

intro: A REBAR TRELLIS - for Home and Garden

A trellis is a support over which vines and other plants can grow. They can provide us with food, beauty and shade. One of the cheapest, easiest, and most esthetically attractive ways to make a trellis is with iron rebar.

Forget straight lines for a moment and think outside the ubiquitous square box. Rebar is flexible and can easily be bent to make arches, tunnels, domes, and free-form curvy shapes. There is really only one step in making a rebar trellis; putting the rebar where you want it and tying it in place with wire. There are several design considerations however. This instructable will cover the simple "how-to" and the more complex "why" of design considerations.

A rebar trellis can also be converted into a cement structure by covering it with a mesh material and then plastering it with cement. My home was made using a trellis-like support for nylon fishnet and cement. A second-generation trellis now covers my home for shade. It could also be cemented someday, allowing for a third-generation trellis over that, and so on. The end result would evolve into something resembling a termite nest-like city, and create a radically different way of life for everybody involved.



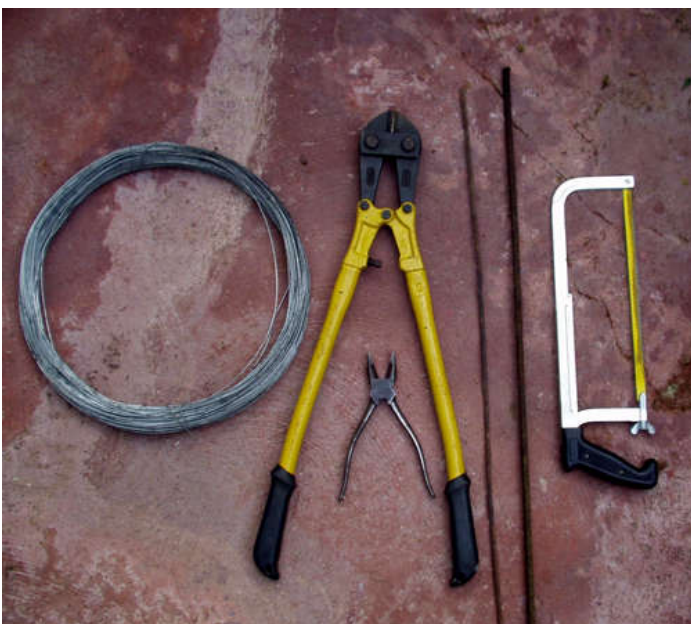
step 1: Tools and Materials

Bolt cutters are the best tool for cutting rebar, but a hacksaw will work. Lineman pliers are my favorite pliers for cutting and twisting the tie wires that join the rods where they intersect.

I use mostly 1/4 inch rebar, but 3/8 inch rebar is also useful, especially at first to establish the major lines. 1/16 inch galvanized iron tie wire is used for tying it all together.

When you tie the rebar together at the intersections, you have the option of either twisting the wires clockwise or counter-clockwise. One way is usually better than the other, depending on how the rods overlap each other. If the wire doesn't stay tight, the joint will be loose. The direction you turn is something you have to decide on each time you twist, and it is something I have a hard time explaining to people even in person. Good luck learning it on your own! Practice and keep thinking as you go.

One hint: pull as you twist. On the last twist, bend it all over if you can, to avoid snagging on the wire ends later.





step 2: Contact with the Ground

If you plan to convert your garden trellis into a cement structure someday, you would probably want to set the rebar in a cement foundation. (The attached photo shows an early stage of my house construction. As far as the rebar structure goes, it's the same as a garden trellis.)

For strictly garden use a foundation is not necessary. You can just stick the ends of the rods directly into the ground and start wiring more rebar to them to make the shape you are after. When the ends in the ground eventually rust away, which takes many years, you can drive rebar stakes next to them and tie wire the stakes to the structure. With or without rebar anchoring it to the ground, the trellis is not likely to blow away once it is up.



step 3: GEOMETRY - Complex Curvature

Keep in mind these basic design principles -- complex curvature, diagonal bracing, ribs and columns.

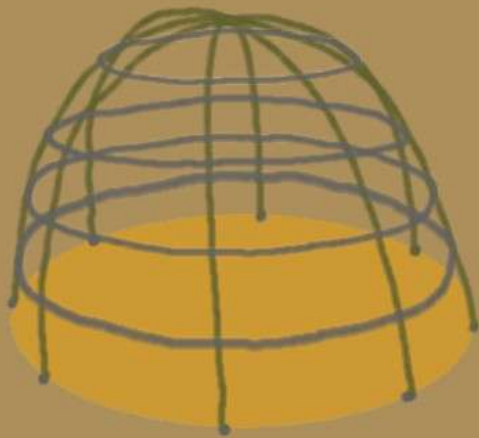
An egg shell tends to be stronger than a flat cracker because of its complex curvature. In a cement dome, all of the forces are in compression, and cement is very strong under compression. In a flat roof, the bottom side is under tension. Cement is weak under tension.

Domes are also good for garden trellises. They have a rigidity that the same amount of material in a flat configuration does not have. Rebar bends easily to make domes and trellises, and free-form curvy shapes. I prefer those shapes for aesthetic reasons, as well as structural ones, so that's the way I work.

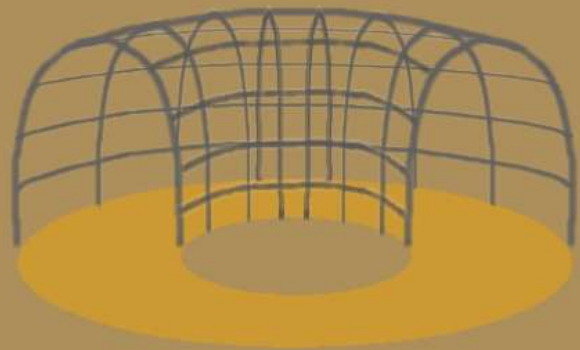
Domes give you the maximum interior volume with the minimum of material. High ceilings are nice, too.

Because of complex curvature, a curved tunnel is stronger than a straight tunnel. Rebar trellises allow for a great deal of design flexibility. You can adapt to just about any existing situation. Keep the general design principles in mind and the odds are that you will come up with a successful design. If it doesn't work, you can always take it apart and try again.

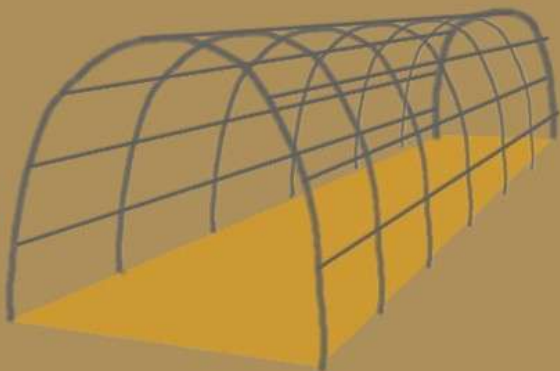
Dome



Curved Tunnel



Straight Tunnel

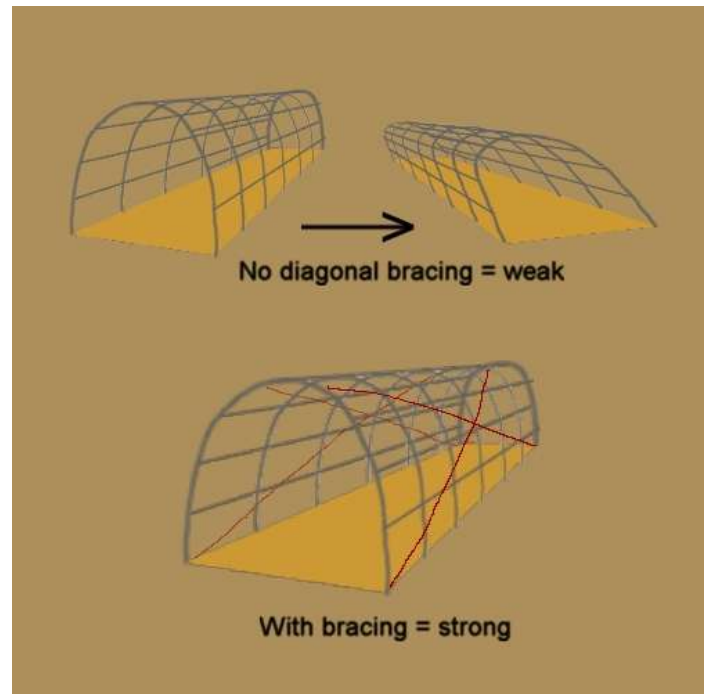
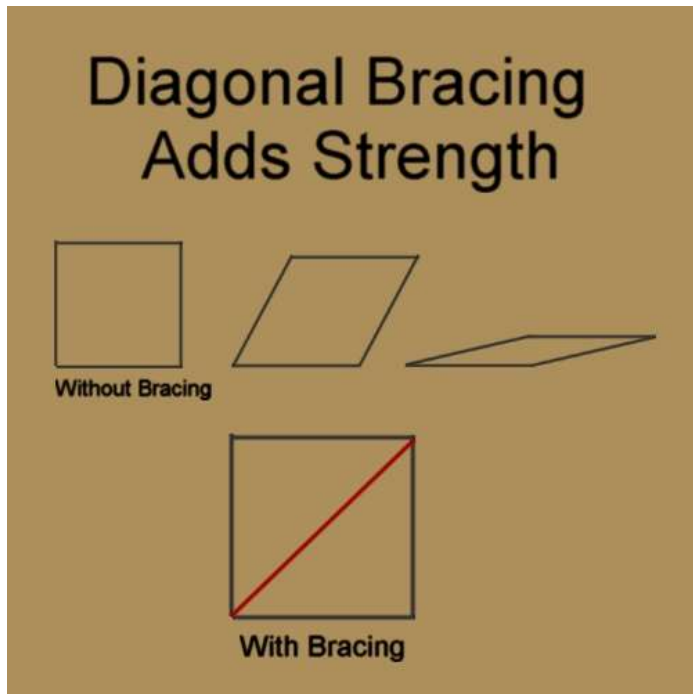


step 4: GEOMETRY - Diagonal Bracing

Among shapes composed of linear elements, the triangle is the strongest shape. Without breaking the corners, there is no way to distort a triangle. Incorporate triangles (diagonal bracing of rectangles) into the rebar grid design and you will increase the rigidity of your structure.

A rectangle, or a rectangular grid, can collapse, if the corners are not rigid. If you put a diagonal brace between opposite corners, that creates two triangles and makes the rectangle rigid.

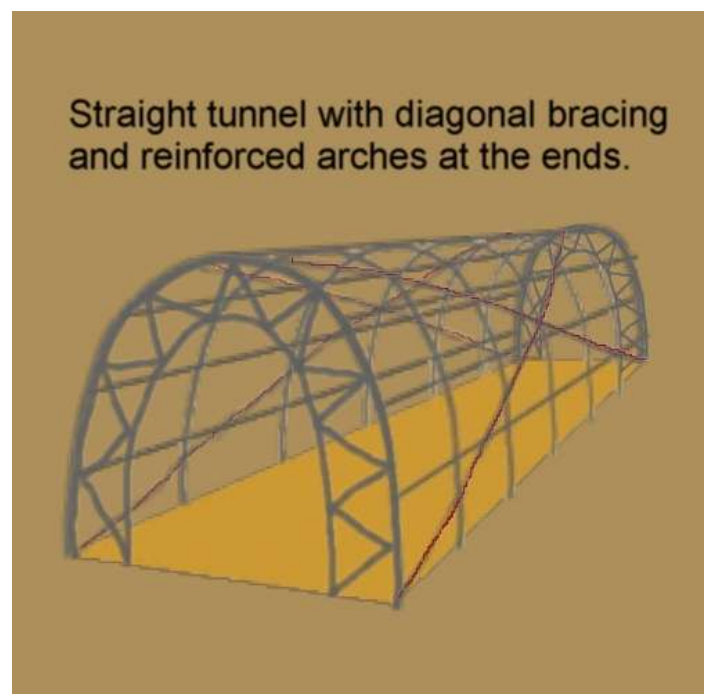
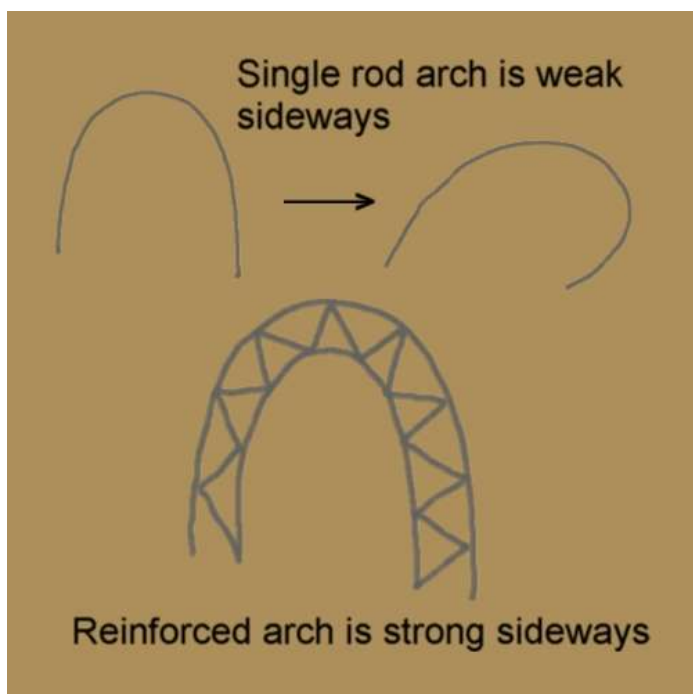
Also, the more rebar you put into a trellis and the more intersections you tie with wire the stronger it will be. Rebar costs money, so there is a natural tendency to be economical using it. With too little, your structure may fail. With more than is needed, there is the issue of wasted materials. I usually play it by feel as I go along. If it needs more rebar, don't hesitate to put it in.



step 5: GEOMETRY - Ribs

Rebars are flexible, which makes them easy to work with, but they need to support each other to create rigidity. A single rod arch can distort sideways. To keep that from happening, you have to reinforce the rod from the side. One way to reinforce a rebar arch is shown below. Putting such a reinforced arch at the end of a straight tunnel will keep the tunnel from collapsing sideways.

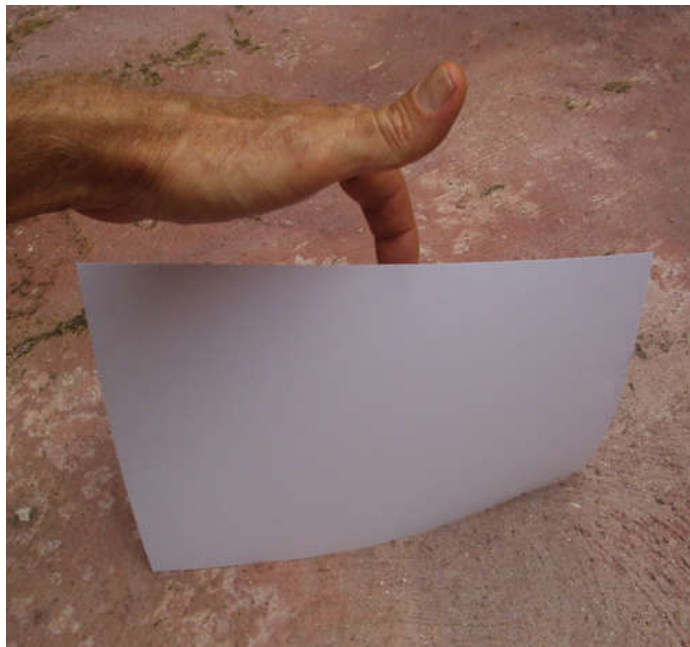
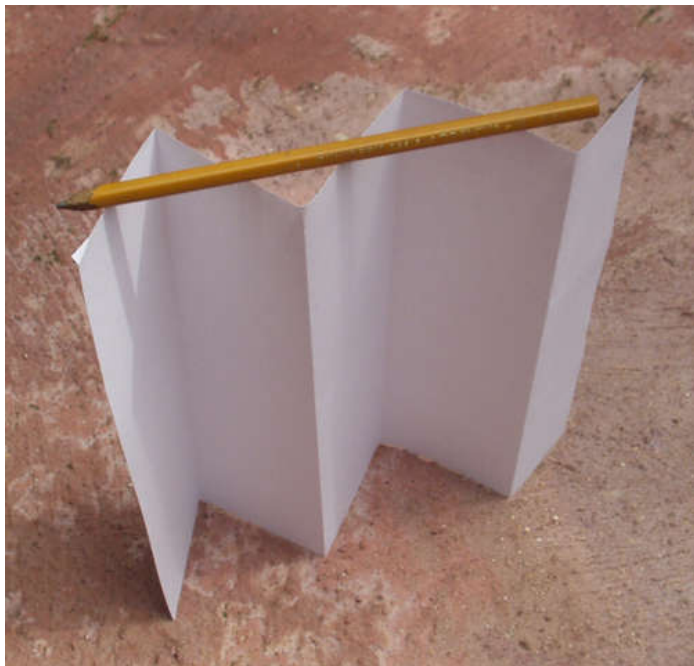
Ribs and columns formed by intersecting planes are similar. One plane's strength reinforces the other plane's weakness.



step 6: GEOMETRY - Columns

If you try to balance a piece of paper on its edge, it will collapse. If you fold the paper, the intersection of planes will create rigidity and the paper will stay standing. It can even support additional weight. In effect, the intersection of planes does the job of a column. Use this principle around doorways, for example, if they are weak.

The rolled edge around the top of some cooking pots is another example of how rigidity is gained from sideways distortion.

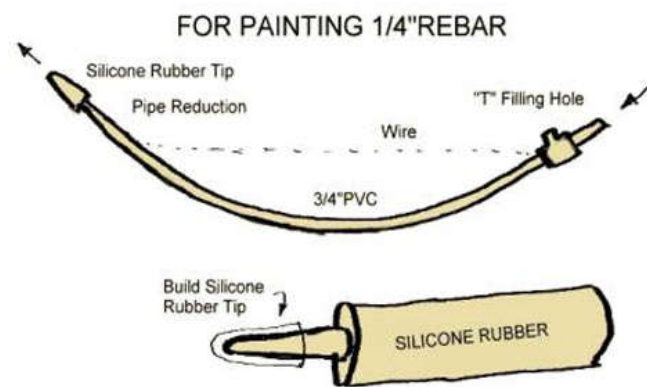


step 7: Painted Rebar

I painted the rebar for this trellis to try out a painting system I came up with using a piece of 3/4 inch PVC pipe as a paint reservoir for dip-painting rebar. The 1/4 inch rebar enters one end of the pipe and as it exits the other end it passes through a silicone rubber tip that scrapes off the excess paint and keeps it in the reservoir.

For garden trellises I don't normally paint the rod, but I will for any cement construction I do in the future. Rusting rebar expands and breaks out pieces of cement. Painting the rods first should add many years to the longevity of cement structures.

At the joints inside the pipe, trim any obstructions at an angle with an X-acto knife before assembly. That way, the rebar will pass through smoothly.



step 8: EXAMPLE - A Trellis Fence

It is a little hard to see in this picture, but the top of this straight fence is basically a straight line. The bottom of the fence zig-zags, similar to the photo of folded paper in Step 6, "GEOMETRY - Columns". This wavy base line helps give lateral support to the trellis. If it was a straight line, the trellis would topple over to one side or the other.

I used sections of PVC around the rebar at ground level to help protect my string trimmer line when I am weeding.



step 9: Random Trellis Photos

Some of these photos show the bare bones of trellis geometry, and some show vine-covered trellises. The idea here is not to show specific designs for you to copy, but rather to illustrate the general principles you have already learned, and hopefully inspire you to pick up the ball and run with it.

I would like to see whole cities built this way, and covered with green. I can't do that alone. This is just a sample showing what can be done. Hopefully, it will inspire you and others to take the next steps.





Image Notes

1. Temporary pipe supports during construction.



Image Notes
1. New Zealand spinach.



Image Notes
1. Some of the rebar has been wrapped with rope and cemented as security railings on the roof.



Image Notes
1. Zocato -- a melon-like fruit. Delicious!



Image Notes
 1. Chayote -- not a strong flavor, but very good steamed.

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