Application of Soil Mechanics
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Lecture – 26

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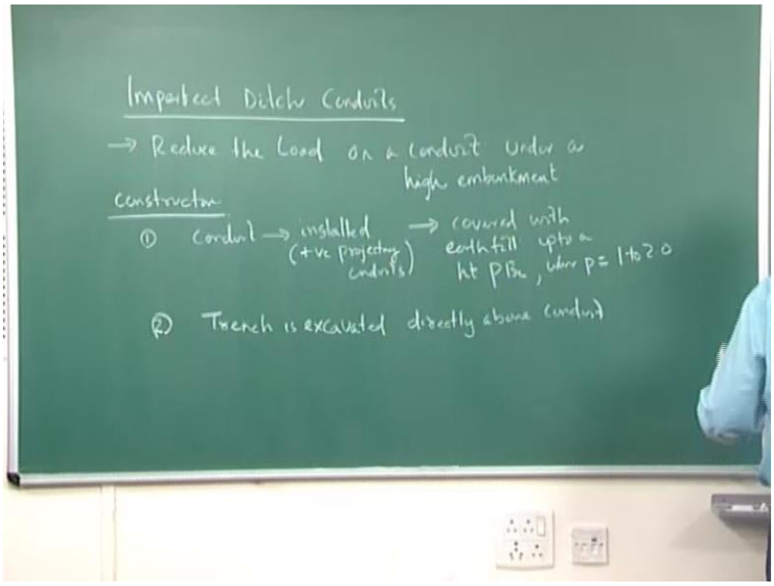

Imperfect ditch condvils these are the special conducts are used there reason being it has to be reduces the load reduces the load on a conduct under a high embankment. So, imperfect ditch conducts have special type of conducts. And it has been used particularly to reduce load on the conducts what we have seen generally the load coming on the conducts generally it is very higher. So, it is reducing this load on the conducts under a high embankment if the embankment is very high the constuction it has been generally done by two ways one is fast conduit installed conduit installed as a positive projecting condoits has a positive projecting condoits, then it is covered with hard earth till up to a hight p b c where p is bearing from one to two point zero, and of couse the till will be well compacted this your constructions; there are two ways the second way of construction is that trench is excavated directly about the conduit means trench is excavated directly about to conduit from the initial level of embankment to the top of the condoits, then trench will be back field upto what will be back filed.

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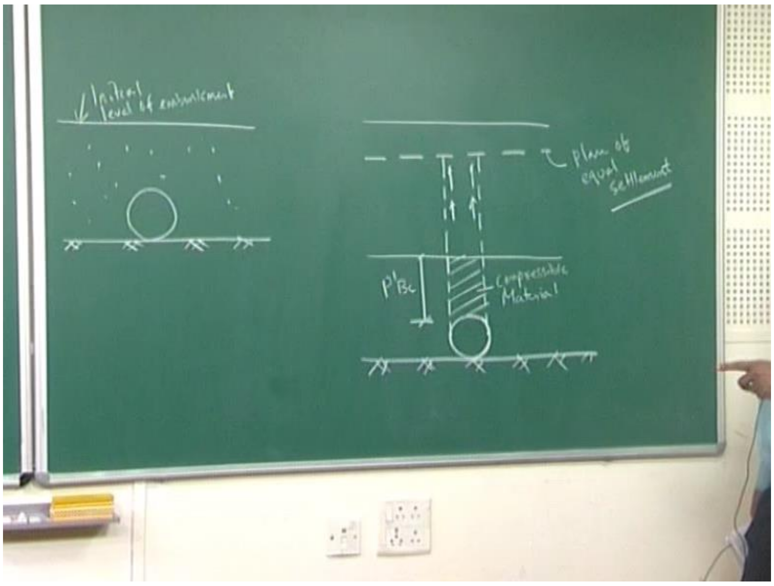

So, if I starts with the a one if I draw the figure a, and b how it looks. So, this is your initial level of embankment, you can say that initial level of embankment, then second one is if you look at here second one is this is your top of final emb embankment and this part is your as I said plane of equal settlement, and this is where it lies this. If I draw the diagramically the two cases this is your compressivable material.

And this part is your you will see if you look at this two parts as I said earlier this is special type of ditch conduit in perfect ditch conduit to say, and it has been used particularly to reduce the load on the condoits under a high embankment this is a high embankment what are the load coming to the condits it has been reduced by in this method. So, there are two ways of there are two ways of constuction first one is your, let the let the condoits placed let the condoits placed, and it should be installed like a positive projecting condoits what is a positive projecting condoits.

That means the entire condoit will be above the surface thats way this is called positive projecting condoits, then then after that coverd with earth till, then you can say covered with earth till, then p b c p is equal to one to two point zero, second one is second one is after placing this after placing this a trench will be directly excavated a trench will be directly directly excavated above the condoits; that means, first excavate the trench. If you look at the two cases two way of construction first way of construction is first place the condoits, and place the condoits, and then fill this material fill your soil material in this case instead of eacavating placing this first excate the trench first to excate the trench; that means, from these embankment these excavament has been made this is of your plain of plain of equal settlement plain of equal settlement; that means, first to make the trench first to make the trench in this case, then put your put your condoits down, and this trench are filled up look at the two difference between the this two construction menthod. In this case first condoits has been filled first condoits has been filled, then soil has been soil has been first condoits has been placed, then soil has been filed in a back made construction has been done in this case whole entire embankment is there first make a trench first make a trench, then condoit has been placed below this, then you can fill the material. So, these are the there are the two ways of doing this condoits. So, this is a special case of condoits this is called imperfect discondoits.

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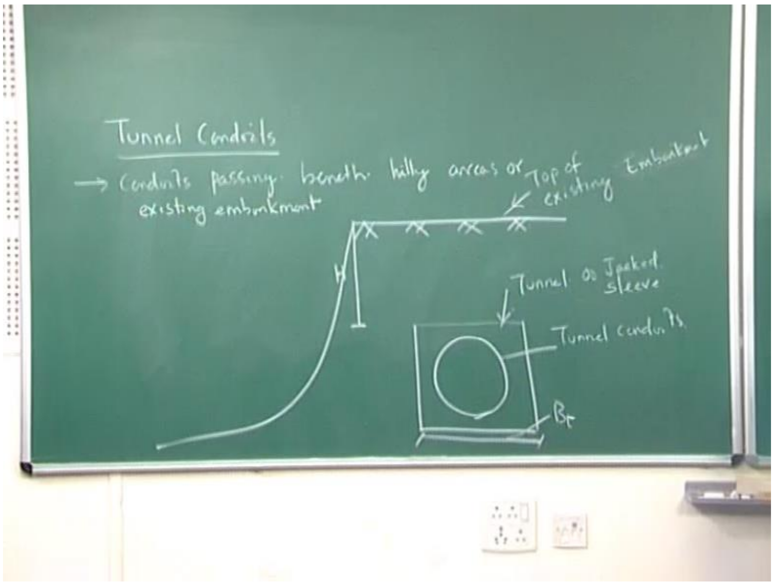

Then another special case is coming that is your tunnel condoits condoits passing this beneth of below the exiting embankment or hill area are known as the tunnel condoits, but particular condoits we can write it condots passing below or beneth hilly areas. Hilly areas or existing embankment or existing embankment are known tunnel condoits are known as tunnel condoits. If you look at the tunnel condoits definition; that means, condoits passing very hilly areas or existing embankment; that means, this embankment in this case imperfect ditch condoits what will happen they embankment has to be constructed above the condoits in this case alredy the embankment is there. So, beneth the embankment you have to pass the condoit or beneath this hilly areas you have to pass this condoits in this case it is called tunnel condoits. So, particularly this these are all your severe pipes example in a highway or railway lines ppelines. In a highway or railway lines, if you look at these how it figurewise how it looks this is your top of your existing condoits this is your total height h. Now if you come back this is called tunnel or jacked sleeve.

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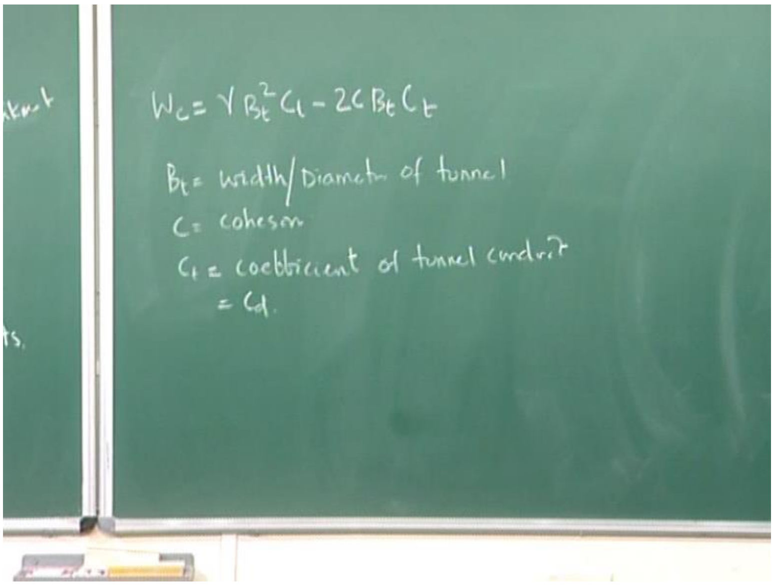

And this is your tunnel condoits this part is your called bt bt in this case load on the condoits can be find it out can be found out gamma bt square ct minus two c bt ct bt is your width or diameter of tunnel width or diameter of tunnel C is your cohesen strength of soil c is your cohesen strength of the soil c is equal to cohesen ct is equal, as I said earlier this is your coefficient of tunnel condoit, and which is equal to cd or condoit means equalent to this condoits this is your coefficient of tunnel condoits, and which generally ct is equal to cd if you look at here particularly in case of tunnel condoits now now there is alredy this embankment or hilly region is there look at this this kind of it may be an embankment or this kind of hilly region is there you want to make a pipe inside it make a pipe inside.

So, that without sisturbing your existing embankment; that means, makin a whole inside and, then pass pipe inside that. So, this is called particularly tunnel condoits. So, if you look at here this this is your existing existing top of the existing embankment existing embankment, then below this existing embankment hight h this condoits has been inserted. So, best example is particulrly pipe lines pipe lines. If we look at there without doing anything else without much expecting we push this pipelines below the embankment below the embankment these are called tunnel type of condoits. So, we can get it like as earlier only this two c bt ct has to be deducted. So, ct is equal to coeffiecient of tunnel condoits which is equalent to your cd eralier. We are derived for this condoits coeffiecient of this condoits you can find it out the pressure on the condoit, that is your wec these are two special type of condoits, one is your imperfect ditch condoit, second one is your tunnel condoits.

So, imperfect ditch condoits has been used particularly to reduce the pressure above this condoits tunnel condoits has been used particular below the hilly area or a existing embankment example is your best example is your pipelines below this rail roads below road or below any hill area. So, this is your best example particularly this pipelines, then we will come back to next part that is your about will start new one that is stresses in the soil in the vicinity of vertical soft these are all about condoits what we have finished this is about your condoits now we will start about this stresses in soil in the vicinity of a vertical shaft next part is your stresses in the soil in the vicinity of a vertical shaft if a vertical shaft is going inside the soil.

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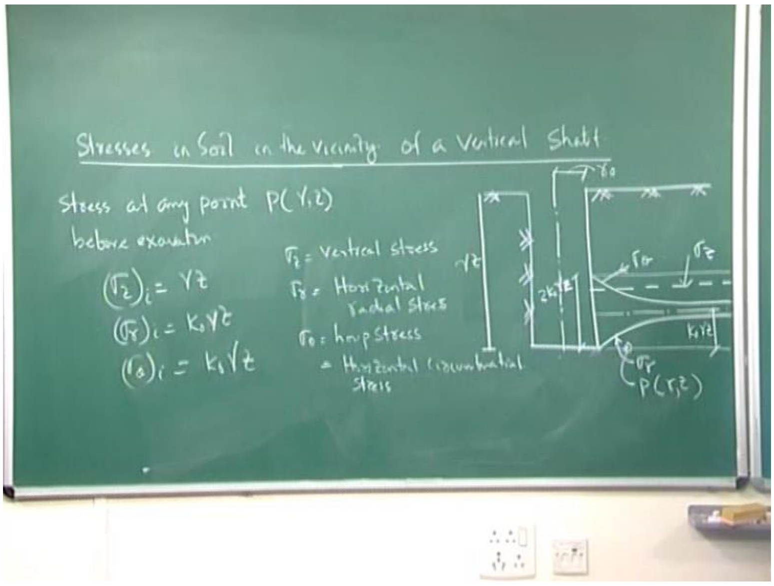

So, what is the stress around the pheripheri of this vertical soft. Let us draw this diagram, this is r zero, and this depth is your a vertical shaft of gamma z gamma z. Now stresses in the soil around the pheripheri of a vertical shaft this is the vertical shaft, if I draw it sigma theta this is your sigma z, and this is your sigma r, and this will be k zero gamma z k zero gamma z let us consider a point around this vicinity.

So, let us say p into rz. So, this will be total will be, let us say two k zero gamma z two k zero gamma z two k zero gamma z let us consider for example, let us consider a vertical shaft of internal means this radius is equal to r zero vertical shaft of radius is eual to r zero, and with this vertical shaft of depth of gamma z this is upto depth of gamma z now we are interested to find it out what are the stresses along the soil means if it is vertical stresses variation along the vicinity of the vertical shaft let us say stresses any point let us consider a point p at any distance here let us consider a point p p is equal to gamma z let us consider stress at any point any point say p gamma z before the of start r given by let us consider p gamma z before we have done any exavation a point at this point at a distance of the gamma z at this point. So, let us this before vocalised noise] before this exavation stress at any point b gamma z before exavation sigma z I is equal to gamma z sigma r I is equal to k zero gamma z sorry this is not r this is gamma z sigma theta I is equal to k zero gamma z. So, sigma z is equal to vertical stress sigma z is equal to vertical stress sigma r is equal to horizontal radius stress.

Sigma theta is equal to hoop stress sigma theta is equal to hoop stress or it may be a horizontal circumfential stress horizontal circumfential stress gamma is equal to unit weight as you know gamma is equal to unit weight k zero is equal to this stress are zero you see stress are zero, because before any excavation you. If you look at here supose there is no vertical shaft for example, there is no vertical shaft the ground is full means this is a soil this is a ground, then in this case what are the stresses. So, stresses are point vertical stresses obvious. Vertical stresses is equal to unit weight gamma is equal to unit weight times of z, then horizontal or radius stress horizontal or radius stress that also horizontal or radius stress.

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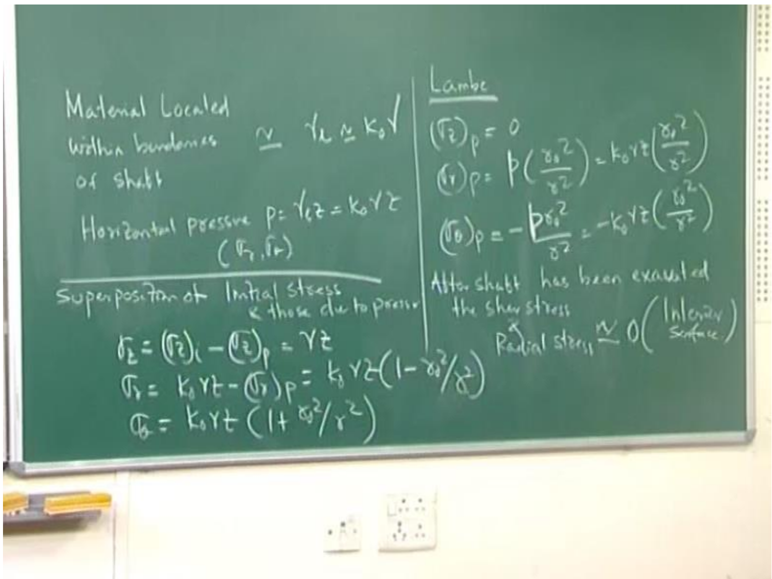

If you look at here a ground is there at this point I am asking what is the stress. So, the particle stress is equal to gamma whether radial or hoop stress; these are all k zero times gamma z k zero times gamma z means k zero is equal to r are tressed coefficient of are tressed into gamma z, this is your stresses or preserves now once the examination has been done in this case once the examination has been done suppose the once the examination has been done, then what will happen? Now let us say let us say the material, let us say on the cylinderical surface with in this the soil are zero the material located within the boundaries of the proposoft can be replaced by material located within boundaries of shaft is this your shaft material located at the boundaries of the shaft can be replaced can be replaced by a liquid by a liquid of unit weight of gamma l equal to equal to equal to k zero gamma, what I have taken what we have taken in these material if this is a shaft around the pheripheri around the pheripheri what are the materials material is soil, and what is the stress coming into k zero into gamma.

So, this can be replaced as a equavalent fluid that is your unit weight k zero into gamma unit weight is equal to gamma l now the horizontal pressure p due to equavalent liquid load. So, this horizontal pressure, now it will become, because of a liquid p is equal to gamma l z which is equal to k zero gamma z are the pressure is equal to gamma ri gamma theta I there is no effect on stress in the soil in the vicinity in the shaft this pressure horizontal presure. If you look at this this horizontal presure is nothing, but sigma r, and sigma theta.

This is nothing, but your sigma r, and sigma theta sigma theta. So, now, this stress due to equavalent fluid presure can be found by lambe base formula lambe has given lambe has gi given stress due to equavalent fluid pressure lambe what what we have taken how it has been modeled, because here what will happen there is a shaft the shaft has been . So, there are the soil. So, lambe earlier what he he has given the equation suppose there is a shaft inside the fluid instead of soil there may be fluid water may be fluid inside the fluid what is the stress what are the stress coming into the picture. So, that formula has been used here in this case supose there is a fluid around the pheripheri of the shaft, then the sigma z p p is your point p is your point.

This point where we are discussing about the stresses sigma zp is equal to zero sigma rp is equal to p r zero whole square by r square, which is equal to k zero gamma z r zero whole square by r square sigma theta p sigma theta p is equal to minus p r zero whole square by r square which is equal to minus k zero gamma z r zero whole square by r square. So, p is equal to small p. So, these are all small p these are all your small p small p is your stress are due to presure p of the equavalent fluid this small p is your stress due to equavalent fluid. Arond the pheripheri of shaft, what is the equavalent fluid now after the shaft has been excavated once the shaft has been excavated along the depth the sher stress, and radial stresses on the interior surface are zero the sher stresses after shaft has been excavated after shaft has been excavated the sher stress, and radial stress are zero radial stress are zero on the interior surface on the interior surface.

So, stress at any point after the eacavated of the shaft can be obtained by super position of initial stage, and those due to presure you see if you look at here if you look at here what we have done what we have basically done initailly we consider there is no shaft there is no shaft as if there is a ground, then at point p what is the what is the stress what is the presure coming these are all your presure coming, then second part what we have done keep one shaft has been put inside. So, both the sides of the soil has been taken into equavalent fluid equavalent fluid. So, with this what are the stress has been come has if a shaft inside the fluid. So, what are the stresses are coming into picture, if I want to bring into this picture. So, what will happen I will take out the shaft.

That means I super impose case one without the shaft stresses, and second major which shaft what is your stresses, then shaft has to be taken out, then by super position of method of super position we can find it out stress due to the presure of the extra vertical shaft by method of super position. So, stress at any point after excavated shaft can be obtained by super position of by super position of super position of initial stress, and those due to presure , and those due to presure. So, now, this becomes sigma z is equal to sigma z i. I is equal to initial I forgot I is equal to initial case before your excavation I is equal to initial case. So, this minus sigma z due to pressure due to pressure equavalent to fluid or due to may be earth which comes out to be gamma z, in this case is equal to zero, then sigma r whcih is equal to k zero gamma z minus sigma r p which comes out to be k zero gamma z into one minus r zero whole square by r square. So, similarly sigma theta also sigma theta comes out to be k zero gamma z one plus r zero whole square by r square now with these if we look at the variation. If we look at the variation the variation has been drawn the variation has been made sigma r how it is varying, and sigma theta how it is varying wherever what is the variation of sigma z.

If we look at the variation of sigma z it around the vicinity this is my shaft has been excavated in the vertical direction. So, what will happen my sigma z at this point it is gamma z at this point it is gamma z at this point also it is gamma z at this point also gamma z at this point also gamma z there is no change. So, thats why this is a straight line this is a straight line now come back to sigma r sigma r is equal to sigma r is equal to if this is my sigma r k zero gamma z one minus r zero square by r square. R square is nothing, but the distance from here to here this point this point is the distance from here to here this.

If you look at the cordinates your r, and z z is cordinate from here to here this is your z vertical distance r is your radial distance as I increase the radial distance as I increase the radial distance what will happen? The variation will start the variation will start like this similarly for sigma theta it is also one plus r zero square by r square differention has been given. So, these are all your stress in the soil in the vicinity of vertical shaft if I excavate a vertical shaft vertical shaft, then what will happen what are this stress variation in the soil as I go radial distance as I go radial distance what will happen why are it is in practicle importance suppose a vertical excavation or vertical shaft has been inserted or may be vertical excavaton has been made.

So, in that case you can find it out, you can find it to know what is its influence while suppose there is a another structure is there near by what is it influence? How the variation of sigma r, and sigma theta. So, this r distance is your designed parameter distance based on the our distance, you can go for another construction may be embankment may be any other man made construction you can do it, this as a this sigma theta, and sigma r as a significant role in stress variation particular in the soil in the vicinity of the shaft.

Thanks a lot.