Accessibility for Elderly and Handicapped Pedestrians - A Manual for Cities

Research, Development, and Technology

Turner-Fairbank Highway Research Center
6300 Georgetown Pike
McLean, Virginia 22101

U.S. Department of Transportation

Federal Highway Administration

Report No.
FHWA-IP-87-8

Final Report
October 1987

FOREWORD

This user's manual provides guidance for implementing the accessibility provisions for elderly and handicapped pedestrians in the city environment. It draws upon the state of the practice of eight cities and uses nationally accepted standards.

The report describes a method for planning and programming accessible pedestrian routes in cities. It provides explanations of the details needed to execute an accessible pedestrian route.

Copies of the report are available from the National Technical Information Services, 5285 Port Royal Road, Springfield, Virginia 221612, (703) 487-4690.

R. J. Betsold
Director, Office of Implementation

NOTICE

Technical Report Documentation Page

1. Report No.	2. Government Accession No.	3. Recipient's Catalog No.
FHWA-IP-87-8	PB88 113170/AS	

4. Title and Subtitle	5. Report Date
ACCESSIBILITY FOR ELDERLY AND HANDICAPPED PEDESTRIANS - A MANUAL FOR CITIES	October 1987
	6. Performing Organization Code
	8. Performing Organization Report No
7. Author's George Earnhart and Linda Simon	
9. Performing Organization Name and Address KRW, Inc. 8996 Burke Lake Road Burke, Virginia 22015	10. Work Unit No. (TRAIS)
	11. Contract or Grant No.
	13. Type of Report and Period Covered
12. Sponsoring Agency Name and Address U.S Department of Transportation - FHWA Safety and Traffic Implementation Division McLean, Virginia 22101	14. Sponsoring Agency Code

15. Supplementary Notes

16. Abstract

Since publication in 1980 of FHWA's manual entitled, Development of Priority Accessible Networks: an Implementation Manual - Provisions for the Elderly and Handicapped Pedestrians, Federal rules and standards have been updated and revised. Cities across the country have also been building up their own body of knowledge by testing and evaluating accessibility techniques.

This manual includes two sections. Part I: Planning and Programming describes the four planning stages and provides guidance for planners and other officials to follow in developing an accessibility program. Some examples from successful city programs are included.

Part II: Design provides explanations of the details needed in executing the accessibility plans in Part I. Each design chapter provides definitions, Federal and other standards if they exist, illustrations, and an extensive part on Problems and Recommended Solutions. In this part, a checklist of commonly encountered general and specific design problems is provided, and then recommended solutions are listed by each problem.

17. Key Words	18. Distribution Statement
Accessible Route, Elderly and Handicapped, Walks and Corridors, Curb Ramps, Street Furniture	

19. Security Classif. (of this report)	20. Security Classif. (of this page)	21. No. of Pages	22. Price
Unclassified	Unclassified	210	PC A10/MF A01

Form DOT F 1700.7 (8-72) Reproduction of completed page authorized

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF FIGURES (continued)

LIST OF FIGURES (continued)

LIST OF FIGURES (continued)

INTRODUCTION

Background

Section 504 - Revisions and Interpretations

Cities and other local and State agencies have made considerable progress in elderly and handicapped pedestrian accessibility programs throughout the 1980's as they have worked to comply with updated Federal rules and standards. These efforts piggybacked on pioneering actions taken during the 1970's, particularly following the passage of landmark Federal legislation in 1973, Section 504 of the Rehabilitation Act of 1973 assuring nondiscrimination in Federal Programs for nation's handicapped population.

The regulations implementing the 1973 legislation, later scaled down in scope, mandated that State and local governments receiving Federal funds begin developing plans for ways to make sidewalks, buses, trains, and other forms of transit easier to use. Formulation of these plans required background in city planning, engineering, architecture and financial management.

The most recent revisions to Federal rules and standards on measures to aid elderly and handicapped pedestrians are the Uniform Federal Accessibility Standards (FAS) established by the General Services Administration, Department of Defense, Department of Housing and Urban Development, and U.S. Postal Service that were published in the Federal Register on August 7, 1984.

Progress of Cities

In addition to the updated and revised versions of the Federal standards developed over the past several years, cities have been building up their own body of knowledge by testing and evaluating accessibility techniques on their own streets and sidewalks.

Cities across the nation have exhibited creativity and leadership in planning and implementing pedestrian improvements for the elderly and handicapped. Three cities; Baltimore, Seattle and New Orleans; were awarded Federal Highway Administration grants in the early 1980's to develop new approaches to solving the accessibility problems of this population group.

All three cities conducted extensive planning processes, and Seattle set out on an aggressive program to implement its plan. Baltimore and New Orleans attempted projects more limited in scope because of financial and political constraints, but Seattle as of 1986 had finished a large portion of its 12 planning projects, including making key sections of the Central Business District accessible to elderly and handicapped pedestrians. A majority of the city's half dozen projects implemented to date have involved about six intersections per neighborhood and cost from about $8,000 to $17,000 for each project on the route.

Other cities of various sizes and makeup, such as San Diego and Huntington Beach in California, and Omaha, Nebraska, have also been aggressive in tackling accessibility programs. These three cities planned substantial routes for the disabled along oceanfront beaches, in shopping malls, and other locations that required community consultation, ranking and selection of routes, and commitment of public funds.

Still other cities such as Chicago, Illinois and Boulder, Colorado are in the earlier planning stages of such routes, but seem to be taking these projects seriously and are or will be applying some high-level commitment to their execution. In Chicago, for example, A Pedestrianway Plan was completed in June 1982, that pointed out the problems of the city's existing fragmentary grade-separated pedestrian network in the City's Central Business District or "Loop." The two major recommendations emerging from this plan were: (1) to link together major pedestrian-traffic generators, existing transportation facilities, and existing pedestrian segments; and (2) to provide weather-protected pedestrian walks through

downtown Chicago. The plan also identified and ranked pedestrianway system segments by a large number of factors including usage, accessibility and existing circulation problems.

How cities have actually tackled implementing their "ideal" plans for accessibility has depended in large part, of course, on the financial resources and political leanings of the local jurisdiction's officials. New Orleans and Baltimore are good examples of cities with beautiful plans but limited execution.

Smaller cities have frequently tried to completely execute their plans at key intersections, finishing every phase of their accessibility program from curb cuts and ramps to street furniture. Other cities, especially the larger, metropolitan areas, have attempted more "staged" accessibility programs, perhaps first installing curb cuts widely throughout the city because certain State or Federal sidewalk improvement funds were available.

New Areas of Focus

Local government's frequently intense involvement in accessibility programs has been enhanced by pressure from elderly and handicapped advocacy groups who have pushed for improvement and forced officials to address concerns and devise new alternatives. The use of tactile warning surfaces and audible signals, for example, has attracted so much attention that, at the Federal level, the Architectural and Transportation Barriers Compliance Board is contemplating some form of regulatory treatment within the next year or so on tactile strip installation. The growing interest in both of these treatments reflects the fact that many city officials feel that, in previous years, too much emphasis was placed on wheelchair users and their needs, while the blind members of the community were not given as much consideration.

How Accessibility Systems Are Evaluated

Research and experience in the field have indicated that programs to assist elderly and handicapped pedestrians can fail to work in one of three ways: a failure of elements, a failure of components, or system failure. Each type of failure is defined as follows:

Elements. An element can be defined as one part of the pedestrian system such as a bench, curb ramp, or stair. When an element fails, the reason for failure is usually based on design or maintenance. An example of element failure is a curb ramp that is designed and situated to help wheelchair users but poses a hazard to other elderly and handicapped pedestrians such as blind persons.

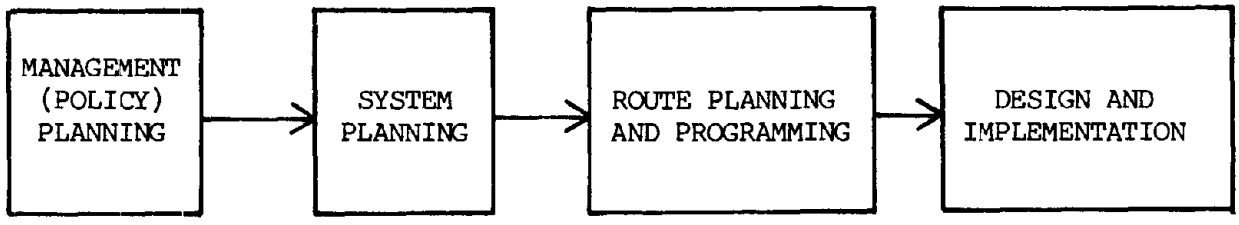
Components. A component is a collection of elements which forms one part of a system. An illustration is a street crossing which may consist of these elements: curb ramps, signals, signs, refuge island, and crosswalk. Lack of consideration for accessibility is the main reason for failure of elements making up the components. An example of failure is when a street crossing has only one of two curb ramps built, or traffic signals that do not allow for sufficient time to cross the street.

System. A system is actually an entire transportation system or a continuous route connecting origin and destination points, and system failure usually occurs because of lack of continuity.

One Way to Correct These Failures

In order to avoid potential pitfalls of trying to install improvements for the elderly and handicapped community, a systematic planning approach can be used that draws largely on the principles of effective transportation planning. Two broad types of planning are initially needed to accomplish an effective systematic planning approach: policy planning and system planning. Once these two planning processes are completed, the planners can

proceed to route planning and programming, and design and implementation, as illustrated below:



This planning process closely resembles the concept of developing a "priority accessible network" or PAN as described in earlier publications. PAN is a planning technique aimed at designing entire routes for a handicapped person so that a pedestrian trip started on one street corner will not be interrupted five blocks later because a city planner failed to see the need for curb cuts.

This manual adopts the systematic planning approach instead of PAN because experience in the field has indicated that PAN was rarely fully adopted and more frequently modified to resemble systematic planning, which allowed for greater flexibility in implementation.

In the systematic planning method, policy planning is the first step, and is conducted by top management in the city, county, or whatever type of governmental unit is appropriate. This type of policy planning is also called management planning and involves a staff effort to: review existing policies and programs, develop program goals, establish an advisory council, and recommend goals, staff resource limits, budget and schedule.

The staff recommendations are then reviewed by actual policymakers or executive management, who then adopt some version of the staff-recommended goals, planning budget, and schedule. The previously established advisory council is then asked to review or comment on the goals, and a final revision is made, if necessary, of the goals, budget, and schedule. The appropriate city or local government agency is designated to proceed with these policy decisions into plan development.

Once the management planning process establishes an acceptable set of broad directives, a system planning process takes over. Planning staff resources are first used for selecting accessible routes by gathering relevant data, identifying the desired study area, developing objectives consistent with goals, and then defining and ranking districts within the study area. Management level planning officials then review this work, the advisory council also reviews and comments, and final revisions are made.

After these system planning steps, the more detailed route planning and programming process begins with inventorying and prioritizing routes as the first steps. After a series of reviews and evaluations in terms of route feasibility based on cost, politics, and other factors, the actual routes with the highest priority are chosen and an implementation schedule is prepared for a multi-year period. At this stage, local officials must decide if they want a staged or incremental accessibility approach, or if they can manage the funds to do a comprehensive accessibility program, completing all elements at one time for each chosen route.

The next phase, design and implementation, involves preparing a detailed design for each route and designing each element. A cost estimate for construction that corresponds to the city's priorities for routes as well as financial and political limits is then prepared. The final step of this stage is implementation and is usually dependent on the current year's budget and priority for other needed city projects.

How To Use This Manual

This manual involves two sections: Part I: Planning and Programming and Part II: Design. Part I describes the four planning stages and is intended to guide a city planner through a series of planning processes to develop a comprehensive program of elderly and handicapped pedestrian improvements along carefully chosen routes that make sense. Each type of planning described in this approach is discussed in detail, with a chapter devoted to each.

Part II of the manual provides explanations of the details necessary to know in executing the accessibility plans developed with the aid of Part I. Each design chapter provides definitions, Federal and other standards if they exist, illustrations, and an extensive part on Problems and Recommended Solutions. In this part on problems and solutions, a checklist of commonly encountered general and specific design problems is provided, and then recommended solutions are listed by each problem.

PART I: PLANNING AND PROGRAMMING

CHAPTER 1: Management Planning

INTRODUCTION

This chapter outlines the basic steps in the management planning process, the first type of planning that city staff and officials will undertake in developing systematic elderly and handicapped pedestrian plans for their cities. Under each major step in this planning process, checklists of items or ideas to consider are included so planners using this manual can have a guide for their work.

What is Management Planning?

Management planning is also called policy planning and involves reviewing a government unit's existing policies and programs so that resources can be assessed, a review panel organized, and goals developed and finalized. There are four main parts to management planning: (1) initiate the planning program, (2) formulate goals, (3) establish an advisory council, and (4) adopt goals.

a. How is a Planning Program Initiated? These steps should be followed:

Checklist of Steps

- ☐ Appoint staff to develop policy.
- ☐ Identify budget.
- ☐ Set timetable for policy development.

☐ Appoint staff to develop policy.

Before any grand plans are announced or new advisory commissions formed to solve the problems for elderly and handicapped pedestrians, the most important step is to appoint the appropriate staff to work on goal and policy setting. A city must devote paid staff time to such a comprehensive project as this, or the job will never get done.

Most cities have found that initial review and policy drafting is best accomplished by trained professionals instead of relying on volunteer commission members for this detail-level work. Technical support can be found in such city agencies and departments as planning, public works, and traffic and transportation engineering. Consultants with more flexible work arrangements could also be hired.

☐ Identify budget.

In addition to naming a staff dedicated to this project, city officials need to identify and set aside a budget amount for the effort to cover staff salaries, travel, field work, materials and other expenses.

☐ Set timetable for policy development.

A timetable needs to be prepared that suggests a deadline for draft goals and objectives to be ready for review. How long it should take to draft goals and objectives will hinge on whether the city has completed any recent assessment study of elderly and handicapped needs, or if this effort must be started from scratch. With recent reports available with goals already developed, drafting modified goals could take as little as two weeks. If more research and background is needed, this step in the process could take a month or more.

b. How Are Goals Formulated? How are priorities established for achieving elderly and handicapped pedestrian improvements? These steps should be followed:

Checklist of Steps

- ☐ Review existing policies and programs.
- ☐ Develop broad general guidelines and suggested goals.
- ☐ Recommend goals, staff resources for planning effort, budget for planning effort, and timetable for planning effort.

☐ Review existing policies and programs.

Before a city even begins to consider what kind of advisory body of concerned citizens should be formed to guide staff through its planning for elderly and handicapped pedestrian improvements, the staff selected for this project needs to review all existing city documents, policies and programs to determine what has already been done and decided in this area.

Comprehensive plans, special reports of elderly and handicapped, Section 504 reports to the Federal government, city council resolutions, ordinances, Mayor's proclamations, building codes, zoning reports and any inventories of street and sidewalk conditions in the city are all useful to review for this step. Key city officials and department heads should be interviewed either in person or on the telephone to assess what their view of city practices and policies are at the present time regarding elderly and handicapped pedestrian projects.

☐ Develop broad general guidelines and suggested goals.

Once key documents are read and interviews conducted, city staff should write up some broad general guidelines and suggested goals as a starting place for management and an Advisory Council to review. In addition to these goals and objectives, related problems that have already been confronted to some degree should be noted. For example,

when the City of Baltimore developed guidelines on how to plan for elderly and handicapped pedestrian improvements, here are some of the sample goals, objectives and related problems they formulated:

Goals	Objectives	Related Problems
To provide access to downtown.	To develop routes in downtown that are accessible from start to finish.	Cannot get to City Hall from the Municipal parking lot.
To provide access to persons with any mobility handicap.	To plan improvements that are possible to allow access by persons with any known handicap.	Wheelchair ramps are hard for blind persons to detect and they end up tripping on them.
To provide continuity in pedestrian access improvements.	To link important destinations with senior citizens housing.	The new pedestrian mall is accessible, but not from the highrise for the elderly.
To invest local resources in pedestrian access.	To lay out a plan to provide access over a five year period in an amount City Hall can afford.	City Hall says they can not afford all the improvements needed.

☐ Recommend goals, staff resources, budget, and timetable.

After a "first cut" draft of goals and objectives is completed so the project staff has some general parameters established for this effort, a general memorandum needs to be prepared reiterating these goals. Then a rundown on budget, timetable, and staff resources needed should be reviewed by the city administrator, Mayor or other appropriate city person. The city person with authority to review the plans and goals for this effort needs to consider what his or her funding and time constraints are. Can existing staff be used, or will new staff need to be hired? What local funds are available in this year's budget? Is the time table realistic, and does it conflict with other city projects? Once these questions are answered, then attention can turn to establishment of an advisory council.

c. How Should the Advisory Council Be Established? Choosing an advisory council to provide policy guidance on an elderly and handicapped improvements program can be one of the most helpful steps in the process, or can be a challenging nightmare. From experience with cities across the country in finding good, qualified individuals to sit on such a panel, one suggestion is to not select a separate group of people to just oversee this one program. These factors should be considered:

Checklist of Factors

- ☐ Structure of advisory council.
- ☐ Type of advisory council.
- ☐ Membership of advisory council.
- ☐ Size of advisory council.
- ☐ Roles and responsibilities of advisory council.
- ☐ Appointments to the advisory council.

☐ Structure of advisory council.

Where Should Council Fit In City Government Structure? Some cities are naturally wary of setting up too many special interest advisory boards, but the real reason for recommending using an existing group or even establishing a sub-group is that it is frequently physically difficult for handicapped persons to attend regular meetings. Their time is also extremely limited, and there is a minimum of knowledgeable elderly or handicapped people willing to serve on such boards. In addition, making an advisory council part of an existing body helps contribute to its longevity and can be helpful in getting plans implemented.

☐ Type of advisory council.

What Kind of Council Is Most Effective? Before individuals are nominated for membership to the council, the type of council or sub-group that is desired should be considered. Alternative types include an advocacy group that is politically oriented, and a more technical group that would be able to scrutinize data collection, coordination, monitoring/evaluation and responsiveness functions. A third type of group combines the technical and

advocacy approach so that members can benefit from the technical expertise of the government agency or consultants, but also have the first-hand knowledge and dedication of the handicapped user.

☐ Membership of advisory council.

Who Should Serve On The Council? In addition to city staff, the city select individuals who are currently serving on task groups or committees dealing with similar matters. The following kinds of individuals can be selected:

- o Executive/Legislative. Representative of executive office (e.g. mayor's assistant); representative of Legislative body (e.g. city council, board of alderman).

- o Administrative. Planning director, city engineer, traffic engineer, budget director, head of redevelopment or transit authority.

- o Users. Representatives of social service agencies or of consumer groups who can represent various handicapped and elderly categories such as retarded citizens associations, handicapped leaders, blind organization, veterans groups, and so on.

Some cities just include "executive/legislative" and "user" members on their advisory councils, but no "administrative" members such as city department heads and other high-level staff. The rationale for not using administrative members on the advisory council is that the support staff already represents the administrative side of the city, and high-level administrative officials can provide input to the advisory council in other ways.

Recruiting good advisory council members from the users group has proven to be frustrating and difficult in some cities because of the overwhelming demand for such individuals' services. In terms of other types of user groups, the recruitment problem can be the opposite. Senior citizens groups, for example, tend to have abundant numbers of volunteers to offer to serve on such councils, but staff choosing advisory council members should be prepared to narrow down choices and to allow no more than two representatives per group.

Potential advisory council members should also be screened so that their level of knowledge about elderly and handicapped pedestrian improvements will help and not hinder the council's work. Members should know about pedestrian access issues, be able to cite specific problems, and be willing to discuss needs not always in their own interest.

☐ Size of advisory council.

The ideal size of an advisory body for this effort is a variable each city must decide. The body may be set up exclusively to review elderly and handicapped pedestrian issues, or an already existing panel can be used. Some cities that originally set up advisory councils that had members totalling between 10 and 15 said after the council's work was completed they would have worked more effectively and efficiently with only between six and eight members.

☐ Roles and responsibilities of advisory council.

What Are The Roles And Responsibilities Of The Council? The main role of the advisory council should be to serve both as a sounding board for ideas and to raise issues that staff may have neglected or overlooked. Based on the size and organizational structure of some cities, some advisory councils set up to review elderly and handicapped pedestrian programs might go beyond this broad, reactive policy-making role and do more "nitty-gritty" type of work such as interviews, field work, or other research and memo writing. Cities with experience in working with such citizens advisory

groups generally agree that these groups function best as purely advisory bodies with no real staff function or responsibilities.

☐ Appointments to the advisory council.

Once the size and type of advisory group is selected and potential members are screened, the chosen members need to be appointed by some official city method such as executive order or local ordinance and meetings then are scheduled on a regular basis. Some cities, to accommodate their members' already overextended schedules, set up monthly luncheon meetings.

d. How Are Goals Adopted? Once staff members and an advisory council can sift out priorities and develop some reasonable goals with consensus approval, how are goals actually adopted? Three steps need to be followed:

Checklist of Steps

- ☐ Develop work tasks.
- ☐ Establish timetable for program development.
- ☐ Designate responsibility for program development.
- ☐ Establish planning budget.

☐ Develop work tasks.

As soon as a set of goals is agreed upon and approved by the advisory council, work must begin immediately so that the goals are translated into work tasks. Work tasks might include establishing basic parameters for the project such as to what extent should the private sector be involved in terms of financing improvements. Another key consideration is assessing what place pedestrian issues have in city planning, i.e. are these advocacy groups a force to be reckoned with?

Another work task is preparing an inventory of all improvements, if any, already progressing that are designed for pedestrian assistance. For example, Baltimore's building code calls for all new construction to have curb cuts, so this effort was already launched before a concentrated elderly

and handicapped program was in place.

A useful work task would be to check with libraries or national organizations to determine how other cities tackled such improvement programs.

☐ Establish planning budget.

A planning budget; which has been put together before, in draft form, with broadly defined parameters; now can be finalized and laid out in more detail. Items to consider in this budget are staff salaries, overhead, materials and travel funds for field work, and special assistance such as a signing person for any deaf members on the Advisory Council. In addition, the cost of reproducing materials for the Advisory Council should be included as well as other council expenses such as mileage or lunches.

☐ Establish a timetable for program development.

A specific timetable for program development needs to be prepared so that the planning budget funds are spent in a timely and careful way and the appropriate city agency should be selected to begin program development. The next phase of this effort, system planning, requires that effort be spent in these areas: gathering data, identifying the study area, defining the districts, developing objectives, and ranking districts. Planning staff manpower and resources must be assigned to each of these areas.

☐ Designate responsibility for program development.

Many cities have put this function in their city planning department, although others do use such agencies as public works or transportation. For the broader tasks of gathering data and defining and ranking districts, it seems to work best to assign these functions to the planning department. Once detailed design is required, the engineering department is usually the most appropriate agency. The final implementation step is then handled by the city construction and maintenance department.

CHAPTER 2: System Planning

INTRODUCTION

This chapter deals with the process of selecting priority districts in which routes will be designated to be made accessible to elderly and handicapped pedestrians. This screening process is called system planning and is outlined in detail in this chapter, with checklists of steps and substeps provided to guide planners using this manual.

What Is System Planning?

Within the parameters of planning for this program, system planning involves first assessing and gathering relevant data and identifying the desired study area. Also included is development of objectives consistent with goals prepared in chapter 1 and then ranking districts by the order in which improvements should be completed. Management-level planning officials then review this work, the advisory council selected earlier also does review and comment, and final review and revisions are then made. The main parts to system planning are: (1) prepare to select study districts, (2) review district selection work, (3) select routes in priority districts, and (4) finalize route selection.

a. How are study districts selected? These steps, all to be completed by the planning staff, should be followed:

Checklist of Steps

- ☐ Gather data.
- ☐ Identify study area.
- ☐ Define study districts.
- ☐ Develop objectives consistent with goals.
- ☐ Rank districts.

☐ Gather data.

Finding ways to quantitatively describe land areas in a locality and to measure activity by elderly and handicapped pedestrians are the primary challenges to gathering data for this project. Initiating new, expensive origin destination studies is one way to proceed, but most cities with experience in this field have preferred using data already on hand. Some cities have also opted for the intuitive method of making informed "planning hunches." Some large cities with numerous, sprawling city neighborhoods limit data collection to what is available at their particular city's planning unit level. One potential hindrance to much of this information gathering is that agencies in some cities find great difficulty in getting other public agencies to release data.

Availability of data may also determine which study units are feasible to analyze. A useful guide is to select districts already established for some other purpose and then to determine what data is available for each of these districts. Some cities recommend making up a chart describing planning units in the community and including their number, whether their boundaries overlap and if detailed population information is available. Factors such as average size (in population and land area) and whether the districts are similar in size can also be added. Table 1 is a sample of the chart Baltimore devised:

Table 1. Potential study districts in Baltimore.
(a sample listing)

Planning Units in Baltimore	#	Do Their Boundaries Ever Overlap?	Is Detailed Population Data Available
Council districts	6	No	Yes
City school districts	4	No	No
Neighborhoods	over 500	Yes	Varies
Census tracts	215	No	Yes
Regional Planning Districts (RPD's)	26	No	Yes

Besides considering whether boundaries overlap, it should also be noted if potential study districts have stable boundaries. For example, school districts sometimes change their boundaries, as do Congressional districts, to compensate for shifts in population.

In Baltimore, regional planning districts were chosen for the study districts because of their convenient size and number, the readily available data, and fairly stable boundaries that do not overlap. Census data was gathered and published for these units as was other data on employment, land use and future population size. New Orleans, in trying to develop study districts, determined that the best data available came from the city's own recent land use plan, 1980 census and summary data from the Regional Planning Commission.

In broad terms, the kind of information that is useful in selecting study districts is found in these categories:

1. Residential population distribution of elderly and handicapped individuals in the locality.

2. Land use data showing concentrations of trip destinations in areas devoted to such purposes as shopping, office, service-institutional, recreational and mixed use.

3. Location of special facilities for elderly and handicapped individuals.

4. Travel or trip-making patterns and preferences, including trip purposes, number of trips per day and transportation modal choice.

City land use plans, census information and Regional Planning Commission reports and studies are the obvious sources for much of this data. The following are these sources and others grouped under each data category:

- Residential population distribution of the elderly and handicapped.

  Sources of data:

  - Census data.
  - Land use plans.
  - Service agencies.

- Data on location of special facilities.

  Sources of data:

  - Classified telephone directories (yellow pages).
  - Inventory of medical and social service agencies.
  - City directories.

- Data on travel preferences of the elderly and handicapped.

  Sources of data:

  - Survey of field interviews previously done.
  - A new survey that could be initiated but is not considered that crucial.
  - Some census data that might be helpful.

In general, cities determined that the amount of information collected to determine the study districts should be minimal since picking the study routes is the step requiring more hard data.

☐ Identifying the study area.

Once all these sources of data are scrutinized in terms of availability, accessibility, and usefulness, a decision must be made on what to identify as the study area. Any study area chosen should take into account the diverse units into which a town or city is divided. It is a good policy to have a study area that contains the different environments an elderly or handicapped person faces in the community, such as a study district with a central business strip and a study district that is purely residential. The study area should be defined so that it can be easily divided into districts for more detailed analysis.

☐ Define the study district.

Study districts can be defined as planning units or whatever else is appropriate for each city. In addition to having a workable structure for the study district, it makes sense to choose a set of districts that have widely varying characteristics, an approach many cities have followed. Baltimore's efforts to promote diversity are notable because an especially thoughtful plan was used. The three types of districts Baltimore adopted, which serve as excellent models, include the following:

- A downtown area, with a central business district and special attractions, an area that attracts many handicapped visitors as pedestrians and contains housing for the elderly or handicapped.
- A densely developed residential district with a neighborhood commercial area. (This area would have a good share of elderly or handicapped residents and visitors from outside the district).
- A less densely settled 'outer city' area with a local retail area, also having a relatively high number of handicapped residents as pedestrians and points that attract handicapped pedestrians as visitors.

After Baltimore's 26 regional planning districts were divided into these three types of districts, they were compared with those districts that had been reviewed earlier and that ranked high in numbers of mobility handicapped residents in the district. After that screening, districts were evaluated in terms of income level, racial groups served and location so that, for example, not just the affluent areas were being considered.

Finally, such factors as fairness and political expediency were also included so that the entire selection process held some air of reality. A city such as Seattle, for example, used the political and intuitive approach as the main factor in choosing the central business district as one "no-compromise" district to use in the project. One alternative approach has suggested using such factors as service, density, demand, and availability as the main guides for defining districts for this project. But correctly weighing all those factors has been found difficult to accomplish, so cities for the most part have adopted their own unique ways to pick the districts they want to work with.

☐ Develop objectives consistent with goals.

Once the study districts for this project have been defined, objectives must be developed consistent with the goals that were developed earlier. Objectives should be written keeping in mind the type of districts that will be candidates for priority routes. In this vein, objectives can be drawn up using specific examples that pertain to particular districts. An example of objectives developed from broad goals set forth in Seattle are shown in figure 1.

GOAL:	NORMALIZE THE MOBILITY OF ELDERLY AND DISABLED PERSONS AND ASSIMILATE THE UNIQUE NEEDS OF THESE CITIZENS WITHOUT SINGLING THEM OUT FOR SPECIAL TREATMENT.
Objective:	Install curb ramps and pedestrian walkways city wide, on a prioritized basis, to promote the mobility and interaction of elderly and handicapped people in society.
Objective:	Facilitate pedestrian-transit service interface by constructing pedestrian walkways, curb ramps, bus pullout, and bus landing pad surfaces to encourage trip-making of all kinds and distances.
GOAL:	CREATE, TO THE MOST PRACTICAL DEGREE, A CONSISTENT AND PREDICTABLE PEDESTRIAN ENVIRONMENT.
Objective:	Use standard plans for designing, locating, constructing and inspecting pedestrian improvements such as curb ramps, walkways, curb cuts, utility poles, and signs.
Objective:	Practice barrier-free oriented engineering judgement when planning, designing, and constructing pedestrian improvements, particularly when atypical conditions exist in the field.
GOAL:	APPLY THE PROVISION OF ACCESSIBILITY PLANNING IN SEATTLE TO SYSTEMATICALLY IDENTIFY, PRIORITIZE, AND CONSTRUCT PEDESTRIAN IMPROVEMENTS.
Objective:	Designate city districts and identify clusters of housing, business, and recreation land use and the related pedestrian routes serving elderly and handicapped people.
Objective:	Investigate pedestrian improvements along designated priority routes and incorporate the identified needs into existing city improvement programs.

Figure 1. Elderly and handicapped access goals and objectives.

☐ Rank the districts.

Once a specific number of study districts have been chosen, the next step is to decide which district should have elderly and handicapped improvements done first, then second, and so on. This ranking activity is conducted by planning staff, who should develop criteria for ranking. A wide range of criteria can be used for this task including such factors as level of activity within district, activity density, transportation service, demand, and availability.

Cities that have tried out these various kinds of criteria mostly reject the idea of having all relevant criteria counted as factors because the process becomes too unwieldy. Cities such as Seattle have opted instead for using limited factors and have tried to do one district a year. New Orleans, on the other hand, made transit interface a priority in selecting its districts, and ranked routes along the transit lines where buses had wheelchair lifts (about 20 percent of the bus system routes). As stated before, Baltimore followed this approach:

- Census data were used to rank districts by the number of residents who are elderly or handicapped as pedestrians.
- Three kinds of communities (downtown, dense residential, sparse residential) that handicapped pedestrians confront were identified from among the districts highly ranked in population characteristics.
- Considerations of geographic distribution, racial, or ethnic groups to be served and income level were added to the final choice of three Regional Planning Districts as study districts.

b. How is this district selection work reviewed? The work conducted to date should be reviewed by the following:

Checklist of Reviewers

☐ Planning management staff.

☐ Advisory council.

☐ Review by the planning management staff.

Planning staff should review the districts selected and the objectives set to determine if they are consistent with the goals adopted by management. In addition, a review of the priority district selection should be conducted to insure that all social and political concerns have been addressed. Following this review, changes should be made as directed by management.

☐ Review by the advisory council.

After planning management scrutinizes this critical information, then it is the Advisory Council's turn to look at the objectives developed and at the final selection of priority districts. It is important to not involve the advisory council any earlier in the process or needless time might be wasted by council members.

Finally, after these review processes by planning management staff and the Advisory Council are completed, a final revision should be made by planning management staff to incorporate worthwhile suggestions.

c. How are accessible routes located in priority districts? Ideally, these three steps would be conducted by the planning staff in an effort to locate accessible routes in planning districts:

Checklist of Steps

- ☐ Identify the boundaries of the priority districts.
- ☐ Rank points of arrival and destinations in the district by volume.
- ☐ Identify routes.

In reality, these three steps are usually greatly modified by cities to save time and money.

☐ Identify the boundaries of the priority districts.

One ideal way to define boundaries of districts is to: (1) identify the locations of entry points to popular activity centers in the district; (2) identify the locations of arrival points such as bus terminals and parking lots; and (3) identify the zones of movement around the arrival points for the various handicapped groups.

Cities with background in planning accessible routes usually choose quicker methods to plot these points and draw boundaries. New Orleans picked the ten transit routes in the city accessible to wheelchair users, selected major origin and destination points that had been identified previously, and placed all the information on a large map for analysis. San Diego focused on heavily travelled commercial routes and looked at bus transfer points and social service agencies.

In Baltimore, volumes of pedestrian traffic for each point were not used because this information in Baltimore is rarely available for specific locations, a problem other cities encountered. It was noted that in Baltimore even providers of services targeted to the elderly and handicapped do not monitor the numbers of daily visitors. Instead, Baltimore used the inventory approach adding the following to the traditionally mentioned origins and destinations: on-street metered or reserved parking spaces; multipurpose designations; cultural facilities, special pedestrian facilities such as plazas and malls, and other special facilities for the elderly or handicapped.

☐ Rank points of origins and destinations in the district by volume.

Ranking points of origins and destinations by volume to see where activity is concentrated is an approach used by cities if the data is readily available, which is frequently not the case. Traditional examples of points of origins for which to determine volumes include housing, parking garages and lots, transit terminals, transit stops, drop off zones and special facilities for the handicapped. Typical destinations or activities

within the district that could be ranked if data is available include work destinations for which number of employees and number of handicapped employees would be useful. Other typical destination points to review include retail and service establishments, as well as institutional points including schools, churches, and government buildings.

☐ Identify routes.

Once points are plotted on a map or other device; whether they be measured by volume or simply inventoried as a critical origin or destination point; routes can be identified by looking for concentrations of origin and destination points, and dropping isolated points of destination, unless they represent facilities of special importance to the handicapped. Figure 2 shows how origin and destination points are plotted. Figure 3 shows how these points are connected with routes.

d. How are routes finalized? Once routes are preliminarily plotted and identified as shown in the previous example(s), the advisory council's role is to review and comment on these routes, keeping in mind such factors as needs of the elderly and handicapped and restraints in terms of time and budget. After advisory council input, planning staff will make any necessary revisions.

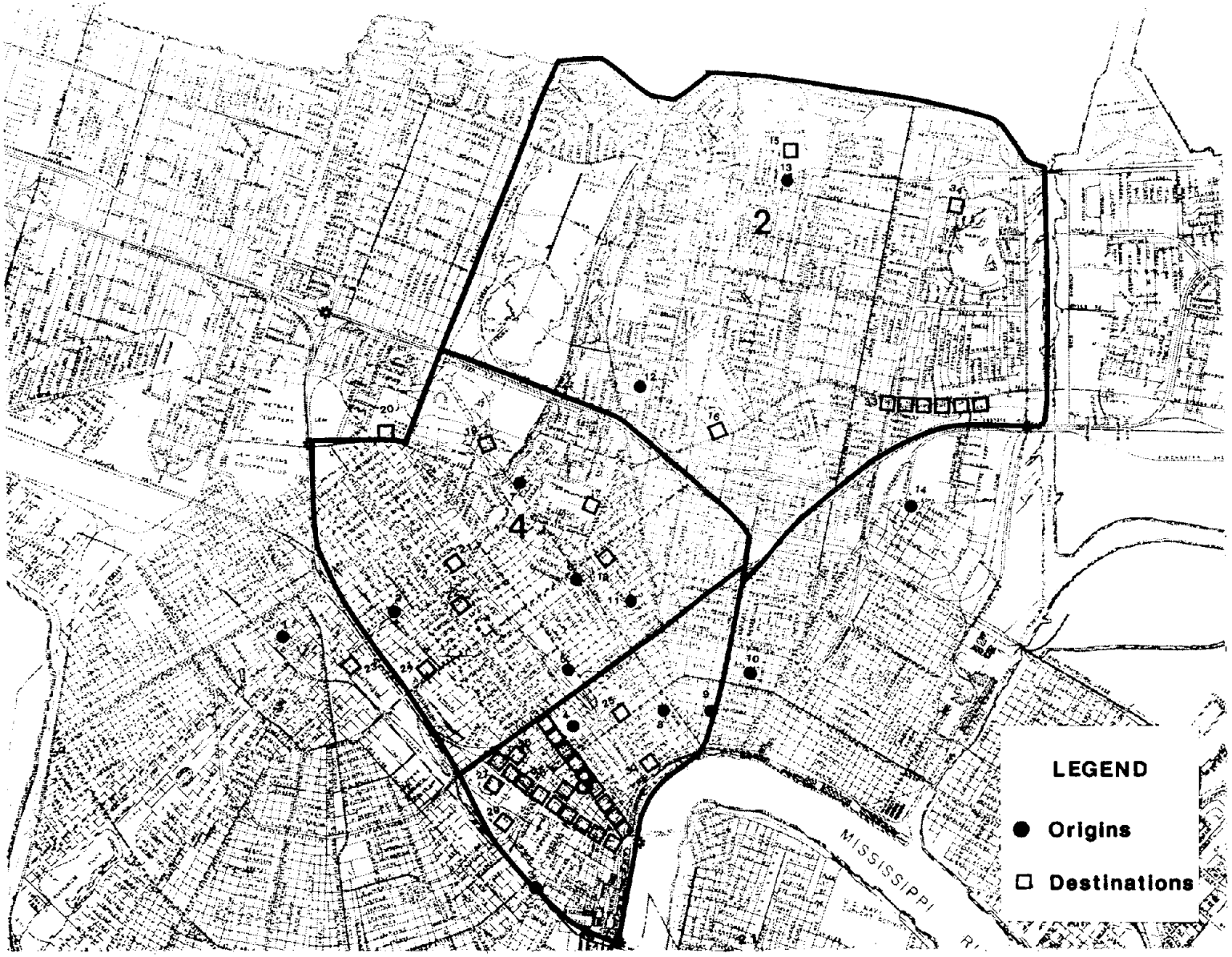


Figure 2. Origin and destination points.

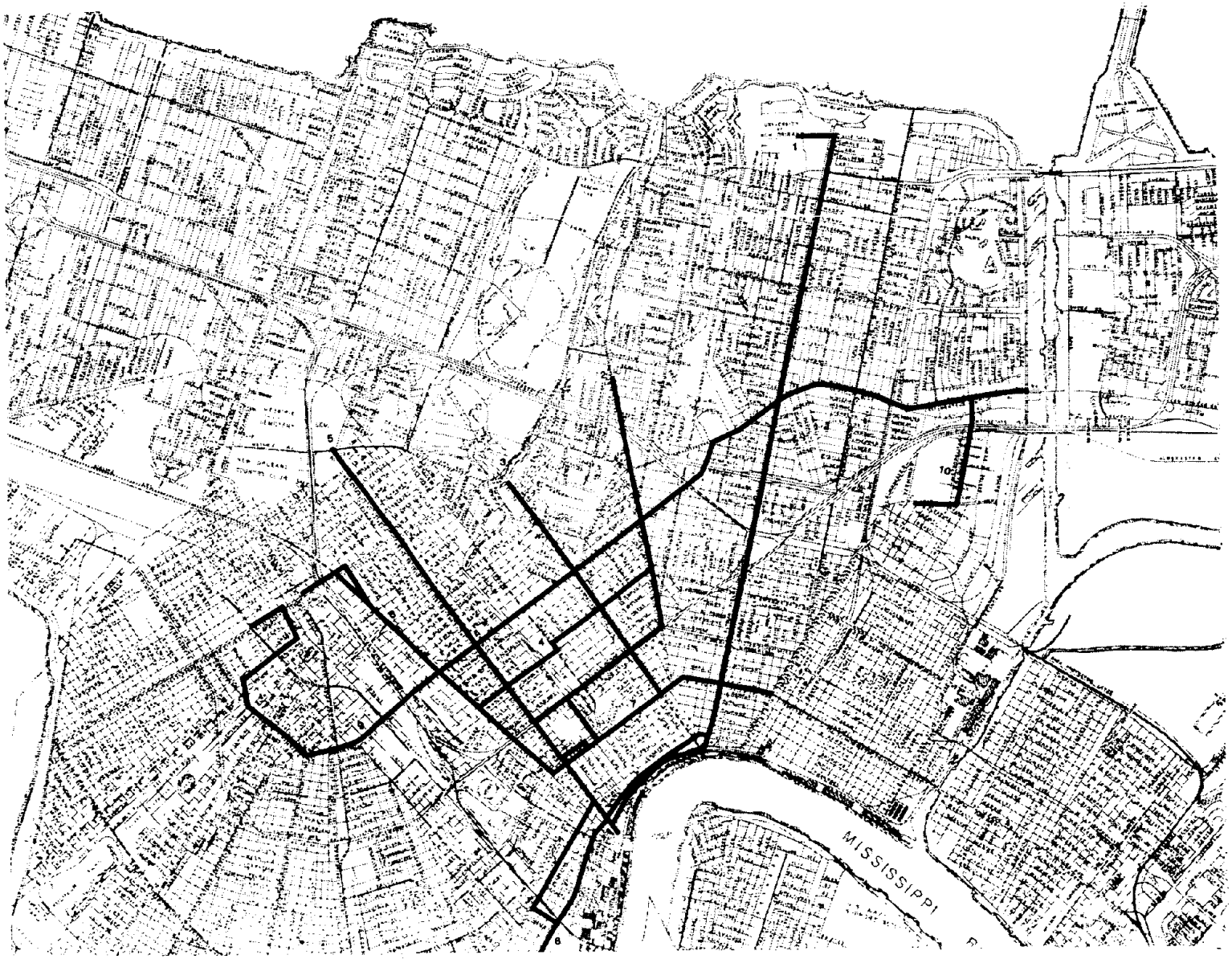


Figure 3. Route identification

CHAPTER 3: Route Planning and Programming

INTRODUCTION

This chapter describes what happens after accessible routes have been located within priority districts in terms of how they are inventoried, prioritized, and plugged into a city's annual development budget. Under each step in this planning process, checklists of items or ideas to consider are included so planners using this manual can have a guide for their work.

What Is Route Planning And Programming?

Route planning and programming is the process of taking a number of accessible routes that have been designated within priority districts, listing them, and ranking them according to the route plans that should be implemented first based on a variety of factors. Route planning and programming also frequently involves the most critical aspect of such planning; cost estimating weighed against existing financial resources; and attempts to develop creative plans to meet existing needs within cost constraints. A review of final cost and schedule estimates is also part of the process to make sure these factors are consistent with goals developed earlier. Following are the seven main parts to route planning and programming: (1) inventory and prioritize routes; (2) analyze and rank route components; (3) develop conceptual cost estimates for design and construction; (4) prepare multi-year development program; (5) review program cost and schedule for consistency with original goals; (6) review and comment; and (7) adopt program, assign responsibility for design and construction, and identify budget.

a. **How are routes inventoried and prioritized?** These steps should be followed by the planning staff:

Checklist of Steps

- ☐ Inventory routes.
- ☐ Assemble data for route prioritization.
- ☐ Prioritize routes.

☐ Inventory routes.

Inventorying routes includes providing a detailed map and a listing of major barriers present to the elderly and handicapped as well as all relevant data available for each route. Some cities such as New Orleans developed a worksheet based on maps. The worksheet was used to verify the conditions along the route in the field as planners guided a wheelchair along each route. In Baltimore, planners took small tape recorders to the field and made notes about the routes as they walked. The inventory process will identify major and minor barriers along each route.

Once this list of routes, or inventory, is prepared, then the prioritization process can begin since few cities rarely tackle all the projects that need attention in their jurisdictions.

☐ Assemble data for route prioritization.

Some of the information required to prioritize routes is: (1) determine concentrations of origin and destination points; (2) note key points such as those near accessible transportation or unique origin points (such as the only subway stop in a neighborhood); (3) consider community-wide attractions for elderly or handicapped persons such as a rehabilitation center or a university; and (4) factor in such issues as distribution of routes in terms of geography, race, or income groups served. This "user" data should be assembled for each route. This "user" data can then be analyzed along with the physical inventory data collected on each route.

☐ Prioritize routes.

One common sense approach to prioritizing or ranking the routes includes looking at destinations served by the route and the volume of traffic between origin and destinations assessing the needs of special groups using the route and investigating the accessibility of destinations by special groups.

In practice, cities have used modified versions of this approach to suit their locality's special needs. Some cities put their emphasis on weighing all the information they can accumulate on arrival and destination points. Others, such as New Orleans, actually used a numerical ranking system to rank its routes following these three criteria: activity within district, activity density, and transportation demand and access. In a smaller city such as Omaha, the need for such elaborate ranking seemed unnecessary because, as one city planner explained, "there just tends to be some natural connections."

Baltimore also made sure to note unique origin points, such as the only subway stop in a neighborhood, and considered community-wide attractions for elderly or handicapped persons such as a rehabilitation center or a university. Also factored in were such issues as distribution of routes in terms of geography, race, or income groups served.

In Seattle, top priority routes were recommended by their Advisory Council. All those approved, according to Seattle planning officials, also showed high concentrations of population and land use related to elderly and handicapped pedestrian trip demand. Those not ranked in the top 12 by the Advisory Council tended to be high in capital cost or had a more distant relationship to transit access.

The actual ranking or prioritizing of these routes can be accomplished using the process of elimination and coming up with a desired number of routes, or using a numerical ranking system such as that used by New Orleans. New Orleans assigned values and weights to each route, in much the same way it had earlier ranked accessible districts.

b. **How are route components analyzed and ranked?** Planning staff should follow these two major steps:

Checklist of Steps

- ☐ Analyze route components.
- ☐ Rank order needed improvements.

☐ Analyze route components.

Analyzing route components first to see what improvements need to be costed out for a realistic estimate will vary with city management style. This step is extremely critical however, because of the need to determine what changes might have to be made to each proposed route. Indeed, in some cases, proposed changes might be so expensive or extensive so as to require a change in the final ranking of routes.

Some of the problems that might be found analyzing these components include:

- o No provision of an element, such as a handrail at a flight of stairs.
- o No provision for access by an elderly or handicapped pedestrian, as in a curb at a corner with no ramp.
- o Improper design, installation, maintenance, or regulation as in a pedestrian bridge with steps at one end, curb ramps with a lip at the street surface, sidewalks with chipped pavement, parked cars that block a crosswalk, or no aisle next to handicapped-reserved parking space.
- o Elements not properly located with respect to one another in a component, where a street sign was mounted in a curb ramp at a corner.
- o Accessible elements missing from a component, as in a street intersection with only one curb ramped.
- o Accessible components not joined, such as a pedestrian bridge with no elevators or ramps to get down to the sidewalk.

To analyze route components the physical inventory sheets should be reviewed in detail and a conceptual design developed so that the planner can determine the extent of the components required to make the route accessible.

A conceptual design can simply be a listing of the number of curb ramps, crosswalks, traffic signal modifications, and sidewalk repair required along the specific route. If a major intersection is encountered that appears to require refuge islands or a pedestrian bridge, special note should be taken.

In Baltimore a worksheet was used to document observations made in the field. A copy of the worksheet is figure 4.

☐ Rank order needed improvements.

These improvements need to be ranked so that if an incremental construction strategy is chosen, an order of priority has been established. An incremental construction strategy refers to building improvements piecemeal or in stages, i.e. just installing curb ramps and later adding crosswalks. Some of the factors to consider in determining these rankings include:

- Degree of access lost by the presence of the barrier to be removed: (1) complete loss of access, (2) creates difficulty or danger, or (3) inconveniences the elderly or handicapped pedestrian.
- Who is affected by a barrier (among the main groups in the population of elderly or handicapped pedestrians) and where non-handicapped pedestrians are severely affected.
- The cost of making the access improvement and the availability of resources to do so (high, moderate, low, or none).
- The ease of making the needed improvement (in steps from already planned or funded to impossible or without local precedent).

In addition to this generalized ranking, Baltimore developed another quantitative way to more effectively weigh the countermeasures needed to overcome access problems through a vehicle called a "prioritization model." The prioritization model considers these two factors: the severity of a problem posed by a given barrier to pedestrian movement, wherever it might be found; and characteristics of the route where a countermeasure is needed.

The model places numerical weights on the removal of an access problem, according to: the degree of barrier posed, the group(s) of handicapped pedestrians affected by the barriers; and type of countermeasure outlined in the design details--weighted slightly for problems that greatly affect non-handicapped pedestrians.

Observation Sheet For The Intersection Of_____
Date and Time_____

DIRECTIONS

A. List the pedestrian observed by handicap:

1. elderly person
2. children a. with adult(s)
   b. without adult(s)
3. wheelchair user
   a. with attendant
   b. without attendant
4. person walking with aid
5. person with leg/foot handicap w/o aid to movement
6. blind/vision-impaired person
7. deaf/hearing-impaired person
8. confused/disoriented
   a. drunk
   b. other (psych) problems
9. mentally retarded
10. non-handicapped person with burden affecting ped. movement: packages, stroller, etc.

B. Note how the observed person approached the intersection, from what direction, where dropped off by car or bus, or leaving what building.

C. Record the use made of the intersection and the following block face (1/2 block).

- o adjacent sidewalk (1/2 block to and from, or point of entry to departure if less)
- o traffic/pedestrian signals (used or not; problems using)
- o curbs/curb cuts or ramps (which used; problems in use; avoidance)
- o crosswalk (used or avoided)
- o other street furniture (benches; paper boxes or other items walked around or in the way-including cars parked or stopped through a crosswalk, curb-cut-ramp)

Pedestrian Observed	Approach to the Intersection	Use of the Intersection

Figure 4. Observation sheet.

c. **How are conceptual cost estimates for design and construction developed?** Once the major route components have been analyzed and ranked by planning staff, conceptual cost estimates for design and construction of the routes can be developed either by planning or engineering staff. In some cities, the planning department handles these financial estimating details; in other cities, it is the public works or engineering departments that are best equipped to perform this task. Planning staff should follow these four steps:

Checklist of Steps

- ☐ Develop unit costs for standard elements.
- ☐ Specify major improvements.
- ☐ Develop costs for each major improvement.
- ☐ Develop total costs for each route.

☐ Develop unit costs for standard elements.

Unit costs for standard elements such as a curb ramp, crosswalk, signs, and traffic signal and sign modifications can be obtained from the bid documents of prior pedestrian projects, or a current edition of "Building Construction Cost Data" published by Robert Snow Means Company, Inc., P. O. Box G, Duxbury, MA 02332. The date of the previous project should be noted and the price escalated to reflect current year dollars.

☐ Specify major improvements.

Major improvements to be constructed such as refuge islands, new traffic signal installations, pedestrian ramps, or bridges must be specified along each route. A sketch of each major improvement should be completed and field checked to insure that there is not another less costly solution.

☐ Develop costs for each major improvement.

Conceptual cost estimates for major improvements can be developed by using unit costs from similar projects which have been completed. For example, a traffic signal installation contract for a similar intersection

should provide a reasonable cost estimate.

☐ Develop total costs for each route.

The total cost of each route is arrived at by adding the costs of the standard elements and the costs of the major improvements. Since this is a conceptual estimate, a contingency factor of 20 percent to 30 percent should be applied. In addition to the contingency factor, a 5 percent to 10 percent factor should be added to cover construction management costs. The cost of detailed design can be arrived at by multiplying the total construction cost with the contingency by 5 percent to 10 percent. An example of a route cost estimate for design and construction is figure 5.

d. **How is a multiyear development program prepared?** Planning staff should follow these four major steps:

Checklist of Steps

- ☐ Consider extent of financial resources.
- ☐ Decide on total or "staged" approach.
- ☐ Determine time period for duration of project, including political considerations.
- ☐ Prepare general design and construction program.

☐ Consider extent of financial resources.

One way to consider the extent of financial resources available for implementing plans for accessible routes includes three funding options. Those three options include: (1) redesigning present programs using existing revenues, (2) reallocating among existing programs using existing revenues, and (3) adding new programs or program elements using new revenues.

A first step in considering financial resources is taking an exhaustive look at available funding sources at State, local, Federal, and even private levels. Federal funding for such projects has shrunken in the last five years, but States have managed to keep sidewalk improvement funds or street maintenance monies in their budgets in many cases. California, for example,

COST ESTIMATE BREAKDOWN SHEET

ROUTE : Seminary Road - Greenwood to Trinity **DATE :** 02/06/87

ELEMENT DESCRIPTION	UNIT	QUANTITY	UNIT COST	AMOUNT
Crosswalk lines (6 inch wide)	LF	1200	$ 0.50	$ 600.00
Conc. sidewalk 4" thick (includes curb ramps)	SF	500	$ 2.50	$ 1,250.00
Signs 12 inch x 18 inch on steel post	EA	20	$ 50.00	$ 1,000.00
Traffic signal (mid block pedestrian)	EA	1	$16,700.00	$16,700.00
Park bench with back 8 feet long	EA	10	$ 485.00	$ 4,850.00
Street trees (3 inch caliper)	EA	10	$ 525.00	$ 5,250.00
Subtotal				$29,650.00
Contingency 25%				7,400.00
Subtotal				$37,050.00
Management 10%				3,700.00
Total Construction Est.				$40,750.00
Design (10% x Construction Estimate)				$ 4,000.00

Figure 5. Cost estimate breakdown sheet.

has a portion of all State gas-tax revenue earmarked for pedestrian facilities, and a city such as Seattle sets aside a specific pot of funds each year in the city budget for pedestrian walkways and curb ramps.

☐ Decide on total or "staged" approach.

Once the level of available financial resources is established, a city must then make the critical decision of how to proceed with implementing improvements to the routes it has ranked the highest. Is it better to finish all the plans for one complete route, or is it more effective to take a staged approach and, for example, just install curb ramps on all designated routes?

Smaller cities have more frequently opted for the total approach because the scale of their projects is never that grand or elaborate. In most big cities, however, a staged approach seems to make more sense, especially in cases of limited funds which can only be used for specific parts of the improvement plans, such as walkways or ramps.

☐ Determine time period for duration of the project, including political considerations.

Figuring out a reasonable timetable for completing improvements to be part of the plan is another key step. Does the time period completely fall within the tenure of a particular mayor or governor, or does it extend beyond their tenure so that political support may be jeopardized? Sometimes these political considerations weigh more importantly than financial or social needs.

☐ Prepare general design and construction program.

When the financial resources have been investigated, a total or staged approach selected, and a time period agreed upon, planners are ready to prepare a multiyear development plan outlining the physical, financial organization and time constraints of the projects.

e. **How should the program cost and schedule be reviewed for consistency with original goal?**

The multiyear development plan should be compared with the original goals finalized by the Advisory Committee and with the city's current comprehensive plan to ensure that these planned improvements fit into the city's overall goals. This step should be initially performed by the planning department staff, and then reviewed later by planning management officials. Specific guidance should be provided in terms of financial resources found, budget, and schedule.

f. **What revisions and comments are necessary?**

Once planning management officials have reviewed the planning staff's work, the staff should make any revisions if necessary and then turn this product over to the Advisory Council for review and comment. Again, it is important to note that the Advisory Council should not become involved any sooner in this process so as to not waste the limited time of Advisory Council members.

g. **How is the program adopted?**

Once the Advisory Council reviews the multiyear development plan, then the plan is submitted to the Mayor and City Council (or other appropriate bodies) for implementation. The appropriate city agency should be assigned responsibility for final design and construction, and a specific budget amount identified. The project is now ready to proceed to the design and implementation stage.

CHAPTER 4: Design and Implementation

INTRODUCTION

This chapter is supported by Part II, Design Details of this manual which goes into detail on hundreds of specific design problems encountered in providing access to elderly and handicapped pedestrians.

What Is Design And Implementation?

Design and implementation is the process by which the planned improvements can proceed to the construction stage. The products emerging from the route planning and programming stage are screened and analyzed so detailed plans can emerge from the general ones prepared before.

The main points to the design and implementation stage are: (1) prepare detailed design for each route by designing each element on the route, (2) prepare cost estimates for construction consistent with adopted schedule, (3) review and comment, and (4) implement projects.

Preparation of detailed designs for each route and their elements is the beginning of the final stage in the four-part planning process for executing accessibility improvements. Examples of the relevant standards and necessary detailed illustrations are provided in Part II of this manual.

Part II of this manual contains a chapter on each of the following elements:

- Walkways and Sidewalks.
- Curb Ramps.
- Crosswalks.
- Refuge Islands.
- Parking Spaces, Passenger Loading Zones, and Bus Stops.
- Ramps.
- Steps and Stairs.
- Handrails and Railings.
- Street Furniture.
- Signage.
- Lighting and Illumination.
- Traffic Signals.
- Tactile Surface Treatments.

Each element is defined and design standards, if available, are presented. Design standards were obtained from the following documents: Uniform Federal Accessibility Standards; Policy on Geometric Design of Highways and Streets, 1984; Manual on Uniform Traffic Control Devices for Streets and Highways; Traffic Control Devices Handbook; and American National Standards Institute Standards.

Once design standards are presented a series of problems with recommended or possible solutions are addressed which are intended to assist the designer in preparing a design package for an accessible route.

After elements and routes are designed in detail, then more specific cost estimates are prepared for construction that reflect the multiyear development program prepared earlier. These designs and cost estimates are reviewed by the Advisory Council, revised, if necessary, by the design staff, and then implemented.

PART II: DESIGN DETAILS

CHAPTER 5: Walkways and Sidewalks

1. Scope

This chapter addresses walkways and sidewalks as an element and shows how the walkways and sidewalks should be designed to relate properly with other connecting elements like curb ramps and ramps.

2. Definitions

Walkway or walk: An exterior accessible route or part of an accessible route with a prepared surface intended for pedestrian use, including general pedestrian areas such as plazas and courts.

Sidewalk: A walk within a street right-of-way.

3. Standards

a. Width

The minimum clear width of an accessible route shall be 36 in (915mm) for a single wheelchair and 60 in (1525mm) for two wheelchairs. The minimum clear distance at a point shall be 32 in (815mm) (figure 6). If a person in a wheelchair must make a turn around an obstruction, the minimum clear width of the accessible route shall be as shown in figure 7.

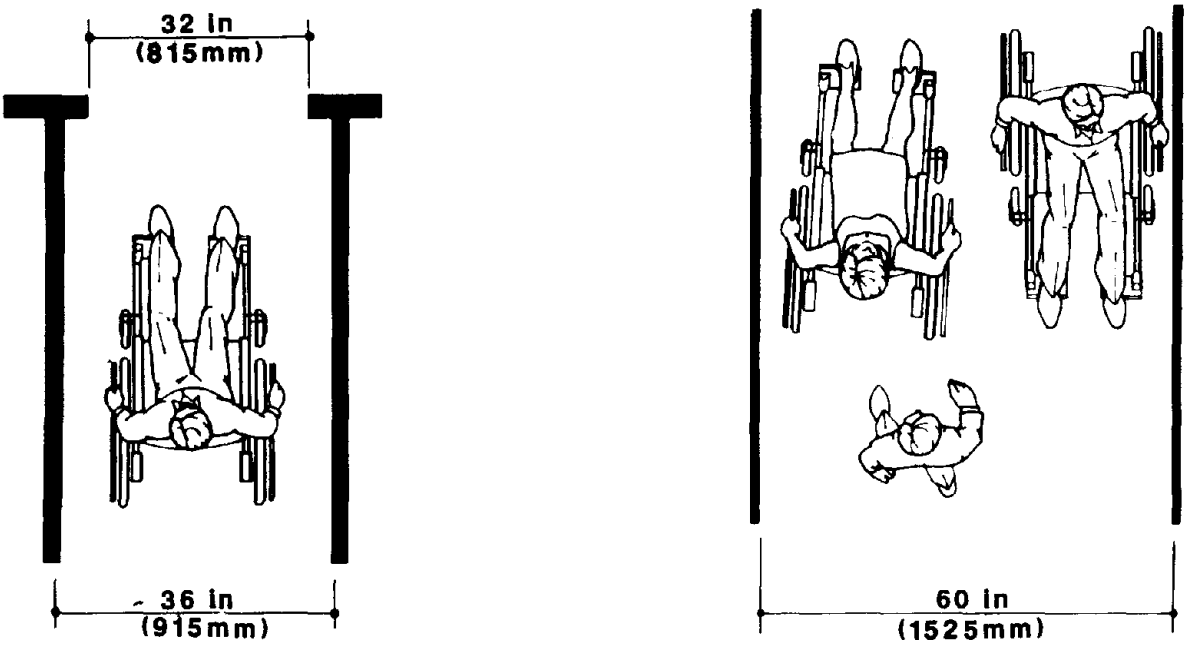


Figure 6. Width of accessible route.
(minimum clear width for single and two wheelchairs).

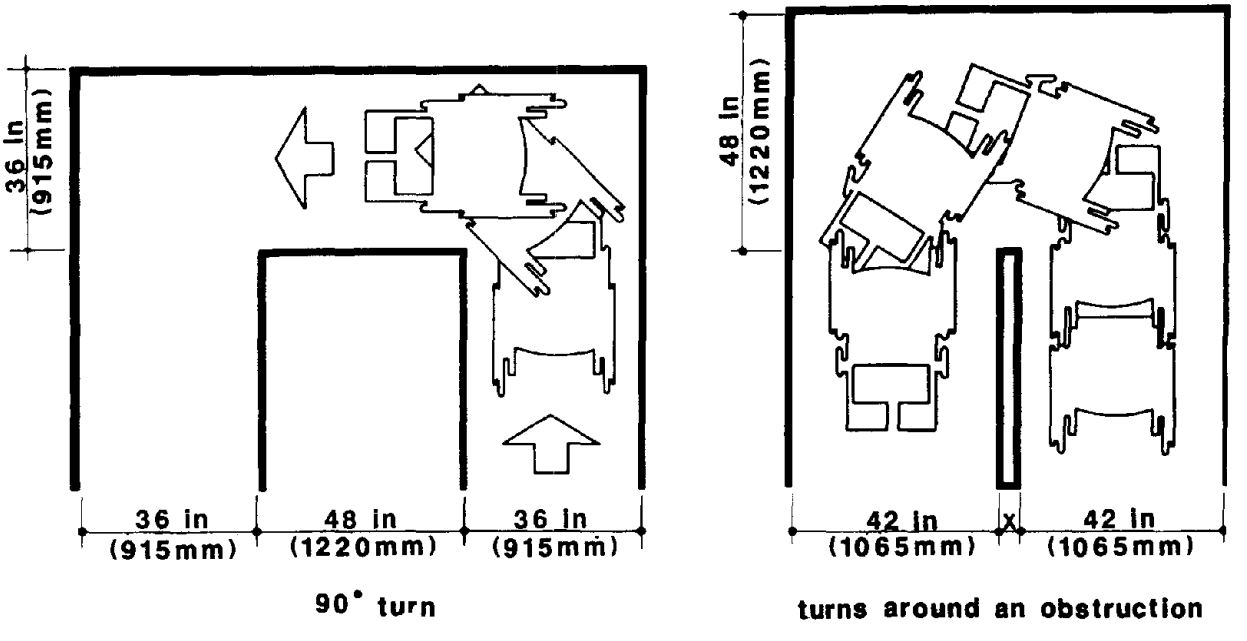


Figure 7. Width of accessible route.
(turns around an obstruction).

b. Passing Space

If an accessible route has less than 60 in (1525mm) clear width, then passing spaces, at least 60 in by 60 in (1525mm by 1525mm), shall be located at reasonable intervals not to exceed 200 ft (61m). A tee intersection of two walks is an acceptable passing space.

c. Head Room

Walks, walkways, and sidewalks, or other circulation spaces shall have 80 in (2030mm) minimum clear head room (figure 8). If a vertical clearance of an area adjoining an accessible route is reduced to less than 80 in (2030mm), a barrier to warn blind or visually impaired persons shall be provided (figure 9).

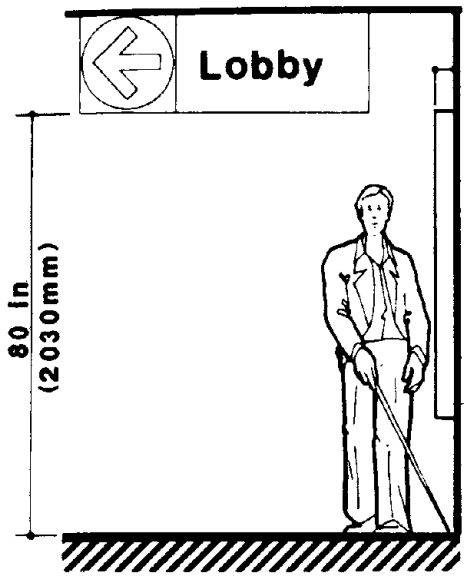


Figure 8. Vertical clearance of an accessible route.

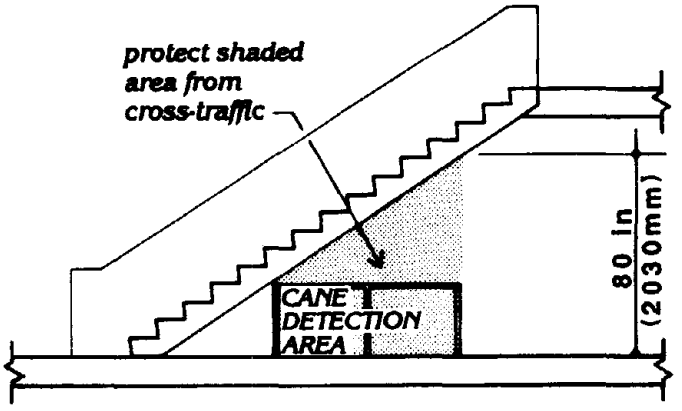


Figure 9. Vertical clearance of an area adjoining an accessible route.

d. Surface Textures

Ground and floor surfaces along accessible routes including floors and walks shall be stable, firm, and slip resistant.

e. Changes in Level

Changes in level up to 1/4 in (6mm) may be vertical and without edge treatment. Changes in level between 1/4 in and 1/2 in (6mm and 13mm) shall be beveled with a slope no greater than 1:2. Changes in level greater than 1/2 in (13mm) shall be accomplished by means of a ramp (figure 10).

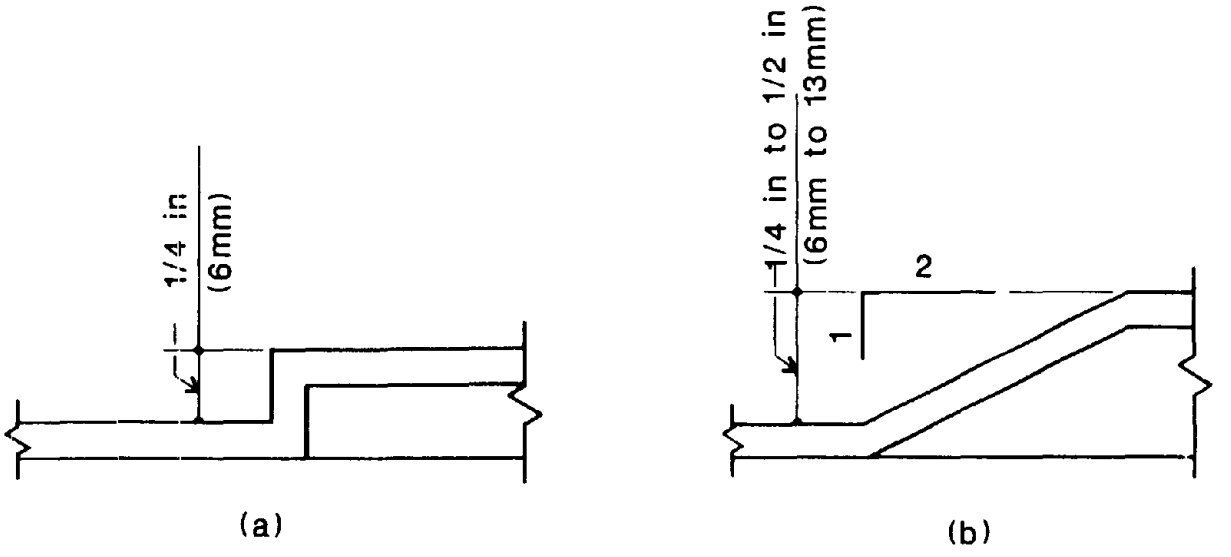


Figure 10. Changes in level.

f. Gratings

If gratings are located in walking surfaces, then they shall have spaces no greater than 1/2 in (13mm) wide in one direction. If gratings have elongated openings, then they shall be placed so that the long dimension is perpendicular to the predominant direction of travel (figure 11).

g. Slope

An accessible route with a running slope greater than 1:20 is a ramp and shall comply with the ramp standards. Nowhere shall the cross slope of an accessible route exceed 1:50.

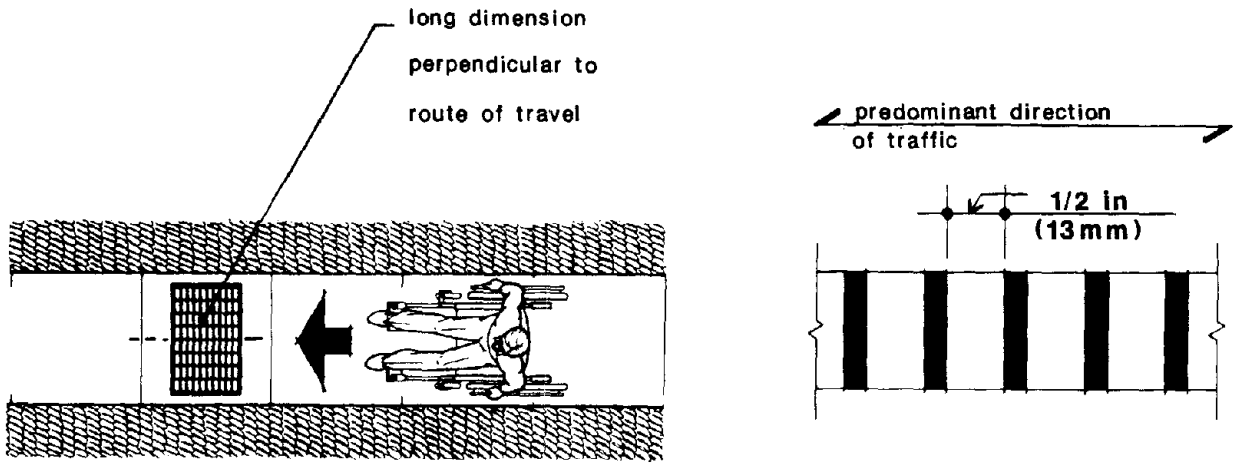


Figure 11. Gratings.

4. Problems and Recommended Solutions

Problems and recommended solutions for walkways and sidewalks are presented at two levels of detail: (1) General design problems and recommended solutions address layout and placement of walkways and sidewalks; and (2) specific design problems and recommended solutions address the design details of the walkway or sidewalk.

General Design Problems (Layout and Placement)

Checklist of Problems

- ☐ Walkway location.
- ☐ Walkway placement.

☐ Walkway location.

Problem: In many suburban areas, sidewalks and walkways are not provided, forcing pedestrians to use the roadway. This creates a hazardous condition.

Recommended Solution: Whenever feasible, sidewalks and/or walkways should be provided adjacent to the roadway.

☐ Walkway placement.

Problems: Pedestrians with poor vision using walkways that abut potential hazards could be injured by stepping off the edge or tripping.

Trees and bushes that overhang or project into the walkway are hazardous. Surface roots of trees adjacent to the sidewalk can cause the sidewalk to break apart resulting in rough, uneven surfaces, difficult to traverse for wheelchair users.

Recommended Solutions: Walkways should be designed so that there are minimum hazards adjacent to the walkway. If the hazard cannot be avoided a means should be devised to protect the pedestrian from the hazard.

Trees and shrubs should be trimmed to insure an 80 in (2030 mm) vertical clearance above the sidewalk surface. Protective barriers or handrails should be placed along the edge of the sidewalk if a hazardous condition exists. Trees with large surface roots should not be planted next to sidewalks.

Specific Design Problems (Design Details)

Checklist of Problems

- ☐ Walkway width.
- ☐ Walkway slope.
- ☐ Walkway cross slope.
- ☐ Walkway surfaces.
- ☐ Walkway maintenance.

☐ Walkway width.

Problems: Sidewalks and walkways are frequently too narrow to permit passage of persons in wheelchairs or semiambulant persons using a prosthesis especially in areas with high volumes of pedestrian traffic.

Turns of 90 degrees and 180 degrees are difficult for persons in wheelchairs to negotiate if the walkway is narrow.

Recommended Solutions: Walkways should be designed to accommodate projected pedestrian volumes. The minimum width of a walkway on an accessible route is 36 in (915mm). Recommended width is 60 in (1525mm) to accommodate two-way traffic. If 60 in (1525mm) cannot be maintained on the route then 60 in by 60 in (1525mm by 1525mm) passing spaces should be provided every 200 ft (61m) (figure 12).

The standards section shows the minimum widths that are required for wheelchairs to negotiate 90 degree and 180 degree turns.

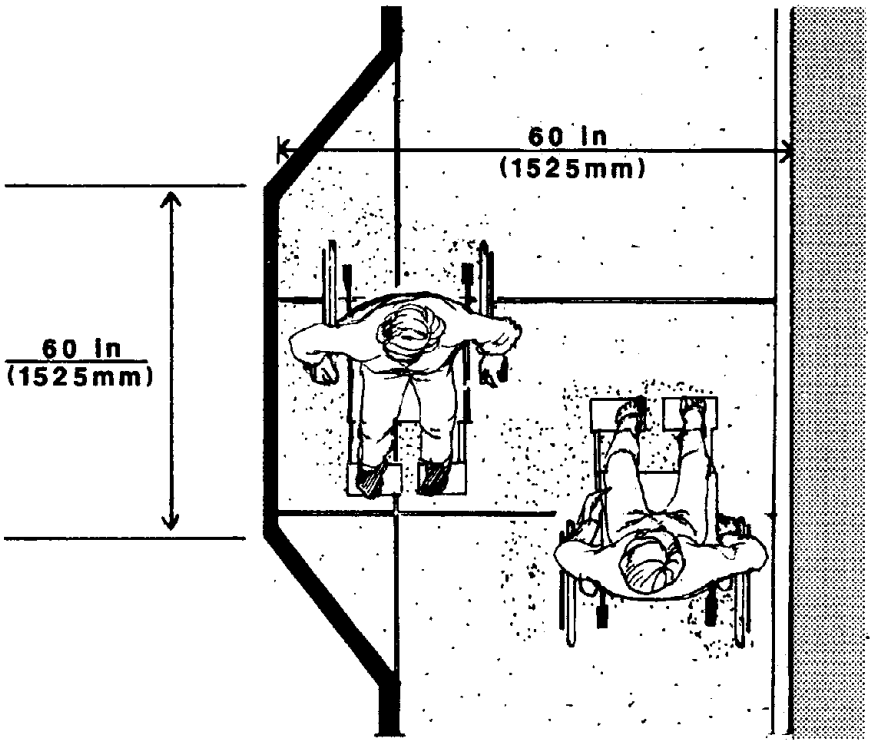


Figure 12. Passing spaces.

☐ Walkway slope.

Problems: Some walkways are so steep that they cannot be used by the elderly and handicapped. Some are so flat that they do not drain properly.

Recommended Solutions: Walkway sections with slopes greater than 1:20 (5 percent) shall be treated as ramps. Since it is often impractical to meet the standards for ramps along an accessible route, the designer must insure that the accessible route is located in such a way to avoid steep grades wherever possible.

Walkways should be graded in such a way to avoid puddling of water.

☐ Walkway cross slope.

Problem: Many handicapped people, especially the visually impaired, people with balance problems, and wheelchair users, have difficulty traveling in a straight line on walkways with severe cross slopes.

Recommended Solution: The cross slope of a walkway should be reasonably level. A 1:50 (2 percent cross slope is acceptable (figure 13).

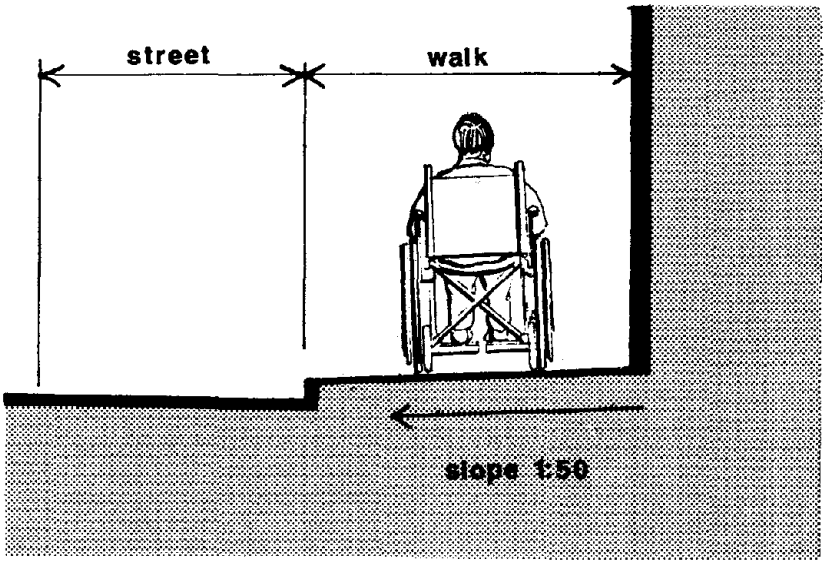


Figure 13. Cross slope.

☐ Walkway surfaces.

Problems: Gravel, loose material, and lawns are difficult for many handicapped persons to traverse. Walkways finished with smooth materials like terrazzo, marble, or tile may be slippery especially when they are wet. These surfaces are particularly hazardous for those on crutches.

Uneven surfaces, surfaces with many joints, and uneven joints between two different materials are difficult and uncomfortable for handicapped persons. They may cause a handicapped person to trip and fall or could upset a wheelchair.

If a walkway surface is adjacent to a parking lot or filling station which has the same material as the walkway, people with poor vision may wander off the walkway.

Differential settlement may cause a vertical offset between two surfaces causing a hazard to handicapped persons.

Recommended Solutions: Walkway surfaces shall be stable, firm, and slip resistant.

Expansion and construction joints should be no greater in width than 1/2 in (13mm). Expansion joint material should be flush with the adjoining surfaces (figure 14). Wherever possible, avoid the use of small paving units with numerous joints. Avoid unsealed gravel surfaces, cobblestone, and corrugated textures except when used as a warning or tactile surface.

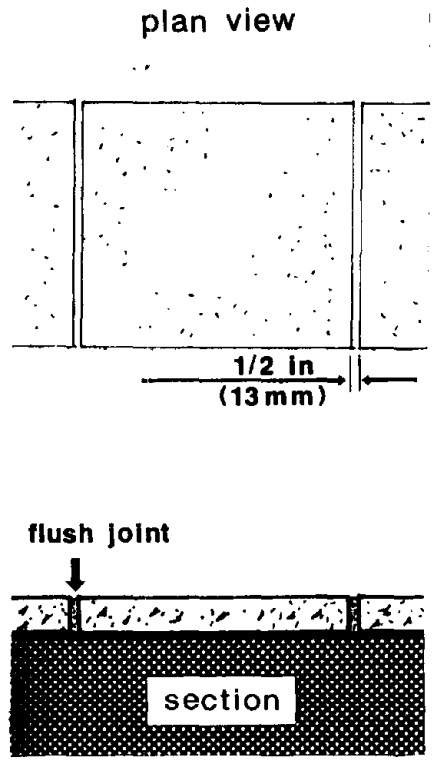


Figure 14. Maximum permissible width of construction joints.

Provide a physical barrier or a textured surface between the walkway and parking lots that are constructed of the same materials (figure 15).

Joints between different materials should be flush. A maximum of 1/4 in (6mm) is allowable. A vertical difference between 1/4 in and 1/2 in (6mm and 13mm) shall be beveled with a 1:2 slope.

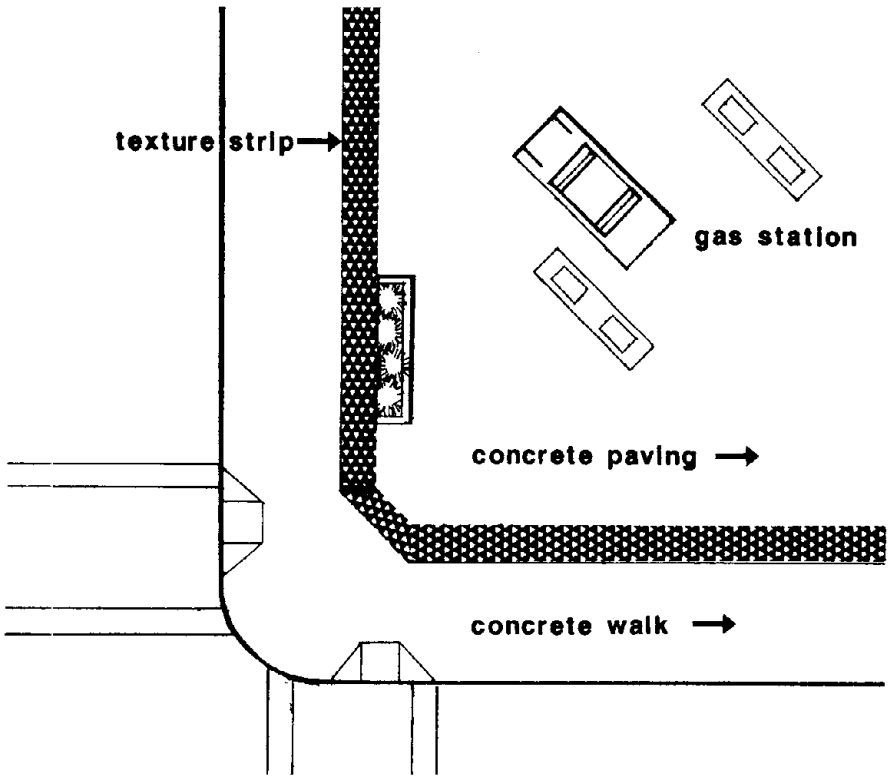


Figure 15. Recommended edges for walking boundaries.

☐ Walkway maintenance.

Problems: Cracked and spalling concrete surfaces, poorly placed temporary patches, broken concrete, and construction may prevent someone in a wheelchair from being able to use the walkway and can be hazardous for those with poor vision and balance.

Trash, loose sand, oil, and grease on walkways may cause people to slip and fall and may be picked up by the wheels of wheelchairs and transferred onto the hands of the person using the wheelchair.

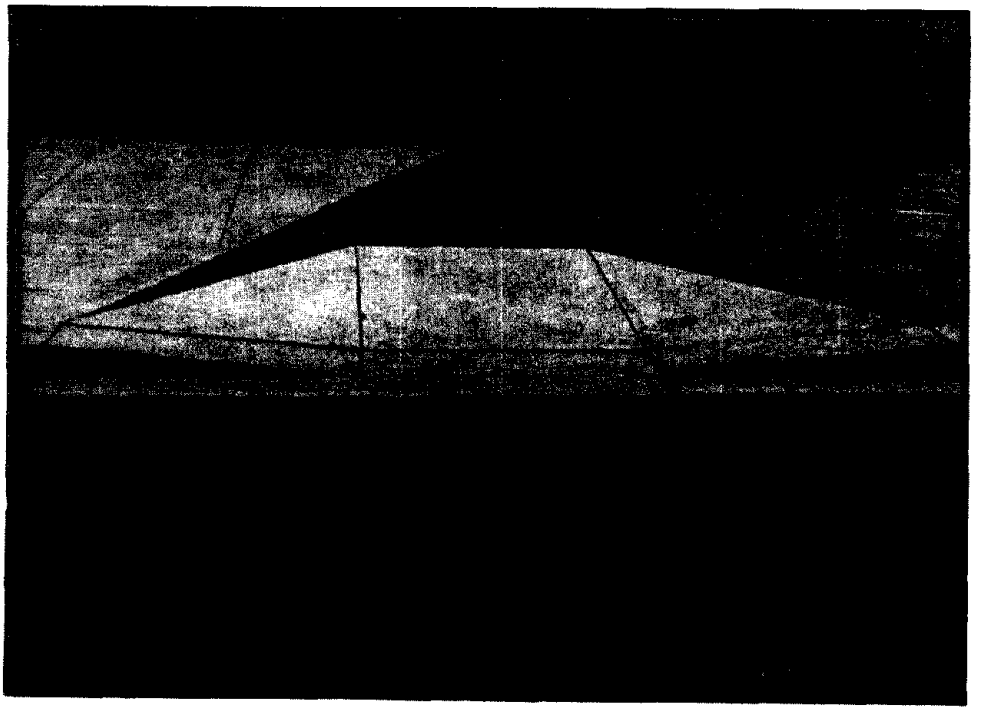
Ice and snow make walkways impassable to the elderly and handicapped.

Recommended Solutions:

Walkway surfaces that are part of an accessible route should be inspected periodically to insure that they are properly maintained. When there is construction activity in the vicinity of the accessible route, the walkways near the construction project should be inspected and properly maintained or an alternate route away from the construction activity designated.

Walkways which are part of an accessible route should be scheduled for periodic inspection and cleaning.

Special arrangements should be made to give accessible routes a high priority for snow and ice removal.



CHAPTER 6: Curb Ramps

1. Scope

This chapter describes curbs, curb cuts, and curb ramps. Curb ramp standards are presented. Problems and recommended solutions are addressed to show how curb ramps should be designed and installed to properly interface with the other elements that make up an accessible route.

2. Definitions

Curb: The edge of a walk or street surface which has been raised to protect or contain.

Curb cut: The removal or termination of a portion of a continuous street curb to permit a ramped connection between two surfaces at different elevations.

Curb ramp: A pedestrian ramp which cuts through a curb (figure 16) or builds up to it (figure 17) from a lower level.

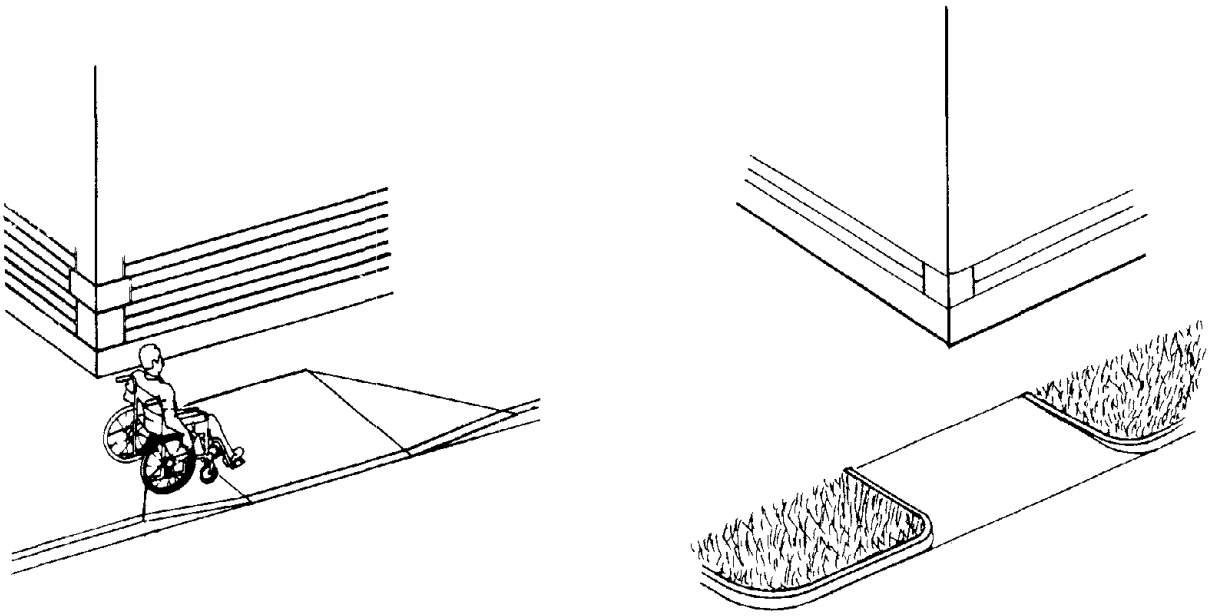


Figure 16. Curb ramps cutting through a curb.

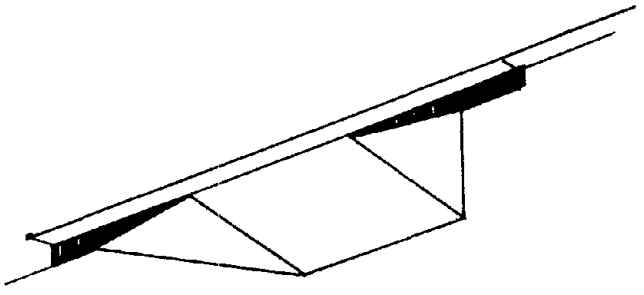


Figure 17. Built-up curb ramp.

3. **Standards**

a. Location

Curb ramps shall be provided wherever an accessible route crosses a curb. Curb ramps at marked crossings shall be wholly contained within the markings, excluding any flared sides (figure 18).

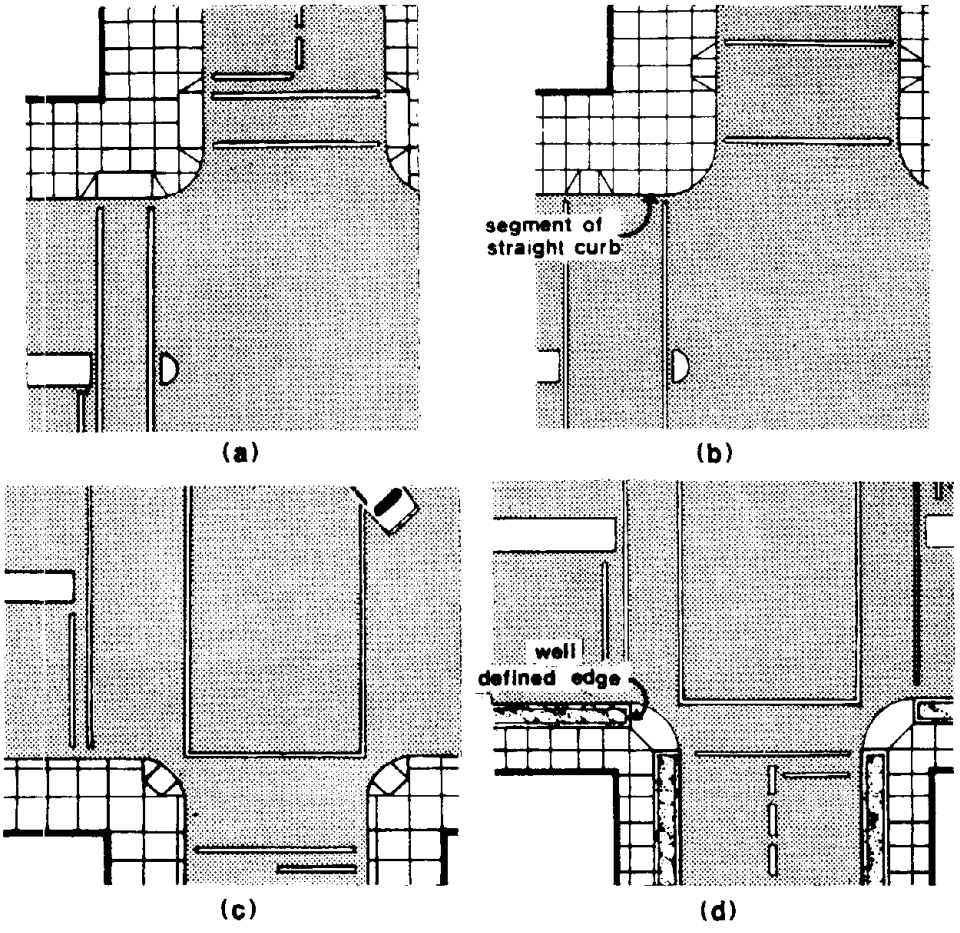


Figure 18. Curb ramps at marked crossings.

b. Slope

The slope shall be measured as shown in figure 19. The maximum slope for new construction shall be 1:12. Curb ramps constructed on

existing sites may have slopes and rises as shown in table 2. Transitions from ramps to walks, gutters, or streets shall be flush and free of abrupt changes. Maximum slopes of adjoining gutters (road surface) adjacent to the curb ramp or accessible route shall not exceed 1:20.

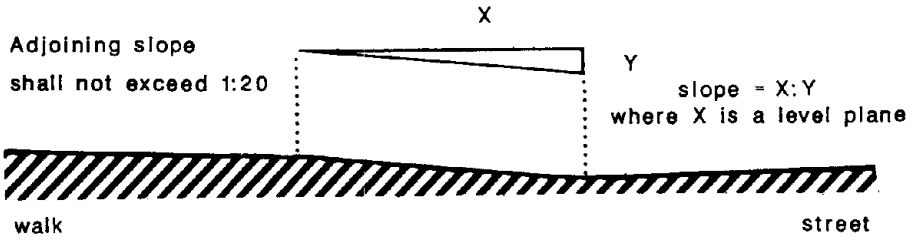


Figure 19. Measurement of curb ramp slopes.

Table 2. Allowable ramp dimensions for construction in existing sites, buildings, and facilities.

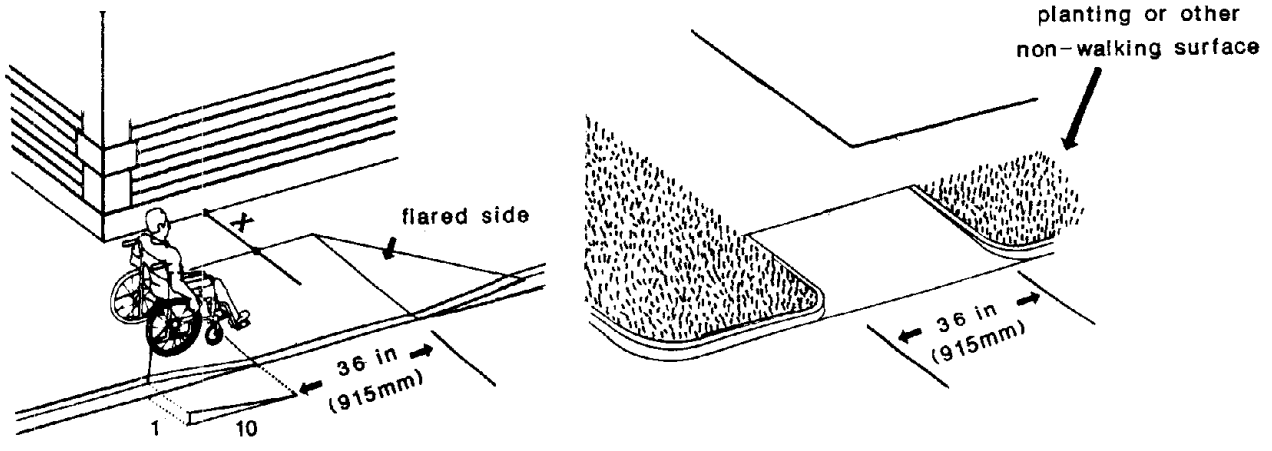
	Maximun Rise		Maximum Run	
Slope*	in	mm	ft	m
Steeper than 1:10 but no steeper than 1:8	3	75	2	0.6
Steeper than 1:12 but no steeper than 1:10	6	150	5	1.5
*A slope steeper than 1:8 not allowed.				

c. Width

The minimum width of a curb ramp shall be 36 in (915mm), exclusive of flared sides (see figure 20).

d. Sides

If a curb ramp is located where pedestrians must walk across the ramp, or where it is not protected by handrails or guard rails, then it shall have flared sides; the maximum slope of the flare shall be 1:10 (figure 20). Curb ramps with returned curbs may be used where pedestrians would not normally walk across the ramp (figure 20).



(a) flared sides

(b) returned curb

If X is less than 48 in, (1220mm) then the slope of the flared side shall not exceed 1:12.

Figure 20. Width and sides of curb ramps.

e. Obstructions

Curb ramps shall be located or protected to prevent their obstruction by parked vehicles.

f. Surface

Surface of curb ramps shall be stable, firm, and slip resistant. If there is a change in level between the curb ramp and street or sidewalk up to 1/4 in (6mm) it may be vertical without edge treatment (figure 21). Changes in level between 1/4 in and 1/2 in (6mm and 13mm) shall be beveled with a slope no greater than 1:2 (figure 21).

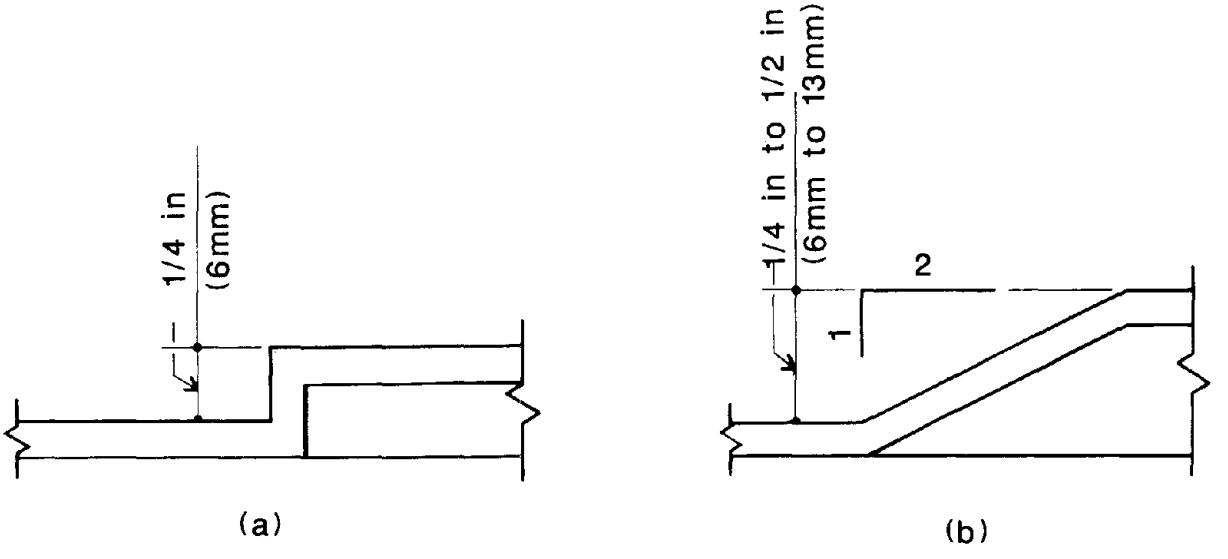


Figure 21. Changes in level.

4. Problems and Recommended Solutions

Problems and recommended solutions for curb ramps are presented at two levels of detail: (1) General design problems and recommended solutions address layout and placement of the curb ramp; and (2) specific design problems and recommended solutions address the details of curb ramp design.

General Design Problems (Layout and Placement)

Checklist of Problems

- ☐ Curb radius.
- ☐ Curb height.
- ☐ No curb.
- ☐ Curb ramp direction.
- ☐ Curb ramp location.

☐ Curb radius.

Problem: Curbs with a radius greater than 25 ft (7.6m) are less satisfactory for visually impaired people because they do not provide directional information about the crosswalk.

Recommended Solutions: When locating a curb ramp on a curb with a radius greater than 25 ft (7.6m) the designer should layout the crosswalks first to determine if one curb ramp per corner is sufficient. In some instances two curb ramps will be required at each corner of the intersection if the curb radius is greater than 25 ft (7.6m).

☐ Curb height.

Problem: Very high or low curbs are difficult for some pedestrians to cross and are difficult to treat with a curb ramp.

Recommended Solution: Whenever possible, curbs should be 6 in (150mm) high or less. When locating a curb ramp in an area that has curbs higher than 6 in (150mm), the designer should insure that the sidewalk is wide enough to accommodate the runout of the curb ramp using the desirable slope of 1:12. If a slope steeper than 1:8 is required, the placement of the curb ramp should be changed. Low or "mountable" curbs as shown in figure 22 are <u>not</u> suitable for wheelchair access without a curb ramp.

A mountable curb is not a curb ramp.

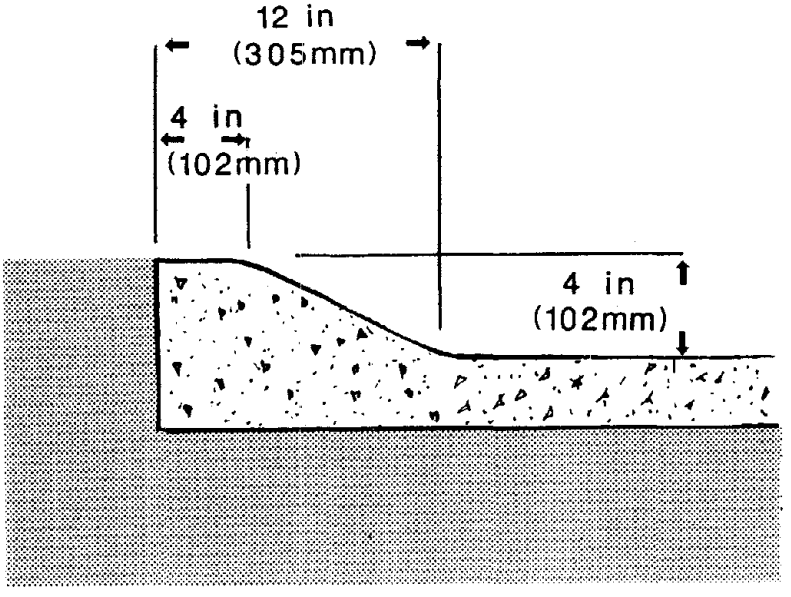


Figure 22. Mountable curb.

☐ No curb.

Problem: Where there is no curb separation between the sidewalk and the street, it is more dangerous for visually impaired people who may walk into the road.

Recommended Solution: When no curb exists some form of separation should be provided to guide the visually impaired to the marked street crossing. The separation can be in the form of a landscaped strip, low planter boxes, a textured strip, or a strip between the sidewalk and street which is made of a different material than the sidewalk or street (figure 23).

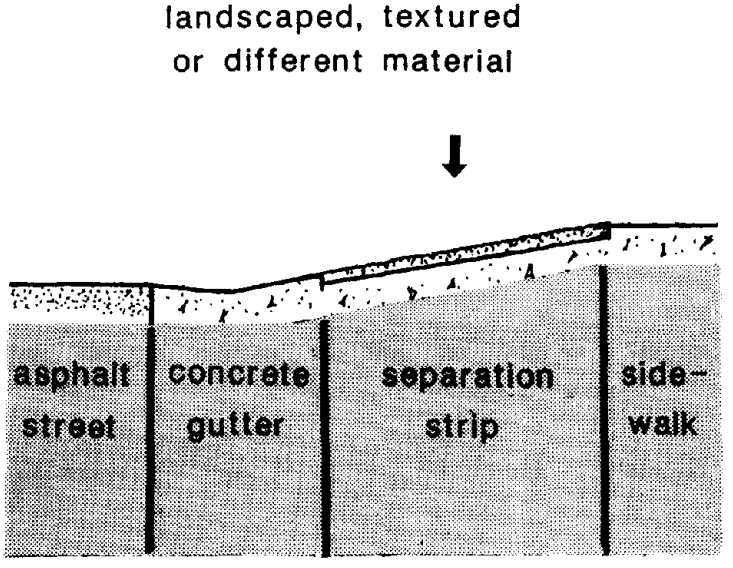


Figure 23. Textured strip between concrete gutter and concrete sidewalk.

☐ Curb ramp direction.

Problem: A curb ramp can be hazardous if it is located such that:

(1) it directs the user out of the marked crosswalk.
(2) it requires the user to make abrupt turns.
(3) it does not line up and point in the same direction as the crosswalk.
(4) it requires the user to enter the pedestrian flow at a right angle.

Recommended Solution: When determining the direction of a curb ramp the designer should insure that it is positioned in such a way that there is an overrun space at each end of the curb ramp. The overrun space should be a minimum of 48 in (1220mm) (figure 24). If 48 in (1220mm) is not available at the top of the curb ramp then the slope of the flared sides of the curb ramp should not exceed 1:12. The curb ramp should be positioned within, line up with, and run generally in the same direction as the marked crosswalk.

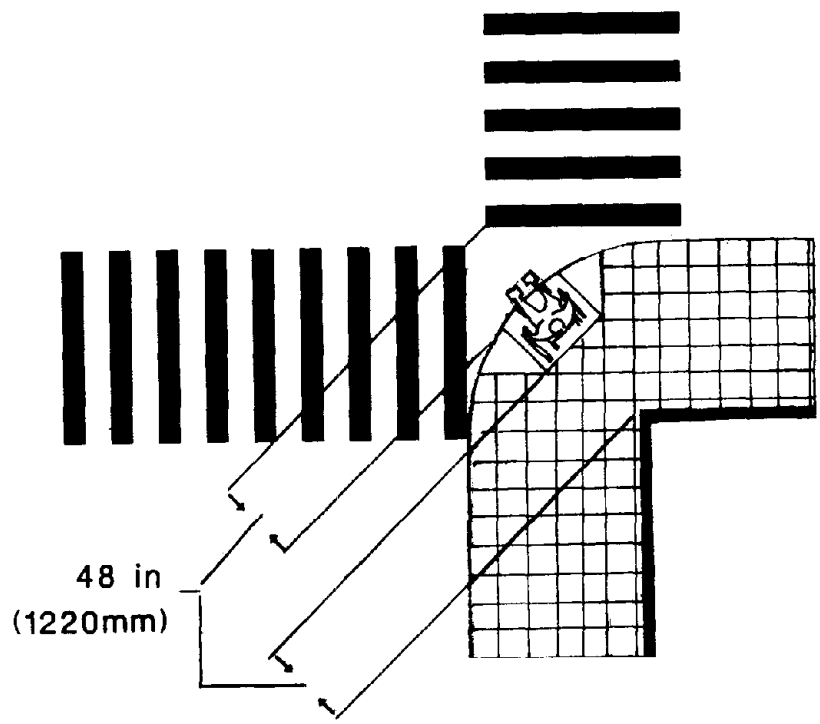


Figure 24. Minimum overrun distances at ends of curb ramps.

☐ Curb ramp location.

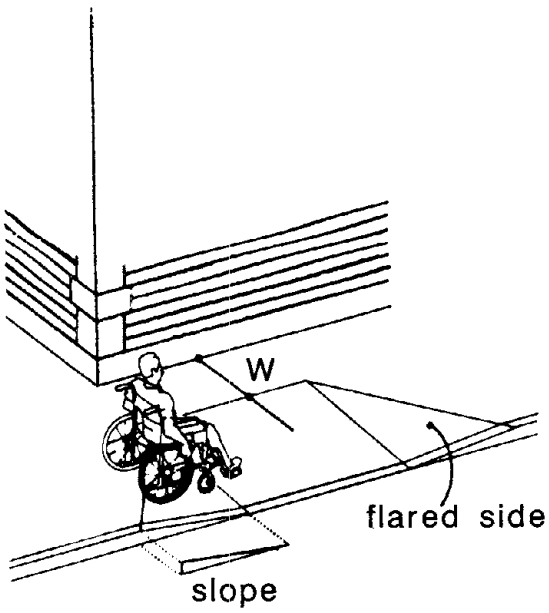
Problem: Curb ramps can be ineffective to the user if there is no matching provision on the other side of the roadway or through intermediate traffic islands.

Recommended Solution: There should be similar provisions on the other side of the roadway and through intermediate traffic islands to insure that a wheelchair user can safely traverse the roadway (figure 25).

Figure 25. Curb ramp location.

Problem: Curb ramps are difficult for some pedestrians to travel across because of the side slopes of the ramp flares.

Recommended Solution: Pedestrian traffic should not have to move across the ramp and side flares. If this not possible, then side flares should not exceed 1:12 (figure 26).



If W is:	then slope of side flare shall be:
less than 48 in (1220mm)	1:12 or less
greater than 48 in (1220mm)	1:10 or less

Figure 26. Slope of curb ramp side flares.

Problem: Some visually impaired people find it easier to locate the edge of the street at a curb rather than a curb ramp.

Recommended Solution: Whenever possible, curb ramps should be located away from the direct line of travel used by the visually impaired. In all cases the curb ramp must be within the crosswalk lines (figure 27).

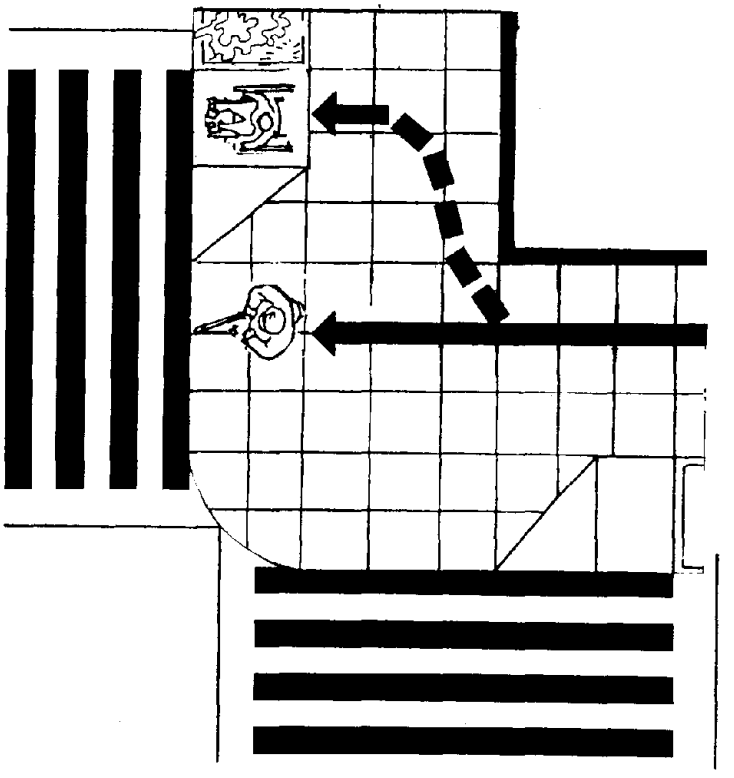


Figure 27. Preferable location of curb ramp for visually impaired.

Problem: Poor drainage or a drain or grate placed in the path of a curb ramp makes it difficult to use.

Recommended Solution: Whenever possible, avoid locating curb ramps near storm outlets or where users must cross gratings or manhole covers. If a curb ramp must be located in line with a grating, insure that the open spaces in the grate are no greater than 1/2 in (13mm) in one direction and that the elongated openings are perpendicular to the predominate direction of travel.

Problem: Curb ramps placed too close to each other or too close to signs, poles, or street furniture are difficult to use.

Recommended Solution: Whenever possible, locate the curb ramp in such a way that one curb ramp will provide access to both directions at the corner. Do not locate curb ramps too close to each other or too close to signs, light poles, or street furniture. In some cases, signs or street furniture may have to be relocated to properly locate the curb ramp.

Problem: Curb ramps located behind tall bushes or street furniture can be hazardous because they obscure wheelchair users from oncoming traffic.

Recommended Solution: Curb ramps should be located so there is a clear line of sight between the user of the curb ramp and oncoming vehicles. "No Parking" signs may be warranted to maintain a clear line of sight.

Specific Design Problems (Design Details)

Check List of Problems

- ☐ Curb ramp width.
- ☐ Curb ramp slope and length.
- ☐ Curb ramp transitions.
- ☐ Curb ramp side flare slope.
- ☐ Curb ramp surface materials.
- ☐ Curb ramp maintenance.

☐ Curb Ramp Width.

Problem: If the curb ramp is too narrow and is heavily used by pedestrians, handicapped people may be forced to wait in the street. Snow clearance equipment cannot clear narrow curb ramps. If the curb ramp is too wide, there is little level ground left for people who do not want to use ramps.

Recommended Solutions: Width of curb ramps shall be no less than 36 in (915mm). In areas where snow is common, a 48 in (1220mm) width makes snow removal easier. On street intersections with high pedestrian volume, curb ramps should be wider to lessen the conflict between wheelchair users and other pedestrians (figure 28).

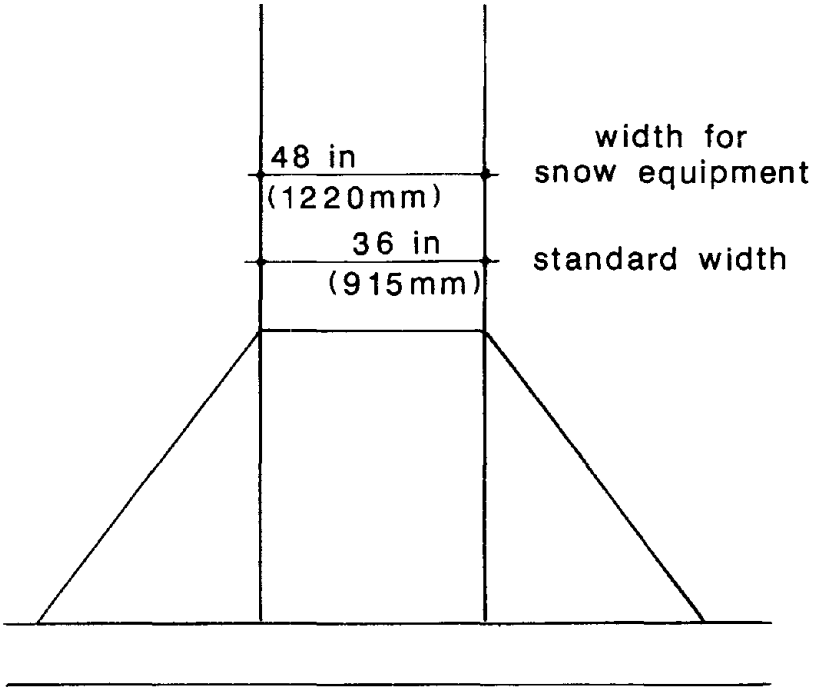


Figure 28. Curb ramp width.

☐ Curb ramp slope and length.

Problem: Curb ramps that are too steep or too long cannot be traversed by some handicapped people. If the gradient of the existing sidewalk and the camber of the road are not considered the curb ramp may become too steep.

Recommended Solutions: The maximum slope of a curb ramp constructed as part of a new facility shall be 1:12. If a curb ramp is installed at an existing intersection and the desirable 1:12 slope cannot be achieved then a steeper slope may be used within the following parameters.

Maximum Curb Height	Maximum Horizontal Projection	Available Slope Range
3 in (75mm)	2 ft (0.6m)	1:10 not to exceed 1:8
6 in (150mm)	5 ft (1.5m)	1:12 not to exceed 1:10

In no case can a slope steeper than 1:8 be used.

☐ Curb ramp transitions.

Problem: A step as small as 1/2 in (13mm) will prevent some people in wheelchairs from using the curb ramp. Wheelchair users often have to "take a run" at a ramp. Any step at the bottom of the ramp or an abrupt transition between the ramp and the sidewalk or street may overturn the wheelchair. Abrupt transitions between the curb ramp and the street may snag the foot rest of the wheelchair.

Recommended Solutions: Transitions between the curb ramp and sidewalk and the curb ramp and the gutter shall be free of abrupt changes in grade. The slope of the adjacent sidewalk and gutter shall never exceed 1:20 (figure 29).

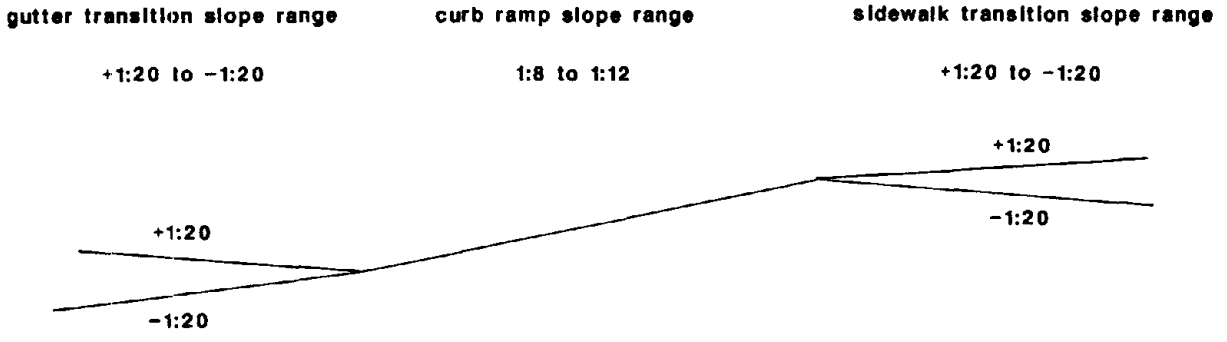


Figure 29. Curb ramp transitions.

☐ Curb ramp side flare slope.

Problem — The flared sides of the curb ramp are often very steep and are hazardous for all pedestrians, especially for wheelchair users.

Recommended Solutions: — The location of the curb ramp determines the treatment of the slopes or sides. If a curb ramp is located where pedestrians would not normally walk across the ramp and the sidewalk width at the top of the curb ramp is greater than 48 in (1220mm), a curb ramp with returned curbs may be used (figure 30).

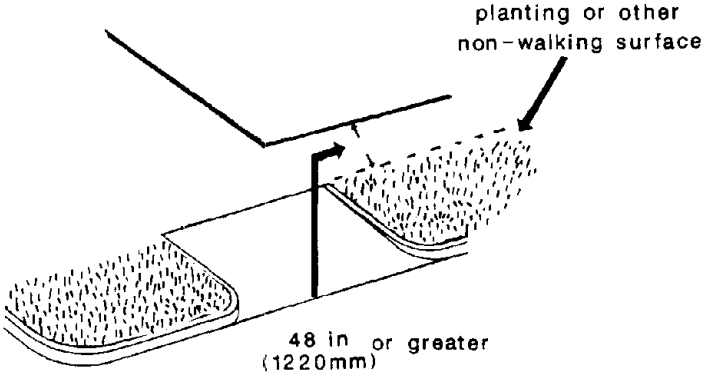


Figure 30. Curb ramp with returned curb sides.

Problem: A curb ramp with steep side flares located such that its length traverses the entire sidewalk is hazardous to all pedestrians. A vertical drop off at the edge of a curb ramp is hazardous.

Recommended Solutions: If a curb ramp is located where pedestrians must walk across the ramp and the sidewalk width at the top of the curb ramp is less than 48 in (1220mm), the curb ramp cross slopes shall not exceed 1:12 (see figure 12). If a curb ramp is located where pedestrians must walk across the ramp and the sidewalk width at the top of the curb ramp is more than 48 in (1220mm), the curb ramp cross slopes shall not exceed 1:10 (figure 12).

☐ Curb ramp surface materials.

Problems: Curb ramp surfaces are sometimes slippery, particularly around the gutter. Curb ramp surfaces finished with rough textures to assist the visually impaired are difficult to keep clean and can become hazardous. Visually impaired people may not detect the location of the curb ramp if it is the same color and texture as the sidewalk or street. Painting of curb ramps with certain paints can make them slippery.

Recommended Solutions: Curb ramp surfaces shall be stable, firm, and slip resistant. The texture of the curb ramp should be different than the texture of the adjoining sidewalk and street. This can be achieved by using different materials e.g., concrete curb ramp, asphalt street, and a different finish on the concrete sidewalk. The surface of the ramp should not be so smooth that it is slippery when it is wet and it should not be so rough that it collects dirt or makes it uncomfortable for wheelchair users.

☐ Curb ramp maintenance.

Problem: Snow, ice, and deicing agents can deteriorate curb ramps making them hazardous. Snow and/or debris accumulation can make curb ramps unusable.

Recommended Solution: A maintenance program should be initiated to insure that all curb ramps on accessible routes are cleaned periodically and snow is removed.

Problem: Repaving of the street can cause a step or a transition problem at the bottom of the curb ramp.

Recommended Solution: When streets are repaved or sidewalks repaired, the contract specifications for the project should specify a maximum of 1/4 in (6mm) vertical edge between the new pavement or sidewalk and the gutter or curb ramp.

CHAPER 7: Crosswalks

1. Scope

This chapter reviews design considerations for marked crosswalks and shows how the crosswalk should be placed in relation to other elements which make up the street crossing component.

2. Definitions

Crosswalk: A part of a roadway, generally at an intersection, that is delineated for pedestrian crossing.

Stop Line: A solid white line on the roadway surface extending across all approach lanes which is used in conjunction with a stop sign, traffic signal, officer's direction, or other legal requirement indicating the point behind which vehicles are required to stop.

3. Standards

Crosswalk markings at signalized intersections and across intersectional approaches on which traffic stops, serve primarily to guide pedestrians in the proper paths. Crosswalk markings across roadways on which traffic is not controlled by traffic signals or STOP signs, must also serve to warn the motorist of a pedestrian crossing point at non-intersectional locations, these markings legally establish the crosswalk.

Crosswalk lines shall be solid white lines, marking both edges of the crosswalk. They shall be not less than 6 in (150mm) in width and should not be spaced less than 6 ft (1.8m) apart. Under special circumstances where a stop line is not provided or where vehicular speeds exceed 35 mi/h (56 km/h) or where crosswalks are unexpected, it may be desirable to increase the width of the crosswalk line up to 24 in (610mm) in width. Crosswalk lines on both sides of the crosswalk should extend across the full width of pavement to discourage diagonal walking between crosswalks (Figure 31).

Crosswalks should be marked at all intersections where there is substantial conflict between vehicle and pedestrian movements. Marked cross walks should also be provided at other appropriate points of pedestrian concentration, such as at loading islands, midblock pedestrian crossing, or where pedestrians could not otherwise recognize the proper place to cross.

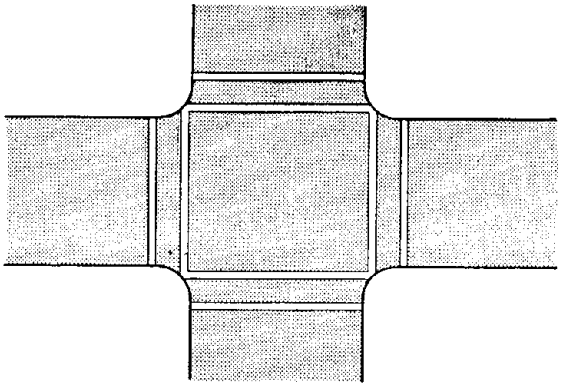
Crosswalk markings should not be used indiscriminately. An engineering study should be required before they are installed at locations away from traffic signals or STOP signs.

Since non-intersectional pedestrian crossings are generally unexpected by the motorist, warning signs should be installed and adequate visibility provided by parking prohibitions.

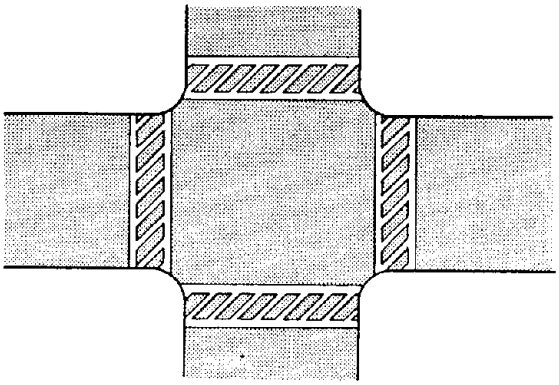
For added visibility, the area of the crosswalk may be marked with white diagonal lines at a 45 degree angle or with white longitudinal lines at a 90 degree angle to the line of the crosswalk (Figure 31). These lines should be approximately 12m to 24m (305mm to 610mm) wide and spaced 12m to 24m apart. When diagonal or longitudinal lines are used to mark a crosswalk, the transverse crosswalk lines may be omitted. This type of marking is intended for use at locations where substantial numbers of pedestrians cross without any other traffic control device, at locations where physical conditions are such that added visibility of the crosswalk is desired or at places where a pedestrian crosswalk might not be expected. Care should be taken to insure that crosswalks with diagonal or longitudinal lines used at

some locations do not weaken or detract from other crosswalks (where special emphasis markings are not used). When an exclusive pedestrian phase signal, which permits diagonal crossing, is installed at an intersection, a unique marking may be used for the crosswalk.

Standard crosswalk marking.



Crosswalk marking with diagonal lines for added visibility.



Crosswalk marking with longitudinal lines for added visibility.

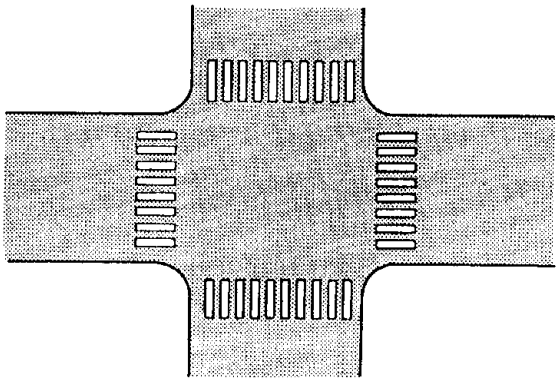


Figure 31. Standard crosswalk markings.

4. Problems and Recommended Solutions

Problems and recommended solutions for crosswalks are presented at two levels of detail: (1) General design problems and recommended solutions address layout and placement of the crosswalk; and (2) specific design problems and recommended solutions address the design details of the crosswalk.

General Design Problems (Layout and Placement)

Checklist of Problems

- ☐ Crosswalk location.
- ☐ Crosswalk angles.
- ☐ Visual obstructions.
- ☐ Platoon space.

☐ Crosswalk location.

Problems: There are too few marked crosswalks at busy intersections and along long blocks, encouraging people to take risks by jaywalking.

Visually impaired people find it difficult at some places to detect the location and extent of crosswalks, particularly those at midblock.

Recommended Solutions:

Crosswalks should be marked at all intersections where there is substantial conflict between vehicle and pedestrian movements. Marked crosswalks should also be provided at other appropriate points of pedestrian concentration, such as at loading islands, mid-block pedestrian crossings, and/or where pedestrians could not otherwise recognize the proper place to walk.

Special consideration for the needs of the visually impaired should be considered at the entrance and exit of the crosswalk, especially at mid-block (figure 32). At non-intersectional pedestrian crossings, pedestrian crossing warning signs should be installed and parking restricted to provide a safer crossing.

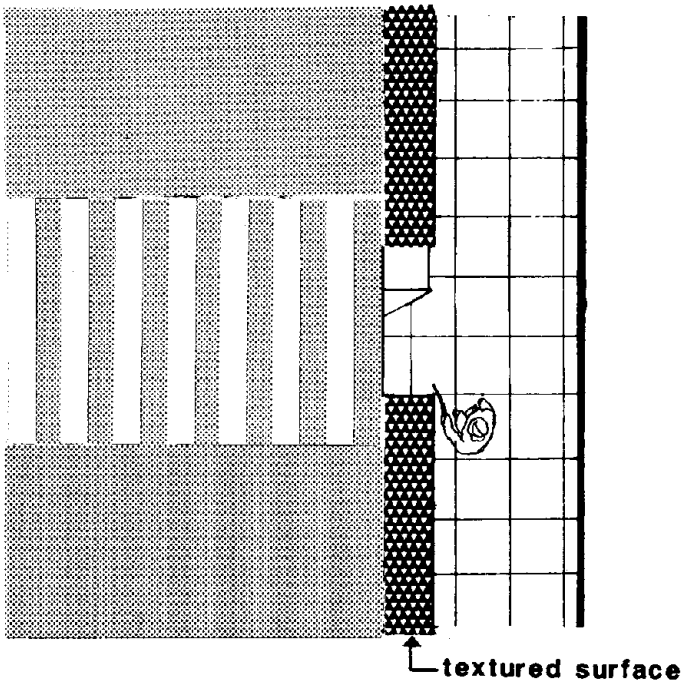


Figure 32. Crosswalk location clues at midblock crossings.

☐ Crosswalk angles.

Problem: Crosswalks that are not placed perpendicular to the curb line may cause visually impaired people to stray out of the marked area and encourage pedestrians to take the shortest route even if it is outside the marked crosswalk.

Recommended to Solution: Whenever possible, crosswalks should be placed perpendicular the curb line. If not possible, care should be taken to direct the visually impaired in the direction of the crosswalk by pointing the curb ramp in the same direction as the crosswalk, and using a marking material or technique that is detectable to the visually impaired, and/or using other directional techniques such as tactile strips, low planter boxes or railings along the curb (figure 33).

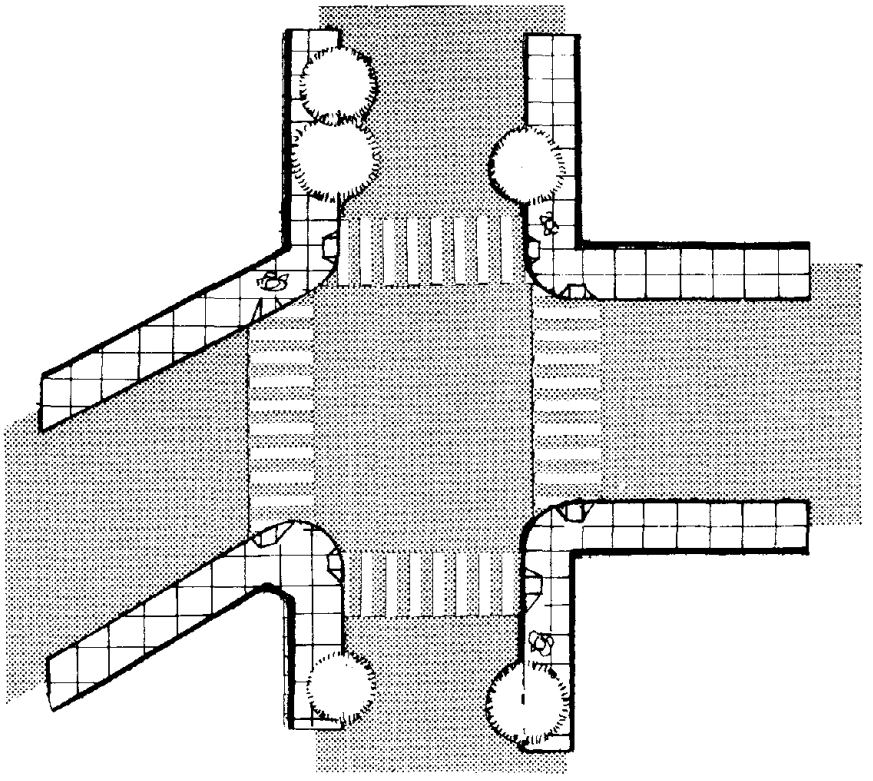


Figure 33. Curb ramps directed in same direction as crosswalk.

☐ Visual obstructions.

Problems: People in wheelchairs, children, and others with short stature are less visible to the oncoming vehicle.

Vehicles parked in the near vicinity of a crosswalk obscure pedestrians from the drivers view.

Where turns on red are permitted and where the driver's view to the left is obstructed by trees, hedges or buildings, vehicles will move into the crosswalk area preparing for the turn. The vehicle in the crosswalk encourages pedestrians to travel outside the crosswalk area. The vehicle in the crosswalk hides people of small stature and people in wheelchairs from view of other oncoming vehicles (figure 34).

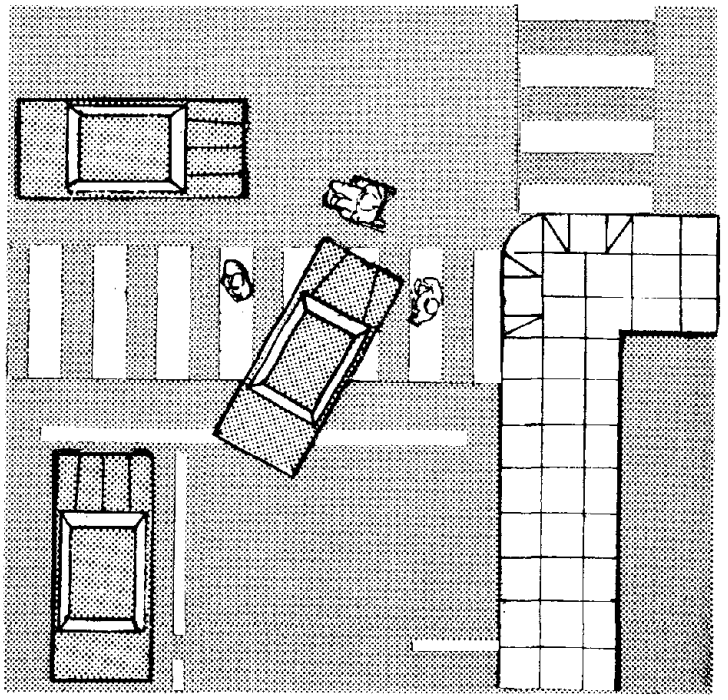


Figure 34. Right turn on red obstructs crosswalk.

Recommended Solutions: Crosswalks should be located so they are fully visible to oncoming vehicles. If this is not possible, pedestrian crossing warning signs should be installed. Street furniture, mail boxes, telephones, large poles, trees and large planter boxes should not be located in the vicinity of the crosswalk where they may block the line of sight of the motorist. Parking should not be permitted within 20 ft (6m) of the nearest crosswalk line at unsignalized intersections. At signalized intersections, parking should not be permitted within 30 ft (9m) of the nearest crosswalk line (figure 35).

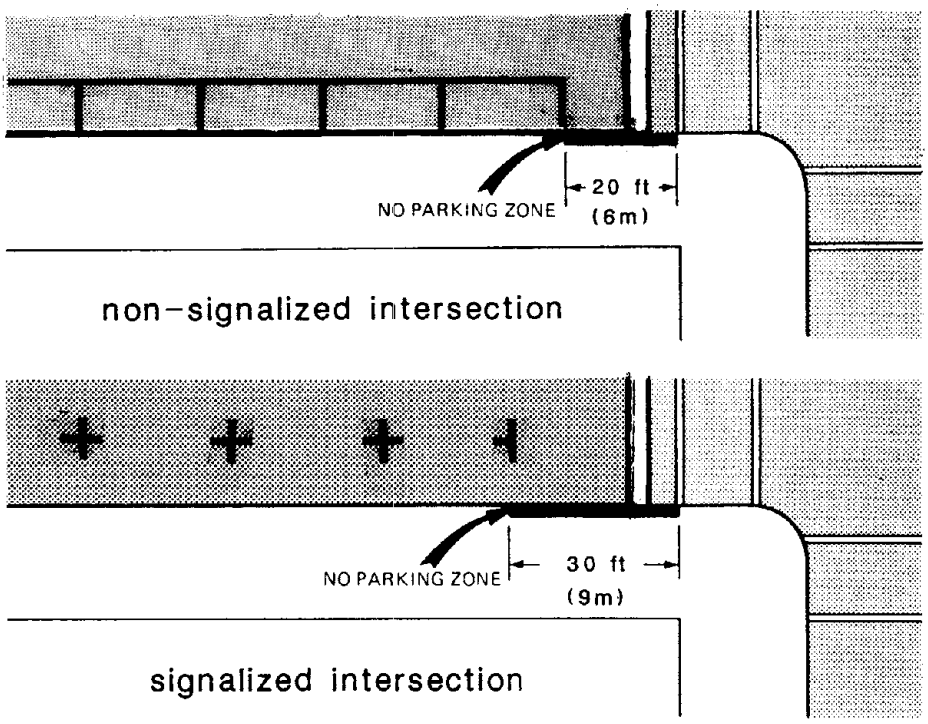


Figure 35. Typical parking space limit markings.

If parking cannot be restricted as recommended above, visibility can be improved by extending that part of the sidewalk that adjoins the crosswalk out to the edge of the parking lane (figure 36).

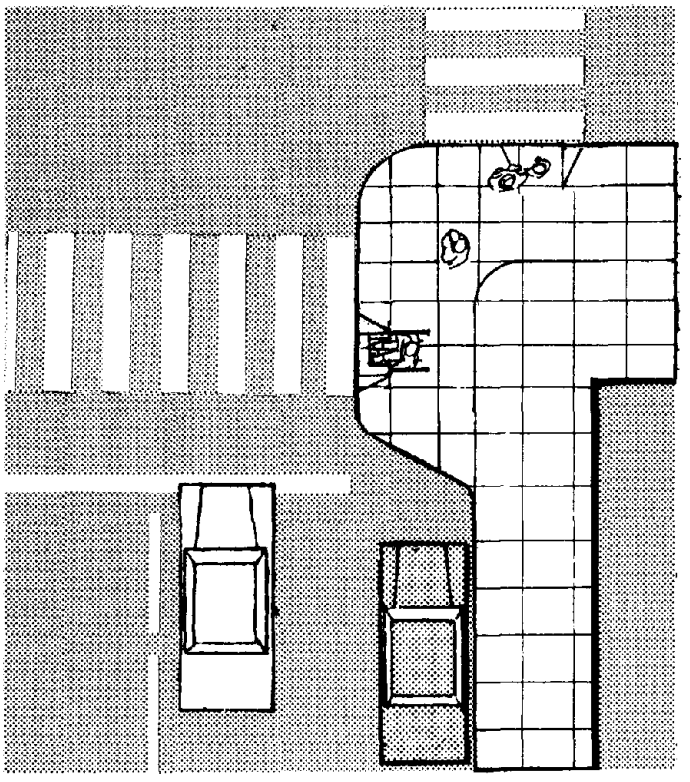


Figure 36. Sidewalk extension into the intersection.

At certain intersections it may be desirable to prohibit right turns on red or to prohibit right turns on red when pedestrians are present.

Stop lines may be provided at intersections that have a stop sign or a traffic signal. The stop line should be placed 4 ft (1.2m) in advance of and parallel to the nearest crosswalk line. In the absence of a crosswalk, the stop line should be placed at the desired stopping point, in no case more than 30 ft (9m) or less than 4 ft (1.2m) from the nearest edge of the intersecting roadway.

☐ Platoon space.

Problem: At intersections with high pedestrian volumes, there is often insufficient space on the sidewalk to wait to cross. The resultant crowding is troublesome to some elderly and handicapped people, and may encourage other pedestrians to stand in the street or in the crosswalk.

Recommended Solution: At intersections where there is a high volume of pedestrian traffic, a platoon space or waiting area may be formed by extending a part of the sidewalk into the crosswalk areas. On streets with parking permitted, this platoon space also permits better visibility for the pedestrian and motorist (figure 37).

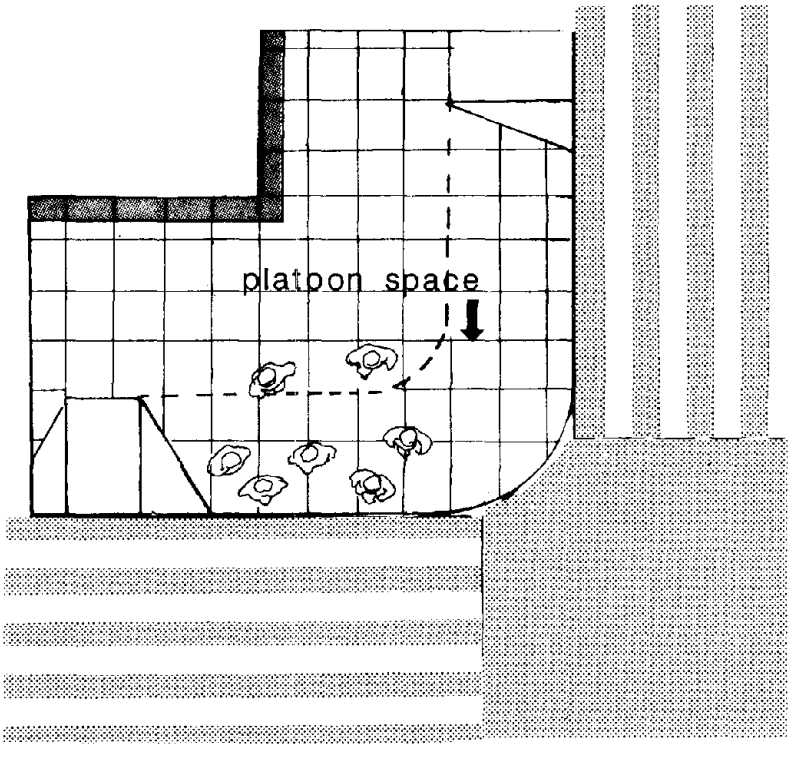


Figure 37. Extended sidewalk for platoon space.

Specific Design Problems (Design Details)

Checklist of Problems

- ☐ Crosswalk width.
- ☐ Crosswalk length.
- ☐ Crosswalk markings/stopline markings.
- ☐ Crosswalk surface.

☐ Crosswalk width.

Problem: Crosswalks are often too narrow and during heavy pedestrian movements become congested. For people with poor balance and ambulatory difficulties, this may be hazardous.

Recommended Solution: Crosswalk width should be based on pedestrian volume. Crosswalks shall never be less than 6 ft (1.8m) wide.

☐ Crosswalk length.

Problem: The greater the time the pedestrian is exposed in the crosswalk the greater the risk of an accident. When the road is very wide, elderly and handicapped pedestrians may not be able to complete their crossing before the traffic light changes. Very wide streets may be of too great a distance to travel without an opportunity to stop and rest.

Recommended Solutions: At signalized intersections the length of the crosswalk should be coordinated with the green time provided by the signal. The safe green time for a signal should be determined by assuming a maximum speed of 3.5 ft per second (1.07 m/sec) plus a tolerance of 2 seconds for reaction time.

If it is not possible to allow sufficient green time on the signal for a safe crossing, the crosswalk can be shortened by; adding a refuge island in the middle of the street (figure 38) or by extending the sidewalk to the edge of the parking lane.

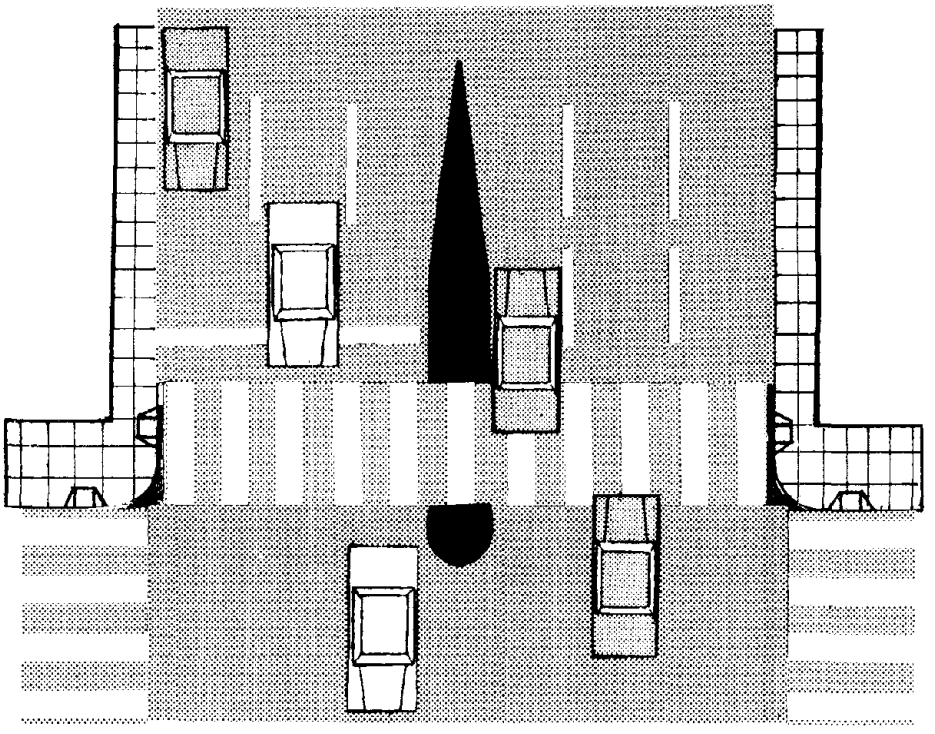


Figure 38. Refuge island.

☐ Crosswalk markings/stopline markings.

Problems: In some areas, crosswalk markings appear to vary. Some places use a different material than the street pavement to mark the crosswalk while others use white paint.

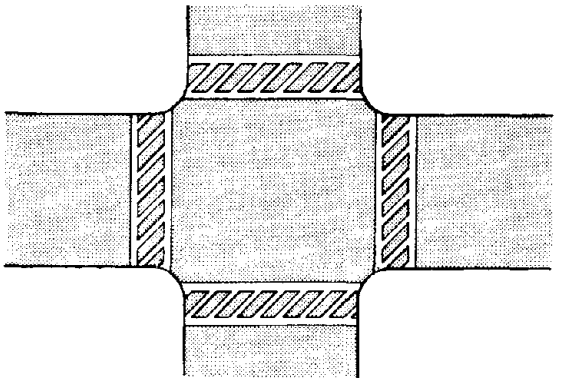
Crosswalks delineated with brick tend to become rough because of the many joints making it difficult for some wheelchair users to negotiate.

Visually impaired people may stray out of the crosswalks because painted crosswalk markings are difficult to detect.

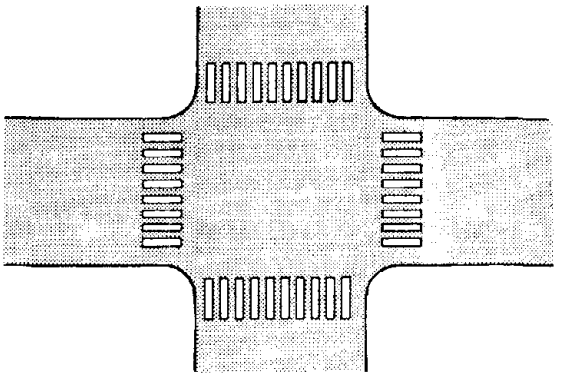
What is the standard size and color of the stopline?

Recommended Solutions: The standard markings for a commonly used crosswalk are presented earlier in this chapter under "Standards".

Under special circumstances where no advance stopline is provided or where vehicular speeds exceed 35 mi/h (56 km/h) or where crosswalks are unexpected, it may be desirable to increase the width of the crosswalk line up to 24 in (610mm) in width. For added visibility, the area of the crosswalk may be marked with white diagonal lines at a 45 degree angle or with white longitudinal lines at a 90 degree angle to the line of the crosswalk. These lines should be approximately 12 in to 24 in (305mm to 610mm) wide and spaced 12 in to 24 in (305mm to 610mm) apart. When diagonal or longitudinal lines are used to mark the crosswalk, the transverse crosswalk lines may be omitted (figure 39).



(a) Crosswalk marking with diagonal lines for added visibility.



(b) Crosswalk marking with longitudinal lines for added visibility.

Figure 39. Typical crosswalk markings.

If a different material than the street pavement is used to delineate the entire crosswalk area, avoid the use of brick pavers or other materials in small units with many joints.

The crosswalk lines can be delineated with a different material such as brick pavers or a concrete strip set in the roadway pavement. In addition to the different material insets, solid white lines shall designate the limits of the crosswalk.

Stop lines are solid white lines, normally 12 in to 24 in (305mm to 610mm) wide extending across all approach lanes of the roadway.

☐ Crosswalk surface.

Problems: The traversable area within the crosswalk lines sometimes contain manhole covers, grates and/or are painted, making it difficult or slippery to use.

If the crosswalk and the curb ramp or walkway are constructed of the same material there is a danger that visually impaired people may enter the crosswalk unknowingly.

Recommended Solutions: Crosswalks should have a stable, firm, slip resistant surface. Wherever possible manhole covers, gratings and other access covers should not be located in the crosswalk. If manhole covers, gratings or other access covers must be located in the crosswalk they should be flush with the surface, visible and slip resistant. Gratings should be designed to conform with the standards listed in Chapter 5 of this manual.

The surface or material of the crosswalk, curb ramp and sidewalk should be different so that the junctions between them are detectable to the visually impaired.

CHAPTER 8: Refuge Islands

1. Scope

This chapter deals with pedestrian refuge islands. Standards for refuge islands are presented. Problems and recommended solutions are addressed to show how refuge islands should be designed and installed to properly interface with the other elements that make up an accessible route.

2. Definitions

Traffic control island: A defined area between traffic lanes for control of vehicle movements or for pedestrian refuge.

Pedestrian refuge island: Specifically defined areas for those pedestrians that cannot cross the entire roadway at one time.

3. Standards

a. General

The specific function of a pedestrian refuge island is to provide a stopping place for pedestrians who cannot cross the entire roadway width at one time safely because of changing traffic signals or on coming traffic.

Refuge islands are particularly useful at intersections in urban areas where there is a considerable amount of pedestrian traffic and where heavy volumes of vehicular traffic make it difficult and dangerous for pedestrians to cross, such as:

- On multi-lane roadways.

- In large or irregularly shaped intersections.

- At signalized intersections to provide a place of safety between different traffic streams.

When refuge islands are required at each intersection along a street, consideration should be given to providing a continuous median divider strip between intersections.

Passenger loading islands are considered to be a special class of refuge islands inasmuch as they serve as a pedestrian refuge while loading and unloading passengers from transit vehicles.

The necessity for islands should be determined only by careful study, since they are placed in an area that would otherwise be available for vehicular traffic. This is particularly true for a channelizing island because the shape and size of the island will vary widely according to the intersection conditions. For this reason, it may be desirable to test the layout by temporarily delineating channelizing islands before final installation.

Islands should be carefully planned and designed to provide travel paths that are obvious, easy to follow, and continuous, so as not to constitute a hazard in the roadway.

The number of channelizing islands used at any intersection should be kept to a minimum and the entire layout should be the simplest design that will accomplish the desired intersection control. Usually a few carefully placed islands larger than minimum size are more effective than a greater number of small islands which create multiple channels and cause confusion.

Islands should be clearly visible at all times and from a position sufficiently in advance so that the vehicle operators will not be surprised by their presence. Islands should occupy the minimum of roadway space needed for the purpose and yet be of sufficient size to be noticeable.

The approach nose of a divisional or pedestrian refuge island which separates opposing traffic movements should be offset to the left, as faced by approaching traffic. The right curb of the island should form a diverging taper to deflect traffic toward the right. Where a channelizing or divisional island is introduced between two lanes of traffic moving in the same direction, similar offsets should be used, to the extent that space permits, on each side of the nose to direct traffic into the separate roadways.

Criteria for the design of islands are contained in A Policy on Geometric Design of Highways and Streets, 1984.

b. Size and Shape

Islands generally are either narrow and elongated or triangular in shape. The size should be governed by site conditions and the function of the island. An island should be large enough to command attention.

For rural conditions, triangular islands should be at least 75 square feet (22.9m square meters) and preferably 100 square feet (30.5m square meters). For urban conditions where speeds are low, islands about two-thirds this size may be acceptable. Elongated islands should be not less than 4 ft (1.2m) wide and 20 ft (6.1m) long. In special cases where space is limited, elongated islands may be as narrow as 2 ft (0.6m) except where used as pedestrian refuge areas, and as short as 12 ft (3.66m).

Refuge islands should preferably be at least 6 ft (1.8m) and in no case less than 4 ft (1.2m) wide. The usable length along the roadway, including any section at pavement level at the crosswalk, should not be less than 12 ft (3.66m) or the width of crosswalk, whichever is greater.

c. Designation of Island Areas

Easy recognition of islands by approaching vehicle operators is necessary for efficient and safe operation. The forms or means of designating island areas vary, depending on their sizes, locations, and functions, and also the character of the adjacent area, rural or urban. An important consideration, in all locations, is to provide a contrast in color, and preferably texture, between islands and adjacent pavements.

Generally, islands should present the least potential hazard to approaching vehicles and yet perform their intended functions. When curbs are used, the mountable type is preferable except where a barrier curb is essential for traffic control or pedestrian refuge. Barrier curb also may be used on islands where traffic control devices are installed.

Islands may be designated as follows:

- Raised and outlined by curbs and filled with pavement, turf, or other material.

- Formed by pavement markings (sometimes supplemented by buttons or raised bars or flexible stanchions on all-paved areas).

- Unsurfaced areas (sometimes supplemented by delineators, guideposts, or other devices).

Raised islands shall be cut through level with the street or have curb ramps at both sides leading to a level area at least 48 in (1220mm) long in the part of the island intersected by the crossing (Figure 40).

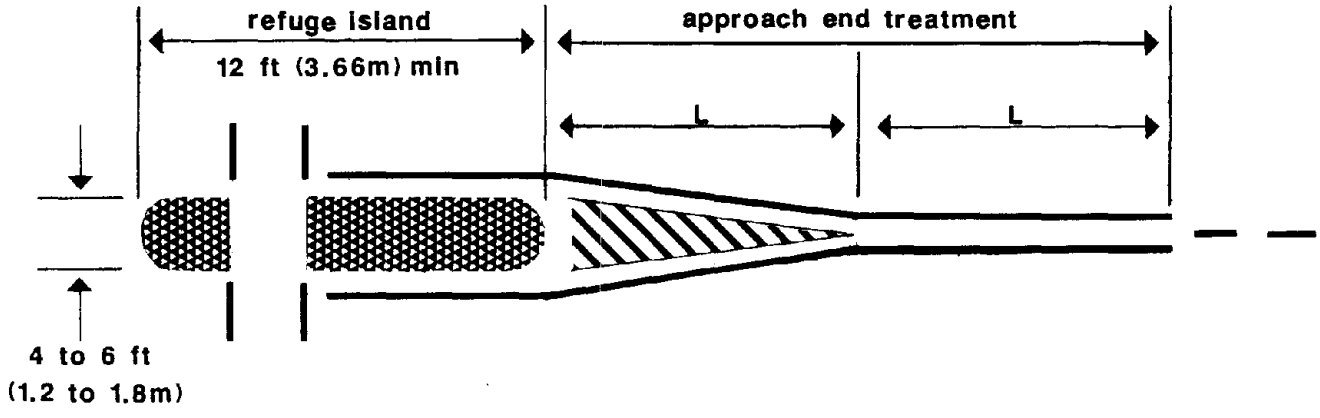


Figure 40. Size and shape of refuge islands.

Landscaping, where used, should be carefully planned to provide unrestricted visibility for vehicle operators and pedestrians. Since pedestrian refuge and channelizing islands are located in the line of the traveled-way, no physical obstructions, other than traffic control devices, should be placed in the islands.

d. Approach End Treatment

The approach end of an island or group of islands must be carefully designed to provide a maximum degree of warning of the presence of the island and a definite indication of the proper vehicle path or paths to be followed. This applies to the approach to all refuge and channelizing islands and to individual divisional islands, but is not applicable to island ends at median openings on a divided street or highway and may not be

necessary at secondary islands located within a multiple-island intersection.

Various methods of approach-end treatment have been used with satisfactory results: contrasting pavement colors or textures, raised bars, buttons, and median blocks.

The ends of islands first approached by traffic should be preceded by a gradually diverging marking on the roadway surface, so as to guide vehicles into desired paths of travel along the island edge (Figure 40). These markings may contain slightly raised (usually less than 1 in (25mm) high) sections of coarse aggregate or other suitable material that may be crossed readily even at considerable speeds. These rumble sections provide increased visibility of the marked areas and produce an audible warning to vehicles inadvertently travelling across them.

Higher raised bars or buttons may be used in advance of islands having barrier curbs, but they should not be used where they constitute an unexpected hazard. These devices should not project more than 1 to 3 inches (25 to 76mm) above the pavement surface, so that any wheel encroachment within the area will become obvious to the vehicle operator without a resultant loss of control of the vehicle. Where practical, such bars or buttons may be preceded by rumble sections, or their height should be gradually increased as approached by traffic. Pavement markings may be used with raised bars or buttons to better designate the island area.

e. Illumination

All islands and the proper channels of travel through them should be made clearly visible at night by adequate reflectorization and/or illumination. Illumination of refuge islands, including their approach-end treatment, should be sufficient to show the general layout of the island and immediate vehicular travel paths, with the greatest concentration of illumination at points of possible danger to pedestrians or vehicles, as at barrier curbs or other structures.

f. Signs and Markings

Although safety and efficiency of operation of sections of roadways adjacent to islands depend to a considerable degree on the geometric design, the physical layout should be supplemented by effective signing and marking as a means of informing, warning, and controlling drivers. Signing and marking should be coordinated with the physical layout prior to completion of design. Signing and marking cannot correct an improper geometric design feature. Since many standard signs and markings are applicable and needed because of the existence of islands, the reader should refer to the Manual of Uniform Traffic Control Devices for guidance on signing and marking selection and placement.

4. Problems and Recommended Solutions

Problems and recommended solutions for pedestrian refuge islands are presented at two levels of detail: (1) General design problems and recommended solutions address the layout and placement of the refuge island; and (2) specific design problems and recommended solutions address the details of refuge island design.

General Design Problems (Layout and Placement)

Checklist of Problems

- ☐ Refuge island location.
- ☐ Refuge island placement.

☐ Refuge island location.

Problem: Designers of accessible routes are faced with the trade-off of providing full width traffic lanes versus providing safe refuge places for elderly and handicapped pedestrians.

Recommended Solutions:

To determine when a pedestrian refuge island is needed, designers should study the location thoroughly. At signalized intersections (figure 41) the distance of the street crossing and the walk cycle of the signal should be reviewed. If the entire roadway cannot be traversed, using a speed of 3.5 ft/sec (1.07 m/sec), within the walk cycle of the signal and the signal timing cannot be lengthened or an alternate crossing designated then a refuge island should be considered.

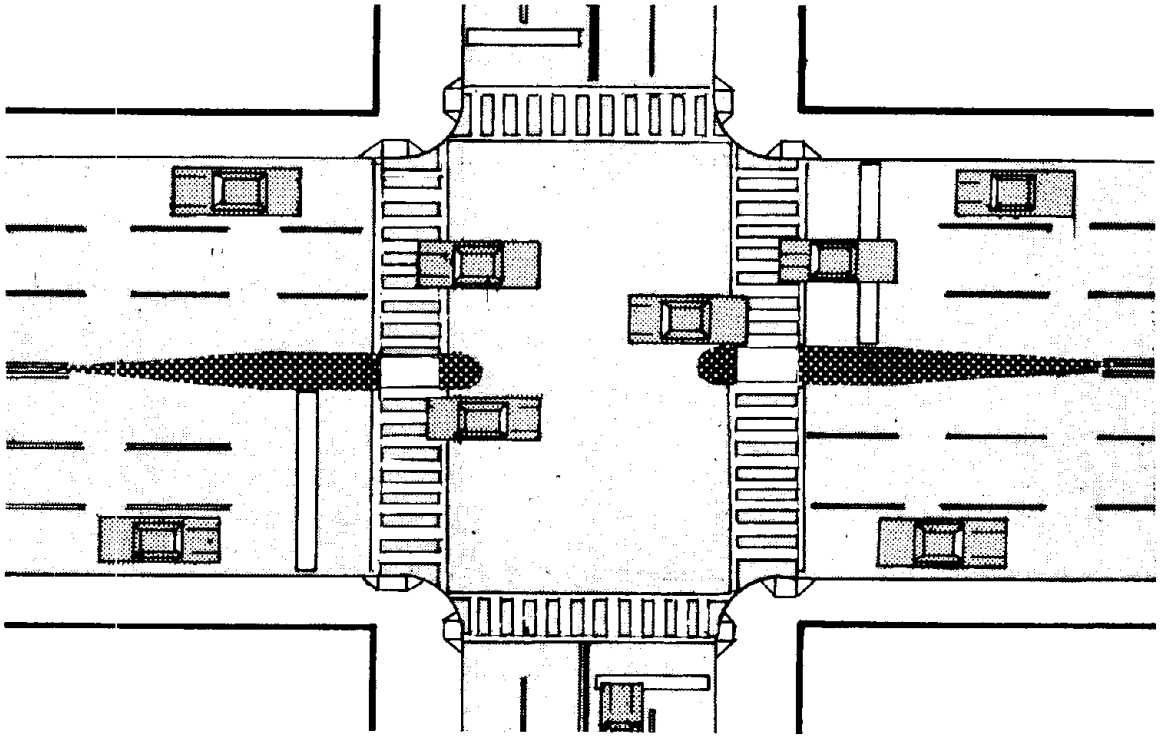


Figure 41. Refuge islands at signalized intersections.

On multi-lane roadways (figure 42), refuge islands should be considered to allow elderly and handicapped pedestrians a place to stop and rest and to observe the traffic coming from the opposite direction.

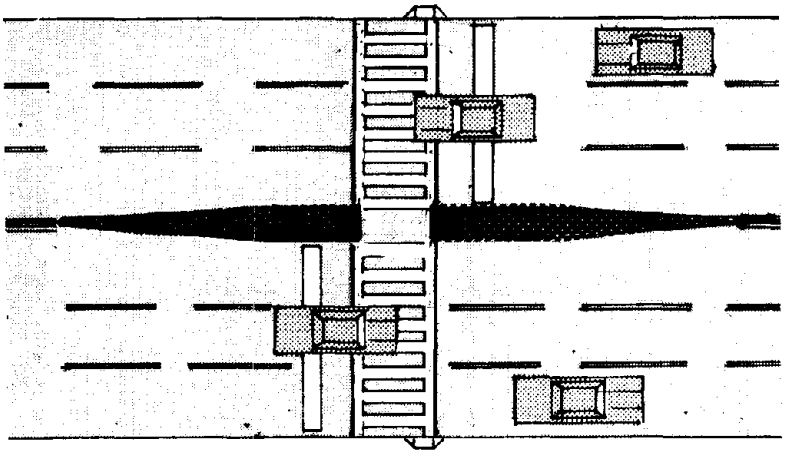


Figure 42. Refuge islands on multi-lane roadways.

At complex or irregularly shaped intersections (figure 43), refuge islands should be considered to provide elderly and handicapped pedestrians a place to stop and rest and to get oriented to the flow of on coming traffic.

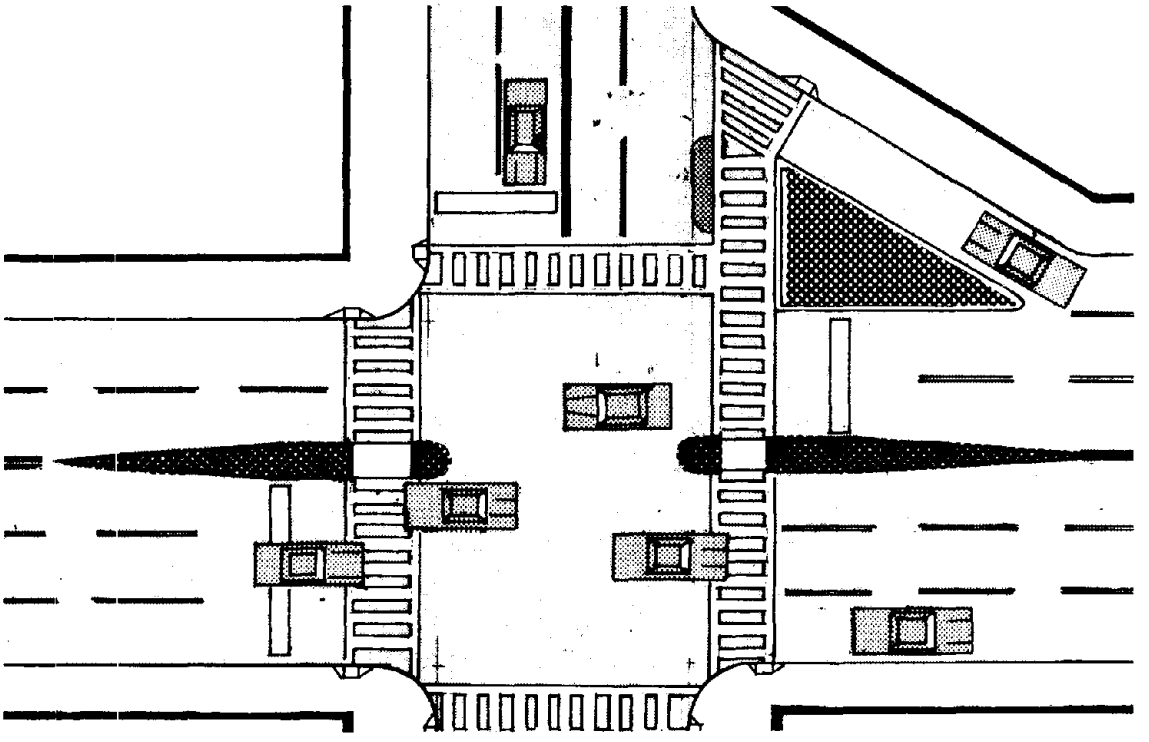


Figure 43. Refuge islands at complex intersections.

☐ Refuge island placement.

Problem: Some refuge islands are placed in areas that are difficult to see from the on coming vehicles.

Recommended Solutions: Refuge islands must be placed in areas that are clearly visible at all times. The refuge island must be seen from a position sufficiently in advance so that the vehicle operator will not be surprised. Large trees or shrubs or large pieces of street furniture, electrical or signal timing boxes should not be placed on the refuge island since they can obstruct the view of the vehicle operator.

Problem: Some refuge islands are placed such that they strand elderly and handicapped pedestrians in the middle of complex intersections.

Recommended Solutions: The placement of each refuge island must be reviewed carefully in relation to the overall intersection. Complex intersections with dedicated turning lanes must be carefully studied to determine the most advantageous placement for refuge islands. The pedestrian signal phases must be set to insure that when the elderly or handicapped pedestrian leaves the refuge island at the start of the walk cycle, the trip can be completed by the end of the walk cycle.

Specific Design Problems (Design Details)

Checklist of Problems

Refuge Island:

- ☐ Shape.
- ☐ Size.
- ☐ Delineation.
- ☐ Markings.
- ☐ Signs.
- ☐ Surface.
- ☐ Visibility.

☐ Refuge island shape.

Problem: The shape of some refuge islands is such that they entice pedestrians to cross the street at areas where crossing is prohibited or they do not accommodate waiting pedestrians at designated crossings.

Recommended Solutions: The shape of islands should be either elongated or triangular. In areas where pedestrian crossing is prohibited the island should be narrow enough to deliver the message not to cross. Where the island is to be used as a refuge island the shape should be such that it will accommodate waiting pedestrians (figure 44).

Figure 44. Refuge island shape.

☐ Refuge island size.

Problem: Some refuge islands are so narrow that it is unsafe for persons in attended wheelchairs to stop.

Recommended Solution: Refuge islands should preferably be 72 in (1828mm) wide. In no case should they be less than 48 in (1220mm) wide.

Problem: Some islands are so small that it appears to be unsafe to stop on them.

Recommended Solutions: The length of a refuge island should be no less than 12 ft (3.66m) measured from end to end of the island and including section at pavement level at the crosswalk location. Raised islands shall be cut through level with the street or have curb ramps at both sides leading to a level area at least 48 in by 48 in (1220mm by 1220mm).

☐ Refuge island delineation.

Problem: Some refuge islands are difficult to see because of obliterated pavement markings, dirt, ice, or snow.

Recommended Solutions: Refuge islands can be delineated by using pavement markings, a different texture of pavement, buttons, or flexible stanchions. Refuge islands should preferably be raised and outlined by barrier curbs and filled with pavement, turf, or other materials.

Problem: Some refuge islands appear to be unsafe because they are at the same level as the street.

Recommended Solution: In areas of high traffic volumes refuge islands will be more visible and safer for the pedestrian if they are raised (outlined with barrier curbs and filled behind with pavement).

☐ Refuge island markings.

Problem: Some refuge islands seem to be better marked than others.

Recommended Solutions: In general, islands should be marked with reflectorized white or yellow paint as determined by the direction of travel. Object markers should be used on island approach noses to indicate the presence of a raised curb. Delineators, when used, should be the same color as the edge lines except when facing wrong-way traffic they shall be red.

☐ Refuge island signs.

Problem: Some islands are difficult to see from a distance because there is nothing to delineate them from the roadway.

Recommended Solutions: Signs and/or markers should be used to designate all approach noses of raised refuge islands. All signs used on the island should be reflectorized or illuminated. Usually signs will not be used on islands designated only by painted markings on the pavement thus care should be taken to properly maintain and illuminate painted pedestrian refuge islands.

☐ Refuge island surface.

Problem: It is sometimes difficult for the visually impaired to know where the boundaries of the refuge island are if the surface continues at the same level as the crosswalk.

Recommended Solutions: The surface of the refuge island should be a different color and texture than the street and crosswalk surfaces.

☐ Refuge island visibility.

Problem: Some refuge islands have plantings, signs, or signal and electrical boxes on them making it difficult for vehicle operators to see pedestrians of small stature or people in wheelchairs.

Recommended Solutions: No physical obstructions other than the required traffic control devices should be placed in pedestrian refuge islands. If landscaping is required it should be carefully planned to provide unrestricted visibility for vehicle operators, pedestrians of small stature, and people in wheelchairs.

Problem: Some refuge islands are difficult to see at night.

Recommended Solution: Illumination of refuge islands should be sufficient to show the general layout of the island with the greatest concentration of illumination at points of possible danger to pedestrians.

CHAPTER 9: Parking Spaces,

Passenger Loading Zones and Bus Stops

1. Scope

This chapter discusses parking spaces, passenger loading zones and bus stops, as well as, the access to and from these elements. Design standards are presented and problems with recommended solutions are reviewed to show how these elements should be designed and properly installed to interface with other elements that make up an accessible route.

2. Definitions

Parking space: Pavement dedicated by signage or markings as a space to be used for vehicular parking.

Passenger loading zone: A pavement area dedicated for temporary parking by a vehicle to on- or off-load passengers.

Bus stop: An area dedicated by signage or pavement markings or a specially designed turnout or pull through area for on- or off-loading passengers.

3. Standards

a. Minimum number of accessible spaces

If parking is provided at a site, the required minimum number of accessible spaces for different parking lot sizes is shown in table 3.

If passenger loading zones are provided at a site, one passenger loading zone shall be accessible.

Parking spaces for side lift vans are accessible parking spaces and may be used to meet the above requirements.

Table 3. Number of accessible parking spaces.

Total Parking in lot	Required Minimum Number of Accessible Spaces
1 to 25	1
26 to 50	2
51 to 75	3
76 to 100	4
101 to 150	5
151 to 200	6
201 to 300	7
301 to 400	8
401 to 500	9
501 to 1000	*
1001 and over	**

* 2 percent of total

** 20 plus 1 for each 100 over 1000.

b. Location

Parking spaces for disabled people and accessible passenger loading zones that serve a particular building shall be the spaces or zones located closest to the nearest accessible entrance on an accessible route. In separate parking structures or lots that do not serve a particular building, parking spaces for disabled people shall be located on the shortest possible circulation route to an accessible pedestrian entrance of the parking facility.

c. Parking space dimensions

Parking spaces for disabled people shall be at least 96 in (2440mm) wide and shall have an adjacent access aisle 60 in (1525mm) wide minimum (figure 45). Parking access aisles shall be part of an accessible route to the building or facility entrance. Two accessible parking spaces may share a common access aisle. Parked vehicle overhangs shall not reduce the clear width of an accessible circulation route. Parking spaces and access aisles shall be level with surface slopes not exceeding 1:50 in all directions.

If accessible parking spaces for vans designed for handicapped persons are provided, each should have an adjacent access aisle at least 96 in (2440mm) wide.

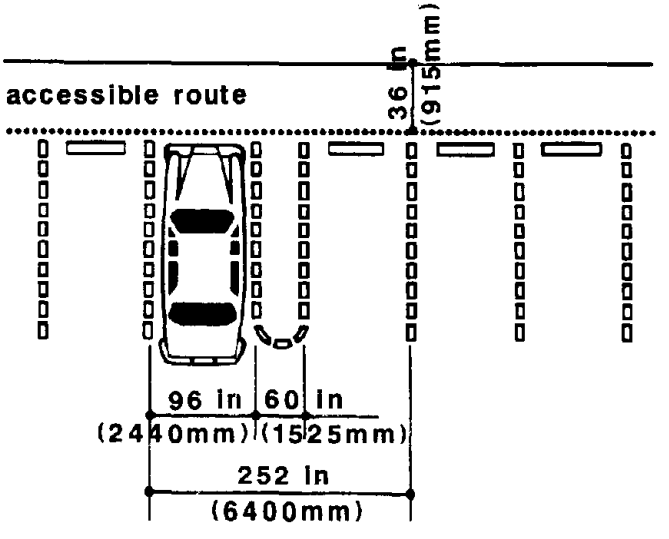


Figure 45. Dimensions of parking spaces.

d. Passenger loading zone dimensions

Passenger loading zones shall provide an access aisle at least 60 in (1525mm) wide and 20 ft (6m) long adjacent and parallel to the vehicle pull-up space (figure 46). If there are curbs between the access aisle and the vehicle pull-up space, then a curb ramp shall be provided. Vehicle standing spaces and access aisles shall be level with surface slopes not exceeding 1:50 in all directions.

Minimum vertical clearances of 9.5 ft (2.9m) shall be provided at accessible passenger loading zones and along vehicle access routes. If accessible van parking spaces are provided, the minimum vertical clearance should also be 9.5 ft (2.9m).

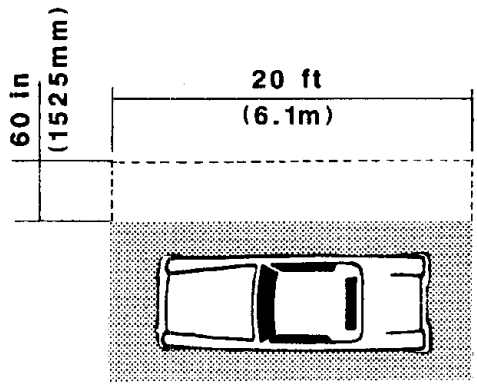


Figure 46. Access aisle at passenger loading zone.

e. Designation

Accessible parking spaces and passenger loading zones shall be designated as reserved for the disabled by a sign showing the International Symbol of Access (figure 47). Such signs shall not be obscured by a vehicle parked in the space. Parking space markings shall be white.

sign size
12 in by 18 in
(305mm by 457mm)

Figure 47. Reserved parking sign.

4. Problems and Recommended Solutions

Problems and recommended solutions are presented at two levels of detail: (1) General design problems and recommended solutions address the location and placement of parking spaces, passenger loading facilities and bus stops; and (2) specific design problems and recommended solutions address the design details of those facilities.

General Design Problems (Location and Placement)

Checklist of Problems

- ☐ Number.
- ☐ Location.
- ☐ Placement.
- ☐ Enforcement.

☐ Number.

Problem: There are generally too few parking spaces which are fully accessible to the handicapped.

Recommended Solution: In all parking garages and parking lots, the minimum number of accessible parking spaces recommended is shown in table 4.

Table 4. Number of accessible parking spaces.

Total Parking in lot	Required Minimum Number of Accessible Spaces
25	1
50	2
75	3
100	4
150	5
200	6
300	7
400	8
500	9
1000	2% of total
greater than 1000	20 plus 1 for each 100 over 1000

☐ Location.

Problems: Accessible parking spaces are often located too far from the destination point. Barriers often obstruct a clear path from the parking space to the destination. Wheelchair occupants are often not visible to other drivers when traversing a parking lot.

Recommended Solutions: Parking spaces and passenger loading zones which are designated for the handicapped should be located as close as possible to the accessible route or accessible entrances of the buildings and facilities served by the lot. Parking spaces, passenger loading zones, and bus stops should be located so there is a clear accessible route between them and the primary facility which they are serving. Every effort should be made to provide access from the parking space, passenger loading zone, or bus stop via an accessible walkway. The elderly and handicapped, especially persons in wheelchairs, should not be forced to use the parking lot as a walkway.

☐ Placement.

Problem: Parking spaces and passenger loading zones, are often placed in a way that it is difficult to utilize the access aisles leading to the accessible route.

Recommended Solutions: Ideally, an accessible parking space should be placed in an area where the handicapped person may position the vehicle so it can be exited from either side and have clear access to the accessible route. Passenger loading zones that require parallel parking should be placed in an area where there is ample room to position the vehicle for exit from either side with a 5 ft (1.52m) clear width between the parked vehicle and oncoming traffic, or the curb.

Problem: Bus stops are often placed where it is hazardous for the elderly and handicapped to enter or exit the bus.

Recommended Solution: Bus stops at intersections may be located on the near (approach) side or the far (exit) side of the intersection. There are advantages and disadvantages to each situation. Each case should be examined separately and a determination made as to the most suitable location, with consideration given to service and safety to patrons, efficiency of transit operation, and traffic operation in general. Far-side stops are generally better than near-side stops. Far-side stops are advantageous at intersections where: (1) other buses may turn in either direction; (2) turning movements from the arterial in the direction being considered are heavy, particularly right turns; (3) cross traffic is heavy and the curb lane is needed for storage during periods when the signal is red; and (4) several streets meet at the intersection. Far-side stops have proven to be an effective measure to reduce pedestrian accidents. When near-side stops are used the view to the right may be blocked by a stopped bus. Near-side stops also cause difficulty to vehicles making right turns. Drivers frequently swing around the bus to turn right which may cause a hazard to an elderly or handicapped person in the crosswalk. On highly developed arterials with ample right of way bus stops should be placed in bus turnouts (figure 48).

Problem: Some bus stops which are located on city streets are so cluttered with street furniture (trash receptacles, newspaper racks, and street signs) that there is not sufficient room for a person in a wheelchair to gain access to the wheelchair lift on the bus.

Figure 48. Bus turnout.

Recommended Solution: Care should be taken when designating a specific corner as a bus stop to insure that all unnecessary street furniture is located so that a clear area of at least 60 in by 60 in (1525mm x 1525mm) is available in a location where the bus lift can be accessed. A 96 in (2440mm) wide access aisle is preferred.

☐ Enforcement.

Problem: Parking spaces and passenger loading zones reserved for the handicapped are often used by able bodied people.

Recommended Solution: Reserved spaces for the handicapped should be clearly signed and marked (figure 49). The spaces should be located in view of parking attendants and police so that they can ensure that the reserved spaces are used for the purpose intended.

Figure 49. Reserved parking sign.

Problem: Automobiles or delivery trucks are often parked in the bus stop area making it impossible for the bus to pull up to the curb to serve the elderly and handicapped.

Recommended Solutions: In large urban areas the transit authority police force could be given the authority to issue citations to vehicles parked in bus stop areas. In small cities the local police force should enforce the parking regulations.

Specific Design Problems (Design Details)

Checklist of Problems

- ☐ Width.
- ☐ Length.
- ☐ Clear height.
- ☐ Grade.
- ☐ Bus stop shelters.

☐ Width.

Problem: Parking spaces and passenger loading zones reserved for handicapped are often too narrow for persons in wheelchairs to exit safely from the vehicle.

Recommended Solutions: Parking spaces reserved for handicapped should be at least 252 in (6400mm) wide. This allows 96 in (2400mm) for the vehicle and provides a 60 in (1525mm) access aisle to the accessible route (figure 50). If two adjacent spaces are reserved the total width should be 348 in (8840mm). If a parallel parking space or passenger loading zone is reserved for the handicapped a 60 in (1525mm) clear access aisle should be provided out of the path of traffic. If accessible spaces for vans designed for handicapped (lift equipped vans) are provided each space should have an adjacent access aisle at least 96 in (2440mm) wide.

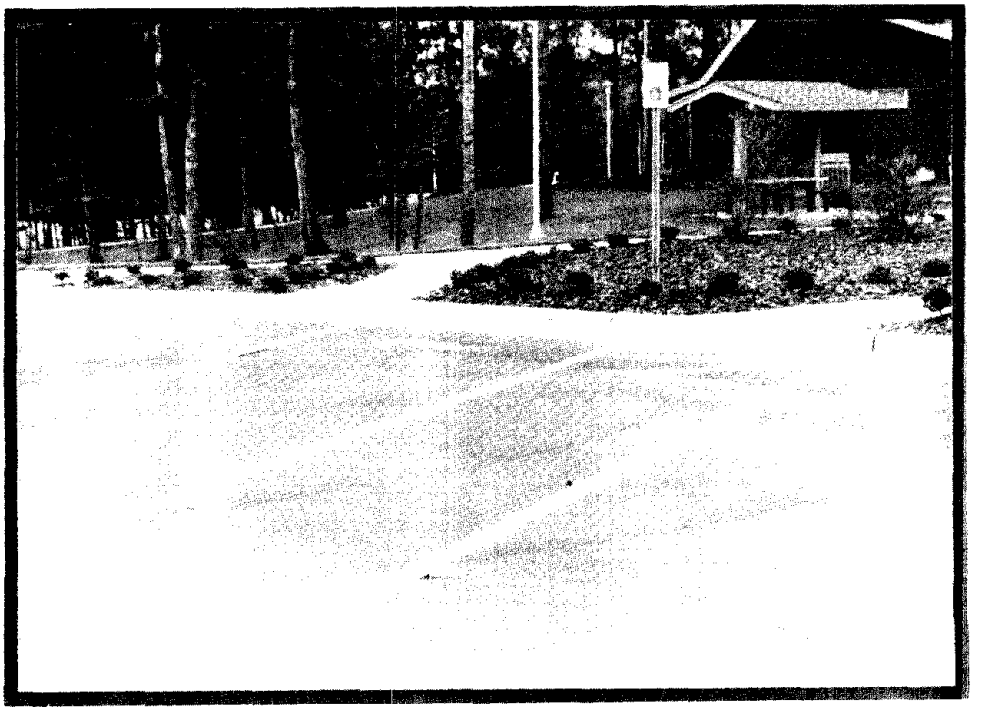


Figure 50. Accessible parking space.

Problem: Some bus turnouts are so narrow that the bus cannot pull completely out of the through traffic lane. This situation can cause traffic back-ups especially when an elderly or handicapped person is boarding the bus due to the longer dwell time required to operate the bus lift.

Recommended Solution: The width of bus turn outs on arterials should be at least 10 ft (3.05m) and preferably 12 ft (3.66m). A clear access aisle 96 in (2440mm) wide should be provided for loading and unloading at the door of the bus when a wheelchair lift is used.

☐ Length.

Problem: Parallel parking spaces and passenger loading zones are sometimes not long enough to permit the elderly and handicapped easy access to the curb.

Recommended Solution: Parallel parking spaces should be at least 20 ft (6.1m) long preferably 22 ft to 26 ft (6.7m to 7.9m) long. If parallel parking spaces are reserved adjacent to each other a 5 ft (1.52m) access aisle should be marked between the spaces (figure 51).

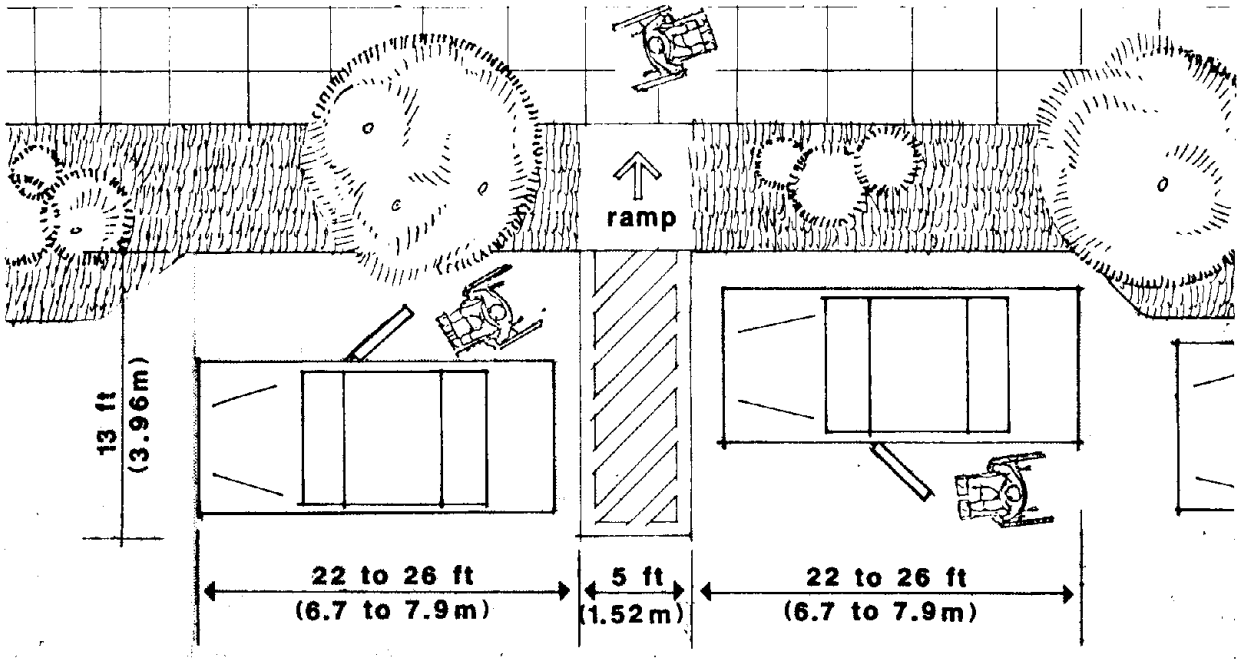
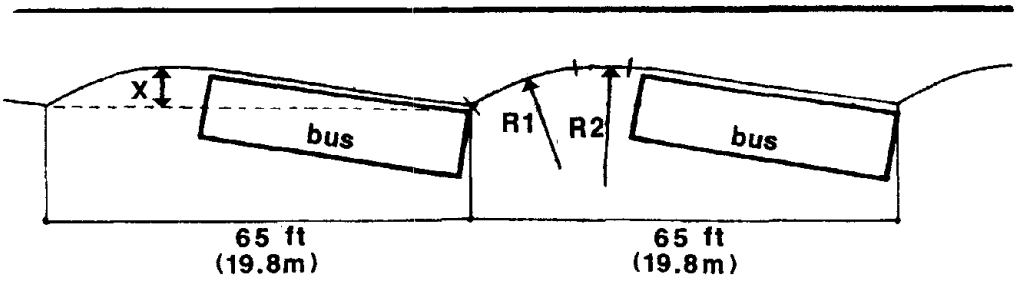


Figure 51. Parallel parking spaces.

Problem: Some bus turnouts are not long enough to allow the bus to pull completely out of the through traffic lanes.

Recommended Solutions: Bus turnouts should provide about 50 ft (15.2m) of length for each bus, preferably 65 ft (19.8m). The bus loading area can be a parallel or a sawtooth design. Where more than two buses are expected to be using the turnout at one time a sawtooth arrangement is preferable, because it is easier for buses to bypass a waiting bus. A recommended design for a sawtooth arrangement is shown in figure 52.



X = 6 ft (1.8m)
R1 = 30 ft (9.1m)
R2 = 100 ft (30.5m)

Figure 52. Sawtooth bus loading area.

☐ Clear height.

Problem: Some parking garages do not have sufficient clear height to accommodate vans equipped with lifts for persons in wheelchairs.

Recommended Solution: A 9.5 ft (2.9m) clearance height is required for vans. If a parking garage does not have that clearance height some other provisions should be made to accommodate the disabled.

☐ Grade.

Problem: Parking spaces located on a sloping grade make it difficult for the disabled to enter and exit the vehicle.

Recommended Solution: Handicapped parking spaces, passenger loading zones, and bus stops shall be approximately level with surface slopes not exceeding 1:50 in all directions.

☐ Bus stop shelters.

Problem: Some bus stop shelters are designed and located such that a person in a wheelchair cannot use them.

Recommended Solutions: Bus stop shelters should be designed with access openings at least 32 in (815mm) wide. Maneuvering clearances at the openings should be 48 in (1220mm) for a front approach and 42 in by 54 in (1065mm by 1370mm) for a side approach.

If the bus stop shelter does not have access openings the shelter should be located at least 36 in (915m) away from the back of the curb to allow a person in a wheelchair ample width to access the shelter.

Problem: Some bus stop shelters do not have adequate space for persons in wheelchairs to wait for the bus out of the elements.

Recommended Solution: The inside dimensions of bus stop shelters should be such that a clear area 48 in by 42 in (1220mm x 1065mm) is available for a wheelchair (figure 53).

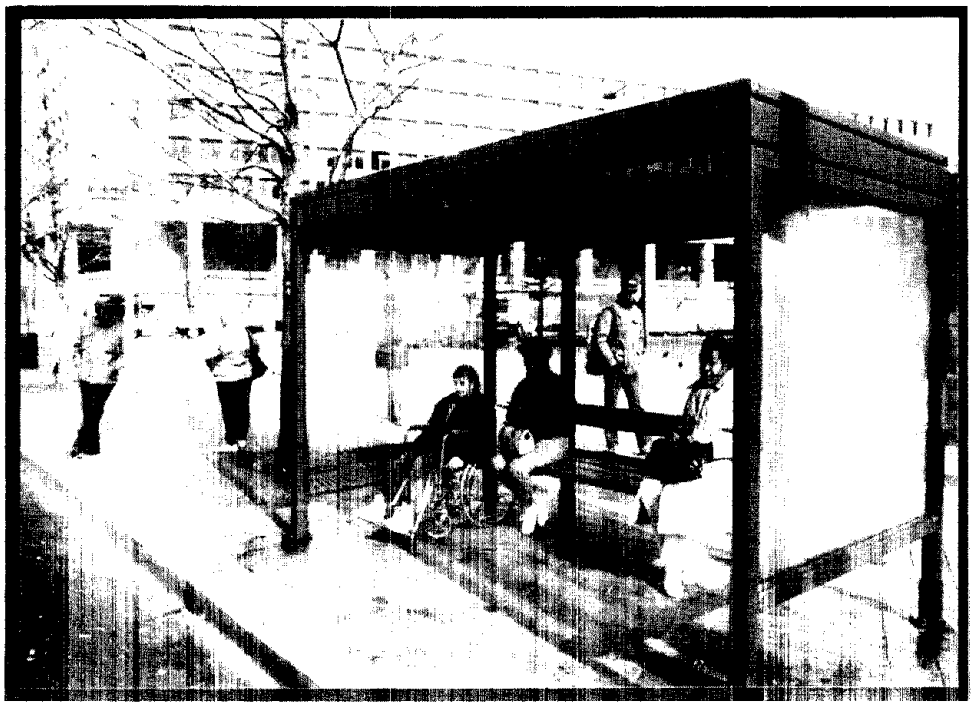


Figure 53. Bus stop shelter.

CHAPTER 10: Ramps

1. Scope

This chapter addresses requirements and recommendations for the design of ramps. It shows how a ramp should be located in relation to other elements that make up the accessible network.

2. Definitions

Ramp: Any part of an accessible route with a running slope greater than 1:20 (5 percent).

Landing: A level area at the bottom and top of each ramp run.

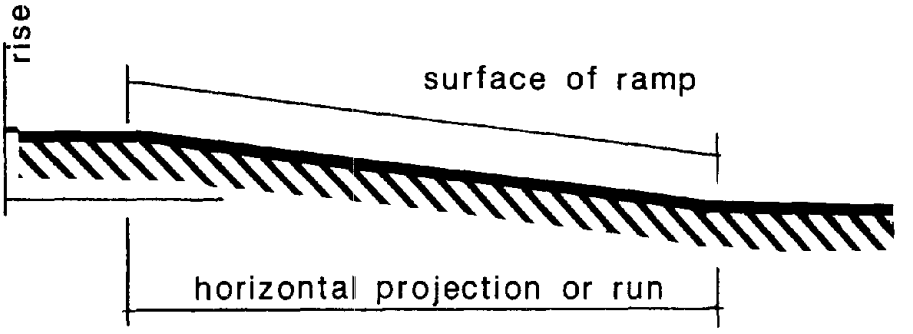
3. Standards

a. Width

The minimum clear width of a ramp shall be 36 in (915 mm).

b. Slope and Rise

The least possible slope shall be used for any ramp. The maximum slope of a ramp in new construction shall be 1:12 (8.33 percent). The maximum rise for any run on a newly constructed ramp shall be 30 in (760 mm) (figure 54). If space limitations prohibit the use of a 1:12 slope or less on existing sites or facilities, then ramps may have slopes, rises, and horizontal projections as shown in table 5. In any event a slope steeper than 1:8 is not allowed.



	maximum rise		maximum horizontal projection	
slope	in	mm	ft	m
1:12 to < 1:16	30	760	30	9
1:16 to <1:20	30	760	40	12

Figure 54. Maximum rise and horizontal projection for single ramps on new construction.

Table 5. Maximum rise and horizontal projection for single ramps on existing sites or facilities.

	Maximum Rise		Maximum Run	
Slope*	in	mm	ft	m
Steeper than 1:10 but no steeper than 1:8	3	75	2	0.6
Steeper than 1:12 but no steeper than 1:10	6	150	5	1.5
*A slope steeper than 1:8 not allowed.				

c. Landings

Ramps shall have level landings at the bottom and top of each run. Landings shall:

- Be at least as wide as the ramp run leading to it.
- Be a minimum of 60 in (1525 mm) clear.
- Be a minimum of 60 in by 60 in (1525 mm by 1525 mm).
- Be level and clear in front of doors and gates.

d. Handrails

If a ramp run has a rise greater than 6 in (150 mm) or a horizontal projection greater than 72 in (1828 mm), then it shall have handrails on both sides. Handrail design shall comply with the standards set forth in the chapter on handrails.

e. Cross Slopes and Surfaces

The cross slope of a ramp surface shall be no greater than 1:50. Ramp surfaces shall be stable, firm, and slip-resistant. Changes in level up to 1/4 in (6 mm) may be vertical and without edge treatment. Changes in level between 1/4 in and 1/2 in (6 mm and 13 mm) shall be beveled with a slope no greater than 1:2.

f. Edge Protection

Ramps and landings with drop-offs shall have curbs, walls, railings, or projecting surfaces that prevent people from slipping off the ramp. Curbs shall be a minimum of 2 in (50 mm) high (figure 55).

g. Outdoor Conditions

Outdoor ramps, approaches, and landings shall be designed so that water will not accumulate on walking surfaces.

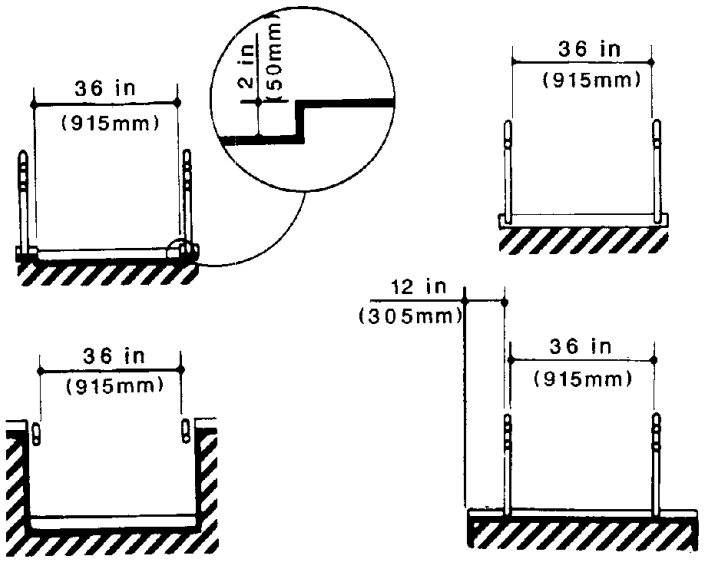


Figure 55. Edge protection for ramps.

4. Problems and Recommended Solutions

Problems and recommended solutions for ramps are presented at two levels of detail: General design problems and recommended solutions address layout and placement of ramps; specific design problems and recommended solutions address the design details of the ramp itself.

General Design Problems (Layout and Placement)

Checklist of Problems

- ☐ Preference for stairs.
- ☐ Adequate space.
- ☐ Use of handrails.

☐ Preference for stairs.

Problem: Many handicapped people, particularly those with braces, prostheses, and crutches, prefer steps to ramps.

Recommended Solution: When deciding if a ramp is needed in place of stairs, the designer should try to accommodate the needs of all pedestrians and, wherever possible, provide access with stairs and a ramp (figure 56). For small changes in level requiring up to three steps, a ramp should be used in place of the steps.

☐ Adequate space.

Problems: Adequate space is often not provided at the top or at the bottom of a ramp. The space in front of doors is often too small for a person in a wheelchair to maneuver.

Figure 56. Ramp and stairs.

Recommended Solutions: When a ramp leads to a doorway or when a doorway is at a landing on a ramp, the areas in front of the doorways should be designed to have a 60 in by 60 in (1525mm x 1525mm) minimum maneuvering clear area.

Level landings shall be provided at the bottom and top of each ramp run (figure 57). The standards describe the physical layout and dimensions of the required landings.

Figure 57. Ramp with intermediate landings.

☐ Use of handrails.

Problem: Some handicapped people with balance problems are concerned about slipping or falling on ramps. Ramps without handrails accentuate this concern.

Recommended Solution: Handrails shall be installed on both sides of the ramp with a rise greater than 6 in (150 mm) or a horizontal projection (run) greater than 72 in (1828 mm). Where sidewalks or walkways are classified as ramps i.e., slopes greater than 1:20 (5 percent), handrails on the street side may be omitted if impractical.

Specific Design Problems (Design Details)

Checklist of Problems

- ☐ Ramp width.
- ☐ Ramp length and slope.
- ☐ Ramp edge protection.
- ☐ Ramp surfaces.

☐ Ramp width.

Problem: Ramps are sometimes too narrow for a wheelchair and often too narrow for a person in a wheelchair to pass anyone.

Recommended Solution: Minimum ramp width by standard is 36 in (915mm). A width of 60 in (1525mm) is desirable which will allow two wheelchair users to pass each other on the ramp. Landings shall be at least as wide as the ramp runs leading to them.

☐ Ramp length and slope.

Problem: Handicapped people find it difficult to use extremely long or steep ramps, or to traverse ramps with severe cross slopes.

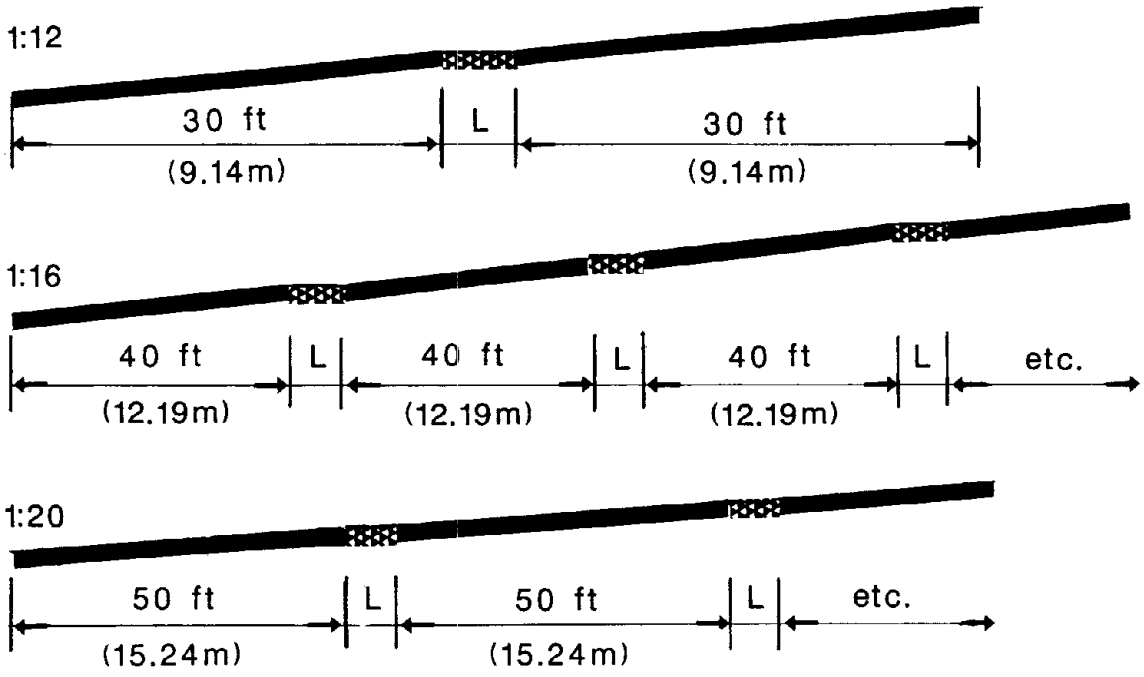
Recommended Solution: Using the maximum rise of 30 in (760mm) for a single ramp run (the standard), maximum horizontal projections are shown in table 6 for slopes ranging from 1:20 (minimum) to 1:12 (maximum for new construction).

Table 6. Ramp slopes.

Slope	Maximum Rise In A Single Run	Maximum Length Of Horizontal Projection
* 1:8 (12.5%)	3 in (75mm)	2 ft (0.61m)
* 1:10 (10.%)	6 in (150m)	5 ft (1.52m)
1:12 (8.3%)	30 in (760mm)	30 ft (9.14m)
1:14 (7.1%)	30 in (760mm)	35 ft (10.67m)
1:16 (6.25%)	30 in (760mm)	40 ft (12.19m)
1:18 (5.5%)	30 in (760mm)	45 ft (13.72m)
1:20 (5%)	30 in (760mm)	50 ft (15.24m)

* Slopes greater than 1:12 can be used for ramps that are being placed within or on existing sites or facilities. A slope of 1:8 shall not be exceeded.

An illustration of the above calculation is shown in figure 58. Note that landings must be placed between ramp runs if the horizontal projection reaches the maximum length.



Note:

Slopes greater than 1:12 can be used for ramps that are being placed within or on existing sites or facilities. A slope of 1:8 shall not be exceeded.

Figure 58. Maximum length.

☐ Ramp edge protection.

Problem: Some ramps are designed without sides or handrails to allow pedestrians access onto the ramp at intermediate points along an adjacent stairway. This is hazardous to handicapped people since they could slip and fall over the edge.

Recommended Solutions: All ramps should be designed to prevent movement onto or off of the sides of the ramp. Curbs, walk railings, or some other projecting surface should be designed as part of the ramp edge. If a curb is used, it should be at least 2 in (50mm) high and wide enough to accommodate a handrail installation, if required sometime in the future (figure 59).

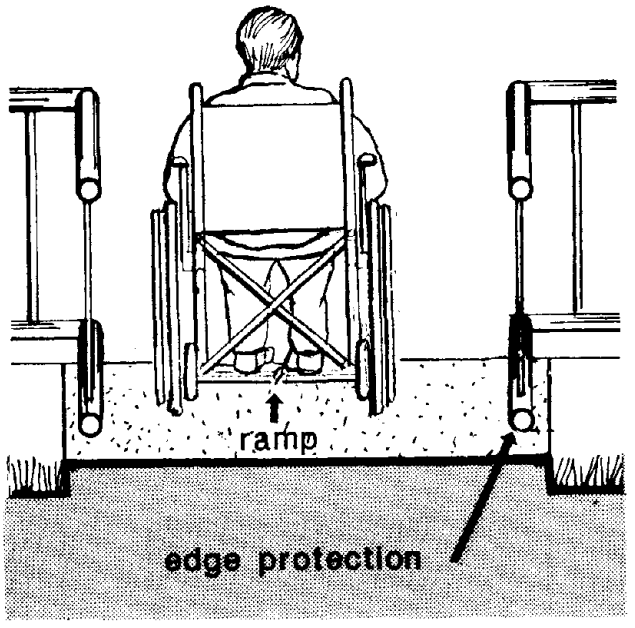


Figure 59. Ramp edge protection.

☐ Ramp surfaces.

Problem: Ramp surfaces can be more hazardous than a flat walkway surface because of the slope.

Recommended Solution: Surface materials for ramps must be slip resistant. Depending on the exposure, care must be taken to correctly maintain the ramp to keep it free from wet leaves, snow, and ice, and see that it drains properly.

CHAPTER 11: Steps and Stairs

1. Scope

This chapter covers design characteristics for steps and stairs.

2. Definitions

Step: One unit that addresses a change in elevation consisting of a riser and a tread.

Stairs: A series of steps, with or without landings, giving access from one level to another.

Tread: The horizontal surface of a step.

Riser: The upright (vertical) face of a step.

Nosings: The rounded edge of a stair tread that projects over the riser.

3. Standards

a. Treads and Risers

On any given flight of stairs, all steps shall have uniform riser heights and uniform tread depths. Stair treads shall be no less than 11 in (280mm) deep measured from riser to riser (figure 60). Open risers are not permitted on accessible routes.

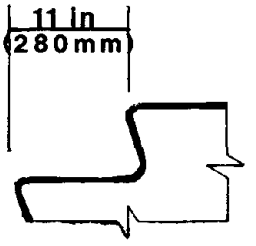


Figure 60. Usable stair tread depth.

b. Nosings

The undersides of nosings shall not be abrupt. The radius of curvature at the leading edge of the tread shall be no greater than 1/2 in (13mm). Risers shall be sloped or the underside of the nosing shall have an angle not less than 60 degrees from the horizontal. Nosings shall project no more than 1-1/2 in (38mm) (figure 61).

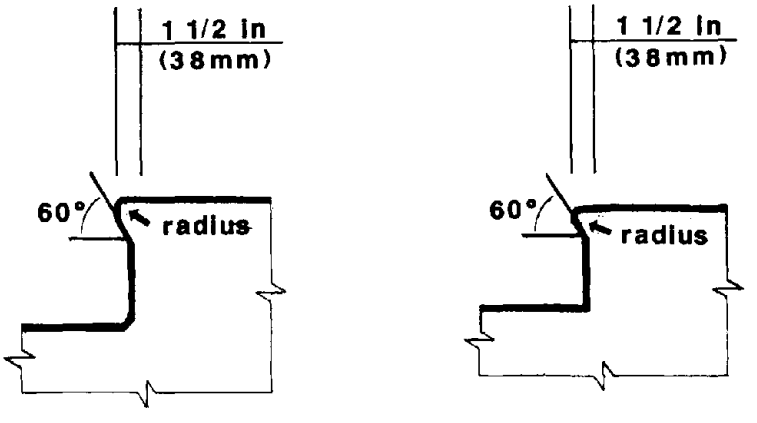


Figure 61. Angled and rounded step nosing.

c. Handrails

Stairways shall have handrails at both sides of all stairs and shall comply with the standards for handrails.

d. Outdoor Conditions

Outdoor stairs and the approaches shall be designed so that water will not accumulate on the walking surfaces.

4. Problems and Recommended Solutions

Problems and recommended solutions for steps and stairs are presented at two levels of detail: General design problems and recommended solutions address location and placement of stairs. Specific design problems and recommended solutions address the design details of steps and stairs.

General Design Problems (Layout and Placement)

Checklist of Problems

- ☐ Level changes.
- ☐ Stair/walkway links.
- ☐ Long flights.
- ☐ Short flights.

☐ Level changes.

Problem: Elderly and handicapped pedestrians have difficulty negotiating stairs so many accidents occur at level changes.

Recommended Solutions: When locating an accessible route large changes in level should be avoided whenever possible. When changes in level must be accommodated, access should be provided with a ramp and stairs if feasible. If stairs and a ramp are not feasible, a ramp should be used.

☐ Stair/walkway links.

Problem: Accidents frequently occur where stairs lead directly onto walkways.

Recommended Solutions: Stairs leading to walkways should be set back from the edge of the main walkway at least 24 in (610mm) at the bottom of the stairs and 12 in (305mm) at the top of the stairs.

If a stairway must be located so that it passes over a walkway and protrudes into the walkway more than 4 in (100mm), the walkway that goes under the stairs must have a clear height of 80 in (2030mm). Any height less than that must be protected with a railing that is 27 in (685mm) high (figure 62).

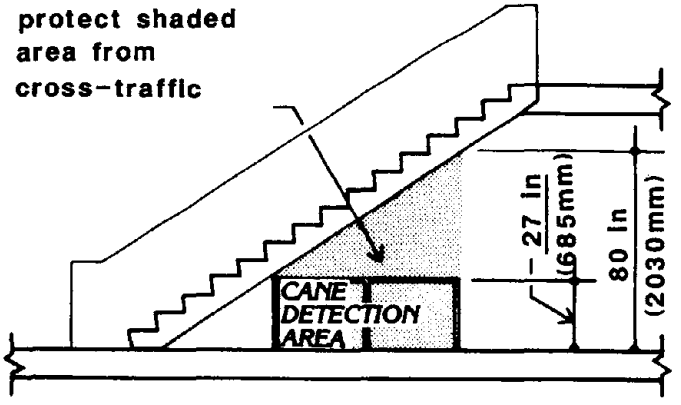


Figure 62. Clear height of overhead stairway.

☐ Long flights.

Problem: Long flights of stairs are difficult for the elderly and handicapped because there is no place to pause and rest. Accidents on long flights of stairs are likely to be more severe.

Recommended Solution: If long flights of stairs are required to change levels, intermediate landings should be designed into the stairway (figure 63). For intermediate landings between straight flights of stairs or when there is a change of direction at a landing, the minimum clear width of the landing should equal the width of the stairs leading into the landing and the length of the landing should be at least 48 in (1220mm).

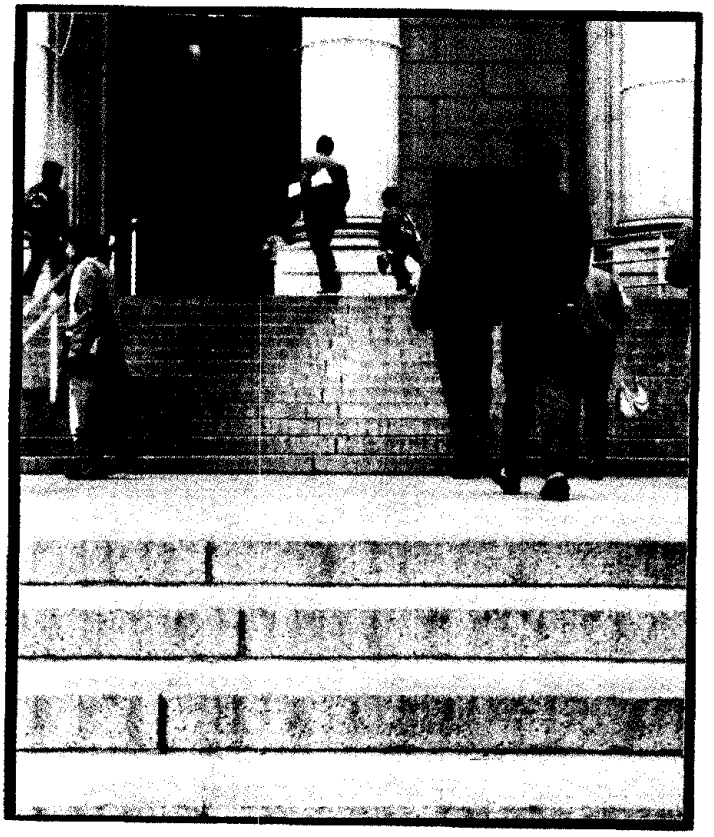


Figure 63. Intermediate landings.

☐ Short flights.

Problem: Very short flights of stairs or one step may not be noticeable by people with poor vision.

Recommended Solution: For small changes in level requiring up to three steps, a ramp should be used in place of the steps.

Specific Design Problems (Design Details)

Checklist of Problems

- ☐ High risers/narrow treads.
- ☐ Nosings.
- ☐ Surfaces.
- ☐ Narrowness.

☐ High risers/narrow treads.

Problem: Many people have difficulty with steps, especially steps with high risers and narrow treads.

Recommended Solutions: All steps in a flight shall have uniform tread depths and riser heights. The minimum tread depth is 11 in (280mm). Safe and comfortable tread/riser relationships are shown in table 7.

Table 7. Tread/riser relationships.

Riser Height		Tread Depth	
in	mm	in	mm
7	178	11	280
6-1/2	165	11 to 12-1/2	280 to 318
6	152	11 to 14	280 to 356
5-1/2	140	11 to 13	280 to 330
5	127	11 to 12	280 to 305

The treads on outdoor stairs should slope approximately 1/8 inch in 12 in (3mm in 304mm) down toward the nosing (figure 64).

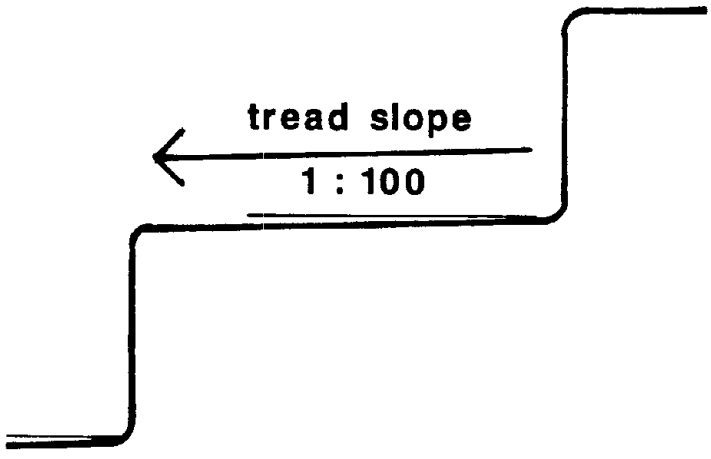


Figure 64. Outdoor stair tread slope.

☐ Nosings.

Problem: Stair nosings that project too much make it difficult for people with prosthetic legs to climb the stairs because their feet can get caught in the projecting nosing.

Recommended Solution: Stair nosings must be designed and constructed to conform with the standards. Open risers are not permitted, abrupt (square) nosings are not permitted.

☐ Surfaces.

Problem: The surface of some steps are slippery which causes people with balance problems to fall.

Recommended Solution: Stair treads should be slip resistant. When possible, the stair nosings should be of a different texture to insure slip resistance and to be more visible.

☐ Narrowness:

Problem: Some stairways are too narrow for two handicapped people to pass safely.

Recommended Solution: One-way stairways should have a minimum width between walls of 36 in (915mm). The minimum recommended width for two-way stairs is 60 in (1525mm).

CHAPTER 12: Handrails and Railings

1. Scope

This chapter deals with elements of guidance and support at stairs, ramps, landings, and protective elements at obstructions.

2. Definitions

Handrail: A narrow rail for grasping with the hand as a support, placed on stairs and ramps to assist pedestrians in ascending or descending.

Railing: A narrow rail similar to a handrail which functions as a barrier.

Barrier: A material object or set of objects that separates, demarcates, or serves to block off or prevent access.

3. Standards

a. Location

Handrails shall be located along both sides of ramp segments that have a rise greater than 6 in (150mm) or a horizontal projection greater than 72 in (1828mm) and along both sides of stairs.

b. Continuous Handrails

Handrails shall be continuous along both sides of stairs. The inside handrail on switchback or dogleg ramps and stairs shall always be continuous (figure 65).

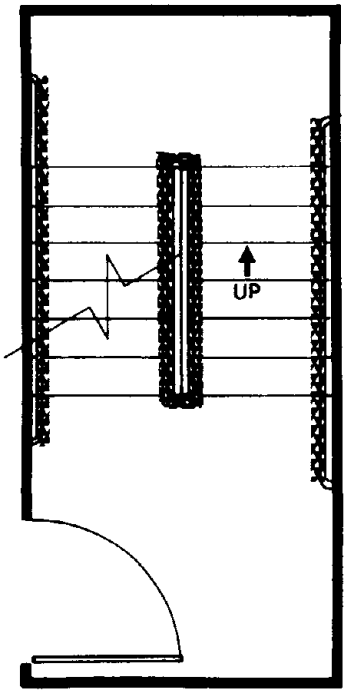


Figure 65. Continuous handrail on both sides of stairs.

c. Noncontinuous Handrails

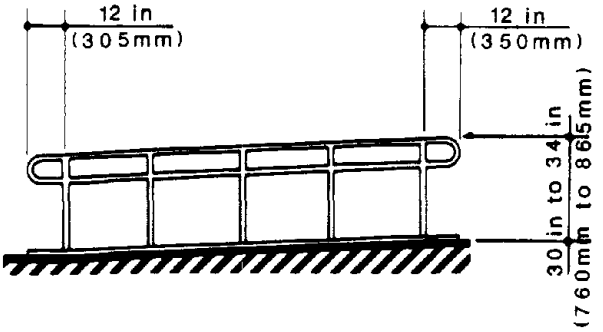
If handrails do not continue through the landings between ramp segments they shall extend at least 12 in (305mm) beyond the top and bottom of the ramp segment. The extension shall be parallel with the floor or ground surface (figure 66). If handrails do not continue through the intermediate stairway landings they shall extend at least 12 in (305mm) beyond the top riser and at least 12 in (305mm) the width of the one tread beyond the bottom riser. At the top, the extension shall be parallel with the floor or ground surface. At the bottom, the handrail shall continue to slope for a distance of the width of one tread from the bottom riser; the remainder of the extension shall be horizontal (figure 66).

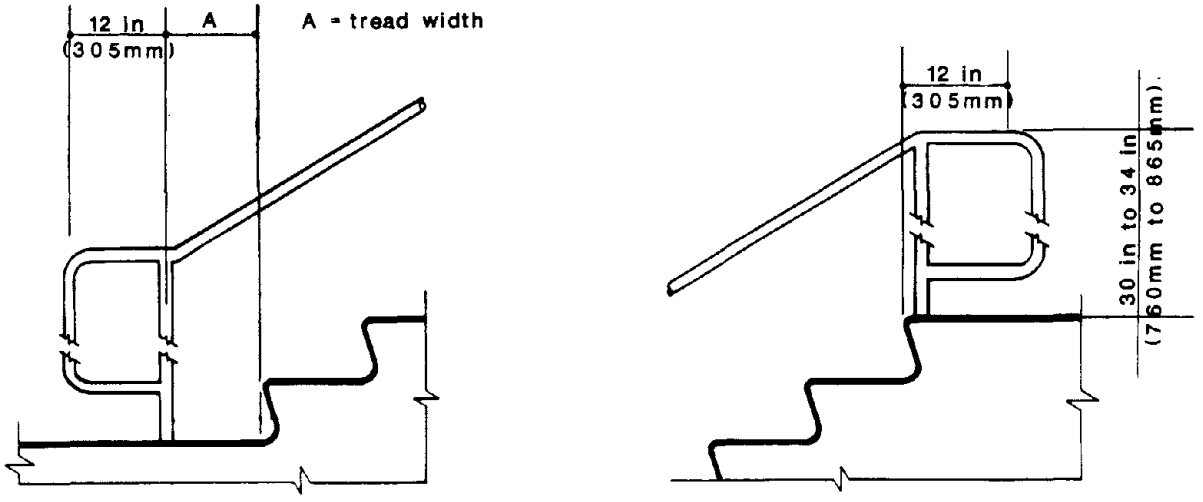
d. Handrail Height

The top of the handrail gripping surface shall be mounted between 30 in and 34 in (760mm and 865mm) above ramp surfaces and stair nosings (figure 66).

e. Handrail End Extensions/Protruding Objects

Handrail end extensions shall not protrude into walks, halls, corridors, or passageways. End extensions shall be either rounded or returned smoothly to floor, wall, or post.





Extension at Bottom of Run

Extension at Top of Run

Figure 66. Handrail and extensions and handrail heights.

f. Handrail Fixation

Handrails shall not rotate within their fittings.

g. Gripping Surface

Gripping surface shall be continuous on ramp handrails. Gripping surfaces on stair handrails shall be uninterrupted by newel posts, other construction elements, or obstructions. The diameter or width of the gripping surface shall be 1-1/4 in to 1-1/2 in (32mm to 38mm), or the shape shall provide an equivalent gripping surface. If the handrail is mounted on the wall the clear space between the wall and the gripping surface shall be 1-1/2 in (38mm) (figure 67). Handrails may be located in a wall recess if the recess is a maximum of 3 in (75mm) deep and extends at least 18 in (455mm) above the top of the gripping surface (figure 3).

h. Structural Strength

The shear force induced in a fastener or mounting device from the application of 250 lbf (1112N) shall be less than the allowable lateral load of either the fastener or mounting device or the supporting structure, whichever is the smaller allowable load.

The tensile force induced in a fastener by a direct tension force of 250 lbf (1112N) plus the maximum moment from the application of 250 lbf (1112N) shall be less than the allowable withdrawal and the supporting structure.

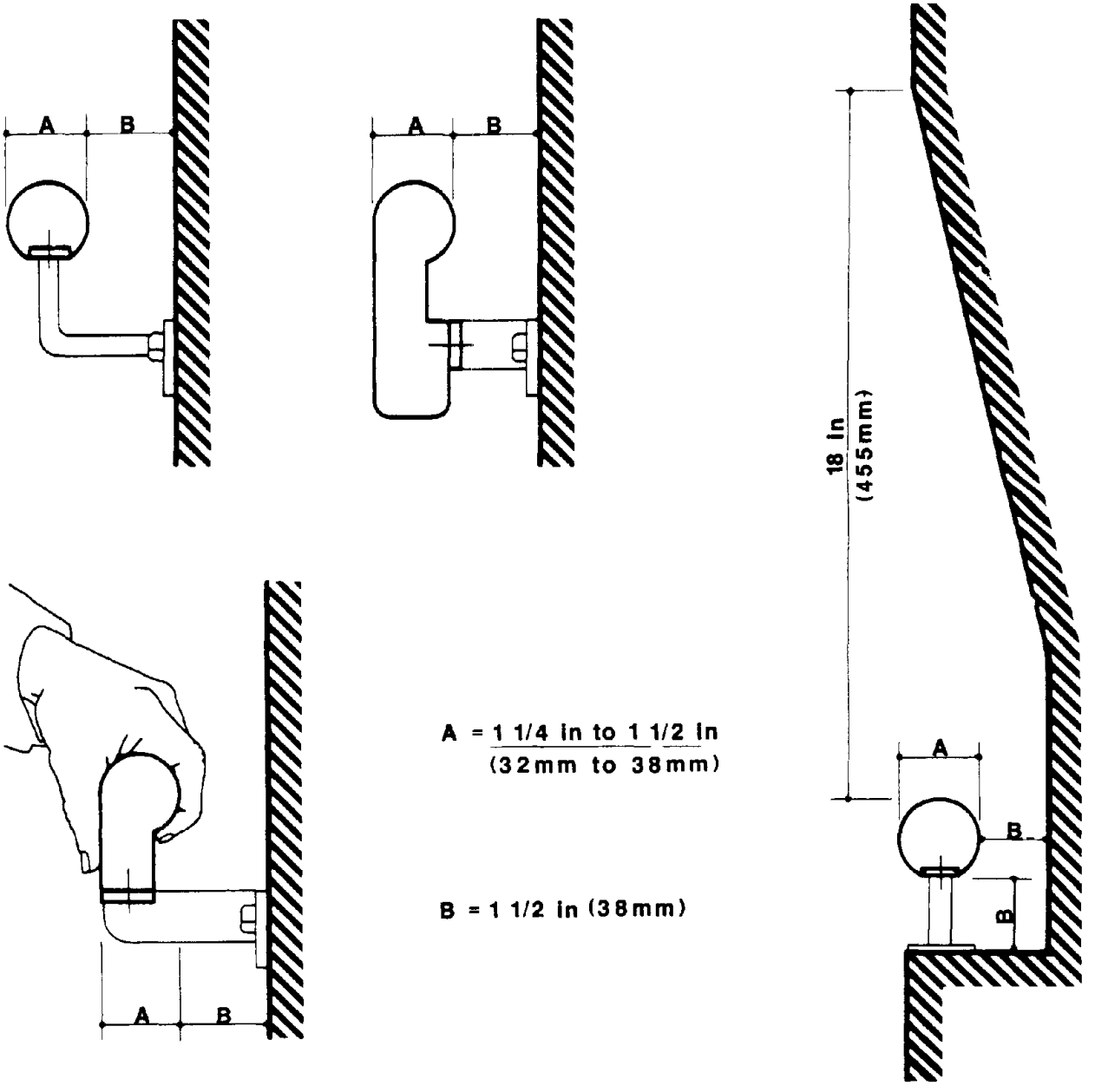


Figure 67. Gripping surfaces of handrails.

4. Problems and Recommended Solutions

Problems and recommended solutions for handrails and railings are presented at the design detail level.

Specific Design Problem (Design Details)

Checklist of Problem

- ☐ Need for handrails, railings.
- ☐ Handrail height.
- ☐ End extensions.
- ☐ Proximity to walls.
- ☐ Temperature.
- ☐ Balusters.
- ☐ Barricades.

☐ Need for handrails, railings.

Problem: Many elderly and handicapped people cannot negotiate ramps and stairs unless there are handrails.

Recommended Solution: Handrails are required on all stairs and on ramps that have a rise more than 6 in (150mm) or a horizontal projection greater than 72 in (1828mm).

☐ Handrail height.

Problem: Handrails that are too high or too low may be hazardous. Railings are sometimes too low to prevent a person from falling to a lower level.

Recommended Solutions: The handrail gripping surface should be between 30 in and 34 in (760mm and 865mm) above the ramp surface or stair nosing. An intermediate handrail can be added for children or people of small stature at 16 in to 27 in (406mm to 685mm) from the ramp surface or stair nosing (figure 68). Railings should be at least 42 in (1067mm) from the top rail to the ground surface.

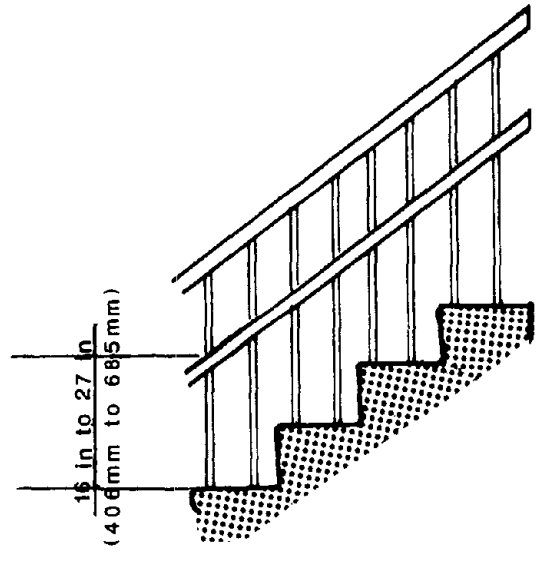


Figure 68. Intermediate handrail height.

☐ End extensions.

Problem: Some handrails are inadequate because they do not extend far enough to assist people as they use the first and last step.

Recommended Solution: Handrail end extensions shall be either rounded or returned to floor, wall or post (figure 69). Dimensions for handrail end extensions are addressed in the standards section of this chapter.

Figure 69. Handrail end extension.

☐ Proximity to walls.

Problem: Handrails that are fixed too close to the wall cannot be grasped.

Recommended Solution: Handrails should be mounted such that there is 1-1/2 in (38mm) clearance between the wall and the gripping surface. Rough textured walls should be avoided behind the handrail.

☐ Temperature.

Problem: Metal handrails may become too hot in summer or too cold in the winter for use out of doors.

Recommended Solution: Handrail gripping surfaces that are exposed to the elements should be made of materials that do not conduct heat. Gripping surfaces should be smooth but not slippery.

☐ Balusters.

Problem: Handrails supported by balusters can be hazardous when the balusters are spaced too far apart allowing children to get caught between the balusters.

Recommended Solution: The spacing between balusters and the space between horizontal members should be less than 4 in (100mm).

☐ Barricades.

Problem: Barriers placed around hazardous areas or construction sites should be designed and placed to accommodate people with limited vision.

Recommended Solution: Railings and temporary construction barricades should not be more than 27 in (685mm) from the ground. Chain and ballard barriers should not be used since they are difficult to detect by visually impaired people using long cane techniques.

CHAPTER 13: Street Furniture

1. Scope

This chapter addresses some of the most common street furniture elements found in the pedestrian environment. Standards are presented where applicable and a range of problems with recommended solutions are addressed to assist the designer in location, placement, and the detailed design of street furniture.

2. Definitions

Street furniture: Equipment or structures of a permanent or temporary nature located within the pedestrian environment for the purpose of facilitating either pedestrian or vehicular activity or providing a service. Examples are: sign posts, traffic light poles, parking meters, waste receptacles, seats, tables, vending machines, mail boxes, telephones, drinking fountains.

Clear head room: Unobstructed distance between the ground or floor surface and an overhead object.

3. Standards

Standards for the broad category of street furniture will be addressed first in general terms followed by specific design standards for the more common pieces of street furniture.

Street furniture must be located such that it does not present a hazard to the elderly or handicapped pedestrian and, at the same time, is functional. If the street furniture cannot be located so as not to present a hazard, it must be designed in such a way that the handicapped pedestrian will be aware of its presence.

a. Wall-mounted street furniture

Objects projecting from walls with the leading edges between 27 in and 80 in (685mm and 2030mm) above the ground or finished floor shall protrude no more than 4 in (100mm) into walks, halls, corridors, passageways, or aisles (figure 1). Objects mounted on walls with the leading edges at or below 27 in (685mm) above the ground or finished floor may protrude any amount (figure 70).

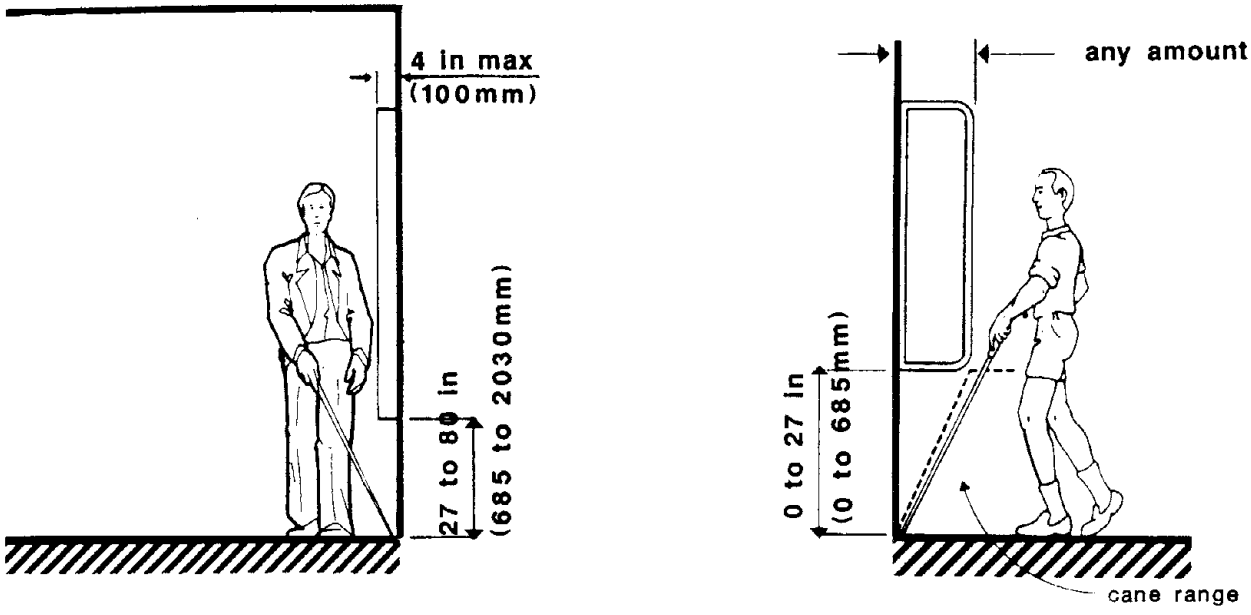


Figure 70. Wall mounted object.

b. Free-standing street furniture

Free-standing objects mounted on posts or pylons may overhang 12 in (305mm) maximum, from 27 in to 80 in (685mm to 2030mm) above the ground or finished floor (figure 71). The overhang of a free-standing object can be greater than 12 in (305mm) on the side(s) where no person can approach the object. Freestanding objects with the leading edge at or below 27 in (685mm) above the ground or finished floor may protrude any amount (figure 72).

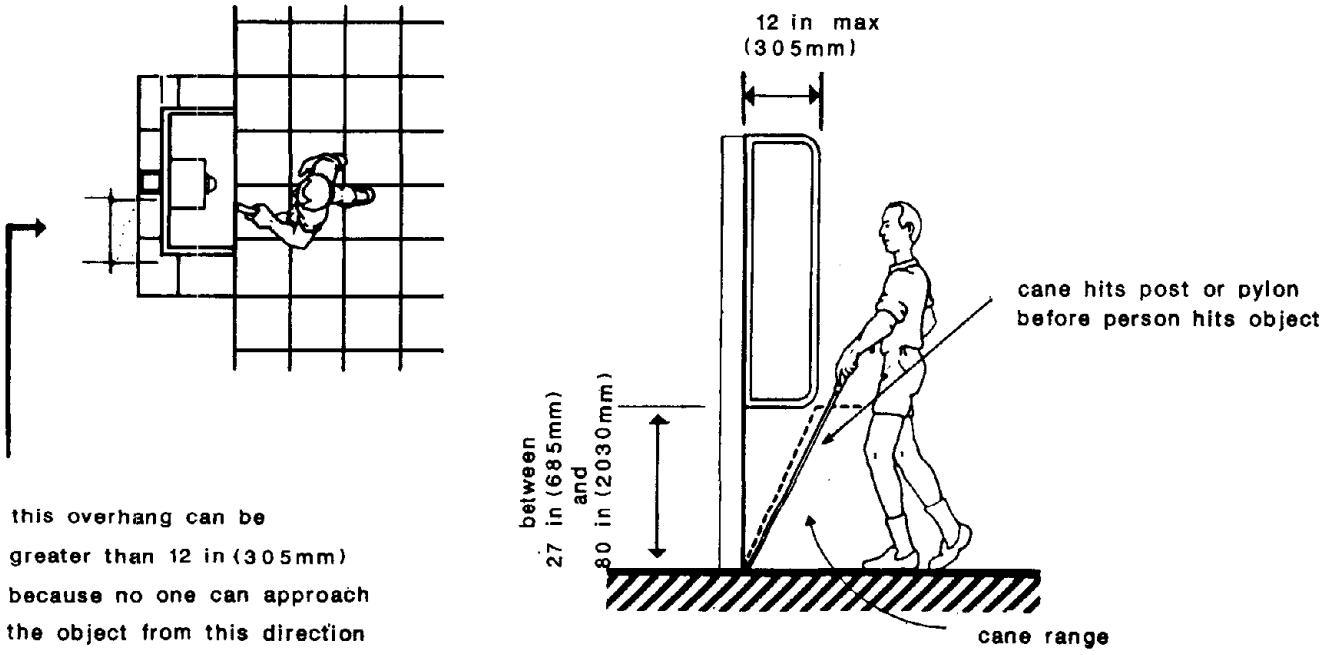


Figure 71. Freestanding objects

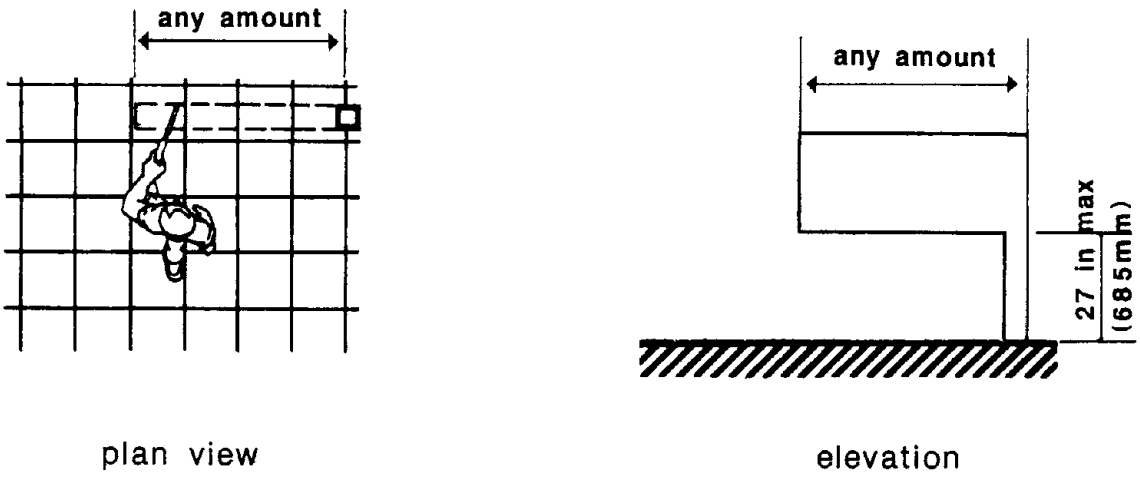


Figure 72. Freestanding objects.

c. Head room

Walks, halls, corridors, passageways, aisles, or other circulation spaces shall have 80 in (2030mm) minimum clear head room (figure 73). If vertical clearance of an area adjoining an accessible route is reduced to less than 80 in (2030mm), a barrier to warn blind or visually impaired persons shall be provided (figure 74).

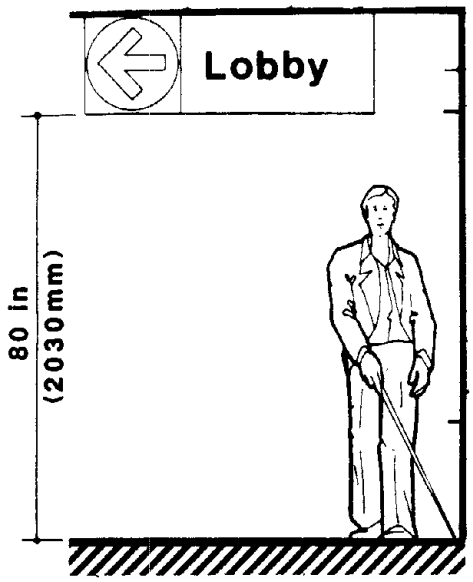


Figure 73. Head room.

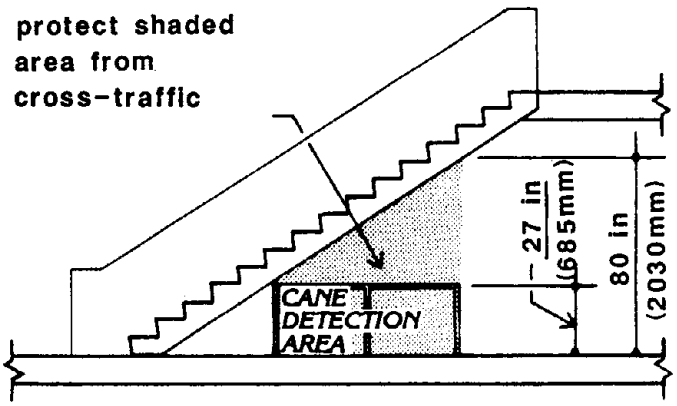


Figure 74. Restricted head room.

d. Clear width

Street furniture shall not reduce the clear width of an accessible route or maneuvering space (figure 75).

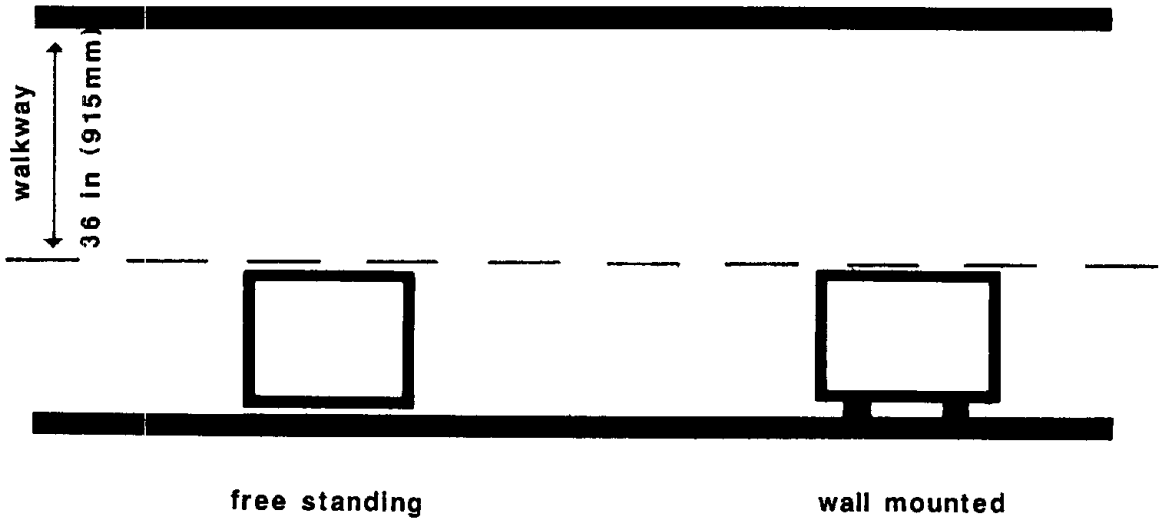


Figure 75. Clear widths.

e. Drinking fountains

Wall- and post-mounted cantilevered units shall have a clear knee space between the bottom of the apron and the floor or ground space at least 27 in (685mm) high, 30 in (760mm) wide, and 17 in to 19 in (430mm to 485mm) deep (figure 76). Such units shall have a minimum clear floor space 30 in by 48 in (760mm by 1220mm) that allows a person in a wheelchair to approach the unit facing forward.

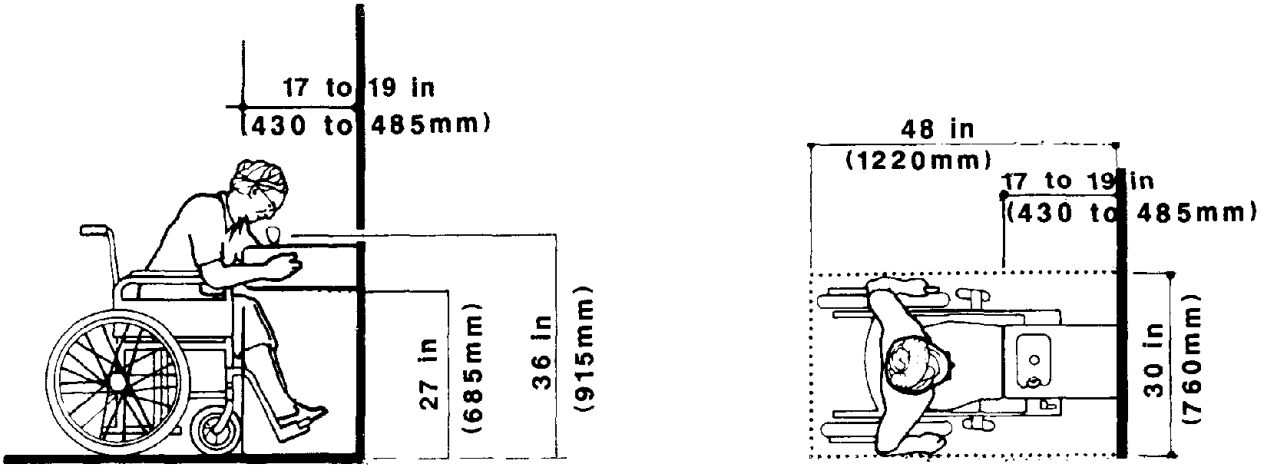


Figure 76. Wall- and post-mounted drinking fountains.

Free-standing or built-in units not having a clear space under them shall have a clear floor space at least 30 in by 48 in (760mm by 1220mm) that allows a person in a wheelchair to make a parallel approach (figure 77).

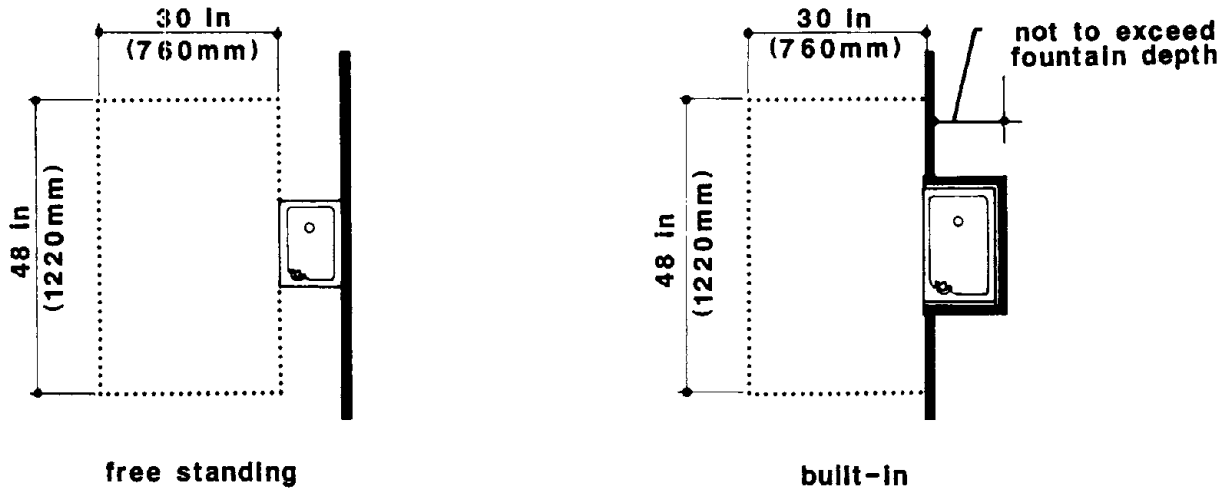


Figure 77. Free-standing and built-in drinking fountains.

Spouts shall be no higher than 36 in (915mm), measured from the floor or ground surface to the spout outlet. The spout shall be located at the front of the unit and shall direct the water flow in a trajectory that is parallel or nearly parallel to the front of the unit. The spout shall provide a flow of water at least 4 in (100mm) high so as to allow the insertion of a cup or glass under the flow of water.

f. Telephones

A clear floor or ground space at least 30 in by 48 in (760mm by 1220mm) that allows either a forward or parallel approach by a person using a wheelchair shall be provided at telephones. Bases, enclosures, and fixed seats shall not impede approaches to telephones by people who use wheelchairs.

The highest operable part of a telephone shall be 48 in (1220mm) for a forward reach and 54 in (1370mm) for a side reach (figure 78).

Telephones shall be equipped with a receiver that generates a magnetic field in the area of the receiver cap. Telephones shall have push button controls where service for such equipment is available. The cord from the telephone to the handset shall be at least 29 in (735mm) long.

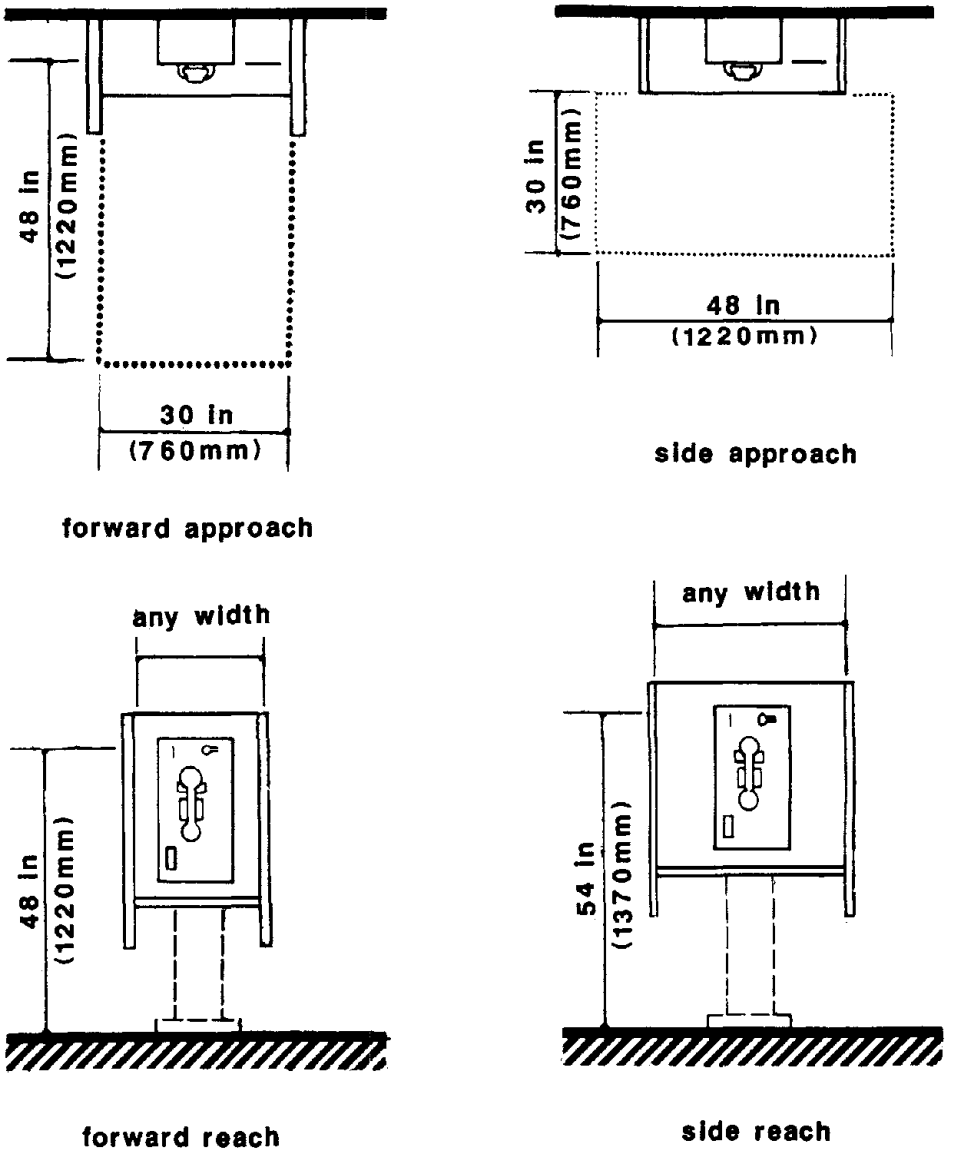


Figure 78. Clearances and mounting heights for telephones.

Telephone books, if provided, shall be located between 48 in (1220mm) and 15 in (380mm) above the ground surface for a forward reach and between 54 in (1370mm) and 9 in (230mm) above the ground surface for a side reach.

g. Seating and tables

A clear floor or ground space of 30 in (760mm) by 48 in (1220mm) is required if seating for people in wheelchairs is provided. Minimum knee space for people using wheelchairs shall be 27 in (685mm) high, 30 in 760mm) wide, and 19 in (485mm) deep. Table tops shall be from 28 in to 34 in (710mm to 865mm) from the floor or ground surface. Figure 79 illustrates the minimum clearances for seating and tables.

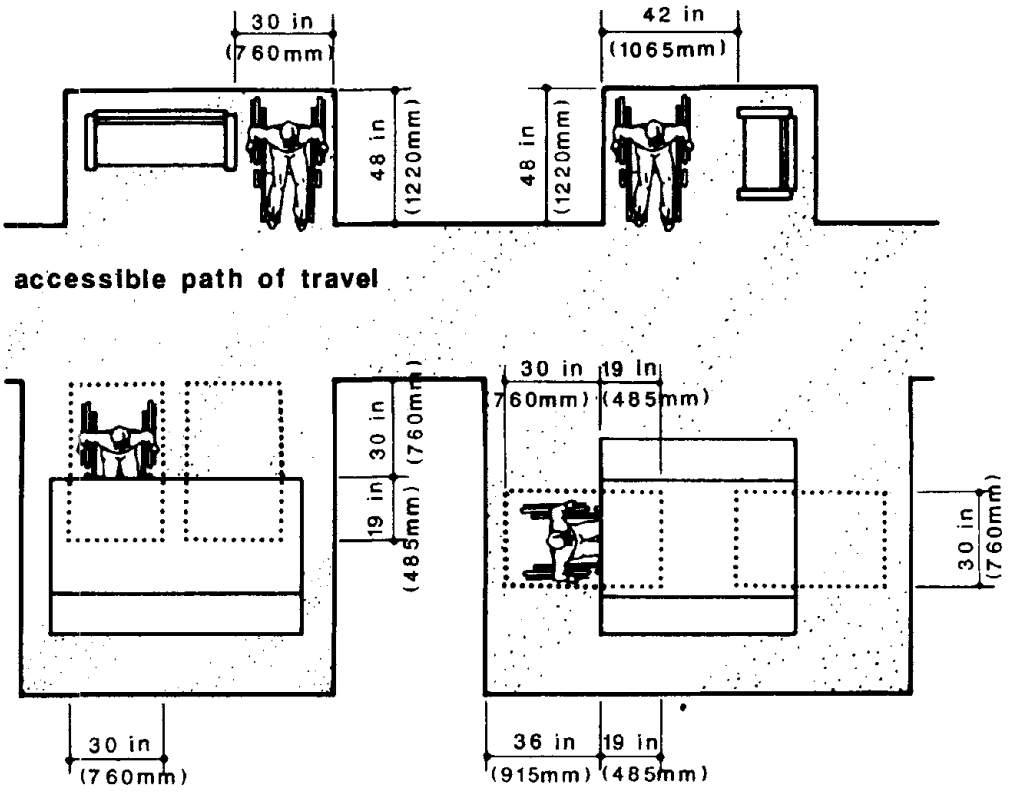


Figure 79. Minimum clearances for seating and tables.

4. Problems and Recommended Solutions

Problems and recommended solutions for street furniture are presented at two levels of detail: (1) General design problems and recommended solutions address the location and placement of street furniture; and (2) specific design problems and recommended solutions address the details of street furniture design.

General Design Problems (Location and Placement)

Checklist of Problems

- ☐ Moveable street furniture.
- ☐ Freestanding street furniture.
- ☐ Wall mounted street furniture.
- ☐ Seating.

☐ Moveable street furniture.

Problem: Moveable street furniture (newspaper dispensers, portable signs, trash receptacles, etc.) is sometimes placed where it presents a hazard to the visually impaired and blocks the way for wheelchairs.

Recommended Solutions: Moveable street furniture must be placed so that the design width of the accessible route is maintained. Whenever possible moveable street furniture should be located on the sidewalk within a strip close to the curb. This furniture strip could be surfaced with a material different than the sidewalk. Local ordinances could be adopted to control the placement and location of moveable street furniture. If adopted, these ordinances should be strictly enforced.

☐ Freestanding street furniture.

Problem: Freestanding, permanently affixed street furniture (sign posts, light posts, traffic signals, fire hydrants, telephone poles, telephones, water fountains, parking meters, etc.) is sometimes placed where it presents an overhead hazard or an obstacle to the visually impaired and blocks the way for wheelchairs.

Recommended Solutions: The location and placement of freestanding, permanently affixed street furniture must be addressed during the design of the accessible route. Street furniture objects must be located or relocated to assure a minimum clear width of 36 in (915mm), and a clear headroom of 80 in (2030mm). If a clear headroom of 80 in (2030mm) can not be achieved, the overhang must be less than 12 in (305mm) (figure 80).

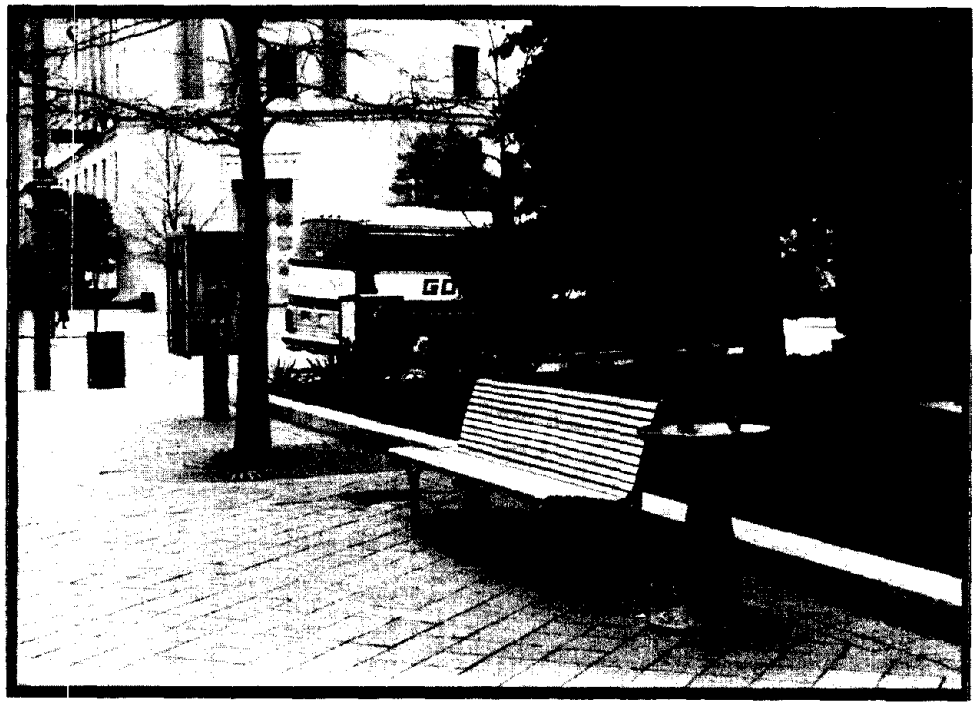


Figure 80. Freestanding street furniture.

Whenever possible, street furniture should be placed on a strip adjacent to the curb. The furniture strip could be surfaced with a different material than the sidewalk. If the minimum width for the accessible route cannot be maintained because of free-standing street furniture, the street furniture should be mounted on the exterior walls of the adjacent buildings. The standards for wall-mounted street furniture should be followed for those applications.

☐ Wall-mounted street furniture.

Problem: Wall mounted street furniture (signs, awnings, drinking fountains, telephones, trash receptacles, benches, etc.) are sometimes located where it presents an overhead hazard or protrudes into the path of the visually impaired.

Recommended Solutions: The location of street furniture on the wall of a building or on fences must be addressed during the design of the accessible route. Care should be taken to insure that the clear width of the accessible route is maintained and that a minimum clear headroom of 80 in (2030 mm) is achieved between the ground surface and a wall mounted object. If street furniture is attached to a wall or a fence that is adjacent to the accessible route, the object should be designed or placed to comply with table 8.

Table 8. Minimum clearances for wall mounted street furniture.

Height of Object Above Ground Surface		Maximum Projection of Object from Wall	
in	mm	in	mm
0 to 27	0 to 685	Any amount, but must maintain minimum width of accessible route	
27 to 80	685 to 2030	4	100
>80	>2030	Any amount.	

☐ Seating.

Problem: People with little stamina need to stop and rest frequently, especially after crossing a busy street or climbing stairs or ramps.

Recommended Solutions: Where possible, seating should be provided at strategic places along the accessible route. A clear space for wheelchairs should be provided adjacent to the seat. Seating and wheelchair-clear areas should be provided at or near street crossings, near the top of stairs or ramps, and at intermediate points along the accessible route. The seating and clear area for wheelchairs should be located adjacent to and outside the flow of pedestrian traffic, and should not reduce the width of the accessible route. Seating area dimensions are shown in figure 81.

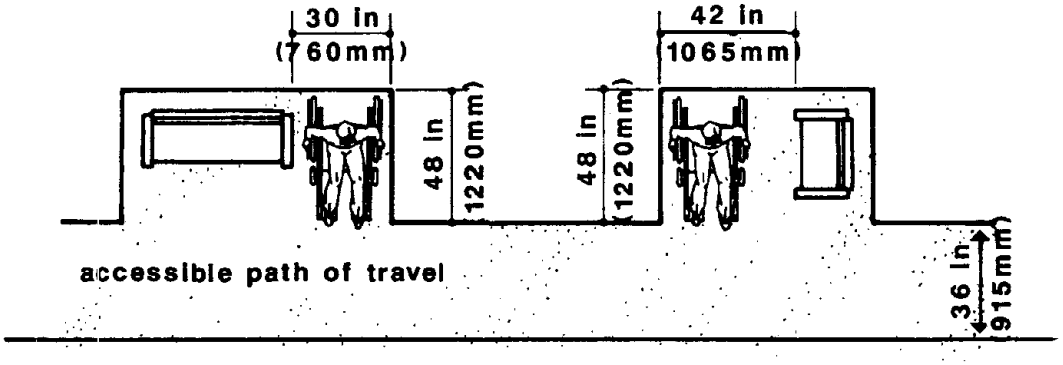


Figure 81. Minimum clearance for seating.

Specific Design Problems (Design Details)

Check List of Problems

- ☐ Seating and tables.
- ☐ Telephones.
- ☐ Drinking fountains.
- ☐ Trash receptacles.

☐ Seating and tables.

Problem: Some elderly people find it difficult to get up from or down into low seats or seats which slope steeply to the back. Arm rests can aid the elderly and handicapped. Some seats become uncomfortably hot in summer and cold in winters.

Recommended Solutions: Seats and benches should be 18 in to 20 in (457mm to 508mm) from the ground surface and should be a uniform height. The seat should be sloped from front to rear a minimum amount to shed rainwater. Depth of the seat should be 12 in to 18 in (305mm to 457mm). A 24 in (610mm) width should be allowed for each person. The seat should overhang the chair support at least 3 in (75mm) to allow for heel space. Arm rests of sufficient strength to support a persons weight should be provided. Care should be taken to select a material that will not become uncomfortably hot in the summer or cold in the winter (figure 82).

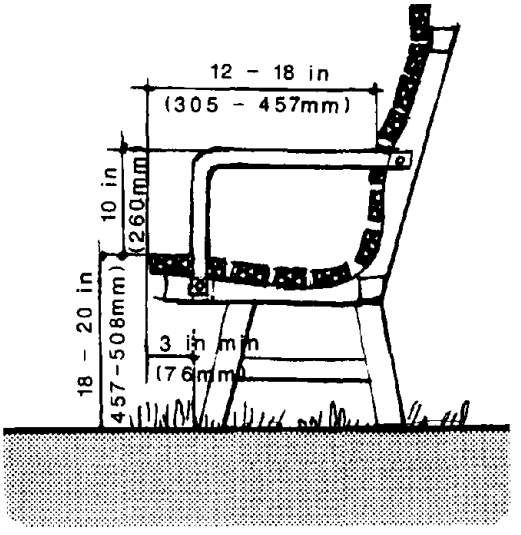


Figure 82. Seat dimensions.

Problem: Tables at rest areas along an accessible route are often unusable by persons in wheelchairs.

Recommended Solutions: Tables should be designed to accommodate wheelchair users Spaces for wheelchair users can be provided in addition to permanent bench spaces. A minimum knee space of 19 in (485mm) deep and 27 in (685mm) high should be provided. A clear area of 30 in by 36 in (760mm by 915mm) should be provided approaching the table (figure 83).

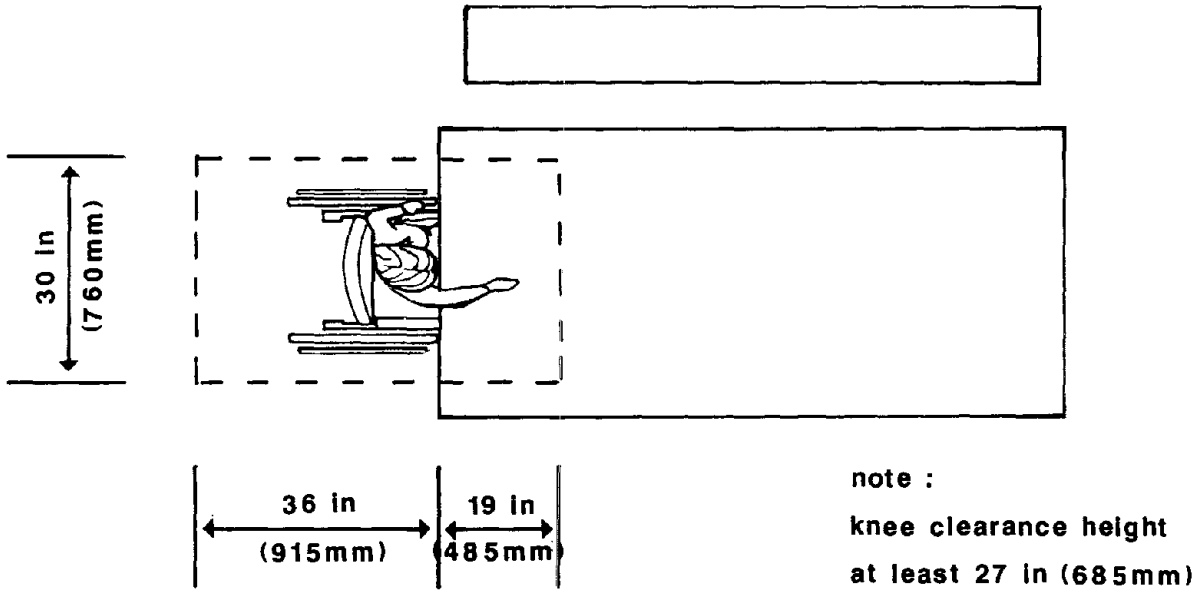


Figure 83. Minimum dimensions of tables.

☐ Telephones.

Problems: Some handicapped people cannot enter telephone booths. Coin slots and controls are often too high to reach. The telephone cord length is sometimes too short. Telephone books are often placed in an area that is hard to access by the handicapped.

Recommended Solutions: Telephones should be mounted on walls or free standing pylons without doors. Specific design details for accessible telephones are provided in the standards section of this chapter.

☐ Drinking fountains.

Problems: Many drinking fountains are too low or too high for people in wheelchairs. Some handicapped people cannot lean over to drink and must use a container. The hand controls on some drinking fountains are difficult to work for some people with little strength or dexterity in their hands.

Recommended Solutions: Drinking fountains should be designed to accommodate the elderly and handicapped. Specific design details for drinking fountains are provided in the standards section of this chapter. Hand controls for drinking fountains should comply with the controls and operating mechanisms standards provided in the standards section of this chapter.

☐ Trash receptacles.

Problems: Some elderly and handicapped people cannot use certain types of trash receptacles. Hinged door openings are difficult to use and the trash receptacle is often too unstable for a handicapped person to lean against while trying to deposit the trash.

Recommended Solutions: Trash receptacles should be operable using a single hand movement. The receptacle should be stable enough so that it will not tip over if leaned upon. The opening of the receptacle should be no more than 36 in (915mm) above the ground.

CHAPTER 14: Signage

1. Scope

This chapter deals with design considerations for conveying information about the accessible route and the environment near the accessible route.

2. Definitions

Signage: Messages conveyed by means of graphic symbols or lettering. Verbal, symbolic, tactile, and pictorial information.

3. Standards

a. Character Proportion

Letters and numbers on signs shall have a width to height ratio between 3:5 and 1:1 and a stroke width to height ratio between 1:5 and 1:10.

b. Color Contrast

Characters and symbols shall contrast with their background; either light characters on a dark background or dark characters on a light background.

c. Raised or Indented Characters or Symbols

Letters and number on signs shall be raised or incised 1/32 in (0.8mm) minimum and shall be sans serif characters. Raised characters or symbols shall be at least 5/8 in (16mm) high, but no higher than 2 in (50mm). Indented characters or symbols shall have a stroke width of at least 1/4 in (6mm). Symbols or pictographs on signs shall be raised or indented 1/32 in (0.8mm) minimum.

d. Symbol of access

Accessible facilities shall be identified by the international symbol of access as displayed in figure 84.

Standard Dimensions

	in	mm
A	24	610
B	1/2	13
C	3	76
D	18	457
E	1 1/2	38

Figure 84. Symbol of access.

e. Mounting Location and Height

Signage for accessible parking spaces shall be mounted such that the sign shall not be obscured by a vehicle parked in the space.

f. Tactile Warnings on Doors to Hazardous Areas

Doors that lead to areas that might prove dangerous to a blind person (for example, doors to loading platforms, boiler rooms, stages, and the like) shall be made identifiable to the touch by a textured surface on the door handle, knob, pull, or other operating hardware. This textured surface may be made by knurling or roughing or by a material applied to the contact surface. Such textured surfaces shall not be provided for emergency exit doors or any doors other than those to hazardous areas. Textured surfaces for tactile door warnings shall be standard within a building, facility, site, or complex of buildings.

g. Facilities Requiring Accessibility Signage

Elements and spaces of accessible facilities which shall be identified by the International Symbol of Access are: parking spaces designated as reserved for physically handicapped people; passenger loading zones; accessible entrances; and accessible toilet and bathing facilities.

4. Problems and Recommended Solutions

Problems and recommended solutions for signage are presented at two levels of detail: General design problems and recommended solutions address location and placement of signs. Specific design problems and recommended solutions address the design details of the signs.

General Design Problems (Location and Placement)

Checklist of Problems

- ☐ Height.
- ☐ Symbol of accessibility.
- ☐ Accessibility sign obstructions.

☐ Height.

Problems: Street signs are often located too high or are located behind other street furniture or trees where they cannot be seen by the pedestrians.

Street signs are sometimes located near the sidewalk and at a height close to eye level. This mounting height in a location near the travelway could be hazardous.

Displays and written information are difficult to read because of where they are mounted.

Recommended Solutions: Street signs should be located at a height that can be read by all pedestrians. Signs should be located so they are not obscured by street furniture or trees.

If the sign must extend into an accessible route the sign should be mounted at a sufficient height above the sidewalk level to accommodate the safe passage of a pedestrian under the sign.

Signs located and mounted on the wall near doorways should be mounted at a height between 54 in and 66 in (1370mm and 1675mm).

☐ Symbol of access.

Problem: Where and when should the international symbol of access sign be used?

Recommended Solution: The international symbol of access should be displayed at: the beginning of accessible paths leading to public spaces if other paths are not accessible; at accessible entrances to buildings and facilities if all the other entrances are not accessible; at dedicated parking spaces for the handicapped; at accessible toilet and bathing facilities; and at passenger loading zones.

☐ Accessibility sign obstructions

Problem: The international symbol of access sign used to mark reserved spaces for the elderly and handicapped is sometimes obscured by vehicles parked in the space.

Recommended Solution: Signage for accessible parking spaces shall be mounted such that the sign shall not be obscured by a vehicle parked in the space.

Specific Design Problems (Design Details)

Checklist of Problems

☐ Sign legibility.
☐ Raising or indenting characters.

☐ Sign legibility.

Problem: Signs are sometimes difficult to read because the size of the characters on the sign are too small or because background of the sign does not contrast with the letters.

Recommended Solution: The legibility of signs depends on the distance between the sign and the viewer. Once the location of the sign has been determined, care should be taken to properly size the sign and the letters on the sign so that the viewer can easily read it from the appropriate accessible point. Light colored characters on a dark background are the most legible to the elderly. A simple print style should always be used since elaborate styles are more difficult to read. Sans serif characters should be used on all signs to insure readability (figure 85).

Figure 85. Sans serif style characters.

☐ Raising or indenting characters.

Problem: Visually impaired people cannot read signs unless they can feel the characters.

Recommended Solution: Signs for the visually impaired should have raised or incised characters (figure 86). The characters shall be as prescribed in the standards section.

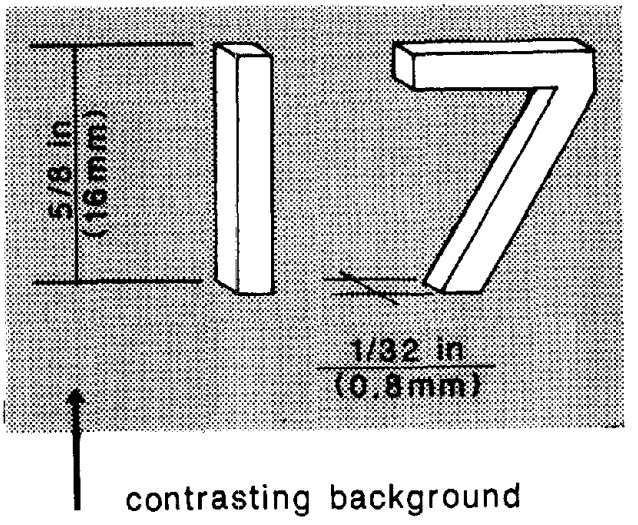


Figure 86. Raised sign characters.

CHAPTER 15: Lighting and Illumination

1. Scope

This chapter sets out guidelines for lighting pedestrian areas. Problems and recommended solutions are addressed to ensure that there is sufficient illumination to permit the elderly and handicapped pedestrian and the vehicle operator to anticipate and perceive hazards.

2. Definitions

Lumen: The unit of measurement for the amount of light energy given off by a light source.

Footcandle (lux): The unit of illuminance on a surface, every part of which is one foot from a uniform point source of light of one candle and equal to one lumen per square foot. Values cited in this chapter are given in minimum average maintained horizontal footcandles (lux).

3. Standards

Specific standards addressing illumination levels for elderly and handicapped pedestrians have not been adopted. The following references may be used during the design of an accessible route to assure all the elements of the routes are properly illuminated:

IES Lighting Handbook, Current Edition, Illuminating Engineering Society, 345 E. 47th Street, New York, N.Y. 10017.

"Fixed Illumination for Pedestrian Protection", FHWA-RD-76-9.

4. Problems and Recommended Solutions

General design problems and recommended solutions relating to location and placement of lighting are addressed.

General Design Problems (Location and Placement)

Checklist of Problems

- ☐ Security lighting.
- ☐ Lighting levels.
- ☐ Illumination of steps, stairs and ramps.
- ☐ Illumination of crosswalks and refuge islands.
- ☐ Illumination of parking places, passenger loading zones and bus stops.

☐ Security lighting.

Problem: Many elderly and handicapped people are concerned about the risk of crime in poorly lighted areas.

Recommended Solution: In high crime areas, pedestrianways should be well lighted, preferably double the usual recommendations but never less than 0.5 horizontal footcandles (5 lux).

☐ Lighting levels.

Problem: The elderly and the visually impaired need higher levels of illumination than is generally recommended.

Recommended Solution: Pedestrian walkways should be illuminated to a level of at least 2.0 horizontal footcandles (22 lux) in commercial areas and 0.5 horizontal footcandles (5 lux) in residential areas.

☐ Illumination of steps, stairs and ramps.

Problem: Steps and stairs located outdoors are potentially hazardous. Small flights of stairs or one threshold step at the entrance to a building, if improperly illuminated, can be a hazard to the elderly and visually impaired. Grade changes between ramps and landings may be hazardous without proper lighting.

Recommended Solutions: Steps, stairs, and ramps must be well lighted. Care should be taken in the placement and design of the light source to minimize damage by vandals. The recommended illumination level for steps, stairs, and ramps leading to building entrances is 5.0 horizontal footcandles (55 lux). Use of a light source that produces a glare to people using the steps, stairs, or ramp should be avoided.

☐ Illumination of crosswalks and refuge islands.

Problem: Elderly and handicapped pedestrians are concerned that drivers may not be able to see them crossing the street or waiting in a pedestrian refuge island.

Recommended Solutions: Crosswalks and pedestrian refuge islands should be adequately illuminated. An illumination level of 4.0 horizontal footcandles (44 lux) is recommended. In areas of high traffic volumes or at complex intersections illumination levels of at least 7.0 horizontal footcandles (75 lux) may be warranted.

☐ Illumination of parking places, passenger loading zones, and bus stops.

Problem: The adjoining areas to parking places, passenger loading zones, and bus stops are generally unfamiliar to the elderly and handicapped and should be well lighted to reduce the potential for accidents.

Recommended Solutions: An illumination level of 2.0 horizontal footcandles (22 lux) should be maintained in the immediate areas surrounding parking places, passenger loading zones, and bus stops. Care should be taken not to install the light source in a position that causes an obstacle to the elderly and handicapped.

CHAPTER 16: Traffic Signals

1. Scope

This chapter describes traffic signals and audible signals. Warrants for traffic signal installation are addressed as they relate to pedestrian movements. The meaning, application, and design requirements of pedestrian signals are discussed. Information is also presented on audible pedestrian signals.

2. Definitions

Traffic Signal: Any power-operated traffic control device, other than a barricade warning light or steady burning electric lamp, by which traffic is warned or directed to take some specific action.

Signal Face: That part of a traffic signal which controls one or more traffic movements in a single direction.

Signal Head: An assembly of one or more signal faces.

Signal Indication: The illumination of a signal lens.

Pedestrian Signal Indications: Special types of traffic signal indications intended for the exclusive purpose of controlling pedestrian traffic.

Audible Signal: An audible unit used in conjunction with pedestrian signals which informs the visually handicapped when it is safe to cross the street.

Pedestrian Signal Detector: A manually operated device (usually push buttons) which detects the presence of a pedestrian.

3. Standards

Standards for signal design are presented in detail in the Manual On Uniform Traffic Control Services, Part IV (MUTCD). Traffic control signals should not be installed unless one or more of the warrants presented in the MUTCD are met. This section highlights the standards which are applicable to pedestrian signals once the signal installation is warranted.

a. Application of Pedestrian Signal Indications

Pedestrian signal indications shall be installed in conjunction with vehicular traffic signals (which meet one or more of the traffic signal warrants set forth in the MUTCD) under any of the following conditions:

- When a traffic signal is installed under the Pedestrian Volume or School Crossing warrant.

- When an exclusive interval or phase is provided or made available for pedestrian movement in one or more directions, with all conflicting vehicular movements being stopped.

- When vehicular indications are not visible to pedestrians such as on one-way streets, at "T" intersections; or when the vehicular indications are in a position which would not adequately serve pedestrians.

- At established school crossings at intersections signalized under any warrant.

Pedestrian signal indications may also be installed under any of the following conditions:

- When any volume of pedestrian activity requires use of a pedestrian clearance interval to minimize vehicle-pedestrian conflicts or when it is necessary to assist pedestrians in making a safe crossing.

- When multi-phase indications (as with split-phase timing) would tend to confuse pedestrians guided only by vehicle signal indication.

- When pedestrians cross part of the street, to or from an island, during a particular interval (where they should not be permitted to cross another part of that street during any part of the same interval).

b. Pedestrian Signal Indications

The indications consist of the illuminated words WALK and DONT WALK or the illuminated symbols of a walking person (symbolizing WALK) and an upraised hand (symbolizing DONT WALK).

c. Meaning of Pedestrian Indications

The meanings of pedestrian signal indications are as follows:

- The DONT WALK indication, steadily illuminated, means that a pedestrian shall not enter the roadway in the direction of the indication.

- The DONT WALK indication, while flashing, means that a pedestrian shall not start to cross the roadway in the direction of the indication but that any pedestrian who has partly completed his crossing during the steady WALK indication shall proceed to a sidewalk, or to a safety island.

- The WALK indication means that a pedestrian facing the signal indication may proceed across the roadway in the direction of the indication. The WALK indication means that there may or may not be possible conflict of pedestrians with turning vehicles.

- A WALK indication shall not be flashed.

d. Design Requirements

Design requirements for pedestrian signals include the following:

- Pedestrian indications should attract the attention of, and be readable to, the pedestrian (both day and night) at all distances from 10 feet (3.0m) to the full width of the area to be crossed.

- All pedestrian indications shall be rectangular in shape and shall consist of the lettered or symbolized messages WALK and DONT WALK (figure 87). Only internal illumination shall be used.

- When illuminated, the WALK indication shall be lunar white with all except the letters or symbols obscured by an opaque material.

- When illuminated, the DONT WALK indication shall be Portland orange with all except the letters or symbols obscured by an opaque material.

- When not illuminated, the WALK and DONT WALK messages shall not be readily distinguishable by pedestrians at the far end of the crosswalk they control.

- For crossings where the distance from the near curb to the pedestrian signal indication is 60 ft (18.3m) or less, the letters, if used, shall be at least 3 in (75mm) high or the symbols, if used, shall be at least 6 in (150mm) high. For distances over 60 ft (18.3m), the letters, if used, should be at least 9 in (229mm) high.

- The light source shall be designed and constructed so that in case of an electrical or mechanical failure of the word DONT, the word WALK of the DONT WALK message will also remain dark.

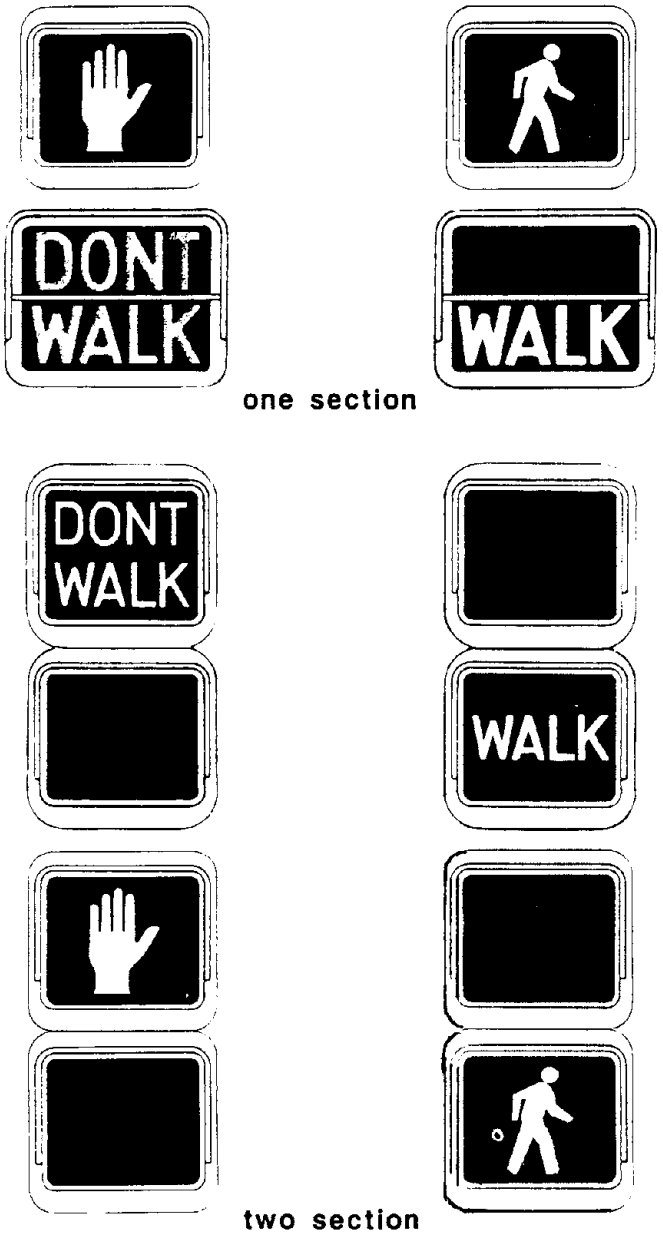


Figure 87. Traffic signal pedestrian indications.

e. Location

Pedestrian signal faces shall be mounted with the bottoms of the housing not less than 7 ft (2.1m) nor more than 10 ft. (3.0m) above the sidewalk level, and so there is a pedestrian indication in the line of the pedestrians' vision which pertains to the crosswalk being used.

Traffic signal pedestrian indications.

The DONT WALK indication shall be mounted directly above or integral with the WALK indication.

Pedestrian signal heads may be mounted separately or on the same support with other signal heads. When mounted with other signal heads there shall be a physical separation between the two heads.

The pedestrian signal head shall be so positioned and adjusted as to provide maximum visibility at the beginning of the controlled crossing.

f. Detectors

Pedestrian detectors (usually push buttons) should be conveniently located near each end of crosswalks where pedestrian actuation is required. A mounting height of 3-1/2 to 4 ft (1.07 to 1.22m) above the sidewalk has been found best adapted to general usage. Permanent-type signs (figure 88) shall be mounted above or in unit with the detectors, explaining their purpose and use. At certain locations, it may be desirable to supplement this sign with a larger sign suspended over the sidewalk to call attention to the push button. Where two crosswalks, oriented in different directions, end at or near the same location, the positioning of pedestrian push buttons should clearly indicate which crosswalk signal is actuated by each push button. Additional push-button detectors may be required on islands or medians where a pedestrian might become stranded.

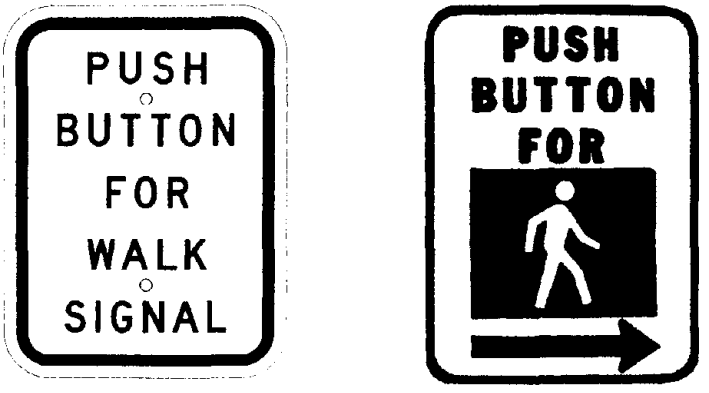


Figure 88. Detector use sign.

g. Pedestrian Intervals and Phases

Pedestrians should be assured of sufficient time to cross the roadway at a signalized intersection. Where traffic signals are of the actuated type, control equipment should provide sufficient pedestrian crossing time when there has been a pedestrian actuation and the minimum vehicular time is less than that needed by the pedestrians. Where traffic signals are not of the vehicle-actuated type, pedestrian actuation may be used to provide sufficient pedestrian crossing time, or the vehicular time should be adjusted to provide the crossing time needed by pedestrians.

Under normal conditions, the WALK interval should be at least 4 to 7 seconds so that pedestrians will have adequate opportunity to leave the curb before the clearance interval is shown. The lower values may be appropriate where it is desired to favor the length of an opposing phase and if pedestrian volumes and characteristics do not require the longer interval. The WALK interval itself need not equal or exceed the total crossing time calculated for the street width, as many pedestrians will complete their crossing during the flashing DONT WALK clearance interval.

A pedestrian clearance interval shall always be provided where pedestrian signal indications are used. It shall consist of a flashing DONT WALK indication. The duration should be sufficient to allow a pedestrian crossing in the crosswalk to leave the curb and travel to the center of the farthest traveled lane before opposing vehicles receive a green indication (normal walking speed is assumed to be 4 ft per second (1.22 m/sec).) On a street with a median at least 6 ft (1.8m) in width, it may be desirable to allow only enough pedestrian clearance time on a given phase to clear the crossing from the curb to the median. In the latter case, if the signals are pedestrian-actuated, an additional detector shall be provided on the island.

4. Problems and Recommended Solutions

Problems and recommended solutions for pedestrian traffic signals are presented at two levels of detail: General design problems and recommended solutions address the warrants and location of pedestrian traffic signals; specific design problems and recommended solutions address the design details of pedestrian traffic signals.

General Design Problems (Warrants and Location)

Checklist of Problems

- ☐ Warrants.
- ☐ Location.

☐ Warrants.

Problem: Elderly and handicapped pedestrians find it difficult to cross streets where there is heavy traffic or fast moving traffic and no traffic signals.

Recommended Solutions: Traffic signals should be provided at intersections where they are warranted. The "Manual on Uniform Traffic Control Devices" contains a detailed description and explanation of warrants for traffic signal installation. These warrants should be followed when addressing the need for traffic signals.

☐ Location.

Problem: Pedestrian traffic signals are sometimes placed in locations that make them difficult for pedestrians to see, or confusing because of illuminated advertising signs. The latter problem is acute for those with poor vision.

Recommended Solution: Pedestrian traffic signal faces should be located so there is a pedestrian indication in the line of pedestrian's vision which pertains to the crosswalk being used. The pedestrian signal head should be positioned as to provide maximum visibility at the beginning of the controlled crossing.

Specific Design Problems (Design Details)

Checklist of Problems

- ☐ Signal face height.
- ☐ Signal face readability.
- ☐ Letter size and pedestrian symbols.
- ☐ Pedestrian detector height.
- ☐ Pedestrian signal timing.
- ☐ Audible pedestrian signals.

☐ Signal face height.

Problem: Some elderly and handicapped pedestrians, especially those confined to wheelchairs, find it difficult to see the signal face because automobiles block the line of sight.

Recommended Solution: Pedestrian signal faces should be mounted with the bottoms of the housing not less than 7 ft (2.13m) nor more than 10 ft (3.0m) above sidewalk level.

☐ Signal face readability.

Problem: Some handicapped, especially those with poor vision, find it difficult to see the pedestrian signal face at night and across wide intersections.

Recommended Solution: Pedestrian indications should be readable to the pedestrian at day and night at all distances from 10 ft (3.05m) to the full width of the area to be crossed.

☐ Letter size and pedestrian symbols.

Problem: Some of the older pedestrian signal faces and lettering are so small that they cannot be seen by those with poor vision especially across wide intersections.

Recommended Solution: For crossings where the distance from the near curb to the pedestrian signal indication is 60 ft (18.29m) or less, the letters, if used, shall be at least 3 in (75mm) high or the symbols, if used, shall be at least 6 in (150mm) high. For distances over 60 ft (18.29m) the letters, if used, should be at least 4-1/2 in (114.3mm) high and the symbols, if used, should be at least 9 in (229mm) high.

☐ Pedestrian detector height.

Problem: Traffic signal controls for pedestrians are sometimes located where they are not obvious and at a level that is too high for people in wheelchairs.

Recommended Solution: Pedestrian detectors (push buttons) should be conveniently located near each end of the crosswalk where pedestrian actuation is required. A mounting height of 42 to 48 in (1065 to 1220mm) above the sidewalk has been found best adapted to general usage. Signs should be mounted above the detectors clearly showing which direction of travel the detector controls.

☐ Pedestrian signal timing.

Problem: Many elderly and handicapped people move more slowly than other pedestrians, and, this is often not considered in the timing of traffic control signals. As a result, this group of people sometimes find it difficult or impossible to cross the street within the time allotted.

Recommended Solutions: The time required for the pedestrian clearance interval is a function of pedestrian volume, pedestrian walking speed, and the width of the intersection.

Pedestrian volume affects walking speed. Studies have shown that platoons or groups of pedestrians tend to walk at a slower rate than individual pedestrians. In addition, walking speeds of the very young, the elderly, and the handicapped are significantly slower than the "normal" pedestrian population. Also, female pedestrians, as a group, have a slower walking speed than male pedestrians.

The Manual on Uniform Traffic Control Devices (MUTCD) cites an assumed normal walking speed of 4 ft per second (1.22 m/sec). However, research verifies that one-third of all pedestrians cross streets at a rate slower than 4 ft/sec (1.22 m/sec) and 15 percent walk at or below 3.5 ft/sec (1.07 m/sec.). Those having slower walking speeds have the moral and legal right to complete their crossing once they have lawfully entered the crossing. Vehicular traffic is to yield the right-of-way to pedestrians lawfully within the intersection.

This suggests that the timing of pedestrian signal indications near facilities that serve segments of the population with slower walking speeds should be calculated based on a slower walking speed. Such populations should be anticipated near shopping centers, convalescent or rest homes, therapy centers, etc..

Problem: Some traffic engineers tend to resist using the slower walking rate because it may result in less favorable signal splits and longer cycle lengths resulting in longer vehicular delays.

Recommended Solution: Engineering studies and judgement should be exercised for each problem intersection to obtain the optimum balance between pedestrian and vehicular traffic. Table 9 presents typical minimum pedestrian clearance intervals as a function of street width, for walking speeds of 3.5 ft/sec and 4.0 ft/sec (1.07 m/sec. and 1.22 m/sec). One solution is to install a detector for the elderly and handicapped that will provide a longer clearance time.

Table 9. Minimum pedestrian clearance intervals.

Street Width		Minimum Clearance Intervals*			
ft.	m	@3.5 ft/sec	@1.067 m/sec	@4.0 ft/sec	@1.22 m/sec
30	9.14	7.1	2.16	6.3	1.92
40	12.19	10.0	3.05	8.8	2.68
50	15.24	12.9	3.93	11.3	3.44
60	18.29	15.7	4.78	13.8	4.21
70	21.34	18.6	5.67	16.3	4.97
80	24.38	21.4	6.52	18.8	5.73

*Based on street width minus 5 ft (1.52 m) for distance to farthest lane (assuming no parking).

☐ Audible pedestrian signals.

Problem: Blind, visually impaired, and other disabled persons find it difficult to cross streets and intersections relying solely on traffic signals or standard pedestrian traffic signals.

Possible Solutions: Audible pedestrian signals (figure 89) could be used with standard pedestrian traffic signals. Audible pedestrian signals emit two distinct audio signals that resemble bird calls; one for the north-south walk direction and another for the east-west walk direction. The audible units are equipped with sensors that adjust amplification to suit ambient noise levels, so they are louder during the day and quieter at night. It is important to note that audible signals should be utilized to help properly trained blind and visually impaired pedestrians to recognize when a walk signal is operating in a given direction.

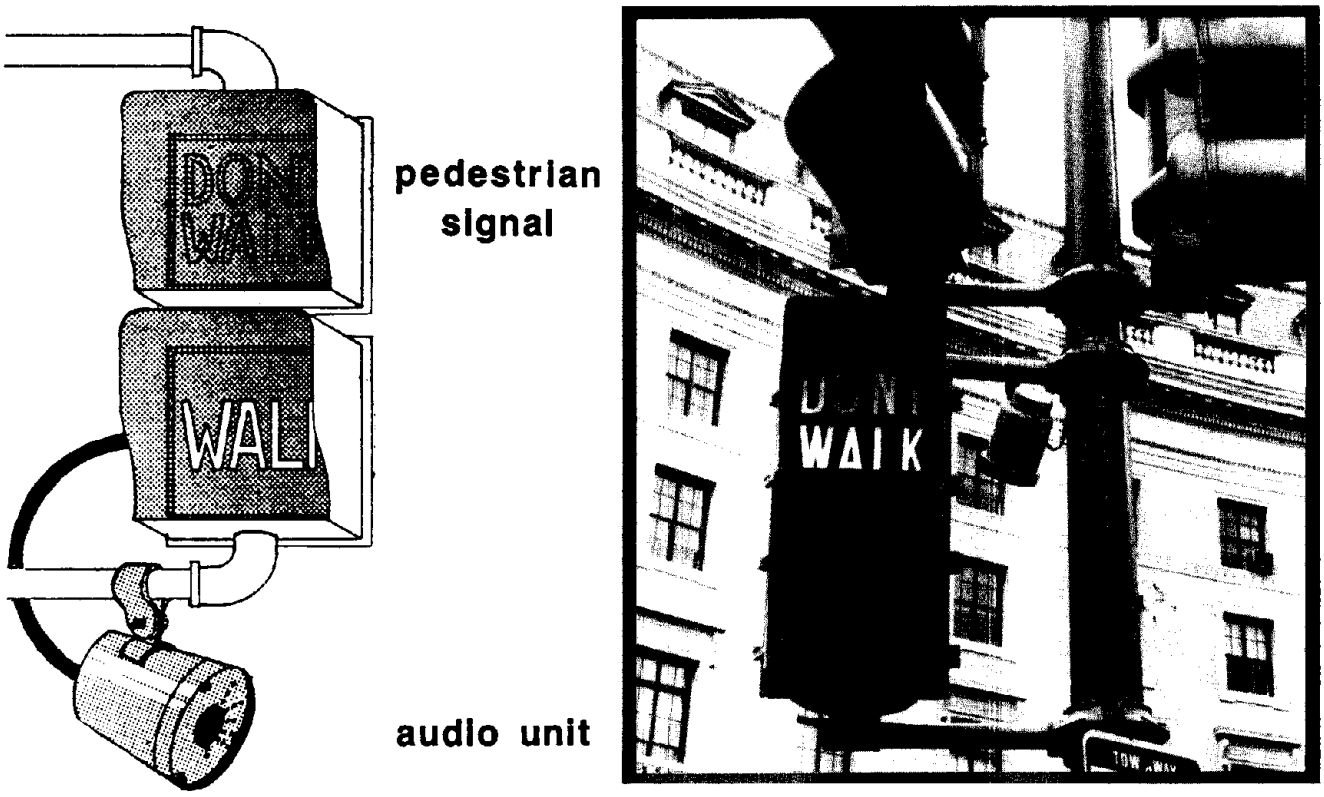


Figure 89. Audible pedestrian signal.

The type of audible signal devices installed in U.S. cities, mainly in the western States, is the bird call device. Some variations include a buzzer sound used in Cincinnati and a bell in Chicago. Other cities have devices with actual taped voices or gongs.

Huntington Beach, California, a leader in the use of audible signals, used the following set of criteria before selecting the devices in use in their city. Salt Lake City is among other cities officially adopting these criteria for the devices:

1. It must not be annoying to the average pedestrian or resident.
2. It must have noise levels as measured at an intersection from 10dB to 120dB. (The devices in Salt Lake City were measured at 85 dB).
3. It must be low cost with respect to intersection cost.
4. It must have adjustable upper and lower volume limits.
5. Simple and low cost installation was required.
6. It must require no or very little maintenance in a harsh environment.
7. It must be mechanically adjustable as to direction.
8. It should not require any extra wiring to the cabinet.
9. It should not in any way interfere with the normal signal operation.
10. The audio signal must only operate when the walk indication is displayed.
11. It must have a different, easily distinguishable sound for each direction.

While a number of cities are expanding their interest and/or use in audible signals, it is important to point out that the devices are the source of deep controversy between two major organizations representing the blind population. The National Federation for the Blind has opposed the signals on philosophical grounds that emphasize total independence of blind persons in traveling throughout the community without devices for special assistance.

Other blind organizations, including the American Council of the Blind with a national membership of more than 60,000 persons, support their use.

CHAPTER 17: Tactile Surface Treatments

1. Scope

This chapter provides information on the use of tactile surface treatments. Problems are listed and alternative methods that have been used to address the problems are presented.

2. Definitions

Tactile surface: A surface that can be detected by touch.

3. Standards

Specific standards addressing tactile surface treatments for elderly and handicapped pedestrians have not been adopted. The following references may be used to assist in the design of tactile surfaces:

American National Standards Institute (ANSI) A117.1, (1980), Sections 4.29.2, 4.29.4, 4.29.5, 4.29.6, 4.7.7.

Detectable Tactile Surface Treatments, U. S. Architectural and Transportation Barriers Compliance Board. Contract No. 300-83-0279. October 31, 1985.

4. **Problems and Possible Solutions** Problems with possible solutions are presented at two levels of detail: (1) General design problems address the use and placement of tactile surface treatments; and (2) specific design problems address the materials used for tactile surface treatments.

General Design Problems (Use and Placement)

Checklist of Problems

- ☐ Use of tactile surface treatments.
- ☐ Placement of tactile surface treatments.

☐ Use of tactile surface treatments.

Problem: Steps, stairs, curb ramps, and other elements of an accessible route that may not be detected by visually impaired people can be hazardous.

Possible Solution: Tactile surface treatments on walking surfaces can be used to provide information for visually impaired cane users. Linear tactile strips can be used to define the edge of a walkway.

Problem: Where the junction between a walkway and a street is not clearly separated by a curb, a planter, a curb ramp, or a different material there is a danger that those with impaired vision may wander into the street.

Possible Solution: The junction between the walkway and the street can be marked with a detectable tactile surface.

Problems: At oblique angle street crossings, where the crosswalk is set at angles other than 90 degrees to the curb, visually impaired pedestrians may stray out of the crosswalk into the lane of moving traffic.

It may be difficult for a visually impaired person to navigate across large open parking lots (at shopping centers, for example), plazas, etc., which have no street furniture, kiosks, or others locational landmarks.

Possible Solutions: Avoid the use of oblique angled crosswalks. However, if this type must be used, the pavement markings should be constructed so that they will be detectable to the visually impaired using the long cane technique. This may be achieved with the use of sand or glass beads embedded into the thermoplastic pavement markings at the time it is applied.

Paths for pedestrians (particularly for those with poor vision) across large open paved areas, such as shopping center parking lots, plazas, etc., can be demarcated by using a material for the walkway that is detectably different from that of the surrounding surface or by the use of a detectable edge strip at each side of the walkway.

☐ Placement of tactile surface treatments.

Problems: If tactile strips are too small, they may not be detected. If they are set too close to the hazard or environmental point about which they are intended to provide information, then the pedestrian may not have sufficient space and time to react to the strip.

If tactile strips are too large, they will become ineffective because information for the users will be too far from the potential hazard.

Possible Solutions: Tactile strips, to provide information on potential hazards, should extend for the full width of the hazard, should be at least 24" (610mm) in depth, and should extend at least 36" (915mm) from the hazard.

Tactile strips should not extend further in any direction than is necessary for the information to be conveyed.

Problem: Street furniture is used by the visually impaired as locational landmarks, but too much furniture tends to be confusing and obstructive.

Possible Solution: Street furniture can be placed within a strip of sidewalk dedicated for this purpose. The strip can be of a different surface than the sidewalk so that it is detectable to the visually impaired.

Specific Design Problems (Tactile Materials)

Checklist of Problems

☐ Tactile materials.

☐ Tactile materials.

Problem: Comprehensive specifications and guidelines have not been developed that apply to the use of tactile surface materials, yet many localities have installed materials that have been successfully used by the visually impaired.

Possible Solutions: Individuals with no vision and partially sighted people can more readily detect materials which rely on sound and resilient cues than materials which rely on textural cues.

Research has been conducted using the following materials:

- o gritty thermoplastic
- o resilient thermoplastic
- o artificial grass
- o narrow-ribbed rubber mat
- o steel checker plate
- o stainless steel grate with hollow space underneath
- o gritty, anti-slip mat

Of the seven materials listed above, three were shown to be more reliable from the perspective of simple detection. The three are:

- o artificial grass
- o narrow-ribbed rubber mat
- o steel checker plate

Other materials have been used successfully as tactile surface treatments. They include guide strips made of an epoxy gravel material used at intersections in San Diego with unusual geometric configurations.

The Bay Area Rapid Transit (BART) District in the Oakland/San Francisco area is currently installing a tactile warning tile at all of its 34 stations platform edges. The tile is rubber with raised bumps which alert the blind or visually impaired person to the platform edge. Extensive testing of this tile and other treatments (raised strips of PVC material or epoxy polyaggregate) showed the tactile warning tiles to be superior because they:

- Are statistically more detectable than other materials tested.
- Provide a satisfactory low-vision stimulus.
- Are less expensive to install, maintain, repair or replace.
- Have incurred no noted safety incidents since installation.
- Provide insulation between the train and the platform.

Most of the BART stations are outside and subject to inclement weather. The tiles were installed in two foot wide strips at the platform edge.

Many factors must be considered before a locality chooses a specific material for use as a tactile surface treatment. Some of the factors are:

- Environmental conditions (snow, ice, etc.).
- Maintainability.
- Durability.
- Presence of vehicular traffic.
- Fastening method.
- Structural support.
- Cost of material.
- Cost of installation.