Irrigation and Drainage
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Lecture - 04
Soil Water

Friends, welcome to lecture number 4 of Irrigation and Drainage lecture series. So, in this we are going to learn so, the basically the soil, water, relationships. And, we are going to see how the water is held between you know the soil particles I mean among soil particles. And what are the forces with, which these I mean the water body is held within the soil particles. So, and then we are going to talk about soil water and soil water potential and some examples in the end of the lecture.

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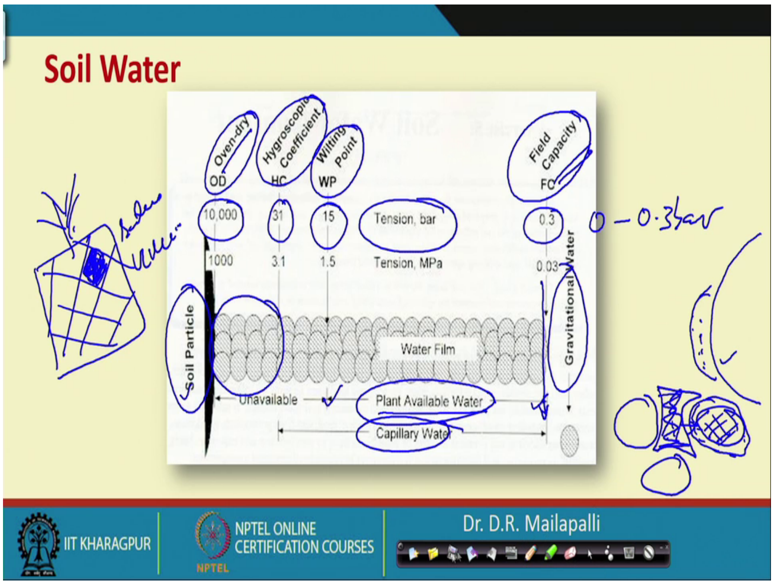

So, here if you see so, clearly if you see; so, this one is the water status between these 2 soil particles, if you draw. So, here you have soil particle here ok. So, and there is another soil particle somewhere here is not it. So, in between these 2 soil particles so, we are talking about how the water is going to held between these 2 soil particles ok.

So, assume that this is centre of the soul to soil particles. So, exact this is the centre of these 2 soil particles ok. So, since generally what happens with the nearest part of the soil particles, the water is held tightly the water is held tightly. So, here also the water is held very tightly ok, but whereas, the centre the water is held I mean very loose, without I mean with less you know tension.

So, that water is called the water, which is flowing through gravity or the gravitational water. So, this can easily pass through the soil particles with because the tension with which this particular water held is you know 0 2 you know 0.3 bars 0 to 0.3 bars so, generally. So, that that is what the gravitational water.

Then after that so, at exactly at point 3 bar the whatever water, which is held with the tension at 0.3 bar it is called field capacity. So, the; this is very important as for the irrigation is irrigation is concerned. So, we will be I mean this is the main criteria I mean the threshold for giving irrigation water ok.

So, then after that if you see from 0.3 to 15 bar tension so, the water at which the I mean the water which is held by 15 bar tension is called the wilting point. So, the water is at wilting point we call water is at wilting point. So, the water, which is available for the plant lies between field capacity and wilting point ok. Field capacity and wilting point this is called plant available water, this is the plant available water ok

So, then after that from 15 bar to 31 bar. So, the waters soil water will be held by a you know the some forces or mostly the capillary forces. So, so this is called the permanent wilting point so, here. So, at 31 we call this permanent wilting point and also we call this hygroscopic water hygroscopic coefficient ok.

So, then after that the water is really tightly held at the soil particle with the; you know absorption forces. So, or head is the forces you can say. So, and up to 10000 bar ah. So, this is called you know the oven dry water. So, if you keep and I think the previous lectures we talked about the oven dry water I mean if you keep a moisture sample in a you know oven. So, at the dry sample contains still some water. So, that is I mean. So, that is called oven dry water, but it is completely dry condition ok. So, this is the plant available water between 15 bar to 0.3 bar and then there is a capillary water this 0.3 bar to 31 bar ok.

So, I mean the overall; so, in this slide what we are going to demonstrate is so, the water which is present between the soil particles is held by certain forces. So, the first one is the gravitational force. So, with the gravitational force water will pass through the soil particles, which is not available to the plants and whereas, due to the due to different materials this is solid and then water is always some adhesive forces right; so adhesive forces there going to going to keep the water towards the soil particles ok.

So, why we are talking about these, because the plants have to extract this moisture except the gravitational water so, the other moisture really required for the plant growth ok. So, that is the reason we are interested in the water, which is held between the soil particles. And so, so what this tensions indicates the tension the bar. So, the bar assume that the soil is completely saturated ok, the soil is completely saturated; that means, as I said the soil has the pores the pore contains is a water or the gases ok.

So, assume that the water with the voids, which are occupied by completely water ok. So, when there is a plant. So, since plant requires water, the plant extracts water, and whatever this kind of the tiny reservoirs the tiny reservoir is going to get empty. So, then it get empty. So, then the negative pressure is going to create so; that means so, these from saturation soil to unsaturated soil conditions it is going to achieve. So, this negative or the tensions, that is called soil moisture tension.

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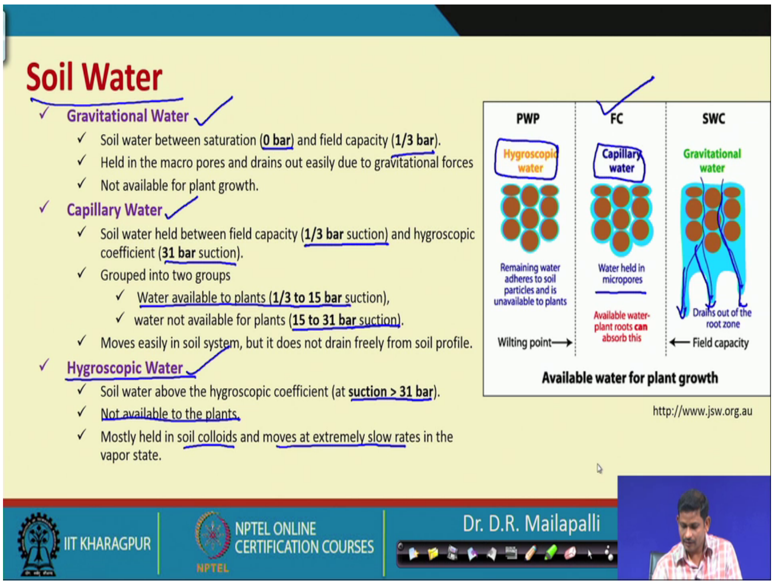

So, let us see in the so, next so, here the soil water. So, we are talking about soil water. So, as I explained before it is a gravitational water right and the capillary water and hygroscopic water. These are the 3 water you know types we need to consider for the irrigation, you know purpose.

So, the gravitational water as I said it is between 0 bar to one-third bar it is between 0 bar to one-third bar if you see the picture here. So, the water so, which is the gravitational water this is completely saturated initially and it is going to drain through the soil pores so; that means, this is not going to available to the plants anymore.

So, then the and the capillary water, if you see the capillary water here. So, what is held in micropores? Ok. And, then so, and this is in between one-third bar section 2 31 bar section. So, this is the total capillary water whereas, the water available to the plant is lying between one-third bar to 15 bar this is a wilting point. And whereas, water not available to the plants the 15 to 31 bar section so, it is called permanent wilting point and the plants cannot extract anymore water whereas, one-third to 15 bar the plants are going to show some kind of wiltiness ok.

So, then the hygroscopic water so, the hygroscopic water, if you see this hygroscopic water. So, this is going to remain in the soil, which is held tightly to the soil particles. So, the soil water above hygroscopic point is a section, which is greater than 31 bar and of course, it is not available to the plants ok. And mostly held in soil collides and move extremely slow rates in the vapor state. So, extremely slow rates in the vapor state. So, this is not going to available to the plant.

So, our main focus or interest is the field capacity water I am sorry.

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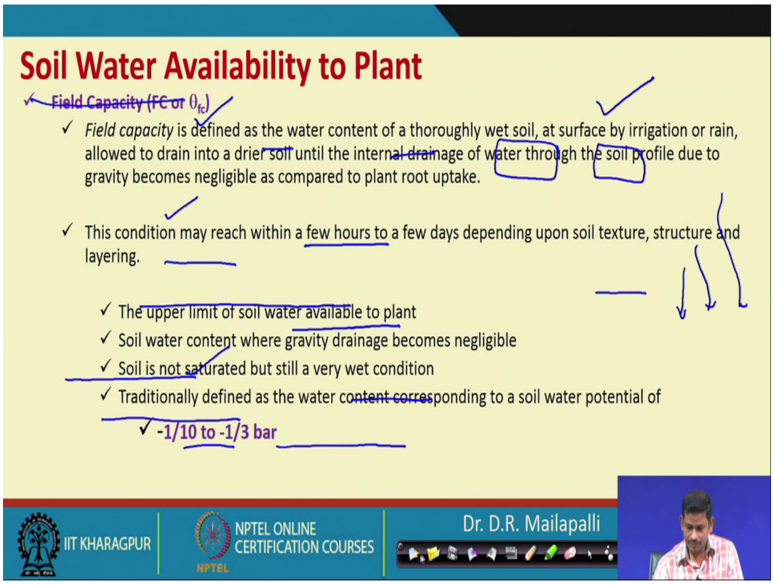

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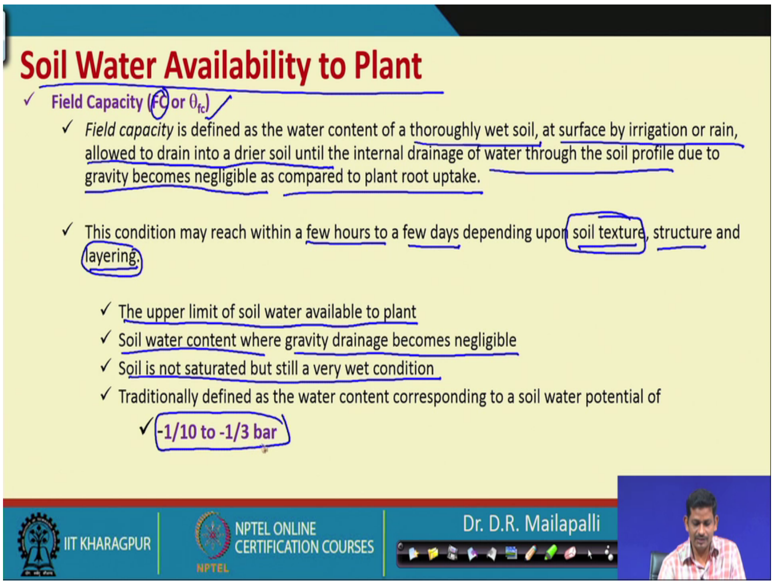

So, then the soil water available to the plant. As I mention; so, the field capacity, which is denoted with is FC or theta FC ok. So, in literal sense the field capacity is defined as the water content of thoroughly wet soil, at surface by irrigation or rain. Suppose you have a field right which has water previously by either rain or irrigation. So, that; that means, the field is completely saturated. And that saturated field was is allowed to drain i nto dried soil. So, with the top is you know the top is saturated whereas, the bottom is still dry. So, that the gravity water the gravitational water is going to pass from saturation to unsaturated zones.

So, then the drain through water soil profile due to the gravity becomes negligible as compared to plant root update. So, the situation when the gravity water flows going to be 0 or there is no gravity flow, then the moisture content of that soil is called field capacity. So, in; that means.

So, suppose you have rainfall today ok. So, the soil is completely saturated and then after that event. So, there is no rain and overnight no rain then the next morning you have gone to the field and check the soil is still wet the soil is still wet it is not saturated completely, but still wet. So, that condition is called the field capacity so; that means, whatever water, which is saturated which is means used in saturation is drained by gravitational force and the remaining water, which is retained within the soil pores or soil matrix is called the water is called field capacity water ok.

So, this condition may reach within a few hours or few days ok. And depending on the soil texture, or soil structure, and layering ok. So, here you have like a for example, sandy soil right soil texture you have lot of sand. So, what happen in few hours the gravitational water is going to drain out ok. So, whereas, if the clay soil it takes long time to drain out the gravitational water ok.

So, the similarly the layering so, you have you know number of layers that are first layer, second layer, third layer and the top layer is for example, it is you know imperious kind of like semiperious layer. So, it takes time to you know you know the gravitational water to penetrate from 1 layer to another layer and it takes time to reach the field capacity level.

So, the upper limit of a soil water available to the plant. So, this field capacity is also known as upper limit of soil water available in the plant and soil water content where gravity drainage becomes negligible. So, when so, the gravity initially is more than after that started declining. So, then the moment the gravity water is 0 we call it reach the field capacity and soil is not saturated, but still very wet conditions. So, if you observe during field capacity time, the soil is not right so, it is still wet and not saturated and as I have mentioned. So, the soils moisture stress at field capacity vary between minus 1 by 10 bar to minus 1 by 3 bar.

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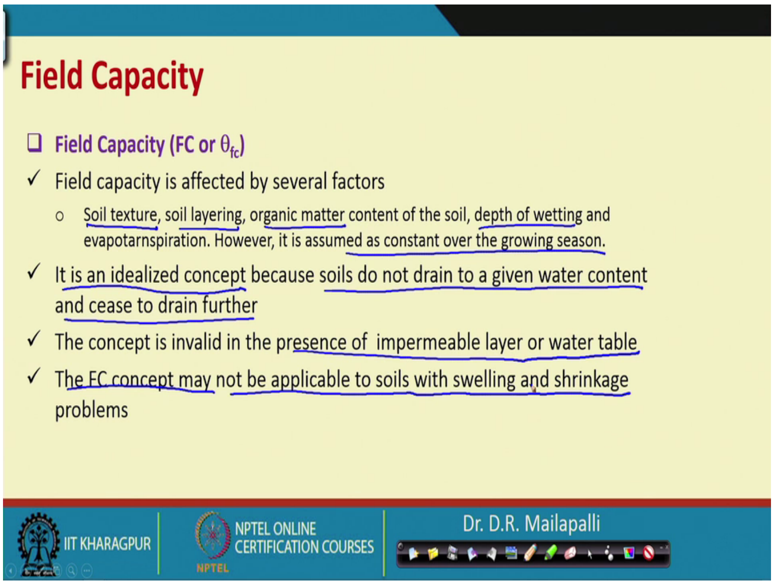

So, then so, next is the field capacity, which is affected by several factors. So, as I mention soil texture, layers, organic matter, and also there are depth of wetting. Ah. However, it assumes as a constant over a growing period. So, we I mean when you do modelling or even field experiments or a water band studies. So, we consider field capacity is constant throughout the growing period and then we decide irrigation based on that. . And then this is of course, this field capacity is a idealized concept and because salts do not drain to a given water content and ceases to a drain further ok.

And, the concept is invalid in the presence of impermeable layer or water table suppose, if you have a water table lying down the soil and then also the imperious layer. So, what happens if there is a water on top it is enter into the soil through evaporate sorry infiltration process. And, since there is a clay layer or any water table it is not going to move further and the water will not drain further so; that means, the gravity water still there in the surface. So, that causes the drainage problem ok.

And, then the field capacity concept may not be applicable to soils with swelling and shrinkage. So, suppose you have a clay soils. So, the field capacity I mean reaching field capacity takes longer longer time, because the soil swell with the water right it is not going to drain water anymore down.

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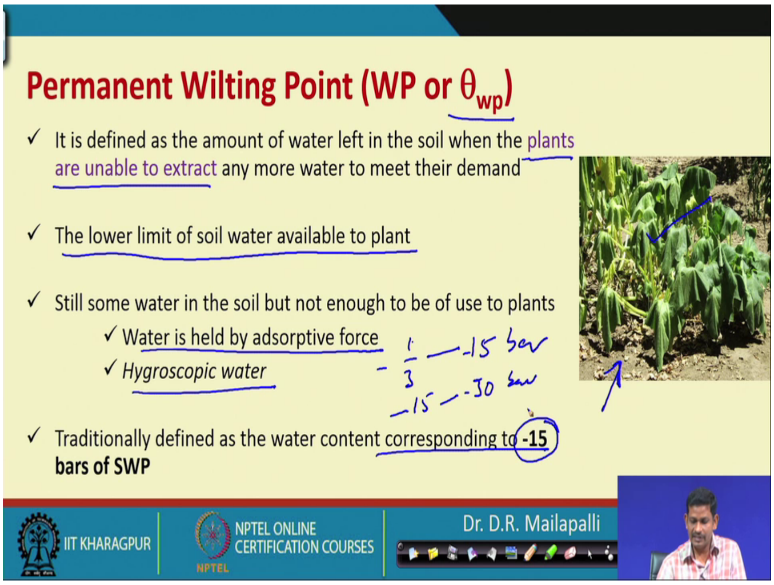

And, then the permanent wilting point here, if you I mean this generally denote with theta WP here in our lecture. So, it is defined as the amount of water left in the soil, when the plants are unable to extract ok. So, when the plants unable to extract anymore water to meet their demand.

So, during that time what happen if you observe the plants is going to wilt. So, this kind of symptoms you can observe when you look at the plants ok. So, it is; that means, it requires water, now it is reaching the wilting point level. So, this is also called the lower limit of soil water available to the point ok. So, one is upper limit and other one is lower limit. So, upper limit is field capacity and the lower limit is the permanent wilting point ok.

Still some water in the soil, but not enough to be use to plants. So, here water is held with absorptive forces and hygroscopic water. So, some part of water is available to the plant in the other part is not available; that means, you have like one-third to 15 bar of course, this is negative. So, this is available to the plant whereas, minus 15 to 30 bar this is not available with the plant, but it is defined as water content corresponding to minus 15 bar this is called wilting point ok.

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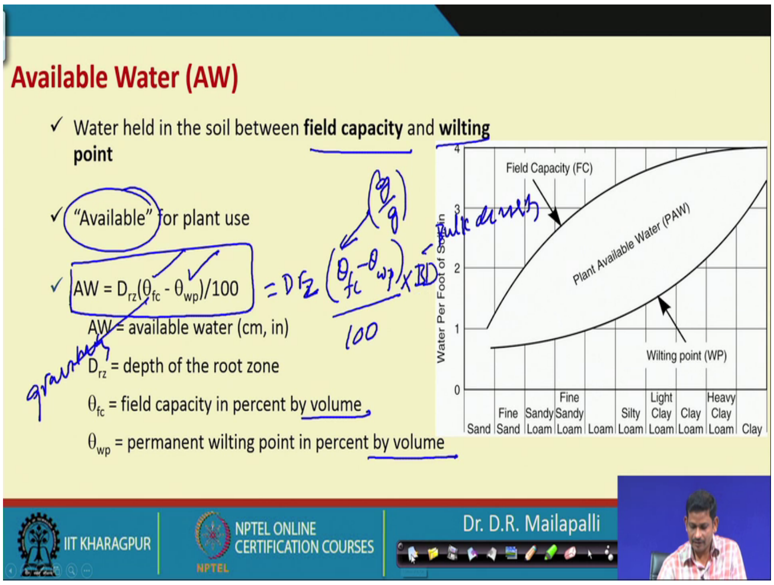

So, then so, next the available water which is if you consider the lower limit and upper limit ok. So, the water which is lying between lower and upper limits so; that means, pump field capacity and wilting point. So, that is called the available water; that means, available this water is available to the plant ok.

So, here if you see the water is held soil between field capacity and wilting point ok. So, then this is called available and there is an equation to calculate available water here. So, D r z so, the this is the root zone depth and theta FC the this is the moisture content at field capacity. And theta WP this is moisture content at wilting point and divided by 100, because this is in percentage. So, we need to divide by 100. So, and theta FC and theta WP all are in volumetric basis, suppose if you have that in gravimetric basis. So, in order to convert the volumetric into gravimetric or the gravimetric into volumetric basis just like this you have to multiply with the bulk density.

So, the same equation if this is if this is in gravimetric right this is in gravimetric. So, in order to convert these into volumetric basis so, the same equation can be written D r z sorry D r z into theta FC minus theta WP still divided by 100, but we have multiplied with bulk density so, so where theta is gravimetric basic gram per gram ok.

So, this is gram of water gram of soil ok. So, so, then you need this is this is called bulk density bulk density only thing the conversion right all right.

So, here this graph show us for different soils, so, how and also an y-axis water per foot of soil that is in inches water depth in the soil.

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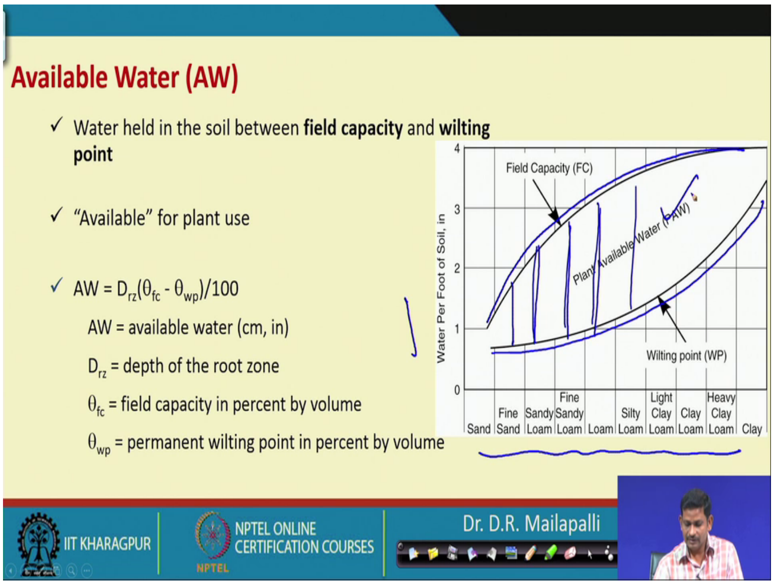

So, so this is upper limit we call this is a field capacity and this is the lower limit this is the wilting point. So, the water which is in between so; that means, the water per foot of soil held in between we call the plant available water this called plant available water.

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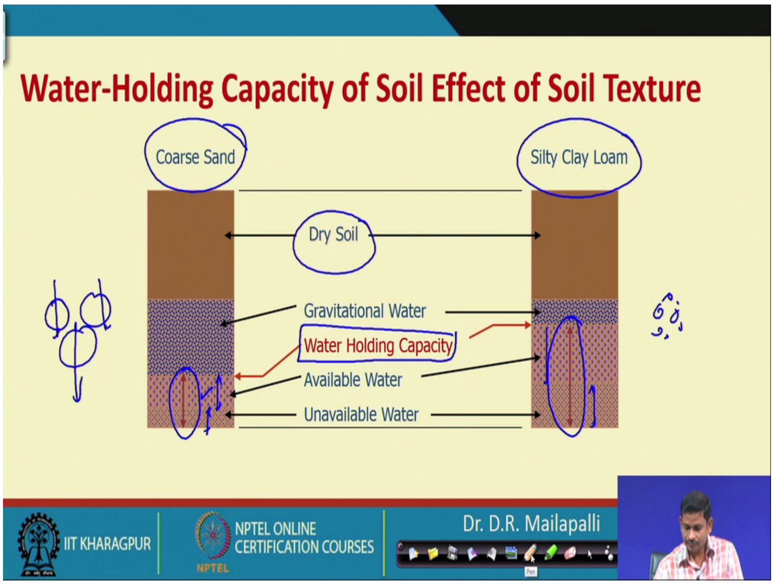

So, then so, the next is if you compare the this coarse sand and a silty clay loam so; that means, one is coarse structure the other one is fine texture soils. And see how the water holding capacity varies right between these fine texture and coarse texture per soils ok. So, and assume that in the both cases the dry soil is same and here in the coarse sand the gravitational water is more, because the gravitational water is more because the pore size is larger compared to hear the tiny pore size ok. So, that is why it is very easy to the gravitational water can pass very easy way through the pores ok.

And, then the next one is available water the available water here since it is a fine texture soils right. So, it can retain larger water compared to the core structure soils ok. So, that is the reason if you see. So, this amount is the available water this amount is available water whereas, unavailable water here unavailable water is even the smaller and unavailable water is larger here, because the tiny pores and the water is held strongly with the soil particles right.

So, if you see the water holding capacity. So, this is the magnitude and this is the magnitude so; that means, this the fine texture soils will hold larger water compared to the coarse structure soils ok.

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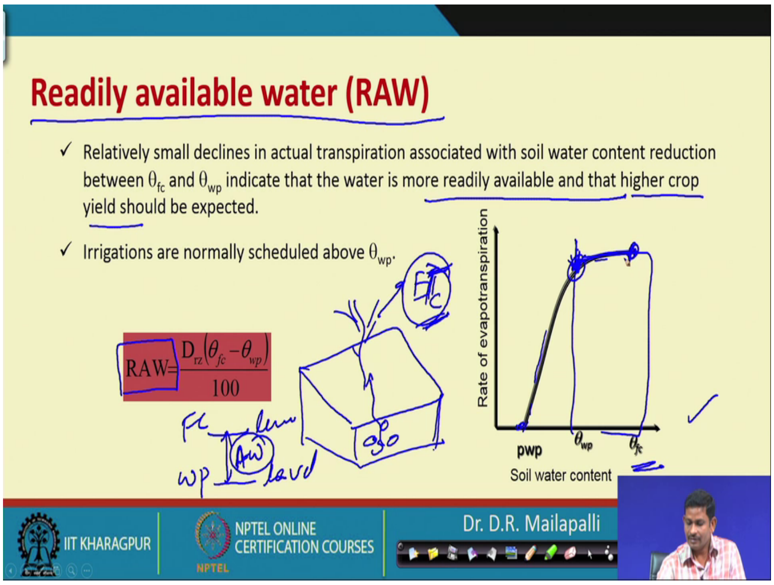

And, then so, here another concept called readily available water ok. So, and this is very important as per the irrigation is concerned, because based on this we are going to decide the when to give irrigation then how much to give irrigation? So, these this irrigation scheduling we call.

So, so, what happens? So, suppose once the field the field has the moisture at field capacity and there is a plant, which started you know extracting water from the reservoir right through evapotranspiration we are going to talk about this more in the following lectures. So, this is crop evapotranspiration. So, due to that, the water, which is held between the soil particles going to escape through the plant ok? So, then there is a negative pressure or negative soil moisture is going to create ok. So, that means, the water is ah. So, soil water is going to deplete the soil water is going to deplete.

So, when that is going to deplete so, from upper level to the lower level, that is called field capacity to wilting point. So, so, these 2 levels so, we are talking about this is available water ok. And due to this E T C this water reservoir this is called reservoir let us say. So, the level of reservoir is going to decline ok.

So, here so, the water which is available to the plant readily available to the plant for getting the higher crop yield is called readily available water. If you see this picture here so, on x axis this water content in percentage and y axis rate of evapotranspiration ok.

So, as I said the evapotranspiration increases evapotranspiration increases. So, initially this is starting point then after that due to loss of water you know it is reaches the wilting point. So, then the curve goes down to permanent wilting point here and no more evapotranspiration here ok.

So, then here r a w readily available water what we are talking. So, that. So, here if you see the watery which is down down down up to here even if you reduce water, even if you wait to replenish water up to this point up to this point. So, that is I mean not exactly, if you see this the this graph so, here almost this constant right theta FC.

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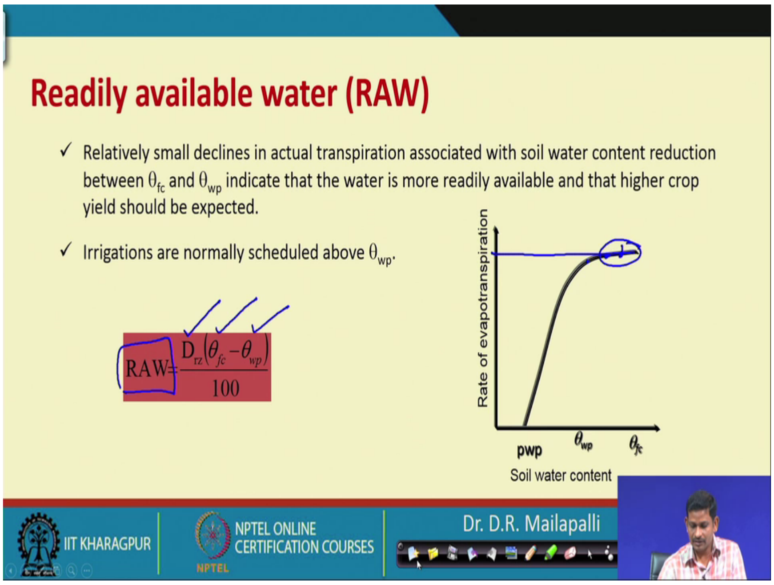

So, at this point somewhere even if you reduce I mean give wait till this moisture content give irrigation the it is may not be affecting you know the crop here maybe up to here may not be affecting crop here, but beyond that if you still you know wait for the crops to extract water and not giving any irrigation, that definitely is going to you know influence you your crop yield.

So, this the condition up to which the moisture content up to which the yield reduction is negligible is called the readily available water. So, here so, generally the readily available water is estimated with the root zone depth and theta FC the this is the soil moisture at field capacity soil moisture at wilting point divide by hundred readily available water ok.

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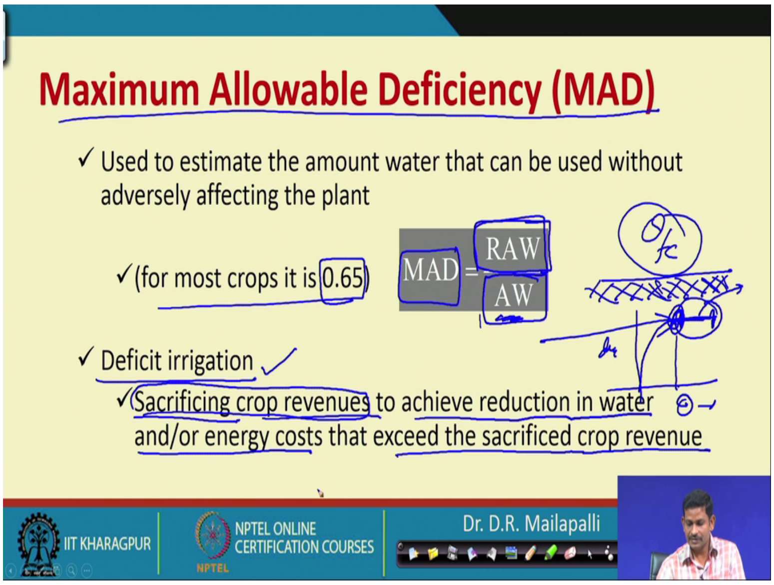

So, then so, the next is next concept is called the maximum allowable deficiency this called M A D. So, this is the you know can be used as irrigation engineers for most crops. So, this is 0.65 M A D; M A D is defined as readily available water and divided by available water ok, this is the fraction of total available water reservoir and up to which the plant I mean up to which you can achieve the I mean you can achieve no reduction in crop yield. So, that is RAW and AW ok.

And, this kind of irrigation so, our aim is to fill the soil moisture to the to the field capacity ok. So, if every time if you maintain the field capacity right field capacity absolutely I mean no problem, you can achieve the maximum yield right, but the thing is you have to irrigate frequently in order to reach the I mean maintain this kind of situation.

So, that is why so, and as you seen before the graph right when this is theta and the depletion here. So, at some point up to sudden moisture content so, the yield is going to be same.

So, why should we you know give frequent irrigation, we can wait till this point right this moisture content and then give irrigation ok. So, here MAD decides this kind of this point basically ok. So, at what at 65 percentage of depletion in available moisture content ok. So, that is MAD. So, this kind of irrigation pack is called deficit irrigation right. So, because you are allowing you know the plant to be little bit stressed ok.

So, what is deficit irrigation the sacrificing a crop revenues to achieve reduction in water and energy these are 2 inputs ok. So, water energy costs that exceed the scarifying sacrificed crop revenue. So, what happens you have some inputs water and energy costs? So, those costs are higher right and if you reduce that if you reduce that higher higher in the sense that is exceeding the crop revenue.

So, if you can reduce that and scarifying little bit you know crop revenues, that is not going to you know impact much on form economy. So, that is called the deficit irrigation.

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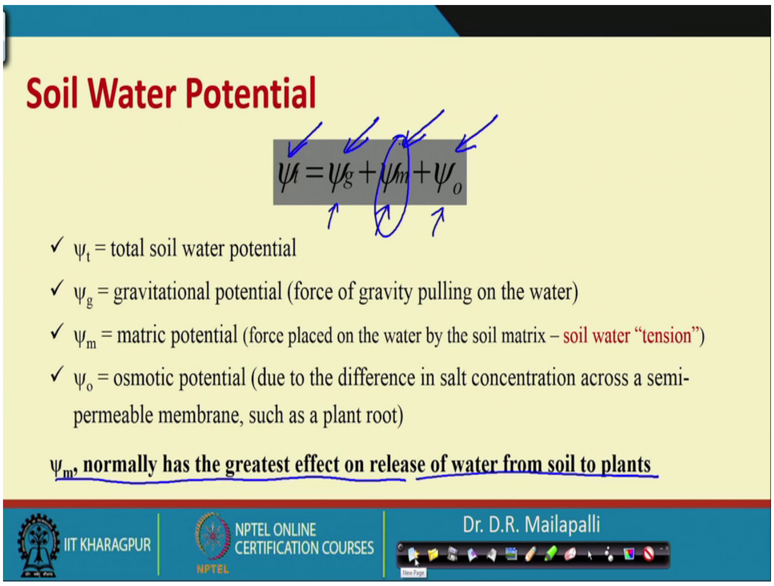

So, then though the next thing is so, here soil water potential. If you talk about soil water potential the whole thing the water potential contains these 3 components. So, this is the total water potential and this is gravitational water potential and metric potential and this is osmotic potential ok.

So, this gravitational potential we have seen before the potential which is you know experienced by the gravity I mean water and then metric potential mostly the capillary water and then osmotic potential this is due to you know the salts, which are present in the I mean the soil water ah. So, normally what we do here the metric potential, which is the greatest effect on release a water from the soil to the plant and our main concern is the metric potential here ok.

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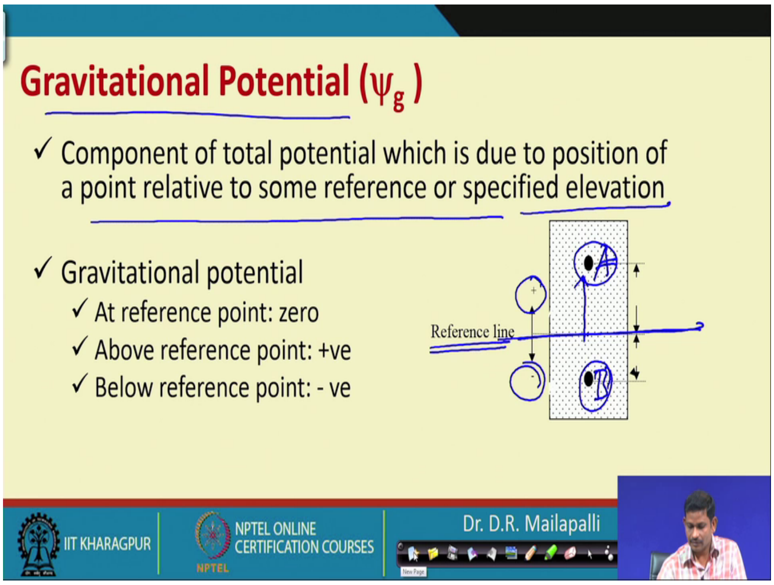

So, then so, the next is you going to see the gravitational potential, metric potential, and osmotic potential since we are not you know in this lecture we are neglecting. So, here the gravitational potential if you see. So, this is the component of total potential. So, which is due to position of the point relevant to some reference a specific elevations, here this is the reference suppose this is the soil stratum and let us say the point A and point B. So, these 2 points this is the reference point and from the reference point if you go up so; that means, this the positive you know potential and go down this is the negative potential.

So, what does it mean? So, that means, here is the water reservoir and 1 guy wants to you know fetch water from this to this; that means, he has to do some work he has to do some work; that means, the positive work. So, he has to do some positive work in order to get water from this reference line to here whereas, the guy which who is inside you know below the reference line. So, the water is on top of him he does not need to work much. So, this called a negative potential. So, and since the water is you know very slow in this case in the porous medium we are not considering any kinetic energy here only potential energies ok.

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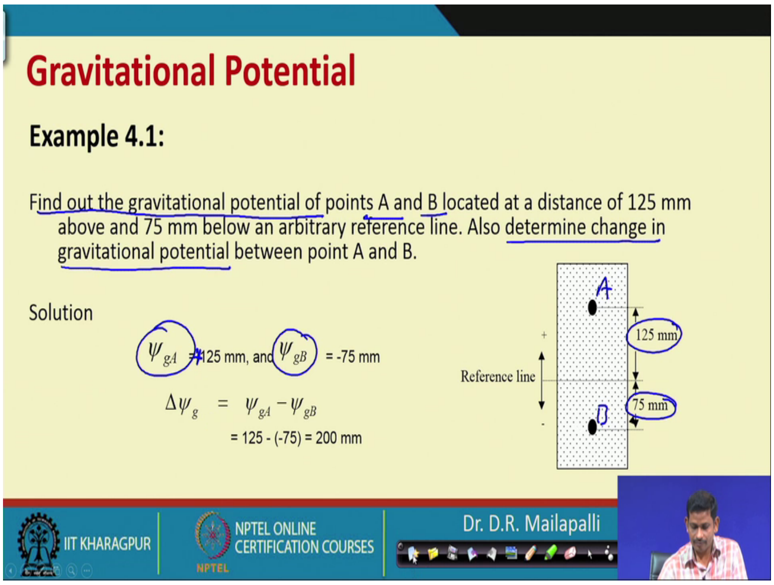

So, then let us see here an example of gravitational potential. So, for example, here the gravitational potential let assume A and B are the 2 points right A and B are the 2 points located distance 125 mm above ok, and 75 mm below the reference line. Also determine a change in ok, the what we have to find we have to find the gravitational potential of points A and B and also change in gravitational potential between A and B.

So, since this is given see psi g A is given 125 mm psi B 75 mm this is a negative sorry. So, this is positive right. So, psi g A is positive because this is above the reference line, above the reference line.

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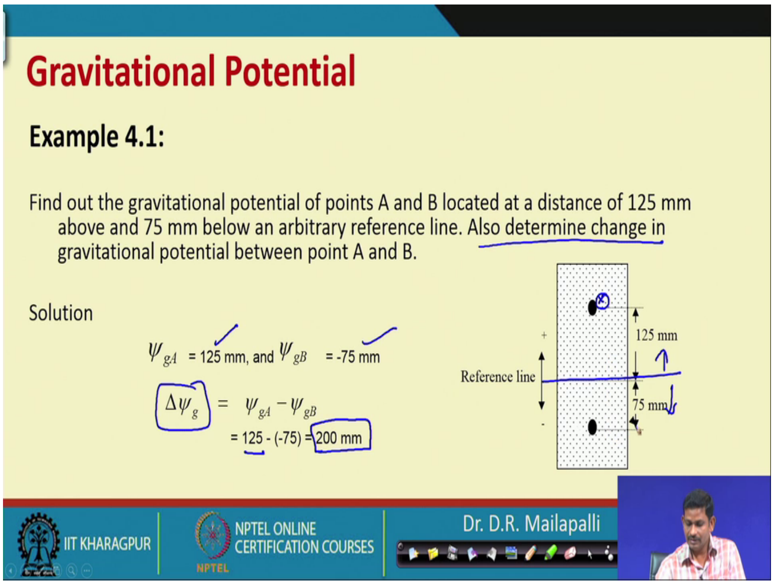

So, that is why this is positive and psi g B is negative because this is below the reference line right.

So, then this what is the difference the also determine the change the change is g A minus psi B. So, 125 minus of minus 75 total 200 mm is the gravitational I mean potential I mean change in gravitational potential ok, with reference to I mean at this point the change in gravitational potential from A to B is 200 mm ok.

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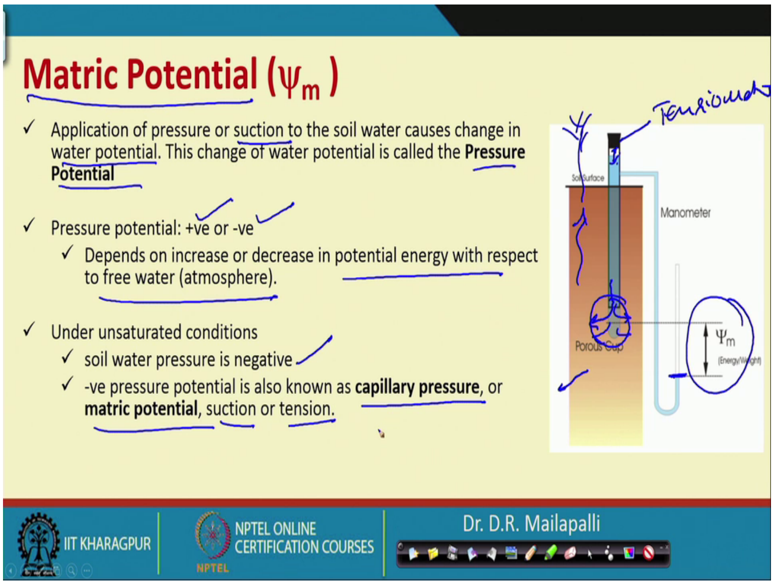

Then the next is the metric potential. So, the metric potential here the basically when we are talking about the soil moisture stress right. So, gravitational potential that goes you know through gravity. So, whereas, the metric potential we are talking. So, which is the water is held by soil particles the mostly.

So, the application of pressure or suction to the soil water causes the change in water potential so, this change of water potential called pressure potential. So, here for example, the pressure potential could be positive or could it could be negative depends on the increase or decrease in potential energy with respect to free water atmosphere ok.

Generally an atmosphere if talking the potential or metric potential atmosphere is A 0 ok. I mean the water table level it is A 0 and when you grow up or is going up; that means, when the water is depleting from the soil surface and the negative pressure is going to create ok.

So, for example, here if you see so, this is called a tensiometer right this is a tensiometer which is installed in the soil. So, it has a porous cup at the bottom so, and the other side the top, which is connected to the manometer ok. So, initially the water I mean the tube is filled with the tensiometer is filled with water completely before installing it, and then you have the initial you know initial water level in the manometer.

Then, after that after few days if you see the manometer level is going to get down, because this water I mean the water, which is present in the soil is going to deplete because of the water taken by the plant there is a plant takes water. So, then the water which the soil water, which is surrounding the porous cup is going to deplete.

And since this there is a water reservoir available water available, that is going to come out is going to come out from the a ceramic cup. And here there is the empty space so; that means, there is a suction is going to create and this level can be monitored here this is called metric potential ok. Under unsaturated condition, soil water pressure is negative, and negative pressure potential is also known as capillary pressure or metric pressure potential or suction or simply tension ok. There are some relative all these stems are relative ok.

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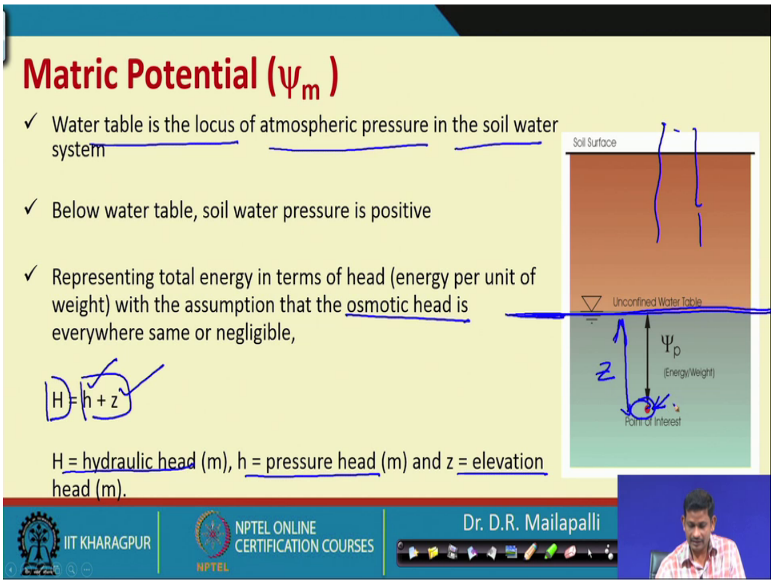

And then let us go into the next slide so, where the metric potential. So, the metric potential has the as I said this is a pressure potential. And water table for example, here we are talking about the water table, which is the locus of atmospheric pressure in the soil water system. So, this if this is a unconfined aquifer. So, this is a water table. So, exactly at this point this is atmospheric pressure because is this open to the open to the atmosphere so, the same atmosphere.

Whereas here in the down this is a suppose if the point here this is the point of interest ok. So, this is the point of interest this is the total potential the total potential here h which is 2 components right. So, one is pressure potential the other one is elevation. So, at this is the elevation and here as I said we are not considering the other potential so, that is called the osmotic potential that is we are not considering here. And also kinetic energy because the water is you know a water moves very slowly we are not considering that.

So, the hydraulic head the total hydraulic head and the pressure head and elevation head. So, elevation so, here there is a pressure head and then the distance from here to here. So, that is the called elevation. So, so, here the this is the z here the pressure point right. So, and then this is the total head.

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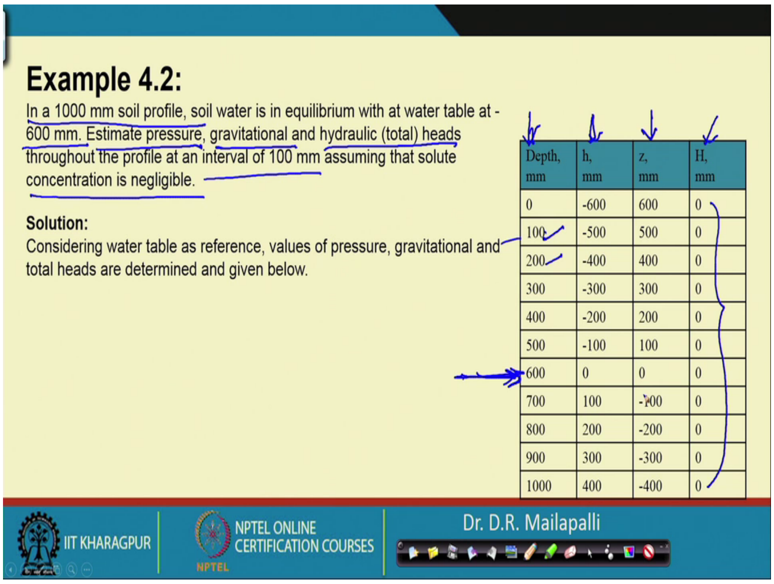

And, then for example, here in this example if you see so, there is a 100 mm soil profile 100 mm sorry 1000 mm soil profile, which is the more divided into 100 mm sections 100 mm sections. So, water table let us say water table at 600 mm distance from the top. Then the question is estimate pressure gravitational and hydraulic the total heads ok, throughout the profile at an interval of 100 mm assume that solute concentration is negligible; that means, osmotic potential is negligible here.

So, if you see here the depth is so, this is the depth a 100 mm 200 mm 300 mm following and this is the h. So, since this is you are reference. So, above you know above the reference you get a negative above the reference you get a negative because this is elevation this sorry this is the pressure..

So, above sorry this is the pressure. So, pressure is negative above that and whereas, pressure below that is a positive and z this is elevation. So, above that the elevation is above the water table. So, the elevation is positive whereas, below the water table elevation is negative and I mean the total hydraulic head the total hydraulic head is going to be 0 with this negative and positive effects.

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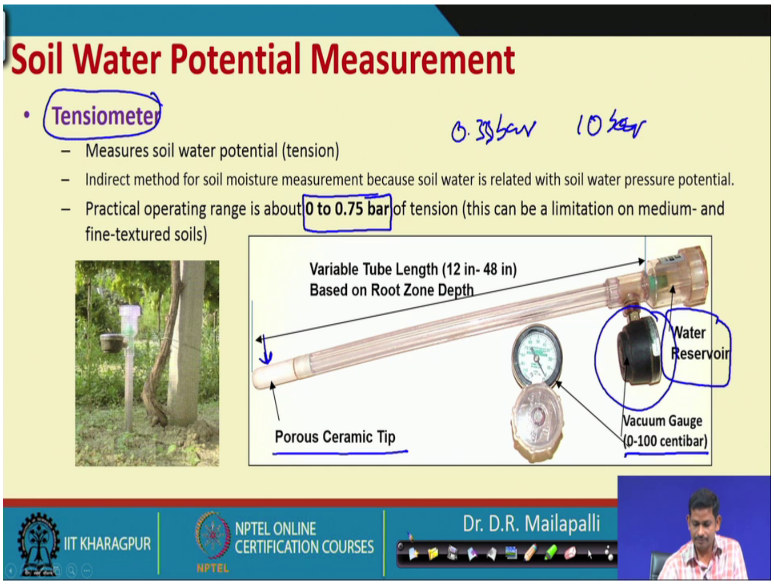

So, how to estimate sorry how to measure the soil water potential here the soil water potential is generally measured with tensiometer ok. So, the tensiometer has a longer you know the 2 and the bottom there is a ceramic porous porous ceramic tip and top there is a water reservoir and there is a gas vacuum gas which is attached to that which is which is read between 0 to 100 centibars ok.

So, this is, but if you observe this so, with this tensiometer we can measure only 0 to 0.75 bar only 0 to 0.75 bar. So, so, if you observe the field capacity 0.33 bar right 0.3 bar one-third bar. So, you can measure that and then there is a 10 bar sorry 15 bar ok.

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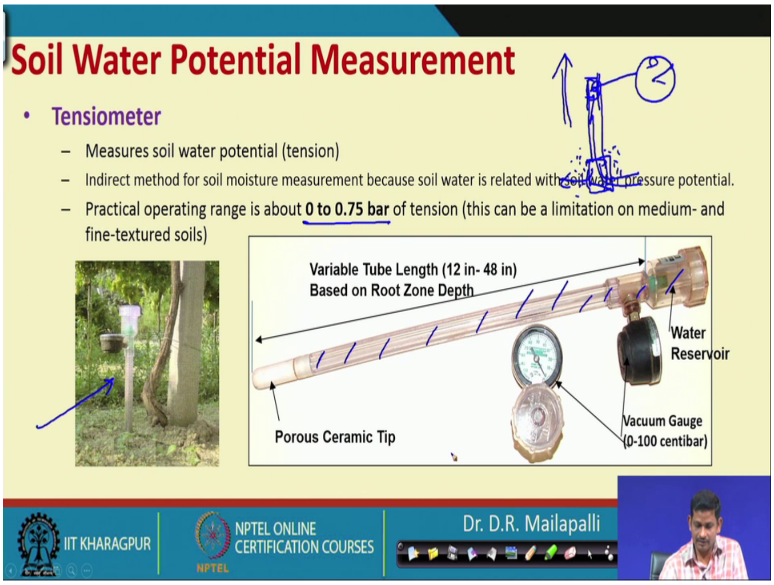

So, you can you can only practically with the using tensiometer you can measure 0 to 0.7 5 bar. So, this picture shows how to install it in the field. So, how is going to work because initially before installing the into installing it in the field. So, this complete this a column right is completely filled with water so; that means, is complete reservoir the moment you installed in the field right. So, the water which is surrounding I mean the soil water which is surrounding the cup ok.

So, if suppose this is initially saturated then after few you know hours it is going to be equilibrium. So, then due to the I mean soil water depletion the water is going to escape from tube to here and here the water level is going to decline and that creates you know the vacuum here and the vacuum will be measured ok. So, that way this tensiometer is going to work.

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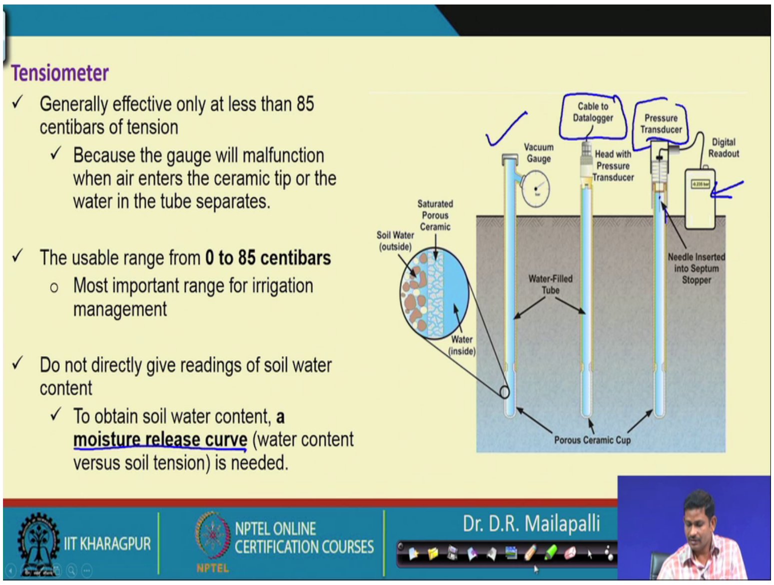

And then and the next there are different kind of tensiometer, if you observe here right. So, this is a simple vacuum gas kind and other one is cable to datalogger you can directly connected to a data logger and you can also record the soil moisture tension in different time intervals. So, here there is a other one is the pressure transducer based.

So, so he this is also continuous base. So, here is there is a digital readout you can directly attached to the readout and get the reading. So, here there is a needle. So, the needle the moment water goes down the suction will be read through suction will be sensed by transducer pressure transducer and that is read by digital readout meter.

And so, with we with tensiometer also we can indirectly measure the soil moisture. So, for that what we require is the soil moisture release curve. So, how do we extract how do you get that soil moisture release curve here.

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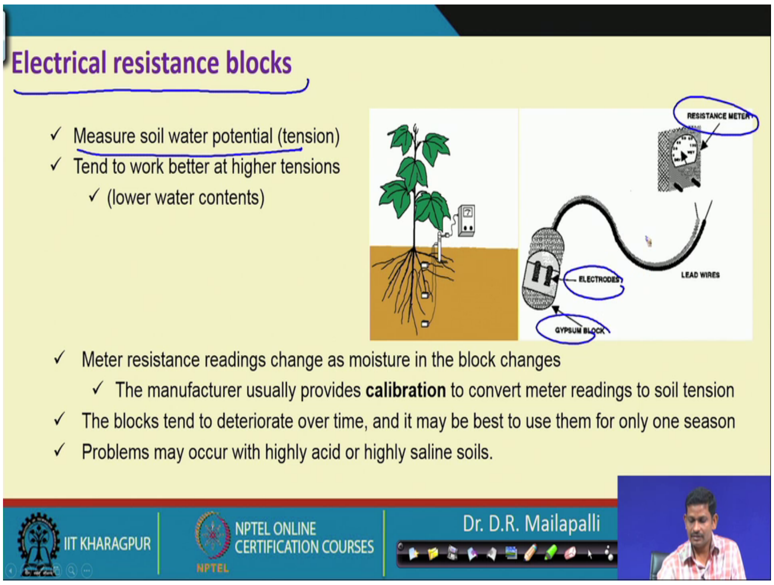

Ah Yeah that that is a one thing the before that I would like to mention there is another is called sorry.

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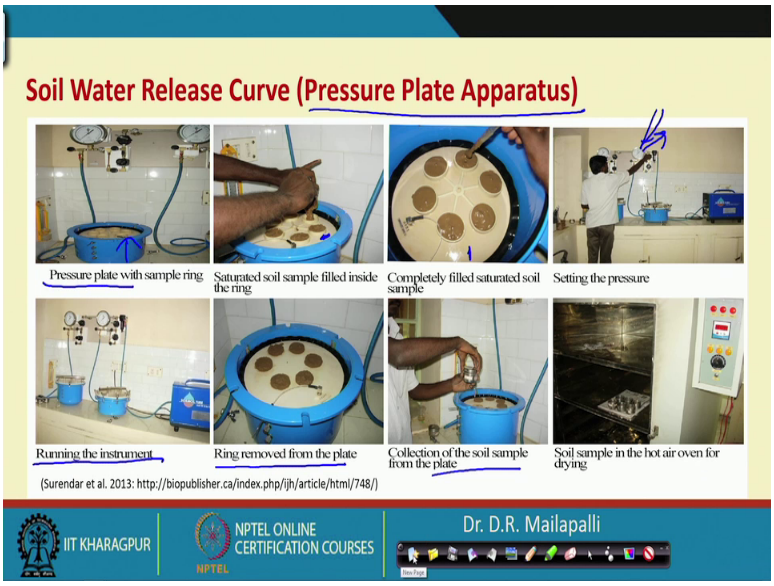

So, there is another you know the equipment that is electrical resistance blocks the gypsum blocks we call. So, we can also use gypsum blocks to measure tensiometer measures the soil moisture tension. So, measure it measure the soil water potential intention and then so, what basically it has. So, it has electrodes inside and there is a there is a gypsum block the electrodes are connected to resistance meter ok.

So, then the water then the when there is a water the electrical conductivity will be more, when there is a less water electrical conductivity will be less. So, based on that principle this gypsum blocks is going to work. And, here in order to make the water content and the soil moisture tension. So, there is an apparatus called pressure plate apparatus here the series of pictures show the operation, the first thing is this is called a pressure plate. So, which is connected to a vacuum pump so, to the vacuum pump will allow take out the; you know the pressure or create suction inside the inside the chump basically.

So, it contains the porous plate here if you observe this is the porous plate and then the samples are kept on top of this. So, like this is the porous plate and the samples this all completely saturated samples, then you put the lid on top and then the tightly you know screwed. So, because there is no leakage and then the set the you are going to set the pressure here ok.

So, then you run the instrument; that means, you keep the vacuum for a overnight or 1 or 2 days. So, then after that remove the lid and take out the sample and way the soil moisture I mean measure the soil moisture using what you call oven method ok. So, then so, that corresponding to the corresponding I mean I mean the soil moisture corresponding to the soil corresponding to the vacuum you created here ok. So, that way you can measure the soil moisture at a particular soil moisture tension a soil moisture tension.

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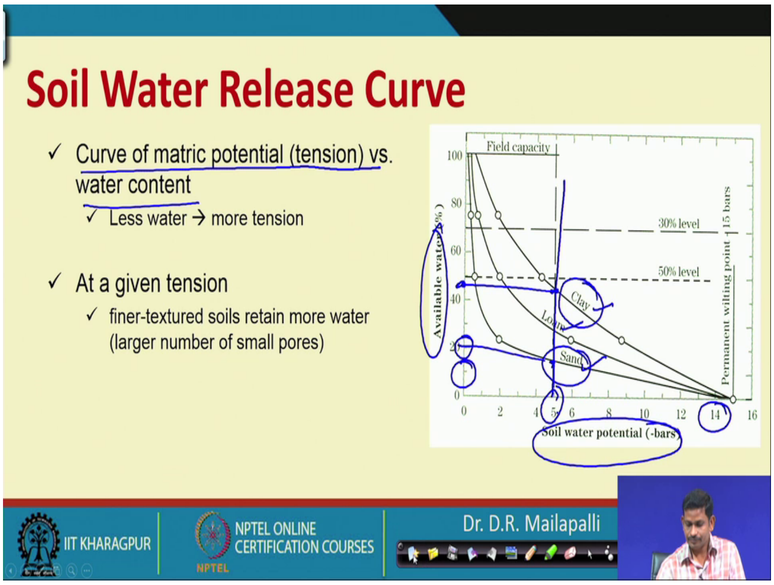

So, here once you do that you are going to get this kind of graph. So, the soil water release curve we call. So, curve matrix curve of matric potential or tension versus water content. So, here this is available water and soil moisture tension, that is in bars. So, for different the sand loam clay. So, this curve is initially for you know the less negative pressures less negative pressure the soil moisture is higher the after that is going to decline.

And, here in order to take out the moisture content lower moisture content you need to invest higher pressures ok. So, that is the reason here. So, if you see this the curve for a particular you know moisture tension particular moisture tension. So, sandy soils so, for 5 bar sandy soils can only retain you know 20 percent moisture right whereas, clay soils can retain you know 50 percent or 45 percent moisture content; that means, the retention capacity of clay soils is higher than the sandy soils.

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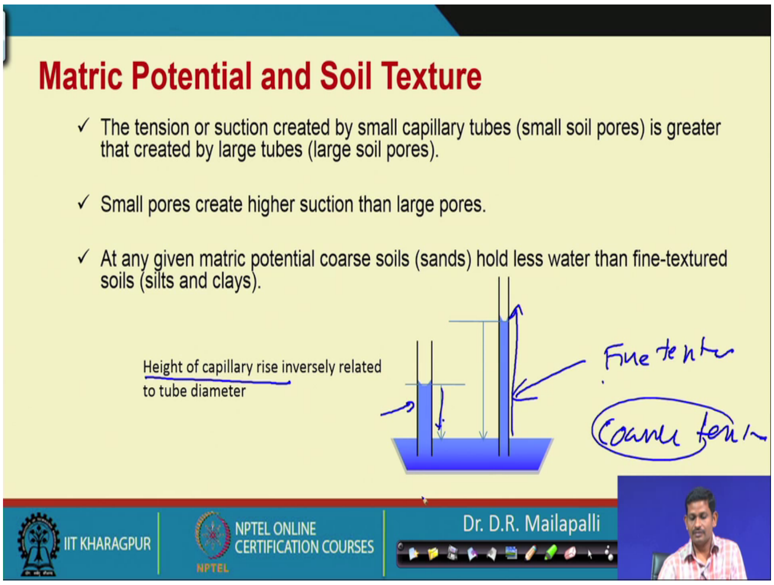

So, then this shows how you know the soil texture is going to influence the you know height of capillary rise so; that means, you have a fine texture soils, fine texture versus you know coarse texture soils coarse texture soils. So, this is an example of coarse texture and this is example of fine texture soils.

So, since fine texture soils will have you know smaller coarse. So, the capillary rise is going to be you know higher, the compared to the capillary rise in case of coarse texture soils this one. So; that means, the pore size is very important in also that in influence the matric potential ok.

Thank you for your patience.