Fundamentals of Manufacturing Processes
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Lecture - 34
Metal working Processing: Dies and Die set

Hello, I welcome you all in this presentation related with the subject fundamentals of the manufacturing process. And we are talking about the metal working processes. We know that for processing the sheet metals, processing we need the die and punches.

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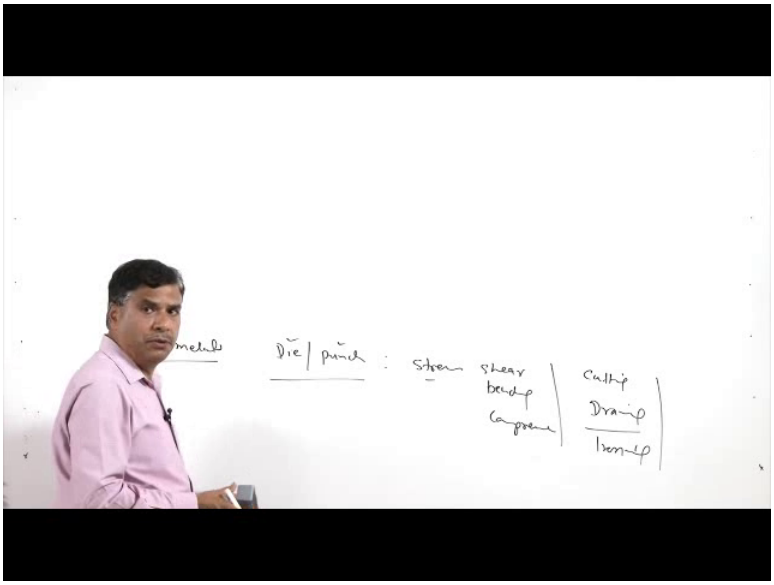

So, that suitable kind of the force can be developed so that the stresses like shear, bending, compression can be induced into the sheet metal, so that desired cutting drawing or ironing etcetera can be achieved but for the die and punch so they are used to apply the force on to the sheet metal.

So, the what kind of the die what metal of the die is to be used that becomes important in the sheet metal processing.

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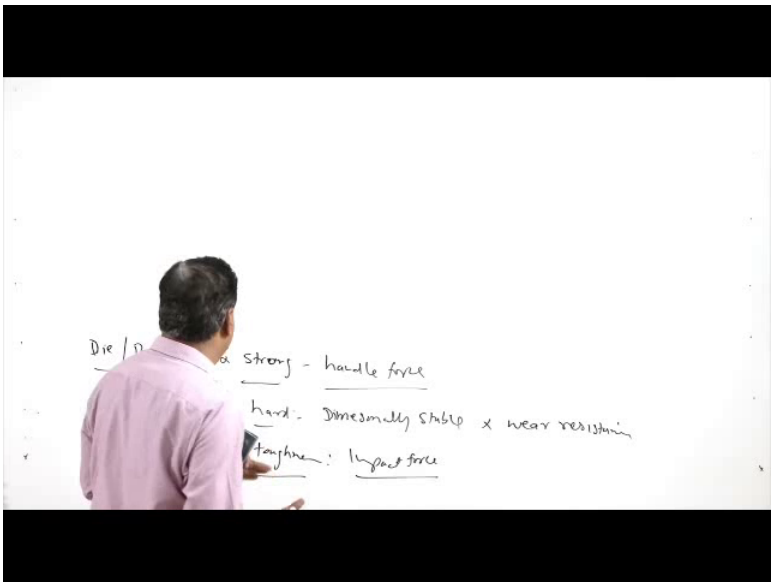

So, basically the die and punch are the components which will be used to apply the force on to the sheet metal so that desired kind of the stresses can be induced. And so, the suitable size and shape can be realized. These dies and punches need to be like they need to be strong enough so that they can handle the force being applied, which is being applied on to the sheet metal. And at the same time they need to be a hard also. So, they are dimensionally stable, the one more thing when it is hard. So, it will be more like wear resistant. So, the loss of the dimension as a function of time during the service will be limited.

So, at the same time also sometimes when the force is of the impact in nature at that time the good toughness of the die and punch material becomes important. So, not just the high rigidity is important, but sometimes the combination of the good toughness is also required. So, especially where impact forces act on to the sheet metal or during the on to the die and punch during the sheet metal processing, the good combination of the toughness is also required. So, consider at the same time apart from these the mechanical property requirements, the material must be suitable for the fabrication so that desired size and shape can be given. And the same time it should be easily available in the cost effective. So, considering these requirements the common materials which are used include the white cast iron dies,.

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So, these are we know that the cast iron dies is very hard and brittle.

So, it offers very good rigidity, it is very cost effective, as well as it is very easy to process. So, the casting route can be taken for making the dies and punch so that desired a die and all that a punch can be made and these are also cheaper. If you see they are cheaper as compared to the other options which will be which are available. But the of course, these the cast iron white cast iron will not be good.

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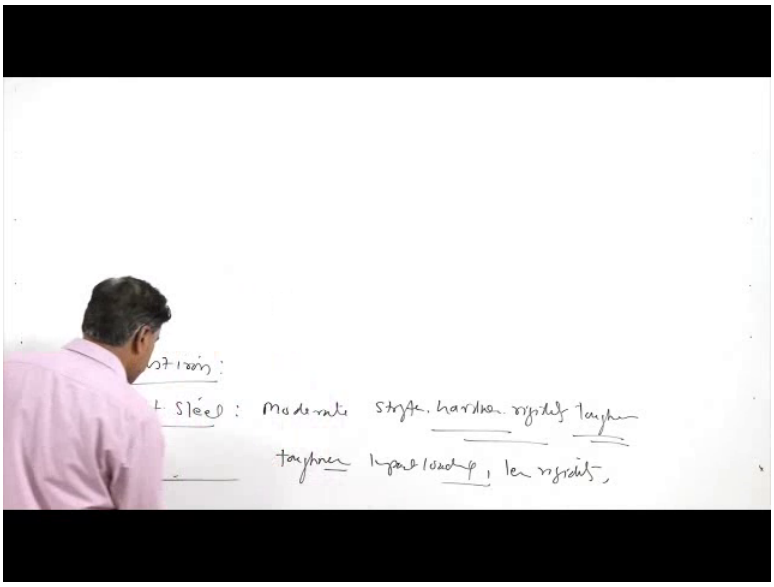

So, like cast iron and die and punch. Another is cast steel. Since the cast iron die cast iron dies are hard and brittle they are more dimensionally stable more wear resistant.

But they are low in terms of the they are poor in terms of the toughness. So, these are not good for the situations where impact load will be acting on to the punch and die during the sheet metal processing. Cast steel is the another one which offers the moderate a strength, hardness, rigidity as well as toughness. It also offers a reasonably good toughness. So, it is a it is good for most of the applications, but slightly the cost is a high then there is the wrought iron is the another kind of the metal system. Wrought iron dies are used for those where high toughness requirement exists to deal with the impact loading conditions.

However this kind of the dies are somewhat less rigidity, and not that much dimensionally stable. So, good for those situations where the impact resistance is required. Now we will see how these dies and punches will be actually working.

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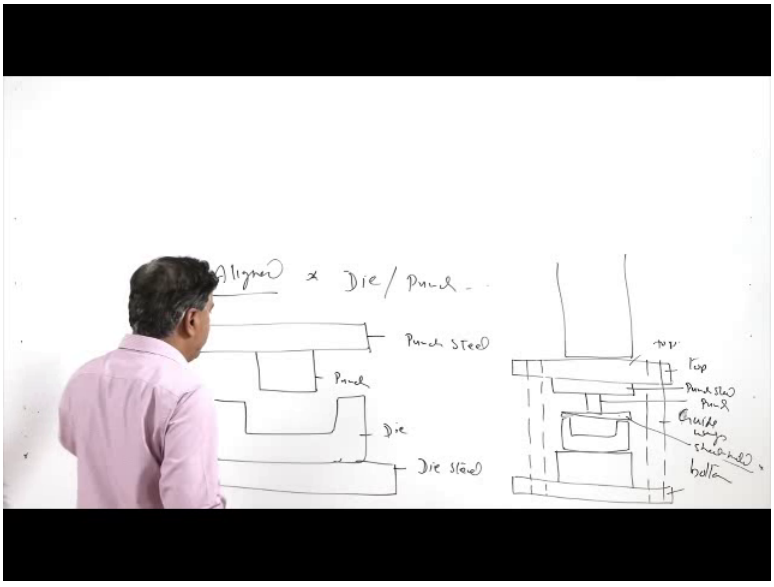

So, basically the there is one plate to which the punch is attached. So, this is punch of course, will be made of the suitable material like the cast iron or cast steel or wrought iron, then this metal plate to which the punch is attached is called a Punch Steel. And the similarly on the other hand we will have the die, the die will also be attached to the another plate.

Which will be termed as so, this is the die, and this is die steel. And between these two the sheet metal is placed. In order to ensure that the movement of the punch and the die is properly aligned, as well as the die and punch both are mounted securely for both these functions basically the die set is used. So, die set is nothing just it is a platform which will be providing the so, suitable movement aligned movement of the die and punch as well as provision for their mounting, a mounting of the die and a punch as well as their aligned movement.

So, what it is basically there is one top plate, and there is one bottom plate like this. And they will be fitted with the guide ways like this, the 2 or more 2 2 guide ways are there, but if they bed that the area of the die set is very large for mounting the dies, then there can be 3 or more number of the guides and between these. So, this so, this is the top plate and this is the bottom one. And these are the guides. Guide ways along which only the top plate will be moving. So, the movement of the top plate is regulated by these guides, and between these two only the punch and the die a steel with the die and punch is placed. So, here we have punch steel and then punch, and then here we have the die is die and then die steel is placed onto the bottom plate.

And between these two we have other members also So, this is the So, basically we are mounting the punch steel and the die steel on the top and the bottom plates, and the movement of the punch with respect to die is maintained with the help of the top plate of the die set. So, the die set facilitates the 2 thing. One is the mounting of the punch and die, and another is properly aligned movement of the punch with respect to the die and then force onto the sheet metal through the punch is applied through the through the press. So, the ram of the press actually working on to the top of the die set. So, here the force is applied on to the die set, die set top plate will be moving down and This the punch is attached to the top plate of the die set.

So, this is how the punch the force will be transferred from the ram to the top plate of the die set then to the die oh sorry, punch is steel and then to the punch and from the punch it will be applied on to the sheet metal. So, this is punch steel this is the top plate, this is the punch and this is the sheet metal. So, this is the kind of the general arrangement which is a used for in case of the die, and the punch to be used for sheet metal processing. So, depending upon the constructional a style of the dies, the dies are classified in different ways. So, there are basically 2 factors based on which the dies are classified.

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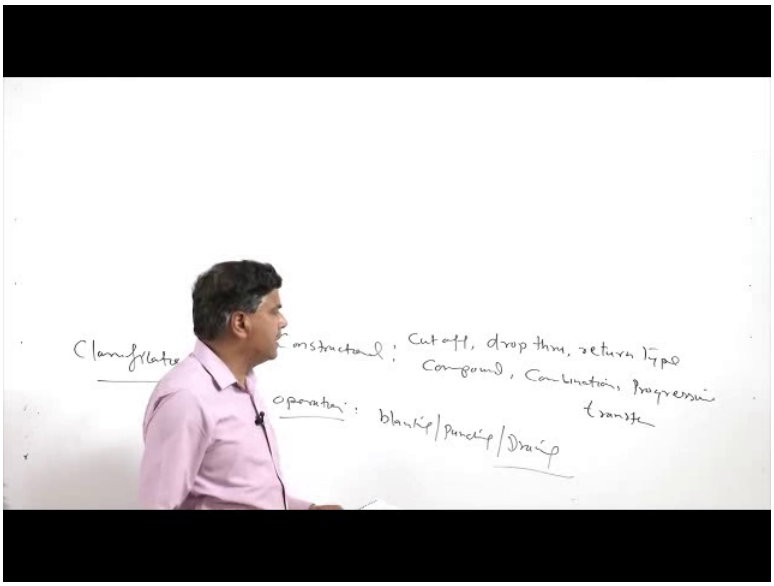

These include one is the class means the classification of the dies is based on the two factors. So, one is on the constructional aspect and another is operational. Means the kind of operation which will be performed like the blanking die or the punching die or the drawing die etcetera. Or then based on the constructional styles so that based on the constructional style or the way by which they work in, like cut off die is one. Drop through die is another, then we have the return type die then compound die. Then combination die, then progressive die and finally, transfer die. So, these dies based on the constructional details the classification of the dies based on the construction retail is more commonly used, and each defers each kind of the die defers from other in number of ways in terms of the features and the way by which they perform. So, we will be starting with the cut off die.

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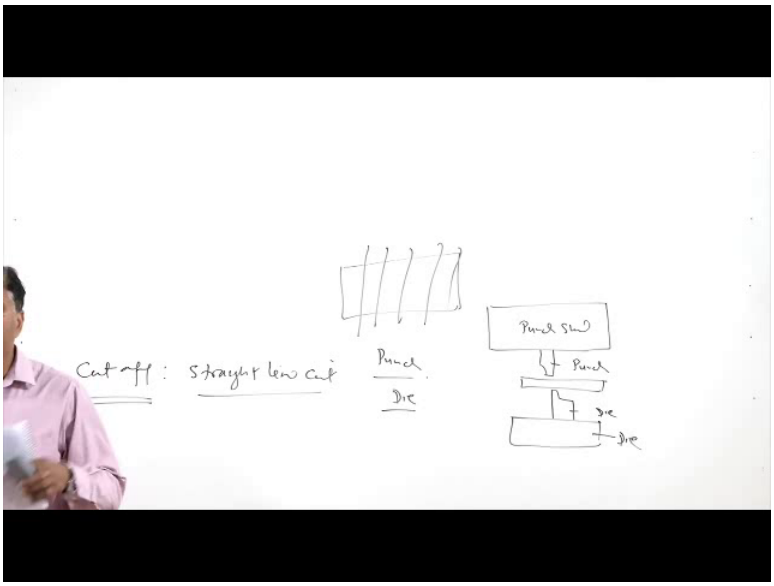

Cut off die dies are basically used for the for making the a straight line cuts. So, it uses one the punch having the a straight line blade kind of thing and then die. So, the structure is like this here, we have the punch steel and this is where one punch is connected. And here we have the die steel is connected to the sorry, die is connected to the die steel, and between these two sheet metal is placed.

So, when the cut as a strip like this in the top view if we see, the cut is made like this. So, this these 2 will be deciding the line along which the cut will be made. So, basically the met material wise this is very efficient process because this is used for mainly for cutting this the small pieces of the metal from the large strip or large sheet or from the large role. A seat it is also used for making the blanks. So, this is the cut off die it is we will be used for making the cuts a line in the straight line so that the blanks are the smaller sizes strips can be produced for further processing. So, this is the cut off die.

Another is drop through die. So, cut off die I can show here with the help of this diagram. This is the cut off die wherein we have one the punch show or the punch steel, and this is the punch, this is the die and this is the die steel or the die shoe.

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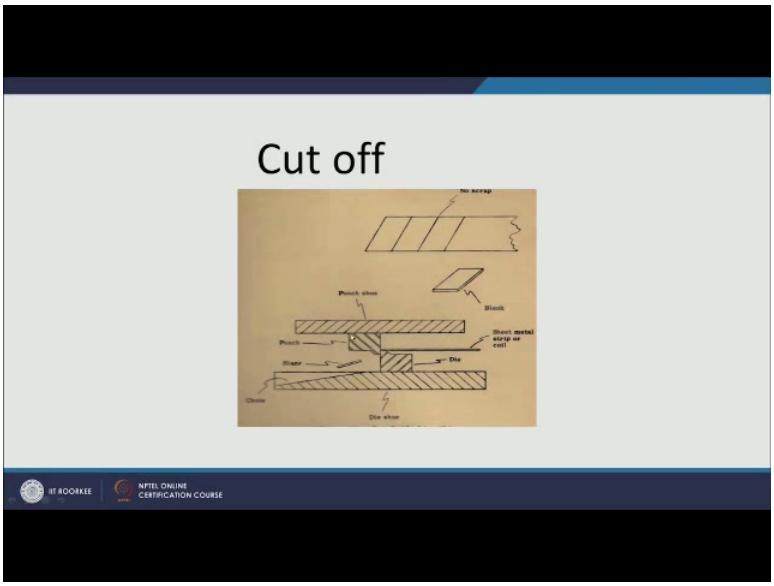

And this strip is placed between the punch and die and when the force is applied on to the sheet metal then strip or the piece of the metal is cut, which you have been in form if the blank or in form of the a smaller size the sheet which can be processed further. So, the cuts are made like this is a big strip and the cuts are made in the straight line so that it can be used for producing the smaller size blocks or the blanks which can be processed further. So, this is what is their the cut through die, the cut off the die.

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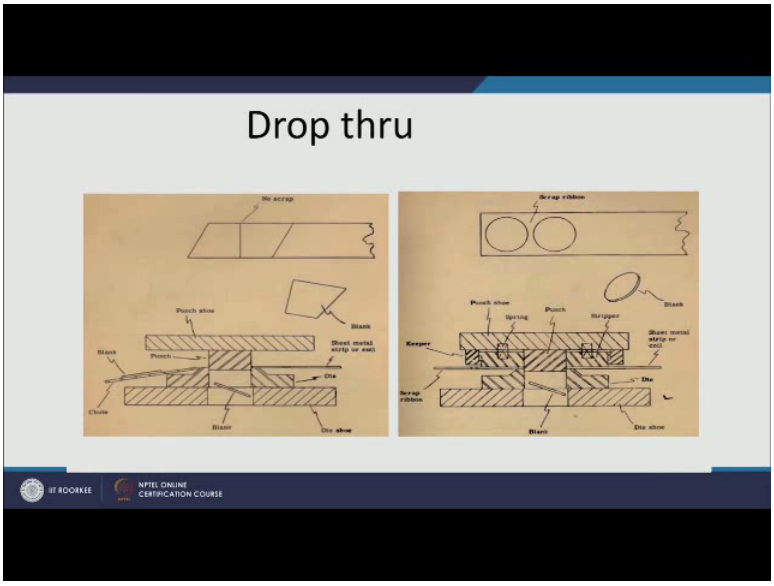

The drop through die is the another one. Where in like say this is the punch and this is the die. So, the a strip this is their strip. So, this is the portion which is left after the cutting and the after the cutting this is the portion which has been removed. So, in this kind of the dies there is in need of the opening at the bottom. And mostly at the bottom side we have that material handling device or the conveyor. So, as soon as the material is processed or it is cut off a it will be falling on to the metal handling device, and then it will be moved. So, the in the in case of the drop through dies after the processing of the metal it will be falling down on to the material handling device, like conveyor belts or any other arrangement.

So, that it can be transported. So, no need of the manual interventions is required. So, in this case no manual intervention is required to handle the processed component. And it will automatically falling down onto the metal handling device so that it can be transported further. So, this is a oh what is there in the drop through die it can be used for making the blanks. In this case if we see this is the example of the drop through die wherein this is the ray stock and the a blank of this shape is cut. So, using this type of the die wherein this is punch show, and this is the punch. This is the die shoe, this is the die, and between the punch and die the sheet metal is placed.

When the sheet metal acts on to the when the oh sorry, punch acts onto the sheet metal one is small piece of the metal in form of the blank is removed. And this blank also drops though the opening present in the lower side of the die. And where from it is taken further away using the suitable material handling device. This is another example of the drop through die wherein the holes the blank is made in form of the circular strips. This is the raw stock which is fed sequentially So, when the punch acts on to the sheet metal the small size circular shape blank is removed. And that the blank falls down onto the material handling device then it is taken away. So, means in case of the drop to through dies.

The material after getting processed falls onto the material handling device through the opening in the die in the lower side so that it does not require the manual interventions in order to ha handle the material. After the processing, but it directly drops through the drops through on the opening at the lower side So, that it can fall down onto the metal.

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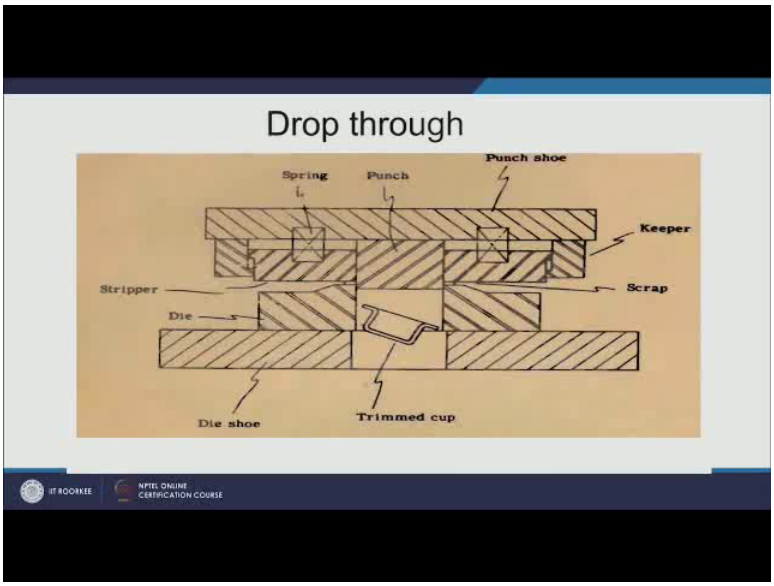

This is the another example of the drop through die, wherein the punch acts on to the sheet metal for the drawing purpose. And then the draw here is in this case basically that the trimming operation was performed. So, here the cup after the drawing process the cup was placed, and whatever the extra material was present that has been removed, and the very trimmed cup after the trimming. It falls down onto the material handling device. So, in all these cases if we see in these 3 cases there was a opening at the bottom of the die and through which the process material can fall down onto the metal handling device Where from it can be taken care of further for the further processing or for use. So, this is another example of the drop through device.

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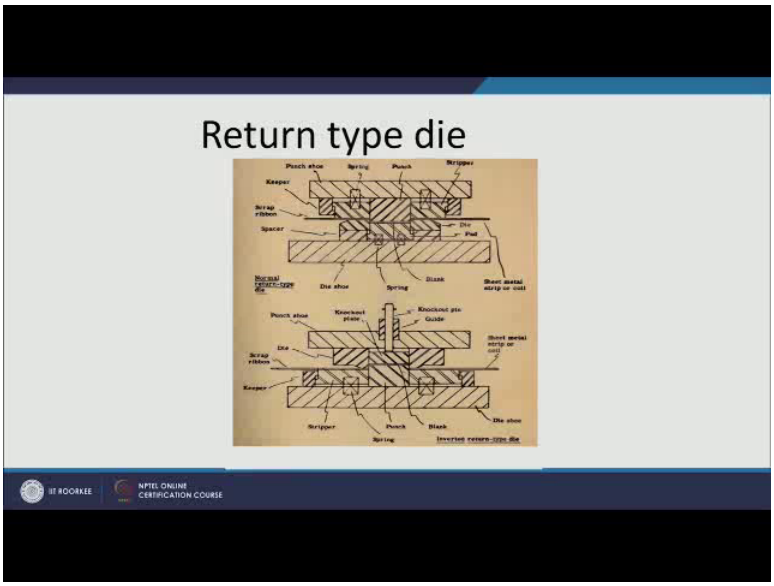

Now, the return type of the die is the another one. In this case let me explain there are 2 kind of arrangements here This is the die.

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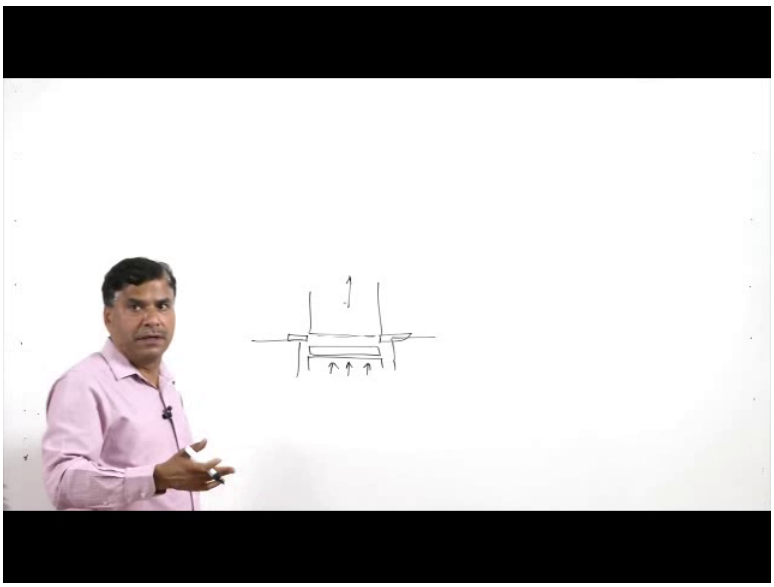

So, and this is the punch, so many times whether they are may not opening at the bottom side of the die may not be feasible in order to clear the processed product, because of the press bad may not have opening of that kind. So, what is done in the such kind of cases like this is the sheet metal and after the processing of the sheet metal. Say this portion is removed. So, this portion once this portion is removed. So, it will be available here in

form of this strip. So, what we have we have one arrangement as soon as the material is removed.

So, it will be pushing it back and then returning to the original position. So, this after the processing punch will be going back and this the cut off the metal which has been processed will be moved up with the suitable arrangement so that it returns to it is oh original position where from it can be handled transported and taken away to some other location for further processing. This is what has been shown in these 2 cases of the return type of the dies these are the 2 different types of the dies, here in one case yeah. So, there are 2 examples are related with the return type of the die. In one of the cases like this is the die steel this is the sorry, this is a punch steel this is the punch.

This is the strip which has been processed this is the die and this is the die steel. So, what we do once the punch walks on to the sheet metal the sheet metal is removed, sheet metal is removed. So, in order to get it back in it is normal position, this portion will be moving up so that the sheet metal processed it or the part which has been removed is brought back to the normal position. So, this is one type of the example where in the return type of die is used means with a me sheet metal after processing is returned to it is normal position so that it can be taken of. This is normal return type of the die. In another example here this is the inverted return type of the die. In this case the punch is placed in the bottom side, and the die is placed on the upper side.

So, when the die move is down; obviously, the sheet metal will be removed, and the removed material will be moving up. So, this is the location of the punch this is the punch is steel and this is the sheet metal which was pro processed and this is a removed material and this is the die. So, once the material is processed; obviously, the punch is moving out. So, in order to bring it back in it is normal position basically this knock out pin, move is the steel or the sheet metal back to it is normal position. So, this is inverted type of the die. Here knock out pin actually helps to bring the processed sheet metal to it is position normal position so that it can be taken out for use or for the processing. Now the compound type of the die is the another one.

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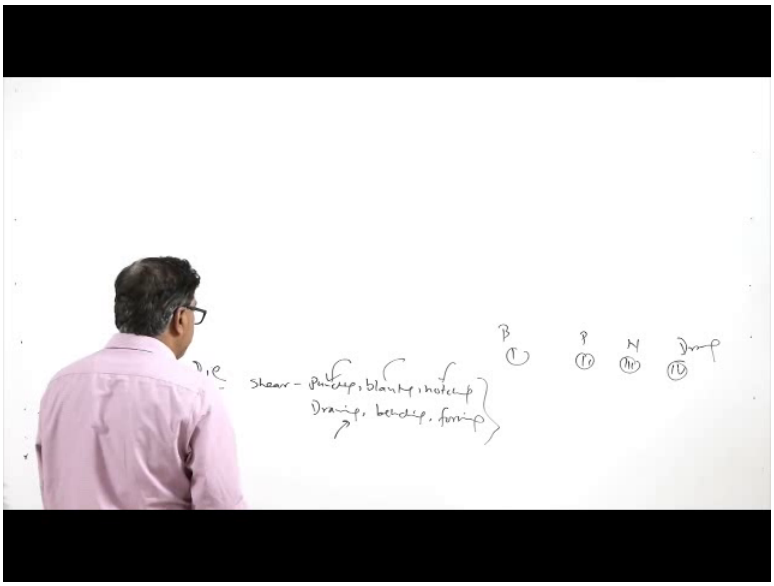

Compound die, we know that there is a very wide range of the processing operations which involves like shearing based operations for example, punching, blanking, notching etcetera. Then it involves the drawing, bending and forming a stress forming etcetera. So, these are the independent operations. So, it may be possible that for making one product we may require first blanking, than punching, and then notching, and then drawing. So, these are the various operations which will be performed in 4 steps 1 2 3 and 4. So, first of all say performing blanking then next is punching then notching, and then maybe say drawing. So, the we need to process these in 4 steps or So, but if a the dies are designed in such a way that the to operations are performed in one group of the of the punch.

In that case like say the first the blank blanking a is perform, and thereafter the punching is done in the same movement of the punch. So, if such kind of the combination is realized, in terms of the operations to be performed on the sheet metal then such kind of the designs are called the compound dies. Where in 2 or more number of operations can be performed in one go of the punch. So, such kind of the dies are called the compound dies.

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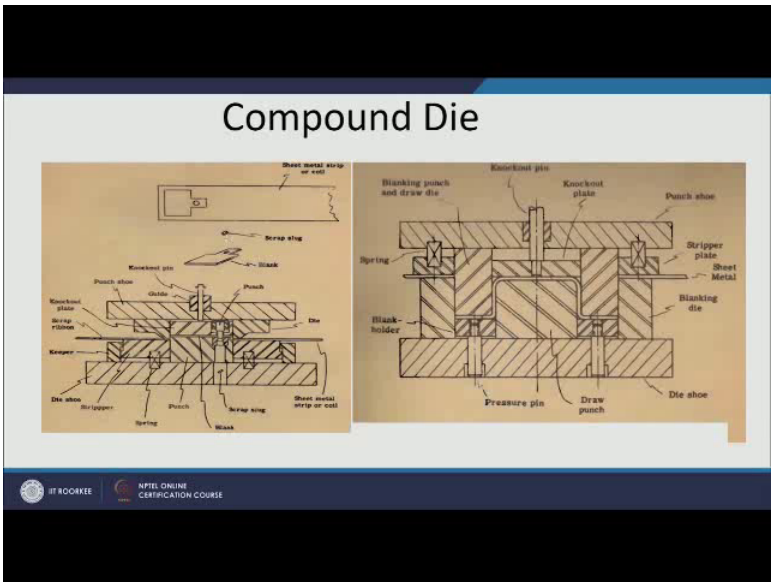

So, such kind of the dies are of co of course, they are completed in the design and the shape like for example, in this case this is the sheet metal where from we have to make this kind of product. So, making this kind of product requires that 2 steps first is the production of the blank, and then making of the a hole. So, for these 2 operations we need to perform blanking as well as punching. So, both of these are incorporated in the compound dies wherein like say they are there are 2 dies and the 2 punches both are clubbed here in one go. Like this is the punch and this is the die for blanking purpose. So, this is the punch and this is the die for blanking purpose and for punching purpose this is the punch and this is the die.

So, when the punch move is down it performs first the blanking, and then here this punch will be acting onto the sheet metal to perform the punching. So, both punching as well as the blanking as well as punching are performed in one go. So, when both are realized they will be leading to the development of the blank first and then making a hole where in this crap in form of the slag is removed in this shape. Then there is another example where in the blanking as well as the drawings are combined. So, here in we need a completely different kind of the die here the initially the sheet metal was placed like this. This is the sheet metal where it was placed like this.

So, when this is the blanking and the blanking punch and the drawing die. Basically this is the blanking punch and the drawing die. So, when the blanking punch comes first it

shares of the metal along this and along this point all around the periphery. And thereafter this is the draw punch and this is the draw die. So, where the further movement of the draw die after the blanking leads to the drawing operation. So, first the material is blanked and once after the blank is produced it is subjected to the drawing like this. So, in this case the 2 operations like blanking and the drawing has been clubbed using the compound dies.

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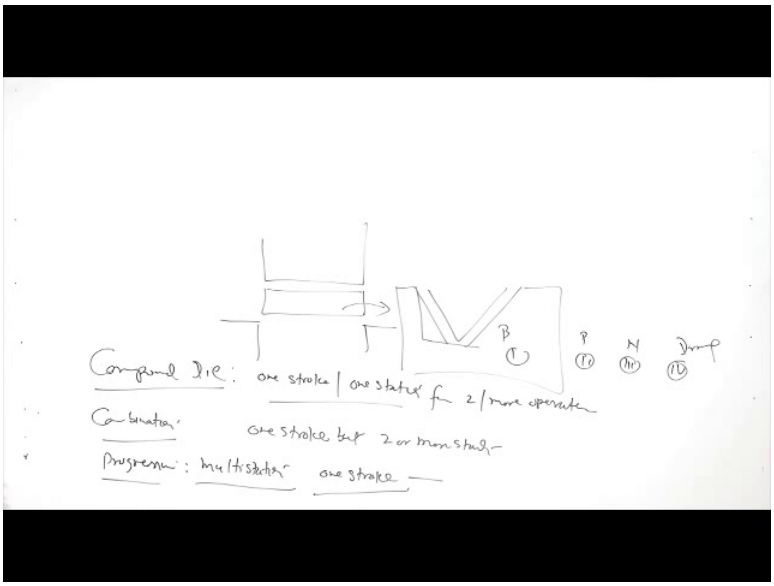

Another one is the combination of combination dies. So, in case of a compound die one stroke and one station is realized. So, for one stroke of the punch and die on one station for 2 or more operations of the sheet metal, while in case of the combination dies combination dies there is one spoke But 2 or more stations.

So, like say in this case the first the blanking is done, and then that forming is done. So, at one stage like say this is the punch and this is the die and once this one is created it is transported to the another set another station where it will be subjected to the forming. So, the 2 operations are also performed in combination of the dies, but these are performed at the 2 different stations. That is what we can see here.

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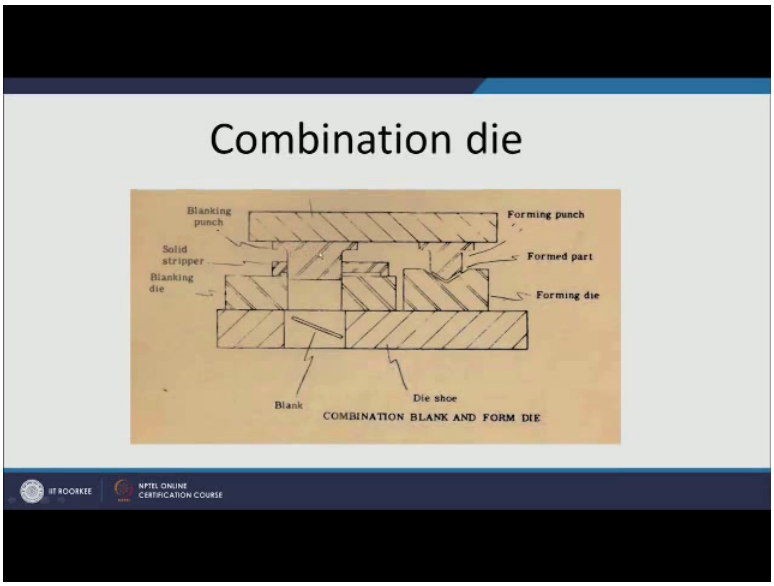

This is our the punch steel or the punch shoe this is the punch, and here our die and the this is where the sheet metal is placed and This is the another the punch having the v shape and this is v shape die. So, whatever the So, here basically the blanking is performed in it is as one step. And then this blank is used for further forming or like bending to produce the v shape product. So, it is a combination of the blanking and the form die where v shape product by bending is achieved. So, if we see in both the cases there is one stroke of the punch but there are 2 stations which will be performing the different oh operations at one station. Here it is blanking and another station this is the forming or the bending, forming by the bending operation. Coming to the progressive die.

This is multi station approach, multi station and one stroke. Maybe more number of their strokes also can be used. So, here if we see in this arrangement, this is the punch shoe where in number of the punches have been attached. The first one is this.

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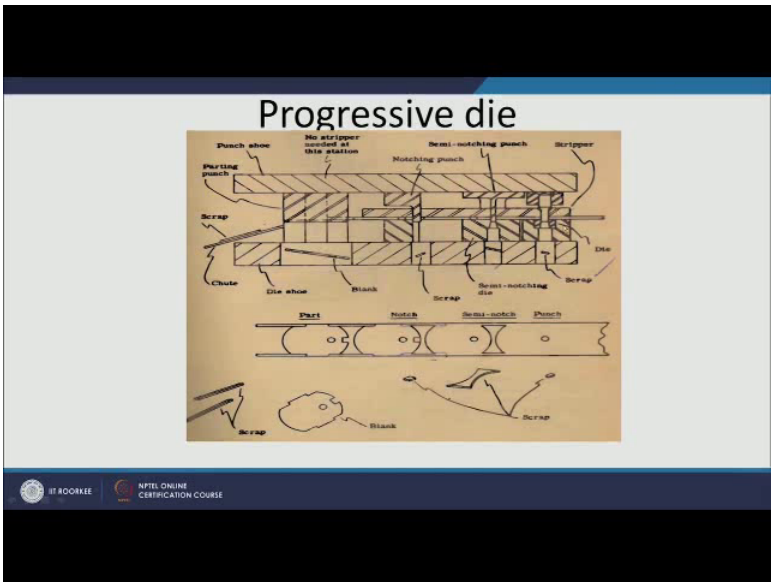

This is one punch stripper, this is the stripper, this is the one punch then the semi notching punch, and the notching punch, and this is the another one here the punch shoe for the punching purpose. So, here the sheet metal is first fed from this side. So, it will be making a small hole producing this kind of is it is it is scrap. Then the sheet metal is moved further wherein another semi notching operation like this.

Where the cut is made all along the internal surface or internal contour is created of this form. And then the notching is performed. So, then when notch is made the cut is made at the edges of the sheets like this. So, another scrap is created. So, all these are the steps of the different configurations this is from like say notching, this is from the semi notching and this is from punching and then the finally, the cut is made to produce the blank of this kind.

So, here the number of stations sheet metal is moved sequentially from one station to another to perform. The operations in a one particular order, but there are number of complications are related with the proper designing and it may not be possible to combined all the operations in one go in kind in a progressive dies. Because the movement of the sheet metal need to be controlled and regulated very perfectly and many times despite of this one also it does not become possible to produce a different kind of the geometries and the products using the progressive dies. So, as a more versatile and more useful multi station die is the transfer die.

So, the transfer die like the progressive die is the another the multi station die which uses the number of operations, transfer die.

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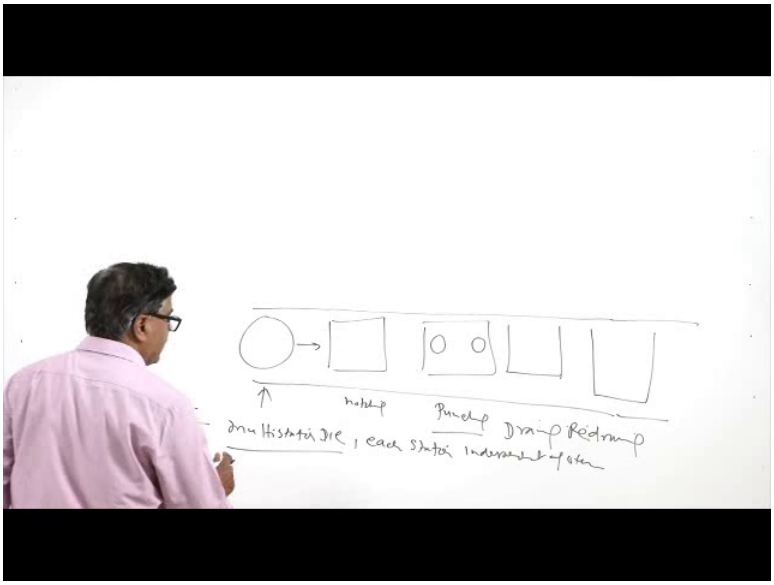

So, as it is name appears in basically in transfers transfer die, it is a mighty station die, multi station die. Wherein each station is independent of other. Each station independent of other stations. So, here say we feed the blank, which is to be processed.

So, the blank or the raw material to be processed here. So, at the station one maybe one kind of the operation will be performed. Like say it may be notching. And then another operation is performed in the next step or the next station, like say the punching of the holes. So, punching and then the drawing operation may be performed in the next step. And there redrawing may be performed as a further step re drawing the good part is that each station is independent and, but the part need to be moved from one station to another.

And it does not have the limitations of the progressive die regarding the movement of the product. In very controlled way because in this in the in earlier case they were related with each other, but here the raw material is a independent and each station is independent for with respect to the processing. So, it provides a lot of flexibility and accuracy in terms of the movement of the material from one station to the another. So, this results in very versatile application of the transfer dies in the industrial field.

So, here now I will summarize this presentation. In this presentation I have talked about the kind of metal systems which are used for making the dies. And punches and the different at types of the dies, which can be classified on the basis of the construction as well as on the operations. So, basically in detail I have talked about the class the details of the dies which are classified on the basis of the construction.

Thank you for your attention.