Application of Soil Mechanics
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Lecture - 04

Last class we have finished the cantilever sheet pile wall means find it out the depth of the penetration of cantilever sheet pile wall in granular soil. The solution has been calculated how to find it out this depth of amendment of cantilever sheet pile wall.

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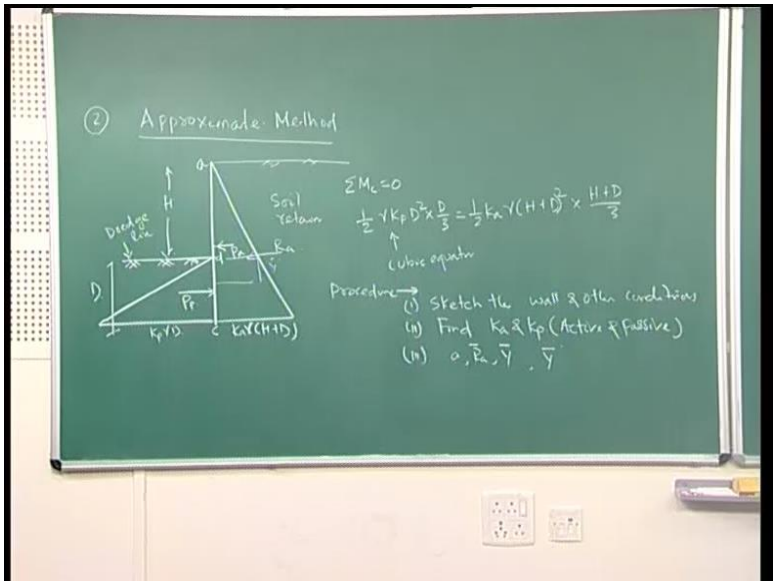

Now, there is one another one method is called approximate method. Remember these whatever you are discussing these are for cohesion less soil and granular soil in approximate method. If this is the sheet pile wall, and this is your dredge line and this distance is d, let us say this part is your retaining of soil, now this height is, let us say h height in this approximate solution, the pressure distribution in the back. If you look at this, this is my wall, and let us say a, this is small d, this is your c, so; that means, this is you dredge line; up to this dredge line, below this dredge line, there is a soil filling up.

The assumption for this approximate method is below the dredge line; that means, back of the wall, this part is your soil retain. That means, if this is the front face of the wall and this is the back face of the wall, this has been assume that this back face will be acted upon by passive earth pressure, and front face will be acted upon by active earth

pressure. So, this is not a case in the exact solution, but in case of approximate solution. For a quick calculation, this had will made take it below the dredge line, and back face acted upon by passive earth pressure and front face acted upon by active earth pressure. Now if take moment are point c, moment at point c is equal to zero, then you can find it out half gamma k p d square into d by three is equal to half k a gamma h plus d whole square into H plus D by 3. Now this is a completely this is a cubic equation you can say that this is cubic equation.

Now, how to find it out this, then you can start with this procedure is that first sketch the given condition, sketch the wall and other condition, then find k a and k p. That means, active and passive earth pressure, also compute distance a resultant R a compute and its location y bar if has a total process is coming result end a somewhere else. Here R a how far it is distance from this y bar of distance a means you can find it out, what is the y bar. Then you can find it out how much is your y bar then find the in this case would be value of y instead of d. You can put the value of y and find it out find it out by and find it out the value of what is the value of d by approximate value, you can put it what is the value of d approximate method as a say it has been assume one site of this below the dredge line.

This has been assume that by passive earth pressure; that means, back of the wall if this is my wall this is the wall. So, this is the back of the wall it is acted upon the passive pressure and front of the wall acted upon by active better this retain in the soil mask. So, taking moment are point c m is equal to c is equal to zero. So, we are getting a cubic equation how to solve bit the procedure first we draw in this case the wall and other condition; that means, soil parameter. See if the parameter what is the height of the wall if of the dredge line then once you get it find the k a and k p depending upon the f y value, you can find it out earth pressure k a and k p active as well as passive. Then find it out from the k a gamma d k a gamma h plus d y bar, you result is earth pressure act t and the distance of y bar then once you get y bar then put this value up trial and error you put this. And you will find it out d once you get the d you find it out l is equal to h plus d; that means, total length of your wall will equal to h plus d.

Now these are the two method one is your whatever we saw last class, one is your actual method and other is your approximate method. Then will a design engineer they use some time this approximate method for will calculation to know what is the length of this

wall they are they are suppose to provide now we solve the typical problem of this cantilever retaining in wall in run roller soil whatever solved whatever we derived last class. So, now, will solved the typical example problem

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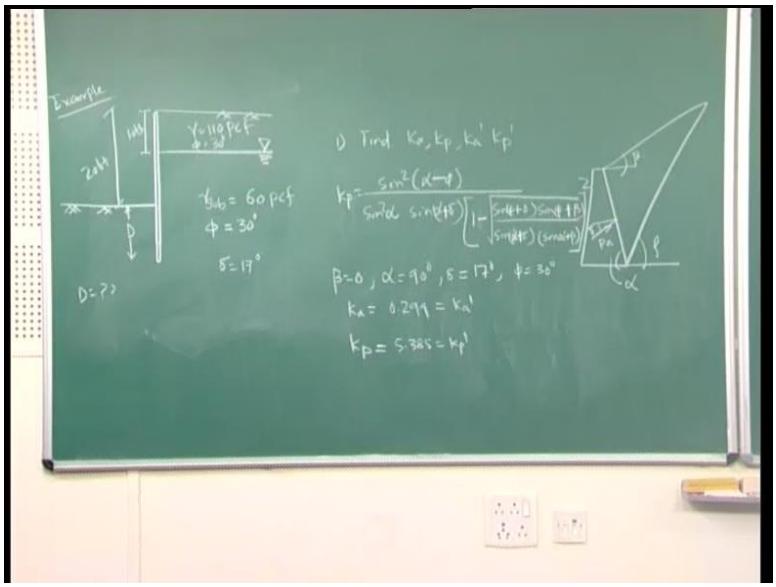

So, now this is the given conditions one is a example, wall is there. In this wall, this is the distance d is suppose to find it out, now one side it retain soil, now water table is lying, water table symbol generally we provide in this way. Water table is a lying is below ten feet this is your ten feet. And these distance is twenty feet and this is a purely cordialness soil gamma is equal to one one zero p c f pastel for cubic feet five is equal to thirty degree. And here gamma is equal to yours sixty six zero p c f and five is equal to thirty degree this is the condition find the length of embedment; that means, the d has to you have to find it out spooning figure either you can solve this by means of approximate method or whatever we derived the actual solution.

We can do it now. First step, what is your first step step one find k a k p k a dash k p dash now if you look at here delta is equal to stills it file and sand value of delta friction between sheet file wall and soil is define seventeen degree. Now if I take a retaining wall these kinds of what is the formula find it out k a and k p at this is my wall it may be retain.

So, this is your beta, this is your rho, and this is alpha and this is p a, this is your delta. Now with these what is the formula for k a and k p k a is equal to sign square alpha plus

f y divided by sign square alpha sign alpha minus delta into one plus root over of sign f y plus delta sign f y minus beta divided by sign f y minus delta sign f y minus delta into sign alpha plus beta alpha plus beta and this whole square. Now if you look at here, in these conditions, this is plan that we in these conditions beta is equal to beta is equal to zero beta is equal to zero, then what is about alpha, this alpha.

If you look at this alpha this alpha is state vertical; that means, this alpha is equal to ninety degree. And what is out raw what is out a raw value is a failure amble of raw value you can you have an a taken it here and what is value of delta delta is equal to seventeen degree f y is equal to thirty degree f y is equal to thirty degree. Now if you would find it out with alpha beta if you terms are delta delta alpha beta beta now k a is to be find it out which is equal to zero point two nine nine are the soil value is same for the both this sides. So, k a is equal to k a dash similarly for k p. Similarly for k p, if I say to find it out the k p, now I can change with this equation.

What is the value of k p k p is equal to sign square alpha minus f y and this is your sign square alpha sign square alpha plus delta and one plus one this is not plus this is your minus root over sign f y plus delta sign f y plus beta. Now sign alpha plus delta sign alpha this is not f y we will are you alpha plus delta. Now sign alpha plus beta this is the value of this is the derivation of k p then putting this value you can find it out k p is equal to k p is equal to five point three eight five five point three eight five which is equal to nothing but k p dace. That means, first step these case and you find it out k a k p k a dash k p dash because these are all your earth presser distribution, earth pressure values active earth pressure k a and k k k a dash. There is a earlier if the soil conditions are same soil conditions are same; that means, k a is equal to k a dash

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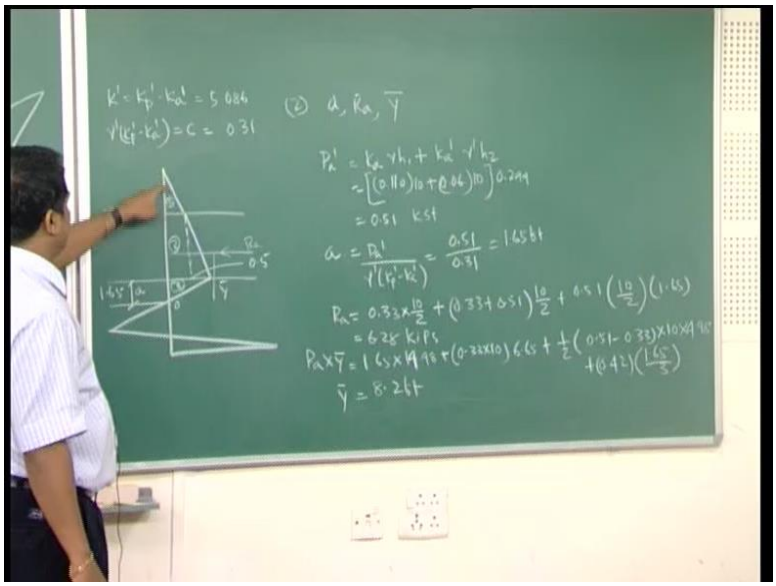

Now, k dash is equal to k p dash minus k dash which is equal to five point zero eight six now gamma dash k p dash minus k a dash which is equal to let us c which is equal to zero point three one. Now if I draw the actual pressure distribution diagram how it looks as we have explain on derived yesterday this is my wall now the there is a what a table somewhere else here. So, actual pressure distribution diagram will be this will go and this way then it will go somewhere else then it will go in this way. Now you have to find it out the area how to calculate this earth pressure earth pressure value unless otherwise you do not find it out the area. How do calculate you know the k a and k p now you can divided into number of parts number one then put it number two then put it number three like this. And this is your distance say point a at point o it distance say point a now next step is your step two find a R a and y bar.

A is your distance a is equal to distance below the dredge line where it rotate it rotate some points that is a point of rotation and now that your point of rotation, and y bar r a is equal to your result temperature acted somewhere else we are result temperature acted at a distance from here decider. How much it is it is you y bar now calculate a y bar. If you go back to previous whatever we have derived p a prime is equal to k a gamma h one plus k a prime gamma sum merged h two. Now this I calculate zero point one one zero into ten plus zero point zero six into ten into zero point two nine nine which is equal to zero point five one k s f.

Now if you go back to last class derivation, I have derived that. How to get your point a value a is nothing but is your d a prime divided by gamma sum merge k p dash minus k a dash which is is equal to your zero point five one by zero point three one which is is equal to one point six five feet. Now we got this is the value this is the value p a dash this is how much it is coming zero point five point he distance we got it your one point six five one point six five, this is your next step.

Now find it out, what is the value of resultant R a. R a is equal to zero point three three into ten by two plus zero point three three plus zero point five one into ten by two plus zero point five one ten by two into one point six five, which is equal to your six point two eight. So, R a generally R a act that is a distance y bar from point of rotation. This is the point of rotation r a result and force acted distance y bar from the point of the rotation now will calculate your point of rotation means y bar.

If I say R a into y bar is equal to one point six five into fourteen. Fourteen point nine eight plus zero point three three into ten six point six five plus half into zero point five one minus zero point three three into ten into four point nine eight plus zero point four two into one point six five by three which is equal to eight point two feet. Now we get the result and forces r a by taking this tranquil by taking a area area into k a or k p you can find it out result and force means forces act tranquil one means portion one two three then then you can find it out what is a result an forces.

These result and forces at what distance it act from the point of rotation that also we calculated y bar is equal to from point of rotation this to be decider is it your eight point two feet now point of a rotation also will get it one point six five feet now next step is your find the value of find the value of d

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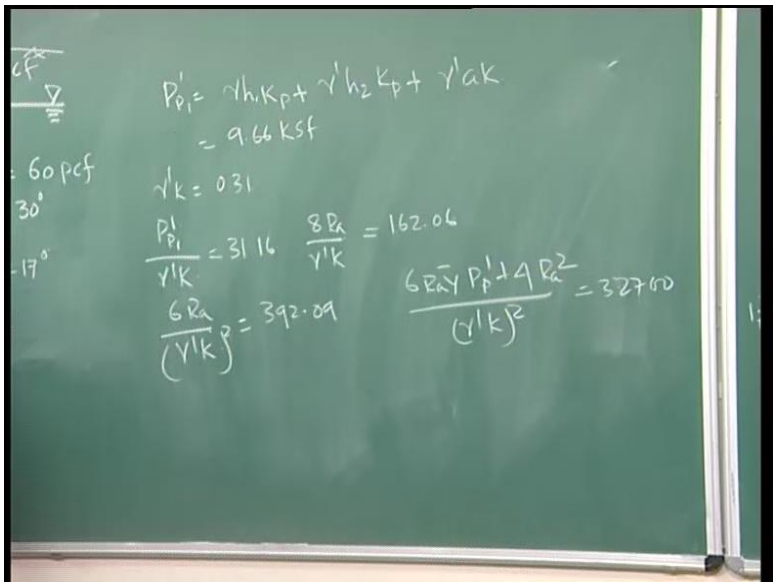

Now, if i say this is my p p dash. What is the value of p p one dash is equal to gamma h one k p plus gamma sum merged h two k p plus gamma into k. From there, it comes out to be nine point six this and gamma sum merged k is equal to zero point three one now p p one dash by gamma sum merged k which is equal to thirty one point one six. Now eight R a by gamma prime k which is is equal to 162.06. Now six r a by gamma sum merged k hole square which is equal to three ninety two point zero nine. Now if you look at this what is the formula generally find it out we have derived. The formula to get it this is your formula now also you can get it six r a y bar p p dash plus four r a hole square by you are gamma sum merged hole square this is your three twenty seven point zero zero

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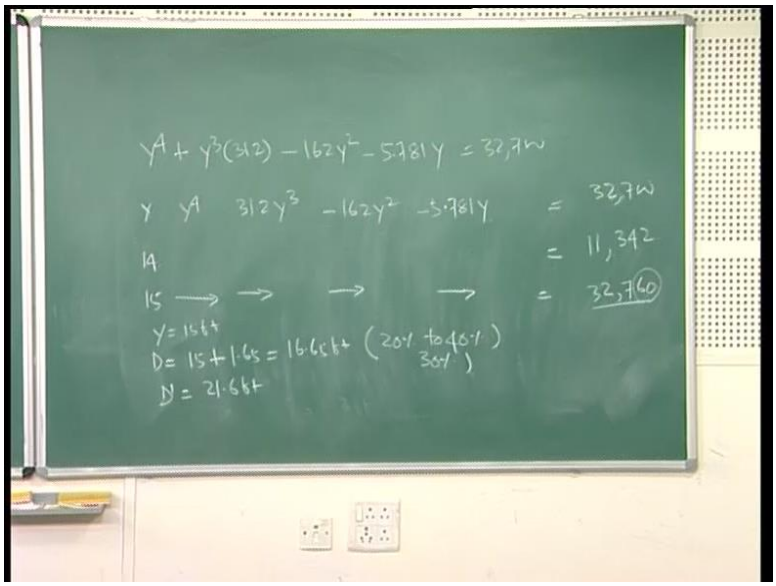

Now, if I put the equation y forth plus y cube. This is the terminology I have calculated from here, then thirty-one point two minus hundred sixty two y square minus five seven eight one y is equal to thirty two seven hundred. These has to be solve by means of trial and error means, write y ten y forth then thirty one point two y cube, then hundred sixty two point y square then minus five point five point seven eight one y and this would be your thirty two thirty two seven hundred. If I put the value of because this is a trial and error, you can considered value start with a value initial value by assume value.

See how for it is, it should be equal because this is forth requisition it should be equal how for it is varying from this. Let us start with a value of fourteen now, this value of fourteen you can calculate y forth y cube this you can calculate approximately coming eleven thousand eleven thousand three forty two eleven thousand three forty two now with this eleven thousand three forty two.

If I take another value of fifteen y is equal to fifty then you calculate all other parameters all other parameters are it is given. So, this value is coming approximately thirty two thousand seven hundred sixty. How these has been calculated this has been calculated based on your approximation solution; that means, you have to start with work particularly y area value of assume value of y. Once you are taken is it fourteen then you can say that it is less than this then you increase to fifty you see that how much it is coming it is lightly larger than this.

So, it will count between fourteen point nine eight or fourteen point nine six. These range it will from now once will get the value let us a y is equal to fifteen. Let us a y is equal to fifteen feet now you can get it d is equal to fifteen plus one point six five which is equal to sixteen point six five feet. Now as I said this is the value of d where getting sixteen point six five feet from the example, you have to use the factors of setting; that means, increase between fifty percent two forty percent value. Lets a thirty percent increase, let us a thirty percent increase; that means, the prime is equal to twenty one point six feet the one, means as I said earlier the d value to be whatever you get the d value.

With that d value increase, a factors twenty to forty percent, we have take and thirty percent either you take factors of here or you take factors of in the value of k a or k p it is your one point five times it can take a t y one point five times. So, you are getting d prime is equal to twenty one point six feet; that means, with these value it is just able it is just able with value increase this from twenty one point six feet it is safe to be safe or it will be more than more than safety it can is said that. So, other is a set, these completely to has been calculated by means of trail and method and this is able generally equation past you have to find it out draw the diagram find it out to you water table where water table is line.

Once you get your water table find it out to value of k and k p the way I calculated. Once you get the k and k p, draw the diagram it draw earlier diagram and point it out, point a a is a point of rotation, this is point a ,below this point of rotation then find it out resultant force R a, and point of the distance resultant, course point of rotation. Once you get R a, and y bar then find it out the terms. In these y bar, y q y square these are the terms we calculated from these based on these equation, these are the terms, I will calculated. Now once you put this value and find it out what is this is the given value.

These says this is the value of h; that means, this is the external code apply these load is given earlier. So, once this is given will these fourth order equation you get it now the question is how much they have I can penetrate this a completes it file wall. So, once you put it the value by trial and error, you can find it out, what is your depth. These are depth is sixteen point six five feet then from their if put your factors of t then this is your depth is to go up to the one point six feet. Then this will be stable, this will the stable and more safe and if you provide d is equal to fifteen feet this is just about to take if anything load

coming, it will fail immediately. So, how is this is one of the example problem, how we have solve. Next class I will try to solve one more problem.