

# Home Accessibility Remodeling Series

## Chapter 1: Design and Contractor Guidelines

The Minnesota Housing Finance Agency developed this information series to show how single-family homes can be modified for persons with a disability. Other chapters in this series address the following topics:

Chapter 2:	Movement
Chapter 3:	Ramps
Chapter 4:	Stairs
Chapter 5:	Lifting Equipment
Chapter 6:	Bathrooms
Chapter 7:	Kitchens
Chapter 8:	Grab Bars and Handrails
Chapter 9:	Controls
Chapter 10:	Reading

As you think about how a home could be improved for accessibility, remember that a “handicap” occurs when a task can't be performed because the environment presents barriers a person's physical ability can't overcome. Handicapping situations can be reduced or eliminated by modifying the task, the individual's capabilities (with personal assistance/mechanical aids) or the environment.

This series focuses on the most permanent and usually most expensive option -- structural changes. The topics in this series highlight why, when and how to install accessibility improvements to increase a disabled person's safety and independence.

The following issues are important ones anyone considering a home accessibility project should ad-

dress. Included are an introduction to home remodeling activities in general and a perspective on the planning process.

### Design Codes

Making a home more accessible requires modifications that fit both the unique needs of a disabled person, and the unique design, layout, hardware and fixtures found in a particular home. Because the mix of these factors is never the same, no single set design standards can be developed to fit all situations.

The existing federal and state accessibility codes are intended for application in public/commercial settings, and their design standards combine the needs of many disabling conditions. As a result, they frequently aren't flexible or responsive enough to meet the needs of a particular person in his/her home. This is a key reason why single-family homes are exempt from a building code's provisions for accessibility, as is the case with the Minnesota State Building Code's Chapter 1341, which defines public/commercial accessibility standards.

Although single-family homes don't have to comply with Chapter 1341 or similar codes, the design criteria and dimensions they contain may serve as a starting point in your considerations. The chapters in this information series will identify key code standards, indicate their importance and explain how they may require tailoring for particular situations.

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## Personal/Household Factors

The starting point in planning for any home access modifications should be a review of the important tasks the disabled individual needs to perform. Break these activities down into stages and think about how disability impairs independence at each stage:

- How high and low can the person reach to the front and side? What is a comfortable work height? What is the person's ability to reach over/around obstructions (like counters)?
- How much upper body strength and mobility is there for holding/carrying objects, strength for push/pull/lateral movements, finger/hand control?
- How much lower body mobility is there for bending, walking/climbing, weight support for transfers?
- What are the dimensions and profile of aids (e.g., wheelchair, walker, crutches, etc.) the person relies on, and the space required when in use?
- Will the person's situation change over time (e.g., growth of a child, an improving/worsening condition)? When change can be predicted, modifications should be designed to fit or adjust to current and future needs.

If cost is an important factor, arrange activities in priority order so modifications can be evaluated in both cost and benefit terms. Also check if any portable equipment may adequately and safely respond to needs so permanent modifications aren't required.

Evaluate if personal assistance could take the place of modifications, too. Major changes may not be required if family members, friends, neighbors or in-home services can provide help long term. Weigh the dollar value on volunteers' time/capabilities or service fees against modification costs.

If you've determined that home access modifications are appropriate, you'll need to think about the following:

- Consider how modifications may affect other household members - plans may require adjusting to balance among competing needs.
- When making decisions about type/quality of materials and sturdiness of construction, factor in how intensely a modification may be used, frequency of use over time and effort needed for general maintenance and cleaning.
- Check on whether part or all of the work's cost may be eligible for the federal personal income tax deduction available for medically related capital expenses. For more information, contact the U.S. Internal Revenue Service and request Publication 507, "Medical and Dental Expenses."

## Working with a Contractor

Some accessibility modifications can be successfully completed by a good do-it-yourselfer, but many others require a contractor skilled in home improvements and remodeling. If you decide to hire a contractor, keep in mind the following points:

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## Working with a Contractor continued

- Look for experienced, reputable firms and individuals. Ask relatives, friends and neighbors for referrals from successful projects. Local lenders and building and trade councils may be another good source. Agencies like housing and redevelopment authorities and community action programs can sometimes identify firms that have done acceptable work for them.
- Explain clearly what your needs are or provide a written work description to several contractors and ask them to submit a proposal and bid for the job. Look for persons or firms willing to take time to acquaint themselves with your home, your disabled family member's and the household's needs.
- Don't expect a contractor to know any more about accessibility than you do – familiarity with improvement and remodeling doesn't guarantee an understanding of home accessibility remodeling. Even if the person or firm has done some projects, what "worked" on the last job likely won't be exactly right for your home and disabled household member. Avoid a contractor who wants to "go by the book" and use federal or state accessibility standards exactly as they are published.
- When you do select an individual/firm, make sure a written contract is prepared. It should clearly outline issues including:
  - The work to be performed
  - Quality, quantity, styles and types of materials to be used
  - Project time period
  - Itemized costs
  - How cleanup will be handled

- Payment terms

If fairly extensive construction or remodeling is involved, make sure to obtain "working drawings" showing how finished improvements will appear. Any drawings should become part of the written contract, and if there are differences between the two, both parties must agree beforehand which document has the final authority.

The Minnesota Dept. of Labor and Industry distributes a useful publication that anyone planning to build or modify a home should review. It's called "Hiring a Residential Building Contractor," and it covers choosing a contractor, writing a home improvement contract and understanding what mechanics' liens are and how they can affect a property. Copies of the brochure are available at: [www.doli.state.mn.us/rbc\\_hiringcontractors.html](http://www.doli.state.mn.us/rbc_hiringcontractors.html) or by calling the Dept. at 651.284.5000 or the TTY at 651.297.4198.

The Minnesota Attorney General's Office also provides publications on the contracting process. You can check for them at: [www.ag.state.mn.us](http://www.ag.state.mn.us) or by calling 1.800.657.3787 or the TTY at 1.800.366.4812.

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## Chapter 2: Movement

Safe and comfortable movement for a disabled person results from attention to details like door sizes, hallway widths, floor coverings, seams and surface joints, hardware styles and furniture placement. People using mobility equipment require increased space, not only in floor surface area but also volume of space occupied as the equipment moves. We'll first review the basic dimensions for various types of equipment, then review how these translate into circulation design requirements.

### Mobility Equipment/Dimensions

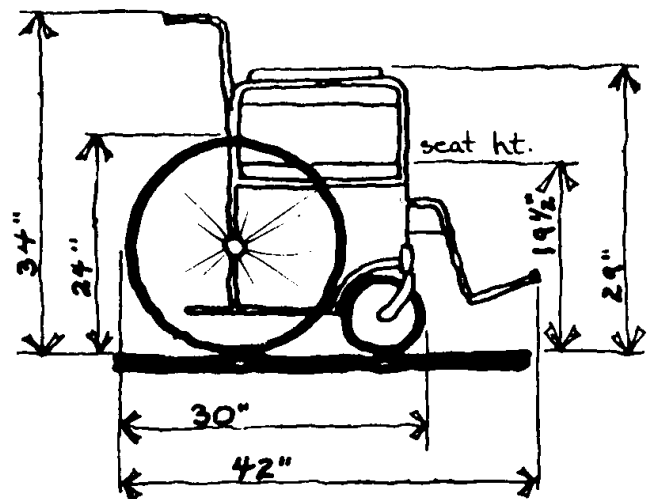
For decades, the adult-size, manual (folding) wheelchair has served as the benchmark in designing accessibility features. Its average dimensions are:

- Width: 27"- 29"
- Length: 42" (including footrests)
- Seat height (from floor): 18"- 19-1/2"
- Armrest height (from floor): 29"
- Handlebar height (from floor): 34"
- Weight: 20-30 pounds

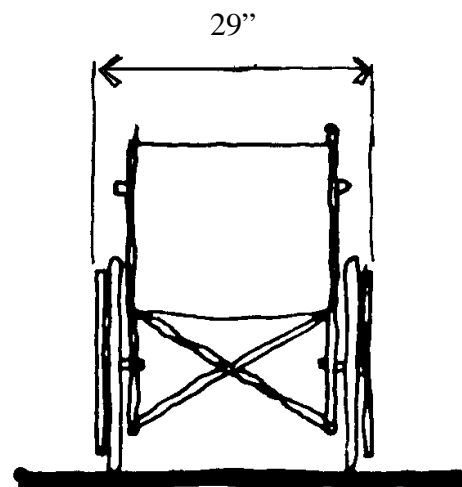
However, the range of equipment has expanded considerably over the years – e.g., electric wheelchairs, manual/electric chairs with special features, three- or four-wheel electric “scooter carts.” Their dimensions and operating characteristics may vary greatly from those of the standard manual chair. For example, motorized chairs can weigh from 60 to 80 pounds. They also have a “joystick” control that is usually mounted on

an armrest. This feature requires an additional 3" – 4" beyond the typical 29" vertical clearance. As a result, use the standard chair's dimensions and operating characteristics as a general guide.

Standard Wheelchair Dimensions



Standard Wheelchair Dimensions

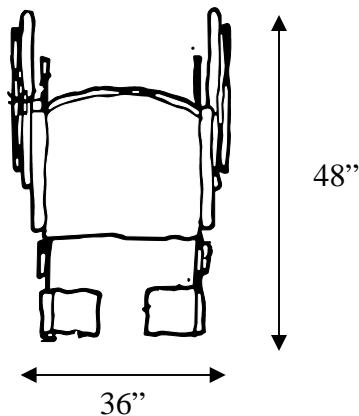


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## Mobility Equipment/Dimensions continued

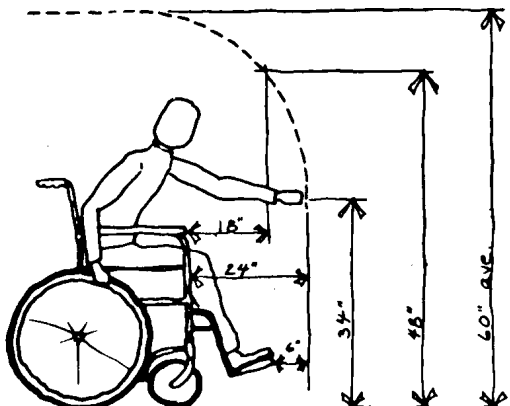
A stationary, standard manual chair takes up approximately 36"x 48" of "clear floor space." The 36" provides enough room for hands and elbows on the hand rims, and the 48" provides enough room for footrests extended in various positions.

Standard Wheelchair Clear Floor Space

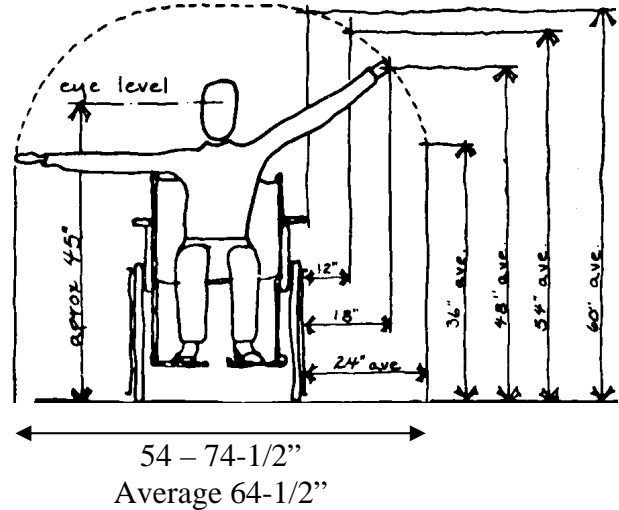


"Range of reach" for a person in a wheelchair is controlled by a number of factors, among them the individual's height, upper body strength/flexibility and natural limits from being in a seated position. The figures here are averages for a person approximately 5'6" tall with full upper body capacity – test these out for a specific user.

Range of Reach – Front

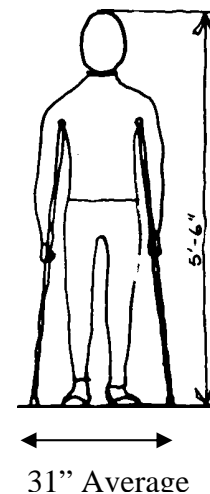


Range of Reach – Side



**Walkers** come in a variety of shapes and sizes - some are like a cane and support one side of the body (e.g., a "four-pronged walker"), others are designed for two-handed support in front/around the body. This type of walker typically requires a floor area of approximately 18" x 24".

Floor Space – Crutches



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## Mobility Equipment/Dimensions continued

**Crutches** and canes need floor area determined by a person's height and upper body strength/control. For example, a person approximately 5'6" with good upper body control using two crutches needs a floor space approximately 31" – 32" wide. If that same person were using a cane or one crutch, the space requirement would be approximately 25" – 27".

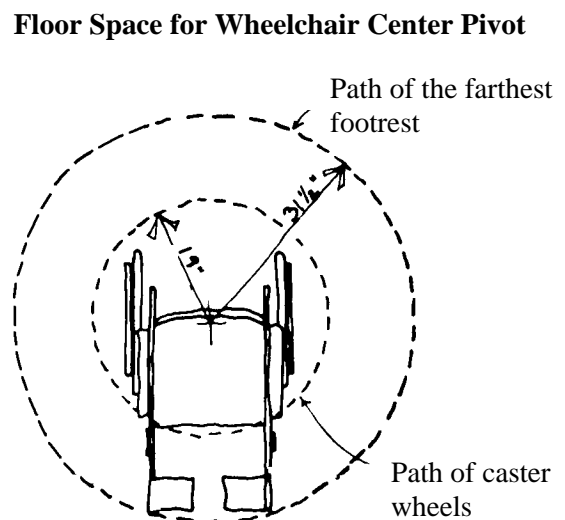
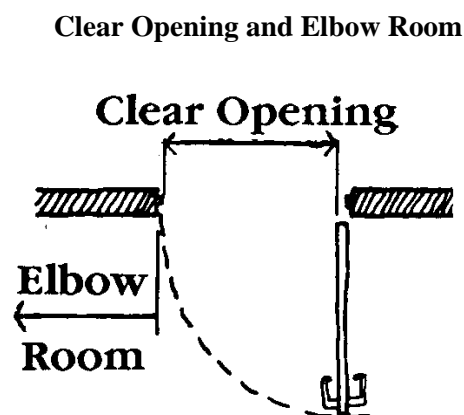
## Mobility Equipment/ Circulation Space

**Clear Opening** is the amount of doorway or arch width available for passage. It is not the same dimension as the stated width of a door or its frame. A conventionally hinged door's thickness and its stops (the part of the frame the door rests against when closed) both project into the doorway and reduce clear opening by 1-1/2" or more. Clear opening should be at least 31" for a standard, manual adult-sized chair's approximate 25" – 27" width and the hand room required on both sides for pushing wheel rims.

**Elbow Room** is the floor space needed off the handle side of a door swinging backward into the path of travel. This space enables users to move off to the side when opening the door to avoid being in the path of its swing. Without this space, users must back up at the same time they're opening the door. This may not cause problems for people who are standing/walking, but can for people using wheelchairs and other mobility equipment.

**Maneuvering Room** is the area required to move around or change direction. The minimum pathway for straight-line movement in a standard manual chair should be 36". This is slightly larger than the 31" dimension for doorways in order to provide a margin of comfort.

Chair users complete a full-circle turn (360 degree) in one of two ways. In the "center-pivot" method, one wheel rolls forward as the other rolls backward the same amount. Approximately 60" of floor space is required for a chair with footrests to complete this maneuver.

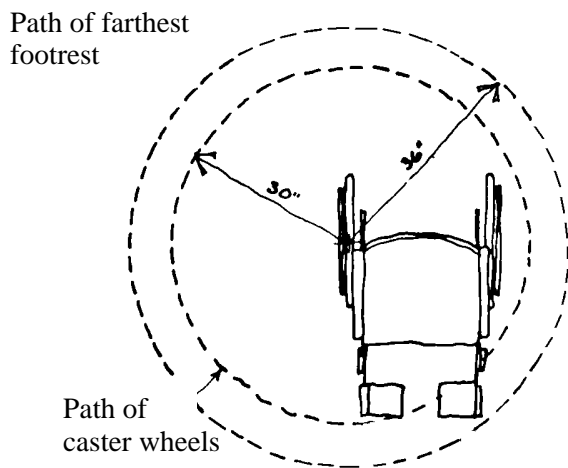


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## Mobility Equipment/Circulation Space continued

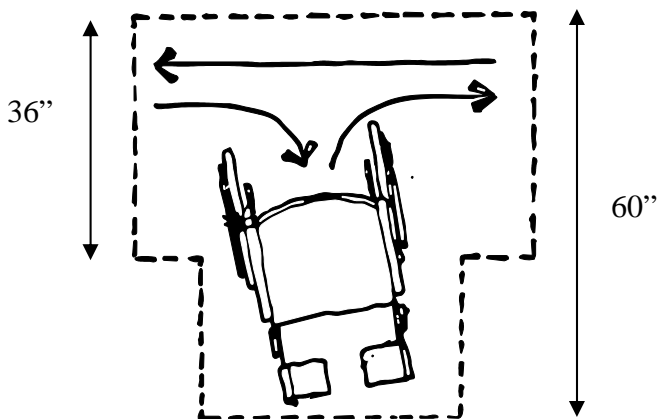
In the “side-pivot” method, one wheel is held in place while the other wheel rolls forward or backward. Approximately 72” of floor space is needed for a chair with footrests to complete this movement.

### Floor Space for Wheelchair Side Pivot



When maneuvering room is limited, chair users can still reverse direction by completing a “three-point” or “T-turn.” Movements here are like those when a car pulls into a parking space, then backs out and

### Three-Point or T-Turn



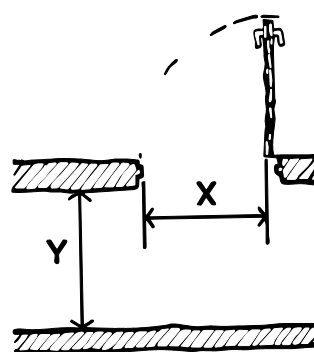
heads off in the opposite direction. This maneuver needs 36” wide pathways at least 60” long.

When a person using a wheelchair with footrests makes a right-angle (90 degree) turn from a hall through a doorway, there’s a direct relationship between the minimum clear opening and minimum hallway or aisle width required. This relationship is based on the fact that the profile of a wheelchair with footrests is a rectangle of floor space, not a square. As a consequence, narrow doorways require larger hallway widths and vice versa.

With a narrow clear opening, the hallway serving it must be wide enough so most or all of the turn is completed in the hall and the chair passes straight through the opening. Wider clear openings can have narrower hallways because a chair can complete part of its turn when angling through the opening.

The following chart gives recommended hall and doorway clearances for a standard, manual adult wheelchair with footrests. Chairs without footrests, though (e.g., used by persons without legs or who can use their feet for some movement), take up floor space shaped closer to a square than a rectangle. The ratios can be revised for these situations.

### Clear Opening/Hallway Relationship



X	Y
36”	36”
35”	37”
34”	38”
33”	40”
32”	42”
31”	45”
30”	50”
29”	55”
28”	60”

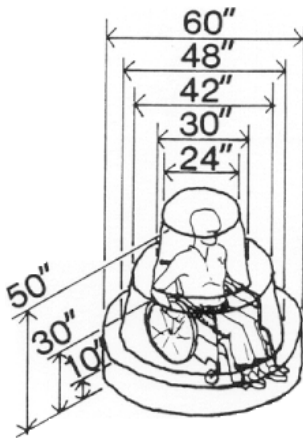
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## Mobility Equipment/Circulation Space continued

Not only is adequate floor space needed to perform the various maneuvers highlighted so far, but an adequate volume of space may also be critical in certain locations. In three-dimensional view, a person seated in a wheelchair takes up a tiered volume of space. When a person in a chair completes a 360-degree turn, this volume has a “wedding cake” shape.

The measurements here become very important to consider in certain locations. These are where a person has to maneuver near or around objects projecting into the path of travel above the floor, like a wall cabinet or wall-hung sink. Floor space may be adequate here, but the volume of space the person and chair have to pass through may be blocked.

### Wheelchair Turning Volume



## Flooring Design

Floor surfaces should be securely fastened down so they don't bubble or pucker under the pressure of crutches or wheels. For carpeting, this usually requires “continuous gluing” instead of tacking on

the perimeter. The preferred floor surface varies according to type of disability and mobility aid used. Sheet vinyl and linoleum are best for wheelchair users because they're firm, smooth and create the least wheeling resistance. (Even indoor/outdoor carpet increases the amount of energy needed to move a wheelchair by almost 20 times.)

Most crutch or cane users benefit from a low pile, dense, unpadded carpet because it provides increased traction. Shag and sculptured carpets and thick padding should generally be avoided because they may become tripping hazards. However, thick padding may ease the pain from certain foot/leg disabilities. Remember that carpeting is harder to clean than sheet flooring (which can be a definite issue for chair users) and holds dust that can cause breathing problems or increase those present with some disabilities.

Seams or joints (as in tiled floors) should be kept short because they can become sliding tracks for crutch or cane tips. Use a random pattern of squares and rectangles, a herringbone pattern, or irregular shapes. Try to keep straight-line seams under 4" in length. Joints should also be shallow or flush to the surrounding surface and as narrow as possible to avoid a “washboard” ride for wheelchair users.

Flooring surface heights changes, such as from linoleum to carpeting or at door thresholds, must have a low profile to avoid becoming rolling or tripping hazards. The edge should be beveled (angled) or ramped where a change in surface height between 1/4" and 2" is required. Generally, these rises can be beveled fairly steeply (up to 45 degrees or a 1:1 slope) without affecting accessibility. The shorter the rise, the steeper the bevel that can be used - 45 degrees for a rise up to 1", 30 degrees for rises up to 1-1/2", etc.

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## Flooring Design continued

High doorway thresholds (rises between 2” and 3”) require special attention to avoid causing balance problems. One option is to install a small “stub” ramp, which should have less than 9” of horizontal projection so that it fits under wheelchair footrests and also doesn’t affect the reach or balance of a standing person. Units out of wood can be constructed on site, or metal models are also available. Another option is to raise the landing area to the doorsill height and install a ramp to handle the increase in rise at a nearby location. (See Chapter 3 for detailed information on ramps and slopes.)

### “Stub Ramp” for Small Threshold Rises



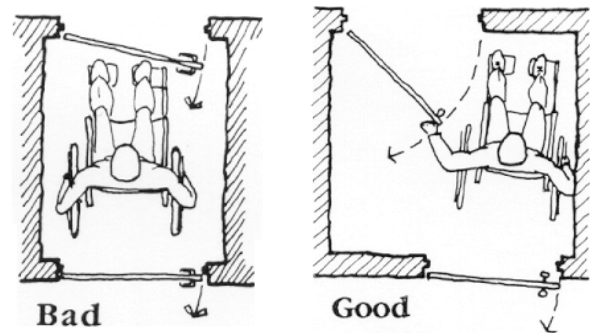
## Door/Doorway Design

Standard hinged doors are the easiest for most people to operate, followed closely by sliding doors. Pocket doors, which slide into the wall, are good in confined spaces because they eliminate the maneuvering problem a swinging door causes. Bi-fold and accordion or folding panel doors may also be good options, but make sure to install high-quality units to avoid operating problems over time.

A person in a wheelchair may have problems using a pair of doors both swinging into the path of travel if

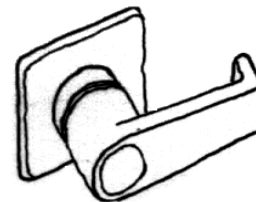
less than a 72” space is provided between them - 36” for the door swing area, 48” for the chair's length. In this situation, either swing doors away from each other or offset them to provide adequate maneuvering room.

### Clearance for Doors in a Series



Select hinges, latches and locks for their ease of operation, frequency of use and quality. “Lever-action” door handles are easier than standard knobs for persons with impaired grip strength and/or hand control to operate. They’re usually a convenience for many other users as well.

### Lever Door Handle

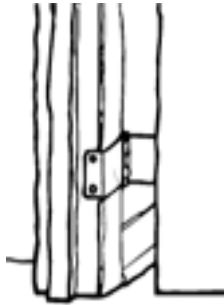


“Swing-clear hinges” are specially designed units that can very inexpensively increase a doorway’s clear opening. They set a door’s thickness (which may project into the opening 1-1/2” or more) totally out of the way.

# Home Accessibility Remodeling Series

## Door/Doorway Design continued

### Swing-Clear Hinges



Kickplates - protective panels out of metal or plastic - should be installed on doors where wheelchair footrests, crutch legs/tips, etc., will frequently bang or dent the bottom.

Although not a preferred design solution due to safety concerns, room accessibility sometimes can be improved by simply mounting a door so it swings out into the hallway instead of into the room it serves.

Fire code regulations often require automatic door closers in residential construction - for example, the door between an attached garage and a house must be self closing. When a closer is installed, mount it at a height that won't obstruct the clear opening. (Note: If the equipment has special manual features like a hold-open catch, make sure it's located at a comfortable reaching height.) Also be careful to select equipment that will effectively close the door without greatly increasing the strength required to open it.

Automatic residential door openers are also marketed. Models typically operate either electrically or pneumatically (by compressed air). Pneumatic devices work a set number of times during a power failure, depending on the size of the reserve pressure tank - electrical ones obviously don't. When a power opener isn't in use, the door is self closing.

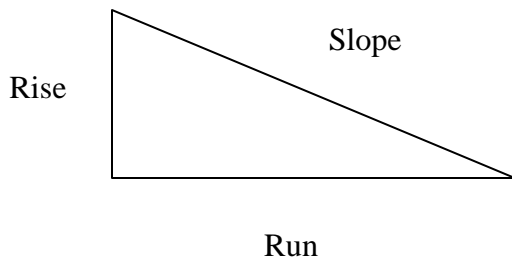
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## Chapter 3: Ramps

Ramps are built for people who can't use stairs or need a gentler, less stressful way to change levels. A successful home ramp project requires careful planning because compromises may be required among many competing factors: the disabled person's and other household members' needs, budget available, security concerns, appearance, property market value. The following information should guide you in the planning process.

### Slope

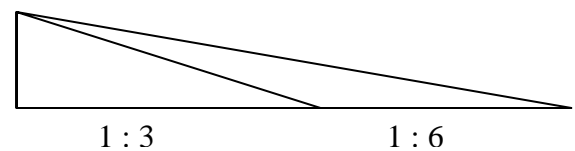
A ramp's slope - the angle of the inclined surfaces - is perhaps a project's most critical consideration because it directly affects layout requirements, expense involved and the ramp's ultimate usefulness.



Slope is the right-angle relationship of vertical height (rise) to horizontal length or projection (run). It is typically expressed as a ratio of these two measurements, with the rise figure usually set at a unit of one. For example, a slope of 1:12 means that as each dimension unit of height changes (say, one inch), the right-angle side projects out 12 units (or 12 inches), which together result in a certain angle for the inclined, third side of the triangle

It's very important to note that the larger a slope's run figure, the **gentler** the inclined surface's angle is. A 1:6 slope, for example, is **not** as steep as a 1:3 slope. This fact may confuse the average person not familiar with how the slope calculations work - the expectation is that a bigger number must mean a steeper slope. The following drawing shows how the situation is exactly the opposite.

Comparison of Slopes



How to choose a residential ramp's slope is another source of confusion for many people. Minnesota has a section in its building code - Chapter 1341 - that mandates how certain accessibility features must be designed and installed in public/commercial settings. Chapter 1341 mandates slope ratios for ramps at public/commercial properties, but single-family residences aren't required to comply with these code requirements. Home ramp design instead must be tailored for a particular person's, household's and home's circumstances.

Ramps in public/commercial settings have separate maximum required slopes for exterior and interior ramps. Interior and protected ramps may have slopes up to a 1:12, while exterior ramps (in precise code language referred to as "walks") must have gentler slope not exceeding 1:20. Because the code uses a 1:20 slope for exterior ramps, some people assume this is the only slope that can or should be used at houses as well. In reality, ramps built at

# Home Accessibility Remodeling Series

## Slope continued

many different slopes can be "right" for homes. The selection process requires balancing the desire for a very gentle slope with the amount of construction/cost involved, yard space that must be used and appearance.

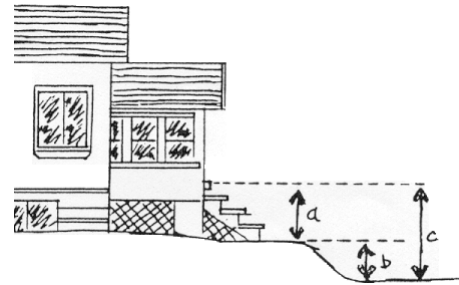
The one general guideline that should be followed is that the slope should not exceed 1:12. Slopes steeper than this may be beyond the strength/control of many people using manual chairs. They also could cause an electric wheelchair going up the ramp to tip backwards from a weight imbalance due to the low position where the chair's battery pack is carried. Steeper slopes can also cause or aggravate back problems for helpers pushing a chair up a ramp or controlling a chair traveling down one.

Slope calculation starts by first determining how much total rise has to be covered. Two measurements must be checked to obtain this figure. The first is the distance from the exit door's sill down to the ground - or "grade" - at the house's foundation. Since a ramp is constructed a certain distance out from the house into the yard, though, any change in grade in the ramp construction area also must be taken into account.

For example, if the change in grade from one home's doorsill to the ground at the foundation is 29" and the yard area where the ramp will be built is flat - no change in grade - then the total rise to cover is 29". As shown in the following illustration, though, if the change in grade at another house's foundation is 29" (a) but the yard where the ramp will be located drops away another 13" (b), then the total rise to cover is 42" (c).

Once total rise (typically stated in inches) is determined, it's then multiplied by the desired run

## Determining Total Rise



ratio chosen to obtain the total amount of horizontal projection required to achieve that particular angle of slope. Dividing this figure by 12 converts it into a more workable measurement of feet of horizontal projection required.

Here's an example to help understand the process. Say that a 1:12 slope is chosen for a ramp being built at the home with the 29" total rise described earlier. The required horizontal projection is  $29" \times 12 = 348"$ . When divided by 12 to convert back to feet, this results in 29 feet of horizontal projection. Say however that a ramp with a gentler slope - a 1:16 - is desired.  $29"$  of total rise  $\times 16 = 464"$ , and when divided by 12 equals over 38 feet of horizontal projection needed.

A very, very important detail to be aware of is that the figure resulting from this calculation is the amount of horizontal distance on the ground with inclined surfaces above the structure must cover to yield a desired slope. It is not the measurement of distance traveled on inclined/ramped surfaces as is often assumed, and it also doesn't include horizontal distances covered with any flat landings above - these are extra in the design.

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## Landings

Landings are the level areas required at a ramp's top and bottom and sometimes also at in-between locations. They allow a person to maintain balance while performing tasks like opening doors, transferring in and out of a vehicle, resting and then changing direction when a ramp makes a turn. Recommended landing sizes are based on these functions.

### Top Landings

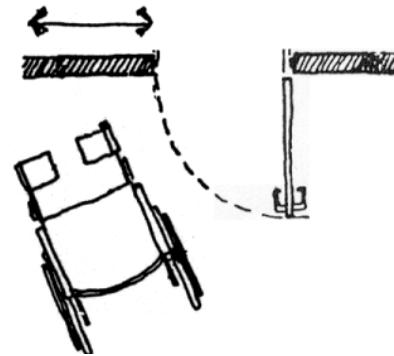
Top landings should be nearly flush with the exterior door's threshold. 1/2" is the typical maximum height difference, particularly when a wheelchair is involved -- anything larger will abruptly stop the chair's small front wheels or is a tripping hazard for walkers. Pay attention, too, to threshold measurements if a new exterior door is installed. If a "pre-hung" unit (which includes the door framing) will be used, most don't have the necessary low threshold.

For homes on footed foundations (i.e., supports sunk to the frost line), it's advisable in most parts of the state to bolt the top landing into the home's foundation. This will avoid the potential problem of the relatively lightweight ramp landing lifting up due to frost heave and jamming under an out-swinging door (like a storm door). For unfooted structures or temporary foundations such as mobile homes on blocks, bolting the landing may still be appropriate, but the ramp shouldn't be footed for the opposite reason - the structure needs to "float" with the frost heave. Local soil conditions - e.g., clay vs. loam - will also play a definite role.

Top landings at minimum should be at least 60" x 60" if there is a storm door, with at least a 12" to

24" of "elbow room" space provided off the door's handle side. These dimensions give enough room for a person (particularly those using a wheelchair) to move off to the side while opening the door without having to back up to get out of the way of its swing. If there is no storm door, the landing may be somewhat narrower, probably 48" at minimum.

### Elbow Room



### Intermediate Landings

Intermediate landings for a long, in-line run of ramp can have the same width as the running surface and length can range from 36" to 60". The slope chosen is a factor to account for here, with a steeper slope like a 1:12 requiring a longer distance in which to stop when coming down the ramp. A rough guideline to use is to install an intermediate landing if a section of ramp covers more than a 30" change in rise, but persons with limited stamina/control may need one sooner than this.

Dimensions for intermediate landings where a direction change occurs depend on ramp width and the user's circumstances. For a manual wheelchair,

# Home Accessibility Remodeling Series

## Landings continued

a 48" x 48" landing for a 90-degree turn is comfortable; for a 180-degree turn, 48" by the size of the two ramp sections' width is typical.

## Bottom Landings

Typical minimum dimensions for bottom landings when in-line travel's involved are as wide as the ramp by about 48" long for walking users, and about 60" to 72" long for persons using a manual wheelchair. Larger-width landings may be called for if the person has to make a direction change (e.g., 90-degree turn). Larger-length landings are advisable for persons using a motorized wheelchair. Make sure the ramp/landing intersection isn't greater than 1/2" to avoid creating a tripping/rolling hazard.

## Ramp Width/Running Surface

Running surface widths can range from 36" to 48", depending on the personal assistance or mobility equipment involved. 36" may be appropriate for a person on foot or using a cane, crutches or a walker. (32" may be appropriate for persons on foot who needs to lean on both railings when moving.) 42" to 48" is appropriate for wheelchair users or where persons can walk with a helper at the side

Surface height changes from the door sill and top landing to the bottom landing shouldn't vary more than 1/2" on all ramp sections and landings. Higher bumps can abruptly stop a wheelchair or trip people walking, particularly those who don't have a steady step rhythm.

Ramp runs and landings must be level from side to side. Any cross slope (slope perpendicular to the direction of travel) can upset balance and require

more strength/effort on a person's "downhill" side.

Even the nearly unnoticeable slope (1:96) built into public sidewalks to aid with water runoff can be tiring for a wheelchair user.

Ramps should have an "anti-slip" running surface, which may be a general code requirement in some communities. Treatments on ramps with running surfaces made out of wooden planks can include commercially-available "grit" tapes, strips of rolled roofing or shingling, or laying down multiple coats of polyurethane into which sand is sprinkled. (Surfacing can be installed across planks every 3' or so of run.) Concrete ramp surfaces can be brushed with a broom before hardening to create a rough texture.

## Safety Features

Handrails, guardrails, crutch stops, gutters and sheltering all are good features to consider for a ramp project.

Handrail positioning should account for variables including a person's height, arm and hand strength, how the rails are used and any general local building code requirements that apply. For example, standing users who lean on rails for support with arms extended often need a very different rail height than a person seated in a wheelchair and who moves by pulling along the rails.

31" to 34" is the typical height range, and the rails should be capable of supporting a 250-pound load at any point along the length. The diameter should be no more than 1-1/2" and may need to be 1-1/4" or less for children or adults with impaired grip

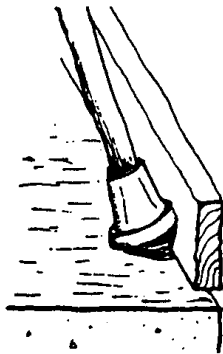
# Home Accessibility Remodeling Series

## Safety Features continued

strength or smaller hands. The preferred material is wood – metal piping is sometimes used but wet hands can stick to it in the winter.

Guardrails and crutch stops (also known as bump boards) are safety features that keep users from slipping sideways off a ramp or landing. Guardrails are mounted along ramp sections and landings at a seated person's knee height - around 18" to 20". Crutch stops are curbing mounted on or a few inches above the ramp and landing surface. (When located above, they can both provide necessary protection as well as not get in the way of snow shoveling!)

### Crutch Stop



Two additional safety features to consider are gutters and sheltering. Roof gutters are recommended for ramps running close to a home to handle the safety hazard water runoff creates. In cases where the disabled person's mobility is severely restricted, some form of ramp sheltering should also be considered. Depending on siting and a house's roofline, one strategy for ramps hugging a house is to build a small extension off the roof. The upright supports can be provided by extending the ramp's posting vertically.

## Layout

The three most common ramp layouts are:

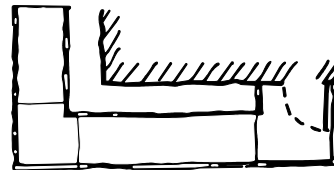
- “Straight” or “in-line” -- landings and ramp run in a straight line:

### Straight or In-line Layout



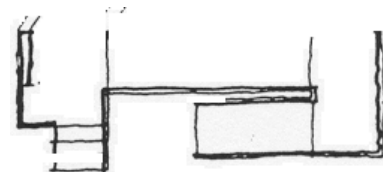
- “Dog-legged” or “L-shaped” - ramp changes direction 90 degrees at an intermediate landing; can also be called a “wrap-around” when it hugs the house:

### Dog-Legged or L-Shaped Layout



- “Switchback” – 180-degree change in direction between one section of ramp, an intermediate landing, and the next section of ramp.

### Switchback Layout



# Home Accessibility Remodeling Series

## Layout continued

Ramps generally follow the path of travel household members use most frequently, such as from the kitchen to the garage or driveway. However, using the main path may create problems or hazards for some households (for example, those with young children). The tradeoff of locating the ramp at the lesser-traveled exit may need to be weighed here. Also, a stairway off a ramp's top landing is a good design feature to include. It enables other household members and visitors to enter/exit more directly instead of having to use the ramp.

In some situations, it's not practical or cost effective to locate a ramp at any of a home's existing exits. An option to consider is creating a new exit - one common strategy is to convert an existing window into a new doorway. Depending on dimensions, the window area may have the structural framing and positioning a doorway requires.

A ramp's visual impact may be an important factor to consider in choosing a layout. Straight ramp runs, particularly very long ones, can look really unattractive. Ramps sited close to/around a house often have a much more discreet appearance. Landscaping (bushes and plants, timbers, etc.) and other finish details (lattice and other skirting to mask the area below or create a storage area, etc.) can also improve appearance. Does the sight of a ramp in the front yard raise security concerns? If so, locating the ramp at the side or back may reduce the visual message that a person with a disability lives there.

Most landings are designed as squares or rectangles where ramp lengths (and the resulting shift between flat and inclined surfaces) join straight on. If a landing intersects a ramp section at any angle other than this, though, the landing must be designed so that the straight-on intersection is maintained.

The reason for this is an extremely important safety requirement for persons using a wheelchair. It involves the timing for when wheels cross over the intersection. When a ramp length and landing join straight on, the front and back wheels pass over the intersection at the same time. However, if the

### Ramp Intersecting Landing at an Angle



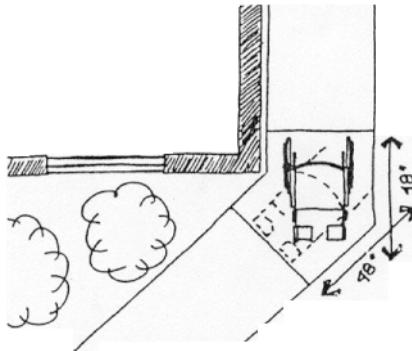
intersection is angled, one wheel crosses the boundary ahead of the other. The chair's balance becomes unstable because there's "air" under the leading wheel. The chair tilts to this side and drops down onto that wheel, leaving "air" under the back wheel on the opposite side until all wheels are either on the landing or on the ramp length. The danger of course is that an unstable chair could tip and spill the user.

Landings that aren't square or rectangular also require special design for the same safety reason just described. The flat landing and inclined ramp sections in this type of construction similarly must join straight on to the direction of travel. When wheelchair users are involved, the landing additionally must provide enough space for rolling onto the landing, turning slightly, and rolling off. This is usually about 48" in each direction of travel for a manual chair.

# Home Accessibility Remodeling Series

Layout continued

## Angled Landing



Locating a ramp on the south side of a house takes advantage of the sun for drying rain or snow off the surface. Additionally, locating a ramp to take advantage of any neighborhood/lot wind patterns can aid in clearing snow and leaves. Locations near trees or bushes often should be avoided because of the branches, seeds and other material dropped.

Don't forget to think about the impact a ramp's location will have on competing yard uses. For example, running a ramp from a door straight through the back yard to the garage may be the most efficient and least costly layout. If this placement limits games and other recreation activities that frequently go on in this area, though, is the tradeoff acceptable? How about ease in mowing? Or getting back and forth between a garden area on one side and where tools are stored on the other? Remember to account for issues like these in layout decisions.

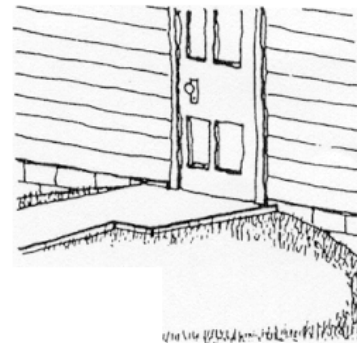
## Construction Methods

### Berming

Berming can be a good, cost-effective way to handle total rises that don't exceed about 18". The grade

along the path of travel is built up with dirt or sand, then a walk made out of concrete, blacktop, patio blocks or even treated wood decking is installed. The yard can be finished as desired with new sod, reseeding and plantings. By blending in with the house and yard, this form of "ramping" is usually much less obvious than a frame structure.

### Berming



### Post and Beam

A majority of ramps built at homes use the "post and beam" construction method. In it, vertical posts are installed, followed by horizontal beams attached between posts. Framing for ramp sections and landings is then attached on top of the beams, and the running surface and various safety features finally attached on the framing.

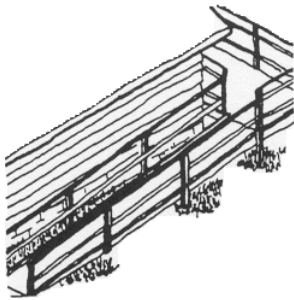
There are two common ways to install posts. One is to sink them into the ground below the frost line in holes filled with sand, gravel or concrete. The other is to pour concrete into the hole flush to the ground, then install anchoring brackets on top into which the posts are bolted.

# Home Accessibility Remodeling Series

## Construction Methods continued

Ramp and landing surfaces for post and beam construction are typically made out of wood, infrequently out of metal grilling or concrete over a corrugated metal or a plywood base. When wood is used, the preferred method is to lay dimension lumber (e.g., 2" x 6" planks) perpendicular to the direction of travel, spaced with a slight gap (about 1/4") through which rain/snow/ dirt can fall. Don't

### Post and Beam Construction



use plywood as a running surface because it can separate over time and it becomes very slippery with ice/rain. Indoor/outdoor carpeting is also sometimes installed, but similarly, it's not appropriate for ramps exposed to the weather because it can stretch over time and collect/hold water.

Bottom landings can be constructed out of wood or concrete. A post and beam bottom landing may be designed as a continuation of the surface decking (e.g., a "duckwalk"). Specs for concrete are essentially the same as for a typical sidewalk - the pathway is excavated, sand/wire mesh is laid to give a good foundation, then 3" to 4" of concrete is poured. The surface can be brushed with a broom before it sets to provide texture for traction.

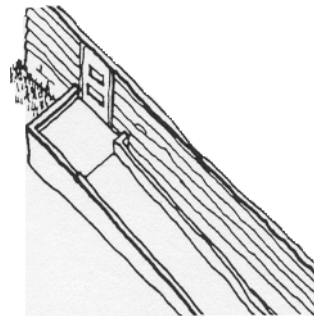
Round, wood handrails may be installed or 2"x 4" lumber notched on one side can be mounted to cre-

ate a finger-hold area. Either should be sanded smooth and sealed with paint or polyurethane. Guardrails commonly are made out of 2"x 4" lumber, crutch stops out of 1"x 2" lumber.

### Solid Construction

This type of ramp is typically built out of concrete. While infrequently used at homes, it's the most stable and probably most efficient for wider widths (e.g. 42" to 60"). Temporary forms (usually wooden) are erected and filled with rubble (e.g., field stone, broken concrete blocks, bricks, etc.). Concrete is then poured to create the one-piece structure. Concrete ramp design is best done by masonry professionals, because of the likely need for reinforcing, expansion joints and special structural tie-in with the house.

### Solid or One-Piece Construction



# Home Accessibility Remodeling Series

## Chapter 4: Stairs

Although it may seem unusual to consider stairs as part of accessible design, they are easier than a ramp or lifting device for some people to use. For example, people with artificial legs, crutches and/or braces may not be able to get the proper leg “swing” on a ramped surface that they can use steps. In addition, a ramp takes longer to travel than a stairway and may require too much energy for some users.

Basic elements of an accessible stairway (and safe stairways in general) are:

- Step Design/Safety
- Nosing
- Handrails

### Step Design/Safety

Step design involves the relationship between treads -- the flat area for standing -- and risers -- the vertical area between treads. The safest risers are enclosed and guide the foot or support crutches/canes as a disabled person climbs the steps. Many basement stairs are the open riser style where only the treads are present. Avoid this type of design because it’s a tripping hazard for virtually everyone. General building code standards require that all treads and risers in a stairway are the same size - this is to avoid disturbing a person’s step rhythm and possibly causing a fall.

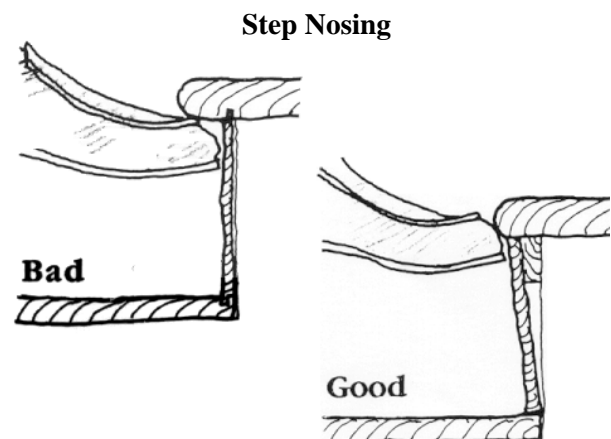
People using walking aids, particularly “four-point” walkers, may need custom steps with longer-than-normal treads - 18” to 24” or more compared to the standard 10” to 11” - and lower risers - 4” to 6” instead of the 7-1/2” norm. These are called “shallow stairs.”

Don't place risers less than 4” high in main walks and other public traffic areas - their low profile is hard to see and can create a tripping hazard. Set them wherever possible as an alternate path of travel. As another safety factor, consider installing “anti-slip” grit taping on the outside edges.

Make sure a stairway has good lighting. This can involve increasing bulb watts, installing battery-powered lights, installing switches at a stairwell’s top and bottom (“three-way” switches), or installing small lights along the stairwell wall a few inches above the treads.

### Nosing

The intersection where a tread meets a riser is called the nosing. Nosing should project over treads as little as possible to avoid catching a person’s toe when climbing and creating a tripping hazard. 1” is the recommended maximum, and the underside edge



# Home Accessibility Remodeling Series

## Nosing continued

should be beveled or rounded. Another option is to install trim or molding strips that slope to the riser. Carpeting a stairway may eliminate a nosing problem, but can affect balance and safety by making steps spongy and slippery.

## Handrails

Handrails need to “fit” a user. A diameter of 1-1/2” is the standard size for public/commercial settings. However, children, adults with smaller hands or persons with impaired grip may find a 1-1/4” diameter much more comfortable and safer. Test out what’s best for the person with a disability and other household members.

Handrail “Fit”



The clearance between a handrail and a wall should be large enough to allow space for the hand, but small enough to prevent a person's arm from sliding down between the rail and the wall. A 1-1/2” distance is the recommended maximum, but a smaller clearance may be wise when children are present or are the prime users.

If decorative railings are installed, make sure the gripping surface closely matches a standard rail

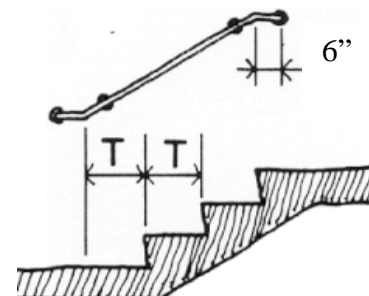
Handrail Clearance



shape. For outside stairs, avoid metal rails or piping because wet gloves/hands can stick to them in the winter.

Stairway handrails should be continuous with no breaks or gaps and project a short distance beyond the steps to provide support at a constant height when going up or coming down. A railing should continue at the same angle the distance of one extra tread (“T” in the sketch) to assist in gaining balance, and then either project at least 6” horizontally or end in some type of “railing return” design.

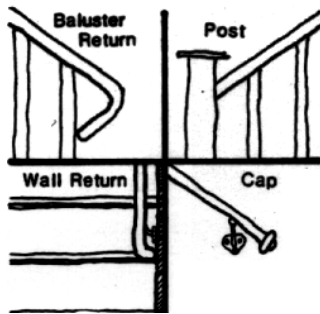
Railing Projection



# Home Accessibility Remodeling Series

## Handrails continued

### Railing Return Options



Mount handrails at a height comfortable for the disabled person - the typical range is between 30” and 34”, but children and adults of less-than-average height may need them lower. Anchor a rail to support at least a 250-pound weight anywhere along its length without bending or movement. People with only one “good” hand/side need rails on both sides of a stairway or hallway to provide safe and easy movement in both directions – this is a good feature for all users.

Check with the building official in your area before working on a stairway. There may be state or local standards regulating:

- Maximum riser height
- Minimum tread depth
- Minimum stairway width
- Handrail and guardrail details (under certain circumstances)

# Home Accessibility Remodeling Series

## Chapter 5: Lifting Equipment

Accessibility problems should generally be responded to with options that aren't mechanical or require electricity. The main reasons are the safety risks present with frequent transfers, maintenance/repair expenses and unavailability during power outages or breakdowns. However, lifting equipment - units powered with electricity and propelled by chain, cable or screw drive shafts - may be the best or only mobility solution available in some circumstance.

For example, some yards don't have enough space for constructing a properly sized ramp, or constructing a ramp with a complex design may be extremely costly. Equipment may also be the best response when accessibility needs are temporary or short-term. Some properties - such as "split-entry" homes with living levels above and below the entry level - may present major design challenges where the only practical solution may be to install lifting equipment.

When selecting any type of equipment, be sure it has features that promote user independence. Be sure the controls match a person's hand capabilities and range of reach. Models with both "call" and "send" controls can take a person to one location and the equipment then can be sent away if it becomes a hazard for others. Safety features to consider are cranks for manually lowering a unit during a power failure and automatic shutoffs triggered by pathway obstructions.

Compare units offered by various manufacturers - they're not all the same. Make sure to consult with local officials about the unit you're considering, because general building and fire code requirements

vary widely around the state. Equipment power demands in some cases may require upgrading a home's electrical system, too. A final note of caution - check the unit's packed and unpacked dimensions to make sure it will fit through all doorways, stairwells and corners on the way to its installation site!

### Ceiling Lift

This equipment has an electric-powered, ceiling-mounted track from which a sling-style body lift hangs and is positioned under a person. He or she is then lifted/moved in a seated position to another location - say, from a bed to a nearby wheelchair or another part of the bedroom.

When considering this type of equipment, check to make sure ceiling joists (framing) are strong enough to support the total weight being carried. Another major installation issue is when equipment must travel between rooms - say, from a bedroom down the hall into the bathroom. In these cases, a section of wall above doorways must be removed up to the ceiling and reframed/repared. This is necessary so the tracking can remain anchored against the ceiling for the full length of the equipment's run.

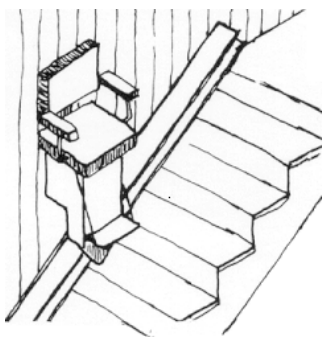
### Stair or Chair Glide

Stair or chair glides are padded chairs that run on a track or rail installed either on the wall or on top of a stairway. The chair and tracking are typically sold separately, because the tracking layout is custom designed. Units capable of 90- or even 180-degree turns are available.

# Home Accessibility Remodeling Series

## Chair Glide continued

### Chair Glide



Some chair glides are capable of “horizontal overrun” from the stairway into one or both landing areas. This allows a person to transfer to and from the seat on the level, reducing the risk of a balance problem and possible fall into or down the stairway.

Stair glides don't provide a place to carry equipment like a walker or wheelchair, so a user may still need help or equipment may have to be located at both ends. Glides shouldn't be used on stairways with less than a 38” width that are intended for emergency exit by other household members, because they may become a tripping/blocked hazard.

## Inclined Platform Lift

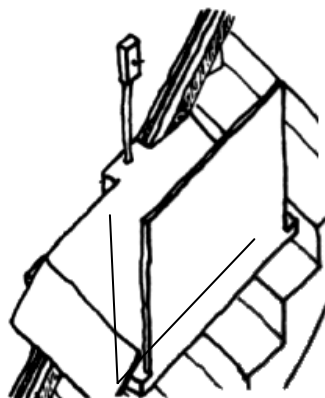
Inclined platform lifts have a wheelchair-sized, flat platform connected to a wall-mounted track or rail that follows the stairway's slope. Units capable of 90- or even 180-degree turns are available. Platforms are 3” or 4” thick, which can create two problems at the bottom landing. One is rolling on and off for a chair user. The other is the potential tripping hazard created for people using the stairs on foot - the height of all steps in a stairway should be the same, and the platform shortens the distance (or

“rise”) from the last step to the landing area.

One way to handle the bottom landing entry/exit problem is to install a small approach ramp. Another option that can respond to both this problem and the tripping hazard is to create a pit in which the platform rests flush with the surrounding floor. However, this requires cutting into/removing existing flooring, and in the case of wooden framing, notching/reinforcing underlying floor supports. (Note: A pit or complete rebuilding of the stairway to maintain equal height steps may be required in areas where the Minnesota State Building Code is enforced.)

When people will be using this type of equipment in a standing position (like someone with a walker), make sure there aren't any head clearance problems.

### Inclined Platform Lift



## Vertical Platform Lift

This is a wheelchair-sized, flat platform that rises and lowers in one location. It typically operates

# Home Accessibility Remodeling Series

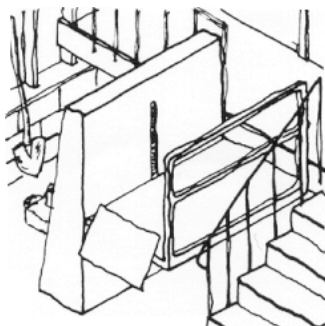
## Vertical Platform Lift continued

with a screw-drive mechanism or a scissors-type jack powered pneumatically (compressed air). It's usually used for porch/entry door access or short rises, although a number of models are capable of traveling a full story. Standard design is for straight-line entry and exit, but 90-degree turns are possible

When installed in an enclosed area, check to make sure head clearance is adequate for standing users. Unsheltered, outdoor installation isn't recommended in Minnesota, due to possible snow build-up on or under the device and mechanical problems very low temperatures can cause.

The location of a unit's operating cables and controls must be accounted for in installation design. They vary among manufacturers - some are on top of the cab, some are underneath. Make sure to check how workable this is for a particular installation (i.e., adequate ceiling/attic space for top-mounted units, likely need for a pit or entry/exit ramp for bottom-mounted units).

### Vertical Platform Lift



## Elevator

The most costly and sophisticated lifting equipment is the residential elevator. Units have a fully enclosed cab usually sized for a wheelchair (at least 3' x 4'). They also typically require constructing a framed-in shaft, which may have to be of fire-resistant materials, depending on the number of floors served and local codes. Some enhanced vertical lifts are now marketed with enclosures that can be installed similar to an elevator, if permitted by general building codes.

# Home Accessibility Remodeling Series

## Chapter 6: Bathrooms

There are a number of goals to keep in mind when modifying a bathroom. The primary one is to install features that help the disabled individual (sometimes with personal assistance) take care of hygiene and grooming as independently, comfortably and safely as possible.

Remember, too, that there are some changes that all household members can benefit from, not just the person with a disability. For example, grab bars that help a disabled person transfer also can prevent or reduce the impact of a potentially serious fall anyone might take. (Grab bars can always double as extra towel bars, too.) Similarly, faucets limiting water temperature (or turning down the water heater's setting) can prevent anyone from accidental scalds or burns.

Unfortunately, though, some changes may benefit the disabled person but disadvantage other residents. The second goal, then, is to identify potential conflicts that may result, carefully weigh possible trade-offs and come up with the best workable compromise. For example, removing a tub to install a roll-in shower area can be a great improvement for a person using a wheelchair. However, it may create problems if a tub's needed for bathing small children or so another member can soak a "bad" hip. Retaining the tub but installing a wall-mounted shower seat and adjustable showerhead could be an effective compromise in this situation.

Since bathrooms were designed very compactly until only recently, floor space may have to be expanded and fixtures changed or relocated to better fit a disabled person's needs. Carefully consider product design, selection and placement in relation to a per-

son's range of reach, grip strength, upper and lower body flexibility and any "strong" side favored in transferring or holding articles.

Portable aids and equipment may also need to be considered in some cases. These devices may provide a less stable/safe alternative than a permanent modification and may reduce independence if assistance is required to operate them. However, they may be an acceptable trade-off for an extremely limited budget or when only short-term use is required.

Make sure to thoroughly research what access-related products are available and where they can be obtained. Check literature from many sources - plumbing manufacturers, general plumbing and building suppliers, hospital and washroom supply firms. Talk with staff at hospital rehabilitation departments or community rehabilitation organizations. Internet sites are very good resources these days. Don't forget to also think about how standard fixtures and products could be made accessible through minor changes in location, choice of hardware or mounting methods.

Also make sure to consult with the local building or zoning official when changes in a home's plumbing system or fixtures are planned to determine what plumbing code requirements must be followed.

### Sinks

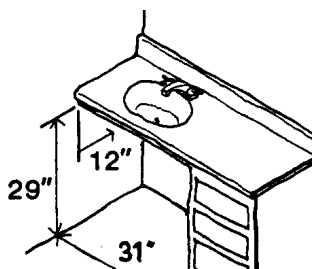
Bathroom sinks can be made more accessible in a number of ways:

# Home Accessibility Remodeling Series

## Sinks continued

- Seated users – whether in a household chair or wheelchair – need adequate knee space. One way to provide it is to install a wall-hung unit, or small length of counter that's mounted on bracing in the wall instead of supported by legs or a cabinet. (Additional bracing is required if users lean on the sink or counter for support.) Where space permits, another common option is to install a sink in a counter extending over a vanity unit at one or both sides - the necessary open knee space can be provided and the counter rests on the vanity unit(s) for support.
- When a standard-sized adult wheelchair with armrests is used, the typical minimum dimensions needed are 29" high (from the floor to the "apron" or sink front's bottom edge), 31" wide and 12" deep from the fixture's front. These dimensions can be reduced if a stool, household chair or modified-design wheelchair is used. However, greater height is required for electric-powered chairs with a hand control ("joystick") on top of the armrest.

**Knee Space**

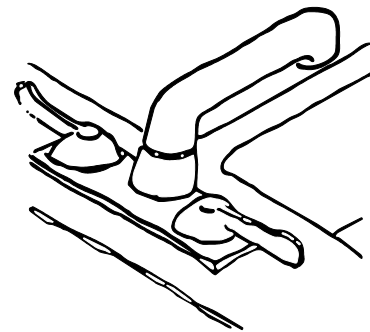


Changing a sink's height can reduce back strain for standing users or bring the unit into better range of reach for seated persons. When determining a good height, consider not only ability to reach/operate

controls, but also reaching/bending into the sink. The depth of some units or a high placement can make it difficult to retrieve articles from the bowl or to bend over comfortably when washing.

- Adjustable sinks units that raise/lower in place with either manual or electric controls are now on the market. They can eliminate clearance problems for seated persons as well as tailor positions when a household has a mix of short and tall members.
- If a seated person's legs have impaired sensitivity to heat and cold, shield the hot water and drain lines or wrap them with insulation to protect against burns.
- "Lever action" or "single-lever mixer" faucets should be considered if a person has reduced grip strength or hand flexibility.

**Lever Faucet Handles**



- If range of reach to the standard faucet placement at the back is a problem, sinks designed for side-mounted controls are available.
- If layout permits, consider positioning a sink off-center in a counter length, rather than right in the

# Home Accessibility Remodeling Series

## Sinks continued

middle. This layout is particularly important for persons with only one hand or arm or who can only use one side of the body. Available storage/counter space can be concentrated on the “good” side.

- If a disabled person uses the bathroom sink not only for typical activities but to do a fairly large amount of hand laundry, consider installing a utility model sink.

## Medicine Cabinets/Mirrors

These fixtures may need to be lowered or relocated to make them more usable. For seated persons, relocating a medicine cabinet to a wall next to the sink sometimes can be very helpful. Mirrors mounted with a slight downward tilt can be used by both standing and seated persons - an existing mirror can be modified in place or adjustable models are available from many washroom supply companies.

## Toilets

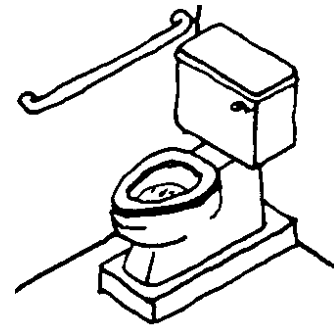
These can be made much more usable by the following:

- Seats raised above the standard height (17” to 19” instead of 15” to 16”) can assist with transfers or when a person has difficulty moving from/to a seated position. Taller “high-rise” or “comfort” models can be installed, or a platform built or specially designed insert are now available to installed under a standard fixture.

Make sure this equipment fits a particular per-

son’s wants and needs, though - just because units are marketed for “elderly/disabled users” doesn’t mean they fit every elderly and disabled person’s situation/needs! Portable devices that attach to seats can be purchased, too, but stability and sturdiness should be checked carefully.

**Platform Base**



- Floor space may have to be increased on one side, both sides and/or in front of the unit to allow more comfortable approaches, transfers and/or leg room (such as for user with an artificial leg or leg brace). Toilets with triangular-shaped tanks are available for corner installations, and can create space on both sides of a unit.
- The paper holder should be within a comfortable range of reach. Units permitting one-handed paper installation are now available.

Grab bars should be installed to help maintain balance when standing or performing transfers. Pay particular attention to the person's pushing/pulling strength and if he/she has a preferred method or direction for transferring. (See Chapter 8 for specific information on grab bar selection and mounting guidelines.)

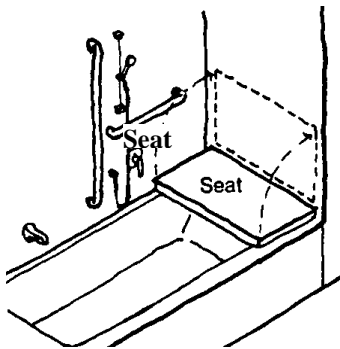
# Home Accessibility Remodeling Series

## Tub/Shower

Accessibility can be provided by the following:

- A tub can be raised by installing it on a platform. Raising the bottom may ease back strain on a helper (as long as the increase doesn't cause transfer problems for the disabled user).
- A tub or shower can be equipped with a fixed, folding or portable seat. Many of the fixed or folding units are designed for installation in a shower stall, and some can be modified for installation in a tub. Folding seats must be anchored securely, following the same steps used in mounting grab bars. (See Chapter 8.)

### Folding Seat

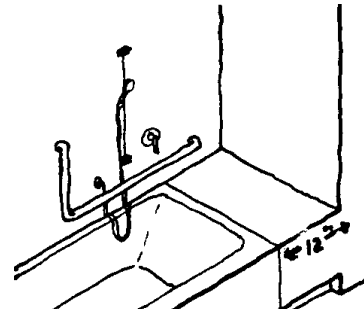


- Some layouts permit building a platform at the back end of a tub instead of installing a seat. Recommended dimensions are 18" deep and as wide as the tub. The sitting surface should slope to the tub - 1/8" per foot is a typical dimension - and be smooth, repel moisture and the edge at the tub rim should be rounded for comfort and safety. Storage can frequently be designed into this space.

People using a wheelchair require an additional

12"- 18" of floor area behind the platform to allow space so the back chair wheels line up for a safe transfer to the platform.

### Transfer Platform



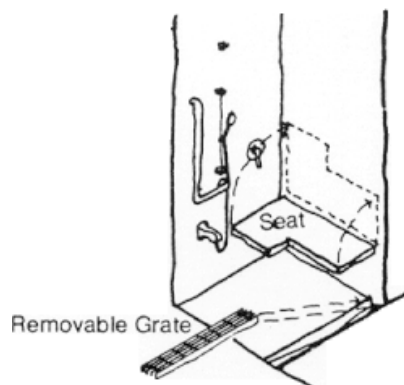
- A shower stall can be designed large enough so that a person in a standard adult wheelchair either can wheel in and shower directly or transfer to a seat. 60" x 60" is the best size for wheel-in showers, and 54" x 36" is the minimum. Showers with transfer seats should be at least 36" x 36". Custom showers can be built in many shapes and sizes using ceramic tile, vinyl-faced hardboard or laminated plastic sheets on the walls.
- Ready-to-assemble "retrofit" kits can convert a bathtub space into a shower stall once the tub is removed. Bases can be purchased separately, with the walls and controls custom finished.
- Glass, plastic or other rigid shower and tub doors should be avoided because they restrict movement in and out of the fixture and create a number of sharp edges and corners. Good control is also usually needed to work the handles. Use a curtain to avoid these potential access or safety problems.

# Home Accessibility Remodeling Series

## Tub/Shower continued

- Specialty tubs with a hinged door for side entry are also now marketed.
- Shower floors should slope gently to the drain - 1/8" per foot is recommended.
- Showers designed without a threshold avoid any tripping hazard and allow easy passage for a wheelchair or shower chair. To control water overspray into the rest of the room, the floor 12" beyond the shower entrance or curtain should be tiled and sloped to the drain.
- A drain trough can also be installed at a shower's outside edge. The trough is covered with a metal grate that collects water while maintaining a firm, level surface for walking or wheeling. The trough pit increases the volume of water that can be removed in comparison to a standard drain.

### Shower with Trough Drain and Folding Seat



to the room's center where an additional drain is located. Ceramic tile with an anti-slip surface is installed throughout.

- "Lever-action" or "single-lever mixer" faucets usually are advised used for persons with impaired hand functions. A flexible hose showerhead can help people shampoo more easily or shower while seated. As shown in the previous drawing, locating controls and the showerhead on the wall next to a seat or platform vs. the standard position on the opposite wall brings them into better range of reach.
- Grab bars should be installed in tubs and showers to help users maintain balance when standing and transferring and/or to assist helpers. Pay close attention to physical capabilities and preferred transfer approach when considering placement. (See Chapter 8 for specific information on selection and mounting guidelines.)

- Depending on budget, one additional strategy is to redesign the whole bathroom as a "wet room" – build the floor up slightly and slope it gently

# Home Accessibility Remodeling Series

## Chapter 7: Kitchens

The decision about whether or how much to modify a kitchen typically requires balancing many factors. Among them are:

- How often the disabled person needs to be involved in meal preparation/cleanup
- Tradeoff between benefit for the disabled person vs. potential inconvenience for other household members frequently performing kitchen chores
- Opportunities/constraints existing space, features and budget present

Minor improvements/modifications still can be very helpful even when existing cabinets, counters and appliances must remain in place. When a larger budget is available or justifiable, there is virtually no limit to the adapted appliances, custom cabinets and counters or layout changes than can be considered.

Accessible kitchen planning is based on the same principle as good conventional kitchen planning, which is economy and comfortable movement among the basic work centers - the sink, range/oven (these days, microwave as well) and refrigerator. This principle takes on increased importance when designing for a person with a disability, because poor accessibility results in complicated, time-consuming and tiring meal preparation/cleanup.

The basic design goal is to position counters, appliances and storage so the flow of tasks accommodates movements that are difficult or impossible. Task flow for preparing meals depends

in part on the type of cooking done. For example:

- People frequently preparing convenience foods (going directly from cupboard or refrigerator to stove, oven or microwave) may use a lot of storage and little counter space
- Persons cooking mostly from “scratch” may need much more counter space, work areas with lap space and connected or continuous counters to help move heavy dishes
- Some persons may also use one cooking appliance more than another (e.g., the stove top or a microwave more than the oven) so it should receive greater attention in planning

### Floor Space/Layout

Floor and space requirements vary greatly, depending on disability and mobility equipment used. Kitchen layouts can be broadly grouped into three categories according to counter/appliance placement and resulting task flow - corridor/galley, L-shaped and U-shaped.

L- and U-shaped layouts have the most open floor space. They’re good designs for wheelchair users or when a disabled and able-bodied person share kitchen duties. A more compact layout like a corridor style may work better for persons using a wheelchair who have impaired upper body strength/control or persons affected by a stroke, severe arthritis or stamina limitations.

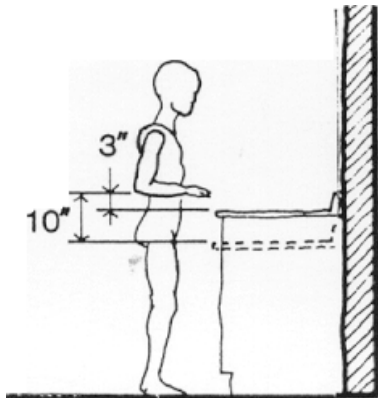
# Home Accessibility Remodeling Series

## Floor/Space Layout continued

Planning appliance placement and overall layout will require special attention if a person prefers or must rely on one hand or side of the body. For example, a person with only one “good” side needs counters/appliances located so items move and tasks “flow” away from that side.

Counter and other work space heights should be carefully tested. Ideally, counters should be located 2” - 3” below a person's elbow for light chores and approximately 10” below for the maximum shoulder/arm leverage heavy chores (like kneading bread or cutting a watermelon) require.

### Good Work Heights

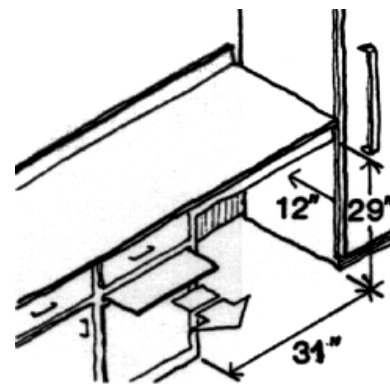


Kitchen cabinet/counter dimensions, however, have been standardized over the years at a 36” height, which causes problems for most seated and some standing users. When counter changes are needed, one option is to mount a new section of counter on brackets so its height can be adjusted. Another option, particularly when only minor modifications can be afforded, is to install pull-out “transfer platforms” that serve both as lowered work spaces and aid in shifting articles up to a countertop.

A challenge for wheelchair users is to locate these surfaces low enough for comfort but still providing

adequate lap clearance underneath (29” high, 31” wide and 12” deep for a standard-size manual chair). People with impaired ability to stand for long periods may also want a low work surface or pull-out board with adequate lap space when seated on a household chair.

### Knee Space



Consider counter edge style from a safety standpoint. For example, rounded edges minimize the injury that would result from a fall against a squared-off edge – this may be particularly important for seniors. And a unit with a band of contrasting color on the edge (particularly when the counter and floor are similar colors) can help persons with impaired vision better locate the counter edge to avoid articles falling off to the floor.

## Storage

Some kitchen storage areas are often out of a disabled person's range of reach. For example, people using a wheelchair can't reach standard upper kitchen cabinets, a person with a back or leg disability may not be able to reach lower cabinets, and others may only be able to reach objects located at the very front of a shelf. Each person has an opti-

# Home Accessibility Remodeling Series

## Storage continued

imum range defined by disability and factors like age, height and mobility equipment used. The goal is to set as much storage capacity inside this range as possible.

A person's ability to lift and carry objects of various weights also affects storage heights/needs. Heavy, frequently used items should be located where the least amount of movement/effort is required, often near the range's center. Lighter objects can then be placed in the upper and lower limits.

Most of the following suggestions can be either incorporated into new or applied to existing cabinets to increase useful storage capacity:

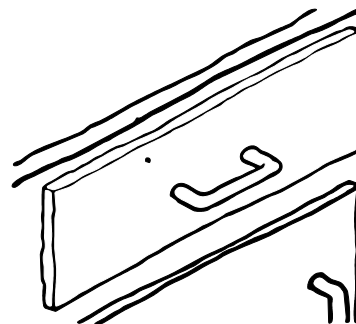
- Wood strips can be nailed across shelves to create curbs that keep objects from wandering out of reach at the back. (A suggestion: Store infrequently used items behind the strips.)
- "Lazy Susan" trays and tracking are at least two ways to make the rear portion of shelves easier to use. With the carousel-style Lazy Susan, all objects stored on the unit can be rotated to the front (although some space is lost around the unit). Tracked shelves pull out like drawers to bring objects at the rear within reach. The rear and side shelf edges with these approaches should have small trim piece installed to keep articles from falling off.
- Shelf units are now available that can be installed in an empty volume of upper cabinet space. They are hinged so the entire unit pulls down into the midrange of reach for use, then pushes back up into place.
- Shallow shelves, racks or trays can be mounted

on the inside of cabinet doors. Door hinges may have to be strengthened to carry the extra weight. Check to see if existing shelves must be cut back so the new door shelves don't upset items in the cabinet.

- Shelves, racks and trays can also be mounted to the underside of an existing shelf or upper wall cabinet.
- Where space permits or cabinet replacement can be afforded, consider installing a pantry-style unit that concentrates a large amount of storage in the middle range of reach.

The final detail affecting storage access is the type of hardware used - drawer pulls and door handles. Individuals with impaired finger control need hardware they can operate without having to grasp it between their thumbs and fingertips. The most accessible style is the "staple" or "loop" handle, designed with approximately 1" clearance from the mounting surface.

### Loop Handles



Generally, very small round pulls and grooved

# Home Accessibility Remodeling Series

## Storage continued

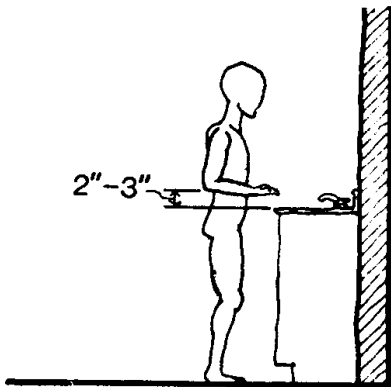
drawer or door edges should be avoided, since they require good finger control and strength. Handle placement also makes a difference in operation - mounting them near the door edge instead of in the middle increases leverage.

## Sink

Kitchen sink access depends on a number of factors. Locating the sink at the right height is an important consideration, particularly for extremely tall or short people, individuals with arthritis or chronic back pain as well as seated users.

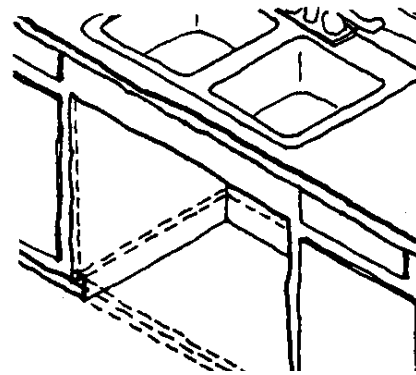
For persons using the sink from a standing position, locate the rim 2" - 3" below the elbow. People who use wheelchairs or who prefer to sit while working at the sink will have a conflict between a good rim height and the clearance needed for their legs or laps. (As previously indicated, the clearance for a standard, manual adult wheelchair with armrests is a space 29" high, 31" wide and 12" deep.) When lap clearance is essential, a "shallow bowl" sink 5-1/2" deep instead of the standard 7-1/2" can be purchased. These sinks can be set with a lower rim height and still have adequate clearance.

Good Sink Height



Providing space for a seated user at an existing sink can be easier in some cases than first assumed. Most sinks have a "false floor" and "toe space" trim that can be removed. The existing toe space trim or other new trim can then be mounted on the cabinet door bottoms to mask the gap created. New flooring usually must be installed in the false floor area because it previously was unfinished. Doors can also be removed and replaced by a curtain, or tracked units can be installed that open 90 degrees, then slide back out on each side out of the way.

Modified Sink Space



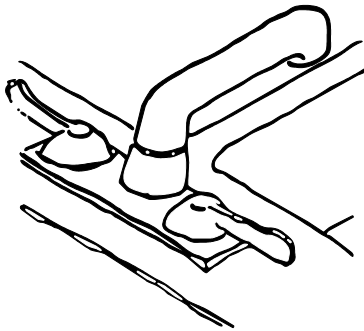
Seated users with impaired leg sensitivity need protection from the hot water and waste pipes. Shield the pipes by wrapping with insulation or installing wood screening. An alternative is to set the water heater to a temperature of 110° F. (Many dishwashers, however, require a hot water temperature of 140° F. Also consider what water temperature is comfortable for bathing/showering.)

Adjustable sinks units that raise/lower in place are now on the market. They operate either manually or electrically and can eliminate clearance problems for seated persons as well as adapt for short and tall household members.

# Home Accessibility Remodeling Series

**Sink** continued

## Lever Faucet Handles



Check sink controls (faucets, sprays, handles) for easy operation and appropriate location. For people with impaired hand functions, “single-lever” faucets controlling both hot and cold water from one handle are usually much more convenient than round knobs or two-handled faucets.

There are many single-lever models available, but avoid the style in which a knob must be turned to set the temperature and then pushed or pulled to adjust the flow - these aren’t lever-action faucets and won’t aid a person with impaired hand control. Electronic, “touch-free” units are now also available. Additionally, if range of reach to the standard control placement at the back is a problem, sinks are marketed with a design for side-mounted controls.

## Stove, Cooktop and Oven

Recommended stove, cooktop and oven modifications depend on variables like range of reach, hand control, cooking style, preferred fuel type and other personal preferences. People with a very restricted downward range of reach (e.g., people with arthritis, who use crutches, who have spinal injuries impairing arms and hands) may prefer a cooktop unit and separate oven so burners and oven racks can be individually set at the best work heights.

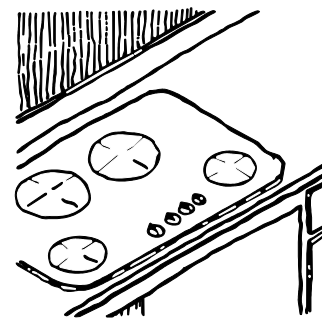
Side-hinged wall ovens are available, making transferring hot dishes easier and safer. Installing a pull-out transfer board by the oven can also help in shifting hot articles up to a countertop.

Some individuals using wheelchairs, however, may prefer a drop-in range with burners set slightly lower than a conventional range and located next to a counter with lap space. If a cooktop is installed over lap space, the underside of the cabinet should be closed to prevent burns.

Once the preferred appliance style is determined, make sure controls are accessible when the unit is installed. Avoid cooktops or ranges with controls at the back, since reaching over hot pots or burners to make adjustments can be dangerous.

If considering an oven with the thermostat and timer at the top, make sure the settings are easy to see and read. Try to find appliances with controls that operate comfortably - larger buttons or dials work well, especially for people with impaired hand function or coordination. Also, consider burner placement options - models with a “staggered layout” provide some protection against burns caused when reaching over front burners or hot pots to the back burners.

## Cook Top with Staggered Burners



# Home Accessibility Remodeling Series

## Refrigerator/Freezer

Refrigerators and freezers should be selected on the basis of how usable the two storage areas are. A side-by-side combination is often recommended because it provides both refrigerator and freezer space in the middle range of reach many people need. Units with the freezer on top and refrigerator on the bottom have reversible doors that provide more floor plan flexibility and may actually provide an equal volume of accessible freezer space.

Models are also available with the freezer on the bottom and refrigerator on top - this might be a preferred style for a person who microwaves many frozen articles. “Shallow-depth” models - the same size as a standard counter - are now marketed. As with the range, a counter or a pull-out board next to the handle side of the refrigerator will assist in transferring articles. If the disabled person uses a wheelchair, make sure adequate lap clearance is provided.

## Dishwasher

Better access to the dishwasher can be provided in various ways. Portable units are good options for some people because they can be rolled to the preparation and eating areas for loading. Models specially designed to fit under a conventional height counter or a “shallow-bowl” sink are available. Built-in units can be installed on about a 4” – 6” platform to bring shelves (particularly the lower one) into a better range of reach for everyone in the household.

## Other Appliances

Garbage disposals, trash compactors, etc., should be

selected based on the same concepts as discussed already for other appliances - range of reach, control ease of use and options for locating essential functions at appropriate heights. On/off switches, which typically would be mounted on a wall behind a counter or appliance, can be made much more accessible by mounting them on a lower cabinet face above or next to doors or drawers.

# Home Accessibility Remodeling Series

## Chapter 8: Grab Bars and Handrails

Transfer and balance aids are important safety features needed wherever a disabled person changes position (such as on or off the toilet), changes levels (at an entry or stairway) or remains stable in an unsafe or slippery environment (in the bathtub or shower). Handrails and grab bars are the most common types of aids.

Grab bars are available from many manufacturers. They're produced in a very wide array of layouts, diameters, wall clearances and grip surfaces. Bars are most commonly manufactured out of metal, but high-impact plastic units or metal bars coated with plastic are marketed as well. They now come in "designer colors" and with attractive shapes and appearances that blend in, don't look "institutional" and can match towel bars, soap and cup holders, etc.

Plumbers or plumbing supply firms carry the largest selection, but building supply centers now carry a number of basic models. Because there are so many types with so many features, make sure to check manufacturers' literature thoroughly when placing an order and specify precise model numbers according to length, right or left side, etc.

Before looking at selection and installation issues, it's important to point out two mistakes frequently made in installing grab bars in homes. One is the assumption that bars must be installed in the exact locations specified by state or federal access codes. As highlighted in the introduction to this series, the Minnesota State Building Code's Chapter 1341 and similar design codes were developed to govern installation of accessibility features in public and commercial locations. Single-family homes are

exempt from these code requirements, because modifications should either be tailored to the unique needs of a particular disabled person and household/home or installed with capacity for flexible adjustment over time.

The second mistake often made is assuming that bars are only installed for a disabled person's needs. In many cases, they're installed to provide a helper with support and bracing. Also, since grab bars are a good safety feature, they can benefit everyone in the household in more ways than one - remember that bars can always serve as an extra towel rack, but never vice versa.

There are five key features to check when selecting and installing these aids:

- "Fit" for a user's hand
- Safety clearance from the mounting surface
- Material used and grip surface treatment
- Placement
- Ability to support the user

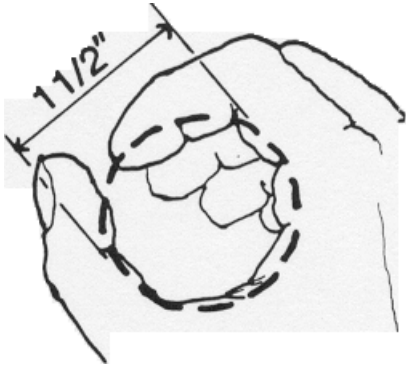
### Fit

Some people find that a round or oval shape 1-1/2" in diameter fits their hands best. This is also the size accessibility codes require for public/commercial installations. However, aids are typically available in 1-1/4" or even 1 " diameters, which may be much more comfortable for young children or many adults with smaller hands.

# Home Accessibility Remodeling Series

Fit continued

Grab Bar "Fit"



Carefully evaluate needs and don't let the numbers here fool you. They sound very small but actually result in very large differences in grip stability - make up some bars out of cardboard tubing and test the difference.

## Clearance

Wall clearance for grab bars and handrails should be large enough to allow comfortable reaching and gripping but small enough to prevent an arm from sliding down between the aid and the wall. 1-1/2" is the distance required by the access codes for public/commercial installations, and is a good guide-

Wall Clearance



line for home projects as well. However, a smaller clearance may be important if young children are around or are the primary users.

## Material

Bathroom grab bars and balance aids should be made of stainless steel or plastic to resist mold, mildew, bacterial growth and corrosion. When installing metal bars, be careful to make sure that the screws and other fasteners are of a compatible type of metal - if they're not, breakdown will occur over time where the two come in contact.

Aids with a textured grip surface should be installed in areas where users' hands will be wet and/or soapy. One finely textured steel finish is called "peened" surfacing - it looks and feels like sandpaper. Another rougher, cross-hatched treatment is called "knurled" surfacing.

Tubular metal rails or properly sanded/sealed wood handrails can be used for interior stairs, hallways, ramps, etc. For units installed outside, metal rails or piping should be avoided because wet gloves/hands can stick to them in the winter.

## Placement

A user's physical capabilities, mobility equipment required, and constraints presented by room layout or fixtures all affect aids' shapes and placements. In selecting an aid, consider:

- Comfortable range of reach
- Whether the user will lean, push, or pull (like a chin-up) on the aid for support or in making a transfer

# Home Accessibility Remodeling Series

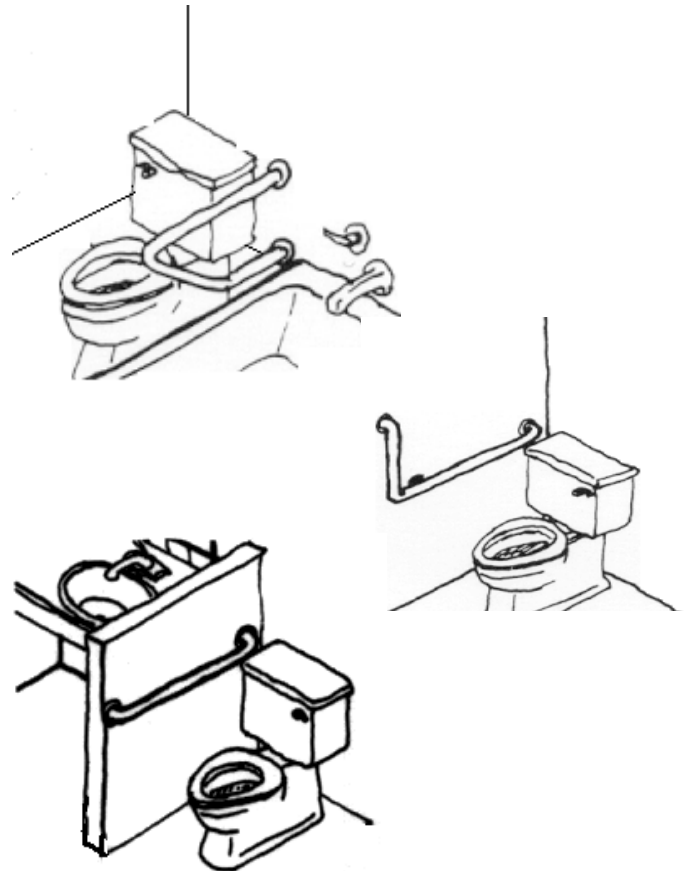
## Placement continued

- Whether a trapeze, pull-down or swing-away bar would work better than a fixed bar
- “Handedness” or “sidedness” - whether the person prefers or must have the aid located on a particular side of a fixture, wall, stairwell, etc.
- Horizontal, vertical, and angled mountings, and how the orientation will ease or complicate gripping or improve leverage
- Federal/state accessibility code requirements. (Although not mandated in homes, the code settings may match a particular user’s needs.)

(1/2” minimum) can be installed to provide a panel for easy relocation. Wall studs are notched to the depth of the panel's thickness, the panel attached, new sheetrock installed over it to create a level surface for refinishing and the aid mounted.

Stainless steel aids are typically designed to support 250 pounds anywhere along their lengths. Where wood handrails are installed, they need support brackets spaced closely enough along the rail's length to handle a similar load and prevent bending - 30” to 36” distances are recommended.

## Grab Bar Installation Examples



## Support/Mounting

Aids must have proper “backing” or reinforcement to prevent them from bending anywhere along their lengths or pulling out of their mountings. Nearly all grab bar and some handrail remodeling installations involve removing a section of wall covering and sheetrock, inserting backing/anchoring and then patching and refinishing the wall.

Backing must be installed because many bars have a circular mounting plate with three screws spaced so that they can’t all be drilled into the face (narrow edge) of a wall stud. Also, some bar lengths (like 18”, 24” and 30”) don't match the standard 16” spacing commonly used for centering wall studs in residential construction.

When backing must be inserted in an opened-up wall, 2”x 8” or 2”x10” boards are typically nailed horizontally between studs to create a mounting plate. If bar location is somewhat in question or may need to change over time, a sheet of plywood

# Home Accessibility Remodeling Series

## Chapter 9: Controls

Disabled persons, like other members of a household, need to control the home environment in a number of ways, including:

- Adjusting the thermostat, baseboard valves, or register dampers
- Opening and closing drapes, shades and windows
- Plugging and unplugging appliances; operating light switches; resetting or replacing circuit breakers, fuses or light bulbs.

A disabled person's range of reach, hand control and strength, and the operating characteristics of any mobility equipment used will have an impact on the choice of modifications. These projects require careful attention to detail, but often are relatively simple and inexpensive.

Switches, valves and dampers for heating, ventilating and air conditioning equipment need to be mounted in fairly open areas within a comfortable range of reach. They should be matched to a user's finger/hand flexibility and coordination skills. This may only require simple furniture rearrangement or the more complex procedure of replacing and/or relocating the devices. Some dampers or baseboard valves may be operated with a simple aid, like a rod with a cap that fits over a valve or hook that catches a damper lever.

Thermostats, humidifiers and electric fuse boxes or circuit breaker panels need to be selected and located so that their moving parts can be easily reached and labels or settings easily read. This may require lowering the device in some situations, or in

the case of the fuse box/circuit breaker panel, may require relocating from a basement to the main floor (particularly for a disabled person living alone).

Opening and closing windows is often another problem. They may be inaccessible or unusable for any number of reasons, including:

- Placement (too high, too low, too near a corner)
- Window type (e.g., lifting vs. sliding)
- Hardware type (may require too much finger control)
- Controls' locations (e.g., drapery cords, locks, etc., may be out of reach)

Replacing window hardware or reversing a drapery rod's cord location involves little or no expense. To replace a window requires removing trim and the interior wall surface to allow access to the opening's framing. If the window will be relocated or a new unit of a different size installed, the exterior siding may have to be cut back, replaced and/or patched. When a window is relocated, make sure to position it so that the sill or other components don't block the view for a seated person and so locks and latches are within easy reach.

Residential windows come in five hinged and sliding varieties:

- Casement (side hinged)
- Awning (top hinged)
- Hopper (bottom hinged)
- Double-hung (vertical slide)
- Glider (horizontal slide).

# Home Accessibility Remodeling Series

## Controls continued

Each style varies for how easy or hard it operates, depending in part on how disability affects hand control, arm and upper body strength. Each style also has a standard hardware type/location. The awning window probably has the most favorable set of locations because both the locks and the crank or handle are at the sill, rather than up on a side or on a transom (cross bar). Windows also don't just come in manual styles these days - some of the major manufacturers now carry powered units with remote controls.

Another important environmental element is access to electricity - plugging in lamps, fans and small appliances, etc. Electrical outlets located between 24" and 30" above the floor can help persons who have difficulty bending over or with a reduced downward range of reach use.

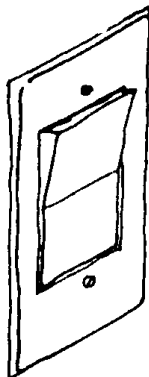
Persons with severely impaired hand control may not be able to operate conventional wall "toggle" light switches. Pad-sized "rocker" switches or "rheostat" switches that click on and off and adjust lighting intensity can be easily installed instead. Motion-sensing switches are also marketed that automatically turn lights on and off when a person

enters or exits a room. Outlets and switches can be relocated from walls to a lower bathroom/kitchen cabinet face to bring the controls into a better range of reach.

Persons who use a wheelchair or who have balance problems may be unable to change the bulbs in ceiling light fixtures. Floor, table and/or wall-mounted lamps are better than relying on ceiling lights. Control of these lamps and equipment like wall-mounted air conditioners can also be modified by rewiring them so the unit is turned on and off with a new wall switch.

Sophisticated systems are also on the market that operate several appliances, lights, or objects from a central panel or remote control. This type of equipment may be appropriate for a severely disabled person and can also provide special cues for someone with a sensory impairment. For example, a system can be set up to "hear" the doorbell or a baby's cry and then turn on a light, fan, or vibrator to attract the attention of a person who is hearing impaired or deaf.

### Rocker Switch



# Home Accessibility Remodeling Series

## Chapter 10: Readings

The following bibliography contains materials with useful information for planning an accessible home construction or remodeling project. Listings cover the issue from three perspectives:

- Accommodating persons with mobility and other physical limitations, the conventional focus in the field. Materials either approach it from the standpoint of tailoring features for a particular user's needs or installing more generic "universal design" features that benefit a wide range of users and can be adjusted over time.
- Sensory and cognitive needs that sometimes must be addressed - for example, safety and communication resources for persons with hearing or vision impairments, and safety and support features for persons with thinking/memory conditions like Alzheimer's.
- Healthy building practices" – choosing products and using construction techniques that result in good indoor air quality and energy efficiency. Experience clearly shows that newer building technologies and materials can cause not only structural but health problems if not properly installed. Additionally, past or current exposure to chemicals and other products may cause extreme physical sensitivities in some people.

### Physical/Sensory

**A Consumer's Guide to Home Adaptations**, The Adaptive Environments Center (Boston, MA), 1989, 52 pgs.

**A Comprehensive Approach to Retrofitting Homes for a Lifetime**, prepared for the National Association of Home Builders Research Center (Upper Marlboro, MD) by Lenny M. Rickman, Carol E. Soble and June Prescop, 1991, 82 pgs.

**Accessible Cabinetry**, IDEA Center, State University of New York at Buffalo (Buffalo, NY), 1996, 32 pgs.

**Accessible Housing**, Leon A. Frechette, McGraw Hill Publishers, 1996, 386 pgs.

**Accessible Cabinetry**, IDEA Center, State University of New York at Buffalo (Buffalo, NY), 1996, 32 pgs.

**Accessible Housing by Design: Universal Design Principles in Practice**, Steven Winter Associates Staff, McGraw-Hill Professional Publishing, 1997, 120 pgs.

**Accessible Plumbing**, IDEA Center, State University of New York at Buffalo (Buffalo, NY), 1996, 29 pgs.

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Physical/Sensory continued

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**Physical/Sensory** continued,  
**Cognitive Conditions,**  
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