Principles of Casting Technology
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Lecture – 23
Riser Design
Risering methods- II

Welcome to the lecture on Riser Design, in this lecture we are going to further discuss another method for calculating the riser volume. So, we are going to discuss about the shape factor method. It is also known as naval research laboratory method.

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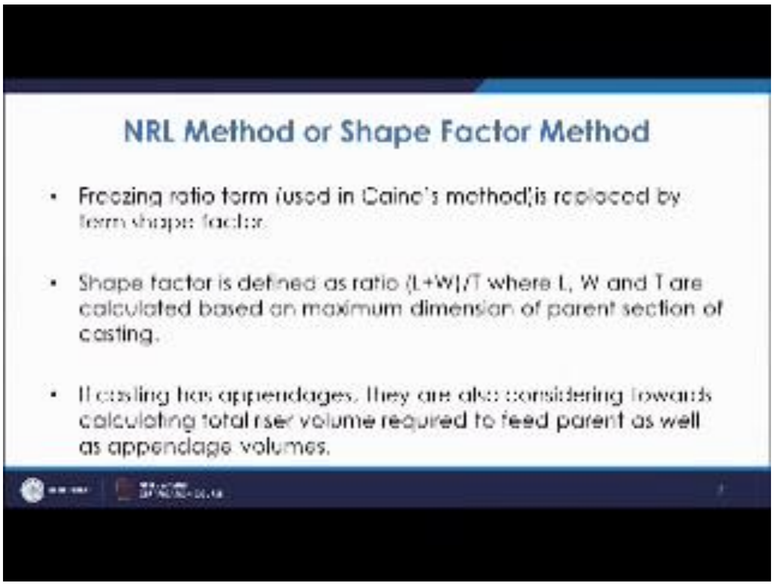

So, here we are going to use this parameter shape factor. Now what we have seen earlier the method which was proposed by Caine's in that basically you had to calculate the freezing ratio and because of that you need to solve an equation and based on the value of the solution of the equation you are you can come at the results.

And that is somewhat complex. So, there has been an effort to somehow simplify the approach. So, this naval research laboratory method was suggested, in that basically on the x axis I mean in place of this freezing ratio this L plus W by Term T that is known as shape factor this was used. Now L plus W by T if you look at this T is the thickness and L plus W that is length plus width. So, basically if the thickness will be larger it will be a chunky casting, if the thickness will be a smaller it will.

So, based on that you know it is freezing characteristics, will change. So, in that what we do is first of all we calculate the L plus W by T, that is the shape factor of the casting and then based on the curve which is proposed against that L plus W by T value you get in the y axis, you have the volume ratio that is volume of riser to volume of casting and from there you can directly get the volume of riser which is required to feed certain casting. This T is basic and all these dimensions L W and T they are based on certain maximum dimension of the parent section of the casting.

So, once you have the dimension of casting, then you can first calculate the shape factor and based on that you can get the volume ratio of the I mean ratio of the volume of riser to casting and based on that volume of riser can be found out; this was the graph which was suggested, as you see this is the length plus width upon thickness.

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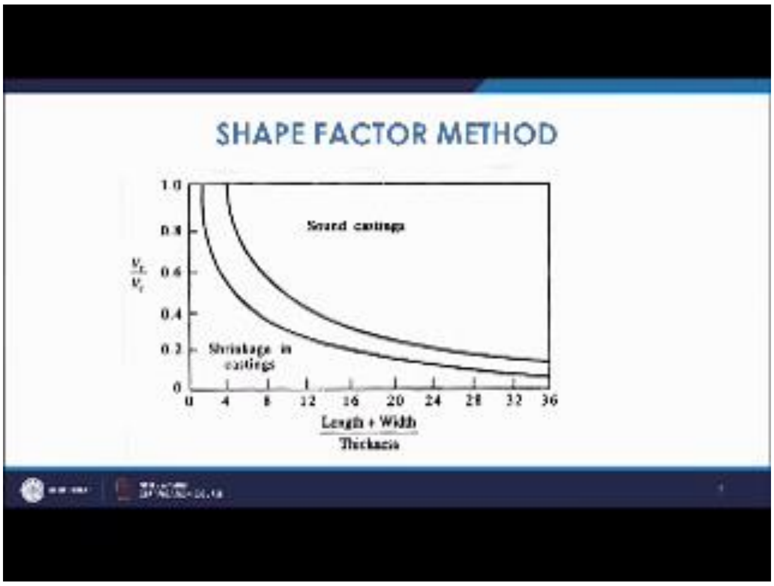

So, once you get this length plus width upon thickness value, based on this value you have this. So, you will come here these 2 line so the lower and the upper limit. So, basically you have because in between the experiments were done and the findings were found out, the readings were in this zone that is why this is shown by 2 lines and many a times you will have a single line. So, that single line will be showing the value of V r V c with respect to any particular value of length plus width by thickness.

Now, what we do further? Now what happens? This can be done for simple shaped castings, now what happens in this method you have another advantage because many a times the appendages are attached.

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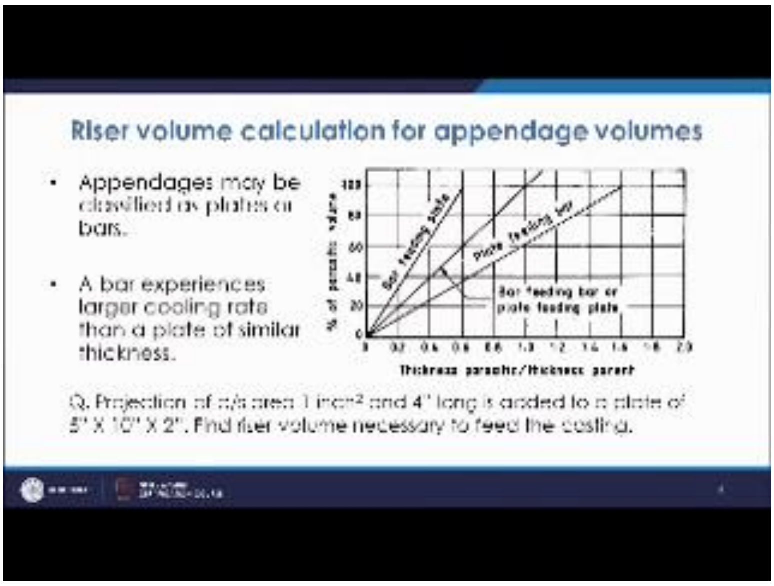

So, you may have a casting and in that there may be certain volumes which are adequate and the parent casting basically feeds the metal to that appendage. So, these appendage volumes they are also known as parasitic volumes. So, in this method if suppose these parasitic volumes are very thin then in that case there is no need to specify extra material in the riser to account for that particular volume.

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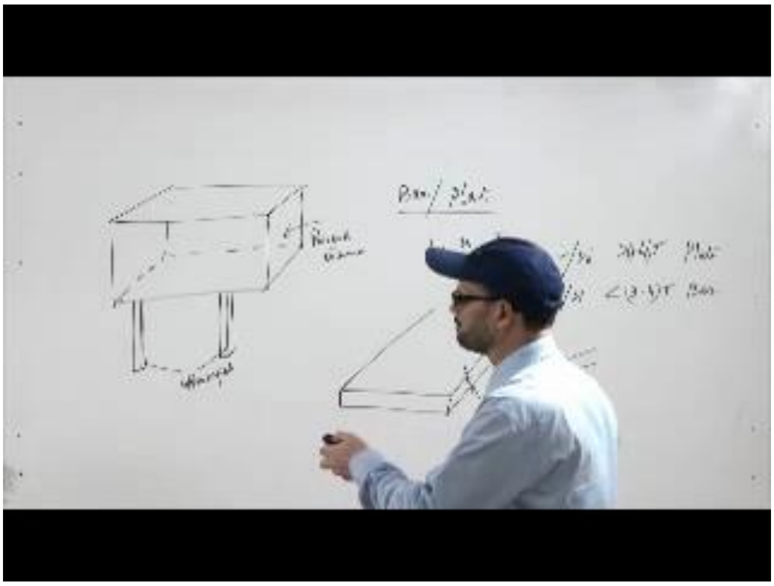

So, suppose you have a casting like this and this is the main casting. So, this is your parent casting and if suppose you have few volumes are attached to it, suppose these are the 2 volumes which are attached to it. So, what happens this is your parent volume and these are known as appendages, because now in this when we cast this material you need certain volume of the riser to feed this and to see that there is no shrinkage while casting this component.

Now, if there is a projection to this casting in this form there are thin surfaces, if there are very thin components in that case it does not require much of the material and there is also no problem of having any shrinkage; however, if they are not thin, if they are dimensions are considerable, in that case you need to supply certain extra material when you try to give the riser dimension for this particular casting. So in fact that has also been proposed in this particular method.

So, now these appendages they are normally classified as bar or plate. So, what is bar or what is plate? So, normally you have length, width and thickness. So, it is seen that if length or width is more than 4 times the thickness or many a times it may be 3 times the thickness. So, 3 to 4 you can say, if it is more than 3 or 4 times the thickness then you call it as a plate and if length or width is less than 3 to 4 times thickness, then it is known as a bar.

So, this is normally defined somewhere you may find it is 3 times and somewhere it may find it as 4 times. Now we have to calculate what amount of volume of metal extra will be required, when you calculate the riser volume for this parent casting and you have to incorporate for this. So, what we do is now coming to the point of this bar and plates, what happens? A bar basically has the cross section where the thickness and width is smaller and it has larger length whereas, a plate has larger length and width and very small thickness. So, normally what happens in the case of bar it has 4 effective surfaces from where the heat extraction takes place.

So, the larger area exposed is there from where the heat transform can take place, that is why a bar is experiencing larger cooling rate then a plate of similar thickness and that is why a bar requires a smaller amount of feed metal to a count for the shrinkage. So, that is why because if you look at a bar it will be like this, you will see that for this, for such bars now in this type of sections, what happens? All these 4 sides they contribute towards the heat transfer whereas; in the plates this thickness is quite small. So, in the plate basically normally you will have the thickness very small and then this length and width will be quite. So, this will be thickness, where as in this the thickness is this much.

So, what happens in this case in the case of plates, effectively you have only 2 surfaces from where the heat attraction taking place. So, for the same amount of metal if you have same amount I mean thickness given, then in that case the plate experiences I mean in that case the heat extraction from the plate will be lesser as compare to that for the bar. So, that is why the bar is experiencing a larger cooling rate in the case of these appendage volumes.

Now, how to calculate this riser volume, which will be enough to feed these appendage volumes? So, for that you have been given this graph, what this graph tells that you are given suppose a parent casting and this one is the parasitic volume, now in that case first of all you calculate the riser volume necessary for this parent casting. So, the step will be to calculate first the riser volume for the kept parent casting.

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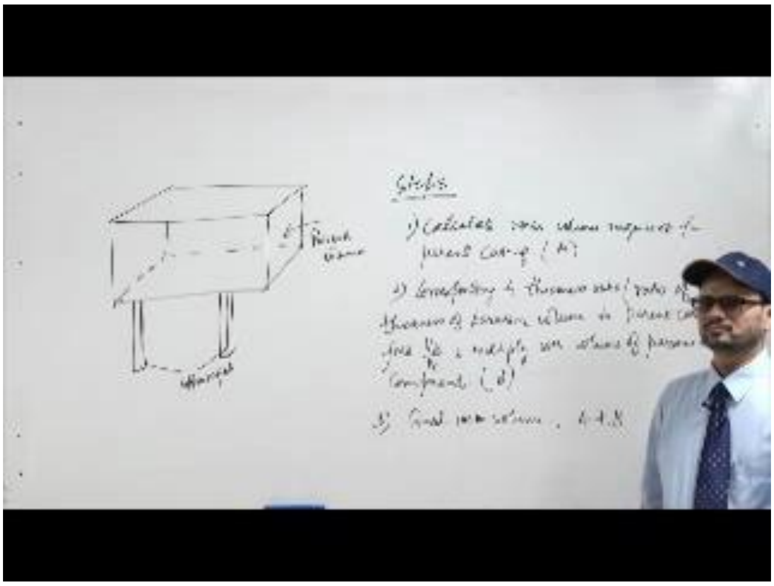

So, steps first calculate riser volume required for parent casting. So, you have to find using the shape factor method first of all for this casting you will try to find what is the riser volume required. Then you will see the ratio of the thickness of the parasitic volume to thickness of parent volume and once you get corresponding to thickness ratio, thickness ratio you nothing, but ratio of parasitic volume thickness to the parent casting thickness.

So, corresponding to this thickness ratio, that is ratio of thickness of parasitic volume to parent casting. So, once you get this thickness ratio, find V r by V c and multiply with volume of parasitic component, basically this is A and this is B, A is the volume of that material of for the riser, which is required for feeding this parent casting, then you get the volume of all the appendages and corresponding to this thickness ratio get a percentage volume from here that is percentage of parasitic volume and that is multiplied with this parasitic volume and that basically gives you how much is required for feeding the appendage volume.

So, final riser volume will be A plus B. So, once you get that, you get the final riser volume and then based on the condition like what kind of riser you wants in (Refer Time: 14:25) riser with either s equal to d or s equal to 2 d or whatever condition you can find the riser dimensions. So, this is how the requirement of metal for the appendage volumes can be met using this shape factor methods.

Let us solve a problem for such cases and that problem is shown here, the problem is that a projection of cross sectional area 1 inch square and 4 inch along is added to a plate of 5 inch by 10 inch by 2 inch. So, find the riser volume necessary to feed the whole casting.

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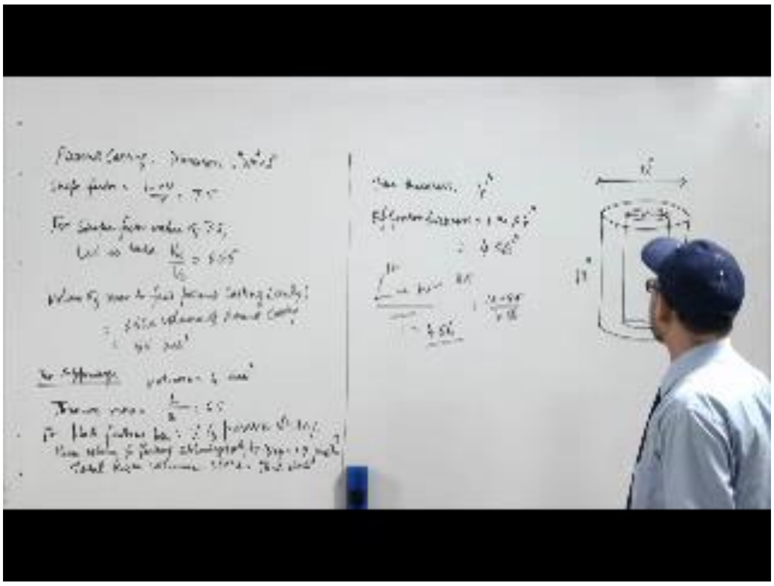

So, in that basically you have parent casting has dimension of 5 inch by 10 inch by 2 inch.

So, what we have seen is we have to find first the riser volume required for parent casting. So, we will use the shape factor method, now once we use the shape factor method in that we need to find the shape factor for this parent casting. So, shape factor will be L plus W by T. So, L and plus W that is 15 upon 2. So, that is 7.5. So, you have to refer this table and corresponding to this value of 7.5 here. So, we get this 7.5 at this point and this point will go and we will have a point basically these 2 lines are normally represented by a single line. So, we will have to have a point somewhere in between in the center of these two. So, may be that it is somewhere close to 0.55.

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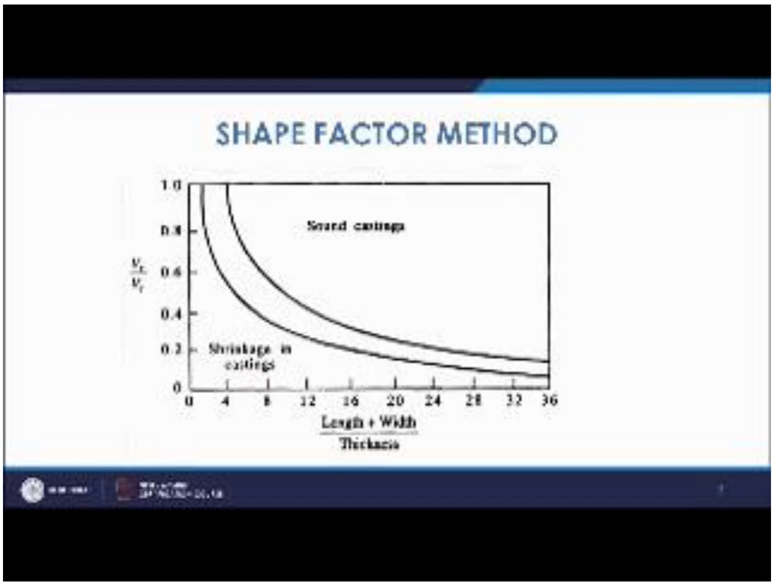

So, if you take 7.5, it will come close to this place, may be close to 0.55. So, if for shape factor value of 7.5, let us take V r by V c as 0.55. So, if we take this value as 0.55 in that case the volume of riser to feed parent casting alone will be 0.55 times volume of parent casting. So, volume of parent casting is 5 into 10 into 2. So, it is 100 inches cube. So, it will be 55 cubic of inches. So, this is the volume which is required for feeding the parent casting that is this. Now we have an appendage and this appendage has the dimension of 1 inch square and 4 inch long.

So, for appendages the volume will be the cross sectional area multiplied by it is length; it will be 4 inches cube. Now what we have to do is we have to find the thickness parasite by thickness parent that is thickness ratio. So, for this case we have to calculate the thickness ratio; thickness ratio will be thickness of the parasitic volume that is given as one inch because it is cross section is 1 inch by 1 inch. So, it is cross section is 1 inch thickness is 1 inch. So, 1 divided by thickness of the parent casting was 2 inch, so by 2 this is 0.5.

Now, in this case if we are taking it as a plate. So, in this case if we take it as a plate. So, the situation is that it is a case of plate feeding bar, now if we take this curve plate feeding bar, this is the curve of plate feeding bar and we have a thickness ratio of 0.5. So, corresponding to this 0.5 of thickness ratio this is cutting the curve at this point that is around 30 percent. So, for plate feeding bar, we have percentage of parasitic volume is given as 30 percent, which is from the graph we are calculating. So, riser volume for feeding appendage only will be basically 30 percent of it is own volume.

So, it will be point 3 times 4, that is 1.2, 1.2 inches cube will be extra of the metal which is required to ensure that, after feeding the parent casting the metal is available even for taking care of the shrinkage if it occurs in that appendages volume. So, that is why the total riser volume will be this will be 55 plus 1.2. So, that will be 56.2 inches cube. So, this is how you can calculate the total riser amount which will take care of the shrinkage in the parent casting as well as in that appendages whichever is attached to the main casting; many a times we also come across certain shapes which has the reassess in the center portion that is hollow cavities.

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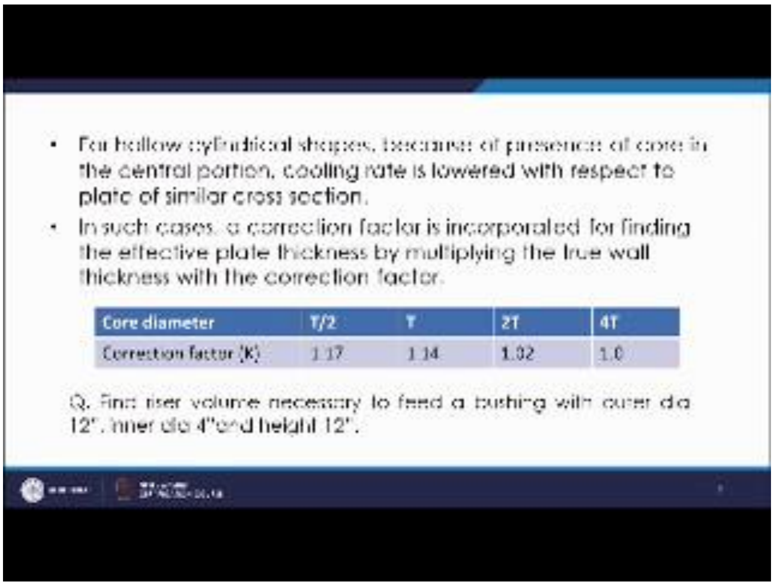

So, in those cases like hollow cylindrical shapes, basically we have the cavity is there. So, if that is taken care of by the presence of core in the central reason; now this core basically is posing a problem that is basically lowering the cooling rate because that is not an exposed portion and from there the heat extraction rate cannot be expected. So, in such cases, there are certain corrections which are incorporated for finding the effective plate thickness by multiplying the true wall thickness.

So, what happens in such cases, depending upon the thickness of the plate and depending upon the core diameter? So, if the core diameter is 3 by 2, the effective plate thickness will be 1.17 times the true thickness of the plate. So, this is given as a correction factor in such cases. Now what happens we can see that how to calculate in such cases the volume of riser metal required. So, in those cases suppose in this case you have the riser volume required for a bush with auto diameter 12 inch inner diameter 4 inch and height 12 inch. So, what we see here is in these cases, if you see you have to find first of all the correction factor.

So, this correction factor now we have to see what will be the correction factor? Now correction factor is for here while calculating the correction factor, we have to find, this is your volume and this is the inner dimension. So, the outer diameter is given as 12 inch, and inner diameter is given as 4 inch. The thickness actual thickness, so true thickness is 12 minus 4 upon 2 that will be your 4 inch.

Now, you have to see what will be the effective thickness? So, for effective thickness or the core diameter is what is the function between core diameter and the thickness? So, from the table if you look at core diameter is 4 inch and your thickness is also 4 inch. So, for this when the core diameter is equal to T your correction factor is 1.14. So, effective thickness becomes 1.14 times 4 inch.

So, effective thickness becomes 4.56 inch. So, basically the 4 inch of thickness because of the presence of this central portion where the core is located, that effective thickness of the plate becomes 4.56 inch because there is no cooling surface on the inner side basically it is like a heat source, which is heated and it is basically I mean it is deteriorating the heat transferred taking place from this particular section. So, in that case now we can have the L plus W by T. So, then the procedure is followed in the same fashion you will find L plus W upon T. So, L plus W upon T and now for this case the length is 12 inch or height is 12 inch. So, L can be taken as 12 inch.

The width you can have like you have 4 inch in this portion and this is 12 inch. So, you can have the average of this diameter as 8 inch. So, for that you will have the perimeter that is pi into 8. So, this will be 8 pi this will be 12 and this thickness is 4.56. So, based on this once you calculate, this will be 12 plus 8 pi by 4.56 that will be your shape factor, corresponding to this shape factor we have to calculate the V r by V c value from here. So, once we calculate the V r by V c from here, then we can directly multiply that with the volume of this particular geometry and that factor when multiplied with the volume of the geometry will give you the actual reading of the metal required.

Now, calculation for piping type of side riser; now what happens in many cases you need to have a riser calculation based on the pipe being formed. So, what happens in those cases that we need to understand what the piping type of riser is?

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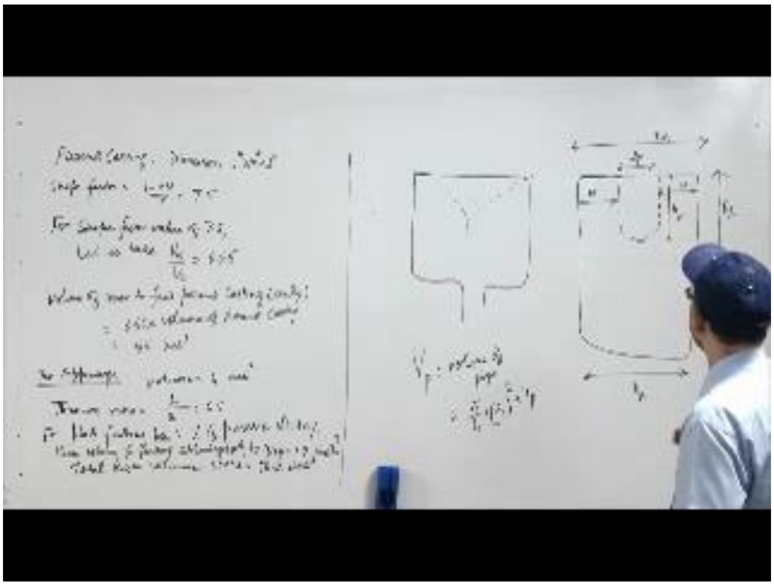

Now as we know when we have a riser. So once we have a riser and suppose this was the top portion of the riser.

So, what happens you can depending upon the feeding, you will see that it will feed the liquid metal in this fashion and this is known as the pipe and this will be nothing, but the volume of metal which has gone into the casting and that is basically because of the shrinkage. So, once you know the feed metal percentage or the volumetric shrinkage depending upon the volume of the casting, you can have this volume of the metal which has gone into it or from the riser itself when the pipe is formed by pouring water into it and finding the volume of the water, you can find the volume of metal which has gone to account for this shrinkage.

And once you are basically getting this volume, now that will be the volume of. So, you can find a piping type of riser. So, that piping type of riser is designed like this. So, what happens once you get this volume of the pipe, this is volume of pipe, now this volume of pipe will have will be based on there will be pipe formation. So, for these this will be the height of the pipe and this will be the diameter of the pipe. So, basically this volume this will be nothing, but the volume of this particular cavity and that will be pi by 4 into d p square into h p. So, h p to d p ratio can be we having something may be closed to 2.5 or so, it is normally taken, based on that you have this dimension.

Now, this is the diameter and basically this is the neck portion which is connected to the. So, this is the diameter of the riser d r and this is also the diameter of the riser this is d r. Now these values d r known as the width values. So, basically there are values taken for this v w and based on that this piping kind of riser is designed in certain cases and it has been proved to be effective in certain type of castings in the foundry industries, normally for malleable iron castings this method has been proved to be very effective while calculating the riser dimension or riser shape and size.

So, this is known as the calculation of riser size based on this piping formation and based on that we calculate. So, we have understood how to calculate this riser sizes by the conventional methods we have discussed about the 3 methods and then also for a piping type of riser.

Thank you.