Soil and Water Conservation Engineering
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Lecture – 39
Drop Inlet Spillway

Hello good morning, today we are going to study the week 9 lecture that is Drop Inlet Spillway.

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So, drop inlet spillway here we are going to cover the introduction part the Spillway Design, here some problem will come and the followed by solving of Numerical Problem then Drop Inlet Spillway Design II and then the design problem. So, these are the lectures we are going to cover in this particular chapter.

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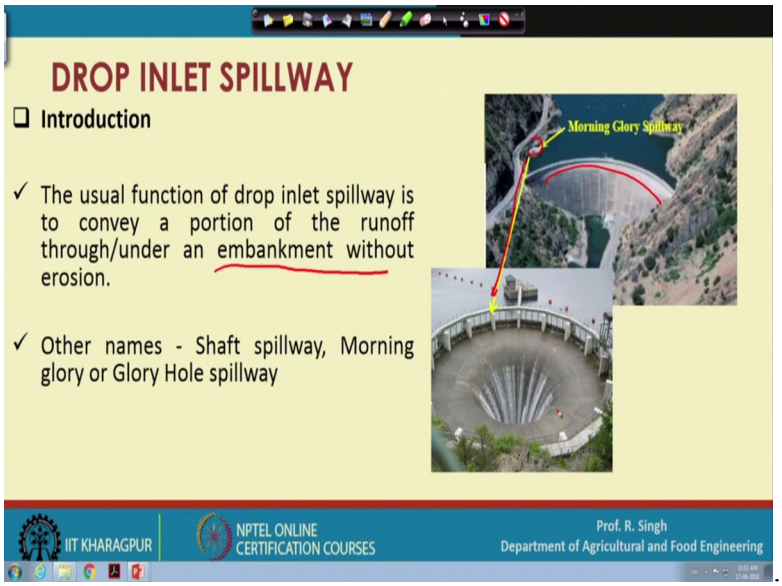

So, what is drop inlet spillway? So, drop inlet spillway is a kind of spillway where the function is to convey the portion of runoff through or under the embankment without any erosion.

So, this is the portion of the runoff which is carried through or under the embankment without the erosion and there are some other name of this drop inlet spillway are shaft spillway, morning glory or glory hole spillway. So, here you can see this is the portion of the dam and here a morning glory spillway is located. So, this is in a small version and then if you go through inside of this, so, you can see how the water spills through here and enter inside the morning glory spillway. So, this is the kind of structure in a drop inlet spillway.

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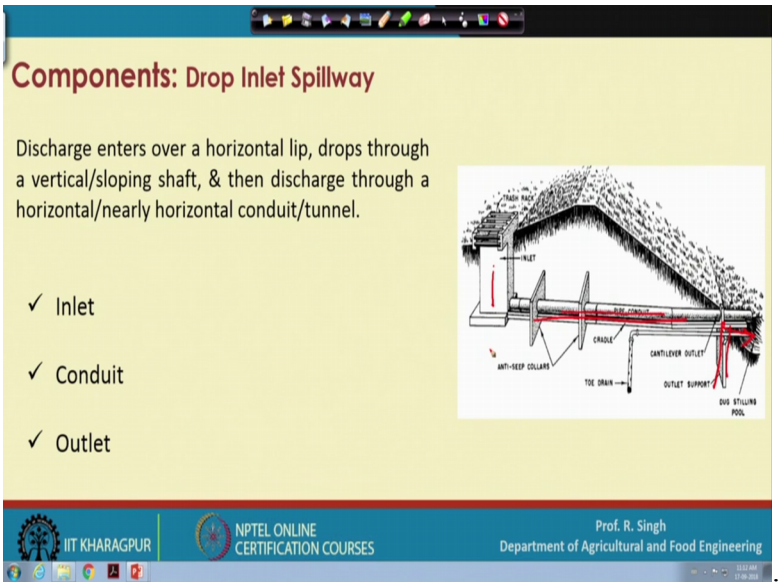

So, there are three basic components of drop inlet spillway; one is inlet, conduit and the outlet. So, what happen here? The discharge enters over a horizontal lip drops through a vertical shaft and then discharge through a horizontal or nearly horizontal conduit and tunnel. So, here three are the basic component of this drop inlet spillway. So, here the inlet is located and then it flows through a conduit, a pipe conduit and then discharge is through outlet. So, here the outlet point. So, these are the three basic component of this spillway and in the following chapters we are going to design this each of this component. So, these are the basic components of this spillway structure.

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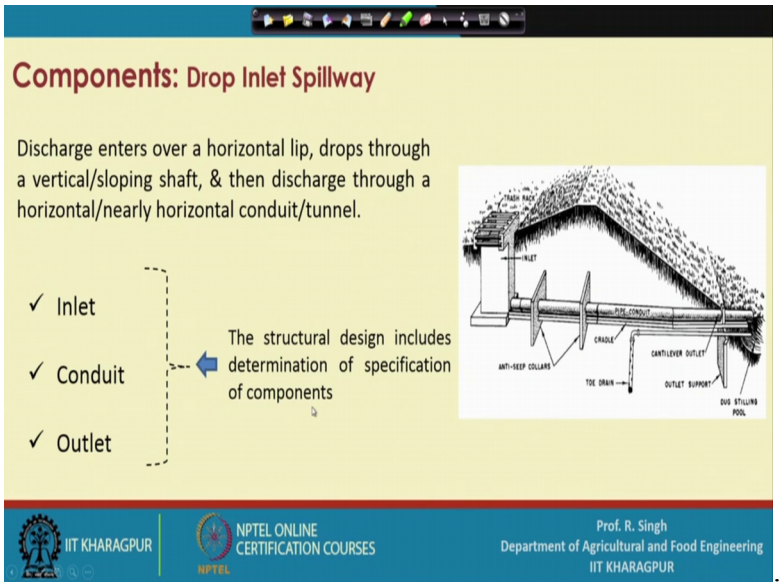

Now coming to the design, the structural design include that is determination of the specific components as I described earlier.

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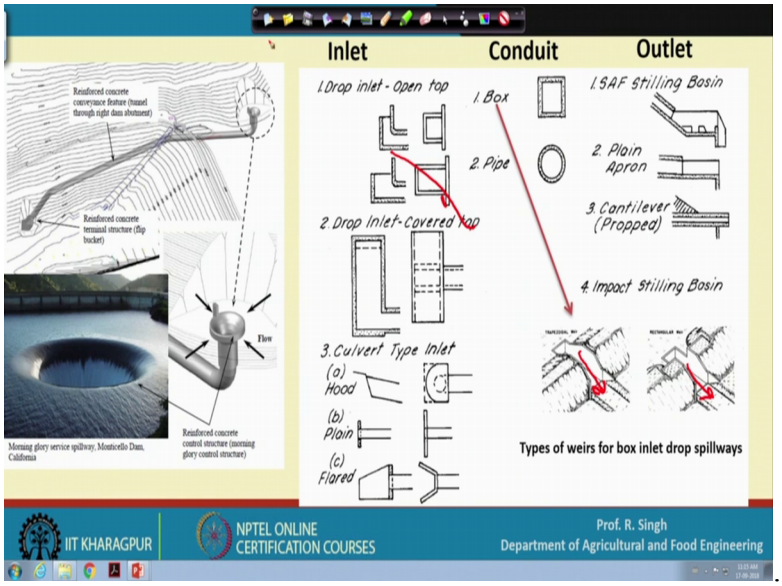

So, this is a drop inlet spillway. So, here you can in the left side you can see a morning glory service spillway. So, this is in one of the structure located in Monticello dam in California and here you can see the reinforced concrete conveyance feature or the tunnel through the right abutment of the dam. So, from here the morning glory spillway takes the water here and then it goes here. So, here the flow of water takes place and these are

the reinforced concrete control structure or the morning glory structures, where the water enters and then it conveyance through the pipe or tunnel.

So, these are the three basic component as I described in earlier slide; so, inlet conduit and outlet part. So, drop inlet the open top, so this can be of any shapes; so, these are some basic shape, so, where the top is kept to be open. And if it is a covered top, so, here the inlet cover top and these are the culvert type inlet. So, here the water enters here so, hood, plain and a flared kind of structure. So, these are three basic structure for inlet design and then the conduit. So, conduit can be of two kind; so, one is box conduit and another could be a pipe conduit. So, cross sectional shapes are provided here from the plan view. So, since it is a box entrance, so this box is created and the pipe structure, so, it is a circular structure.

And in from the cross sectional view you can see these are the trapezoidal weir is located and this is the box conduit here you can see the conduit structure. So, this is the box conduit structure over there and this is a pipe conduit structure this is located also pipe. So, these are some of the basic structure and then going to the outlet position. So, outlet has a three different kind, so it can be the SAF or stilling basin kind of outlet or the second kind could be plain or apron kind of and third could be cantilever kind of. So, these are the three basic outlet structure in the drop inlet spillway.

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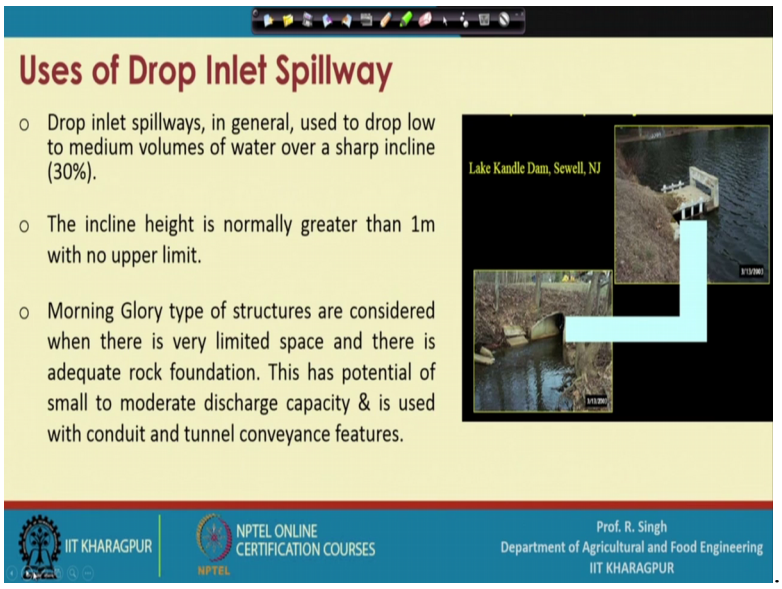

So, what are the basic uses of this spillway structure? So, these are in general used to drop low to medium volume of water over a sharp incline structure. So, you can see here so, this is a kind of drop inlet spillway structure is designed here over the lake Kandle dam in New Jersey. So, here this is a drop of medium volume of water and this is located this is a in cross sectional front view and this is the plain or the exceed view of this structure and the incline height is normally greater than 1 meter with no upper limit. So, these are the basic drop inlet structure.

However, in case of morning glory type of structure these structures are considered when there is a very limited space and there is adequate rock foundation. So, this has the potential of small to moderate discharge capacity and is used with conduit and tunnel conveyance features. So, these are kind of drop inlet spillway that is morning glory kind of structure is only used when there is a limited space and there is some adequate rock foundation is available.

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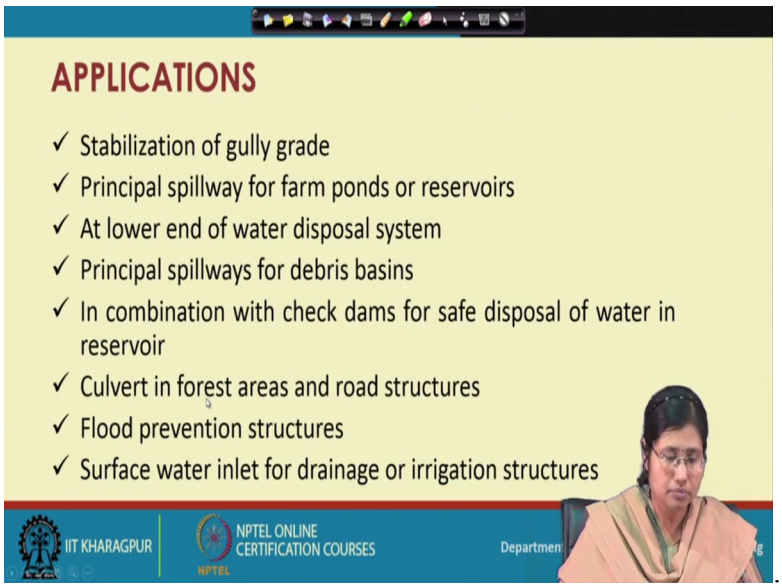

So, now coming to application of drop inlet spillway in general; so, there are many application. So, first is stabilization of gully grade second is principal spillway for farm ponds or reservoir and third is at lower end of water disposal system. Principle spillways for debris basins, fifth in combination with check dams can this can be used in combination of check dam for safe disposal of water into reservoir and sixth culvert in forest areas and road structures, flood protection structures, surface water inlet for

drainage or the irrigation structures. So, these are some basic applications of drop inlet spillways.

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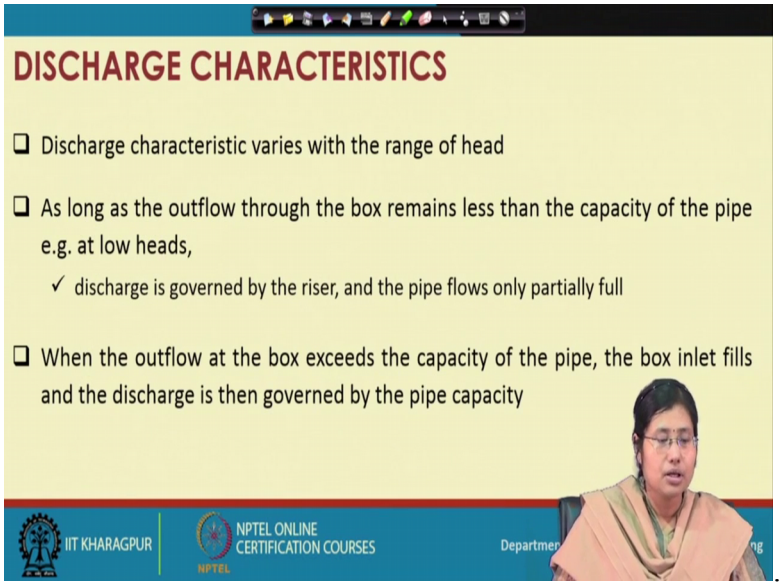

Now, coming to discharge characteristics, discharge characteristics varies with the range of head, second as long as the outflow through the box remains less than the capacity of the pipe example, at low heads. So, discharge is governed by the riser and the pipe flows only partially full. Third when the outflow at the box exceeds the capacity of the pipe the box inlet fills and discharge is then governed by the pipe capacity. So, these are some the special some of the discharge characteristics.

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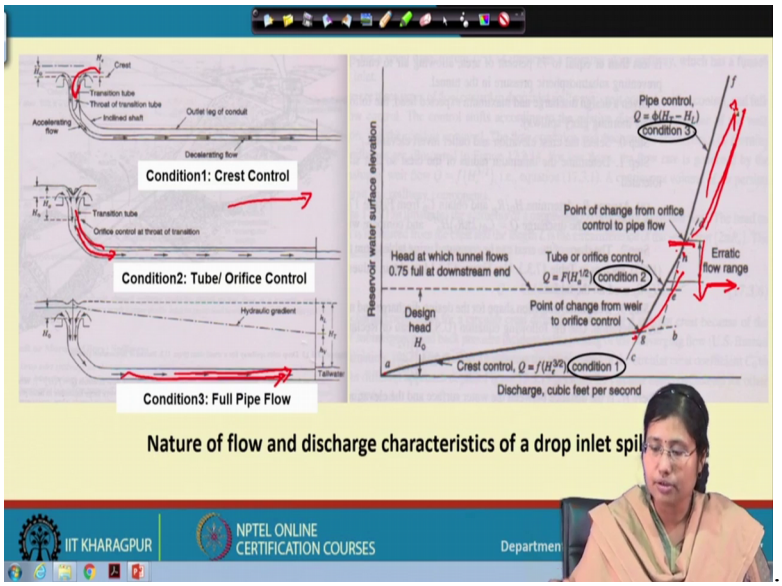

And now this particular figure shows the nature of flow and discharge characteristics of drop inlet spillway. So, here in the flow of drop inlet spillway; so, three condition prevail. So, first is condition 1 that is a crest control, when the water enters through the crest and the second is when it flows through the tube or the transition phase when tube or orifice control takes place and the third is the full pipe flow conditions, so, which is the last part.

So, here so these are the reservoir water surface elevation versus the discharge characteristics curve of the drop inlet spillway. So, here, so coordinate starting from a to g the condition one prevails, that is the crest control prevails until the coordinate a to g.

Then coordinate g to h the tube or orifice control prevails until the coordinate g to h and the third part or the last part the full pipe flow begins beyond h. So, whatever flow goes beyond the coordinate h as you can see here, there is a erratic change flow distribution at this range and beyond the coordinate h there is a full pipe flow condition prevails. So, these are some of the basic discharge characteristics.

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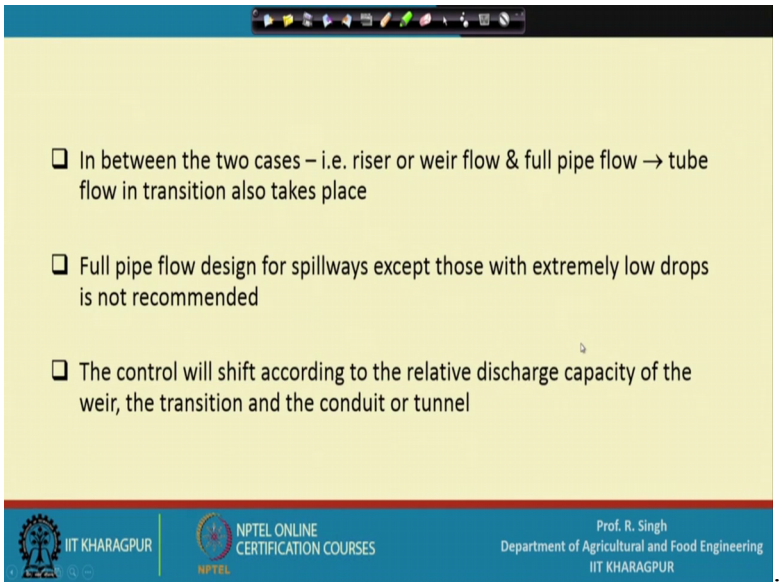

Now, in between the two cases that is riser or weir flow and the pipe flow tube in that case the tube flow in transition also takes place. And Secondly, full pipe flow design for spillways except those with extremely low drops is not recommended and third the control will shift according to the relative discharge capacity of the weir, the transition and the conduit or tunnel.

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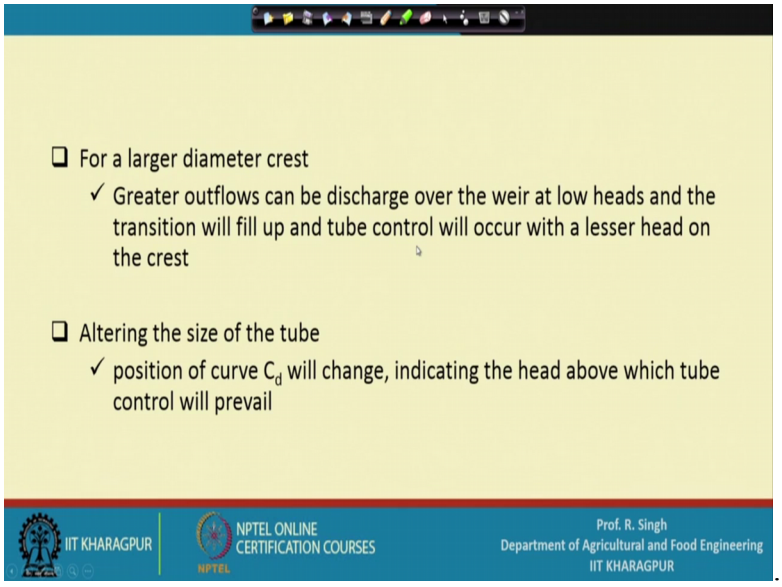

Now, for a large diameter crest greater outflows can be discharge over the weir at low heads and the transition will fill up and tube control will occur with a lesser head on the

crest. Now, altering the size of the tube the position of curve C d will change, where c d is the coefficient of discharge indicating the head above which tube control will prevail.

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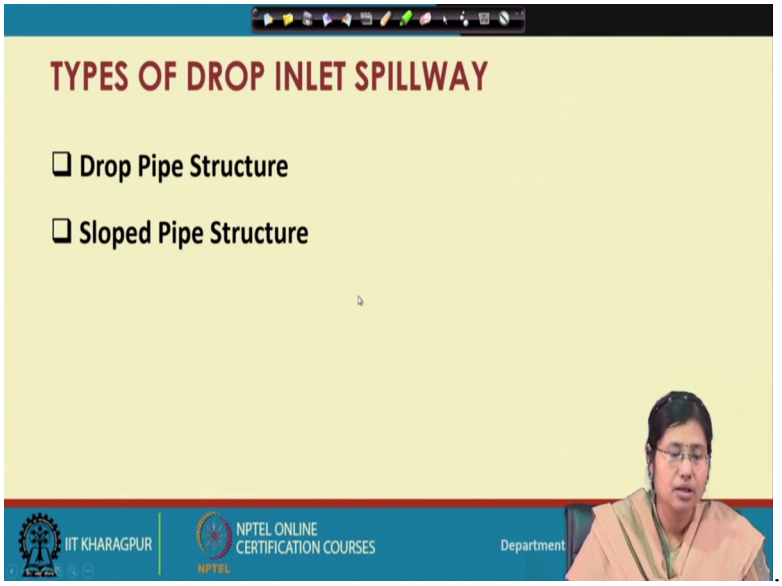

Now, what are the type of drop inlet spillway? So, there are basically two types. So, first is drop pipe structure and the second one is slopped pipe structure.

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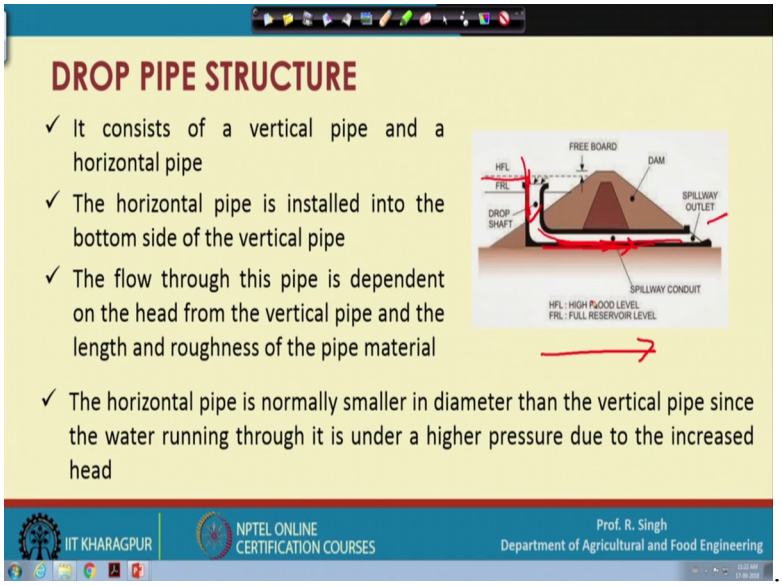

Now coming to the drop pipe structure; so, here at the right side you can see the drop pipe structure. So, this is one of the drop pipe structure. So, here is a free board is

maintained, here is a dam, this is spillway outlet this is the head water level and this is drop shaft this is a kind of drop pipe structure. So, as you can see from this figure it consists of a vertical pipe and a horizontal pipe. So, this is the vertical pipe and the horizontal pipe, the horizontal pipe is now installed at the bottom side of the vertical pipe.

So, as you can see from the figure and the flow through this pipe is dependent on the head from the vertical pipe and the length and the roughness of the pipe material. Now this horizontal pipe is in general smaller in diameter than the vertical pipe as this is also in the picture.

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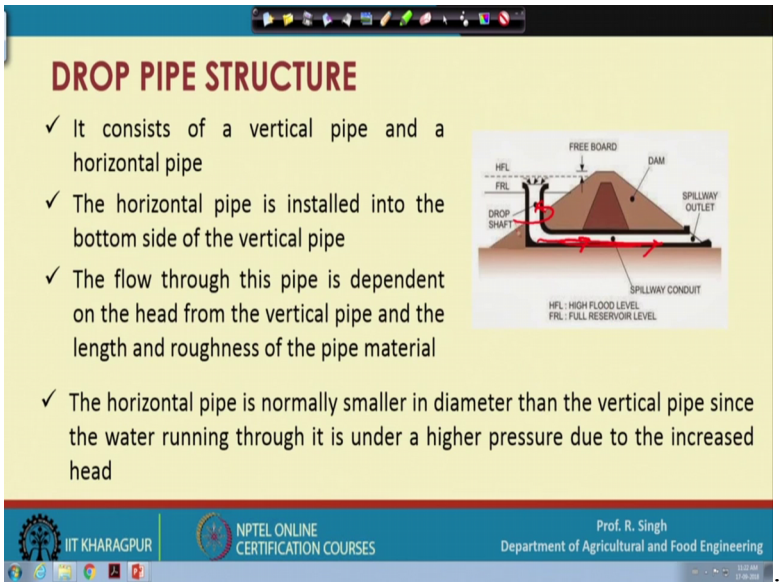

That you can say the diameter of this horizontal pipe is much lesser in diameter than the vertical pipe, why? Since the water running through it is under at high pressure and due to high since the water is flowing through it at a high pressure. So, increased head prevails so, the diameter of this is kept smaller than the vertical pipe.

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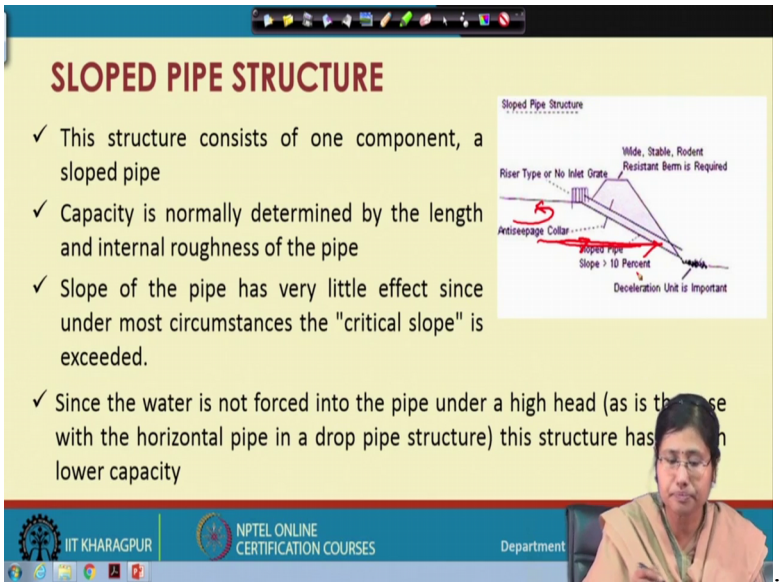

Now coming to the second kind of structure the slope pipe structure, this structure consists of one component and a. So, this component that is a sloped pipe only one component is available here and the capacity is normally determined by the length and internal roughness of the pipe. So, that basically control the capacity of this sloped structure and the slope of the pipe has very little effect since under most circumstances the critical slope is exceeded. So, as you can see here the sloped pipe the slope is kept as a 10 percent. So, it has a very little effect since in most condition it kept as a steep slope.

Since the water is not forced into the pipe under a high head as this is the case with earlier, this structure has a little bit lower capacity as compared to the pipe structure the as I described earlier.

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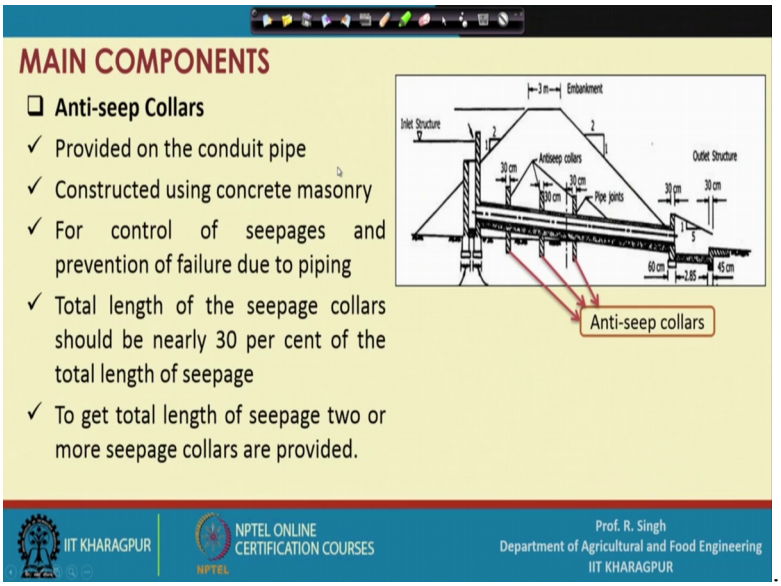

Now coming to the main component; so, here we are going to cover some of the main component of this drop inlet spillway. So, first one is anti seep collars. So, you can see, so here is the inlet structure here is the complete the conduit part and this is a outlet. So, in the conduit structure or the conduit pipe structure is a anti seep collars are provided. So, you can see the small collars are provided here.

So, these are in general constructed using concrete or masonry. For control of; why these are provided? For control of seepage and prevention of failure due to piping and the total length of this seepage collar should be nearly 30 percent of the total length of the seepage and the last is to get total length of the seepage two or more seepage collars are provided. So, you can see to get rid of seepage there are the anti seep collars are provided, where there should be a multiple anti seep collars throughout this conduit pipe.

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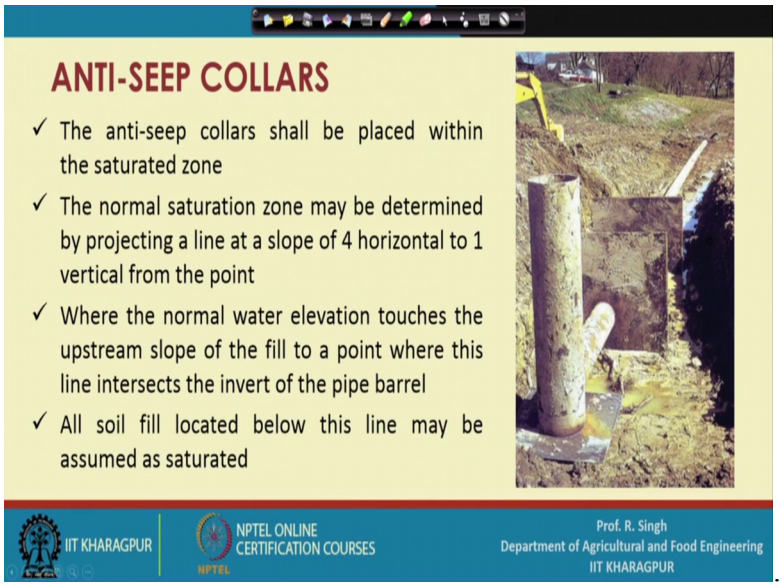

The Anti Seep Collar shall be placed within the saturated zone. So, where this is a conduit structure as you can see. So, where is there is a saturated zone. So, there these collars are provided the normal saturation zone may be determined by projecting a line at a slope of 4 horizontal to 1 vertical from the point, where the normal water elevation touches the upstream slope of the field to a point, where this line intersects the invert of the pipe barrel and all soil fill located below this line may be assumed as a saturated. So, this is some of the steps, where you can find the position where the saturation zone and based on this position you can provide the anti seep collars throughout the conduit of the drop inlet structure.

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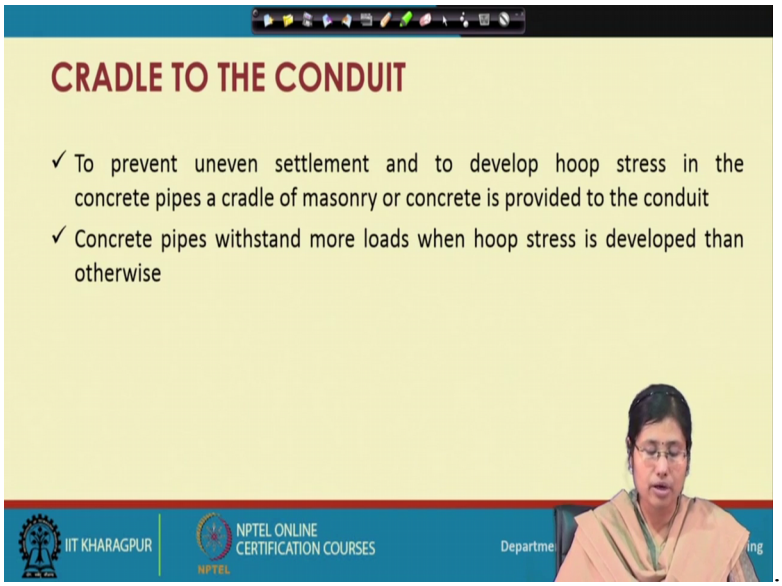

Now, cradle to the conduit to prevent uneven settlement and to develop hoop stress in the concrete pipe a cradle of masonry or concrete is provided to the conduit. So, concrete pipes withstand more loads when hoop stress is developed then otherwise. So, when the concrete pipes are provided when the hoop stresses developed in the system.

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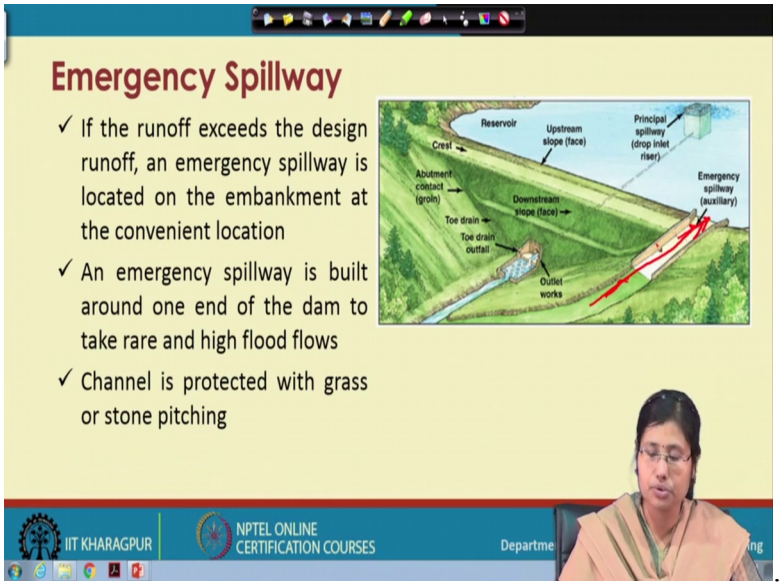

Now, it also consists of an emergency spillway. So, if the runoff exceeds the design runoff, so, as here in this case an emergency spillway is kept, which is located at a embankment at a convenient location.

So, as you can see in this figure, so here emergency spillway structure is provided. So, where this emergency spillway is located? It is built around one end of the dam to take care of very high flood flows and the channel is protected with a grass or stone pitching. So, that runoff the effect of runoff can be reduced and dampen and the velocity of flow can be reduced. So, this is the channel is protected with grass or stone pitching.

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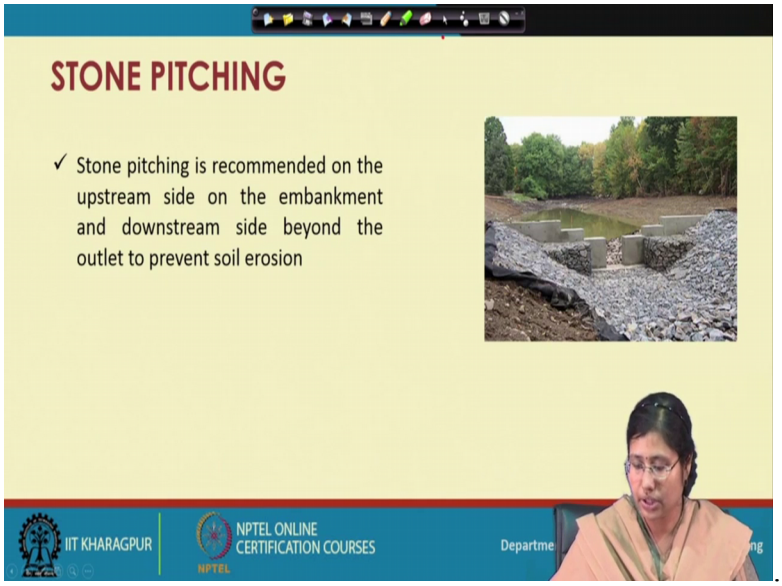

Now, as you can see this is a emergency spillway structure here and there is a stone pitching is provided to reduce the flow of water or the velocity of flow. So, stone pitching is recommended on the upstream side of the embankment and the downstream side beyond the outlet to prevent soil erosion because of the high flow of the water. So, the stone pitching is provided.

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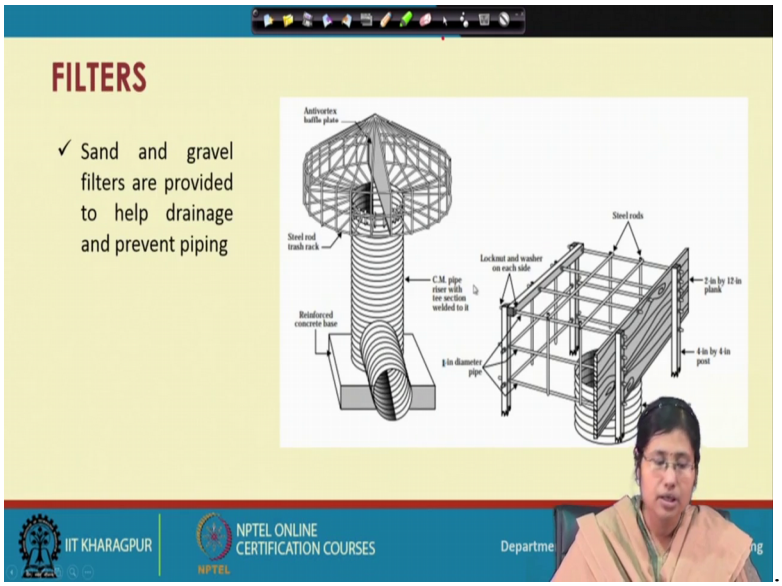

Next coming to the filter; sand and gravel filters are provided to help drainage and to prevent piping. So, as you can see here the sand and gravel filters are provided. So, this is a baffle plate and steel rod and here the filter is located here. So, this is a filter structure here. So this end up the introduction part of the drop inlet spillway. Now, we will going to move to the next chapter.

Thank you.