2 Understanding Sidewalk and Trail Users

Chapter

Understanding Sidewalk and Trail Users

Figure 2-1. *Accessible facilities and high quality experiences on sidewalks and trails result from an understanding of the wide range of abilities that exist within the population and how the design process can meet the needs of people of all abilities.*

In order to meet the needs of a broad group of sidewalk and trail users, designers and engineers must have a true understanding of the wide range of abilities that will occur within the population and how design parameters can influence those abilities. Since people are naturally most comfortable and confident with their own needs and experiences, designers and engineers should attempt to create a connection between themselves and the broad range of people who will use the facilities that they create. A successful understanding between designers and those they are designing for will result in a future of more accessible facilities and higher quality experiences on public sidewalks and trails.

2.1 Function, activity and participation

In 1981, the World Health Organization published the International Classification of Impairment, Disability and Handicap (ICIDH) so that communication and terminology could be standardized and understood on an international level (World Health Organization, 1980). The ICIDH defined three terms for describing health-related restrictions of an individual's level of function:

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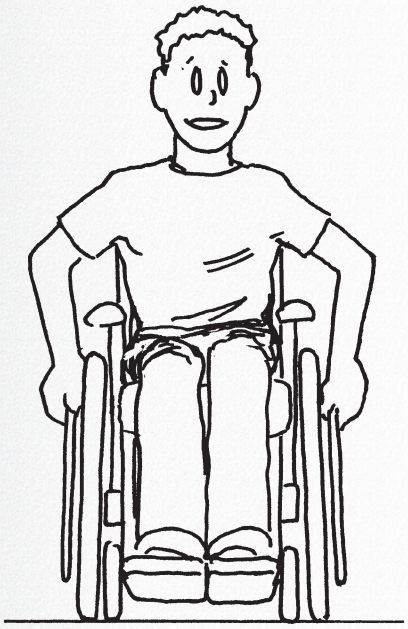

Figure 2-2. *This wheelchair user has a mobility impairment that may or may not create a disability depending on the design of his environment.*

Impairment — a difference in the way a body is constructed or functions;

Disability — a limitation in the way daily functions in the community can be performed as a result of an impairment; and

Handicap — a limitation of function imposed by the beliefs of the community.

These definitions highlighted a basic premise that has been the foundation of accessibility issues and concerns during the past two decades:

An impairment is a function of the individual. A disability or handicap occurs because of limitations imposed on the individual by the community in which he or she lives. Thus, disability and handicap are functions of the environment rather than the individual and both are preventable through a combination of education, assistive technology, planning, and design.

Recent revisions to the ICIDH go even further in identifying disability as a function of the environment (World Health Organization, 1999). The new classification system (ICIDH-2) is designed to describe the health status of all individuals, with and without disabilities. The labels of "disability" and "handicap" have been removed from consideration. Using the ICIDH-2, the functional status of each individual can be described using the following dimensions:

Function — the physiological or psychological functions of the body or the anatomical body parts;

Activity — the performance of a task or action by an individual;

Participation — an individual's involvement in life situations within his or her society;

Contextual Factors — environmental and personal factors that impact the individual's functional state.

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Figure 2-3. *Impairments are problems in body function or structure.*

Using the ICIDH-2, the ability of each individual to use a sidewalk or trail environment can be described through a combination of the these dimensions. In addition, the barriers to sidewalk or trail use that may be encountered can also be described. Each of these dimensions is explained in greater detail in the following pages.

2.1.1 Function

Body functions describe the physiological or psychological functions of the various systems within the human body. Body structures identify the anatomical parts of the body, such as organs or limbs. Body functions and structures are used to describe the functional and structural integrity of all individuals. Impairments are problems in body function or structure.

Impairment = Problem in Body Function or Problem in Body Structure

Impairments may be a reduction, loss, addition, or deviation. Impairments can be temporary or permanent, progressive or static, intermittent or continuous, minor or severe. The presence of an impairment does not necessarily indicate the presence of a disease or disorder. Body function or structure can only be changed through interventions that restore the function (such as, a kidney transplant can restore a loss of kidney function) or structure (such as, a bone graft can be used to rebuild a shattered bone). However, an impairment may or may not limit a person's ability to perform activities or participate in society.

2.1.2 Activity

Activity is "what an individual does" (World Health Organization, 1999). It describes a task or action that can be performed by an individual within all aspects of human life. An activity limitation results from difficulties that an individual may have in the performance of an activity. For example, activity is limited when an individual has difficulty

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performing an activity in the expected manner or is unable to perform the activity at all. The limitation may relate to qualitative or quantitative differences in the way an activity is performed. The following examples demonstrate how activity limitations can be addressed:

Assistive devices — a larger handle can enable someone with limited grip to grasp a toothbrush and brush his/her teeth;

Personal assistance — a gardener can be hired to look after the exterior home environment if the individual is unable to do so; and

Modifications to the environment — replacing a set of steps with a ramp will enable someone using a wheelchair to enter a building.

Although these types of modifications cannot eliminate an impairment, they can be used to eliminate activity limitations.

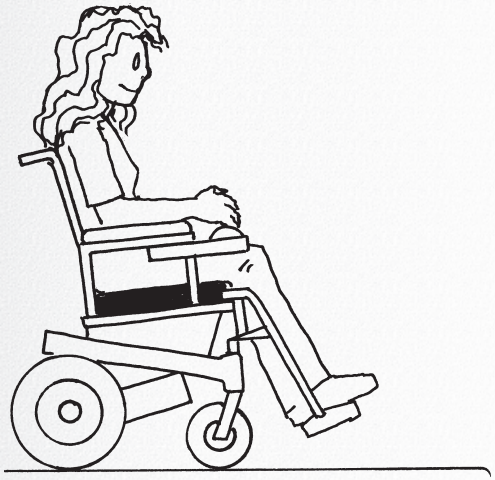

Figure 2-4. *A powered wheelchair is an example of an assistive device that helps to prevent a mobility impairment from causing an activity limitation.*

2.1.3 Participation

Participation refers to the individual's involvement in life situations within his or her community. It describes the individual's degree of involvement, as well as society's response to the individual's level of functioning. Included within the societal context are all of the physical, social, and attitudinal factors that may be encountered. Involvement in life situations has objective and subjective aspects. Objective aspects include being engaged in an area of life, being accepted, or having access to the required resources. Subjective aspects include satisfaction, fulfillment, and enjoyment. Participation differs from activity in that it describes external factors rather than the "internal" abilities of the individual. Participation restrictions describe problems that an individual may encounter when they attempt to be active in life situations. Restrictions may result from the social environment, even when the individual has no impairment or activity restriction. For example, someone who is HIV

positive with no symptoms or functional impairment may be denied insurance or excluded from activities because of social attitudes.

2.1.4 Contextual factors

Contextual factors represent the complete background of an individual's life and living (World Health Organization, 1999). They include any environmental or personal factors that have either a positive or negative influence on the individual's function, activity, or participation.

Environmental factors are external to the individual, and include the physical, social, and attitudinal environments that exert an influence on individual functioning. Major categories of environmental factors include:

- Products and technology;
- Natural environments and human changes to the environment;
- Support and relationships;
- Attitudes, values, and beliefs;
- Services; and
- Systems and policies (Gray & Hendershot, 2000).

Personal factors are attributes or features of the individual that are not related to the individual's functional state. These may include factors such as age, gender, educational background, socioeconomic status, personality, fitness, habits, social background, or coping traits.

2.2 Different abilities for sidewalks and trails

People with and without impairments use a variety of methods to travel within their environment. Some people are fit and athletic, others less so. Some people rely primarily on automobiles for travel within their community, while others walk extensively, bicycle, or utilize public transportation. Most people are very familiar and comfortable with the "rules" and expectations for traveling within their community while others may have

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Figure 2-5. *For people who are blind, the use of sidewalks is essential to perform daily living activities. Sidewalks must be designed to meet the needs of all potential users across a full spectrum of abilities.*

difficulty understanding or following expected travel patterns. Children and older adults have different physical and cognitive abilities than young adults. People with disabilities often utilize different methods, skills, and abilities than those generally used by people without disabilities. In these and many other ways, each individual is unique.

The range of abilities among our population is also reflected in the wide variety of factors that might affect the use of sidewalks and trails. Whether a particular individual, or group of individuals, can safely and effectively access a sidewalk or trail will depend on a large number of functions, such as:

- Agility
- Balance
- Cognition
- Coordination
- Endurance
- Flexibility
- Hearing
- Problem solving
- Required behavior(s)
- Sensory processing capacity
- Strength
- Vision
- Walking speed

Among any group of individuals, there will be a wide range of abilities for each of the functions that affect the accessibility or usability of the sidewalk or trail. For example, vision is often required to identify signs or directional information that enhance the safety of pedestrians. Vision abilities range along a continuum from 20/20 vision to no vision. Pedestrians using sidewalks and trails may have visual abilities at any point along the continuum. The greater the range of visual abilities that can be accommodated in sidewalk or trail designs, the larger the

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proportion of people who will be able to safely and effectively travel on the sidewalk or trail.

The ability to participate in community life depends on the ability to travel independently. Virtually every activity that requires people to venture outside of their homes requires the use of pedestrian travel paths, such as sidewalks and trails. Even when relying primarily on automobiles, people still must become pedestrians to get from their automobile into the building or destination. Since the use of sidewalks is essential for performing activities of daily living, such as grocery shopping or errands, access to sidewalks is a right of all individuals. Therefore, it is essential that sidewalk design parameters meet the needs of all potential users across the full spectrum of abilities. Sidewalks are basic to independent living and must meet the highest standards. The use of and access to trails must also be a high priority, particularly for those trails that provide access to essential services and facilities in outdoor environments (such as, visitor facilities and restrooms).

2.3 Designing for all abilities

While function relates solely to the individual, most of the ICIDH-2 dimensions (activity, participation, and contextual factors) are influenced by the society or environment in which the individual lives. All individuals have the right to fully participate in their community. If neighborhoods do not have a safe, comfortable, and convenient pedestrian system, this can leave people isolated in their own homes and unable to participate in everyday activities. Given the broad influence of environmental factors on the individual's level of function, professionals who design or construct sidewalk or trail environments have a significant influence over whether individuals will be able to use and enjoy the sidewalk and trail environments that they create.

Historically, our society believed that the presence of a disability was a function of the attributes of the individual. As such, it was the responsibility of the individual to change or adapt in order to

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Figure 2-6. *Older adults rely on sidewalks to travel within their community to perform daily activities.*

"fit" into the community. For example, if an individual's legs were paralyzed, the individual was expected to find a different way to walk up a flight of stairs and into a building. However, as the ICIDH classification system demonstrates, activity and participation are not just a function of the individual but a reflection of the community environment in which they live. The installation of stairs with no alternate means of access creates activity and participation limitations for those who are unable to walk up the stairs. When a person's independence is denied because of facilities not being accessible, the person, their family, and society pays the cost of their isolation and dependence.

2.3.1 The need for a new approach

Sidewalk and trail developers, engineers, and construction personnel build for the future. Since months or years can elapse while a project is developed, designed, and constructed, projects constructed today will not be replaced for many years. Therefore, sidewalk and trail developers must not only be prepared to solve current design problems, but to also be fully aware of how current solutions will meet user demands in the future.

The design of sidewalk and trail environments is important to all pedestrians, but is particularly important to those with activity limitations related to the use of pedestrian environments. Older adults, people with vision impairments, and children frequently rely on sidewalks to travel within their community. People with mobility impairments must also incorporate knowledge of barriers and the location of accessible routes of travel as they plan their participation within the community. For instance, someone using a wheelchair may want to go to the

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Figure 2-7. *Designers and engineers must meet the needs of people of all abilities. Different functional abilities may involve varying walking speeds and endurance.*

bank, post office, and grocery store. The selection of where to go will be influenced by the accessibility of each facility, as well as the accessibility of the paths of travel between each facility. Barriers along a path of travel may actually force an individual with activity limitations to use different facilities than they would prefer.

Traditionally, the project development, design, and construction of pedestrian facilities have been based on the design characteristics of a "standard pedestrian." Oftentimes the parameters for the "standard pedestrian" were based on a young adult male of "normal" body function and structure. It has always been recognized that these design parameters were meant to represent an average among the population. While these parameters may have been appropriate for pedestrian facilities in the past, the composition of our population has changed significantly in recent decades. Some examples of changes in the population that may affect sidewalk and trail design parameters include:

- There is an increasing proportion of older adults;
- Approximately 20 percent of Americans have a disability and the percentage of people with disabilities is increasing (U.S. Census Bureau, 1994);
- Decreasing mortality rates for a variety of disabling illnesses and injuries are resulting in an increase in the length of time that people live with functional limitations (i.e., people are living longer with less function);

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- Over 50 percent of adults in the United States are now obese, making obesity the norm (Center for Disease Control, 1997);
- Many children travel on their own to and from school.

These changes are expected to continue, and probably accelerate, in the future. Today, even more so than in the past, the concept of the "standard pedestrian" is detrimental rather than helpful in creating high quality pedestrian facilities. In reality, the travel speeds, endurance limits, physical strength, stature, and judgment abilities of pedestrians vary tremendously, and the range of abilities is increasing as our population changes. For example, the average pedestrian as defined in the Manual on Uniform Traffic Control Devices has a walking speed of 1.2 m/s (4 ft/s) (U.S. Department of Transportation, 1988). In contrast, research with older adults indicates an average walking speed of 0.85 m/s (2.8 ft/s) (Staplin, Lococo, Byington, 1998).

Use of a "standard pedestrian" may create unnecessary barriers because the associated design parameters no longer reflect the abilities and needs of our population. In order to meet the needs of our changing population, designers should use the knowledge and awareness of the range of abilities among our population to develop sidewalk and trail environments that do not impose activity or participation limitations because of artificial or unnecessary barriers.

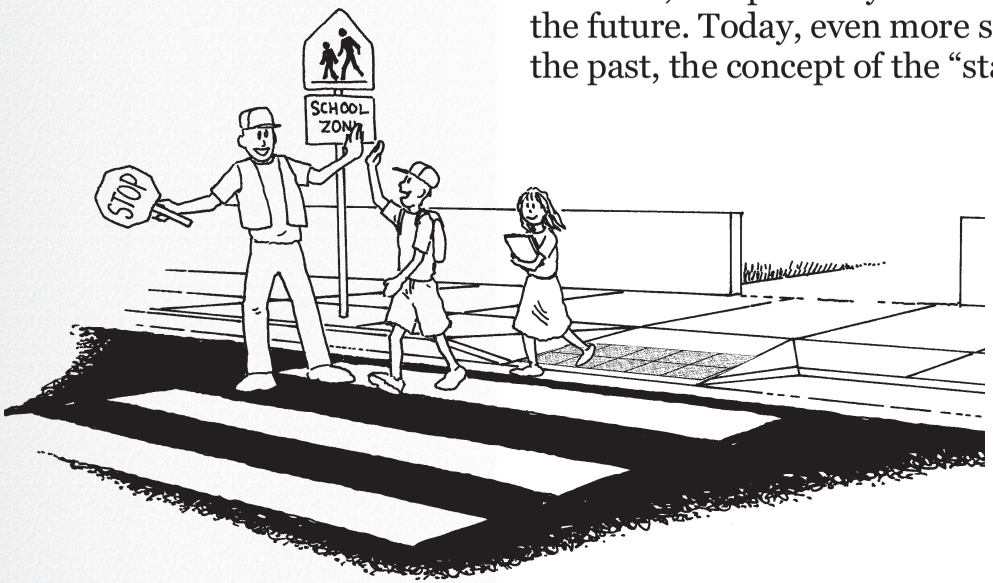

Figure 2-8. *Signs, marked crosswalks, and crossing guards create accessible sidewalk environments for children who travel on their own to and from school.*

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2.3.2 Accessible environments through universal design

Our society now recognizes that everyone has the right to have and use pedestrian facilities. Society's recognition of these rights is supported by legislation prohibiting discrimination, such as the Americans with Disabilities Act, which prohibits discrimination on the basis of disability. Designing sidewalk and trail environments to meet the current and future needs of our changing population requires an inclusive design approach. Building pedestrian facilities now and for the future means beginning to address the needs of a broader range of sidewalk and trail users, including older pedestrians, people with disabilities, and children. Just as roadways are designed to suit the needs of all types of vehicles, sidewalks and trails should be designed to accommodate the needs of all pedestrians (Washington State Department of Transportation, 1997).

Universal design is "an approach to creating environments and products that are usable by all people to the greatest extent possible" (Mace, Hardie & Place, 1991). Instead of designing solutions that benefit only a small target audience (such as, the "standard pedestrian"), universal design emphasizes meeting the needs of all potential users to the greatest extent possible. In addition, universal designs take into consideration the physical, cognitive, emotional, and social changes that each individual experiences over the course of a lifetime.

Universal design encourages and supports the development of facilities that include and are usable by people of all abilities. Providing a ramped entrance to a building at the back door when the front entrance has stairs is not a universal design. Although considered accessible, this solution separates users by their abilities. A universally designed solution would seek to meet the needs of all users by creating access for all through the primary entrance. Successfully addressing the current and future needs of our changing population means incorporating the principles of universal design into all aspects of sidewalk and trail development.

2.3.3 Natural and constructed environmental constraints

The benefits of universal design are not specific to people with disabilities. The key to creating high quality pedestrian environments is to recognize that all individuals have different abilities for using sidewalks and trails. No one is "standard." Everyone has strengths, weaknesses, and differences in abilities along a continuum from very high to very low levels of function. Whether these differences result in an activity or participation limitation depends, in large part, on the demands or constraints found within the sidewalk or trail environment. Activity and participation limitations in sidewalk and trail environments can result from a variety of factors. In general, these factors relate to either the constructed or natural environment. Limitations in the constructed environment are created when built facilities do not meet the needs of users. For example, offices at the top of a tall building would have a tremendous disadvantage for attracting clients if an elevator was not provided. Limitations imposed by the natural environment are not caused by human efforts but may need to be mitigated through human changes. For example, a landslide can make travel along a trail difficult or impossible, particularly for individuals that are not very fit or agile.

The goal of sidewalk and trail design and construction is to ameliorate the constraints within the natural environment and to avoid constraints in the constructed environment to enable effective pedestrian travel. Sidewalk and trail developers should:

- Ensure that the environments that they design and construct do not create activity or participation limitations; and
- Minimize the activity or participation limitations that result from existing natural conditions.

It is only through a universal design approach that activity and participation limitations can be minimized and the

barriers within the constructed environment can be eliminated.

2.4 Barriers create activity and participation limitations

Activity and participation limitations can result from an almost limitless range of factors. Within the scope of this guidebook, it is not possible to discuss the full range of potential factors that may result in activity or participation limitations for an individual. Therefore, the following discussion will focus on the most common barriers found within sidewalk and trail environments. In general, the ability of an individual to participate in sidewalk and trail environments is influenced by two types of barriers:

- Movement barriers; and
- Information barriers.

2.4.1 Movement barriers

A movement barrier is anything that restricts an individual's ability to physically move along or within an environment. It may limit the individual's movement from one place to the next (e.g., travel from one side of an intersection to the other), or the ability of the individual to position his or her body within one location (e.g., move the arm and hand in order to use a pedestrian actuated signal device or to get close enough to push it). The movement barrier may create a physical barrier to movement (e.g., soft, unstable surfaces), or it may result in a barrier because of the type of movement the individual is required to perform (e.g., short signal times require rapid analysis and very fast positioning and movement to cross and may not provide enough time for decisionmaking before crossing). Movement barriers result from a variety of factors within the environment and/or the individual.

Movement barriers within the environment can occur in both natural and constructed environments. Examples of movement barriers within the environment include:

- Difficult terrain (e.g., steep slopes or cross slopes and soft, unstable, or uneven surfaces);
- Travel path designs that require high speed movements and/or sudden or frequent changes of direction (e.g., short signal phases that do not provide sufficient crossing time);
- Travel paths without areas for rest or shelter;
- Obstacles within the path of travel (e.g., lamp posts, benches, rocks, railings, or barrier);
- Sidewalk/trail design that exposes the user to potential hazards (e.g., unregulated at-grade crossing of a multi-lane highway);
- Environmental designs that require unusual movements or coordination (e.g., placement of pedestrian actuated signal devices in a location that cannot be accessed by all pedestrians); or
- Over and under passes with stairs or steep ramps.

Movement barriers within the individual are determined by the individual's body function and structure. Examples of movement barriers within an individual are:

- Limited agility (e.g., ability to negotiate obstacles, steps, or curbs);
- Limited endurance (e.g., inability to increase heart rate or breathing, quick onset of fatigue, or increased energy expenditure for ambulation with crutches or canes);
- Limited speed (e.g., limited coordination or lack of strength for quick movements);
- Unpredictable movement patterns (e.g., children often go from "start" to "stop" or may change directions or plans on the spur of the moment); and

- Deliberations in decisionmaking (e.g., people with vision impairments or older pedestrians with cognitive disabilities may take longer to start and determine when to cross).

Table 2-1 provides examples of how some sidewalk and trail users may experience activity or participation limitations because of environmental or individual movement barriers.

Professionals who design or build sidewalk and trail environments should ensure that they:

- Do not create movement barriers within the environment;
- Eliminate or at least minimize the movement barriers that naturally occur within the environment; and
- Design environments that do not impose a barrier that results in movement barriers for an individual; thus creating a disability from an environment that doesn't function (see Table 2-1).

Design recommendations on how to achieve these objectives are discussed in more detail in the Sidewalk Development and Trail Development sections.

2.4.2 Information barriers

Information barriers restrict the individual's ability to use information contained within the sidewalk or trail environment. An information barrier may limit the individual's ability to:

- Recognize or receive information (e.g., a loss of vision and loss of hearing and vision together prevents an individual from utilizing visual signs);
- Understand the information received (e.g., a person with a cognitive impairment may see a flashing "WALK" or a "DON'T WALK" signal but not understand what it means; children have difficulty judging the speed of an approaching vehicle);

Table 2-1. Movement Barriers

The following table provides examples of how some sidewalk and trail users may experience activity or participation limitations because of environmental or individual movement barriers.

	Environmental Movement Barriers					Individual Movement Barriers			
User Description	**Difficult terrain**	**Soft surface**	**Obstacles**	**Signal actuation**	**Complex decisions**	**Limited agility**	**Limited endurance**	**Limited speed**	**Unpredictable movement patterns**
Stroller User	X	X	X				X		
Wheelchair User	X	X	X			X	X	X	
Inline skater	X	X	X			X			X
Individual with limited balance	X	X	X			X			X
Individual with a vision impairment			X	X			X	X	X
Older adult					X	X	X	X	X
Child	X				X	X	X		X
Individual who is obese	X					X	X	X	
Crutch or support cane user	X	X	X			X	X	X	
Individual with low fitness levels	X						X	X	
Individual with a cognitive impairment				X	X			X	X
Individual with an emotional impairment					X				X

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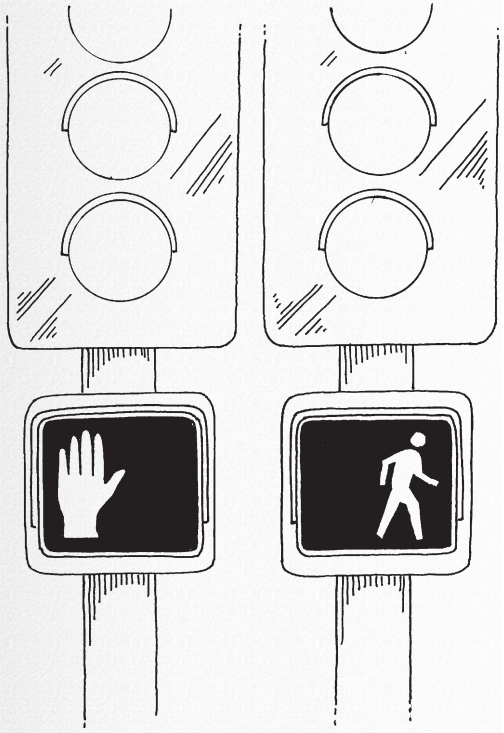

Figure 2-9. *Pictorial symbols are easier for people with cognitive impairments or limited English language skills to understand.*

- Decide on a course of action quickly (such as, picking a gap), align themselves properly, and start to cross within the signal phase; or
- Act upon the information in the anticipated manner (e.g., young children believe that adults will protect them from harm, so they may ignore a stop sign for pedestrians to stop on trails or shared-use paths, even though they see and understand the sign).

Information barriers may result from factors within the environment and/or the individual. The design of high quality, accessible pedestrian environments includes measures to ensure that information about the environment is available to all pedestrians.

Information barriers within the environment include:

- Limited sight lines;
- Complex paths of travel;
- Inaccessible formats for pedestrian information;
- Ambiguous or unclear signs or signals;
- Information available through only one format (e.g., visual but not auditory);
- Unclear or missing information about the appropriate pedestrian path of travel; and
- Decisions (e.g., selecting a gap) requiring vision.

Information barriers for some individuals can also be addressed through the design of the sidewalk or trail environment. Examples of information barriers for some individuals include:

- Limited ability to receive information (e.g., limited vision may prevent a person from receiving visual information, and loss of hearing will prevent a person from receiving auditory information);

- Limited ability to process or understand the information received (e.g., an individual with a brain injury may see a traffic sign but be unable to understand the meaning of the text);
- Limited ability to act in accordance with information received (e.g., a person with an emotional impairment may be so overwhelmed with the desire to get to a different location that they ignore a red light even though it can be seen and understood); and
- Decreased speed for processing information, making decisions, and implementing action (e.g., an individual with a cognitive or vision impairment may require more time to decide that it is safe to cross an intersection and, by then, the conditions may have changed or the light may be red for the pedestrian).

Table 2-2 provides examples of how some sidewalk and trail users may experience activity or participation limitations because of environmental or individual information barriers.

Those who design sidewalk and trail environments must ensure that they:

- Do not create information barriers within the environment;
- Eliminate or at least minimize the information barriers that naturally occur within the environment; and
- Design environments that do not impose a barrier that results in information barriers that occur for specific people thus creating a disability from an environment which doesn't function (see 2.2).

Design recommendations for creating sidewalk and trail environments with information accessible to all pedestrians are discussed in more detail in the Sidewalk Development and Trail Development chapters of this guidebook.

Table 2-2. Information Barriers

The following table provides examples of how some sidewalk and trail users may experience participation limitations because of environmental or individual information barriers.

	Environmental Information Barriers				Individual Information Barriers			
User Description	**Sight lines**	**Inaccessible formats**	**Irregular and skewed intersections**	**Complex signage**	**Limited ability to receive**	**Limited ability to process**	**Slower speed to process**	**Limited ability to have an expected response**
Individual with a vision impairment	X	X	X		X			
Individual with a hearing impairment	X	X	X		X			
Individuals with brain injury			X	X	X	X	X	X
Individual with a mobility impairment	X		X					X
Individual with limited English language skills		X		X	X	X	X	X
Older adult			X	X			X	X
Child	X		X	X		X	X	X
Individual with limited concentration abilities			X	X			X	X
Individual with a cognitive impairment		X	X	X		X	X	X
Individual with an emotional impairment			X				X	X

2.5 Conflicting pedestrian needs

All pedestrians will have different needs; therefore, changing a design to enhance access for one group can create additional barriers for other individuals. It must be recognized that it is not possible to create an environment that provides equal levels of accessibility to every individual. However, the goal should be to make all sidewalk and trail environments accessible to the largest possible number of potential users.

In order to create high quality sidewalk and trail environments that are usable by the highest proportion of pedestrians, designers should understand how a user's abilities are impacted either positively or negatively by any given design feature. The following examples illustrate the need for designers to be aware of the impact of design features on all potential users:

- **Walking on slopes** — A ramp installed to permit access into a building without the use of steps may impede access for someone who has a limited ability to walk on sloped surfaces. People who use walking aids or have limited balance may have greater access via a set of stairs than can be provided if they are required to use a sloped surface, such as a ramp or graded terrain.
- **Detection of the sidewalk-to-street transition** — Curb ramps are critical access features for people who use wheeled forms of mobility (e.g., wheelchairs, strollers, bicycles, and inline skates). However, they make it much more difficult for people with vision impairments to detect the transition between the sidewalk and the street. It is very difficult to detect differences between gradual slopes in the absence of visual cues. Individuals who have reduced sensory capacity in the extremities experience similar barriers. These problems are enhanced further among individuals with sensory and other impairments (e.g., diabetes can lead to vision and sensory function loss).

- **Knowledge of traffic movement** — Roundabouts and right turn slip lanes are used to improve intersection efficiency for automobiles. However, they also disrupt the "stop and go" traffic patterns that are typically found at an intersection and force pedestrians to rely on visual cues to identify gaps available for crossing. The traffic sounds that people with vision impairments use to identify the gap for a safe crossing are disrupted or absent when there is a continuous traffic flow. Furthermore, if the traffic does not yield to the pedestrian, problems may be created for people with slower walking speeds and starting times, as well as for those who have difficulty determining the appropriate crossing time or location.

- **Different abilities among users on the same path** — Along a shared-use path, different user groups may compete for the same space. Differences in factors such as travel speed, type of technology, noise or anticipated experience may create conflicts between users. In addition, when people of different abilities use the same travel space, improving access for one user group may reduce the accessibility provided to other users. Examples of conflicts between users of different abilities include:

1. Grade reductions through elongated, winding trails to enhance accessibility for pedestrians with movement limitations may decrease the usability and desirability of the trail for cyclists commuting to work who are looking for optimal speed and efficient paths of travel;

2. Individuals with limited agility may have difficulty avoiding cyclists traveling at higher speeds if cyclists are not easily detected;

3. Road cyclists and pedestrians generally prefer a firm and stable surface, while runners and equestrians prefer a softer surface; or

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4. Mountain bike riders may prefer a trail with many obstacles while runners, wheelchair users, and road bike riders prefer a smooth trail surface.

When addressing the conflicting needs of users, designers should focus on making improvements to include use of the widest range of potential users. Maximizing use may mean employing additional design tools. For example, a detectable warning (see Chapter 6) located at the bottom of a curb ramp can improve curb ramp detectability by persons with vision impairments. Users traveling at various speeds can be accommodated by splitting shared-use paths to provide separate travel paths for slower users. The needs and capabilities of all potential users should be considered and balanced when designing pedestrian facilities.

Figure 2-10. *Some ambulatory pedestrians with mobility impairments benefit from walking aids, such as walkers, to minimize the effects of their impairment.*

2.6 Function, activity, participation, and technology

We are living in the "technology and information" age, and technology is constantly and rapidly changing the way we do things. Technology allows us to travel farther and faster, communicate information instantly, and do activities and perform feats that were previously extremely difficult or impossible.

One facet of the technological revolution is the development of assistive technology to enhance function, activity and participation. There is an ever-increasing array of technology available to individuals. Some types of assistive technology, such as the gears on a bicycle, are widely known and understood. Other types of assistive technology, such as the devices used by many individuals with disabilities, are not widely recognized.

While it is not possible for every designer to have detailed knowledge of every type of assistive device, a general understanding of the functions and uses associated with the more common types of assistive technology used by people with impairments is an important factor for enhancing activity and participation.

Assistive technologies play a valuable role in enhancing the ability of people with

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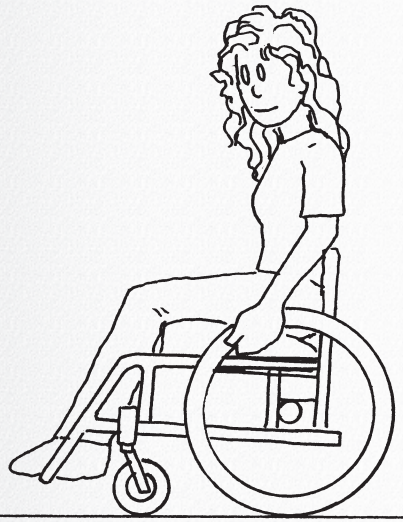

Figure 2-11. *A wheelchair is an example of a personal technology that allows a person with a mobility impairment to accomplish all types of daily activities.*

disabilities to navigate independently through indoor and outdoor environments. These devices can sometimes be used to minimize or eliminate the activity limitations and participation restrictions that exist within sidewalk and trail environments.

The broad range of assistive technologies for people with disabilities is often discussed in terms of a continuum of technologies that include (Axelson, 1988):

- Personal technologies;
- Activity-specific technologies; and
- Environmental technologies.

2.6.1 Personal technologies

Personal technologies are things that are closely associated with, and usually connected to, the individual. They include things that you utilize, such as a long white cane, eye glass, wheelchair, or guide dog, as well as things you wear, such as eyeglasses, a hearing aid, or prosthesis. Personal technologies enhance the body's function or structure with the goal of enhancing the individual's ability to accomplish a variety of day-to-day activities.

Personal technologies generally only benefit the owner of the technology, and require the individual or the individual's health care or insurance provider to bear the cost of purchasing and maintaining the device. In addition, each type of technology will have positive and negative aspects. For example:

- A **wheelchair** provides easy mobility on flat, firm surfaces. However, it is much more difficult to maneuver on slopes. Traversing steps or curbs is extremely difficult if not impossible.
- A missing leg can be replaced with a **prosthetic leg**. Current technology works quite well if the individual retains his or her own knee. However, a prosthetic leg does not provide the sensory feedback that is needed to ensure stable foot placement, detect obstacles, or maintain balance.

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Figure 2-12. *A long white cane is an example of a personal technology that allows a person with a vision impairment to independently accomplish many daily activities.*

- **Eyeglasses** are a very common type of technology used to correct mild to moderate vision impairments. However, eyeglasses are cumbersome to use in rain, fog or cold weather conditions, and special "safety" frames are required for sports or activities that might result in impact to the device.
- Individuals with severe vision loss often use a **long white cane** or **guide dog**. A long white cane provides advance warning about obstacles on the path ahead, but it is not effective at detecting other visual cues, including obstacles above 685 mm (27 in). Guide dogs can get around obstacles, but their owners must provide instructions and directions as to where they want to travel.
- A **hearing aid** can be used by individuals who are deaf or hard of hearing to magnify the sounds in their environment. However, the magnification is not selective, so a pedestrian using a hearing aid hears the sounds of traffic and audible pedestrian signal magnified.

2.6.2 Activity-specific technologies

Activity-specific technologies are devices that enhance an individual's ability to perform a specific activity. They include all types of sports equipment (e.g., bicycles and inline skates), equipment for activities of daily living (e.g., pots and pans, toothbrush, and hairbrush), as well as devices designed specifically for one individual (e.g., knee brace and custom ski boots). Activity-specific technologies can also be used to compensate for an impairment.

As with personal technologies, activity-specific technologies often benefit the owner of the technology and require the individual or provider to bear the cost of purchasing and maintaining the device. However, many private and trail organizations make activity-specific technologies available to a broader spectrum of users. For example,

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Vail Mountain in Colorado rents mountain bikes and mountain-bike wheelchairs.

The best products work for everyone, but in some instances, activity-specific technologies may need to be modified or new technologies may need to be developed in order to assist people with impairments. For example, most people would use a pair of alpine skis to go skiing. People who are unable to stand could use a sit-ski, mono-ski, or bi-ski, which would allow them to ski while seated. Similarly, bicycles are designed to allow people to travel at greater speeds and distances using human power. People without the use of their legs could use a handbike to perform a cycling activity using only their upper body.

Figure 2-13. *Hand bicycles are an example of an activity-specific technology that allows a person with a mobility impairment to participate in cycling.*

Each type of activity-specific technology will have both positive and negative impacts on the individual's function, activity and participation. For example:

- **Hand bicycles** allow individuals to participate in cycling activities without the use of their legs, but the small muscles of the arms require a much finer gradation of gearing and current designs require a low seating position with less visibility. Scenic lookout points on multi-use trails often do not take the inability of hand bike riders to walk into consideration.
- A **saddle with back supports** can enable people with paralysis or limited strength or balance to ride horses. However, they may be unable to dismount during the ride. For example, someone who uses a wheelchair may not be able to dismount and walk while they traverse a steep hill or very narrow trail.
- Biathlon is a combination of cross-country skiing and shooting. Individuals with a vision impairment participate in the target shooting phase by using **headphones connected to a laser light** that generates audible tones to identify the target.

- **Mountain-bike tires** make it much easier to ride on unpaved surfaces. However, they also increase the rolling resistance of a bicycle or wheelchair and, therefore, increase the amount of energy that will be needed to pedal or push a given distance.

2.6.3 Environmental technologies and design

Environmental technologies are modifications or designs of a space or environment to increase its usability. Universal design requires the insightful use of environmental technologies to create environments with greater access for everyone. The application of universal design principles focuses on the use of environmental technologies that enhance the participation of users with a broad range of abilities. For example, toilet facilities may be provided on a trail for the comfort of users and protection of the environment. The use of environmental technologies and designs such as a larger clear floor space, accessible door handles, and an at-grade entrance will ensure that the restroom is accessible to a broader spectrum of users.

Examples of sidewalk and trail environmental technologies that benefit individuals with impairments include accessible pedestrian signals, curb ramps, elimination of glare, stabilized trail surfacing, and detectable warnings. The use of environmental technologies and the principles of universal design are the cornerstones for designing high quality pedestrian facilities. Incorporating environmental technologies, particularly those that benefit the broadest spectrum of users, into the sidewalk or trail environment should be every designer's priority.

As with all types of technology, environmental technologies may have a positive or negative impact on a particular user. For example:

- Traditional **audible pedestrian signals** in the U.S. emit loud tones, bells, buzzes, or bird calls from the pedestrian signal head during

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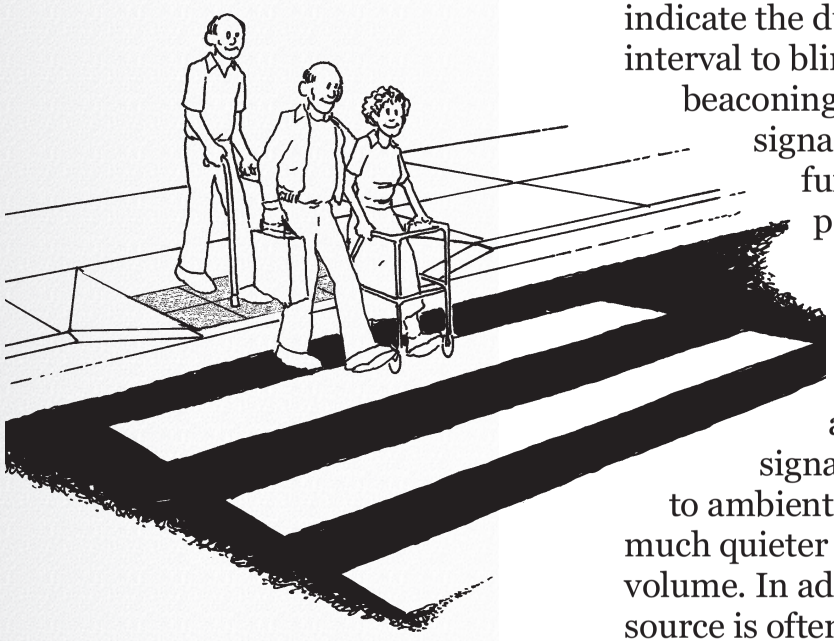

Figure 2-14. Curb ramps in the sidewalk environment provide for an easier transition from the curb to the street for people with mobility impairments, and detectable warnings placed appropriately at the bottom of the ramp aid people with visual impairments in recognizing the transition from the sidewalk to the street.

the walk interval that are intended to serve as audible beacons to the opposite corner, as well as to indicate the duration of the walk interval to blind pedestrians. The beaconing function of these loud signals has been found to function relatively poorly, and their noise is often annoying to people living and working in the area. Contemporary audible pedestrian signals nearly all respond to ambient sound, so they are much quieter in times of low traffic volume. In addition, the sound source is often at the push button, and it is therefore more localized.

- A **ramp** may be installed to provide access to a shared-use path constructed on a former railroad bed for people using wheeled forms of mobility (e.g., wheelchair, stroller, or bicycle). However, long ramps are harder to negotiate for people who use crutches or canes, or who have limited balance on sloped surfaces.

- **Bulletin boards** are often used to convey information to users at the trailhead. However, posting documents with regular size print makes it difficult for people with low vision or people standing at a distance to read the information. Similar problems may be encountered by individuals with limited English language skills (e.g., people who do not speak English or people with cognitive impairments) if the written language is very complex.

2.6.4 How does technology influence design?

In order to design high quality, accessible environments, it is necessary to have an understanding of the types of environmental technologies that can be incorporated into the universal design process, and how the use of personal or

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activity-specific technologies may impact the abilities of the user.

The knowledgeable and thoughtful use of environmental technologies will create pedestrian environments with universal access to people of all abilities. This practice of universal design is increasingly recognized and encouraged to allow all persons, with or without disabilities, to move more freely, independently, and safely in outdoor environments.

Figure 2-15. *This manual mountain bike wheelchair, with its longer wheel base, is significantly more effective on rugged terrain than a traditional hospital style manual wheelchair.*

The impact of some types of impairment can be mitigated to a certain extent through the use of personal or activity-specific assistive technologies. While it is recognized that an environment can never be fully and independently accessible to every possible user, many pedestrians can utilize personal or activity-specific technologies to enhance their ability to function within the environments that designers create. These types of technology can assist people with impairments to become more independent, however individuals may not have access to these technologies and, therefore, the first priority should always be the use of environmental technologies and the universal design process.

Many types of assistive technologies, such as walking aids, improve mobility but do not eliminate the need to design and construct accessible environments. During the design process, it is helpful to have knowledge about the many types of assistive technologies that could be used on sidewalks and trails. The needs and abilities of each user will vary depending on the performance characteristics of any particular type of technology. The benefits obtained from a particular type of technology will also be influenced by the skill, experience, and ability of the user, as well as the characteristics of the environment. For example, there are a wide variety of wheelchairs for individuals with mobility impairments. The outdoor

environment performance characteristics of the traditional, hospital-style manual wheelchair are very different from the mobility that can be achieved using a powered wheelchair specifically designed for rugged, outdoor environments.

Personal, activity-specific, and environmental technologies are interdependent. The choice of a personal, activity-specific, or environmental solution will depend on specific parameters of the barrier, such as its location or availability for public use. For instance, a person who is paralyzed may use a wheelchair as a personal technology. However, to use a sidewalk or shared-use path effectively, environmental modifications, such as curb ramps also need to be provided. If the same person chose to use a more rugged recreation trail, an activity-specific technology, such as a mountain-bike wheelchair might be required. Understanding the interdependent relationship between the environment, the required activity, and the abilities of the person is an important fundamental step in the ability to design effectively for the future.

Selecting a wheel design and technology is a decision based on ability, type of usage, and, often, cost. Manual chairs and power chairs maneuver differently in turns and changes in level. Manual chairs have advantages of being portable, generally smaller, lighter in weight, require less maintenance, and generally cost less. A manual chair allows the person with the upper body ability to stay physically active, but power chairs can be more effective on steeper grades.

2.6.5 Limitations of technology

Despite the tremendous benefits provided by assistive technology, there are major limitations related to the essential use of assistive devices to overcome barriers within the environment.

- The cost of most assistive devices makes them unavailable to many people, especially for the disproportionate number of people who have disabilities that do not have jobs and/or live in poverty;

- Even with the use of the most sophisticated forms of assistive technology, the individual still needs many skills and abilities to have independent mobility in the community. For example, a person who uses a power wheelchair for mobility must have the cognitive and physical abilities to operate the wheelchair safely and effectively;
- The usability of the technology must also be considered. In many cases, existing technology can perform a similar but somewhat different function than the function that has been lost as a result of the impairment. For example, a long white cane can be used to avoid obstacles on a sidewalk, but cannot actually replace the functions of human vision;
- Reliability is also a major factor for consideration. It is relatively unlikely that your legs will suddenly and completely stop functioning. However, a flat tire or a loss of battery power can instantly immobilize some types of technology; and
- Portability is a significant factor for individuals who drive, ride as passengers, or take taxis. Powerchairs weigh hundreds of pounds and do not fold.

For these reasons, and many others, the use of personal or activity-specific assistive technology cannot be assumed and should not be considered to be an alternative to appropriate, high quality, and accessible designs.