Manufacturing Process-I

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Module - 1
Lecture - 10
Sheet Metal Working-Processes

A very warm welcome to all of you in this session on sheet metal working. We will be discussing in this particular session the basic details of the presses, which are used in sheets metal working operations. In our previous lecture, we have seen what the different types of die punch, type of arrangements are, different types of dies like conventional types, inverted type, compound type, progressive type were discussed, the relative advantages disadvantages like where the progressive type of die is advantageous was discussed in the previous lecture.

So, another important point that was left over in the last lecture was the different types of die manufacturing methods. So, we have been talking regarding the different mechanisms as how die and punch will operate, but we have not discussed that how the dies are made. That is also an important aspect because as long as we do not know how the dies are made, we are not able to completely understand that what are the type of products that we can make, because if the surface finish of that die is not of very high standards is not of very good quality, we may not be able to replicate the shape that we exactly want to make in the final product. So, we need to understand how the dies are manufactured.

So, in today's lecture we will discuss that how the dies are made, then we will come on to the different die failure mechanisms, and after that we will start our discussion regarding the presses at the onset, and important point that has to be made is that the presses are of different types depending upon what is the requirement, depending upon what is the specification of the final product, depending upon what is the infrastructure that is available with us, we have to make a decision that what type of a press we should select for our use.

Now, we will discuss in this section regarding that what are the various factors that will influence the selection of a press for a particular case. Then, we will see the different

types of classifications of the presses, and then we will compare some 2-3 different types depending upon on a number of factors. So, all that will be discussed in today's lecture on Sheet Metal Forming or Sheet Metal Working in which we are putting our emphasis on presses only. So, before going on to the presses, we will see how the different types of dies are manufactured.

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Now, these are the different die manufacturing method on your screen you can see.
The processes include now the die can be made by any of these processes, or by a combination of these processes. These are casting, forging, machining, grinding, electrical, and electrochemical method in combination. So, different combinations of all these methods may be used. Now, suppose we want to make a gear using the casting process, or we want to make any particular product using a casting process. The quality standards are of utmost or the most important parameters.

Now, depending upon the quality of that die that we want to produce, we have to make a judicious selection of the manufacturing method. As example I have quoted, if we want to make a gear, if it has to be used for a very rough or tough type of application like a juice mill that are used to make sugarcane juice, if you want to make a gear for that particular application. The quality standards are not too stringent there, but on the other hand suppose we want to make a gear that has to be in a mechanical type of a wrist watch, the quality standards are extremely high. So, depending upon the quality standard,

we have to make a judicious selection among the various computing manufacturing methods.

Now, similarly when we want to make a die, we have to make a judicious selection depending upon the various parameters. Now, sometimes we may be able to cast a die, we may be able to manufacture a die using a casting process, but the surface finish that we want may not be up to the desired level. Suppose we are using it, we are making it using a sand casting process. So, if the quality is not very high, it is not according to our specifications, what we need to do? We need to perform subsequent operations. Now, subsequent operations can be either machining or it can be grinding.

Now, depending upon the surface finish that is required, we have to make a selection that we are going to make a final product or the final die with these particular processes. For example, first we may go for casting the basic structure, and then we may go for machining, converting that raw product that has been cast into a shape that is quite similar to the die, and then giving the finishing operation using any of the finishing process is like grinding can be one process. There can be other processes like super finishing, lapping, and honing depending upon the requirement. We have to make a selection that what type of process we are going to use for finishing the die surface.

Now, the processes as you can see on your screen include casting, forging, machining, grinding, electrical and electrochemical methods in combination. In combination means that we may select all these processes in combination also. Now, electrical and electrochemical non-traditional methods of manufacturing which are also very important and hold a fair of degree of significance in die manufacturing. What is that significance we will discuss that. Now, dies are usually heat treated for greater hardness and wear resistance. Now, what is the most important parameter that we have been discussing, and wherever we discussed regarding the die material or die characteristics.

We have seen wear resistance is one of the most important characteristics of dies. If they are not wear resistance, as the cost of die is extremely high. If the wear resistance is not good, the die may worn out after certain particular cycles or may worn out after a number of processes or a number of operations. Then, we have to replace the die or we have to go for a subsequently operation of plating or putting a liner. Some kind of

arrangement has to be done if the die worn out. So, we do not want the die to worn out. So, if we want the die should not wear out or it should not wear out, though we want that it should not wear, we want that the wear resistant should be extremely good. Therefore, we sometimes heat treat the dies. So, the dies are usually heat treated for greater hardness.

So, we need hardness as well as the wear resistance. If the die surface is not hard, it is not resistant to brazen or resistance to indentation is not good. Then, sometimes when we are punching some particular edges of the blank that is getting formed may rub against the die wall or the die surface, and may abrade it or may call some kind of indentation. So, we want that the hardness should be of very quality as or very high value or very high level as well as the wear resistance should also be good. So, the dies are usually heat treated for this particular purpose, and then the surface profile and the finish are improved by finish, grinding and polishing. So, we have seen hardness and wear resistance are improved by heat treatment on the contrary surface profile, and the finish or the final finish is improved by finish, grinding or by polishing.

So, the finish is also very important if the die walls are not particularly finish the quality of the blank, or the quality of the pierce portion, or the quality of the final product, or the quality of the sheet metal component that we are making will not be up to the desired standards, or will not be according to the desired requirements or specifications.

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Now, cast steels are usually preferred for dies for large work pieces because of strength and toughness and the ease with which their composition, grain size and properties can be controlled or modified. Now, we have seen different types of materials in some of our previous lectures. We have seen that for this particular application, what should be the material of the die that has already been discussed, but here another important material that is a cast steel is usually use for making dies, and if the size of the work pieces is large, we may go for cast steel dies.

Now, why should we go for a cast steel die? Very clearly in this point it is mentioned that we should use cast steel because of its strength and toughness. So, toughness is also important. So, the cast steels are tough as well as the strength is adequate, strength is good. So, we can use cast steel as a material for making die. Then, it is very easy with which there composition as well as their grain size and properties can be controlled and modified. So, we have seen there are certain properties that are required in the die. What are those properties? The surface should be hard, it should be wear resistant and then, there may be other properties. The surface finish should be very good. So, depending upon the properties, depending upon the requirements, we have to choose a material.

Now, cast steel has been given as one of the examples which is preferred for making dies. Why? Already material properties we have told which material properties are good for cast steel. Similarly, it is very easy to control its composition grain size, and other properties that may be required for making a very useful as well as a very good die which should have a long life. Then, machining can be difficult for high strength and wear resistant die materials.

Now, machining we will discussed in the subsequent lectures. What are the basic aspects of machining? Some machining sometimes is extremely difficult for high strength and wear resistant die materials. Why it is difficult? It is because machining is the basic principal of relative hardness. So, if high strength and very hard wear resistant material we are machining, we need to have a tool which is even harder than the material that we are machining. So, sometimes the machining is difficult, the tool life is not that good. We need to add lubricant or we need to use a lubricant. The forces that are encountered in machining are extremely high tool breakage, tool chipping. All those parameters have to

be taken care of. So, the material that are having high strength that are wear resistant and that are hard or heat treated, it is very difficult to machine those materials.

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The proper selection of temperatures and atmospheres for heat treatment or of quenching media of tempering procedures is important. So, already we have seen that heat treatment is an important process when we are manufacturing a die, but the proper selection of all these parameters or all these points that have been mentioned in this particular section. What are those points that are proper selection of temperature and up to what temperature should we heat it and the atmosphere for heat treatment should we use inert atmosphere, or should we heat it in proper atmosphere of any particular gas, or any particular medium. All those things, all those aspects have to be taken care of.

Similarly, we have to take care of the quenching media. We should quench it in air or we should quench it in oil or the quenching cycle. How the quenching should take place, it should be a rapid fall in temperature or it should be at a particular desired profile, the cooling rate should be controlled. So, all those points, all those aspects have to be taken care of. If all these aspects are not taken care of, there may be certain problems. What can be those problems? The hardness may increase to a particular level and brittleness may be induced. So, if the material becomes brittle as soon as the punch will come and it will strike the die may break.

Similarly, other problem may also be encountered. We may not be able to get the adequate hardness, and we may not be able to get the adequate strength. So, when we are heat treating any particular material for making it for using it as a die material, we have to ensure the proper selection of temperatures, proper selection of atmospheres for heat treatment, proper selection of the quenching media as well as of the tempering procedures that have to be adopted. Now, dies may be subject to various surface treatments for improved frictional and wear characteristics.

So, already we have seen, we have discussed it earlier also that the wear resistance is one of the most important points that have to be taken care of in manufacturing type. Now, certain particular treatments dies may be subjected to, so that the wear resistance or the wear characteristics are extremely good as well as the frictional characteristics are good. If we are performing a drawing operation, we have seen that within the die there is a surface, die surface, then there is a material and then, there is a punch. So, always there is a contact between the punch die and the material. So, all those frictional characteristics have to be taken care of. So, sometimes we give some treatment to the surface of the die wall or sometimes, we use some lubricants in order to avoid the wear, the frictional losses or in order to reduce the friction. So, all those aspects have to be taken care of when we manufacture a die.

So, at the point of operation, sometimes we may not be able to use a lubricant and then, initially at the design stage only we can design the die in such a manner that we give certain treatment on the die surface, so that later on there should be no use of a lubricant. So, all these aspects have to be taken care of while we are manufacturing a die.

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Now, coming on to die failures one important aspect that has been left unanswered here is that in the previous or in the first slide, we have seen on die manufacturing that there are different techniques that are used for making dies. What are those different techniques? Those are casting, forging, machining or may be a combination of all these. There we have seen that there is another set of operations or another set of methods that can be used for die making. What are those? They were electro and chemical methods like electro discharge machining or electro chemical machining. So, I told that we will be discussing this in the subsequent slide. So, important point to note here is that why do we require electro discharge machining, or why do we go for electrochemical machining? So, there are certain aspects that have to be taken care of…

The most important aspect to a point out here if we want to make a very large hole, the diameter is considerably smaller. Suppose the diameter is 2 millimeter and the height or the depth up to which we want to drill the whole is 20 millimeters, so you can imagine a diameter of 2 millimeter and a depth of around 200 millimeter, or suppose we can say 50 millimeters. So, we see that this type of a hole, it is very difficult to machine using a conventional drilling process, and it has been noted, it has been observed, it has been reported that whenever we make a die, there are many such intricate features which are present in the design of the die which are very difficult to machine using the conventional drilling, operation or conventional machining operation.

So, all those profiles, all those shapes, and all those geometrical entities have to be properly made into the die, so that the die performs its intended function. Now, in order to create these geometrical entities or these geometrical features into the die surface, we go for some unconventional or non-conventional manufacturing methods. For example, electro discharge machining or electrochemical machining. So, that is all that we want to address that electrochemical and electro discharge machining are important. Wherever we have to take into account certain geometrical features which are very difficult to machine using the conventional machining operations like drilling or turning or may be any other type of operation that can be performed on the conventional machining operations or conventional machining machines.

So, we have seen that all these aspects are really important. Electro discharge machining, electro chemical machining, super finishing. We have to take into account all the manufacturing aspects when we make a die. Now, once the die has been made, then it is put into its intended function. What is the intended function of the die? The intended function is that we have to produce a final product using this die and punch type of arrangement. Now, when we use this die, there are certain reasons, certain modes, and certain mechanisms under which if the die is subjected to, it may fail.

Now, failure of the die has to be avoided at any cost. If the die fails, it not only hampers the production, it not only stops the production, it also incurs a lot of cost because already we have seen that die making or the manufacturing methods for dies are not so simple. It is not that we take any material and turn it on the lathe machine and we will get a die. Some of the simple dies can be made that way, but the complex dies require too many operations. Sometimes, we are not able to make the die with the help of a conventional machining operation, or a conventional manufacturing method. We have to go for unconventional manufacturing method which adds to the cost of the die. So, we have to avoid any kind of failure of the die, so that whatever we are producing, we are able to produce it at an economical cost, and we are able to sell it in the market at a reasonably competitive price. So, die failure has to be avoided. So, failure of dies in manufacturing operations generally results from one or more of the following causes.

So, there are different types of causes that cause the die failure. So, what are these different types of causes? It may be because of the improper design. Now, design is also

very important aspect. So, we will have take into account the design aspects. We have to see that if you have to make a hole, then what should be the distance of that hole from the edge. Sometimes some of the designers may, so design may die, so that we have to make a whole which is very close to the edge. So, all those aspects are there. One example I have given. There are numerous such examples where particular design guidelines are there if you do not follow those design guidelines. So, whatever design we make is proven to fail. So, in our case also we have seen the die failures may take place because of the improper design.

So, design has to be in immaculate, it has to be properly planned, it has to be properly chalked out, so that while manufacturing the die, no failure takes place. That is no failure at the manufacturing stage plus no failure at the use stage also. In service performance also, there should be no failure that should take place in the die because of the improper design of the die. So, when we design a die, proper guidelines should be taken care of.

Similarly, defective material if it is used already we have seen in one or two previous lectures. We have seen what should be the material of that die that should be used for making the dies. Now, if we are not using the adequate material of adequate strength, adequate toughness, then sometimes there may be problems of die failures. So, all those type of failures have to be avoided by the proper selection of the die material.

Now, if we are using a defective material, then after sometime the die is going to fail. So, proper check of the material, proper different types of testing procedures are available like non-destructive testing procedures are available, wear out of material out of which we are going to make a die. We are going to use the material as a raw material for making that die. That material should be subjected to different types of non-destructive testing mechanism, so that if any cracks, any prior cracks, micro cracks, any porosity is there in that material, that should be removed or it should be heat treated before that. So, depending upon what should be the material if any defective commodity is there within the material out of which we are going to make a die.

We should try to avoid that material or we should do the treatment to that material before we use it for making a die. Sometimes during the manufacturing stage also, some of the problems may be encountered or some of the residual stresses may be developed or some

kind of micro cracks may be developed during the processing of the raw material into the die. So, these particular problems will be particularly critical when we use this die in the operation. So, after the die has been made and before it is being used, proper check on the quality of the die that has been made should be there.

If we are not going to check the quality of the die that has been made using any of the manufacturing methods that have been discussed earlier, then there are chances that all these micro cracks or all these cracks that have been developed or some residual stresses that have been developed may further result into the failure of the die during the operations. So, we have seen that either, that design is improper or the material is defective then we have to go for heat treatment. If the heat treatment is not proper, in heat treatment also we have seen that what should be the tempering procedure, what should be the quenching media, what should be the temperature up to which the material has to be raised. So, all these parameters have to be taken care and another important parameter was the atmosphere. Either we go for inert atmospheres, or we go for an atmosphere of a particular medium.

So, all those parameters have to be taken care of. If we are not properly heat treating the material, then there are chances that some of the residual stresses may not be relived and subsequently, may act as a die failure. Similarly, overheating and heat checking are important aspects that have to be taken care of, and that may result in the die failure. Similarly, excessive wear. So, already we have seen that we have to design the die wall in such a way that wear should be minimum, or the surface should be coated or the surface should be developed in such a manner, so that the wear characteristics are good and adequate coating is provided, so that the wear does not take place. So, die failure may take place because of the excessive wear which has to be avoided at any cost. Then, there are other problems that may be overloading.

Suppose a die has been designed for a particular load, if we are overloading it or we are using it beyond certain prescribed cycles, then there are chances that the die failure may takes place. Similarly, if we are misusing it which most of us do not do, there are chances a die failure may take place. Then, improper handling is another point which may result in the die failure. So, we have seen that there are different methods of making the dies which can be classified into conventional and unconventional method. In

conventional methods, we have seen it can be made by casting, machining, forging depending upon the final requirements. Then, sometimes there may be some intricate geometrical features which are not processed or which are difficult to process using the conventional machining, or forging, or casting operations. We go for non-traditional operations like we may go for electro discharge machining. We may go for electrochemical machining depending upon the material of which we are going to make a die surface or the die design.

So, depending upon the manufacturing processes, we have to make a decision, we have to make a selection that what particular type of manufacturing process should be used. Once the process has been selected, the die has been made. We have to see that it operates according to the desired level, according to the desired specifications, but there are certain reasons that may result into the die failure. So, that die failure may be because of the points that have been listed here.

Just to summarize it can be because of the improper design, it may be because of the defective material of that die, and it may be because of the improper heat treatment and finishing operations. Die failures may also take place because of the excessive wear. It may take place because of overloading. Then, another important point is misuse and improper handling. So, die failure may take place it has to be avoided and we have to take proper precautions, so that the die is not failing because what are the implications of die failure already we have discussed.

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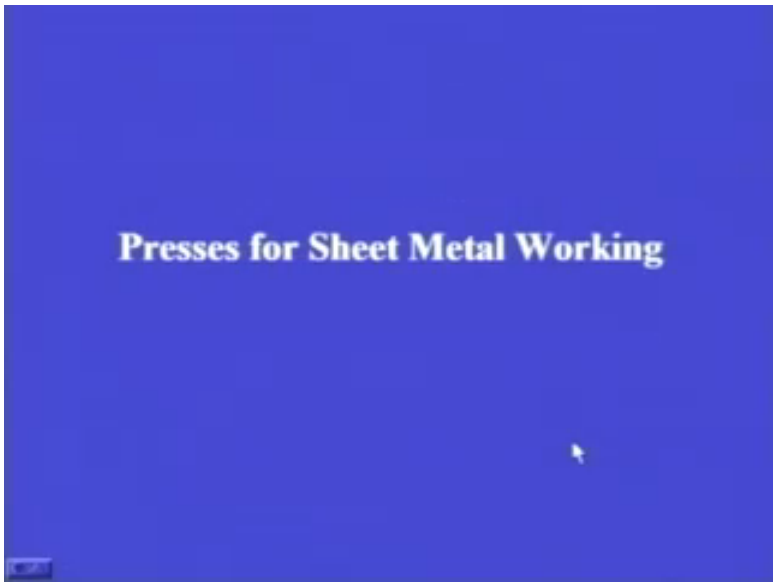

Now, we come on to our discussion on presses for sheet metal forming. So, there are different types of presses, and they are classified on the basis of number of different methods. So, depending upon that we classify the presses. We will see that how that presses can be classified, and then we will see how to select appropriate press. Then, we will see what different feeding mechanisms are because sometimes some of the accidents may take place. The hand of the person may come below the ram or the punch and some kind of accident may result because of that. So, what are the different types of stock feeding mechanisms and that we will discuss in the subsequent part of this lecture. Now, the classification of presses. This is important.

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The types of presses for sheet metal working can be classified by one or a combination of characteristics. Now, depending upon the points that we are going to address, now of the sheet metal presses can be classified. Now, these can be classified on the basis of source of power. So, the power may come mechanically, or it may come pneumatically, or it may come from any particular source. So, depending upon the source of power, you may classify the presses. Also, we may classify the presses on the basis of number of slides. We will see this in the subsequent part of this lecture and then, the presses may even be classified on the basis of type of frame and construction.

So, depending upon how the presses are looking, what is the type of the frame and how the press has been constructed, what is the press type of the frame. We can classify the presses according to the type of frame and construction also. Similarly, what is the type of the drive that is used in the press, we may classify the presses depending upon the type of drives. Then, we can classify the presses on the basis of the intended applications, where the presses are going to be used. Depending upon their use, we may be able to classify the presses. Now, the first classification that we are going to address in this lecture is on the basis of source of power.

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So, already I have told either the presses can be hydraulically operated, or they can be pneumatically operated. They can be mechanical presses or these can be manual presses. So, depending upon the source of power, four different classifications have been there. How the presses are operated, or what is the source power for the press. So, we have seen that it can be manual mechanical hydraulic or pneumatic press.

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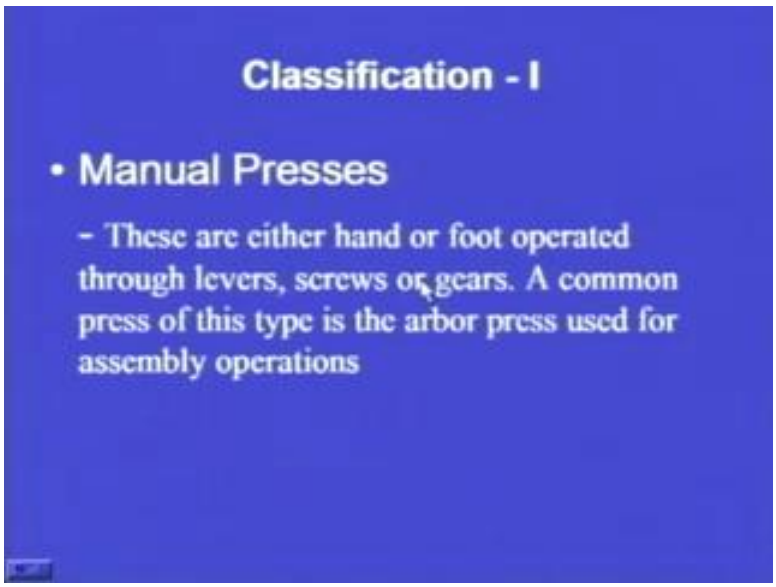

Now, what is the manual press or what are the different manual presses? Now, manual presses are either hand or foot operated through levers, screws or gears. So, manual as

the word suggests that these are operated manually. They are either operated with the hand. There may be a lever which will be used to bring the ram down, or it may be foot operated. Sometimes below our foot, there can be a paddle that is provided. You press the paddle and the ram will come down. So, how the action that we are taking? We have discussed two actions we are taking. The first action is we are pressing the lever or we are pressing a paddle.

Now, either it is hand operated, or it is foot operated. Now, depending upon hand or foot operated, this action that we are taking is getting transformed into a motion of the ram. So, this is how this motion is getting transferred or however, action is getting transferred to the drive with the help of levers, screws or gears. A common press of this type is the arbor press used for assembly operations. So, sometimes we use arbor press for assembly operation which is an example of a manual press.

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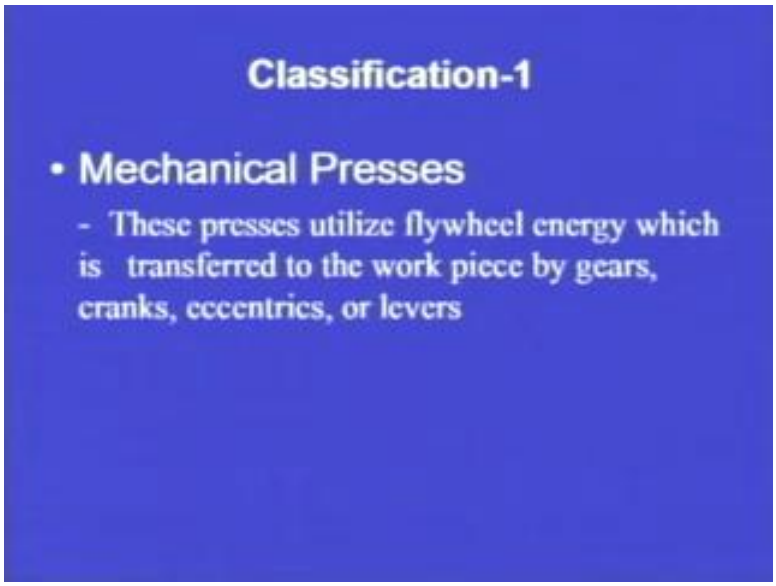

Then the second one is the mechanical presses. The mechanical presses utilize flywheel energy. So, flywheel energy which is transferred to the work pieces by gears, cranks, eccentrics or levers. So, here a mechanical press is there. The drive is mechanical. Now, depending upon the mechanical drive, we are able to give a motion to the ram. So, on the basis of power, we have seen either we have to operate with hand or with the foot. That is hand operated or paddle operated or foot operated and the motion is transferred to the ram. Similarly, in mechanical presses, the mechanical energy is getting converted into

the motion of the ram. How this is transferred? This is transferred to the work piece by gears, cranks, eccentrics or levers.

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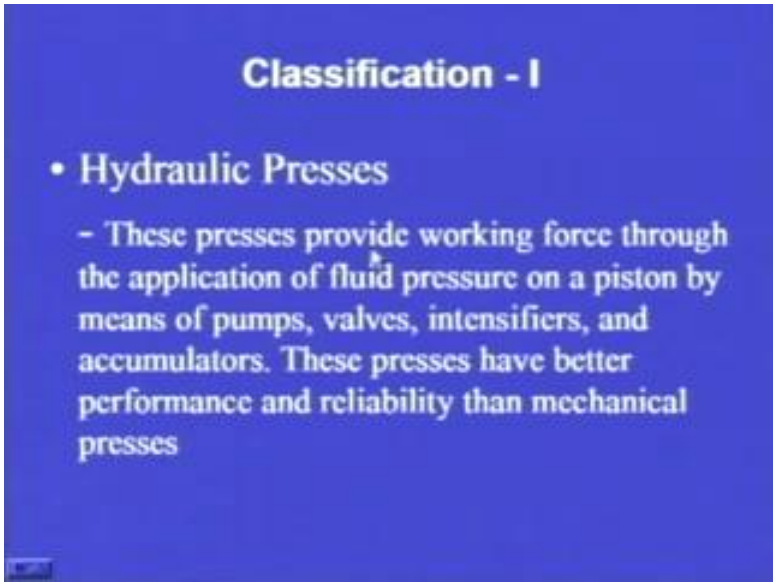

Now, we come on to the hydraulic presses. Hydraulic process is presses provided working force through the application of fluid pressure. So, in mechanical and a manual, it was the mechanical force. Here it is the application of a fluid pressure. So, fluid may be of any type on a piston by the means of pumps, valves, intensifiers and accumulator. So, these are the devices that are used for converting the fluid pressure or exerting the fluid pressure on the drive that we want to move using the hydraulic press. Now, these processes provide working force. The working force is provided through the application of fluid pressure on a piston by the means of pumps, valves, intensifiers and accumulators. These presses have better performance and reliability than mechanical presses.

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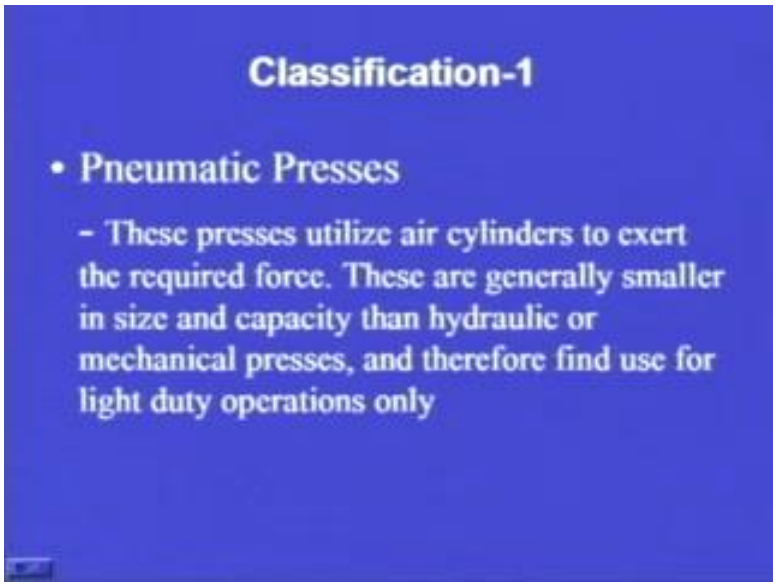

So, coming on to the next type of presses under the classification, where we have classified the presses on the basis of sources of power. We have seen that there are three basic, four basic types. Three we have already seen. What were those? These three were, the first one was manual press. Then, there was a mechanical press and then, there was a hydraulic press. Now, we come on to the fourth classification that is pneumatic presses.
Now, in pneumatic presses, these presses utilize air cylinders. So, source of power is different. Initially three of the sources of power were different. Here, the source of power is air cylinders to exert the required force. In hydraulic, we were exerting the required force with the help of a fluid pressure, but here in pneumatic presses, we are providing the pressure with the help or we are providing the force with the help of air cylinders. These are generally smaller in size and capacity than hydraulic or mechanical presses.

So, wherever we need that, only the force requirements are not too high. We may choose pneumatic presses because these are generally smaller in size. The size is also smaller.
So, wherever portable press is required, we may go for a pneumatic press or wherever space constraints are there, we may go for a pneumatic press. Then, if smaller in size and the capacity is also less, then the hydraulic or mechanical presses and therefore, they find there use in the light duty operations only. So, the pneumatic presses utilize air cylinders to exert the required force. These are generally smaller in size and capacity than hydraulic or mechanical presses and therefore, pneumatic presses are used for light duty operations only.

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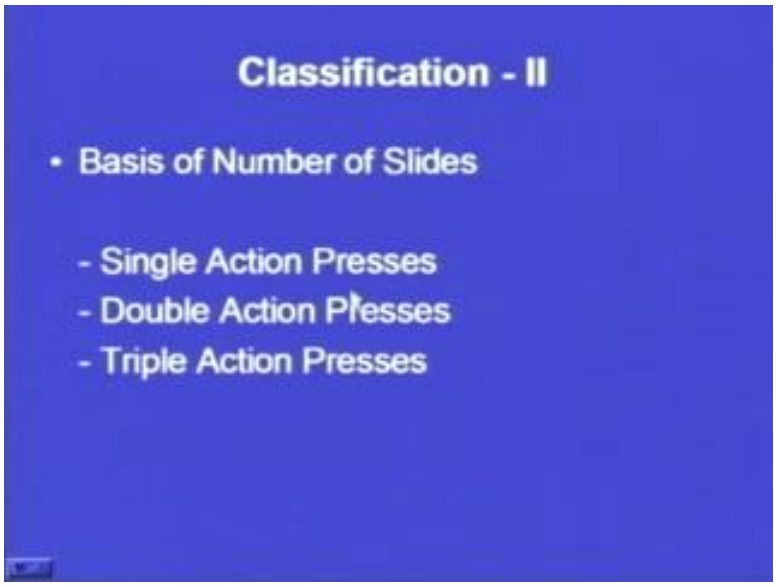

Now, first classification was on the basis of sources of power. Now, the second classification is on the basis of number of slides. Now, on the basis of number of slides, we can have three basic types of presses. These three basic type presses are: Single action presses, double action presses and triple action presses.

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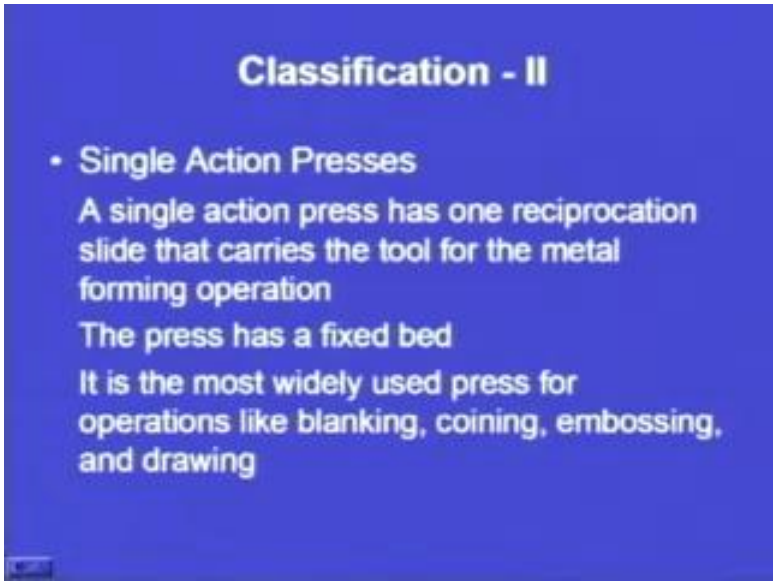

Coming on to the single action presses. A single action press has one reciprocating slide that carries the tool for the metal forming operation. So, it has only one reciprocating slide that is carrying the tool. The tool sometimes is the punch in the die set. So, the

single action press has one reciprocating slide that carries the tool for the metal forming operation. The press has a fixed bed. The bed is fixed. It is the most widely used press for operations like blanking, coining, embossing and drawing. We have already discussed the basic mechanism or the basic operation of blanking, coining, embossing and drawing. There we have seen with the help of a very simple diagram that how the operation is taking place.

So, the press was a most common part that was used there, or punch is coming and it is blanking the shape or it is causing the coining operation, or it is resulting into embossing operation. So, all those presses were there. We have discussed that there punch is attached to the press ram, so that press ram basically the single action press ram, that is used for the blanking, coining, embossing and drawing operations. Now, the double action presses.

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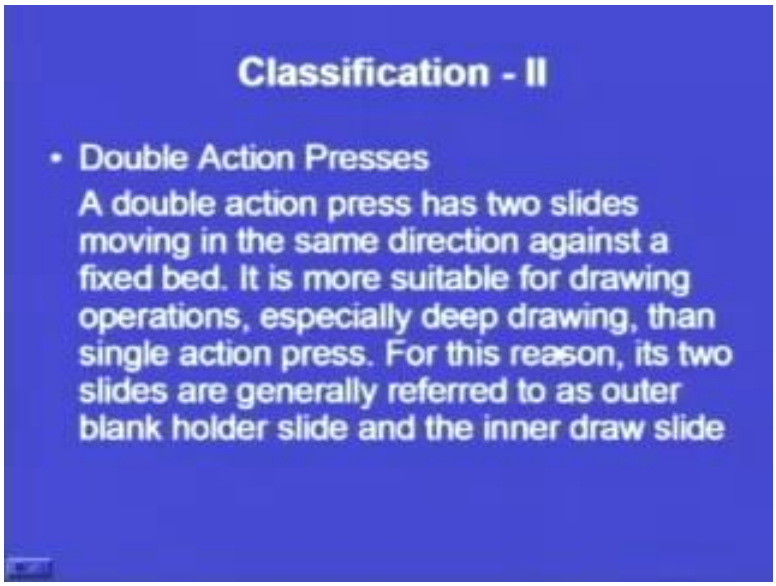

A double action press has two slides. In single action presses, it was single slide that was the reciprocating slide. Now, here we have two slides. A double action press has two slides moving in the same direction against a fixed bed. The bed is fixed and it is more suitable for drawing operations, especially deep drawing. So, if we are going to have operation of deep drawing, we may go for a double action press. For this reason, it is two slides generally referred to as outer blank holder slide and the inner draw slide. So, here two slides are there, and they have been accordingly the outer one is the outer blank

holder slide, and the inner one is the inner draw slide. So, drawing is taking place at the inner slide.

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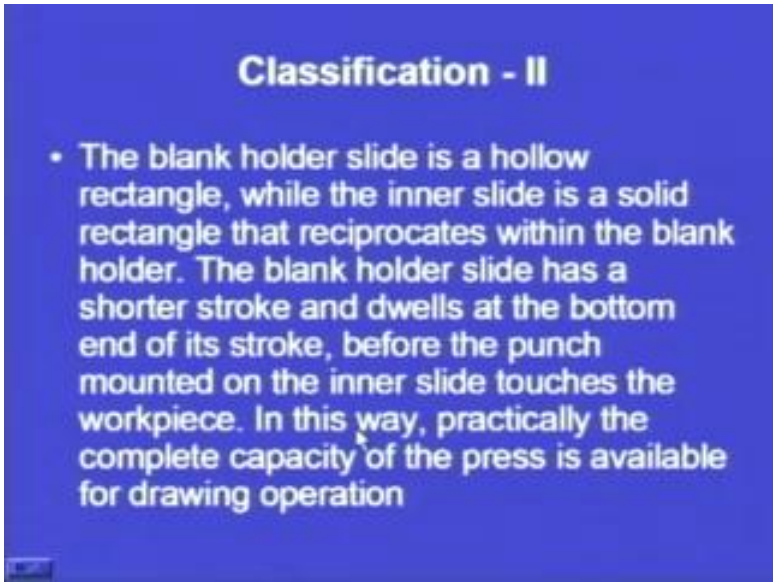

The blank holder slide is a hollow rectangle. Now, the blank holder slide that is holding the blank is hollow while the inner slide is a solid rectangular. Now, two slides are there. Already we know in double action presses. Now, first one is the blank holder slide, and the second one is the inner draw slide. So, the blank holder slide is hollow, and the inner slid is a solid rectangle that reciprocates within the blank holder. Now, we have to perform the drawing operation. So, the solid or the inner slide that is a solid rectangle will reciprocate and will reciprocate within the blank holder. So, blank holder is a hollow slide.

The blank holder slide has a shorted stroke and dwells at the bottom, and its stroke before the punch mounted on the inner slide touches the work piece which is very clear.
In this way, practically that complete capacity of the press is available for drawing operation. So, the complete capacity of the press, the stroke that is the capacity of the press is completely utilized in case of a double acting presses.

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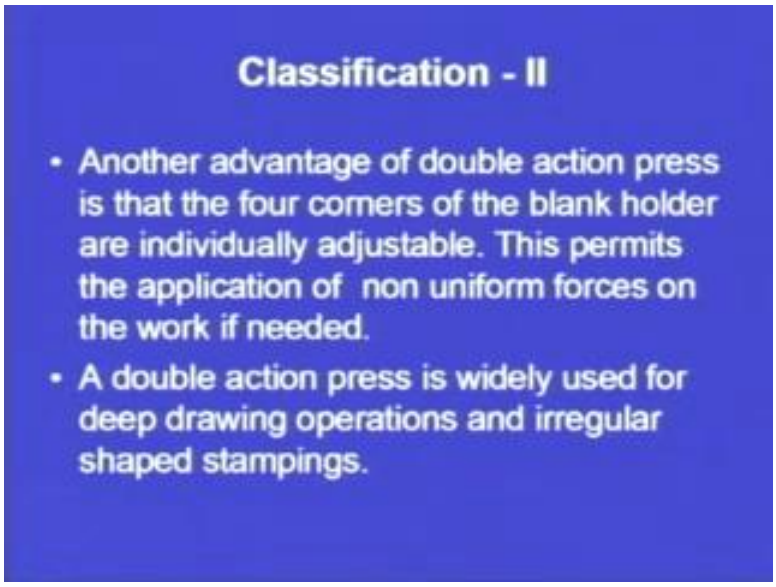

Now, another advantage of double action press is that four corners of the blank holder. There are four corners of the blank holder, and they are individually adjustable. So, it is not that all corners are adjusted using a same mechanism or same drive, they are adjustable individually. So, if you want to adjust at one corner, we can do all that adjustment. So, this permits the application of non-uniform forces on the work if needed. Now, sometimes we need to impart non-uniform forces on one edge. We want the forces should be more. On the edge, we want there the forces should be less or one corner, it should be more and another corner, the forces should be less.

So, another advantage of double action press is that the four corner of a blank holder are individually adjustable, and this permits the application of non-uniform forces on the work. So, if needed we can go for non-uniform application of forces on the work piece. Now, double action press is widely used for deep drawing operations and irregular shaped stampings. So, already we have seen how it can be used for a drawing operation. There are two. One is hollow, another one is the fixed. Another one is the solid and the solid goes into the hollow, and performs the drawing operation. The basic mechanism is like that only.

So, a double action press is most suitable for deep drawing operation, and it is used widely for deep drawing operation and for irregularly shaped stampings. So, if the

stampings have to be made where the shape is not regular, then we can make use of double action presses. Now, coming on to the triple action presses.

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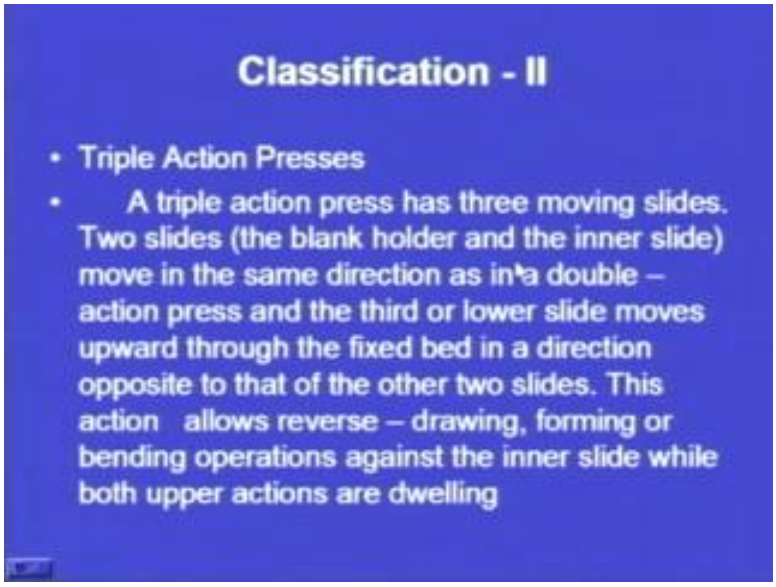

A triple action press has three moving slides. So, as the name suggest, it has three moving slides, two slides. The blank holder and the inner slide, similar in case of double action presses. Move in the same direction as in the double action press, already we have seen and the third or the lower slide moves upward through the fixed bed. The bed is fixed, and the third slide will move upward through the fixed bed in a direction opposite to that of the other two slides. Two slides if they are moving in the top direction, so this will move in the lower direction. If these two slides are moving in the lower direction, it will move in the upper direction.

So, the third slide of the lower slide move upward through the fixed bed in a direction opposite to that of the other two slides. Already we have seen. This action allows reverse drawing. So, if we want to go for reverse drawing operation forming or bending operations against the inner slide while both upper actions are dwelling, we can go if we want to go for a reverse drawing type of arrangement. We have to select a press which has triple action arrangement. So, triple action presses can be used for reverse drawing, forming or bending operations. So, we have seen that on the basis of the action that is taking place or the number of slide, we can have single action, double action or triple action presses.

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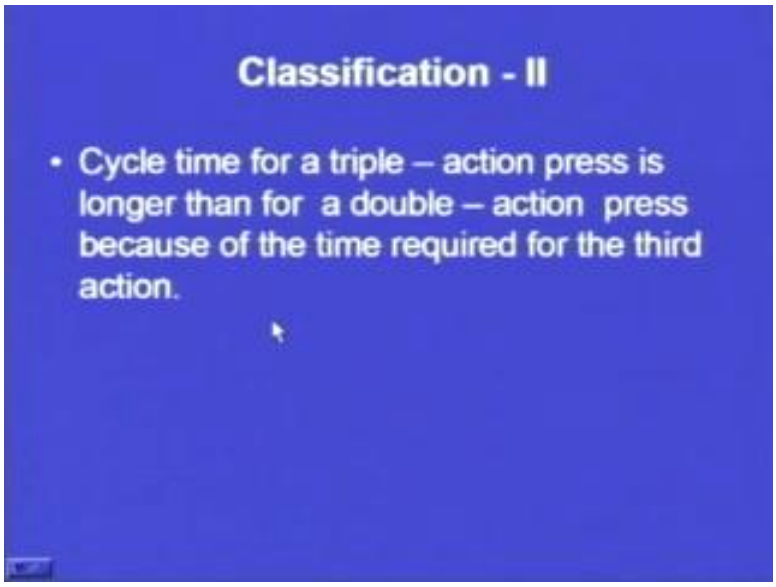

Cycle time for a triple action press is longer than for a double action press because of the time required for the third action. So, this is quite normal that when we have to perform another operation, so the cycle time that will add on the complete cycle time, the cycle time or that amount of time that is required using a triple action press is more than a double action press. Coming on to the third important classification that is on the basis of frame and construction.

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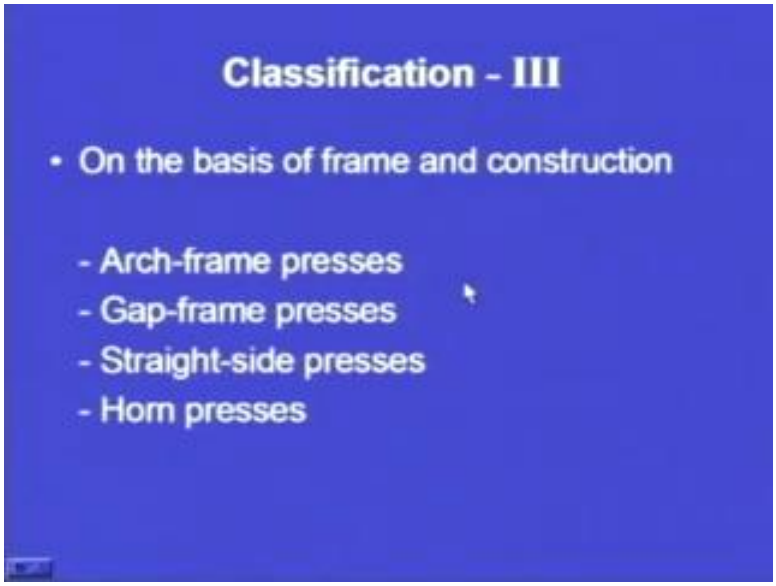

So, on the basis of frame and construction, we can have different types of presses. What are those different types of presses? There are arch-frame presses, gap frame presses, straight side presses and horn presses. So, we will try to understand these different types of presses with the help of a very simple diagram.

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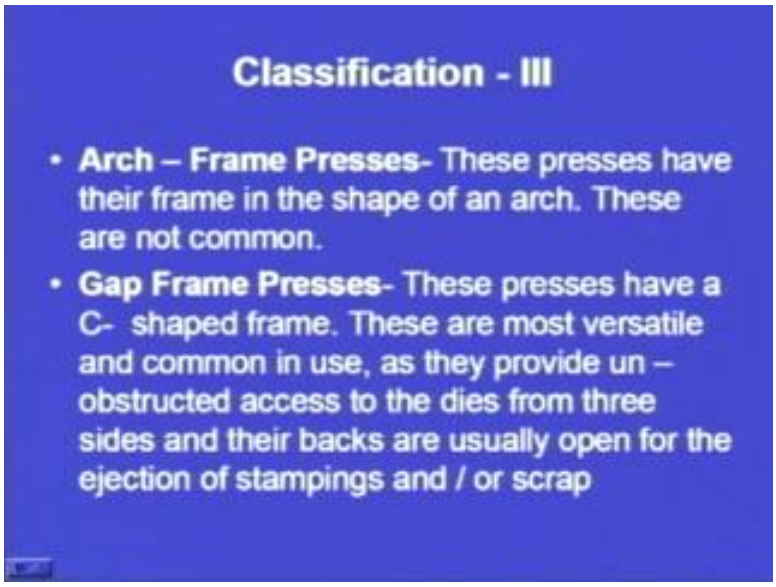

So, arch frame presses. These presses have their frame in the shape of an arch. So, the frame has a shape of an arch which we will see in the subsequent slide, where we will see the diagram. These are not very common. So, arch frame presses, although they are in use, but are not the most common presses that are used.

Then, gap frame presses. These presses have a C-shaped frame like this is the C. So, these have a C-shaped frame. These are most versatile and common in use. So, gap frame presses are the most versatile type of presses. These are in maximum use. Now, they provide unobstructed access to the dies from three slides, and their backs are usually open for ejection of stampings or scraps. Now, when we are using a gap frame presses, what do we want is that access to the dies should be easy. Whatever we are making, whatever is our final product, we should be able to remove it also at a very fast phase because it adds on to the production rate. In some cases or in any case if we take lot of time to remove the final product or the blank or the scrap material from the press, it takes lots of time. Then, this time is going to add up to the complete cycle time.

So, we want to avoid this time and this gap frame presses a particularly suitable, where we have to have a very high production rate. So, these presses have a C-shaped frame which we already discussed. These are most versatile and common in use, all right. As they provide unobstructed access, there is no obstruction to the die from three slides, and their backs are usually open for rejection. So, the back is open. We can very easily remove the final product or the raw or the scrap material from the die.

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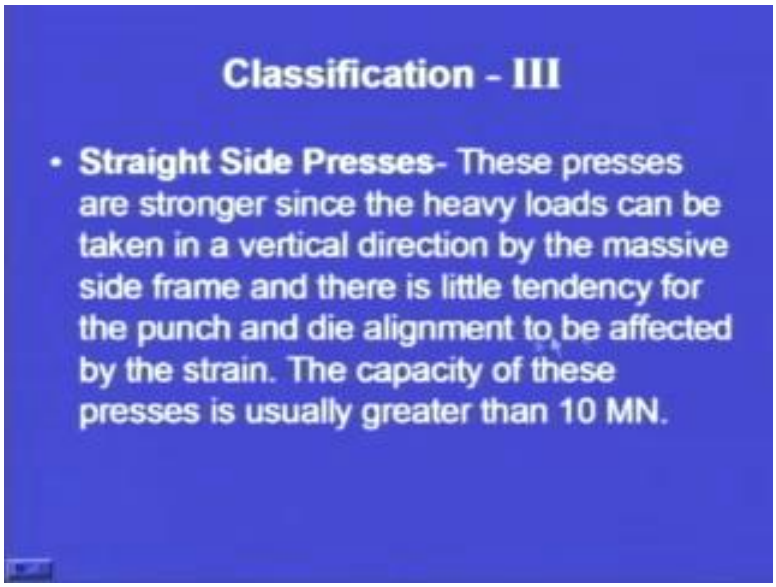

Now, straight side presses. These presses are stronger, since the heavy loads can be taken in a vertical direction by the massive side frame and there is little tendency for the punch and die alignment to be affected by the strain. The capacity of these presses is usually greater than 10 mega Newton. So, you can see that the capacity is greater than 10 mega Newton, and heavy loads can be used. These presses are stronger since heavy loads can be taken in a vertical direction by the massive side frame, and there is a little tendency for the punch and die alignment to be affected by the strain. So, here we see that there is no strain that is acting on the punch and die arrangement.

So, if a lot of strain will act that will affect into the performance of the die, it may also hamper the performance of the punch. So, if these types of presses, straight side presses all those problems are not encountered. Now, another proper classification on the basis of frame and construction are the horn presses.

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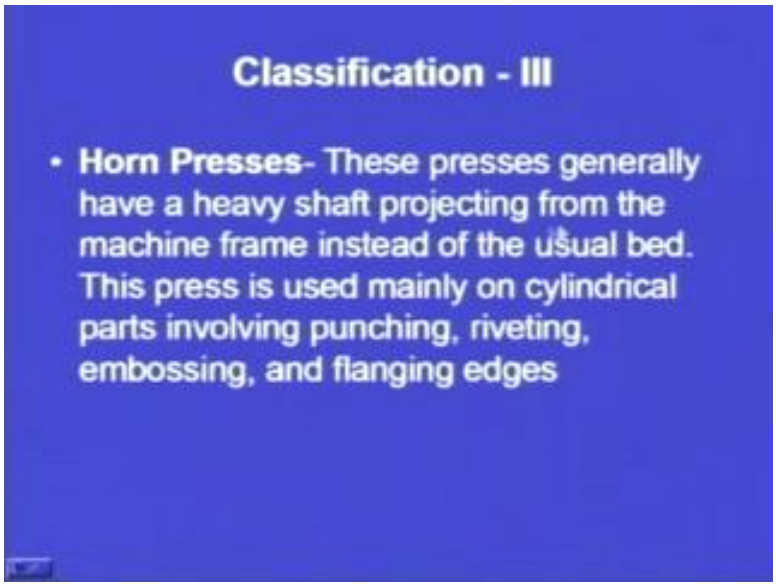

These presses generally have a heavy shaft projecting from the machine frame instead of a usual bed. So, in other type of presses, there are usual beds, but here in case of horn presses, usual bed is not there. It is absent. So, these presses generally have a heavy shaft projecting from the machine frame. So, there is a machine frame, there is a heavy shaft that is projected from the frame. The press is used mainly on cylindrical parts involving punches, riveting, embossing and flanging of edges. So, this process is basically used on cylindrical parts because the flat bed is not there. There is a shaft that is projecting from the machine frame. So, that is why this is used for on cylindrical parts.

What are the different types operations that we can perform on horn presses? These are punching, riveting, embossing and flanging the edges. If you want to flange the edges, then we can go for horn presses. Now, all we will see the diagram for all these different types of presses.

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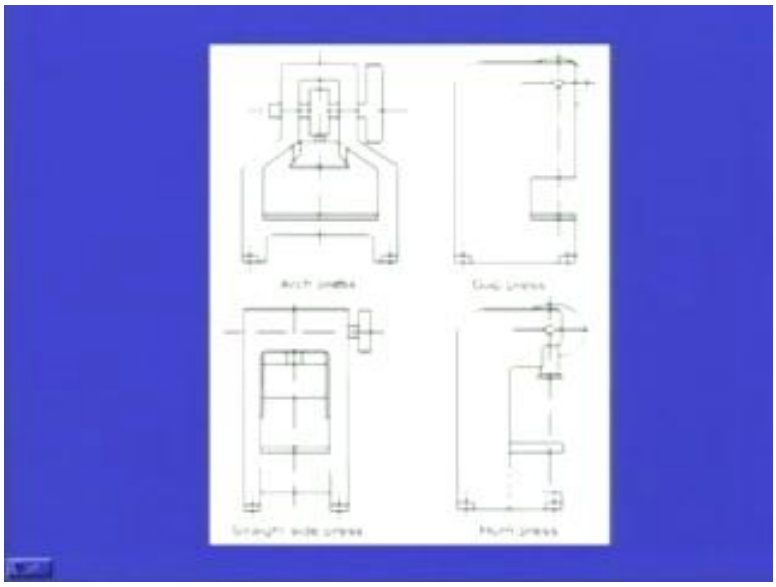

Now, this is the arch press, typical in the size of the shape is like an arch. Then, there is a gap press. Already we have seen this is the C-type of press. We see this is C, and there is a table here, a bed here, and the punch comes and performance the required operation. Then, there is a straight side press; this is a straight side press. Here we can see from all the three direction access is there. We have an unobstructed access to the die, and the material can very easily be removed also. Then, there is a horn press. This is a horn press. There is no flat bed that is available here. There is this shaft that is protruding from the frame here, and we can perform different operations on this shaft.

So, depending upon that, what are the various requirements, what the final product specifications is, we have to choose the press according to that particular requirement. If that particular requirement is not being made, then we have to design the press according to our own design levels, or according to our own specifications, or according to our own requirement. So, these are some of the basic types of presses that we have seen, but if these are not all the type of presses, we may sometimes tend to design a press for our important application or for our dedicated application.

Now, coming on to we have seen that there are four different, three different types of classifications based on a number of parameters. May be it can be a source of power, it can be number of drives, or it can any other parameter. Now, depending upon the classification, we have seen there are number of type of presses that are available with

us, but we cannot directly pick any particular press for our application because our requirements, our final product requirements are very important to us. If we are not able to make the final product according to the desired level, so the scrap will be more. We may not be able to economically justify our manufacturing strategy.

So, we have to particularly choose a press which is most economical, which is most suitable to our requirement. Although we have seen that on the basis of number of parameters, we can classify the presses into different types, but selection of a press is also very important. Why proper selection of a press is necessary?

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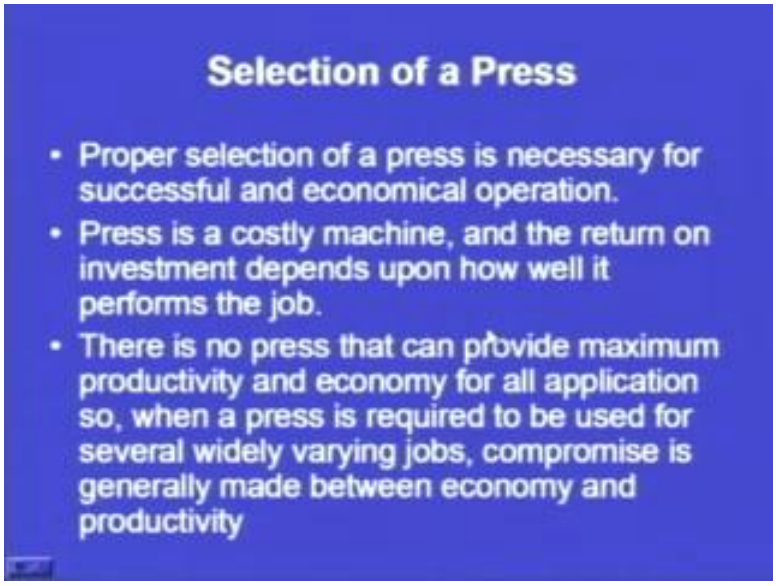

For successful and economical operation if we are not choosing the press according to our desired requirements, the process may turn out to be uneconomical process and we may lose a huge amount of money in that. Now, the press is the costly machine and the return on investment depends upon how well it performs the job. So, very clearly it has been depicted that press is not a very cheap machine which we can go and buy in the market. It is a very costly machine. If we are making that much investment, we should get return on investment and we should be able to economically justify the use of that particular press. So, the selection is also very important.

So, there is no press that can provide the maximum productivity and economy for all application. So, depending upon the application, I have been addressing this point for

long time that depending upon the application, depending upon the requirement, we have to properly choose the press. So, it is not that if we choose any press, it will be maximum. It will show maximum productivity for all the applications, or it will be economically justifiable or economically feasible for all the applications, but depending upon the application when a press is required to be used for several widely varying jobs, compromise is generally made between economy and productivity.

Now, for all the applications, same press cannot be used. We have to properly choose the press, and sometimes we have to make a trade of between economy and the productivity depending upon the final product that we want to make.

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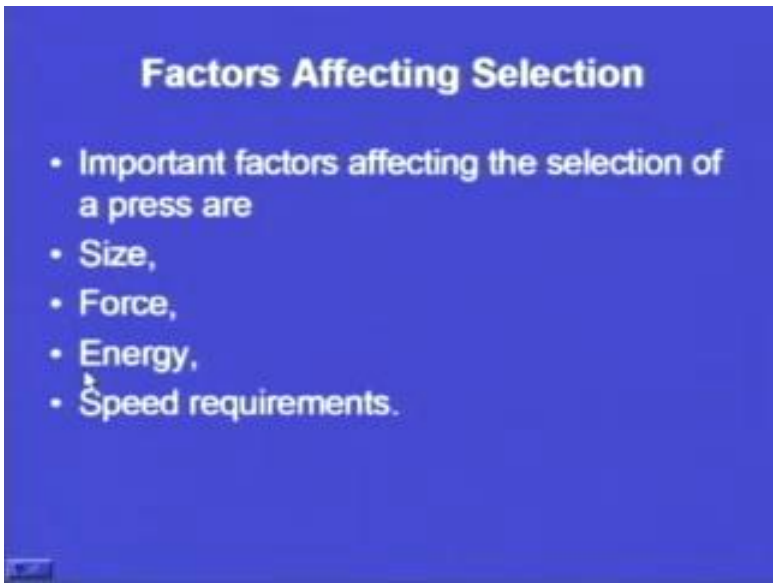

Now, the different factors, which help us to select a process. What are the various factors that have to be taken into consideration? So, important factors affecting the selection of a press, these are size force energy and speed requirement. So, force and energy can be clubbed together as one of the specifications, or one of the parameters affecting the selection of the press. So, we have size force and energy and speed requirements.

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Now, depending upon the size, size bed and slide areas of the press should be of enough size. So, as to accommodate the dies to be used and to make available, the adequate space for die changing and maintenance. Suppose we want to change the die after sometime because the die is related to the final product that we are making. So, if the design of the product changes, we have to change the die also consequently. So, depending upon the requirement, the press area or the size bed and slide areas should be such that easy changing and maintenance of the dies is possible.

Now, the stroke requirements are related to the height of the parts to be produced. Now, with depends we want to make a glass. So, the height of the component will dictate the stroke. How much should be the stroke length? So, the stroke requirements are related to the height of the parts to be produced. Already this has been discussed. Press with short stroke should be preferred because it would permit faster operation. Thus, increasing the productivity. So, although the final product will dictate that what should be the stroke length, but we should always aim for a shorter stroke length because it will perform the operation at a very faster pace. Thus, enhancing productivity.

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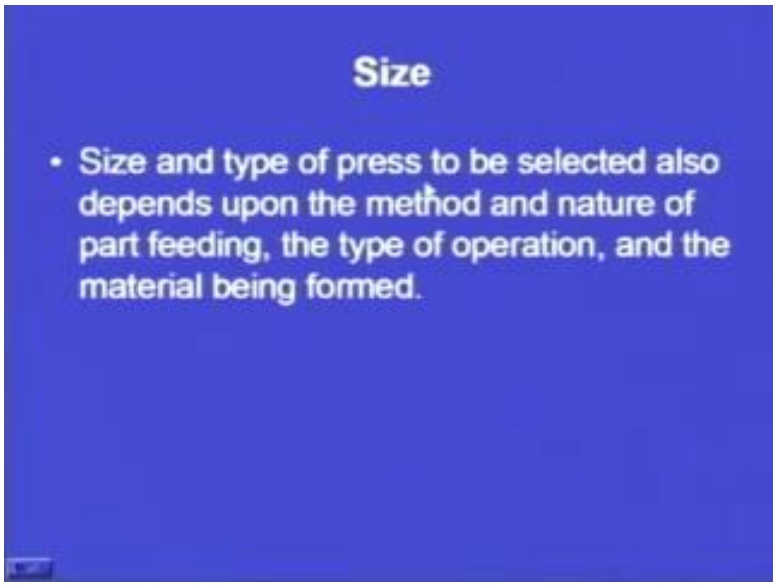

Also, the size and type of press to be selected depends upon method and nature of part feeding, the type of operation and the material being formed. So, on these three parameters also, size and type of press will depend. What are those? These three parameters, this is a nature of the part feeding, the type of operation and the material being formed.

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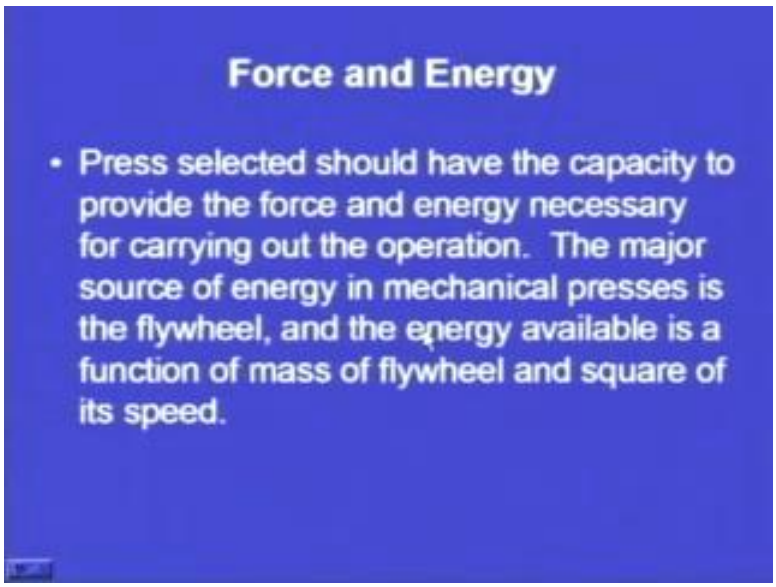

Now, force and energy requirements. This is another important parameter of acting the selection of a press. Press selected should have the capacity to provide the force, and

energy necessary for carrying out the operations. So, fourth requirement already we have seen in one of the classification that pneumatic presses, hydraulic presses, mechanical presses depending upon the force requirement, we can classify them that wherever the force requirement is less, we are going to go for this type of press. Wherever this power requirement is more, we are going to go for this type of press.

So, press selected should have the capacity to provide force, and energy necessary for carrying out the operation. The major source of energy is mechanical presses, the flywheel, and the energy available is a function of mass of flywheel and square of its speed. So, some mathematical formulation can be drawn from this, but the basic point to address here is the force and energy requirement of the presses have to be taken care of while selecting the press, for the press working operation or the sheet metal forming operation. Then, third important point is press speed.

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So, fast speeds are generally desirable, but they are limited by the operations performed. High speed may not, however, be most productive or efficient. Size, shape and material of the work piece, die life, maintenance costs, and other factors should be considered while attempting to achieve the highest production rate at the lowest cost per piece. So, basically the aim is to achieve the highest production rate, and we need to achieve it at the lowest cost prize per piece. So, for that we have to take into account not only small number of parameters, but large number of parameters.

So, what are those parameters? That is size, shape and material of the work piece, die, life, maintenance cost and other factors. So, numbers of factors have to be considered while we select a press and after the selection, all these parameters have to be taken care of for most economically production and at the lowest possible cost. So, with this we come on to the end of this session on sheet metal working operations in which we have put our emphasis on the different types of presses that are used in sheet metal operations.

We started today's discussion with a very important aspects of die manufacturing methods in which we discussed what are the various processes, what are the various methods that are used in making a die. Then, we discussed the various results, or what are the various implications of improper design, or how the die failure is going to take place, and what are the factors that dictate the die failure are. Then, we progressed to discuss what are the different types of presses, then the classification of presses depending upon number of parameters, and then we discussed that what is the important criteria or what are the important factors that are important for the selection of particular press are. So, with this we come to the end of this session.

Thank you.