3 or 4-Legged Stool

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Stool Design:

- Major design choices:
  - Stool height (milk stool, counter, bar)
  - 3 or 4 legs
  - Furniture style
  - Desired finish (clear, stain, paint)

- Seat:
  - Seat should be approximately 12” to 13” diameter, slightly dished. 11” seat is OK if you have a smaller lathe. Consider more leg splay.
  - Seat should be 1” to 2” thick. 8/4 material is a good choice to start.
  - Grain direction should be flat/plane sawn through seat.

- Legs:
  - Straight grain with grain running continuously through entire length.
  - Leg splay should be between 10° and 15°. Taller stools should have less splay.
  - Legs should be relatively thick where the stretchers attach.
  - Leg tenon should be at least ¾”. Preferred tenon is 7/8” to 1”.
  - Cylindrical legs tend to look clunky except maybe short stools. They also look mass-produced.

- Stretchers:
  - Straight grain with grain running continuously through entire length.
  - Stretchers for feet should be about 16” to 18” below the seat height.
  - For stools shorter than 12” to 14”, stretchers are not usually needed.
  - For stools 12” to 24”, stretchers should be about 6” to 7” from floor. Too close to the floor and the stool looks poorly proportioned.
  - For stools 24” to 30”, keep the 16” to 18” rule from seat height.
  - For taller stools, consider two tiers of stretchers.
  - Stretcher tenon should be about 5/8”. Larger than ¾” probably makes the leg weak.
  - Cylindrical stretchers tend to look clunky. They also look mass-produced.

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Images:

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Bill of Materials:

1. Seat blank – 12 to 14” round x 2” thick; qty=1
2. Leg blanks – (your choice of length) x 2” square; qty=4
3. Stretchers – 17” x 1-½” square; qty=4
4. Wedges – 1” x 2” x 1/8” wedges; qty=4
5. Wood glue
6. Finish

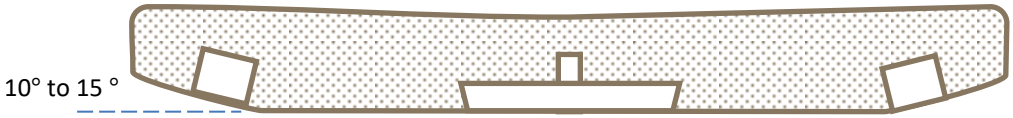
Tools:

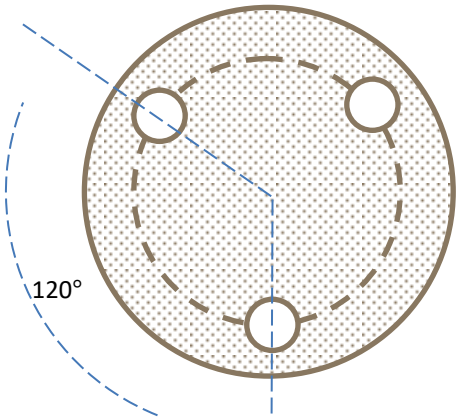
1. Turning:
    a. Tools:
        i. Roughing gouge
        ii. Skew(s)
        iii. Spindle gouge
        iv. Bowl gouge
        v. Beading & parting tool
        vi. Parting tool
        vii. Drill for screw chuck
        viii. Bedan for chuck dovetail
        ix. Round scraper
    b. Turning aids:
        i. Calipers
        ii. Dividers (mark chuck diameter)
        iii. Go/no go gauge for tenon sizing
        iv. Story stick
    c. Mounting:
        i. 4-prong or safety drive
        ii. Live center
        iii. Scroll chuck
        iv. Compression chuck with rubber pad (reverse turning)
        v. Screw chuck (optional)
        vi. Steady rest (optional)
        vii. Long tool rest (optional)
2. Drilling:
    a. Drill motor or drill press
    b. ¾” to 1” Forstner bit for seat
    c. 5/8” Forstner bit for stretchers
    d. Drill guide for lathe
    e. Depth stop (tape)
3. Measuring:
    a. Tape measure
    b. Pencil
    c. Snap punch
    d. Awl
    e. Bevel gauges or angle jig for drilling legs
    f. Protractor
    g. Compass to mark leg locations
    h. Depth gauge for mortise
4. Assembly:
    a. Hammer for pounding wedges
    b. Dead-blow hammer
    c. Saw to cut tenons, tenon kerfs, wedges, leg length, and stretcher length
    d. Level
    e. Wood glue
    f. Band clamp
    g. Quick grip clamp
    h. Disk sander for beveling feet
    i. Gouge to clean off thru tenons
    j. Sanding mandrel to clean off thru tenons
5. Finishing
    a. Sanding materials
    b. Top coat of choice

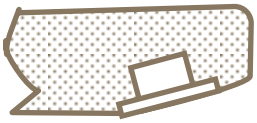
Step-by-Step:

1. Stock Preparation:
    a. Cut a 2” x 13”D blank of selected hardwood for the seat
    b. Cut 3 (4) - 28” x 2” x 2” (square leg blanks of selected hardwood
    c. Cut 3 (4) – 18” x 1” x 1” stretcher blanks (for legs greater than 14-18” long)
    d. Cut 3 (4) – 1” x 2” x 1/16” tapered wedges for thru tenons (if used)

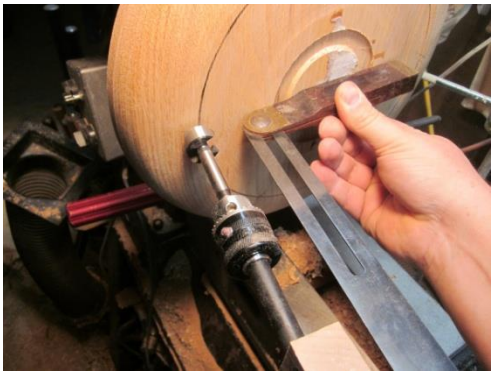
2. Turn the Seat:
    a. Select best looking side of seat blank for top of seat.
    b. Mount the seat blank between chuck jaws and tailstock with bottom toward tailstock.
    c. True up the rim and cut a shallow chucking mortise on the bottom.
        i. You can also drill a screw chuck pilot hole in the bottom and mount the seat that way, but you have less access to turn the bottom contours.
    d. Shape the bottom as desired. I turn a slight taper of about 10° to 15° to create visual lightness and to approximately match the leg splay.
    e. Mark leg location using a compass, dividers, and/or lathe indexing system. Make sure the grain pattern is symmetrical with three legs.
    f. Drill leg holes. Either stopped mortises or thru mortises. Drill using a drilling jig for the lathe. If drilling on a drill press, drill before turning the seat top.
        i. Consider drilling a shallow ledge to seat the top of the tenon shoulder.

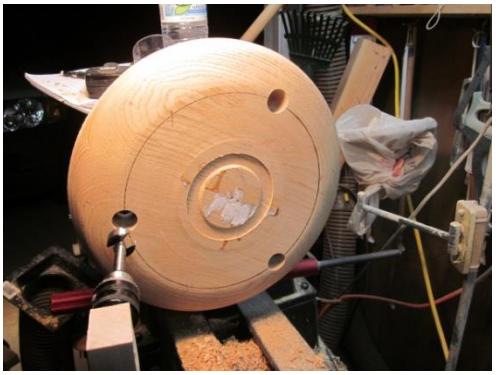






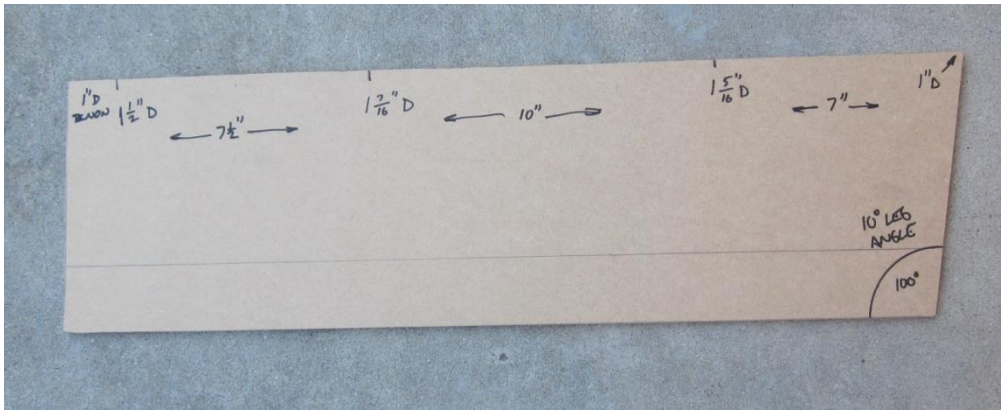
Optional leg mortise with shoulder for leg.



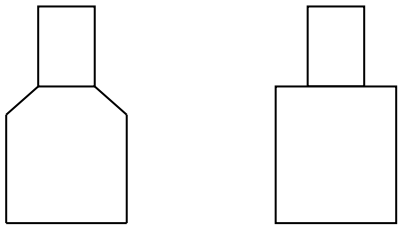


g. Sand the bottom on lathe without disturbing the chuck mount. Raise the grain with a damp rag before final sanding.
h. Reverse the seat onto the chuck or screw chuck.
i. Turn and sand the seat top. Seat should be flat to slightly concave (less than ¼").
j. Sand top of seat. Blend to rim. Raise the grain before final sanding the top.

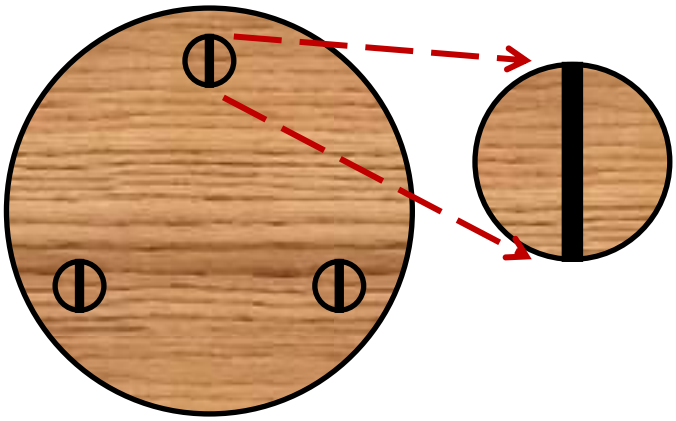
3. Turn the Legs:
    a. Cut leg blanks to desired length. Be precise.
    b. Rough turn the leg to a cylinder with a roughing gouge.



    c. Lay out the leg contours and seat tenon.
        i. Use 1”D x 1”L tenon for stopped mortise.
        ii. Use 1”D x 2”L tenon for through mortise.
        iii. Plan stretcher locations to be in thicker leg cross sections.
    d. Turn the leg.
        i. Cut the seat tenon. Test fit in the seat often.
        ii. Shape the leg as desired.
        iii. Chamfer end of tenon for easier insertion.
        iv. Taper tenon shoulder of leg if not using a stepped mortise.
        v. Optionally, square the top of the leg as a shoulder to sit in a stepped mortise.

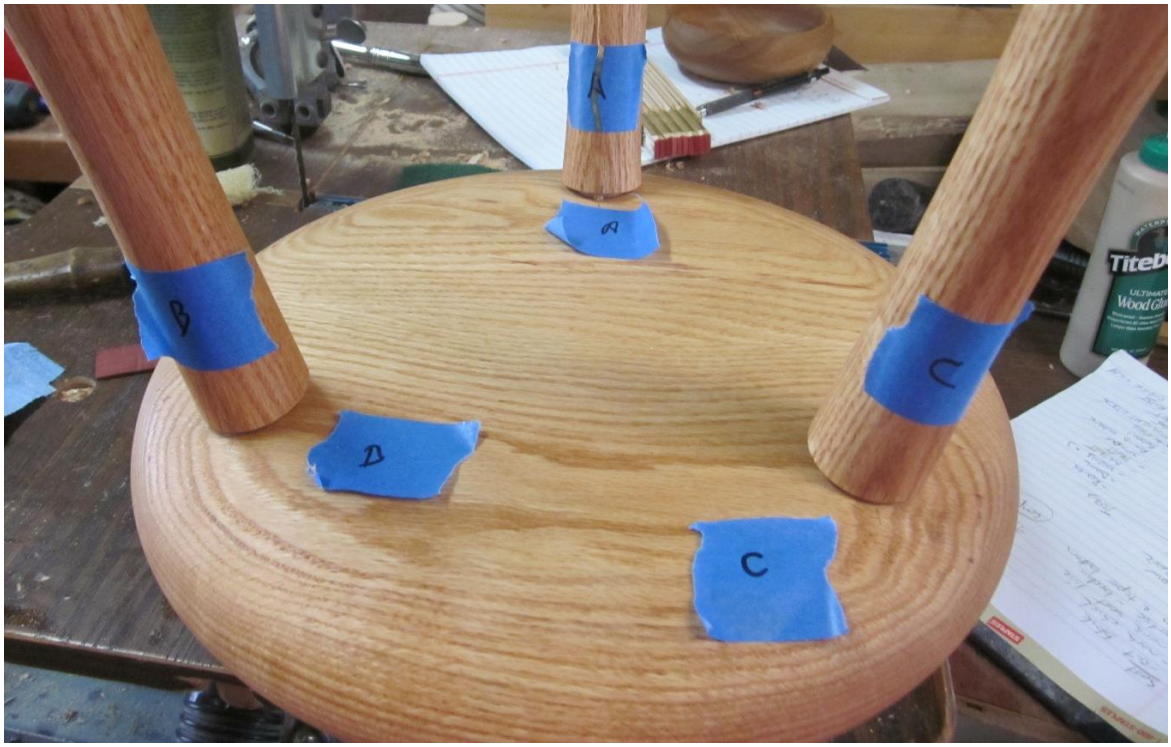


    e. Sand the leg. Do not round off details. Raise the grain before final sanding.
    f. Repeat for successive legs.
    g. If using thru tenons, cut across-grain kerf in the tenon to accept the wedge.
    h. Dry-fit the legs into the inverted seat.
    i. Orient the legs so that the grain of each leg is tangent to the grain of the seat. Mark the orientation on mating pieces. This is critical if you are wedging thru tenons.
    j. Cut the wedge slots in the leg tenons using a bandsaw. If you use a wider blade, the wedge needs to be thicker accordingly.

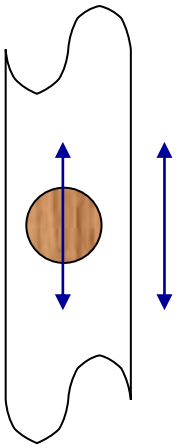


4. Turn the Stretchers:
    a. Mark stretcher locations on the legs.
    b. Measure first stretcher length. Add 1-9/16" for tenons.
        i. Each stretcher tenon will be 5/8"D x ¾"L.
        ii. Add 1/16" to stretch/tension the legs.
    c. Drill leg mortises for this stretcher. Eyeball or use a jig.
    d. Rough the stretcher with a roughing gouge.
    e. Layout the tenons and stretcher features. Consider using a story stick for layout.
    f. Turn the stretcher.
        i. Cut the leg tenon. Test fit often.
        ii. Shape the stretcher as desired.
        iii. Chamfer end of tenon for ease of assembly.
        iv. Taper the shoulders of the tenons to accommodate the insertion angle.
    g. Sand the stretcher. Do not round off details. Raise the grain before final sanding.
    h. Dry-fit this stretcher.
    i. Repeat process for remaining stretchers, but leave the previous stretchers in place.

5. Assemble the Stool:
    a. At this point, the stool should be dry-assembled and inverted. Verify that all of the parts are fit as you desire.
    b. Mark all pieces with tape so that you can put the stool back together once disassembled. Make sure to maintain all grain orientations.



c. Disassemble the stool.
d. Apply glue to the leg mortises (not the tenons).
e. Quickly assemble the stretchers into the leg mortises. Use a Quick Grip clamp to pull the joints together as you go, if needed. Use a dead-blow mallet to encourage joints closed.
    i. The stretchers should have the side grain face forward/backward for strength.



The grain of the stretcher is vertical and parallel to the grain of the leg.

f. Once all the stretchers are glued in place, set the band clamp around the stretchers.
g. Apply glue to the seat mortises (not the tenons).
h. Quickly assemble the legs into the seat mortises and use the dead-blow hammer to seat the tenons.
i. Right the stool on the floor and carefully apply a small amount of glue into the tenon kerf.
j. Hammer home the wedges until seated.

k. Clean any glue squeeze-out with a knife after the glue has skimmed over.
l. Allow the glue to dry overnight.
m. Trim the leg mortises and sand the tenons flush to the seat.
n. Using a stationary belt sander or a sanding disk on the lathe, sand floor angles on the bottom of the legs.
o. Chamfer the bottom edges of the legs.

6. Finish the stool:
    a. Apply desired stains, dyes, milk paint, etc. to the stool.
    b. Apply two to three top coats of a satin flat finish for durability.

Resources:

- "NewWoodworker.com"; http://www.newwoodworker.com/turning/turnstool.html
- "The Woodturner's Workshop"; http://www.turningtools.co.uk/projects/stool/stool.html
- "Tripod Stool"; http://www.craftsmanspace.com/Free%20projects/Tripod%20Stool.pdf
- "Woodworker's Journal"; Ernie Conover, http://www.youtube.com/watch?v=NFdcBq1NYC4
- "Turning a 3-Legged Stool"; The Woodturners of Southwest Missouri, Gary Hindgartner, http://www.youtube.com/watch?v=xEbhd1XinaM
- Designing and Building Chairs; pp36-41, Harriet Hodges, Taunton Press, 2006; http://www.finewoodworking.com/PlansAndProjects/PlansAndProjectsPDF.aspx?id=2479
- "American Woodworker"; pp52-57, Alan Lacer, June/July 2012
- "Full-size Three-legged Stool"; Alan Leland, http://alanleland.com/content/handouts/3_leg_stool.pdf

Notes from resources:

Ernie Conover:

- Use an open end wrench as a tenon gauge.
- Break corners of tenons.
- Seat leg angle – 10°to 12°.
- Rungs - 14-7/16" plus 1-5/16" tenons (5/8" tenon).
- Stretcher tenon size = 5/8"D x ¾"L.

Gary Hindgardner:

- Use a bevel gauge or wood jig for leg angle. Register it off the flat of the bottom of the seat.
- Use a horizontal drill jig to do everything on the lathe.
- Use a compass to mark seat, leg circle, and leg locations.
- Use a ferrule slipped over the drive spur for sizing the tenons.

Alan Lacer:

- Use a go/no go gauge for tenon size.
- Use a story stick for leg layout.
- Use a screw chuck for mounting the seat from the bottom.
- Apply glue to the mortise only.

Harriet Hodges:

- Design legs to have nice curves. Plain legs look mass-produced.
- Hold the first leg upright to insure that it looks good.
- Glue up leg and stretcher assembly first, then assembly to legs.

Alan Leland:

- For loose-fitting seat tenons, cut a kerf perpendicular to the annual rings in the leg tenon, and then insert a small wedge to enlarge the tenon. This can be done for stopped tenons.
- For very loose-fitting tenons, cut a scrap of the leg wood with the proper size hole for the current leg and glue it on the tenon. When dry, re-turn the leg tenon to the correct seat mortise diameter. Make sure grain orientation matches the original tenon.