Production Technology: Theory and Practice
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Lecture - 31
Lab - 08

(Video Starts: 00:21)
Hello and welcome to the course on manufacturing technology - theory and practice. Now what we are going to demonstrate to you is how to make a block ready with the hole and the required surfaces as per the drawing that you can see here. So, in this drawing you can see that this is a block in fact this is the blank for this job, this is the final job and here these two are parallel surfaces, these two are perpendicular surfaces.

And they are smooth now, there are two holes, the hole locations are given from this axis as well as from vertical axis and the distance between the holes can be found out; then we will show you how to file these surfaces; how to make sure that these two surfaces are perpendicular to each other, those blocks that I have shown you that through which you cannot see the light, in that case this is perfectly aligned to the horizontal and so on.

After that there will be marking; initially you have to mark so that the hole can be drilled. So, there are two holes which have to be drilled and on those two holes according to the drawing you can see that there are also threads. So, first the hole will be made with a drill and I already told you that after the drilling the diameter of the hole will be slightly different than the diameter of the drilling drill and it is normally little more than the diameter of the drill because of the vibration of the drilling machine.

So, overall, the accuracy of the hole is not perfect. Therefore, to improve the accuracy we have to tap it, we have to ream it first using the reamer. We will show you how the reaming can be done in this case we will be using the hand reamer; after hand reaming, we will show you how the internal thread can be tapped in these holes. So, there will be a tapping operation and how this internal tapping or the internal thread can be made.

These are the operations that we are going to demonstrate to you right now. So, as I said that first it has to be filed to make sure that this dimension is perfect according to the drawing and I have shown from the drawing to you, so they have to be parallel absolutely parallel and this

dimension has to be according to the drawing. For this purpose, this has to be filed so that the material is removed and this dimension can be maintained.

So initially, since a lot of material has to be removed, so and it has to be done manually. Mr. Aman Singh will demonstrate this device, in this device this job has to be mounted and then it will be filed manually, first with the rough file that I have shown you earlier. Here you can see closely that this is rough file and these are double cut.

When sufficient material has been removed, the final material removal will be through the fine file. So, this is the final one, as you can see, smoother one and this smoother one will remove less material, but it will improve the surface finish and this is also a double cut file. So, using both the rough and the smooth files, we can make a very smooth surface and these dimensions can be maintained.

Dimension between these two surfaces and the dimension between these two surfaces as well as we have to make sure that these two surfaces are absolutely parallel. These two surfaces are absolutely perpendicular to each other and these two surfaces are parallel to each other. These are the processes which Mr. Aman Singh is going to demonstrate to you and then the marking will be done for drilling the holes.

Hole will be drilled in the drilling machine. They will be hand reamed and then finally the internal thread will be cut with the hand tapped. So, it will be first clamped in the vise and while clamping make sure that this is kept absolutely horizontal. So, now this is the rough file, just mind it for the safety purpose you cannot hold it this way because in that case you may actually hurt your hand.

So, we always ask the students to keep the hand like this so that even if it comes in there, hand will not be hurt. It has to be done on the horizontal surface if it is done vertically in that case you know that this will not be a flat surface, but this may be rounded off surface.

Now the rough filing has been done and then we will be fine filing. This is fine filing; in fine filing you can see that much less material is removed as I said but the surface is smoothened; surface is smoother than after it was obtained with the rough file and then all the time it will be checked whether this is perfectly horizontal; after it is satisfied you can see that there is no

light seen and therefore, it is absolutely perpendicular to the other surface as well as it is horizontal.

That surface is flat horizontal now it is turned around and the lower surface or the other surface on the opposite side will be similarly filed. This is the fine file, rough file and this is fine file. So, while doing so, you have to have two checks, one that this is horizontal then you have to make sure that this is vertical, those 2 surfaces are vertical this surface and this surface.

And then you have to also make sure that this dimension is maintained this dimension is given by the drawing. So, this dimension has to maintain otherwise, if you more bit more and this dimension will be then less than the then given in the drawing so it will be useless. So, all the time those checks you have to do that the surfaces are proper as well as the distance between the 2 surfaces is according to the drawing.

Now, it has been rotated at 90^0 and again the rough filing is done. So, most of the material is removed in that case and the check is done that this is perfectly flat then the fine filing to remove the bars as well as to improve the surface smoothen the surface then it is checked again that these surfaces are at $90^0$to each other these two surfaces, so, if you do not see any light through this T square in that case it is OK.

You can make sure that those two surfaces are perpendicular to each other. Now the opposite surface similarly it is a rough filing and then it will be fine filing, the same procedure which has been followed for the other surfaces and then you have to check whether it is horizontal and whether these two surfaces are perpendicular to each other, the side surfaces.

So, they are perfectly perpendicular to each other as well as what you have to see is that whether these distances matched, this distance has to be also according to the drawing that is given and this distance has to be also checked that they are given according to the drawing that I have already shown you, that this is the dimension which is given and this is the dimension which is given.

So, these dimensions have to be also checked, the vernier caliper is there so, you can quickly check by reading the main scale and the vernier scale and where these 2 scales reading are

meeting, you multiply by the least count which is 0.02 and so on. So, this has been already told to you in the power point presentation of the metrology class, in metrology session.

And then we have to mark that for drilling that hole. This is to remove the burrs because when the filing has been made there are some small burrs appearing. So, now it is perfect. Now it will be marked. So, as I was telling that there will be some kind of painting or you can even use chalk for that so that the marking will be visible. So, you can also use a white paint so that it could be visible prominently.

Now, this is the height maker, height checker. So, check the height using the height gauge, this is the 0 position and then according to the requirement that is there in the drawing that at which height you have to have the hole from one of the basis that is either from here are from here accordingly you have to make the marking so, that is 10 mm. So, you mark the 10 mm in the height gauge and you the just make the marking.

So, this is along the axis along which the holes will be drilled. So, that line can be visible now it is a vertical line, one horizontal and one vertical so, their meeting point will be the centre of the drilling of the hole where you have to drill the hole then it is 25 from other axis. So, centre to centre distance is 25 mm.

So, at a distance of 25 millimetre, he is marking, so another centre will be at 40 millimetre this is as per the drawing. Accordingly, you can see those drawings so this is the distance which is given 25, 40, 10. So, accordingly he is setting up the marking gauge, height gauge and through the height gauge he is marking.

Now the marking is done and you can see the marking is visible clearly because it has been painted by the chalk and here exactly the drill point will be used and point will be made here where the hole has to be drilled, here and here, this is the hand punch, marking will be done at the centre of each of these holes like that. So, these are the two holes, these are the centres of the hole.

Where you have to make the hole and also there is a slot to be cut. So, that is for slot cutting, he is also marking the slot, you can see here from the drawing, this is the slot that we will be cutting because there is a sawing operation and that operation also we will demonstrate. So,

these are the markings and the centres are marked as well as the position for the slot is also marked with the help of the hand punch.

Well, first of all the job has to be mounted for drilling the hole. So, job has been mounted using the vise and according to the drawing, the hole that has to be drilled and tapped, a hole of 10 mm diameter. When the hole will be drilled, the drill diameter has to be less than the diameter of the hole. Because if you take the 10 mm diameter drill to make a hole of 10 mm, then invariably the hole diameter will be little more than the 10 mm.

And you cannot meet the accuracy. Therefore, the drill that has been selected here is 8.5 mm drill then the reaming will be done then the tapping and finally, the hole will be metric hole, M10. So, that is how it is written on the drawing the hole as M10 which is metric and the 10 mm diameter. The machine is switched on. Since the marking is already there for the centre, the drill is touched first and then it is given the downward movements for penetrating the workpiece.

And the hole will be a through hole and then the drill is taken out and the machine is switched off. So, one hole has been drilled. Then the next hole has to be drilled. So, that is for the another hole with the same speed, the another hole is being drilled the cutting fluid has to be provided because there will be a lot of friction and a lot of heat will be generated. So, otherwise the drill will be worn out very fast and the accuracy of the hole drill will be less.

This is because of the high friction between the drill and hole that is being drilled. So, now both the holes have been made and as you can see that they are of different diameters because different diameter of drills have been selected; now it will be hand reamed. Now the hole has to be reamed because the hole accuracy is not very high.

So for that purpose, this is the reamer and if you remember I told you that the reamer teeth are like that. This reamer particularly has 6 teeth. Normally if you see all the reamers will always have even number of teeth. So, there are two purposes for that.

One purpose is that the reamer being an accurate instrument, you have to use it not to remove the material as much but for the improving of the accuracy. So, you have to very accurately find out what is the diameter of this reamer. For example, if it is worn out then the diameter

can be decreased. So, before reaming, according to the requirement of your hole, you have to measure the diameter very accurately. That is possible if only the teeth are of the even number.

Another reason for having this even number is that the force requirement here is not as much as in the case of the drilling because the material removal rate is not high. Therefore, the force balance is very important for the opposite teeth and if there are even number of teeth only then the opposite teeth will have the balanced force.

And that is another reason why the number of teeth given in the reamer is always even number. So, in practice you will see any reamer, be it a machine reamer be it a hand reamer, the number of teeth will always be an even number. So now this reamer has to be fitted in the reamer holder. This the reamer holder and using this this square cross section now this will be held in the reamer holder so, this will be hand reaming and by hand.

Using the hand using the force, torque as well as the thrust given to the reamer by hand this will be reamed, and as you have seen that a cutting fluid has been provided. So, if you see the difference between this fluid and the fluid that we have used in the machine as cutting fluid, you should understand that here it is oil-based fluid.

Because here the friction is more important. Therefore, the coefficient of friction has to be decreased and for that the oil-based fluid has been used whereas, in case of the drilling machine or the turning machine, water-based fluid was used because there a larger amount of heat has to be removed.

Similarly, now it will be tapped. So, now, next operation is that within here there will be internal thread. For that a particular tap has been selected and by providing the torque by hand and by providing the thrust, that is the penetration of the tap to the workpiece, the thread will be cut.

This is the technique that is used that you have to turn this to and fro so that it can actually have a smooth exit. So, the drill hole is now reamed and tapped. So, this is the final tapping. Now, these are intermediate or final intermediate tapping so, tapping has to be done thrice,

once is rough, once is intermediate and the final is the smoother one where it is the perfect tolerances and the sizes accuracy of the thread or the threaded hole can be maintained.

So, this is the final tapping to have the final accuracy of the drilled hole. So, this is filing, he is filing to remove the burrs from the top from both the sides, otherwise it will disturb the threads to come in. So, you can see that now the holes are made and this hole is tapped and this hole is reamed. So, this is a reamed hole without any internal thread as per the drawing.

We have seen the techniques, how the holes can be drilled, can be reamed and can be tapped. That is how the internal thread can be cut and the final operation as per this drawing is showing this slot. , Now Mr Aman we will make that operation and show it to you. Again that is clamped and while clamping you have to make very sure that this is clamped absolutely horizontally.

And this is the handsaw and using that handsaw the slot has to be made. Initially he has marked, this is the height of the slot and depending on the size of the slot which is given in the drawing you select a particular saw blade because this blade is making this slot.

Therefore, the slot width has to be little more than the width of this blade. Accordingly you select the blade because this width will be given here, this is just an example to demonstrate how it can be made, but it can be of different dimensions it can be wider, it can be thinner and so on. Well now we are going to demonstrate the working principle of shaping machine.

You can see the shaping machine here as a matter of fact, I would like to mention the difference between the shaping and the planing which most of you might be aware of. Nevertheless, in case of shaping the small workpieces are made in general. So, in shaping normally the flat surfaces are made the groove can be fabricated and dovetail surface can be fabricated.

In this machine what we will be doing today is this shape or this part. So, you can see from the drawing that in this part we have a flat surface, a groove here and we have a dovetail surface. We will show you the part then it will be clear to you that the groove has this dimension in the other section, other view and these dimensions are given.

Height, breadth and all the dimensions of the flat surface, the angle for the dovetail and the groove surface are given. So, the basic difference in case of shaping and planing is in the quick return mechanism. Because in case of planing, normally the bigger surfaces are produced. However, the kind of surfaces that we produce in shaping remains the same as in case of planing as well.

Now in shaping the tool reciprocates, tool is connected to the ram here and this reciprocates to and fro and while reciprocating in 1 cycle, 1 cycle consisting of going forward and going backward, this is 1 cycle or this is rather called the stroke, during 1 stroke that is in forward motion and the backward motion the workpiece is given the feed which is perpendicular to the direction of the movement of the tool.

That is perpendicular to the direction of the actual movement is the cutting movement, cutting speeds, so the cutting speed in this case will be the stroke of this tool. Now the stroke length can be changed depending on the length of the flat length of the surface that you are covering and that can be done with the help of a mechanism we are going to show you right now. Now in case of planing the surface is much bigger.

Therefore, for reciprocating the tool, the quick return mechanism becomes very big in the sense that in case of shaping, since during the forward movement the material is removed and during the backward movement the material is not removed, therefore, during the backward movement normally the tool is lifted up again not removing the material and at a higher speed.

So, the speed difference or the speed ratio in the forward and the backward movement is called a quick return ratio. That quick return mechanism, by which the quick return ratio is provided here in this case it is the Whitworth quick return mechanism in case of shaping while in planing you cannot make the same kind of a whitworth quick return mechanism.

The bull gear which rotates continuously and which is giving the movement of that quick return becomes very big in case of planning machine. Therefore, the same mechanism if you are going to make for planing where you have the very big surfaces to be machined, in that case the machine would have been very big.

Therefore, the quick return mechanism in case of planing is different than the Whitworth quick return mechanism used in case of shapping and in case of planing it is the loose pulleys and cross belt system normally used. We are not going to show you the planing mechanism, the planing lathe or planing machine, but in this example of the shaping machine it will be very clear how the planing can be operated.

And it is only that in case of planing the workpiece reciprocates instead of tool as in case of shaping and the feed movement is giving to the tool in the same direction perpendicular to the motion of the workpiece reciprocation in case of planing. So, that is the basic difference in the case of the shaping and the planing that in shaping the tool reciprocates and in case of planning the workpiece reciprocates.

Because the workpiece is very big and therefore, in case of planning, the quick return mechanism is different from the one which is used here and in case of planing it is not the Whitworth quick return mechanism but the loose pulley and the cross-belt mechanism is used. Now, Mr. Srinivasalu is going to demonstrate the operation of the shaper, that is, the shaping machine.

And as I showed you, the kind of surface or the kind of the part with the flat surface, with the dovetail surface, with the groove that will be fabricated in this machine. When the machine is on, this is the reciprocation of the tool which is mounted on this arm and feed is given to the workpiece in each stroke, feed movement of the workpiece is along the direction perpendicular to the direction of the reciprocation of the tool.

So, you have to mount the tool. Here we have two different tools which will be mounted on the arbour or the arm. This is the tool which is used for making the flat surface as well as the inclined surface, for the dovetail surface and this is the tool which is grooving tool that we have shown earlier, this will be used to make the groove so this tool as you can see that this is very similar to the tool that is used in the case of turning.

This will be mounted in this way and it will be reciprocating as well as this is the grooving tool which will be mounted after this dovetail surface and flat surface is made, to make the groove. Mr Srinivaslu is going to mount these tools one by one and he is going to

demonstrate how these surfaces can be obtained; now this tool that will be making the flat surface as well as the dovetail surface this is being mounted.

You can see that how the tool can be mounted, now you can start. This way you can adjust the height of the tool with respect to the workpiece and the machine will be on now. You can see that there is a certain stroke length which is fixed depending on the size of the workpiece. If the size of the workpiece required is bigger, then the stroke length required would have been more and that can be adjusted.

So, now you do that flat surface. Here by this mechanism, you can change the feed and the height, this is going in the cross direction it is similar to the cross feed given to the tool in turning, but this is given to the table where the workpiece is mounted, he is trying to make the contact of the tool with the workpiece with a flat surface of the workpiece and then the depth of cut will be given.

Now, the depth of cut will be given to the tool that is the tool will be lowered with respect to the workpiece this is definitely slower process as you can see that in one stroke a small amount of material or the small width is removed and it will take some time for the entire flat surface to be generated. you can see that in each stroke that is going forward and coming back some material has been removed depending on the depth of cut that has been given and a certain amount of material is removed.

So, after each stroke, the tool is moving along the width of the workpiece and for the next pass to happen and for the next width to be removed so that the entire surface ultimately can be machined and the flat surface can be fabricated and notice one thing that during the backward movement the time taken for the backward movement is less because the backward movement is at a higher speed than the forward movement.

Since at the backward movement no material has been removed, during the backward movement as I have shown you, the tool is lifted up if required. So, if the very high depth of cut given, you could have seen that the tool is being lifted up here. It may not be visible very well that the tool is still being lifted up while the tool is moving back. So, you can see that the flat surface is being made.

Now, for the demonstration purpose this groove was made, this flat surface was also made, but again final pass has been given just to speed up the process but otherwise you understand that the same way the entire surface will be produced and then the tool will be inclined according to the angle which is given for the dovetail which is 45^0 So, it will be inclined at an angle of 45^0 to this side.

When the inclined surface will be produced and at an angle of $45^0$to that side when this angle this surface will be produced. So, that will be demonstrated to you right now and after that how this grooving can be done that will be shown to you. Tool head has to be moved and tool has to be inclined at an angle of 45^0. So, you can see that the arrangement is being made for the inclination of the tool.

And the tool is being inclined as you can see here and there is a graduation there is a scale according to which you can find out what is the angle of inclination and the angle of inclination will be $45^0$and then you tighten this and the tool is fixed at that angle which is 45^0so then the right hand side inclination of the dovetail will be completed by this afterwards we will go for the left hand side inclination and the entire dovetail of dovetail groove can be made that way.

Now the tool is straightened up see the tool post has been inclined as you can see and the tool has to be straightened up because tool cannot cut as you understand at that angle of 45^0 so the tool has to be exactly straight that has to be made with the head inclined at an angle of 45^0once again and once again the same operation will be conducted that is the tool has to be in touch with the workpiece initially then the depth of cut will be given and step by step the operation will be completed for the inclined surface of the dovetail.

So, at this moment we are preparing the left side of the piece we will be making. He is ensuring that the tool is in contact with the workpiece so that the depth of cut can be given and the surface can be made. The machine is on now and the depth of cut is given. You can see in the backward movement the tool is being lifted up.

Because the depth of cut given is little more than in the previous case when the flat surface was produced. Again similarly, after each stroke, the feed is given to the workpiece in the direction perpendicular to the direction of the reciprocation of the tool. So, you can see that

the incline surface is made and similarly, if we rotate the head tool head on the other side and make a 45^0angle then straighten up the tool in that case the left side inclination of the dovetail will be completed.

So, now, the tool will be inclined to 45^0on the other side. So, that the left side inclination can be machined; according to the graduation on the circular scale the 45^0angle is determined and it is fixed after that the tool has to be straightened up now, the tool is being straightened up with respect to the workpiece so, that it could be perpendicular to the flat surface of the workpiece.

Again, the tool is to be made in contact with the workpiece initially, so that the machine can be switched on and the operation can go on that will be very similar to the surface that has been made on the right side of the workpiece. So, now the tool is in touch with the workpiece after which the machine will be switched on and the feed or the depth of cut will be given to the tool in the vertical direction.

After that, the process is going to be a very similar one in comparison to what we have done on the left side because the feed will be given depth of cut will be given now that you can see that the depth of cut has been given to the tool and the tool has started removing the material on the inclined surface of the left side. Now, next operation is the grooving and that is the grooving tool as I have shown you earlier.

That grooving tool will be now mounted on the tool holder in place of the tool that was made for making the flat surface and the inclined surface. This has been mounted this is this has to be set and then it will be tightened on the tool holder. So, the width of the tool is equal to the width will be equal to the width of the tool and that would be done in one pass.

Only thing is that the depth of cut will be given so that the depth of the groove according to the drawing can be made so, it is just touching the surface from where the grooving has to be made and then the depth of cut will be given so that the depth of the groove can be accordingly made. The tool is lowering down so that the depth of cut can be given and the tool is removing material along the length of the workpiece.

So that the grooving depth can be increased now, as you can see that the groove is being machined and once again during the forward motion the material is being removed and during the return motion the material is not moving therefore, the return stroke or the return motion is at a higher speed than the forward motion here the workpiece is not given any feed.

Because we do not want any wider groove than the width of the tool, well, here you can see that there is a purposely made window for demonstrating it to the students. So, here through the window you can see the quick return mechanism which is called the Whitworth quick return mechanism and here as you can see that there is a bull gear and there is an arm which reciprocates.

During that reciprocation, it goes to and fro. So, here we can see that this is the forward motion and this is the backward motion. So, when it will go like that, this is the forward motion when the tool will be removing material and then from here to here it will come at a higher speed. So, the time taken for the tool to come from here to here will be less than the time taken for the tool to go from here to here, there is a forward stroke and this ratio is the quick return ratio.

So, by changing this by changing the distance this length of the arm you can change the quick return, the stroke that is the speed. We will show you that how that speed can be changed by changing the arm length. You have seen that this is being changed, now the arm length has been changed and if we switch on you can see that the stroke length has been increased.

You can see the stroke length has been increased that means the bigger length of the surfaces can be machined. That can be done by changing the arm in the mechanism. As you we can see, you can see the working principle of the bull gear and the arm and overall, the Whitworth quick return mechanism. Now we have shown you the how the stroke length can be increased.

But then also the speed of this that means the how fast this will be moving the ram we will be moving that can also be done here we have 3 speeds that is at 82, 48 and 108. So, depending on the position of this lever, we can actually have the higher stroke speed and the lower stroke speed. Let us say we will for comparison we will right now we will have 82 speed.

And you can see that the stroke speed is changed and this is an 82 that is 82 strokes per minute and mind it stroke, I will repeat, is to and fro movement together is one stroke, stop and then you change that to 48. So, now you can see that the stroke speed has been reduced to 48 and if you switch on the speed is reduced stop and then we will be changing to 108 now you can see that it is a faster stroke speed.

And this is at 108 strokes per minute that is the maximum one well now we are going to demonstrate the working principle of shearing machine. This is very important because we have the material that in the form of the plate that we can purchase would be very bigger in size they will never cut you into small pieces and sell it. They sell in the very big pieces.

So, we purchased them and then according to the requirement we cut it in length and in the width. This is a hydraulically operated shearing machine and since it is hydraulically operated, so, you understand that the strength or the load carrying capacity of this machine would be very high. Here you can see that this is the cutter which works in the principle of guillotine and it moves downwards.

And this is moved by the hydraulic cylinders inside the chamber here inside the machine as the machine is on the plate will be coming the shearing plate or the tool cutter will be coming down and prior to that we have to set the distance in the X axis, what is the length that you like to cut, up to 4 feet of the width can be cut here and length you can adjust by adjusting this value.

So according to your requirement you can adjust the length and this width that you can take For example, here we have taken a certain width now the length is important for us. So, you can cut it in small pieces or you can cut it in bigger pieces that depend on how much you are setting in the X value. So, we have the plate which the thickness here is 6 mm, but you can go up to 8 mm.

So, up to 8 mm thickness of steel plates can be sheared off and that the shearing force which is which will be required here that will be very high and therefore, the hydraulically operated machines are used. So, right now the we will demonstrate to you how this 6 mm thick steel plate this is the mild steel plate how this can be sheared off and we will adjust the values of according to the to the to the take the thickness of this plate.

Now, what is that adjustment that we have to make for the depending on the thickness if the thickness of the plate is smaller, you understand that the shearing force needed will be less and therefore, the distance between this plate and this plate that distance has to be less and as the plate thickness is increasing that distance has to be more and that adjustment has to be made by the handle there in the machine.

And then this shearing process will be effectively performed that will be show will show it to you right now you can actually switch on now. So, this is the adjustment which is being made and that adjustment as I said is the gap between the cutter and stationary plate which is there on which the plate our plate to be cut is station this is inserted and this will be according to the length that we have selected.

Now, this will be on and you can see that the cutter will come down and it will actually cut it so it will be clamped and it is cut off. The piece is segregated. Before the cutter comes down it has to be clamped. Those are the clamps which are spring loaded. Those clamps we clamp properly on the stationary plate and then it will be sheared off by the guillotine or the cutter which is there. Thank you for your attention.

(Video Ends: 01:00:14)