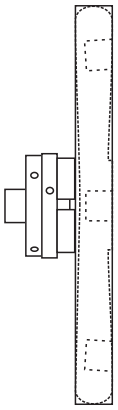
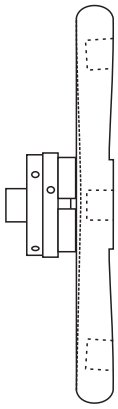
WOODTURNERS
SOUTH AUCKLAND
WOODTURNERS GUILD INC
TURNING TOMORROW'S TREASURES

Three-legged Stool

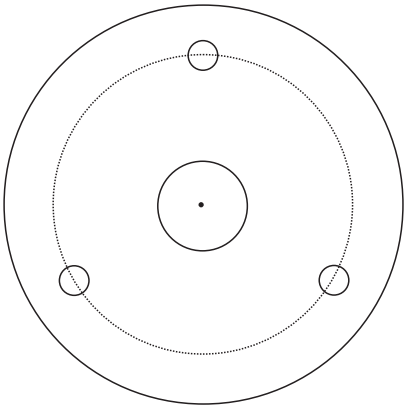
A three-legged stool will be stable on uneven surfaces, and may even be built without perfectly equal leg lengths. Dimensions for this stool are the makers choice.
There are numerous ways to get the stool top mounted on the lathe for shaping: screw a large waste piece on with screws at the planned position of the leg holes; or glue on waste blocks; or hold the wood between centres to cut the first chuck bite; or use a vacuum chuck while cutting the first chuck bite; or drill a shallow screw chuck hole on the under side and decorate it later.



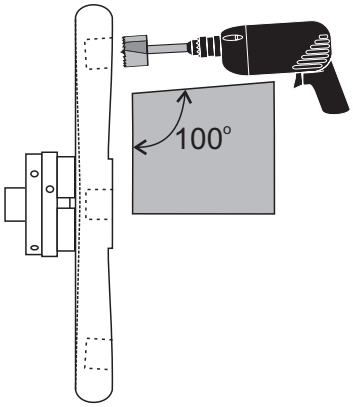
Mount the stool top on the lathe using a spigot cut into the top or an added waste block.



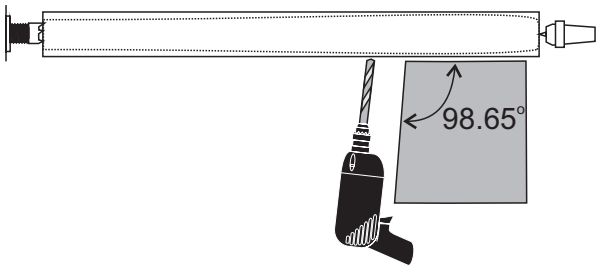
Round the wood and create the rollover at the edge. Cut a spigot into the underside of the stool top, or an added waste block.



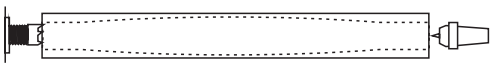
Draw a circle with a radius that is between 3/4 and 7/8 of the radius of the stool top. Mark the positions for the three legs on that circle using the lathe index or stepping around with a compass set to the radius of the circle.



Drill the leg holes. The holes may pass completely through the top or only part way depending on your choice of leg fixing method - glue joint; blind tenon; or right through and wedged.
The holes should all be at the same angle. Make a template (100° recommended) to ensure consistency. Use a drill holding jig if possible.
Turn the stool top over and finish the upper side. Then turn it again. Hold it in Cole jaws, Longworth chuck, vacuum chuck, or other method to remove the spigot from the under side. Finish the under side.

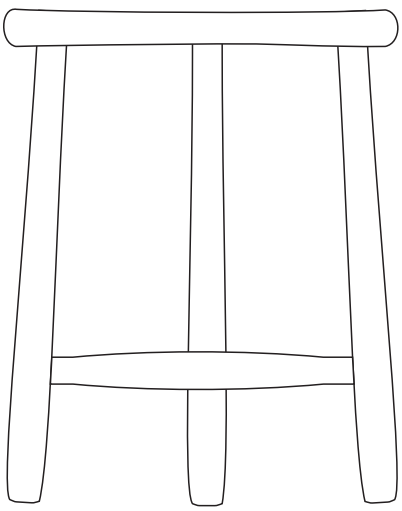


Mount the wood for the legs between centres and turn it to round. Drill the holes for stretchers at this stage. The 100° template will work for the angle but a 98.65° angle is more accurate.
Then turn the three legs to shape and finish.



To calculate stretcher length either use math, or dry fit the legs and measure.
Turn the three stretchers between centres and finish.

Assemble the stool



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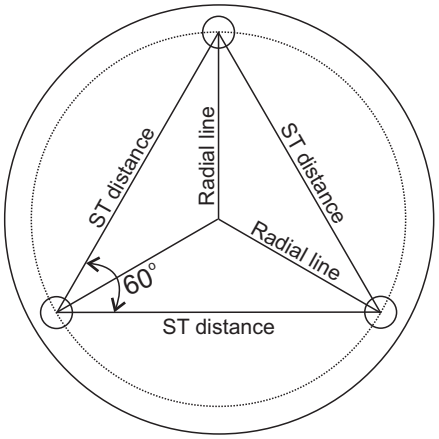
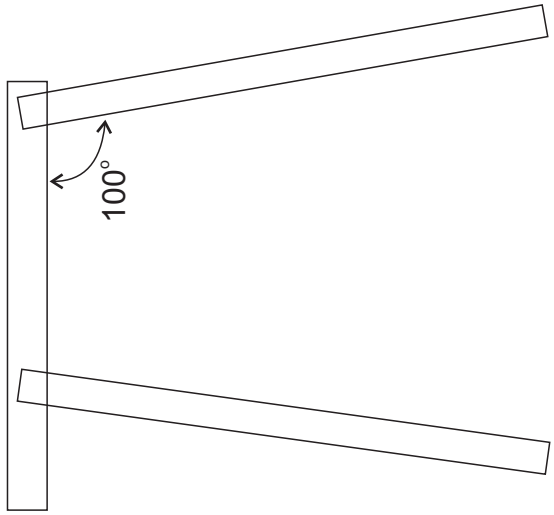
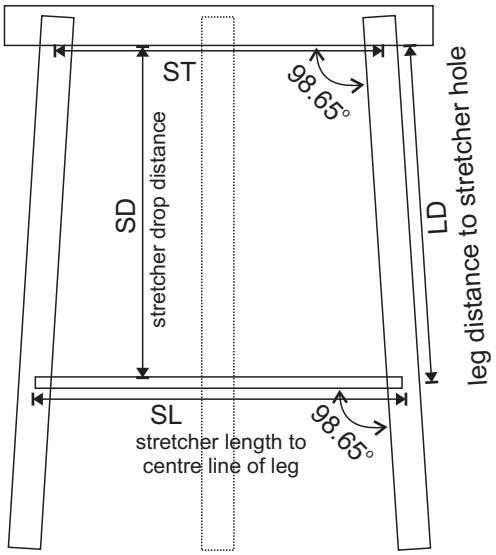
Calculating Stretcher Details

The legs of a three-legged stool are sloped outwards at an angle of 10° from vertical, or 110° measured on a radial line from the centre of the stool top. To calculate the length of a stretcher to be fitted between these splayed legs can be a challenge.







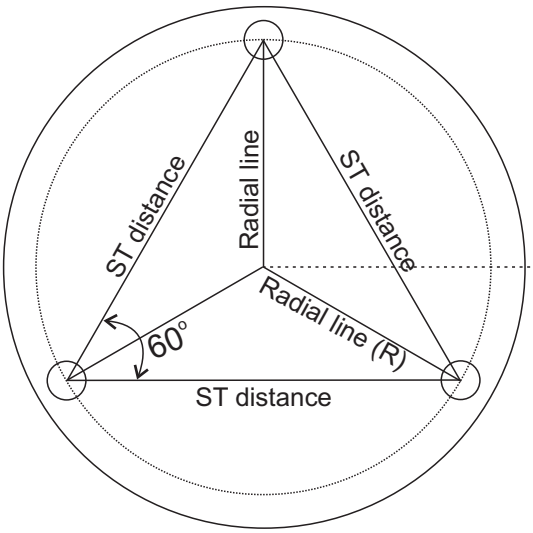
The angles of the legs when measured on the line between each leg (the ST distance), is 96.66°. The stretcher holes in the legs should be drilled at this angle. The ST distance is known or can be measured. The SD length will be your choice. The SL stretcher length is therefore ST distance plus 2 x Add (from the table). Add or subtract the distance the stretcher hole bottoms are from the leg centre line. To be super accurate positioning the stretcher holes use the length LD from the table beside the SD length in use.

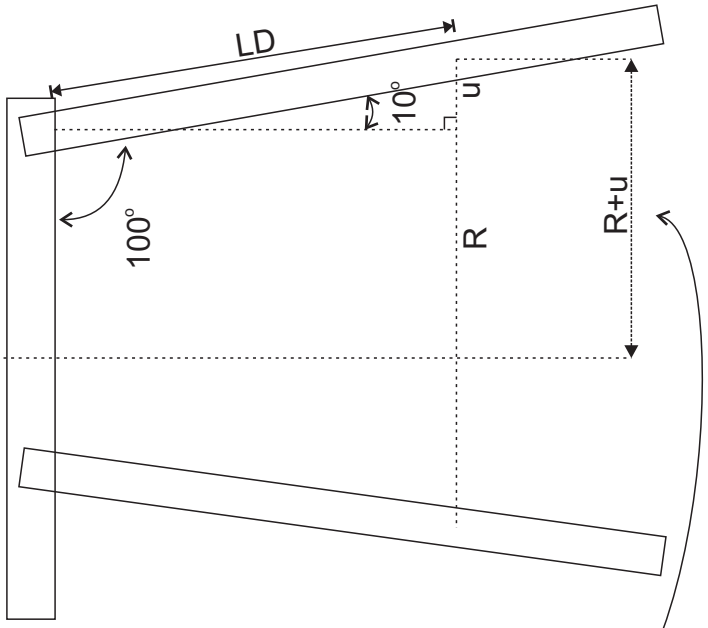
SD	LD	Add
150	151	17.5
160	161	18.7
170	171	19.9
180	181	21.0
190	191	22.2
200	201	23.4
210	211	24.5
220	222	25.7
230	232	26.9
240	242	28.0
250	252	29.2
260	262	30.4
270	272	31.6
280	282	32.7
290	292	33.9
300	302	35.1
310	312	36.2
320	322	37.4
330	332	38.6
340	342	39.7
350	352	40.9
360	362	42.1
370	373	43.2
380	383	44.4
390	393	45.6
400	403	46.7

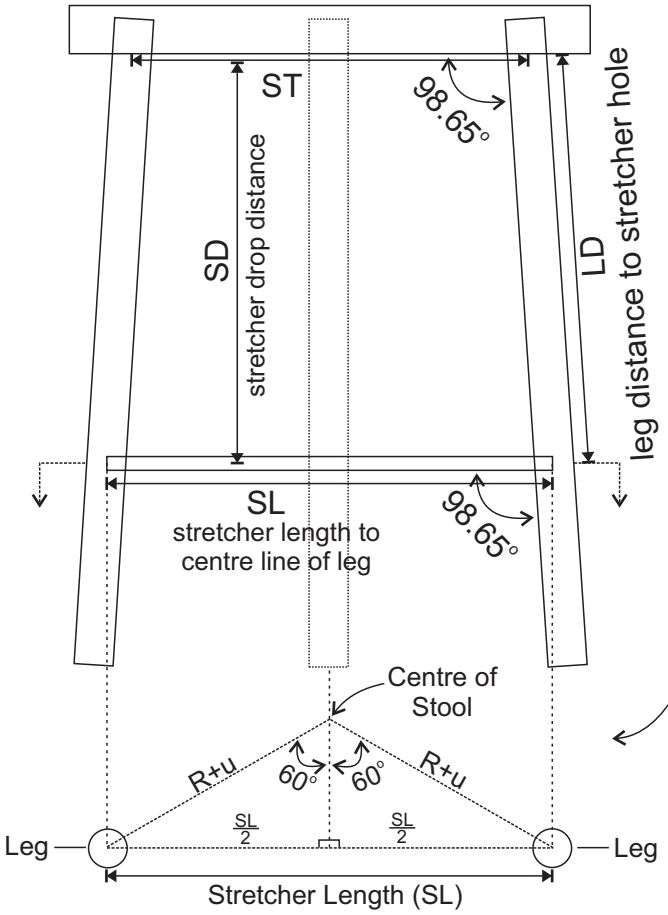
The data in the table are derived from the website http://saltire.com/applets/triangles/tri1s2a.htm

Three-legged Stool Calculations

This page provides a mathematical method to calculate the stretcher length for a three-legged stool. It does presume that the stretcher extends in to the centre of the leg but many woodworkers advise that the stretcher should not go more than one third of the leg thickness into the leg.







To find stretcher length (SL)

We first have to find R + u
R = radius to the leg holes
u = unknown radial at stretcher height

$$\sin 10^\circ = \frac{u}{LD}$$

$$u = LD \sin 10^\circ$$

The angle at the centre of the stool between the radial lines = 120°
Make an imaginary triangle at the plane of the stretchers and dissect it to make two right angle triangles

$$\sin 60^\circ = \frac{\frac{SL}{2}}{R + u}$$

$$\frac{SL}{2} = (R + u) \sin 60^\circ$$

$$SL = 2(R + u) \sin 60^\circ$$

$$\text{Stretcher} = 2(R + LD \sin 10^\circ)\sin 60^\circ$$

$\sin 60^\circ = 0.866$
$\sin 10^\circ = 0.1736$

$$\text{Stretcher} = 2 \times 0.866\ (R + (LD \times 0.1736))$$

$$\text{Stretcher} = 1.732 \times (R + (LD \times 0.1736))$$