The Construction of a Yurt

By Ellisif Fkakkari (Monica Cellio)

The Mongolian *yurt*, or *ger*, is a round, nominally portable, self-supporting structure suitable for camping in comfort. It does not rely on ropes or stakes to hold itself up; rather, the walls, rafters, roof ring, and tensioning bands all work against each other, in a marvel of physics and engineering, to keep the structure standing. It is thus an especially appealing structure for camping events where space is at a premium, such as Pennsic, because all of the space it requires provides useful living space -- no extended ropes are required as they are for pavillions.

SCA campers have also found other useful features that the Mongols must have designed into the structure. A yurt does not even *think* about moving or falling down in a storm; consider, for example, the winds out on the steppes. With a pavillion, the structure is provided by the roof canvas and ropes; if any of these gives, the pavillion comes down. With a yurt, the wooden frame provides the structure and is much more stable. The yurt frame also has a lot of redundancy built in; if a single rafter or piece of wall fails, the structure is not affected.

Because the rafters bear the weight of the roof ring, no center pole is necessary unless the yurt is very large. The Mongols would build their cooking fires in the center of their yurts, opening a smoke hole for the purpose. SCA campers faced with fire restrictions rarely have this option.

Yurts are also remarkably comfortable during the summer heat. Once you get up in the morning, you can open the flap over the roof hole and hike up the walls in 3 or 4 places. This sets up a nice convection current, and the yurt stays relatively cool all day. (Of course, this doesn't work when it's raining...) There were afternoons at Pennsic XXIV when I was more comfortable sitting in the yurt than under a canvas fly, because the yurt had a vent at the top.

For modern (and historical) convenience, the yurt collapses down into pieces no longer than 8 feet. I transport mine on and in my Mazda 323 hatchback, though I did have to install a roof rack for the purpose (much to the amusement of the auto dealer). A minivan would also suffice if you don't want to deal with roof racks.

What They Did

The Mongols are said to have built their yurts from saplings laced together with leather thongs. The rafters might have been either painted or plain. Felt was used for the walls and roof. It is not clear to me how they transported the yurt; the folded walls would be quite a burden for a horse.

The Parts of the Yurt

The key parts of the yurt are as follows:

- The *khana*, or walls. The walls look like giant baby gates; they are criss-crossed lattices that open out or fold flat. Most people build two sections of khana and bolt them together as part of setting the yurt up. Because I'm not quite strong enough to lift half the khana onto my roof rack, I break mine into three pieces.

- The door frame. The ends of the khana are attached to the door frame in some fashion, usually bolted or tied.
- The rafters. Rafters notch into the top of the khana at one end and into the roof ring at the other. (Two rafters are designed to sit on top of the door frame.) Any given rafter bears only a small part of the weight.
- The roof ring. This goes in the center and has slots for rafters to fit into. The fit should be tight to prevent the ring from twisting. Once the ring is in place, you do not need any center supports.
- The *belly bands*. Two bands are wrapped around the outside of the khana to prevent the rafters, which are pushing down, from pressing the khana farther open. One band goes around at the top and one midway up the wall.

There are additional pieces, notably the canvas and the rope that holds the cloth walls up, but they are not structural.

This article describes how to build a yurt that is approximately 16 feet in diameter. While in theory this can be scaled up, I do not know for certain how big you can make a yurt without requiring a center support. (I am told that an engineer determined that you could go as large as 30 feet, but I'm not sure I believe that.)

Materials and Tools

To build a yurt, you will need the following materials and tools:

- Khana: about 8 8-foot 2x4s of good quality and a table saw, *or* 70 8-foot lathes, 1/4 inch thick by 1.5 inches wide. About 300 1.25-inch carriage screws, 300 washers, 24 (or 48) wing nuts, and 250 hex nuts. A drill, ideally with a drill press. A hex wrench.
- Door frame: 2 10-foot 2x4s or 3 8-foot 2x4s (there'll be waste). 4 bolts long enough to go through a 2x4 in the wider direction, plus washers and nuts, or leather and nails to make hinges. A saw.
- Rafters: 24 to 36 1x3 firring strips, of the best quality you can find. (Firring strips are cheap lumber and you'll have to pick through the pile to find ones that aren't completely scrungy.) A jig saw and drill. Sandpaper. Optionally a power sander. (The number depends on how many rafters you want, which in turn depends on how cautious you're feeling. I used 30 at Pennsic XXIV.)
- Roof ring: 1 sheet of 3/4-inch plywood. The grade doesn't really matter, but if the top isn't finished you'll need to sand it to keep it from chewing up your roof canvas. The scraps from your rafters. 2 gross (288) of drywall screws. A power screwdriver or an appropriate drill bit. A saw to cut the plywood. Optionally, some scrap lathes.
- Temporary support: 2 8-foot 2x2s or 1 8-foot 2x4 and a table saw. The scraps from your door frame, or other scrap lumber. A few nails.
- Belly bands: 2 nylon or other non-stretch, strong straps, 50 feet long by at least 1 inch wide. I got mine at an Army-Navy store.
- About 120 feet of 1/4-inch rope (not cotton).

- A few dozen S-hooks. (The 2-inch size works well for hanging walls; you may want a few large ones for securing the door curtain.)
- 4 stakes. (These are to hold the flap that covers the smoke hole.)

Note that all of this lumber will weigh in the vicinity of 100-150 pounds. If you transport it on a roof rack, make sure it's a real roof rack and not a "ski rack"; the latter will probably buckle under the weight.

I bought my canvas pre-made. The canvas for my yurt comes in the following pieces; there are many other ways to design the roof canvas, but this is the simplest to implement:

- Wall: 50 feet long, 6 feet high, with grommets along the length of one side every 2 feet or so. (There are also 3 grommets along each short side.)
- Roof: a 20x20 square with a 2x2 square cut out of the center. The edges of the hole are heavily reinforced. There is one grommet in each outside corner.
- Roof hole cover: a 4x4 square with grommets in the corners.
- Door curtain: 6 feet high by 4 feet wide, with grommets down each side and across the top (every foot or so).

My roof comes down to the ground in the corners and has to be staked down there. Some people have built roofs that are circular and conical, and these do not require staking. Other people run a roughly foot-wide band of cloth around the outside, at the top, over the wall, to hold the descending roof canvas down. I'm not enough of a pattern drafter to be able to tell you how to do a fitted roof, however. (Note, by the way, that my roof is not under any tension.)

The Khana

For the khana, you want to end up with a large number of lathe boards. You can buy them, but where I live they're outrageously expensive (40 to 60 cents per linear foot). Here, it's actually cheaper to buy 2x4s and the table saw to cut them down, and then throw the table saw away when you're done. (I was able to save myself that expense by using a friend's radial arm saw, which worked almost as well. We didn't break any blades, but we had to let the saw cool down after every 10-12 cuts.) We managed to get about 9 lathes out of each 2x4 on average (sometimes 10, sometimes only 8). Remember, in planning for this, that the saw blade has thickness, and that all the sawdust has to come from somewhere.

Each lathe needs to be drilled every foot, offset by 3 inches. That is, counting from one end, you have holes at 3", 15", 27", 39", and so on. (You should have 9 inches of lathe left after the last hole.) If you are cutting your own lathes and you have a drill bit long enough to go through a 2x4 in the 4" direction, I strongly recommend drilling the 2x4s *before* cutting them. (A drill press helps a lot for this.) Otherwise, you have to clamp the lathes together, hope nothing slips, and do a lot of extra work to drill the holes.

Once you have a pile of lathe boards, you start bolting them together into a lattice. Make sure that all pieces going in one direction are on top and all pieces in the other direction are on the bottom; you do *not* want any interlacing or weaving. (This will prevent you from being able to fold the khana.)

To apply a bolt, push the bolt through both pieces of lathe (with all the heads ending up on the same side), put the washer and nut on the other side, use the wrench to pull the head as far in as it will go, and then loosen the nut by half a turn. The last step is very important; you need to be

able to move the lattices, but you also need to make sure the head of the screw is firmly seated so it can't fall out. (An advantage of carriage screws is that they effectively have the washer built in on the head side.) And, of course, you don't want the nuts to be so loose that they fall off.

You can actually make the khana with 1-inch bolts instead of 1.25-inch ones if you want to; you have just enough room to make everything fit. One of the small benefits of a yurt, though, is that you have 100+ convenient coat hooks; I used the longer bolts so I would be able to hang clothes, my cloak, hats, my drum, towels, my drinking horn, and so on from them.

The ends of the khana that adjoin the door need to be straight. This means that the last few pieces on each end will not be full-length; because you will have this problem on both ends, you can cut down some lathes to make these pieces with very little waste. (See Figure 1.)

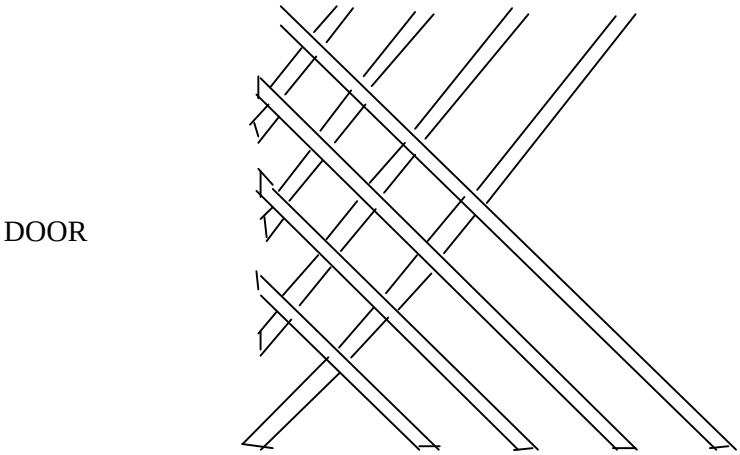

Figure 1: One end of the khana.

You will need to break the khana into at least 2 sections for transport. To do this, pick a point approximately in the middle, remove the nuts and washers, and push the bolts out from the inside layer of wood, leaving them embedded in the outside layer. (When you assemble the yurt, you will probably want to fasten these joints together with wing nuts, which you can tighten with your bare hands.) See Figure 2 for a diagram of how the wall comes apart into sections.

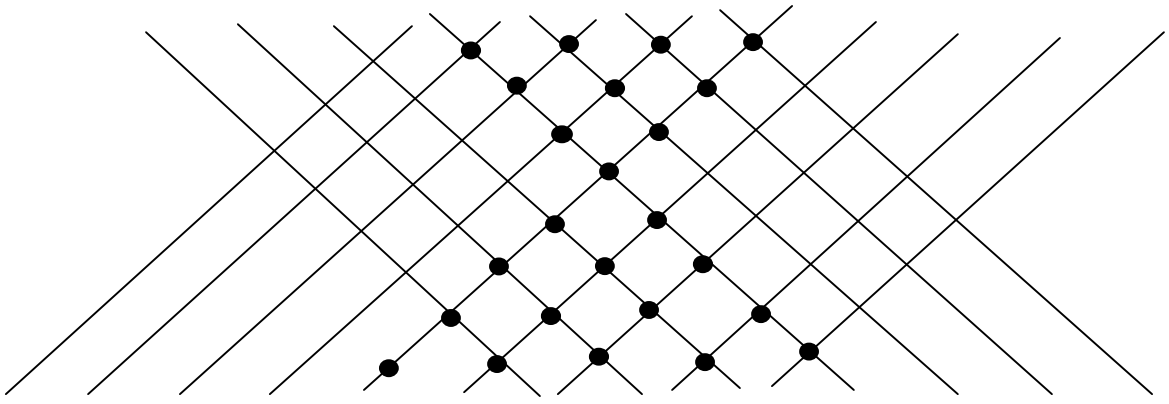

Figure 2: Location of bolts to remove (to separate khana).

Be careful when folding, unfolding, and carrying the khana. Make sure you lift it slightly off the ground before folding or unfolding. While the overall structure is very strong, each individual lathe is fairly weak. (The good news, however, is that the weight is distributed so well that you can even replace a broken lathe while the yurt is standing, and it's ok to have 3 or 4 broken lathes if they aren't all next to each other.) It's generally a good idea to keep a few spare lathes on hand for repairs.

Making the khana is perhaps the most tedius part of constructing a yurt. Don't be discouraged that it's taking a long time to insert all the bolts. You only have to do it once, for the most part.

The Door Frame

There are many ways to make a door. I've seen frames that are tied to the khana, frames that are bolted to the khana, frames that have slots for the ends of the khana to slide into, and actual doors (not curtains). You may come up with something you like better, but what I'll describe is the basic tied-in door frame.

You need 2 pieces of 2x4 that are 6 feet long and 2 that are 3 feet long. Cut tabs in the short pieces and notches in the long pieces, as shown in Figure 3. When you put the pieces together, you'll get a door frame that's 6x3 (and 4 inches deep).

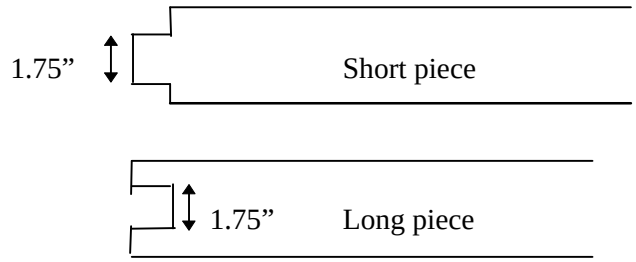

Figure 3: Notches for door frame.

My door frame has leather hinges. That is, there are sturdy pieces of leather nailed to the outside of the frame, with a "latch" at one corner. This allows me to unfold the frame while keeping it in one (long) piece; I can then fold this piece and toss it on the roof rack.

You might, instead, prefer a frame that you can take entirely apart. The easiest way to do this is to drill holes through the 4 joints (in the 4-inch direction) and put a bolt in each one. This should also make for a sturdier frame, as leather can loosen over time. (You could use metal hinges instead of leather to solve that problem, I suppose.)

The important thing is that you end up with a sturdy frame. It's going to be under tension from 3 directions, so you want to make sure it will hold.

The Rafters

The rafters hold up the roof ring. Each rafter hooks over the khana at one end and slides into the ring at the other. The number of rafters you need depends on how cautious you want to be and how many slots you manage to fit into your roof ring (see next section). It's a good idea to cut a few spare rafters; I've found that a couple of mine have bowed when I didn't have them exactly straight into the roof ring, and it's nice to be able to replace them easily.

Figure 4 shows what a single rafter looks like.

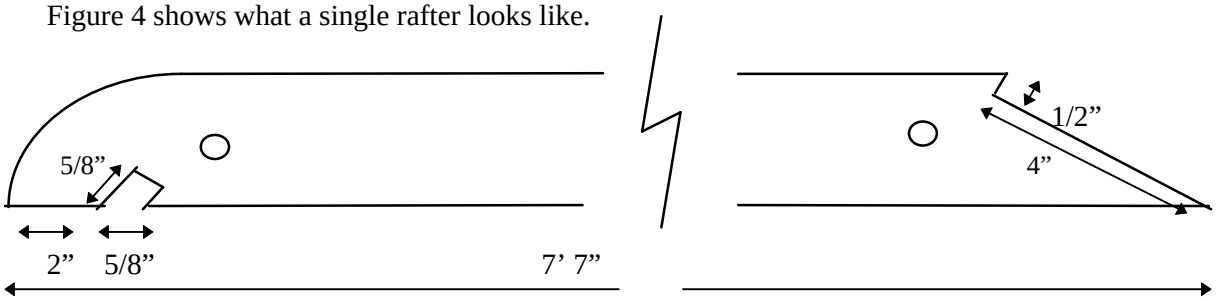

Figure 4: Rafter layout.

For ease of cutting, I recommend screwing 4-6 1x3s together and cutting them as a group. You can then remove the screws. This is much faster than cutting each rafter individually. A jig saw works well for cutting the rafters. For the notch, you may find it easier to make the two parallel cuts and just use an old screwdriver to break out the pieces.

The holes shown in Figure 4 need to be large enough for a rope to pass through. A 5/16-inch drill bit would probably work, though it would be snug; a 3/8-inch bit should provide plenty of room. You will note that the positions of the holes are not shown precisely; the left one should be within an inch or so of the notch and closer to the bottom edge; the right one should be 1-2 inches from the angled cut and closer to the top edge. Precision is not that important here -- but read through *all* of this article, including the setup instructions, before cutting the rafters so you understand the function of the holes.

The rounded outer edge of the rafter (at the khana end) should be sanded; your roof canvas will be pulled over this, and you don't want to cause wear on it. If the top edge of the rafter has any rough spots or splinters, you should also sand them. Other sanding may be called for depending on your tolerance for the occasional splinter. Do not sand the sides of the board at the end that will be inserted into the roof ring; it is important not to change the thickness of the board at that point.

For two of your rafters, instead of cutting the khana end as shown in Figure 4, use the cut shown in Figure 5. These rafters will rest on top of your door frame.

Figure 5: The outer end for the door-frame rafters (make a 90-degree angle).

Save the scraps from the rafters to make the roof ring.

The Roof Ring

The roof ring will require some fussing, but it's worth the time to do it right the first time. (Trust me. We've made two.)

The ring consists of two rings of plywood separated by pieces of 1x3. It looks sort of like a large wooden doughnut, 30" across and 4" high.

Start by drawing two 30-inch (diameter) circles on the plywood. In the center of each, draw a concentric 26-inch circle. Cut these out. You should now have two rings of plywood, each 4 inches from outside to inside edges.

Take 3 pieces of scrap 1x3. (Two should be 4 inches long; the third can be longer as it's only a spacer.) Take one of the plywood rings and position the 3 pieces of 1x3 together under it, such that the center piece (the spacer) points straight out. (See Figure 6.) You'll probably want to use some other 1x3 scraps to hold the ring up so it's level. Check the 3 pieces to make sure they're right up against each other (no gaps), and when you are satisfied, apply 2 drywall screws to each of the outer pieces (see Figure 7). Slide the spacer in and out a bit to make sure it can move. You can now remove the spacer.

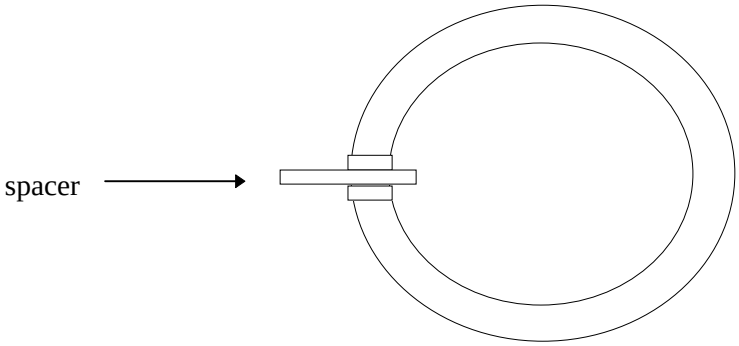

Figure 6: Positioning the 1x3 pieces and spacer.

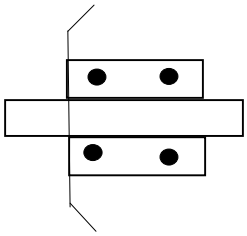

Figure 7: Positioning the screws.

You have just created a slot into which one rafter will fit snugly. Now do the same thing on the opposite side of the ring. (That is, create another slot 180 degrees away from the first one -- not on the other side of the piece of plywood.)

Now you have two starting points. Pick one and place 2 more pieces plus the spacer as close as you can to the existing slot, while still allowing the spacer to point straight out from the center of the ring. Screw the pieces in, and then proceed to the next position. As you add slots, you will find that the inner ends are generally right up against each other, while there are gaps between the outer edges. (It's like the spokes of a wheel.) This is normal; do not try to fill in those extra spaces between slots in the front. All rafters must point directly toward the center of the ring. Figure 8 shows a roof ring in progress.

Continue to place slots around the ring until you run out of room. Depending on luck and skill, you should be able to place somewhere between 30 and 36 slots in the ring. (You could get more

in by filing down the 1x3 pieces, as shown in Figure 9, but I do not think it's worth it. 30 rafters will be plenty.)

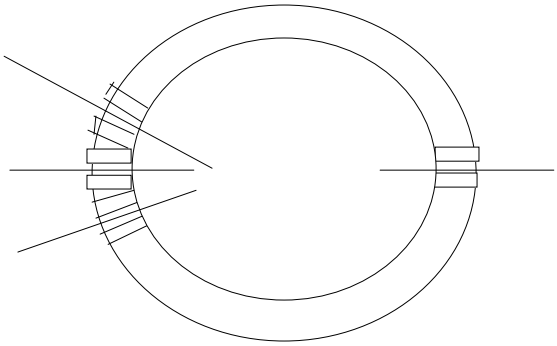

Figure 8: Adding more slots (longer lines show where rafters go).

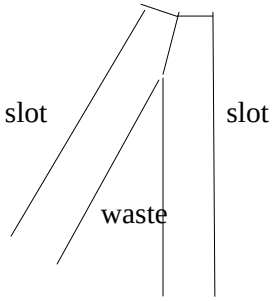

Figure 9: Shaving edges to pack in a few more slots (optional!).

Once you have attached all the spacers to one of the plywood rings, turn the ring over (so the plywood is on the bottom), position the other ring on top, and screw it together.

Note: you will find a drill with a screwdriver bit *very* helpful in construction of the roof ring.

Once you have completed the ring, drill two holes in one side, opposite each other. These are the holes for the center support (used during erection). See Figure 10.

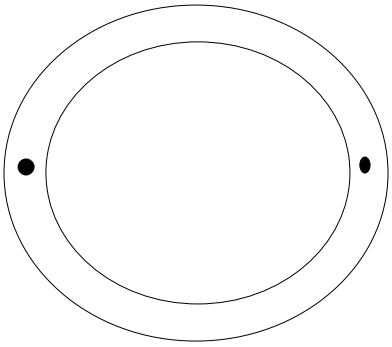

Figure 10: Positioning of support holes (ring viewed from bottom).

Make sure the plywood on the side opposite from where you drilled the holes is smooth. If the surface is rough, sand it to avoid wear on your canvas. You don't need to sand any of the other

surfaces of the ring, though you might want to sand the outside edges (plywood and 1x3s) to make the ring easier to handle.

You might want to cover the inside edge of the ring in some way, to prevent rafters from trying to push through. You can use scrap lathe for this. This is an optional step.

Another optional step depends on how you're going to be transporting the ring. You will note that when the yurt is set up, you will have a flat spot in the middle of the roof that's 2.5 feet across, and that is mostly not covered by wood. Rain will tend to collect on the canvas in the center of the ring. So far I haven't had any problems due to this, but you might want to find some way to create a "dome" in the center of your ring. One way to do this is to take some scrap lathe and form an "X" on the inside of the ring (see Figure 11). This will create a dome that prevents water from pooling.

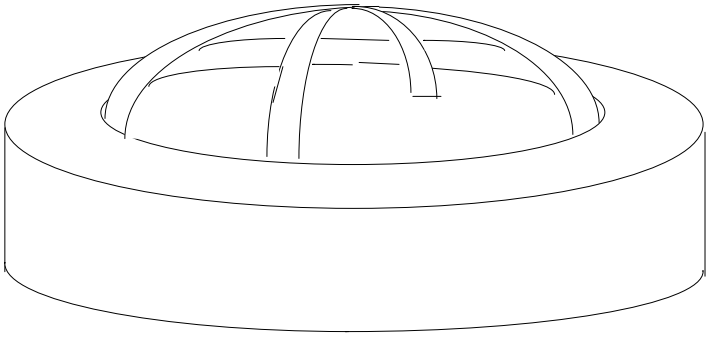

Figure 11: A domed roof ring (optional).

The Temporary Support

The job of the temporary support is to hold up the roof ring until you've inserted enough rafters that the configuration is stable. You will need 2 8-foot poles with nails in the ends, two cross-beams that are a little shorter than your roof ring is wide, and the means to attach the latter to the former. You can nail it all together to look like an "H" with two cross-beams, but this can be a little awkward to pack. Mine has leather hinges that allow the contraption to be folded.

During erection, the nails in the top of the support slide into the 2 holes you drilled in the bottom of the roof ring, and one person stands in the middle of the yurt holding this up while other people insert rafters (see Figure 12).

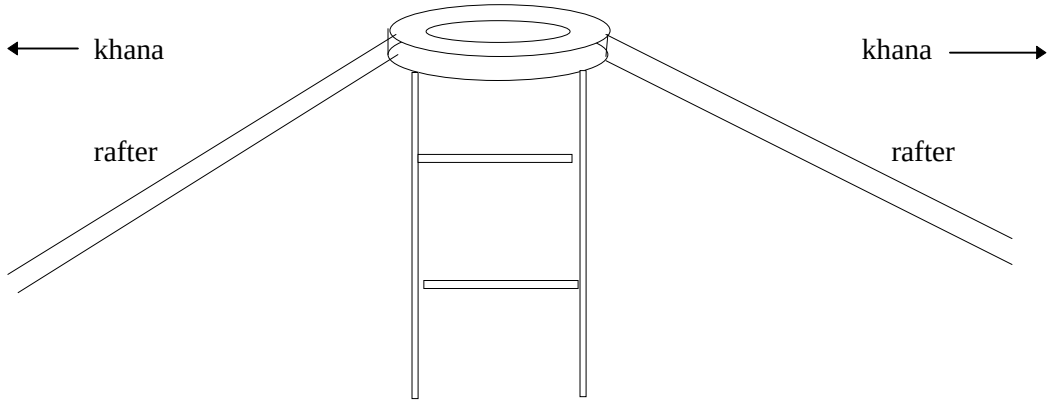

Figure 12: The center support.

Putting It Together

The first time you put your yurt up, plan to spend a few hours on it. It *will* get easier once you've done it once or twice!

Putting up a yurt works best if you have at least three people, though two can do most of it if they have to. While at least one person I've heard of has built "support gear" to enable him to set his up all by himself, I don't recommend this at first.

Here are the basic steps to putting up a yurt:

1. Find a good stretch of ground and spread out the khana. (You'll need about 50 feet.) You want all the angles to be 90 degrees (so each section of criss-cross is a square and not elongated). Overlap the two sections and bolt them together as described in the section on construction. While you're doing this, inspect your khana for cracks, and mark any pieces that might need to be replaced. Hairline cracks that haven't spread very far can be patched by wrapping duct tape around the lathe. (This also serves as a visible marker so you'll know which ones to replace later.)
2. Stand the khana up in a straight line. Be careful not to crack the bottoms of the lathes! This is best done with three or four people taking up positions along the length. Go slowly.
3. Walk the khana into a circular shape, leaving a gap of two or three feet between the ends, with the ends of the bolts pointing into the circle and the heads on the outside. This is very much a process of successive approximation; get it approximately round/oval first and then walk around it and fix specific areas. Also make sure that your angles continue to be 90 degrees, and that the height is even. (I walk around the inside and spot-check the height of the top bolts against my own height.)
4. Attach the door frame. My door frame is tied to the khana (using more rope than is probably necessary, but better safe than sorry); some people bolt theirs. See the discussion in the section on constructing the door frame for more comments on this. Whatever you do, make sure the door frame is *tightly* attached. A door represents an inherent weak spot in the design.
5. Attach your belly bands. Each band should be tied onto the door frame, walked around the outside of the yurt maintaining an even height, and tied to the other side of the door frame. Use a knot for which you can adjust the tension, as you're going to fuss with these a lot. One belly band goes around the top (over the heads of the top-most bolts), and the other goes halfway down the wall. The belly bands keep the khana from spreading farther out. See Figure 13.
6. Verify that your khana is still maintaining an appropriate shape and height. If you have to make any adjustments, tighten the bands again.
7. Now you're ready for the roof ring. Take your center support and slide the nails into the holes in the bottom of the ring. Stand the supports up in the approximate center of the yurt. (You'll have to guess.) The person holding the center support needs to be able to keep it vertical (so the ring remains horizontal) and needs to pay attention to what's going on because of the occasional falling rafter.
8. While one person is holding the ring up, other people insert the first 4-6 rafters (see Figure 12), evenly spaced around the yurt. (Start with one, then the one opposite it, then the ones between them, and so on.) The easiest way to insert a rafter is to stand outside the yurt, lift

the rafter over the top of the khana at an intersection, push the angled end of the rafter into one of the slots in the roof ring, and then set the end you're holding onto the khana and push the notch over the top intersection. If you find that some rafters aren't quite fitting and some are trying to fall out, it means the ring isn't quite centered and needs to be moved. Be very careful when moving a "loaded" ring; falling rafters hurt! (When I'm the one holding the ring, I try to keep my head directly under the center of the ring, so I'll take any falling rafters on the shoulders instead of in the head.)

9. After you've put several rafters in (about 8 in my experience, but it varies), the ring will lift up enough that the center support is no longer needed. At this point walk the support out and put the rest of the rafters in. You don't need all the rafters, but the more you put in the flatter your canvas will lie (reducing the number of places where rain can pool) and the more secure you'll feel. At Pennsic XXIV we used 30; we will probably go down to 24 or so next time. I've seen yurts that used as few as 11, but I don't recommend that for a first time.

10. Now that there's real downward pressure trying to push the khana farther out, you'll need to adjust the belly bands again.

11. After all the rafters are in, tie a rope to the top of the door frame on one side, run it through the holes in the ends of the rafters, and tie it off on the other side of the door frame. (If your door curtain has grommets in the top, you'll want to leave a few extra feet of rope at this point so you'll be able to thread the curtain.)

12. For extra security, run a rope through the holes in the rafters next to the roof ring. This prevents any rafter from moving more than an inch or two (depending on how close to the ring you got the holes). It isn't necessary, but it's comforting. (You'll need to stand on a chair to reach the ring.)

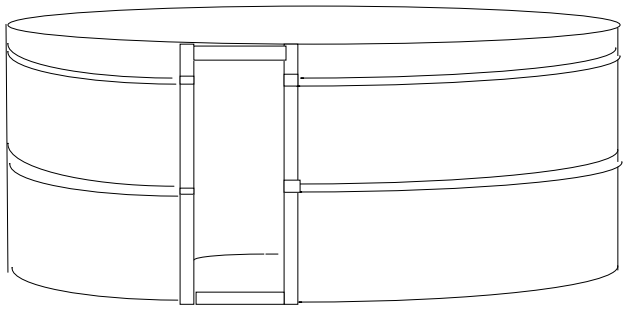

Figure 13: Positioning of belly bands on khans.

The structural parts are now done. Now you just need to deal with the canvas:

1. Attach the wall by unfolding it around the outside of the yurt and attaching it with S-hooks to the rope that's running through the rafters. If the grommets fall too close to the top intersection of the khana in a few places, don't worry about it and just skip those grommets. If it happens a lot, adjust the position of the wall by a few inches. You should have enough wall left over to wrap around the door frame and into the yurt on each end. Later you can use some scrap rope to tie off the center and bottom grommets on each end if you like. (Just attach them to a convenient section of khana.) You can attach the inside top corners to the rafter rope with S-hooks.

2. Pull the roof canvas over the top. (This is easier said than done, because the canvas is heavy.) This works best with 3 people -- two on the leading corners and one person inside the yurt with a pole (such as a spare rafter) to guide the center of the leading edge. Go slowly and be careful of the center hole, which can easily catch on the ends of the rafters.

3. Attach your door curtain. If you have grommets in the top, take the excess rope from the rafters, run the curtain through it, and tie the rope off on the other side of the door frame. If you have some other method of hanging your door curtain, use it. You might want to get a couple of large S-hooks so you can hook the sides of the curtain to the khana during high winds, to keep the curtain from blowing inward and letting in rain. I have a couple of roughly 5-inch (hand-forged) hooks that I use for this purpose; large hooks are easy to manipulate from the outside of the yurt. Someone in Moritu has a door curtain that drags the grouns by a foot or so, and just keeps a piece of 2x4 on hand to hold it down.

4. Take the smoke-hole cover, tie a 15-foot rope to each corner, and drag it across the top of the yurt (this works best with two people, one to pull each leading rope). Check its position from the inside, and when it's centered, tie the ropes tightly to stakes. To open the flap, loosen two of the ropes and drag the flap a few feet down one side.

Congratulations, you now have a yurt!

What To Do When Something Goes Wrong

Nothing ever goes perfectly the first time, so here are some hints on how to solve specific problems. (I welcome additional problems, with solutions if you have them.)

The roof ring isn't horizontal during setup; it's tilting to one side.

This sometimes happens in putting the yurt up, especially on uneven ground. If you don't do something about it, the roof ring will corkscrew and all the rafters will fall out. It is important for the person holding the center support to keep it vertical, but the ring can still shift after the center support has dropped out.

There are two ways to approach this, depending on how bad the tilt is, how many rafters are already in, and how brave you're feeling. You should first try to push up on the lower side of the ring (with a spare rafter or the center support) and see if that causes it to settle into a better position. If that doesn't work, and you're feeling brave, you can toss a rope up through the center of the ring and out on the *high* side, take both ends of the rope, and pull down gently. (There's nothing quite so scary as standing under a loaded roof ring and pulling it *toward* you, but this does work.)

Some of the rafters are bowed.

This usually means that you're trying to force a rafter onto a part of the khana where it doesn't want to be. Try moving it one position to the left or right. If you're having this problem a lot, you might need to rotate your ring slightly.

Everything creaks and groans and makes scary noises over the course of the first day.

Relax; that's normal. It's sort of like a house settling. Inspect your rafters to make sure nothing is bowing badly, and inspect the khana to make sure a section isn't being pushed way back at the top (which may mean you need to tighten the top belly band). But if all that looks ok, you should be fine.

Some of the khana is bent outward a lot at the top.

Your top belly band might need to be tightened. Once the yurt is set up, make adjustments to the belly bands only with great care; if you release tension on them or pull too hard too suddenly, everything could come tumbling down. (This is why you want to tie a knot that can be slid to tighten, rather than tying a knot that you'd have to untie to adjust.)

Accessories

Now that you have a yurt, you have a world of possibilities in the area of add-ons. You'll probably find yourself making additions and changes every year.

One obvious feature is that you have many, many places to hang things. In addition to the pegs provided by the bolts, you can hang clothes (on hangers) by hooking the hanger over any intersection on the khana. You no longer need a clothes rack. (Alternatively, you could experiment with a clothes rack that is anchored on one end at the khana and at the other by a free-standing pole, so your rack is perpendicular to the wall.)

The yurt is large enough that you can curtain off a private section and still have plenty of room in which to entertain guests. Because we aren't allowed to have open flames (let alone campfires) inside structures at Pennsic, I spread carpets over the floor. (Pillows and cushions are an obvious addition, if you do a lot of entertaining.) If you install a cross beam in your roof ring, you can hang a light from the center of the ceiling.

S-hooks are your friends; they hook over the khana and can hold up all sorts of things.

For Pennsic XXV, I'm thinking of building shelves. The basic idea is that a shelf will be approximately 1.4 feet long (the diagonal of one square on the knana), and the back corners will have hooks that are spaced to go over 2 khana intersections. In the front corners will be cords or light chains with S-hooks on the ends. These hooks are then attached to the khana directly above the intersections holding the shelf back. (See Figure 14.) I wouldn't recommend putting anything heavy, like books, on such a shelf, but it seems like it could be a great way to store clothing that has to be folded, jewelry, and miscellaneous small items. I'm not sure if a shelf twice as long could be safely used, but I may try one.

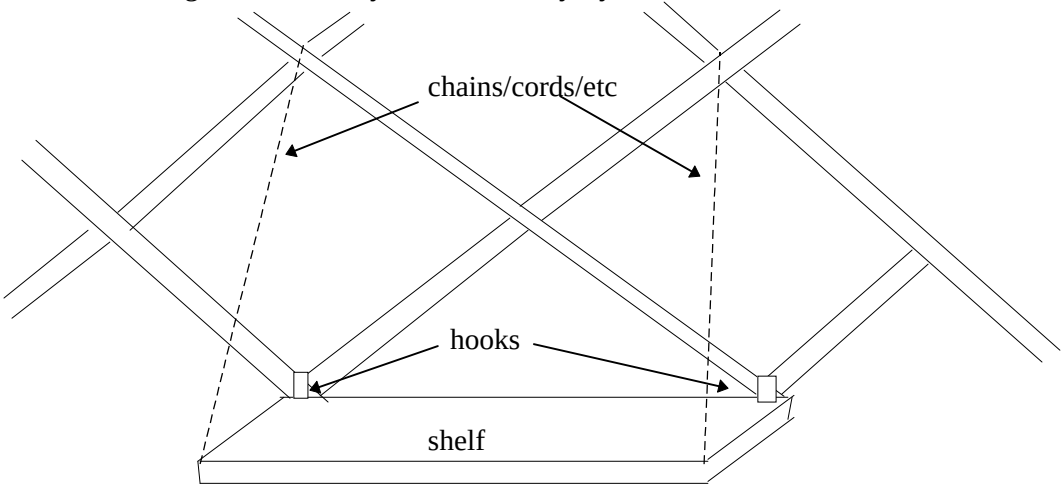

Figure 14: A khana-supported shelf.

Packing the Roof Rack

I pack my roof rack in the following order:

First layer: rafters, standing on their edges (so they're 3 inches high).

Second layer: khana, bolt heads down, one layer per khana section.

Third layer: door frame and center support, to the sides of the khana; carpets on top of the khana. (The carpets help hold the khana down and protect it a little more.)

The canvas and roof ring go inside the car, as does the bag containing the wing nuts, S-hooks, ropes, stakes, wrench, and miscellaneous items like seam-sealer.

Remember when tying stuff onto your roof rack to wrap and tie down the front of the pile. The khana is light enough that the wind produced by driving at even moderate speeds can otherwise cause it to bend up and break. And if you don't know how to tie a diamond hitch, ask someone to show you. It may seem paranoid, but it would be a *real* pain to have to re-make the khana because it wiggled loose!

Acknowledgements

I am not a carpenter. I am also not an expert on things Mongolian. I learned about yurts from Todric and Bakshi of the Moritu, who were gracious enough to take me on a yurt tour at Pennsic XXII and explain in general terms how they work. I built my yurt from a set of plans by Ino Ogami, who based his plans on ones written by Todric. (My Ogami plans were casualties of the construction process, so I no longer have them to refer to.)

Johan von Traubenburg provided tools, carpentry knowledge, the difficult cuts,. and the realization that it was cheaper to cut our own lathes; he also helped with the first couple setups while we figured out how to debug it. Johan and Dani of the Seven Wells did a large amount of the construction work, which was especially nice because I prefer to remain far away from large power saws.

I would also like to thank Haraldr Bassi, who bravely attempted to build a yurt from a previous, informal instantiation of my description, and got much farther than I would have thought possible without diagrams.

I welcome feedback on this article, especially from people who actually build from it.

About the Author

Ellisif Flakkari is a tenth-century Dane who likes to camp in comfort. Monica Cellio (7634 Westmoreland Avenue, Pittsburgh, PA 15218, mjc@telerama.lm.com) has far too much crap to fit in a proper Viking A-frame tent for 2 weeks at Pennsic, and wouldn't be able to transport 15-foot poles anyway.

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