Decisions about Special Seats and Wheelchairs

In this chapter we look at the things you will need to consider when buying or building a special seat or wheelchair, to best meet the needs of a child. Adaptations of seats and wheelchairs for special positioning needs are discussed in Chapter 65. Designs for building 6 basic wheelchairs are in Chapter 66.

Meeting the needs of the individual child, family, and community

Most children who need a wheelchair or special seat have severe weakness in parts of their bodies, or muscles that pull them into awkward or deforming positions. Seating should, as much as possible, keep these children in healthy and useful positions. It must provide support, but also allow them enough freedom to move, explore, and develop greater control of their bodies. For example:

1. A child who is ‘floppy’ and slow to develop ability to sit,
2. may at first need a seat with straps and supports to hold her up,
3. As she develops better head control and then body control, the supports can be removed little by little,
4. until finally—if possible—she is able to sit anywhere, with little or no special supports. Now low back support is all she needs.

CAUTION: If a child needs to be supported as much as the one in the second picture, do not keep her strapped in her seat for long. She also needs periods of free movement and exercise to develop more independent head and body control. Keeping her strapped in for too long, or providing too much support after she has begun to gain more control, may actually slow down her progress. Seating needs to be changed and supports reduced as the child develops.

Also, children who do not feel in their butts need frequent position changes and ‘lifting’ (see p. 198), and special cushions (see p. 200).
Special seats and wheelchairs need to be adapted not only to the individual child, but also to the particular family, local customs, and community situation. For example:

A ‘high chair’ lets the child join the family that eats at a table.

A ‘low chair’ lets the child fit in where the family eats at ground level.

Also, a ‘high’ wheelchair may be helpful where cooking and other activities are done high up.

But a low ‘wheelboard’ or ‘trolley’ may be better where cooking and other activities are done at ground level.

It is also important to consider the type of ground surface on which a wheelchair will be used.

Where land is flat and fairly smooth, and entrance into houses is level, a chair with a small wheel at the rear may work well and be less costly to make.

But where there are curbs, steps, rocks, or other obstacles, a chair with small wheels at the front works better.

On rough, sandy surfaces wide back tires and relatively large, wide front casters make moving about much easier.

Narrow back tires and small front wheels allow for faster travel on hard smooth roads but are useless on rough, sandy roads.

To jump over obstacles, the child can learn to do a ‘wheely’ (tilt the chair back with the front wheels in the air).

Wider tires, like the wide feet of a camel, help in sandy places.

Having the right wheelchair for the local situation frees the child to move about more easily in the community.
Healthy, comfortable, and functional positions

Whether or not a chair has wheels, **the position in which it allows a child to sit is very important.** (See Chapter 65.)

For most children, the chair should help them to sit more or less like this:

- back straight
- hips in straight line with the back, against the back of the chair
- legs at a right angle to the back
- looking ahead (not tilted back or down)
- knees at a right angle
- ankles at a right angle
- feet firmly supported
- head evenly centered (not tilting to one side)
- shoulders even
- knees somewhat separated
- ankles and feet separated
- body straight and centered above hips
- hips centered
- legs straight down
- feet supported at right angles to the body (not tilted in or out)

**CAUTION:** The seat should be wide enough to allow some free movement and narrow enough to give needed support (see Measurements, p. 602).

Common seating problems and possible solutions

**Problem: Hips tilt back**

In children with spastic cerebral palsy the hips often stiffen backward. This triggers spasms that straighten the legs and cause other muscle tightness with loss of control.

Also, children with weak hips or back, from spinal cord injury, spina bifida, or severe polio, often sit slumped with their hips tilted back and the back severely curved. This can lead to permanent deformity.

One of the most common causes of backward tilting hips is a chair like this one that is too big for the child.

Other causes of backward tilt and bad position are:

- a chair back that tilts far back
- and a cloth back that sags.

These let the child lean back and cause the hips to slip forward.

A good position can often be gained through:

- a fairly stiff, upright back at a right angle to the seat.
- a chair that fits the child so that his hips reach the chair back.
- the knees at right angles, and feet firmly supported.

Also, footrests that are far forward so that knees do not bend enough can increase spasticity that tilts hips back

To tilt the chair back, the rear wheel mount can be moved higher up. You may also need to move the wheel mount back farther to keep the chair from falling backward when going uphill. Be sure the front caster barrel is still straight up or making turns will be harder.

Most children, and especially a child who tends to fall forward in his seat, will sit better and more comfortably if the whole chair tilts back a little. But be sure to keep right angles at hips, knees, and ankles.
Keeping cost down and quality up

For many families, a wheelchair can be a great or even impossible expense. There are many ways to keep costs down. But be careful. Some low-cost choices may make the chair too clumsy, weak, or unsafe. Other low-cost choices may actually increase the chair’s usefulness and life. For example, a very useful, long-lasting wheelchair can be made of wood—or from a cheap wooden chair. Even wheels made of wood (if made well) may work well and last a long time. But, making the hubs or bearings of wood usually leads to trouble. Standard wheelchair wheel bearings are very expensive. However you can often get strong, high-quality, used metal bearings free or very cheap at electrical appliance repair shops or auto repair shops.

Factory-made or homemade wheelchairs?

Often you can save money by making your own wheelchair or by asking a local craftsperson to make one. Also, a homemade chair design can be more easily adapted to your child’s particular needs.

On the next pages we give information that may help you decide about different wheelchairs and effective low-cost ways to make them.

You can make a fairly effective low-cost wheelchair by attaching bicycle wheels or wooden wheels to an ordinary wooden chair. Also, it is easier to attach special aids or supports to a wooden chair than to a metal chair. This design is adapted from Healthlink Worldwide’s booklet, “Personal Transport for Disabled People” (see p. 604).

REMEMBER: A wheelchair needs to satisfy the rider—not just the maker. Before (and after) buying or making a chair, think carefully about the different features that will help it best meet the needs of the particular child and family.
When buying or making a wheelchair (or any other aids), consider:

- **Cost.** Keep cost low but quality high enough to meet the child’s needs (see p. 592).

- **How long will the chair last?** The longer the better, unless it is only for temporary use.

- **How easy and quick is it to make?** The easier and quicker the better, as long as it meets your needs.

- **Availability of materials.** Make use of local low-cost, good-quality resources (local wood, cheap metal, used bearings, bike parts, etc.).

- **What tools and skills are needed to make it?** If welding equipment or skills are not locally available, a wooden chair may be a more practical choice.

- **How easy will it be to adjust or repair?** Wood chairs that are bolted together are often the easiest to adjust or add special supports to.

- **Weight.** The lighter the better, while making sure it is strong enough.

- **Strength.** Heavier persons need stronger chairs and stronger axles. (A small child’s chair may be supported by a bicycle axle attached on one side only. A bigger child needs the axle to be supported on both sides, or a stronger axle. See p. 598 and 615.)

- **Width and length.** The narrower and shorter the better while meeting the child’s needs (but not so short that it tips over easily).

- **How easily can it be moved**—by the child sitting in it or by someone behind? **How easily can it be tilted back** to go over rough spots? **Lifted** up stairs? **Transported?** (Does it need to fold to take up less space?)

- **How well is it adapted to the particular child’s wants and needs?** Is it comfortable? Does it allow the child to sit in a healthy position?

- **Fit and growth factor.** How well does it fit the child now? How long will it continue to fit her? Can it be adjusted to fit her as she grows?

- **How well is it adapted to living situations,** the **home,** local customs, width of **doorways,** surface of **floors** and **roads,** curbs and other barriers?

- **Appearance.** Is the chair attractive? Does the child take pride in it? Do other children want to ride it?

In considering choices for the design, building materials, and special features of a wheelchair, be sure to carefully consider the above questions.
### Design choices for wheelchairs

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<tr>
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<th>DESIGN DETAILS</th>
<th>ADVANTAGES</th>
<th>DISADVANTAGES</th>
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<tbody>
<tr>
<td><strong>WHEEL SIZE AND POSITION</strong></td>
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<tr>
<td><strong>2 big wheels</strong> with 1 or 2 small caster wheels</td>
<td>- Large wheels let rider push herself.&lt;br&gt;- Small caster wheels allow easy turns (on cement, not sand).&lt;br&gt;- For leg amputees, rear wheels must be moved back to prevent tipping over backward.</td>
<td>- Child can move it herself if she has hand and arm control.&lt;br&gt;- Large wheels go over rough surfaces easier.</td>
<td>- takes up more space&lt;br&gt;- harder to get in and out of from the side (because wheels need to be higher than seat so that rider can push herself)</td>
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<tr>
<td></td>
<td>[Diagram showing 2 big wheels and 1 or 2 small caster wheels]</td>
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<tr>
<td></td>
<td>Child’s weight should be mostly over big wheels.&lt;br&gt;rear wheel set back to avoid tipping backward on slopes</td>
<td></td>
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<tr>
<td><strong>4 small wheels</strong></td>
<td>Very simple temporary chairs can be made by putting 4 wheels on an ordinary wood chair.</td>
<td>- good only on smooth floors for a child who cannot push or help push his own chair&lt;br&gt;- cheaper&lt;br&gt;- takes up less space&lt;br&gt;- easier to move child in and out of.</td>
<td>- not good on rough surfaces&lt;br&gt;- Child cannot move it herself.&lt;br&gt;- creates dependency</td>
</tr>
<tr>
<td></td>
<td>[Diagram showing 4 small wheels]</td>
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<tr>
<td><strong>3 big wheels</strong></td>
<td>- You can use 3 bicycle wheels.&lt;br&gt;- Some models have removable front wheels so that chair can be easily changed to have small front wheels for use inside the home.</td>
<td>- excellent for long distance and rough road travel&lt;br&gt;- can be used by a person with strength in one hand only</td>
<td>- too big for use inside home&lt;br&gt;- more costly&lt;br&gt;- more difficult to make</td>
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<tr>
<td></td>
<td>[Diagram showing 3 big wheels with hand crank and steering]</td>
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<tr>
<td><strong>BUILDING MATERIAL FOR FRAME</strong></td>
<td>Thin-walled electrical conduit tubing can be used—5/8 inch to 1 inch diameter.</td>
<td>A strong, long-lasting, fairly light chair can be made better and cheaper than most commercial chairs.</td>
<td>requires welding skills, some design ability, and a fair amount of equipment&lt;br&gt;- a good chair for a well-equipped rehabilitation center workshop to build, but not a family&lt;br&gt;- builders need to be trained</td>
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<tr>
<td><strong>Steel tube</strong></td>
<td>Whirlwind wheelchair See p. 622.</td>
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<td></td>
<td>Healthlink Worldwide design, see p. 604.</td>
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<tr>
<td><strong>Wood</strong></td>
<td>For wood design details, see p. 615 and 620 and references on p. 604.</td>
<td>- relatively cheap and easy to make—mostly wood, few or no welds&lt;br&gt;- easy to adapt and to add special supports or tray tables</td>
<td>May not be as stable and long-lasting as other models&lt;br&gt;(For tighter joints and more adaptability, use nuts and bolts instead of nails.)</td>
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<tr>
<td></td>
<td>Healthlink Worldwide model</td>
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<td></td>
<td>plywood model design p. 620</td>
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<td>FEATURE</td>
<td>DESIGN DETAILS</td>
<td>ADVANTAGES</td>
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<tr>
<td>Re-bar (metal reinforcing rod used to strengthen cement)</td>
<td>Design can be the same as for metal tube chairs, but it is easier to adapt because the re-bar is easy to bend.</td>
<td>• relatively cheap&lt;br&gt;• easier to bend and weld than steel tubing&lt;br&gt;• can have plastic woven seat and back (easy to clean)&lt;br&gt;• especially good for small chairs</td>
<td>• A heavy person or rough treatment may bend it out of shape.&lt;br&gt;• fairly heavy</td>
</tr>
<tr>
<td>PVC pipe (plastic water pipe)</td>
<td>• Use 15 mm. PVC pipe.&lt;br&gt;• comes with joints so that it can be fitted together with a special glue&lt;br&gt;• For details see reference, p. 606.</td>
<td>• lightweight&lt;br&gt;• can be built mostly by gluing pieces together</td>
<td>• costly materials (around $100 US)&lt;br&gt;• Plastic tubing will in time sag or bend in the direction of stress. Therefore it may be necessary to fiberglass the frame—which adds to cost, work, and weight.</td>
</tr>
<tr>
<td>SEATS AND BACKS&lt;br&gt;Soft canvas or leather stretched between supports</td>
<td>For child who is likely to pee or shit in the chair, use a cloth that is easy to wash.&lt;br&gt;• Plastic-coated canvas makes cleaning easy but is hot and may irritate child’s bottom. Best to use an absorbent washable pad over it.</td>
<td>• easiest seating and back design for folding wheelchairs&lt;br&gt;• Adjustment to shape of butt gives comfort (but cushion is needed to protect against pressure sores).&lt;br&gt;• Curving back may help keep child from falling sideways.</td>
<td>• Soft; curving back lets child bend in an unhealthy position (see p. 591).&lt;br&gt;• hard to attach positioning aids&lt;br&gt;• In children with spasticity or muscle imbalance, this may increase the risk of developing knock-knee contractures.</td>
</tr>
<tr>
<td>Firm (but padded) back and seat</td>
<td>• Use wood or thin plywood.&lt;br&gt;• Special designs allow a wood seat to swing up for folding.</td>
<td>• Wood seat and back allow easy addition of supports and adaptations.&lt;br&gt;• Firm wood back and seat help child sit with back straight and knees apart (especially important for children with spasticity).</td>
<td>• may be less comfortable&lt;br&gt;• without cushion may cause pressure sores in child with no feeling in his butt&lt;br&gt;• heavier&lt;br&gt;• difficult or impossible to fold the chair</td>
</tr>
<tr>
<td>Woven seat and back</td>
<td>• Use natural basket fibers, reeds, or rattan,&lt;br&gt;• or use plastic webbing,&lt;br&gt;• or use tightly stretched strips of car inner tube.</td>
<td>• An open weave is cooler in hot weather.&lt;br&gt;• Plastic or rubber woven seats can be easily washed. Can be used as a chair to bathe in.</td>
<td>• must be kept stretched tight; not useful on folding chairs&lt;br&gt;• may not last long if material is not strong&lt;br&gt;• same sag problems as with canvas or leather</td>
</tr>
<tr>
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<td><strong>TIRES</strong></td>
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<tr>
<td><strong>Pump-up with air ‘balloon’ tires</strong></td>
<td>• Bicycle tires and tubes work well for the large wheels—20 inch (51 cm.), 24 inch (61 cm.), or 26 inch (66 cm.), wide or narrow.</td>
<td>• softer ride</td>
<td>• Puncture (hole in tire) may occur—especially on rough roads.</td>
</tr>
<tr>
<td><strong>Solid tires (standard wheelchair wheels)</strong></td>
<td>Buy from wheelchair supply center to fit diameter and width of rim.</td>
<td>• no flat tires</td>
<td>• more costly than some other tires</td>
</tr>
<tr>
<td><strong>Rubber hose inside bicycle tire</strong></td>
<td>• Overlap ends and cut at 45° angle.</td>
<td>• no flat tires</td>
<td>• hard to replace</td>
</tr>
<tr>
<td><strong>Thin strip of old car tire</strong></td>
<td>• Cut strip in wedge shape to fit rim.</td>
<td>• no cost</td>
<td>• very hard, bumpy ride on rough surfaces</td>
</tr>
<tr>
<td><strong>Large machinery fanbelt (discarded)</strong></td>
<td>• Use old power belts or fan belts from industrial machinery or tractors. Cut to fit and wire ends together.</td>
<td>• no cost</td>
<td>• very narrow—sinks into sand</td>
</tr>
<tr>
<td><strong>Piece of old bicycle or scooter tire</strong></td>
<td>• used for middle-sized or small wood wheels.</td>
<td>• cheap</td>
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<tr>
<td><strong>BIG WHEELS</strong></td>
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<tr>
<td><strong>Standard factory-made wheelchair wheels</strong></td>
<td>• Buy to fit chair.</td>
<td>• little work needed (if they are bought to fit standard hubs)</td>
<td>• hard, bumpy ride (but softer than on wood wheel alone)</td>
</tr>
</tbody>
</table>
| **Bicycle wheels (rims and spokes)** | • For children, standard thickness spokes may be enough.  
• For large persons, heavy-duty spokes may be needed.                                                                                              | • less costly than standard wheelchair wheels  
• available in different sizes and widths                                                                                                           | • may tear off                                                                                                                                                                                     |
| **Bicycle rims with wooden spokes** | • notched wood cross-pieces on a triangular wood base can be greased and used as the hub                                                                                                                     | • no need to know how to fit spokes  
• works with wood hub                                                                                                                                   | • Rim may easily get bent—especially on rough roads.                                                                                                                                                  |

DISABLED VILLAGE CHILDREN
<table>
<thead>
<tr>
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<tbody>
<tr>
<td>Wood wheels—big or small</td>
<td>Use boards or plywood. To avoid splitting, screw and glue 2 layers together with grain running in opposite directions. Cut notch in rim to hold solid tire.</td>
<td>relatively cheap, little skill required—mostly carpentry, works with wood axles, heavy-duty bearing can be added</td>
<td>often heavy, may not hold up long—especially in wet climate or mud (Keeping wood oil-soaked helps them last. Use old engine oil.)</td>
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</table>

CASTERS AND WHEELS

(Caster means that the wheel can swing in different directions for making turns.)

**Standard wheelchair caster wheels**

- Casters come with hard or balloon tires in many sizes, weights, styles, and prices. If possible, get (or make) casters with ball bearings.
- little work to attach—especially if standard mount and bearings are used
- usually very costly, may not be locally available

**Casters from other (non-wheelchair) equipment (used or new)**

- Use 3 inch to 6 inch wheels.
- larger, wider wheels for rough ground
- Be sure bearings are strong enough and in good condition.
- Drill holes in rubber wheels to make them weigh less.
- less costly (especially if not new)
- often full wheel and caster bearings come with them
- Poor quality casters make wheelchair much harder and more awkward to use.
- Hard-rubber casters make a bumpy ride.
- Some used casters are too weak.

**Bent and welded steel caster forks**

- Choose bolt width to fit bearings.
- A bent steel tube can be used instead of a metal band.
- less costly than factory-made casters
- strong (if well made)
- needs special equipment (bending jig) and welding skills

**HUBS, BEARINGS, AND AXLES**

**Standard wheelchair bearings**

- A standard wheelchair uses 12 bearings: 2 for each wheel axle and 2 for each upright caster bearing.
- How a ball bearing works: axle does not move
- These bearings come as part of standard wheelchair hubs and wheels.
- Most factory-built wheelchairs have unusual sized axles and therefore must be fit with special wheelchair bearings.
- Bearings on most factory-built chairs are costly, of poor quality, and wear out quickly.
- Unusual hub size makes it hard to replace commercial wheelchair bearings with other standard machine bearings.

**Bicycle bearings and axles**

- For mounting alternatives, see wheelchair designs p. 598 and 615. Also, see the Healthlink Worldwide Manual (see p. 604).
- cheap—especially if old bicycles are used
- easy to get
- can be used with complete bicycle wheels
- Axle is too weak to be supported by one end only (except in a small child’s wheelchair).
<table>
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<th>FEATURE</th>
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<th>DISADVANTAGES</th>
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</table>
| **Rear bicycle wheel axle and bearings** | - First take free-wheel mechanism apart and remove ratchets.  
- Then attach hub to a metal plate as shown and spot weld it.  
- Other methods for one-end axle support are in the Healthlink Manual (see p. 604). | - Allows axles to be attached by one end only. | - Needs fairly skilled work and welding.  
- heavy |
| **Used machinery bearings** | - Find used high-speed bearings of the size shown (or near the size). Volkswagen alternator bearings and certain power tool bearings work well.  
- Use 5/8 inch steel bolts for axle. For details, see p. 604, 622, and 623. | - no need to adjust, grease, or clean  
- usually free or very cheap  
- In wheelchairs they will last a very long time.  
- If done well, results are better than with commercial hubs and bearings. | - very careful, exact work needed for good results |
| **Wood bearing** | - Use a hard wood that will not split.  
- Soak wood in old motor oil.  
- For more ideas and details on wood bearings, see Healthlink Worldwide Manual p. 604. | cheap and fairly easy to make | tends to wear out, wobble, or crack quickly unless very well made; not as smooth or easy to ride as with ball bearings |
| **SUPPORT OF AXLES**  
**Axle supported on one side only** | - Strong steel axles are needed for support at one side only. Axle should be at least 5/8 inch thick for a large person.  
- For a very small child bicycle axles can be supported by one side only. One way is to weld bicycle axles to a thin metal pipe. | - Not as wide or heavy as the chair with 2-side support.  
- easier for user to get a full-length push with hands and arms  
- narrow size important for doorways and transporting  
- Pass pipe through a wood frame; | For adults and large children, standard bicycle axles are too weak for one-side support.  
- Even for smaller children, bicycle axles are weak, and rough use can bend them. Put a sign on chair:  
FOR SMALL CHILDREN ONLY |
| **Axle supported on both sides** | - Place outer bar of axle support so that it allows as much room for hand pushing by the rider as possible.  
- 2-sided support allows use of standard bicycle wheels and axles.  
- easy to build and replace | chair wider, more difficult to get through narrow doors and spaces; more difficult to transport  
- Wheel supports get in the way of hands when user moves by pushing wheels.  
- heavy | |

---

**Notes:**
- This can be done in several ways:
- metal strips on wood frame  
- metal tube on tube frame  
- wood on wood frame
### SPECIAL SEATS AND WHEELCHAIRS

#### TO FOLD OR NOT TO FOLD

<table>
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<th>DISADVANTAGES</th>
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</thead>
<tbody>
<tr>
<td><strong>Folding:</strong></td>
<td>- narrow when folded for easier transport or storage</td>
<td>- smoother ride due to flexibility</td>
<td>- heavier</td>
</tr>
<tr>
<td><strong>Non-folding:</strong></td>
<td>- cheaper and lighter</td>
<td>- easier to make</td>
<td>- more adaptable</td>
</tr>
<tr>
<td><strong>Non-folding:</strong></td>
<td>- more adaptable</td>
<td>- often stronger</td>
<td>- cheaper and lighter</td>
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</table>

#### ARMRESTS

- **No armrests**
  - Note: Many chairs are built so that armrests are part of the main structure and strength of the chair. The armrests cannot be easily removed, even though this might benefit the child. Carefully consider the child's need for armrests before buying or making a chair.
  - Many children with strong arms and trunk control prefer a chair with no armrests and a very low back support.
  - Moving by pushing the wheels is easier.
  - less weight
  - Getting off and on from the side is easier—especially important when legs are completely paralyzed and when arms are also weak.
  - Many small children need armrests for stability, for positioning, or for comfort.

- **Fixed armrests**
  - Armrest height and length should be determined for each child and her needs.
  - For measurements, see p. 602.
  - especially helpful if child cannot use legs to get out of chair
  - They can help child to sit in a better position and be more comfortable.
  - They can sometimes be used for attaching a removable table.
  - They get in the way for pushing wheels and for getting off chair to the side.
  - For many children, fixed armrests get in the way more than they help.

- **Removable armrests**
  - In folding chairs, armrest attachments must be placed so they do not get in the way of folding.
  - Provides arm support when needed, yet can easily be removed for travel and transfer.
  - requires more work, materials, and exact fittings
  - adds slightly to weight
  - Separate armrests may get lost.
### FOOTRESTS

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<th>Advantages</th>
<th>Disadvantages</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Positions</strong></td>
<td>For a small child, often footrests can position legs straight down. This is important in many cases (see p. 591).</td>
<td>Good positioning and support of the feet help the whole body to stay in a better position. A footrest like this, may help feet like these.</td>
<td>A footrest that keeps the leg at right angles may cause or increase knee contractures in some children. Children should not stay sitting too long and should do daily exercises to stretch their legs, feet, and hips. To prevent or correct contractures, one or both legs may need to be kept as straight as they will go.</td>
</tr>
<tr>
<td>Fixed position footrests</td>
<td>If the footrest is too low, blocks can be placed on it to make it higher. They can be removed as the child grows. However, fixed footrests that are too high are more difficult to correct. So it is better if they are too low.</td>
<td>easiest to build. For a small child who can easily be lifted in and out of the chair, they are fine. If footrests are screwed or bolted onto a wooden wheelchair, their position can easily be changed as the child grows.</td>
<td>They often get in the way when the child gets in or out of the chair, or in the way of the person lifting a larger child. (See other methods below.)</td>
</tr>
<tr>
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<td>very adaptable, easy to make, can support a casted leg.</td>
<td>A cushion or padding should be placed over the leg board (unless leg is casted). Side supports may be needed to keep leg from slipping off.</td>
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<td>No footrests</td>
<td>Seat is mounted low so that feet rest flat on floor.</td>
<td>useful for persons who can pull their chair along with their legs and feet—especially when one or both arms or hands are too weak to push the wheels.</td>
<td>Feet may drag when someone else pushes the child in the chair. Swing-away footrests may be the best solution.</td>
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**REMEMBER:** Cushions or seating adaptations will change the height needed for the footrests.

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**FOOTRESTS**

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<th>Advantages</th>
<th>Disadvantages</th>
</tr>
</thead>
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<td><strong>Fixed position footrests</strong></td>
<td>If the footrest is too low, blocks can be placed on it to make it higher. They can be removed as the child grows. However, fixed footrests that are too high are more difficult to correct. So it is better if they are too low.</td>
<td>easiest to build. For a small child who can easily be lifted in and out of the chair, they are fine. If footrests are screwed or bolted onto a wooden wheelchair, their position can easily be changed as the child grows.</td>
<td>They often get in the way when the child gets in or out of the chair, or in the way of the person lifting a larger child. (See other methods below.)</td>
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| PARKING BRAKES | There are many brake designs. This one is from Healthlink Worldwide. Two others are on p. 623. | • takes little space  
• fairly easy to use if made right (which often they are not) | • needs welding and skill to make  
• Homemade brakes often give problems—yet it is important that chairs have them if possible. |
| Lever brakes | **SIDE VIEW**  
push handle out and up  
metal plate  
welder  
split pin  
catch  
pivot  
wrap tube around several times to make several rims at once.  
Wrap tube around several times to make several rims at once.  
Cut down this line before removing from jig. Weld ends. | • easy to make, requires no welding, and is cheap  
• If the child usually only gets in and out of the chair in one or two places in the home, blocks in these places may be all that is needed. | • a heavy, awkward object to move from place to place  
• not practical outside the house (or in it)  
• have to tilt child to one side to ‘park’ chair |
| Parking block | Brakes on wheelchairs are for keeping the chair from rolling when getting in or out, or stopped on a hill.  
The simplest form of brake is a parking block that keeps the wheel from turning.  
To ‘brake’, roll wheel up ramp and into groove. | • Handrims help keep hands clean. (Otherwise child has to push on tire.)  
• especially important where there are very dirty paths and roads | • Added width makes it harder to get through narrow doorways.  
• adds weight |
jig for bending tube  
Cut a piece of rubber hose lengthwise and tape it onto rim.  
• For child with weak or paralyzed hands, a smooth rim can be hard to grip—especially if it is chromed or galvanized.  
• Putting rough cloth tape, a rubber hose, or many small handles on the rim will make pushing easier.  
• Or you can wrap the rim with a long thin strip of car tire inner tube. | • Pegs sticking out from rims increase width of chair.  
• Pegs sometimes cause hand injuries—especially when going fast downhill. | |
| Handrim grip improvers | • Handrims help keep hands clean. (Otherwise child has to push on tire.)  
• especially important where there are very dirty paths and roads | • easy to make, requires no welding, and is cheap  
• If the child usually only gets in and out of the chair in one or two places in the home, blocks in these places may be all that is needed. | • a heavy, awkward object to move from place to place  
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Fitting the chair to the child: measurements

These measurements are for wheelchairs and for special seating without wheels.

**SEAT WIDTH**

Measure across hips or thighs—whichever is wider.

Add 1 cm. (1/2 inch) to both sides for seat width.

**SEAT DEPTH**

Subtract about 1 cm. for depth of seat to leave a little space behind the knees.

**SEAT HEIGHT**

- **CAUTION:** Be sure to include cushion when measuring height for chair seat.

**Note:** Raising the seat of a small child higher lets his feet rest above the casters and therefore directly below the knees. The higher seat also helps for eating at the table with the family. Sideways transfers are also easier. Sometimes seats are placed even higher than shown, but this makes pushing wheels with hands more difficult.

**ARMREST HEIGHT**

Put armrest height a little higher than his elbow so that the elbow will be positioned away from the body.

**Note:** This measurement is standard, but some children need arm support at a higher level. Experiment.

**BACK HEIGHT**

**Note:** This measurement is standard, but some children need a higher back, and sometimes head support. Others prefer a back that supports only the hips.

**IMPORTANT:** Also check how much hips and knees bend, as this may affect position of footrests and casters.

**Caster here will not work.**

**Knee contracture**

**CAUTION:** When measuring, be sure to allow for cushions or backboards that will be added.
Wheelchair production as a small ‘village-industry’

In several countries small groups of disabled persons have started to produce low-cost, good-quality wheelchairs adapted to local needs. Usually this is in places where standard factory-made wheelchairs are very high-priced and are not suited for use on rough or sandy ground.

Some of these ‘little factories’ try to be self-sufficient. A few have even succeeded in making a modest profit, while keeping prices low.

Sometimes, a small-scale wheelchair making and repair shop is set up as part of a community rehabilitation program. Self-sufficiency (selling the chairs for a little more than it costs to make them) is often a goal. But because families with the greatest need are often least able to pay, the chairs must often be sold below cost.

WHAT KIND OF WHEELCHAIRS TO MAKE

This depends on many factors: cost, skills or training available, tools and equipment needed, amount of money available to start, building materials available, the possible market, the local economy, and needs of the wheelchair user and family.

For example, folding tube-metal chairs are relatively expensive to make and require more skill, training, and equipment. However, they often work smoother, last longer, and are easier to transport than are many other models. These high-quality, good-looking chairs—painted or even chrome plated—may sell the best, even if expensive, and may compete with factory-made chairs (see p. 622).

If the wheelchair users will be mostly children and poor families, low-cost wooden chairs may be more appropriate. These can be easily built to size and adapted to the needs of the individual child. The chair may not last as long. But the child is growing and her needs may change. Simple wood chairs also require fewer skills to build—mainly carpentry. They are easier for the family to build, repair, or add changes to at home.

Ideally, a village shop would make a variety of chairs out of different materials and at different prices. Chairs of all models, sizes, and adaptations should be kept on hand to give the child and family a chance to know and try different possibilities. **Be sure to make child-sized chairs. And make chair inserts so that adult-sized chairs can be adapted for children.**

**Look for every opportunity to keep costs low.** Providing repair services for used and broken chairs is good ways to keep children on wheels. Also use as much ‘waste’, and used and free materials as you can: old bicycle wheels, old machinery bearings, scrap metal, and bolts from junk yards. For basic building materials, check prices of different sellers. Once you are sure of what you need, try to buy large amounts at lower cost. If you explain to the sellers the purpose of your purchase, they may lower prices or give you useful scraps.

**Designs for 6 different wheelchairs are in Chapter 66.**
How-to-do-it reference materials for wheelchairs, wheelboards, and other seating

It is impossible, in a book such as this, to give detailed building plans for more than a few wheelchairs, scooters, wheelboards (trolleys), and special seats. The following reference materials have more detailed plans. You can send for them at the addresses shown. Some may also be available from TALC, P.O. Box 49, St. Albans, Herts, AL1 4AX, England. With each reference we give one or more drawings of key designs and a few comments about their usefulness and cost.

**Personal Transport for Disabled People—Design and Manufacture**

Healthlink Worldwide
56-64 Leonard Street,
London EC2A 4LT,
UNITED KINGDOM

Also available through TALC

- many good designs and plans for low-cost aids
- does not compare strengths and weaknesses or describe limitations of different designs
- no design for wheelchairs with casters in front (which are needed for many areas)

**Independence through Mobility:**
A Guide to the Manufacture of the
ATI-Hotchkiss Wheelchair

Whirlwind Wheelchair International
San Francisco State University,
1600 Holloway Ave. SCI 251,
San Francisco, CA 94132, USA

- design for the 'whirlwind', a high-quality middle-cost steel tube wheelchair that can be built by disabled craftspersons as a village industry
- short training usually needed to build it effectively; welding skills and simple math required
- cost of materials about US $100

**Local Village-made Wheelchairs and Trolleys**

by Don Caston

Available upon request.

DON CASTON
202 Cheesman Terrace
London W14 9XD
ENGLAND

- simple, very low-cost aids, made mostly out of wood, using bicycle or wood wheels
- all models are based on one 3-wheel trolley design
- Instead of a standard caster, the front slides on its axle and is pushed back to center by a choice of simple methods. (This method is cheap and clever, but unstable and does not turn as well as designs with casters.)
Asia-Pacific Disability Aids and Appliances Handbook, International Commission on Technology and Accessibility (ICTA)
Rehabilitation International
25 E. 21st Street, 4th floor
New York, NY 10010, USA
- brief descriptions and non-technical drawings and addresses for information on many aids

An Accent Guide to Wheelchairs and Accessories
ACCENT
P.O. Box 700
Bloomington, IL 61702
USA
- information about different aids, features, and accessories of factory-made chairs
- basic information on cleaning and repairing
- design and building information limited to a few accessories

UPKARAN: A Manual of Aids for the Multiply Handicapped
Bandra Reclamation
K.C. Marg, Bandra (West)
Mumbai 400 050, INDIA
- an excellent resource
- many simple, practical designs for seating, wheelchairs, crawlers, standers, walkers, therapy aids, and toys

How to Make Basic Hospital Equipment
Practical Action Publishing
The Shumacher Centre for Technology and Development
Bourton on Dunsmore
Rugby, Warwickshire
CV23 9QZ UNITED KINGDOM
Also available through TALC and Healthlink Worldwide
- simple, attractive designs using tube steel
- welding skill required; fairly costly to make
- no designs for casters-in-front chairs


### Functional Aids for the Multiply Handicapped

*by Isabel Robinault*

Harper and Collins Sales
10 East 53rd Street
NYC, NY 10022 USA

- mostly factory-built examples but some are simple and well-illustrated enough to serve as design guides
- many good wood special seats
- also support frames, standers, walkers, toys, and eating aids

---

### Measuring the Patient

*Everest and Jennings, Inc.*

Graham-Field Health Products
3601 Rider Trail South
Earth City, MO 63045-1116 USA

- good information on measurements for standard chairs
- illustrated discussion of problems with chairs that do not meet a person’s specific needs

---

### ‘Build Yourself’ Plastic Wheelchair

Directions for assembly available from:

Spinal Research Unit
Royal North Shore
Hospital of Sydney
St. Leonards, NSW 2065 Australia

- relatively expensive (materials about US $100)

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### Positioning the Client with Central Nervous System Deficits: The Wheelchair and Other Adapted Equipment

*by Adrienne Falk Bergen and Cheryl Colangelo*

Valhalla Rehabilitation Publications, Ltd.
P.O. Box 195 Valhalla, NY 10595 USA

- excellent detailed discussion of specific needs of children with cerebral palsy
- many well-illustrated examples
- written for developed countries but many aids and designs are simple and can be made anywhere at low cost

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