Geotechnical Measurements and Explorations

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Lecture No. # 15

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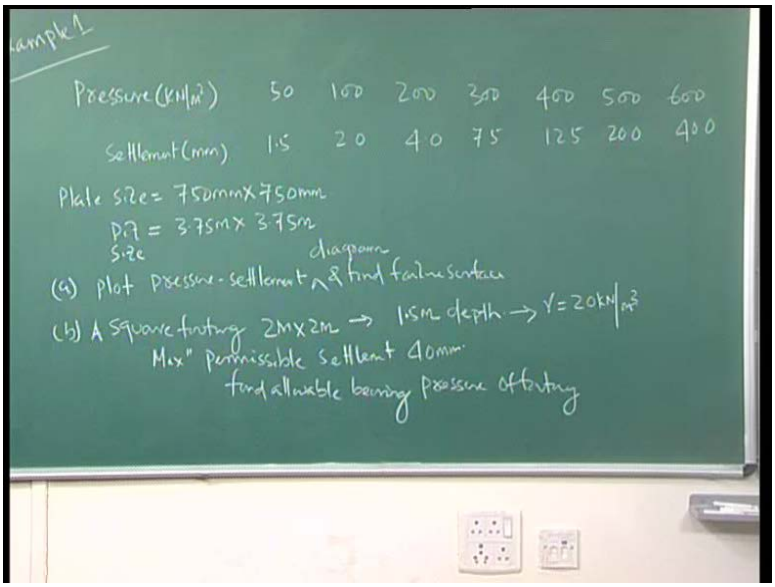

Let us solve some problems example one, it is given plate load test was conducted on a uniform deposit of sand, and the data's are given pressure - kilo newton per meter square, and settlement in mm; for pressure is equal to 50, 100, 200, 300, 400, 500, 600. The settlement is 1.5, 2.0, 4.0, 7.5, 12.5, 20.0, 40.0; plate size given 750 mm by 750 mm, it is a square size, and pit size is pit size 3.75 meter by 3.75 meter.

Now, question is plot pressure settlement, and find failure surface, then b is your a square footing a square footing 2 meter by 2 meter is to be founded in at 1.5 meter depth, maximum permissible settlement maximum permissible settlement 40 mm, find allowable bearing pressure of footing, gamma here it is given in for particular soil, gamma is equal to 20 kilo newton per meter cube.

Now, this is the example a plate load test has been conducted from that plate load test, this is these are the data's of pressure versus settlement, and plate size is 750 mm by 750

mm, pit size is 3.75 meter by 3.75 meter, from these it has been asked plot pressure versus settlement diagram, and find failure surface. Plot pressure versus settlement diagram, and find failure surface; part b - in that particular area a square footing 2 meter by 2 meter has to be constructed. And it will be rested at 1.5 meter depth below the ground surface, 1.5 meter depth below the ground surface, and particularly that ground gamma value is 20 kilo newton per meter cube, and for maximum permissible settlement of 40 mm for square footing find allowable bearing pressure of footing.

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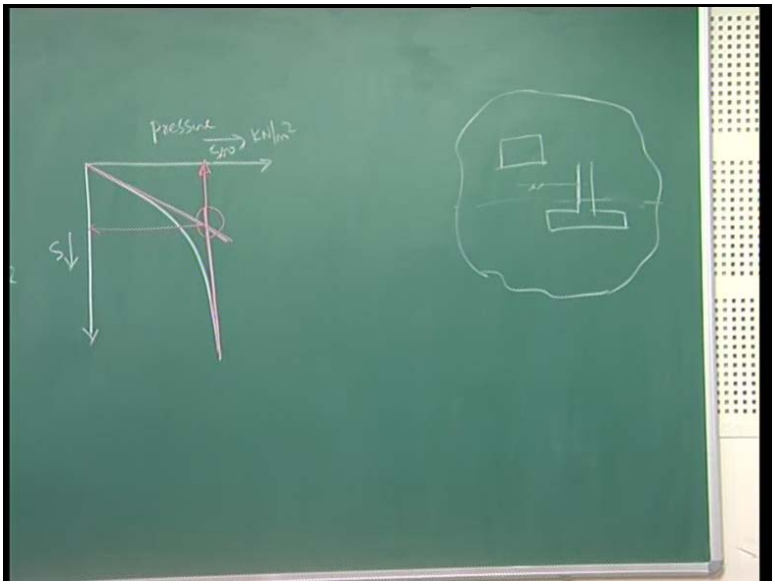

Now answer, let us say part A - with this help of pressure versus settlement draw pressure settlement diagram, it is your settlement, this is my pressure - with this pressure settlement diagram by means of double tangent method as I said, yesterday initial part of this curve is linear with this a tangent has been drawn, and bottom at the bottom part of the curves it is asymptotic, that part of this also a tangent has to be drawn. And the intersection point where it intersect has taken as failure point, and that point corresponding to pressure that is your failure pressure, and corresponding to settlement that is your failure settlement. So, here it is coming 500, coming 500 500 kilo newton per meter square.

Now, in this case q ultimate is equal to 500 kilo newton per meter square of plate. Now, the movement you are going to find it out the allowable bearing pressure of footing, suppose this is an area; in this area a plate load test has been conducted, and that area

because in that area a footing has to be constructed, and it has to be laid below the ground surface say 1.5 meter. Now, to find it out bearing capacity of footing what you are supposed to get, one should get the value of phi from where this value of phi will come, if I know the ultimate capacity or ultimate bearing capacity of this plate, then from there we you can get your value, we means particularly value of the phi of soil.

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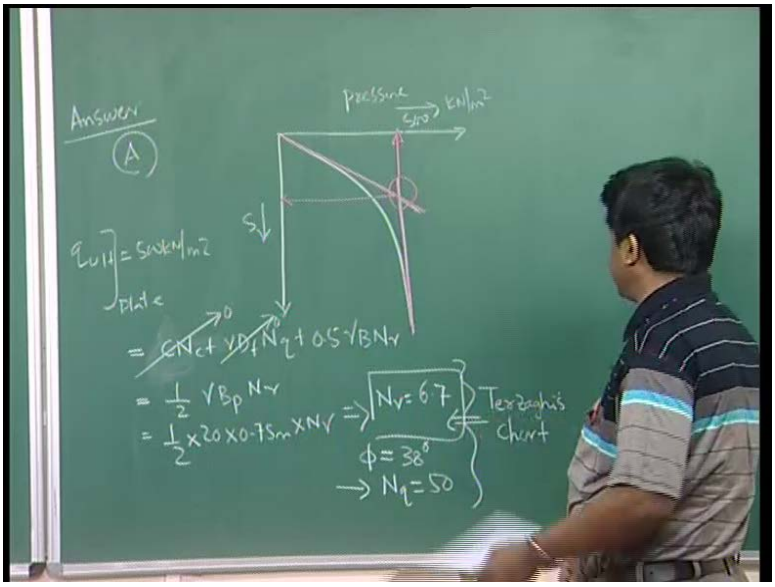

Now, q ultimate of plate is equal to half gamma if I write q ultimate is equal to CN c plus gamma D f N q plus 0.5 gamma BN gamma. Now, as it is cohesion less soil CN c is equal to 0, as depth of particularly plate - plate has to lie on the surface depth is 0; so it is is equal to 0. Now, this is equal to your half gamma B p; B p is p is your plate, B is equal to width B p N gamma.

Now, I know these values, so it is equal to half, gamma is equal to 20, B p is equal to 0.75 meter into N gamma, from there you can find it out N gamma is equal to 6.7 with N gamma is equal to 6.7 with N gamma is equal to 6.7, indirectly you can find it out phi is equal to 38 degree. Once, you get phi is equal to 38 degree from there, you can find it out N q is equal to 50, these you will get it from terzaghi's chart

Now, this is part one this is part one plot pressure settlement diagram, and find the failure surface with this help of whatever the data given pressure, and settlement - pressure settlement diagram has been done, and with this help of pressure settlement diagram initial part is linear, one tangent has been drawn. And the end part is asymptotic

another tangent has been drawn; with this intersection point this has taken as failure point with that intersection point corresponding pressure is taken as failure pressure, and settlement also value settlement. This is part one with this help of this ultimate bearing capacity of plate, indirectly we can get the value of phi from we can get N gamma from N gamma phi can get it; once you get phi then N q you can get it, these you can get it from terzaghi's chart.

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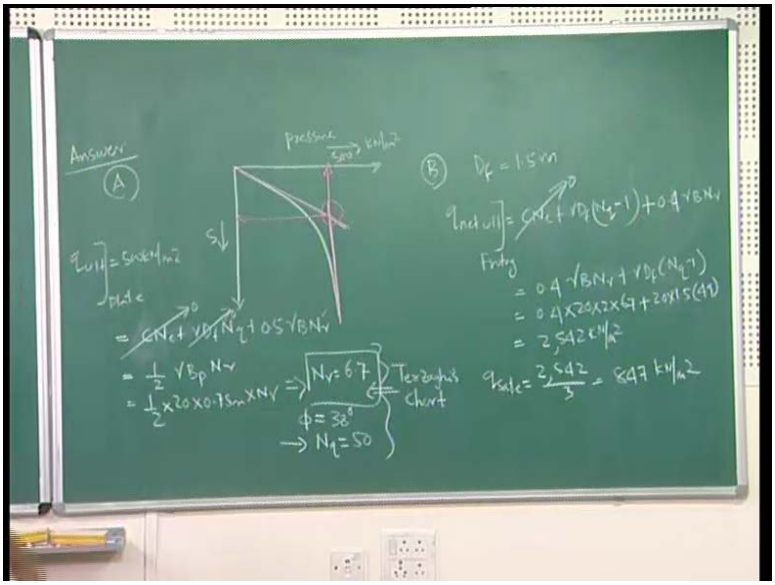

Now, part B: So, D f is equal to… It is given depth of foundation depth of foundation is equal to 1.5 meter, D f is equal to 1.5 meter, then you can find it out q net ultimate which is equal to 0.4 CN c - this is for your footing plus gamma D f N q, N q it is net N q minus 1 plus 0.5 gamma BN gamma. But in this case, it will be 0.4 as this is a for square footing this will be 0.4; this equation is for straight footing. So now, with this help as it is a cohesion less soil, so CN c is equal to 0 with that you will get it 0.4 gamma BN gamma plus gamma D f N q minus 1 which is equal to 0.4 into 20 into 2 into 67 plus 20 into 1.5 into 49. From there you will get it 2542 kilo newton per meter square, then q safe is equal to 2542 by 3 which is equal to 847 kilo newton per meter square, this is your shape bearing capacity

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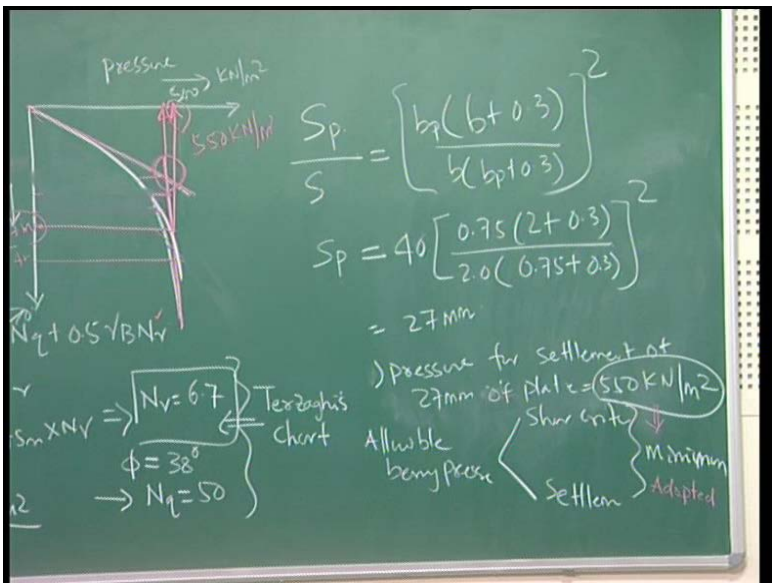

Now, it is given maximum permissible settlement of 40 mm, so that means settlement of plate by settlement of footing for as it is a footing settlement calculated in cohesion less soil, it would be b p into b plus 0.3 by b into b p plus 0.3 whole square. Now, S p settlement of plate corresponding to settlement of maximum permissible settlement of footing is given 40 mm which is equal to 40 into 0.75(2 plus 0.3) divided by 2.0 into 0.75 plus 0.3 whole square, which is equal to 27 mm. So, now with corresponding to maximum permissible settlement of 40 mm 40 mm, you are getting settlement of plate is equal to 27 mm, so with corresponding to settlement of plate 27 mm 27 mm.

So, this this will come somewhere else nearby, if I if I make it this plot with this corresponding to 27 mm, somewhere else it is coming 550 kilo newton per meter square. Now, you can write pressure for settlement of 27 mm of plate, which is equal to 550 kilo newton per meter square, secondly… So, then allowable bearing pressure bearing pressure, it is first one is shear criteria, second one is settlement criteria, then this is minimum. If you look at here, in the part A with this pressure settlement curve, we will get the failure, that is coming around 500 from there this phi, and N gamma N q has been calculated from there this bearing capacity of footing has been calculated, it was coming approximately 847, q safe of footing footing is equal to eight 847 kilo newton per meter square, it has come.

Now, based on settlement criteria maximum permissible settlement of footing is 40 mm from there from the settlement correlations, settlement of plate is 27 mm. So, this is 27 mm coming with corresponding to 27 mm, how much is your pressure is coming 550 kilo newton per meter square. So, now with these which one is smaller, whether 550 kilo newton per meter square is smaller, and this is because of your shear or 847 kilo newton per meter square is smaller, that means 550 kilo newton per meter square is smaller, these value is to be adapted - these value to be adapted.

Now, if you look at this questions it it says find allowable bearing pressure of footing, that means true two criteria has been consider: One is bearing capacity based on shear criteria, and bearing capacity based on settlement criteria with this bearing capacity based on shear, and settlement whichever is coming low or may be minimum that is should be adopted, in these case bearing capacity based on settlement criteria, it is coming minimum. So, 550 kilo newton per meter square has been consider for permissible or allowable pressure of footing.

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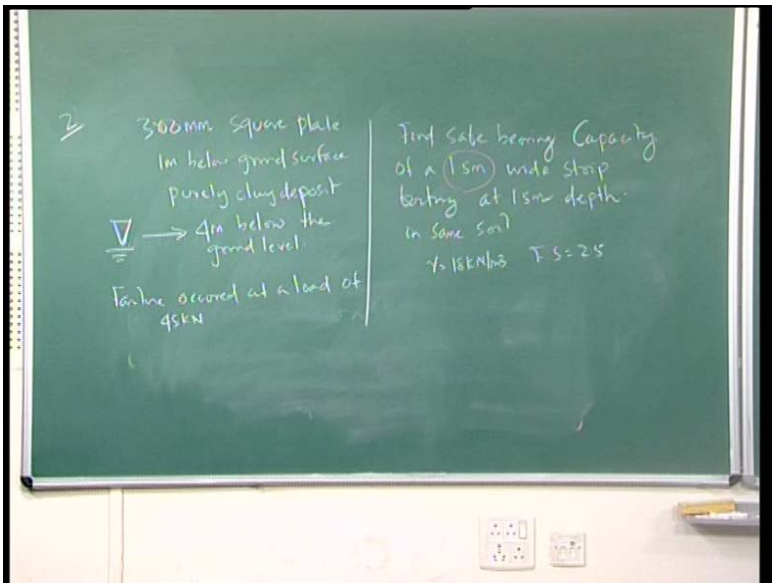

Now, come back to example two. Now, it is given load conducted, similarly for for this plate load test example two; the plate size is 300 mm, it is a square plate, and depth is equal to at a depth one meter below ground surface purely clay deposit.

The water table - water table is located generally water table we write in this way, water table is located at a depth four meter below the ground level, failure occurred at a load of

45 kilo newton at a load of 45 kilo newton. Now, this is for plate, now what is the shape bearing capacity find shape bearing capacity of a 1.5 meter wide strip footing at 1.5 meter depth in same soil, gamma you can take it 18 kilo newton per meter cube, and factors (( )) equal to 2.5. It is a similar kind of question of problem number one - example number one, but in this case this is a cohesive soil. So, 300 mm square plate, and one has been plate load test has been made with 300 mm square plate; one meter below the ground surface and it is purely clay deposit, and water table is located four meter below the ground level, and also given failure load is 45 kilo newton.

In the same ground, find the shape bearing capacity of 1.5 meter wide strip footing, 1.5 meter wide strip footing at 1.5 meter depth in the same soil gamma has been given, and factors of t was there. Now, you can find it out as plate size is 300 mm, what is the water table effect on plate size, if I look at this plate size is 300 mm.

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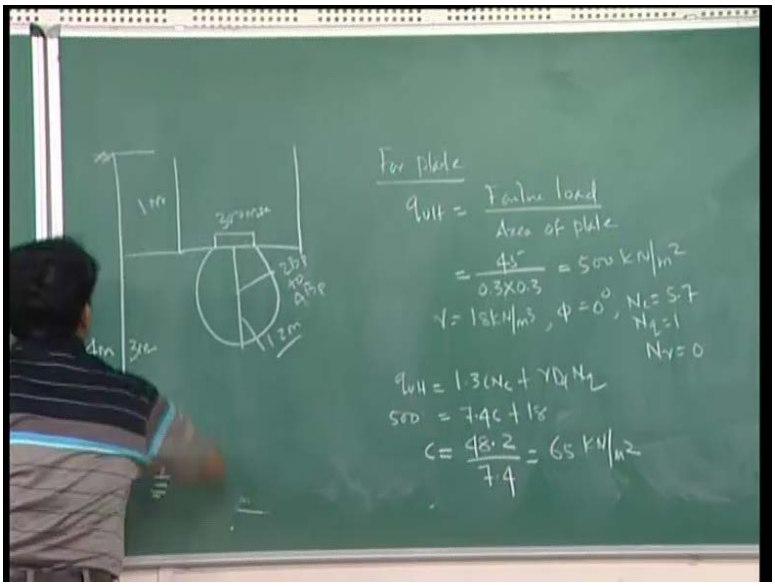

Now, below one meter it says below one meter plate was there, and it is 300 mm, this is one meter; so water table is located at four meter below the ground level. That means water table is located at four meter below the ground level, that means below this plate it is three meter water table, here is your water table. Now, this plate size is 300 mm, that means what will happen with your effect of water table. If I take draw the influence diagram of 2 B to 4 B; 2 B p to 4 B p - 4 B p is your width of plate size four times into 300, it would be one point 1.2 meter, that means water table has no effect in plate load

test, water table is far away from this influence zone of plate, it is below it is influence zone is up to 1.2 meter, and water table is located from plate is about three meter below.

Now, if I write for plate q ultimate is equal to failure load by area of plate, then which is equal to 45, failure load is given here 45 kilo newton 45 by 0.3 by 0.3. So, which is equal to 500 kilo newton per meter square, gamma is equal to 18 kilo newton per meter cube given, phi is equal to 0. So, phi as how phi is equal to 0, it is purely clay deposit cohesive soil, phi is equal to 0. Then as phi is equal to 0, N c is equal to 5.7, N q is equal to 1, N gamma is equal to 0. Why N gamma is equal to 0, because it is plate is lying on the surface.

So, with this help of N c and N q and N gamma q ultimate, you can find it out o1.3 CN c plus gamma D f N q as plate is a square plate, so it will be 1.3 CN c from there. You will find it out 7.4 c plus 18, which is equal to 500 q ultimate, you got it 500 kilo newton per meter square. From there I can find it out c is equal to 48.2 by 7.4, which is equal to 65 kilo newton per meter square.

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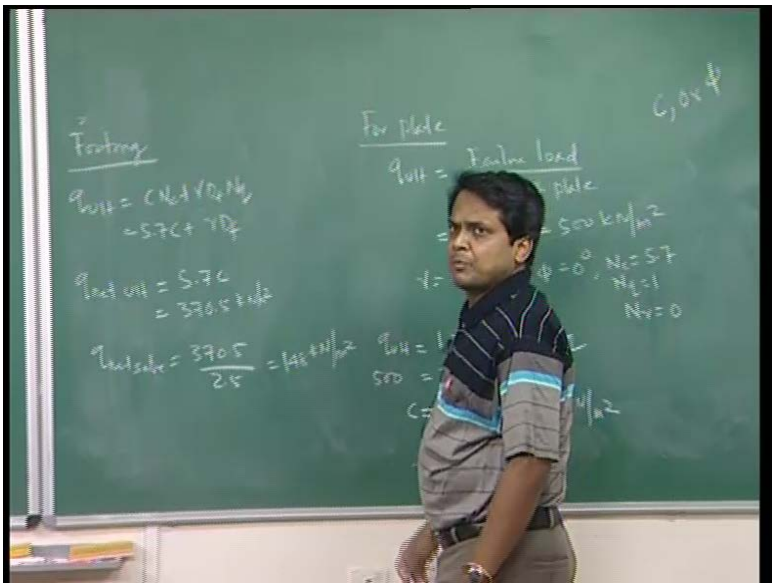

Now, for strip footing for strip footing, now you can write for footing q ultimate is equal to CN c plus gamma D f N q. So, which is equal to 5.7 c plus gamma D f, because N q is equal to 1, N c is equal to 5.7; so q net ultimate of footing is equal to 5.7 c, which is equal to 37.5 kilo newton per meter square, q net safe is equal to 37.5 by 2.5 is equal to 148 kilo newton per meter square.

Now, if look at the both the problems example one, example two. Example one was for cohesion less soil, example two is for cohesive soil; in this case from plate load test, you can find it out unknown parameter either C or phi, either C or phi. In second case unknown parameter C, you can get it from plate load test, we got it c is equal to 65 with use of C for footing - for footing, you can find it out net shape capacity.