

# Inside-Out Turning

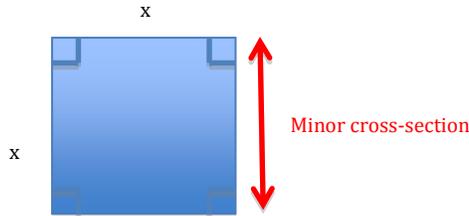
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## Goal of this demonstration/instruction

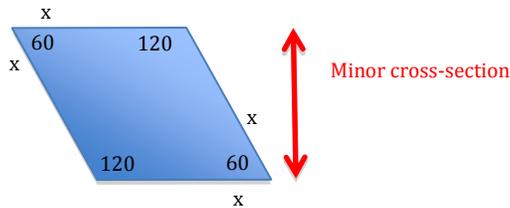
Go through steps needed to plan out an inside-out turning project and then turn it.

## Some Terms

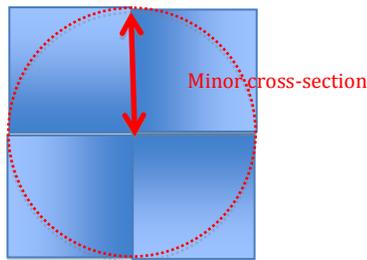
**Square piece** – A length of wood with a square cross-section; that is, sides are equal length, and all angles are 90 degrees.



**Turner's Diamond piece** – A length of wood with a diamond cross-section; that is, the sides are of equal length with included angles of 120 and 60 degrees.



**Minor Cross-Section** – The distance that corresponds to the maximum radius of the piece that can be turned when the pieces are glued together. For example, for square pieces, it is relatively easy to see that the minor cross-section corresponds to height (or width) of one of the component pieces.



## Preparation

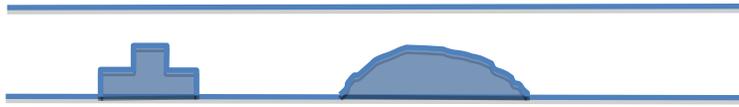
While easy to turn pieces that make people wonder “how did you do that?” there are two aspects of preparation that will help you in achieving your goal.

### Designing the Profiles

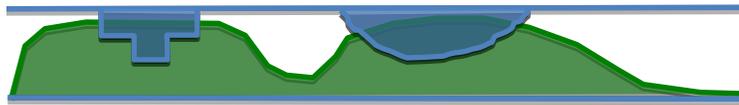
1. Take a piece of paper and draw two parallel lines that represent the minor cross-section.



2. Draw the outline for the inside profile. Use the bottom line as a reference at this time. This will define the areas from which you want to remove the wood. Try to not remove more than 40% of the wood or else when the outside is turned, there will be very little wood to remove.



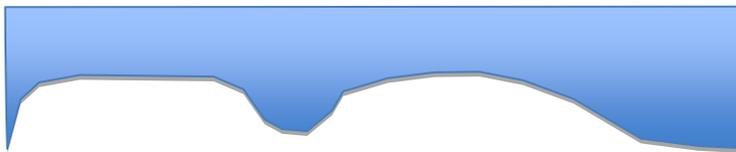
3. Draw the outline of the final turned shape. This is typical of a sketch you might normally draw anyway. To aid in visualizing the cutout windows, turn the drawing over prior to drawing. Note that the heavily shaded areas will be devoid of wood (the cutout areas).



4. (Optional) Cut a template for the inside profile. Note that this template corresponds to wood that needs to be removed from what will be the center of the final piece



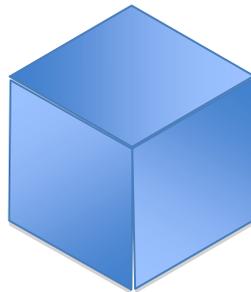
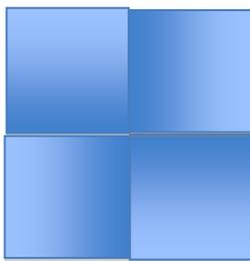
5. (Optional) Cut a template for the outside profile.



### Cutting the Wood

Cut the wood into strips of equal length and of the same cross-section. Be sure to add at least 2 inches of additional length to allow for gluing when preparing to turn the inside in the next section. The easiest cross section is a square, but it is also possible to do turnings with triangles or diamonds. The main thing is that the angles add up to 360 degrees.

1. Four square pieces (must have 90 degree angles, all sides the same length)
2. Three turner's diamonds (angles of 60 and 120 degrees, all sides the same length)



### Preparing to Turn the Inside

The first major step is to assemble the wood strips into a single piece for turning. For example, 4 square pieces need to be temporarily glued together into a larger square piece, or 3 turner's diamonds to form a hexagon. But, the joint must be able to be broken in order to re-glue pieces together later for turning the outside. The instructions are basically as follows, with variations based on the number and shape of the pieces.

1. Take each strip and make a mark at about 1 inch from each end.
2. Glue a piece of newspaper (other papers will work, but newspaper is thin, and is also easy to split apart later. Use a white or yellow glue. But only glue a piece on one side of each mating side. The paper need only cover the 1 inch area
3. Then glue mating sides together by simply adding glue to the paper area.
4. Align pieces and clamp till dry. (See notes below)
5. Mark the end pieces by drawing arrows from center of the piece to the outside edge, and number each piece, in order. This is be used when re-gluing for turning the outside.

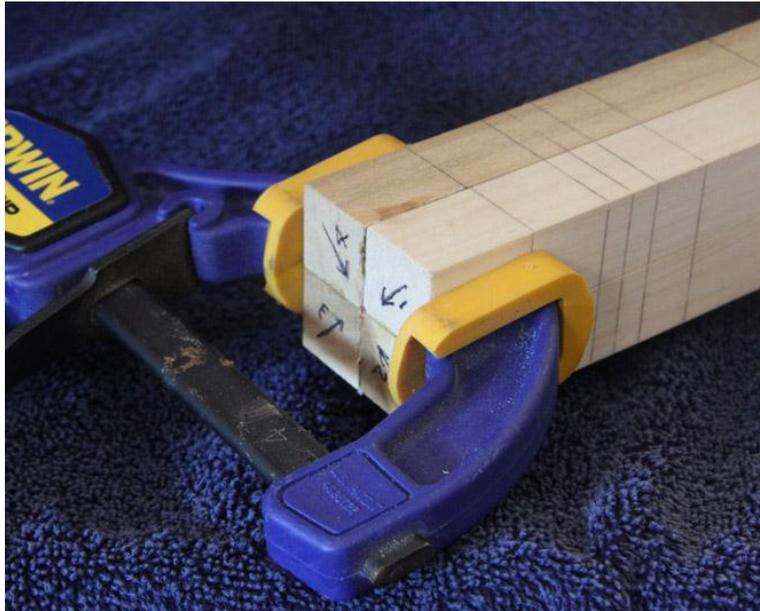
**For square pieces:** First glue the paper on the individual pieces.



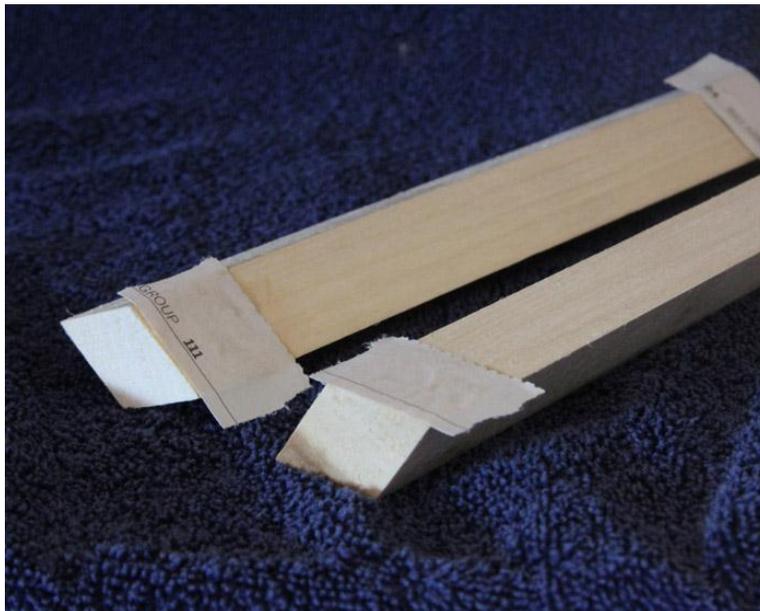
Then glue two pieces together and clamp, making sure that the edges align (that edge will be glued to second group. Create two groups like this.



When the glue dries, glue more paper at the ends of these 'double' pieces. Then, glue the 'double' pieces to form a larger square and clamp in place (I use clamps since the pieces are all square, but rubber bands also work well).



**For turner's diamonds:** Start by gluing paper strips to one side of each piece at both ends.



When dry, apply glue to the exposed paper, and mate up to the unglued wood area of the adjoining piece (there should be a 120 degree angle between the two glued sides). Clamp the pieces together using rubber bands. Make sure that the pieces all meet at the center.



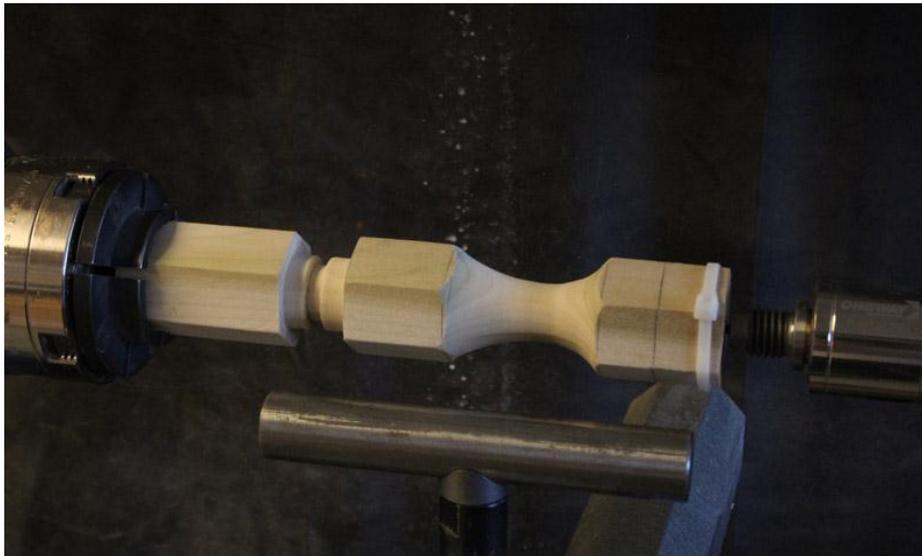
## Turning the Inside

The next step is to turn what will become the inside of the piece.

1. If needed, trim off the ends to make the ends flat. Re-mark the ends if they were cut off. The arrows and number are still needed.
2. Pick one end and make an indentation where the joints meet. This marks the center of the piece and can be done with either an awl or drill.
3. Place the other of the piece in a scroll chuck and bring up the tailstock so that the point is in the indentation previously made in order to center the piece. Tighten down the chuck, but do not overly tighten the live center so as not to break apart the paper/glue joints.. At this point, it is recommended to firmly wrap the glued pieces with a cable tie (or hose clamp) at this end in order to make sure that things don't fly apart.
4. Mark the important important points on the piece using the inside template to demarcate the things like edges, where to place the minimum or maximum diameter, etc. If it's easier, these points can be marked prior to placing on the lathe.
5. Then, turn the inside profile using the inside profile sketch (or template) created in the earlier step.

Note: When turning the inside profile, *always* measure the profile at an outermost edge of the turning. This is because the profile represents the center of the inside, and the center will be formed by the outermost edges when re-gluing the parts together.





### Finish the Inside

Once the inside profile has been turned, it's time to sand and finish the inside.

1. Sand to 320 grit, or whatever you desire.
2. Apply the desired finish to the inside turned areas. You can be as creative as you wish. Either a clear finish, stain, or paint.

Note: Try to keep the finish away from the unturned areas since these will be glued together in the next stage.

### Preparing to Turn the Outside

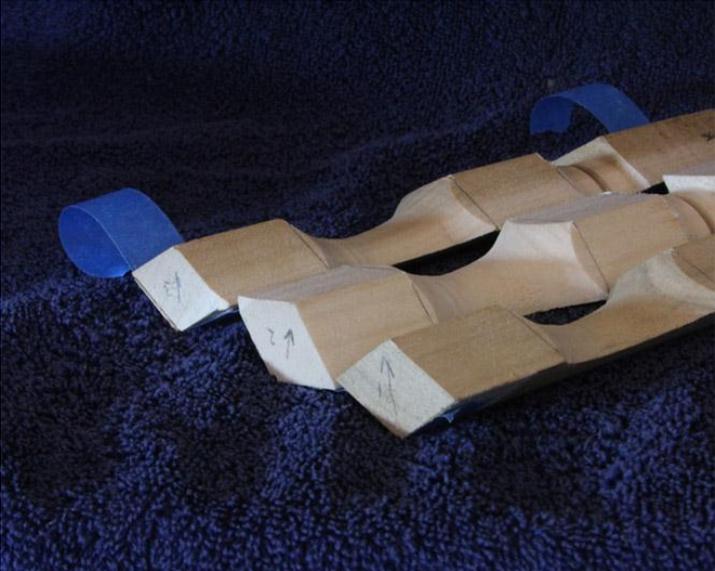
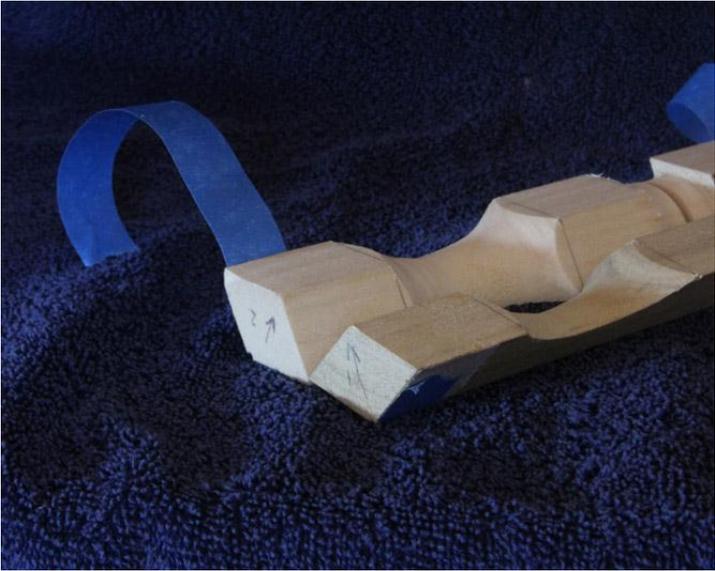
Now that the inside has been completed, it's time to split the parts from each other and re-glue them to expose the outside.

1. Make note of the markings on the end of the turning. This information will be useful after the next step. Also, keep track about the ordering of the pieces.
2. Using a chisel and mallet, split the pieces apart at the paper/glue joints. Be sure to align the chisel with the joint in order to prevent splitting of the wood itself. You might well have to split it from both ends, and at all joints in order to separate all pieces.
3. After being split, rotate the pieces 180 degrees, and reverse their order. The rotation places the inside on the inside. Reversing the order keeps the grain patterns lined up in case you are trying to maintain grain pattern, if not, don't worry about reversing the order.
4. Now glue the pieces together using your favorite permanent glue. *Be sure to apply glue to all mating surfaces since that glue will be holding the wood together after the outside is turned!*
5. Combine the pieces and clamp or rubber band the group together until the glue dries. When assembling the pieces, be sure to align the ends such that the turned areas are lined up.

**For square pieces:** The reassembly sequence is basically the same as for the inside turning preparation except that the mating surfaces must be fully coated with glue. Clamps should be used to ensure that the joint is kept in place. Be careful on the alignment and make sure that the four pieces met at a single central point.

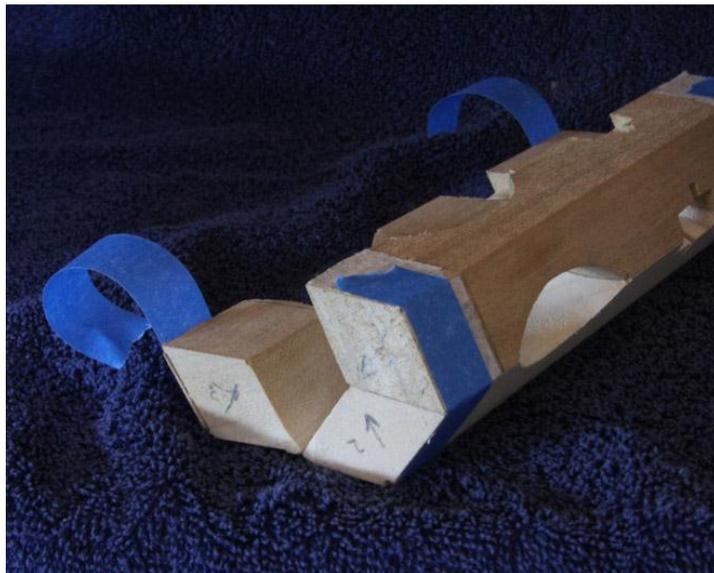
**For turner's diamonds:** The reassembly of the pieces is a little bit different for turner's diamonds. What I have found helpful is to first use masking tape to create a roll-up of the pieces. Start by wrapping tape around two sides of a diamond, then butt up the next diamond so that the tape can similarly wrap around it. Continue with the third diamond, butting its edge up to the second diamond. The edges need to be as

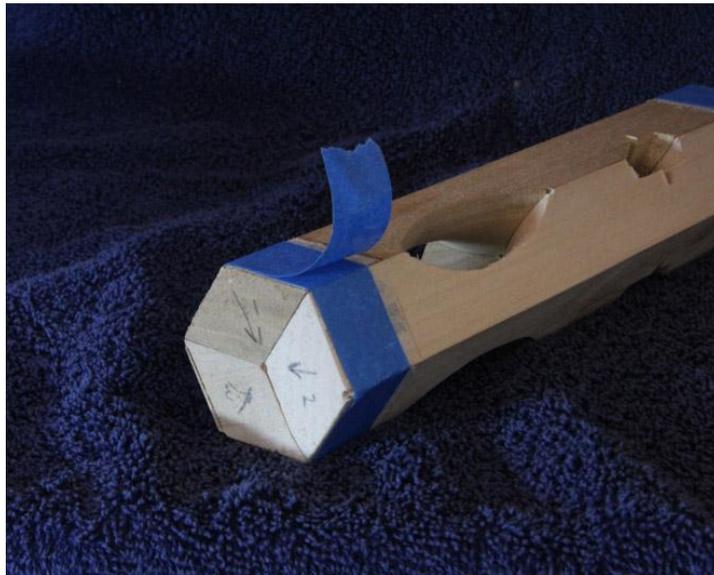
close as possible to each other so that when the pieces are rolled-up, the tape actually stretches around the corner. This will help provide a bit of clamping pressure of its own.





Finally, roll up the taped pieces and clamp it all together with rubber bands.

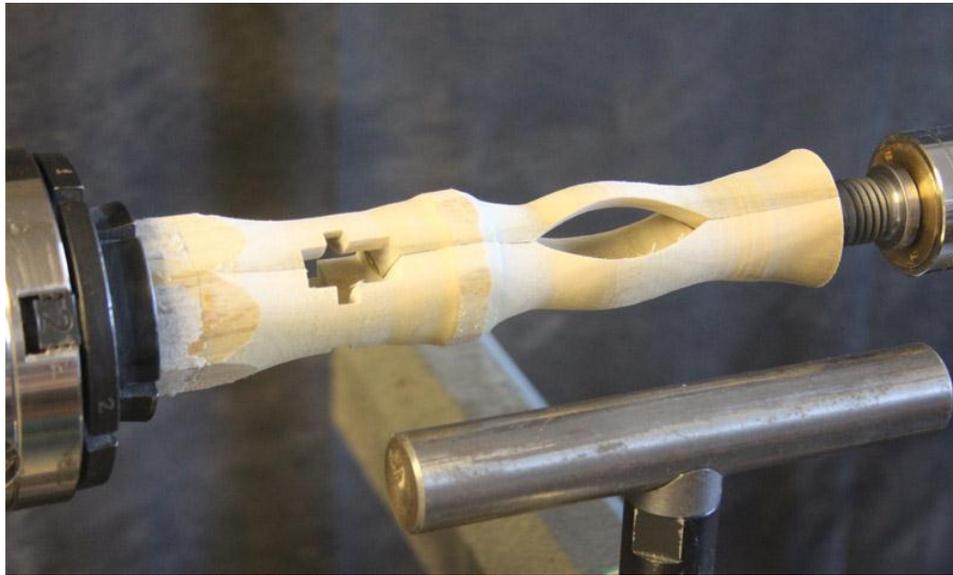
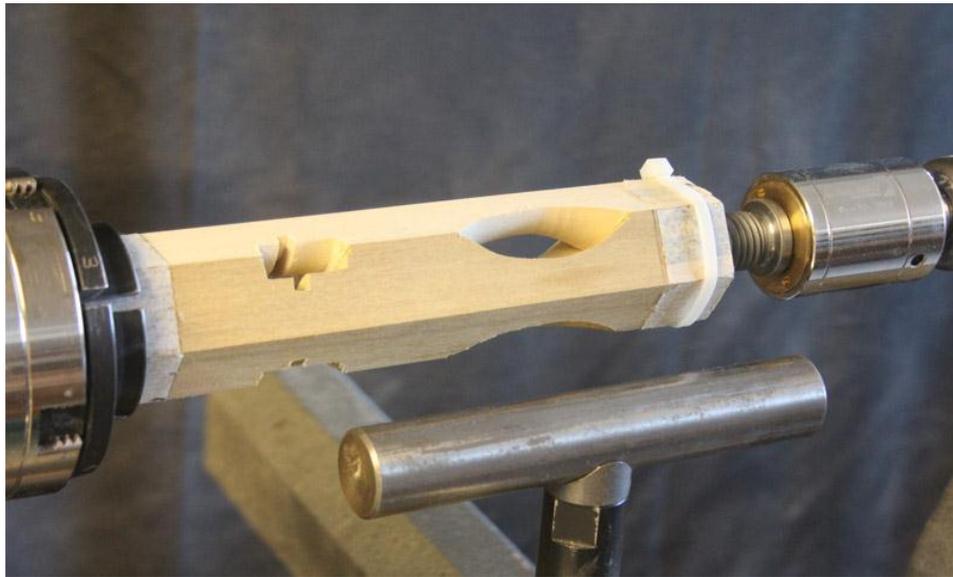




## Turning the Outside

The next step is to turn the outside of the piece.

1. If needed, trim off the ends to make the ends flat. If you have been careful in the glue-up, the ends should be flat enough anyway.
2. Mark one end with either an awl or drill as for the inside turning step.
3. Place the other of the piece in a scroll chuck and bring up the tailstock so that the point is in the indentation previously made in order to center the piece. Tighten down the chuck, but you do not have to be as concerned about the tightness since the glue joints are now permanent.
4. Then, turn the outside profile using the profile sketch (or template) created earlier.



## Finishing

Finish with whatever you want, I have used spray lacquer, Armor Seal™ (an oil and polyurethane mix), and oils. Obviously a shellac friction finish not recommended since inside-out turnings tend to be a bit more delicate.

## Going Beyond – Other Shapes?

For a different look, try using different types of wood for the pieces. For example, using two squares of maple and two squares of walnut for a harlequin-like pattern.

Another possibility is to turn a smaller spindle that can be captured inside the inside-out turning.

Triangular pieces can also be used. For example six equilateral triangles can be used. The problem is that you have to plan on three turning, two being temporary joints, and then one with the pieces fully glued for the final outside turning.

## References

1. American Woodturner, February 2010, Vol. 25, No. 1 – The AAW journal has an excellent article on Turner’s Diamonds. The article goes more into cutting and turning the diamonds, giving many examples of what you can turn, even using more than the three diamonds used in these document.
2. <http://www.cwoodturner.com/files/how-to/ornaments.pdf> - this article also provides another view on turning Christmas ornaments.
3. [http://marleyturned.com/Video Inside-Out-Ornament.html](http://marleyturned.com/Video%20Inside-Out-Ornament.html) - for those who prefer to learn by watching a video demonstration, this one is very good. It well worth watching although there are no verbal explanations, just background music.
4. [http://www.cnew.org/tips\\_techniques/inside\\_out\\_turning.pdf](http://www.cnew.org/tips_techniques/inside_out_turning.pdf) - another good article about the inside-out turning process.