Manufacturing Systems Technology
Prof. Shantanu Bhattacharya
Department of Mechanical Engineering and
Department of Industrial and Production Engineering
Indian Institute of Technology, Kanpur

Module - 03
Lecture – 17

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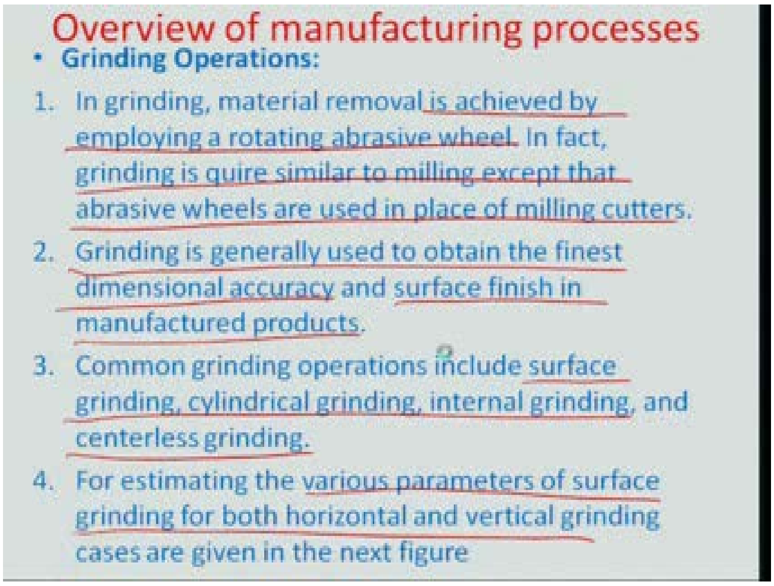

So, hello and welcome to this manufacturing systems technology module 17. We were trying to discuss about the various machining operations as needed in the computer assistant planning process, and in context of that we covered the basic turning and milling operations also drilling operations in the last lecture. Would like to review some more processes and then go to the really the planning approach or how do we plan this different processes for making the union. So, like to start with the grinding operation today. So obviously, grinding is more allows more allows like a finishing process and material removal is achieved in any grinding operation, because we have a rotating abrasive wheeling which sort of digs into a work piece and the abrasive wheel is able to move very small portions of materials from the interacting abrasive tips with the work piece surface.

So in fact, grinding is quite similar to milling except that the abrasive wheels are used in place of milling cutters milling cutter, there is one point at a time interacting with the surface and in the grinding wheel, there are many such points which interact may be at the same instance of time with the surface. Grinding is generally used to obtain the finest dimensional accuracy, and this was in fact the surface finished process which have been developed for manufacturing products actually, and the common different varieties of the variance of grinding processes which are which are involved may be include, you know surface grinding, cylindrical grinding, internal grinding, center less grinding, so on so forth. So, the various parameters of surface grinding from both horizontal and vertical grinding cases are shown here in this particular figure.

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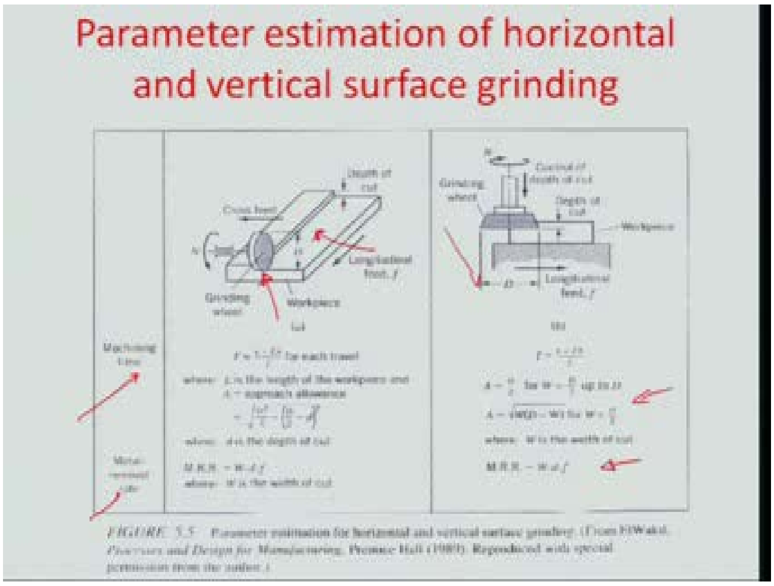

This is the horizontal case which talks about the machining time about the materials removal rate in terms of the various parameters related to how the grinding wheeling its position with respect to the work piece surface k, and for surface vertical surface grinding, also the same kind of estimate had been made in this particular figure. The both machining time as well as material ways rate it slack to different in this particular case, and this on the geometrical derived many manufacturing process technology course.

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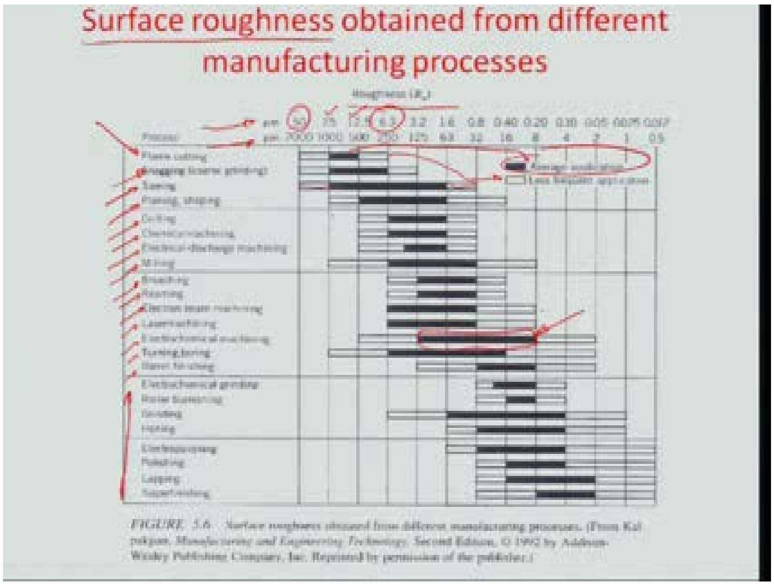

So, now let us look at that just because we said about surfaces and surface roughness, this figure kind of shows you know in the ray of different roughnesses, where we talking about average roughness here hither in micrometer, and micro inches and as function of the different processes, which are which are involved you know in giving this surface finish. So, the various processes here for example, flame cutting has been shown to yield surface between 15 microns, 50 microns; all the way 6.3 microns; obviously, there are certain ranges where you have the relatively higher applications for his black regions here for those process, where there would be average application of the process for obtaining the particular desired roughness, and very less frequently the process may be used for obtaining you know roughness indicated by these white regions.

So obviously, the black regions are the one, which are mostly the roughness regions, which are cover or which are use to cover by this surface the flame cutting. For examples would yield roughness on in average 12.5 to 25 microns surface average roughness, similarly the course grinding operation snagging as it is better known would actually yield a surface form starting form 25 2 6.3 microns. Similarly sawing can go from 25; all the way to 1.6 microns, it is used even beyond, but then these are the less frequently used regions for this machining process. So, variety of this processes sawing planning, drilling chemical machining, electrical discharge, machining milling processes, and then variety of other like broaching, reaming, electron beam machining, laser machining, electrochemical machining, turning boring barrel finishing, electrochemical grinding, roller burnishing, so on so for.

All these different processes have been giving in terms of they are average roughness values which would innovate for most of the frequently use applications. So, that is how the manufacturing processes are classified. So, ones you have this data of surface finish, you can see of plan your hydrophobic sequences, where in a assembly operation you may need the lower surface finish. For example, there may be super finishing need of the range of about point to microns. So, and you may need to use some of these like polishing lapping or super finishing on the top of sum other machining operation which has been made earlier. So, this is how you actually find out the different surface roughness obtained from the different manufacturing processes.

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So, what really is a process planning, you know when we talking about different products, and their components they are designed to perform certain functions mostly; these functions are in assemblies you know. So, assemblies are the different components. So, the process planning is really about how you can choose sequences processes. So, that an engineering part good engineering into assembly operations. So, that can be enable to function as an symbol product symbol final product. So, it really acts as a bridge the planning really acts as a bridge between the design and manufacturing you know, but translating the different see design specifications, which have been arrive that in the design face into manufacturing process details. And therefore, it is nothing but a set of instructions which have to be done to be able the right choices in the processes in the right choices in the sequence of the processes. So, that the particular tolerance in the design of the particular measurement in the design can be realized, finally in the end product following basic 6 steps are needed in developing the process plan.

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Let us look more closing to words it. So, you have number of activities which need to be utilize, and here there is also an optimization, because the various choices which come up and you will have to really choose the correct path of the correct sequence. So, the first step; step is the analysis of the part requirements then you have selection of work piece raw work piece. So, then its materials material selection step determining manufacturing operations, and their sequences most important step you have selection of machine tools. So, selection of tools work holding devices inspection equipments, and then finally determining machining conditions for example, cutting speed feed depth of cut and so on so forth, and manufacturing new times which include set up time processing time and lead time, so on so forth.

So, there is series of these activities which are involved developing of a manual process plan, and then we will letter on see how you can computer assist this, and in what kind of decision making algorithms would be utilize when there are several choice. And there is optimize, it will be that is follow to pick up the appropriate choice to do the correct process sequence.

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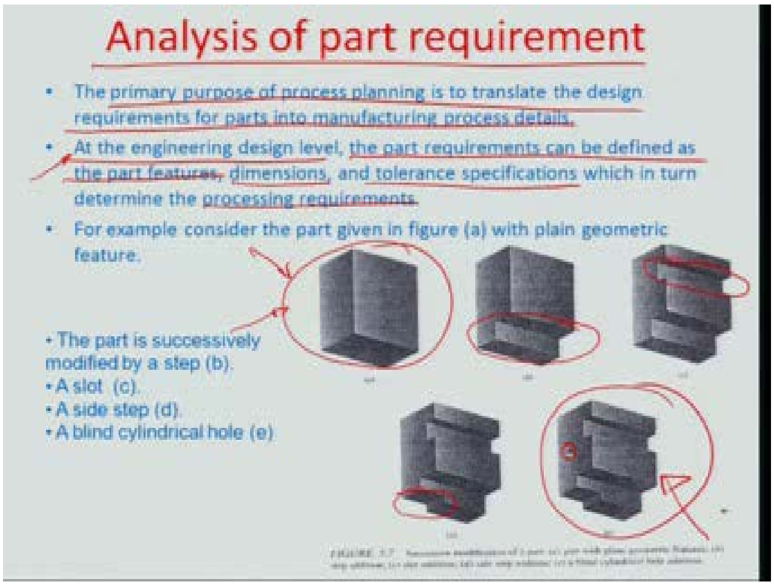

So, let us look one by one on these particular issues what really mean by analysis part requirements. So, the primary purpose of process plan really it to translate the design requirements for parts into manufacturing process details. So, at the engineering design level, remember we had the design process or design thinking earlier where we talked about how you can design various engineering product the part requirements can be defined as part features dimensions tolerance specification etcetera.

We have to convert them into processing requirements, that is the whole reason by analysis of these part requirements are carried out in very very appropriate, very very detail manner. Let us say in consider this particular example that you have a final part to be made of this type show on here in the part e, you know and you consider the part to be coming out of block, you know which is given in the part in the figure a with plain geometric feature. So, therefore the part is successively modified by a the first instance, you actually put a step in this particular region to the part, then probably you put a slot somewhere here. The step is all ready existing carried to the step c, you put a slot somewhere here, and them always the side step which you tried take from this particular area of found.

Then finally, you put blind whole some or here throughout the block to fine the final part blind whole with two steps: one flake step in a side step in a slot in the same particular block. So, this sequence of operations that what proceeds what is nothing but sort of intelligent approach looking at the various machining concept, which have been described before to the requirement the engineering, requirement to realize the final geometry the three dimensional geometry from the solved the block of the material is be consider. So, this analysis process of the requirement of the engineering design; obviously, there has to be a feature size there has to be a tolerance size, there has to be a basic dimension there has to be a process capability; these aspects have to be consider when we have talk about such analysis form part requirement. So, this is step one of process planning.

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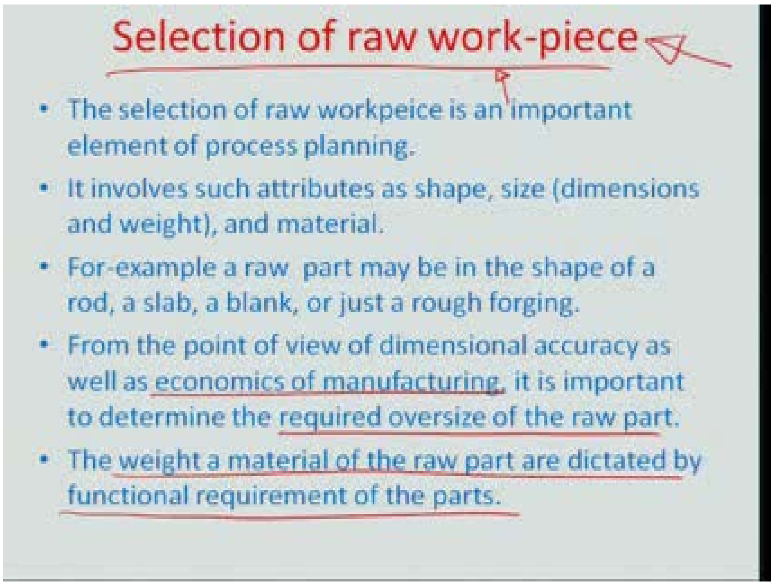

The step two as we indicated selection of the raw work piece. So, basically the raw materials is very important, but only that can I optimize the machining time select something. For example, let us say you have just seen the last step here that the product at e finally, humiliated from a block at a. So, how do we sure that this block is just of the size where minimum machining is carried out to achieve this; obviously, there has to be a profit angle in all organization when you try optimized manufacturing processes.

So, therefore, e the correct raw materials size and shape for example, is it a billet is it a block is it a flat sheet is it a cylindrical bar what exactly are we using what shape, we are using is basic raw materials. So, that the minimum amount of machine, you would be able to have final engineering parts is of very importance very perennial question, that is one part that we ah need to have as far as the selection of the raw work piece is concerned. And then obviously economics of manufacturing would determine the overall require over size of the raw part. So, that you can remove minimum amount of part two create the engineering part of question the weight of the material of the raw part; obviously, dictated by the functional requirements of the parts also and you know things like for example, what is the type of the materials to be chosen, whether it can whether it can really take up the ultimate yield strength or performance, which is needed for that particular engineering part while in a assembly or while in the machine these accept also come to the stage of selection of the raw work piece or raw work piece material.

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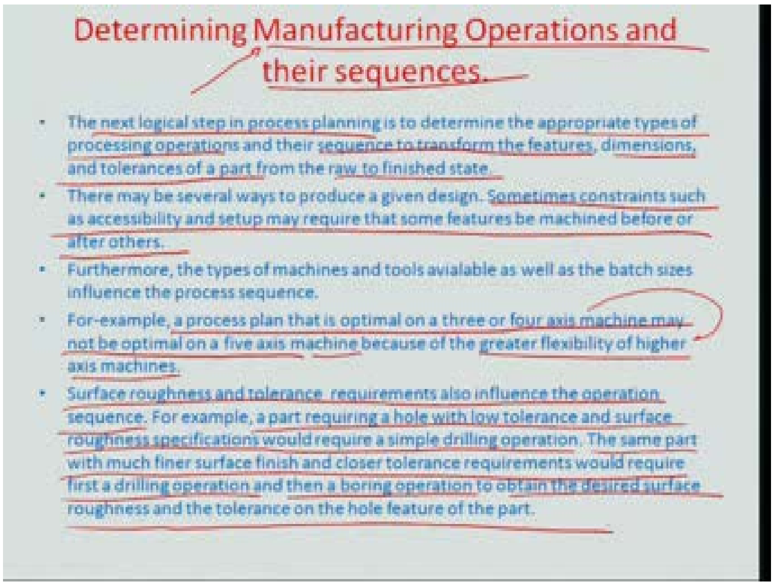

So, once that is defined then obviously the manufacturing operations and their sequences need to be planned. So, that is the next logical step in the process planning, determining the appropriate types of processing operations their sequence to transform the features dimensions tolerances of a part from the raw to finished stage. Then several ways to produce a given design sometimes constraints such as accessibility, and setup may require that some other feature be machined before the others I just showed you one example, before where we talked about what is this as you know the different process involved here. For example, it is in the black you just carved out this particular step function right, and this is step this must have been done by some kind of a face milling operations something on this or may be even you know combination of this to shopping process with respect to grinding processes hybrid you know, and then you consider doing this particular slot then a side slot.

I have done the side slot earlier and then start working on the slot, it will not be a very appropriate mechanism, because you know the slide slot, then in that case would have to go greater amount of depth you know, and the material would have to be subject to tremendous amount of in comparison to if you have already created this step. So, that is a sequence in which you have created the side step with respect to the whole you know step here in figure b of the in part requirements. So, there is obviously, basis for the sequence of the different operations, sometimes you talk about holes or you talk about corners, which are inaccessible when another machining process is worked upon it.

So, can I have the accessible part first and then later on when we have already assembled the inaccessible later on. So, that you know one part which was not accessible in the assembly stage in accessible data compliments stage. So, some of these are really very important consideration to determine the sequence of the processes while doing process planning. So, they can be some other questions ask for example, whether process plan is optimal on a 3 or 4 axis machine, and whether it can the same plan can be on a five axis machine, because of the greater flexibility of higher axis machines. So, if such a thing is this is can be combined these requirement which could otherwise have been generated on a three or four axis 2 or 5 axis. So, it have been additional comparably something more to the same part, if need be feature change of design of the particular part.

So, these kind of things are also a part of the manufacturing operations and their sequences and ah the surface roughness and tolerances particularly in as a design requirements also influence the operations selection. For example, let us say part requiring whole with a role with surface roughness specification would require a simple drilling operation, and the same part with much finer surface finish, and closer tolerance requirements would require first drilling operation, then a boring operation to obtain the desired surface roughness. And then the tolerance of the whole feature on the whole feature of the part can be realized as per the design. So, these are some of bases of finding out what are the manufacturing operations and their sequences.

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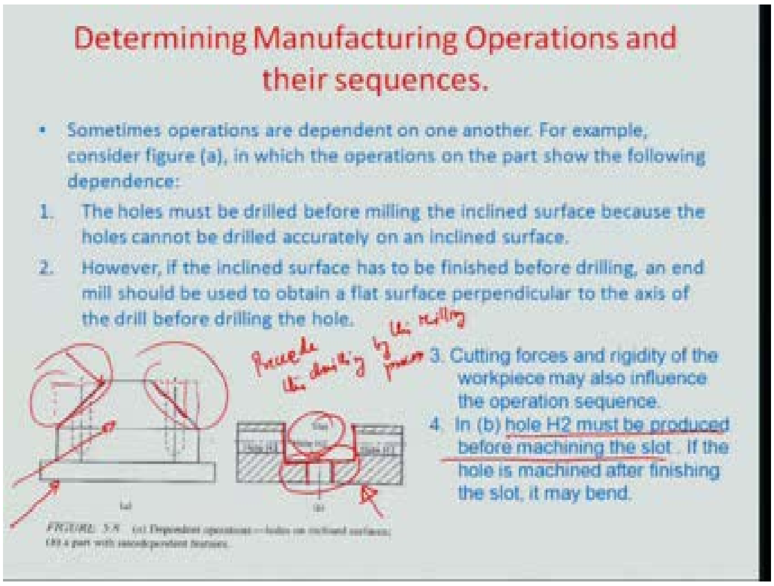

So, having done that the next step you know is the sequence of the process, I will just illustrate two example problems here in this one example problem how we do for example, realize this part. So, its combination of various cutting motions there may have been a block of this sort you know a solid block out of which probably there has been some milling, and milling which in use material in this particular zone of this particular zone there has been also as drilling as you can see here. So, if I have to proceed the drilling by the milling process meaning there by that, let us say the meaning has been done and then the brilliant perform. So, is it a good option the answer is know, because obviously, drilling is much tougher then drilling on a surface. For example, in the block for solid in a not been done in the drilling took place from that particular surface. So, that you later on obviously, the portion has been made that would have been a much better operations.

So, the drilling coming first in this process followed by the milling is something; that is engineering it which gives engineering sense or engineering logic for handling this part. For example, in this particular part again you can see that in the hole h 2, this particular hole must be produced before machine in the slot here. And other wise if you produce this hole after this slot has been cut, there is chance this section to bend, and it may actually do form. So, therefore, determining such manufacturing operations sequences is very important from engineering part requirement point of view.

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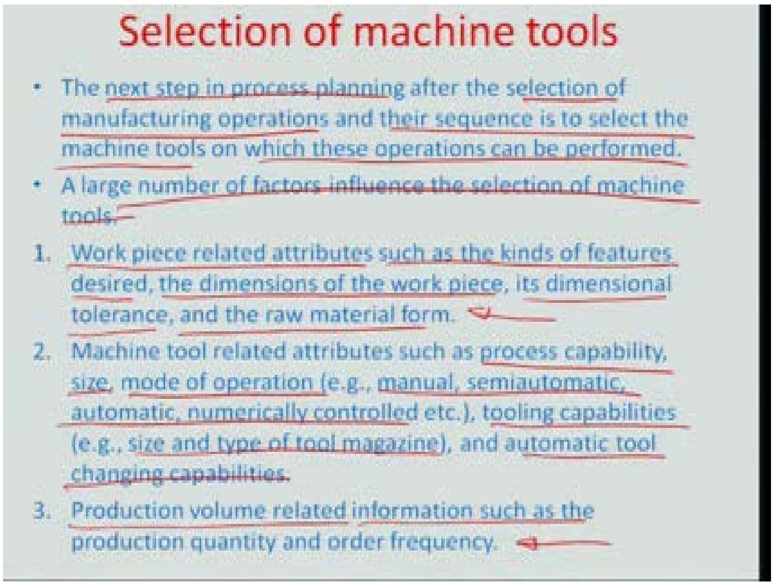

Therefore, you know the cap or the computer assistance process planning should work on such experiential modules of determining what comes first, and what comes next would determine the whole process sequences manufacturing process sequences the other important issue is the selection of the machine tools. So, that is the next step in the process planning after the selection of manufacturing operations, and their sequence is to and their sequence, now you have to select the machine tools on which these operations can be performed. So, a large number of factors would influence the selection of machine tools.

For example work piece related attributes such as kinds of features desired the dimensions of the work piece its dimensional tolerances, and the raw material form that would be something that is first need for that is first factors, which you include the selection of the tool machine tool related attributes, such as process capability size mode of operation whether it is manual semiautomatic, automatic numerically controlled machine tooling capabilities such size, and type of tool magazine etcetera or automatic tool changing capabilities; those are some of the determining again for selection of the machine tool. And finally the production volume related information whether machine would be able to give you the particular or neat the production quantity requirement. So, the order frequency requirement, that is big issue which needs to be taking care while doing the selections of machine tools.

So, in a nut shell we have now covered the analysis of part requirement, that is first step of the process planning we have then obviously covered the selection of the raw work piece, you also covered determining of given manufacturing operations, and their sequence. And then finally, selection of the machine tools, now you will also tried to analyze how this process capability of different tooling can be matched to these specification, we will take simple example of doing the turning basic turning operation on a shaft you know, and then tried to see how we can do process capability analysis of machine.

So, that particular machine of range of machine scan be of selected, you know based on the requirements of the design given in the shaft design. So, that will be in the next modules. So, I will close on this module here by just mentioning that process planning; obviously, is the intelligence of the operators who are actually associated with processes longer amount of times as read in a very organized to manner. And then you know the engineering design to part what are the bridges which need to be sort of covered is what the process planning is or is really what the intelligent process planning would be on all about.

Thank you.