Application of Soil Mechanics
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Lecture - 12

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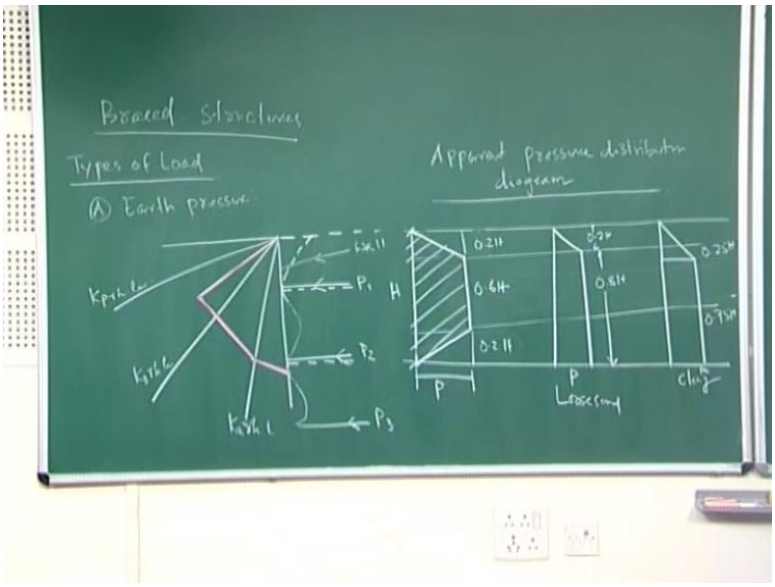

So, in braced structures, we are doing earlier discussed about the this designs of parameters. Now next part of your design parameters types of load first one is your earth pressure if me see this earth pressure distribution diagram. If I draw three earth pressure lines k p, this is k p gamma, it is the line, and this is your earth pressure, a traced gamma it is a line, this is your active earth pressure at rest sorry active earth pressure gamma its line and this is my wall and this is your ground surface. So, generally what happened. So, this will be your p one in the start p two then this is your p three.

Now, if I draw the apparent earth pressure distribution diagram for particular typical cases of best expression, generally the earth pressure distribution diagram, it light. This is your pressure distribution diagram apparent pressure distribution earth pressure diagram, it lights if you look at here it light between k p to k p line two k zero line. They need changes from k zero line to k a line k p line is your perceive earth pressure line k zero is your earth pressure at rest light and k is your active earth pressure line. So, this earth pressure distribution particularly in braced called it is where in between k p to k a line and k p to k zero line and k zero to k a line.

Now what is your apparent earth pressure distribution diagram based on these based on these apparent pressure distribution diagram pressure distribution diagram now if i draw a apparent pressure distribution diagram of kind of a sand at will as k. So, this is height h, now if I draw it. So, this will be zero point six h and this is your zero point sorry zero point six is looks very small one. Let us put it in this way, so that it will be this is your zero point six h and this is zero point two h. This is zero point two h and this is your pressure p coming on this trot coming on this trot these diagram is your apparent pressure distribution diagram for sand. Now for loose sand what is apparent pressure distribution diagram the loose sand apparent pressure distribution diagram will be this is p these value is a zero point eight h and this is your zero point two h.

Now for clay for clay for clay it is coming zero point two five h, and this is your zero point seven five h and this is clay and this is also p, this is for loose sand. If we look at this apparent pressure distribution diagram, because there is no specific pressure distribution diagram for particularly braced structure as this earth pressure distribution diagram is wearing from k p; that means, perceive line to earth pressure at rest then earth pressure at rest to active line.

So, based on this variation of earth pressure, there are apparent pressure distribution diagram. For in general, for sand, this is various enough apparent pressure distribution diagram, it is varying from zero point two h at the top, then zero point six h then for loose sand zero point two h and zero point eight h for clay it will be varying from zero point two five two zero point seven five h. It remains constant the where is an all be up to zero point two five page. So, these apparent pressure distribution diagram as will derived from these earth pressure distribution diagram, and that is why it is called apparent this has taken as approximate, because this pressure distribution is not a constant. It is varying from k p line to k zero line and k zero line to k a line. Now based on the apparent earth pressure distribution diagram what are empirically equations for sand.

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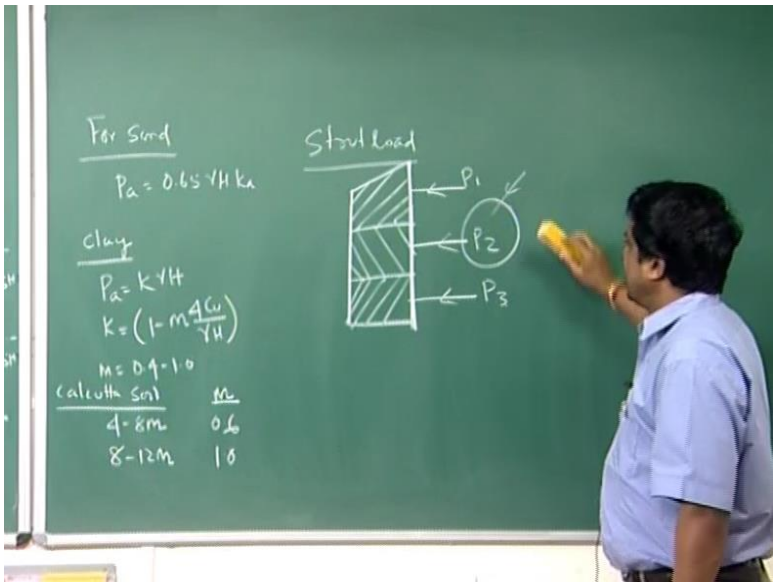

For sand P a equal to zero point six five gamma h k a were clay were clay p a equal to k gamma h and k equal to one minus a m four c u by gamma h. So, m value is wearing between zero point four two one point zero for example, for Kolkata soil for example, for Kolkata soil, depth the coating four to eight meter m values is wearing m values wearing for zero point six and depth of coating eight to twelve meter m values varying one point zero. This is a typical example of Kolkata soil from these apparent pressure distribution diagram your p a value of sandiest zero point six five gamma h in to k a k zero active earth pressure.

For clay p is equal to p a equal to k gamma h k equal to one minus m course u by gamma h c u is your undergo cohesion, m is a factor m is a factor it is wearing from zero point four to one point zero. So, based on the different cities different soils these m values wearing for example, for Kolkata soil of a extradition four to eight meter m values zero point six per eight to twelve meter m values equal to one point zero. So, load this is about your earth pressure distribution diagram and from their apparent apparent pressure distribution diagram non-pressure distribution diagram.

What is the value of pressure coming in the strut that is for sand clay the this all about then strut load if this is my pressure distribution diagram. If I draw this is the pressure distribution diagram on the wall, so this is p one, this is p two, this is p three. How do decide your strut load means what strut load you are going to considered for your desire

suppose this is my apparent pressure distribution diagram based on one of the pressure distribution diagram for sand are loose sand are clay.

So, if this is the pressure distribution diagram on the wall. This is suppose, this is the wall, now find it out maximum pressure, where it is coming maximum pressure where it is coming or maximum pressure where it is coming or maximum load, where it is coming. Suppose this is a pressure distribution line diagram, suppose in this case p one and p two and p three suppose maximum load is coming about p two; that means, this strut load suppose p one is a strut load p two. Just strut load p three is a strut load; that means, maximum strut load is coming about p two these has to be considered for design; that means, from pressure distribution diagram maximum strut load has to be considered for your design.

Now once this part of your earth pressure distribution diagram is over. Then from they are if you find it out pressure from they are you will find it out your load on this strut then from this load on this strut maximum load on this strut you have means the design has to be done maximum load on this strut. Now what are the effects on the braced cut or major concerned, before we solve one example.

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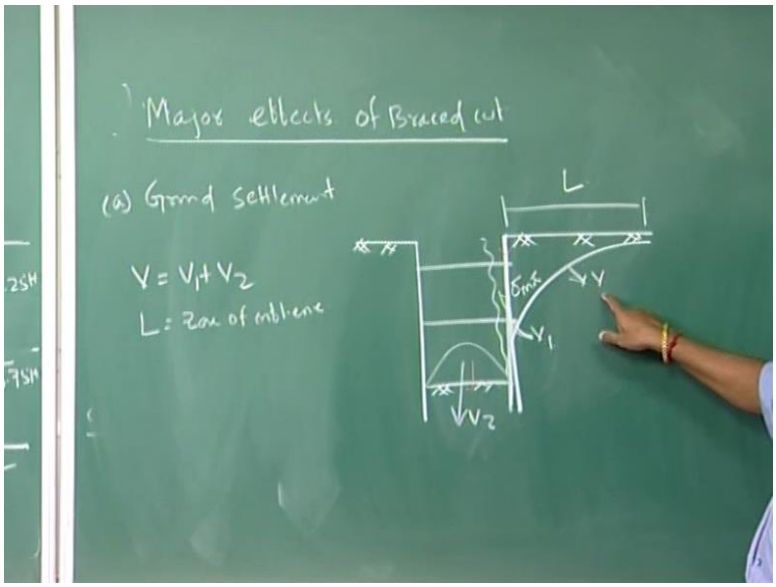

So, what are the major concerned on the braced cut or major effect major effects of braced cut. So, part one is your ground settlement. If you look at these this is a wall and there as struts. So, as I said there will be bottom hip say this is your volume b two and

there is also a lateral movement this is called total volume v because of your ground settlement. So, these volume changes your v one and this is your delta maximum now volume of ground b volume of ground how much is a volume of ground it is your v one plus v two. And l is your zone of influence, l is your zone of influence zone of influence how do calculate lateral movement lateral movement will be lateral settlement. Lateral movement will be calculated from your rigidity of your structure, if how rigid is your wall look at here, how rigid appear wall at here in this position also how rigid appear wall in this positions. So, what happened when there is a ground settlement occur this.

If this wall is not rigid this will be deflected if this will be deflected there is a change in volume there is a change in volume this is called v one because of v one because of lateral displacement lateral displacement of wall. It depends upon your rigidity and v two is your because of your hip once it displace then there is a chance this soil will be co insides. So, there would be hip. So, total ground settlement if I say total v what is the volume; that means, v one plus v two and what is l. So, it will displays ground settlement will occur, it will go some (( )) little much; that means, up to these distance there would be a zone of influence this length has to be calculated fast because unless otherwise if you do not know zone of influence.

Then how to calculate in within that zone whether there would be a any ground settlement or not. So, these both the parameter b v volume as well as a how much your delta maximum it has been calculate based on your rigidity of your rigidity of your structure. So, there are empirical procedures empirical procedure given by peck how to calculate your particularly rigidity of this if i write this empirical procedures here about your ground settlement.

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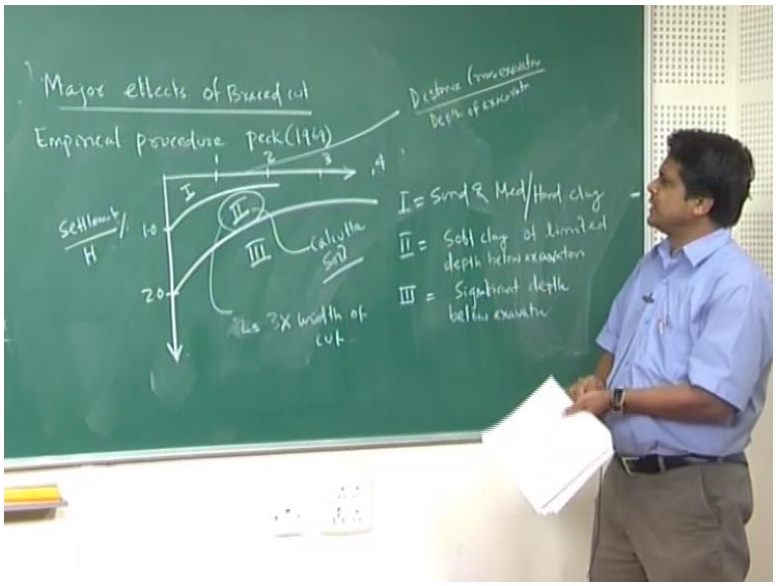

So, this is your empirical relation empirical procedure given by peck peck nineteen sixty nine. So, in this case peck nineteen sixty-nine. If you look at here this is distance these parameter is your distance from excavation divided by depth of excavation. Now if I draw this is my wall, this is the wall that means, what is this parameter. This parameter is saying distance from excavation as I said earlier zone of influence distance from excavation, this is your l and depth of a excavation from these depth excavation; that means, over the ground settlement occurs this is distance from excavation to depth of excavation it has been expressed in diamond unless form. So, that it can be used for any where it can be use. So, this value is varying from one, two, three, then four.

Then settlement then next diamonds unless parameter is your settlement by height in terms of percentage. So, this will be one point zero, and this will be two point zero what is it mean how much settlement occurs how much ground settlement divided by total height its divided by total depth of excavation h suppose this is your settlement occurs; that means, these settlement is a delta. So, this will be delta by h this will be delta by h and in terms of percentage one percent two percent and three percent both x as well as y x is this has been given in diamond unless form these all your empirical relations given by peck nineteen sixty nine for different soils if I draw it.

So, this is your zone of influence one means zone one then this is your zone two this is your zone three now what is it mean, if I am drawing it zone one means one means sand

and medium or hard clay then two is your soft clay of limited depth below excavation. Then zone three or three equal to significant depth significant depth below excavation, these are the observation he has observed based on your sheet file and most of the Kolkata soil.

If you look at here, for example, most of the Kolkata soil is soft clay followed by s tip clay and it falls under zone two most of the Kolkata soil falls under the zone two; that means, zone of influence will be. If it is in zone two for Kolkata soil zone of influence equal to zone of influence or l l equal to zone of influence equal to three times width of cut. If you look at here it is going to what is your three times so; that means, distance from a excavation is your zone of influence equal to three in to your width of the cut; that means, depth of the excavation. So, it will be three types.

Now based on this chart based on the chart what you are supposed to do based on the chart first identify. What is your soil, what is your soil profile in the excavation then make a call if it is sand or medium or hard clay for sand it is varying from one to two much some value wearing from two. That means, zone of influence l you can find it out two times into width of your cut then for zone two. It is varying up to three so; that means, maximum value is three into width of cut for zone three it is wearing more than four from they are you can find it out your influence zone from they are you can find it out your influence zone.

Also you can find it out how much your settlement, the settlement by h in percentage for zone one is in your one percent, zone two is your one percent to two percent, and zone three is your from two percent. On what it is very suppose it is a zone two; that means, settlement equal to one percent of total h; that means, h equal to total depth equal to five; that means, five to in to one percent so that means, five mm. So, one by hundred is five m m zero point zero five m m so; that means, with these empirical procedure there are two parameters you can find it out one is zone of influence other is your within that zone of influence what is your maximum settlement or maximum ground movement you can expect.

Now, this is one of the design parameter before we start because this will influence your completely ground displacement and the ground movement zone of the ground movement and maximum settlement it will also effect your total pressure distribution

diagram these has to be found from the beginning.

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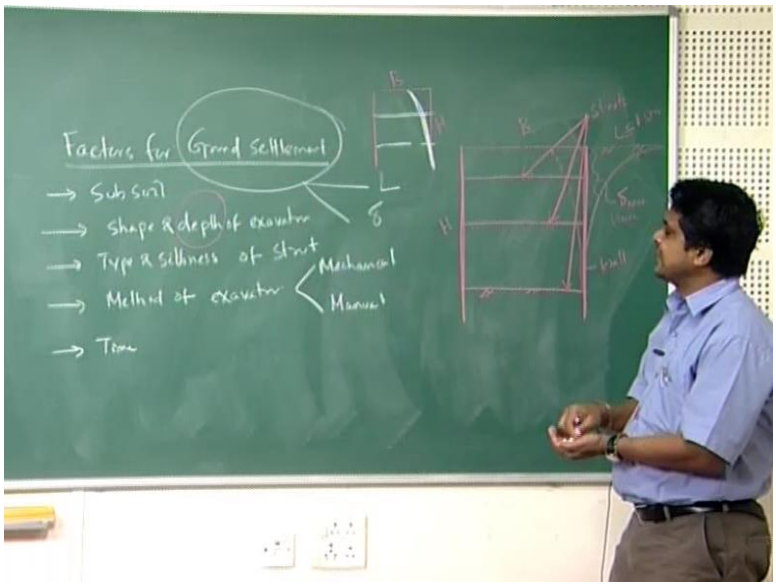

Next part you are what are the factor factors for your ground settlement factors for ground settlement or factors influence the ground settlement. If I start with these past one, obvious it is your sub soil characteristic or you can write it out sub soil. Then it depends on shape and depth of excavation shape and depth of excavation then type and stiffness of strut then method of excavation; that means, method of excavation means by means of mechanical or by means of manual then time means these are the factor then will effective your ground settlement.

If you look at here, as I discussed by means of given nineteen seventy nine, the chart what is your sub soil profile. If sub soil profile is sand means the ground settlement will be less, but if it is varying from soft clay then it is coming zone two or zone three then ground settlement as well as zone of influence it will be more. Then what kind of shape and depth of excavation, what is a shape, what is a depth are you going for a longer depth or deep depth or shallow depth. This is basically influence your ground settlement for example, shape and depth what kind of what is a width how much excavation. You want what weight you are doing is like this is one type of excavation or you can do one is your small width then you can find it out your excavation you can go for excavation.

Now what is your a h value, what is a depth are you going for a means deep excavation or shallow excavation. If deep or shallow are you going for what is a width b of this

excavation, this is very small or large it depends upon said shape and depth of the excavation. Then next one is your type and stiffness of strut means suppose I am applying your this is my wall. For example, this is the wall may be diaphragm wall or sheet pile wall. Now at regular interval, you are providing strut, these are all your, you can say that strut, now once you provide this struts means what is dip types of strut. You providing by wooden strut or are providing steal strut or are you are you providing any what is the rigidity it means what kind of strut your providing based on this strut.

You are providing what is the stickiness means once there is a ground movement, this strut what will happen. This initially this strut will resist lateral movement of the your wall; that means, if this wall is supposed to displays laterally displays in this way what will happen this strut will keep this wall in intact; that means, it wont to allow the lateral displacement of your strut. So, if it is not going to allow it depends upon its hipness what kind of strut your providing means steal wooden aluminum or very rigid strut are the more the rigid the strut will be more the rigid there is a less chance of your lateral displacement of your wall more.

It again it depends upon your economy also once you are providing the rigid strut the cost will be high. So, depending upon that strut particularly thickness an type this lateral movement also of the ground can be reduced. So, makes core practice. So, also another another factors which is important method of excavation, how you are excavating how how you are excavating means method of excavation are you doing mechanically or manually. In India generally what happen this man power is very cheap, people go for manually the movement you go for method of excavation by means of manually; that means, by manual they were by layer by layer you are going. What will happen it takes time manually once you reach here, by that time what happen, these wall has been already displays laterally because it takes time.

And chances of ground movement is high, but if you doing mechanically you can finish within the time. So, that before placing what will happen once you are doing manually once you start excavation and start your placing your wall before providing your strut this wall already started lateral displacement; that means, it is because of manually, but if you do it by mechanically mechanical method. So, what happen there a chances of ground movement will be very less then another one one is your time construction time means particularly how your construction time more you take on construction time more

chances of lateral excavation will be more or ground movement will be more. So, as soon as possible you should finish this construction process. So, that ground displacement or ground movement can be appointed from these one. So, once again this summarizing.

This this is because one of the major factor ground settlement is a major factor for design for doing this ground settlement you you need to have two parameter either we discussed earlier one is your zone of influence other is your settlement or ground movement once you know the zone of influence and as well as ground movement. So, what this is my zone of influence this is a zone of influence and this is your maximum displace on of ground displacement. Once you know, you can decide whether there is any structure whether already there is a any construction whether already a whether there is already any existing building. So, what happen generally this underground construction as been don particularly in metro areas you have to take you have to take consideration of your what kind of building what kind of structure is already they are in zone of influence.

Once you know the zone of influence you would then based on your zone of influence and delta maximum yours thickness has to be decided. It is either way suppose before design you find that delta maximum is equal to then away and zone in zone of influence is suppose this is equal to say shape kind of zero point five meter or zero point centimeter. So, within these zone of influence suppose say there are multi story building already existed already existed so; that means, before doing this construction starts you should be these your that the they are should not be these kind of delta maximum there should not be zone of influence.

So, took protect this ground movement further what will happen you provide your stripe strut. So, that it would not allow further this there is a lateral displacement of your wall. So, it is either way because this ground settlement has one of the major parameter this has to be taken consideration before starting of your rigid. So, maybe I will stop here. Next class I will start a complete design how to solve the problem taking in to consideration of ground settlement.

Thank you.