Roundwood Kiosks: Construction and Assembly

Dated 02/07/02

The information given here should be used along with the plans acquired from Beaudette Consulting Engineers (BCE) for building small-diameter roundwood kiosks. Although with determination anyone with the ability to use tools should be able to build a kiosk, familiarity with working with wood is a definite plus. Those in the construction trade; especially log home manufacturers should be able to build a kiosk with minor difficulty. Your second kiosk should be easy to build and it would be a good idea to help someone else build one before building your own. Rather than step-by-step instructions, the information given here addresses questions that may arise while building from the engineering plans. There are many options in design and connectors, and over time the plans and these instructions will probably evolve. Please note the dates of both the instructions and the engineering plans to make sure they correspond. The plans found on the website, sheets 2-17 are for determining what options you want; they are not complete. There is also a report *Roundwood Kiosks for 2002 Winter Olympics in Salt Lake City* (available on our website) that contains figures and other helpful information.

The **Ordering Plans**, available on our website, are for information and to determine what options you will be selecting for your kiosk. After you have made your selection of kiosk options, you may submit your order over the web or order your plans from Beaudette Engineering.

**Materials**

The smallest logs needed are 3 inch in diameter for the web member in the truss (sheets 15-17) and (when walls are not used) for bracing. Bracing can be eliminated in a wall-less structure by increasing the diameter of the columns and burying them into the ground to provide the racking resistance. The largest logs needed are 6 in. for the columns, the plate log, and the top chord of the truss. The diameter is measured midway on the log. The longest piece is the top chord, whose finished length is 13 feet. This log must be at least 5 inches in diameter at the compression hub. If the columns will be buried into the ground, they should be preservative treated and at least 4 ft longer than listed in Table 1. Treatment comes in a variety of flavors. The treatment must be suited for the species of wood, it must be PRESSURE treated to at least .6 lbs per cubic foot such as used for utility poles and usually the wood needs to be dry when treated. If you have questions about preservative treatment contact the Forest Products Laboratory. If you cannot obtain appropriate treatment, you should use one of the other designs! The kiosk is designed for 110 lb/ft² live load, so if your requirements are less or you use stronger roundwood (e.g., Douglas fir), there may be options to use smaller members or not use the web members in the truss, but Beaudette Consulting Engineers must approve any deviations from the plans before construction begins.

Green logs can take more than a year to dry if the bark is left on. During this time, conditions may be ideal for decay fungi (rot) to colonize, resulting in unacceptable material. If a kiln is used, it may not be necessary to debark the log, but a kiln can add significant cost. Debarked logs can be ready to use in as little as a month of properly stacked air drying. But this is during good drying weather. During the winter, logs may not dry at all. Harvesting standing dead trees can alleviate the need for drying. Most log home manufacturers will not buy green logs. During a
few weeks in the spring, many freshly cut (live) trees can be easily debarked. Although radial and tangential shrinkage dominate when a log dries, the length also shrinks. Typically, shrinkage is only 0.1% to 0.2%, but sometimes it can be more. A 0.2% shrinkage on a 14-ft log amounts to more than ¼ in. Twist in a log is a bigger concern than shrinkage. Some species can twist a large amount during drying, which could be a disaster during assembly. It is best to get your logs within a few percentage points of final moisture content (they must be below 19%) before shaping. Final moisture content will vary depending on the climate, but for most areas of the country, it is about 8% indoors and 12% outdoors. There are commercial moisture meters that give moderately good readings. The moisture content of green wood can be well over 100%. As wood loses moisture there is no shrinkage until it gets down to about 30%. If you see checks, that is a good indication that the wood you are looking at is below 30%. Even though you may see end checks, wood not near the end could still be very wet.

Table 1 lists the roundwood needed for the frame. Other parts of the kiosk could also use roundwood; however, for the first two kiosks that were built, only the frame was roundwood. The majority of roundwood is used in the roof and cupola (dome). If severe drying conditions resulting in unacceptable end checking are likely, you will need longer lengths so the ends can be cut off.

<table>
<thead>
<tr>
<th>Section of kiosk</th>
<th>Number</th>
<th>Diameter (inch)</th>
<th>Length (feet)</th>
</tr>
</thead>
<tbody>
<tr>
<td>top chord of truss</td>
<td>8</td>
<td>6</td>
<td>14</td>
</tr>
<tr>
<td>bottom chord of truss</td>
<td>8</td>
<td>5</td>
<td>13</td>
</tr>
<tr>
<td>web member of truss and cupola</td>
<td>16</td>
<td>5</td>
<td>7</td>
</tr>
<tr>
<td>cupola – compression hub</td>
<td>24</td>
<td>5</td>
<td>1</td>
</tr>
<tr>
<td>web member of truss</td>
<td>8</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>top plate - tension ring (plate log)</td>
<td>8</td>
<td>6</td>
<td>10</td>
</tr>
<tr>
<td>columns (poles)</td>
<td>8</td>
<td>6</td>
<td>9</td>
</tr>
</tbody>
</table>

**Foundation**

Permanent foundations include burying treated posts (no walls), which alleviates the need for cross bracing or piers and footings. Beaudette Consulting Engineers will indicate the column diameter required to alleviate braces. For buried posts, gravel (which permits drainage) must be compacted (especially) at ground level to prevent movement. A concrete base is not recommended for buried posts. Concrete tends to keep wood wetter, which increases the need for wood treatment. Temporary foundations present many problems, including applying for building permits and should be considered only in special circumstances e.g. the building will be disassembled and moved.
Floor and Roof
For the kiosks built for the Olympics, Structural Insulated Panels (SIPs) made up the floor and roof. For simplicity, the floor panels rest on laminated veneer beams. The use of SIPs simplified some aspects and reduced the time for final assembly. At 200 to 300 pounds, the SIPs require several people to move and a crane is necessary for installing them on the roof. (Note, a small crane or boom truck is also handy for installing the trusses.) Most structures do not have the need for rapid assembly so less expensive options can be used instead of SIPs. Some options include incorporating roundwood into the floor or pouring concrete for the floor. The roof could be supported with materials other than SIPs, such as purlins, to which sheathing could be applied. The purlins could be roundwood but need to be turned round or have flats cut on them for continuous contact with the sheathing. Sheet 13 shows roof framing using 2 by 8 lumber. Again, Beaudette Consulting Engineers must approve any deviations from the plans before construction begins.

Walls
In addition to framed walls, you may wish to explore using SIPs for the walls.

Connectors
The connectors at the top and bottom of the columns require welding. The top connector was made of several plates of steel (knives).

See the figure to the right. ➔

One knife was inserted into the top of the column, another into the base of the roof truss, and two knives were inserted into the plate logs. The plate log has a high degree of tension and holds the roof trusses in place. The bottom connector uses a large angle iron and threaded rod. Buried columns (treated wood floor or gravel) require only the top connector. To facilitate assembly, these connectors should be as accurate as possible. With a proper set of jigs, the connectors can be reliably accurate. As an alternative, after the plate is fit into the wood, the wood could be drilled and the plate marked with the drill bit for later drilling. The wood and plate could be drilled simultaneously and immediately bolted. The plates are 1/4 or 3/8 in thick depending on the saw you will be using to cut the slots in the wood.
The trusses can be bolted together or, after setting your shop up with a gunpowder-driven nail gun, steel plates (powder-driven mortised plate) could be just as simple. Here steel plates are placed in slots cut in the log and the gun usually used to shoot nails into concrete foundations is used to shoot nails through the wood and plate.

See the figure to the right. →

Here two plates are used because the nails used with powder driven fasteners are usually not that long. When longer nails become available, it may be possible to use only one plate. The smallest charge on the gun we used was able to penetrate the wood and a 1/8 in plate. Larger charges can penetrate 1/4 in plate.

Keys or split rings can increase the shear resistance of bolts, permitting the use of smaller bolts. Coarsely threaded screws and wooden pegs may also have suitable applications. Again, you need approval from Beaudette Consulting Engineers.

For dowel nuts, the dowel should be counter sunk to aid in the rod finding it. The first few threads of the rod should be filed enough to aid starting. A good jig is also necessary for drilling the holes in the log for the dowel nuts. If the longitudinal hole is not centered on the dowel hole center, the dowel will twist (the rod hits the side of the hole in the dowel).

The bottom connection to the cupola meets the truss at a 90° angle so the rod could be made shorter than the top chord. However, if all the holes are placed in the trusses so that all rods are the same length, one size will fit all. With all the rods the same length, the nut can be welded tight (making it a bolt), which also simplifies the process.

**Construction**

It is worthwhile to construct a large (8- by 16-ft) layout and worktable for use during construction. →

Alternatively, a floor to which blocking can be fastened can be used.
The following two photographs show a fancy and simple jig to use for drilling holes for the threaded rod for the dowel nuts. The simple jig shows a threaded rod in it after the drill bit has been removed. The log that will be attached can be drilled at the same time. The old fashion wood drill bit (pointy twist bit) cuts though much faster and easier than will augers or spade bits.

Fancy Jig

Simple Jig

If you have access to turned logs and a large drill press, you should consider using a deep hole saw to cope the members. For steep angles such as the small end of the truss, it is necessary to make more than one pass to complete the cut.

Large Drill Press and Hole Saw

Miter with Key

If you have access to a small sawmill, moveable band saw, or jigs for a chainsaw, you can miter rough or turned logs. In the photograph of a miter, you can see a key, which makes the joint much stronger. Along the length of rough logs, high spots can be knocked off or flats can be sawn. Sawn flats are easier if done prior to making any joints. All measurements are made from an imaginary line in the center of the log. If sawing flats will remove a substantial (more than ½ in. deep) amount, it is advisable to move the measuring point closer to the flat so less material will be removed. In most instances, the top chord of the truss will have two flats sown on the top that are 20° apart. One method to cut the flats is to drill guide holes in the end of the log. Jigs with pegs (put in the holes) hold the log for one cut and the log is rotated 20° for the second cut. If the plate log needs a flat for the top of the wall, the angle between the roof flat and the wall flat is 29°, so the log would need to be rotated 151° between cuts. While in the jigs, the logs can
be marked for future cuts. Other methods to accommodate log variability are worth pursuing to avoid cutting flats, which if overdone will weaken the log.

To the right is a portable sawmill with a jig to cut the miter in a log.

Below left shows how capped logs fit together in the cupola; below right shows rough logs with flats cut on them where two logs meet.
One of the trickier cuts will be at the top of the column where the bottom of the truss and the plate logs meet. Because most of the weight on the column is being transferred from the truss, it is important to provide as much bearing surface as possible for the truss. Although there are several ways to cut this, you should cut away the inside portion of the plate logs so that the truss can rest on that portion of the column. The truss must also bear against the tension plate connector, which is the critical bearing in a tension ring compression hub design.

The column can be coped on the outside for the plate log as shown in the upper right photograph, or flats sawn as shown in the photograph in the lower right.

**Doors and Windows**—Assuming you have walls, normal installation of doors and windows should be completed. There are also openings in the cupola for windows. If there will be no walls, no windows will be necessary in the cupola; however, flashing should be installed so that any wind-blown rain or snow will not enter the structural elements or run down the ceiling. There are several ways to install windows in the cupola, the easiest is to cut sheet acrylic, drill, and screw to the face of the cupola logs. Again, flash to appropriately divert all water.

Questions regarding the construction should be addressed to

Mark Knaebe  
Roundwood Structures Coordinator  
Forest Products Laboratory  
USDA Forest Service  
One Gifford Pinchot Drive  
Madison WI 53705-2398

608-231-9422  
Fax 231-9395  
mknaebe@fs.fed.us  
http://www.fpl.fs.fed.us