

Yurt Without Steel

by [TimAnderson](#) on January 18, 2008

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Author: **PRO** [TimAnderson](#) [author's website](#)

Tim Anderson is the author of the "Heirloom Technology" column in Make Magazine. He is co-founder of [www.zcorp.com](#), manufacturers of "3D Printer" output devices. His detailed drawings of traditional Pacific Island sailing canoes are at <http://www.mit.edu/people/robot>.

Tim's philosophy involves building minimum-consumption personal infrastructure from recycled scavenged materials. Redirecting the waste stream. Doing much with little. A reverse peace-corps to learn from poor people all over the world.

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Intro: Yurt Without Steel

I built this 10 foot diameter yurt without metal fasteners from free materials. It has the same proportions as the "standard" Mongolian ger scaled down. The varnished wood and white liner give it a marvelous feeling inside. Lots of people told me this was the best shelter they'd seen at Burningman.

("Yurt" is the Russian word. "Ger" is the Mongolian)

Most of the wooden parts are sawed from the slats of a futon couch.
The wall lattice pivots are knotted cord.
The door frame is made from hockey sticks.
The smoke ring is an aluminum bicycle rim.

At Burning Man I set the yurt up on top of my truck's lumber rack on a platform of redwood boards. That enabled us to drive around and move camp easily. In the first photo it's just been set up. In the later ones it's been through some 70 mph dust storms. We've sealed it up and tied it down much more securely.

In the next photo Pete and **Leslie** take shelter in the Yurt during a dust storm.

During a break in the dust storms there's some rain. **Star** stands on the tailgate "balcony" to soak up the happiness from a huge double rainbow.

Billy likes the dust. He's out in an easy chair reveling in it.





step 1: Yurt Frame Parts

Here are the complete parts of the yurt frame laid out.
From left to right and top to bottom they are:

1. Two rafters which have longer strings at the wall end to tie them to the top of the doorframe.
2. The bundle of the other 30 rafters. These are all the same, 3/4" rods with a loop of cord at the wall end and a short taper down to 9/16" at the hoop end.
3. The wall lattice. This is a small yurt so there's a single wall lattice with thirty tops. At the top the sticks are whittled into a "thumb" shape to insert in the rafter loops. There are 30 "heads" or peaks to the lattice.
Where the lattice sticks cross cords are inserted in holes and knotted for pivots. This is done at crossings 1,2,4,6,7. Crossings 3 and 5 have no pivot cords.
4. The door frame. It's a trapezoid of ash hockey stick pieces that fit together with mortise-and-tenon joints. A rectangle would have been just as good a door, easier to make and set up.
5. Smoke ring. This is the hub of the wheel that is the roof. It's an aluminum bicycle wheel with 32 evenly spaced holes drilled into it at a downward angle.
6. Shoulder cord. Circles the wall lattice at the top to keep it from spreading outward while setting up.
7. Umbrella cover for smoke ring hole. It's a silvered parasol of the type Chinese women use instead of sunscreen lotion.
8. Shoulder Band. Circles yurt where the rafters meet the wall lattice. Makes this area smooth rather than bumpy and keeps the sticks from poking holes in the yurt covering.
9. Bicycle innertube. Tie the ends of the wall lattice to the sides of the door frame with this.



Image Notes

1. 30 identical rafters
2. Two rafters with shoestrings to tie them to the top of the doorframe
3. thumbs to hook rafter loops over

4. knotted cord pivots at intersections
5. loops of cord to hook over top of wall lattice
6. door frame
7. smoke ring
8. shoulder cord
9. shoulder band
10. umbrella
11. bicycle innertube to tie wall lattice to door frame

step 2: Scavenge Lumber

My lumber came from a discarded futon couch frame like this.

I ripped it lengthwise for the lattice sticks and rafters. I used a thin blade on my little tablesaw to not waste wood.

I was totally thrilled to think I could build a house from a couch. And the house would be plenty big enough to put the same kind of couch inside.



step 3: Smoke Ring

The smoke ring is an aluminum 26" bicycle rim from a mountain bike.

"Standards" being what they are, the inner diameter of the rim is 23.5" and the outer diameter is 25".

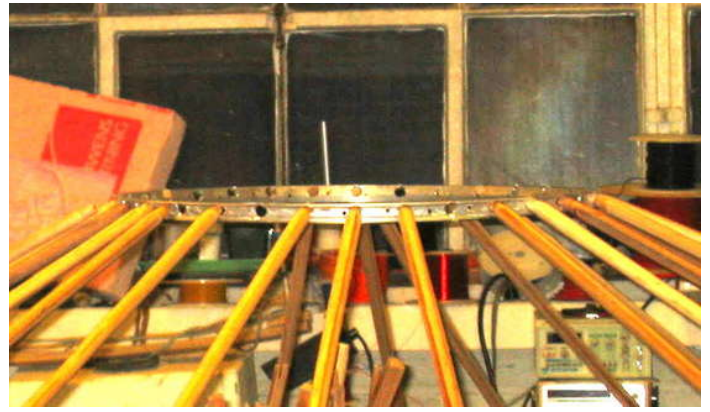
It was hard to get the 32 holes evenly spaced. It had 36 spokes originally, so the rafter holes lined up randomly with the spoke holes. I drilled small pilot holes with a center drill first. Then I rested the rim in a wooden vee block to drill the holes big with a drillpress.

I drilled the holes at a 26 degree downward angle for the slope of the roof.

I also cut an alternative roof ring from the top of a heavy plastic barrel, but this one is much nicer.

In this shot Billy removes the rafters from the roof ring while we wait in traffic out of Burningman.





step 4: Rafters

The rafters are 53.25" long. I ripped them 3/4" square on my little table saw with my skinniest blade.

Then I rounded them with four passes of a quarter-round router bit.

I did that using an improvised router table, screwing the router to the underside of a board with a hole in it for the bit. That work made a lot of sawdust and noise. Octagonal would have been fine. Square with blunt edges would have been fine also.

Then I moved the fence and used the same router table to taper the end down to 9/16" to insert in the holes in the smoke ring.

Then I drilled two 1/8" holes in the other end of the rafter and added a loop of cord through the two holes. I tied the loop over a lattice stick to get it the right size. I melted the ends to blobs to keep the knots from sliding off. When I varnished the whole thing I varnished the loop also.



step 5: Wall Lattice Head End

Here's what the top edge of the wall lattice looks like.

It has 30 "heads" or peaks, one for each of 30 rafters. Two other rafters rest on the doorframe.

The sticks are 53.25" long, same as the rafters. They are 3/8" thick and 3/4" wide. Mine are hardwood because that's the straightest grain stuff I could scavenge. They're stronger than they need to be. They could be softwood like the Mongolians use.

If anyone is curious I'll dig out the dimensions and hole spacing of a standard Mongolian lattice stick. They're standardized so ger parts can be interchangeable. Okay, someone asked, so they're at the bottom of the page.

My knotted pivot cords are spaced 8" apart. I skipped the two pivots on either side of the middle on each stick. The tip of the stick is 2.25" beyond the top pivot and the bottom extends 3" below the bottom pivot. $(6 \times 8") + 2.25" + 3" = 53"$!

If you want your walls to be wider at the bottom, make the hole spacing wider at the bottom there and narrower at the top.

I melted and squished the end of a nylon cord into a sort of needle to make it easier to thread through the holes in the sticks. I pulled the knots tight with a hemostat and needlenose pliers. I used wet cord because nylon shrinks when it dries. I got blisters from pulling those hundreds of knots tight.

I tried lots of ways of whittling the thumbs.

I ended up doing most of them with a small beltsander clamped to a bench. I manipulated the stick over the round end of the beltsander to carve the waist of the thumb.

[Mongolian wall lattice stick dimensions, from "The Complete Yurt Handbook" by Paul King:]

The stick is 82.5" long. The knotted pivot cords are spaced 7" apart. There would be a dozen holes for pivot cords, but they skip pivots #3, #5, #7 counting up from the bottom. The tip of the stick extends 2.5" above the top pivot and the bottom extends 3" below the bottom pivot. $(11 \times 7") + 2.5" + 3" = 82.5"$

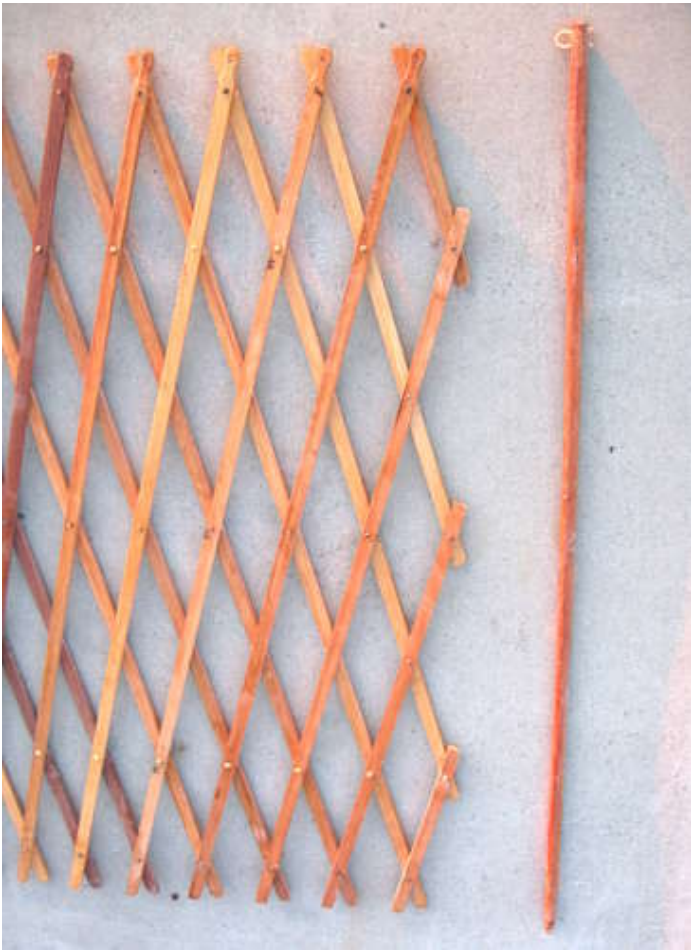


step 6: Wall Lattice Edges

The outer edges of the lattice are truncated, assembled from shorter sticks. It's a bit difficult to figure out. To avoid thinking I planned to make my lattice "infinitely long" and then cut it down at the sides. But that would have wasted many sticks.

The outer edges of the lattice fall on crossings 2,4, and 6. The two outer edges are mirror images of each other.

I thought maybe I'd make three more of these wall sections and stack them horizontally and vertically to make a big yurt. Some Afghani yurts are made that way.



step 7: Door Frame

The door frame is made from chunks of ash hockey sticks.

They fit together with mortise-and-tenon joints.

I rounded the protruding ends at the top so as to not poke through the cover.

I made my door frame a trapezoid shape because I had a theory about making the base of the wall wider than its top. That was an unnecessary complication.

Make yours rectangular. Then there's no left-right-top-bottom problem.

The inside dimensions of the assembled frame are 24" wide at the top and 40" vertical.

The sticks are 1" wide and 3/4" thick.



step 8: White Liner

The Mongols put a liner in their ger, so I thought I'd try it. The varnished wood frame looks really good against the white cloth.

ROOF LINER

It took some trigonometry to figure out the pattern for the roof covering. The wall is 10 feet in diameter and the rafters extend up at a 26 degree angle. Some trig gets us the following pattern to cover it:

It's shaped like the red 'C' in the Colorado state flag seen below.

The outer circle is 11 feet in diameter and the inner one is 27" in diameter.

The pac-man style "mouth" gore is 40" wide at the outside and 9" wide where it touches the inner circle.

I scavenged a big roll of knit cotton t-shirt material. I sewed my roof lining from that. It's easy to stretch over the frame. I sewed a drawstring into the outer edge of the roof liner. That helps it hook over the tops of the wall lattice.

WALL LINER

The wall liner is easy - the cloth on the roll was wide enough to cover the wall with no sewing at all. Make yours long enough to wrap around the inside of the door frame and secure inside to the lattice. The stretchiness of the knit made it easy to hook over the tops of the walls under the shoulder band. The knit fabric is heavy. If your fabric isn't stretchy or if it's slippery you'll need to sew loops into the edge to hook over the tops of the wall.

Pete and Leslie take shelter from a dust storm.



step 9: Outer Skin

I scavenged some insulated mason's tarps to use for the outer skin. It's two layers of aluminized polytarp with a sheet of "ethafoam" polyethylene foam insulation in between them.

The pattern for the roof is the same Colorado flag thing as the roof liner. I made it too big, expecting the insulation to be thicker than it was. I made walls also but didn't end up installing them at Burningman. I just relied on the wall liner.



step 10: Steps of Setting it Up

1. Smoke ring. Put the smoke ring in the middle. It's bad Mongol luck to carry it through the door or lift over the wall.
2. Door frame. Assemble it.
3. Wall Lattice. Spread it out in a circle and tie it to the door frame.
4. Shoulder cord. Tie it around the wall to keep it from spreading too far.
5. Rafters. Insert a lattice thumb in the cord loop and insert the other end in a hole in the smoke ring. Install three widely spaced rafters first to support the smoke ring.
6. Smoke ring. I wrote numbers 1-8 next to each hole and the same # on the correct lattice thumb. That makes it easier to not get crossed up.
7. Tie the two odd rafters to the top of the door frame
8. Shoulder band. You might prefer to put it on now, or after the linings. Try it both ways.
9. Roof lining. Throw that over the top and hook the drawstring over the wall. You could also sew the walls to the roof part and install them both at once.
10. Wall lining. Wrap it around the walls, At the door you can either have flaps or wrap it around the sides of the door and secure it inside.
11. Outer wall cover. Do the same as the lining. Line the door flap up with the door frame.
12. Outer roof cover. Throw it over the top and tighten the drawstring around the edge.
13. Halter. Throw some ropes over the top to keep the whole thing together and keep it from blowing away. If you're an observant Mongol you'll use weights instead of pegs so as to not stab mother earth.

<http://www.instructables.com/id/Yurt/>

14. Smoke hole cover. Use your umbrella or a small tarp with long cords from the corners as you see fit.

15. Enjoy your cozy yurt!



Related Instructables



GerTee - Portable tent home made of recycled materials by AlaskanTentLady



Build yourself a portable home - a mongolian yurt by davidbuzz



Make Oars from Two by Fours by TimAnderson



Burning Man Skills by TimAnderson



How to scavenge wood with a kayak by nativewater



Catproof Your Yard by Jabberwocky246



Make a collapsible table for concerts in the park! by Marsh



Build a lumber storage rack out of fencing scraps by liseman

Comments

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openperspective says:

just wondering, why didn't you use pivot cords for those certain crossovers?

Oct 21, 2009. 2:34 PM [REPLY](#)



incorrigible packrat says:

I'm thinking... build it into a trailer. Make a trailer with rounded sides that fold down flush with the deck, to form the yurt base. All the yurt components (and camping-related junk) should fit easily into the trailer, with the sides in the up position. Could even make a rigid transport cover to keep everything in the trailer while driving. If the cover interior was lined with aluminized Mylar, tinfoil, old chip bags, etc. it could serve a secondary purpose as a solar concentrator for heating water, roasting wienies, etc. While you couldn't achieve a sharp focus, with the reflector not being parabolic, the size of the reflector should suffice to heat stuff up.

Jan 24, 2008. 9:59 AM [REPLY](#)



openperspective says:

on the idea of building the portable yurt bottom into a trailer: that does seem like an awesome idea. i would do it myself, but i'm pretty sure the one i built is too big for that (~16' diameter). that said, if you live in (or camp in) a wet climate, the best fabric i've heard of using is sunforger canvas. its waterproof, and more importantly, flame retardent, which is important when its cold and rainy and you wanna jack up the fire inside. next best is the felt that MelanieTraver was talking about. also for wet climates, you can build a gutter for your yurt using a long strip of VERY waterproof fabric. simply fold it in half longways, like a really long U, and attach it to your eaves, making sure that your roof runoff will actually land in the trough you've made. then just run the ends so they go all the way around and open up on the downhill end, letting all the water run off and away, rather than under you and your sleeping friends.

I just finished mine in time to bring it to my home burn (alchemy, what what!). i love it, and i loved making it so much i wanna make them for a living, for people who don't have the drive that us folks do.

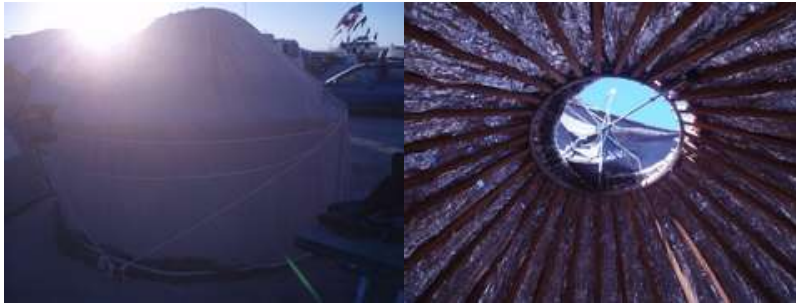
Oct 21, 2009. 2:32 PM [REPLY](#)



thedarkapok says:

I built a yurt following these instructions; it worked out fine and I even completed it in time for my trip to BRC in '08.

Jan 30, 2009. 6:26 PM [REPLY](#)



thanson says:

What kind of insulation is that?

Sep 19, 2009. 4:22 PM [REPLY](#)



TimAnderson says:

excellent! you made my day! post more pictures!

Jan 30, 2009. 11:32 PM [REPLY](#)



kurtsyurt says:

Hay tim nice yurt!!!!

My question is The top an bottom of the lattice do not need to be the same distance Mine is 2" top and bottom yours is 3"bottom 2.5 top so the X's are the same in between ? . well i am having an awha moment.

question 2 you pulled out the spokes of the hub? wouldn't that colaps on itself?

thanks

kurtsyurt

May 17, 2009. 10:40 AM [REPLY](#)



TimAnderson says:

The "thumbs" at the top and bottom of the lattice are slightly different, but it's not too important. The top ones are short so they don't poke through the skin.

The bike rim has no spokes, it doesn't collapse because the force from the rafters is all the same. A bike wheel with plastic tied over it would make a nice skylight, set on top of the hoop.

May 17, 2009. 10:49 AM [REPLY](#)



openperspective says:

when you talk about making multiple wall sections and "stacking" them, do you mean you could add another piece of wall to give it more internal area? i was thinking of something like this, but the logistics of changing roof size befuddles me

Apr 9, 2009. 4:31 PM [REPLY](#)



TimAnderson says:

Yes. If you had four of these wall sections, you could stack them vertically and horizontally. The resulting yurt would have twice the height at the eaves and twice the circumference. It would need either much longer rafter poles or a very large smoke ring.

Sep 9, 2009. 10:58 PM [REPLY](#)



openperspective says:

well, if you have them, i would be interested in those dimensions. this is a great instructable, and i especially love the non-use of metal. very classy, and also a little easier to do myself

Apr 9, 2009. 4:25 PM [REPLY](#)



TimAnderson says:

Thanks! post pix of the one you build!

I added the standard Mongolian stick info, from "The Complete Yurt Handbook" by Paul King. It's a good book.

The stick is 82.5" long. The knotted pivot cords are spaced 7" apart. There would be a dozen holes for pivot cords, but they skip pivots #3, #5, #7 counting up from the bottom. The tip of the stick extends 2.5" above the top pivot and the bottom extends 3" below the bottom pivot.

$(11 \times 7) + 2.5 + 3 = 82.5$ "

Apr 9, 2009. 10:53 PM [REPLY](#)



burntbob says:

Nice design and great salvage ideas. How much headroom did you have inside. on a side not you have a bike trailer with an army stretcher on it... were you one of the EMT's on site? I'm always looking for bike ambulance ideas...

Sep 13, 2008. 6:52 PM [REPLY](#)



emac says:
what kind of fabric would u recomend for a wet climate

Sep 9, 2008. 10:15 PM [REPLY](#)



graphak says:
screw the OC, i live in CO. (i just noticed your flag pic, if you are near denver and going to BM 2009, maybe our camps could combine. I plan on bringing a few hexayurts, but yours looks awesome as well)

Aug 22, 2008. 10:02 AM [REPLY](#)

<http://hexayurt.com/>



louie_gee_gee says:
Very cool instructable! I think they'd make great temporary accomodation for disaster victims.

Jul 29, 2008. 5:26 PM [REPLY](#)

Can I just ask, what do you put the yurt on? Does it go straight onto the dirt (with or without a groudsheet?) or onto a platform?



louie_gee_gee says:
I just realised I missed out the D in 'groudsheet' - oops! (I really should use the spellcheck!)

Jul 29, 2008. 5:27 PM [REPLY](#)



abadfart says:
what did u use as a door

Jul 28, 2008. 12:18 AM [REPLY](#)



MelanieTraver says:
i lived in mongolia in a ger while in the peace corps. the only suggestions i would have is if you construct the lattice pieces in three or four sections (its hard to tell if you did that or not), you can take the whole thing down instead of putting it on top of your truck. Other than the fact that the sheet you used around it doesn't seem very insulating (Mongolians use big, thick wool felt pieces cuz it's colder than a fill-in-the-blank there), it looks very good. cool idea for the states, though!

Jun 13, 2008. 5:17 AM [REPLY](#)



TimAnderson says:
do you have some photos from your time there?
it would be great to see them!

Jun 13, 2008. 8:31 AM [REPLY](#)



garden burger says:
in my sleep away camp we stay in yurts..... and work on a farm.....

Jun 13, 2008. 3:27 AM [REPLY](#)



oxania says:
Just gorgeous - my Kyrgyz mates would laugh their socks off.

May 1, 2008. 1:24 AM [REPLY](#)



DirtyWater99 says:
That's the life right there.

Mar 19, 2008. 5:44 PM [REPLY](#)



digjam says:
JEALOUSY!!! This is awesome..I'm inspired to find myself an old yota and do the same...THANKS!

Feb 25, 2008. 12:43 PM [REPLY](#)



jake101 says:
this is excellent, I'll be building one for the summer for sure =]

Feb 25, 2008. 11:12 AM [REPLY](#)



incorrigible packrat says:
I also have an observation about the folding chair seen in the intro photo of the truck front view (experiencing severe truck-envy, btw. What year is it? (the truck, not the chair))
I hope nobody paid money for the chair. I get chairs like that all the time at my dump, they seem to break with astounding regularity. (Could also be that the people that bring them are sporting a few extra pounds, are over-fond of drink and abuse their chairs by leaning over too far, trying to reach the cooler...) Anyhow, I like to recall the days before planned obsolescence hit the portable lawn furniture sector, by using folding aluminum lawn chairs. Much lighter, usually sturdier, and easily repairable when the webbing degrades. I've seen ones done with flat cord, similar to shoelace, rather than wide webbing, with funky patterns woven in.
The only problem with these chairs is the lack of the integral cup holder, which is probably the main selling point of the other type of chair. Resourcefulness can easily remedy such a situation.

Jan 24, 2008. 10:24 AM [REPLY](#)



SWV1787 says:

why exactly did you put it on top of the car? other than that i loved it, it looks simple, awesome, and sounds plenty warm.

Jan 23, 2008. 7:26 AM [REPLY](#)



subkontrabob says:

I'm sooo going to build one! Simple, beautiful.....

thank you so much!

Jan 22, 2008. 11:13 AM [REPLY](#)



LinuxH4x0r says:

Nice! I want a truck now!
Great instructable!

Jan 19, 2008. 10:54 AM [REPLY](#)



GorillazMiko says:

Dang... nice job, all your Instructables and stuff rule!

Jan 19, 2008. 10:23 AM [REPLY](#)



jpmartineau says:

Did you actually drive to Burning Man with that on the top of your car? Hope you didn't live too far.

Nice yurt, BTW.

Jan 19, 2008. 10:15 AM [REPLY](#)
