Introduction to Machining and Machining Fluids
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Lecture - 21
Practical Machining Processes – 1

Now, after some machining processes as well as Machining Fluids, now we are moving to the practical machining processes in this particular course and in particular in this class ok.

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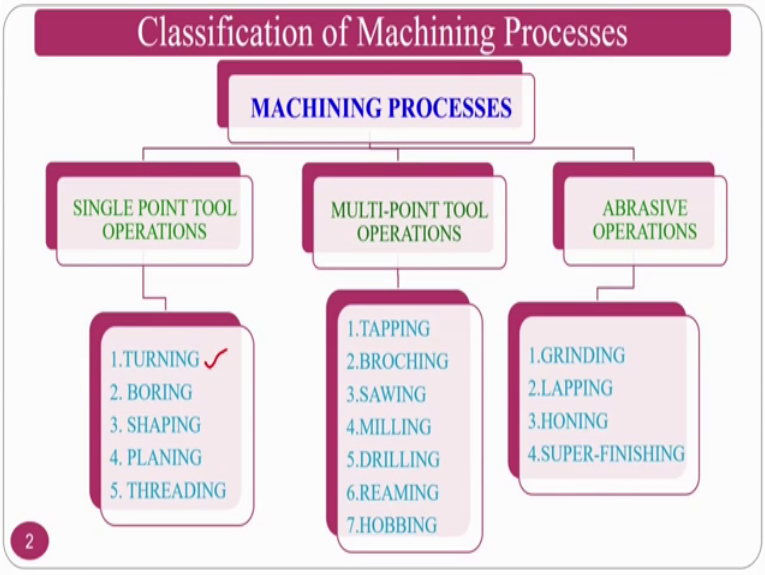

So, what are we have done in the classification of machining process single point we have done turning process that is a basic machining process, we have done and we are moving to another practices.

So, if the classification is single point cutting tool multiple point cutting tool and abrasive process all processes we will deal in this particular course, till now we have conducted the lectures on the turning process, which is also a basic machining process, where you can understand the basic physics in the introduction as well as the machining fluids in particular slightly in deep analysis.

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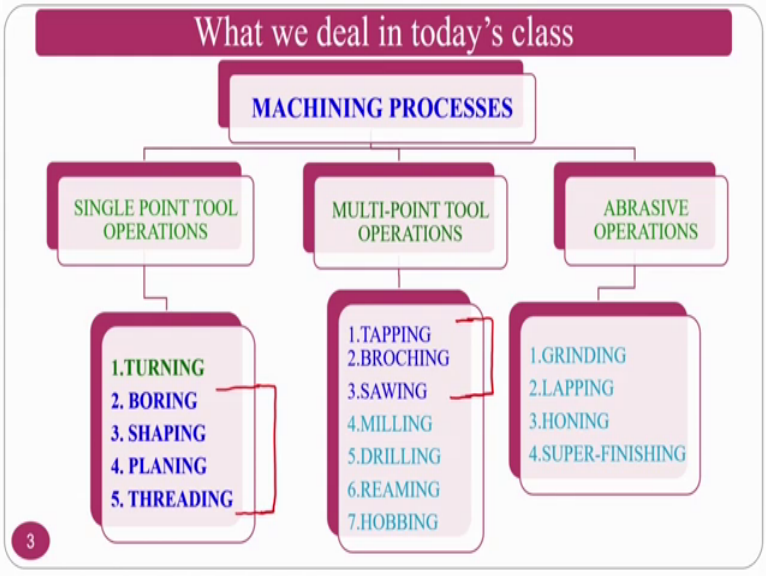

So, now we will move on to the other processes in this particular class we deal with boring, shaping, planning, threading and the tapping, broaching and sawing. These are the processes that we are going to take up and these are also called as a some of the practically applicable processes, I mean to say that the turning is not a practical process a move ahead these are the other processes that are practically useful.

Now, we will move to the some of the single point cutting tool process some of the multiple point cutting tool process, and which are it is named in a some of the books like a practical machining processes. That is why I also called it as a practical machining processes and so on, we will follow in the next class other multi point cutting tool processes and followed by the abrasive processes and all those things.

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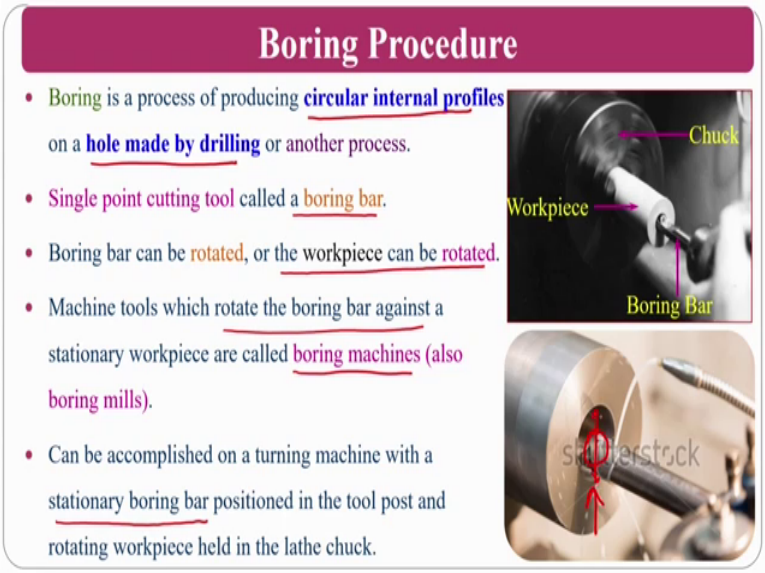

Now, we will go to the boring process as a first process, if you see the boring processes. It is normally looks like this just and I will explain you that boring process is producing the circular internal profiles, hole made by the drilling process; that means, that you required a predrilled hole; normally boring process is to enlarge the existing hole for that purpose you should have major amount of times some of the special cases it is ok, but normally if you have a existing hole that is drilled and you can enlarge that hole, that is called as a boring process.

Single point cutting tool is called the boring bar which is a along with the chuck. Now if you see here this particular thing is nothing, but the boring bar including the tool the boring bar can be rotated or the workpiece can be rotated both things can happen. If at all I want to rotate the tool I can rotate it, if I want to rotate the workpiece I can rotate the workpiece also. Normally in case of lathe if you are doing by the boring by the lathe process the head stock will rotate or evolve. So, the work piece will revolve.

The machine tool which rotates the boring bar again as the stationary workpiece are called the boring machines, there are specially called boring machines and also called as boring mills also. So, can be accomplished in the turning machine also by keeping the stationary boring bar positioned, but the workpiece can be rotated so; that means, that the boring tool or the boring bar can be held in the tool post as a stationary and you can rotate your workpiece.

So, that you can do this boring process you can see here this is a lathe on which the chuck is a held the workpiece is held in the chuck and the cutting tool, which is called as a boring bar is stationary and it is drilling happening that is about the boring process.

So, existing there was a small hole now I want to enlarge the hole in this particular thing previously may be like this where it can enter, then it is enlarged to this particular dimension that is about the boring process.

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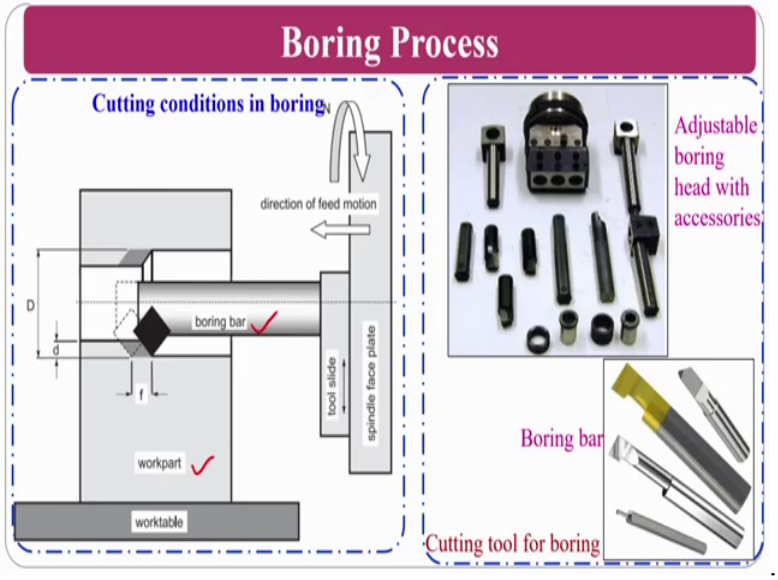

So, if you see the schematic diagram of the boring process. This is the boring bar and this is the work part or the workpiece work table is there. In the previous case it is workpiece is rotated now the boring bar is rotated. So, that you can get the enlargement of the hole, that is shown here in the schematic diagram.

So, these are the boring bars if you see the boring bar there are different varieties of boring bars which are nothing, but the cutting tools that are used in the boring process. You can use the HSS single point cutting tool, where you can do the boring bar by using a tool and cutter grinder has per your requirement and all those thing. For that purpose only thing you have to do is you should know how to utilize? How to make particular chuck or the blank that is given by the supplier, which is a HSS material just you go to the tool and cutter grinder as per your drawing, you can change to this one commercially available boring bars are there just you can use this to make the bore.

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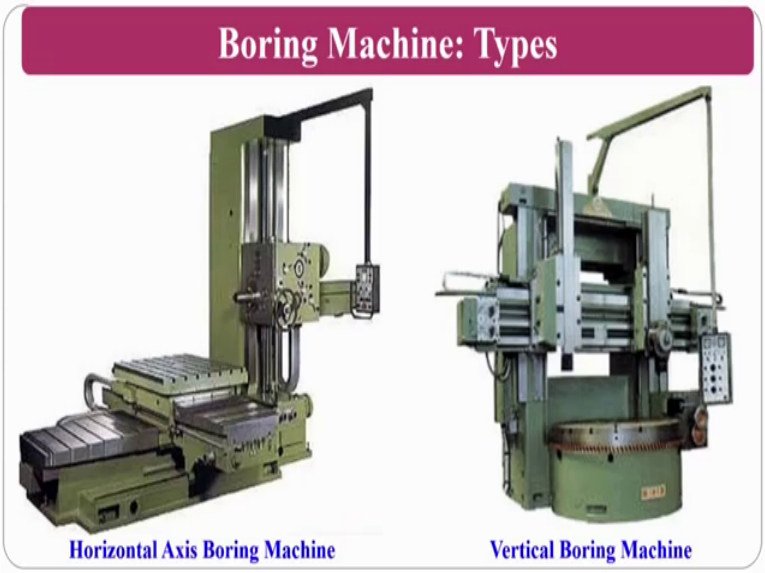

So, boring machine types normally there are 2 varieties one is a horizontal boring and another one is a vertical boring. So, you can use horizontal also or vertical also ok.

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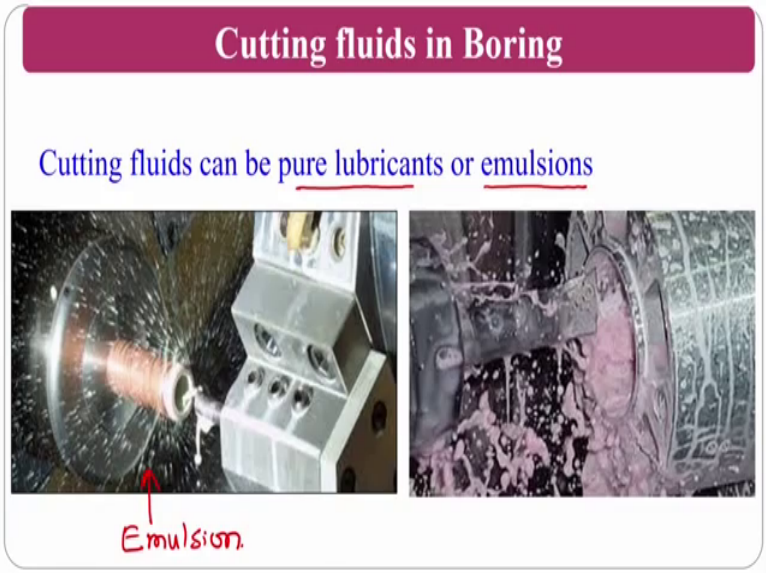

This is about the tool ok. Normally, the cutting fluids, the cutting fluids since it is the machining and machining fluids so, we should also look up at we also should look at the cutting fluids that are used. Normally, you can use both because the boring process can be slightly lower cutting speeds compared to turning process or some people they may

operate depend on the tool material if they have a very good high hard stool material they can go for higher speed also.

So, you can go for the pure lubricants also as well as emulsion types also in this one if you see it is looking like a milky color. So, whatever the cutting fluid they have used is a cutting fluid emulsion.

If you see in the some other cases you can go for the higher amount of a pure lubricant oil with low amount of water. So, the lubricating properties will be better in boring process ok. So, this is about boring process, now we move on to another practical process that is called threading. Threading is nothing, but making of threads internal threads as well as external thread.

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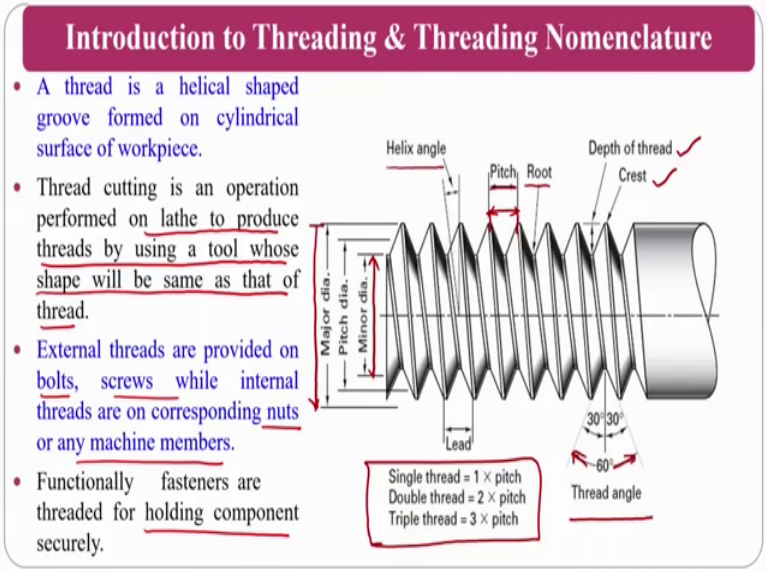

So, threading is helical shaped groove formed on a cylindrical surface of the workpiece. So, it is a continuously formed helical groove. So, threading cutting operation performed on a lathe to produce a threads by using a tool whose shape will be same that are the thread ok.

Assume that I want to make a thread shape. So, you have to have the similar type of shape on the tool also ok. So, external threads are provided on the bolts screws while the internal threads are incorporated on the nuts and any other machine members this are the 2 varieties; if the functionality of the fasteners are thread for the holding component.

Normally, if at all I want to hold the component for that purpose this threaded components are used. If you see the picture this is how the thread look like. So, it will have a pitch, it will have a lead, it will have a normally this is the root, pitch, crust to crust is nothing, but pitch there are single start multi start threads are also there. So, therefore, thread is there and this is the crust. So, one crust to another crust it normally the distance is normally known as a pitch and the lead is nothing, but how much it will move in one rotation ok.

If it is a single start thread normally it will move lead equal to pitch if it is a multi-start you have to multiply by that multi what is the it specified by l. So, helix angle will be there and the major diameter of the thread minor diameter of the thread under pitch diameter also will be there this is major diameter and this is the minor diameter of the thread and you will have also the pitch ok.

So, you will have the minor diameter major diameter as well as the pitch diameter. So, this is pitch diameter also you can say it as a mean diameter of that particular threads ok.

So, the now we will have also have thread angle normally in this one commonly used are commonly explained threads are like v threads, where you will have a 60 degrees you can see which you can divide into 30 and 30 here. So, the you will have normally single start thread multi start thread that was I was talking about and I will explain you what are the single start multi start and all those thing.

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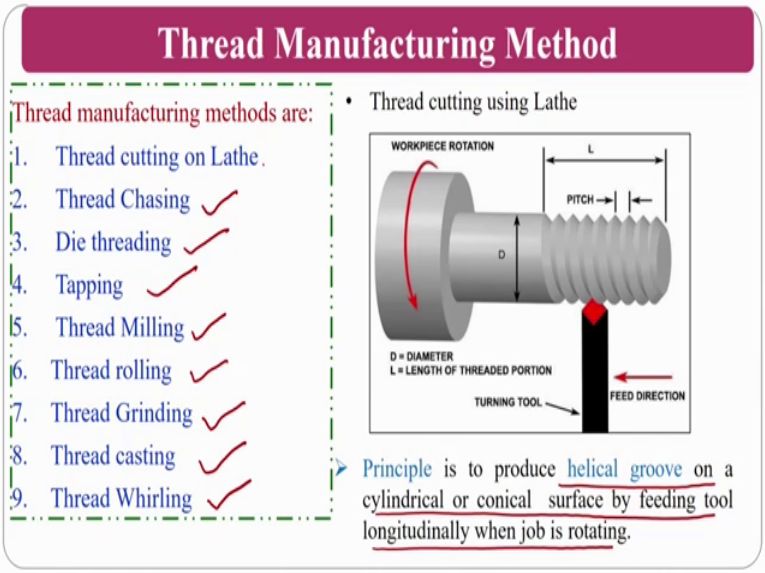

So, the thread cutting or the thread manufacturing can be done by various techniques first and foremost basic technique is thread cutting using lathe, thread chasing using chasing, die threading, tapping is there thread milling is there thread rolling and thread grinding, thread casting, and thread whirling all these are the varieties of the manufacturing techniques of this threads.

So, whatever you can see here is the simple technique that is what I have explained in the previous slide also that is called thread cutting by the lathe process, in a lathe machining process you can cut this threads. So, the principle to produce the helical groove on a cylindrical or a conical surface by feeding longitudinally, when the job is rotating that is how you can generate the threads on the lathe by using a lathe machine.

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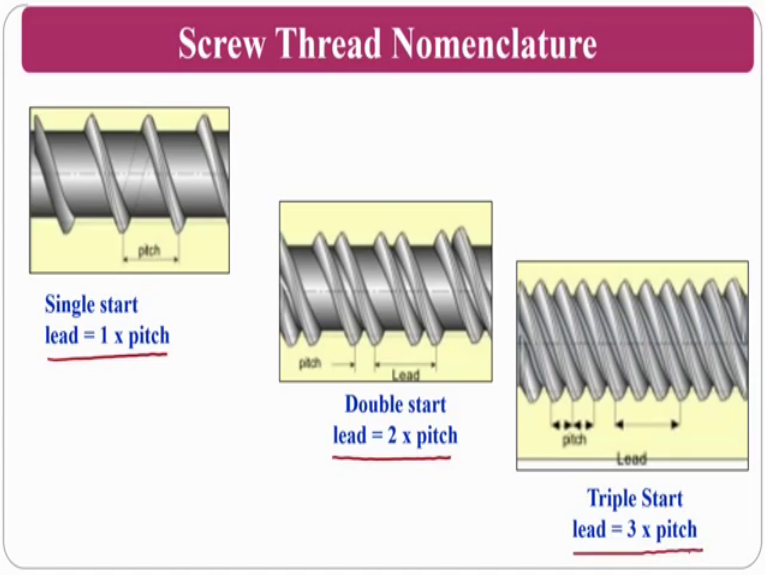

Screw threads there are 3 varieties or multi varieties are there, normally in the common practice will have single start, double start, and triple start. So, where ever if you see a single start normally lead equal to pitch, where pitch if you multiply by one normally pitch will be pitch only. So, that is nothing, but is called single start, if you have lead equal to double of the pitch; that means, that double start and if you have lead equal to multiply by 3 into the pitch; that means, it is called triple start thread.

Normally, why we have to go for single start to triple start (Refer Time: 11:29) the students may know there is about single start threads are there double start or triple starts are there, but the practical use of this one is if at all I want to open certain caps or

something. So, if at all I want to put less energy and I want to get more outcome there you will normally the people go for the double start and triple start.

If you for example, if you see the some of the cool drink bottles, if you if you what if at all if you rotate in one go it will may come some of the bottle may not come. So, those come where ever you just rotate in one go automatically complete it may come out, that is called the technology they may use is double start or triple start.

So, if you put less energy or one rotation itself it will come out, but if you tighten it also in one rotation itself it will take perfectly. So, if at all I want to open with less amount of energy and tighten it with less amount of energy you have to go for multi start thread, oh if in a single start thread it will have long time. So, it has to go and go it go on it will be ok.

For that purpose normally multi start threads will be used.

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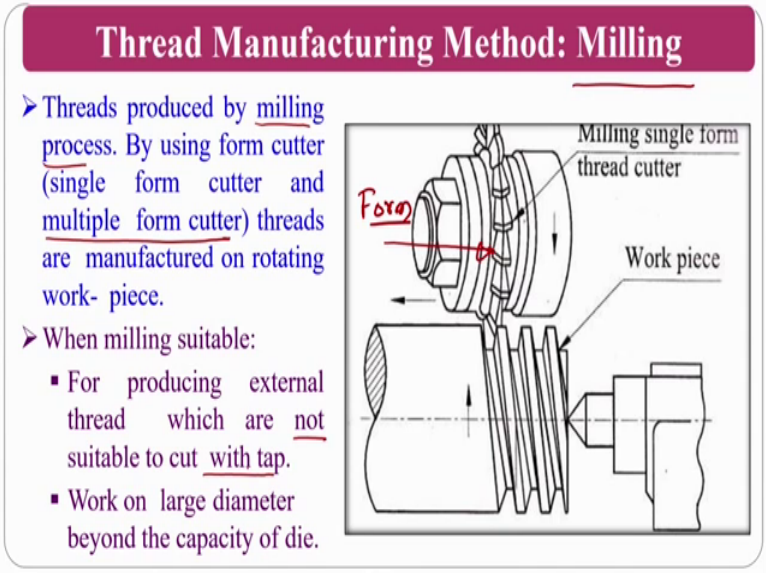

So, thread manufacturing the another process is milling process you can also do by the milling cutter, the threads can be produced by the milling process also that is using the form cutter. So, depend on the shape of the threads that you want your thread cutter you will choose ok. The form you can choose depend on your requirement of the threads ok. So, the that is why you will use the form cutter.

So, normally when this is suitable is when producing external thread which are suitable to cut with a tap not with a tap; that means, that if you are unable to cut using the tapping process. The tapping process you can you will come across in the upcoming slides in this particular class. So, where the threads are not in a position to cut by this tapping process you can cut external as well as internal.

So, I am talking about external in this particular slide if you are unable to cut there you can go for this one. So, normally if you have a very big diameter then you can go for the thread milling process, work that I said on large diameters beyond the capacity of a die if I if die is cannot do normally you can go for the thread milling process.

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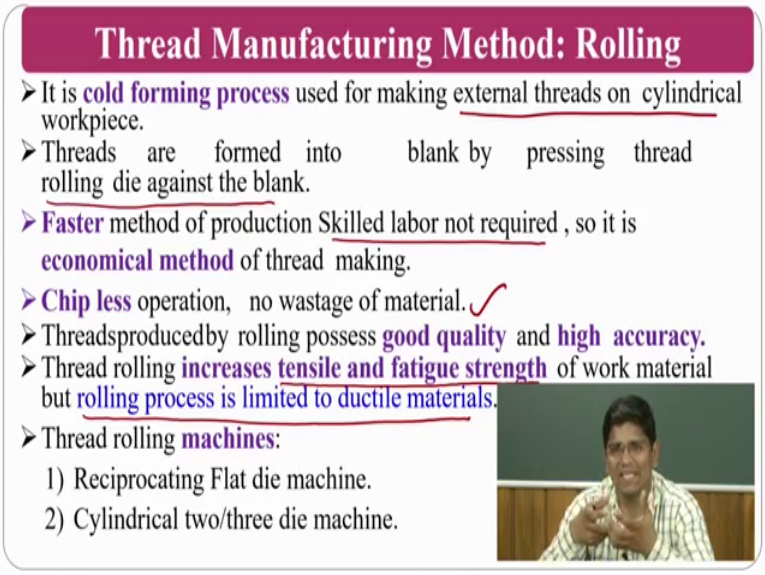

So, thread milling it is cold forming process for making external threads on a cylindrical surfaces and the threads are formed into the blank by pressing the thread rolling against the die or a blank. Normally you can use this one this is what I am talking is not about the milling it is called the what I am talking is thread rolling process ok.

Rolling process is a cold forming process for making external threads on a cylindrical surface threads are formed into blank by pressing the or the rolling against blank. If you see it is a faster method of the production skilled labors not required. And it is it is a chip less operation there is no chip; that means, that there is no material wastage like in a metal cutting process you will get the chip wastage that is material waste in form a chips.

So, here it is a material it is a material forming process. So, you do not have any chip formation. So, there is no loss of the material, threads are produced by rolling possess good quality and high accuracy. So, whatever the things are you are going to get will have a better accuracy and good quality. Thread rolling increases the tensile as well as fatigue strength of the workpiece material; that means, that whatever the output that I am going to get will have good strength I mean to say tensile strength has well as fatigue strength also.

So, for the problem with this thread rolling is it is limited to the ductile materials. Means the material should plastically deform easily, the ductile deformation should be there if it is a brittle material what will happen it will fracture and it will damage the workpiece. So, the threads may not form on the particular surface.

So, thread rolling you have a two type of varieties one is cylindrical, another one is reciprocating flat die machine.

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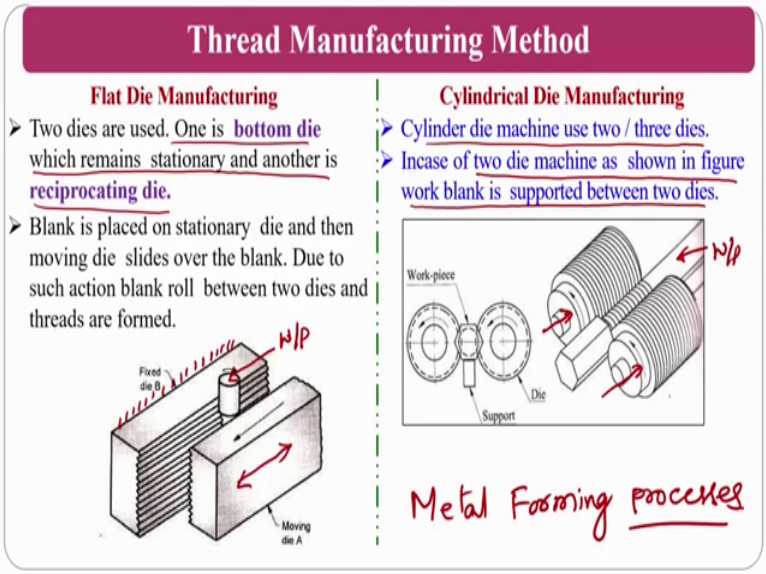

This is called flat die manufacturing process where 2 dies are used one is at the bottom die, which remains stationary and other is reciprocating die, what is I mean to say is this is the fixed one and this is the moving one. So, you can reciprocate here. So, that this is your workpiece, the threads are formed on this one by metal forming process where chip is not there and all those thing.

The another process is cylindrical die manufacturing, where you will have the die on one side, another one is the workpiece will be there at the center then you will have a another support and you can generate it. Cylindrical die machine uses 2 or 3 dies depend on the requirement, you can use 2 or you can use 3 also.

So, in case of 2 die machine as shown in the figure the blank is supported between the dies and this 2 rollers are rotating you can see here there is a directional symbol is given here there is a directional symbol is given. So, these are rotating against the workpiece that is there here this is the workpiece threads are formed on the workpiece. So, this is called cylindrical die manufacturing, both this are all metal forming process ok. These are all metal forming process, which are not metal cutting process that we learnt in the previous lectures are in this particular lecture also that is the only difference you have to make sure about this particular slide.

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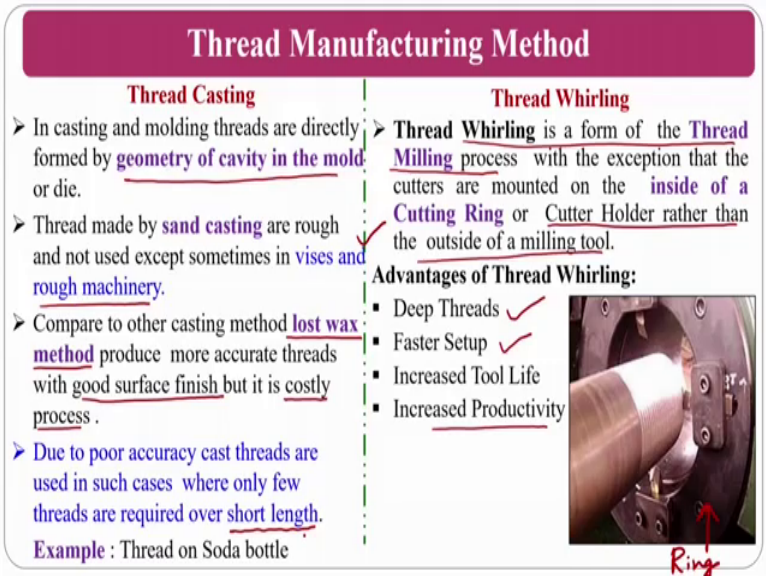

Another method is thread casting method where casting all of you may know, because it is a one of the primary manufacturing process, where you can take the cavity of the mold then you can make it like you just melt it and you just pour it into the cavities the threads are made by the sand cast are rough and not used for except sometimes vises and rough machinery; that means, what I mean to say here is sand casting type of threads if you are somebody is manufacturing those are very rough and not used in precision applications, these those are used for rough machinery application.

Compared to the other casting lost wax method is one of the casting methods as you know these gives the good surface finish, but costly process this is slightly costly from the point of manufacturing of this.

So, other thing that I want to specify this particular thread manufacturing by the casting process is due to poor accuracy casting threads are used in such a areas where threads are very short ok. So, small length if you somebody is producing that is where normally the thread casting process is used; So, the precise things that if you want you have to go for or the thread cutting operation only.

So, if at all you are going for a casting operation there is a problem, because the sand casting the surface is very rough and if you are using this as nut or a bolt then what will happen the accuracies are not maintained for that purpose. Normally you can go for again the rough machining process as are you can go for making it as a some low precise operations, for that purpose you can go for thread casting the threads that are manufactured by the casting process ok.

So, if you see thread whirling. So, whirling is form of is nothing, but a thread milling process, where you can have the cutter inside a ring this is the ring. The cutter will be there inside, which is a tool cutter holder rather than the outside that one and you can rotate it ok.

So, you can rotate the workpiece and if the threads will be formed once you rotate the workpiece then you will get the threads on it. So, advantages of this one is you can get the deep threads assume that, I want a very high depth threads you can go for faster process you can go for if at all I want at very less time normally you can go for this one then increased tool life. So, tool life will be high; that means, the tool ware is less and increased productivity as your setup time is a faster so; obviously, your production time will be same and the productivity will be increased ok.

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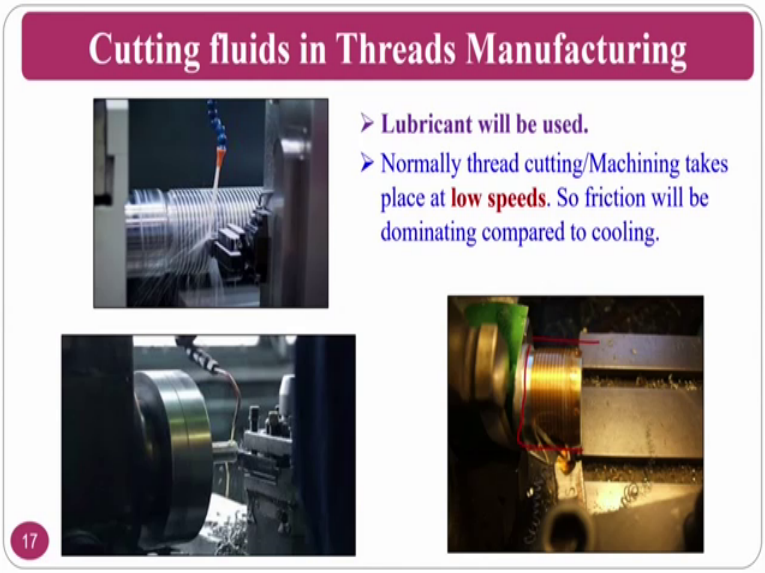

So, if you see the cutting fluids in the thread manufacturing. Normally thread manufacturing one thing, whenever you go for thread cutting using the lathe process in that circumstances. Normally there was one thing you can note that is nothing, but the cutting speed that you will use always will be much much lesser compared to the turning process. If the speeds are much less what will happen the friction place a major role rather than the cooling, in that circumstances majority of the cutting fluids they will use the mineral oils, where emulsion emulsification is very negligible; that means, that if at all some people want to use water. So, it they will be using very very minimally or you can directly go ahead with the pure lubricant.

You can see here the pure lubricants are used for cutting the process, but I said know if at all you can go you can go for the emulsions here the emulsions are used in this particular figure one emulsions are used, but you can use it, but the thing is that if the speed is too low what will happen friction is the major. So, friction can be countered by the lubrication actions, that is why normally you prefer the lubrication action; that means, less water or without water type of cutting fluids will be used in the thread cutting process.

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You can also see here. So, emulsification as whenever if you want to cut at higher speeds normally there is a chance of thread failures and all those things, there you can go for the emulsions or some of the people they will also use dry cutting also.

So, if you have a very low strength material like Aluminum or something, then they may not be required of your coolant and all those thing in that circumstances dry type of thread cutting also will be used.

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So, this is flood cooling type of used and I said mostly this is the lubricant type of thing, that is what the most of the cases if you see the thread rolling process? You have seen cylindrical flat die and all those things, in case of thread cutting also you will use the pure type of lubricant. You can see here the completely it is the lubricant.

So, lubricant or mineral oil based cutting fluids is used in the thread cutting process or thread rolling process ok. So, that is what about the cutting fluids or the machining fluids that are used in the thread cutting process or the thread threading process.

Now, we move on to the taping process so, where the taping process; if you see the taping process the schematic diagram or the sectional view also you can see here.

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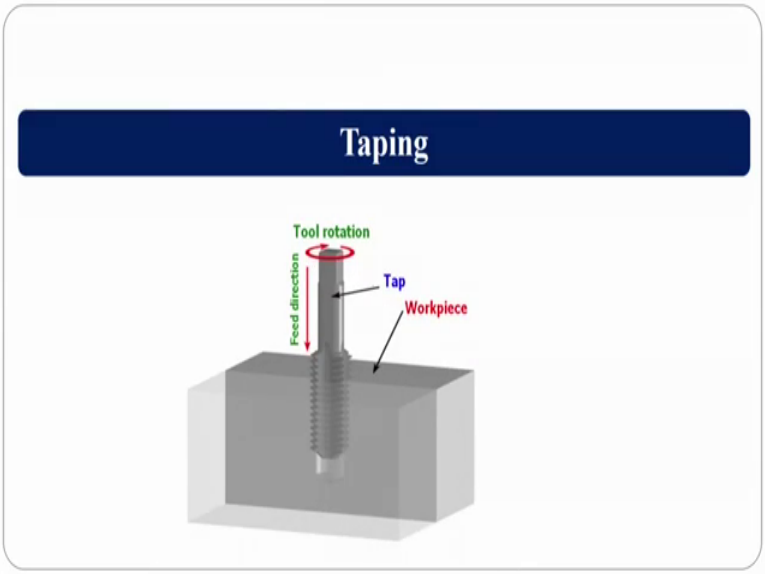

So, this is the tap and this is the workpiece where you can generate it by the machine or also you can generate by the hand also, there are taps hand operated there are the taps the machine operated also are there.

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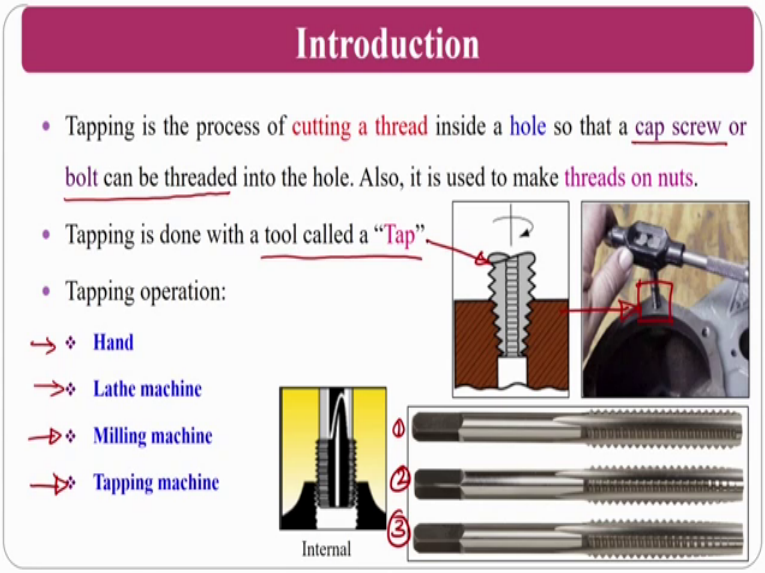

So, one by one we will see introduction to the taping process taping process is the cutting thread inside a hole. So, that the tap cap screw or can be bolt can be threaded into a hole that means; my prerequisites I required a hole to make the tapping process. There is no hole I cannot generate the threading on particular workpiece; that means, that I cannot generate the threadings if there is no hole.

So, I require a hole on which I can generate the threadings. Taping is done with the tool called which is called tap. So, you can see here this is called as a tap, the taping operation it can be done by the hand taping lathe machine also you can use milling machine also you can use and taping machine also, you can use there are 3 varieties of taps, you can get and the tap is used for internal as well as external threadings.

So, whatever you are seeing here this is what is here and this is what the internal threads are generated here? The same time you can see here 1 2 and 3 these are the tap sets. Whenever somebody want to purchase tap set normally the people will purchase in a set it will come as a set. Normally you can also purchase nowadays, because the materials technology developed. So, you can even go for a single tap, but advisable is you should go for a tap set.

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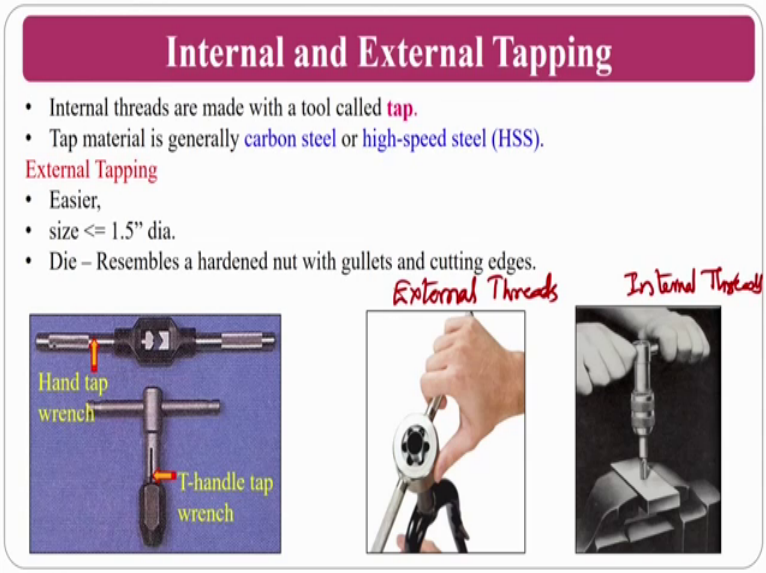

So, one can generate the external as well as internal this is how the external threadings will be done and this is how internal threads ok. So, this how the internal as well as external threads are generated.

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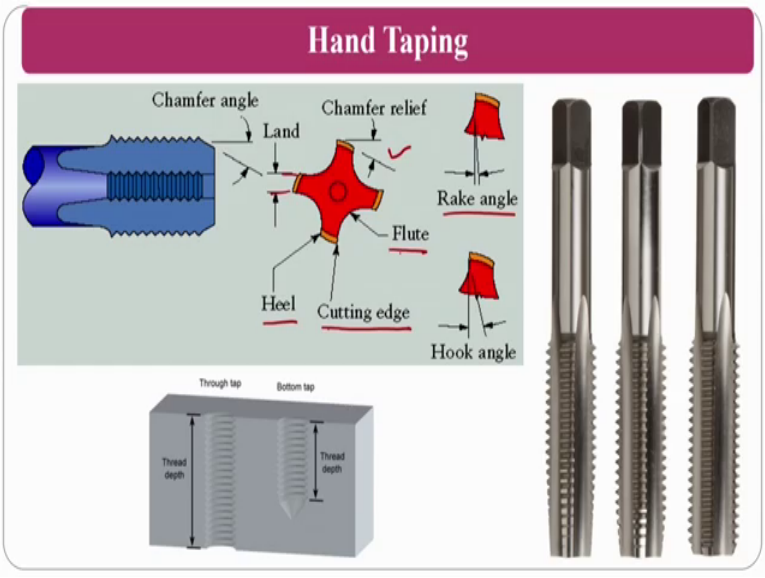

So, now we will move on to the basic thing that is how the hand held taping process is work. So, this is how the tap will be normally the tap geometry will be like cutting edge will be there on edge heel this is particular thing is the land how much width is there that is nothing, but the land everything here also you will get a relief normally that is called

chamfer relief and it will also have certain rake angle here and you will also have the flute.

So, that the chips will come out whenever whatever generated there it has a provision to send it out. So, you can see the flute here these are the flutes where through whatever the things that are coming here, it will come then along with the lubricant or along with the cutting fluid that are used here.

You can generate 2 types of taps or threadings that is called through threadings also you can do and bottom tap also you can do where you can terminate at certain distance itself.

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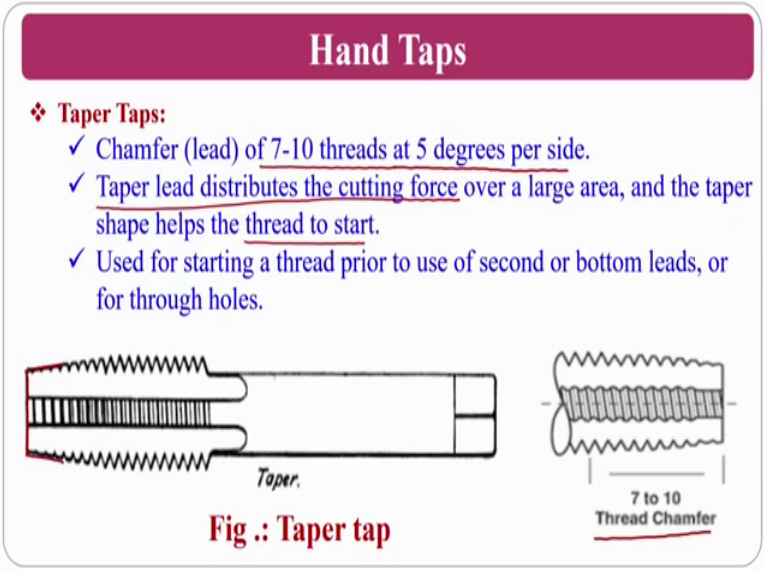

So, these are varieties of threadings you can do here; hand taps the first one is the taper tap. I said there are set of taps will be there normally a tap set will contain 3, which you have seen in the previous slide. So, among that one whenever I want to generate a particular thread assume that I want to generate m 10, for that particular normally the prerequisite is you should have a drilled or reaming hole first you do the drilling operation then, you do the reaming operation then you go and use the first one is taping taper tap.

So, you may not go for 10 mm hole you can go for 10.8 or 9.7 5 or something. So, that this taper will be there this particular taper, which is there can penetrate at the initial stage. So, that it will once you twist on it will gradually enter into the workpiece ok.

Chamfer normally lead 7 to 10 threads at the 5 degrees per side you can see here 7 to 10 threads are there, which are chamfer will be there ok; that means, that there will be some taperness will be there. The taper lead distributes the cutting forces over the large area and the taper shape help the threads to start; that means, that if I have a 9.8 mm hole, this taper will help me in positioning at the initial stage ok.

Let me position first then you can generate the threads ok. So, used for starting a thread prior to use the second and bottom. So, there are other 2 taps before that one you have to use it; that means, that I have a 9.8 mm hole, where I use that taper tap and I just generated a initial threading before I go for second and third taps ok. Once I complete the taper tap I will move on to the second one that is called plug tap or the second tap.

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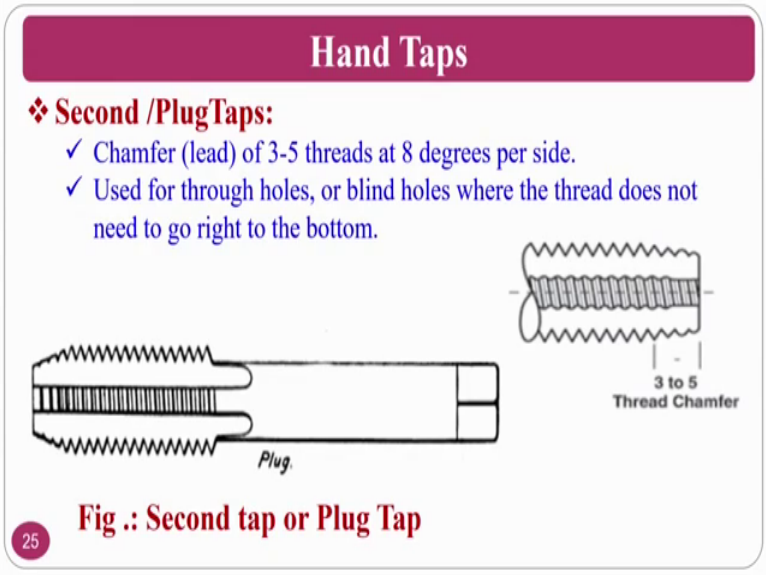

Which is here instead of 7 there here you will have 3 to 5 threads will have chamfer and use through holes are also you can generate the blind holes where the threads are not need to go to the right bottom; that means, that you can also go for the blind holes also where blind holed threads also.

And what is the point here to be noted is that you have to use this particular one after your taper tap ok. So, taper tap followed by the plug tap then followed by the third one that is called bottoming up tap ok.

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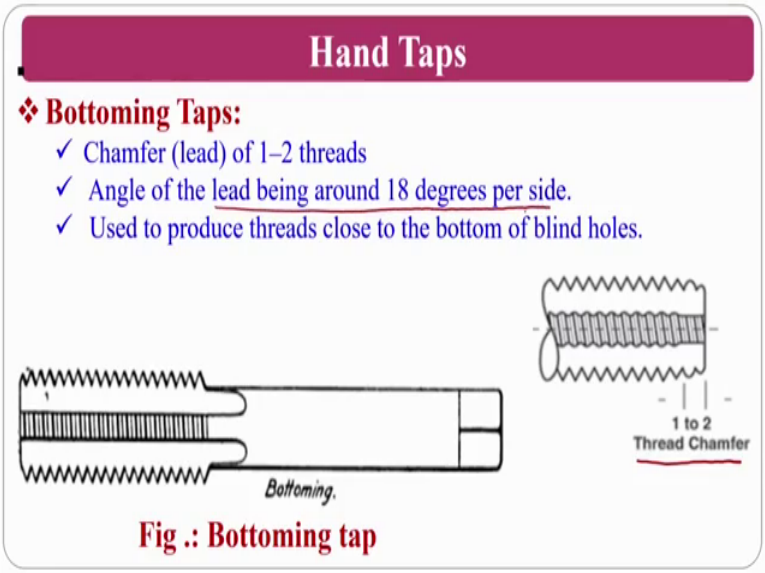

So, chamfer normally here it will be 1 to 2 threads and angle of the lead being around 18 degrees per side and used to produce close to the bottom of the blind holes. Normally if at all I want to generate a perfectly threads across the cross section of the workpiece the means that I want a through threads of the workpiece completely in that circumstances I have to use this particular thing; that means, first taper will be there then the plug will be there, then bottoming tap will be there.

So, that you will get the perfect throughout M 10; that means that it will have M 10 generating threads on this one. This is about the 3 varieties in a taps set taper plug and bottoming taps.

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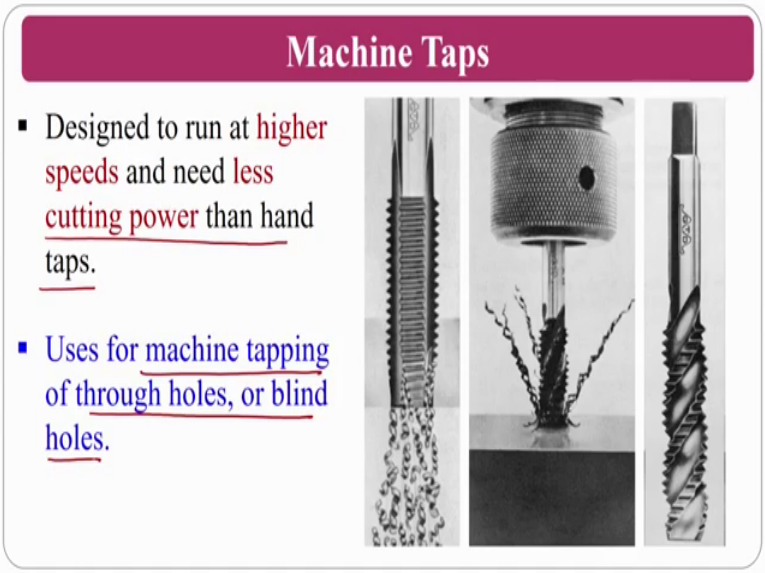

You can also generate this threadings by using the machining there you can hold the tap in a machine and you can also use it for that purpose there are different types of taps are there, whatever we have seen the 3 varieties which are in the previous slides those are the hand held here whatever you are seeing is a machine held ok. Design for higher speed and need less power than the tap hand held taps, because these are all designed for higher speed. So, you can generate at higher speeds, I mean to say not very very high speeds compared to the hand because in hand you can rotate at certain speed; here you can still more you can use the higher speeds for better production rates ok.

So, for that purpose normally you can use the machine taps use for the machine taps for through holes or blind holes, you can use this machine taps to generate either through threads or blind hole or the threads that are developed in the blind holes also ok. That is the beauty about the machine taps.

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Cutting fluids are the machine fluids in the tapping normally the taping if you are rotating with the hand the speed is very very minimal. In that minimal speeds the basic thing that you are going to use is lubricant type ok. You can see here the first lubricant will be filled inside the workpiece then the lubricant also will be applied on the periphery of the tap converse, type of threads that are generated and then you can do the threading operation. It can be machining based threads or the hand held threads most of the time it is suggested to go for the lubricant dominating, because the friction will be.

So, high because of the low cutting speed. So, to counter it; obviously, as a machining and manufacturing scientist or person you can always prefer to the lubricant dominating mineral oil pure mineral oil rather than mixing with the water, but as I said for the economy point of view if there is a generation of any heat or something minute heats you can also use emulsions, but the emulsions you can go for 1 is to 1 or 1 is to 2 not more than that one that is suggesting for the generation of low speed taping processes ok.

Now, we move on to the knurling process where knurling is nothing, but embossing of diamond cone pattern or some other pattern for the griping purpose.

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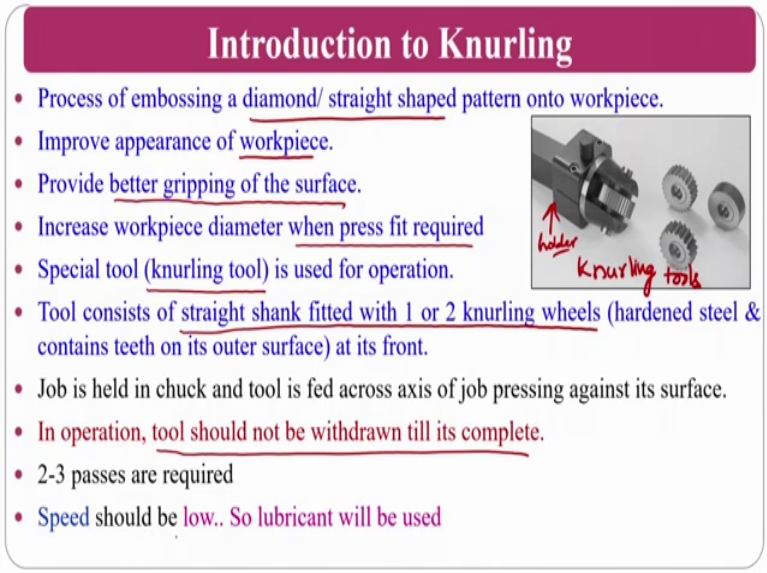

Introduction to knurling process normally process of embossing the diamond or straight shaped pattern on to the workpiece that is called knurling process. It improves the appearance of the workpiece it can gives good aesthetics to the workpiece at the same time provide better gripping, this is the major advantage or major application of the knurling process is to have the grip. Normally whenever you see our homes locking systems and all those things will also have the gripping if it is in cylindrical shapes and all those things. So, you can use for those grippings the knurling process ok. So, in case of the workpiece diameter when press fit required normally if at all I want for the press fit.

So, if you can use the knurling process what will happen it is a metal defrocking process, because of which the dimensions will slightly change and then you can fit it perfectly. Special tool that is called knurling tool is used for this particular operation, whatever you are seeing here this is these are all knurling tools ok.

This is the tool holder how the knurling tools are held? Tool consist of straight shank fitted with 1 or 2 knurling wheels these are the knurling wheels or the knurling tools these are held in the shank this is the tool holder or a tool shank. Job is held in the chuck and tool is fed across the job pressing against; that means, that you will press and then you rotate the workpiece in a lathe in a tool post you can hold the knurling in shank and where the knurling wheel is mounted multiple knurling means also you can mount. Then

you just give some depth of cut then you rotate the workpiece you will get the knurling operation.

So, in this case tool is not withdrawn till the process is completed. Normally you can complete this process in 2 3 passes if required and speed should be completely low. Normally the knurling process where you are embossing; embossing means you are printing some pattern on it assume that if a 1 rupee coin or 2 rupee coins are there, if you have normally it will be a blank. So, when you just print certain our symbol national symbols whatever the Indian government symbols are whatever things are there just they will dive converge dive will be there just go and emboss on top of it.

That is nothing, but embossing in case of that one if you are embossing a diamond cone pattern or a straight line patterns or cross as patterns that is nothing, but the knurling process.

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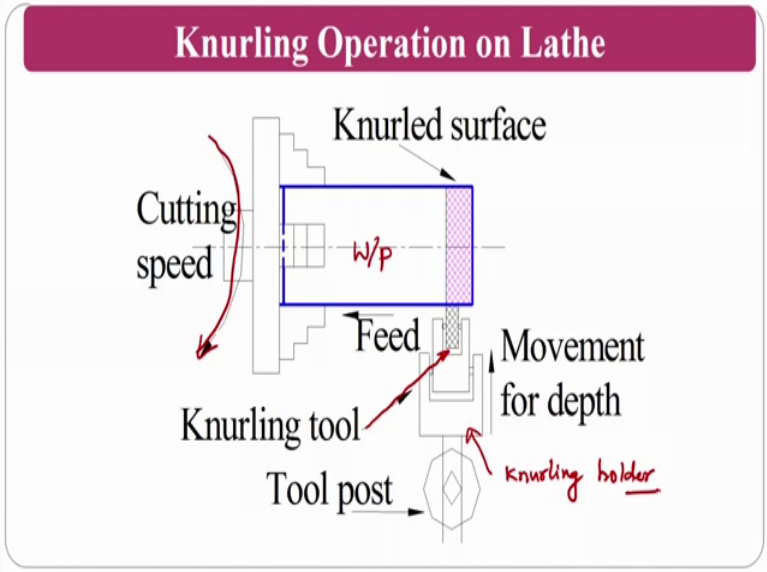

So, knurling operation on lathe if you see just now I was explaining you will have the workpiece, this is the workpiece. This is the movement of the depth this is the knurling tool will be there ok. This is the tool post and this is the holder or a shank ok. So, you can feed and you can rotate the workpiece, by giving the cutting speed to the head stock. So, the pattern is generated this pattern will have a proper griping, if you are going for some of the grip applications and all those things. Grip applications are very very useful in

daily life of a human especially in terms of sports and all those places to grip the weight lifting rod and all those things.

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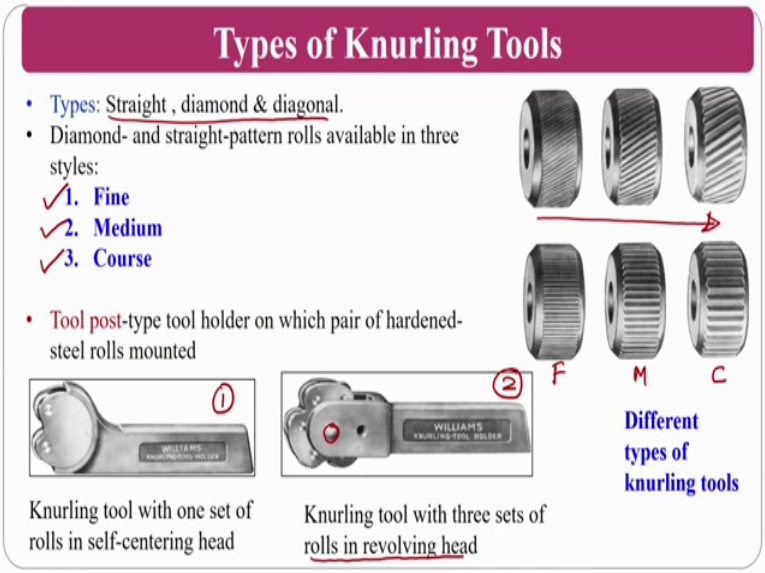

There are 3 types of knurling can be done that is called straight diamond as well as diagonal. So, diamond and straight pattern holes are available in 3 styles that is called, you can generate fine medium and course type of things also you can generate. The people here one suggestion for the those people who are doing the PHD or the masters they can go for fine knurling operation on a surface and you can change the contact angle of the surface ok.

So, 2 things you can try out here one is you can try out the contact angle, where you can may generate the hydrophobic surface or hydrophilic surface and you can use for the bio medical applications for the implants and all those things. The second things is you can generate the knurling operation. Then you can cut using the machining operation normal cutting knurling and cutting you can see there will be drastic change in the cutting forces and the cutting may be easy in the second case there are certain papers, where they are generating certain grooves on the workpiece then they are cutting. So, the cutting forces are gradually reducing. So, the people can try these 2 aspects as a small part of your thesis ok.

So, let me repeat you can change the surface engineering by fine knurling operation, if it on a fleet or if it is on a cylindrical surface, whatever you want to do. The second thing is

that just generate the fine pattern then you cut the using the same cutting tool and you can compare with the normal turning operation. I mean to say if you have a take the cylinder first generate the fine knurling operation and do the machining operation and measure the cutting force as well as temperature, the same rod you can take on the other side if you just rotate it which is on head stock or something you just the normal surface is there you just do the turning operation and you may experience the forces difference. So, you need to study more and more on the from the point of temperature forces surface morphology and all those things.

These applications are very good from the point of bio medical applications, where if I want to machine titanium or some type of materials, the temperature should not go very high, because titanium is not good conductor. So, the temperature stays on the surface itself ok. So, you can cut by generating some pattern on it. So, that the temperature will be very less so, the metallurgical changes in the workpiece will not be so, high. So, this is suggestion may be used or may be neglected. So, it is up. So, ball is in your court now.

So, knurling here knurling tool with one set of roles is there self-centering head will be there, another on is knurling with a 3 sets of rolling or revolving head will be there. So, here the difference between 1 and 2 is here there is a fixed head in one, the second one there is a revolving head not only revolve against the workpiece at also it can revolve about it is own axis also ok. There if you see there are different different types of knurling wheels are there these knurling wheels you can use single or you can use multiple also.

So, different different patterns and different different distances also you can generate, it can see the file to course in this way this is the fine is medium and this is course. You can generate different different types of knurling not only one you can also use two so, that you can generate cross edge patterns and all those things.

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The lubrication in knurling operation the knurling operation is very slow process that is why you always go for mineral oil based cutting fluids there were the lubrication is dominating ok. So, you need lubrication is dominating lubrication that is why you always go for mineral oil based cutting fluids you can also go for emulsions, but preference you can give for mineral oil.

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If you see the application normally the application of knurling is most important from the point of sports from the point of the people and all those things, where if you want to hold, or the held, the grip in the weight lifting.

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We can see here how to a particular person is here the particular person require a huge amount of grip otherwise weight lifting rod may slip. So, it is as dangerous as possible; that means, that griping place a major role in the daily life of a human ok. You can see now he this particular part is nothing, but the clean and jerk of weight lifting process or a weight lifting game, where heavy weight will be taken and you are having the proper grip on the rod then only you can perform. Otherwise it will be not safe from the game point of view ok.

So, hopefully the grip plays a major role in the weight lifting rod in particularly just it is a one of the example, you can have the many many examples, but you should generate the grip very very sophisticatedly depend on the application is concerned.

Now, we move on to the shaping process. Shaping process is a different process compared to the lathe, whatever till now what we have seen is some of the accessories that you can mount on a lathe then you can perform it. Now the shaping process is slightly different, which is some of you know it about this process shaping.

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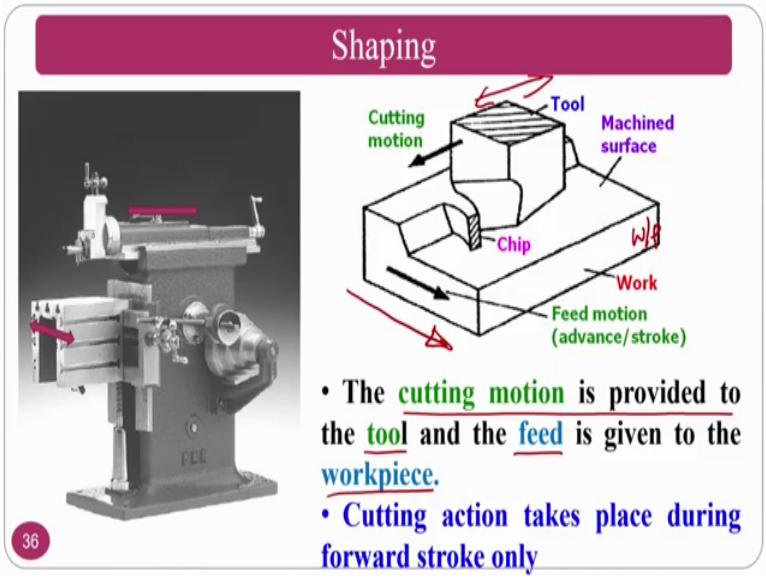

Shaping this is the shaping process where you can give the cutting motion is provided to the tool and the feed motion is given to the workpiece. Basically you have a workpiece this is the workpiece and this will be provided the feed motion; that means, that this type of motion will be given and the cutter will be reciprocating like this.

So, cutter will reciprocate as well as the feed will be given to the workpiece in that circumstances the material removal takes place in the forward stroke. These all work under quick return mechanisms, the quick return mechanism is one of the mechanisms that you may come across in the theory of machines and other courses where in the forward stroke only it will cut and in the return stroke if there is no material removal and it will come at very faster rate.

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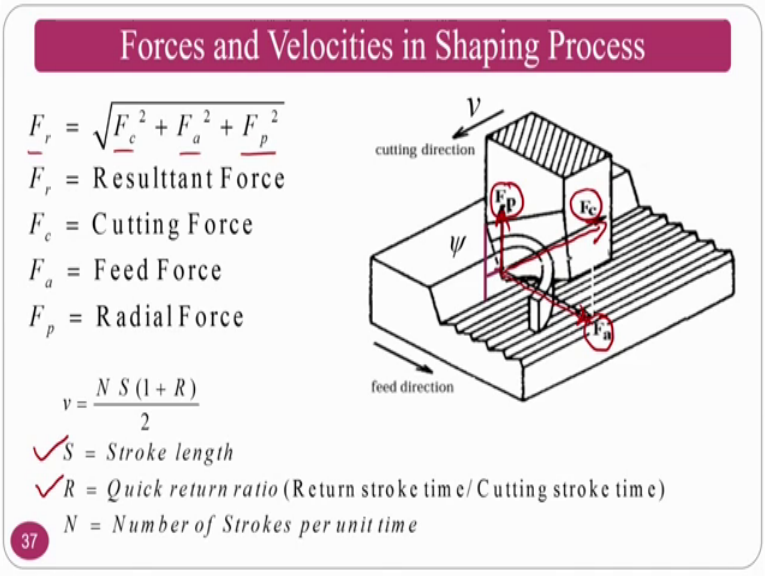

There will be 3 forces that is generating that is called F c F a and F p where F r is nothing, but the in this shaping process there are 3 forces are generated, which results in F r. So, where F r is a resulting force or a resultant force F c is the cutting force h a is the feed force as well as F p is the radial force. You can see here F a is in this direction and F c this is the cutting force and F p which is the radial force and the feed force is in this direction, 3 forces are there and the cutting velocity will be given to the tool ok.

So, the velocity if at all I want to calculate, because there is a quick return mechanism is involved the velocity of forward stroke is different from reverse stroke. That is why you have to always be attentive in that circumstances it cannot be l 1 plus l 2 by 2 or something. So, you need to take many things here where v equal to ns 1 plus r by 2 where S I S nothing, but the stroke length how much stroke it is moving R is the quick return ratio and N is the number of strokes per unit time ok. For unit time how many number of strokes are taking place, these are all will give me the velocity in the shaping process.

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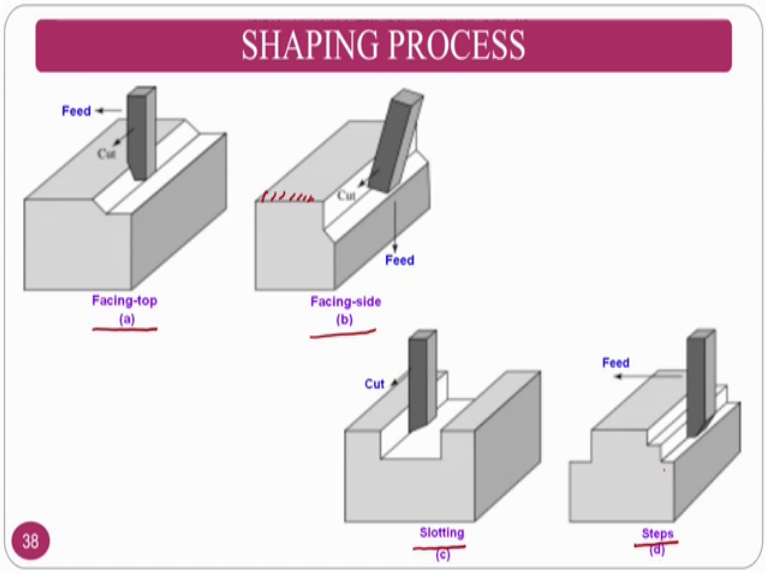

If you see the shaping process there are many varieties of the shapes that one can generate that is called facing on a top, this is the one type of generation facing on a side because this is the top surface. So, it is done on the facing on the side ways and some of the thing is you can also generate the slots, where you can put the keyways and all those things at the same time you can also generate the steps also. These are the varieties of applications of the shaping process that one can generate.

Now, move on to the another process that is called planar process this is similar to your shaping process.

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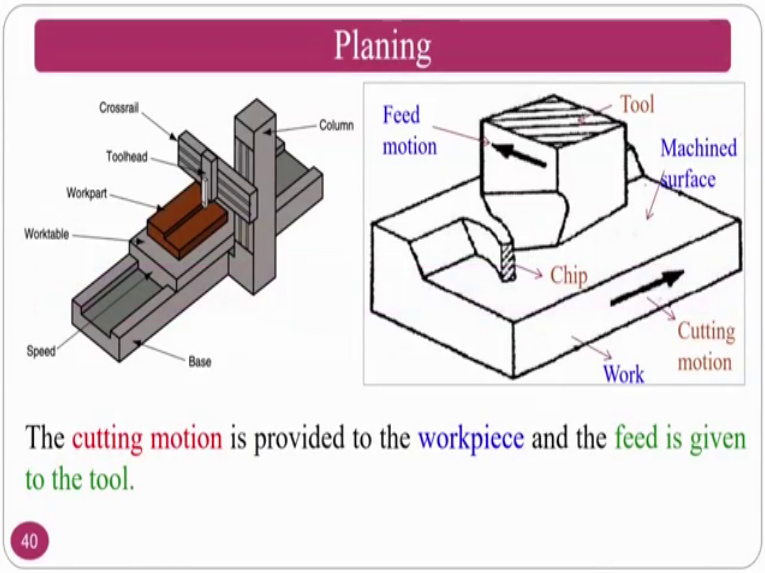

But only the motions are vice versa here the cutting motion will be given to the workpiece and the feed motion is given to the tool ok. So, the planing machines normally used for big workpieces, the shaping normally uses for the small workpieces that is a only difference if you see the straight and flat surfaces created on both surfaces.

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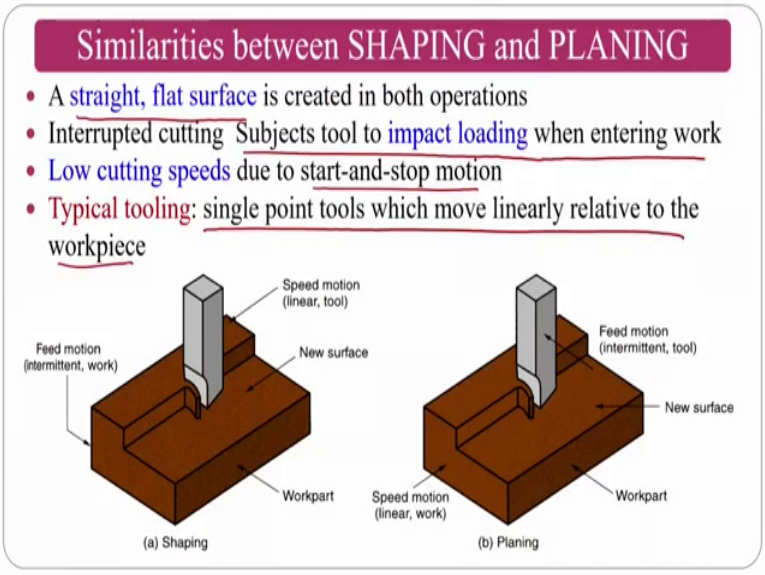

Now in this particular slide, if you see here the similarities between shaping and planing is explained, in the both shaping and planing the straight and flat surface is created on the both surfaces interrupted cuttings subjected to tool impact when entering the tool; that

means, that when the tool is starting it is journey what will happen it have some impact on it; that means, that there will be a impact load on it.

So, low cutting speeds are due to the start and stop mechanism, because at the start it will start from 0 and it has to go to 0 velocity for; that means, normally this particular process will be conducted either shaping or a planing process at lower speeds ok.

So, typically tooling single point tools which moves linearly relative to the workpiece in the both either, you are giving a cutting motion shaping or whether you are giving a feeding motion in the planing both are like linear motions for the shaping as well as planing.

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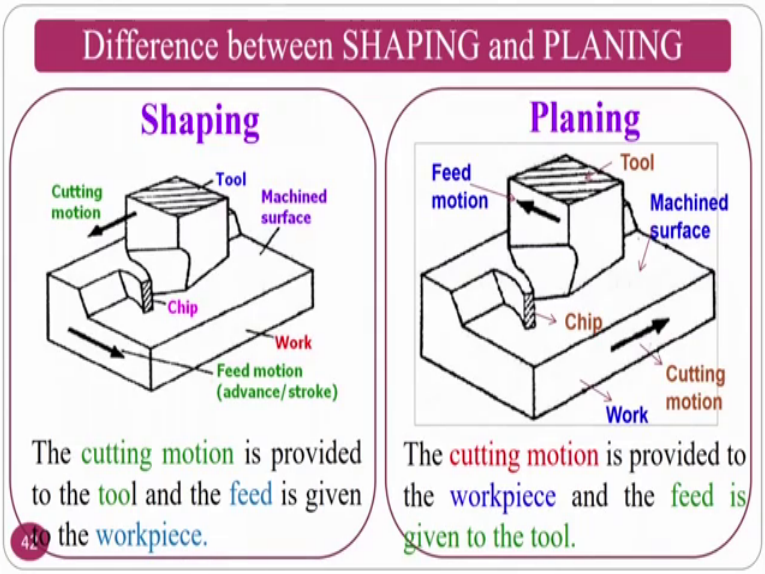

The difference some of you may face the interviews in some of the jobs mechanical oriented jobs there the one of the common questions you may come across is what is the difference between Shaping and Planing? So, people many of you know it, but it is my responsibility to just remind you that here the cutting in the shaping, cutting motion will be given to the tool as well as feed motion will be given to the workpiece in a planing cutting motion is given to the workpiece and feed motion will be given to the tool. So, that is vice versa in both cases.

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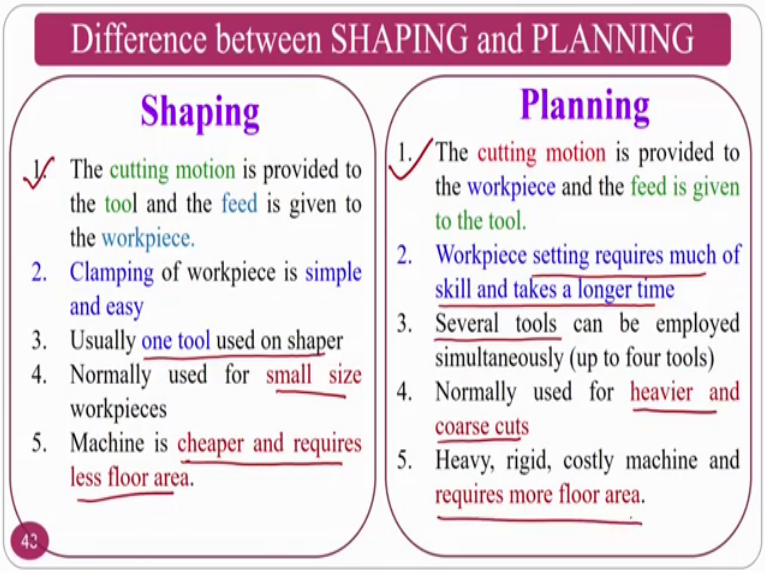

The shaping and planing these are the differences first difference I already taught you and second thing clamping of the workpiece is simple and easy in the shaping process, workpiece setting require much and skill is required because you are going to hold very very big workpieces. Usually one tool in a is used in shaper several tools may be used in the planing operation, because your workpiece is so large.

Normally used for smaller size workpieces as I said here heavier and coarse cuts you can go for the planing and you can go for the very big workpieces. Machine is cheaper and requires less floor area it requires more floor area; that means, planing machine normally will be in big in size and the shaping machine can be very small ok.

That is why some of the colleges are small small engineering colleges, they will have for the demonstration shaping machine, but may not be planing machines. Normally the planing machines you can see in very big big industries, where you require to cut very big structures especially like HAL Hindustan aeronautical limited where you have to cut some of the big big shapes and so on. So, RND laboratories where they will deal with big workpieces or deal with the planing process.

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CNC planers you can see how big this planer machines are if you see in this picture it may not look very big, but if you imagine that this are the big big equipment where you have to mount the large workpieces to cut. Till now we have seen the multipoint cutting tool process, as well as single point cutting tool process, those processes which are used in the lathe as well as after the lathe we moved on to the shaping, planing in this particular class now we see this summary of today's class.

We have studied about the some of the single point operations or single point cutting tool operations in the machining processes.

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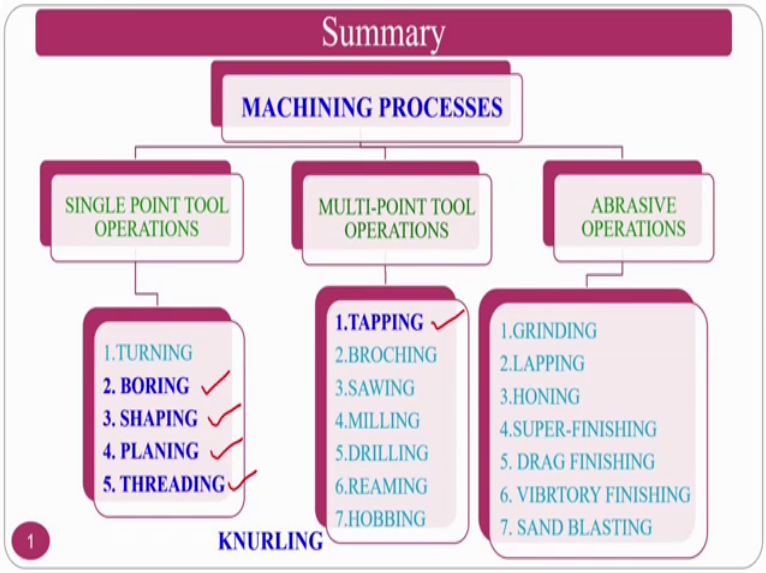

Since, we have already seen in a elaborative way about the turning process. Now in this class we have seen some of the single point turning processes or the single point machining processes, such as the boring process, shaping process, planing process, threading process, and some of the multipoint cutting tool process also like taping process, and mostly we have also seen about the knurling process ok.

This is about the today's lecture that we have seen and we will see about the other multi point cutting tool operations in the upcoming classes and followed by the abrasive processes such as grinding lapping and all those things ok.

So, in the next class we will see about the multipoint cutting tool operations then followed by the abrasive processes. And I want to say at this particular moment of time. So, what is the importance of knurling since you have already seen a video in the when I was teaching the knurling operation, if you see the knurling is most important and all those things.

Now you can see my own video because at that point of time I have not told you to not disturb you in the middle of the class and when I was a student at some other IIT that is IIT Kanpur. So, I have being a record of player of weight lifting and body building team. So, let me show my own experience, because how the knurling plays a important role in griping the weight lifting rod.

So, now, you can see how much important it is from the point of weight lifting, because if there is a small slippery in the rod of the weight lifting heavy weights are pulled against the gravity and all those things the fast pulling as well as the properly griping and all those things play important role for all these things knurling is one of the operations that will give you the proper griping.

Thank you.