Foundation Design
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Lecture - 13A
Design of Foundation- Part 2

Last class started a design problem this is what given one interior column.

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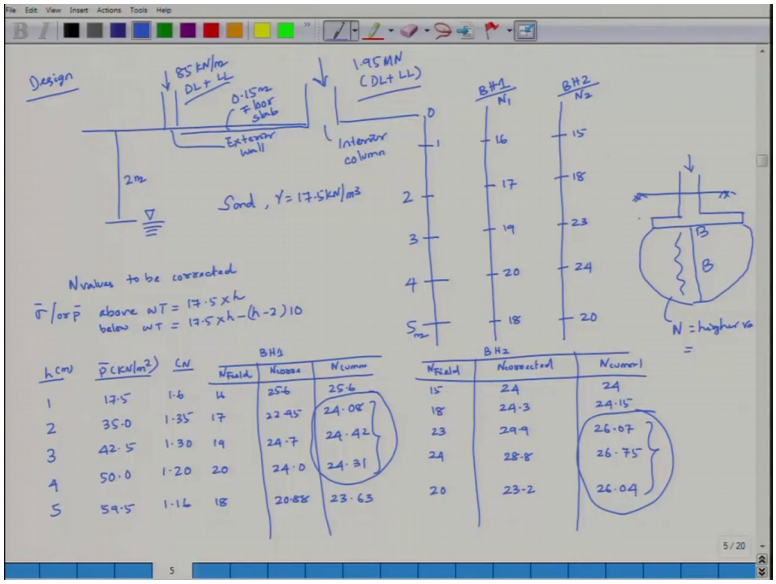

Column load is 1.95 mega Newton, so it consists of dead load plus live load. And there is one exterior wall loading density is coming 85 kilo Newton per meter. Generally in this type of design for all buildings generally we provide 0.15 meter of your floor slap. And this soil consists of sand and gamma is given 17.5 kilo Newton per meter cube, water table is located at depth 2 meter below the ground surface. So, there are two boreholes recording borehole 1 and borehole 2 and an n value has been given up to 5 meter depth.

Now, let us start this design. So, first your n value is to be corrected. So, sigma prime or p prime above water table which is equal to 17.5 into h; and it is below water table which is equal to 17.5 into h minus h minus 2 into 10. So, below your water table that would fine. So, put it in a tabular form h in meter, p prime in kilo Newton per meter square. Correction factor you can get it from IS score. Then borehole 1; in borehole 1, there is one n field then n corrected, then your n cumulative average. And second one is your borehole 2, again it is n sorry field n corrected then n cumulative average.

So, if I take it in a tabular form that will give me idea. So, h in meter that is your 1 meter, 2 meter, 3, 4 and 5. P is equal to 17.5, for 2 is equal to 35.0 p prime is your over burden, above water table and below water table it had been calculated, then 42.5, then 50.0, then 59.5. Correction factor is your 1.6, 1.35, 1.30 and it is your 1.20, and this will be 1.16. And field is your which is given that is 16, 17, 19, 20, 18; and corrected 25.6, 22.95, 24.7 then 24.0 20.88; and cumulative is your 25.6 then 24.08, 24.42, 24.31 then 23.63. Here it is 15, 18, 23 per borehole 2, 24 and it is 20. N corrected is your 24, 24.3, 29.9, 28.8 and it is 23.2; n cumulative is your 24, 24.01, 26.07, then is your 26.75, then it is your 26.04.

Now, once you have taken the n cumulative, many books if you see they assume the width of the foundations as an trial and error, but here it is not true. If this is the case suppose for example, interior column is there, suppose there is a footing has to be provided; this is my load. I will look a depth forward fast below the ground surface at which my SPTN cumulative values are consistent. If you look at here between 2 to 4, here it is between cumulative average 3 to 5, we are getting almost equal values of n cumulative. Now, as foundation has to be provided. So, minimum depth of the foundation generally provided it varies us from 0.5 to 1 meter.

So, then we have to choose size of the footing in such a way that and this is B this should be at least B. And within this zone, the SPTN value should have higher value should have higher value what does it means; that means, it will take the load because this is our load intensity within this zone, it will take entire load, beyond this it is not effective. So, that is a region you can choose your footings either placing 2 meter, 3 meter or 4 meter below the ground surface depending upon whether you are getting and size, so that the pressure intensity whatever it covered it covered within this zone, within this zone as well as within this zone. Here the values are quite consistent and said it is 24.08, 24.42, 24.31, here it is 26.07, 26.75 and 26.04. This is the concept, no assumption about your foundation size as well as depth. I will assume in such a way that my depth of the foundation, so that my width of the foundation I will take it the pressure wall pressure intensity should come within this region as well as within this region.

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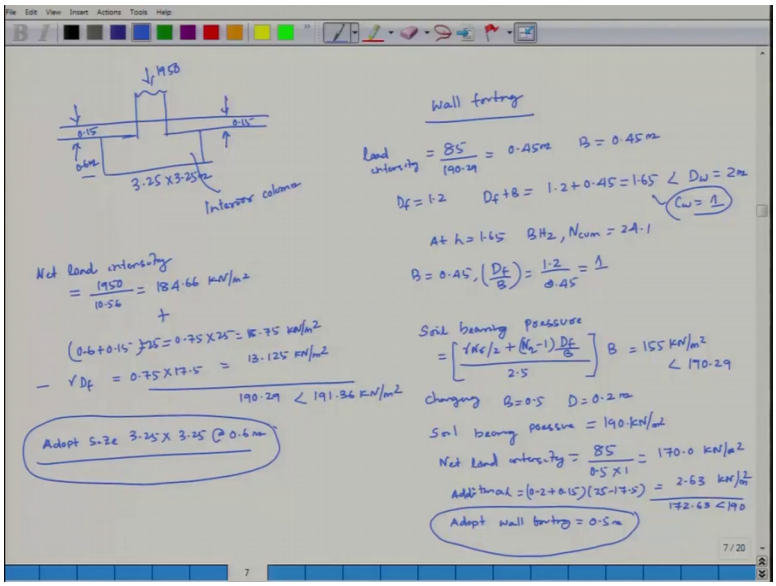

Let us start it. So, column footing interior column footings and this settlement is given permissible settlement is your 25 mm. Assuming settlement governs design, why it is assuming settlement governs design because the permissible settlement is already given; it should not be more than 25 mm. So, then you consider n is equal to 24, and h is equal to 4, height or borehole 1. Then in that case spc, what is your spc, spc is your soil pressure settlement considering settlement as the criteria.

So, then sps is your 10.5 into n, 10.5 into n, it comes from here asp allow soil pressure or sps 10.5 mm for 25 mm settlement; for 50 mm it is 21 n. Then it comes out to be 252 into 0.7 minus 0.7 to 0.8 water table, some water table correction has to be taken so here 191.52 kilo Newton per meter square. So, area required area is your 1950 from where it has come here 1.95 mega Newton. So, 1950 Newton divided by 190 sorry kilo Newton 1950 kilo Newton divided by 191.52. So, this comes out to be 10.18 meter square. So, then once it is 10.18 meter square area, then the size of the footing size, let me take it 3.25 by 3.25 and which is your 10.56 meter square which is greater than 10.18, 10.18 is your required area. So, it is ok now.

Now, this 3.25 has to be put it, size of the footings is your 3.25; at least here it should be 3.25. So, if it is given up to 5 meter, so 3.25 let us see. So, take the depth of the foundations depth of the foundation is equal to 0.6 meter. So, then actual what is the height you are getting, what is the h you are getting 0.15, where is your 0.15 coming slab

- floor slab 0.15 plus 0.6 depth of the foundations plus 3.25, 3.25 is your width because then up to here, this b minimum b 3.25, then it is coming like at 4 meter for borehole 1.

So, consider that 4 meter is ok with the size which has been identified the complete size of the foundation, complete size of the foundation size. This is your 3.25 meter by 3.25 meter and depth of the foundation is equal to 0.6 meter. This is your size you got it. Then we have to check with this size whether this bearing capacity and settlements are coming within this permissible limit or not with this size we have to check it.

So, then soil-bearing pressure, soil-bearing pressure; so sbp - soil bearing pressure is equal to gamma n gamma by 2 plus n q minus 1 into D f by B, let me take factors of t is equal to 2.5 into B. So, you can easily find it, for n is equal to 24 what is the value of n q and n gamma n is equal to 24 you can find it out what is the value of 5 then from there you can find it out n q and c gamma. So, this I leave it you, you do it and check whether this calculation is correct or not. So, this comes out to be 255.15 kilo Newton per meter square.

Now, a water table correction, so water table corrections has to be added: water table water table corrections C w is equal to 0.5 plus 0.5 2 by 0.6 plus 0.15 plus 3.25 which is equal to 0.75. Here it is 0.5 plus 0.5 D w water table is located at 2 meter D f plus B, water table is located at 2 meter. So, it is here 0.5 plus 0.5, 2 meter. D f 0.6 depth of the foundation plus floor slab 0.15 plus footings size 3.25, this your 0.75. So, soil bearing pressure soil bearing pressure, which is equal to 255.15 into 0.75, which comes out to be 191.36 kilo Newton per meter square; soil pressure considering settlement, which is your 191.52. So, generally minimum value you have to take it. So, minimum is your 191.36, hence bearing capacity is calculated as 191.36 kilo Newton per meter square.

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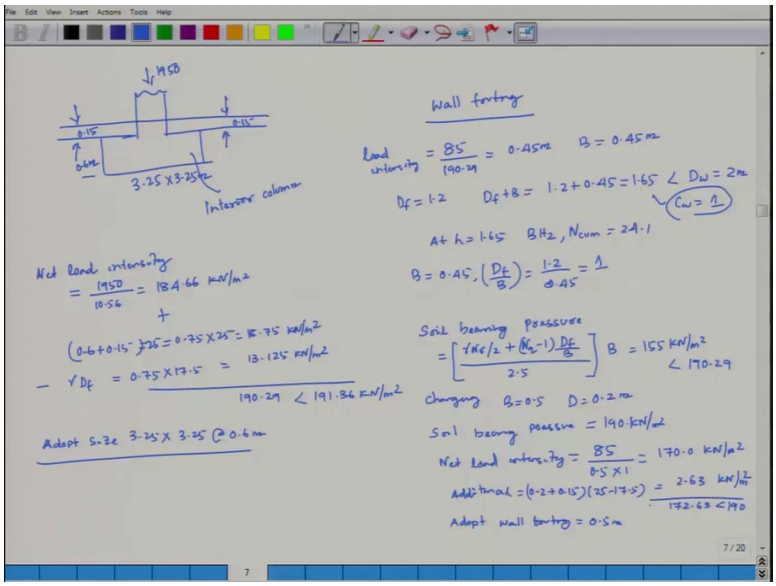

This is what floor slab 0.15, and footings size is your 3.25 by 3.25 meter, and this is your 0.6 meter. So, this is your interior column. Now, net load intensity, let us see net load intensity. Net load intensity is equal to 1950 by 10.56, 10.56 is actual area. So, it is coming out to be 184.66 kilo Newton per meter square plus there is a concreting here. So, this has to be 0.6 plus 0.15 which is equal to this into 25 which is equal to 0.75 into 25, 25 is the concrete density. So, which comes out to be 18.75 kilo Newton per meter square minus gamma D f which is equal to 0.75 into 17.5 which comes out to be 13.125 kilo Newton per meter square which comes out to be 190.29 and which is less than 191.36 kilo Newton per meter square.

So, after checking it now it is fine; it seems it will come out it will come out to be fine because we have taken care of that preserver. So, now final recommendation adopts size 3.25 by 3.25 at a depth of 0.6 meter. Similarly, you can check for your wall footings. At the end of the wall footing, this is about your bearing capacity and settlement based on your 10.5 n values. At the end also you have to check also how much is the settlement that has to check even if it is 10.5 mm considering 25 mm, you have to check once again.

So, next part is your wall footing exterior wall footings. Generally, wall footing these are walls coming exterior wall interior columns are their outside exterior walls are there. So, load intensity on column footing you can start with your load intensity is given how much 85 kilo Newton meter, load intensity 85 by your bearing capacity 190.29 which is

equal to 0.45 meter then B is equal to 0.45 meter. Then take D f is equal to 1.2 then D f plus B which is equal to 1.2 plus 0.45 - 1.65; 1.65 less than D w water table which is your 2 meter. Hence your if it is less than water table then correction factor is your correction factor for water table is equal to 1. So, at h is equal to 1.65, at h is equal to 1.65, so borehole 2 generally what happens out of this two boreholes if you look at here the borehole one has been taken from the interior column, borehole two taken nearby is your exterior wall. Then B H 2, N cumulative is equal to 24.1.

So, considering B is equal to 0.45 D f by B is equal to 1.25 by 0.45, it comes out to be 1. So, soil bearing pressure soil bearing pressure is equal to gamma N gamma by 2 plus N q minus 1 into D f by B 2.5 into B which is equal to 155 kilo Newton per meter square which is less than 190.29. So, this things you calculate based on your N values, you can find it out N q and N gamma, N gamma and N q because based on your N values you can calculate is your 5 then N q and N gamma. So, then we just change slightly changing B is equal to 0.5, D is equal to 0.2 meter. So, your soil bearing pressure soil bearing pressure which is equal 190 kilo Newton per meter square.

So, then net load intensity, we can very easily find it out net load intensity. Net load intensity which is equal to 85 load coming into then considering B is equal to 0.5 because this is a wall per meter length into 1, which is equal to 170.0 kilo Newton per meter square. Then additional which is equal to 0.2 plus 0.15 into 25 minus 17.5 which is equal to 2.63 kilo Newton per meter square, which comes out to be 172.63 less than 190 then you adopt wall footing which is equal to 0.5 meter 0.5 meter.

So, if I summarize what we have done this is the case has been given; one is your exterior wall, another is your interior wall. And it has been advised or it has been asked to design particularly for the loading is given 1.95 mm and exterior wall is your 85 kilo Newton per meter. And water table is located at 2 meter below the ground surface and this is a sandy soils. And there is a borehole one it has been this borehole has been made and SPTN near the interior wall and there is a borehole to near is a exterior wall.

So, basically an N value has been corrected, these are all field N values. So, C n values are taken from BIS - Bureau of Indian Standard we chat from there. So, with h, what is your over burden pressure C n for borehole 1 n field, n corrected and n cumulative for borehole to n field n corrected and n cumulative. If we look at this two basically we are

identifying a depth at which the SPTN value is consistent and slightly higher SPTN is consistent and slightly higher as compared to this so that if I can put a foundation in such a depth so that entire pressure bulb passes through this, then your foundation is set. In that case considering this parameter, so you have started with the interior column footing and it is given 25 of mm permissible settlement, this is your permissible settlement.

So, then N is equal to 24, h is equal to four for borehole one soil pressure considering settlement it is 10.5 mm. So, area is coming size of the foundation is coming 3.25 and depth of the foundation we are putting at 0.6, so that h is 0.15, this is my floor slab 0.6 plus 3.25, this is your floor. So, total size is coming 3.25 and 3.25, D f is 0.6. Here there is no assumptions based on the SPT value. Then we cross check with your soil bearing pressure water table corrections and bearing capacity comes out to be 1.9, 1.36 then with this net load intensity has been calculated then we conform that this size is fine, this size is fine.

Similarly, wall footing wall footing size has been found out by 0.5 meter. This is how it started, how we have to proceed the design. Only one part I left it that you can try that is your settlement, check the settlement whether it is coming below 25 mm or not. Considering this footing size that part I left it will come. Next class, I will go for footings in plane. I will stop it.

Thank you.