Principles of Casting Technology
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Lecture - 24
Riser Design
Feeding Distances

Welcome to the lecture on riser design, in this lecture we will discuss about the Feeding Distances. So, as we have understood that riser has to feed the liquid metal into the casting riser is also a casting in itself. So, riser will also solidify in the long run; as the casting solidifies the riser will also solidify. Now how the riser will behave how I mean we have discussed about the shape and size of the riser by different methods. Now when we are going to cast, different type of castings so, different shapes of castings and particularly when we are going for plate or bar shape of castings, how to place this riser so that you know that these many risers will be enough for feeding the metal. So, riser placement is important.

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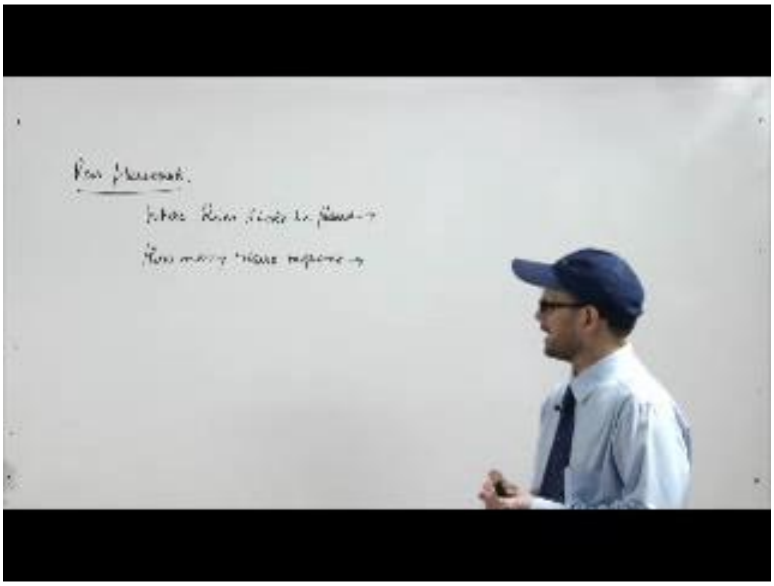

So, riser placement; now how many risers to be placed and where are the risers to be placed? These are important in the context that where it should be placed. Now first of all, all this risers or runners or gates, they are basically not desirable as far as the productivity is concerned. So, larger will be the size of the riser or larger will be the number of the risers, they are going to basically decrease the yield of the casting. So, we have to use the riser in an optimum way so that wherever we put the riser, it should be used effectively and in the sense that riser will have certain capacity to feed the liquid metal up to certain distance, I mean the riser if it is placed at some point it can ensure that it can feed the liquid metal coming into a zone of suppose x inches or x centimeters. So, that will be the distances up to which the riser can contribute and that is known as riser contribution.

Now, the thing is that where to be placed. So, first of all there are certain rules when we talk about non uniform type of casting then we certainly see that riser should be replaced somewhere which should be somewhat the chunky part so that there the maximum chances of shrinkage is there but when we talk about the cross section like either plates, or bars then we need to know that where it should be placed; for that also if we try to know how many risers are required. So, for this we have to know that if we place one riser up to what distance it can feed.

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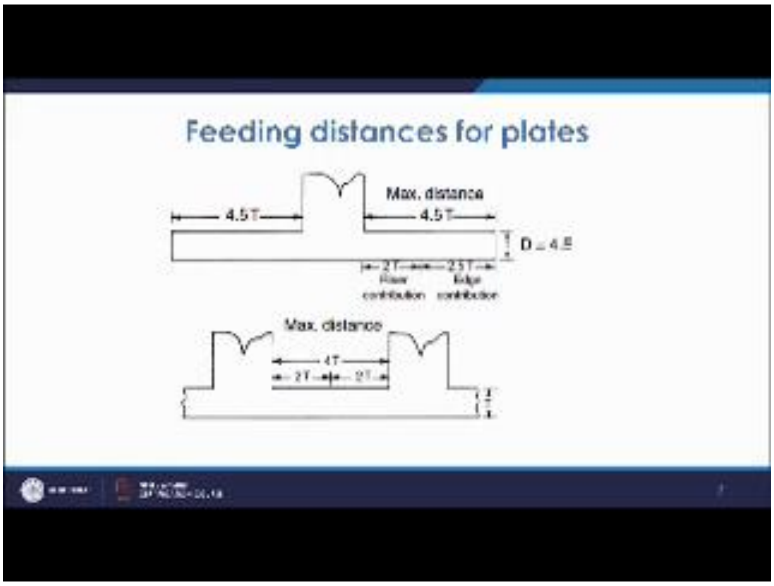

So, that distance is known as feeding distance. So, we will discuss about the feeding distance is in case of risers and the geometry been either the plates or the bars. Now let us discuss about the plates.

So, what we tell that how many risers will certainly depend, that what is the dimension of the longitudinal dimension of the product that is the casting and what is the basically distance up to which a riser can feed. Now if we take this casting, it is a plate type of the structure. So, in this case what we see is the distance which is shown this is basically the maximum distance which it can feed, that is 4.5 T. T is the thickness of this plate. So, this is the feeding distance for this plate, now in this case you have 2 things one is the riser contribution and another is the age contribution.

Now, riser contribution means the riser will be able to see that there is not at all any shrinkage in this portion because up to this distance the riser will be feeding the liquid metal this is known as the age contribution. So, we have understood that when we discussed about the directional and progressive solidification, then we had discussed that when the metal is poured and it will come towards the end, then at all these places where it is touching the walls, solidification will start and it will move towards the inner part of the casting. So, that is all basically a part of a type of solidification known as progressive solidification. So, at this point when this riser comes towards the end, in this end basically it has the end effect.

So, this portion additionally is exposed to the mold wall. So, you will have solidification starting at that particular point as well as it will solidification will start from all these points; now because of this end point and because of this being the side, from here the certification will move and it will see that up to certain distance you cannot see and will show that there will not be any shrinkage effect shrinkage I mean problem. So, that is why the distance up to which because of this age, these shrinkages are not likely to come that is known as the age contribution. So, what we see is that maximum distance which it can feed is composed of 2 parts; one part is riser contribution, another part is age contribution. So, altogether it comes out to be 4.52, out of which you have to 2 T as the riser contribution and you have 2.5 T has the age contribution.

Now, let us see how many risers to be placed. Now if we see that the distance is more than that you will have to place more number of risers. So, if suppose there is a large plate having large length and in that case if you places this 2 risers, we know that the riser contribution is 2 T. So, between these 2 risers, this riser will be able to feed up to this point, so it will 2 T and this riser also will have its riser own contribution that is 2 T. So, the maximum distance between the risers, the placement of the 2 risers has to be the 2 T.

So, this how you try to place that many member of risers, so that you see that there is no possibility of any shrinkage. If you have even larger you will have to accordingly decide the number of risers at different points, certainly the size of the riser you will determine earlier and based on that you will say that at these locations the risers are required because this will be the riser contribution and towards the end where this portion will have end and towards that end you will have a space of 4.5 T because there are you will have certainly the riser contribution as well as the end contribution.

Next is that when we used the chill, now what happens in many cases that you have used the riser and you have certain riser contribution, but very small portion is left. Now, in that case placing a riser placing an additional riser is the solution, but it is not an economical solution. So, the practically what we do is, we try to see that the end contribution what we are getting, whether we can get somewhat more end contribution like sort of things, so that some extra portion do not required the riser or there is no possibility of having any shrinkage in certain extra sections. So, basically chills are designed, we have discussed about chills and chills are basically those materials which normally aid in the extra solidification.

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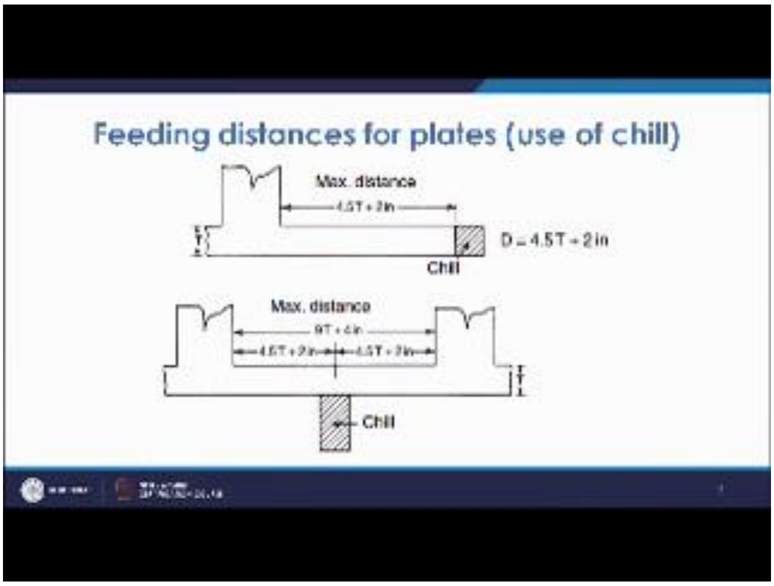

So, what is the chill is basically a material of higher conductivity, which extracts heat at a faster rate. So, what we do is we use the chills, now if we use the chills, this chills will be certainly giving certain extra space over which the chances of shrinkage will be less.

So, in that case it is seen that in case of plate castings, when we provide the chill this 4.5 T which was there earlier without the use of chill, this was increased by 2 inches. So, this 2 inch is the basically the contribution because of the presence of this chill. So, this is known as chill contribution and that is 4.5 T plus 2 inch is the maximum distance with a riser and also a chill, with riser also has the riser contribution you will have the age contribution and you will have 2 inches as the chill contribution.

So, that is why that is how use of chill is instrumental and beneficial towards the end you can have the chill or in way even in between the casting, suppose you have 2 risers and you see that some 2 or 4 inches are left. In those cases what we see here if you have 2 risers we are putting, in these cases you are providing a chill in that case what we see is your 4 inches come out to be provided by this presence of chill. So, these are the formulas which basically can be applied to find what will be the effective feeding distance for the case of plates with or without the use of chill.

Coming to another kind of section that is bars, so I we know that in the bars we have the all the cross sectional areas, they are all effectively active in transmitting the heat from the surface. So, it has somewhat different feeding strength as compared to that of the riser. Now in the case of bars when we see the maximum distance by a riser which comprises of the riser contribution as well as the age contribution, it is coming out normally to be 6 roots T. So, this is the 6 root T is the total distance maximum distance which is can cover because of the pressure of riser as well as because of the age, out of that 1.5 T to 2 T is basically because of this is 0.5 T. So, 0.5 T to 2 T is basically because of the riser contribution and 1.5 T to 2 T is because of this age contribution.

Now, in this case what we see that, if we provide these 2 risers we see that this will be further multiplied. So, you have 0.5 T to 2 T and 0.5 T to 2 T. So, both this 2 T will be on both the sides. So, basically it will vary from 1 T to 4 T. So, this you have 2 risers 2 riser contributions will be seen at these 2 points. In the similar fashion once we go in the case of bars and we use the chill, in those cases what we see is because of the chill you get T as the extra distance up to which the feeding is not required. So, this apart from the riser and the age contribution this T will be the distance up to which the contribution will be provided by the chill and you do not require a riser up to that much distance to feed any extra material and similarly if you have the use of chill in the central portion, you will have T and T both side. So, you will have to 2 T of extra distance up to which you do not require the riser to supply the metal that shrinkage calculation or shrinkage amount will be taken care of by the presence of the chill. So, this is how this feeding distance is varying and based on the section or based on the dimension you can design or you can think about the placement of risers at different positions.

Now, let us discuss about the riser neck dimensions, how we should design this riser we know that once we calculate the size of the riser basically we certainly by default we feel that normally we make the cylindrical type of riser and we specify certain condition, based on which like h equal to D or h is equal to 2 d, we get the diameter of the cylindrical riser as well as the height of the cylindrical riser. Now this riser has to be connected to the casting. So, the riser where it connects to the casting at that place you must have the adequate design because any way riser has to basically be cut off from the casting. So, that portion has to be typically in such a way that is does not pose much of the problem when we try to cut it. So, that portion where it is connected is known as the riser neck and there is particular design for this neck dimensions.

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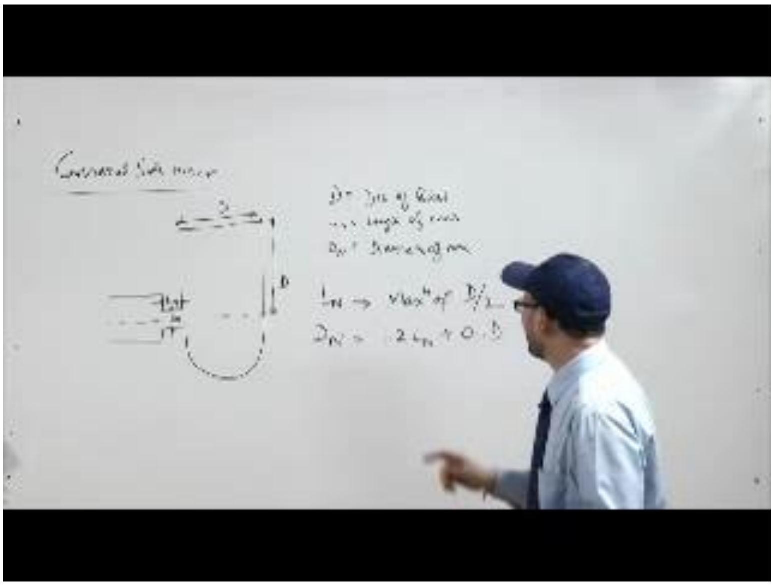

So, let us see how this riser neck can be designed. So, for a general side riser what we see is, this is a general type of side riser, this is the diameter same as this is D then this portion is known as the neck portion of the riser. So, this neck this is known as the length of the neck LN. So, LN is the length of the neck, this is the diameter of the riser. LN is the length of the neck; this portion is known as the neck of the riser where it is connected to the casting. So, that is known as the neck of the riser. So, this is length and this is known as the diameter of the riser, 9 diameter of neck should DN is diameter of the neck. So, what we see is this diameter this diameter this is the length and this is the diameter of the neck. Now first of all LN it is taken as maximum of D by 2. So, what we see is the length of this neck has to be taken maximum of D by 2 and the diameter of the neck it will be one point 2 LN plus 0.1D.

So, once we get this D it will maximum of D by 2 and then once we get LN we get the DN. So, this way we design a general type of side riser for this particular casting, next will be a type of top riser, in case of top riser the dimensions are straightly different.

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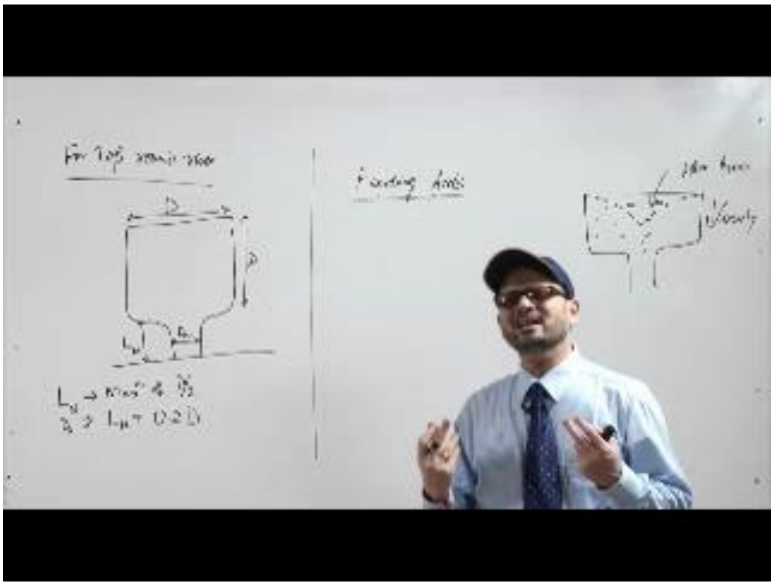

So, for top round riser, top round riser lock looks like. So, this will be the length of the neck and this will be the diameter of the neck, we are discussing a riser with height equal to diameter, so both these dimensions are equal to the diameter. Now in this case again LN will be maximum of D by 2 and D N will be LN plus 0.2 D. So, these are the 2 kind of riser which are normally used in practice either side riser or a round riser that is a top riser and in those cases once we know the diameter of the riser, you can design this riser in this following way like you have the length of the riser neck, diameter of the neck and this is these are the diameters. So, based on these conditions you can design a particular riser.

Now we have feeding aids, what are the feeding aids? The feeding aids means that somehow those materials which should reduce the volume of the riser, you know feeding requirement is there feeding requirement hardly 3 percent to 4 percent or 5 percent, but since riser also part of the casting a riser has to be larger than quite larger than that particular volume and larger will be the volume of the riser, so larger will be or smaller will be the productivity or the smaller will be the yield of the product. So, that is why we try to minimize the size of the riser.

Now what are the challenges in a riser? So, in a riser what we have discussed that is turn normal riser basically when it feeds the metal, the metal is experiencing the pressure one is the atmospheric measure and another is the gravity force. So, under these 2 forces the riser is basically feeding the liquid method. So, one is atmospheric pressure and another is gravity. So, because of these 2 forces, the riser is able to feed the liquid metal into the casting. Now the thing is that if this surface becomes solid is solidified is does not remain in liquid state in that case that atmospheric pressure will stop working and would because of the gravity, if the since there will be formation of vacuum so feeding will be difficult.

In those cases what we do is, if we try or suppose in normal cases if you take a certain volume of the riser to be sufficient for feeding certain casting, how to see that it is basically you can reduce the size of that particular riser. The thing is if you can induce a condition because of which the liquid metal into this riser remains in liquid state for larger duration of time, then in that case you can thing of having riser of smaller size. So these feeding aids are the ones which are used for keeping riser in the liquid form more time.

So, the compounds which are used to keep this liquid metal into aid, in liquid state for larger amount of time that is known as feeding aids. Now for that either you can use the exothermic material at the top. So, when you use the exothermic material at the top, they basically react and they produce the heat and the because of that heat this portion remains hot for longer duration of time. So, once the heat is generated then that will be help in converting, if suppose the temperature has dropped little bit if there will be isothermic reaction that will increase the temperature locally and that will further convert the solid state into the liquid state.

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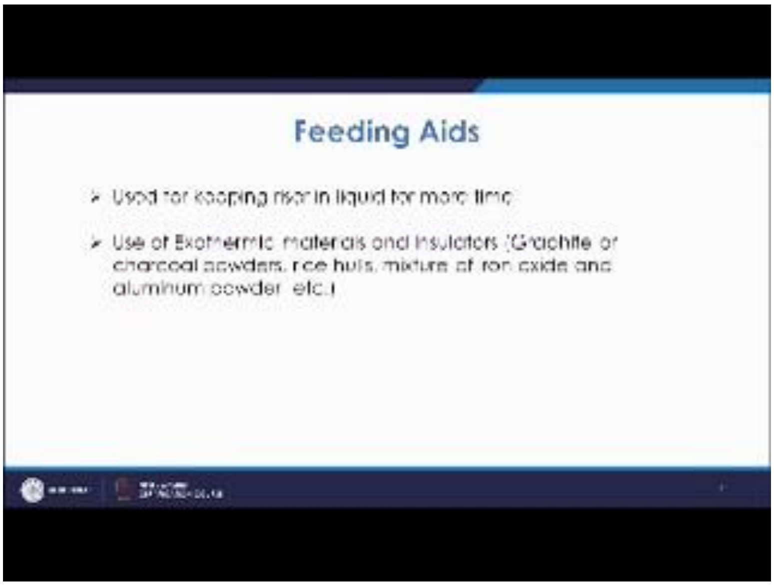

So, once you use the exothermic reaction at this point, now that can be done by adding certain compounds like Fe2O plus al exothermic mixture which is there, if you use that the reaction between them is an exothermic reaction. So, this mixture is put here and then you will see that they react they release the heat and because of that heater released this material, this portion remains in liquid state for larger amount of time. Similarly you can also do the covering, you can basically cover it or you can basically make it adiabatic there is no heat transfer. So, you can use some insulators, so once you use the insulators basically they will stop heat transfer from that surface.

So, that also helps in basically reducing the heat transfer to the surroundings and the riser will have the liquid state for larger duration of time. So, these are the 2 ways the use of exothermic materials and the use of insulators. So, in that process we use either the graphite or charcoal powders, you may use the rice hulls which they are basically they are the compounds carbonaceous compounds also they react and they keep that in liquid state for larger amount of time, mixture of iron oxide and aluminum powder that is the mixture which is used as the compound which reacts and releases a large amount of heat, so this way your now for that what happens they will effectively reduce the size of the riser.

So, ultimately that helps in reducing the size of the riser, which otherwise would have been larger. So, if you do certain means by which the liquid will be for larger amount of time in liquid state, then in that case you can reduce the size of the riser and that will improve the productivity of the process casting process. So, these are known as feeding aids. So, by and large we have to see that how can we minimize the number of risers, also how can we reduce the volume of the metal in the riser these are our main aims and we should see that how can we move towards increase the productivity of this whole casting process.

Thank you.