Application of Soil Mechanics
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Lecture – 24

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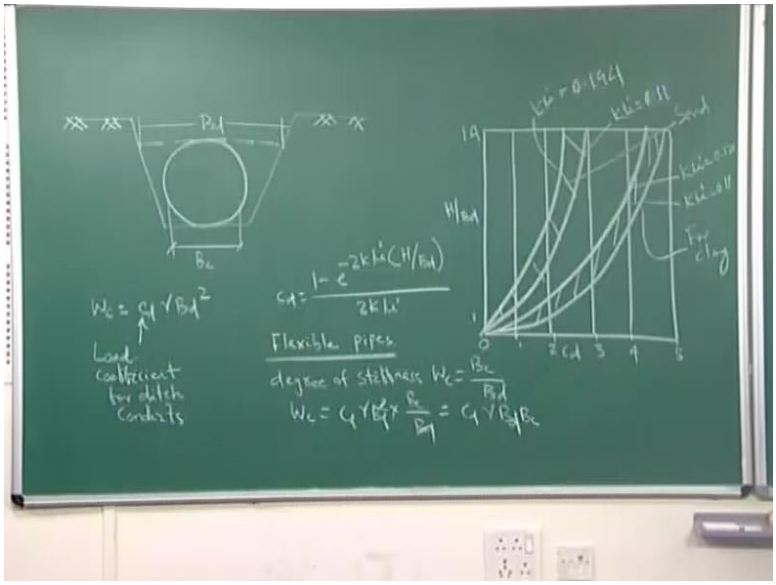

Yesterday we have derived this equation for tracers ditch conduits, and it is not possible ditch conduits vertically got generally the side slope has been provided in case ditch conduits. So, this is your distance b d, and you have derived this of this is my b c b c is your diameter of the conduits b d is your b d is your width of your ditch. We have derived this w c is equal to yesterday c d gamma b d square were c d is equal to c d is called load coefficient c d is called load coefficient ditch conduits load coefficient for ditch conduits. Now the value of c d is equal to we derive one minus e to the power minus two k mu prime capital h by b d, and divided by two k mu prime. So, it has been this coefficient of load coefficient for ditch conduits of an given graphically for ditch conduits. If I plot between this h by b d versus is your load coefficient c d start with this zero one two three four, and this is five now its start with one up to fourteen.

So, the range is coming about between this, if a look at here this has been given graphically now this value of, if I take it k mu prime value of zero point one two, and this value is equal to k mu prime is equal to zero point one one, and this range this range is for clay proper clay, and this if I am taking k mu is equal to k prime k mu prime is equal to one point one one two one nine four one point one one two, this is your k mu prime is

equal to one point nine four. So, this is this range is particularly for sand or cosign less soil this is your dimensionless parameter, if I take it a s by b d this is a dimension less parameter, and c d is equal to load coefficient. If you note the load coefficient, because this load coefficient had been derive for depend value of h by b d depend value of k, and mu prime k is your lateral or k ditch coefficient mu prime is your fix an between your ditch, and your side fill feel soil, and if you note this k mu h, and b d you can find it out this c d value.

So, it has been floated, but different soils it has been take an for two kinds of soil one is your co soil sand less soil that is sand other is for clay be range is well defined for clay it is were in between k mu prime zero point one one two k mu prime is equal to zero point one two within this band of this range, this is for clay soils, and this for sand k mu prime is equal to one point one one, and k mu eprime is equal to one point sorry zero point one one two zero point one nine four at it a mistake zero point one one two zero point one nine four. So, the range is well defined you can say that for particularly zero point one one to zero point one nine four, you can say that this is for sand zero point one one to zero point one two zero you can say that this is for an for clay in case of this this derivation is basically for rigid ditch. So, in case of flexible pipes can do it is. So, what will happen in case of flexible pipes some degree of stiffness would be apply for flexible.

Flexible pipes some degree of stiffness at the pipe itself value we can say that degree of stiffness w c, which is equal to b c by b d the load on flexible pipe would, then be, then it to will be this is your degree of stiffness. So, w c is equal to c d gamma b d square in to b c by b d. So, this comes out to be c d gamma b d, and b c gamma b d and b c. If you look at this if this pipes sometimes what happen actually in practice not a single pipe or may all pipes, and not perfectly rigid there will be some flexibility.

So, this flexibility degree of stiffness as been added with these the modified value of load is coming how mu c h to the particle means particularly above the ditch this is your c d; that means, load coefficient to gamma b d into b c b d is your would copy your ditch b c is your diameter of copy your ditch, and b c is your diameter of your conduit. So, in these case this is for rigid conduit, and this is for your flexible pipes or flexible conduit now will move per what for the other classification one part is over I say earlier there are three types of basically we used these conduit one is your ditch conduit other is your positive projecting conduit had your negative projective conduit.

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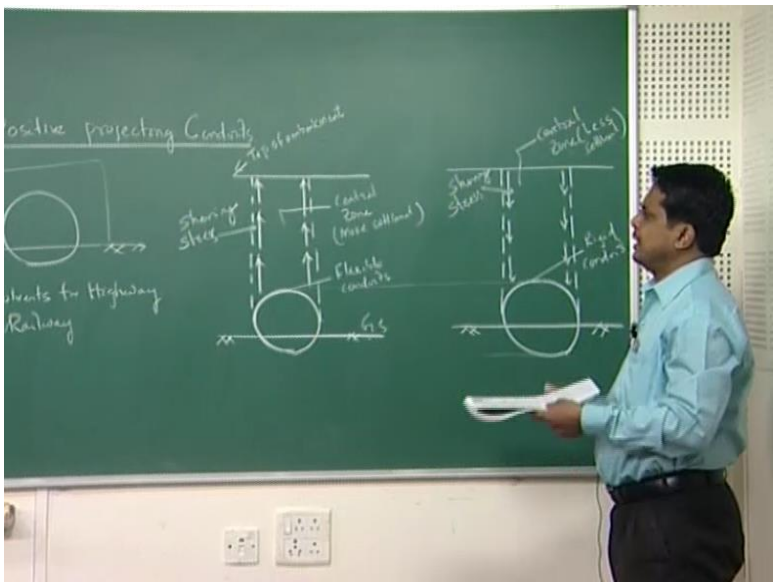

Let us start with the second one this is your positive projecting conduits projecting conduits means it will be race, it will look at here it will race. For example, why it is called positive projecting conduit, if you look at here exhaust light embedded bellow the ground surface, and it will this pipe or the conduit, it will above of the ground circle above of the ground circle that is why it is projecting this some part is projecting above of the surface.

That is why it is called positive projecting conduits now where it has been used I just say earlier it has been used for culverts for highway call what is for highway, then railway or are field. If you look at here, if there is a ground surface here if this is your positive projecting conduits what will happened generally this has been allow passage of water. So, what happen the road has been constructed above this, but actually this conduit this line above of the ground surface your ground surface is here.

So, it has been practically used particularly culverts or railways culverts for highways culverts for railways it has been practically applied. So, now if I am considering this a projecting projecting conduits. So, there is a differential settlement with in the central zone directly over line the conduit, and this zone let me draw to figures. So, this is your top of embankment this is a top of embankment, and this is your ground surface this your ground surface or ground label now what will happen? If I let me draw it completely.

So, in this case, this is your shearing stress shearing stress this is a central zone this

called central zone more settlement, and this I can term as a flexible conduits, now same thing I draw of a rigid conduits. Now in case of rigid conduit, if look out the graph this is your shearing stress this is your shearing stress, this part is your central zonal less settlement. Now I can say that this is your rigid conduits. There are two difference, if I am taking this positive projecting conduit, I can separate out this what is your shearing stress, and central zone these are the two conduits positive conduits here it is your ground level, and ground surface if it is a flexible, what will happen? This central zone there are two zone one is a central zone at the middle part other part is your side or shearing stress zone what will happen the central zone will settled more than your side shearing stress develop. So, what will happen the shearing stresses will be vertically a part in case of flexible conduit what is the rigid in that in flexible conduits central zone will settle more, because it is line above we are conduits, because it is flexible conduits it will also settled. So, this central zone will settle more as compare your side.

So, shearing stresses will be acting a part in case of rigid conduits rigid conduits if you look at here it is perfectly rigid those settlement of the rigid conduit as compare to flexible conduits will be less. So, this shearing stress will be botticelli down what, and beside fixer may side settlement will be more as compact your central zone central zone will be a less settlement this is the difference between flexible conduit, and your rigid conduits particularly positive projecting conduits.

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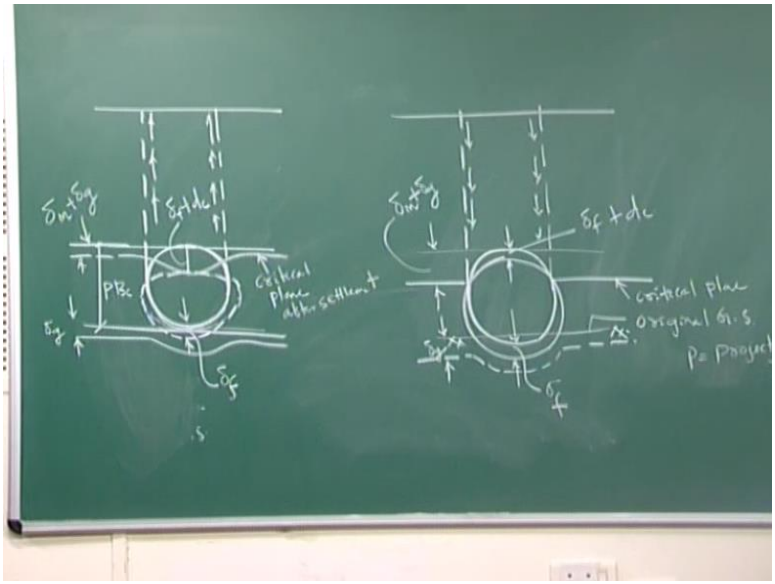

Now, if I start with these detail how this settlement of occur as compact to top, and bottom, let me draw another two figures critical plane as t be zone this critical plane where it is lying the direction of shearing stresses can be determine from the settlement of a plane means particularly the direction of this shearing stresses can be determine from the settlement of a plane that is called critical plane. So, let me draw it. Now this is my say you can say that this is your ground surface as compare to these.

So, these distance these is your completely let me write it this is p b c b c is your b c is your diameter of your conduits, and this is your, this part will be delta g, and now how the conduits. So, will behaves this conduits will go. Now this part to this part is your delta F, and this complete part will be over delta f plus d c dc is your width of your means d c is your means vertical deflection of your conduits d c, then this is called this is called critical plane after settlement. Now if I takes this side shearing stresses are comparative of biotical means central zone now one more figure.

This is particularly in case of what is the mechanics particular mechanic is I am showing this is in case of flexible conduits this is in case of your a rigid conduits now this is my critical plane after settlement. And this will be delta m plus delta g, and this becomes your delta f plus d c. Now this is your delta f now this is your original ground surface, now this is your delta g, now I can right it out a ratio known as settlement ratio a ratio known as settlement ratio with respect to this, I am coming back.

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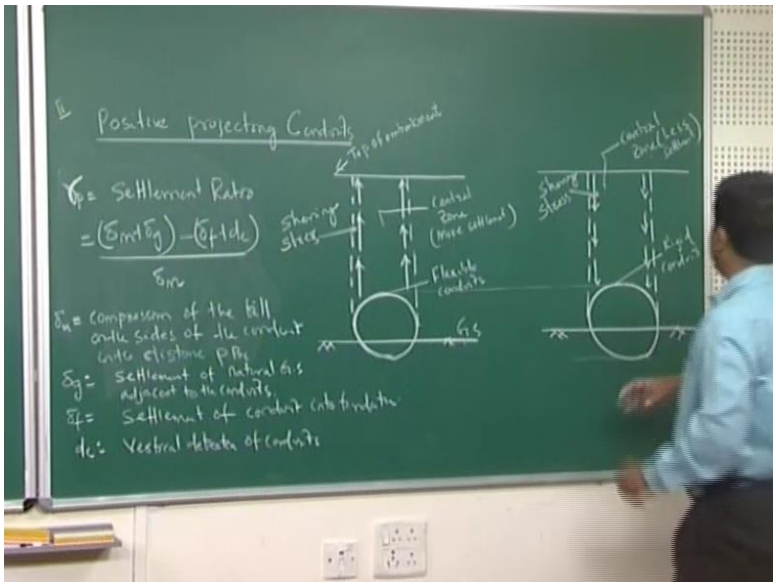

Let me to rigid a ratio called settlement ratio this is called r p r p this is not gamma this is a r p called settlement ratio which is equal to delta m plus delta g minus delta f plus d c by delta m. So, delta m is your let me defined it delta m is equal to compression of the fill compression of the fill on the sides of the conduits in the distance p b c.

So, delta m is equal to compression of the fill on the sides of the conduit in the distance, in the distance p b c delta g is equal to settlement of natural ground surface settlement of natural ground surface adjust sent to the conduit adjust sent to the conduits delta f is equal to settlement of conduits in to the foundation settlement of conduits in to foundation, and d c d c is equal to biotical deflection of conduits this is equal to biotical deflection of conduits. So, if you look at these p g is equal to projection ratio of p is equal to projection ratio b c is equal to diameter or width of the conduits. If you look at here now there in case of positive projecting conduits, there are two; one is your flexible conduits other is your rigid conduits, let us start with to one by one, this is your flexible conduits in case of flexible conduits what it happen are the conduits is flexible what will happen it will settle.

That means, the soil above of the conduits that we called as a central zone, and soil side by this conduits this is called side zone the central zone will be see are more as combative side zone that is. So, I what will happen this shearing stresses will be vertically upon. Now if I look at this, if I look at this look at there is called critical plane it cannot settle up to way to certain depth it will settle up to the critical plane after the settlement. So, what will happen it will look at here delta f plus d c what is d c d c is your vertical deflection of conduit d c is your how much vertical deflection of your conduits, and delta f is your settlement of conduit into the foundation settlement of the conduits in to foundation vertical deflection vertical deflection of conduits.

If you look at here d c is your vertical deflection of your conduits delta f is your settlement of conduit into the foundation; that means, once the reject flexible conduits, what will happen? The conduits itself deflection this is called d dc also the conduits also both inside your foundation; that means, it will also penetrate inside your foundation. So, this is your critical plane p is your projection ratio what do mean by projection ratio how much it is projected above b r ground able or ground surface how much it is projected it, this is my conduits from this how much it is projected above we are ground surface it, this is my ground able how much it is projected ground surface as compare it, this is

might d or dc or b c whatever usage it which is the diameter with these respect to diameter how much it is projected above.

So, with respect to p b c the deflection are the top will be total deflections are top will be delta f plus d c, because it is a flexible conduits. Now if I right it in terms of settlement ratio in terms of settlement ratio it will be delta m plus delta g minus delta f plus d c delta m what is the delta m compression of fill on the sides of the conduits in the distance p b c compression of fill delta m compression of fill on the sides. If I look at this, this is your this value is your this is your delta g, and this value is your this complete values your delta m plus delta g, delta m plus delta g delta m is your compression of fill on this sides of the conduits in the distance p b c on this side of the conduits how much soil sample side both the sides of the conduits, it will compress it will settle, and delta g is your settlement of natural ground surface adjust, and to the conduits settlement of natural grounds of surface this is my natural ground surface how much it settle delta g adjust, and to your conduits how much settle, now these with with respect to this settlement ratio we can find it out what is a settlement of your central zone are of your flexible I will lets rigid conduits.

Now you come back to rigid conduits in case of rigid conduits what will be happened? If see this is your delta f plus d c the delta f, what is the delta f settlement of conduit into the foundation vertical deflection of conduits these part will be less as compare to your flexible as compare to flexible in case of flexible delta f plus d c will be more than your delta f plus d c in case of rigid that is why what will happen central part of be soil among this conduits will settle more. Once it will settle more whole mass will be settling as compact your side soil that soil these shearing stress will be vertically of in this case what will happen the central part will be settle less as compare to your side soil, what will happen?

Your shearing stress will be vertically down what this is the physics. So, these are all this p is equal to projection ratio b c is zero diameter of this conduits now with respect to this settlement ratio with respect to this settlement ratio, then if I say settlement ratio is negative the moment I say that settlement ratio is negative that is mean conduits settle more than your critical plane settlement ratio were it will be possible to negative delta m plus delta g delta m plus delta g your settlement of adjusts sent soil adjusts sent soil compact your compact your conduits. If you come back to delta f plus d c, this is your

settlement of your, this is your settlement of your conduits. Now if I the moment I say settlement ratio is negative; that means, these value is more than this value. So, what will happens settlement is ratio of if it is an negative conduits will settle more than yours more than your critical plane this conduits particularly this conduits will settle more than your critical plane this exactly happened in case of delta f plus d c will be more than delta m plus delta g in case of flexible conduits, but in case of rigid conduits it will be more than this case. So, accordingly that this physics will sent. So, settlement ratio of where you settlement of a different conduits the value as been given some values. I am just writing this some few of this values best on your settlement ratio we can decide whether it is a flexible conduits or reject conduits.

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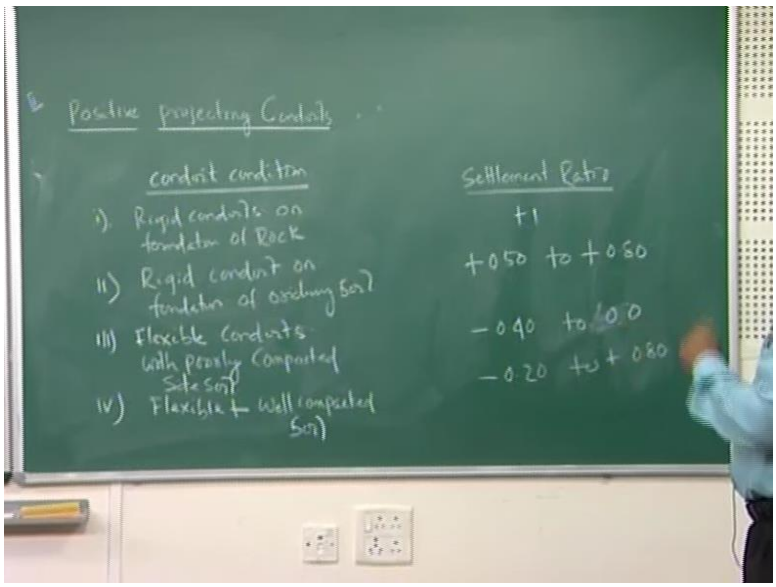

So, now the values of this settlement ratio has been given conduits condition, and this is your settlement ratio. Now rigid conduits on a foundation of rock just few cases you can get it start from there are different starts means different values also. There are i just enumerating few cases past one is your rigid conduits rigid conduits on foundation of rock this value will be exactly plus one this value will be exactly settlement ratio is equal to plus one, because it is rigid conduits again it is on the surface of the rock rock mass means the settlement of ground surface will be less as per as per as for possible, and the settlement of rigid means conduit also it will settle less means, it is very negligible negligible that is why the settlement ratio will be more plus one now second part is of rigid conduit on foundation of ordinary soil ordinary, soil means any soil it is were in

from plus zero point five to plus zero point eight why it is plus why it is not negative the why it is plus, because this is a rigid conduits the settlement ratio, if I right it this settlement ratio is equal to once again for you reference r p is equal to delta m plus delta g minus delta f plus d c by delta m. If you look at it is positive, because this term settlement of this side of the soil will be more, then compare to your settlement of your conduits that is why it is plus, and this range is plus five two point zero point five two zero point eight second part is of flexible conduits flexible conduits with poorly compacted side soil poorly compacted side soil this comes out to be minus zero point four zero to one point zero, then fourth part is your just this flexible it is a flexible conduits plus well compacted plus well compacted well compacted soil this comes out be minus zero point two zero to sometimes plus zero point eight zero if it is sorry zero point four it will be zero point zero.

If you look at this particularly flexible conduits if this soil has not been compacted properly it will be always in the minus side it will be always in the minus side, because the defluxion, because your conduits defluxion, because a of your soil bellow the foundation conduits bellow the foundation will be more as compare to this. Now for if it is a well compacted soil generally is where income minus zero point two to plus zero point eight these are earlier typical rate all stop it here. Next class I will start about your negative projecting conduits that is…