Application of Soil Mechanics

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Lecture - 09

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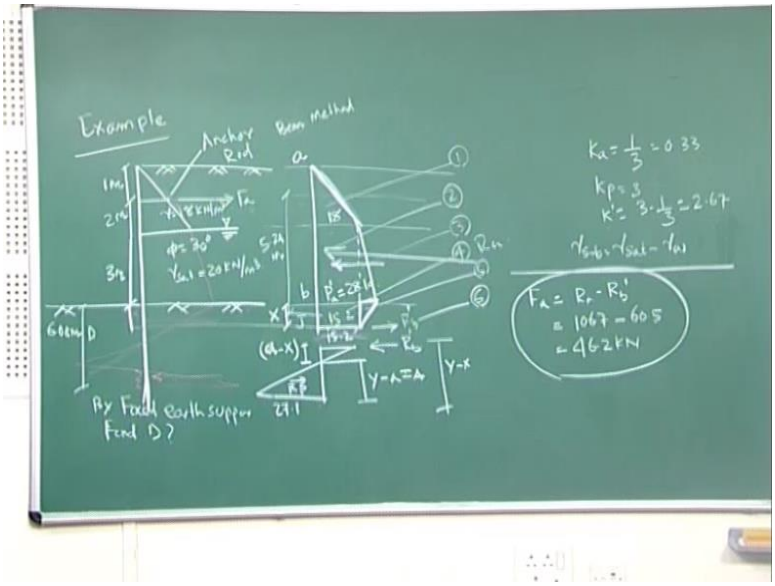

Bulkhead anchors as we have finished last class above the fixed earth support. Let us solve one example; anchor is there means sheet pile is there, then it has been decided to provide anchor rod say at a distance one meter. And the soil profile is saying two meter of the anchor rod, this is the anchor rod below two meter of anchor rod, there is a water table, this is a symbol of a water table. And gamma above the water table is eighteen kilo newton per meter cube. And phi equal to for both the cases phi equal to thirteen degree. Gamma saturated is equal to twenty kilo newton per meter cube that is below to water table. And this height is three meter.

Now it has been asked by means of fixed earth support method. Find the embedded depth D by fixed earth support; find D, and anchor rod capacity also F a. As we have discussed, it can be solve by means of elastic line, or by means of equivalent beam method. We will see now for equivalent beam method how we can solve it. For the case of equivalent beam method, as I said earlier steps first principle is to find it out your k, k p all other parameters. So, from the whatever value of phi is given from there k a is equal to one-third as it is thirty

degree; k p equal is to three and k dash is equal to three minus one by three which is equal to 2.67.

And next step once you find it out k e, k ,p k dash, draw the special distribution diagram then find it out what is your pressure. If I take it into the two parts by means of I am solving these example by means of beam method - equivalent beam method; that means, taking these and I am drawing this pressure distribution diagram. Now here is your water table and here is your anchor rod. Now this is the water table; and from there, it is coming because at a certain distance, if a draw given idea how to pressure distribution diagram it is, I am just drawing here. In this question paper, I am just drawing how it is comes, it comes in a way like this, and this part if you remember will this part as been as it is a fixed earth method, there will not be any deflection, so this part will be replaced by an equivalent load.

So if you make it by means of a particularly equivalent beam method, you assume up to this where it is zero, up to these point of contra lexure, say contra lexure is as a distance x. Up to this, we consider as one part and below you considered as one part. And just reviewing what we done in the last class for solving this problem. Now I taken in to consideration particularly we are if you take it, this is my point of contra lexure. So, upper part of form here it has been considered as a one unit and better part of one unit. So, as assumption is that it is a heel support equivalent beam method, with this is there are two process apposite to acting to each other, so that that net force will be zero.

So, one side draw these, so this is a height one meter, this is your height two meter. Now find it out pressure distribution diagram from there, you can find it out what is the value of pressure, it will be twenty eight point one nine then this is your fifteen point two. If I name it a, b, j, and here if I draw take into consideration of the bottom part then this is fifteen point two, and these will be or 27.1. And this is your R p, and this is your somewhere else we can write it done, this is your R b.

Then this distance as I said this distance is x, and this distance is your a minus x. And from here to here this distance y minus y minus a which equal is to nothing but I have taken capital A; and form here to here, these distance is y minus x. Now we will solve these by step-by-step. Now let me calculate value of as you said this is your pressure diagram and this part will take at a one unit, this is has a one unit by equivalent beam. So, here we can

find it out what is is the pressure distribution at step by step we can find it out, we can calculate. Then see whether this value is are coming whatever I have written whether these values coming are not. Then let us start with the top part distance is your say one meter. If we look at here, from here to here, distance is one meter; and here to here, distance is three meter; and here to here distance is three plus two plus one, this is your six meter.

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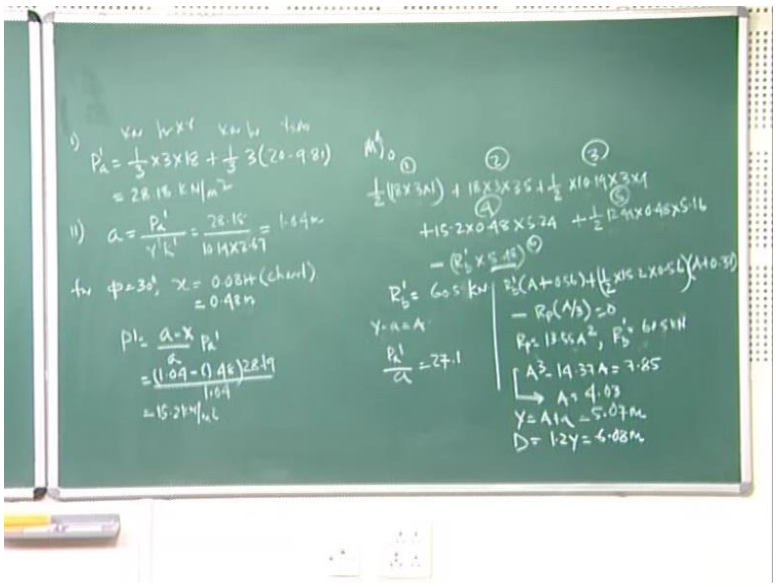

So, now P a dash is equal to one third into three into eighteen plus one third into three into twenty minus nine point eight one. How it has come this P a dash, these P a dash, it has come, if you divide into small small parts, this is your, you can take it as a whole, your k a is equal to one third. So, k is equal to one third one third into three means, this is your k a this is your h, this is your gamma. If you look at here, this will be your entire this. So, now as I said k a is your one-third, and gamma is equal to eighteen. And for these part, this is your k a, this your h, this is your gamma submerged. Gamma submerged is nothing but gamma saturated minus gamma w, gamma saturated weight is given twenty kilo newton per meter cube and gamma w is nothing but your weight of water unit of weight of water, so 20 minus 9.81, how the concept as come 20 minus 9.81.

This is the pressure at the base. So, it is coming twenty eight point one eight kilo newton per meter square. Now next step is this is step one, you find it out fresher at the base lines next step is find it out distance a. So, a is equal to P a prime divided by gamma prime k prime. So from there which is equal to twenty eight point one eight divided by ten point

one nine into two point two point six seven two point six seven is a k prime. From where you have calculated this two point six seven, and this is coming about one point zero four meter. Now then you find it out from the chart, if you remember, well I have given a chat last class from there we can find it out x. As you know for phi is equal to thirty degree, x is equal to from the chart x is equal to zero point zero eight h, this is form the chart. From where x is coming about zero point four eight meter; that means, distance below the dredge lines at which we are getting point of (( )); that means, bending moment is equal to zero that distance we are getting from the chat for five is equal to thirty degree is about zero point four eight meter.

Now once you get these one, we can find it out what is the P prime, this is your P prime. So, P prime is equal to a minus x by a into P a dash which is equal to one point zero four minus zero point four eight then twenty eight point one nine by one point zero four which is equal to fifteen point two kilo newton per meter square. This is the value I have written from the pressure distribution diagram. If you look at here, this is eighteen kilo newton per meter square, this is twenty eight point one nine kilo newton per meter square, and this is your fifteen point two kilo newton per meter square.

Then once you get P a, P prime then a, you are next step is going towards your taking what is your next step, we will have to find it out R b. From this pressure distribution diagram we know all these value, what is is the other value you missing. The other value is missing your that means, you have to find it out R b force - R b. This force R b will come from your of equilibrium conditions. What is that condition and this conditions is moment about anchor rod is equal zero. This is the assumptions as I said earlier movement about anchor rod is zero.

Now taking moment is equal to zero of the entire free body diagram about the anchor rod is equal zero. From there, you can find out of half eighteen into three into one plus eighteen into three into three point five plus half into ten point of one nine into three into four then plus fifteen point two into zero point eight into five point two four then plus half twelve point nine nine into zero point four eight into five point one point six minus r b brain into five point four eight.

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Let us start to the step by this step how a take a movement half eighteen three into one. if

look at here this tiringly look at hear (eighteen into three eighteen into three eighteen into three half this is your area right the course is coming and it will be acted upon acted upon at a distance one bellow this movement. So, this area into one then eighteen into three eighteen into three it not three point five if i look there at half case if i write it one this is a two this is a three this is four this is a five and this is a six one party is your movement.

in anchor rod of one now go back second part eighteen into three point five if i take into two parts this is ur eighteen this distance is three this is your area and it has been acted upon the cg the c g will be one point five and one point five plus two this is your three point five. So, these part is for two then come back to third is your area half pressed here into height. So, presser is your half ten point nine into three into height is equal to four height is equal four means this is a one third of cg one. So, third of three this is two and this is your two. So, this distance is four then come back four this is a four if you

take into part fifteen point two into x fifteen point two into x this is zero point four eight plus five point four these distance for three plus to five and this is equal to point four eight divided two this is your five point totally I add this is your five point four if i taking for cg from to here to here this is your five point two four five point four two meter now about fifth point. So, this is your part second i have a written this is part this is four now these part your fifth this is your if you look at here this part is fifth this part is fifth now part this.

Fifth what is pressure(noise) half into twelve point and nine nine into zero point eight plus five pint one six this is your height from the cg of that triangle to of the anchor rod these are these course are acted upon if a look at here this process are acting these are above anchor rod and this is your for that price this is negative this is a positive. So, r p prime will act of the base so; that means, three plus two five point four eight at a distance it is your five point eight is a distance and this is your part six why i am solving details if you do if you part to by part one by one then chances of doing committing mistake will be less now one's a get from these after solving

if can find out r b prime is equal to sixty point five sixty point five kilo meters now these for one's greater p these r p is equal to twelve and opposite these r p or r p prime because these. So, there will be not any moment. So, r p if prime is equal and opposite cross to be there it is r b prime a r be to get they can very easy (noise) find out body regarding this all income tax y. So, let us foot let us foot y minus a is equal two capital a now prime a which

is is equal to twenty seven point one taking moment now taking moment of the lower part now taking is moment is equal to zero from here to here the lower part if can find it out what is r b value in terms of in terms of in terms of a so

Take this calculation r p dash into a plus a minus x is nothing, but a value what is the value a a is equal to one point zero four x is equal to what is the value of x zero point four eight one point zero four minus zero point four eight this is a a minus x. So, r b prime a plus x zero point five six zero point five six zero point five six plus half into fifteen point two into zero point five six into a plus zero point three seven minus r p into a by three which is equal to zero now one's foot the value of r p dash sixty point five in this case if can find out r p is equal to thirteen point five five a square thirteen point five five a square and r b dash is equal to sixty point five kilo meters how do i get r p

r p is coming r p is coming this is my r p half area of the triangle these into these this is you're a half these and these and up on the high from they are r p is coming thirteen point five five a square and r b dash this is coming sixty point five sixty point five kilo meter. So, foot the value r b dash and r p here in this equation at the moment equation after footing this value you will get and equation a q minus fourteen point three seven a which is is equal two seven point eight five now by trial and error a is coming about four point zero three meter now one's gets a they can find out is is equal to a plus a a is nothing by, but y is remember. So, from they are if can find out five point zero seven meter and e these nothing, but your twenty two forty times more it will be one point two half y which is is equal to six point zero eight meter six point zero eight it meter d is equal to coming six point zero eight meter now one gets the value of d, but one's the get the value of d then it can easily find out what the value of f a fa nothing but.

f a is nothing, but r a minus r b dash. So, r a is equal to what is r a resultant process of all these these these these total regulated these process updated here this is r a minus r b this is your f a. So, from there are r is coming about i have not done the calculation if you do it r a is equal to one zero six point seven minus r b dash minus equal to to sixty point five which is equal to forty six point two kilo meters this is all solve the example complete the details calculation have given in these particularly sheet pile bulk head sometimes i neglect this how the calculation of down(for you for. So, that you can try, but one example i have solved in detail detail calculation. So, let me that review one's again these are all you are parameter has been given sheet pile is give a and there is anchor rod and these are soil your

parameter are there and this is it has been asked find out it is embedded depth d by means of fixed act supported method by means of fixed are supported method and also find out what is the fourth anchor rod. So, in these case i said earlier this fixed are support oh fixed are support for particularly bulk head anchors sheet pile it in these case there are two methods beam method one is your by elasticity line method other is by beam method in beam method in b method are the point of contra of picture

are the point of contra of picture the upper part as been updated liked one been lower part has been updated open by other been how is assumption is the at the point of contra lexure there will be hence there will be hence in the hence; that means, one's you one's you assume there is hence that is equal to zero b meaning of point contra picture is that at that point moment is equal to zero. So, ones meaning is assuming there will be two reaction course each equivalent opposite. So, that moment is equal into zero which these b method now next step is your draw distribution of diagram of a upper part and refer this distribution diagram and lower part. So, take one calculate your best from the five calculate k a k p and k price and it is has been calculated five equal to thirty degree. So, k equal to zero point three three and

k p is equal to three k dash is equal to k p minus k a which is equal three minus one by three which is is equal two point six seven and r water table acted below three meters from the ground f a. So, below water table going consider some of unit with about the it will be you're the dram will be given it is eighteen kilo meters temp per q for summer unit weight is equal to gamma circulated by minus dram w basic one parameter your calculated once it is draw the pressure distribution diagram and the pressure distribution diagram has been drawn. So, then take find out of pa dash refer at this point and p dash there are the points. So, insisted of find out total what a i have done it by make in to part by part by one two three like this part by part by from these from these

so pa dash is coming about twenty eight point one eight kilo meters per meter square. So, this is your twenty eight point one eight one eight kilo meters for meter square at these point then once you get it there we find it out what is the value of a that distance of a where these you are distance a. So, a has come from pa dash by gamma prime and k prime it is is equal to one point zero four meter. So, based on the value of five as a said earlier by means of chat from the chat value of five form chat x equal to zero point zero eight h this is coming about zero point four eight meter once we get these you are zero point four eight

meter; that means, point of contra lexure below the desire lines is about zero point four eight meter. So, you are getting zero point four eight meter value of x

once we get the value of x we can find it out we prime we prime means at these what the fresher. So, p prime equal to a minus x by an into pa dash. So, from there it is coming about fifteen point two kilo meters per meter square. So, now, all the step to all the pressure distribution diagram is over all the pressure distribution diagram is over has it is an equal in to b considered above these above the point of contra lexure these has a warm body and take what is the second assumption the movement about the anchor or to be zero. So, take movement about anchor rod. So, take will be zero by considering movement about anchor rod. So, movement has been taking in to consideration. So, again in these case I have taken into part by part one part two part three part four part five part and six part.

So, form there at the value at the prime force coming is about sixty point five kilo meters once we get the force sixty point five kilo meters these about you are sixty point five kilo meters. So, these are equal and opposite. So, these value also sixty point five kilo meters. So, similarly, we can considered movement of these second beam these you are first assumption one unit one beam these you are beam about the best because these a fixed support. So, from there it has been done. So, it is term of r b dash and r p dash r p then r b and r p as value as been in term of a and what we have put, we can get the value of a prime. There a is nothing but y minus a from there we can get it y is equal to five point zero seven from there would is coming about twenty percent higher twenty to forty percent. So, one to two times y it is six point zero eight meter.

Once these coming, so taking an equal to beam of the of per part are a r b dash coming all force of the base result and forces you are r a. So, it is an r a minus r b dash force in the anchor road is coming about forty six point two kilo meters. This is all about what I have discuss about sheet pile p support fixed support and sheet pile wall with your anchor rod p and fixed support earth method. And in these case, there are two cases for each case one is you are cohesion less soil. Another one is corrosive soil, this is all case by case I have derived how to get you are embedded from the basification hence each and every case you are solve one particle example how to get the and how to get also anchor rod force this is all about will start next class some other new topic.

Thank you.