Manufacturing System Technology

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Module - 03

Lecture - 16

Welcome to this module 16 on Manufacturing Systems Technology. In the last module, we were talking about mostly about, how translation strategies can be implemented across variety of different process. And we tried to understand, what are the kind of modalities possible for translating between two processes independently or using a neutral file format in between, where as one translation only preprocessor into the file format and other as a postprocessor of the file format into the version, which would be understood by the machine.

So, we also talked about the various different neutral file formats or data exchange formats and their structures and then, we went on to sort of initiate what all this data would be needed for in terms of computer aided manufacturing or CAPP.

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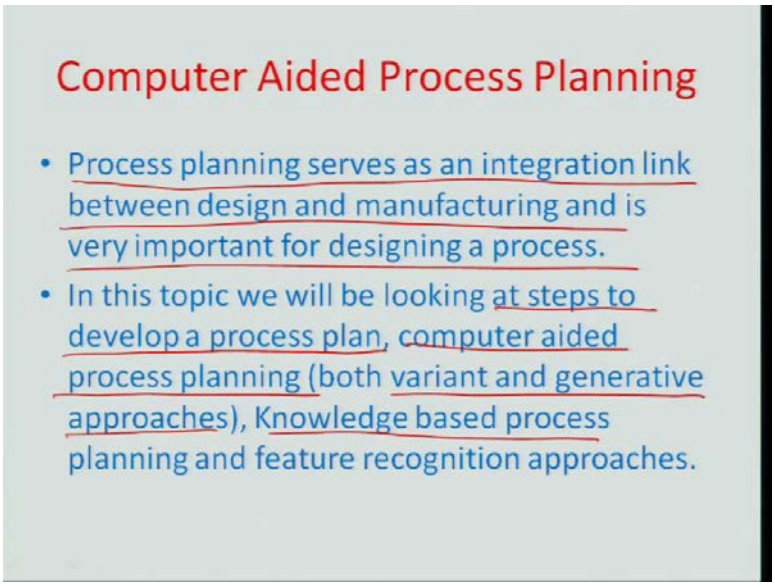

So, the computer aided manufacturing as we discussed last time really necessitates a good process sequence, where the manufacturing processes which are involved there into manufacturing parts have to be done in a sequential in a proper manner in a logical manner, so that there are no problems related to access the process. And therefore, every manufacturing activity necessitates something called a process plan and the process plan is although really a manual experiential plan, which comes up, because of the people who are associated directly with the process.

But, then there is a strategy, which is involved in sort of gathering together all that information data, that experiential data of personal involved in manufacturing directly and trying to put logical sequence in to all this, so that, because it is a vast amount of information. So, this is the variant of this kind of a process planning is known as computer assisted process planning or computer aided process planning.

So, therefore, I think you have just mention this before that the process plan serves as an integration link between the design and manufacturing and is very important for designing a process. And we will be typically looking at different steps to develop a process plan, particularly a computer aided process plan in this particularly topic and there are two different approaches for this process planning, one is called variant and other is called the generative approach for process plan. And then; obviously, we have knowledge based process plan in the CAPP or Computer Aided Process Planning.

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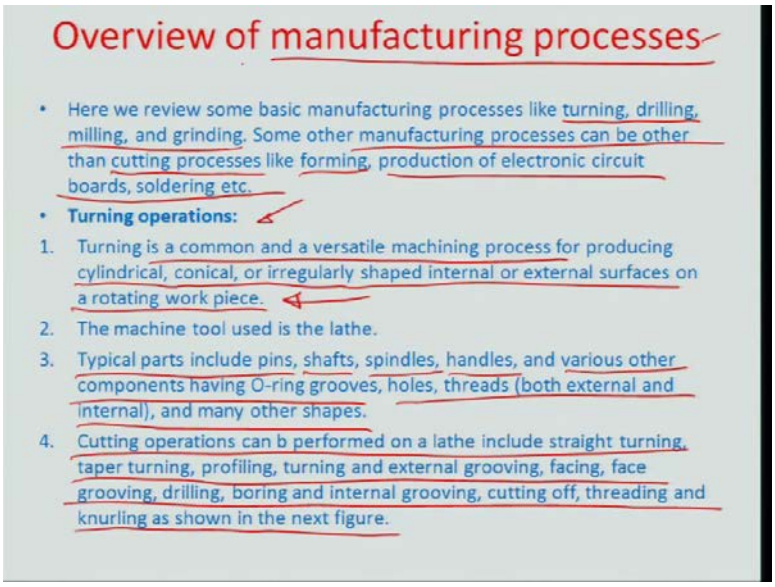

So, lets us now look at some of the manufacturing processes and I think I had discussed yesterday that whenever we are talking about a CAPP. In fact, a perfect or closed to a perfect seams or computer integrated manufacturing system as all in on a industrial scale has really been achieved at the level of machine shop. Operations like assembly shop or you know some other shop, whatever you know those may not be very close to a completely computer integrated manufacturing system.

But, definitely assembly is in fact, one of the hardest processes, where there is a substantial contribution from you know manually driven processes. And therefore, thinking about a totally computer automated process would really not be a very good idea for such complex assembly processes. So, we would therefore, be likely to focus mostly on the machining side, when we are talking about CAPP and let us look into the some of the manufacturing processes involved in doing the machining.

So, some fundamental processes make just like turning, drilling, milling, grinding probably all of you are quite aware of basics of this process. And then, there can be some other processes which are not really the primary processes, but are for different variance of manufacturing, like the rod processes, there are cutting processes, where you can do shift and cutting, there are forming operations, where you do bending and pressing of the sheets, production of electronic circuits, boards, soldering, so on and so forth.

These are some of the not, so important, but yet you know the secondary level processes, which are available as far as the manufacturing processes domain goes. So, turning operations looking into the details of turning operations is a common and versatile machine processes and it introduces all different symmetrical shapes like cylindrical, conical and some irregularly shaped internal or external surfaces. Typically they are done on rotating work piece, all of you must have seen a turning centre or a lathe.

And the typical parts that would needed to be process on a turning centre are things like, let us say pins or shafts, spindles, handles, various other components having o ring grooves, holes, threads, both external and internal many other shapes, so on and so forth. And; obviously, cutting operations can be performed on lathe include straight turning, taper turning, profiling turning and external grooving, facing, face grooving, drilling, boring, internal grooving, cutting off, threading and knurling and this is shown in here, illustrated here.

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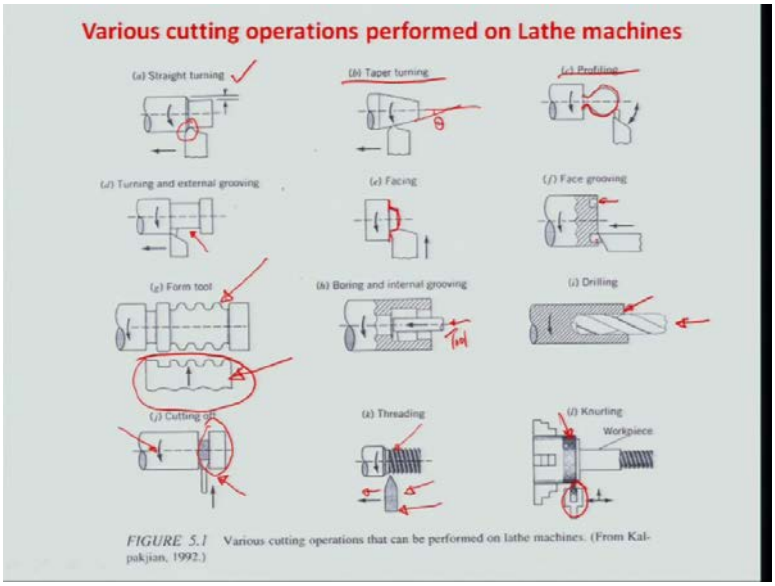

So, shown in the next figure right here which talks about straight turning operation for example. You know these are all variances of in the rotating, the work piece rotates and the tool moves perpendicular to the access of rotation of the particular work piece. So, there is a straight turning operation being done here, where there is a single point cutting tool as you can see, which engages with the work piece or rotating work piece and it tries to peel off the metals. It is a taper turning in this particular figure, where the tool moves not parallel to the axis, but at an angle to a particular axis.

You can see this particular angle theta being described by the tool path with respect to the central axis of the work piece. Profiling, where the same complex topology like that on a door handle for example, has is being illustrated by creating a tool path, which kind of tries to create the shape you know. So, the tool was somewhere here and you know along this red marks the tool moves up to the axial center here.

And; obviously, because it is a rotational symmetry the work piece is rotating, you will have this shape of the feature put in or embedded in or made from that particular cylindrical work piece. And there you have other operations like turning and external grooving, you can see this external groove, which is being made you know by virtue of turning and then you have facing. So, one side of the particular cylindrical barbing stock being used here is being faced.

So, there is smooth finishing at this particular end here and it goes all the way up till this area, this is small area is completely taken off from the material that can be face growing. So, in a face you can actually further make grows here as illustrated in this particular area; obviously, the groove goes all the way circularly from this end to this end just because of the rotation of the work piece, which takes place. There is farming operation, where you use instead of a single point cutting tool or forming tool you know, which has a certain topology with negative of which you want to cut off on the work piece, which is rotating.

And then, you have other operation like boring and internal grooving. Here for example, you can see that the tool really is creating an impression by you know, by boring whole on to one side of the particular, the work piece in question. You can also have a drilling operation, you have the drilling tool is taking of material from this end of the central work piece while it is rotating. You have a cutting off operation again on lathe, where you can completely cut off a section of metal from the remaining portion of the bar, which is rotating on the spindle side of the lathe machine.

You have a threading operation, where again there is threading tool and it has given a certain rate of movement in the direction parallel to the direction of the rotating axis and you can actually see this threads being cut at a certain pitch, you know based on the movement of this tool with respect to the work piece. You also have knurling operations, where this texture this rough texture normally introduce for increasing the grip etcetera in the bar handle is being done.

This is the knurling tool you know, which provides that texture. So, it is a sort of a form tool, but it has you know instead of the major amount of material being formed by virtue of the tool it has only a very small texture on the surface, which gets printed on to the work piece.

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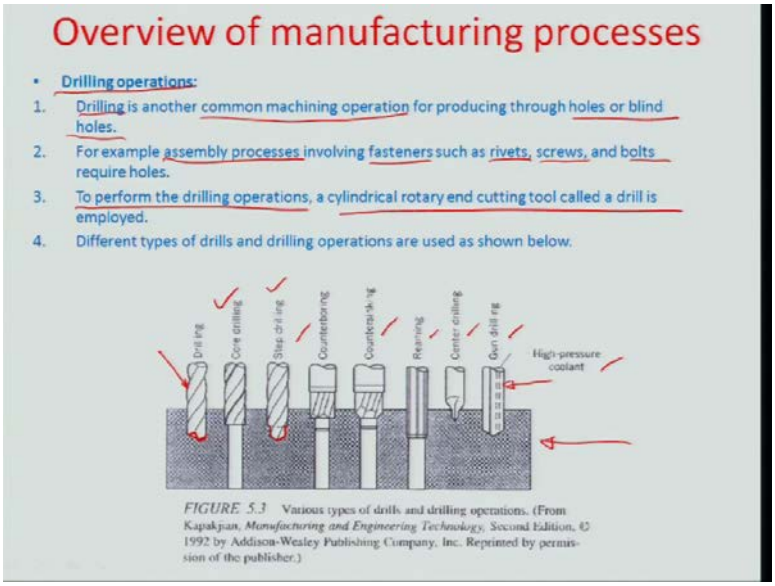

So, these are some of the operation which are performed on the lathe machine will have similar operation for drilling different wholes or creating different wholes of different aspect ratios with in materials. So, drilling of cause is very common again another very common machining operation and it can produced either holes or blind holes you know across work pieces and these holes are, then further use for the assembly processes for all these work pieces.

So, you can you know sort of whatever you have drilled can utilized for holding fasteners for examples rivets, screws and bolts you know the fasteners can ensure to can hold two objects to gather as an assembly. So, that if one of them is important than motion the other automatically starts to get dragged along translate the motion from one end to other end in this manner.

So, to perform the drilling operations a cylindrical rotary and cutting tool called a drill is employed this is the drill you know this is look like how flute and these are something like probably all of you may have at some point of time done in your or seen in your basic manufacturing workshop relative activities. So; obviously, it is also peeling process and feeling happens really towards this tip here the drill tip here and there are to ends of this particular tip and peeling would happened dramatically opposite one here and one dramatically opposite to it across the drilling periphery.

So, that is how drilling is operated you have various forms of drilling different types of drilling operations you can have a core drilling, step drilling has the name show in corporate step you know something like this counter boring if count sinking, reaming, centre drilling, gun drilling, hyper shape cooling etcetera. So, I am not going into the various details of the different kind of drilling operations is not really manufacturing process related course.

But, you can understand that basic idea here of motion and if you really wanted to auto made such a system would be that you rotated the tool and you know and then, make the work piece translate against to the rotated tool. So, that there is peeling of the material by virtue of the relative motion between this tool and the work piece.

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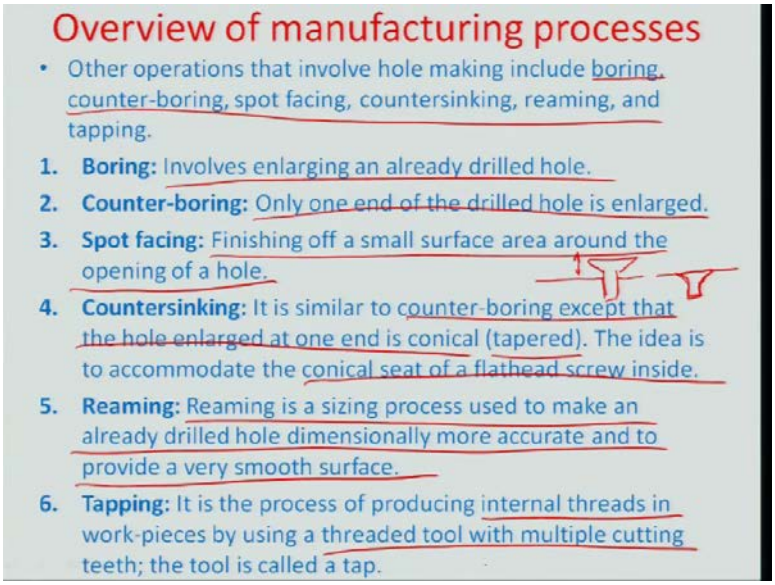

So, that is another operation, so; obviously, if you look at just the basic difference between the different types of drilling and associated processes you know there can be associated process like boring, counter boring, spot facing, countersinking, reaming and tapping. And they have various purposes for example, boring involves in enlarging and already existing drilled hole or counter boring only is done one end of the drilled hole.

So; that is enlarging and typically it is done for counter shank of a screw or in terms of head sitting inside the surface you know, so that is countersinking on a surface, so counter boring on a surface. And, so you have to enlarge the hole on one side of the threaded hole, which existing inside the work piece, where this screw is set in he is a spot

facing which have finishing of small surface area around the opening of a hole countersinking of course, similar to counter boring except that the hole enlarged at one end is conical manner.

So, if the screw that we are using has a conical head, then countersinking and countersinking is the best process for doing that and the idea is to accommodate the conical set of flathead screw inside. So, that there is no protrusion on the surface of this head in the surface as such planner, because in this count sinking operation on the surface. So, it is something like if you had a hole like this you are essential trying to now, do a countersinking on that hole by creating a conical surface.

So, that otherwise the we bolt would have sat some were here there would have been a prorogation, which would have been protraction surface now, in this case bolt actually set here and there is no protraction from the surface. So, there are reaming operation reaming is the sizing process used to make a already drilled hole dimensionally more accurate to provide a very smooth surface based on that taping operation.

Obviously, to cut internal threads in work pieces by using as threaded tool with multiple cutting teeth the tool is also called a tap as I thing some of you may have already seen on the manufacturing process work shop, so these are the associated process of the drilling.

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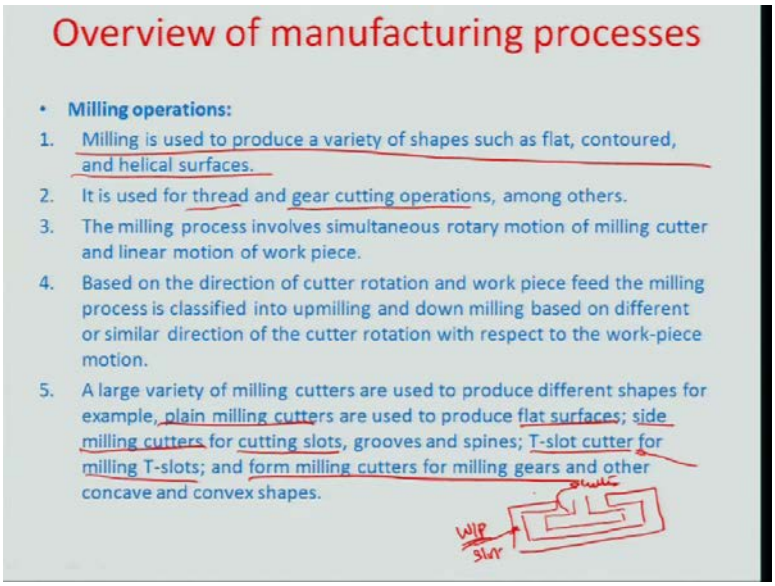

Again let us come to milling operations, so; obviously, mill is used to produce a variety of shapes such as flat contoured and helical surfaces very hennery manufacturing process of gear cutting operations also for threads in some of the cases. So, the process involves simultaneous rotary motion of a tool surface and you know there is a linear translation of the work piece with reference to the rotating tools the spindling of the shaft, which contains the tool is also can her bar cross the tools is being put in.

And, so just as in the lathe process you have a turning work piece and a linear reaming tool it is the way around it is the turning tool in the linear reaming work piece and this particular operations. So, based on the directions of the cutter with respect to the proceeds of the work piece you classified up milling and down milling. Obviously, if the cut reason to the similar direction to the movement of the work piece are down milling and vice versa for up milling.

Large variety of milling cutter is used to produce the different shapes some of the shapes you know, let say if you wanted to deal with flat surfaces is plain milling cutters if you are doing lot of slots on the surface you have to use side milling cutters if you have a t slot a milling on the subtractive can use on t slot cutter for that is the combination of the shaping on the generation process. So, you have a milling cutter in the shape of these slots itself and the slots gets machined you know, because of the shape of the milling cutter.

So, basically this is the work piece slots, which is been machined by virtue of this machine milling cutter. So, you can form cutters and for milling gears particularly other concave and convex shapes.

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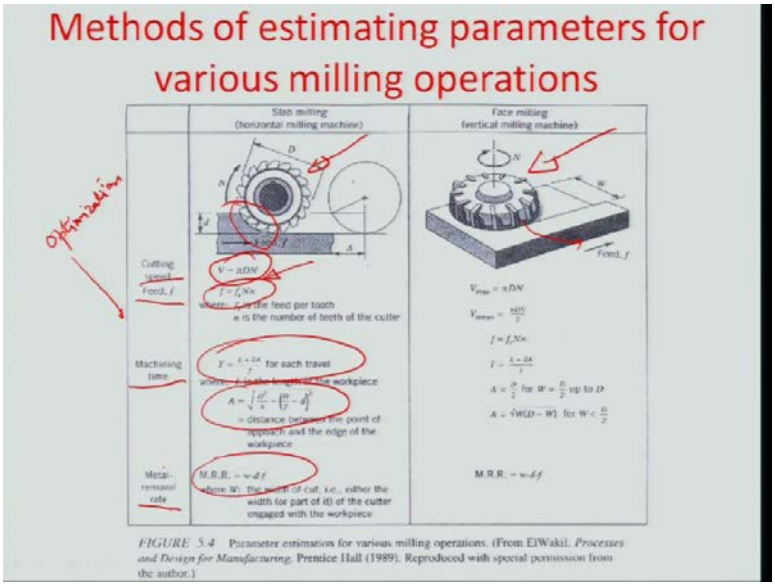

FIGURE 5.4 Parameter estimation for various milling operations. (From ElWakil, *Processes and Design for Manufacturing*, Prentice Hall (1989). Reproduced with special permission from the author.)

So, these are what milling operations capable of doing, if you look at really to a milling cutter there is a face milling options shown here and a slab milling options shown in the other directions. So, here in one case it is the rotating face of the cutter, which is removing the material in other case it is actually the teeth of the milling cutter presents in sides and the rotating of this respect to the work piece removing the material from this particular zone.

And, so there are various formulations, which probably at some point of time you may have studied in any manufacturing process course, which talks about, what is the cutting speed for examples, what is feed what is machine time metal removal rate, so on, so forth these on the very important from optimization stand point, which will be mostly following in this particular course all though we are not going to delve into the details of how these formulations really came is other manufacturing process course for that. But, we would be interest to definitely take of these formulation and to try do some you know optimization. So, that would be able to get a most optimize process in our systems.

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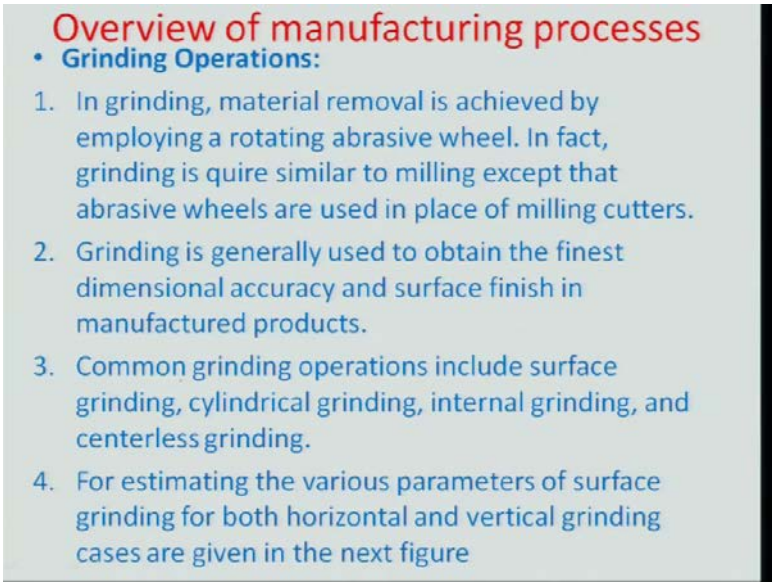

So, that is what milling process are have you also have other manufacturing process like grinding or you know something is related to surface finishing operations, which will probably take up in the next module ((Refer Time: 18:05)) and also tried to see various aspect of how to sequence some of the process to build manufactured items or parts machine components. So, with this I would like finish the module the current module and in the next module we are going to take up some of this process in little more details and then, start doing the process planning operations for making engineering parts.

Thank you.