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Lecture - 47
Earth Pressure – VII

So, last class I have I have solved one example problem related to earth pressure on retaining wall. And that was a three layer soil system and I determined the earth pressure due to the soil earth pressure due to the water separately, and then the total earth pressure for that soil system. Now, today I will calculate the force that is coming due to that earth pressure and the point of application of that force.

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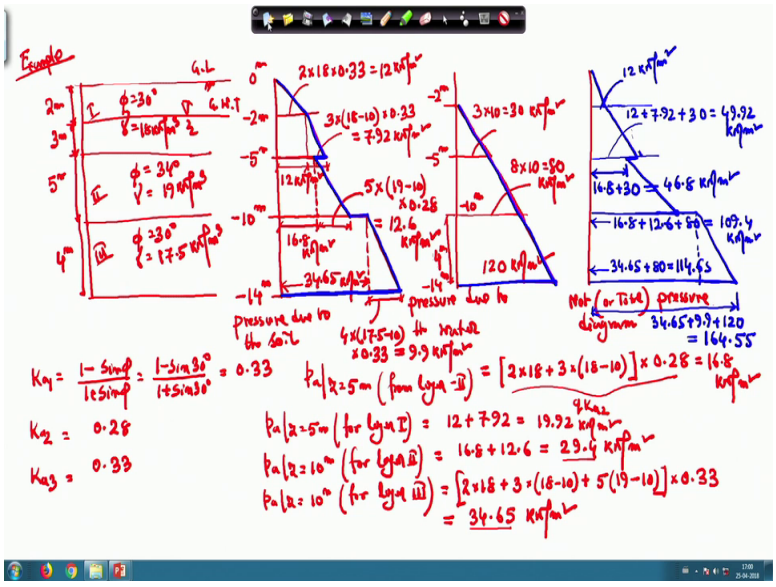

So, so this was the problem, so that we solved or discuss in the last class. So, I will consider this diagram and then I will solve the or I will calculate the forces that is coming due to this pressure ok.

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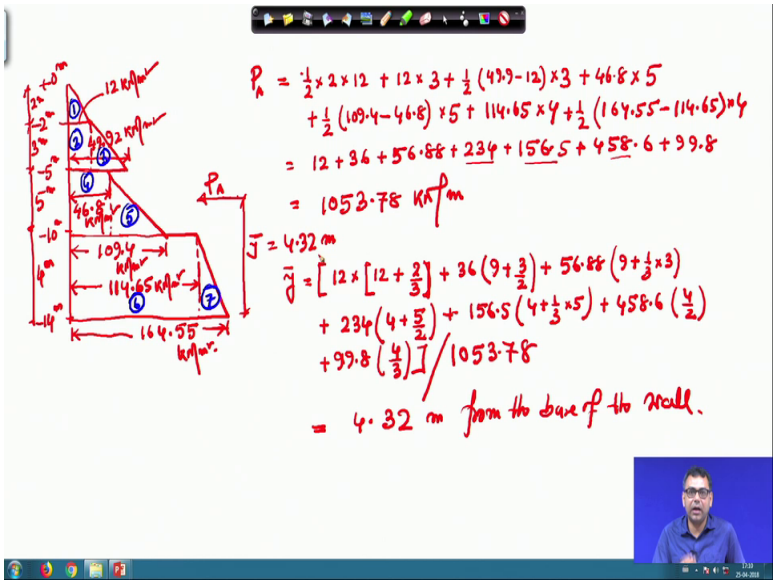

So, I will first separately I will quickly I will I am drawing that diagram again, and then I will calculate the force. So, this is minus 2 meter, this is minus 5 meter, and this is minus 10 meter, and this is minus 14 meter. So, this is the diagram cause this is 12 then there is increase, then there is a decrease of the diagram, then again increase it is increasing then again increasing and finally, this was the diagram ok.

So, now I am writing those values. So, this is plus 0 meter. So, I am writing those value this was 12 kilo Newton per meter square. Now, this total value was this total value was 49.92 kilo Newton per meter square. This small one was 46.8 kilo Newton per meter square.

Now, this value this smaller one was 109.4 kilo Newton per meter square. And this bigger one was 114.65 kilo Newton per meter square ok.

And this total one was 164.55 kilo Newton per meter square. So, this was the problem. So, and the separately also I can calculate what would be the value and then I can calculate this thing ok.

So, let us start the force that pa or p small a. So, it has a number of components, so I am taking. So, this is one part, then this one another part, then this is one part. So, if I start from the top, so I am giving the marking, so this is my component 1 this is 2, this is 3, this is 4, 5, 6, 7. So, there is 7 parts ok. So, I am now calculating the force for the 7 parts.

So, first one is this is this is the triangle. So, half the height is 2, and the pressure is 12, this is for the first part. The second part is a rectangle. So, this rectangle was. So, this is 12. So, it is also coming with 12. So, rectangle. So, this is 12 into the height is your 3 meter because this height is 5 minus 2 3 meter so. So, plus in this triangle this triangle is half. So, total one is 49.92, so 49.92 minus 12 into 3 ok, this is for the third part.

Now, for the fourth part again it is rectangle. And this rectangle is 46.8, so this will be 46.8 and the height is 10 minus 5 meter ok. Then the fifth part, fifth part is again a triangle total is 109.4. So, this will be half 109.4 this 46.8 into 5 ok, this is the fifth part.

Now, for the sixth part is it is 114.65. So, this is the rectangle 114.65 into 4 meter, because this is the 14 minus 10, 4 meter. This is the sixth part. And then the final part - seven part, again it is the triangle. So, this is the total is 164.55 minus this 114.65 into 4. So, this value is coming out to be.

So separately I am calculating this is 12 plus 36 plus 56.88 plus 234 plus 156.5 plus 458.6 plus 99.8. So, this is equal to 1053.78 kilo Newton per meter ok.

Now, I am calculating this is the P which is acting P A now I am calculating the pointer application of this P A from the base. So, y bar I am calculating again for the seven com parts that I have divided this total earth pressure distribution diagram in seven parts. So, first one the first this is for the first part.

So, first part your force is 12 and the liberum will be this is liberum is 12 meter this is 4 plus 5 plus 2 so this is 5 plus 3, so this is 12 meter from here to here it is 12 meter. So, this is 12 plus this is one-third of two as this is this will be this is the acting as one-third of two. So, 2 divided by 3 one-third of two.

Then for the rectangle, so this rectangle force is thirty six then this height or the liberum is 12 meter sorry this is not 12 meter, this is this will be 9 meter ok. Because from here this will be the 4 meter plus 5 meter, so this is the 9 meter ok, so 9 meter.

So, I am just again writing this is 2 meter, this one 3 meter, this one 5 meter, and this one 4 meter ok. This is the total 14 meter high wall. So, this is this one is the 4 plus 5, 9 meter. Then this is the rectangle of height 3 meter. So, this will be 3 by 2, because it will rectangle it will at centre of the rectangle or half of this height 3 by 2.

Then the third part this is the force is 56.88 and it is a triangle so it will be again the 9 plus one-third of the height. So, one-third into height is 3. Now, it is for the fourth part, fourth part is a rectangle. So, the force is for the fourth part 234 and the height is 4 meter plus 5 divided by 2.

Then for the fifth part, fifth part is a triangle whose force is 156.5 so height is 4 meter plus that is a triangle, so one-third of 5. So, then this is what the first, second, third, fourth, fifth part. Now, it is the sixth part, 6 part is the rectangle force is 458.6, so this will be 4 divided by 2 ok, 4 divided by 2.

Then the last part, it is the tangle force is 99.8, and this will be 4 by 3 one-third of the height. And then the total one we have to divide by the total force that is 1053.78. Now, if I solve this is coming to if coming out to be 4.32 meter from the base of the wall. So, this is equal to 4.32 meter.

So, this way we can calculate the point two applications as well as the total force. So, now I have solved this problem this three layer problem for, here the three layers are phi soil.

Now, the next problem or the next example that I will I will select where the same 14 meter high wall I will consider, but I will change one soil layer and make it c phi soil and then let us see how we can calculate the pressure.

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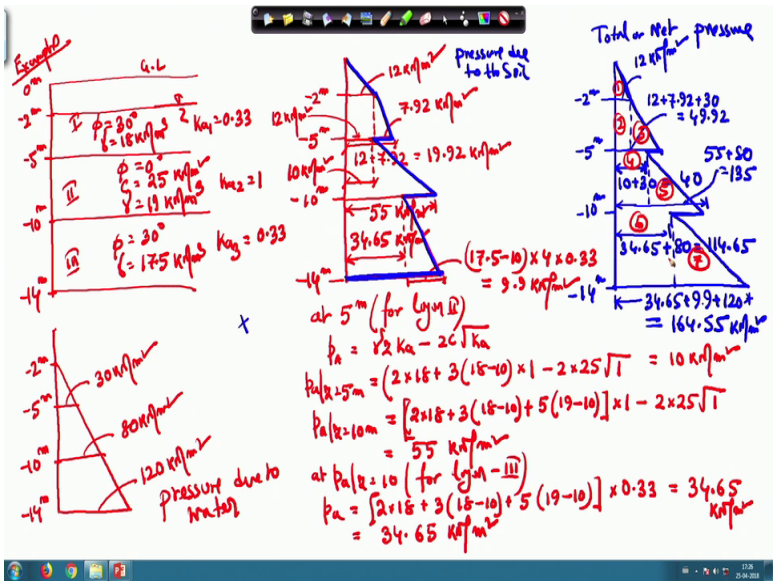

So, the next example. So, I am taking the same 14 meter wall. So, this is 0 meter, then 2 meter, then minus 5 meter, then minus 10 meter, then minus 14 meter. So, we have this is the three layer soil. And water table is here this is the ground level.

So, again here I am taking the phi value is equal to 30 degree and unit weight is 18 kilo Newton per meter cube, the same value I am considering here. So, my K a 1 will be 0.33 the like the previous one. Now, this is for the layer 1.

And for the layer two I have changed the soil layer. So, this is 0 degree, and c value I am taking as a 25 kilo Newton per meter square. And unit weight I am taking 19 kilo Newton per meter cube.

And for the third layer, the same soil properties I am considering 30 degree unit weight is 17.5 kilo Newton per meter cube, so that means, here K a 2 will be 1, because our phi value is 0. So, 1 minus sin phi divided by 1 plus sin phi that value will be 1. And here K a 3 value will be again 0.33.

So, now again I will draw the earth pressure distribution due to the soil and the water pressure that will not change. So, I am just drawing the water pressure distribution here, so that we will remain same it will not change ok, because the same problem I have taken. So, this is minus 14 meter. So, this is minus 10 meter, this is minus 5 meter, this is minus 2 meter.

So, again this will be 30 kilo Newton per meter square. This will be 80 kilo Newton per meter square. And this will be 120 kilo Newton per meter square. This is the pressure due to water ok, so that I have the same as the previous problem this distribution, but the soil distribution will be different.

So, for the first portion up to this is minus 2, this is minus 2 meter, this is minus 5 meter, and this is minus 10 meter, and this is minus 14 meter.

So, up to 2, it will be no change again this will be a 12 kilo Newton per meter square. So, now, the change will come at the at the 5 meter level. So, at the 5 meter, so this will continue because we are considering the same soil layer. And this will be the earth pressure due to the first layer below the water table. So, this value as usual you know that is 7.92 that we have used for the first or the previous problem.

So, this is 7.92, and this one is this one is or I can write this side. So, this value is 12 kilo Newton per meter square. So, total will be the 19.92. So, now, for the 5 meter depth for 5 meter depth, if I want to calculate this is for layer 2.

So, layer 2 is the is the sea soil and P A expression for that is kind of soil is gamma z K a minus 2 c root K a ok. So, at 5 meter, so P A at z equal to 4 meter for that soil, so gamma z is again gamma is 2 into 18 plus 3 into 18 minus 10. And K a value for this layer or K a 2 K a 2 is equal to 1, so minus 2 C a value is 25 again K a 2 is equal to 1. So, this value is coming out to be 10 kilo Newton per meter square.

So, now, the total one here this value is 12 plus 7.92 this will be 19.92 kilo Newton per meter square, but this is for the first layer at this point. But for the second layer this is coming out to be 10 kilo Newton per meter square. So, it will go inside.

So, now, if I take the blue colour, then this is the diagram. So, this will go inside fine. And this value that is 10 kilo Newton per meter square. So, this value I am just taking as 10 kilo Newton per meter square because this is 10 kilo Newton per meter square.

So, now, I will calculate that P A at z equal to 10 meter. So, I will use the same expression, but here unit weight will change. So, unit weight value will be effective over then pressure will be 2 into 18 plus 3 18 minus 10 then plus this is 5 meter and the unit weight is 19 minus 10, so that will be equal to 1 into 1 that is the K a 2 so and then minus 2 into 25 root over 1.

So, this is this value is coming out to be 55 kilo Newton per meter square. So, here from here we will increase this value up to this is 55 kilo Newton per meter square ok. So, these things we will go from here 55 kilo Newton per meter square.

Now, I will calculate that at P A at z equal to 10 meter this is for the layer 3, because I have done for layer 2 and that is coming out to the 55. What the value for layer three. So, layer 3, P A value will be the again this is the unit weight is coming this is the q surcharge or the effective overburden pressure.

So, I am writing 2 into 18 plus 3 18 minus 10 plus 5 19 minus 10, but here the K a 3 is 0.33 this is 0.33. So, this value is equal to 34.65 kilo Newton per meter square. So, this value is 34.65 kilo Newton per meter square or I can write this is equal to 34.65 kilo

Newton per meter square. So, this will be into 0.33. So, this is 34.65 kilo Newton per meter square.

So, and here it is 55. So, it will again go inside. And this value will be 34.65 kilo Newton per meter square. So, if I take this earth pressure diagram, this will go inside.

Now, the final one the earth pressure diagram at 14 meter; so it will be continue like this. So, this will continue like this and then additional part that will come due to the third layer and this part is as usual you know this is for this layer and this layer third layer where unit weight is 17.5 minus 10 into 4 into 0.33, and it is 9.9 nine kilo Newton per meter square.

So, final earth pressure distribution diagram will be this one. So, this total one is 34.65 plus 9.9. So, this is the total earth pressure distribution diagram that I have drawn. Now, I will draw the net earth pressure distribution diagram. So, if I draw the net or the total earth pressure distribution diagram, so this value for the so that means, basically I will add this two this one and this one.

So, the net one will be again for this is minus 2 meter, this is minus 5 meter, this is minus 10 meter, and this is minus 14 meter. So, up to 2 meter, this value is 12 kilo Newton per meter square.

Then at this level, so it will increase because there is water pressure is there, so it will increase. So, this value is basically for the first layer this value is this will be 12 plus 7.92 plus 30 so this is equal to 49.92. I am not writing the unit it is kilo Newton per meter square.

And then for the next part it will go inside ok, and then it will go this side, then again it will go inside. Then finally, this is the earth pressure distribution diagram. So, now, this value is this small one will be how much this is this one is 10, because this is 10 plus this is 30. So, this will be 10 plus 30, so this will be 40.

Now, we will calculate this value. So, this value is how much these value is this is your fifty this one is the 55 is the total one. So, this value is 55 plus 80, so this will be 135. So, this will be 55 plus 80, this will be 135. So, this is the bigger one. And this is 55 and 80.

And the smaller one is 34.65. So, this one will be 34.65, then plus 34.65 plus 80. So, this will be plus 80 and that is 114.65. And thus that the final one this will be this is total 34.65 plus 9.9 plus 120. So, this will be 34.65 plus 9.9 plus 120. So, this value is 164.55.

So, this is this is the earth pressure this is the pressure due to the soil due to the soil. This is the pressure due to the water, and this is the total or net pressure diagram. So, now from this diagram again you can determine the P value and the point two applications. So, I am not doing that because I have done the same thing in the previous problem.

So, you can determine the p value also or you can determine the point two applications. You can try this problem and you can try to determine the p and the point two applications so that means, here also you can take the number of segment. So, these are the number of segments. So, there will be. You can take total 1, 2, 3, 4, 5, 6, again these 7 segments and you can determine the p value the similar way I have done in the previous problem.

So, and you can also calculate the y bar the point two application of that force from the base of the wall. So, with these I am finishing this class. And the next class I will discuss that how I can use these earth pressure theories to determine or apply it for the retaining wall design. And I also discussed another earth pressure theory that is coulombs theory.

So, till now I have discussed the Reinkines earth pressure theory. So, next class first I will discuss about the coulombs theory then I will apply this theory to design the retaining wall.

Thank you.