Bench Lathe 3 in 1

(Lathe - Sander - Grinder/Sharpener)

Intro: Bench Lathe 3 in 1 (Lathe - Sander - Grinder/Sharpener)

Introduction:

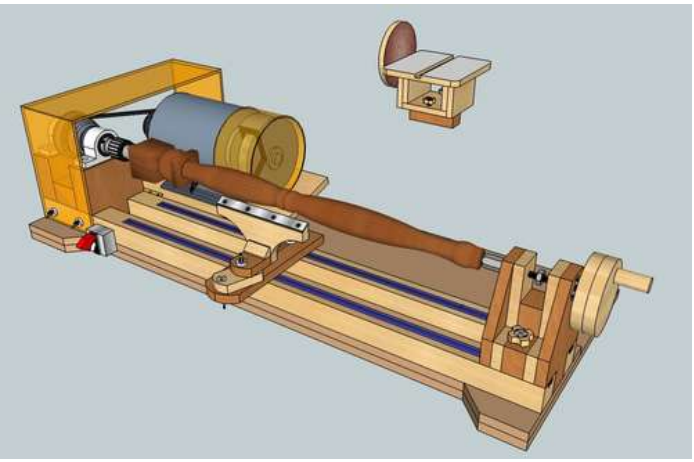
When I started a research on how a lathe should be, I search for different ideas, for various parts of it and studying the mechanisms of other lathes in the market, as I wanted the bench lathe to be completely made out wood.

The trick as I see it, is to find the right components that fit together to build the lathe's headstock turning mechanism. It should not be expensive, so everyone can build it, should be very safe, be solid and sturdy and with very good turning results.

I ended up designing a lathe that has also some add-ons like a faceplate to turn bowls. Has also the versatility to be used as a grinder/ sharpening station and as a sanding station with its attachable disk sander and table.

The lathe I design is big enough to turn an 80cm (31") leg on it, but it could easily be extended either with a bed extension or by simply build longer.

So here it's what I came up with, I hope you enjoy this



Step 1: Materials & Hardware:

The materials I used for this lathe are very basic:

Mainly everything is made out of plywood always 18mm (3/4") thickness, except some parts that you could replace it with hardwood like the headstock, and 2 pieces of 2X2 pine wood stock for the lathe bed (base), the 2X2 stock length can be determent from the length of the lathe you decide to build.

Hardware:

1 Bench grinder
2 Pulleys (3 step)
1 Belt
1 Double ended mandrel
2 Bearings
2 Stop collars
1 Drill chuck
1 Headstock spur drive center
1 Plate flange
1 On/off switch with box
2 Hinges
2 T-tracks
6 Flanged bolts
Various size woodscrews
Threaded inserts
2 Screw down threaded inserts
Bolts / washers / nuts / butterfly nuts / t-nuts
1 Threaded rod
1 Coupling nut
2 Acrylic guards
1 Steel wear plate

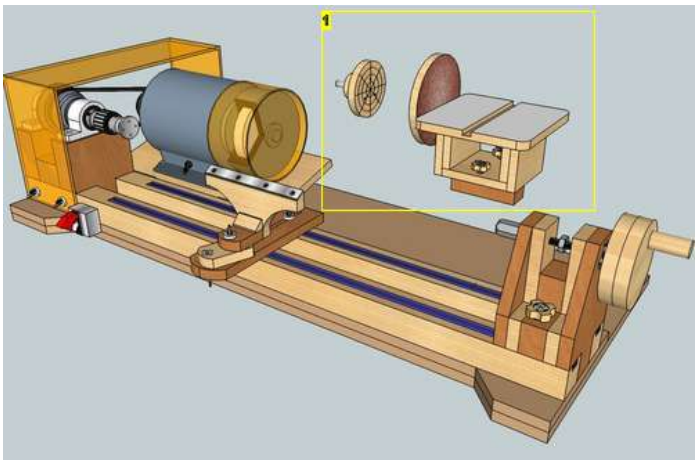


Image Notes
1. Faceplate & Sanding Station Attachments

Step 2: The Lathe Bed:

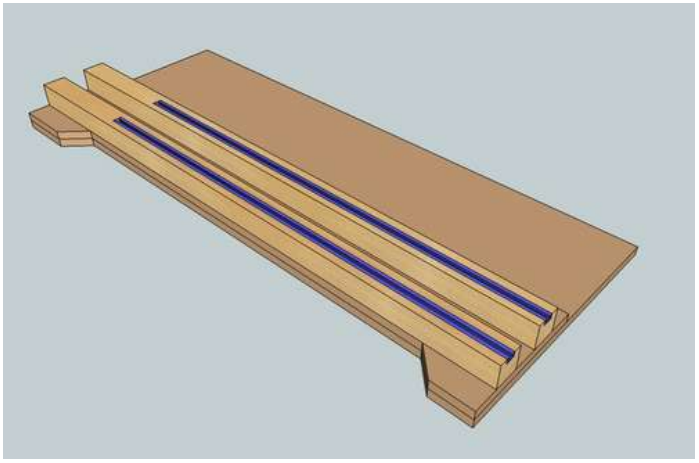
The lathe bed has an important function and it should give a solid/strong foundation to the moving parts of the lathe.

Mainly the bed is made of 1sheet of plywood 50x120cm (20"X47") and on top of it glued at edge there's another sheet of plywood 25cm (10") sandwiched together. After you glue and screw (countersink) the two pieces together you can make that cut with the 45 degrees angle cut to its end (if you want) which serves for clamping purposes only. If you can, it will be best to bolt it down on your bench, it will keep it from walking when large stock is turning.

2 5X5cm (2"X2") pine wood stock 120cm (47") in length is the lathe's body. The stock is flash with that cut of the base and they are 5cm (2") apart.

2 T-tracks sit in the center of each stock and there length goes up to the headstock chuck. So according to the headstock turning mechanism you will use you should calculate its length before deciding the t-tracks length. The ones I use in the drawing have a standard length of 90cm (3 foot) long.
If you don't want to spend money on the t-tracks you can use aluminum curtain tracks. I have tried them out and they work just fine.

In case you want the lathe to be smaller and have an extension attached to it when you need more length, is very possible.
Make another bed with its 2X2 stock and t-tracks and attach it side by side to the existing lathe bed. You can also hold it down with couple of clamps as well as join the stocks between them with an iron plate from both sides.



Step 3: The Lathe's Motor:

As I have said before, everything depends on what hardware you can get you hands on, so you plan the turning mechanism according to what hardware and motor you will use.

In this case for a motor I used a simple and inexpensive 1/4 HP bench grinder (even though I would recommend a 1/2 HP low speed motor 1750 RPM). The grinder has about 3000 RPM so we will need to lower the speed down.
To use the grinder you would need step pulleys of unequal sizes so that the largest step on the grinder pulley would be about the same diameter as the smallest step on the headstock pulley, or you would need another set of pulleys to reduce the speed down.

3 step pulleys of unequal size could give you about the following RPM combinations, and as you can see are quite good for turning.

Motor Pulley	Headstock Pulley	Arppox. RPM
small	large	700
small	medium	1000
medium	large	1250
large	large	1725
large	medium	2500
medium	small	3000
large	small	4150

Before you buy any of these (motor, pulleys or both) ask for advise from your hardware dealer about the speed they will run. Your want about 3000 RPM as a maximum speed and to be able to go down as low as 500 RPM (see last step of instructable about an alternative solution).

Mount the grinder with some bolts onto a piece of plywood and only after you will complete the headstock turning mechanism you will screw it down to the lathe's bed with couple of strong hinges. Make sure you leave room for the hinges to workup and down and cut it 6mm (1/4") shorter from the edge for the guard to sit.

The second pulley (which is about double the size of the motor's pulley) will go on the headstock mandrel and the two of them will turn (towards you) with a belt. The belts tension is achieved from the free pull of the motor.

Finally I attached an in-line on/off switch with a protection cup and its box on the face of the bed for easy access. Any switch type will do as far as you know how to wire it.

Basically what you do is to remove the grinders wire plug and attach it to the IN switch, then you put another wire leaving the OUT switch and with a plug to its end to connect to the socket.

If you are not comfortable doing so please consult a licensed electrician.

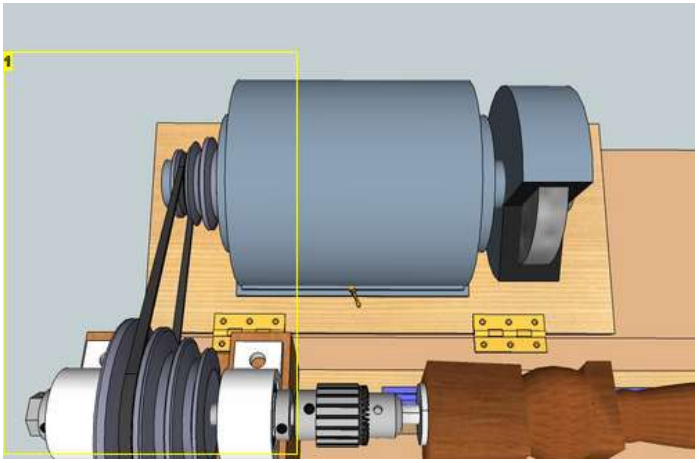


Image Notes
1. The largest step of the grinder's pulley is about the same size with the smallest step of the headstock's pulley.

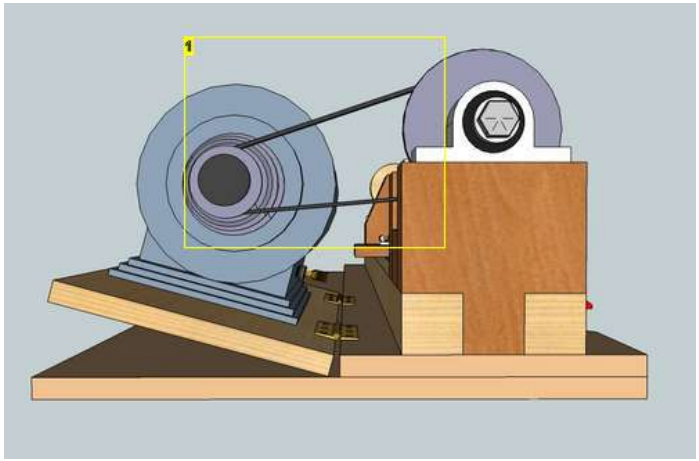
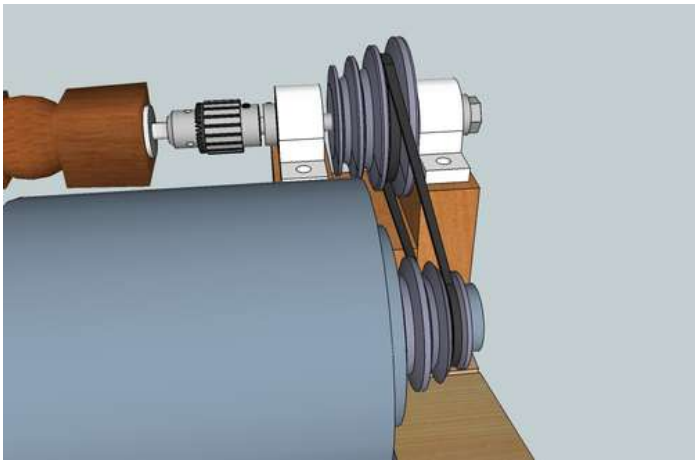


Image Notes
1. The belts tension is achieved from the free pull of the motor.



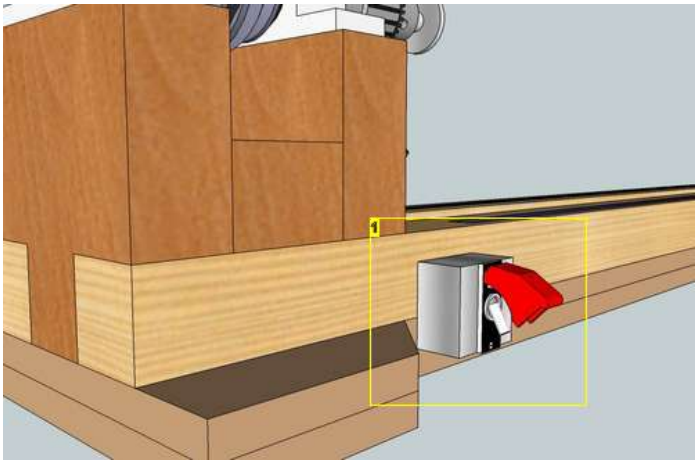


Image Notes
1. safety on/off switch with box

Step 4: The Lathe's Headstock:

The headstock is the piece that will hold the turning mechanism (hardware) and support the work-piece of the lathe, so it should be very strong.

The thickness of the headstock is according to the mandrel and pulley size you will use.
It can be made of thick pieces of hardwood (if you can get your hands on any) or it could be two pieces of plywood stack together which is also makes it very strong.

My design of the headstock starts with thick T shape hardwood which is 15cm (6" wide), 16.5cm (6.5") high and deep enough to take the mandrel base. You will need two identical pieces of these. Then there's the middle piece which has the same length but shorter so that can give allot of clearance to the pulley and the belt, and its thickness is bigger than the pulley's steps. These 3 major wood pieces can be also be made from plywood. Everything needs to be well glued and screwed together solidly.

The headstock mechanism consists from a double ended mandrel with its bearings, a shaft and its locking collars, the second 3 step pulley which goes on the center but facing to the opposite direction from the motor's pulley, and a strong drill chuck at the end.
Now all these have to be found from your local suppliers or the internet and match together before you can build the headstock.

The mandrel is to be fastened down with 4 bolts and nuts into threaded inserts that will go into the wood.

In case you are wondering if you can avoid the mandrel, then I will say that you could make the two edged pieces taller like two towers, drill holes to accommodate tightly the two bearings (bearings need to fit the bolt diameter), use a long bolt without threats to go through the 2 tower pieces (needs to fit the pulley opening), file the bolt flat to the areas that the locking collars will be tight down, and mount the drill chuck to its end.

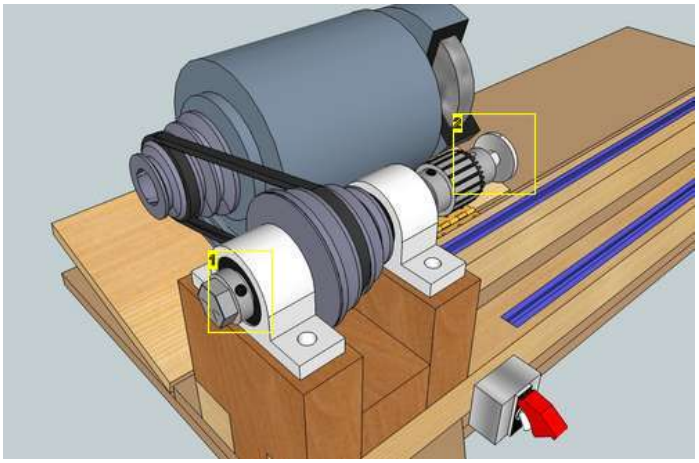


Image Notes
1. Stop collar
2. Spur Drive Center

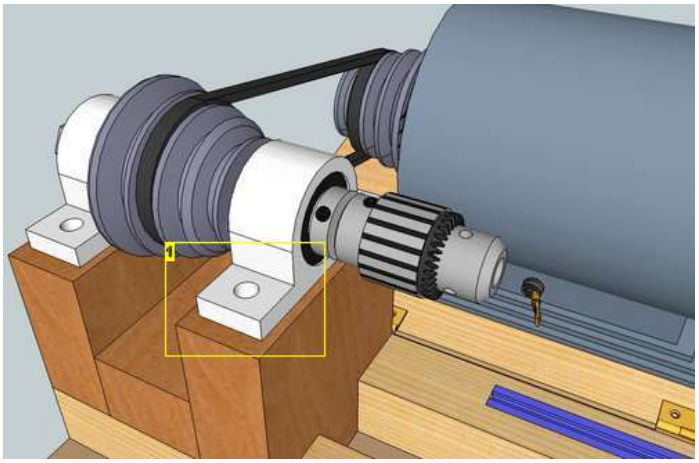


Image Notes
1. To hold the mandrel down use bolts & washers screwed into threaded inserts

Step 5: The Lathe's Tailstock:

Now for the tailstock you can only used plywood sandwiched together (I used a hardwood center piece). The different color pieces you see in the pictures are only for visual clearance purposes only.

The 3/4 plywood pieces overall dimensions are 15cm (6") wide, 21.5cm (8.5") tall, and have the same T-shape cut as the headstock. The angle cut for the two edged pieces is from 22-25 degrees not important. There's a hole on the top that its center is in perfect alignment with the drill chuck's center. Two screw-down threaded inserts are used here for better security, one on each tower. A threaded rod goes through them with its end grinded to a fine point which will help to hold the work-piece in place. The rod is about 180cm (7") long.

At the front end of the rod there's a Coupling nut screwed on, that prevents the turning work-piece to sleep deeper into the point, and also acts as an outer locking stop. In the centre of the threaded rod and between the tailstock's towers there's locking stop nut that can be tight to the left side.

In the inside face of the two towers there's another plywood piece which is identical to the tower but without the angle area. The center width of that piece is 5cm (2") so when you look at it "stand alone" has a cross shape. These two pieces have also the same matching hole on the top. I strongly recommend that you drill the tower's holes at the same time on your drill press.

The center wood piece of the tailstock, is either a piece of hardwood or two 3/4 plywood glued together and cut in a cross shape. The height is not important as long as you leave space to the rod locking nut to be tightened with a wrench. The center wood also provides enough area for the two hold down knobs to hold the tailstock from moving.

Finally at the end of the threaded rod I made a simple hand-wheel to move the rod in and out thus holding the turning piece tight in its position. The hand-wheel is made out of two plywood sandwiched circles 12cm (4.7") diameter, has a wooden dowel handle and is threaded on to the rod with the help of countersink nuts and epoxy.

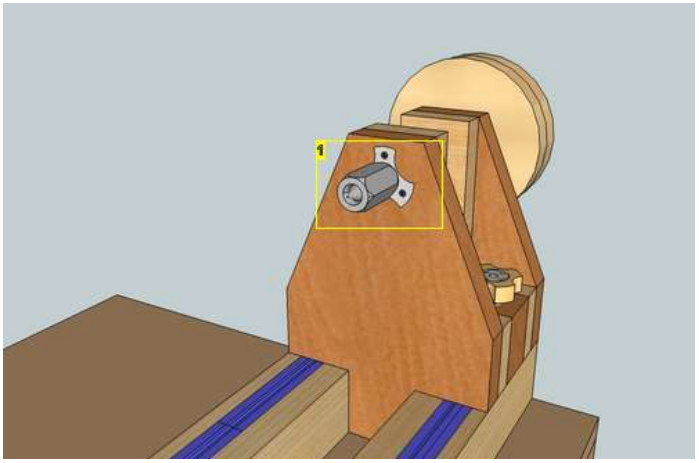


Image Notes
1. Screw down threaded inserts are in both outer sides

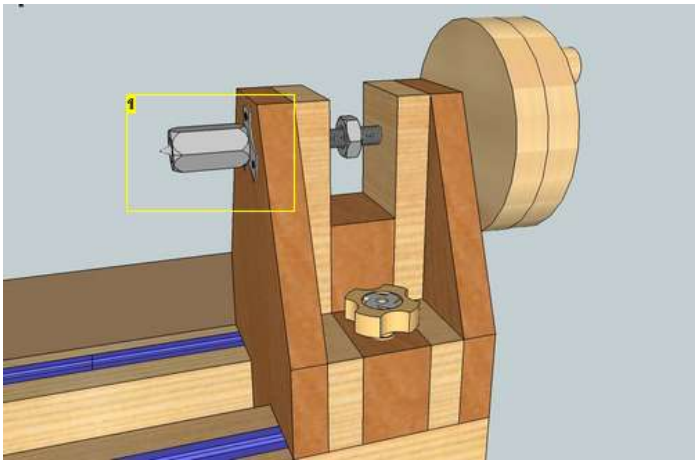


Image Notes
1. Coupling nut with the threaded rod's pointed end coming out

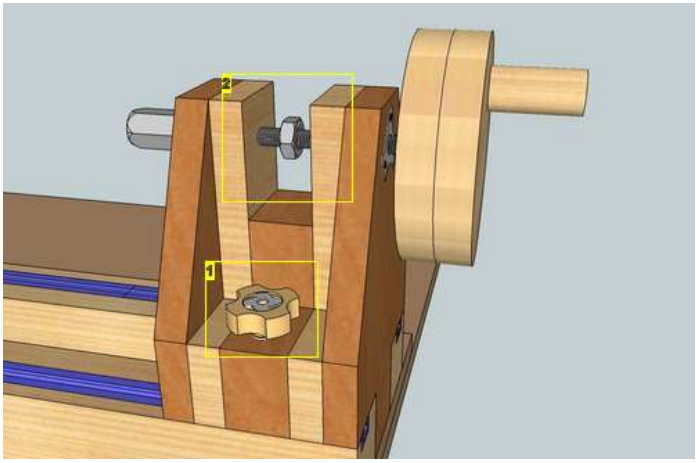
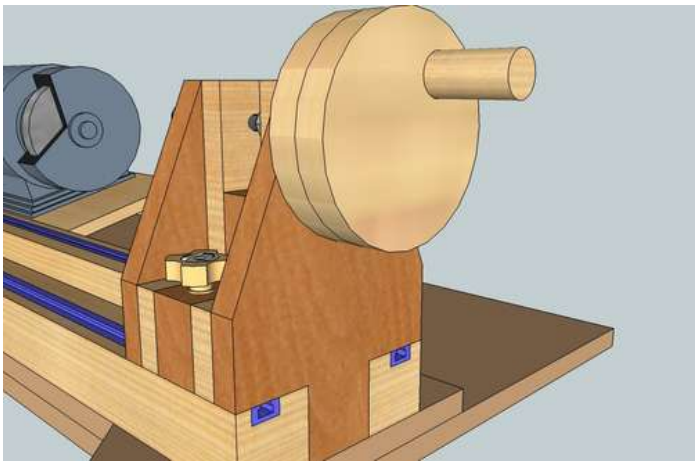


Image Notes
1. homemade gnobs made with t-nuts and plywood
2. Stop locking nut

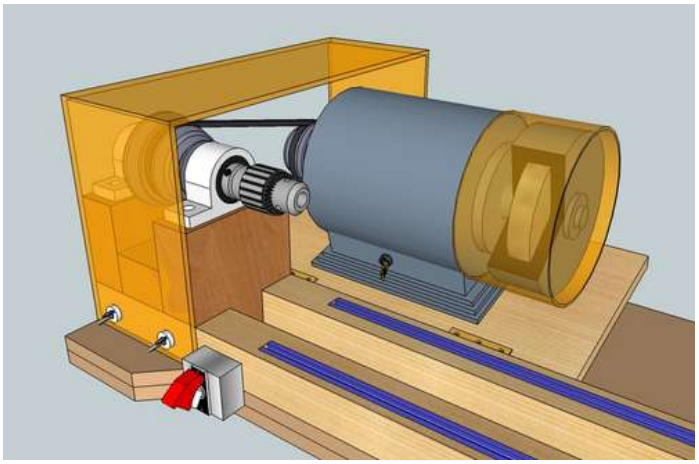


Step 6: Belt & Grinder Guards:

Safety it's always a factor to consider so a couple of guards come in place.

First a belt guard which is very simple to find or make. The guard is made from acrylic, just a simple shape and screwed in the front with 2 butterfly bolt nuts on threaded inserts, any sign maker or advertising gifts shop can make this for you very easily.
The dimensions for the one on the design are 45X17X27cm (17.7X6.7X10.6") these are not critical as long as it fits in front and sits at the back edge also have in mind that the back side is a plywood's height shorter.

The grinder guard is just a round open top box (a small bucket will do) which can be screwed somewhere on the grinder wheel metal protective guard. This area must be protected because the grinding wheel will always spin when the lathe is in operation.



Step 7: Tool Rest:

A modular toll rest is the solution for this design here.
This tools rest was featured in shop-notes magazine and suits our purpose fine here (no reason re-inventing the wheel again).
The tool rest is made in 6 parts and it can give you the flexibility you need to position it in the right position.

For this case here I have positioned the tool rest steel wear plate height to be 6mm (1/4") below the lathes center line. You could adjust this if you want by adding some thin layers of 3mm (1/8") hardwood between the tools rest base and the 2X2's.

Note: It's better, when you cut these pieces, to cut them a little bigger, and trim them down to their final length as you go, better than the other way around.

Toll Rest Parts:

1) Tool-Rest Base
2) Pivot Arm
3) Tool Support Base
4) Filler block
5) Tool Support Arm
6) Steel Wear Plate

So all pieces of the tool rest are 18mm (3/4") plywood:

1) First we have the tool-rest base which is 10X30cm (2"X12") and has a groove in its center for free movement on the t-track bolts. Wing nuts and washers help to hold the tool-rest down in position.
Its outer site is cut in half circle to prevent scratching yourself. As you make this base take the time and make also a few 3mm (1/8") thickness identical shims to use for height adjustment. There's a hole at the front edge with a bolt and a wing-nut and washer to hold the pivot arm.

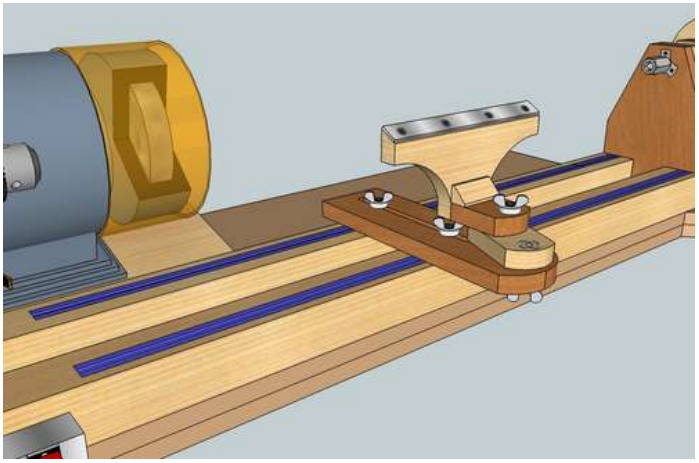
2) Second piece is the pivot arm with dimension 7.5X10cm (3X4"). The piece is rounded at both ends and has a hole at its TOP outer end, a countersink t-nut to secure it on the base. Another hole is about 6.5cm (2.5") in from the outer end, with a countersink t-nut at the BOTTOM to hold the tool support base.

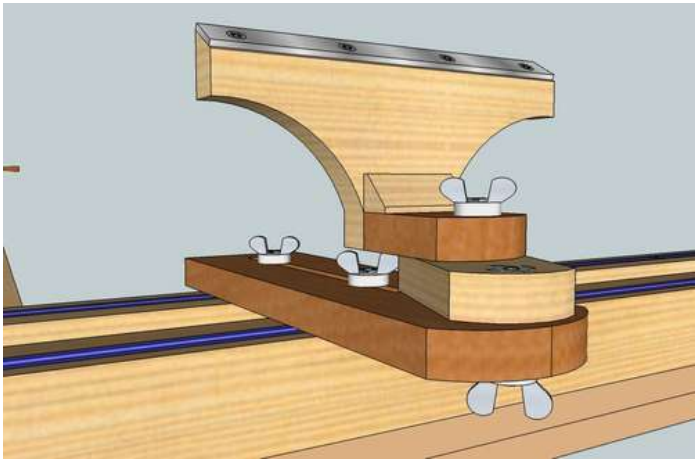
3) Third piece is the tool support base. Its dimensions 6.6x5cm (2.5x2") rounded only at the outer edge while the inner edge remains straight. It has a hole near the outer edge for the bolt and wing-nut and washer to secure it on the pivot arm.

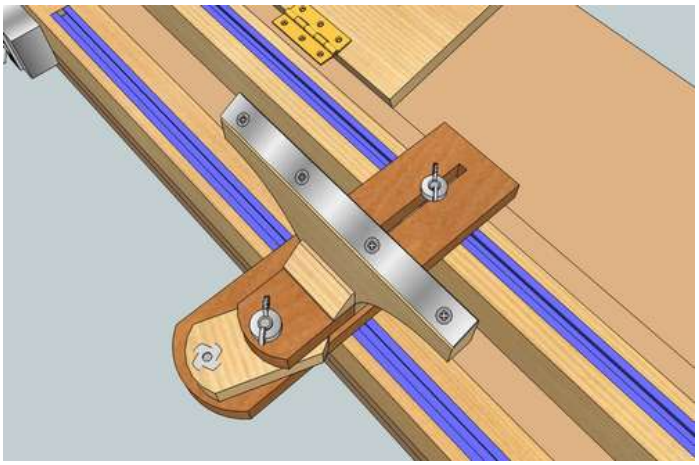
4) The filler block is just 18x18mm (3/4X3/4") hardwood, cut at 45 degrees to give extra support to the tool support arm. You can replace this block with a metal angle if you want.

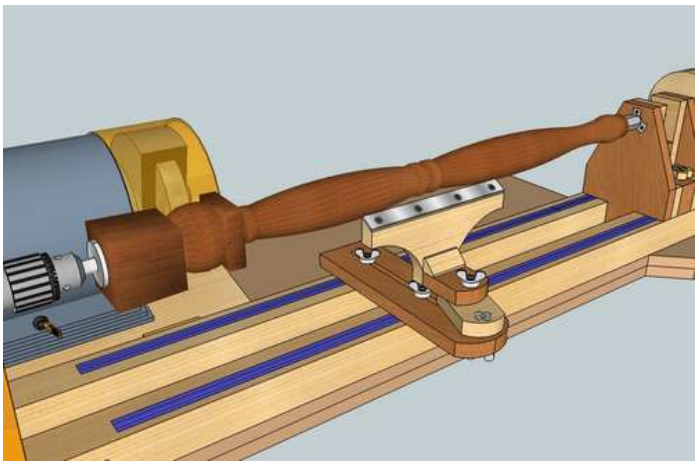
5) The tool support arm is a critical piece. Its overall dimensions are 10x20cm (4X8"), and it sits flash with the bottom of its base. Glued and screwed for maximum strength to its base, it has a big curve cut which starts from the top of the base, and ends 3cm (1 1/4") from its top. There's a 30 degrees miter cut off the top to mount the steel wear plate. If you want the tool support to be wider that's your personal choice.

6) The steel wear plate is a 3mm (1/8") thick plate with four countersink screw holes, and its purpose is to prevent tear and wear as you turn. Please make sure to file round and sand smooth all edges to allow an easy slight movement of your turning chisels.









Step 8: Faceplate Attachment:

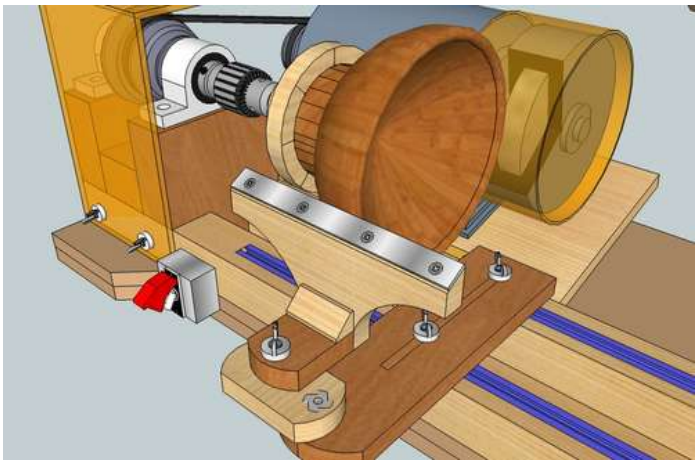
The faceplate attachment is used for mounting thick stock for bowl turning. It's easy to make and has 3 parts:

1) Plate Flange
2) Body Neck
3) Mounting Plate

1) The plate flange is nothing more than a circular plate with an arbor for mounting the faceplate to the chuck. You can find one to your local hardware supplier. I would not recommend trying doing one yourself unless you have access to the tools required and the knowledge, it needs to be perfectly centered and without any play.

2) The body neck is very simple you can cut 2 or 3 plywood circles 6cm (2 1/3") in diameter and glue them together and screw them on the plate flange from the back side of the flange.

3) The mounting plate has diameter of 13cm (5") and it's made of plywood, has all around holes for mounting the work-piece to the faceplate and four holes for mounting the plate to the neck. Glue and screw the plate to the neck and you are ready to turn your first bowl.



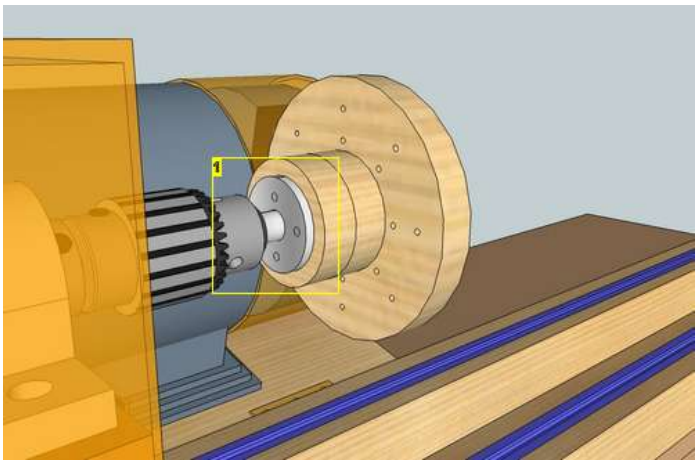
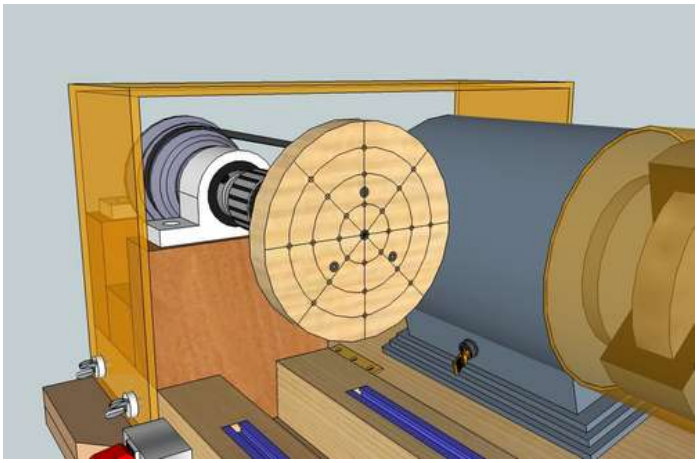


Image Notes
1. Plate Flange



Step 9: Sanding Disk & Sanding Table Attachment:

The sanding Disk:

Now that you have built a faceplate, you know exactly the procedure on how to build the sanding disk because is exactly the same. The disk has minor changes from the faceplate, its body neck has a 7.5cm (3") diameter and the disk plate is bigger 20cm (8").
You need to keep the 4 mounting holes to glue and screw it with the neck.
Attach an abrasive sanding disk to it, and it's ready to go.

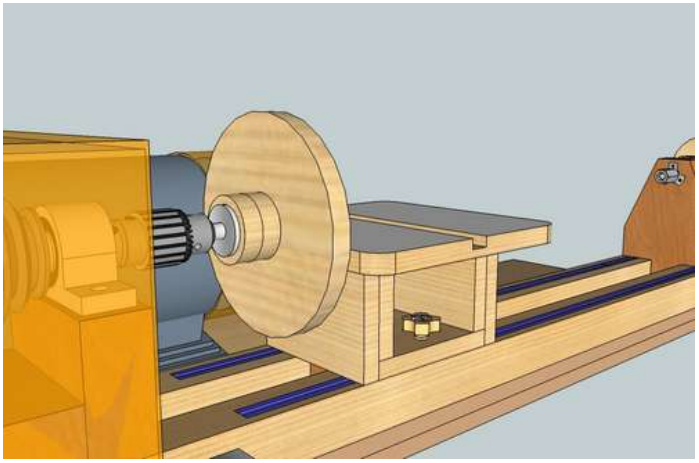
The sanding table attachment:

The sanding table is made out of 7 pieces of plywood and 1 piece of 2X2 pine stock.

A square 15X15cm (6X6") base piece with two knobs aligned with the t-track below to hold it tight on the lathe bed.
Attached under the base piece the 2X2 pinewood stock that will keep the table centered.
Two 15x11cm (6x4 1/3") outer walls and two 15X9.2cm (6X3.58") inner walls form the body of the table.

One top piece of plywood 25X25cm (10X10") with a miter track grooving (to accept a miter gauge or a featherboard) in its center serves as the sanding table's top, it is important that the grooving is parallel to the sanding disk, so use a square to position the table top before you screw it.

Also it will be nice if the top has a melamine sheet glued over it for easy dust off.



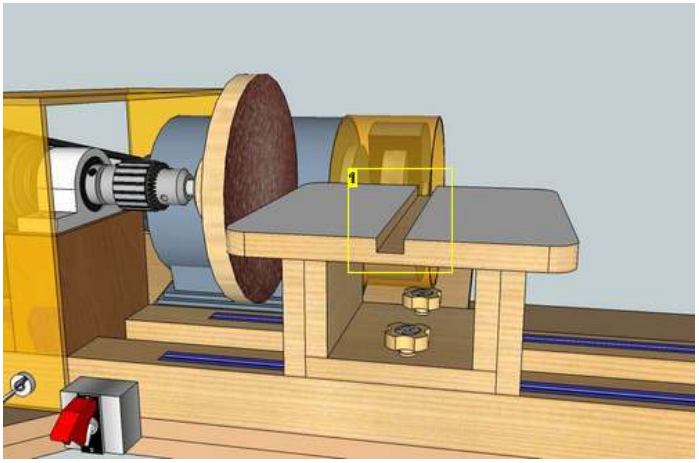
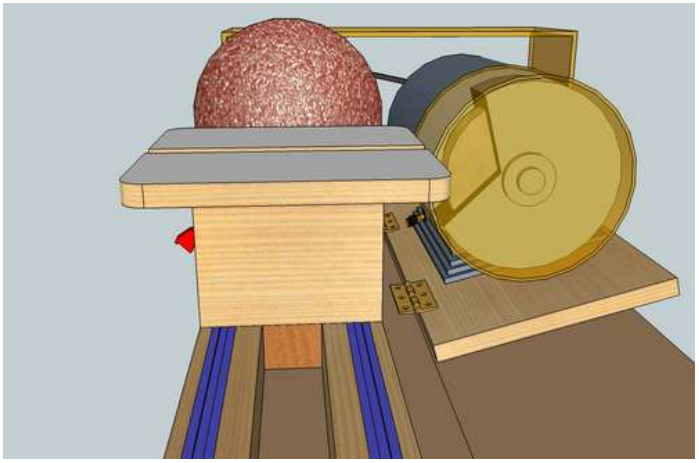


Image Notes
1. Miter track to accept a miter gauge or a featherboard



Step 10: Bench Grinder or Sharpening Station:

By using the bench grinder as the lathe's motor it has its advantages.
While the one side of the grinder is used for the pulley drive, the other site it's free to be used either as a normal **grinder** with a grinding stone wheel or you can replace the stone wheel with an aluminium oxide 'white' grinding wheel and use it as a chisel **sharpening station**.

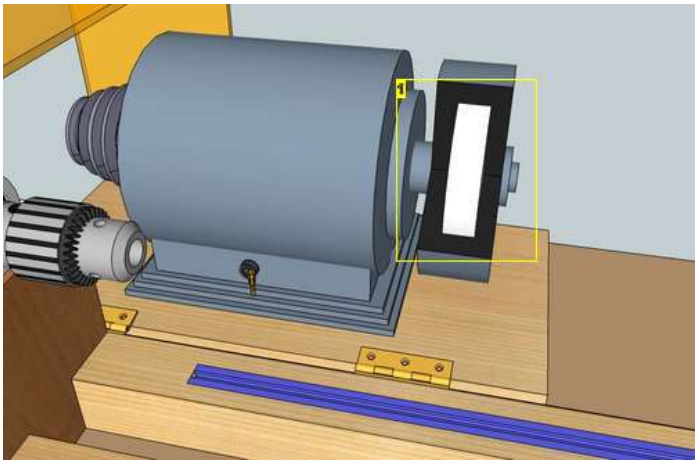


Image Notes
1. Aluminium Oxide 'White' Grinding Wheel

Step 11: An Alternative Solution:

I don't know about you people, but me here where I am, I will have a problem to find the tailstock hardware to put the lathe in motion, and if ever I decide to build this lathe I will have to face a very big dilemma.

One is finding things that will not match exactly, and I will have to ask help from a professional mechanic to fit everything together. That will be very-very costly, time consuming, and it's not worth it.

The other option I have is to import all the necessary hardware and motor from overseas, that also will be costly, so I might as well buy a new factory made lathe and save myself the trouble.

But there's a third solution which I thought about, and I believe it just might do the trick for me or you.
Do you remember those inexpensive Chinese drill presses that you can buy for about 60 dollars?
Maybe if you can get your hands on a second hand drill press?
That will be fantastic.

You will be wondering what to do with the drill press... well a drill press has most of the necessary and matching hardware we need to build the lathe.
It has a strong 400W motor (1/2HP), the two pulleys with the belt, has a strong shaft, bearings and a chuck, so you have almost everything you need and they match together.
Since the pulleys have 5 steps they give the following speeds:
2650 - 1650 - 1220 - 850 - 580 RPM more than enough speed choices for lathe turning.

So there you have it,
*a **3 in 1 Bench Lathe - Sander - Grinder/Sharpener***
I hope you enjoy the instructable and found it interesting.

If you decide to build it, it will be nice to post some picture and tell us your experience in building and turning with it.

All comments, suggestions, information and ideas are welcome

Stelios L.A. Stavrinides
Nicosia - Cyprus

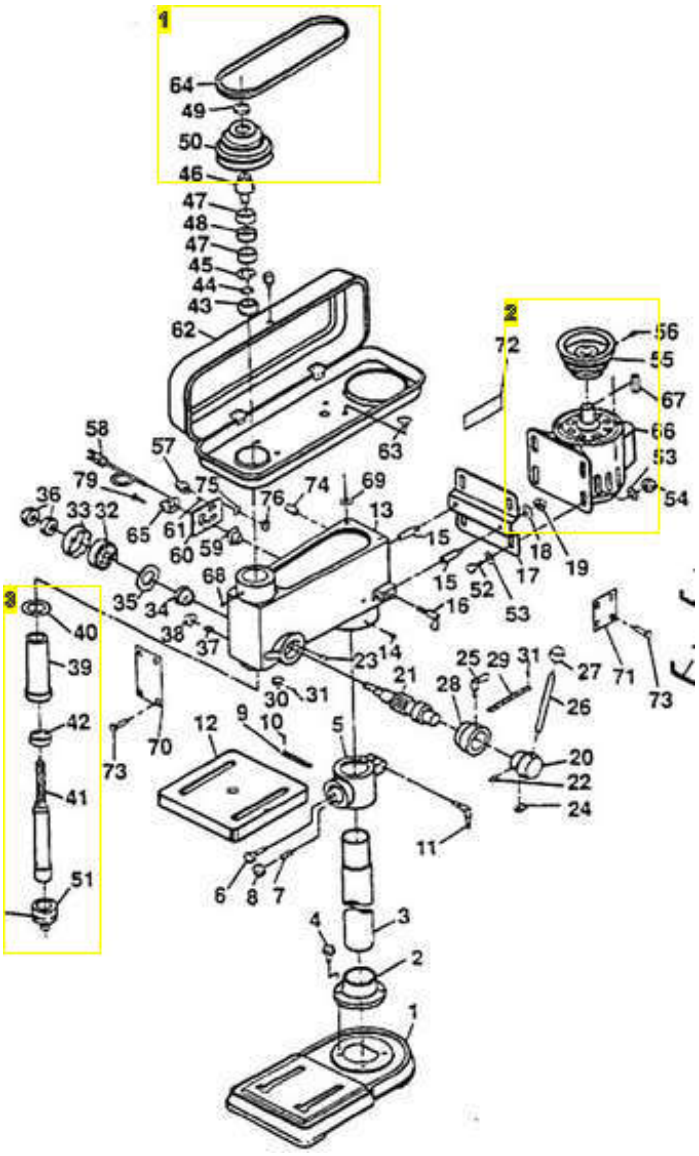


Image Notes
1. Belt and 1st 5 step pulley
2. Motor with 2nd 5 step pulley
3. Chuck, Shaft & Bearings