Manufacturing Processes II
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Lecture No.34
Design and Applications of Jigs and Fixtures

Young friends welcome to the course Manufacturing Processes – II. Our module ongoing is jigs and fixtures for machine shops.

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and the lecture today this is the last lecture under this Module Jigs and fixtures and today's topic is design and application of some jigs and fixtures for some specific jobs.

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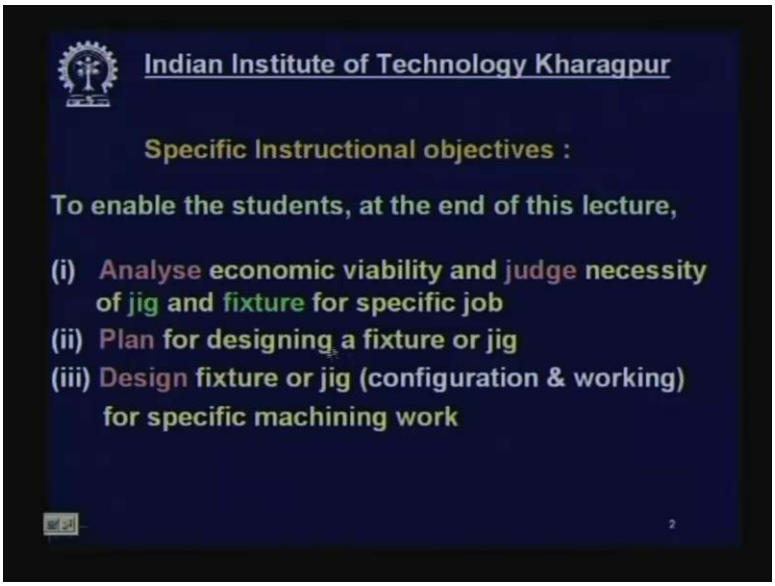

Now what are the specific instructional objectives? Today analyze economic viability and judge necessity of jig and fixtures for specific job. Now whenever we get a task we should decide should we go for jig and fixtures that is to be decided with analysis then if decided that jig fixtures should be used then we have to make a plan for designing a jig or fixtures. Now next is design fixtures or jig configuration and working principle for some specific machining work. Some example will be given for some typical jobs.

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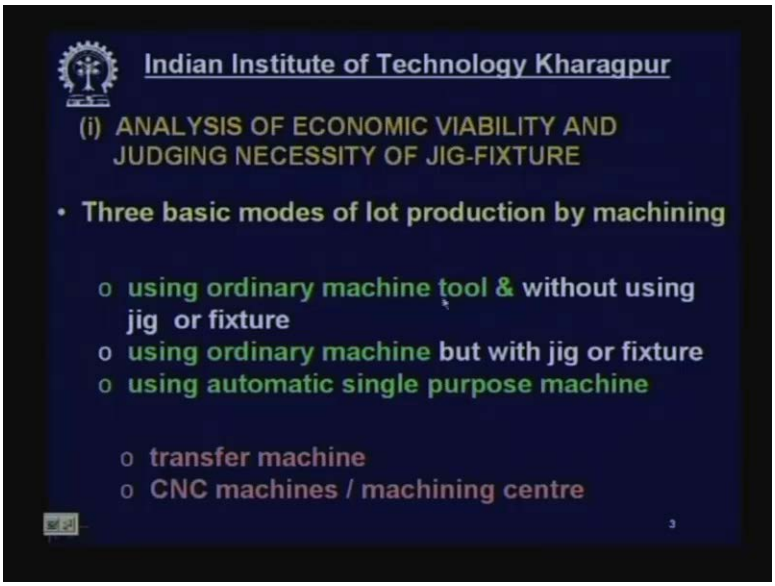

Now first analysis of economic viability and judging necessity of jig fixtures whether jig fixtures we used or should not used before that let us recall the machining work for a lot

production starting from few pieces to a large lot. There are three basic modes of lot production by machining what are those using ordinary machine tool like lathe milling machine ah broaching machine and a similar machine tool boring machine without using jig or fixtures that is total work will be completely manual even marking and locating clamping everything will be manual using ordinary machine but with jig or fixture.

You remember according to definition jigs or fixtures are the devices which enable easy quick and accurate locating supporting and clamping you know but this will done manually with the help of ah human being but will done very easily quickly and accurately. So this will save time using automatic single purpose machine. Now beyond these three modes there are two modes also one possible is transfer machine. Now transfer machine is not a standalone machine tool. It is a group of machine tool arranged in a row comprising say fifty to hundred machine tools. So this is highly automatic. We are not considering these things at this moment. What can be done also in CNC machines or even machining center?

Yes this machining centres CNC machines are applicable for job order production or batch production but these are very expensive sophisticated machine they should be used very for complex jobs which are difficult to be done by other machines conventional machines and the value of the product is very high. So that the total revenue will compensate the cost of the machine. So our discussion will be confined to this first three using ordinary machine tool without fixture using ordinary machine without or with fixture using automatic single purpose machine. Now it is obvious that ordinary machine if we uh work by human the cost of the machine is less but the time will be large you know the production rate will be slow. So the machining cost per piece will be large. If we use jigs and fixtures the cost of the machine remain same but the additional cost of the jig and fixture have to be added. Now if we do it automatic single purpose machine work will be done very quickly accurately no doubt and but the machine is very expensive it has to be available and procured.

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Now out of this three we have to select one selection of manufacturing mode is governed by what is the factor by which it will which based on which we shall select for a particular production task technological feasibility of the modes okay there is a task machining task and there are three modes possible we have to check whether this three modes are feasible technologically feasible for the task or not. For example, if the job is very simple and few then it can be done when ordinary machine by the manual mode but if the work piece is a very complex then it may not be possible to do it in automatic machine if we try to do so the cost of the machine will be tremendous.

So these are few technical feasibility's okay human being can take care of by virtue of a skill understanding and intelligence lot of complexity and all these requirements come automatic machines are not of that type. So technical feasibility these really means we may select technologically from technological point of view a particular mode for a particular task but it may not be technical feasible because uh the machine has to be available jig fixture has to be available if not there should be some experts who can design and construct jigs and fixtures required for the purpose. If it is to be done in automatic machine single purpose then this machine has to be available if not atleast has to be procured that amount of money has to be available and all this. These are called technical feasibility.

Now economical viability that is most important this has to be based on considering cost of manufacturing we are concerned with machining at this moment not casting forging. Only is finishing and finishing by machining based on the cost components cost of the basic machine because this machine will be used for a good amount of time. So the cost of the machine has to be taken into account which will be which will remain engaged cost of design and construction for jig fixtures if this is to be used because jig fixture has to be designed these are not available in the market as such they are tailor made they have to be designed and constructed separately according to the job.

So additional cost will be involved. Volume of production number of pieces yes it may be say piece production one or two pieces very few up to five it can be job order productions

say up to five ten twenty. It can be batch production it can be lot production. Now even if it is lot it can be small lot medium lot and large lot production and top of that it can be mass production. So the number of pieces has also to be taken into account material and labour cost. This has also to be taken into account. If time taken is too much then labour cost will increase. If we can get the work done quickly with the help of say jigs and fixtures or with the help automatic machine then the labour cost will come down drastically beside this manufacturing cost few more points are also to be considered expected product quality and revenue yes, now can this mode provide the desired quality that is required and what will be the revenue because revenue minus manufacturing cost is a profit that is more important objective. Sometime automation can provide quality consistently and as a result revenue increases but for complex jobs or if the number of piece are very few then the human being can do better say manual production in case of piece production. So they can also produce the desired quality and get the revenue. So this factor has to be taken into account total time to complete production or deliver the products.

Now if you take a task you can complete it in one month if you do manually without using jig fixture automation. If you use jig fixtures may be within fifteen days if you do it automatic machine may be within seven days. Now if you can complete the work within seven days and deliver you will get lot of benefits the customers will be very happy they will pay more money for that and you can utilize the time that is saved for other work

so it is it has great impact of the social economy. If you can deliver the goods in time and in short time.

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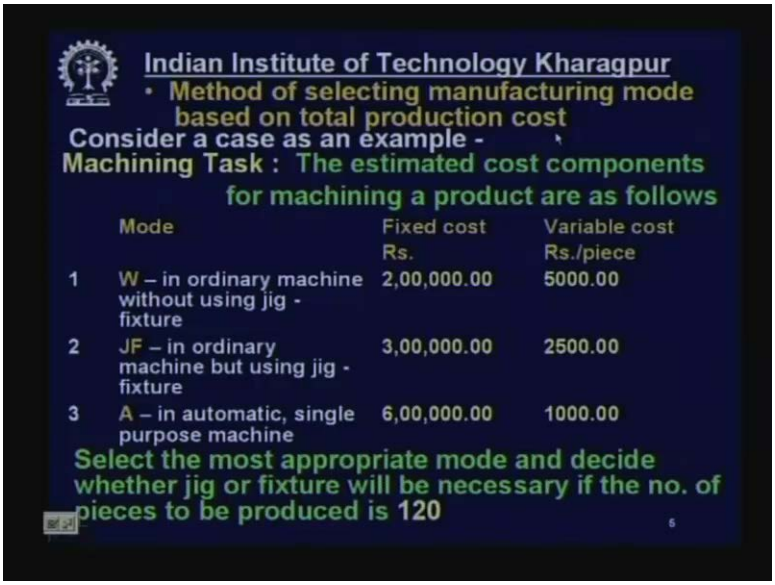

Now after that method of selecting manufacturing mode based on total production cost now we have seen in the previous frame that there are so many factors. Now let we out of which most important is a manufacturing cost. We shall give an example it is discuss is an example ah a selection based manufacturing mode based total production cost that is cost of manufacturing by machining. Consider a case as an example, what is a case

machining task? Now suppose you have to produce hundred twenty pieces of an of an object task is the estimated cost components for machining a product are as follows there are modes possible say mode number one W. W stands for ordinary machine without using jig fixture fixed cost the machine cost will be two lakhs rupees and variable cost that the cost per piece that is a labour cost material cost will be five thousand rupees per piece.

If we use jig fixture along with ordinary machine then the cost will be high then we say one lakh extra for a jig fixture three lakhs initial fixed cost and the variable cost will come down to two thousand five hundred from five thousand because of saving time and reducing rejection that will help reducing the cost per piece. Now finally if we go by mode A in automatic single purpose machine the cost will definitely increase initial cost because of machine will be expensive say six lakhs and the running cost of the variable cost will be one thousand rupees per piece for the material and labour cost.
Now the question is select the most appropriate mode out of this three given and decide whether jig or fixture will be necessary or viable if the number of pieces to be produced is hundred twenty. Now this is very important the decision will be the selection will be finally governed by this components of the cost as well as the number of pieces of the volume of production you can see later on. Next;

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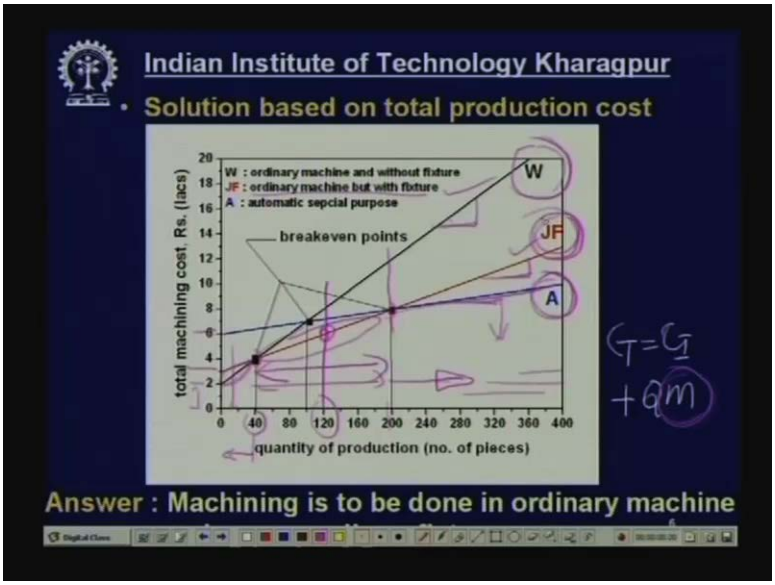

Now in this graph you can see that the first one now this is a graph showing total machining cost quantity of production. Now what is the total cost total cost is CT is equal to CI initial cost plus Q quantity of production multiplied by m marginal cost that is y is equal to mx plus C is a straight line suppose we assume that these are going an of the straight line. Now in case of W say this manu production without jig fixture in ordinary machine. The initial cost is two lakhs. You can see in the previous one it was two lakhs and the running cost the varying cost is this much slope is stiff that is m is large here because it goes slowly and the cost labour cost increases so it rises sharply. Next if we

use jigs and fixtures say JF ordinary machine with fixtures JF then the initial cost will be three lakhs but the cost per piece will come down the slope will comedown because it is only two thousand five hundred rupees per piece. So it will go like this and if we use automatic machine initial cost will be six lakhs but the slope will be even slower that is one thousand rupees per piece. Now what we understand from this. These three points of intersection are called break even points. Now here we can see this is a number of pieces to be produced if the number of pieces to be produced is less than forty suppose less than forty then which one will more most appropriate so for as production cost is concern. The bottom most line here the bottom most line gives the minimum cost what is that that is machining in ordinary machine without jigs and fixtures that is if the number of piece is very small or then may be the machining with in ordinary machine without jig fixtures will be more economic than even jig fixture use or automation.

On the other hand here we can see that if the number of piece are more than two hundred then which one is most economic then the automation system is most economic because that is a bottom most line. So for large lot production or huge production mass production automatic system is most economic but friend what about the region here this region between forty to two hundred or say forty one to one ninety nine we find that this line is the bottom most line that means if we use the machine and jig fixture then this will be most economic. If the number of piece or the volume of production remains within this region forty to two two hundred what is our problem our problem says whether should we use jig fixture or not if the number of pieces is hundred twenty. Now if we draw a line we find that this meets this bottom most line which suggest that using ordinary machine and jig fixture will be most economic in the sense manufacturing cost will be minimum. This is a how the mode is selected based on economic viability and here we can find that this situation suggests that use jig fixture property.

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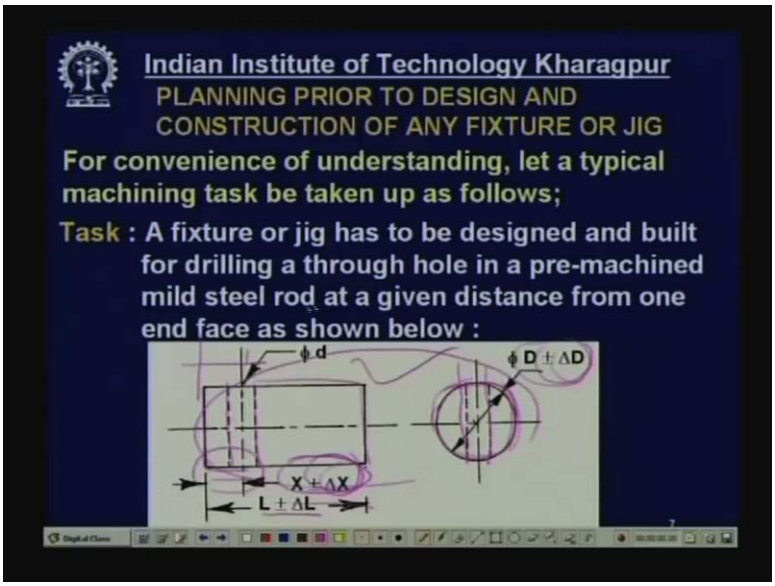

Now planning prior to design and construction of any fixture or jig. Now suppose we decide that yes for a particular task we shall use a jig and fixt jig or fixture. Now before we going to jig fixture we have decided yes we shall go for jig or fixture but before that before going to the real design and construction fabrication we have to make a through plan in sequential steps. Now the for convince of understanding let a typical machining task be taken out as follow. What is the task? Task is this one we take a rod. This is a rod okay straight cylindrical rod of circular section of length L plus minus delta than means length may slightly vary because of the tolerance and a whole this is a real task. A diametral through hole has to be made in into this rod at a given distance this distance is very important this distance X plus minus delta that means the distance should be precisely maintained within a small tolerance diameter of the blank may also vary because this di uh that the rod the blank is pre machine by turning or somehow. So this will also may have some variation in the diameter say delta D small variation. So locating supporting and other thing for the design steps should consider this aspect the preside precision of the distance or the tolerance and variation possibility the variation that diameter of the rod because of this and length can also slightly vary because of machining tolerance. So briefly what is the task? A fixture or jig has to be designed and built for drilling a through hole there is no blind hole through hole in a pre-machine mild steel rod. So is a strong material at a given distance X plus delta X in a pre-machine mild steel rod at a given distance from one end face as shown below this one. So this is the task. Now let us see.

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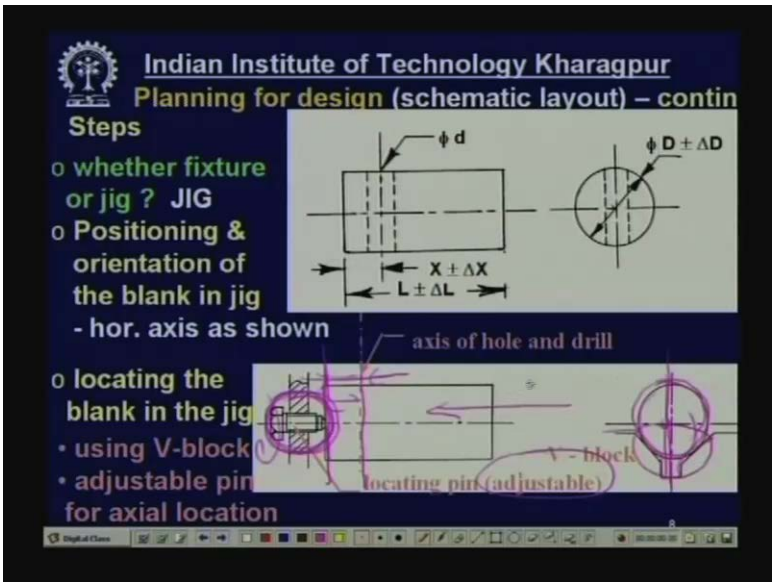

Planning for design: Now we shall really show this schematic layout we shall not go into the design for strength, rigidity, wear resistance that we are not going to do that is a separate issues. We shall design the for the configuration and major principle of working that locating supporting clamping steps. First of all, we have seen the task. So this is rod job where a through hole has to be drill in a transverse plane whether jig or fixtures. Now should I use a jig or fixtures. Now this task says we have to make a through hole by

drilling okay d phi d. So there is no tolerance so a accuracy is required so drilling is best suited most economic and so a jig has to be used because the drill will need some tool guidance as soon as you need a tool guidance and provide it it becomes a jig. Positioning and orientation of the blank. How will you place the blank shall we place blank horizontally vertically or in an inclined fashion. How? Now here we can see ah hole has to be made perpendicular to the axis. Now this hole has to be made by a drill. Now drill in a drilling machine is always in a vertical position. So the drill axis in an vertical position and a hole has to be made perpendicular to axis of the rod. So rod has to be placed horizontally. So drilling can be done vertically by the drill. So this is the configuration this will be configuration rod will be kept horizontally like this locating the blank in the jig. Now this location is very important which was discussed in the previous class previous lecture.

Now since it is a cylindrical rod of suitable say a reasonable length and diameter all right. So and this is pre-machine. So considering this aspects locating by V block is most appropriate. So this will be supported by located by V block. So this is the V block on which this will be located. If the diameter vary no drilling has to be done axially if the diameter slightly varies this will not make any problem because the axis will remain same now there is another part using V block and we should use a pin because this location is very important is not it. So this has to be placed in a proper position along this line. This is also be maintained on one side locating by V block and locating this face. So that the drill axis is know so this distance will be maintained and this is done by an pin locating pin. Now this pin should be locating pin adjustable because there is a tolerance desired.
Now after drilling if there be any error in the distance of the location then by moving this screw operating this screw rotating this can be adjusted again and again as and when required, beside that in the next opportunity if another job comes where the length of the job is slightly bigger or smaller by adjusting the pin the same fixture can be used.

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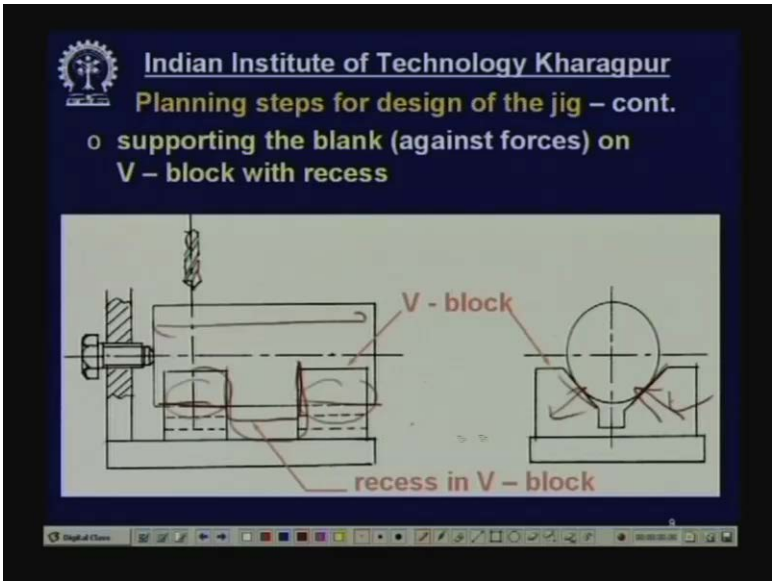

Next is supporting the blank against force what are the forces, clamping force cutting force etcetera will come on to the work piece. So this blank has to be supported on rigid bodies. Now it is already decided that the job will be located on V block all right V block so this V block is strong and rigid. So same V block will be use for supporting also. So this will give the strong support to the blank but sine it is a long rod is a is got sufficient length. So this V block should had some recess here. So contact will be over this length and this length and there is relief. So that the contact here and contact here are assured and this will more this will give more stable support this is an important aspect.

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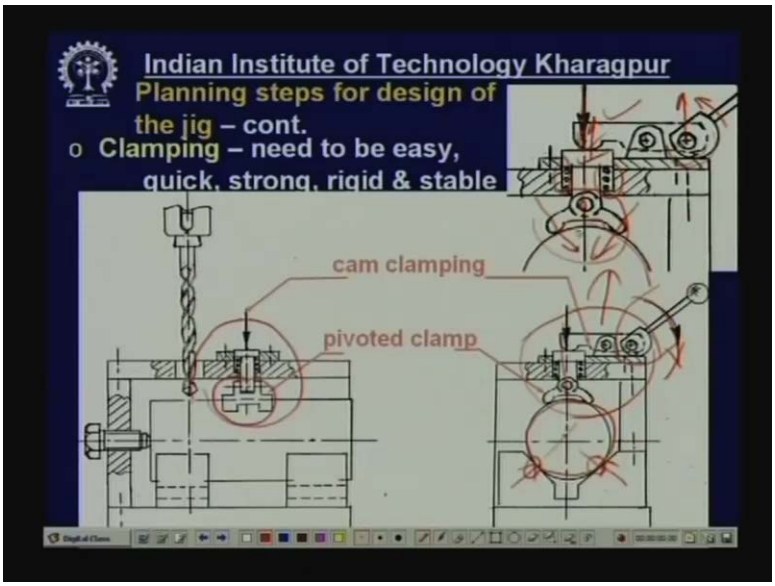

Now come to clamping planing steps going on the clamping this need to be easy with strong rigid and stable. So this few points have to be kept in mind. Now keeping those things in mind this has been proposed. Now remember friends that for you know making this thing you know understandable to you I have given only on example but remember there can be several options some of them may be as good or even better than what has been proposed by the teacher. So this is one example keeping in view that it should be easy quick strong rigid stable as well as this will not hamper the loading and unloading of the blank before and after machining from the jig or fixture. Now this is the rod. This is the rod kept supported located on the V block.

Now the clamping has to be along passing through this point. So this will give stable support. Now here this has been this clamping has been done by a quick clamping method cam clamping. This has been magnified here. You can see here this is the work piece and this is clamped by a trap and trap will exert a force on this pin and this will be exerted by rotating this lever of the cam clockwise in this direction and then this will rise

in this direction this will exert force on the pin. So the pin will not rotate and this force will come on to the pin where a rocker pivoted arm is given where the force will be exerted equally from these two sides and there will be no rubbing or sliding area only there will be point contact and this two contacts plus these two contacts at the support will give very stable clamping and this cam eccentric cam will give a self-locking.

So during machining this will remain in position. Now on this view this is other view this is cross sectional view and is other view this can be shown here. This is a pivoted block. Now here you can see the spring what is the function of the spring when this cam will be withdrawn this spring will push the pin up there will be gap between the pivoted arm in the job and job can be easily released or removed. So this has to be kept in mind.

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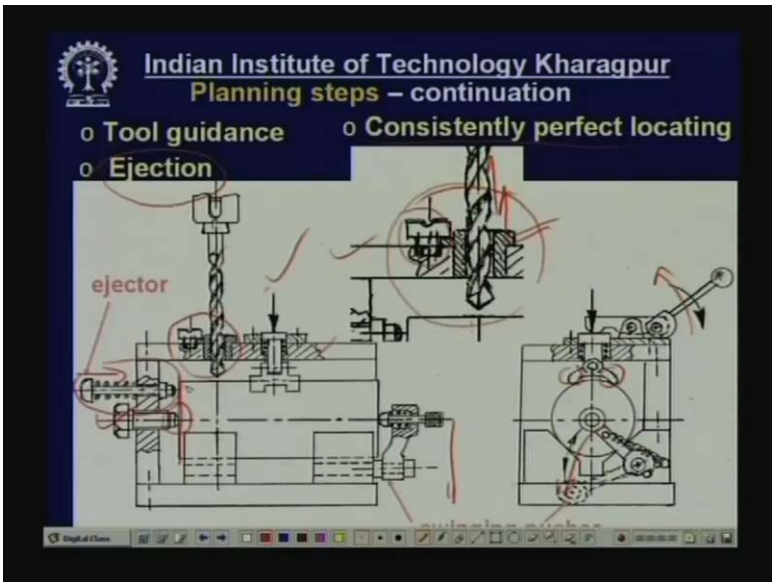

Now step is continuation planning steps tool guidance in in the previous one you can see we have done locating supporting clamping. Now here you can see through this clamping plate okay rigid plate there is hole large hole through which the drill can pass. Now we have to see that the drill has to start on a cylindrical surface drill as such is a slender tool which rotated while rotating it rotates in an with a run out that because of run out because of run out the diameter of the hole become oversize beside that it has to start on a cylindrical isn't the cylindrical surface drilling has to be done do drill has to be guided properly. It should not be allow to move apart considering these aspects the tool guidance is a must and this will be done by a bush that is shown in the next frame.

Here you can see a bush has been fitted here a bush will be fitted here like this and this there will be a small pin to fix it in position this will how it will be fixed. So this is we have explain the bush here. Here you can see the jig bush has been placed here and this enlarged view. This is the plate jig plate in which the bush has been fitted and the bush diameter in a dia is equal to the diameter of the drill slightly bigger and this is the pin

which is holding the pin in position. So that during the reverse of the drill this does not go out and as an when required the worn out bush will be replaced. Now there is another part is consistency consistently perfect locating.

Now friend here is the locating by V block that is okay but what about this another locating pin is this one. So this contact has to be assured and every time this contact should be made an with equal force. Now how this will be assured during you now locating with before clamping the clamping was not done clamping was withdrawn and a rod was a fresh rod was fitted in blank and this was pushed in by finger but this has to be pushed with a force with a given force and the constant force to the small force. So that the contact is assured every time. Now for that a system has been proposed this is called a pusher. Now this pusher if you just push this pin outer is the spring their will be contact
If you release it then under the action of the spring this pin will apply a small force in on the rod against this locating pin. So this will assure absolute contact and after it is fitted in then you know and all the things will be done. Now this will be work this is the other view is like this. So during clamping and machining this lever will remain in this position and is pin will apply a force at the center of the rod. Now after the machining is complete this pusher has to be withdrawn it has to be dropped. So this will be dropped and by the with the help of manually this will done manually is pulled and dropped and this amount of rotation will be governed by this pin and by the cam a slot.

So this spring load spring will help actuation of this pin very quickly and effectively and finally the ejection after the rod is machined then this has to be dropped this pusher tube this has to be dropped. So this will be dropped then this has to be removed. How can you remove it and clamping has been withdrawn. So a gap has been created here so there is no obstruction. Now by this ejector you apply a force in this direction by your thumb by left thumb a pump and then will exert a force le ah by by your hand and this will come out and you can hold it and release it and replace it and then this will be automatically go back and put another blank here then you put it in position then you ah clamp it and then drilling operation will be done. So this is how the work will be accomplished.

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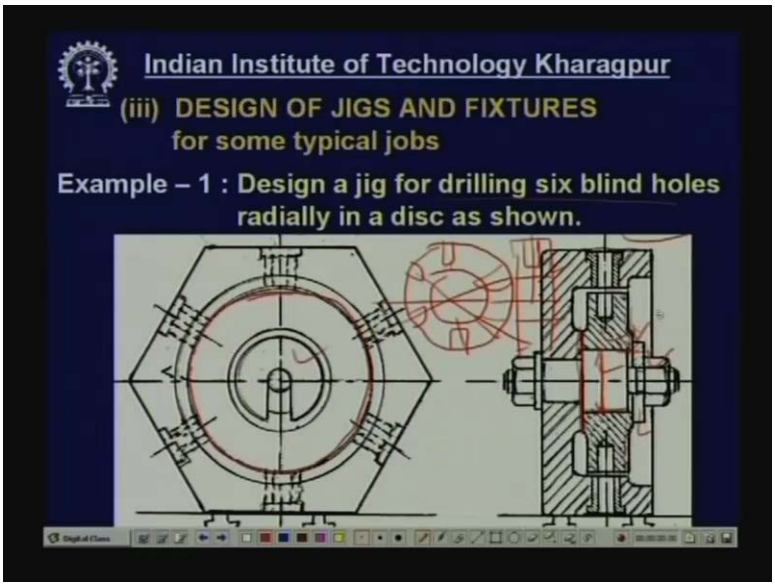

Now let us discuss some specific application example. Design of jigs and fixtures for some typical jobs. We can also some critical as well as typical mostly typical jobs say example one. This is the task is there is a disc okay hollow disc you can call it ring also. Now here six holes have to be made sa uh blind holes not up to the center sorry not this one. One hole here one hole here sa uh it has see clearly. This is the blank hollow disc with sufficient thickness it has got thickness. Now one hole has to be made here one drill here and one drill at such sixty degree apart one hole here one hole here and one hole here. Six holes have to be drill like this and blind not to the fully extent. So it is blind hole and equi spaced holes six holes and drilling task is example number one design a jig why jig because drills have to be made. So this has to be drill guidance design a jig for drilling six blind holes radially in a disc as shown that is equi spaced.

So this is the disc this is the disc in which six holes have to be made. Now how this will be done. There this can be done in number of ways one method has been shown here you take a box like jig hexagonal now this is hexagonal box. Hexagonal box which has got a mandrel inside this is the mandrel and this diameter of the mandrel main part of the mandrel on which this blank will be fitted this is the blank is fitted and then this is clamped by so locating and supporting is done by this part cylindrical part of the mandrel and this size side of the jig plate. So axially and ah radially this is located job is located then clamping is this will be clamped by a nut you can use a quick acting nut also and will be faster and inside there is a swing type collar okay collar or swing type you know a bush like. Now this is fitted so locating supporting and clamping of the blank is complete.

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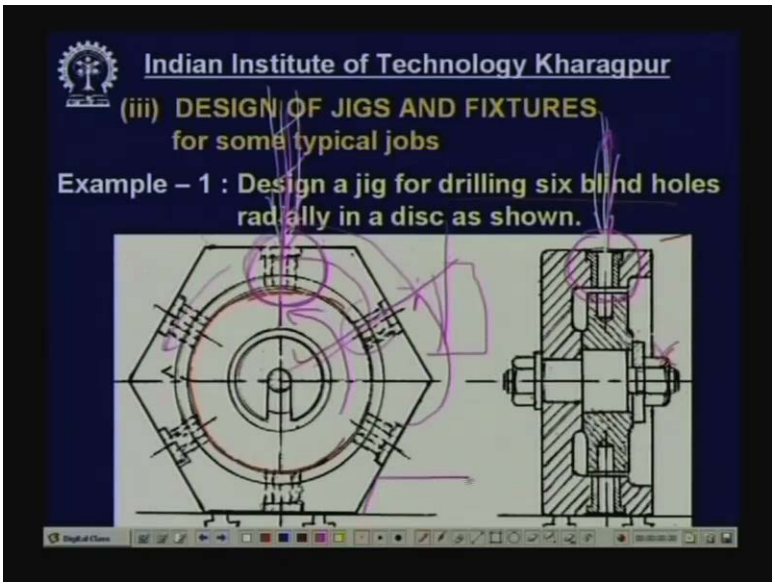

so next now the drilling operation the drill will be working along this axis. This is the drill and in this case this is the drill. So drill position of the drill is fixed in the machine mostly now this along with the job blank this jig fixture has to be shifted and placed manually under this drill in this fashion. So that axis of the whole design is aligned is this axis of the hole is align with the axis of the drill this has to be done manually the this one this fixed uh these are the jig will be placed on the bed and manually it has to be adjusted so that it comes in the position or it can be mounted on the table. This table of the drilling machine can be movable you know which is easy to handle and you can bring the axis under the axis of the drill or if it is a radial drilling machine then putting the job here uh then you bring the drilling position by moving the radial arm. Anyway so the axis of the drill and axis of the hole to be made or axis of the bush that has been fitted is the bush will be required to guide the tool should be aligned and this is mostly manually done. A
After doing this hole complete after certain depth that will be governed by a stop the drill will be withdrawn.
After the drill is withdrawn what next is indexing this is called indexing. So this indexing mechanism that is equal amount of rotation is a part of revolution by sixty degree in this case it has to be rotated by sixty degree you rotate in this direction. So this position will come here. How this will be done? This will be this nut will be loosened uh sorry no no nut like this this will remain tight as it is. What you do you hold this jig in your hand and then lift it and rotate manually by sixty degree and place it again on the bed or table under so that the axis of the next hole is aligned with the drill. Now you do the drill again after drilling you rotate again manually by sixty degree and so one. This way by manual indexing you can get all the six holes all right and the accuracy of the location of the hole will depend upon the accuracy of the location of the this bushes okay with there holes
so this is manual and accuracy may be slightly less but this is manual possible for convenience one stop can be used here. So that again and again his block Z block can be placed against this stop on the table if it is clamped. Now let us take another example.

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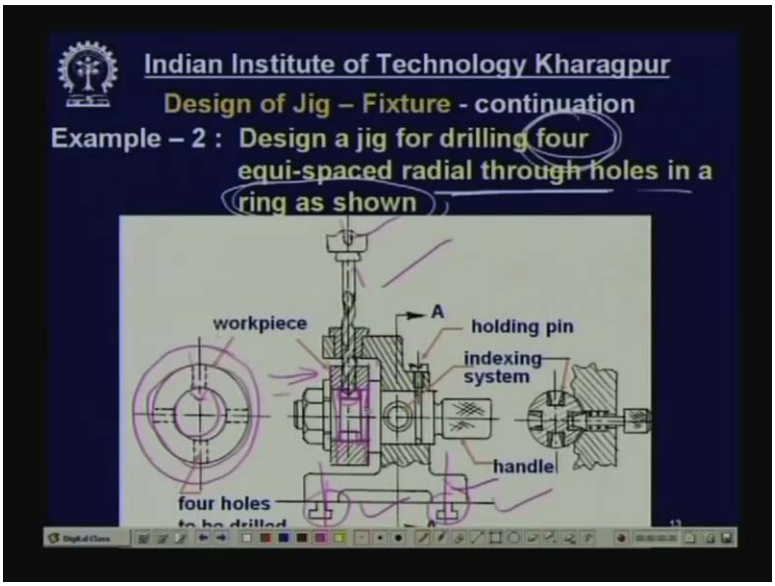

Design a jig fixture it is continuing example number two. What is example? Task design a jig again again a jig for drilling four equi spaced radial through holes. Now here we can see we are considering this time through holes and four that is a ninety degree apart in a ring or a disc as shown here. Now this problem very similar to the previous one ah but the solution will be in a different manner and this will give a simpler and more handy and more accurate possibilities. What is the task? Now first you see the task. This is the disc work piece. This is a ring which has got certain this is the work piece. This is the disc the cross sectional view of the disc four holes have to be drilled through from here to here with a given diameter of the drill known and equi spaced that is ninety degree apart and this can be a batch production obviously. So it should be located supported and clamp conveniently and time to time of unloaded loaded conveniently and since is a drilling operation so a theah tool guidance will be essential and that will be accomplished by a jig bush of this kind may be you know with pin or without pin i you have to decide. Now how this will be done?
see one by one first of all this blank has to be located then supported then clamped then tool guidance and other things. Here this is the jig this is the jig mounted on the bed. This is the T slot which indicates that this is the bed of a machine tool. On the machine tool the jig plate has to be clamped but before clamping it has to be assure that the axis of the hole to be made and axis of the drill should be aligned accordingly this has to be clamped only for once for the whole production. Now what you do? This nut will be open this job will fitted in this is pre-machined.

So this inner surface outer surface and the face surfaces these are all machine. So we you have fit into this mandrel. Now here you see the mandrel in this portion there is a recess why these recess two purposes for better contact or stable contact. On the other hand the drill has to given you know some space to complete the hole because this the though hole to be made. So drill will come out up to certain distance. So there should be recess otherwise this will make hole inside this pin. So this is recess like this. So after locating now this axial location will be assured by the this collar of the mandrel. So this is the

entire mandrel you know one piece and this is a collar which is resting ah this collar or pre machine collar the disc jig and again this end face of the collar the job pieces located so this is not V block location this is on mandrel. Now after that this will be so locating supporting have been complete. So next is,

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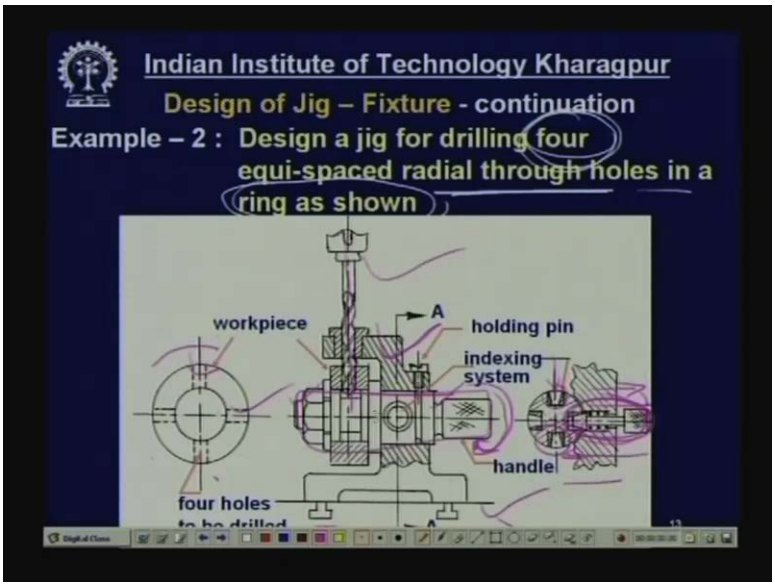

Clamping; now this clamping will be done by this nut. Now this single nut may be a quick acting nut also with taper hole ah at that has been discussed in the previous day previous lecture and this is a collar a swing type collar. It can be a swing type collar you know it can be a swing type collar like this. So the pin will be here. Now this one now you tighten this one so everything is complete now you operate the drill. So drill will rotate like this and will complete the hole after understanding the hole is complete this will move back while going back it is to be assured that this bush does not go along with it. So this has to be fixed by a pin all right and now after the completion of the hole this the hole number one. So next hole has to be made so that requires indexing. Now first of all this now before that the clamping in this case this nut clamps the work piece or blank with the mandrel but what about the mandrel that mandrel should also be fixed in a position. How that is assured that this is a pin called locating pin another is a strong one so here this the cross section this is the cross section this part if you take a cross section here as shown say A. So this is cross sectional view. So here there are four holes inside four holes there are four bushes taper bushes inside there a taper pin getting in.

So when this working will be going on when this when this working will be going on the hole work will going on this will remain in position fixed so that the job does not move relative to the mandrel and mandrel does not move relative to the part and part does not move relative to the base all are fixed of after the completion of one hole then this pin has to be withdrawn okay by by against the spring and then this has to be rotated manually okay approximately ninety degree and you release it. When you release it this taper end will get into the next taper hole automatically and since both of them are taper this will be

self aligned the self locating that is the this will become coaxial automatically and then this will hold this whole mandrel in position. Now you do the next hole easily.

So the second hole is done again you after the second hole is complete then you withdraw this pin then rotate this one again by ninety degree release this pin this this will get into the third third hole this hole and this will job will also you know indexed and this hole will come align with a drill and you make this third hole and similarly you make the forth hole also by this kind of indexing. Now friend again I remind you that compare to the previous one you will recall compare to this previous one where everything is done manually this heavy load and heavy task the shifting locating everything has to be done very carefully with lot of effort compared to that this is easier only once fitted the job is fitted here on the and this remains fixed the jig plate remains fixed so that need not be that need not be moved and the locating will be done is locating supporting clamping will done on the mandrel and this index will be done by this plate this system very easily quickly and effectively that is rigidly. This pin should be strong enough which will not allow this mandrel to rotate or move at all under the action of the drilling force. Now let us take another example.

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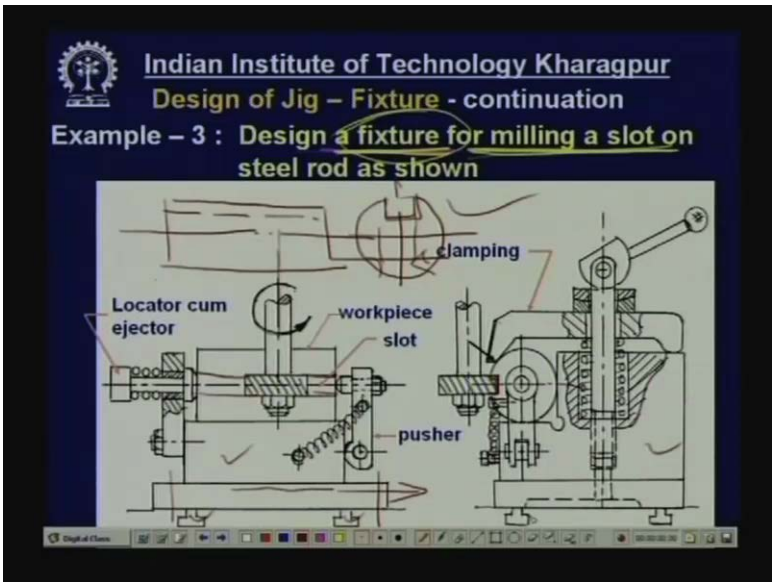

Design of jig fixtures continuation; Example three design a fixture for milling a slot on steel rod as shown. Now look here these are different type this is that design a fixture design a fixture because this is milling operation milling a slot so there is no drilling work or making any hole. So this will be a fixture which has to be design. Now what is the task task that has been told this is a rod okay straight rod pre machine pre machine rod here one slot has to be made here. One rod has to be made here like this that is one slot will be made throughout throughout the length a slot of rectangular section has to be made. Now this will this will be done in milling machine you can do it by end milling cutter you can do it by slot milling cutter disc type slot milling cutter and other thing. We let us take one say disc type slot milling cutter this is a slot milling cutter.

Here the width of the slot cutter is equal to the slot width of the slot that is desired okay so let us choose accordingly. Now so this will be how this will be mounted the axis of cutter will be always vertical is a end mill type this a say vertical axis type of milling machine. If it can be horizontal also then the configuration will be just ninety degree rotated. Let us assume that the axis of the cutter is vertical and this is the cutter say may be high speed steel cutter or it can be a carbide cutter with a number of cutting edges and when this rotates it cuts the slots like this. This will cut the slot yeah this slot and this blank this fixture this is the fixture the entire body is the fixture. This is a fixture. this is clamped on the table of the milling machine that is the uh that is slots that indicate that is a table and this table will move in this direction. So that the cutter will remain in one position this the entire slot will be make throughout the length. Now this is the work to be done. Now we have decided that a fixture has to be design for the purpose for ease of locating supporting clamping that is productivity and quality consistency of quality and so on. How this will be done? Let us clean it. Here you can see that

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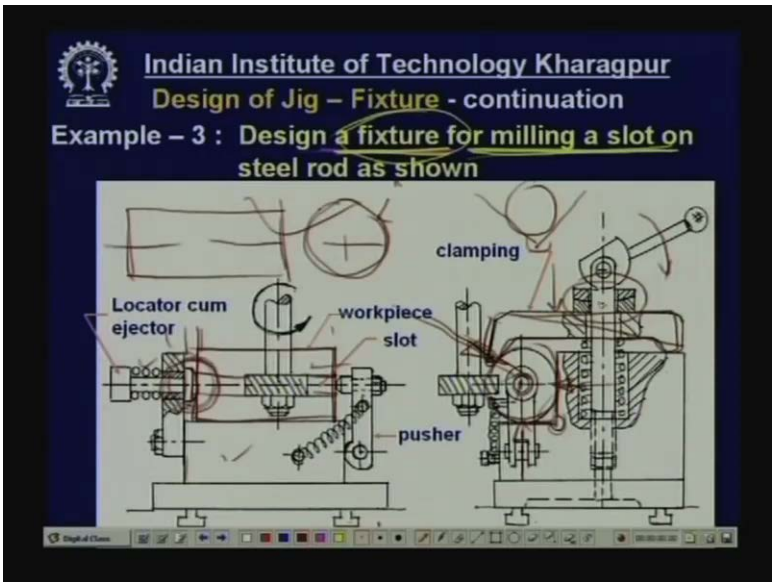

This is the blank. This is the rod like is a straight rod pre-machine rod with good outer surface and length face faces all things periphery. So you put it so obviously V blocks will be suggested for locating and supporting but since a slot has to be cut within horizontal vertical axis. So the job has to be held in this fashion and V block will be in this fashion not exactly like this usual this is usual way of mounting but we can put in a position like this one vertical face and one horizontal face with an angle ninety degree and this is the recess are relief for is of manufacture chip removal position and all these things. So now this the locating and supporting but what about the axial location on this side you can see that this is the rod is mounted on the V block fine placed but what about the axial location whether it be here or here or here or here or here. This will be assured by a locating pin.

Now this a plate which is fixed here okay and then there is a spring loaded pin. So this face of the pin will be arrested here on that of the spring all right compression spring. So this end of the pin will arrest the face of one face of the blank. So this is this is for axial location and these two or for this other two direction locations. Now this has to be this has to be arrest arrest you know all these the freedom so a clamping will be required. So supporting is strong enough here on the V blocks of the vertical sur plane surface and with this uh ah further supporting and locating here strong enough. Now clamping this has to be held in position strongly. Now since it is giving a force will support here and here. So there should be preferably force another force acting in this direction passing through the same point that will be very strong rigid and stable support. This can be done by this trap this is the trap. Now this trap will be pushed down as a result this will apply a force in this direction on this all right. So this will be working.

Now this is a cam clamping. So when you push it down this will push now this is a spherical washer you know because this trap may be inclined like this. So washer and when you put is down this exert force and the clamp and trap will exert force on this. So this is how the force will be applied on this. So you understand that how the clamping

will be done. Now there is no question of tool guidance this has been discussed you know that what is the function of this. Now I shall explain again.

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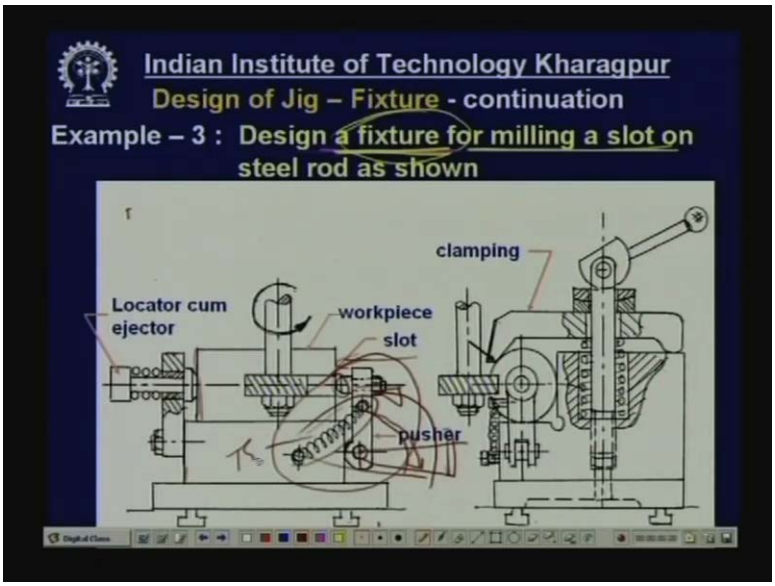

This contact point here on the locating pin has to be assured every time. so against this norm sometime it is done manually. So by finger it is pushed against this before clamping but to get in nominal force and assured force of same magnitude a spring loaded mechanism can be thought of so there is a lever so this will be rotated this will be hinged at here. This is a pin here so this will be dropped here after there is spring this will be this will be placed like this and you mount the job here from this side form this or this side because there is a cutter better you put from uh axially and then freely then you rise this one and put it back here. This spring will keep it in horizontal position and as when we required this will bring it back and this spring will push this rod through this pin. So this this is called tension spring okay tension spring. So this is the lever tension spring that gives a necessary force okay desired.

So what is now done you can see the locating on the V block locating by this pin end supporting on the V block and partially by this pin clamping by this cam quick acting cam quick clamping by cam this spring there is a spring. What is the function of spring this spring will when this will be withdrawn then this has to go up automatically. This spring will push it up so that this there will be a gap and rod the blank can be you know released or unloaded properly but before that this has to be dropped down. What is the function of this last one. This is ejector.

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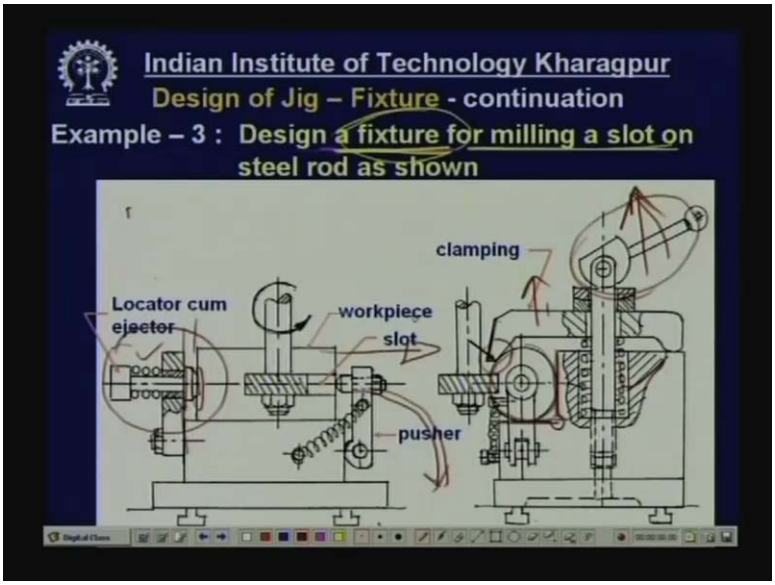

Now this pin here look at this pin this is very double acting pin when it is under this condition under the action of the spring this end is rigidly held at a distance because this end is arrested by the surface. This will be used for locating but after the job is over and this is drop down this is withdrawn then this has to be pushed out smoothly with the help of this ejector. So by your pump on one hand this has to be pushed in this direction and this will exert a force and this will automatically come out. So this is how it can be released. So locating supporting clamping ah pushing and ejection all this can be easily done. Now these are few examples lot of examples can be cited you know it has to be designed accordingly but if to remember that locating supporting clamping tool guide pushing and ejection then other factors like say chip removal chip disposal and all these things have to be taken care of.

Again I remind you that so far our discussion had done today these are the design of the configuration and the principle of working fulfilling the basic requirements like locating supporting clamping tool guide uh ejection etcetera but friend what is design. This is comprised of number of elements now all these elements have to be designed what is a design. Design means selection of the material and then the dimensions of the parts such that this parts will not fail mechanically under the action of the forces coming from the operation. So after this configurational design and design fulfilling their movement requirements location supporting clamping part by part each one has to be design separately that is material selection and then determination of the dimension diameter length and all these things so that design is complete. So this is how this will be done. So friend thank you all.

Now I give you some few only three or four examples but remember it can be you know hundred types but if you follow this basic principle it will remain more or less same. So follow these basic rules. First you decide whether jig fixture will be used at all or not. If you decide yes jigs and fixtures applications will be economically viable justified then you decide with a jig or fixture. If it is to be ah drilled or hole or something like uh that's

thats means use of drill or rimmer or some now counter boring tools or similar tools rotating tools are required then bushing will be require for the tool guidance and it will be automatically jig and after that one by one you have to design for locating supporting clamping and then tool guidance okay then ejection then pusher for assurance is of loading and unloading all these factors have to be designed. So this is very interesting subject and now we can apply.

Thank you.