Fundamentals of Manufacturing Processes

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Lecture – 14
The Pattern Allowances

Hello, I welcome you all in this presentation related with the subject Fundamentals of the Manufacturing Processes. And we are talking about the pattern allowances; and in the previous lecture, I have talked about the shrinkage allowance.

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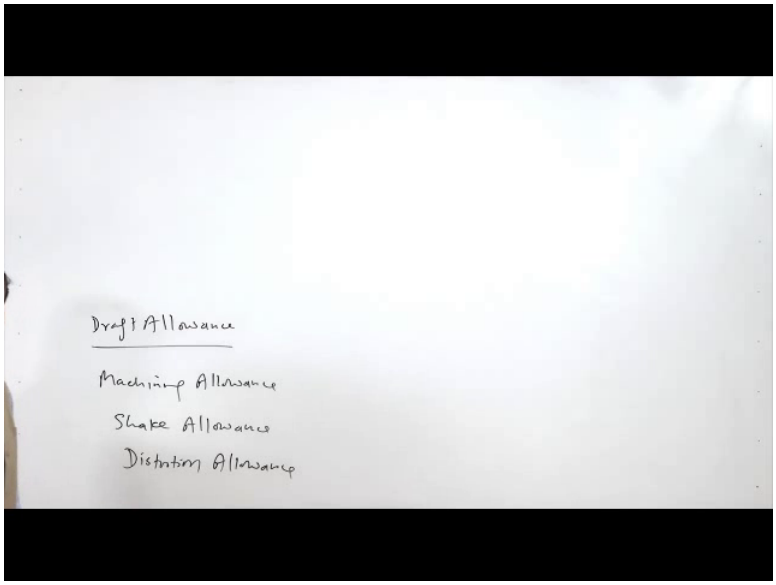

Now, we will see other allowances, which are normally given to the patterns, so that desired size and shape can be achieved in the casting and so other allowances like draft allowance, machining allowance, shake allowance, and distortion allowance.

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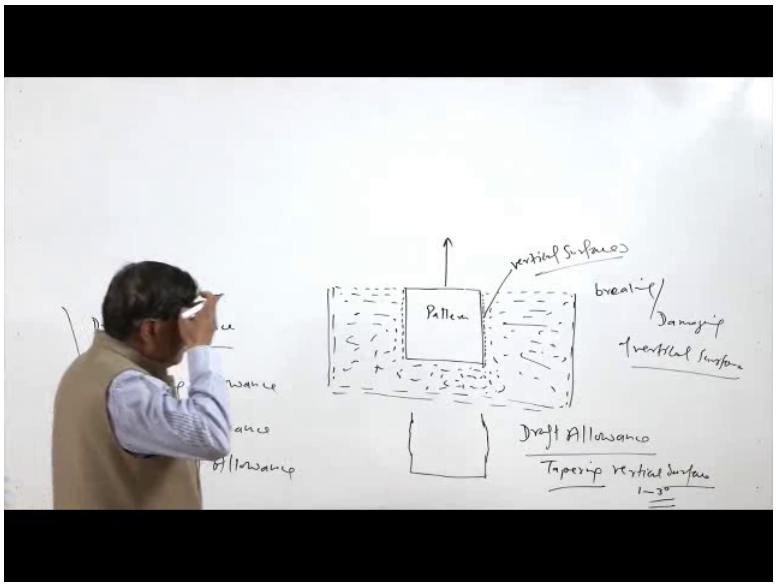

These are somewhat simpler allowances if you see like when we make the mould sand mould of likes shape pattern very simple shape pattern this is shape pattern of wood. So, around this will be packing the moulding sand all around using the flask. So, the boundary is there of the flask and this is the foundation say or it may be the board also. So, actually sand is packed all around the pattern using the proper ramming. And once the ramming is over and the moulding sand has taken the shape of the pattern normally the pattern is taken off by shaking it properly. So, basically when the pattern is taken off after the ramming, the vertical surfaces of the mould having the sand and it has packed properly, then when the pattern is removed these vertical surfaces have tendency to get damaged or broken.

So, the breaking or damaging tendency of the vertical surfaces of the mould is more especially when the pattern is taken off or withdrawn in order to get the desired the mould cavity. So, while withdrawing, if the pattern damages is the vertical surfaces then it will be changing the shape. This change in shape will be leading to the defective casting as well as unnecessary wastage of the material. So, if the material has been removed like this from the vertical surfaces, then unnecessary the shape of the cavity will be modified.

So, to avoid this kind of the damage especially of the vertical surfaces, the draft allowance is given under this draft allowance is given a by tapering the vertical surfaces

tapering is given to the vertical surfaces. And this tapering can be of like say 1 to 3 degrees with respect to the vertical plane and depending upon the location of the vertical surface whether it is external or internal the magnitude of the distortion allowance in terms of the degrees can vary. In addition to that, the type of the metal which is being used also affects the type of the metal or type of pattern material also affects the draft allowance. So, if we see here for different materials and for the different surfaces, the draft allowance magnitude varies in terms of the degree.

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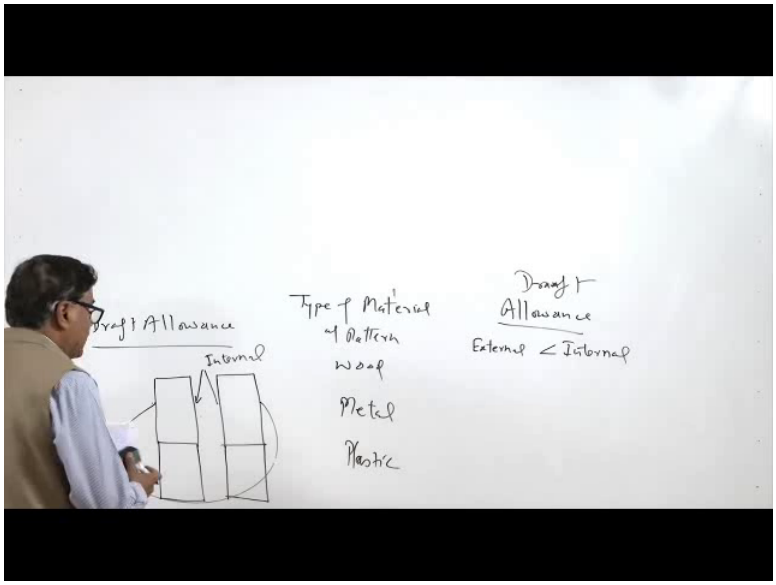

So, if we were have that type of the material of pattern which can be of course, wood which can be of the metal and the plastic. And we know that the dimensions also will be affecting the magnitude of the draft allowance to be given. So, it is basically allowance or the draft allowance which is given. So, depending upon the location of the surface, whether it is external or internal, the vertical surface is internal is for example, like this is the component and having the internal hole like this.

So, these vertical surfaces are the internal surfaces while the external these are the external surfaces. So, internal surfaces are always given more draft allowance as compared to the external surfaces, because tendency for damage in case of the internal surfaces is found to be more than the external surfaces and that is why and another thing is the extent of the magnitude or means the dimension. Greater is the length or the linear

dimension of the component or of the pattern greater will be the draft allowance, which is given. So, it is affected by the size also.

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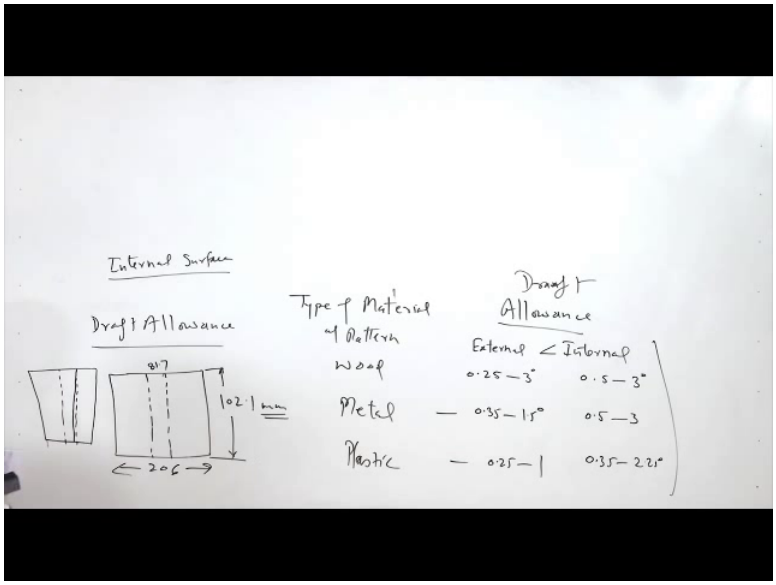

So, the draft allowance which is given safe in case of the wood and so that is what we will see up for wood external surfaces are given the draft allowance in the range of 0.5 to 3 degrees; while for internal surfaces 0.5. So, for external it is 0.25 to 3 degrees; for external it is 0.5 to 3 degrees in case of the wood. For metals, it is 0.35 to the 1.5 degrees while in case of the internal surfaces it is 0.5 to 3 degrees. For the plastics, it is 0.25 to 1, so the minimum draft allowance is given to the plastics because they offer is smoother surfaces, withdrawing is easier; while in case of the internal surface is 0.35 to the 2.25 degrees. So, for internal surfaces always higher magnitude of the draft allowance is given.

Now, we consider the same example here if the vertical surfaces like the dimension, this dimension is 102.1 mm as we have calculated in case of the wooden pattern as determined in the last example related with the shrinkage allowance. And if here is the hole of the 80 mm, which was required so 87 let say this as calculated from the shrinkage allowance after the calculation say this dimension is coming 81.7.

So, what we need to do is and this dimension is 206. So, what is needed, for we need to calculate the now the draft allowance. So, for calculating the draft allowance, basically for internal surfaces what we need to do this is the internal surface, and how it will be

given, in case of the external surfaces a taper will be like this. And in case of the internal since this is the hole, so in case of the internal surfaces tapering is given differently. So, how it is given that is what I will be making may be I will make a separate diagram for this purpose.

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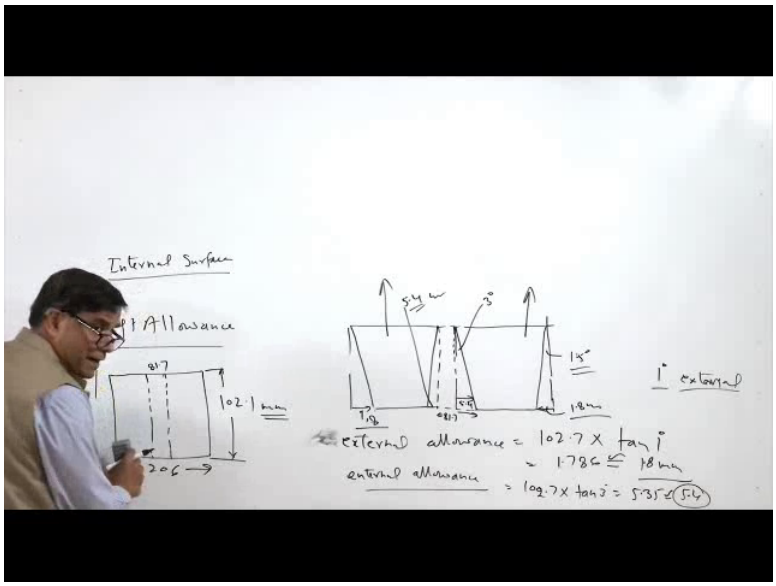

So, this is the kind of taper given for the internals, and this is a kind of taper given to the external. So, this can vary as per the case 1 degree or 0.5 degree or 1.5 degree anything as per the metal of the pattern to be made and this can be to 2 degree, 1 degree or 3 degrees as per the metal of the pattern. So, internal surfaces will be having the higher taperness as compared to the external surface. So, basically what we need to do this for giving this tapering we need to change the magnitude here say this was of the 180 dimension. So, this much magnitude is to be identified. Earlier if it was a 81.7, so this dimension need to be increased. So, for giving the internal for internal and external for giving the external tapering what we need to do is let us say external allowance, external allowance the dimension is 102.7 multiplied by 10, 1 degree, say 1 degree is the external allowance being given. So, we will be writing the one and the value is coming out to be like say 1.786, so this is equivalent to on the safer side 1.8 mm. So, the taper of the 1.u mm is given on this side and similarly on the other side.

Now, coming to the internal allowance, the taper needs to be given on the internal surface, so since the height is same. So, the 102.7 multiplied by 10 of 3 degree say 3

degrees the internal taper to be given, so that is dimension is coming out 5.35. So, considering this 5.4 is equivalent value on the safer side. So, the taper is of given is given of the 5.4 this side, so that the degree of 3 degree taper can be obtained and similarly it is given in the other side like this. So, this one is of 5.4 mm. So, more taper is needed. So, here this is of the 1.8, this is of 1.8 and this is a 5.4 are tap for the internal surfaces. So, more taper need to be given.

So, when the tapering is done in this manner. So, when we way the draw the pattern these this taperness are given to the vertical surfaces will help to avoid the damage to the vertical surfaces of the sand mould so that we can get the casting of the desired size and shape.

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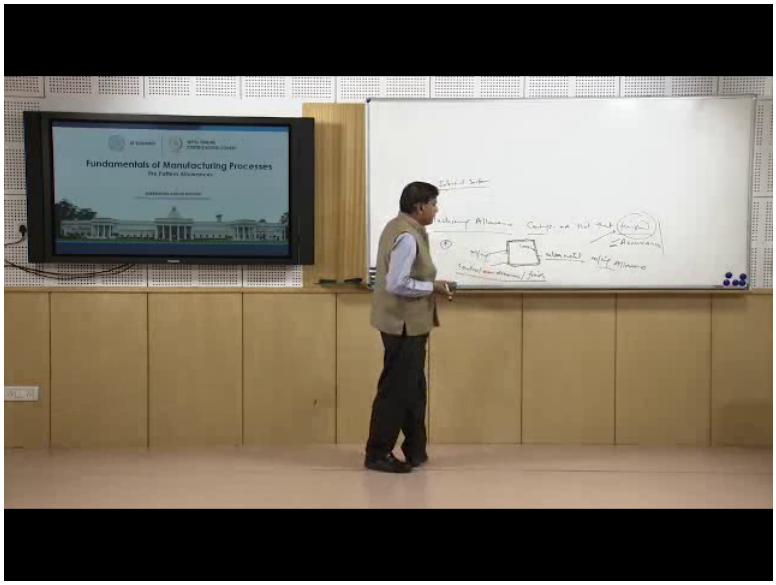

Now, coming to the machining allowance, machining we know that the castings which are made from the sand mould casting or from the die castings they are quite rough and they cannot be used for many applications. So, it is required that since the as castings in as cast condition castings are not that finished surface finish is not that good and accurate in terms of the dimensions. So, these are the two main issues that are related with the cost components.

So, if the final finished casting is needed of like say 100 in 200. So, actually this is rough and the dimensions may vary due to the variety of regions like the distortion or extra dimension. So, what we do basically to have the exactly desired dimensions and desired

finish, some extra material is given to the casting and provision for that is made in pattern. So, patterns are basically made of the larger size. The machining allowance is a in that way a positive allowance which is used for giving the extra dimensions to the pattern, so that the mould of the larger size can be made and accordingly the casting of the larger size can be prepared.

So, this extra material which is a which is given by providing the this extra metal which is provided in the costing by providing the machining allowance this is used basically for machining purpose. So, during the machining we take off all this unwanted material in form of the rougher which is the external layer having the rougher surface and it will also help to achieve the very close control over the dimensions as well as finish. So, to achieve the desired finish and the dimensions it is necessary that some extra amount of the material is provided to the castings, so that it can be machined out in order to achieve the desired finish and control over the dimensions. So, that it can be used for the purpose for which the casting is has been made or the component has been made through the casting route. And therefore, the cast machining allowance is provided to the pattern, so that the casting can be made of the larger dimensions.

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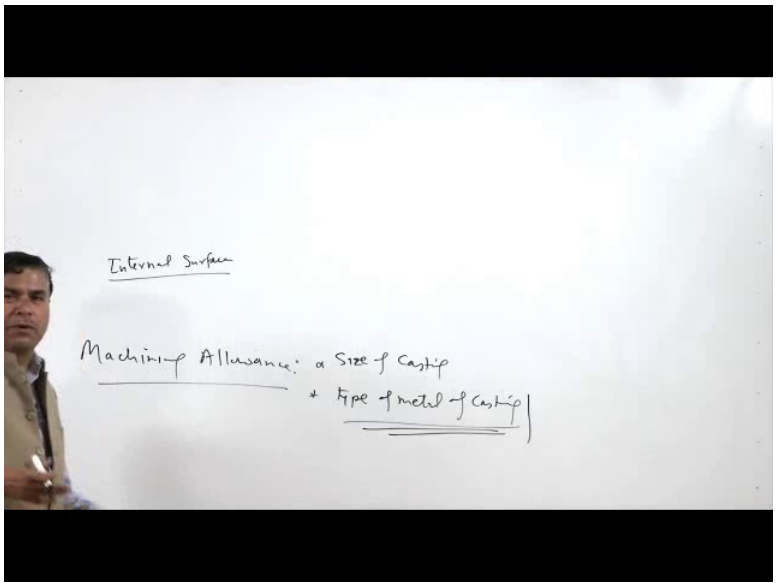

The machining allowance actually depends upon the size of casting one and the type of the metal type of metal of casting. It is very common to assume that if the casting is of the larger size, so obviously, the machining allowance is to be given more as compared

to the castings of the a finer size or smaller sizes. On the other hand, if the casting is made of the like the metals like caster and then more allowances are given as compared to the other metals like the steels and nonferrous metals. So, I will be writing about the kind of machining allowance, which is given for the different metals as well as how does it change with the size of casting.

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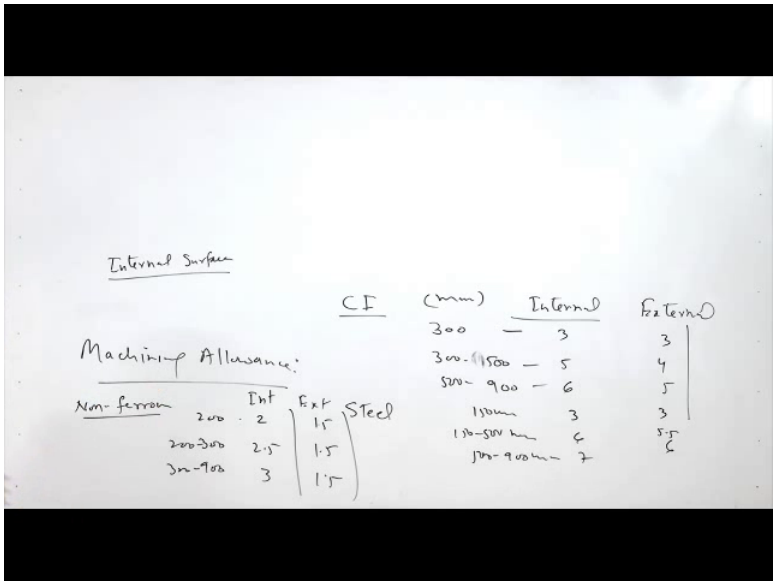

So, if we see here cast irons when the cost iron made of dimensions size of the costing is 300 or in this range of like say 300 to 500 or it is in greater than the or it is 500 to 900, it is in mm dimensions are in mm. So, the kind of allowance which is which is given hum to the surfaces it is like for internal surfaces are it is more obviously, I was compare to the external surfaces. So, for internal surfaces for the cast iron having the size up to is a 3 mm and it is up to 5 mm for internal surface like bores and 6 mm for up to 900 while that is for 3 mm, 4 mm and 5 mm for the external surfaces. In the same way castings made of the cast see steels for the size up to 150 mm size 150 to up to 500 mm, so 150 to the 500 mm and 500 to 900 mm. So, the machining allowance for the internal surfaces is like 3 mm, 6 mm and 7 mm for internal surfaces and for external surfaces it is 3 mm, 5.5 mm, and it is 6 mm.

And similarly for the non ferrous metals in the same way nonferrous metals like aluminium magnesium copper etcetera for the dimensions up to 200 mm for up to 300, 200 to 300 mm and dimensions up to 900 mm 300 to 900 mm how the done the

machining allowance for internal and for the external surfaces will be changing. So, to see that it is given somewhat lesser in amount 2 mm; for internal surfaces up to 200 mm then 2.5 mm and then 3 mm for internal surfaces. And for external surface it is 1.5, 1.5, 1.5. So, for non ferrous metals somewhat lesser machining allowance is given as compared to that of the cast iron and the steel. So, if the casting is a made of a particular metal of particular dimensions then how the machining allowance is given.

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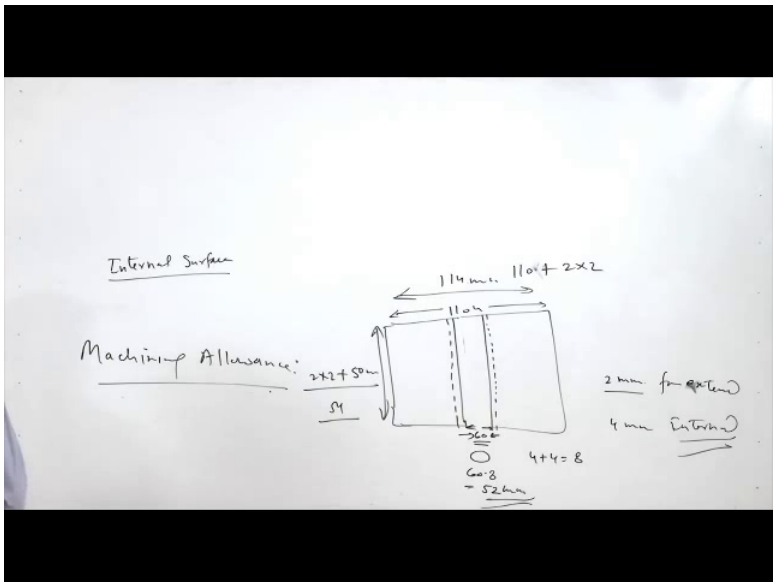

So, if we have got some dimensions after providing the shrinkage allowance and the draft allowance the dimensions are like 110 and 50 mm in that case to provide how to provide the machining allowance say this is a 60 mm, after providing the necessary allowances the diameter is 60 mm. So, to provide the machining allowance assuming that 2 mm is for the 2 mm for the internal or say external 2 mm for external surfaces and 4 mm is for internal surfaces.

So, in that case, what we need to do 4 mm material is to be provided extra on this vertical surface as well as on this vertical surface. So, for that purpose basically if this is the final size of the hole which is required then the 4 mm material is to be added this side and 4 mm material is to be added this side. So, as a result 4 plus 4 this will be, so there will be addition two sides, so basically it will be leading to the 8 mm. So, we need to reduce the size of hole basically 60 minus 8, so the hole will be made a means pattern or the core

will be made of the 52 mm, if we have to provide the machining allowance on the internal surface.

On the other hand, if it is to be provided on the external surface the extra model is to be provided. So, 110 plus external surfaces 2 mm, this side 2 into 2 to the vertical sides and similarly for this 50 plus 2 into 2, so here it will be 54 this dimension and this dimension are will be 114 mm after providing the machining allowance. So, in case of the internal features like holes the dimension of the hole will be reduced to provide the extra material, so that it can be machined out during the machining and while in case of the external surfaces it will be added to the dimensions on the external side. So, the basically the size of the pattern will be increased while in case of the internal surfaces size of the pattern or size of the core will be reduced to provide the extra material to the internal surfaces, so that during the machining it can be taken care of.

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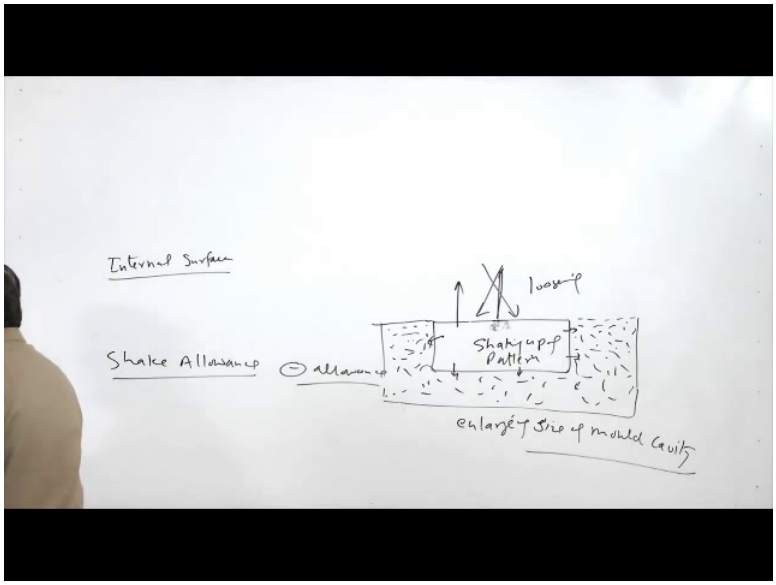

Then coming to the draft allowance oh sorry it is not draft allowance, the shake allowance, basically shake allowance is the negative allowance. We know that to understand this we need to just see the simple thing like when the pattern has been packed the flask. So, after proper ramming of the sand around the pattern, we need to take out the pattern. So, this packing actually ramming of the sand around the pattern will be leading to the firm gripping of the pattern with the mould. So, when we take it out to in order to take the pattern out of the mould, we need to loosen it. So, for

loosening purpose, we have to shake it. So, basically hammering is done, light hammering is done using the mallet that is the wooden hammer little bit hammering is them sideways, so that the pattern inside the mould can be loosened. So, once the pattern is loosened it can be taken out of the mould without damaging the vertical surfaces.

So, when shaking up of the pattern is done when shaking up of the pattern is done basically it moves the walls vertical walls as well as the horizontal walls slightly away by enlarging the size of the mould cavity. So, basically due to the shaking of the pattern in order to loosen it into the mould, so that it can be taken out easily without damaging the internal features as well as surfaces, the shaking leads to the enlargement of the size of the cavity. And that is why if you have to consider this aspect then the pattern needs to be made of the little bit is smaller in size as compare to what is needed in the final size of the casting. So, basically this is negative allowance. And based on the experience the suitable value of the negative allowance or the shake allowance is given.

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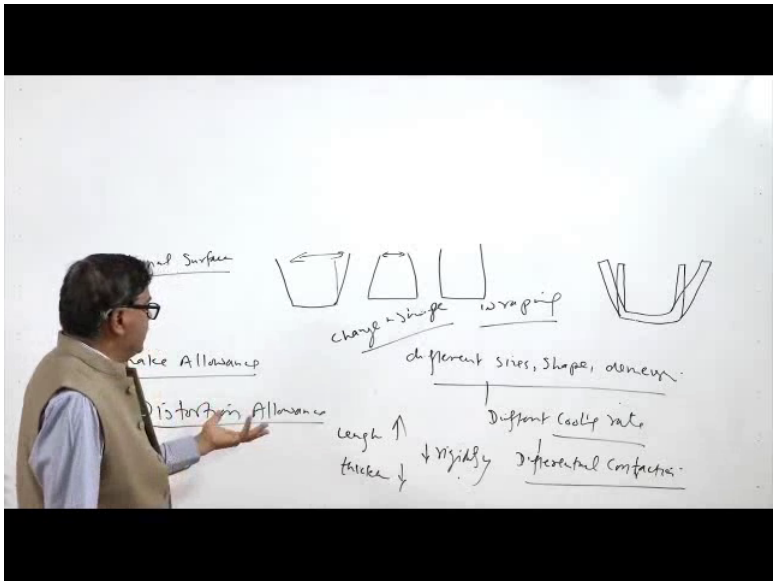

Last is now distortion allowance. Distortion allowance, actually when the molten metal solidifies and after the solidification casting is starts to cool down from the high temperature to the room temperature. Since the castings have the different sizes, shapes, dimensions, so this difference in size, shape and dimensions leads to the different cooling rates in the different zones of the casting. So, the different components or different parts of the castings may be may be cooling at the different rates. So, differential cooling leads

to that differential contraction also, differential contraction or we can say differential shrinkage.

So, this differential shrinkage especially when the length of the section is will high and the thickness of the section is less means the system is less rigidity. So, under such conditions differential cooling rate and differential contractions leads to the undesirable change in shape of the casting which basically appears in form of rapping of the casting or the casting getting out of the shape. So, like say if we have to make the U shaped product then the vertical surfaces of which are not that rigid, these may go outward or these may go inward. So, according to the tendency of the custom, we need to make we need to give the opposite dimensions; if the vertical surface is getting outward then in the pattern is made by giving some negative features, so that after the shrinkage it gains the only the shape which is desired. So, since it was going outward, we will be making the negative allowance; in this case it means that the pattern is modified in such a way that after the shrinkage you get the casting of the desired size.

So, basically depending upon the tendency of the distortion or the independent depending upon the way by which the casting shape is getting distorted, the suitable provision is made, so that the shrinkage can be used favourably in order to get the casting of the desired size and shape. So, for that purpose distortion allowance is given.

So, now, I will summarize this presentation. In this presentation, I have talked about the four types of the allowances and these allowances are incorporated suitably in the pattern, so that the final casting of the desired size and shape can be achieved.

Thank you for your attention.