Foundation Design
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Lecture - 7B
Bearing Capacity of Shallow Foundation- Part 6

Earlier I have finished effect of compressibility. So, theory has been given by basic 1973, why this effect of compressibility has come into picture because there are 2 criteria one is your local shear failure as well as general shear failure as per your Terzaghi's.

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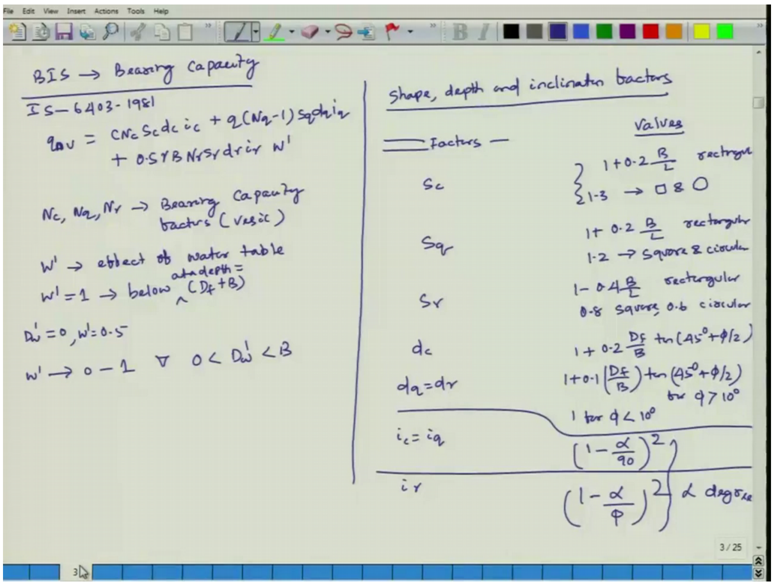

So, instead of taking empirical things so, basic as given effect of compressibility one example I have solved then bureau of Indian standard total provision what is your bearing capacity bureau of Indian standard provided; separate shape depth and inclination factor, they have also given water table corrections bureau of Indian standard.

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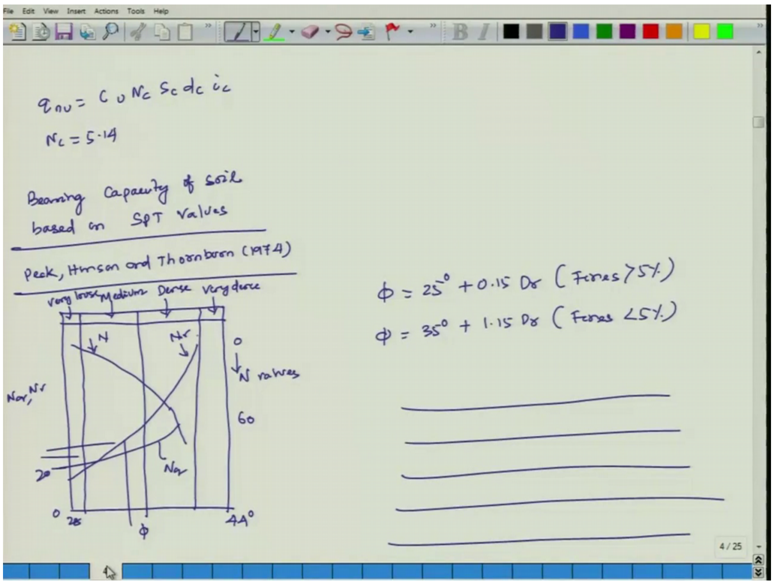

Then bearing capacity of soil based on your standard penetration values there are charts Peck Henson and Thornborn 1974 as given proposed bearing capacity of soil based on a STPN value from STPN value you can get the value of phi.

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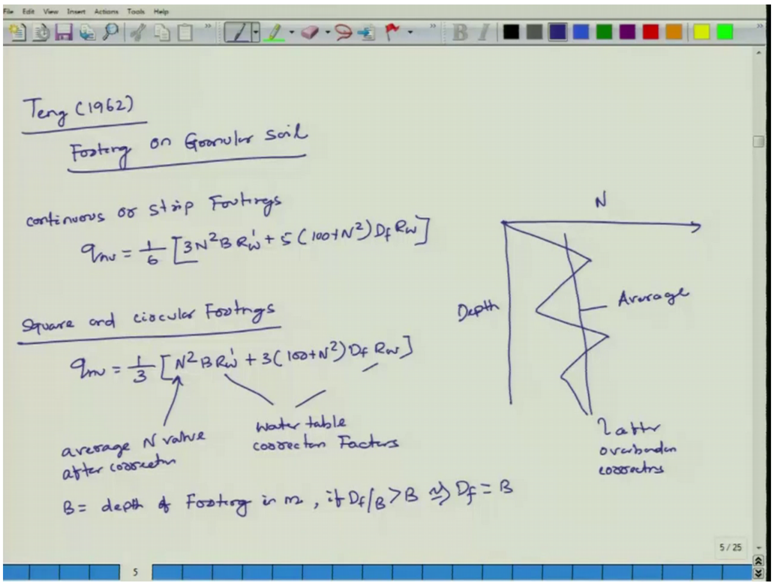

Once you get the value of phi then bearing capacity factor Nc Nq and N gamma we can get it directly up to this I have covered and Teng 1962; Teng 1962 he has given some empirical equation for ultimate bearing capacity of footings on granular soil footings on granular soil Teng as given 1962. So, continuous or strip footings strip footing qNu is equal to 1 by 6 3 N square b rw prime plus 5 into 100 plus N square df rw square and circular footings qNu is equal to one-third N square b gamma w prime plus 3 into 100 plus N square d f gamma w.

So, particularly if you look at here this gamma w prime gamma w this is your water table water table correction factors and when is your average N value this is your average N value after correction. So, basically Teng as given this bearing capacity equation based on your SPT N value some empirical or continuous as well as strip footing and square and circular footing. For example, suppose this is my N for number of penetration per blows and this is your depth and this kind of STPN value you are getting after taking into consideration of over burden corrections after taking into consideration of over burden corrections this is after your over burden corrections then once you plot the N versus depth from this N you have to find it out what should be your average value.

Once you get average value then from there you can find it out what is the value of your net ultimate bearing capacity because qNu is your net ultimate bearing capacity b is equal to depth of footing in meter if df by b is greater than b if df by b is greater than b then use df is equal to b then bearing capacity of granular soil from static cone resistance bearing capacity of granular soil from static cone test.

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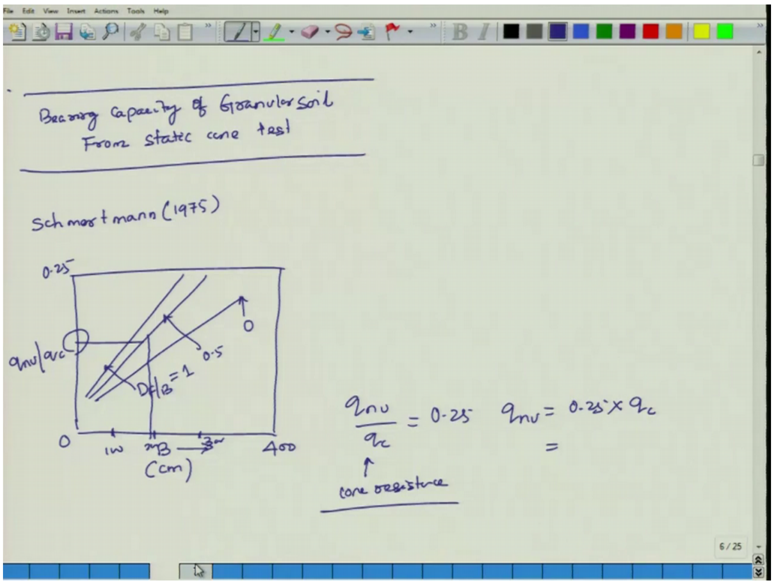

There are 2 test I have covered earlier in your geo technical measurements and explorations one is your standard penetration test other is your static cone test or cone penetration test.

So, this has been given by Schmort Mann 1975. So, they have given a chart this is b in centimetre width of footing in centimetre then here it will be qNu by qc qc. So, it is varying from 0 to 0.25 and width we have taken 0 to 400 centimetre. So, it will be 100, 200, 300, like this it will continue then. So, df by b is equal to 1 in this case then in this case 0.5 in this case 0. So, what will happen whatever the width is there from there if you are taking he has given a chart from the width you take it and for different depth width of the footing this charts has been given suppose df by b is equal to 0.5 and width b is equal to 200 from here you take it what is the value you are getting from here this value you find it out this will give in terms of qNu by qc; qc is your nothing but is your cone resistance.

So, you know the qc from your static cone test whatever you are getting the value suppose you are getting 0; 0.25 then net ultimate bearing capacity is equal to 0.25 into qc you are getting this value.

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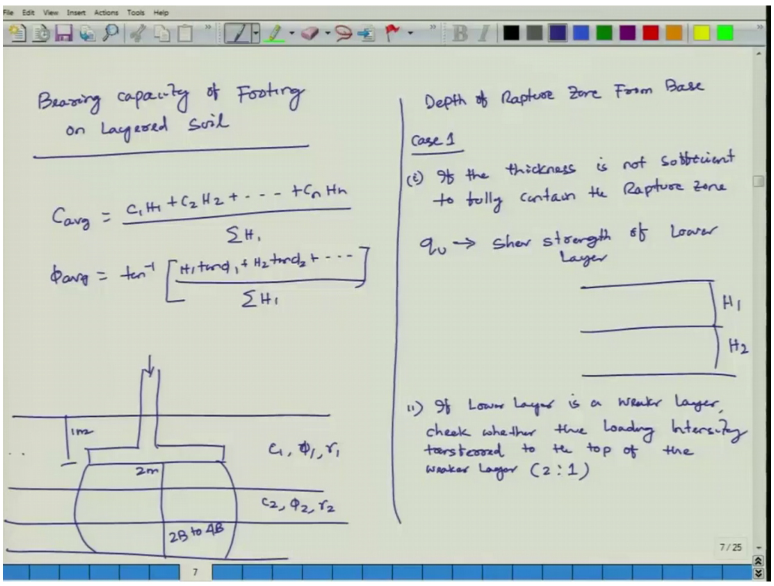

So, directly you are getting bearing capacity from SPT standard penetration test and from also static cone test you can get it. Now next part is your next part is if you come back to bearing capacity of footing on layered soil bearing capacity of footing on layered soils.

So, particularly layered soil layered soil you can always in case of layered soil you can always find it out what is the value of your c average as well as phi average c average is equal to C 1 H 1 plus C 2 H 2 plus Cn Hn divided by height suppose take this example there is a footing suppose to be constructed below depth of say one meter and this is your 2 meter and these are all layered soil it had been provided c 1 phi 1 gamma 1 C 2 phi 2 gamma 2 like this.

So, in this case depending upon that either you calculate individually because what will happen in layered soil you have to find it out suppose this is a 2 meter 2 times to 4 times of b this is your influence zone it will be 2 b to 4 b. So, 2 b to 4 b means 2 b means you are taking 2 into two. So, it will be a 4 meter it will be 4 meter. So, in that case in 4 meter what are the value you are getting c one phi one gamma one c 2 (Refer time: 12:00) phi 2 gamma 2 c 3 phi 3 gamma 3 c 4 phi 4 c 4 phi 4 gamma 4 instead of calculating one by one you can take one cu average considering this 1 2 3 4 layers and also you can find it out phi average it will be tan inverse H 1 tan phi 1 plus H 2 tan phi 2 like this you continue and total height you are considering this is a general philosophy, but there are different conditions there are different theories also for layered soils this is a out of scope generally in advance geo technical engineering advance foundation design foundation engineering in that case particularly master of levels this in details in layered soil how do you calculate bearing capacity that will be discussed.

So, if case one if the thickness of top layer is not sufficient to fully contain the rapture zone. So, depth of rapture zone from the base first finds it out depth of rapture zone from base. So, once you find it out case one if the thickness is not sufficient to fully contain the rapture zone rapture zone. So, ultimate bearing capacity ultimate bearing capacity is generally you consider shear strength of lower layer. So, be there are 2 layers here and here.

So, thickness of upper layer suppose this is your H 1 this is your H 2 suppose thickness of upper layer is not sufficient to take your rapture zone then in that case ultimate bearing capacity you can consider taking into shear strength of lower layer S 2 layer case 1 case 2 layer 1; case 2 if layer is a weaker layer check whether the loading intensity transfer to the top of the weaker layer if lower layer is a weaker layer check whether the loading intensity transfer to the top of the weaker layer or the not by means of 2 is to one distributions.

So, this there are many conditions are there we will solve also problem while doing design your foundation with because every time you will encounter layer soils it is not going to be a kind of single soil layer either coarsen less or may be coercive soils it is a layered soils. So, it will be it is consist to map c phi c one phi one gamma one these are there. So, more discussion I feel will continue about your layered soil while designing the foundation particularly after these settlement calculations I will discuss more about this. So, now come to one example simple example.

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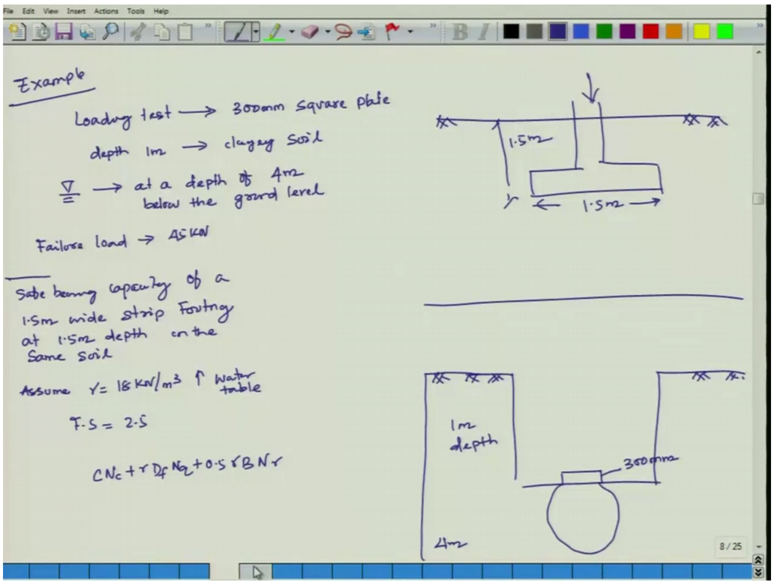

A loading test was conducted with a loading test was conducted with a 300 mm square plate; that means, it is a plate load test at a depth; depth one meter below the ground surface in a purely clayey soil water table is located at a depth of I can put the symbol like this water table is located at a depth of 4 meter below the ground level failure occur at a load of tans plate load test failure load failure load is given that is your 45 kilo Newton, this is what is about your plate load test the question is what is the safe bearing capacity of a safe bearing capacity of a 1.5 meter wide strip footing at 1.5 meter depth in the same soil assume gamma is equal to 18 kilonewton per meter cube it is above your water table and a factors of t 2.5.

So, there is a ground here there is a ground here in this ground it is propose to be a footing strip footing constructed a strip footing of 1.5 meter wide this is your b and depth of the foundation is also given this is also 1.5 meter this is what suppose to be proposed in suppose to be constructed before constructing it has been advised to go for a plate load test and in that plate load test how it has been carried out the plate load test it has been carried out below one meter depth below one meter depth the plate load test plate size is 300 mm and it is a square plate and it is a clayey soil water table is located at a depth 4 meter below your ground surface. So, from plate load test the failure load is observed to be 45 kilometres this is what is problem.

So, finding out this safe bearing capacity what is the formula Terzaghi's CNC plus gamma df Nq plus 0.5 gamma b N gamma basically you need to have to have Nc Nq and N gamma let us solve this problem. So, what will happen the plate size is 300 mm if I take it 4 times 4 into 300 that is your 1.2 plus 1; 1.2 below this plus 12.2. So, water table is located at 4 meter below your ground surface; that means, water table is at or below your ground surface. Similarly if I am taking a footing 1.52 b to 4 b it is also consider there is no effect of your water table.

So, 1.5 into 2 3 meter 1.54; 4.5 that would be find. So, effect of water table on plate load test is negligible. So, it does not affect.

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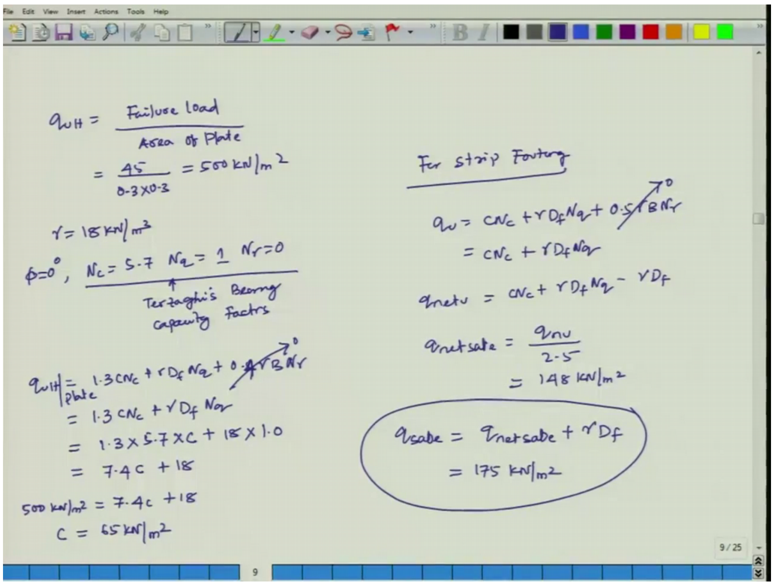

So, from plate load test q ultimate is equal to failure load divided by area of plate which is equal to 45 by 0.3 into 0.3 which is equal to 500 kilonewton per meter square. So, gamma is given 18 kilonewton per meter cube this is remember this is a coercive soil there is no phi so; that means, phi is equal to 0 for phi is equal to 0 earlier I have given the chart Terzaghi's bearing capacity factors charts in Nc Nq and N gamma bearing from phi is equal 2 phi is equal to 50 degree.

For phi is equal to 0 degree Nc is equal to 5.7 Nq is equal to 1 N gamma is equal to 0, this value I have taken from Terzaghi bearing capacity factors or from his charts. So, then q ultimate if I calculate this is a square footing this is not a strip footing for square footing Terzaghi has given 1.3 CNC plus gamma df Nq plus 0.5 gamma b it will be 0.4 not 0.5 gamma b N gamma then because N gamma is 0 this term will be 0 then will be 1.3 CNC plus gamma df Nq. Now from there it is coming out to be 1.3 into C is equal to 5.7 sorry 5.7 C, I do not know Nc is equal to 5.7 c is equal to C gamma df gamma is 18 into depth of this particularly plate load test this is for plate this is for plate this is for plate depth of this plate load test is your one meter.

So, this is coming out to be 7.4 c plus 18 now ultimate load of the plate we are getting from failure load by area this is your 500 kilonewton per meter square now if I put it 500 kilonewton per meter square is equal to 7.0 c plus 18 from their I can get c is equal to 65 kilonewton per meter square. So, basically c parameter has to be calculated from the plate load test once ultimate bearing capacity or failure load is given now for strip footing it has been acts for strip footing, it is a strip footing it is a no more square.

So, here ultimate bearing capacity is strip footing CNC gamma df Nq plus 0.5 gamma b N gamma and this is your 0 which is equal to CNC plus gamma df Nq and net ultimate bearing capacity q net ultimate bearing capacity CNC plus gamma df Nq minus gamma df. So, q net safe is equal to q net ultimate bearing capacity divided by factors of t 2.5. So, this comes out to be 148 kilonewton per meter square, because you know the C; you are getting from plate load test Nc value is your 5.7 per phi is equal to 0 Nq value is your one df is given 1.5 gamma is value is given.

So, this comes out to be one forty eight kilonewton per meter square. So, q safe it is not net safe q safe is equal to q net safe plus gamma df which is equal to 175 kilonewton per meter square. So, basically from plate load test we are getting the value of c taking this c value also from plate load test phi is equal to 0 from there you can calculate Nc Nq and N gamma taking the value of this c obtain from plate load test and putting it for strip footing, we can get it safe bearing capacity of your strip footing. We solve many more problems at this class is progress I will stop it here.

Thank you.