Application of Soil Mechanics
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Lecture - 08

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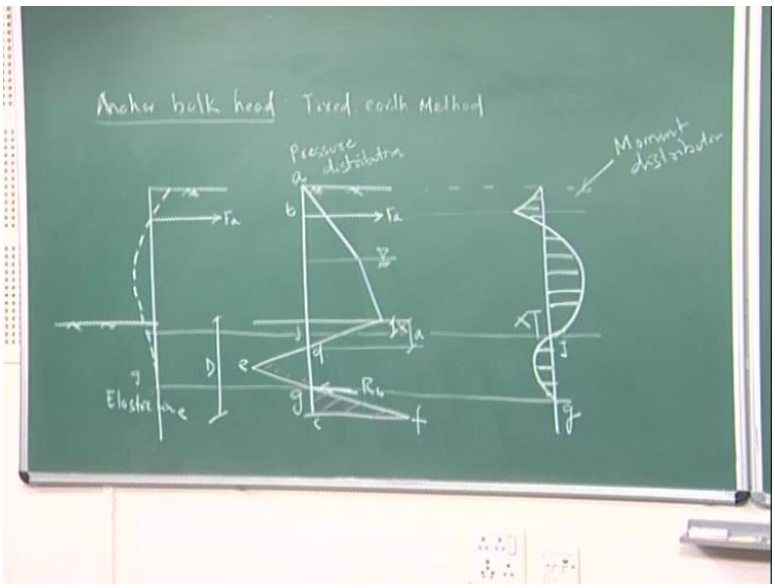

Already you have finished this anchor bulkhead pre earth method. Now we will start next one anchor bulkhead. This is your fixed earth method let me draw this three diagrams this is your elastic diagram then if I draw the pressure distribution diagram if i draw the pressure distribution diagram this is anchor of the special distribution diagram looks as we have drawn earlier now if i name is a t this is j d c e f. So, these distance will be some around say x, and this distance will be a and this your completely d and the movement distribution the same.

If I profile movement distribution diagram and this my anchor rod, and this is your x point of contra lecture where it change is point g. This is your j, this is j distance x at distance x, and look at this three diagram look at this three diagram. One is elastic diagram pressure distribution method, and this is your movement distribution diagram means he start method means this bulk in particularly a, this anchor bulk below the base line to the base line. So, that it will be fixed it will be fixed it will not rotate and earlier case it will not rotate below the base line it will be fixed ones it is fixed it will considered

as a prop cantilever.

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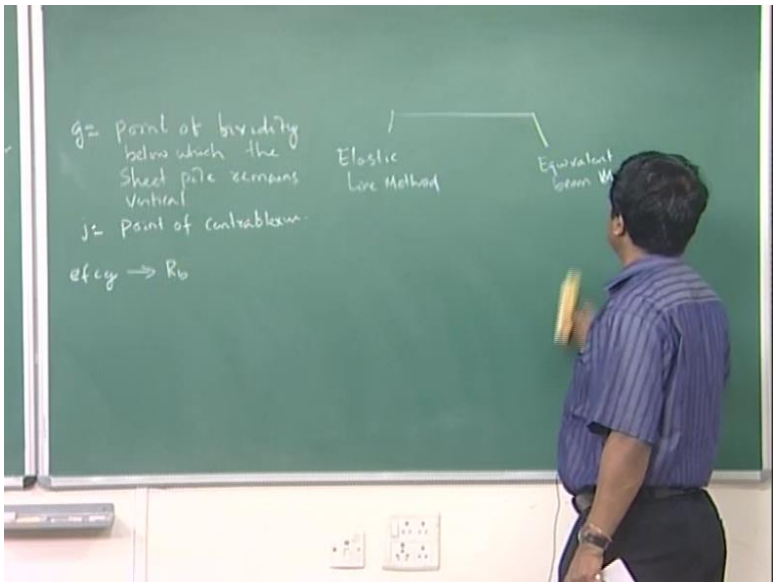

If you look at this this is my cantilever wall and this is road is coming this this part will be simulate we can cantilever wall cantilever wall. If I take this three diagrams, elastic line pressure distribution, movement distribution diagrams and let me g tends to points if fixidity points if fixidity below which below which sheet pile below which the heat pile remains remains vertical. That means, if I take this is my point g this is the point g; that means, if this is the elastic line the elastic line will change was to point g, and it will particular vertical as it is a mixed material method then point j j is nothing but your point of contra flexure point of contra flexure. That means, r point j r point j contra flexure means the bending are bending movement will be zero, that are will be point of contra flexure j for simplicity distribution diagram.

If we look at their e f e f and c g if we see that e f and c g e f and c gm if I mark it e f c g this part generally below the g as it is said below the g. It is a fixed one; that means, the wall will be particle there is no further change in deflection or anything else. So, below point as it is a fixed. So, there part may be replaced may be replaced by simple course of a pleasure distribution by means of a simple course. So, e f c g e f c g can be replace by a course r b acting at the r b acting at the g. So, how do we solve it can be solved by means of elastic line method, it can be solved by means of elastic line method. What is that elastic line method will discuss later, there are two method one is by elastic line method

and other is by equivalent be by method other is by equivalent be by method in particularly elastic line method the discussion will be later on

Now, will start on these two ways two solve it. If I write it there are two ways two solve it one is your by elastic line method and other is by equivalent equivalent beam method. Now I am starting this both method elastic line as well as equivalent and there are so on this. One is elastic line method, other is by equivalent bean method will start the basic how it solve the elastic line method what are the assumption elastic line method.

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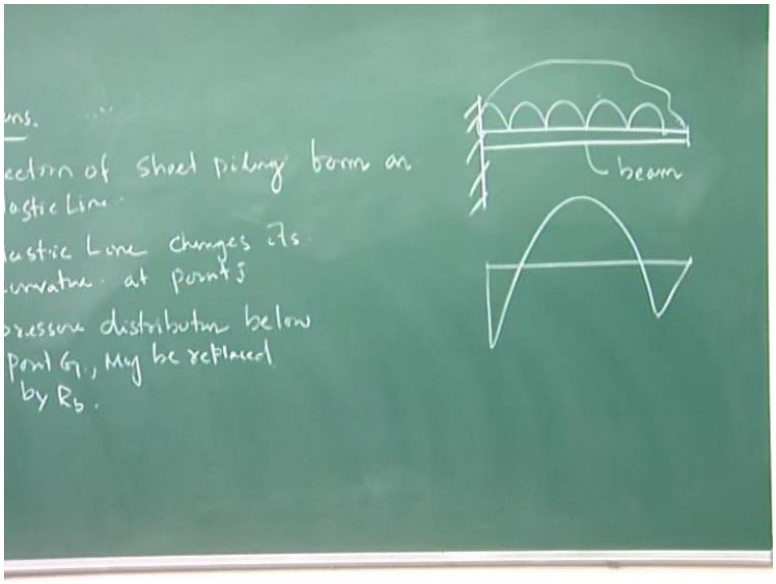

What are the assumptions the basic assumptions deflection of the seat playing hallmark elastic line deflection of a sheet piling form an elastic line then elastic line changes its curvature elastic line changes its curvature changes its curvature at point j. So, this area the course below g pressure distribution below point g may be replaced by r b may be replaced by reaction force r b

If you look at the assumption the deflection of the sheet piling form an elastic line; that means, there will be be a deflection it will form an elastic line. This is called a elastic line and elastic line changes its curvature at point j elastic line changes its curvature at point j; that means, the moment I say that changes curvature at point j means bending moment is equal to zero at point j and pressure distribution below the g. Because as you have assumed these elastic line below g there will not be any deflection the pressure distribution below the g will be replaced by a concentrated course r b concentrated

course r b now the concept con concept of electric line theory. If you see it particularly analysis, now you consider this as a you consider this as a beam consider this as a beam as if this is a beam his is a beam once I say it is. That means, one end is fixed one end is fixed means if you come back here this end as I said this a fixed support, this is completely fixed this end is fixed. And this acted upon by this concentrated load as well as u b l.

So, then you can apply whatever may be this there are the load will be above the it can be analyzed as as a beam fixed at one end then draw the bending moment and c l force then where is your maximum moment comes into picture as its says point j is your point of contra flexure. Then you find it out where is your maximum moment once you find it out your maximum moment taking into consideration of maximum moment. Then you can find it out force of the anchor head f a as well as distance d as well as distance d, this is called by means of elastic line method. Second one is your equivalent d method equivalent d method in equivalent d method.

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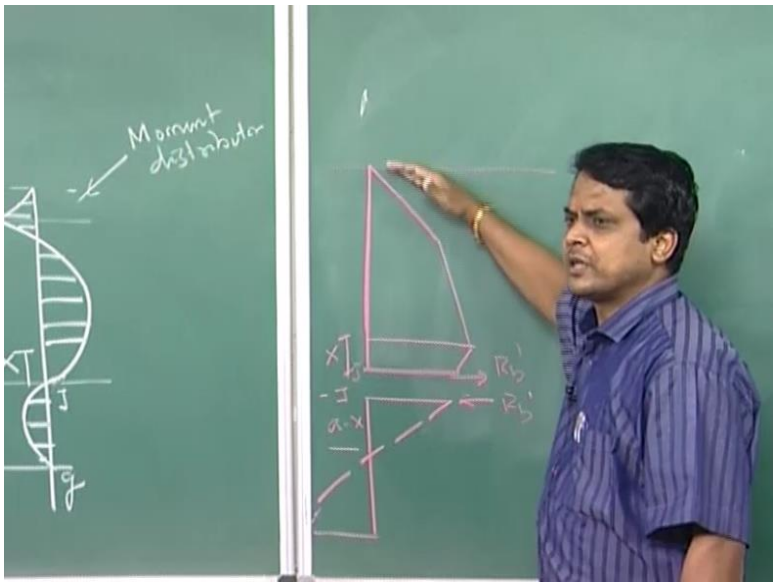

What will happen if you look at here, let us draw redraw pressure distribution diagram again. Again if I draw the pressure distribution diagram one is up to distance look at here these distance x because the point j is your point of point of contra flexure; that means, here there is no moment there is no moment. So, if I consider up to point j here then below the point j below the point j this is my point j and also below the point j below the

point j if you look at is this is x this you are a minus x.

If I take it total, this is the distance a and this is your x these distance will be a minus x. Now if you take it completely this course, and put it equivalent it as it is equivalent beam method r b prime and here also r b prime. Can you see what is the assumption here two opposite force; that means, it has been assumed a inch has been taken at point j a hinge has been considered at point j. So, that the bending point will be zero at the point of contra flexure; that means, the moment you take this hinge at this point is equal to zero; that means, the course will be nullified there will not be force will be equal to each other, so that the bending moment will be zero. So, this is considered equivalent beam; that means, one beam above the point of contra flexure other beam below the point of contra flexure if I summarize it.

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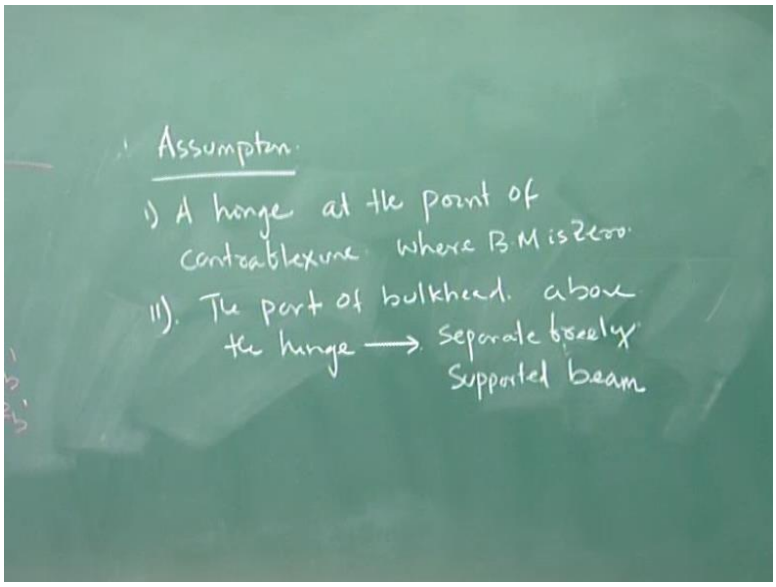

If I summarize it what are the assumption a hinge at the point of point of contra flexure at the point of contra flexure where bending moment is zero. Then the pat of bulk head above the hinge can be treated as separate freely supported beam can be treated as can be treated as separate freely supported freely supported beam or you can say that can be treated as freely supported overall beam or freely supported beam. We have some r b dash acting at the hinge can be evaluated and these r b what is the procedure.

If you look at here once again I am saying that it is a equivalent d method first one is your the elastic line method; that means, it has been assumed as a then consider the

remaining moment. And see your first diagram, find it out the maximum bending moment and from there you can find out what is the anchor course then you can find it out what is the distance that is what is the first method. Second method is your equivalent beam method in these condition, in this case, particularly what is the assumptions there is the point of contra flexure in the beginning or fixed arc method. That means, point j is at point of contra flexure if that point of j is at contract contra flexure; that means, a hinge at the point of contra flexure has been taken; that means, where bending moment is zero as there is hinge assumed at the point of j.

So, what will happen the part above this the part above this has been considered as separate freely supported beam part above this has been considered as separate freely supported beam so; that means, you know you know the gamma you know the phi all the property you know. So, you calculate the arc pressure diagram you calculate the arc pressure diagram and from these pressure diagram you find it out what is our reaction course r b dash because this has been considered as a separate beam as if it is a over hand separate freely supported beam.

So, over hand part has been assumed as a freely supported beam. So, and you will get your action course r b dash once you get the r b dash as there is a hinge at point j; that means, this reaction for lower part of the beam lower part of the beam it should be opposite. So, once you consider your r b dash as once you know the course you can calculate you find out what is the distance. So, this is the case how to equivalent the method has to be solved both the methods can be used. So, we will solve the problem based on the equivalent beam method also.

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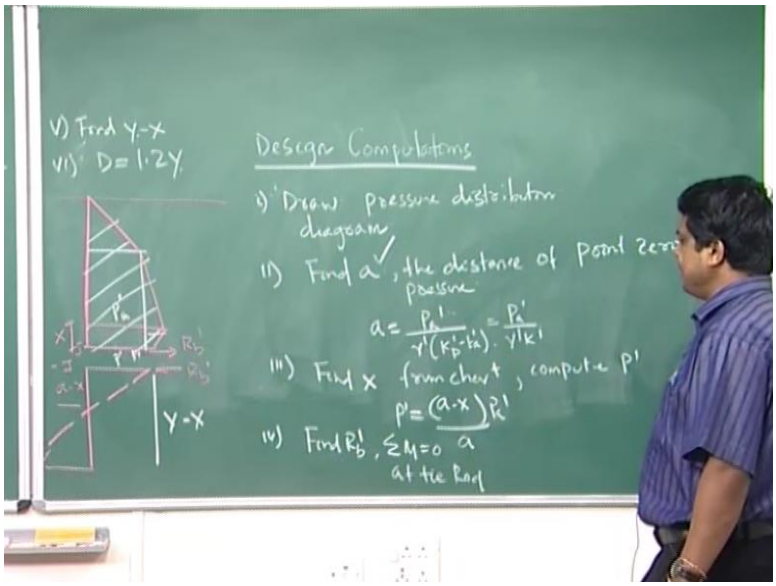

Draw pressure distribution as i said earlier draw pressure distribution diagram; that means, based on your soil property based on your within soil property and water table draw pressure distribution diagram. So, this is my pressure distribution diagram find a find a this the my distance a find a the distance of point zero pressure the distance of point zero pressure below the base line if you look at here this is my base line. So, if this is the base line this distance is a this distance has to be evaluated first because at this distance the pressure has been changed from positive negative to negative positive or negative positive to positive negative; that means, pressure has been changed and point d the pressure will be zero.

So, find the distance a. So, as we have discussed for three arc method one three a is equal to p o prime by gamma prime by k p dash minus k p dash which is equal to p o prime by gamma prime k dash then find x how do you get x the point of contra flexure how do you get x there charts has been provided to find the x. If you look at this chart, we will re draw the chart again also find x; x is your distance below the baseline, where there is a point of contra flexure; that means, bending moment is equal to zero find x from chart. And compute pressure intensity to prime compute pressure intensity a prime. Now where is your tp prime comes into picture. If you look at here this is my p a prime. So, this will be a p rime this will be a p prime.

So, find x find the distance x and compute pressure to a prime. So, p prime is equal to a

minus x into p a prime by a then your fourth point find r b dash by equating moment is equal to zero moment is equal to zero at tie rod this is the tie rod or anchor rod find r b dash equating moment equal to zero at tie rod at tie rod then after you find the tie your r b prime what is then you have to find it out your distance y minus x where is your distance y has come into picture this is the r b and from this r b to this r b to here this is the distance y if this is my distance y.

So, definitely this distance will be y minus x and this distance will be a minus x. So, your fifth point in here find y y minus x y minus x then find d is equal to one point two of y find d is equal to one point two of one point two of now. If I summarize you can make out here, if I summarize first based on the pressure distribution diagram based on this all profile draw an anchor. Draw a anchor along with a anchor and locate where is your water table and write this value is given value is given value of small parameter has been given. So, calculate, so first we have to calculate active air pressure coefficient passive air pressure coefficient all parameters once you calculate then next step draw the pressure distribution diagram. So, this is your pressure distribution diagram. So, draw the pressure distribution up to you up to you hinge line this point x. So, I draw the pressure distribution diagram up to the hinge line.

So, this is my pressure distribution diagram, lots of pressure distribution diagram, can you find it out distance a. If you look at here this is the distance below the base line where pressure has been changed; that means, we are getting zero. So, you know the value then y should draw the pressure distribution diagram, we are not doing mistake. We can derive into small parts because we know the value, we know the height, you can calculate, what is the total pressure. Then once you get the total pressure find distance a in distance a by means of p a prime gamma prime k p prime minus k a prime if you look at your p a prime the pressure up to the base line this your p a prime the pressure up to the distance x this is your p prime.

Now once you find it out a, then find distance x. You will be find it out from the h chart, I will give the chart right now. Then once you find your distance x then you can easily find it out pressure p one; that means, at the base p one is equal to a minus x by a p a prime once you get your pressure p pressure p prime. Then find your r b because bottom line you have to find it out by use of equivalent beam method what is your force or reaction force r b prime once you get the r b prime for this case, as it is a hinge support

this should be equivalent opposite. So, now, it will become equivalent opposite. So, you will find it out r b prime by considering moment pi prime is equal to zero, this is also another assumption at the beginning of your bulkhead or anchor rod; that means, bulk head you can anchor bulk head in that case the assumption is that moment about anchor rod is to be zero. And then once you draw these moment about anchor rod is equal to zero you can find it out r b prime once you get r b prime then find distance y minus x.

So, this is the distance y minus x. So, you know r b prime you know y minus x you can find it out from what is the distance d. So, once you know y once you know y minus x as know the x then once you know y minus x you can find it out y and once you get y you will find it out d is equal to one point two y. So, this the computational procedure we will discuss also we will solve the problem may be some times may be next class ill give you the chart for more you can find it out this x distance x these are the standard graph charts have been given where value of phi.

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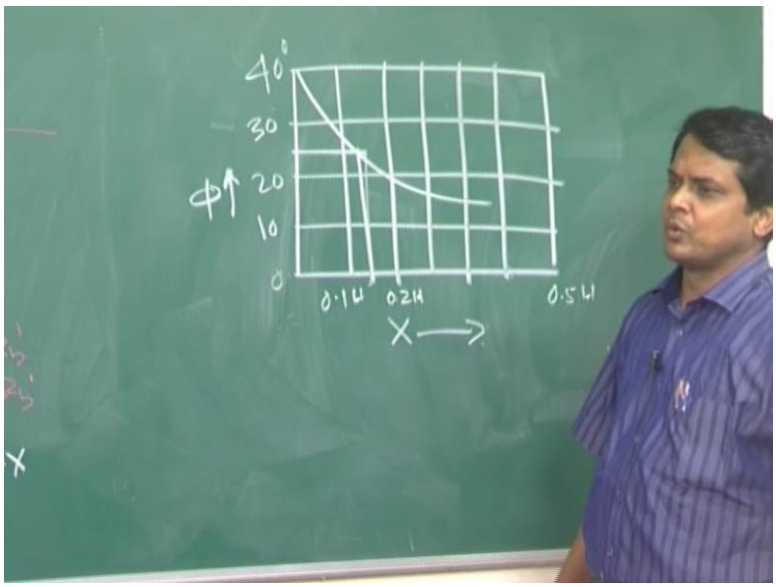

This is the value of phi. So, it is varying from zero to forty degree. So, this will be ten this is a twenty this is a thirty ten twenty thirty and forty degree now zero point one h two h. So, it will up to to zero point five h. So, this graph will be coming in this way this is the distance x; that means, from the chart from the chart we know what is the value of this x is equal to what part of this x. Then once you know the value of phi you can find it out from the chart if you know the phi we can find it out what is the value of x.

So, sub x phi at this space sub x phi is equal to phi is equal to twenty five degree. So, from twenty five degree draw a line where it intersect from there you draw a vertical intersect. So, it is approximately zero point one five eight. So, this is the total height h. So, you know, it will be given once you know total height from there you can find it out x is equal to zero point one five into total height that is it. I am stopping here. Next class, we will solve a complete problem, example problem of this equivalent beam method.