Foundation Design
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Lecture - 11A
Stress Distribution in Soils-Part 4

So last class, I have covered approximate stress distribution method or loaded areas because earlier we have covered what is the stress distribution because of point load line loads strip load circular loaded area rectangular loaded area. Now if you want to find it out very quickly what should be the method this is the approximate method has been prop proposed and it is by means of 2 is to 1 method. So, 2 is to 1 method means 2 vertical and one horizontal based on that of a rectangular loaded area.

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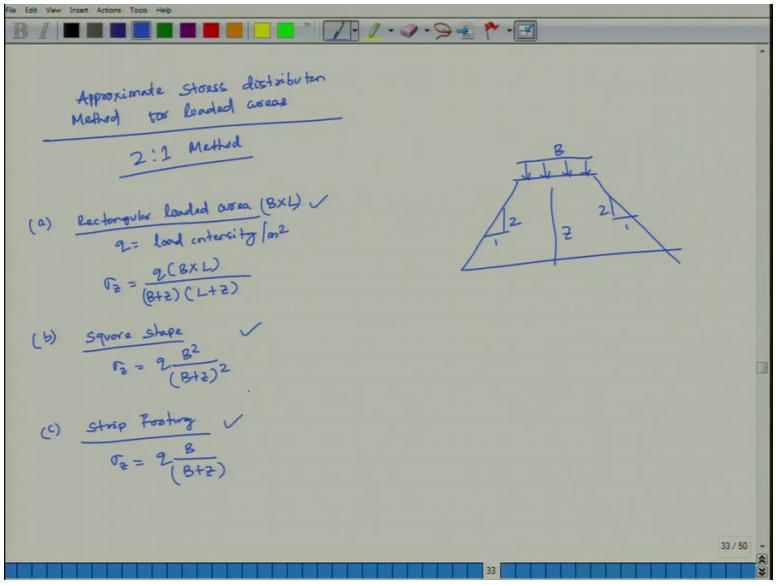

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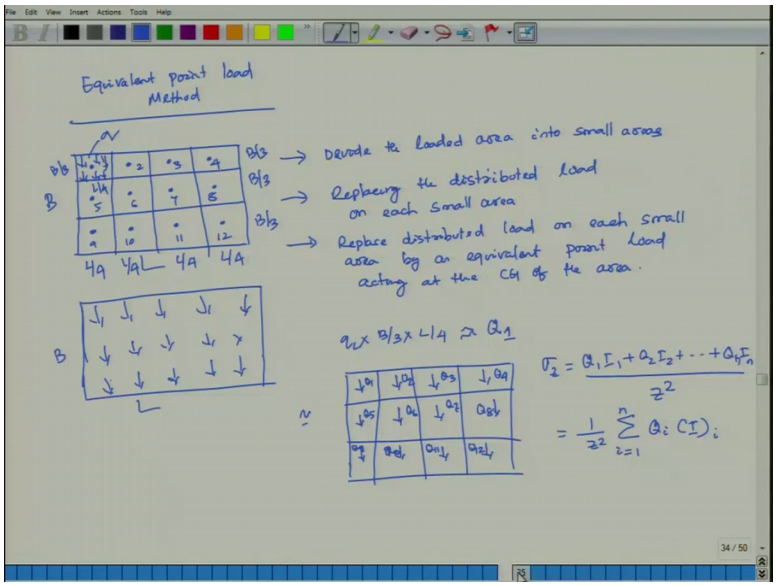

And for square shape or strip footing I have covered then equivalent point method means divide the loaded area into small areas if there is a area B by L into small-small areas.

Then dist replacing the distributed load on each small area and then replace the distributed load on each small area by an equivalent point load which will act at the C G of the area. So, this is your C g. So, equivalent point load act as a C G of the area then sigma z is equal to its a summation of Q 1 I, 1 Q 2 I 2 dot dot Q n I n divided by z square.

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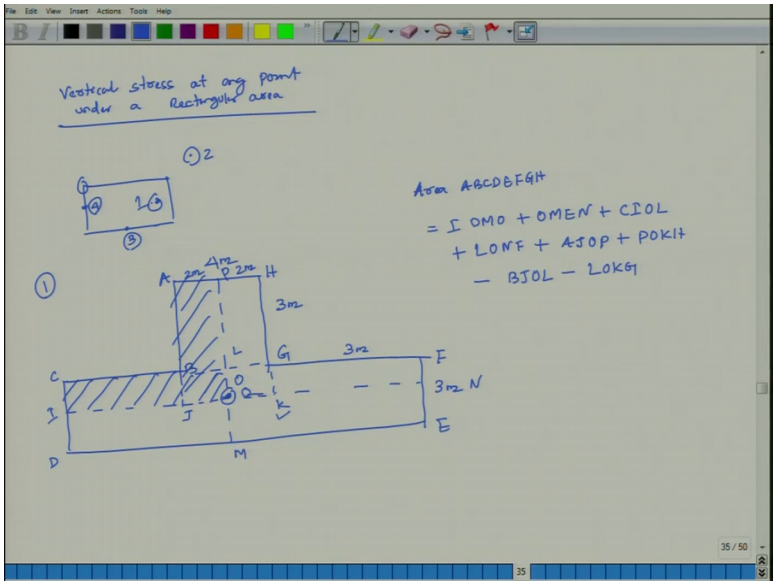

So, based on that I have started one example how to solve it suppose this is the case rectangular loaded area first point load may be anywhere else point of point where your stress you need to find it out. Second, it may be outside the area third it may be one of the phase either B or L it will be there.

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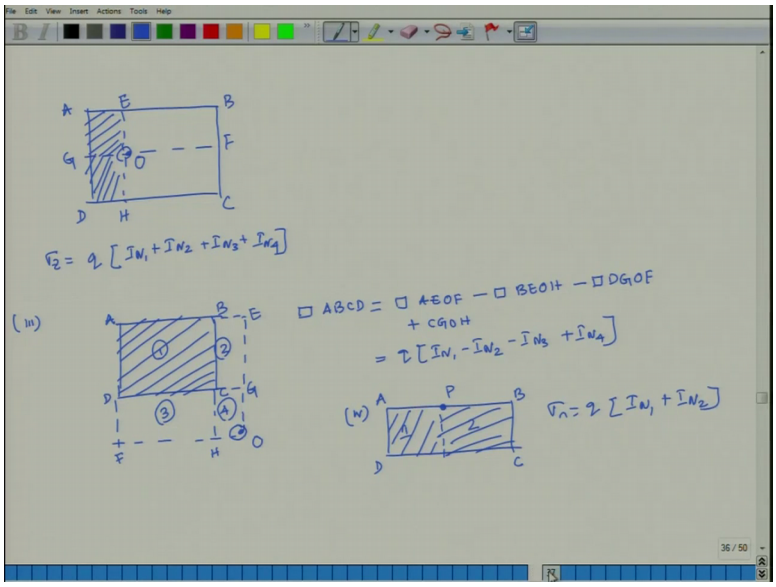

So, first one I have covered go to the second 1; case 2. So, what will happen? So, there is a point somewhere else at point O then in this case it is not equal first principle is I have to divide in such a way that it should be at the corner of your rectangular loaded area; that means, at the corner means if I divide it in such a way that the point O should be common corner.

So, this is the case if I say this is my A, this is B, this is C and this is D; if I make it; it will be E F G H. So, if you look at here I make the area in such a way that this rectangular it is at this point this is your corner similarly these rectangular this is also corner these rectangular this point is corner. So, this rectangular this point is at the corner then in this case sigma z is equal to Q into I N 1 plus I N 2 plus I N 3 plus I n 4 if Q is not equal if it is something else then you can make it different Q 1 I 1 n Q 2 I N 2 Q 3 I N 3 Q 4, I N 4.

Now, go to the third one third case look at here this is your rectangular loaded area and this will be A B C and D with these sorry this is originally this is my area. So, this will be your A B C D and it has been asked some point O which outside your rectangular area

find it out stress because of your rectangular loaded area hart point O which is outside this area.

Now, what is suppose to be done. So, basically I will make in such way that I just expand it in this way. So, that it become I just added areas rectangular areas. So, that it will be becoming a corner now if I put it this is my one this is 2 this is 3 and this will be 4. Now, if I take it one or if I can write it because of the area first make it area a B C D then it will be area E O F then here it is G H. So, this will be area A E O F A E O F I have taken complete a E O F. First one then minus because my our interest is because of this loaded area and at this point increase in stress minus area B E O H minus area B E O H.

Then because this has to be neglected if this is the total area this has to be neglected then this strip has to be neglected what happened this is the point O outside the area I make it extend it. So, that this is the total rectangular area this is at the corner then out of which these rectangular make it out. So, again this is at the corner then out of which these rectangular make it out then again it is at the corner then this is the part which has been come twice then it will be added.

So, minus D G O F then plus C G C G minus D G O F minus D G O F plus C G C G O H you have taken this complete area detected from here once detected one from here once, because this area is super impose of both this areas. So, then it has been detected twice then you have to add it to into once. So, then what will it will happen it will happen Q into I N 1 minus I N 2 minus I N 3 plus I N 4.

Then come to your case 4, case 4 is this is the area and in this area it has been asked to find it out increase in stress at this point. So, for this is my p, so, this will be A B C and D what I am suppose to do this area should be corner then I divided into recent pull way 2 rectangles. So, for this rectangle this point is at corner for this rectangle this point is at the corner then what will happen sigma n is equal to Q into I N 1 plus I N 2 this is one and this is your 2.

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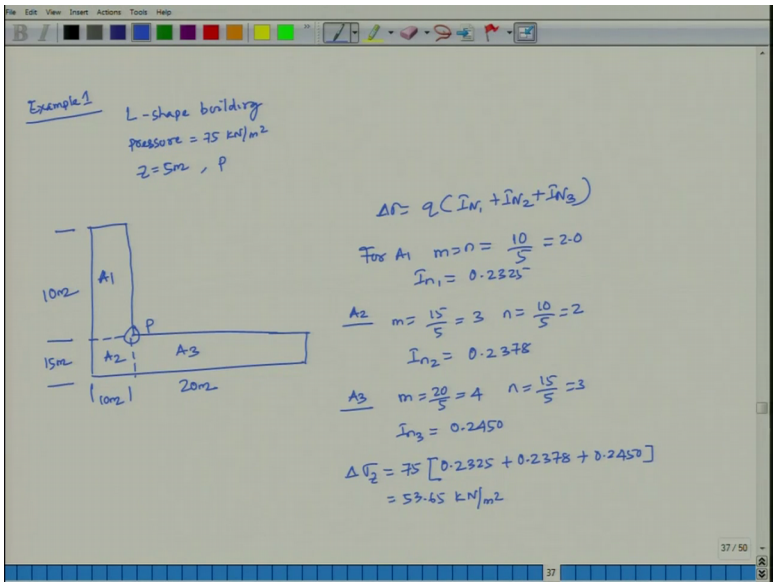

Let us solve one problem one or 2 examples let us solve it how it looks like then we can see it example 1; L shape building L shape building in plain adjust a pressure; pressure on the building 75 kilonewton per meter square on the soil determine the vertical stress of the element at a 0.5 meter z is equal to at a 0.5 meter below the ground surface at point p look at the vertical shape has been given a dimensions has been given this point is your p this dimension is given 10 meter and this dimension is given 15 meter; sorry. And by drawing it is small, but this is your 15 meter this is your 10 meter this is your 20 meter and if I make it this will be my A 1, this will be my A 2 and this will be my A 3.

So, it has been divided into 3 small parts. So, then delta sigma will be Q I N 1 plus I N 2 plus I N 3, I N 1 plus I N 2 plus I N 3, I N 1 plus I N 2, I N 3 why A 1; this is your corner; this is your corner, this is your corner, this is a very straight forward for A 1 for A 1 m is equal to is equal to n which is equal to 10 by 5 10 by 5 means this is your size L is your 10 5 p is your below the depth; depth z is equal to 5 B is equal to 10. So, this will be your 2.0 and I N 1 is equal to 0.2325 for A 2 m is equal to 15 by 5 which is equal to 3 15 by 5 3 n is equal to 10 by 5 which is equal to 2. 2 suppose based on m and n if you come back here based on m and n you can find it out directly I by using this formula.

Then either you can use this formula then find it out from the chart it will be 0.2378 then A 3 is equal to A 3 is equal to m is equal to 20 by 5 which is equal to 4 n is equal to 15 by 5 which is equal to 3 then I N 3 is equal to 0.2450. So, sigma z or delta sigma z is equal

to what is the value of the Q n value of the Q n pressure intensity is given 75 kilonewton per meter square.

So, it will be 75 kilonewton per meter square because it is throughout here it is 75, here it is 75, here it is 75 if it is varying then you can take the varying. So, 75 into I N 1. I N 1 is your 0.2325 plus I N 2 is your 0.2378 plus I N 3 is your 0.2450 which is equal to 53.65 kilonewton per meter square.

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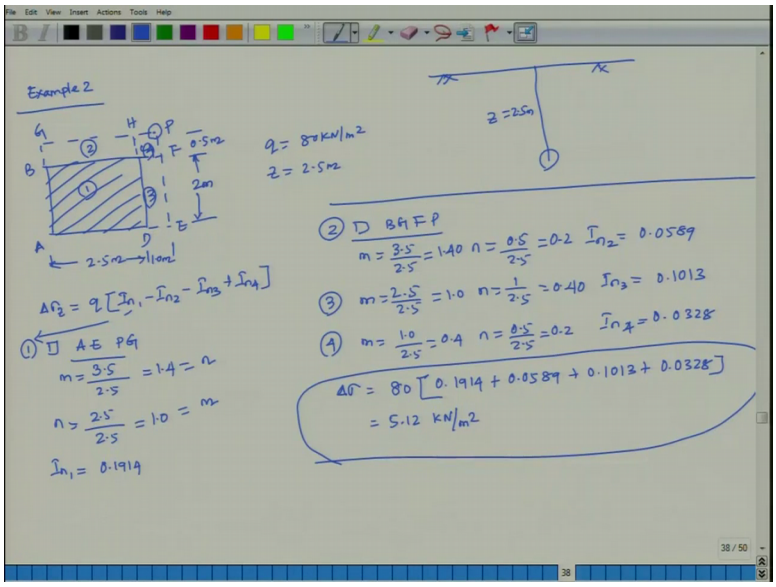

Now, come to example 2 there is a case in this case point p will be located it has been ask to find it out to increase in stress because of your rectangular loaded this at here outside your loaded area at point P. So, as I said I have make it in this arrangement. So, let us name it A B C D then E F P H G.

Now, let us put this dimensions this is your 0.5 meter this is your 2 meter and this is your 2.5 meter and this is your 1.0 meter and load intensity Q is given 80 kilonewton per meter square and z is given 2.5 meter what is the z if this is my surface in this ground surface it has been ask at a distance z is equal to 2.5 meter below find it out increase in stress.

Now, let us write it delta sigma z is equal to Q into I N 1 minus I N 2 minus I N 3 plus I N 4, I N 1, I N 2, I N 3, I N 4, if I put it 1 2 then 3 and this will be my 4, why it is added I

N 4, because while doing this I N 3 and I N 2 this part has been added subtracted twice. So, hence I N 4 has been added.

Now, let us find it out m and n for A 1 or for one loaded here. So, this will be a complete what is your completing I n is for one I n is completing one means this is your a E P G A E P G enter area. So, in this case m is equal to what is the lengths 2.5 plus 13.5 it is your 3.5 by 2.5 it is your 1.4 n is equal to 2 plus 0.5 2.5 by 2.5 which is equal to 1.0. So, I N 1 from that formula or chart it comes out to be 0.1914.

First one is over this is what is your I N 1 then second one second one second one is your if you look at second one that is your rectangle B G F p in this case m is equal to 2.5 plus 1 3.5; 3.5 by 2.5 which is equal to 0.4 n is equal to n is equal to your 0.5 this part is your 0.5; 0.5 by 2.5 which is equal to 0.2; I N 2 is equal to 0.0589.

Similarly case 3: case 3 also m is equal to 3.5 by 2.5 which is equal to 1.0 sorry 2.5 by 2.5 by 2.5 why it is 2.5 by 2.5, now in this case of 3 in this case 3, these are 2 ends 0.5; 2.5 and this case is your one. So, then n is equal to 1 by 2.5 which is equal to 0.4. So, I N 3 is equal to 0.1013.

Then case 4; case 4 m is equal to case 4 this case m is equal to 1.0 by 2.5 which is equal to 0.4 n is equal to 0.5 by 2.5 which is equal to 0.2; I N 4 is equal to 0.0328. So, then delta sigma is equal to you can put it in such a way that Q is equal to 80 into I N 1 I n one is your how much 0.1914 plus I N 2 is your 0.0589 plus I N 3 is your 0.1013; I N 4 is equal to 0.0328 which comes out to be 5.02 kilonewton per meter square are you getting this 2 examples in this example the load intensity is given 80 kilonewton per meter square depth below the ground surface is your 2.5 meter.

Now, this is the case in this case then it is outside the loaded area this is actual the loaded area then I make in such a way that taking into point p I make it. So, that it converts completely rectangular area. So, delta sigma is equal to Q n 2 for these areas if I take complete these areas inside and outside this is the point P then these areas insid,e and outside this is the point p, then these areas, these areas, this is the point P.

So, based on that m and n has been calculated you can always interchange m and n you can always interchange m and n. So, case one m is equal to 2.5 0.1 it is your 3.5. So, 3.5 by your z is equal to 2.5 I can write it as a n I can also write it as a m there is no problem.

So, putting that formula you can get it or you can take a chart you can take a chart from that chart you can find it out I L. Similarly case 2: same case m n and I N 2 case there m n and I N 3 case 4 m n and I N 4 then from there I got delta sigma.

So, these are the 2 problems. So, this 2 problems suppose to be solved we can take it another problem for you I am giving it.

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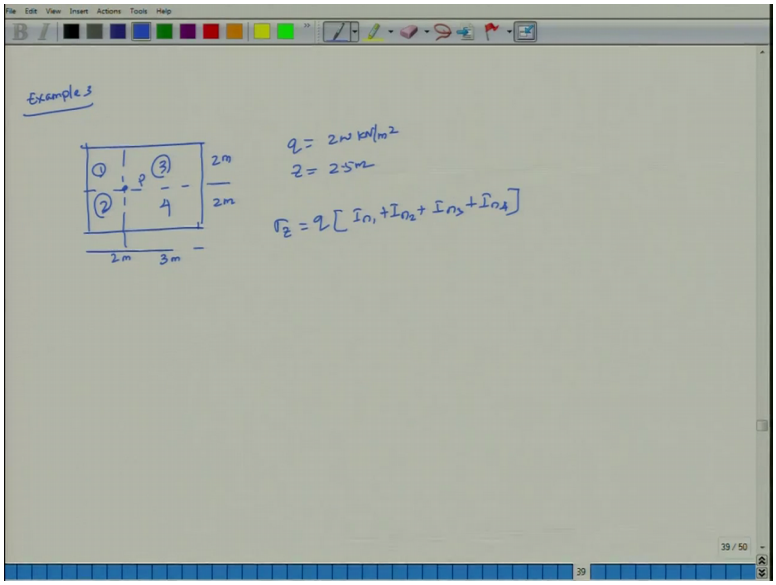

So, I will solve more problems later on. So, example 3 this is your example 3 and this point is your point P inside. So, this distance is point p from here it is your 2 meter here it is 3 meter here it is 2 meter here it is 2 meter, now I if I take it divided in such a way that then this will be 1, 2, 3 and 4.

So, for one all dimensions has been given Q is given Q is equal to 200 kilonewton per meter square and z is given distance below the ground surface is your 2.5 meter. So, you add it. So, what will happen this is for your assignment you can try simple one; sigma z is equal to Q into I N 1 plus I N 2 plus I N 3 plus I N 4 try it for I N 1 what is your m m is your 2 by 2.5 what is your n n is 2 by 2.5. Then here for 2 it is again same 2 by 2 here 4 it is 3 2, 3 is your 3 2 find it out one by one this is an assignment for this. Then I will solve more problems may be next class.

Thank you.