Accessible Street Design

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Introduction

The City of Vancouver Engineering Services, with the support of other Departments, is committed to delivering the highest level of accessible and barrier-free pedestrian environment possible. Over the years staff have investigated, experimented, consulted and trained to encompass all the best techniques and practices in providing a seamless public realm. Our quest is to continually strive to improve accessibility as we move towards an aging population boom and an aging in place philosophy.

This document will provide specific information on standards we are adhering to in our efforts to create the best possible pedestrian environment that meets the needs of the largest range of users, to create an environment that provides opportunities to live, work and prosper within our neighbourhoods.

In designing for inclusion, accessibility and barrier-free pedestrian environments we look to the Seven Principles of Universal Design to guide us.

"Universal design is the design of products and environments to be usable by all people, to the greatest extent possible, without the need for adaptation or specialized design. " Ron Mace (1941-1998) Founder and program director of The Center for Universal Design.

PRINCIPLE ONE: Equitable Use
The design is useful and marketable to people with diverse abilities.

PRINCIPLE TWO: Flexibility in Use
The design accommodates a wide range of individual preferences and abilities.

PRINCIPLE THREE: Simple and Intuitive Use
Use of the design is easy to understand, regardless of the user's experience, knowledge, language skills, or current concentration level.

PRINCIPLE FOUR: Perceptible Information
The design communicates necessary information effectively to the user, regardless of ambient conditions or the user's sensory abilities.

PRINCIPLE FIVE: Tolerance for Error
The design minimizes hazards and the adverse consequences of accidental or unintended actions.

PRINCIPLE SIX: Low Physical Effort
The design can be used efficiently and comfortably and with a minimum of fatigue.

PRINCIPLE SEVEN: Size and Space for Approach and Use

Appropriate size and space is provided for approach, reach, manipulation, and use regardless of user's body size, posture, or mobility.

Things to consider when designing a pedestrian environment are the natural surroundings, including the weather and the users, including people that are large, people that are small, people that use wheelchairs, scooters, guide dogs, white canes, people who have hearing impairments and people who have learning disabilities. Materials, budgets, sustainability, maintenance and new technology are considered. The overall aim of Engineering Services is to provide an inclusive design that will facilitate social inclusion for years to come.

Basic human factors information

Definitions

It is essential that design for people with mobility impairments should be to the highest possible standards. This requires knowledge of the capabilities of different types of person. This section provides information on the basic human requirements for ease of movement. In designing or modifying pedestrian facilities the aim should be to be generous in the allocation of space.

The term disability is a broad one, it includes people with physical, sensory or mental impairment. Many, though not all, face barriers to movement in the environment. This guide is intended to show how these barriers can be removed or at least reduced, but it does have a wider relevance because there are many other people not conventionally considered to have a disability who also encounter barriers to movement.

People with small children, people carrying heavy shopping or luggage, people with temporary accident injuries and older people can all benefit from good design of the pedestrian and transport environment. Without a barrier free environment, many of these people will be mobility impaired.

While it is true that there are many aspects of design in the pedestrian environment that are helpful to all or most disabled people (and many others as well) there are also some specific facilities needed by people with a particular kind of impairment.

Manual wheelchair users need sufficient space to be able to propel the chair without banging their elbows or knuckles on door frames or other obstacles. But someone who walks with sticks or crutches also needs more space than a non-disabled walker; so too does a long cane user or person carrying luggage, or a lot of shopping bags, or with small children. Thus providing adequate clear space on pavements, along passages in public buildings, through doorways etc, is of benefit to many people.

Similarly, visually impaired people need a good level of lighting and a print size that they can read easily. But almost everyone else benefits from good lighting, not least because it gives a greater sense of security, and practically everyone finds reading easier if the print is clear and large.

These are just two examples of design requirements that are essential for people with a particular impairment but which have a much wider relevance.

More specific needs, however, can be just as important for people with certain types of impairment. For example, audible tones at a controlled pedestrian crossing are beneficial if a blind person is to know when it is safe to proceed.

This guide attempts to cover both those requirements that are general in nature and those that are more specific.

As noted at the start of this section, the term disability is a broad one. Disability is defined by the World Health Organization (WHO) as the temporary, prolonged or permanent reduction or absence of the ability to perform certain commonplace activities or roles, sometimes referred to as activities of daily living.

There are various ways or models used to define disability, but in functional terms this guide is mainly concerned with the following:

Locomotion, which includes people who use wheelchairs and those who can walk but only with difficulty often using some form of aid such as a stick or walking frame. Approaching 70% of disabled people have locomotion difficulties: those with walking difficulties outnumber wheelchair users by about 10:1.

Seeing, which can be sub-divided into blind and partially sighted people.

Hearing, which can also be sub-divided into those who are profoundly deaf and those with impaired hearing, ranging from severe to mild deafness.

Reaching, stretching and dexterity, frequently the result of arthritis, which can make these movements painful and difficult, or of muscular dystrophy causing a loss of muscular strength, or of complaints of the nervous system.

Learning disability, making it hard to understand complicated information or to use complex machines (like some ticket machines).

It should be remembered that these categories are not mutually exclusive. Many disabled people, particularly older people, have more than one impairment. The following paragraphs give some basic information on the space needed by people when they are standing or moving. Of course there is a lot of variation in this, but if the dimensions given below are used then the great majority of disabled people will be able to move around buildings and the environment much more easily.

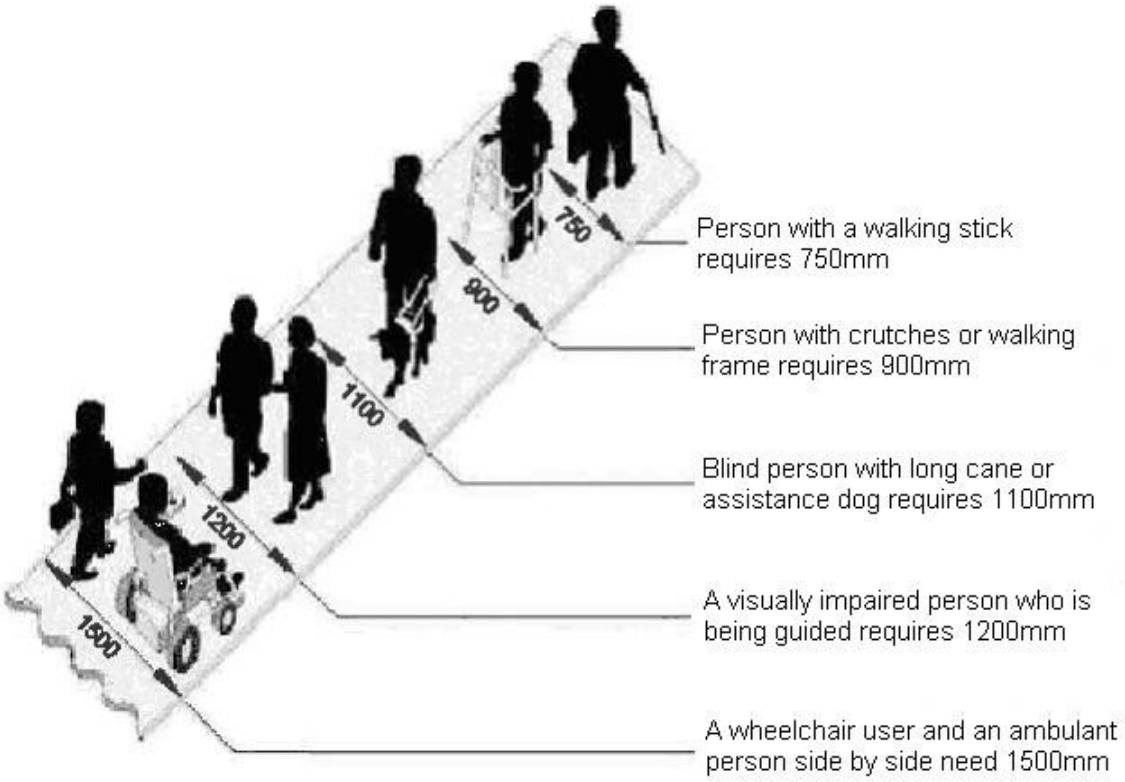
Mobility impaired and visually impaired people

Someone who does not use a walking aid can manage to walk along a passage way less than **700mm** wide, but just using a walking stick requires greater width than this; a minimum of **750mm**. A person who uses two sticks or crutches, or a walking frame needs a minimum of **900mm**, a blind person using a long cane or with an assistance dog needs **1100mm**. A visually impaired person who is being guided needs a width of **1200mm**. A wheelchair user and an ambulant person side-by-side need **1500mm** width.

Unobstructed height above a pedestrian way is also important, especially for visually impaired people. Generally, this should be a minimum of **2440mm**. Where a sign is suspended over a footway or pedestrian area, a minimum clearance of **2743mm** is required. Where trees overhang a footway it is advisable to trim them up to at least **2440mm** clear height.

Typical Dimensioning

Mobility impaired and visually impaired people



Wheelchair users

Although a minority among disabled people, wheelchair users need quite a lot of space to move around comfortably and safely: usually more than mobility impaired people, although those who walk with two sticks can occupy a greater width than someone using a wheelchair.

A comprehensive set of measurements of wheelchair visitors to the Mobility Roadshow (1999) gave the figures for length and width summarized on the opposite page. The range of dimensions is considerable, particularly that for overall length. The greatest lengths are those of conventional wheelchair users with leg supports (maximum 1545mm, though this was the only measurement out of 745 of more than 1500mm) and electric scooters with a maximum of **1500mm**. Conventionally seated wheelchair users do not occupy more than approximately **1250mm**. However, if a wheelchair user has a personal assistant, their combined length will be typically **1750mm**.

The figures given for width, with a 95th percentile of slightly over **700mm** at maximum (for powered chairs), do not make allowance for the wheelchair users elbows and hands. The ISO standard for wheelchairs (ISO 7193) notes that to propel a wheelchair manually needs a clearance of not less than **50mm**, preferably **100mm**, on both sides.

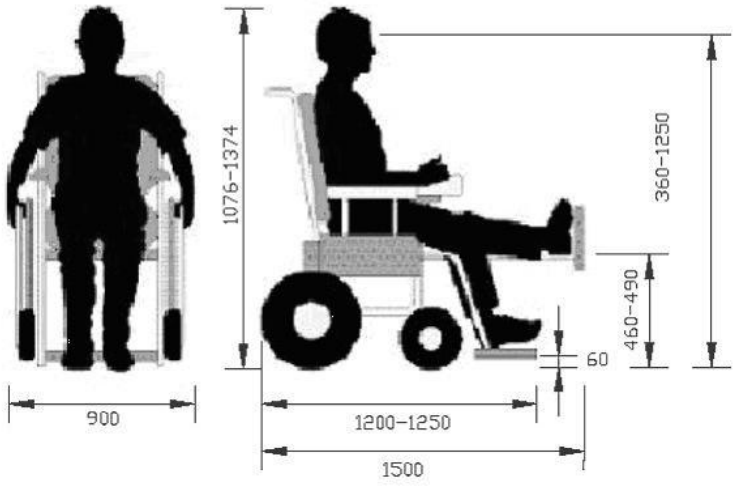
The Mobility Roadshow survey also measured the heights of wheelchair / users. The overall mean height for all types of wheelchair users was **1243mm**, with a 5th percentile of **1076mm**, 95th percentile of **1374mm** and a maximum of just over **1450mm**. As with overall length, scooter users gave slightly greater figures, with a mean height of **1340mm**, 5th and 95th percentiles of **1202mm** and **1438mm** respectively and a maximum of **1502mm**.

Other basic measurements which are of importance when considering design standards to accommodate wheelchair users are:

- Eye height, which is around **120-130mm** below seated height giving a 5th-95th percentile range for wheelchair users from **960mm** to **1250mm** (**1080mm** to **1315mm** for scooter users)
- Knee height, **500mm** to **690mm**
- Seat height, **460mm** to **490mm**
- Ankle height, manual wheelchair users **175mm** to **300mm**; electric wheelchair users **380mm** to **520mm**
- Height to bottom of foot support, **60mm** to **150mm**.

The ability of a person in a wheelchair to reach, sideways or forward, is also important and a number of guidelines give figures for this.

Wheelchair Users



Requirements in transport regulations introduced under the disability Discrimination Act 1995 are based on an occupied wheel-chair 1200X700mm

Wheelchairs that are larger than this can and should be catered for in the built environment but it is not feasible to provide for larger wheelchairs on public transport

Length of wheelchair and user (excluding children)

Chair Type	Mean (mm)	Min (mm)	Max (mm)	Percentiles (mm)	
				5th	95th
Attendant propelled	1080	742	1318	928	1197
Electric wheelchair	1107	758	1549	949	1328
New style manual chair	1033	707	1256	845	1183
Older style manual chair	1108	862	1357	919	1267
Electric Scooter	1187	971	1500	1000	1402
All chairs	**1085**	**707**	**1549**	**894**	**1273**

Width of wheelchair (excluding children)

Chair type	Mean (mm)	Min (mm)	Max (mm)	Percentiles (mm)	
				5th	95th
Attendant propelled	596	520	674	528	658
Electric wheelchair	635	521	755	552	706
New style manual chair	638	511	741	579	702
Older style manual chair	616	511	722	560	686
Electric Scooter	607	501	695	529	685
All chairs	**627**	**501**	**755**	**558**	**695**

Source: A survey of occupied wheelchairs to determine their overall Dimensions and weight: 1999 Survey by R.E. Stait, J. Stone and T.A. Savil. Unpublished Project Report, Transport Research Laboratory.

Dimensions associated with comfortable and extended reach ranges

The distance that an individual can reach varies with both the size of the person and the height to which they are reaching. Reach distance forms an arc based on the shoulder level of the wheelchair user and can be measured as easy or comfortable (reach without much movement of the torso) and maximum or extended (just possible with movement of the torso). Recent research done for the preparation of the new Code of Practice (BS 8300) gives figures for comfortable and extended reach ranges.

These are shown in the table below. The Code of Practice, which gives further and more detailed guidance on reach ranges, should be consulted when designing anything which people will have to touch, push, turn etc.

Dimensions associated with comfortable and extended reach ranges

Person	Access	Reach Angle	Height (H)		Depth (D)	
			Comfortable (mm)	Extended (mm)	Comfortable (mm)	Extended (mm)
Wheelchair User	Front	+70°	1,000	1,150	90	120
		Horizontal	(750)	(750)	180	230
		+24°	650	650	120	200
	Side	+70°	1,060	1,170	100	135
		Horizontal	(750)	(750)	220	310
		+24°	665	630	165	230
Ambulant Disabled	Front	+70°	1,500	1,625	200	250
		Horizontal	(850)	(850)	280	400
		-24°	750	700	180	310

Note 1: Dimensions have been rounded to the nearest 5mm.
Note 2: Dimensions in brackets are for the horizontal reference plans.
Note 3: It is assumed that any kneehole allows full reach capabilities.
Note 4: Maximum heights are measured from the 70° line, minimum heights from the -24° line.
Note 5: For some activities, the recommended dimensions in the standard are extended beyond those resulting from the research trials on the basis of accepted practice.

Source: BS 8300 Design of buildings and their approaches to meet the needs of disabled people - code of Practice.

The height of the feature button, handle etc, - which the wheelchair user has to reach is also important. As a general rule any features that are intended for use by people in wheelchairs, such as push buttons, switches, coin slots etc, should be no less than **750mm** and no more than **1200mm** above ground level. By leaning forward or sideways it is possible for a wheelchair user to reach beyond this range US data suggests an absolute range for sideways reach height from 230mm to 1370mm but placing controls or other features towards the extremes of this range should be avoided if at all possible.

Forward reach measurements are also important. Some wheelchair users find it difficult or impossible to lean forward: if practicable the distance forward, measured at chest height, should be no more than **500mm**; **600mm** should be the absolute maximum.

Manoeuvring space is needed for a wheelchair to turn corners or turn around. Skilled users of manual wheelchairs can turn through 360°° in a space no more than **1500mm** x **1500mm**, but this is insufficient for larger chairs, particularly outdoor electric wheelchairs (turning circle **2420mm**), electric pavement vehicles (turning circle **4350mm**) and for wheelchair users with extended leg rests.

Within transport related buildings, the following dimensions should be taken as the minima acceptable:

- Right angle turn (along corridor) **1200mm** x **1200mm**
- 180° turn (within corridor) **1600mm (width) x 2000mm (length)**

Users of electric scooters and large electric chairs may need greater space than this for 180° turns, but the dimensions given (as minimum) will accommodate users of self-propelled wheelchairs and the majority of electrically powered wheelchairs.

Walking distances

Walking distances were researched in some detail in the late 1980s and, based on the findings from these studies, the following are recommended:

Impaired group	**Recommended distance limit without a rest**
Wheelchair users	150m
Visually impaired	150m
Mobility impaired using stick	50m
Mobility impaired without walking aid	100m

These figures are average measures; there is a lot of variation between individuals. Gradients, weather conditions, whether there are handrails etc, will also affect the distances people are able to walk. US regulations, for example, note that on distances over 100 feet (30m) disabled people are apt to rest frequently. These regulations suggest that to estimate travel times over longer distances allowance should be made for two minutes rest time every 30 metres.

Research based on a follow-up study to the London Area Travel Survey found that of all the people with a disability who were able to walk at all, approximately 30 per cent could manage no more than 50 metres without stopping or severe discomfort and a further 20 per cent could only manage between 50 and 200 metres.

Standing

Standing is difficult and painful for some disabled people, particularly those with arthritis, rheumatism and back problems. In the same study as that mentioned above, nine per cent of the survey respondents could only stand for less than a minute without discomfort, 24 per cent could manage between one and five minutes and a further 22 per cent could stand for up to ten minutes. The findings

from this study emphasize the importance of providing plenty of appropriately placed and designed seating at places where people may have to wait and along pedestrian routes.

Sidewalks and Paths

In general, Engineering Services strives to consistently place sidewalks in a logical order to assist way-finding and provide guidance throughout the city for all pedestrians and in particular people who are blind. Curb ramps are installed to provide access for people who use wheelchairs or other forms of mobility aides.

Sidewalks

Current standards are for a minimum 1500mm wide sidewalk, generally constructed of broom-finished concrete, in low density residential areas. Higher density residential areas have a minimum 1800mm wide sidewalk. Commercial areas are between 3000mm and 3650mm with a minimum clearance of 1800mm to any obstruction, be that a tree, sidewalk patio or produce display, to name a few.

The acceptable cross fall of the sidewalk is 2%. Some cross fall is required for drainage, but should be minimal to reduce impact to pedestrians that use manual wheelchairs.

Standards for sidewalks are outlined in the “Master Municipal Construction Documents” (MMCD) and must be used by all municipalities in British Columbia. The City of Vancouver, Engineering Services has a “Street Restoration Manual” that is used in conjunction with the MMCD. The design standards for sidewalks and curb ramps are contained within these documents for all construction carried out by the City and contractors in Vancouver.

Curb Ramps

Curb ramps are to be installed at all corners, preferably a double design with a maximum grade of 8% (ranges between 5% and 7% are best). Any grade less than 5% may be undetectable to a pedestrian who is blind or has low vision, thus removing a cue that they are leaving the sidewalk.
Where there is sufficient public space, there will be a level area, a minimum of 900 mm wide, along the rear side, to provide easy passage for wheelchair users who are not crossing the road.

Surfaces

Broom-finished concrete sidewalks with saw-cut control joints provide the best surface for pedestrians that use wheelchairs. Vibrations are drastically reduced from those which have trowelled control joints.

Concrete pavers when used, must be laid in a smooth, uniformed manner, have a small chamfer edge 2-6mm and be installed in a 90 degree herringbone pattern to produce lower vibration exposure.

Covers and grates are to be avoided in walking areas, but when they are necessary, they are installed flush with the surrounding surface and slip-resistant. The maximum opening on any grate or cover should be 13mm, and if elongated, be placed at right angles to the predominant direction of travel.

Road Crossings

Standards for pedestrian crossing designs used throughout Vancouver have been derived from the “Manual of Uniform Traffic Control Devices for Canada” (MUTCD) by the Transportation Association of Canada (TAC) and the “Pedestrian Crossing Control Manual for British Columbia” by the BC Ministry of Transportation and Infrastructure.

In developing the MUTCD for Canada, TAC worked with the Federal Highway Administration of the United States Department of Transportation, who have issued a US MUTCD.

These manuals cover, among other things, specifications on: crosswalk widths, crosswalk markings, traffic signals, duration of walk signals, use of audible signals and standardized tones. The City has the ability to increase duration of walk signals and adjust audible tones as required or requested.

Street Furniture

Street furniture may be an obstacle to pedestrians that use mobility aides and pedestrians who are blind or have low vision. For this reason the City endeavours to place posts, poles, fire hydrants, etc. in the front 1200mm utility strip of the sidewalk area and leaving an 1800mm clear path behind the utility strip. When or where placement of furniture, like bus shelters or benches cannot be accommodated in such a manner the default is to provide a minimum of 1200mm clear to any other obstacle.

Street Work

Street work will be properly demarcated with high colour contrast (bright orange or a combination of bright orange and highly reflective white tape) delineators of 1000mm without flagging loops or 1200mm with flagging loops, 1200mm snow fence or 1000mm horse barricades with flashers.

Street Trees

Street trees serve a number of purposes in the urban environment. As well as absorbing CO2, they create a natural barrier between the road and pedestrian walkways, provide shade to pedestrians, and keep hardscape cooler in the hot

weather. Trees also intercept rainfall to reduce run-off into the storm basins. Along with these attributes, we have been challenged by the impact to sidewalks. We have actively pursued species that have less invasive root systems, are hardy, pest/disease resistant and meet the requirements for their unique location. To try and mitigate the impact of the root systems on sidewalks, we install root barriers at all new street trees. These shields deflect the roots down under the sidewalk far enough below the surface to reduce and delay disruption to the sidewalk.

Landscaping

Landscaping, other than grass, must provide a minimum 300mm groundcover strip at the front and back of walk to keep the sidewalks clear for pedestrians. Other requirements may restrict planting to a maximum height of 1000mm to provide clear sight lines where required.

Parking

Street parking spots that are marked with disabled parking signs are installed as close to curb ramps as possible; preferably, the first spot after the intersection, if this area is not already designated for a bus zone. This location provides easy access to the curb ramp at the intersection and allows someone easy access from the road to the sidewalk.

Bus Stops

Bus stops fall under the jurisdiction of TransLink which has developed the “Universally Accessible Bus Stop Design Guidelines” as part of their “Access Transit Project”. The guidelines include consistent placement of bus stops to provide predictable locations for people who are blind, and includes tactile cues like poster collars around poles as an indicator of a bus stop ID pole.

Signs and Information

ClearviewHwy font is used extensively for all overhead information signs, overhead street name signs, standard street name signs and construction signs. This font has been extensively field tested in the United States and has proven itself for outstanding visual clarity and legibility.

For colour contrast and sign layout we again rely on the “Manual of Uniform Traffic Control Devices for Canada” (MUTCD), which sets forth procedures in manufacturing effective traffic and highway control and information signs.

Lighting

Lighting is essential in both the transportation and pedestrian environment for overall safety. Good levels of lighting are provided along major routes with lighting levels increased at intersections. Light is provided by both lamp standards and pedestrian level lighting where appropriate.

Traffic Management

The greatest area of concern to pedestrians is locations where vehicles are encountered. Our goal is to prioritize pedestrians and ways we accomplish this are: to shorten crossing distances, provide bulges, reduce the number of traveling lanes for vehicles, normalize intersections wherever possible to reduce skews and slip lanes, provide pedestrian activated audible signals.

Consultation, Training and Management

Consultation

Planning and developing an inclusive environment is a complex process. By including diverse groups at an early stage, best practices can be modified and improved on, in an ongoing manner, to provide for the evolving needs of the public.

Consultation with different users on a formal and informal basis, provide a clear picture of acceptable tolerances throughout the public realm.

Training

A wide variety of training is offered to civic staff, including, but not limited to, technical courses, managerial courses, awareness training and conflict resolution.

Summary

In summary, accessibility is the physical aspect of getting in the door; things like curb ramps, automatic doors and lower counters. Inclusion is to feel welcomed and valued.

While the Americans with Disabilities Act - Accessibility Guidelines (ADAAG) are far reaching, we find them to be prescriptive and while useful, when installed without perspective may result in a less then adequate pedestrian environment. The City's preferred approach is to take a more holistic approach, where we train people to understand the challenges and address each situation as an opportunity to best provide for the widest range of users.

Whenever work is undertaken, our overall objective is to provide an inclusive design to improve accessibility to achieve social inclusion.

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