Principles of Casting Technology
Dr. Pradeep K. Jha
Department of Mechanical and Industrial Engineering
Indian Institute of Technology, Roorkee

Lecture - 25
Risering Design
Problem solving on riser design

Welcome to the lecture on Problems solving on riser design. So, in this lecture we will solve the problems based on calculating the riser volume by different methods. So, let us take the first question.

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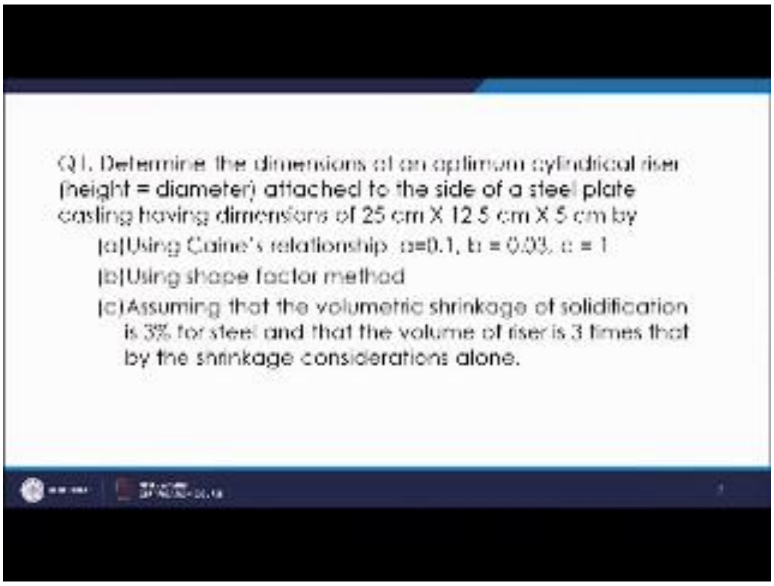

The first question is determined the dimensions of an optimum cylindrical riser, whose height is taken as diameter, attached to the side of a steel plate casting having dimensions of 25 centimetres by 12.5 centimetres by 5 centimetres. So, the dimensions is given of the plate which is to be cast, and we have to find the size of the cylindrical riser, that is side cylindrical riser and first method is by which you have to find is using Caine’s relationship, and we know that the Caine’s relationship is nothing, but x equal to a by y minus b plus c.

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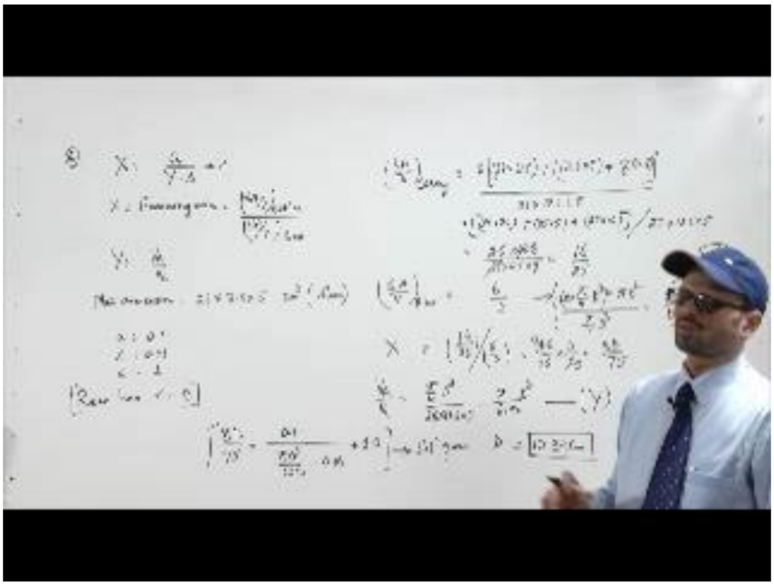

So, Caine's relationship is x equal to a by y minus b plus c, and a b and c is given, where x is the fazing ratio. So, that is surface area of y volume of casting, upon surface area upon volume of riser. So, and then y is volume of riser upon volume of casting. So, that is known as volume ratio that is ratio of the riser volume to casting volume, plate dimension is given. So, plate dimension is 25 by 12.5 upon 5 multiplied by 5 that is centimetre cube. So, this is the volume how the plate.

Then we will find, now we have been given A as 0.1, B as 0.03 and C as 1. So, we have to calculate this x and y. So, let us calculate first the x. So, freezing ratio, for that you have to find surface are volume of casting. So, if find S A by V of casting it is nothing, but surface area of this plate. So, it will be 2 times 25 into 12.5, plus 12.5 into 5, plus 25 into 5 upon volume of the casting. So, that is 25 into 12.5 into 5. So, it will be 25 into 25, plus 25 into 5, plus 25 into 10. So, every term is multiplied by 2, upon 25 into 12.5 into 5. So, you can have 25 in all this terms. So, 25 plus 530 plus 10 40 divided by 25 into 12.5 into 5. So, this will be cut. So, it will be 40 by 50, so 4 by 5. So, that is by mistake it is not 5 basically, it will be 40. So, this will be 8. So, it will be 16 upon 25, which will be 16 upon 25.

Next is surface area by volume of riser. So, if we take the optimum cylindrical riser and the side riser, in that case a riser which as 2 surfaces at the top and bottom acting as a surface which is extracting the heat, which is basically realising the heat, as well as the curves surface. So, for that basically what we get is 6 by d, because it comes from the fact that for h is equal to d. Now we have riser as height equal to d this is the condition. So, for height equally to d, it will be surface area is nothing but pi by 4, d square is the curve surface area plus. So, this is 2 times, no this is the top surface area. So, 2 times pi by 4 d square plus pi d into d. So, that is pi d square, and this will be divided volume that will be pi by 4 d cube. So, in this way this will be 6 by 4 d square, divided by pi by 4 d cube. So, that will become as 6 by d. So, this 6 by d we have got, surface area were volume of the riser that is optimum size and say the cylinders which as both the surfaces realising the heat from here also from here also.

So, we got this. So, in that case we get the freezing ratio x as surface area were volume of casting. So, that comes as 16 upon 25 divided by, surface areas were volume of riser that is 6 upon d. So, it will be 16 upon 25 into d upon 6. So, it will be 8 d upon 75. So, what we see is, we are getting for this dimensions x and y. Now we have to put this in this particular equation, no, one more thing is left that is y that is volume of riser upon volume of casting. So, volume of riser that is pi by 4 d cube, and volume of casting is given as 25 into 12.5 into 5. So, it will be pi upon 25 into 4 that is 100 into 12.5 into 5. So, 12.5 into 5 is 62.5 into 100 that is 6250 d cube, so this is what is the volume ratio.

So, we have calculated this is nothing, but the value volume ratio that is y, and this is x. Now we will substitute this values in this equation, x equal to a by y minus b plus c. So, it will be 8 d upon 75. So, x is freezing ratio, that is 8 d upon 75, that will be equal to a upon a is 0.1, upon y minus b, y is pi d cube by 6250 minus b, b is given as 0.03 plus 1. So, this the equation which has to be solved and this can be solved by aeration methods, may be by trial and error methods, and ones you solve this equation by trial and error methods, solution gives d as 10.89 centimetre. So, using Caine’s method and provided this values of a b and c, we get the diameter of the riser as 10.89 centimetre, and height also is the same as the diameter, and this dimension riser a cylindrical riser is sophisticate to feed a plat casting of 25 centimetre, by 12.5 centimetre, by 5 centimetre and this will use this Caine’s method.

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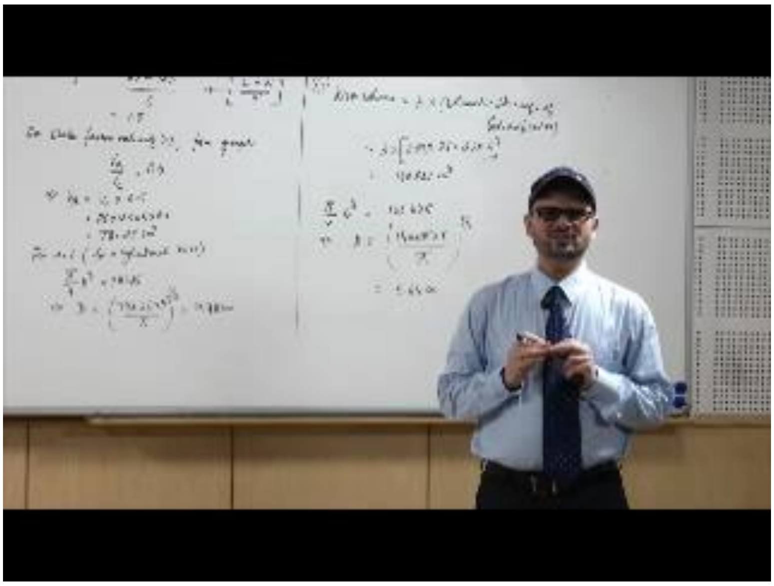

Now we will solve the b part. So, b part is using the shape factor method. As will know in the same factor method, in place of freezing ratio we evaluate the term shape factor, and shape factor is nothing, but the ratio of length plus width and the thickness. So, for that we will calculate the shape factor of this casting, and shape factor comes out to be length is 25, plus width is 12.5, upon thickness is 5, it is nothing, but length plus width upon thickness; social factor is find as that, and this is coming out to be 7.5. Now from this shape factor, using the curves given for this shape factor method, we can directly calculate the V r by V c, now for that we had to refer to this curve.

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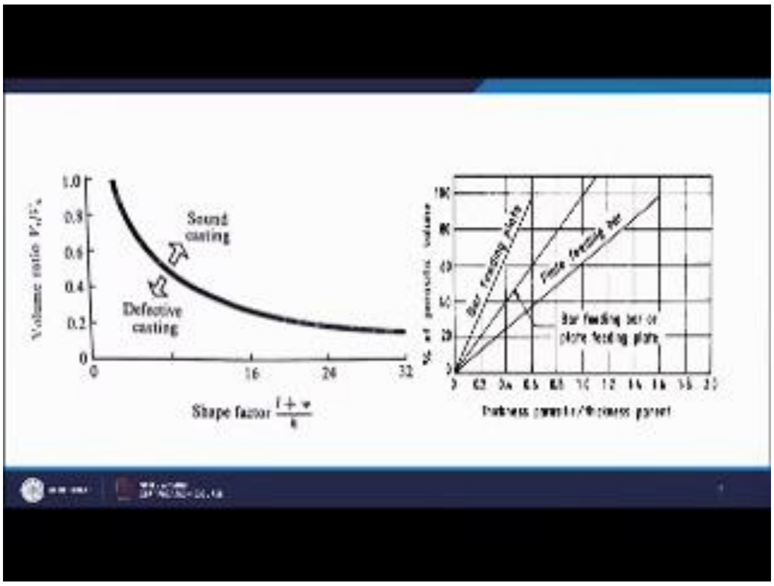

So, if we take the value of 7.5; it will be some were close to this point, and if we go further up it will be some were coming close to 0.5. So, near to this value of 0.5, you can take as the volume ratio. So, for shape factor value of 7.5 from graph V R by V C can be taken as 0.5. So, that is this is very at much clear from here, this will be going up and at this point if you draw the horizontal line, it will be coming close to this. So, that is 0.5, it means V R will be V C multiplied by 0.5. So, V C is 25 by 12.5 by 5 into 0.5. So, this can be calculated and 25 multiplied by 12.5 by 5 by 0.5. So, it will be 781.25 centimetre cube.

So, for this you have to calculate the size of the cylindrical riser, this is the volume of cylindrical riser with h equal to d. So, it means for h equal to d, for a cylindrical riser, volume will be pi by 4 d cube, and that is calculate out to be 781.25. So, d will be calculated as 781.25 into 4 upon pi, raise to be power 1 by 3, and this we can get into 4 divided by 3.14 and its rise to be power 1 by 3. So, that comes out to be 9.98 centimetre. So, what we see is, using the shape factor method the diameter of this riser can be calculated out to be 9.98 centimetres, as well as the height of this riser. So, using the shape factor method we calculate this dimensions like that.

Next part is assuming that the volumetric in case of solidification is 3 percent for stein, and that volume of riser is 3 times that by the shrinkage consideration alone. So, if we assume that the riser volume will be 3 times, the volumetric shrinkage of solidification. So, volumetric shrinkage percentage is 3 percent. So, in that case, the riser volume will be 3 times the volumetric shrinkage of solidification. So, it will be nothing but 3 times volumetric shrinkage is percentage of shrinkage, multiplied by the volume of the casting. So, it will be percentage is 3 percent. So, it is 0.03 times, 25 by 12.5 into 5. So, you have to multiple that and that will be 3 times 0.03 into 25 into 12.5 into 5. So, that comes out to be 140.625 centimetre cube.

Now, for this if you calculate, this is the volume of the riser which we thing on that consideration, if we assume that simply 3 times the shrinkage volume will be enough to feed the casting, and will not cause any shrinkage that will be sufficient for prevention of any shrinkage, in that case it is 3 times that shrinkage volume. So, that is coming out to 140.625, and if the diameter of the riser to be found, it will be pi by 4 d cube is 140.625 and d can be taken as 140.625 multiplied by 4 upon pi, and raise to be power 1 by 3 and this can be taken as 140.625 into 4 upon pi, and raise to be power 1 by 3. So, that is 5.64 centimetre.

So, what we see is, if we take simply the shrinkage consideration and we assume that the 3 times the shrinkage amount will be enough to feed the casting, and will be sufficient to prevent the shrinkage it is 5.64 centimetre, in this case it is 9.98 centimetre, and in earlier case already we have calculated using the Caine’s method (Refer Time: 19:30) 0.89 centimetre. So, these are the different ways of calculation of the riser dimension by the different methods.

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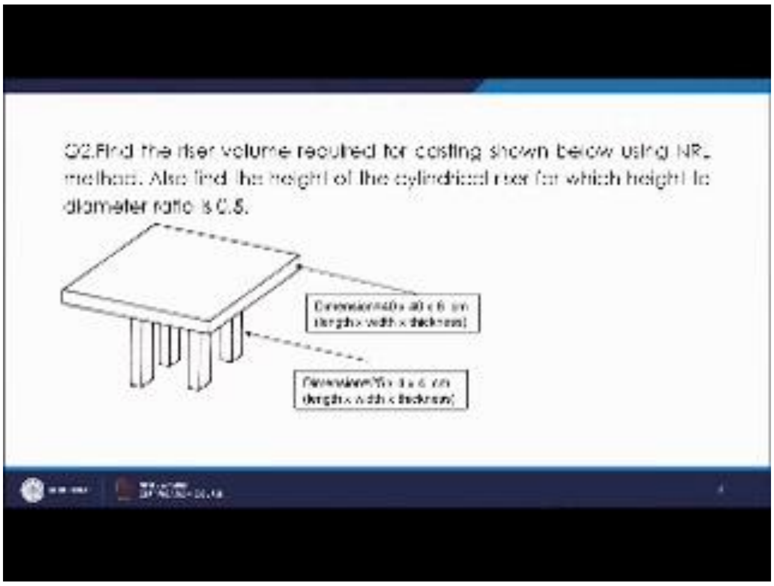

The next question is find the riser volume, require for casting shown below, using NRL method. So, NRL method is nothing, but the shape factor method itself, also find the height of the cylindrical riser for which height to dia ratio is 0.5. So, in this case what we see is, you have a parent casting that is in a form of a plate and it has the dimension of 40 by 40 by 8 centimetre, and to these attached are the 4 legs or the table, and they are taken as they can be considered as the appendence volumes. So, these are the bars, which are the cross section of 4 by 4 and length of 25 centimetres.

So, in this case you have to 2 things to do, one is to find the raiser volume for feeding this plate casting alone which is the top of the table, and then you have to calculate the volume of riser which as to be extra given for compensative the shrinkage which may occur in this 4 appendices volume, for that you have give the extra metal in the riser. So, in that case first of all.

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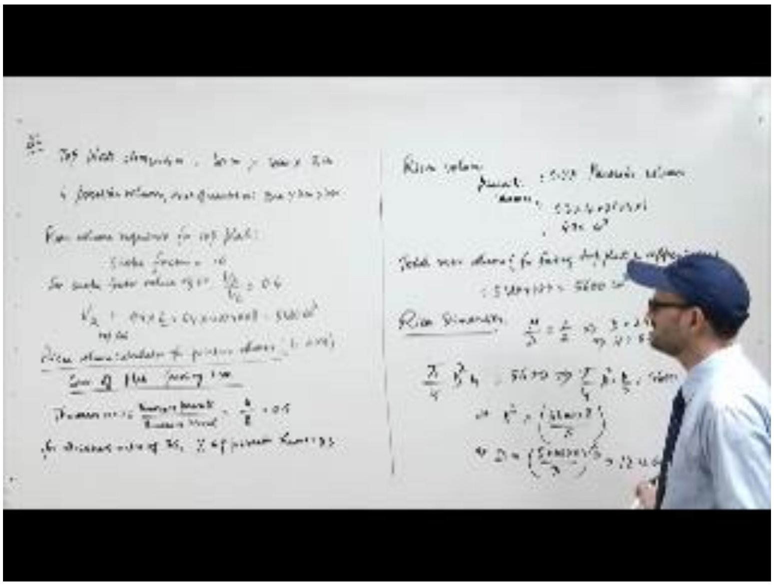

So, in this case you have the top plate, top plate dimension. So, this is question number 2, top plate dimension is 40 by 40 by 8 centimetre, and the 4 parasitic volumes or appends volumes, each of dimension it is given as 25 into 4 into 4.

So, this is the case, first of all for riser volume required for top plate. So, what we do in these cases is first of all we find there is volume for the top plate using the shape factor method. So, shape factor method is l plus w by t. So, l plus w is 40 plus 40 80 by 8, 10. So, for the shape factor value of 10, we will go to the graph and we have to see what is the value of the volume ratio; so if you take here the value of 10, and if you come from here forward, it is coming to close this point which is corresponding to the volume ratio of point 4. So, for shape factor value of 10 V R upon V C is given as 0.4, once we have 0.4 as the V R by V C, it mains V R that is riser requirement for the top plate. So, you can write here top plate will be 0.4 times volume of the casting, and volume of casting will be 40 by 40 by 8. So, it will be 5120 centimetre cube.

So, this riser volume is required for feeding that top plate. Now we are have 4 appendence volumes, now in this case the situation is that there is feeding of the plate by the riser, feeding by the plate and feeding to the bars. So, these are the bars because their cross section is 4 by 4. So, they are bars. So, now, riser volume calculation for parasitic volumes, the 4 bars are taken as that is 4 bars. So, 4 bars are taken as considered as the parasitic volumes, now for that what we see is, this is the case of plate feeding bar because the man parent casting is in the form of plate, and this is feeding this bars. So, this is the case of feeding bar. Now in that case what we see in the graph is that the x axis is thickness parasitic that is known as thickness ratio. So thickness ratio that is nothing but thickness parasitic by thickness parent; so thickness parasitic is given as 4 centimetre, and this is given as a 8 centimetre. So, it is 0.5.

Now, for this the case resembles to a plate feeding bar, and the plate feeding bar is this curve, this curve is bar feeding plate this plate curve is plate feeding bar, and this curve is bar feeding bar and plate feeding plate, and this case being of the plate feeding bar. So, we have to see corresponding to the thickness ratio 0.5, we have to find where that percentage of parasitic volume comes out to be. So, for this, for thickness ratio of 0.5, if you see here, and if you go to curve in the middle, this is 0.5 and it will go like this. So, it will be plate feeding bar. So, here is a touch here at this point and this is nothing, but 30 percent. So, this is 30 percent, it goes from 0.5, it touches this bottom line at this point this is 30 percent. So, percentage of parasitic volume is given as 0.3.

So, in that case, the riser volume for the parasitic volumes, it will be 0.3 times parasitic volumes, and parasitic volume is there are 4 bars and each having this dimension. So, it will be 0.3 times 4 times 25 into 4 into 4. So, it will be 400 into 4600, 1600 into 0.3, that is 480. So, 480 centimetre cube is the contribution which is required for feeding these 4 appendence volumes. So, total volume, total riser volume for feeding top plate and appendences or parasitic volumes, it will be 5120 plus 480, it will be 5600 centimetre cube and from there you can find the volume of the cylindrical riser.

Now, volume of cylindrical riser the condition is given is that, height to their ratio is point 5. So, riser dimension, height to dia is given as 0.5 so 1 by 2. So, d will be 2 h or h will be 2 d 0.5 d. So, pi by 4 d square h will be 5600 that is pi by 4 d square into h is d by 2. So, d by 2 is 5600, and you can calculate d q as 5600 into 8 upon pi raised to the power 1 by 3. So, this way so this is d cube and you can calculate d as 5600 into 8 upon pi raise to be power 1 by 3. So is coming up to be 12.12 centimetres.

So, this is the diameter of the cylindrical riser and height will be certainly it will be d by 2 half of this, and this will be the size of the riser to feed such castings, which has the plate as well as the appendence volume. So, this is the how we calculate the riser volumes required for feeding such castings.

Thank you.