# Ramps

## Universal design

People who inhabit and visit the houses we live in come in all shapes and sizes, ranging from infants to seniors, with various ever-changing abilities and skills. As we grow up, grow old and welcome new people to our homes, our housing needs change. A house that is designed and constructed to reflect the principles of universal design will be safer and more accommodating to the diverse range of ages and abilities of people who live in and visit these homes. One of the goals of universal design is to maximize the usability of environments. Everyone appreciates having a well-designed home that is safe, spacious, relaxing and easy to use.

Universal design is the design and composition of an environment so that it can be accessed, understood and used to the greatest extent possible by all people regardless of their age, size and ability. "The Principles of Universal Design" are found on page 13.

**Bolded** terms throughout this fact sheet are defined in the Glossary on page 11.

Effective universal design and construction can only occur when we truly appreciate how persons with disabilities engage the built environment. Universal design is only a subtle shift from what is typically done; designing for greater accessibility then is not a new way of designing, simply a more focused one. By providing flexibility in the selection of design features and incorporating adaptability into house design, the life and usability of a home is extended, which promotes the concept of **aging in place**.

This concept is increasingly popular with families and individuals who choose to stay in their homes and neighbourhoods as they grow and age. Planning for individuals' changing needs and abilities allows for periodic home customization based on changing requirements and reduces the need for future costly renovations.

Planning for future needs is good practice. Principles of universal design encourage flexibility, adaptability, safety and efficiency.

## When should you consider using a ramp?

A **ramp** can be used to overcome changes in level, either on the inside or outside of a home, as an alternative to using stairs.

A ramp is ideal for people who are having difficulty negotiating stairs for various reasons, be it the need to carry heavy objects between levels, move a child in a stroller or because of a disability. Providing both stairs and a ramp at changes in level will allow people to choose the option that best suits their needs, resulting in a flexible and more universally accessible design (see figure 1).

Figure 1: Straight ramp
*Photo courtesy of the Alzheimer Society of Peel*

Ramps are particularly useful for overcoming changes in level up to about 760 mm (30 in.), from the ground level to entrance level for example. Using ramps for greater changes in level requires a great deal of space—which may or may not be practical. If you are faced with a big change in level, installing a lift or residential elevator may be a better strategy than constructing a ramp (see *Accessible Housing by Design—Lifts and Residential Elevators*). The physical and monetary costs associated with both options should be fully explored when deciding which option will accommodate the greatest number of users.

## Ramp design strategies

There are typically two strategies used for ramp design: a landscape approach and a structural approach.

### Landscape approach

This approach incorporates landscaping, gently sloping walkways and grading to overcome changes in level (see figure 2). A safe path with a gentle slope can be built without railings (unless there are abrupt drop-offs on either side or users need them), resulting in an integrated, low-key design that does not look like a traditional ramp.

The landscape approach is generally limited to smaller changes in level. If you are considering a landscape approach, try to achieve slopes no steeper than 1 in 20.

On larger parcels of land, consider the design of gently sloped ramps that appear to "float in the air" over gardens and clear running water falling in artificial ponds. Add to this scenery large resting areas with seats in the shade. That includes much more than the space typically provided by the landings between inclined paths. Artificial fountains can be installed at such landings, simulating small waterfalls at different levels, which produce distinct sounds of falling water at different heights. Thus, the ramp is no longer just a means for access to different levels, but has become a place of social interaction.

### Structural approach

The structural approach involves building a ramp structure—usually using wood-framing construction (see figures 3 and 4). This results in a more noticeable structure, although its visual impact can be minimized through creative design, landscaping and finishes.

The most common ramp configurations are as follows:

- Straight (see figure 1)
- Switchback (see figure 3)
- U-shaped (see figure 4)
- L-shaped (see figure 5)

Figure 2: Ramp using a landscape approach
*Photo by Ron Wickman*

Figure 3: Switchback ramp
*Photo by Ron Wickman*

Figure 4: U-shaped ramp
*Photo by Ron Wickman*

Angled ramps may also be used, but remember that the start and finish of the ramp must incorporate a straight approach. Curved ramps are not recommended as they make steering a wheelchair, walker or scooter very difficult. In some cases, depending on the length of the ramp, **landings** may be required as resting points.

# Designing a ramp

Designing a ramp requires balancing the site characteristics with the user's mobility needs; scooters, wheelchairs, prosthetics and walkers require different kinds of adaptations.

Ramps generally require a lot of space; particularly if they are used to overcome significant changes in level. In addition, landings, which are required at the top and bottom of a ramp, at all changes in direction and where the run is longer than 9 m (30 ft.), further increase the space requirements for ramps. When designing a ramp, consideration should be given to the following elements:

- Slope
- Length
- Width
- Level landings
- Location
- Handrails
- Effects of rain, snow and ice

## Slope

The run (length) of the ramp will depend on two primary factors: the overall rise (vertical change in level) and the slope used. Building codes require a slope no steeper than 1 in 12 for public buildings. That is, for every one inch of change in height, the ramp must be 300 mm (12 in.) in length. For example, if your porch is 457 mm (18 in.) above ground level, the ramp would have to be 5.5 m (18 ft.) long—and that does not include any landings! Try out ramps recently built in your community at the post office, bank or municipal offices, for example, to see whether a 1 in 12 (1:12) ramp will work for you at home.

Many people find it difficult to independently use a ramp that has a slope of 1 in 12. Slopes of 1 in 15, 1 in 18 or 1 in 20 require less effort and are recommended if the primary users have limited strength or stamina, as they may be easier to use without assistance. Remember, the less steep it is, the longer the ramp will have to be.

Some people may be able to manage ramp slopes steeper than 1 in 12, especially if they use a powered wheelchair—but such steep ramps are generally not recommended as there may be visitors to your home who cannot safely use them. One possible exception to this recommendation is when a ramp is being constructed solely for use as a secondary exit from your home in an emergency situation: in this case a steeper ramp may be acceptable if there is not enough space to construct a 1 in 12 ramp.

A steeper ramp may also be acceptable when it is used to overcome a small change in level, such as at the threshold of a sliding door, at a single step outside or to a sunken living room. In such cases, a slope of 1 in 10 or even 1 in 8 may be acceptable—but be sure to try it out first! Steeper slopes may also be acceptable when independent use is not a priority and assistance is always available, but *check your local building code to see what slopes are permissible.*

## Length

Unless the ramp user has very good strength and stamina, it is recommended that no single length of ramp be more than 6 m (20 ft.) in length between landings. A single length of ramp should never be more than 9 m (30 ft.) in length between landings.

## Width

The clear width of the ramp should be 1,000 mm (39 in.)—this does not include the space required for any **handrails, guards** or other structural components that might be needed (see figure 5).

Note: If users are unable to steer their walkers, wheelchairs or scooters in a reasonably straight line, consider building a wider ramp.

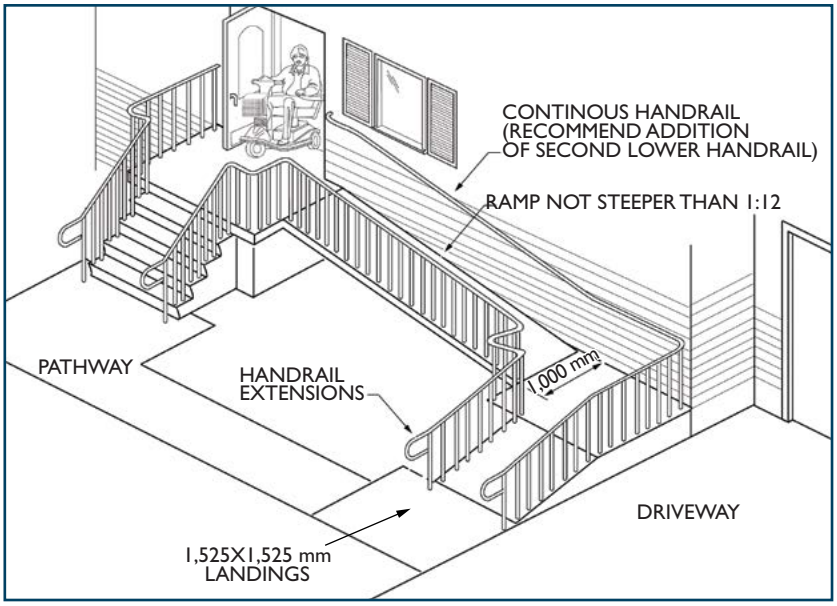


Figure 5: L-shaped ramp (site-constructed concrete ramp)
*Diagram by DesignAble Environments Inc.*

## Level landings

Level **landings** should be spaced 6 to 9 m (20 to 30 ft.) apart and be at least 1,500 mm (60 in.) long.

Where the ramp landing changes direction or incorporates a turn, it should be at least 1,500x1,500 mm (60x60 in.) to provide appropriate manoeuvring space to make the turn. Note: If the ramp is designed to accommodate a scooter or another large type of wheelchair, more space will likely be required—a space of at least 2,100x2,100 mm (83x83 in.) is recommended. Ensuring there is enough turning space is an application of the universal design principle of size and space for approach and use. It is recommended to construct a larger ramp right from the beginning; this strategy will eliminate the need for future costly renovations.

At the top and bottom of the ramp you will need to incorporate a flat area of at least 1,500x1,500 mm (60x60 in.) to provide manoeuvring space to get on and off the ramp. Door swings should not encroach on this space. Note: If a scooter or another larger type of wheelchair is used, more space will likely be required—a space of at least 2,100x2,100 mm (83x83 in.) is recommended.

## Location

As the ramp may also be used by people who are walking, ensure there is clear headroom of at least 2,100 mm (83 in.) above ramps and landings. Also, be sure that protruding objects, such as air conditioners, window flower boxes or low awnings, do not overhang a ramp or its landings. When deciding on ramp location, consider its position in relation to the driveway, the parking areas and the entrance, as well as existing landscape items, such as trees, shrubs, etc.

## Handrails

Ramp **handrails** are usually a building code requirement and are always recommended for ramps steeper than 1 in 20 (1:20).

Where handrails are not required by the building code, it is recommended that a raised lip or edge protection of a minimum of 50 mm (2 in.) be provided to prevent someone from wheeling off the edge of the ramp.

Handrails must be provided on both sides of a ramp located 860 to 915 mm (34 to 36 in.) above the surface of the ramp.

If the primary users are children, persons of a shorter stature or users in wheelchairs who require railings to assist in pulling themselves up, a second lower handrail should be provided on both sides at a height that is best suited to their needs (see figure 6).

Figure 6: Dual height handrail

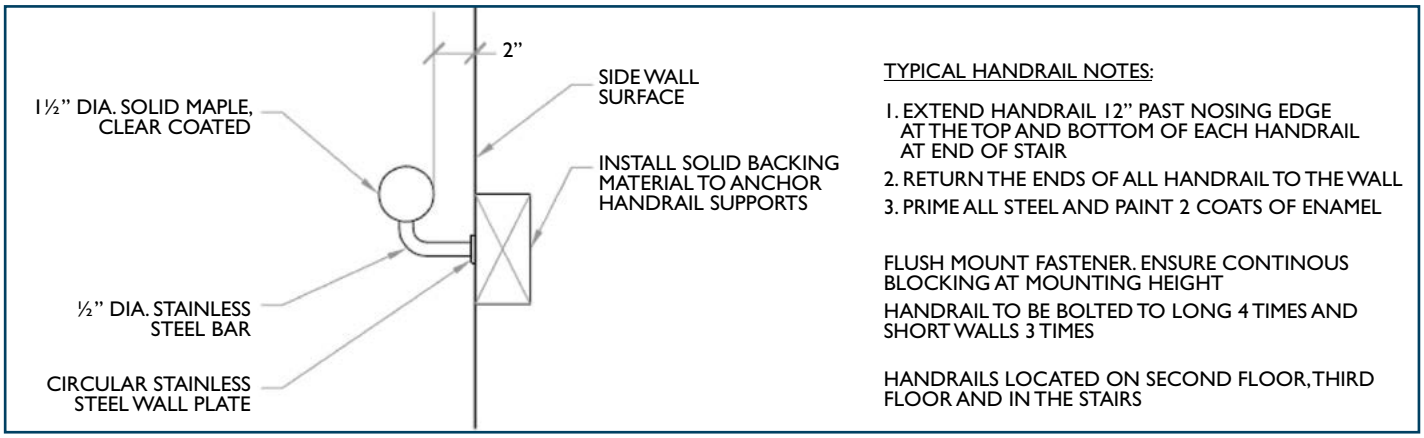


Figure 7: Handrail detail
*Diagram by Ron Wickman, Architect*

Handrails should be of a comfortable size and shape for grasping. A circular shape 30 to 40 mm (1-3/16 to 1-9/16 in.) in diameter is appropriate for most people, although children and other persons with small hands may prefer smaller sizes (see figure 7).

A handrail should be affixed in a way that allows a user to grasp it continuously along its entire length—the location of brackets or posts should not require a user to let go of the handrail at any time.

Some users with limited balance will want to steady themselves using the handrail before they move onto the sloped surface. Handrails should extend horizontally for at least 300 mm (12 in.) beyond the starting and ending points of any sloped surface. Handrails should also be terminated in a manner that does not obstruct travel or create a hazard for users (see figure 8).

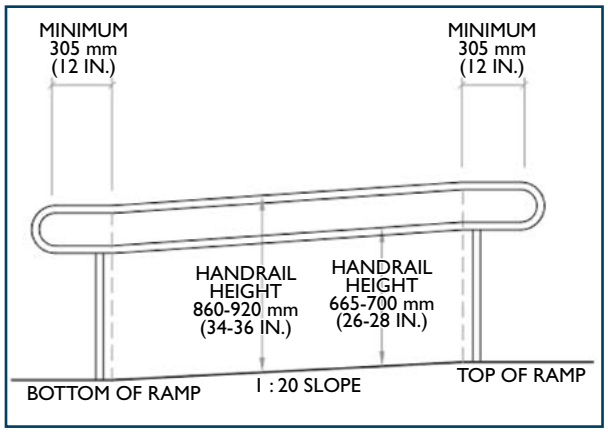


Figure 8: Handrail and stair detail
*Diagram by Ron Wickman, Architect*

If the change in level at the edge of a ramp or landing is more than 600 mm (24 in.), railings or **guards** at least 1,070 mm (42 in.) in height are required for safety. Edge protection is required where the edges of the ramps are not at grade or adjacent to a wall to prevent someone from wheeling off the edge of the ramp.

## What about rain, snow and ice?

If you are building an exterior ramp and live in an area where there is a significant amount of rain, snow or ice, having a covered ramp would be ideal. If this is not possible, consider:

- locating the ramp on the side of your house that is least likely to be affected by snow drifts or windblown rain;
- locating the ramp to minimize the effect of snow and rain falling from the roof;
- choosing durable materials for the ramp surface that can be shovelled;
- leaving a gap at the bottom of handrails and guards to allow for snow removal; and
- choosing materials that provide good grip, even when wet.

Ramp surface materials come in concrete, interlocking brick, metal and wood. A concrete ramp surface can be made non-slip with a broom finish. Concrete is also very durable for chipping ice off or having salt or sand applied.

A metal or interlocking brick ramp surface can come with a non-slip coating applied.

The slip-resistance of a wood ramp surface should be carefully considered. Painted, stained or untreated wood will become very slippery when wet. The wood surface itself can be made non-slip in a number of ways:

- Paint with sand in it is by far the least expensive way; however, it must be redone about every three years, and keep in mind that it doesn't hold up well to shoveling.
- "Grit" paint is a specially designed paint that is very durable, long-lasting, and easy to maintain. However, it's about three times the cost of typical paint with sand in it.
- Grip tape is a "sandpaper" surface tape commonly used on stair nosings to help create a non-slip surface, but tends to help an assistant rather than the person in the wheelchair.
- Vinyl or rubber surfaces are often used in playgrounds and at ice arenas. The material is durable, easy to maintain and non-slip when wet; it is often made from recycled materials such as tires. However, these surfaces are very expensive and can be very slippery when they get icy; a great deal of maintenance is required when there are freezing rain conditions.
- An electric heated mat can cover a ramp surface and melt the ice and snow. This is a very positive but expensive solution, making it not that common.

Again, there is no perfect non-slip surface, and the best way to ensure a ramp stays non-slip is to ensure it is properly maintained.

## Other things to think about

- Ramps should be well lit throughout to create a welcoming area that is safe to use.
- Using colour-contrasting handrails helps people with low vision to identify and use them.
- Using tactile and contrasting coloured strips on the ground surface across the top and bottom of ramp slopes alerts users to a change from a level surface to an inclining or declining surface.
- For safety, ramps should end on a sidewalk or a driveway, not directly on a road.
- Drainage should be carefully considered to avoid the accumulation of water on the ramp surface, particularly where it might freeze and cause a slippery surface. The **cross slope** should not exceed 1:50 (2 per cent). If drains are provided, they should be located outside the path of travel.

# Constructing a ramp

Ramps can be either prefabricated or site-constructed in various configurations and out of various materials.

## Do I need a building permit before starting the construction?

Before commencing the construction of any ramp, it is always a good idea to contact your local building department to find out whether a building permit is required. The building department may also be a great source of information on how best to design and construct a ramp in your area.

Building permits are generally not required when the changes in level are minor and a ramp is an integral part of landscaping (sloped sidewalks, re-grading, etc.) or when a portable ramp is used. However, building permits are usually required for longer ramps or where there is a significant change in level.

## Prefabricated ramp systems

Prefabricated ramp systems come in two basic types: portable and fixed.

### *Portable ramps*

Portable ramps are usually made of aluminum, generally come in various lengths from 900 to 2,400 mm (35 to 94 in.) and are useful for overcoming smaller changes in level such as a curb or a couple of steps.

While they can be a cost-effective solution to overcome smaller changes in level, safety and usability should always be considered. They are an excellent choice for temporary use but their lack of handrails and their steeper slopes do not make them appropriate for many people. Portable ramps can usually be purchased through local home healthcare and medical supply retailers or ordered online.

### *Modular ramp systems*

Modular ramp systems incorporate sloped surfaces of varying lengths, as well as landings, guards and handrails, and can be designed and assembled to meet the specific requirements of almost any situation. They are usually fabricated from metal components and are available in standard "off the shelf" sizes or customized (see figure 9).

Figure 9: One turn modular ramp

When using modular ramping systems, it is important to provide a stable and firm base, and the potential effects of ground settlement and frost heave should be carefully considered when locating and fastening a prefabricated ramp system.

Metal ramps can be very useful in extreme cold weather conditions, like Canada's far north. Metal ramps are very flexible and extremely durable. The metal ramp surface is typically grated metal, which lets snow and rain fall through. In all cases, ramp surfaces should be finished with a slip-resistant coating.

Using a modular ramp system may be a practical and cost-effective solution where a temporary ramp is required, as they are quicker and easier to assemble and disassemble than site-constructed ramps. In addition, when dismantled, the ramp components can often be re-used in other locations. Also, modular ramps can be 100 per cent recyclable and made from recyclable steel.

Modular systems can usually be ordered through your local home health care and medical supply retailers or online.

## Site-constructed ramp systems

The three most common types of site-constructed ramp systems are as follows: poured concrete, interlocking brick and wood framing.

### *Concrete ramps*

In a residential setting, poured concrete ramps are typically used to overcome smaller changes in level. Concrete is poured directly on grade, over a bed of well-compacted granular fill. The surface of the concrete ramps should be broom-finished (a coarse broom is dragged over the almost-set concrete) to create a slightly roughened, slip-resistant finish, which is very durable.

Concrete ramps can be easily configured in most shapes and can easily incorporate handrails, curbs and landings of any shape and size (see figure 10).

Constructing a concrete ramp could be tackled by a homeowner as a do-it-yourself project, but unless you are familiar with techniques of forming, pouring, tamping, finishing and curing of concrete, this type of work is best left to the experts.

Figure 10: Concrete L-shaped ramp
*Photo by Ron Wickman, Architect*

When concrete is used for larger ramps, it is usually reinforced with steel bars. Moulds (forms) are built to temporarily support the concrete, which is poured over steel reinforcing bars, until the concrete sets. Such reinforced concrete ramps should be designed and inspected by a structural engineer and constructed by a licensed contractor.

### *Interlocking brick ramps*

Interlocking brick is frequently used as a material for outdoor ramps because of its flexibility, as well as the variety of colours, sizes and textures that are available. The modular nature of interlocking brick ramps allows them to be configured to almost any shape. Curbs and handrails can also be added.

Interlocking brick ramps are typically used to overcome smaller changes in level (see figure 2).

The bricks are laid directly on grade, over a bed of well-compacted granular fill. The granular fill is a critical component of the ramp system as it drains water away from underneath the bricks—minimizing settlement and the effects of the freeze-thaw cycle.

Ongoing maintenance is required when choosing an interlocking brick ramp system. It is quite common for some of the individual bricks to settle or heave, resulting in a potential tripping hazard for users.

Periodic lifting and re-laying of some bricks will be necessary to ensure a safe and level surface.

The surface of interlocking brick tends to be "bumpy," so if you use a wheelchair and your threshold for dealing with vibration is low, an interlocking brick ramp may not be the best choice. Constructing an interlocking brick ramp is relatively simple and may be a realistic do-it-yourself project for homeowners. Your local lumber store or building material supplier is a great source for installation guides and other "how to" information.

The cost of interlocking brick ramps can vary greatly depending on the type of pavers chosen and features such as handrails, guards and curbs.

## Healthy Housing™ Choices

Consider the following recommendations to maximize resource efficiency, environmental responsibility and provide a healthier housing environment.

- Use kiln-dried, finger-jointed spruce lumber.
- Minimize the use of pressure-treated lumber.
- Use water-based paint and stain finishes.
- When a landscaping approach is used for ramping, incorporate a drip irrigation system, as well as native grasses, native trees and shrubs.
- Avoid the growth of mould in crawl spaces under ramps through proper ventilation.

### *Wood-framed ramps*

Wood-framed ramps usually incorporate a framed structure constructed from standard lumber and usually finished with either plywood sheets or wood decking (see figures 3 and 4). Newer, more durable and/or environmentally friendly decking materials, made of recycled plastic, recycled wood or wood composite, are also available at many lumber stores.

Exterior wood-framed ramps should be constructed on a firm and stable base, with proper footings to minimize the effect of settlement and frost heave.

If decking is used as a finish material, the gaps between the boards should be no more than 6 mm (¼ in.) and the decking should run perpendicular to the path of travel. The use of decking will result in a somewhat "bumpy" surface, which may not be appropriate for some people.

Wood-framed ramps need to be carefully designed to safely support the loads they have to carry, including people, equipment and snow. Local building codes should be consulted for specific design and construction requirements. If you are familiar with basic wood-framing techniques, the construction of a wood-framed ramp could be a realistic do-it-yourself project.

In accessible ramp design, it is a good idea to consult with a health professional, such as an occupational therapist. It also helps to consult with an architect or another design professional who is familiar with the design of accessible residences. During the design, work with the designer and occupational therapist to determine the most positive ramp layout and best placement of handrails.

## Other ramp designs

- Hidden ramp
- Door threshold ramp
- Interior ramp

## Hidden ramp

Ramp renovation projects are especially difficult. A typical major concern is that a renovated home would look institutional and lack "curb appeal." There was also concerns that a ramp located at the front of the house would not only look ugly, but also reduce property value and raise safety concerns that the homeowner is more easily vulnerable to home invasions. With careful design considerations, ramps can be hidden by landscaping or landscape walls (see figures 11 and 12).

Figure 11: Front of a single-family home before a ramp is added.

Figure 12: Front of the same single-family home after the ramp is added but is hidden behind a landscaped wall.

## Door threshold ramp

Sometimes a door threshold ramp is required outside or inside of an exterior door. Often these thresholds are only required to make up a 50-mm (2-in.) to 150-mm (6-in.) elevation difference. These threshold ramps can be made out of metal, wood or rubber. Often the rubber is recycled (see figure 13).

## Interior ramp

A universal design concept in home design that is rarely used is interior vertical circulation with ramps rather than stairs or mechanical lifts. Interior ramps afford all users the opportunity for independent movement, especially those persons who use wheelchairs. With our ever-increasing aging population, dwellings incorporating interior ramps rather that stairs may not be that unusual in the near future.

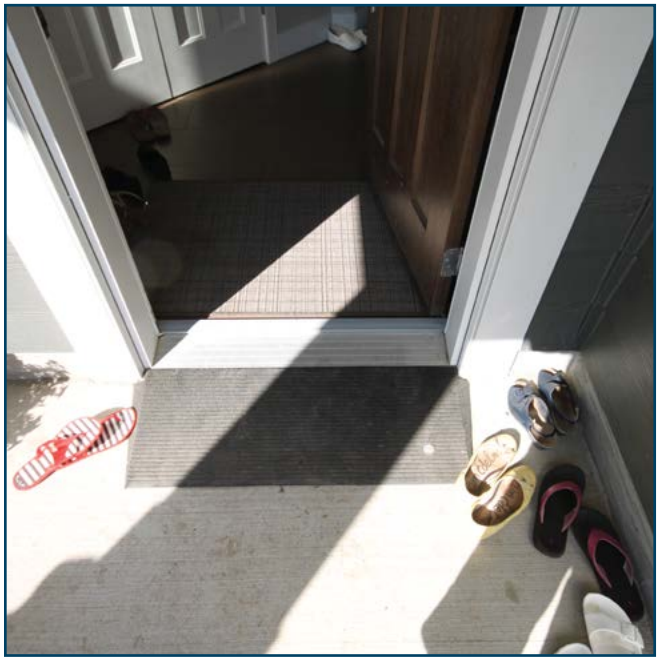

Figure 13: Rubber threshold ramp at exterior entrance

Figure 14: Interior ramp

## Glossary

**Aging in place:** The ability to remain in one's home safely, independently and comfortably, regardless of age, income or ability level throughout one's changing lifetime.

**Cross slope:** The slope that is perpendicular to the direction of travel.

**Guard:** A safety railing used as a barrier to prevent encroachment or accidental falling from height.

**Handrail:** An element that is normally grasped by the hand for support at stairs, ramps and other places where needed for the safety of users.

**Landing:** A flat platform incorporated into a ramp, normally used at the top and bottom of ramps, and at changes in direction.

**Ramp:** A walking/wheeling surface that has a running slope of more than 1 in 20 (1:20).

# Additional resources

## Books

Barrier Free Environments Inc. *The Accessible Housing Design File*. New York: John Wiley & Sons, 1991.

Behar, S., and C. Leibrock. *Beautiful Barrier-Free: A Visual Guide to Accessibility*. New York: Van Nostrand Reinhold, 1993.

CMHC. *Housing Choices for Canadians with Disabilities*. Ottawa, ON, Canada: CMHC, 1995.

Frechette, L.A. *Accessible Housing*. New York: McGraw-Hill, 1996.

Goldsmith, S. Universal Design: *A Manual of Practical Guidance for Architects*. Oxford, England: Architectural Press, 2000.

Jordan, Wendy A. *Universal Design for the Home*. Beverly, Massachusetts: Quarry Books, 2008.

Leibrock, C., and J. E. Terry. *Beautiful Universal Design: A Visual Guide*. New York: John Wiley & Sons, 1999.

Mace, R. *Residential Remodeling and Universal Design: Making Homes more Comfortable and Accessible*. Darby, PA: Diane Publishing Co, 1996.

Pierce, Deborah. *The Accessible Home: Designing for All Ages and Abilities*. Newtown, CT: The Taunton Press, 2012.

Wylde, Margaret, Adrian Baron-Robins, and Sam Clark. *Building for a Lifetime: The Design and Construction of Fully Accessible Homes*. Newtown, CT: The Taunton Press, 1994.

## Websites

**Access North—The Ramp Project** (May 2016)
www.accessnorth.net/cilnm/ramp/ramp.html

**Home for Life** (May 2016)
http://www.homeforlife.ca/

**Institute for Human Centered Design** (May 2016)
http://humancentereddesign.org/

**IDEA Center for Inclusive Design and Environmental Access** (May 2016)
http://idea.ap.buffalo.edu/

**Livable Housing Australia** (May 2016)
http://livablehousingaustralia.org.au/

**NC State University: College of Design** (May 2016)
http://www.design.ncsu.edu/

**The Home Wheelchair Ramp Project** (May 2016)
http://www.klownwerkz.com/ramp/

**Vision Australia Accessible Design for Homes** (May 2016)
http://www.visionaustralia.org/living-with-low-vision/learning-to-live-independently/living-at-home/making-the-best-of-your-vision

# The Principles of Universal Design

## Principle 1: Equitable use

This principle focuses on providing equitable access for everyone in an integrated and dignified manner. It implies that the design is appealing to everyone and provides an equal level of safety for all users.

## Principle 2: Flexibility in use

This principle implies that the design of the house or product has been developed considering a wide range of individual preferences and abilities throughout the life cycle of the occupants.

## Principle 3: Simple and intuitive

The layout and design of the home and devices should be easy to understand, regardless of the user's experience or cognitive ability. This principle requires that design elements be simple and work intuitively.

## Principle 4: Perceptible information

The provision of information using a combination of different modes, whether using visual, audible or tactile methods, will ensure that everyone is able to use the elements of the home safely and effectively. Principle 4 encourages the provision of information through some of our senses—sight, hearing and touch—when interacting with our home environment.

## Principle 5: Tolerance for error

This principle incorporates a tolerance for error, minimizing the potential for unintended results. This implies design considerations that include fail-safe features and gives thought to how all users may use the space or product safely.

## Principle 6: Low physical effort

This principle deals with limiting the strength, stamina and dexterity required to access spaces or use controls and products.

## Principle 7: Size and space for approach and use

This principle focuses on the amount of room needed to access space, equipment and controls. This includes designing for the appropriate size and space so that all family members and visitors can safely reach, see and operate all elements of the home.

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