Space	Transit (Where Provided)
C-1 Natural	Natural landscape	Natural features	Not applicable	Not applicable	Not applicable	Natural open space	None
C-2 Rural	Agricultural with scattered development	Agricultural activity and natural features	Large setbacks	Not applicable	Not applicable	Agricultural and natural	Rural
C-3 Suburban	Primarily single family residential with walkable development pattern and pedestrian facilities, dominant landscape character. Includes scattered commercial uses that support the residential uses, and connected in walkable fashion.	Detached buildings with landscaped yards, normally adjacent to C-4 zone. Commercial uses may consist of neighborhood or community shopping centers, service or office uses with side or rear parking.	Varying front and side yard setbacks	Residential uses include lawns, porches, fences and naturalistic tree planting. Commercial uses front onto thoroughfare.	1 to 2 story with some 3 story	Parks, greenbelts	Local, express bus
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	Local, limited stop bus rapid transit, express bus; fixed guideway
C-5 Urban Center	Attached housing types such as townhouses and apartments mixed with retail, workplace and civic activities at the community or subregional 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 and arcaded walkways	3 to 5 story with some variation	Parks, plazas and squares, boulevard median landscaping	Local bus; limited stop rapid transit or bus rapid transit; fixed-guideway transit
C-6 Urban Core	Highest-intensity areas in subregion 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 and arcaded walkways	4+ story with a few shorter buildings	Parks, plazas and squares, boulevard median landscaping	Local bus; limited stop rapid transit or bus rapid transit; fixed-guideway transit
Districts	To be designated and described locally, districts are areas that are single-use or multi-use with low-density development pattern and vehicle mobility priority thoroughfares. These may be large facilities such as airports, business parks and industrial areas.						As applicable

(Based on transect zone descriptions in *SmartCode* Version 9.2, 2008. Source: Duany Plater-Zyberk & Company.)
Shaded cells represent Context Zones that are not addressed in this report.

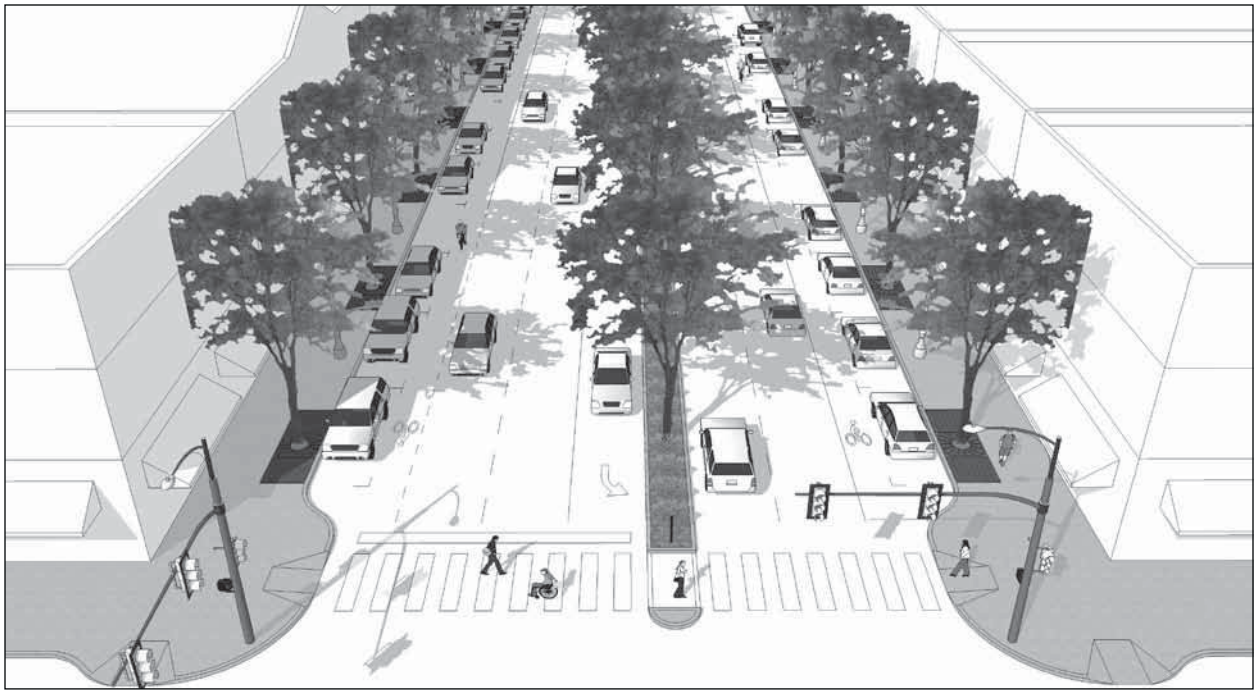

Figure 4.5 Illustration of a boulevard. Source: Claire Vlach, Bottomley Design & Planning.

- Thoroughfare type—governs the selection of the thoroughfare's design criteria and, along with the surrounding context, is used to determine the physical configuration of the thoroughfare. Design criteria and physical configuration address which elements are included in the design and selection of dimensions. Use thoroughfare types, along with context zones, to develop designs for:
    - Streetside (sidewalks, planting strips);
    - Traveled way (lanes, medians, on-street parking, bicycle lanes); and
    - Intersections.

Additionally, use thoroughfare type to determine the following design controls:

- Target speed (see Chapter 7); and
- Sight distance.

Table 4.2 shows specific thoroughfare types that are commonly used in the United States and gives a general description of each type. As this report focuses on urban thoroughfares in walkable areas, only three of the types in **Table 4.2** fall into this category: boulevards, avenues and streets. These thoroughfare types typically serve a mix of modes, including pedestrian, bicycle users, private motor vehicles (for passenger and freight) and transit.

Boulevards are typically larger thoroughfares with medians (**Figure 4.5**). They serve a mix of regional and local traffic and carry the most important transit routes. The multiway boulevard is a variant of a boulevard that contains separated roadways for through and local access traffic. Multiway boulevards may be considered when balancing the needs of abutting land uses (for example, curb parking, pedestrian facilities, land access, fronting buildings) with arterial functions. See Chapter 6 for more discussion of multiway boulevards.

Avenues (**Figure 4.6**) and streets (**Figure 4.7**) are similar to each other in form but avenues can be up to four lanes with a median. Streets are generally two lanes and serve predominantly local traffic. In walkable areas, all thoroughfare types have a strong pedestrian orientation.

Table 4.3 shows the relationship between thoroughfare types and functional classification. In general,

Figure 4.6 Illustration of an avenue. In this example on-street parking is dropped to gain width for a left turn lane at the intersection. Source: Claire Vlach, Bottomley Design & Planning.

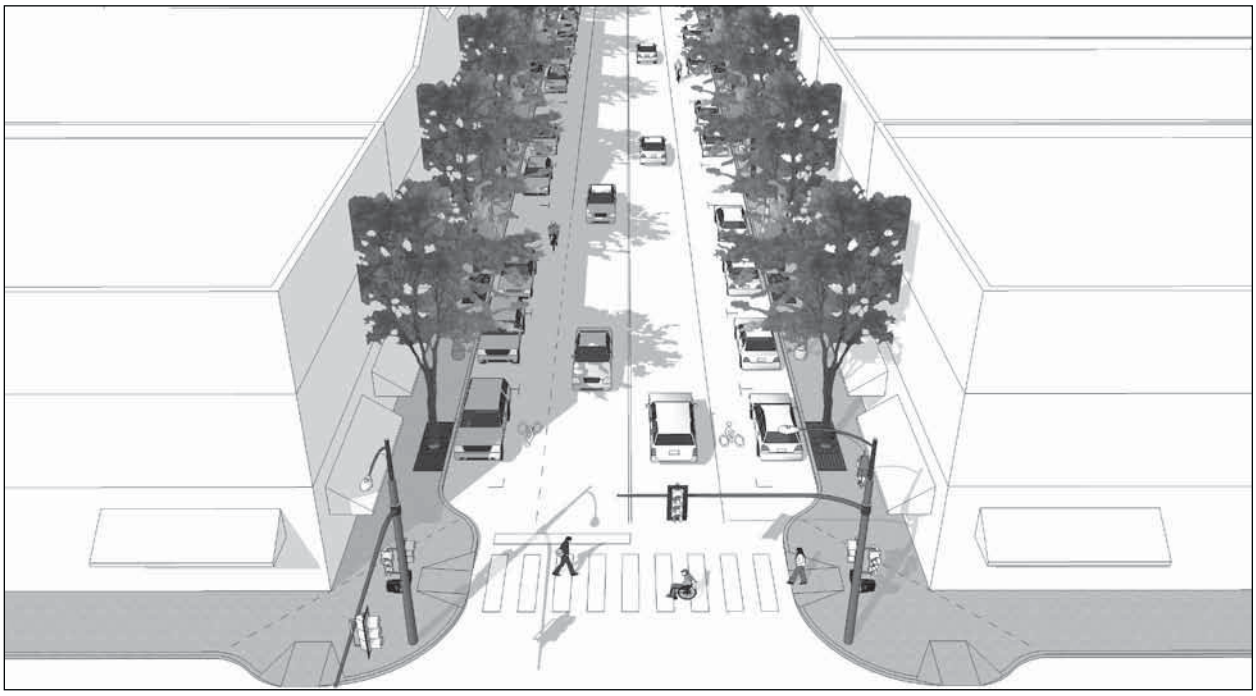

Figure 4.7 Illustration of a street. Source: Claire Vlach, Bottomley Design & Planning.

Table 4.2 Thoroughfare Type Descriptions

Thoroughfare Type	Functional Definition
Freeway/Expressway/ Parkway	Freeways are high-speed (50 mph +), controlled-access thoroughfares with grade-separated interchanges and no pedestrian access. Includes tollways, expressways and parkways that are high- or medium-speed (45 mph +), limited-access thoroughfares with some at-grade intersections. On parkways, landscaping is generally located on each side and has a landscaped median. Truck access on parkways may be limited.
Rural Highway	High-speed (45 mph +) thoroughfare designed both to carry traffic and to provide access to abutting property in rural areas. Intersections are generally at grade.
Boulevard (see Chapters 8, 9 and 10 for design guidance)	Walkable, low-speed (35 mph or less) divided arterial thoroughfare in urban environments designed to carry both through and local traffic, pedestrians and bicyclists. Boulevards may be long corridors, typically four lanes but sometimes wider, serve longer trips and provide pedestrian access to land. Boulevards may be high-ridership transit corridors. Boulevards are primary goods movement and emergency response routes and use vehicular and pedestrian access management techniques. Curb parking is encouraged on boulevards.
	Multiway boulevards are a variation of the boulevard characterized by a central roadway for through traffic and parallel access lanes accessing abutting property, parking and pedestrian and bicycle facilities. Parallel access lanes are separated from the through lanes by curbed islands with landscaping; these islands may provide transit stops and pedestrian facilities. Multiway boulevards often require significant right of way.
Avenue (see Chapters 8, 9 and 10 for design guidance)	Walkable, low-to-medium speed (25 to 35 mph) urban arterial or collector thoroughfare, generally shorter in length than boulevards, serving access to abutting land. Avenues serve as primary pedestrian and bicycle routes and may serve local transit routes. Avenues do not exceed 4 lanes, and access to land is a primary function. Goods movement is typically limited to local routes and deliveries. Some avenues feature a raised landscaped median. Avenues may serve commercial or mixed-use sectors and usually provide curb parking.
Street (see Chapters 8, 9 and 10 for design guidance)	Walkable, low speed (25 mph) thoroughfare in urban areas primarily serving abutting property. A street is designed to (1) connect residential neighborhoods with each other, (2) connect neighborhoods with commercial and other districts and (3) connect local streets to arterials. Streets may serve as the main street of commercial or mixed-use sectors and emphasize curb parking. Goods movement is restricted to local deliveries only.
Rural Road	Low speed (25 to 35 mph) thoroughfare in rural areas primarily serving abutting property.
Alley/Rear Lane	Very low-speed (5 to 10 mph) vehicular driveway located to the rear of properties, providing access to parking, service areas and rear uses such as secondary units, as well as an easement for utilities.

Shaded cells represent thoroughfare types that are not addressed in this report.

Table 4.3 Relationship Between Functional Classification and Thoroughfare Type

	Thoroughfare Types						
Functional Classification	**FREEWAY/ EXPRESS-WAY/PARK-WAY**	**RURAL HIGHWAY**	**BOULEVARD**	**AVENUE**	**STREET**	**RURAL ROAD**	**ALLEY/REAR LANE**
Principal Arterial	■	■	■	■	■		
Minor Arterial		■	■	■	■		
Collector				■	■	■	
Local					■	■	■

Shaded cells represent thoroughfare types that are not addressed in this report.

boulevards serve an arterial function, avenues may be arterials or collectors and streets typically serve a collector or local function in the network.

More detailed descriptions of the general design parameters and desired operating characteristics of the thoroughfare types are given in **Table 4.4**. As mentioned above, this document focuses on the three types that can be considered urban thoroughfares: boulevards, avenues and streets. Those thoroughfare types serving areas with traditional urban characteristics are suitable for the four urban context zones C-3, C-4, C-5 and C-6.

Chapter 5 provides an overview of the design process and identifies how the selection of context zones and thoroughfare types relates to each stage of thoroughfare design. Chapter 6 presents design parameters and criteria for each thoroughfare type based on a combination of functional class, context zone and whether the surrounding land use is predominantly commercial or residential.

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Table 4.4 Urban Thoroughfare Characteristics

Urban Thorough-fare Type	Number of Through Lanes	Desired Operating Speed (mph)	Transit Service Emphasis	Median	Driveway Access	Curb Parking	Pedestrian Facilities [1]	Bicycle Facilities	Freight Mvmt. [2]
Freeway	4 to 6+	45–65	Express	Required	No	No	No	Optional sepa-rated pathway or shoulder	Regional truck route
Expressway/ Parkway	4 to 6	45–55	Express	Required	No	No	Optional sepa-rated pathway	Optional sepa-rated pathway or shoulder	Regional truck route
Boulevard	4 to 6	30–35	Express and Local	Required	Limited	Optional	Sidewalk	Bike lanes or parallel route	Regional truck route
Multiway Boulevard	4 to 6	25–35	Express and Local	Required on access lanes	Yes from access lane	Yes on access roadway	Sidewalk		Regional route/ local deliveries only on access roadway
Avenue	2 to 4	25–30	Local	Optional	Yes	Yes	Sidewalk	Bike lanes or shared	Local truck route
Street	2	25	Local or none	No	Yes	Yes	Sidewalk	Shared	Local deliveries only
Rural Road	2	25–35	Local or none	No	Yes	No	No	Shared or shoul-der	Local deliveries only
Local Street	2	25	Local or none	No	Yes	Yes	Sidewalk	Shared	Local deliveries only
Alley/Rear Lane	1	5–10	None	No	Yes	No	Shared	Shared	Local deliveries only

Shaded cells represent thoroughfare types that are not addressed in this report.

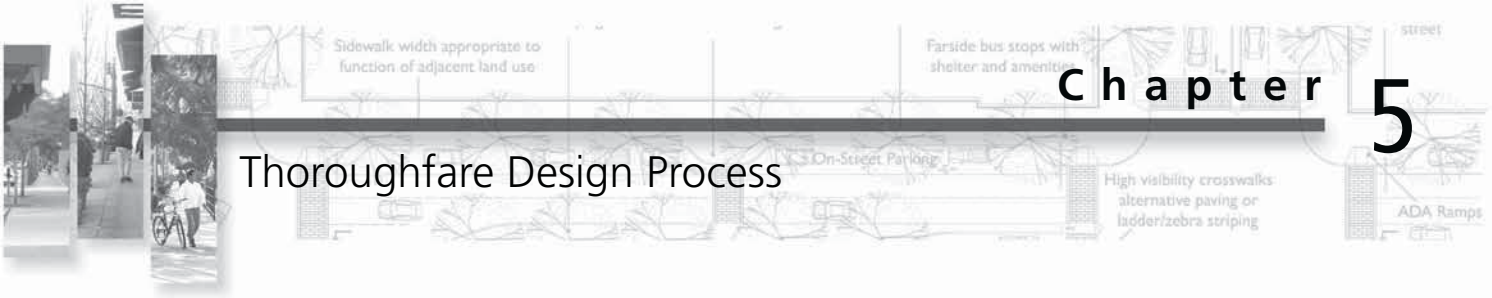
Notes:

[1] Boulevard, Multiway Boulevard, Avenue, and Street thoroughfare types have sidewalks on both sides. Sidewalk width varies as a function of context zone, fronting land use and other factors.

[2] Freight movement is divided into three categories: 1) Regional truck route, 2) Local truck route and 3) Local deliveries only. Cells show highest order of truck movement allowed.

PART 3

Design



Chapter 5

Thoroughfare Design Process

Purpose

This chapter outlines a five-stage process for designing thoroughfares in walkable urban contexts where the community has determined that the character of the thoroughfare and its integration with its surroundings are a high priority. It also presents an approach to designing thoroughfares within constrained rights of way and discusses the flexibility the designer has in applying design parameters. While the focus of this report's approach to design is on walkable thoroughfares in mixed-use areas, the design process presented in this chapter is applicable to all types of areas and thoroughfares, regardless of their modal emphasis.

This chapter presents design criteria that form the basis for the design guidance presented in subsequent chapters. As with the design process, the fundamental design criteria and the flexibility inherent in the interpretation and application of the criteria are applicable to all types of thoroughfares in all types of contexts.

Applicability of Design Criteria

The guidance presented in this report focuses on the design of urban thoroughfares in walkable contexts. As with the design process, the fundamental design criteria and the flexibility inherent in the interpretation and application of the criteria is applicable to all types of thoroughfares in all types of contexts. However, most of the guidance is also applicable to thoroughfares in other contexts where vehicle travel may be a priority. When designing a thoroughfare in a walkable area or a vehicle mobility priority thoroughfare, the practitioner can use this report to identify the sections with relevant and applicable considerations and guidance. If not identified in the report, the guidance provided in the AASHTO *A Policy for the Geometric Design of Highways and Streets*, otherwise known as the "Green Book" (2004), is recommended.

Objectives

This chapter:

1. Describes the various components of the thoroughfare and describes fundamental features of CSS in thoroughfare design;
2. Defines terms that are used in the thoroughfare design process;
3. Provides an overview and describes the five stages of the thoroughfare design process; and
4. Outlines a process for designing thoroughfares in constrained rights of way.

Definitions

Walkable urban thoroughfare design requires attention to many elements of the public right of way and how these elements integrate with adjoining properties. To assist the designer in successfully assembling the elements of the thoroughfare, this report organizes definitions, design principles and criteria into four sections corresponding to the components of a thoroughfare. The three components that comprise the cross-section of the thoroughfare are illustrated in **Figure 5.1** (context, streetside and traveled way), while the fourth component, intersections, is discussed below.

Figure 5.2 illustrates many of the fundamental elements of walkable thoroughfare design, including elements in the traveled way and streetside, and as part of the context.

Each of the components can be described as follows:

- Context—encompasses a broad spectrum of environmental, social, economic and historical aspects of a community and its people. All of these aspects are important in applying CSS principles to thoroughfare design. Thus, context can be the built environment or part of the natural environment. The built environment consists of properties and activities within and adjacent to the public right of way and the thoroughfare it-

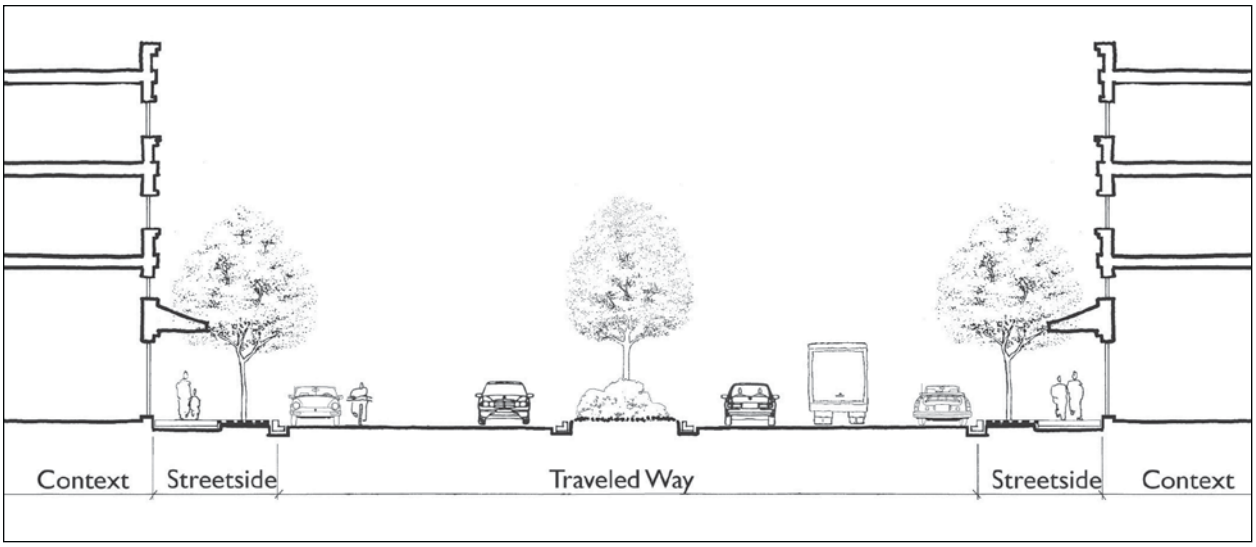


Figure 5.1 Components of an urban thoroughfare. Source: Community, Design + Architecture.

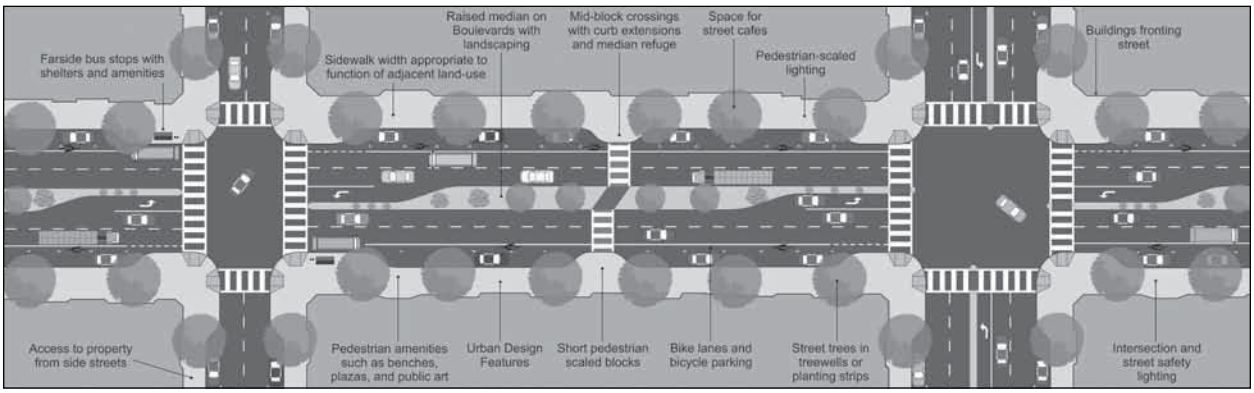


Figure 5.2 An illustration of the elements of a context sensitive thoroughfare. Source: Concept by Community, Design + Architecture, illustration by Digital Media Productions.

self, with surroundings that contribute to characteristics that define the context zone.

Buildings, landscaping, land use mix, site access and public and semipublic open spaces are the primary shaping elements of the built context. The natural environment includes features such as water or topography. In both environments, context can reflect historic or other protected resources. An urban thoroughfare will often change as the context changes from one zone to another. The thoroughfare itself and the activity it handles become part of the context after it is completed. Finally, all contexts whether built or natural, include the equally important elements of economics, time, community perspective, political positions, trade-offs and a multitude of other factors that will directly or indirectly influence the shaping of the context and thoroughfare design.

- Streetside—the public right of way typically includes planting area and sidewalk, from the back of the curb to the front property line of adjoining parcels. The streetside is further divided into a series of zones that emphasize different functions, including frontage, throughway, furnishings and edge zones (**Table 5.1** and Chapter 8 provide detailed descriptions). The function of streetside zones and the level of pedestrian use of

Table 5.1 Definition of Terms and Concepts in Chapter 5

Term or Concept	Definition
Frontage Zone	One of the zones comprising the streetside, the frontage zone is the space between the pedestrian travel way and building faces or private property. At a minimum it provides a buffer distance from vertical surfaces or walls and allows people to window shop or enter/exit buildings without interfering with moving pedestrians. The frontage zone provides width for overhanging elements of adjacent buildings such as awnings, store signage, bay windows and so forth. If appropriate width is provided, the frontage zone may accommodate a variety of activities associated with adjacent uses, such as outdoor seating or merchant displays.
Throughway Zone	The streetside zone in which pedestrians travel. The throughway must provide a minimum horizontal and vertical clear area in compliance with PROWAG accessible route requirements.
Furnishings Zone	The furnishings zone is a multipurpose area of the streetside. It serves as a buffer between the pedestrian travel way and the vehicular area of the thoroughfare within the curbs, and it provides space for streetside appurtenances such as street trees, planting strips, street furniture, utility poles, sidewalk cafes, sign poles, signal and electrical cabinets, phone booths, fire hydrants, bicycle racks and bus shelters.
Edge Zone	The edge zone, sometimes also referred to as the "curb zone," is the transition area between the thoroughfare traveled way and the furnishings zone of the streetside and provides space for the door swing from vehicles in the parking lane, for parking meters and for the overhang of diagonally parked vehicles.
Right of way	Right of way is the publicly owned land within which a thoroughfare can be constructed. Outside of the right of way, the land is privately owned and cannot be assumed to be available for thoroughfare construction without acquiring the land through dedication or purchase.

(See Chapters 8 and 9 for further definitions and design guidelines for the components of the streetside and the traveled way.)

the streetside are directly related to the activities generated by the adjacent context.

- Traveled way—the public right of way between curbs that includes parking lanes and the travel lanes for private vehicles, goods movement, transit vehicles and bicycles. Medians, turn lanes, transit stops and exclusive transit lanes, curb and gutter and loading/unloading zones are included in the traveled way (see Chapter 9 for detailed descriptions).
- Intersections—the junction where two or more public streets meet and where pedestrians share the traveled way. Intersections are characterized by a high level of activity and shared use, multimodal conflicts, complex movements and special design treatments (Chapter 10 contains detailed descriptions).

This chapter uses terms that are commonly used in transportation planning and engineering and introduces new terms and concepts that require definition.

Overview of the Design Process

The context sensitive thoroughfare design process presented in this report encompasses the project development steps from developing project concepts to final design. Briefly introduced in Chapter 2, the design process is composed of the five stages shown in **Figure 5.3**. While this report presents the process in five discrete stages for simplicity, the thoroughfare design process is an iterative process that requires collaboration with the public, stakeholders and a multidisciplinary team of professionals. As stated earlier, this process is applicable for the design of all thoroughfare types under any context.

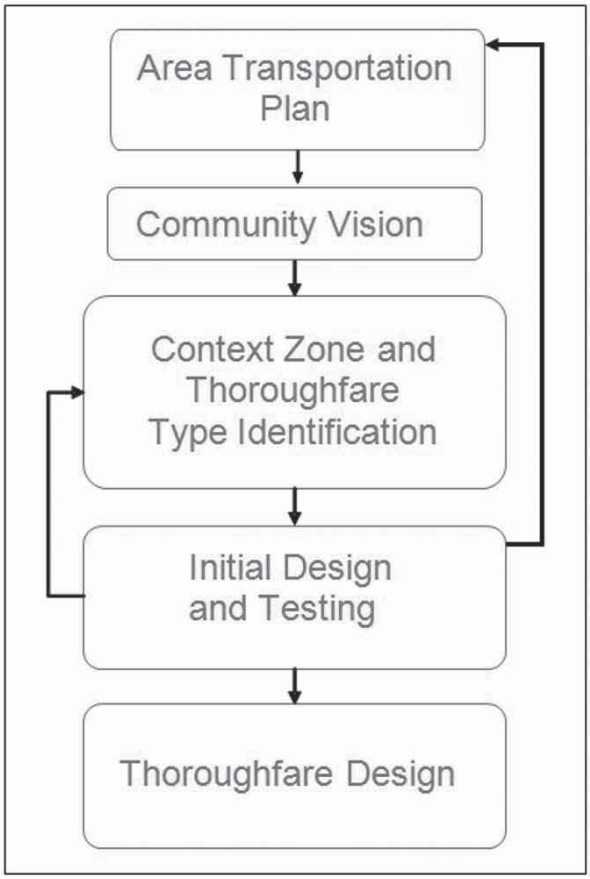


Figure 5.3 Thoroughfare design stages. Source: Kimley-Horn and Associates, Inc.

Stage 1: Review or develop an area transportation plan.

An area transportation plan is a long-range plan based on a public/stakeholder process that establishes goals and objectives for the area, town, or region. The plan results in the pattern of the thoroughfare network, the initial sizing of individual thoroughfares and prioritization of transportation improvements.

The area transportation plan entails development of land use and travel demand forecasts and testing of network alternatives in considering context and area objectives. Often this stage is already available and serves as a direction or resource for the thoroughfare designer. This first stage provides the overall basis for thoroughfare design. The transportation plan establishes guiding principles and policies for the broader community and region. It develops and evaluates the network to ensure the transportation system accommodates projected land use growth.

The plan should identify performance measures for each mode of transportation at the intersection, corridor and network level and should identify how the network supports the community's key goals.

The plan should identify and prioritize discrete thoroughfare projects from which the project development process begins. If an area transportation plan has not been prepared, one should be prepared as part of the thoroughfare design process. Area transportation plans can be in the form of regional transportation plans, comprehensive or general plans, or focused district, area, or specific plans. Chapter 3 provides background and guidance on network systems and design.

Stage 2: Understand community vision for context and thoroughfare.

Understanding the vision, goals and objectives of the place a thoroughfare serves is a critical step. This includes understanding the context as well as the thoroughfare's role in the transportation system. Context sensitive thoroughfare design considers today's conditions but also reflects plans for the future.

In this stage, the designer collaborates with the public, stakeholders and a multidisciplinary team to develop goals and objectives for the project.

If the community in which the project is located has developed a vision and established goals and objectives, this stage entails a thorough knowledge and understanding to ensure that the project achieves the vision. This stage requires review of planning documents, transportation and circulation plans, and land use and zoning codes. Through the community vision, a multidisciplinary team can determine both the existing and future context for the area served by the thoroughfare. It is the future context that defines the long-term transportation and place-making function of the thoroughfare.

If the community lacks a vision, desires a change, or requires further detail in the project area, this is an opportunity to use a public and/or stakeholder process to answer questions that will form the basis of a vision: What do we want the community to be? What do we want the community to look like? How do we want the community to function? Frequently, it is desirable to use a participatory process to develop concepts and alternatives, even if a vision exists. This establishes public ownership in the project and helps meet the requirements of the National Environmental Policy Act (NEPA), where applicable.

The process for working with the public and stakeholders to develop a vision is outside the scope of this report. However, there are resources available to explain the process such as *Public Involvement Techniques for Transportation Decision-Making* by the U.S. DOT Federal Transit Administration.

Stage 3: Identify compatible thoroughfare types and context zones.

Stage 3 determines the compatibility between the existing and future context and the appropriate thoroughfare type. It considers land use and transportation integration, modal requirements, place-making objectives and the functional roles of the adjacent land use and street.

This report provides the tools for this stage in Chapter 4—a framework for urban thoroughfare design. Stage 3 relies on an understanding of the existing and future context identified in Stage 2. Stages will result in the identification of opportunities, design controls and constraints that will dictate thoroughfare design elements and project phasing.

Chapter 4 guides the thoroughfare design team through the process of identifying context and alternative thoroughfare types best suited for the identified context zone. The initial relationship between the context zone and the thoroughfare is tentative, leading to stage 4 of the process.

Stage 3 entails close examination of modal requirements (such as transit, bicycle, pedestrian and freight needs) and establishes design controls such as traffic volumes, speed, corridorwide operations, right-of-way constraints and other fundamental engineering controls (Chapter 7 provides additional information). This stage might be an iterative process that compares needs with constraints, identifies trade-offs and establishes priorities. Specific steps in this stage include:

1. Determining the context zone(s) within which each segment of the thoroughfare is located.The context zones, whether existing or projected, are determined from a community or regional comprehensive plan if one is available. In the absence of such a plan, the context zones can be derived from the description of the function and configuration, the type of the buildings fronting the thoroughfare and whether the context is predominantly residential or commercial. Note that the context zone will likely vary throughout the length of a corridor, requiring the thoroughfare to be divided into segments that may have varying design parameters and elements. **Table 4.1** in Chapter 4 can assist in identifying context zones; and
2. Selecting the appropriate thoroughfare type based on context zone and purpose of the thoroughfare as determined from the area plan, including its functional classification designation.

Tables 4.2, 4.3 and **4.4** in the previous chapter assist a multidisciplinary team in developing the character and general design parameters of the thoroughfare. The thoroughfare's functional classification establishes the role of the thoroughfare in the transportation network. The thoroughfare type helps determine certain design controls such as target speed, the physical design of the thoroughfare and the design elements that serve the activities of the adjacent uses. For urban thoroughfares in walkable communities, the combination of thoroughfare type, functional classification and context zone is used to select the appropriate general design parameters presented in Chapter 6 and the streetside, traveled way and intersection design guidelines presented in Chapters 8 through 10, respectively.

Stage 4: Develop and test the initial thoroughfare concept.

Understanding the balance between the regional functions and local needs of the thoroughfare is a key factor in selecting the appropriate design criteria and prepar-

ing the initial thoroughfare concept. Stage 4 determines whether the boulevard, avenue, or street concept of initial width is appropriate. This step in the process feeds back into the previous stages if the evaluation of the concept results in the need to change the initial thoroughfare type or modify the system design. In this stage a multidisciplinary team uses the design parameters identified by the context zone/thoroughfare type combination selected in stage 3 (**Tables 6.1** through **6.4** in Chapter 6) to determine the basic elements of the thoroughfare that affect its width, including on-street parking, bicycle facilities, number and width of travel lanes, median and general configuration of the streetside.

In stage 4, initial thoroughfare concepts are developed by establishing vital parameters such as speed, number of lanes, travel way and streetside widths, right of way and other design parameters. In this stage, the thoroughfare's function beyond the limits of the project are considered along with its multimodal and place-making functions to ensure both the community vision and the overall network operate as planned.

The team then tests and validates the initial concept at the corridor and network level of performance. A successful urban thoroughfare concept is one that, when viewed as part of an overall system, maintains acceptable systemwide performance even though the individual thoroughfare intersections may experience congestion. Network performance should include multimodal performance measures. Chapter 3 describes the role of the thoroughfare in the network and references network-connectivity guidelines.

Evaluation of the thoroughfare at the corridor and network level will either validate the initial concept or indicate the need to revisit the context zone/thoroughfare type relationship or modify the design parameters. The evaluation might even indicate the need to revise regional or subregional land use and circulation plans.

Stage 5: Develop a detailed thoroughfare design.

Once a successful initial concept has been developed and validated, the process leads to the final step of

The evaluation and initial designs in the previous stages lead to stage 5—refinements and development of a detailed thoroughfare design that reflects the project objectives. This step culminates in final engineering design and environmental approvals.

detailing the thoroughfare design. Stage 5 involves using the guidance to integrate the design of the street components, context, streetside, travelway and intersections. As with any design process, this stage is iterative, resulting in a thoroughfare plan and cross-sections. This stage then leads into preliminary and final engineering. Specific steps in this stage include:

1. *Identifying available right of way and other constraints.*

   In new developments, this step establishes the necessary right of way to accommodate the thoroughfare type and its desirable elements. In existing built areas, this step identifies the available right of way as an input to the thoroughfare design process. It is important to identify any other constraints that will affect the design, such as utility placement.

   In existing areas, an initial cross-section of the desirable streetside and traveled way elements is prepared (see design examples in Chapter 6) and compared with the available right of way. If the total width of the desirable design elements exceeds the right of way, determine the feasibility of acquiring the necessary right of way or eliminating or reducing nonvital elements.

2. *Design the traveled way elements.*

   First identify and select the design controls appropriate for the thoroughfare type and context zone identified in stage 3. These controls include target speed (affects sight distance and alignment), control/design vehicle (affects lane width and intersection design) and modal requirements, such as level of pedestrian activity, parking, bike routes, primary freight routes, or transit corridor and so forth. A trade-offs evaluation may be necessary if right of way is constrained. The design controls and context, along with the available right of way, assist in the selection of the appropriate dimensions for each design element.

3. *Design the streetside elements.*

   The design of the streetside elements requires understanding the characteristics and activity of the adjacent existing or future context. For example, does or will the context include ground floor retail or restaurants that require a wider frontage zone to accommodate street cafes? Does or will the thoroughfare include a transit corridor that requires a wider furnishings zone to accommodate waiting areas and shelters? This report provides general guidance on the optimal and constrained streetside width used initially, but the actual design might require more analysis of existing and future activity levels.

4. *Assemble the thoroughfare components.*

   This is an iterative process, particularly in constrained rights of way. This process entails identifying trade-offs to accommodate the streetside and traveled way elements within the right of way. It is important to refer back to the community vision stage to understand and evaluate the trade-offs. The last section of this chapter provides an approach to design thoroughfares in constrained conditions.

Flexibility in Application of Design Criteria

Flexibility in the application of design criteria requires an understanding of the functional basis for the criteria and the ramifications of changing dimensions or adding/eliminating design elements. Dimensions, whether for elements in the streetside, traveled way, or intersection, should not be applied arbitrarily but should be based on a specific rationale. The concept of design flexibility is not limited to thoroughfares in walkable areas but is a concept that recognizes the unique circumstances of every project under every setting. The challenge that this concept presents is aptly summarized in the Federal Highway Administration's *Flexibility in Highway Design* (1997):

> *For each potential project, designers are faced with the task of balancing the need for the highway improvement with the need to safely integrate the design into the surrounding natural and human environments.*

To correctly apply flexibility, the thoroughfare designer should understand the relationship between a recommended criterion and its role in safety and mobility for all users. The American Association of State Highway and Transportation Officials (AASHTO) emphasizes this requirement in the following quote from *A Guide for Achieving Flexibility in Highway Design* (2004c):

> *Only by understanding the actual functional basis of the criteria and design values can designers and transportation agencies recognize where, to what extent and under what conditions a design value outside the typical range can be accepted as reasonably safe and appropriate for the site-specific context.*

Flexibility is related to the design controls used in the selection of criteria. Design controls recognized by AASHTO include functional classification, location (urban versus rural), traffic volumes and level of service, design vehicle and driver and target speed. All of these design controls are important, regardless of whether the designer believes the thoroughfare design is context sensitive or not.

Design Process in Constrained Right of Way

The nature of thoroughfare design is balancing the desired design elements of the thoroughfare with right-of-way constraints. The thoroughfare designs presented in this report illustrate the desired elements within the cross-section, but actual conditions frequently limit the width of the street. Designing thoroughfares in constrained rights of way requires prioritizing the design elements and emphasizing the higher-priority elements in constrained conditions. Higher-priority design elements are those that help the thoroughfare meet the vision and context sensitive objectives of the community (the objectives established in stage 2). Lower-priority elements have less influence on achieving the objectives and can be relinquished in cases of insufficient right of way.

Often the width of the public right of way varies along the thoroughfare, making the job of the designer even more challenging. When the width of the right of way

varies, it is useful to prioritize design elements and develop a series of varying cross-sections representing:

1. Optimal conditions—sections without right-of-way constraints that can accommodate all desirable elements;
2. Predominant—representing sections of the predominant right-of-way width in the corridor that accommodate all of the higher-priority elements;
3. Functional minimum—representing a typically constrained section where most of the higher-priority elements can be accommodated; and
4. Absolute minimum—representing severely constrained sections where only the highest-priority design elements can be accommodated without changing the type of thoroughfare.

Below the absolute minimum, or if the predominant right of way is equal to or less than the absolute minimum, consider changing the thoroughfare to a different type while attempting to maintain basic function, or consider converting the thoroughfare to a pair of one-way thoroughfares (couplet)—or, further still, consider other solutions that achieve the community vision. This requires recycling through the steps of the design process, potentially requiring a review of the community vision for the thoroughfare and the area transportation plan and/or identifying a new context zone/thoroughfare relationship. If the vision for the corridor is long range, then the necessary right of way should be acquired over time as the adjacent property redevelops. Under these circumstances the optimal (or the predominant) thoroughfare width can be phased in over time, beginning with the functional or absolute minimum design in the initial phase.

In constrained conditions it might be tempting to minimize the streetside width and only provide the minimum pedestrian throughway (5 feet). In urban areas, however, even under constrained conditions, it is critical to provide at least a minimum width furnishing zone to accommodate street trees, utility poles and other appurtenances. Without the furnishings zone, trees, utilities, benches and shelters and other street paraphernalia might encroach into the throughway for pedestrians or result in an inadequate width streetside when the community's vision for the context zone is ultimately achieved.

Table 5.2 provides minimum recommended dimensions for the streetside in constrained conditions, which vary by the predominant land use. In residential areas, the furnishings zone can be a minimum of 3 feet. This width continues to provide a buffer between pedestrians and the traveled way and also allows a minimal width for plantings and utilities. The clear throughway for pedestrians should be a minimum of 5 feet. The frontage zone should be a minimum of 1 foot adjacent to buildings or eliminated adjacent to landscaping. These dimensions result in a minimum residential streetside width of 9 feet.

In predominantly commercial areas with ground floor retail, the furnishings zone minimum width is 4 feet to allow for street trees, utilities and so forth. The clear throughway for pedestrians is a minimum of 6 feet to allow for a higher level of pedestrian activity, and the frontage zone minimum is 2 feet to provide a buffer between moving pedestrians and buildings, resulting in a 12-foot streetside width. When a wider frontage zone is needed (for street cafes and so forth), consider requiring the adjacent property to provide an easement to effectively expand the streetside width.

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Table 5.2 Minimum Recommended Streetside Dimensions for Thoroughfares in Walkable Areas Under Constrained Conditions

Streetside Zone	Minimum Dimension
Residential (All Context Zones)	
Edge and Furnishing Zone (Planting Strip, utilities, etc.)	3 feet
Clear Pedestrian Travel Way	5 feet
Frontage Zone	1 foot
Total Minimum Streetside Width:	9 feet
Commercial with Ground Floor Retail (All Context Zones)	
Edge and Furnishing Zone (Treewell[1], utilities, bus stops, etc.)	4 feet
Clear Pedestrian Travel Way	6 feet
Frontage Zone	2 feet
Total Minimum Streetside Width:	12 feet

[1] Plant only small caliper trees (4" diameter when mature) in 4-foot treewells.

The minimum recommended streetside dimensions for thoroughfares in other areas (such as vehicle-oriented areas) should be based on the designer's understanding of the community's objectives, the future desired traversability of the area, the future potential redevelopment of the adjacent property and the need to accommodate all users.

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Chapter 6

Thoroughfare Designs for Walkable Urban Areas

Purpose

This chapter identifies how design elements can be combined to produce a thoroughfare in urban walkable areas with traditional characteristics. This chapter includes tables of common cross-sectional design elements for thoroughfare types in each context zone and provides design examples under various situations. The variation in design criteria are presented by context zone (C-3 through C-5/6), thoroughfare type (boulevard, avenue and street) and whether the thoroughfare serves a predominantly residential or commercial area with fronting ground floor retail.

The design criteria presented in this chapter focus primarily on thoroughfares in walkable areas, but many of the principles and design examples in this chapter are fully applicable to other areas as well.

Objectives

This chapter:

1. Describes how variables such as context zone and land use type can affect the design of thoroughfares; and
2. Provides design examples that guide the practitioner through the design process.

Basis for Thoroughfare Design Examples

The thoroughfare examples illustrate variations in the traveled way and streetside based on the variables of existing right-of-way constraints, context zone, functional classification, thoroughfare type and predominant surrounding land use and ground floor uses. The general influence of each variable on the design of a thoroughfare is summarized in **Table 6.1**.

General Walkable Thoroughfare Design Parameters

While walkable thoroughfares can be any functional classification of thoroughfare—arterial, collector, or local—this report addresses only arterial and collector thoroughfares. Within those functional classifications, all three thoroughfare types—boulevards, avenues and streets—may be employed and should be designed to be walkable. The remainder of this chapter provides basic design criteria for developing initial cross-section characteristics. However, despite the presentation of these criteria, designers are reminded that each thoroughfare design is unique, and the ultimate design needs to address the context, objectives, priorities and design con-

Table 6.1 Effect of Variables on Thoroughfare Design Elements

Variable	Effect on Design Elements
Context Zone	A designation of design character that affects general design parameters including the selection of thoroughfare type, target speed and the width and treatment of certain streetside elements.
Thoroughfare Type	Affects general design parameters of thoroughfares including target speed, number of through lanes, basic travel lane width, medians and the width of certain streetside elements.
Predominant Land Use and Ground Floor Use	Divided into predominantly residential or commercial. Residential areas affect streetside width, parking lane width, landscaping and building setback. Commercial, particularly where there is ground floor retail, affects the width of the streetside uses for pedestrian facilities, bus stops, landscaping, outdoor cafes and so forth. Adjacent land uses, pedestrian activity, building orientation and so forth directly influence the target speed (and related design elements).

Table 6.2 Selected Characteristics of Walkable Thoroughfares

Characteristic	Walkable Thoroughfares	Vehicle-Oriented Thoroughfares
Target speed range	From Table 6.4.	25–35 mph.
Pedestrian separation from moving traffic	Curb parking and streetside furnishing zone.	Optional, typically separation achieved with planting strip.
Streetside width	Minimum 9 feet (residential) and 12 feet (commercial) to accommodate sidewalk, landscaping and street furniture.	Minimum 5 feet.
Block lengths	200–660 feet.	Up to one-quarter mile.
Protected pedestrian crossing frequency (pedestrian signals or high-visibility markings at unsignalized crossings)	200–600 feet.	As needed to accommodate pedestrian demands.
Pedestrian priority at signalized intersection	Pedestrian signals and pedestrian countdown heads, adequate crossing times, shorter cycle lengths and median refuges for very long crossings.	Vehicle priority; may have longer cycle lengths and require two cycles for slower pedestrians to cross wide streets with medians.
Pedestrian crossings	High-visibility crosswalks shortened by curb extensions where there is on-street parking.	Full street width.
Median width	6 feet minimum width at crosswalk, if used as pedestrian refuge, plus 10 feet for left-turn lane, if provided. 14 foot total width for left-turn lane if no refuge needed.	14–18 feet for single left-turn lane; 26–30 feet for double left-turn lane.
Vehicular access across sidewalks	24 feet or less, except if specific frequent design vehicle requires added width.	As needed.
Curb parking	Normal condition except at bus stops and pedestrian crossings.	None.
Curb return radius	10–30 feet; low-speed channelized right turns where other options are unworkable.	30–75 feet; high-volume turns channelized.

Table 6.3 Design Elements Influenced by Functional Classification

Characteristic	Arterials	Collectors
Network Characteristic		
Continuity	Longer, extending intercity, interarea or serving major corridors.	Shorter, connecting neighborhoods and providing local connections to activity centers; usually 1–2 miles.
Trip lengths	Longer (local and regional).	Shorter (local only).
Role in bicycle network	Designated bikeway with bike lanes or shared lanes depending on context and target speed.	Bike lanes, signed routes, or shared facilities.
Segment Characteristic		
Target speed range (see Table 6.4)	30–35 mph.	25–30 mph.
Traffic volumes (daily)	10,000–50,000.	1,000–10,000.
Transit	Major regional fixed guideway corridor, express, or local bus routes.	Local bus service only, where provided.

cept established for the facility and corridor. Consequently, the thoroughfare designs resulting from use of this guidance may deviate from the initial parameters presented here.

For purposes of comparison, **Table 6.2** presents some of the common characteristics that should be provided for all walkable thoroughfares and contrasts these characteristics with those of conventional vehicle-oriented thoroughfares.

While the characteristics for walkable thoroughfares of all functional classifications and thoroughfare types have much in common, the thoroughfare's functional classification does influence some of the design characteristics, only a few of which affect cross-section. **Table 6.3** compares those design characteristics that vary depending on functional classification.

Table 6.4 presents the recommended initial cross-section and other design criteria to be used in the design of walkable thoroughfares. Chapters 8 though 10 provide additional criteria and discussion on how and when to use the various design elements. While **Table 6.4** focuses on thoroughfares in walkable areas, many of the design elements are applicable in other areas.

Specialized Thoroughfare Designs

This section discusses the design of two specialized types of thoroughfares: main streets and multiway boulevards.

Main Streets

Main streets used to be the principal thoroughfares of American towns, where people could find all types of goods and services. They were the center of commercial, social and civic activities. Main streets thrived up until the 1960s and 70s, when larger-scale, auto-oriented shopping centers became popular. Many communities are revitalizing their main streets to return to a traditional small town mercantile environment or are creating hybrids of traditional and contemporary commercial centers.

Table 6.4 Design Parameters for Walkable Urban Thoroughfares

Thoroughfare Design Parameters for Walkable Mixed–Use Areas									
	Suburban (C–3)						General Urban (C–4)		
	Residential			Commercial			Residential		
	Boulevard [1]	Avenue	Street	Boulevard [1]	Avenue	Street	Boulevard [1]	Avenue	Street
Context									
Building Orientation (entrance orientation)	front, side	front, side	front, side	front, side	front, side	front, side	front	front	front
Maximum Setback [2]	20 ft.	20 ft.	20 ft.	5 ft.	5 ft.	5 ft.	15 ft.	15 ft.	15 ft.
Off-Street Parking Access/Location	rear, side	rear, side	rear, side	rear, side	rear, side	rear, side	rear	rear, side	rear, side
Streetside									
Recommended Streetside Width [3]	14.5–16.5 ft.	14.5 ft.	11.5 ft.	16 ft.	16 ft.	15 ft.	16.5-18.5 ft.	14.5 ft.	11.5 ft.
Minimum sidewalk (throughway) width	6 ft.	6 ft.	6 ft.	6 ft.	6 ft.	6 ft.	8 ft.	6 ft.	6 ft.
Pedestrian Buffers (planting strip exclusive of travel way width) [3]	8 ft. planting strip	6–8 ft. planting strip	5 ft. planting strip	7 ft. tree well	6 ft. tree well	6 ft. tree well	8 ft. planting strip	8 ft. planting strip	6 ft. planting strip
Street Lighting	For all thoroughfares in all context zones, intersection safety lighting, basic street lighting, and pedestrian-scaled lighting is recommended. See Chapter 8 (Streetside Design Guidelines) and Chapter 10 (Intersection Design Guidelines).								
Traveled Way									
Target Speed (mph)	25–35	25–30	25	25–35	25–35	25	25–35	25–30	25
Number of Through Lanes [5]	4–6	2–4	2	4–6	2–4	2	4–6	2–4	2
Lane Width [6]	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 [7]	7 ft.	7 ft.	7 ft.	8 ft.	7-8 ft.	7-8 ft.	7 ft.	7 ft.	7 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.
Horizontal Radius (per AASHTO) [8]	200–510 ft.	200–330 ft.	200 ft.	200–510 ft.	200–510 ft.	200 ft.	200–510 ft.	200–330 ft.	200 ft.
Vertical Alignment	Use AASHTO minimums as a target, but consider combinations of horizontal and vertical per AASHTO Green Book.								
Medians [9]	4–18 ft.	Optional 4–16 ft.	None	4–18 ft.	Optional 4–18 ft.	None	4–18 ft.	Optional 4–16 ft.	None
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.
Access Management [10]	Moderate	Low	Low	High	Moderate	Low	Moderate	Low	Low
Typical Traffic Volume Range (ADT) [11]	20,000–35,000	1,500–25,000	500–5,000	20,000–50,000	1,500–35,000	1,000–10,000	10,000–35,000	1,500–20,000	500–5,000
Intersections									
Roundabout [12]	Consider urban single–lane roundabouts at intersections on 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/Curb Extensions and Other Design Elements	Refer to Chapter 10 (Intersection Design Guidelines)								

Table 6.4 Notes:

1. Multiway boulevards are a special form of boulevards. Generally they add one–way, 16–20 foot wide access lanes adjacent to the outer curb and separated from the through traffic lanes by a longitudinal island at least 6 ft. wide (10 ft. if accommodating transit stops). Access lanes have curb parallel parking plus one moving traffic/bike lane with a target speed of 15–20 mph. All vehicular traffic on the access lanes is local. See Chapter 6 section on multiway boulevards for additional information.
2. For all context zones with predominantly commercial frontage, this table shows the maximum setback for buildings with ground floor retail. In suburban contexts, office buildings are typically set back 5 ft. further than retail buildings to provide a privacy buffer. In general urban and urban center/core areas, office buildings are set back 0–5 ft. Setback exceptions may be granted for important civic buildings or unique designs.
3. Streetside width includes edge, furnishing/planting strip, clear throughway, and frontage zones. Refer to Chapter 8 (Streetside Design Guidelines) for detailed description of sidewalk zones and widths in different context zones and on different thoroughfare types. Dimensions in this table reflect widths in unconstrained conditions. In constrained conditions streetside width can be reduced to 12 ft. in commercial areas and 9 ft. in residential areas (see Chapter 5 on designing within constrained rights of way).
4. Desired target speeds on avenues serving C–4 and C–5/6 commercial main streets with high pedestrian activity should be 25 mph.
5. Six lane facilities are generally undesirable for residential streets because of concerns related to neighborhood livability (i.e., noise, speeds, traffic volume) and perceptions as a barrier to crossing. Consider a maximum of four lanes within residential neighborhoods.
6. Lane width (turning, through and curb) can vary. Most thoroughfare types can effectively operate with 10–11 ft. wide lanes, with 12 ft. lanes desirable on higher speed transit and freight facilities. Chapter 9 (Traveled Way Design Guidelines) (lane width section) identifies the considerations used in selecting lane widths. Curb lane width in this report is measured to curb face unless gutter pan/catch basin inlets do not accommodate bicycles, then it is measured from the edge of travel lane. If light rail transit or streetcars are to be accommodated in a lane with motor vehicles, the minimum lane width should be the

Table 6.4 Design Parameters for Walkable Urban Thoroughfares (continued)

Thoroughfare Design Parameters for Walkable Mixed–Use Areas									
	General Urban (C–4)			Urban Center/Core (C–5/6)					
	Commercial			Residential			Commercial		
	Boulevard [1]	Avenue	Street	Boulevard [1]	Avenue	Street	Boulevard [1]	Avenue	Street
Context									
Building Orientation (entrance orientation)	front	front	front	front	front	front	front	front	front
Maximum Setback [2]	0 ft.	0 ft.	0 ft.	10 ft.	10 ft.	10 ft.	0 ft.	0 ft.	0 ft.
Off-Street Parking Access/Location	rear, side	rear, side	rear, side	rear	rear	rear, side	rear	rear	rear, side
Streetside									
Recommended Streetside Width [3]	19 ft.	16 ft.	16 ft.	21.5 ft.	19.5 ft.	16 ft.	21.5 ft.	19.5 ft.	16 ft.
Minimum sidewalk (throughway) width	8 ft.	6 ft.	6 ft.	10 ft.	9 ft.	6 ft.	10 ft.	9 ft.	6 ft.
Pedestrian Buffers (planting strip exclusive of travel way width) [3]	7 ft. tree well	6 ft. tree well	6 ft. tree well	7 ft. tree well	6 ft. tree well	6 ft. tree well	7 ft. tree well	6 ft. tree well	6 ft. tree well
Street Lighting	For all thoroughfares in all context zones, intersection safety lighting, basic street lighting, and pedestrian-scaled lighting is recommended. See Chapter 8 (Streetside Design Guidelines) and Chapter 10 (Intersection Design Guidelines).								
Traveled Way									
Target Speed (mph)	25–35	25–30 [4]	25	25–35	25–30	25	25–35	25–30 [4]	25
Number of Through Lanes [5]	4–6	2–4	2–4	4–6	2–4	2–4	4–6	2–4	2–4
Lane Width [6]	10–12 ft.	10–11 ft.	10–11 ft.	10–11 ft.	10–11 ft.	10–11 ft.	10–11 ft.	10–11 ft.	10–11 ft.
Parallel On-Street Parking Width [7]	8’	7–8 ft.	7–8 ft.	7 ft.	7 ft.	7 ft.	8 ft.	8 ft.	7–8 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.
Horizontal Radius (per AASHTO) [8]	200–510 ft.	200–330 ft.	200 ft.	200–510 ft.	200–330 ft.	200 ft.	200–510 ft.	200–330 ft.	200 ft.
Vertical Alignment	Use AASHTO minimums as a target, but consider combinations of horizontal and vertical per AASHTO Green Book.								
Medians [9]	4–18 ft.	Optional 4–18 ft.	None	4–18 ft.	Optional 4–16 ft.	None	4–18 ft.	Optional 4–18 ft.	None
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.
Access Management [10]	High	Low–Moderate	Low–Moderate	Moderate	Low–Moderate	Low–Moderate	High	Low–Moderate	Low–Moderate
Typical Traffic Volume Range (ADT) [11]	15,000–50,000	1,500–30,000	1,000–15,000	15,000–30,000	1,500–20,000	500–5,000	15,000–40,000	1,500–30,000	1,000–15,000
Intersections									
Roundabout [12]	Consider urban single–lane roundabouts at intersections on 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/Curb Extensions and Other Design Elements	Refer to Chapter 10 (Intersection Design Guidelines)								

width of the transit vehicle plus 1 ft. of clearance on either side. Most modern streetcars or light rail vehicles (LRT) can be accommodated in an 11 or 12 ft. wide lane but designers need to consider the LRT vehicle’s “dynamic envelope” when designing on horizontal curves and intersections.

7. An 8 ft. wide parking lane is recommended in any commercial area with a high turnover of parking.
8. For guidance on horizontal radius—see AASHTO’s “green book” section on “Minimum Radii for Low Speed Urban Streets—Sharpest Curve Without Superelevation.” Dimensions shown above are for noted target speeds and are found on Exhibit 3–16 (Page 151) in *A Policy on Geometric Design of Highways and Streets* (2004), assuming a superelevation of –2.0 percent reflecting typical cross slope. Depending on design vehicle, horizontal curves may require lane widening to accommodate large vehicle off–tracking. See AASHTO’s section on “Traveled Way Widening on Horizontal Curves” for guidance.
9. See also Chapter 9 for additional detail on medians. For curb to curb intersection crossing distances of 60 ft. or more, medians should be at least 6 ft. wide to serve as a pedestrian refuge, otherwise the median should be at least 4 ft. wide. Where left turn lanes are to be provided, median widths should be increased by the width of the turn lane(s). Where left turn lanes are not needed (e.g., long blocks) median widths may be as little as 4 ft.
10. Access management involves providing (i.e., managing) access to land development in such a way as to preserve safety and reasonable traffic flow on public streets. Low, moderate and high designations are used for the level of access restrictions. A high level of access management uses medians to restrict mid–block turns, consolidate driveways and control the spacing of intersections. A low level of access management limits full access at some intersections, but generally uses minimal measures to restrict access.
11. These ranges of typical traffic volumes are intended to help determine the characteristics of thoroughfares. Volumes can fluctuate widely on all thoroughfare types. These ranges are not intended to establish guidelines or upper bounds for designing thoroughfares.
12. Double–lane roundabouts are not recommended in urban areas with high levels of pedestrians and bicyclists.

Figure 6.1 Buildings on main streets are typically located on small lots and front the streetside. Parking is either located in the rear of the building, on-street, or in nearby public parking facilities. Source: Kimley-Horn and Associates, Inc.

Figure 6.2 The design of main streets supports active uses such as social interaction, street cafes, window shopping and strolling. Source: Kimley-Horn and Associates, Inc.

The value of today's main streets is summarized in this quote from Portland, Oregon Metro's *Main Street Handbook:*

> *"Main streets flourish because they provide a variety of goods and services, a pleasant community environment and efficiency for those who frequent them. When people do their shopping at a main street, they simply accomplish more with less travel and may find the experience more entertaining."*

Creating Quality Main Streets

While main streets vary from community to community, there are some universal characteristics. Main streets may be located in any context zone but are most commonly found in suburban (C-3), general urban (C-4) and urban center (C-5) contexts. They are usually short, walkable segments of arterial or collector streets, often only a few blocks in length. They are within a grid or interconnected system of local streets serving the commercial center of town with short blocks, minimal or no driveways and buildings often served by alleys.

Land uses on main streets consist of compact, mixed-use development, usually with a strong retail and entertainment emphasis on the ground floors and an equal mix of residential and/or commercial office or services on the upper floors. The buildings are low-scale (generally one to three stories) and are oriented to the street without setback. Also, they are closely spaced as shown in **Figure 6.1**. Parking lots or garages are located behind or to the side of buildings. Public parking consists of on-street parking and may include strategically located parking lots or garages that support a "park once" environment.

The design of main streets includes wide streetsides that support active uses such as street cafes, social interactions, strolling and window shopping (**Figure 6.2**). Main streets, by tradition and design, are pedestrian friendly and may have historic or contemporary urban design features, public spaces, or public art. Main streets typically are no wider than two travel lanes, provide on-street parking and may contain bicycle lanes. Transit consists of local service.

The key ingredients for a successful main street include:

- The architecture of the adjacent buildings, urban design features, the appearance of the street frontage and the provision of public spaces;
- The types and mix of uses, particularly those that generate pedestrian activity and create an active day and evening place;.
- Street design that accommodates low-speed traffic, pedestrians, bicyclists and transit;
- Physical and visual thoroughfare and urban design elements that draw together both sides of the street and encourage frequent traversal of the street; and

Figure 6.3 The width of the streetside should be planned to accommodate the activities generated by the adjacent land uses. Source: Kimley-Horn and Associates, Inc.

- A public parking strategy that encourages walking.

According to a report prepared for the New Jersey Department of Transportation (*Scoring Formula for New Jersey's Main Streets*, Rutgers University, March 2003) and based on a visual preference survey, the attributes of a main street that positively affect how people view the street include:

- The proportion of street frontage with active commercial uses;
- A low proportion of street frontage with dead space such as vacant lots, parking lots and blank walls;
- The proportion of the street frontage with parked cars generating activity, providing a buffer between traffic and the streetside and slowing traffic;
- The proportion of the street with a tree canopy;
- Width of sidewalk, with wider facilities providing more public space and greater levels of activity (see **Figure 6.3**); and
- Visible curb extensions that provide for shorter crossing distances and space for plantings, street furniture and traffic calming.

Attributes of a main street that negatively affect how people view the street include:

- A high proportion of street frontage with dead space such as vacant lots, parking lots and blank walls (a negative response is associated with more blank walls); and
- The number of travel lanes, where streets with more than two lanes are perceived as having higher speeds, more traffic, longer crossing distances and a less attractive appearance.

Design Factors That Create Main Street Thoroughfares

The multidisciplinary design team needs to consider a number of factors to create an appropriate main street environment. This process often requires trade-offs, such as balancing traffic throughput with economic development goals.

Traveled Way

In designing the traveled way, there are three important factors to consider: speed, width and parking. Because of the pedestrian-oriented nature of main streets, the target speed should be kept low (25–30 miles per hour) in main street segments, even on thoroughfares designated as principal arterials. This speed not only improves the user's perception of the street but also creates a safer environment, accommodates frequent parking maneuvers and is consistent with restricted sight distances encountered in urban places. The visual interest drivers experience on main streets requires lower speeds.

The width of the traveled way affects users' perceptions of the speed and volume of the street. Wide streets may be perceived as a barrier to crossing where frequent crossings are desired and encouraged. Typically, main streets are two lanes wide with parallel parking on both sides, resulting in a traveled way width of 36 to 38 feet (**Figure 6.4**) or 44 to 48 feet on streets with bicycle lanes. Wider streets may be required to accommodate angled parking (see discussion on implementing angled parking below). An increased number of travel lanes to three or four may be appropriate based on community objectives, the main street's role in the network, and the existence or lack of parallel thoroughfares.

On-street parking is considered an important design element on main streets. It provides a source of short-term parking for adjacent retail and service uses, buf-

Figure 6.4 A typical configuration of a main street traveled way. Source: Reid Ewing and Michael King.

fers pedestrians from traffic, creates friction that slows traffic and produces a higher level of street activity. Parallel parking lane width should be 8 feet to accommodate the high level of parking turnover experienced on main streets.

Main streets, as avenue or street thoroughfare types, should forego raised medians, as they create a physical and visual separation of the two sides of the street in an environment in which pedestrians are encouraged to cross the street frequently. Main streets, as boulevards or any thoroughfare wider than 60 feet, may use medians for pedestrian refuge or turn lanes. Landscaping and urban design elements within the median may be used to provide a unifying theme connecting both sides of the street. Landscaping is an important element of main streets. It serves as an amenity to pedestrians and helps provides a uniform theme, often as part of a planned streetscape. Landscaping on main streets should be designed and maintained so that it enhances the visibility and attraction of storefronts, signs and lighting. On new and redeveloping main streets, the design of building facades and signage should anticipate mature landscaping and accommodate its growth without interfering with visibility.

Common design issues related to main street traveled ways include:

- **Excessive street width:** Whether two- or four-lane cross-sections, excessively wide main streets create barriers to pedestrian crossings, reduce the street enclosure created by the ratio of street width to building height and encourage high travel speeds. The practitioner may consider the following design solutions after assessing the traffic operations and other needs served by the street:
  - Convert four-lane undivided sections to a three-lane section (one travel lane in each direction and a center turn lane or median with left-turn lanes at intersections). Use the width gained to add on-street parking, bike lanes, or, in the case of street reconstruction, wider sidewalks.
  - A five-lane section on streets designated as collectors may be converted to a three-lane section with the remaining width used to provide angled parking on one or both sides of the street, depending on the total width of the street.
  - Wide two-lane sections may be visually narrowed with the addition of a painted center turn lane (or raised median on boulevards), bike lanes, striping parking lane lines, or edge lines. Raised and landscaped curb extensions within parking lanes and at intersections can physically narrow the street.
  - On avenue and street thoroughfares, relatively short (20 to 30 feet in length) raised and landscaped medians can be used to break up the width of the street, provide neck-down areas (especially when combined with curb

Figure 6.5 Angled parking is used to maximize on-street parking on main streets. On narrow streets, some communities use angled parking on one side and parallel parking on the other, and alternate the arrangement from block to block. Source: Kimley-Horn and Associates, Inc.

extensions) and can be used as pedestrian refuges when used in conjunction with mid-block crossings.

- On very wide thoroughfares (exceeding 90 feet curb to curb) or on very wide main streets where traffic throughput needs to be retained, consider implementing a multiway boulevard, potentially on only one side of the street.

- **Implementing angled parking:** Angled parking is one strategy to maximize the public parking supply on main streets, particularly in areas where off-street parking is limited. On low-volume, low-speed collector avenues and streets in commercial main street areas, where sufficient curb-to-curb width is available, angled parking may be appropriate. Angled parking can be implemented on both sides of the street or on one side of the street, with parallel parking on the other side (see **Figure 6.5**). On some main streets, angled and parallel parking are alternated in each block.

  Angled parking can create sight distance problems associated with cars backing out of parking spaces. The use of reverse (back-in) angled parking in some cities has overcome these sight distance concerns and is considered safer for bicyclists traveling adjacent to angled parking. Angled parking requires a wider adjacent travel lane than parallel parking to allow vehicles to back out (or back in) without encroaching onto the opposing travel lane. Because the depth of the angled parking spaces themselves and wider adjacent lanes increase the overall width of the street, the practitioner needs to assess the trade-offs between the addition of parking spaces and the negative effects associated with wider streets.

- **Main street is a state highway:** Many main streets are state highways, especially in smaller towns where rural highways or principal arterials pass through the community's historical commercial district. The design, maintenance and operation of these streets are controlled by the state department of transportation (DOT) and are subject to the state's policies and design standards. During redevelopment projects or during the planning of improvements to state highways, the community may desire features that conflict with state standards. While many DOTs recognize the value the community places on their main streets and are amenable to applying flexibility in the application of their standards using the "design exception" process, some desired design features may not be acceptable to the DOT, even if the local municipality regularly includes these features on its streets. DOTs typically will work with municipalities and the community to find solutions. The key elements to successful planning and implementation of walkable main streets on state highways include:

  - Involving the DOT in the earliest stages of planning and redevelopment projects located adjacent to a state highway;
  - Including the DOT as a key stakeholder in all stages of the project but especially when proposing any change or streetscape design to a state highway or connecting street;
  - Working collaboratively with the DOT and all other stakeholders to define a vision, goals and objectives and to identify a purpose and need statement for the project;
  - Identifying potential tensions early in the process and resolving them so they don't hold up the project in its last stages of planning and design;

- Understanding the DOT's project development and design exception process, as these are the mechanisms through which any nonstandard feature will be accepted;
- Discussing design flexibility with the state's design engineers and establishing the ranges of acceptability prior to developing street designs; and
- Developing an early consensus on the concept plan and nonstandard design features. Build this consensus with a small subset of the ultimate stakeholders before going to the public and decision makers; this avoids establishing public and stakeholder expectations that will not be supported by the DOT, thus also avoiding dissatisfaction with the final concept plan.

Streetside

Streetside design features include an appropriate width to accommodate anticipated levels and types of activity. The provision of distinct streetside zones is very important on main streets. The clear pedestrian throughway should be wide enough, at a minimum, to allow two people to walk side-by-side. The frontage zone should allow for window shopping, seating, displays and pedestrian activity at building entrances.

The furnishings zone needs to accommodate many functions, including street trees, planting strips, street furniture, utilities, bicycle racks, transit facilities and public art. If community objectives desire, and regulations encourage restaurants, then ensure the streetside furnishings zone can accommodate potential street cafes.

The edge zone will need to accommodate frequent car door openings, parking meters and signing. Lighting in the streetside should provide both safety illumination of the traveled way and intersections and also pedestrian-scaled decorative light standards illuminating the pedestrian way.

Requirements for Great Streets

Great Streets author Allan B. Jacobs describes the physical qualities that are required to make great streets. He states that most of the qualities are directly related to social and economic criteria and designable qualities for creating good cities; accessibility, bringing people together, publicness, livability, safety, comfort, participation, and responsibility.

Some of these qualities may be challenging for the thoroughfare designers to quantify in the design, or are outside of the designer's responsibility, thus underscoring the importance of multidisciplinary teams, stakeholder involvement and understanding the community's vision. Jacobs' requirements for great streets include:

- Places for people to walk with some leisure
- Physical comfort
- Definition of the street's edge
- Qualities that engage the eyes without being disorienting
- Complementary building height and appearance
- Maintenance
- Quality of construction and design

For further information on these qualities, refer to Part Four of *Great Streets*.

Intersections

Main street intersection design should emphasize slow speeds and the management of conflicts through appropriate traffic control and improved visibility. Intersections on main streets should emphasize pedestrian convenience, as these types of streets encourage frequent crossing. Main street intersections should be as compact as possible with short crossing distances, using curb extensions where possible. Curb-return radii should be minimized and based on the design and control vehicles selected (see Chapter 7). Crosswalks need to be allowed on all approaches of the intersection. Midblock crossings are usually not necessary due to short block lengths but may be considered where

blocks are unusually long and there is a demonstrated demand to cross. Typical main street intersections would include the following design elements:

- Crosswalks on all approaches of signalized and unsignalized intersections using highly visible markings (e.g., longitudinal crosswalks) or alternative paving material;
- Curb extensions on streets with on-street parking;
- Curb-return radius as small as practicable on streets without on-street parking or where design/control vehicle warrants a larger radius;
- Channelized right-turn lanes are generally inappropriate for main street environments but—where needed due to intersection angle or required design vehicle—design should be low speed, with adequate-sized island for pedestrian refuge and possible signal control in high pedestrian-volume locations;
- Pedestrian countdown timers at signalized intersections; indications should not require button activation;
- Short cycle lengths to reduce pedestrian waiting time, and pedestrian clearance intervals set for slower-walking pedestrians; and
- Wheelchair-accessible curb ramps and audible indicators conforming to Public Rights-of-Way Accessibility Guidelines (PROWAG).

A more detailed discussion of the intersection design elements listed above are presented in Chapter 10.

Main Street Design Parameters

Table 6.5 provides general design parameters for commercial avenues and streets in context zones C-3 through C-5 that may be applicable in the design of main streets.

Multiway Boulevards

The multiway boulevard is an alternative to conventional higher-volume, higher-speed arterial streets. This thoroughfare type may be used where the community's objective is to accommodate urban mixed use or residential development and a walkable environment on corridors with high traffic demands. A multiway boulevard combines a central thoroughfare for higher-speed through movements bordered by landscaped medians that separate the central thoroughfare from one-way access lanes on each side of the boulevard. The access lanes provide for slower local traffic, parking, bicycle travel and a pedestrian-oriented streetside and are designed to discourage through traffic. Multiway boulevards may be considered where a community desires to make a very wide arterial street more pedestrian friendly yet recognizes the need to retain traffic capacity.

Characteristics of Multiway Boulevards

The general configuration of a multiway boulevard is a bidirectional central roadway that contains four or more lanes and may be divided or undivided, with one-way access lanes on both sides separated from the central roadway with medians. Characteristics of the central roadway and access lanes include:

- Central roadway—emphasizes through traffic movement and therefore should minimize impediments to this function. This includes access control between intersections, simplified phasing at signalized intersections and restricted movements onto and from the central roadway. The central roadway may contain a raised landscaped median separating the two directions of travel (in addition to the medians separating the central roadway from the access lanes), depending on right of way and landscaping desires. Parking is generally prohibited on the central roadway. For purposes of this report, the central roadway's target speed would be 35 miles per hour (mph) or less. The design and operation of cross-street intersections is addressed below.
- Access lanes—emphasize local interface with adjacent land uses. The access lanes are narrow, one-lane, very low-speed one-way streets that include on-street parking and potentially a shared vehicle/bicycle lane. Through traffic on access lanes is discouraged through design. Bike lanes may be provided, but it is preferred that bikes share the vehicular lane.[2] The design and operation of cross-street intersections is addressed below. Access lanes preferably should not provide driveway access to adjacent properties.

2 Designers are encouraged to consult the MUTCD for the current signing and marking for this configuration. Traffic control device applications of this type are evolving.

Table 6.5 Main Street Design Parameters

Context	Suburban (C-3)		General Urban (C-4)		Urban Center (C-5)	
	Commercial Main Streets					
	Avenue	Street	Avenue	Street	Avenue	Street
Building Orientation (entrance location)	front, side	front, side	front	front	front	front
Maximum Building Setback	5 ft.	5 ft.	0 ft.	0 ft.	0 ft.	0 ft.
Off–Street Parking Access/Location	rear, side	rear, side	rear, side	rear, side	rear, side	rear, side
Streetside						
Recommended Streetside Width	15 ft.	14 ft.	16 ft.	14 ft.	19.5 ft.	16 ft.
Edge Zone	1.5 ft. minimum for operational clearance. Use 2.5 ft. if angled parking is considered. Ensure edge zone is wide enough to accommodate parking meters, utilities and signs.					
Furnishings Zone Width	6 ft. tree well	6 ft. tree well	6 ft. tree well	6 ft. tree well	6 ft. tree well	6 ft. tree well
	Wider furnishings zone is needed to provide public spaces and if main street uses include the potential for street cafes.					
Pedestrian Throughway (minimum)	6 ft.	6 ft.	6 ft.	6 ft.	9 ft.	6 ft.
Frontage Zone	2.5 ft. to 3 ft. minimum to accommodate commercial activity along building fronts. Wider frontage zone is needed (6 ft. or wider) if potential for street cafes or merchandise displays.					
Street Lighting	Intersection safety lighting, basic street lighting and pedestrian–scaled lighting.					
Traveled Way						
Target Speed (mph)	25	20–25	25	20–25	25	20–25
Number of Through Lanes	2–4	2	2–4	2	2–4	2
Lane Width	10–12 ft.	10–12 ft.	10–12 ft.	10–12 ft.	10–11 ft.	10–11 ft.
Parallel On–Street Parking Width	8 ft.	8 ft.	8 ft.	8 ft.	8 ft.	8 ft.
Min. Combined Parking/Bike Lane Width	13 ft.	13 ft.	13 ft.	13 ft.	13 ft.	13 ft.
Medians	Optional	None	Optional	None	Optional	None
Bike Lanes (minimum/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.
Access Management	Minimize driveways on main streets. Access land uses via cross streets and/or alleys.					
Typical Traffic Volume Range (vehicles per day)	5,000–20,000+	1,000–15,000	5,000–20,000+	1,000–15,000	5,000–20,000+	1,000–15,000
Intersections						
Curb Extensions (with on–street parking)	Yes	Yes	Yes	Yes	Yes	Yes
Minimum Curb Return Radii (if extensions not used)	10–15 ft.	10–15 ft.	10–15 ft.	10–15 ft.	10–15 ft.	10–15 ft.
Roundabouts	Not recommended on main streets, except as gateway intersections					

Property should be accessed from cross-streets or alleys, although access lanes may be intersected by local streets or consolidated driveways without direct access to the central roadway. Access lanes provide on-street parking that may be associated with curb extensions at intersections or extensions that contain street trees. The width of access lanes is composed of the parking lane (7 to 8 feet) and a shared travel lane (10 to 11 feet). Some fire departments may require wider access lanes. However, for emergency access purposes, buildings may be able to be accessed from the central roadway. The maximum width of an access lane should be 17 feet with parking on one side and 24 feet with parking on both sides.

- Median islands—raised medians are used to separate the access lanes from the central roadway. The width of these medians varies because they may serve multiple functions. At a minimum, the median contains landscaping, including trees, streetlights, traffic signs and other utilities. On transit streets, the medians accommodate bus stops or stations. On multiway boulevards with very wide medians, sidewalks, seating and other urban design features may be provided. Medians may be designed with mountable curbs and load-bearing surfaces on the access lane side to accommodate emergency vehicles. Median breaks are provided on some traditional multiway boulevards to allow vehicles into the access lane and entry back into the central roadway where turn movements are restricted at the intersections.
- Streetside—provides a highly pedestrian-oriented environment and access to building entrances. On residential boulevards, the streetside emphasizes planting strips or tree wells and pedestrian-scaled lighting. On commercial boulevards, the streetside is designed to accommodate the activities of the adjacent ground floor uses, emphasizing wide furnishing zones for street trees, seating, urban design features and street cafes. See Chapter 8 for details on the streetside.

General Cross-Section Design Parameters and Right-of-Way Requirements

Because of their multiple components, the multiway boulevard typically has greater right-of-way requirements than other types of boulevards. Although streetside and median widths can vary substantially, the minimum right of way for a basic four-lane multiway boulevard is 104 feet, composed of the following elements (see **Figure 6.6**):

- 9-foot-wide streetsides;

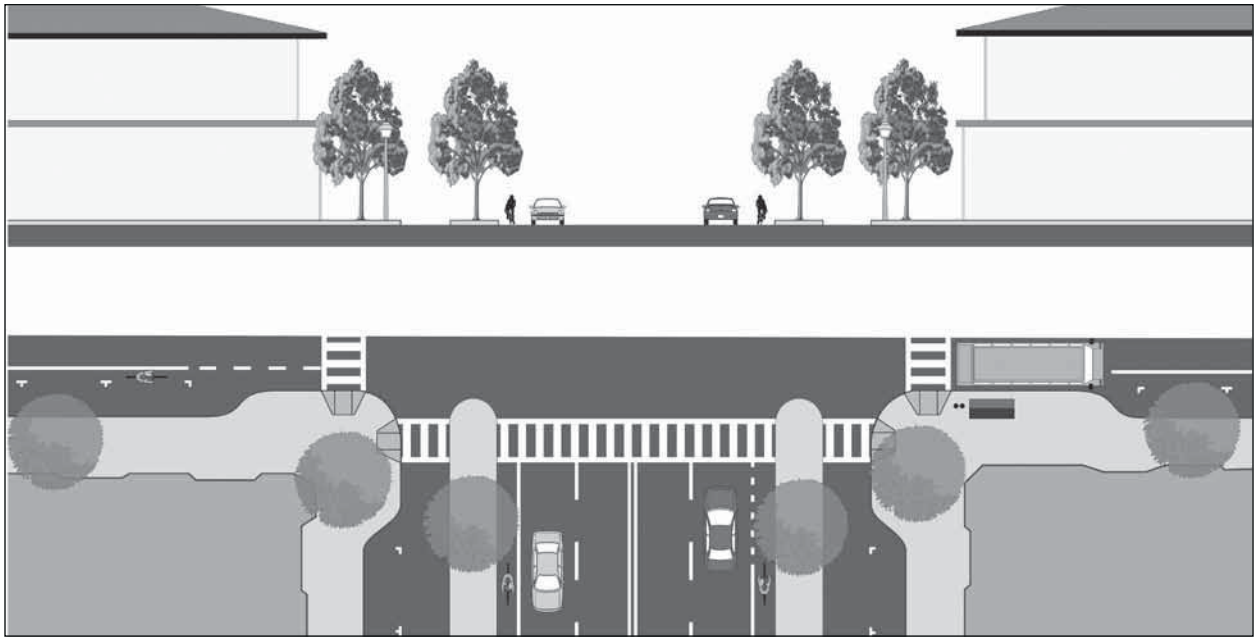

Figure 6.6 A multiway boulevard is characterized by a central roadway with a pair of one-way access lanes. This type of thoroughfare can combine high vehicular capacity with pedestrian-friendly streetsides. Source: Digital Media Productions.

- 7-foot parking lanes;
- 10-foot access lanes;
- 6- to10-foot medians (allows for street trees and utilities); and
- Four 10- to 11-foot central roadway travel lanes.

As an example of a more desirable multiway boulevard width in an urban center (C-5) commercial context, the recommended right of way of a four-lane multiway boulevard, based on the design parameters presented in **Table 6.4** and Chapters 8 and 9, would be 149 feet composed of

- 21.5-foot streetsides;
- 7-foot parking lanes;
- 10-foot access lanes;
- 14-foot medians (space for canopy trees, street lighting, bus stops with seating/shelters and pedestrian refuge); and
- Four 11-foot central roadway travel lanes.

It may be desirable to provide a raised median within the central roadway to provide for access management, street lighting, trees, pedestrian refuge and left-turn lanes at intersections. The width of a median in the central roadway will vary depending on function (see Chapter 9 for recommended median widths), but would add 4 to 18 feet or more to the right-of-way requirements. Bicycle lanes may also be a part of the central roadway, which would require another 10 feet of right-of-way width.

The right of way of several existing two-way multiway boulevards in the United States ranges from 165 feet (The Esplanade in Chico, CA) to 210 feet (Ocean Parkway in Brooklyn, NY). The differences in width are related to the number of central roadway lanes (four versus six), existence of medians in the central roadway and width of access lanes and access lane medians (Bosselman, MacDonald, Kronemeyer. *Environmental Quality of Multiple Roadway Boulevards*, Institute of Urban and Regional Development, University of California at Berkeley, 1997). **Figure 6.7** is an example of a multiway boulevard that merges the access lane in advance of the intersection (see the next section on intersection design).

Figure 6.7 This multiway boulevard merges the access lane into the central roadway in advance of intersections. Source: Kimley-Horn and Associates, Inc.

Multiway Boulevard Intersection Design

Intersections on multiway boulevards provide one of the most challenging aspects of designing this type of thoroughfare. For successful multiway boulevard design, it is essential that all of the design elements work together to manage the various traffic flows safely.

The most frequent concern about multiway intersection design usually relates to how to control the side access lanes. However, if properly designed, the side access lanes will have low volumes, and potential conflicts will be minimal. Proper geometric design and signing are also needed to communicate which user has the right of way at any given time. The access lanes should not be used to carry vehicles going several blocks along the multiway boulevard. Narrow side access lanes and proper intersection control will discourage through use of the access lanes. Because of the proximity of the access lane to the central roadway, queuing on the cross-streets can block access lanes, and this will further discourage use of the access lanes as through routes. Traffic engineers may also be concerned with conflicts between vehicles turning right from the central roadway and vehicles entering the intersection from the access lane. This is best addressed by having tight corner radii for both the central roadway and the access lanes and good sight lines between the central roadway and the access lanes so the turning driver can avoid a conflict.

At this time there is no widely agreed-upon way to design and operate a multiway boulevard intersection. Multiway boulevards, both old and new, exist in many

Figure 6.8 This multiway boulevard provides stop control for the low-volume, low-speed access lanes. The central roadway is controlled by a traffic signal. Source: Kimley-Horn and Associates, Inc.

places in Europe and the United States, and the challenges of the intersections have been addressed in many ways. The traditional design of multiway boulevard intersections is to provide stop control for the access lanes and signalized or stop control for the cross-streets and central roadway (see **Figure 6.8**). In urban areas, the access lanes are often controlled with traffic signals and sometimes restrict selected movements from both the central roadway and the access lanes. Common traffic control and operational configurations for traditional multiway boulevard intersections are described in **Table 6.6** and illustrated in **Figure 6.9**.

Alternative Multiway Intersection Designs

Thoroughfare designers have developed a number of alternatives to the traditional multiway boulevard intersection. These alternatives include:

- Access road slip ramps prior to and after intersections to provide conventional four-leg intersections;
- Forced right turns from the access lane to the cross-street. Where turning movements are restricted, cross-streets should be part of a well-connected grid of streets so vehicles leaving the access lanes can easily return to the central roadway;
- Access lanes diverted away from the central roadway at cross streets increase separation and reduce the complexity of the intersection. This design concept significantly affects the placement of buildings at intersection corners; and
- Access lanes beginning just past an intersection (either with or without a lane drop), and ending with or without a lane addition just before an adjacent intersection, similar to the design of frontage roads.

All of the above alternatives disrupt the continuity of the access lane along the length of the boulevard. This is an important factor in considering local circulation, particularly if the access lanes provide for bicycle travel along the corridor.

Design Examples

The following design examples provide a brief synopsis of the design process, illustrating some of the key steps in developing and evaluating solutions to thoroughfare design problems. The examples do not represent all of the possible combinations but do show some common thoroughfare situations. The four examples respectively illustrate the following thoroughfare design scenarios:

1. Creation of a retail-oriented and pedestrian-friendly main street collector avenue;

Table 6.6 Traffic Control and Operation Configurations for Multiway Boulevard Intersections

Type of Approach Control (Refer to Fig. 6.9)		Special Treatments or Movement Restrictions	Conditions for Application
A	Two-Way Stop Intersection • Central roadway uncontrolled • Cross-street stop controlled • Access lane stop controlled	• No restricted movements, or • Access lane restricted to through-right turn only	• Low-volume cross-street traffic • Moderate-volume central roadway traffic • Residential or low-intensity mixed use and commercial areas
B	All-Way Stop Intersection • Central roadway stop controlled • Cross-street stop controlled • Access lane stop controlled	• No restricted movements, or • Access lane restricted to through-right turn only	• Low cross-street traffic volume • Low to moderate central roadway traffic volume • Residential or low-intensity mixed use and commercial area
C	Two-Phase Signalized Intersection • Central roadway signalized • Cross-street signalized • Access lane stop controlled	• Access lane through and right turns may proceed with central roadway through movement after stop • Central roadway right turns may be prohibited	• Low to moderate cross-street traffic volume • Low to moderate central roadway traffic volume • Residential or low-intensity mixed use and commercial area
D	Multi-Phase Signalized Intersection #1 • Central roadway signalized • Cross-street signalized • Access lane signalized	• Central roadway may have protected left-turn phasing • Access lanes restricted to through and right-turn only • Access lane proceeds during central roadway through movement • Cross-street has permissive turn phasing • Central roadway right-turns prohibited	• Moderate to high cross-street traffic volume • Moderate to high central roadway traffic volume • High-intensity mixed use and commercial area
E	Multi-Phase Signalized Intersection #2 • Central roadway signalized • Cross-street signalized • Access lane signalized	• Central roadway may have protected left-turn phasing • Cross-street has permissive turn phasing • Access lanes have split phasing, allowing all movements	• Moderate to high cross-street traffic volume • Moderate to high central roadway traffic volume with high volume of left turns • High-intensity mixed use and commercial area
F	Multi-Phase Signalized Intersection #3 • Central roadway signalized • Cross-street signalized • Access lane stop controlled	• Access lane right turns only may proceed after stop • Central roadway has permissive turn phasing • Cross-street has permissive turn phasing, and may use split phasing	• Low to moderate cross-street traffic volume • Low to moderate central roadway traffic volume • Residential or low-intensity mixed use and commercial area

2. Transformation of an obsolete suburban arterial to a boulevard in a mixed use area;
3. Design of a high-capacity arterial boulevard in a newly urbanizing area; and
4. Four- to three-lane arterial avenue conversion in a central business district.

The design process used in the examples follows the design stages introduced and described in Chapter 5. The design examples provide a general overview of the process to illustrate the five stages of design. The details of the evaluation and development of the actual design are omitted in the four examples.

Remember Network Potential

In all cases of designing walkable urban thoroughfares, part of the analysis will be to analyze network capabilities, contexts and travel patterns to determine whether and how much the network can accommodate some of the study thoroughfare's existing or projected traffic. This may require operational or physical improvements. However, it may lead to a more contextually desirable improvement and more effective overall solution.

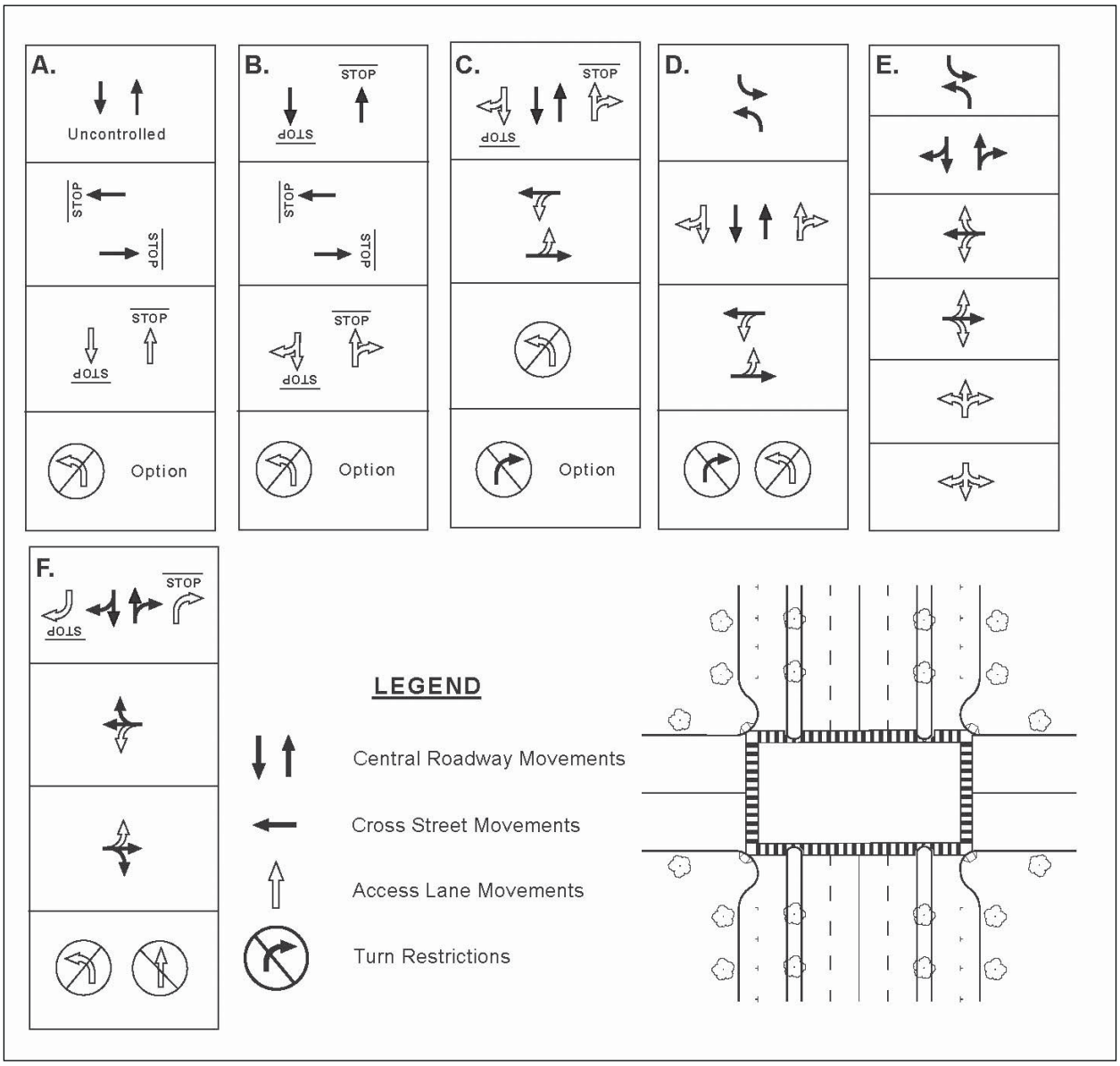

Figure 6.9 Various traffic control and turn restriction options can be employed at multiway boulevard intersections. See **Table 6.6**. Source: Kimley-Horn and Associates, Inc.

Design Example #1: Creating a Retail-Oriented Main Street

Objective

Convert an existing four-lane minor collector street into a commercial-oriented street that supports an adjacent mix of retail, restaurants and entertainment uses on the ground floor.

Stage 1: Review or develop an area transportation plan

Review the area transportation plan to determine how the subject thoroughfare relates to the overall network, types of modes served, functional classification, existing and future operational characteristics and so forth. Collect existing and projected data as necessary.

Existing Street Characteristics
Existing street is a four-lane, undivided collector street with the following characteristics (see **Figures 6.10** and **6.11**).

- Functional classification: minor collector.
- Right of way: 60 feet.
- Four through-traffic lanes plus 6-foot sidewalks on each side.
- On-street parking: none.
- Average daily traffic (ADT): 10,000–13,000 vehicles per day (vpd).
- Speed limit: 35 mph.
- Percent heavy vehicles: 2–3 percent.
- Intersection spacing: 600–700 feet.
- Network pattern: grid.
- Center turn lane: none.
- Transit: low-frequency local route.
- Bicycle facilities: not a designated bike route.
- No landscaping.
- Conventional street and safety lighting.

Stage 2: Understand community vision for context and thoroughfare

Vision
An existing commercial street in a suburban (C-3) area undergoing change to an urban center (C-5). Emphasizes an active street life that is to be achieved through the mix and intensity of land uses, site and architectural design, with an emphasis on pedestrian facilities and on-street parking.

Stage 3: Identify compatible thoroughfare types and context zones

Existing context is identified by assessing the character and attributes of existing land uses such as building orientation to the street, building height, parking orientation, mix and density of uses and so forth. Future context is determined by interpreting the vision, goals and objectives for the area. Thoroughfare type is selected based on the urban thoroughfare characteristics (Table 4.2 in Chapter 4).

- Existing context zone: C-3.
- Future context zone: C-5.
- Desired thoroughfare type: avenue.

Stage 4: Develop and test the initial thoroughfare design

Desirable Design Elements (in prioritized order based on vision)

- Lower target speed.
- On-street parking.
- Wide sidewalks.
- Street furniture and landscaping including benches and space for cafes, public space and so forth.
- Pedestrian-scaled lighting.
- Street trees.
- Bus stops with shelters.
- Transitions between main street and adjacent higher-volume segments.

- Midblock crosswalks on long block sections.
- Bike accommodations.

Factors to Consider/Potential Trade-Offs

- Right-of-way constrained to 60 feet.
- Maximizing parking with angled versus parallel parking; changing to angled parking may increase accidents and delays.
- Reduction in the number of through lanes and vehicle capacity versus wider sidewalks and on-street parking.
- Accommodation of large vehicles versus narrowing lane width and smaller curb-return radii to reduce pedestrian crossings.
- Accommodation of bicyclists versus width of other design elements.

Possible Alternative Solutions (see **Figure 6.12**)

1. Emphasize vehicular capacity by retaining existing four-lane section with 10-foot-wide travel lanes to allow 10-foot-wide sidewalks.
2. Emphasize parking by providing angled parking on one side, parallel parking on the other side and narrowing the two remaining travel lanes.
3. Emphasize parking and wider sidewalks by providing parallel parking on both sides, two travel lanes and 12-foot-wide sidewalks.
4. Emphasize parking and vehicular capacity with parallel parking on both sides, 9-foot-wide sidewalks, two travel lanes and a center turn lane.

In all cases use grid network to divert some traffic from project thoroughfare so reduced number of traffic lanes will suffice. This may require operational or physical improvements to other streets. Traffic to be diverted will depend on travel patterns, context and design of other thoroughfares.

Compare benefits of the four alternatives. **Figure 6.13** demonstrates one way of showing such a comparison.

Selected Alternative

Alternative #3:

- Maximizes sidewalk width;
- Provides moderate to good level of on-street parking;
- Balances street width with accommodation of larger vehicles and speed reduction;
- Allows for left-turn lanes at intersections by restricting parking; and
- Provides 10-foot minimum travel lane width.

Stage 5: Develop detailed thoroughfare design

Figure 6.14 shows a rough schematic view of how the selected alternative might be designed.

Solution Design Features

Traveled Way:

- Target speed: 25 mph.
- Traffic signals synchronized to target speed.
- Two 10-foot travel lanes.
- Two 8-foot parallel parking lanes.

Streetside:

- 12-foot sidewalks.
- Pedestrian-scaled lighting.
- Street trees in tree wells.
- 6-foot furnishings and edge zone.
- 6-foot clear pedestrian throughway.
- No frontage zone.

Intersections:

- Curb extensions to reduce pedestrian crossing distance unless left-turn lane is provided.
- High-visibility crosswalk markings.
- Safety lighting.
- Far-side bus stops with curb extension and shelters.
- ADA compliance.

Parallel thoroughfares (as needed):

- Directional signing.
- Operational adjustments or improvements.
- Physical improvements.

Figure 6.10 View of existing street. Source: Kimley-Horn and Associates, Inc.

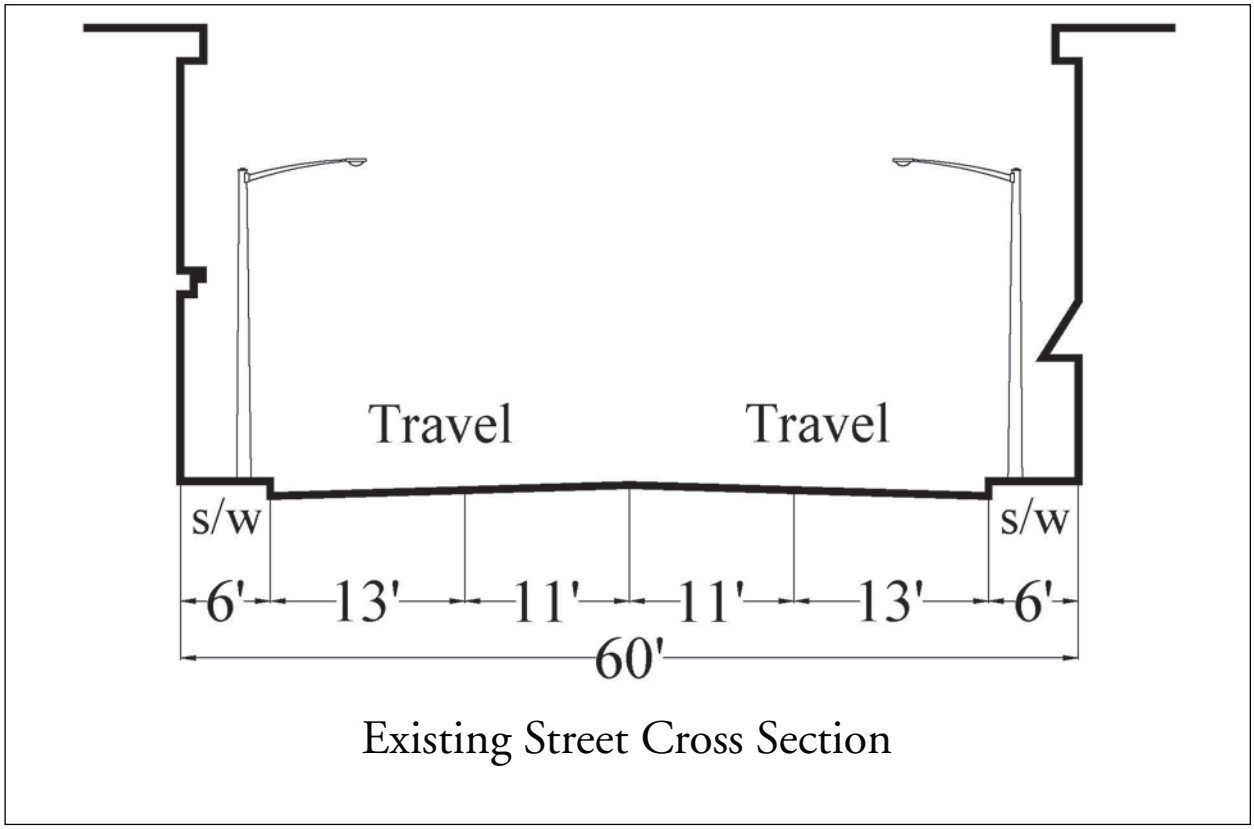

Figure 6.11 Existing street cross section. Source: Kimley-Horn and Associates, Inc.

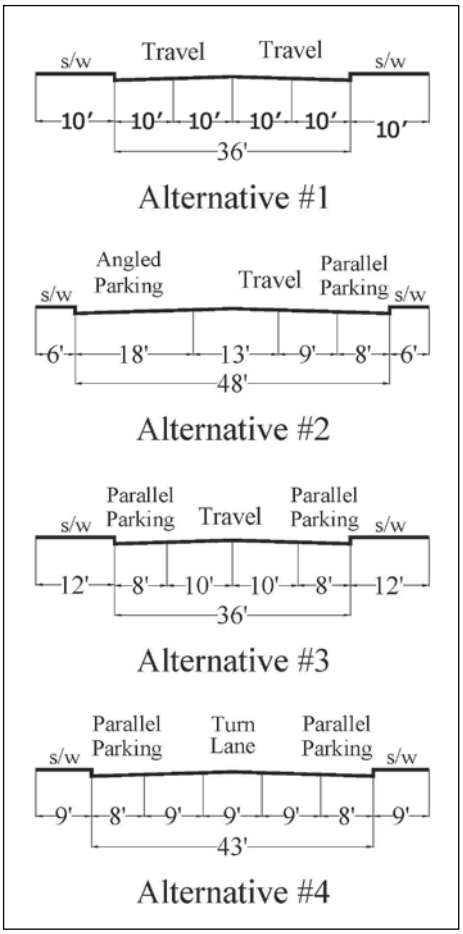

Figure 6.12 Alternative street cross sections. Source: Kimley-Horn and Associates, Inc.

Relative Comparison of Trade-Offs

Alternative	Parking	Sidewalk Width	Vehicular Capacity	Large Vehicle Accommodation	Pedestrian Crossing Width	Left Turn Lanes	Bike Accommodation	Ped. Amenity Accommodation	Speed Reduction
Existing	- -	- -	+ +	+ +	- -	- -	- -	- -	- -
1	- -	+ +	+ +	- -	- -	-	- -	+ +	+
2	+ +	- -	-	+	+ +	+ +	- -	- -	-
3	+	+ +	-	+ +	+ +	-	- -	+ +	+
4	+	-	+	- -	+	+ +	- -	-	+ +

Score (relative to other alternatives)

+ + Good (achieves objectives)

+ Fair

- Poor

- - Fails to meet/achieve objectives

Figure 6.13 Relative comparison of alternative trade-offs. Source: Kimley-Horn and Associates, Inc.

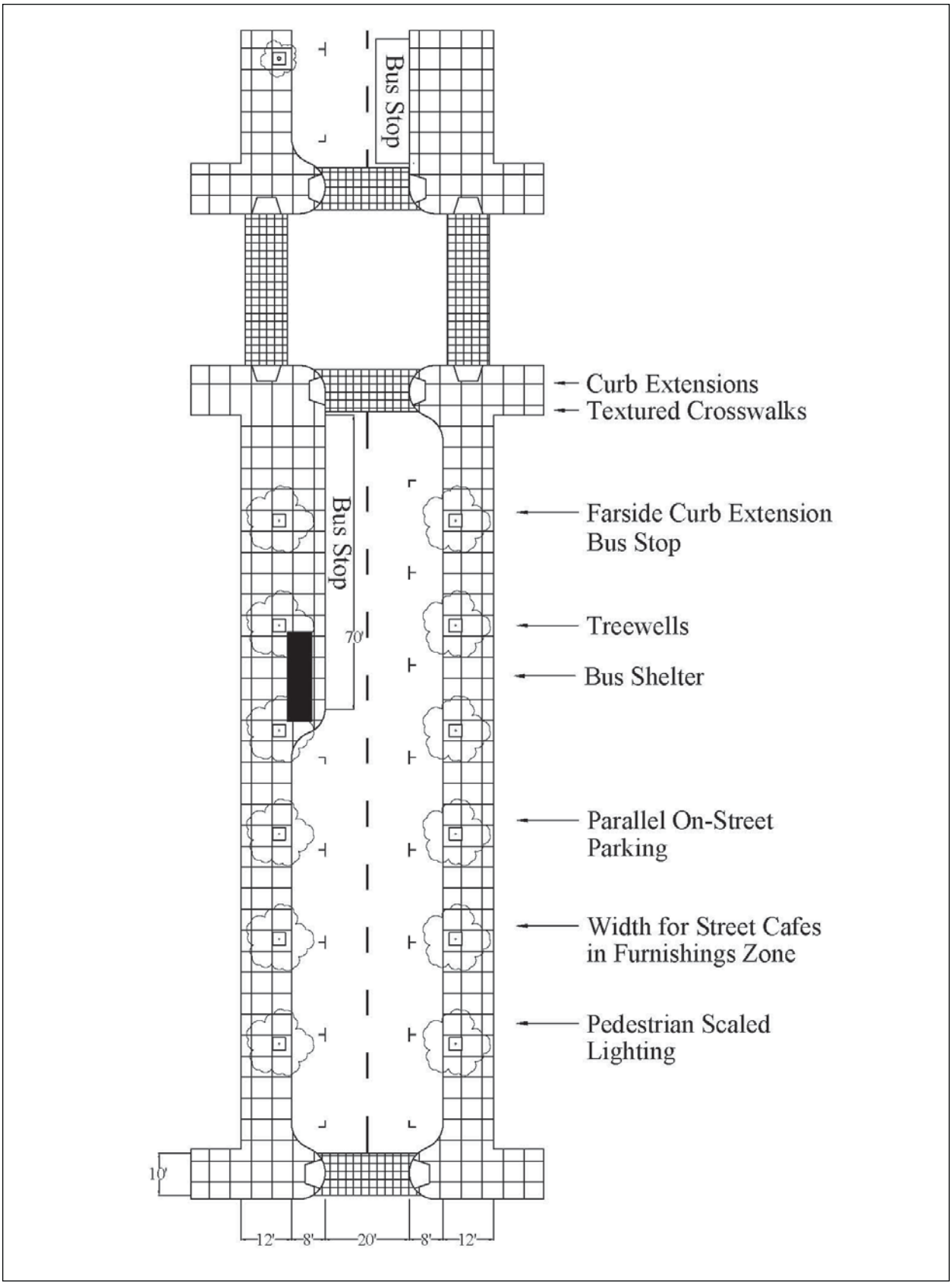

Figure 6.14 Schematic plan view of Alternative #3. Source: Kimley-Horn and Associates, Inc.

Design Example #2: Transforming a Suburban Arterial

Objective

Transform an obsolete suburban arterial into a boulevard serving a mixed-use commercial-oriented street in an area evolving from a typical suburban pattern (C-3) to a mixed environment with commercial activity and walkable development pattern (C-4).

Stage 1: Review or develop an area transportation plan

Existing Street Characteristics (see **Figures 6.15 and 6.16**)
Existing street is a seven-lane undivided arterial street with the following characteristics:

- Functional classification: principal arterial.
- Right of way: 100 feet.
- Six through-traffic lanes plus center turn lane.
- On-street parking: none.
- ADT: 32,000–40,000 vpd.
- Speed limit: 45 mph.
- Percent heavy vehicles: 4–5 percent.
- Intersection spacing: 1,250 feet.
- Network pattern: 1 mile arterial grid.
- Center turn lane: 14-foot two-way left-turn lane (TWLTL) with turn bays at intersections
- Transit: high-frequency regional route.
- Bicycle facilities: not a designated bicycle route.
- No sidewalks (4-foot, unpaved utility easement in right of way on both sides).
- No landscaping.
- Conventional street and safety lighting.

Stage 2: Understand community vision for context and thoroughfare

Vision
Community supports higher-intensity, higher-value development in an existing strip commercial corridor, transforming the suburban character of the corridor to general urban (C-4). Redesign of the street to create an attractive, walkable boulevard is a public-sector investment strategy to stimulate change. The corridor is envisioned to support a diverse mix of pedestrian-oriented retail, office and entertainment.

Stage 3: Identify compatible thoroughfare types and context zones

- Existing context zone: C-3.
- Future context zone: C-4.
- Desired thoroughfare type: boulevard.

Stage 4: Develop and test the initial thoroughfare design

Desirable Design Elements (in prioritized order based on vision)

- Lower target speed (35 mph).
- Gradual speed transition from higher-speed segments to study segment.
- Landscaped median.
- Wide sidewalks.
- Street trees.
- Typical multimodal intersection design.
- Pedestrian facilities including benches and space for cafes, public spaces and so forth.
- Pedestrian-scaled lighting.
- Bus stops with shelters.
- On-street parking.
- Increased crossing opportunities using consolidated signalized driveways.

Factors to Consider/Potential Trade-Offs

- Reduction in the number of through lanes and vehicle capacity versus wider sidewalks and median.
- Accommodation of large vehicles versus narrowing lane width.
- Provision of on-street parking versus median and wider sidewalks.
- Right-of-way acquisition to accommodate desirable features.

- Need to gradually reduce speed on higher-speed segments approaching the lower-speed segment under design.

Alternative solutions (see **Figure 6.17**)

1. Provide parking, median and minimum-width sidewalks by reducing to four travel lanes.
2. Provide wide landscaped median and sidewalks by reducing to four travel lanes without providing on-street parking.
3. Provide all desirable features, including median, wide sidewalks and parking, by reducing to four travel lanes and acquiring right of way or require private development to dedicate 7 feet.
4. Emphasize vehicular capacity and provide median and sidewalks by retaining six narrower travel lanes without providing on-street parking. Alternatively, the 11-foot outside lanes could be used for curb parking during off-peak periods and converted to travel lanes during the peak. This alternative would not provide curb extensions at intersections.

In all cases use grid network to divert some traffic from project thoroughfare so a reduced number of traffic lanes will suffice. This may require operational or physical improvements to other streets. Traffic to be diverted will depend on travel patterns, context and design of other thoroughfares.

Compare benefits of the four alternatives. **Figure 6.18** demonstrates one way of showing such a comparison.

Selected Alternative

Alternative #1:

- Near-term: Provides all desirable design features, except that it results in narrower sidewalks than other alternatives.
- Long-term: As corridor redevelops, right of way can be acquired or development can be required to provide an easement to widen sidewalks further.
- Selected alternative provides a balance between competing needs and provides most of the desirable design features without requiring right-of-way acquisition.

Stage 5: Develop detailed thoroughfare design

Figure 6.19 shows a schematic view of how the selected alternative might be designed.

Solution Design Features

Traveled Way:

- Target speed: 35 mph.
- Four 11-foot travel lanes.
- Two 8-foot parallel parking lanes.
- Tree planters in parking lane to increase planting opportunity.
- Signalized intersection spacing at 400 feet at consolidated driveways or midblock pedestrian signals to create crossing opportunities.

Streetside:

- 12-foot sidewalks.
- Pedestrian-scaled lighting.
- Street trees in tree wells.
- 6-foot furnishings zone and edge zone.
- 6-foot clear pedestrian throughway.
- Throughway and frontage zone ultimately expanded with redevelopment.

Intersections:

- Curb extensions to reduce pedestrian crossing distance.
- High-visibility crosswalks.
- Safety lighting.
- Far-side bus stops within parking lanes.

Parallel thoroughfares (as needed):

- Directional signing.
- Operational adjustments or improvements.
- Physical improvements.

Figure 6.15 View of existing street. Source: Kimley-Horn and Associates, Inc.

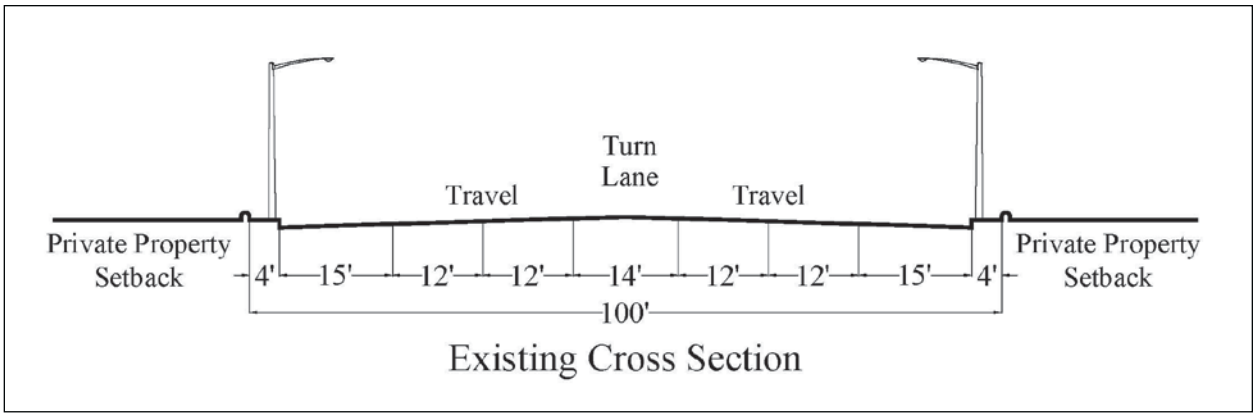

Figure 6.16 Existing cross section. Source: Kimley-Horn and Associates, Inc.

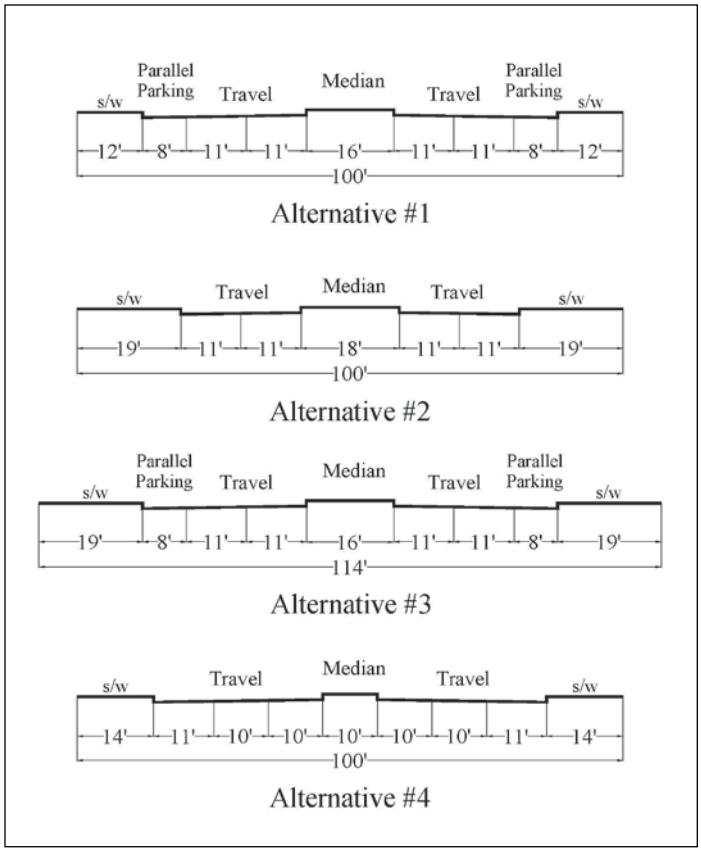

Figure 6.17 Alternative street cross-sections. Source: Kimley-Horn and Associates, Inc.

Relative Comparison of Trade-Offs

Alternative	Parking	Sidewalk Width	Vehicular Capacity	Large Vehicle Accommodation	Pedestrian Crossing Width	Left Turn Lanes	Landscaped Median	Ped. Amenity Accommodation	Speed Reduction	Right-of-way Acquisition
Existing	- -	- -	+ +	+ +	- -	+ +	- -	- -	- -	+ +
1	+ +	-	+	+	+ +	+ +	+ +	- -	+	+ +
2	- -	+ +	+	+	+ +	+ +	+ +	+ +	+	+ +
3	+ +	+ +	+	+ +	+	+ +	+ +	+ +	+	- -
4	- -	+	+ +	-	- -	+	- -	-	-	+ +

Score (relative to other alternatives)

- + + Good (achieves objectives)
- + Fair
- - Poor
- - - Fails to meet/achieve objectives

Figure 6.18 Relative comparison of alternative trade-offs. Source: Kimley-Horn and Associates, Inc.

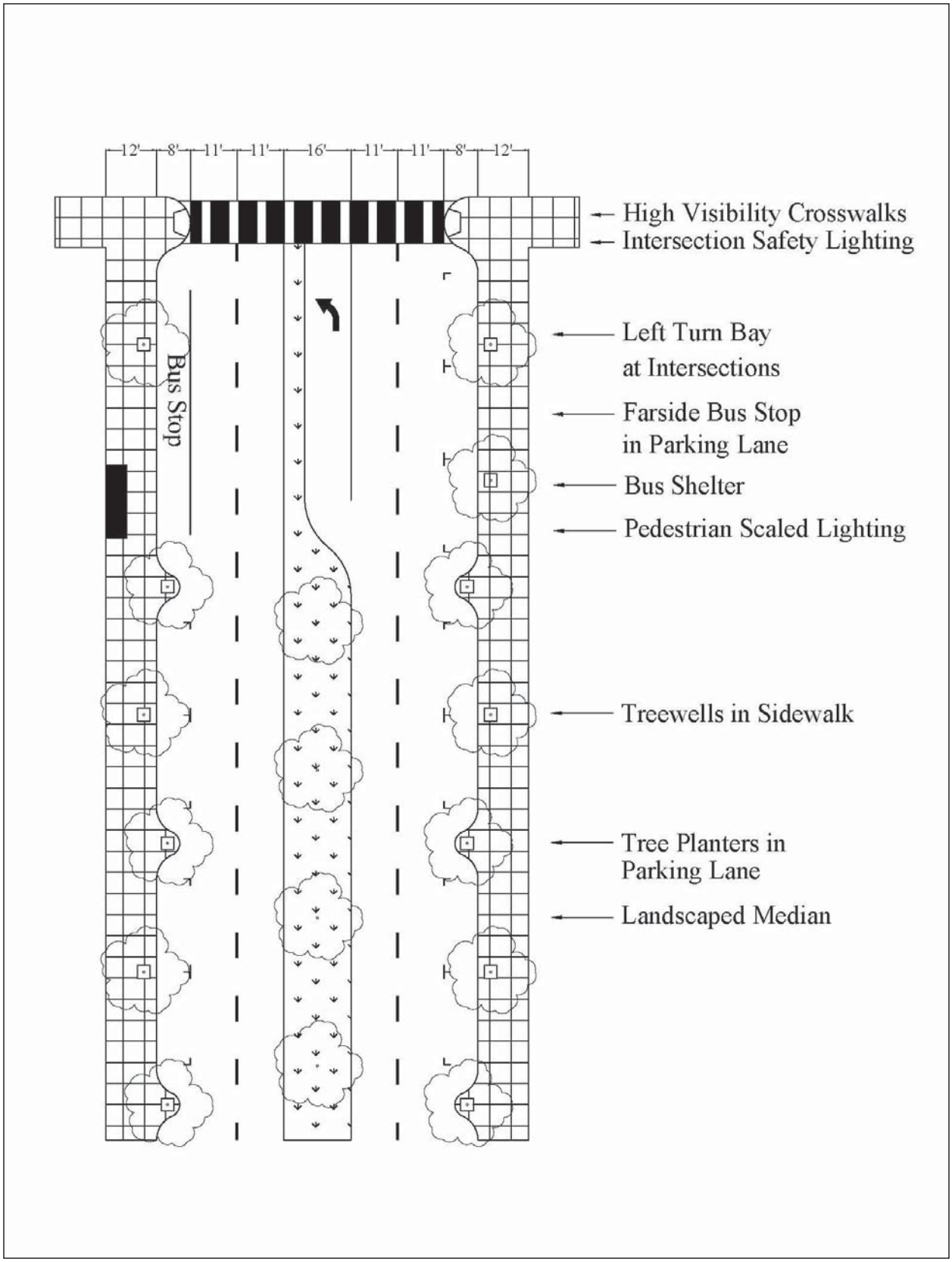

Figure 6.19 Schematic plan view of Alternative #3. Source: Kimley-Horn and Associates, Inc.

Design Example #3: High-Capacity Thoroughfare in Urbanizing Area

Objective

Design a thoroughfare in a newly urbanized area that accommodates high levels of traffic and buffers adjacent land uses from traffic impacts.

Stage 1: Review or develop an area transportation plan

Existing Street Characteristics (see **Figures 6.20 and 6.21**)
Existing street is a five-lane undivided arterial street with the following characteristics:

- Functional classification: minor arterial.
- Right of way: 90 feet.
- Four through-traffic lanes plus center turn-lane, median.
- On-street parking: none.
- Existing ADT: 25,000–30,000 vpd.
- Projected ADT: 45,000 vpd.
- Speed limit: 40 mph.
- Percent heavy vehicles: 4–5 percent.
- Intersection spacing: 600–700 feet, with many driveways.
- Network pattern: Suburban curvilinear; few alternative parallel routes.
- Center turn lane: TWLTL with turn bays at intersections.
- Transit: moderate-frequency regional and local routes.
- Bicycle facilities: designated bicycle route with 8-foot-wide paved shoulders on both sides.
- Narrow attached sidewalks (5 feet) on both sides.
- No landscaping within right of way.
- Conventional street and safety lighting.

Stage 2: Understand community vision for context and thoroughfare

Vision

Area plans envision a mix of high-density housing, retail centers and low-intensity commercial uses fronting the street. Because the roadway accommodates high levels of through traffic, access control is desired. The roadway is currently a bicycle route with bicyclists using the paved shoulder, but bicycle lanes are desired to close gaps in the bicycle system. Adjacent properties provide off-street parking, but some fronting residential and commercial uses would benefit from on-street parking. The area will generate pedestrians who desire buffering from adjacent traffic. The area plan calls for a boulevard design including an alternative for a multiway boulevard with fronting access lanes to provide on-street parking and buffer proposed mixed use development with ground floor retail and housing above.

Stage 3: Identify compatible thoroughfare types and context zones

- Existing context zone: C-3.
- Future context zone: C-5.
- Thoroughfare type: boulevard.

Stage 4: Develop and test the initial thoroughfare design

Desirable Design Elements (in prioritized order based on vision)

- Lower target speed (35 mph).
- Emphasis on vehicular capacity.
- Access management with landscaped median.
- Bicycle lanes.
- Streetside buffered from traffic.
- Street trees.
- Bus stops with shelters.
- Increased crossing opportunities at signalized intersections.
- Pockets of on-street parking adjacent to fronting commercial or mixed use development.
- Multiway boulevard design adjacent to mixed use development.

Factors to Consider/Potential Trade-Offs

- Effective width for streetside buffer versus width requirements for elements in traveled way.
- Accommodation of wider than minimum sidewalks, particularly in commercial areas.
- Provision of on-street parking in select segments versus other design elements.
- Intersections spaced to optimize traffic flow versus need for increased crossing opportunities.
- Accommodation of large vehicles, particularly turning at intersections.
- Right-of-way requirements for implementing a multiway boulevard.
- Efficient intersection operations with multiway boulevard.

Alternative Solutions (see **Figure 6.22**)

1. Emphasize streetside buffering and provision of bike lanes; provide minimal width median for access control and narrower travel lanes.
2. Implement multiway boulevard with local access streets that provide on-street parking and shared bicycle/vehicle environment. This allows a wider streetside area and removes bicycles from higher-speed roadway. This configuration requires 15 feet of right-of-way acquisition on each side of roadway, or adjacent development dedicates streetside and on-street parking lane.
3. Emphasize landscaped median and bicycle lanes by narrowing streetside. Provides minimal sidewalk width and reduced buffer area.

In all cases use grid network to divert some traffic from project thoroughfare. This may require operational or physical improvements to other streets. Traffic to be diverted will depend on travel patterns, context and design of other thoroughfares.

Compare benefits of the three alternatives. **Figure 6.23** demonstrates one way of showing such a comparison.

Selected Alternative

Alternative #2:

- Provides desirable design features, including the desire for a multiway boulevard.
- Is feasible to implement in newly urbanizing area with redevelopment opportunities.
- Requires either dedication or right-of-way acquisition, but could be implemented in phases.
- Requires special design of intersections to maintain efficient operations.

Stage 5: Develop detailed thoroughfare design

Figures 6.24 through **6.26** show a schematic view of how the selected alternative might be designed.

Solution Design Features

Traveled Way:

- Target speed: 35 mph.
- Four, 11-foot travel lanes in central roadway.
- Parallel, 18-foot-wide local access lanes separated by 8-foot-wide landscaped medians.
- Local access roads provide shared vehicle/bicycle lane and 9-foot travel lane.
- Left turn lanes on central roadway at intersections.

Streetside:

- 12-foot sidewalks.
- Pedestrian-scaled lighting.
- Street trees in tree wells.

Intersections:

- Special design treatment required to accommodate multiple movements between central roadway and local access lanes.
- Intersections widened to accommodate left-turn lane within the central roadway.

Parallel thoroughfares (as needed):

- Directional signing.
- Operational adjustments or improvements.
- Physical improvements.

Figure 6.20 View of existing street. Source: Kimley-Horn and Associates, Inc.

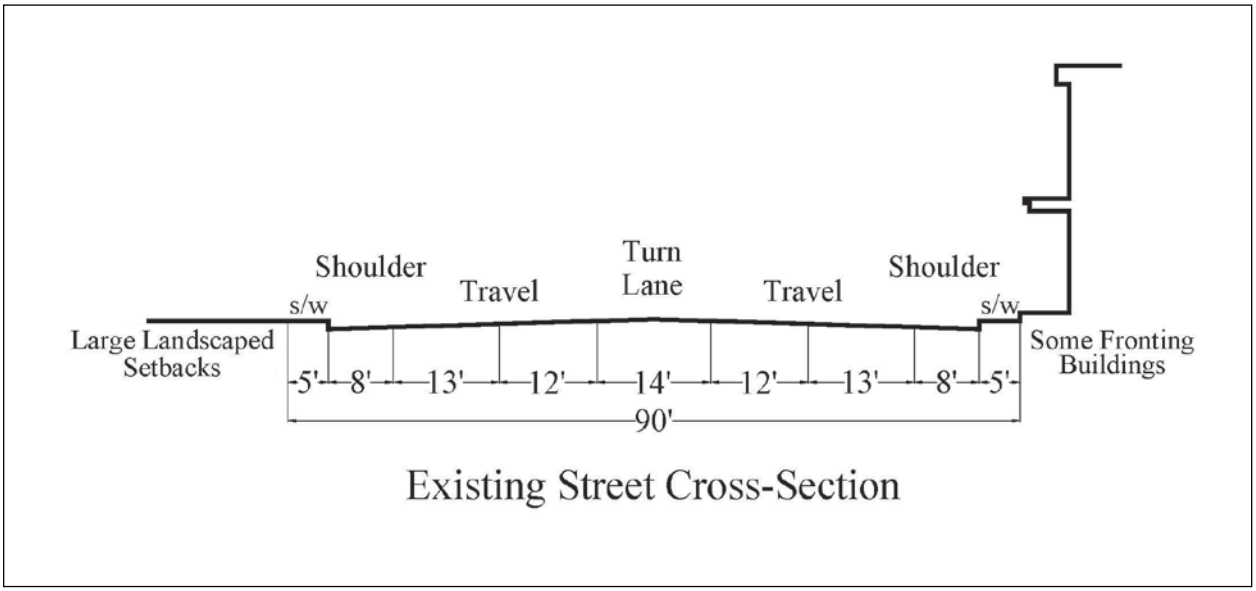

Figure 6.21 Existing street cross-section. Source: Kimley-Horn and Associates, Inc.

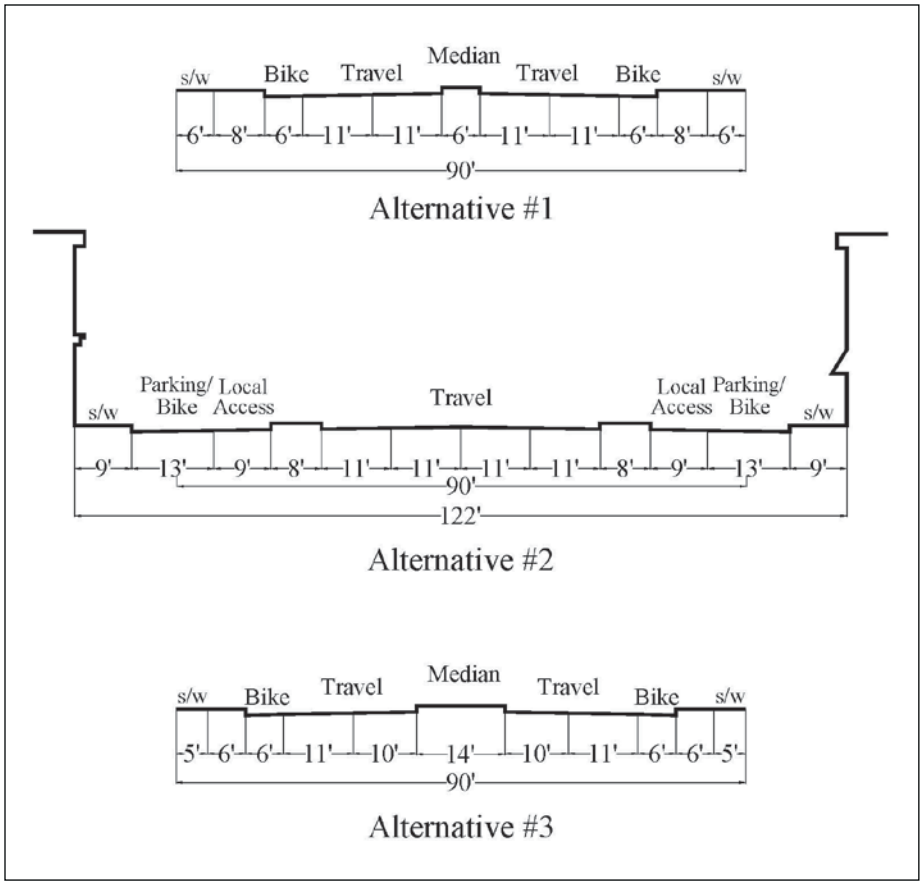

Figure 6.22 Alternative street cross-sections. Source: Kimley-Horn and Associates, Inc.

Relative Comparison of Trade-Offs

Alternative	Parking	Sidewalk Width	Roadside Buffer	Vehicular Capacity	Large Vehicle Accommodation	Pedestrian Crossing Width	Left Turn Lanes	Landscaped Median	Bike Lanes	Speed Reduction	Right-of-way
Existing	- -	- -	- -	+ +	+ +	- -	+ +	- -	+	- -	+ +
1	- -	-	+ +	+	+ +	-	-	-	+ +	+	+ +
2	+ +	+ +	+ +	+ +	+ +	+ +	-	+ +	+ +	+	- -
3	- -	- -	+	+	+	+	+ +	+ +	+ +	+ +	+ +

Score (relative to other alternatives)

+ + Good (achieves objectives)

+ Fair

- Poor

- - Fails to meet/achieve objectives

Figure 6.23 Relative comparison of alternative trade-offs. Source: Kimley-Horn and Associates, Inc.

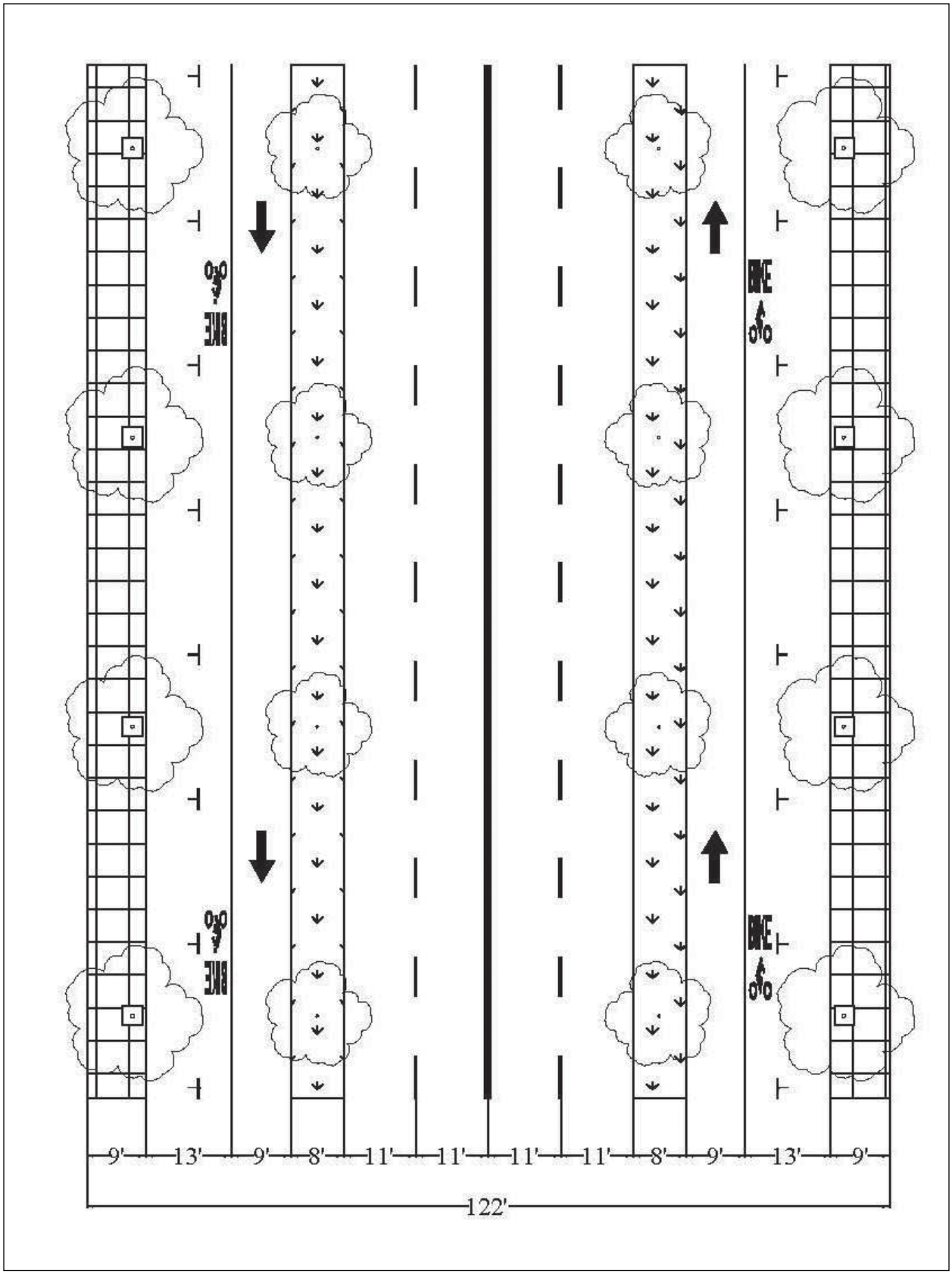

Figure 6.24 Schematic plan view of Alternative #2. Source. Kimley-Horn and Associates, Inc.

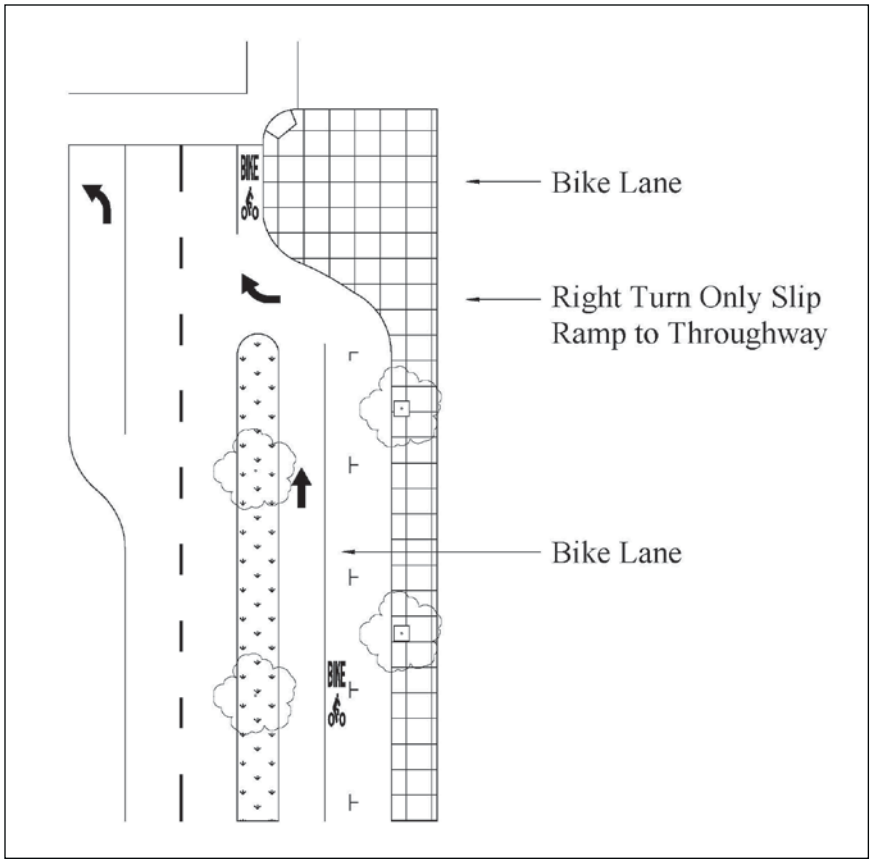

Figure 6.25 Alternative intersection design for Alternative #2. Source: Kimley-Horn and Associates, Inc.

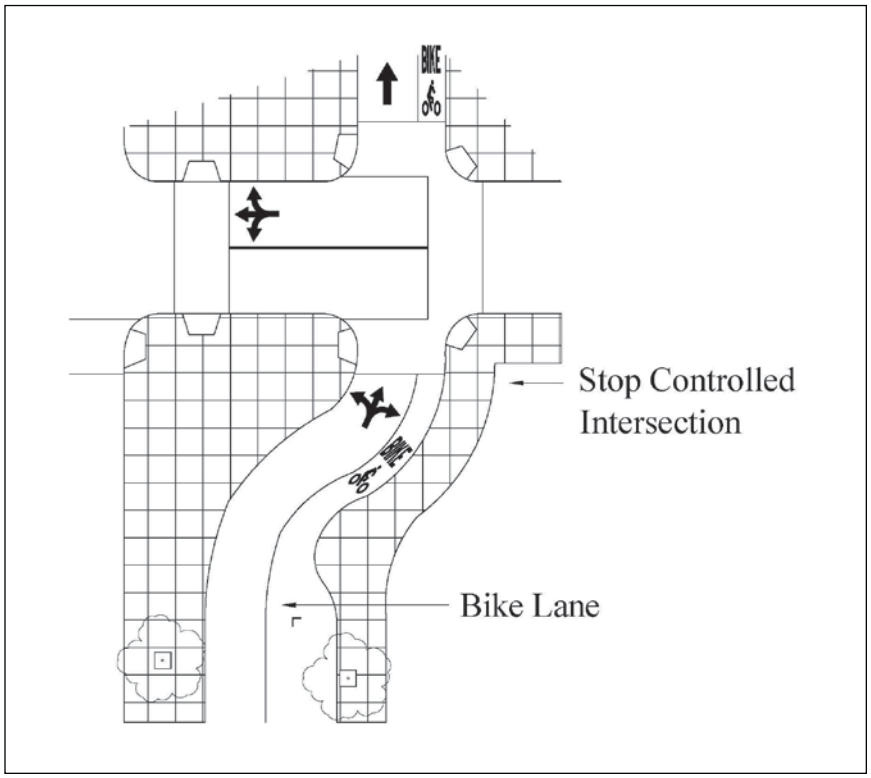

Figure 6.26 Alternative intersection design for Alternative #2. Source: Kimley-Horn and Associates, Inc.

Design Example #4: Central Business District Four- to Three-Lane Conversion

Objective

Convert an undivided four-lane arterial with parking on one side to three lanes plus parking and bicycle lanes on both sides in a central business district. The purpose of the conversion is to increase on-street parking, provide width for bicycle lanes and remove turning traffic from through lanes.

Stage 1: Review or develop an area transportation plan

Existing Street Characteristics (see **Figures 6.27 and 6.28**)
Existing street is a four-lane undivided arterial street with the following characteristics:

- Functional classification: minor arterial.
- Right of way: 100 feet.
- Four through-traffic lanes plus parallel parking on one side.
- Existing ADT: 12,000–15,000 vpd.
- Projected ADT: 18,000 vpd.
- Speed limit: 30 mph.
- Percent heavy vehicles: 2 percent.
- Intersection spacing: 400 feet.
- Network pattern: traditional downtown grid.
- Center turn lane: none.
- Transit: high-frequency regional and local routes.
- Bicycle facilities: designated bicycle route.
- 20-foot-wide sidewalks.
- Street trees in tree wells.
- Conventional street and safety lighting and pedestrian-scale lighting on sidewalks.

Stage 2: Understand community vision for context and thoroughfare

Vision
The central business district is not envisioned to change significantly in terms of its context. It will remain the highest-intensity development in the city with a mix of commercial uses, ground floor retail and office above. The district has very high levels of pedestrian and transit use; however, new high-rise residential development is increasing the downtown population. There is continued demand for on-street parking and an anticipated increase in pedestrian and bicycle travel as new residents increase 24-hour activities. The city has been implementing its bicycle plan over time by adding bicycle lanes to many of the arterial streets. The traffic engineering department continues to look for opportunities to improve intersection operations and pedestrian safety by adding left-turn bays, curb extensions and protected-only left-turn signal phasing.

Stage 3: Identify compatible thoroughfare types and context zones

- Existing context zone: C-6.
- Future context zone: C-6.
- Thoroughfare type: avenue.

Stage 4: Develop and test the initial thoroughfare design

Desirable Design Elements

- Lower target speed (25 mph).
- Emphasis on pedestrian safety.

Figure 6.27 View of existing street. Source: Kimley-Horn and Associates, Inc.

- Improved operations at intersections.
- Bicycle lanes as part of city's master bicycle plan.
- Retention of wide sidewalks.
- Street trees.
- Far-side bus stops with shelters.
- Maximization of on-street parking.
- Reduced crossing width.

Factors to Consider/Potential Trade-Offs

- Vehicular capacity versus width required for all desirable elements.
- Efficiency/safety benefits of turn lanes and protected-only left-turn signal phasing versus four travel lanes.
- Provision of on-street parking in select segments versus other design elements.
- Accommodation of large vehicles, particularly turning at intersections, versus curb extensions and reduced crossing width.
- Ability to bypass double-parked vehicles and emergency vehicle access versus reduced number of lanes.
- Effective turning radius with addition of bicycle lanes.
- Addition of bicycle lanes on major transit route and conflicts with stopped buses.

Alternative Solution (see **Figure 6.29**)

Only one alternative design is considered in this design example:

1. Reduce number of through lanes to one in each direction; add an alternating center turn lane, on-street parking and bicycle lanes on both sides. Implement curb extensions at intersections. Retain existing streetside width.

In all cases the existing grid network may need to divert some traffic from project thoroughfare so a reduced number of traffic lanes will suffice. Traffic diversion could require operational or physical improvements to other streets.

Compare benefits of the existing and alternative conditions. **Figure 6.30** demonstrates one way of showing such a comparison.

Selected Alternative

Alternative #1:

- Projected traffic volumes can be accommodated with two lanes, and added turning lane improves intersection operations.
- Substantial parking supply added.
- Addition of bicycle lanes on both sides of the roadway closes gaps in the bicycle network and improves safety.
- Curb extensions and protected-only left-turn signal phasing provide substantial pedestrian benefit by reducing crossing distance, improving visibility and eliminating left-turn conflicts.

Stage 5: Develop detailed thoroughfare design

Figure 6.31 shows a rough schematic view of how the selected alternative might be designed.

Solution Design Features

Traveled Way:

- Target speed: 25 mph.
- Two 11-foot travel lanes and 12-foot alternating center turn lane.
- Combined 13-foot-wide parking/bike lanes on both sides.

Streetside:

- Retain existing 20-foot streetsides, pedestrian-scaled lighting and street trees in tree wells.

Intersections:

- Curb extensions and protected-only left-turn signal phasing.

Parallel thoroughfares (as needed):

- Directional signing.
- Operational adjustments or improvements.
- Physical improvements.

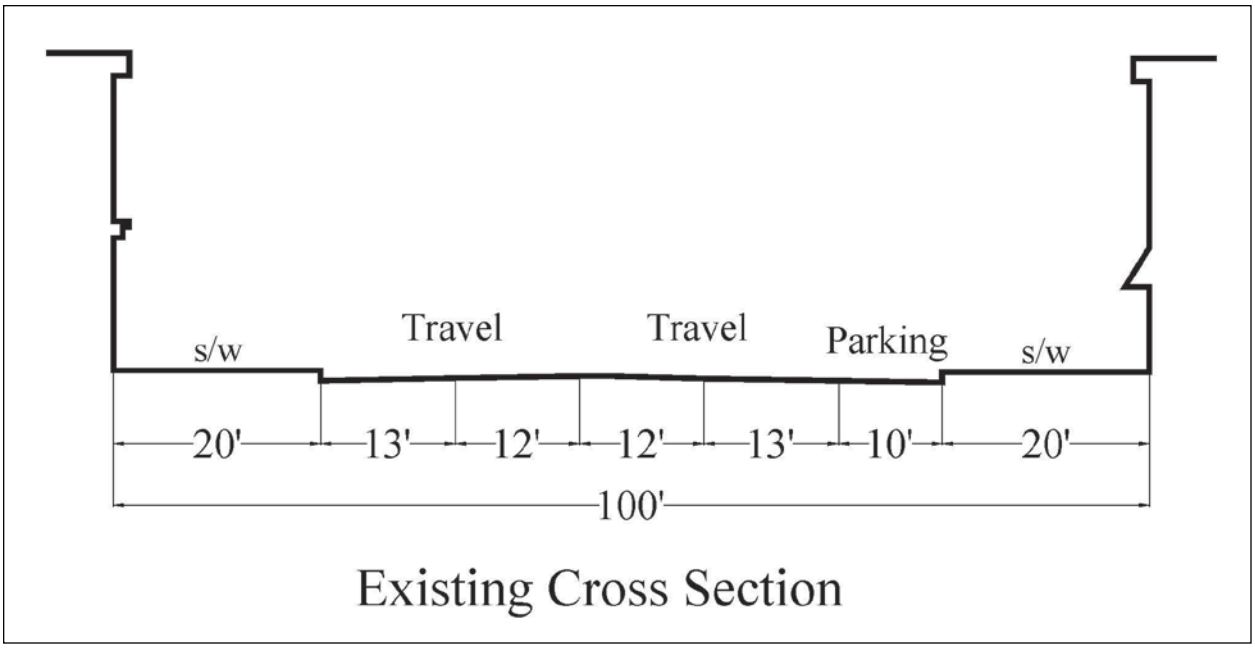

Figure 6.28 Existing street cross-section. Source: Kimley-Horn and Associates, Inc.

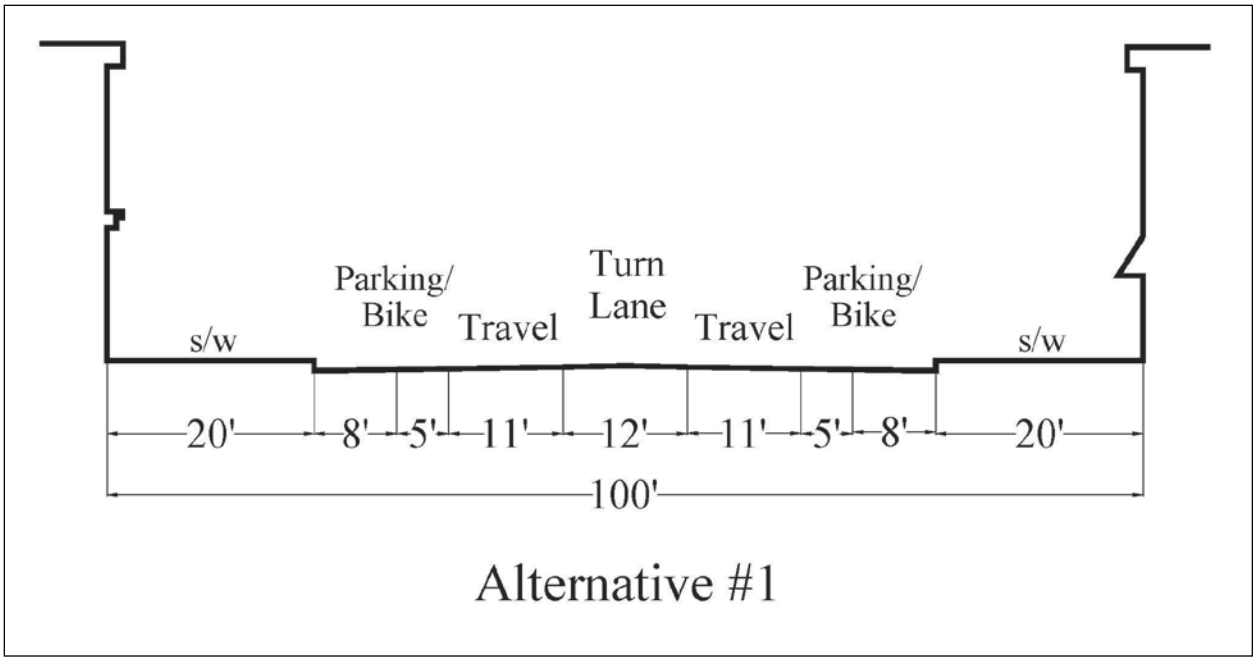

Figure 6.29 Alternative street cross-section. Source: Kimley-Horn and Associates, Inc.

Relative Comparison of Trade-Offs

Alternative	Parking	Sidewalk Width	Capacity and Intersection Operations	Large Vehicle Accommodation	Pedestrian Crossing Width and Safety	Left Turn Lanes	Bike Lanes	Speed Reduction
Existing	+	+ +	+	+	+	- -	- -	- -
1	+ +	+ +	-	+	+ +	+ +	+ +	+ +

Score (relative to other alternatives)

- + + Good (achieves objectives)
- + Fair
- - Poor
- - - Fails to meet/achieve objectives

Figure 6.30 Relative comparison of alternative trade-offs. Source: Kimley-Horn and Associates, Inc.

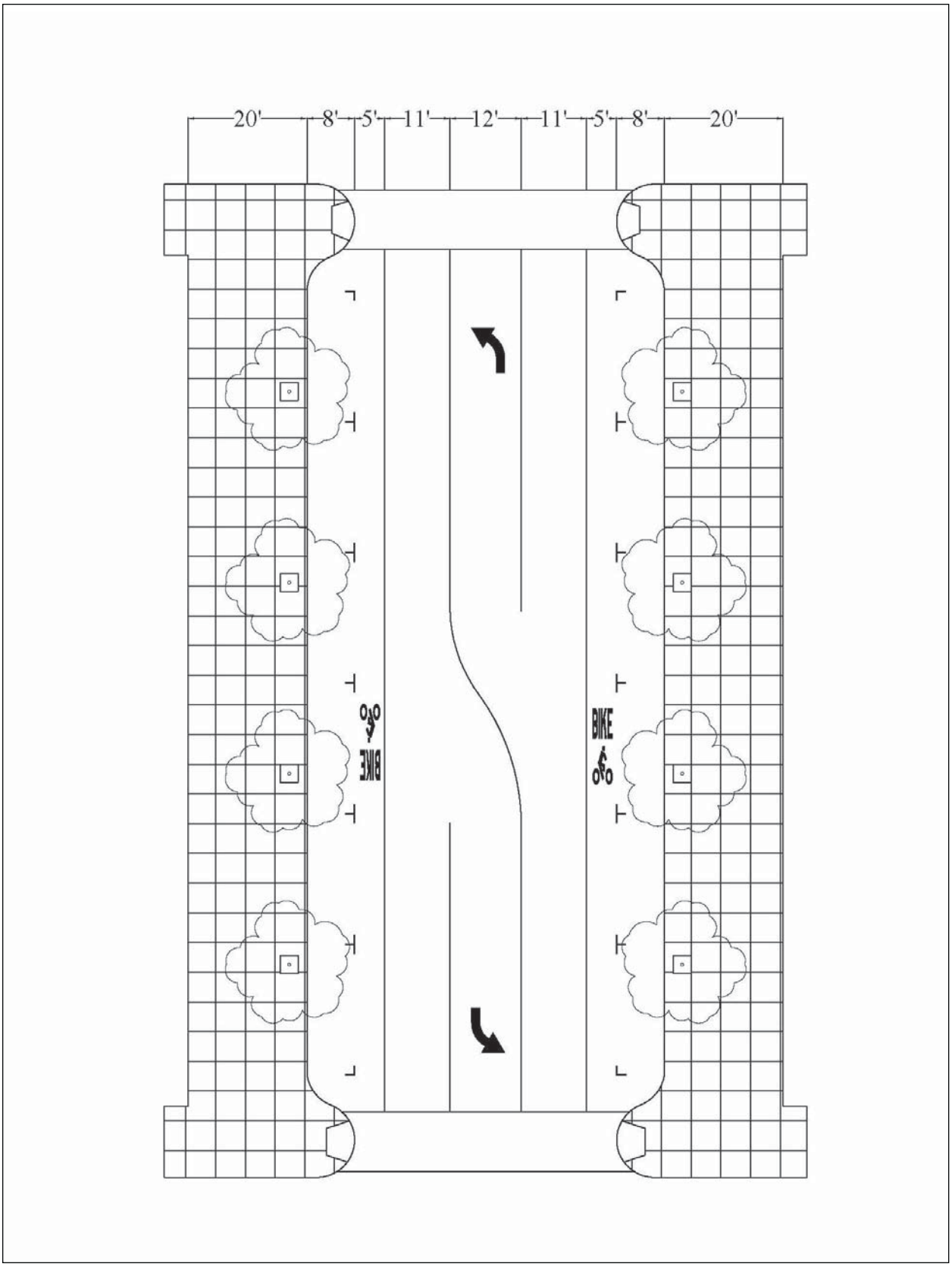

Figure 6.31 Schematic plan view of Alternative #1. Source: Kimley-Horn and Associates, Inc.

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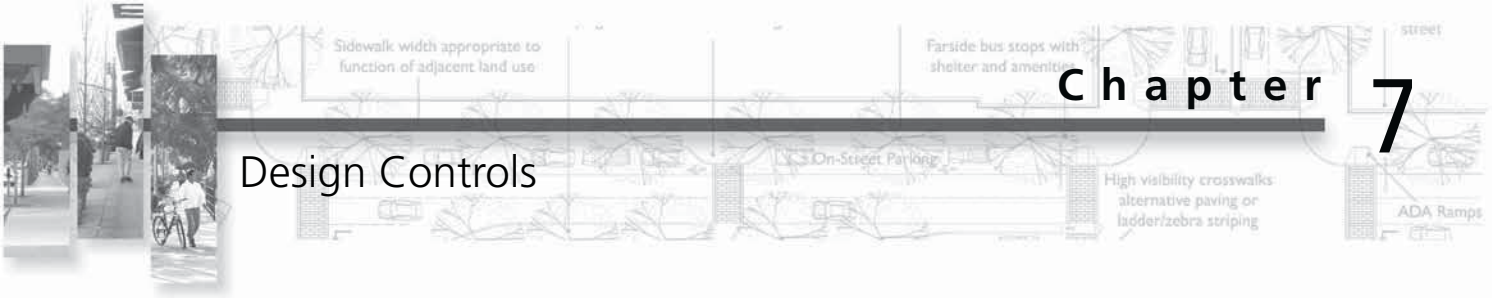

Chapter 7

Design Controls

Purpose

This chapter discusses the fundamental design controls that govern urban thoroughfare design. This chapter is a prelude to the following chapters that present detailed design guidance for the streetside, traveled way and intersections. This chapter identifies the consistencies and divergences between design controls used where capacity is the dominant consideration and where walkability and the character of the thoroughfare is the dominant consideration.

Objectives

This chapter:

1. Defines the term "design controls" and identifies the controls used in the conventional design process;
2. Identifies design controls used in the CSS process and explains how they differ from conventional practice;
3. Discusses the concept of a "target speed" for selecting design criteria;
4. Identifies factors that can be used in thoroughfare design to influence speed;
5. Discusses the concept of a "control vehicle" in combination with a design vehicle to select intersection design criteria; and
6. Provides an overview of the design controls recommended.

Introduction

Controls are physical and operational characteristics that guide the selection of criteria in the design of thoroughfares. Some design controls are fixed—such as terrain, climate and certain driver-performance characteristics—but most controls can be influenced in some way through design and are determined by the designer.

The American Association of State Highway and Transportation Officials (AASHTO) Green Book and its supplemental publication, *A Guide for Achieving Flexibility in Highway Design* (2004b), identify location as a design control and establish different design criteria for rural and urban settings. AASHTO recognizes the influence context has on driver characteristics and performance. The Green Book defines the environment as "the totality of humankind's surroundings: social, physical, natural and synthetic" and states that full consideration to environmental factors should be used in the selection of design controls. This report focuses on design controls and critical design elements in the urban context.

Design Controls Defined by AASHTO

AASHTO guidelines identify functional classification and design speed as primary factors in determining highway design criteria. The Green Book separates its design criteria by both functional classification and context—rural and urban. The primary differences between contexts are the speed at which the facilities operate, the mix and characteristics of the users and the constraints of the surrounding context.

In addition to functional classification, speed and context, AASHTO presents other design controls and criteria that form the basis of its recommended design guidance. The basic controls are:

- Design vehicle;
- Vehicle performance (acceleration and deceleration);
- Driver performance (age, reaction time, driving task, guidance and so forth);
- Traffic characteristics (volume and composition);
- Capacity and vehicular level of service;
- Access control and management;
- Pedestrians and bicyclists; and
- Safety.

AASHTO's Green Book presents the pedestrian needs as a factor in highway design and recognizes the pedestrian as the "lifeblood of our urban areas." Pedestrian characteristics that serve as design controls include walking speed, walkway capacity and the needs of persons with disabilities. AASHTO's *Guide for the Planning, Design and Operation of Pedestrian Facilities* (2004c) and *Guide for the Development of Bicycle Facilities* (1999) expand significantly on the Green Book, presenting factors, criteria and design controls. This report emphasizes pedestrians and bicyclists as a design control in all contexts but particularly in the walkable, mixed-use environments primarily addressed.

Differences from Conventional Practice

This report presents design guidance that is generally consistent with the AASHTO Green Book, AASHTO's supplemental publications and conventional engineering practice. There are, however, four design controls in the application of CSS principles that are used differently than in the conventional design process. These controls are:

- Speed;
- Location;
- Design vehicle; and
- Functional classification.

Speed

The most influential design control, and the design control that provides significant flexibility in urban areas, is speed. Thoroughfare design should be based on target speed.

Target speed is the highest speed at which vehicles should operate on a thoroughfare in a specific context, consistent with the level of multimodal activity generated by adjacent land uses to provide both mobility for motor vehicles and a safe environment for pedestrians and bicyclists. The target speed is designed to become the posted speed limit. In some jurisdictions, the speed limit must be established based on measured speeds. In these cases, it is important for the design of the thoroughfare to encourage the desired operating speed to ensure actual speeds will match the target speed.

Conventionally, design speed—the primary design control in the AASHTO Green Book—has been encouraged to be as high as is practical. In this report, design speed is replaced with target speed, which is based on the functional classification, thoroughfare type and context, including whether the ground floor land uses fronting the street are predominantly residential or commercial. Target speed then becomes the primary control for determining the following geometric design values:

- Minimum intersection sight distance;
- Minimum sight distance on horizontal and vertical curves; and
- Horizontal and vertical curvature.

Target speed ranges from 25 to 35 mph for the primary thoroughfare types described in this report. A lower target speed is a key characteristic of thoroughfares in walkable, mixed use, traditional urban areas.

Design Factors that Influence Target Speed

Establishing a target speed that is artificially low relative to the design of the roadway will only result in operating speeds that are higher than desirable and difficult to enforce. Consistent with AASHTO, this report urges sound judgment in the selection of an appropriate target speed based on a number of factors and reasonable driver expectations. Factors in urban areas include transition from higher- to lower-speed roadways, terrain, intersection spacing, frequency of access to adjacent land, type of roadway median, presence of curb parking and level of pedestrian activity. AASHTO's *A Guide for Achieving Flexibility in Highway Design* (2004c) aptly summarizes the selection of speed in urban areas:

> *"Context-sensitive solutions for the urban environment often involve creating a safe roadway environment in which the driver is encouraged by the roadway's features and the surrounding area to operate at lower speeds."*

Urban thoroughfare design for walkable communities should start with the selection of a target speed. The target speed should be applied to those geometric design elements where speed is critical to safety, such as horizontal and vertical curvature and intersection sight distance. The target speed is not set arbitrarily but rather is achieved through a combination of measures that include the following:

- Setting signal timing for moderate progressive speeds from intersection to intersection;
- Using narrower travel lanes that cause motorists to naturally slow their speeds;
- Using physical measures such as curb extensions and medians to narrow the traveled way;
- Using design elements such as on-street parking to create side friction;
- Minimal or no horizontal offset between the inside travel lane and median curbs;
- Eliminating superelevation;
- Eliminating shoulders in urban applications, except for bicycle lanes;
- Smaller curb-return radii at intersections and elimination or reconfiguration of high-speed channelized right turns;
- Paving materials with texture (e.g., crosswalks, intersection operating areas) detectable by drivers as a notification of the possible presence of pedestrians; and
- Proper use of speed limit, warning, advisory signs and other appropriate devices to gradually transition speeds when approaching and traveling through a walkable area.

Other factors widely believed to influence speed include a canopy of street trees, the enclosure of a thoroughfare formed by the proximity of a wall of buildings, the striping of edge lines or bicycle lanes, or parking lanes. These are all elements of walkable, mixed-use urban areas but should not be relied upon as speed-reduction measures until further research provides a definitive answer.

The practitioner should be careful not to relate speed to capacity in urban areas, avoiding the perception that a high-capacity street requires a higher target speed. Under interrupted flow conditions, such as on thoroughfares in urban areas, intersection operations and delay have a greater influence on capacity than speed.

The *Highway Capacity Manual* (TRB 2000) classifies urban streets (Class I through IV) based on a range of free-flow speeds. The thoroughfares upon which this report focuses have desired operating speeds in the range of 25 to 35 mph (Class III and IV based on the *Highway Capacity Manual*). Level of service C or better is designated by average travel speeds ranging from 10 to 30 mph. Therefore, adequate service levels can be maintained in urban areas with lower operating speeds. Capacity issues should be addressed with highly connected networks; sound traffic operations management, such as coordinated signal timing; improved access management; removal of unwarranted signals; and the accommodation of turning traffic at intersections.

Location

Conventional thoroughfare design is controlled by location to the extent that it is rural or urban (sometimes suburban). This report broadens the choices for context using the urban transect, ranging from suburban to high-density urban cores. Additionally, the variation in design elements controlled by location is expanded to include predominant ground floor uses such as residential or commercial. Land uses govern the level of activity, which in turn influences the design of the thoroughfare. These influences include, but are not limited to, pedestrians and bicyclists, transit, economic activity of adjacent uses and right-of-way constraints. The CSS approach may also consider planned land uses that represent a departure from existing development patterns and special design districts that seek to protect scenic, environmental, historic, cultural, or other resources.

Design Vehicle

The design vehicle influences the selection of design criteria such as lane width and curb-return radii. Some practitioners will conservatively select the largest design vehicle (WB 50 to WB 67) that could use a thoroughfare, regardless of the frequency. Consistent with AASHTO, CSS emphasizes an analytical approach in the selection of a design vehicle, including evaluation of the trade-offs involved in selecting one design vehicle over another.

In urban areas it is not always practical or desirable to choose the largest design vehicle that might occasionally use the facility, because the impacts to pedestrian crossing distances, speed of turning vehicles and so forth may be inconsistent with the community vision and goals and objectives for the thoroughfare. In contrast, selection of a smaller design vehicle in the design of a facility regularly used by large vehicles can invite frequent operational problems. The practitioner should select the design vehicle that will use the facility with considerable frequency (for example, bus on bus routes, semi-tractor trailer on primary freight routes or accessing loading docks and so forth). Two types of vehicle are recommended:

- Design vehicle—must be regularly accommodated without encroachment into the opposing traffic lanes. A condition that uses the design vehicle concept arises when large vehicles regularly turn at an intersection with high volumes of opposing traffic (such as a bus route).
- Control vehicle—infrequent use of a facility must be accommodated, but encroachment into the opposing traffic lanes, multiple-point turns, or minor encroachment into the streetside is acceptable. A condition that uses the control vehicle concept arises when occasional large vehicles turn at an intersection with low opposing traffic volumes (such as a moving van in a residential neighborhood or once-per-week delivery at a business) or when large vehicles rarely turn at an intersection with moderate to high opposing traffic volumes (such as emergency vehicles).

In general, the practitioner should obtain classification counts to determine the mix of traffic and frequency of large vehicles and should estimate how this mix will change as context changes and keep consistent with the community's long-range vision. If there are no specific expectations, the practitioner may consider the use of a single-unit truck as an appropriate design vehicle.

Although state highways have traditionally served through and heavy/large vehicle traffic, modern thoroughfare system planning tries to accommodate movements where they are best handled from a network and context consideration. Large, heavy and unusually demanding vehicles need to be accommodated with reasonable convenience. However, in some

Multimodal Level of Service Measures

A fundamental goal of CSS is to effectively serve all modes of travel. Although good network planning, access management and innovative street designs can provide significant vehicle capacity while accommodating bicycles and pedestrians, trade-offs among modes can be an issue. Evaluating these trade-offs has historically been hampered by the fact that performance measures were developed primarily to measure vehicle movement. However, the traditional *Highway Capacity Manual* level of service framework has been adapted to evaluate performance from a transit, pedestrian and bicycle perspective.

These multimodal performance measures focus as much on the quality and convenience of facilities as they do on movement and flow. For example, the adequacy of pedestrian facilities is not determined by how crowded a sidewalk is but by the perception of comfort and safety. For transit services, frequency is an important attribute, but "on-time performance" and the pedestrian environment surrounding bus and rail stations are also critical aspects of the traveler experience. Below are examples of multimodal performance measures.

Bicycle Level of Service Measures

- Effective width of the outside through lane
- Traffic volumes
- Traffic speeds
- Truck volumes

Pedestrian Level of Service Measures

- Existence of a sidewalk
- Lateral separation of pedestrians from motorized vehicles
- Motorized vehicle traffic volumes
- Motorized vehicle speeds

For more information on multimodal level of service, see References for Further Reading at the end of this chapter.

cases, routes other than state highways may be more appropriate or more easily accommodating. Any such diversions from state routes need to be clearly marked.

Chapter 10 (Intersection Design Guidelines) provides further guidance on the design of intersections to accommodate large vehicles.

Functional Classification

Functional classification describes a thoroughfare's theoretical function and role in the network, as well as governs the selection of certain design parameters, although the actual function is often quite different. As discussed in Chapter 4, functional class may influence some aspects of the thoroughfare such as its continuity through an area, trip purposes and lengths of trips accommodated, level of land access it serves, type of freight service and types of public transit served. These functions are important factors to consider in the design of the thoroughfare, but the physical design of the thoroughfare in CSS is determined by the thoroughfare type designation (as introduced in Chapter 4 and further discussed in Chapter 6).

The Role of Capacity and Vehicular Level of Service in CSS

The conventional design process uses traffic projections for a 20-year design period and strives to provide the highest practical vehicular level of service. CSS takes traffic projections and level of service into account and then balances the needs of all users or emphasizes one user over another depending on the context and circumstances (for example, reduces number of mixed-flow travel lanes to accommodate bicycle lanes or an exclusive busway). While capacity and vehicular level of service play a role in selecting design criteria, they are only two of many factors the practitioner considers and prioritizes in the design of urban thoroughfares. Often in urban areas, thoroughfare capacity is a lower priority than other factors such as economic development or historical preservation, and higher levels of congestion are considered acceptable. The priority of level of service is a community objective; however, variance from the responsible agency's adopted performance standards will require concurrence from that agency. CSS also considers network capacity in determining the necessary capacity of the individual thoroughfare (see Chapter 3).

Thoroughfare Speed Management

Under the conventional design process, many arterial thoroughfares have been designed for high speeds and traffic volumes. As the context of these thoroughfares change over time, such as to walkable compact mixed-use areas, the speed encouraged by the design becomes a matter of concern. Further, municipalities establishing speed limits based on the measured 85th percentile speed are finding they are required to establish higher speed limits than the community desires for the area. In these cases, traffic engineers are tasked with identifying methods to reduce arterial speeds. This section identifies research and the practical experience of agencies in managing arterial speeds.

It is popularly held that higher operating speeds result in higher crash rates and higher severity of crashes. Research on the effect of actual operating speed on crash rate is inconclusive (TRB 1998). However, research does show that higher operating speeds do result in higher crash severity—higher percentages of injury and fatality crashes and more serious property damage. Hence, lower vehicular traffic speeds will be beneficial when collisions occur with other vehicles or pedestrians.

Speed management is an approach to controlling speeds using enforcement, design and technology applications. While "traffic calming" is a type of speed management usually used on local residential streets, speed management can be used on all types of thoroughfares. Speed management methods can use technologies that provide feedback to the motorist about their speed, or designs in which the motorist perceives the need for a lower speed. These techniques include signage, signalization, enforcement, street designs and built environments that encourage slower speeds. Other methods include physical devices that force drivers to slow down, such as roundabouts, raised intersections, or narrowed sections created by curb extensions and raised medians. Physical devices are generally more effective at changing driver behavior but may be more costly to implement and may not be appropriate on all thoroughfares.

Speed management is often a multidisciplinary decision because it requires input from emergency services, engineering, street maintenance departments,

law enforcement and transit service providers. The process of implementing a speed management program benefits from public involvement to understand how the community uses thoroughfares and how it perceives various speed management methods. Bicycle and pedestrian advocacy groups should also be involved in the process. Effective speed management requires knowledge of the existing traffic patterns, both quantitative and qualitative. Quantitative measures of traffic counts, intersection turn movements and speeds help to determine the existing condition and the need. Qualitative information, often gathered from the public or through observation, can explain behavioral issues. Implementation of speed management should be examined along corridors and across jurisdictions. It is important for a corridor to have a consistent speed through different jurisdictions if the character and context also remain constant.

The following is a list of speed management techniques or measures commonly used in the United States on thoroughfares designated as arterials or collectors:[1]

Active Measures

- Roundabouts, particularly when used within a "roundabout corridor."
- Road diets (reducing the number of lanes by adding medians, converting travel lanes to parking, or adding bike lanes).
- Lateral shifts or narrowing (curb extensions with a center island or other techniques that require vehicles to move out of a straight path or create neckdowns).
- Smaller curb-return radii to slow turning vehicles and the elimination of free-flow channelized right-turn lanes.
- Provision of on-street parking where adjacent land uses and activities will generate demand.
- Speed humps and speed tables (not widely used on arterials and lack support of emergency service providers).
- Speed cushions or speed platforms (less impact on emergency vehicles than hump and tables).
- Narrowed travel lanes.
- Raised crosswalks combined with curb extensions to narrow street.
- Speed actuated traffic signals where a vehicle traveling at excessive speeds will trigger the signal to change to red.

Passive Measures

- Synchronized signals to create progression at an appropriate speed.
- Radar trailers/speed feedback signs flashing "SLOW DOWN" message when speed exceeds a preset limit (most effective when coupled with enforcement).
- Visually narrowing road using pavement markings.
- Visually enclosing street with buildings, landscaping and street trees.
- Variable speed limits (using changeable message signs based on conditions).
- Speed enforcement corridors combined with public education.
- Flashing beacons on intersection approaches to slow traffic through the intersection.
- Speed limit markings on pavement.
- Mountable cobblestone medians or flush concrete bands delineating travel lanes for visual narrowing
- Shared streets using signs and pavement markings (such as bicycle boulevards).
- Automated speed enforcement (including red-light enforcement).

Additional Controls to Consider in Thoroughfare Design

In addition to the design controls discussed previously, other critical design controls in the conventional de-

1 Based on interviews with public agencies and experts in the field of speed management. Source: "Best Practices in Arterial Speed Management," prepared for the City of Pasadena. Kimley-Horn and Associates, Inc, and *ITE Journal* article "Complete Streets: We Can Get There From Here," LaPlante, J. and McCann, B., May 2008.

sign process remain applicable in the application of CSS principles. Design controls related to roadway geometry—sight distance, horizontal and vertical alignment and access control—continue to be based on conventional design practices.

Pedestrian and Bicyclist Requirements as Design Controls

Pedestrian and bicyclist requirements affect the utilization of a thoroughfare's right of way. Thoroughfares with existing or desired high levels of pedestrian and bicycle usage require appropriate streetside and bicycle facilities to be included in transportation projects. This requirement usually affects the design elements in the traveled way. Therefore, pedestrian and bicycle requirements function as design controls that influence decisions for the utilization and prioritization of the right of way. For example, requirements for bicycle lanes might outweigh the need for additional travel lanes or a median, resulting in a design that reduces the vehicular design elements to provide bicycle design elements. The design of walkable urban thoroughfares emphasizes allocating right of way appropriately to all modes depending on priority and as defined by the surrounding context and community objectives. This process results in a well thought out and rationalized design trade-off—the fundamental basis of context sensitive solutions.

Sight Distance

Sight distance is the distance that a driver can see ahead in order to observe and successfully react to a hazard, obstruction, decision point, or maneuver. Adequate sight lines remain a fundamental requirement in the design of walkable urban thoroughfares. The criteria presented in the AASHTO Green Book for stopping and signalized stop- and yield-controlled intersection sight distances based on the target speeds described above should be used in urban thoroughfare design.

Horizontal and Vertical Alignment

The design of horizontal and vertical curves is a controlling feature of a thoroughfare's design. The criteria for curvature is affected by speed and is dependent on the target speed. For urban thoroughfares, careful consideration must be given to the design of alignments to balance safe vehicular travel with a reasonable operating speed. The AASHTO Green Book provides guidance on the design of horizontal and vertical alignments for urban streets.

Access Management

Access management is defined as the management of the interference with through traffic caused by traffic entering, leaving and crossing thoroughfares. Access management can be a regulatory, policy, or design tool. Access management on urban thoroughfares controls geometric design by establishing criteria for raised medians and median breaks, intersection and driveway spacing, and vehicle movement restrictions through various channelization methods. The AASHTO Green Book and the Transportation Research Board's *Access Management Manual* (2003) provide extensive guidance on this subject. Chapter 9 (Traveled Way Design Guidelines) provides an overview of access management methods and general guidelines for managing access on urban thoroughfares.

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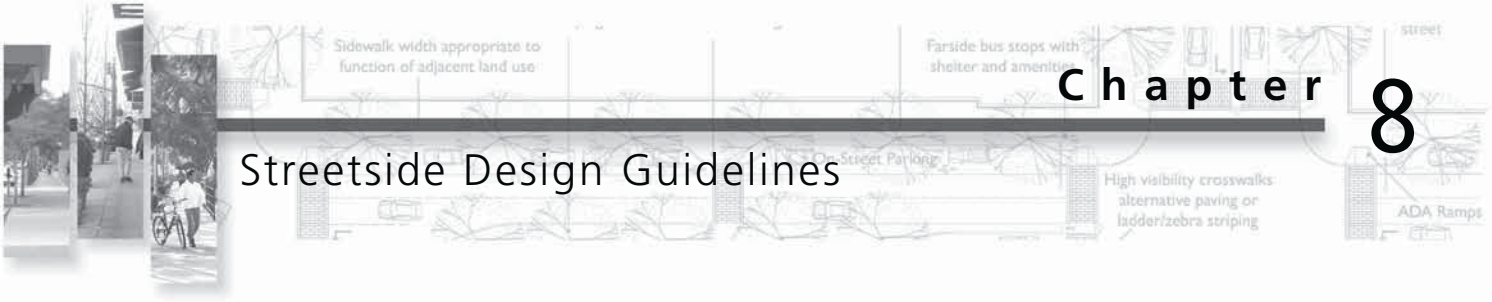

Chapter 8

Streetside Design Guidelines

Purpose

This chapter provides principles and guidance for the design of a thoroughfare's streetside and the specific elements that comprise the streetside. It addresses how the design of the streetside varies with changes in context. The guidance in this chapter is used in conjunction with the guidance for the other two thoroughfare components—the traveled way (Chapter 9) and intersections (Chapter 10).

Objectives

This chapter:

1. Defines and discusses four distinct zones that comprise the streetside: edge, furnishings, throughway and frontage;
2. Describes the uses and activities that are typically accommodated within the streetside in urban areas;
3. Describes fundamental design principles of the streetside as they relate to intersection sight distance, speed and clear zones and lateral clearance;
4. Describes the role and placement of streetside facilities, public spaces and public art; and
5. Provides principles, considerations and design guidance for streetside width and functional requirements.

Introduction

The streetside is the portion of the thoroughfare that accommodates nonvehicular activity—walking as well as the business and social activities—of the street. It extends from the face of the buildings or edge of the private property to the face of the curb. A well-designed streetside is important to the thoroughfare's function as a "public place." Thoroughfares are the most extensively used civic spaces or in our communities.

Streetside Zones and Buffering

This chapter addresses the design of sidewalks and the buffers between sidewalks, moving traffic, parking and/or other traveled-way elements. The streetside consists of the following four distinct functional zones:

1. Edge zone—the area between the face of curb and the furnishing zone that provides the minimum necessary separation between objects and activities in the streetside and vehicles in the traveled way;
2. Furnishings zone—the area of the streetside that provides a buffer between pedestrians and vehicles, which contains landscaping, public street furniture, transit stops, public signage, utilities and so forth;
3. Throughway zone—the walking zone that must remain clear, both horizontally and vertically, for the movement of pedestrians. The Americans with Disabilities Act (ADA) establishes a minimum width for the throughway zone; and
4. Frontage zone—the distance between the throughway and the building front or private property line that is used to buffer pedestrians from window shoppers, appurtenances and doorways. It contains private street furniture, private signage, merchandise displays and so forth and can also be used for street cafes. This zone is sometimes referred to as the "shy" zone.

Figure 8.1 illustrates the four zones using the example of a streetside in a commercial area. Guidance is provided for each of these zones, with the width varying in relation to thoroughfare type and function, context zone and specific land use characteristics.

Urban Design Elements

The streetside can contain a variety of urban design elements, ranging from large-scale elements such as plazas, seating areas, transit stops and other public

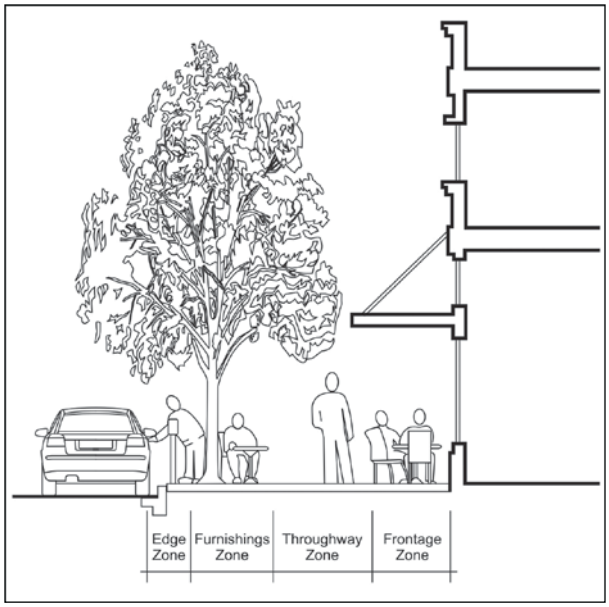

Figure 8.1 Streetside zones. Source: Concept by Community, Design + Architecture, illustration by Digital Media Productions.

spaces to the details of street furniture, street trees, public art and materials used for constructing sidewalks, walls and so forth.

Technical Considerations

There is a broad range of technical and engineering considerations that need to be coordinated with the design of the streetside, including the requirements of *Americans with Disabilities Act Accessibility Guidelines* (ADAAG) and *Public Rights-of-Way Accessibility Guidelines* (PROWAG) (www.access-board.gov/), need for utilities (including lighting for both the traveled way and streetside), provision of signage for traffic and pedestrians and evaluation of multimodal accessibility. This chapter provides guidance for how these technical issues can be addressed in coordination with the other elements of urban thoroughfares.

The Urban Streetside: Uses and Activities

The basic functions of the streetside in any context are the accommodation of pedestrians, access to adjoining buildings and properties and the provision of clear zones and space for utilities and other streetside appurtenances. In urban contexts these basic functions are shared with the activities generated by the adjacent land use and general civic functions, which can include aesthetics (such as street trees and public art), sidewalk cafes, plazas and seating areas, transit amenities (such as benches, shelters, trash receptacles and waiting areas), merchandise display and occasional public activities (such as farmers' markets or art shows).

Streetside functions vary by context zone and predominant ground floor land use. The width of certain elements of the streetside (for example, the furnishings zone functions as a traffic buffer) will vary by thoroughfare type depending on the existence or lack of on-street parking and the speed and volume of vehicular traffic on the thoroughfare. Variations in the width of the streetside are addressed in the design guidelines in the section on streetside width and functional requirements.

Design Principles

Safety

When designing the streetside, the practitioner is concerned about the safety of all users of the thoroughfare. Streetside safety concerns in urban contexts are different than those in rural contexts, where speeds are higher and most travel is by vehicle. In designing the streetside for traditional walkable urban areas, the practitioner is concerned about the safety of a wider range of users, including pedestrians on the sidewalk, motorists, motorcyclists and bicyclists using the traveled way. The practitioner should consider the context of the thoroughfare, including competing demands within limited right of way and time when the space may be needed.

Streetside safety in urban areas is achieved by separating modes of different speeds and vulnerabilities to the extent possible by both space and time (bicyclists from pedestrians and pedestrians from vehicles), informing all users of the presence and mix of travel modes and through provision of adequate sight distance. The difficulty for the practitioner lies in developing solutions to resolve the inherent conflicts where modes of travel cross paths. Design guidelines for improving pedestrian safety at intersections are discussed in Chapter 10.

Streetside safety for the users of the traveled way in traditional urban areas focuses on meeting user expectations, providing uniform and predictable designs and traffic control, removing clearly hazardous streetside obstacles and establishing an appropriate target speed, which in turn controls the speed-related geometric design elements of the thoroughfare. The practitioner should be familiar with the concepts and guidance provided in AASHTO's *Roadside Design Guide* (2002).

Relationship of Speed to Streetside Design

A person's decision to walk is influenced by many factors, including distance, perceived safety and comfort, convenience and visual interest of the route (AASHTO 2004b). In the streetside, pedestrians feel exposed and vulnerable when walking directly adjacent to a high-speed travel lane. Vehicle noise, exhaust and the sensation of passing vehicles reduce pedestrian comfort. Factors that improve pedestrian comfort include a separation from moving traffic and a reduction in speed. In walkable urban environments, a buffer zone that improves pedestrian comfort can be achieved with the width of the edge and furnishings zones, landscaping and on-street parking.

Clear Zones

The application of a clear zone is most critical on high-speed roadways and is usually not implemented on low-speed urban thoroughfares with right-of-way constraints. In many cases the hazard of streetside obstacles is substantially less in urban areas because of lower speeds or parked vehicles.

Public Space

Civic and community functions on the streetside may require additional space to complement adjacent civic or retail land uses or to accommodate the high pedestrian flows of adjacent uses or transit facilities. Public spaces in the streetside are often used for these functions and are an important complement to the thoroughfare as a public place. Public spaces include public plazas, squares, outdoor dining, transit stops and open spaces. Transit stops and some plazas are generally within the streetside. Design considerations should account for the context of the public space within the thoroughfare and the surrounding land use context. Public spaces should be designed to serve functions that enhance the surrounding context, such as public gatherings, special events, farmers' markets, quiet contemplation, lunch time breaks and so forth (**Figure 8.2**). General principles for the design of public spaces include the following:

- Public spaces in private property adjacent to the streetside should be visible and accessible from the streetside. These public spaces can accommodate higher levels of pedestrian activity at entries to major buildings or retail centers.
- Public spaces in the streetside should not impede the circulation of pedestrians and should provide appropriate features such as seating and lighting to make them attractive and functional places for people to use.
- The streetside and public space design should integrate the functions of both in a compatible and mutually supportive maneuver. Functions should interconnect by design.
- Special paving and materials may be used to unify the look of the sidewalk, parking lane and crosswalks.
- There should be a continuity of design in adjacent streetside and public spaces. This may include paving, lighting, landscape plants and materials and other features.
- Street trees, light fixtures, public art and other elements with a unified design can be used to highlight a segment of a thoroughfare that is specifically designed to function as a public gathering place.

Placement of Streetside Facilities

Following the division of the streetside into edge, furnishings, throughway and frontage zones, the placement of streetside facilities (such as kiosks and retail stands, trash receptacles, water fountains, restrooms, public art and small ancillary structures) should occur in the furnishings and frontage zones as well as in curb extensions. In no case should the placement of features reduce the width of the clear pedestrian throughway to less than 5 feet or reduce vertical clearance below 80 inches. All placements should be compliant with the most recent U.S. Access Board and PROWAG requirements and FHWA PROWAAC guidelines: *Special Report: Ac-*

Figure 8.2 Public space adjacent to the pedestrian realm should relate to the activities on the thoroughfare. Source: Kimley-Horn and Associates, Inc.

cessible Public Rights-of-Way: Planning and Designing for Alterations.

Other considerations regarding streetside facilities are as follows:

1. Place facilities in locations where their use will produce pedestrian activity levels similar to a main street or where an activity focus is desired. Features such as public art should be located in highly visible areas, including the center islands of low-speed roundabouts (ensuring sight triangles are maintained and placement does not constitute a streetside hazard).
2. Select the type, design and materials of streetside facilities to reflect the local character of the context and streetside. This will maximize the facility's contribution to creating a sense of community identity.
3. Coordinate design elements (street furniture, light fixtures and poles, tree grates and so forth) to fit into a desired theme or unified style for a given thoroughfare. This can be best achieved through the preparation of a streetscape improvement plan.
4. Streetside facilities are particularly well suited for placement on very wide sidewalks or large curb extensions. Locate facilities at street corners in a manner that maintains clear sight triangles. (For more information, review the discussions on sight triangles and curb extensions in Chapter 10.)
5. Consider vehicle overhangs and door swings of parked vehicles.
6. Facilities should never obstruct the clear pedestrian throughway, curb ramps, or any accessible element of the streetside.
7. Place vertical elements so they provide the required lateral clearance to the face of the curb and satisfactory shoulder clearance from the clear pedestrian throughway zone.

Figure 8.3 Public art adds interest to a walking route. Source: Kimley-Horn and Associates, Inc.

Context Zones

The placement of streetside facilities should be focused in urban center (C-5) or urban core (C-6) context zones with predominantly retail- and entertainment-related ground floor uses with a main street level of pedestrian activity. The need for and benefits from facilities such as kiosks, restrooms, or small-scale retail stands is typically highest in C-5 and C-6 zones.

Facilities in the general urban (C-4) or suburban (C-3) context zones should be located at nodes of increased intensity of ground floor retail and entertainment uses that produce high levels of pedestrian activity. The provision of facilities at public transit transfer centers should be considered in all context zones.

Public Art

Pedestrian improvements create an opportunity to implement public art (**Figure 8.3**). On a large scale, public art has the ability to identify a district or contribute to a design theme. It can be an effective means of encouraging pedestrian travel by adding interest to the route and creating community identity. The redesign of thoroughfares creates opportunities for the implementation of public art as part of an urban design or streetscape plan. This includes, but is not limited to artistically designed paving; design of furnishings, light fixtures, railings, or low walls; and sculptural objects, murals or other surface treatments. Placement of public art and monuments should not obstruct the driver's view of traffic control devices, be a distraction, or be located in a manner that could create a streetside hazard to motorists.

Design Guidance

Design guidance for the streetside elements of the thoroughfare is provided in the following sections. Specifically, design guidance is provided for streetside width and functional requirements, pedestrian buffers and edge and furnishings zone elements (trees and parkways, sidewalk crossings of driveways and alleys, utilities, street furniture and landscaping).

Streetside Width and Functional Requirements

Related Thoroughfare Design Elements

- Intersections.
- Edge, furnishings, throughway and frontage zone principles and considerations.
- Streetside facilities.
- Snow removal.
- Curb extensions.

Figure 8.4 A streetside with well defined zones. Source: Community, Design + Architecture.

Background and Purpose

The streetside, including the sidewalk, provides for the mobility of people and is an important social space where people interact and walk together, wait for transit, window shop, access adjoining uses, or have a cup of coffee at a street cafe. The streetside must be wide enough to accommodate movement as well as the important social functions related to the land uses located along the thoroughfare. The width and function of the streetside influence safety and help achieve accessibility. The optimal streetside width varies with the expected streetside activities, character of adjacent land uses and speed and volume of vehicular traffic in the thoroughfare.

General Principles and Considerations

General principles in the selection of appropriate streetside width include the following:

- The streetside should have well-defined zones so that the pedestrian throughway is clearly demarcated (**Figure 8.4**).
- Sidewalks should be provided on both sides of the street in urban contexts. In a small number of conditions, a sidewalk on only one side of the street is appropriate when unusual land uses, such as a canal, steep vertical wall, or railroad, exist and people do not have a need to access that side of the street.
- Care should be given where driveways and alleys cross sidewalks. At these locations there is a potential for conflict between drivers and pedestrians and an increased possibility that pedestrian safety will be compromised. Crossings of driveways, garage accesses, alleys and such should maintain the elevation of the sidewalk and may be considered for special materials, colors, textures and markings alerting motorists that they are traversing a pedestrian zone.
- Utilities should not interfere with pedestrian circulation or block entrances to buildings or curb cuts or interfere with sight distance triangles.
- Space requirements for, and access to, transit facilities (such as bus shelters) should be included in the design of the streetside but must be outside of the clear pedestrian travel way.
- Sidewalks must provide convenient connections between building entries and transit facilities.
- Designers should coordinate with utility providers regarding the location of utility elements such as poles, cabinets, vaults, grates and manholes.
- Sidewalks should be as straight and direct as possible except to avoid mature trees or unavoidable obstacles. Pedestrians in urban and suburban contexts have a desire to walk a straight course.

Edge Zone Principles and Considerations

The edge zone, which is sometimes referred to as the "curb zone," is the interface between the traveled way and the furnishing zone and provides an operational offset to:

Streetside Zones
A Avenue, Lake Oswego, OR

A Avenue is classified as a major arterial thoroughfare located in a general urban context zone (C-4) in Lake Oswego's downtown central business district and civic center area. Downtown land uses consist of low to medium density commercial mixed use (office over retail/service) with low to medium density residential located one block from A Avenue. The ground floor uses are primarily commercial with a mix of retail, services and restaurants.

Although the streetside on A Avenue is narrow, it contains distinct zones for edge, furnishing, clear throughway and frontage. The edge zone is about 18 inches, allowing an operational clearance for opening car doors.

The furnishings zone (4–5 feet) contains street trees in wells with decorative grates, light standards, shrubs in moveable planters, seating and a collection of public art.

Underground utilities and vaults are also located in this zone. The clear throughway ranges from 5–8 feet and the frontage zone (about 2–3 feet) contains planters, window shopping areas and seating for outdoor cafes.

- Prevent vehicle overhangs from hitting vertical objects when turning or backing toward the curb;
- Provide clearance from tall vehicles that are parked next to the curbs on highly crowned pavements;
- Provide clearance for extended bus and truck mirrors; and
- Permit the opening of parked vehicle doors.

Other principles and considerations include:

- In compact mixed-use urban areas with on-street parking, particularly those areas with ground floor retail activity, the edge zone should be a minimum of 1.5 feet to accommodate the door swing of a parallel parked car and prevent potential conflicts with elements in the furnishing zone. While this zone should generally be kept clear of any objects, parking meters can be placed here with consideration to door swings.
- The width of the edge zone adjacent to angled parking should account for the depth of vehicle overhang, which can vary between 1.5 and 2.5 feet depending on the angle of the parking spaces.

Figure 8.5 Utility poles and other fixtures should not interfere with the pedestrian throughway. This example shows a bus shelter and other street furniture properly located in the furnishings zone. Source: Kimley-Horn and Associates, Inc.

- If reverse (back-in) angled parking is considered, the edge zone lateral clearance must be at least 30 inches due to the added overhang of the rear of most vehicles.
- At transit stops with shelters, the edge zone should be widened to a minimum of 4 feet to provide wheelchair access to and in front of the shelter. A curb extension that stretches the length of the transit stop can also be an effective way to increase the width of the edge zone. Curb extension bus stops have additional advantages for transit operations, including faster passenger loading and unloading, more space for waiting passengers and less time for buses to re-enter the flow of traffic.

Furnishings Zone Principles and Considerations

The furnishings zone is the key buffer component between the active pedestrian walking area (throughway zone) and the thoroughfare traveled way. Principles and considerations concerning furnishings zones include the following:

- Street trees, planting strips, street furniture, utility poles, signal poles, signal and electrical cabinets, telephones, traffic signal cabinets, signs, fire hydrants, bicycle racks and the like should be consolidated in this zone to keep them from becoming obstacles in the throughway zone.
- The furnishings zone accommodates curbside transit stops, including boarding areas, shelters and passenger queuing areas (**Figure 8.5**).
- When signal control cabinets, signal poles and other traffic equipment are installed, they must leave pedestrians in clear sight of, and in alignment with, motorist's views at all times. This might require special setbacks for oversized equipment.
- Retail kiosks, stands, or other business activities are appropriate in the furnishings zone (see earlier section in this chapter on streetside fa-

cilities and public art) if the furnishings zone is sufficiently wide to maintain a 1.5-foot minimum lateral clearance from the curb and overhanging parked vehicles.

- Installation of curb extensions (see the section in Chapter 10 on curb extensions) is an effective way to increase sidewalk space in the furnishings zone adjacent to crosswalks where pedestrians will wait before crossing the thoroughfare.
- Where no furnishings zone exists, elements that would normally be placed there, such as benches, light poles, signals, trash receptacles and so forth, may occupy the frontage zone to keep the clear pedestrian travel way unobstructed and comply with PROWAG requirements.

Throughway Zone Principles and Considerations

Principles and considerations concerning throughway zones include the following:

- Clear pedestrian throughway zones are intended for pedestrian travel only and should be entirely clear of obstacles and provide a smooth walking surface. According to PROWAG, running slopes should not exceed the grade of the adjacent street, and cross slopes should not exceed 2 percent, including across driveways.
- Width of the throughway zone should vary by context and the activity of the adjacent land use (**Table 8.1**).
- Recommended clear pedestrian throughway zone minimum width in constrained conditions is 5 feet in residential and 6 feet in commercial areas (see **Table 5.2** in Chapter 5).
- For very high pedestrian volume areas, such as subway exits, transit transfer points and assembly arena entrances and exits, additional width and special design attention, particularly at crossings, should be provided.
- Within the "station area" of high-capacity transit stations, sidewalks should be sufficiently wide to accommodate expected pedestrian volume surges and provide opportunities for faster pedestrians to overtake slower pedestrians.

Frontage Zone Principles and Considerations

The frontage zone is the area adjacent to the property line that may be defined by a building facade, landscaping, fence, or screened parking area. Principles and considerations concerning frontage zones include the following:

- Use the frontage zone to create pedestrian comfort. Generally, pedestrians do not feel comfortable moving at a full pace directly along a building facade or wall. The width of the frontage zone may vary to accommodate a variety of activities associated with adjacent uses, such as outdoor seating or merchant displays. In all cases, the 18 inches adjacent to a building wall should be considered minimum lateral or shoulder clearance for pedestrians. It should not be included as throughway zone width.
- Sidewalk businesses or other business activities should be conducted preferably in the frontage zone or, in some cases, the furnishings zone. Private furnishings permitted in the frontage zone may include seating and tables, portable signage and merchandise displays. These furnishings may require permits from the agency that owns the right of way.
- Overhanging elements such as awnings, store signage, bay windows and so forth may occupy this zone and extend over the clear pedestrian travel way. These elements add vitality and visual interest to the street but also must comply with local building codes and zoning ordinances. Overhanging elements require a vertical clearance of at least 80 inches.
- Where the streetside passes a parking lot, a buffer, such as a hedge or a low wall, should be used to prevent parked vehicles from overhanging into the frontage zone and to maintain an attractive frontage along the streetside. Where surface parking is exposed to a thoroughfare right of way, and a buffering hedge or low wall cannot be accommodated within the private property, the frontage zone should be widened to provide space for the hedge (2 to 3 feet) or low wall (0.5 to 1 foot) with a visual screen up to 6 feet in height.

Table 8.1 Recommended Streetside Zone Dimensions

	Sidewalk Zone [1]	C-6 and C-5			C-4 w/ Predominantly Commercial Ground Floor Use			C-4 w/ Predominantly Residential Frontage			C-3 w/ Predominantly Commercial Ground Floor Use			C-3 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)	1.5 feet	17.5 foot (recommended)	9 foot (constrained)	1.5 feet 2.5 feet at diagonal parking	16 foot (recommended)	12 foot (constrained)	1.5 feet	15.5 foot (recommended)	9 foot (constrained)
	Furnishings	7 feet (trees in tree wells)			7 feet (trees in tree wells)			8 feet (landscape strip w/ trees and grasses or groundcovers)			7 feet (trees in tree wells)			8 feet (landscape strip w/ trees and grasses, or groundcovers)		
	Throughway	10 feet			8 feet			8 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			1.5 feet			0 feet along lawn and groundcover 1 foot along low walls, fences and hedges 1.5 feet along facades, tall walls and fences		
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)	1.5 feet	15.5 foot (recommended)	9 foot (constrained)	1.5 feet 2.5 feet at diagonal parking	16 foot (recommended)	12 foot (constrained)	1.5 feet	15.5 foot (recommended)	9 foot (constrained)
	Furnishings	6 feet (trees in tree wells)			6 feet (trees in tree wells)			8 feet (landscape strip w/ trees and grasses or groundcovers)			6 feet (trees in tree wells)			8 feet (landscape strip w/ trees and grasses or groundcovers)		
	Throughway	9 feet			6 feet			6 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			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)	1.5 feet	13.5 foot (recommended)	9 foot (constrained)	1.5 feet 2.5 feet at diagonal parking	15 foot (recommended)	12 foot (constrained)	1.5 feet	12.5 foot (recommended)	9 foot (constrained)
	Furnishings	6 feet (trees in tree wells)			6 feet (trees in tree wells)			6 feet (landscape strip w/ trees and grasses or groundcovers)			6 feet (trees in tree wells)			5 feet (landscape strip w/ trees and grasses or groundcovers)		
	Throughway	6 feet			6 feet			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			1.5 feet			0 feet along lawn and groundcover 1 foot along low walls, fences and hedges 1.5 feet along facades, tall walls and fences		

Notes: Recommended dimensions for the throughway zone may be wider in active commercial areas.
See Table 5.2 in Chapter 5 for discussion of minimum streetside zone widths in constrained conditions.
[1] In AASHTO's *Guide for the Planning, Design, and Operation of Pedestrian Facilities*, the furnishing zone is termed the "buffer" zone, and the frontage zone is termed the "shy distance."

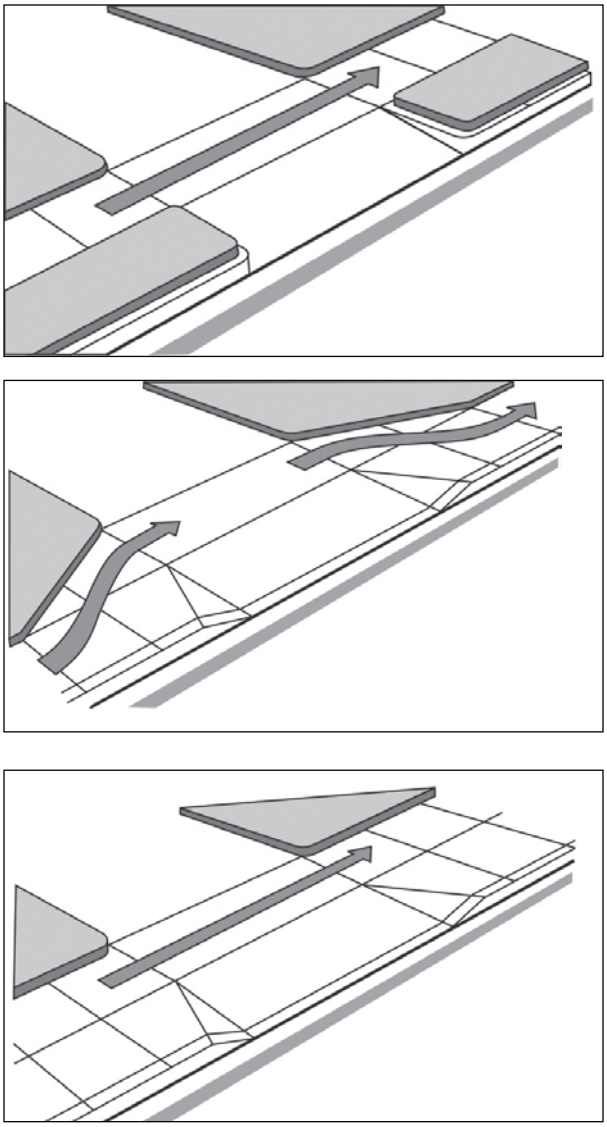

Figure 8.6 Preferred accessible designs for driveway and alley crossings. Source: based on *Designing Sidewalks and Trails for Access*. Illustration by Digital Media Productions.

Table 4.1 in Chapter 4 includes a discussion of context zones and frontage types.

Driveway Crossing Principles and Considerations

Principles and considerations concerning driveway crossings include the following:

- Appearance of the sidewalk (scoring pattern or special paving) should be maintained across driveway and alley access points to indicate that, although a vehicle may cross, the area traversed by a vehicle remains part of the pedestrian travel way.
- It is desirable to minimize, consolidate, or eliminate curb cuts and driveways in areas of highest pedestrian activity such as urban center (C-5) and urban core (C-6) commercial areas. In these areas, driveway and curb cut frequencies and spacing should be kept to a practical minimum, ideally not more than one curb cut per block.
- Consolidation of driveways is particularly important in areas with predominantly commercial ground floor uses in suburban (C-3) and general urban (C-4) context zones.
- Driveway crossings should maintain the elevation of the sidewalk.
- Driveway aprons should not extend into the clear pedestrian travel zone, where cross slopes are limited to a maximum of 2 percent; steeper driveway slopes are permitted in the furnishing and edge zones of the streetside (see **Figure 8.6**).
- Along boulevards and avenues, the elimination of driveways and conflict points may be aided by the presence of continuous medians that restrict left turns.

Recommended Practice

Table 8.1 provides an overview of recommended width for each of the streetside zones described in this chapter. The table provides the recommended width of each of the zones by context zone, thoroughfare type and under varying predominant ground floor use conditions. **Table 8.1** also provides the total width of the streetside for a constrained condition.

Additional Guidelines

Driveway Crossings

- The width of driveways for two-way traffic should not exceed 24 feet unless a specific frequent design vehicle requires a wider dimension. Some driveway volumes warrant two lanes in each direction. In these cases, consider designing a median between directions to separate opposing traffic and to provide a pedestrian refuge.

When a driveway is one way only, a maximum width of 14 feet should be considered.

- In driveway or alley crossing locations, a minimum 5-foot-wide clear pedestrian throughway must be provided. **Figure 8.6** illustrates various designs under this minimum condition. The full pedestrian throughway is maintained across the entire driveway, and the slope does not exceed 2 percent. Note that the sidewalk remains level and the driveway apron does not extend into the sidewalk.

Utilities

- Aboveground utilities should be placed at least 18 inches from the back of curb and may not interfere with the minimum pedestrian throughway. If buildings do not abut the right of way, place utilities behind the sidewalk, where they will not interfere with the use of the adjacent property.
- Placing utilities underground avoids conflicts and clutter caused by poles and overhead wires and should be coordinated with street tree planting planning efforts to avoid conflicts between the trees and below-ground utilities and aboveground utility boxes. Placing utilities underground can be costly, particularly in retrofit situations.
- The design of sidewalks, planting strips, medians and other street elements must allow for service access to underground and overhead utilities.
- Longitudinal underground utility lines should be located in a uniform alignment as close to the right-of-way line as practical or within a planting strip. In urban areas with abutting buildings, locate utilities within the parking lane or planting strip.

Refer to AASHTO's *A Guide to Accommodating Utilities Within Highway Right-of-Way* (2005) for additional information on the design and placement of utilities.

Street Furniture

Street furniture placed along a sidewalk is an amenity that encourages walking. Street furniture—such as public telephones, seating, trash receptacles and drinking fountains—provides both a functional service to pedestrians and visual detail and interest. Street furniture also conveys to other users of the thoroughfare that pedestrians are likely to be present. Guidelines include the following:

- Street furniture may be placed within curb extensions as long as it does not obstruct the clear pedestrian throughway, access to curb ramps, or sight distance at crossing locations. Bicycle parking or landscaped areas with seating walls can be accommodated in curb extensions.
- Street furniture should be placed on thoroughfares expected to have high pedestrian activity. When resources are limited, prioritize locations for the placement of street furniture. Examples of priority locations for street furniture include:
  - Transit stops;
  - Major building entries;
  - Retail and mixed-use main streets; and
  - Restaurants.
- Select the type, design and materials of street furniture to reflect the local character of the surrounding context and contribute to a sense of community identity.
- Ensure that placement of furniture does not reduce the width of the clear pedestrian throughway to less than 5 feet.

Landscaping

Landscaping is typically located in the furnishings zone of the streetside. Vegetation, especially trees, adds soft textures and bright colors to the concrete and asphalt surfaces of the thoroughfare and thereby increases comfort and distinguishes an area's identity. Landscaping also offers important ecological benefits. Trees are frequently the most visibly significant improvement, if properly selected, planted and maintained. They provide shade from the sun, intercept stormwater and buffer pedestrians from passing vehicle traffic. Guidelines include the following:

- Ground cover, grasses and shrubs might be appropriate supplements to add character along residential streets. Raised planters along mixed-use main streets can be used as seating and may increase pedestrian comfort by providing a visual buffer between pedestrians and traffic.

Figure 8.7 Street tree planted in curb extension in parking lane. Source: Kimley-Horn and Associates, Inc.

- Select plants that are adapted to the local climate and fit the character of the surrounding area.
- Consider the use of structural soils to allow for the planting of healthy street trees in narrow furnishing zones.
- Use street trees and other landscaping to complement street lighting and streetside facilities in creating a distinct character for specific streets, districts, or neighborhoods. Because lighting is an important aspect of thoroughfare safety, the practitioner needs to consider the effect of landscaping on the effectiveness of the lighting.
- If a continuous canopy of trees is desired by the community, space street trees between 15 and 30 feet on center, depending upon species, to shade the streetside, define the edge of the street and buffer the streetside from the traveled way.
- Landscape plantings in urban center (C-5) and urban core (C-6) context zones may have a formal characteristic (in a more linear and symmetrical pattern), with plantings becoming less formal in less-intensive context zones (C-3 and C-4).
- In the more urban C-5 and C-6 context zones and along thoroughfare segments with predominantly commercial ground floor uses, trees should be planted in tree wells covered by tree grates to maximize the surface area for pedestrian circulation. Tree grates or landscaped cutouts should be considered for other context zones where commercial ground floor uses predominate.
- Prune trees so that branches do not interfere with pedestrians, street lighting, parked vehicles and sight distance to crossing pedestrians, as well as any traffic control devices. The minimum vertical clearance should be 8 feet above the pedestrian travel way in the streetside and at least

Utilities and Street Trees

Both overhead and underground utilities can pose conflicts with street trees.

Mature trees' branches may interfere with overhead wires and lead to "topping" by utility providers. This practice is unattractive and can be detrimental to the tree's branching structure. To avoid this situation, consider under-grounding utility lines or select shorter trees whose branches will remain below the utility lines.

When planning for street tree planting, identify and avoid any underground utilities that could be damaged during the installation process or tree roots.

Plan to "train" newly planted trees in the first years of growth to guide branch development and vertical clearance.

To avoid damage to utilities, sidewalks and pavement, encourage deep roots with use of watering tubes that allow water to seep into the soil below the roots.

Consider "root barriers," underground barriers enclosing roots, where there is potential for root damage.

Figure 8.8 A combination of on-street parking, furnishings zone and wide pedestrian throughway provides ample buffer from moving traffic. Source: Kimley-Horn and Associates, Inc.

13 feet from the top of curb in the traveled way to provide clearance for larger vehicles.

- On commercial streets with business signs, work with a landscape architect to select the appropriate types of tree and pruning techniques that minimize interference with sign visibility.
- Maintenance issues should be discussed in advance of the preparation of a streetscape improvement plan to ensure clear understanding of pruning and maintenance requirements.
- The width of the streetside landscaped strip should be at least 5 feet (preferred width is 8 feet) to support healthy tree growth.
- Trees can be planted in curb extensions between parking bays (**Figure 8.7**). This helps reduce the visual width of the street and can be part of a design that maintains a wider pedestrian throughway, especially in constrained conditions.

Pedestrian Buffer

The buffering of the streetside from vehicle traffic in the traveled way is one of the most important factors in providing pedestrian comfort along urban thoroughfares. The effectiveness of buffers is largely dependent on width (see the section in this chapter on streetside width and functional requirements) and the contributing buffer elements, such as street furniture and landscaping, that can create a visual and sound barrier between the pedestrian and moving traffic (**Figure 8.8**). On-street parking and edge and furnishings zones combine to provide buffering from traffic. Guidelines include:

- On-street parking should provide a buffer between pedestrians on the sidewalk and moving traffic; especially in areas with ground floor commercial uses and/or where high volumes of pedestrian activity are expected. Texturing parking lanes or bays with the same material as the sidewalk can visually reduce the width of the roadway when the parking lane is empty;

- For thoroughfares without on-street parking and travel speeds of 30 mph or less, the width of the furnishings zone as a buffer for pedestrians should be at least 6 feet wide;
- If necessary to achieve an appropriately wide pedestrian buffer within the furnishings zone, consider reducing the frontage zone to its minimum or eliminating it;
- Bicycle lanes can serve as a buffer if desired streetside widths cannot be achieved or if streetside widths can only be achieved at the lower end of the ranges shown in **Table 8.1**.

Justification

Although the recommendations in this chapter are generally consistent with the guidelines contained in the AASHTO *Guide for the Planning, Design and Operation of Pedestrian Facilities* (2004b), the recommendations for buffer widths in this chapter are wider than those recommended in the AASHTO guide.

Recommendations related to street furniture and landscaping in this chapter are based on recently published best practices, specifically the Santa Clara Valley (California) Transportation Authority's *Pedestrian Technical Guidelines* (2003), which describes the principles behind the use of street furniture and landscaping to encourage pedestrian activity.

The effect of on-street parking as a pedestrian buffer is generally recognized by practitioners as one factor in creating a comfortable pedestrian environment. Some pedestrian level of service methodologies place significant weight on the presence of on-street parking as a buffer for passing traffic.

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