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Geotechnical
Engineering
Laboratory
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Lecture No - 05
Grain size analysis

Apart from all dispersion correction, meniscus correction, temperature correction it is also necessary for immersion correction, so when the hydrometer is measure or inserted into the suspension the surface of suspension rises.

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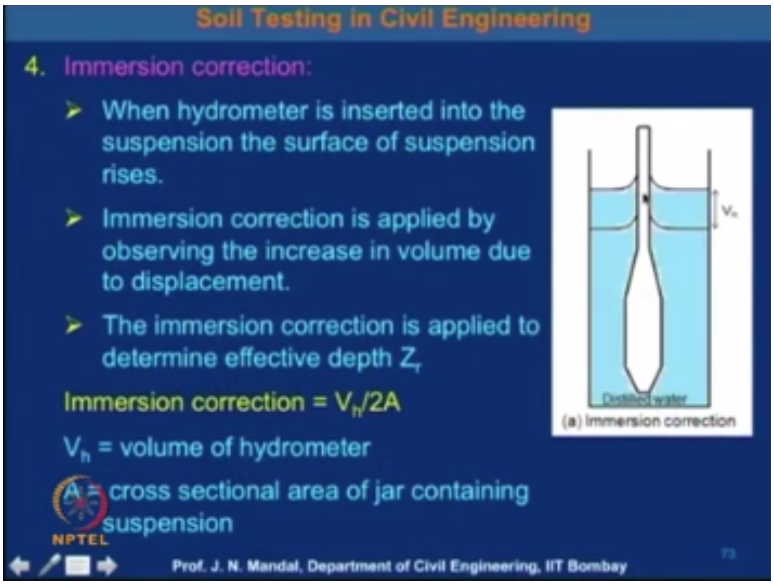

So you can see the, this is the distilled water here and this is the hydrometer and this is the immersion correction and how we go for the immersion correction this, what we what to discuss. So immersion correction is applied by observing the increase in volume due to the displacement. The immersion correction is applied to determine the effective depth and that effective depth is

denoted by Z_r. now immersion correction is calculated by $V_h/2A$ so you can write like this immersion correction that is.

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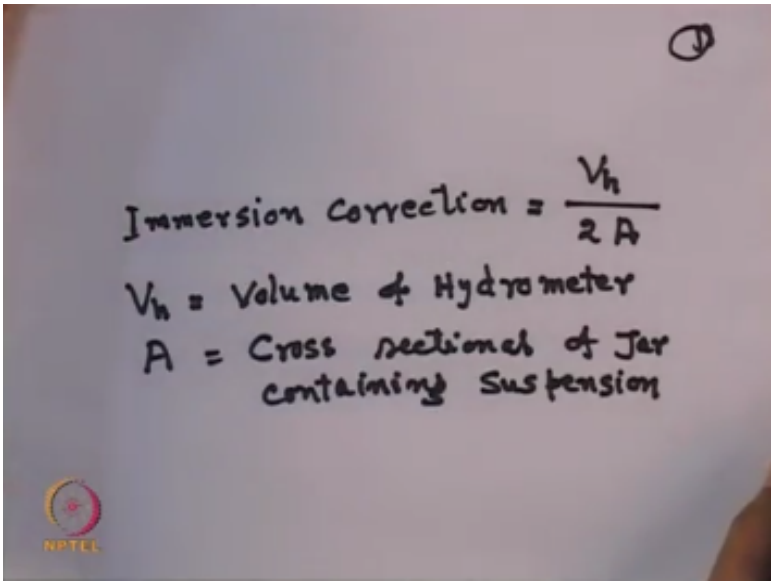

This is equal to V_h this divided by 2A, for this V_h is equal to this is volume of hydrometer and this A is cross sectional of jar containing suspension, so immersion correction we can use this equation $V_h/2A$ that means V_h = volume of the hydrometer A is cross sectional of the jar containing the suspension. Now you recall calibration of the hydrometer.

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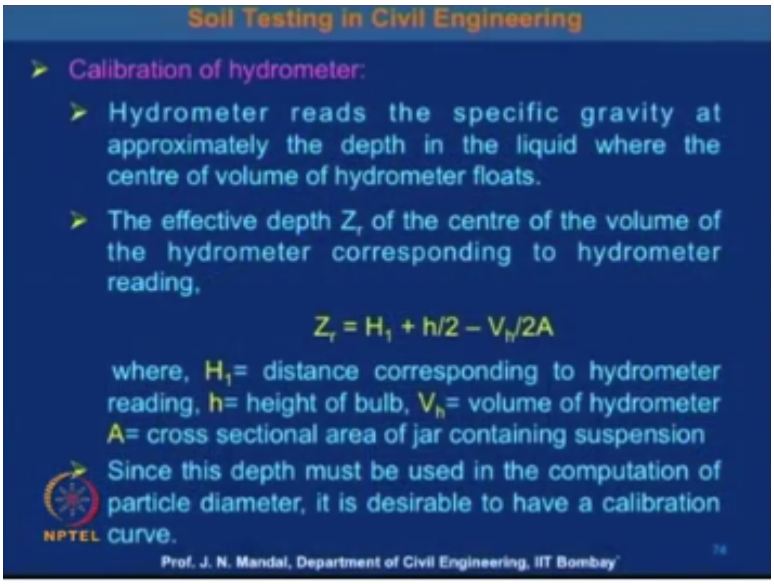

This is important to calibrate the hydrometer and how you can calibrates the hydrometer, so hydrometer reads the specific gravity at approximately the depth in the liquid where the center of the volume of the hydrometer floats. The effective depth which we discussed that is Z_r of the center of the volume of the hydrometer corresponding to the hydrometer reading that means we can express that.

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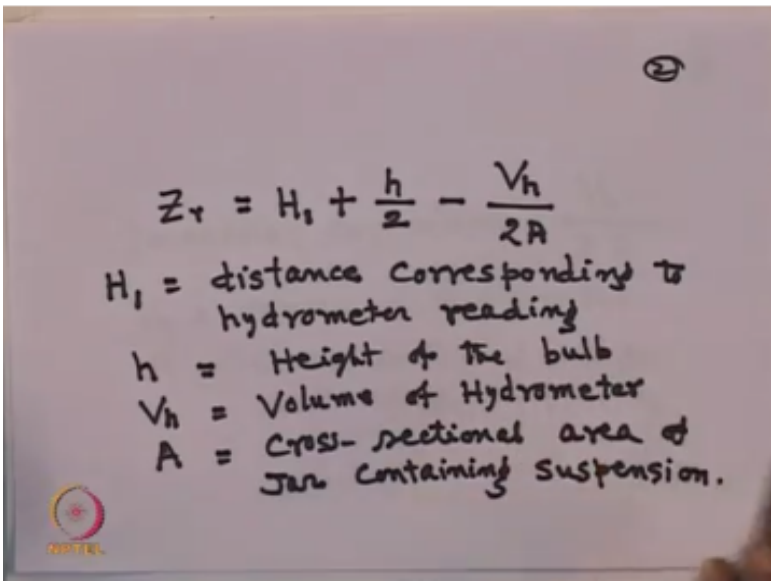

Z_r will be equal to H_1+h/2-V_h/2A I mean this H_1 is the distance corresponding to hydrometer reading, this H_1 and h is the height of the bulb and then this V_h, V_h is the volume of hydrometer and this A is cross sectional area of jar containing suspension. So Z_r you can write H_1+h/2-V_h/2A, since this depth must be used in the computational of particular diameter and it is desirable to have a calibration chart. So you need calibration chart for this.

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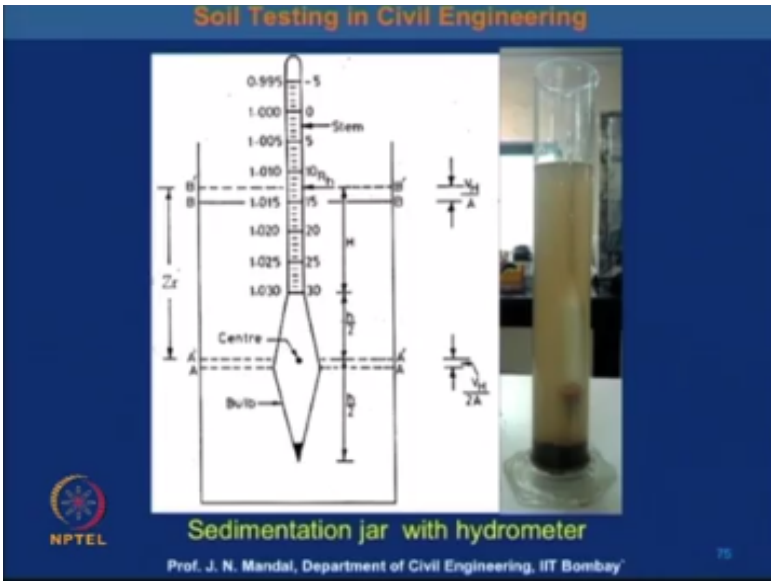

So this is the sedimentation jar with the hydrometer, so here I can tell you this from here to here.

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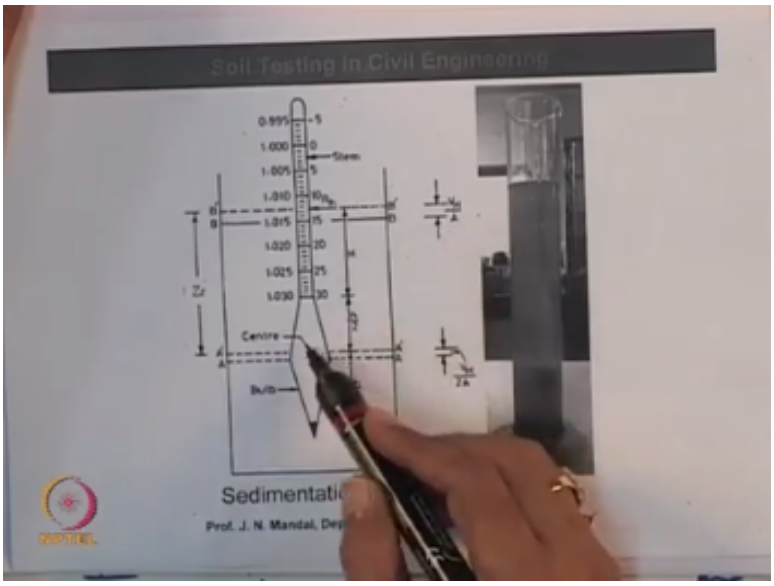

This is Z_r so this Z_r=this H_1+ this is H_2 and this is $V_h/2A$ the $-V_h/2A$ so this Z_r any reading in the hydrometer you can first you distance corresponding to the hydrometer reading that H_1 you have to calculate then this is H_2 that means H is the height of the bulb and then V_h is the volume of the hydrometer and A= the cross sectional area of the jar that containing the suspension. So from this diagram you can also calculate that Z_r.

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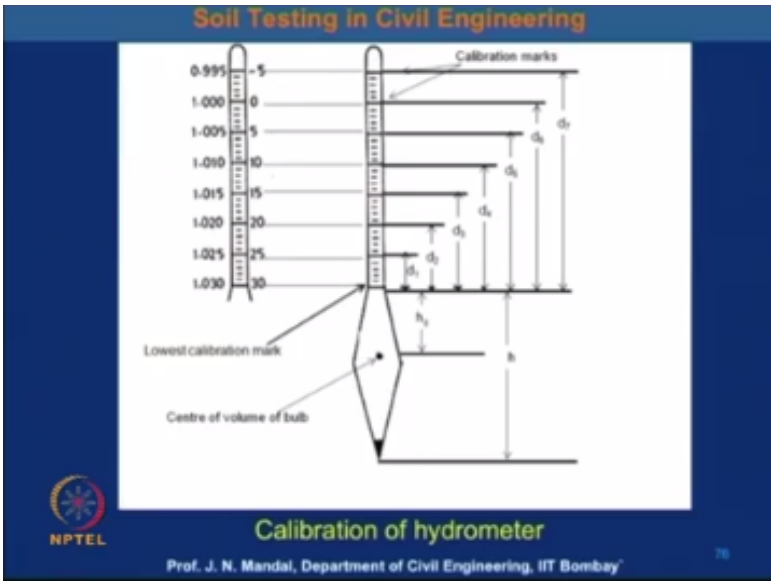

This is other way also you can see you have to calibration of hydrometer.

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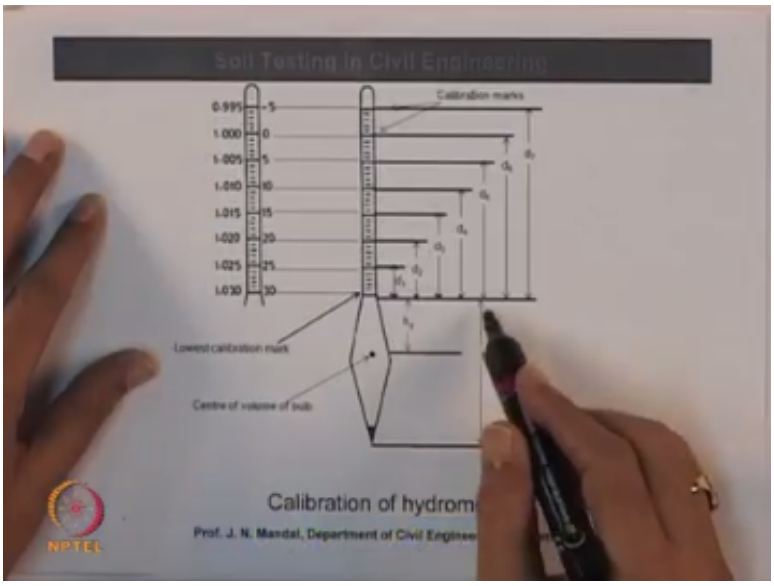

This is H and this is H_g so this is the lowest calibration mark here and this is center of the volume of the bulb and this is small is the height and this is calibration height for any reading D_1 you can measure 25 then 1.0025 like this 20 so you can calibrating this mark like this also. also you can use this calibration of hydrometer.

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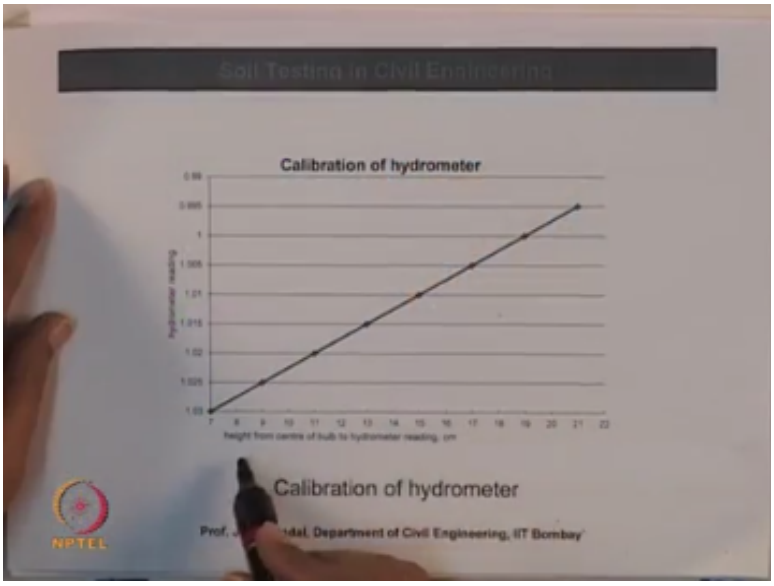

This x axis with its height from the center of the bulb was the hydrometer reading that is in centimeter and this is the hydrometer reading, so that 1.02, 1.02, 1.02, 1.015, 1.01 like this is the hydrometer reading so this is the calibration of the hydrometer so knowing the that what will be the height of the center from the bulb to the hydrometer reading so you can calculate that what will be the hydrometer reading.

So you can calculate and can say for a particular value height of the centre of the valve so you can calculate hydrometer reading that is 1.02 let us say element when it is the height from the center of the valve hydrometer reading is aluminum cm then you are dealing the hydrometer for height you can calculate that what will be hydrometer reading. So you can calculate this hydrometer reading. Now for this we required the certain apparatus.

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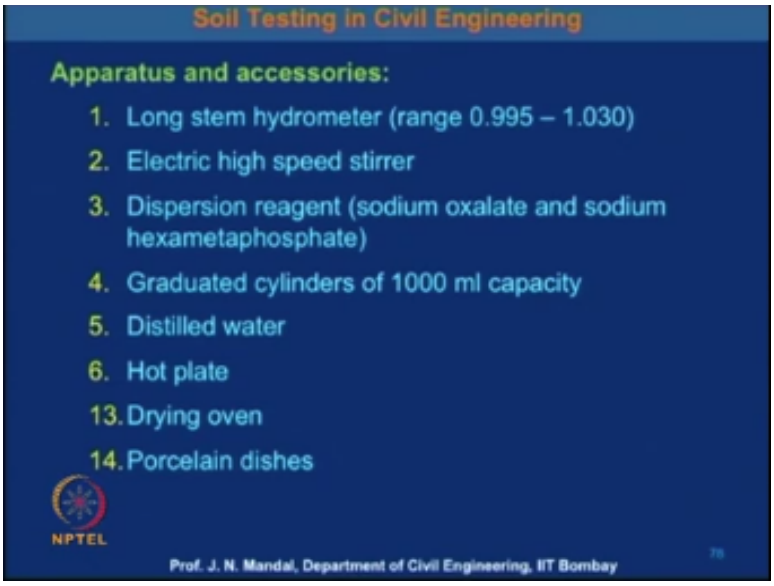

And the accessories you require long stem hydrometer that range about 0.995 – 1.030, you required electric high speed stirrer this dispersion reagent horizontal sodium oxalate and sodium hexametaphosphate, then graduated cylinder of 1000ml capacity with have sodium and they required the distilled water, hot plate, drying oven and the porcelain dishes. So these are the accessories required for performing the test.

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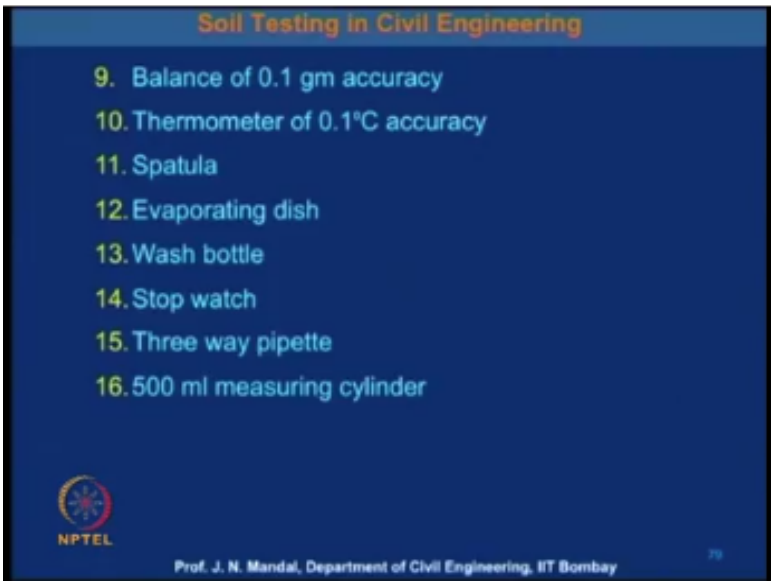

It requires also the balance of 0.1 gm accuracy thermometer of 0.1^0 C accuracy then spatula then evaporating dish wash bottle stop watch then three way pipettes and the 500mm measuring cylinder. So these are the apparatus what we required for performing the hydrometer analysis.

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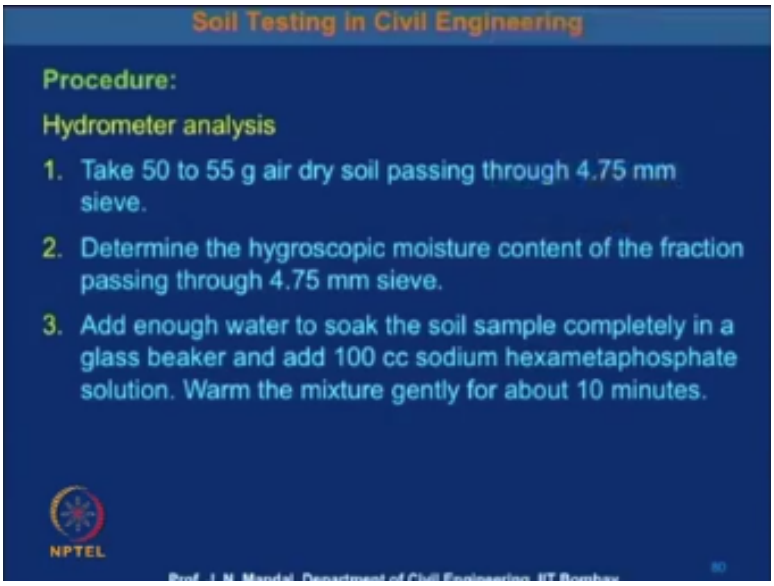

So procedure for the hydrometer analysis first of all we have to take above 50 to 55g of air dry soil passing through 4.75mm sieve. Then determine the hygroscopic moisture content of the fraction passing through 4.75mm sieve you know that how to determine the hygroscopic moisture content. And then add enough water to soak the soil sample completely in a glass beaker and add 100 cc sodium hexametaphosphate solution so warm the mixer gently for about 10 minutes. Now transfer the mixture.

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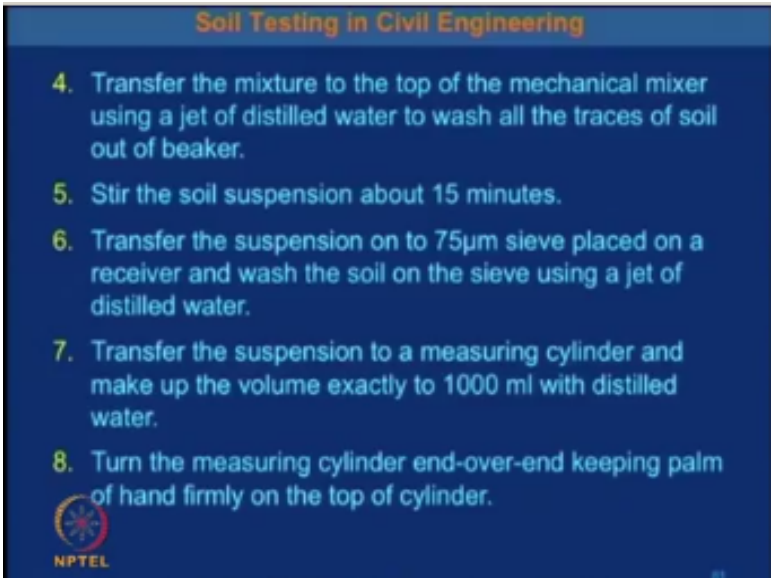

To the top of the mechanical mixer using a jet of distilled water to wash all the traces of soil out of the beaker then stir the soil suspension about 15 minutes transfer the suspension on to a 75 sieve places on a receiver and wash the soil on the sieve using a jet of distilled water, transfer the suspension to a measuring cylinder and make up the volume exactly to 1000mlwith the distilled water. Turn the measuring cylinder end - over - end keeping the palm of hand firmly on the top of the cylinder. Now start the stopwatch.

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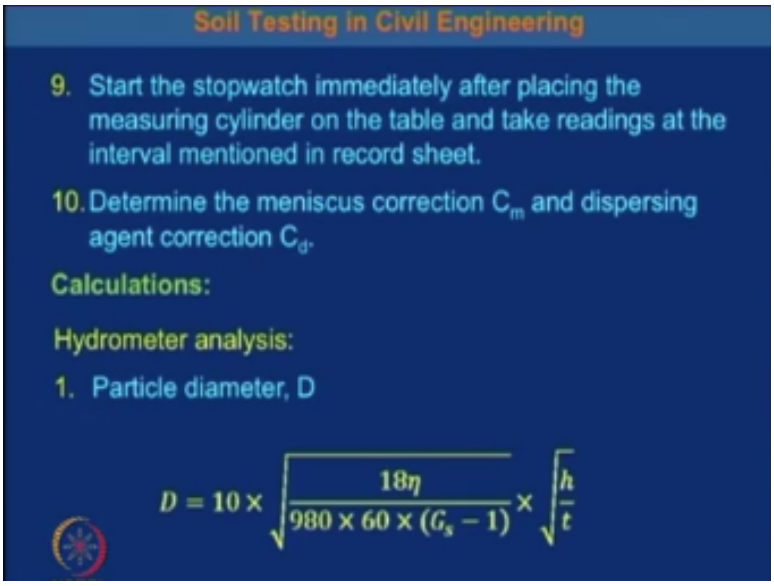

Immediately after placing the measuring the cylinder on the table and take the reading at the interval mentioned in the record sheet. And then determine the meniscus correction which I explain earlier how to calculate the meniscus correction that is Cm and then also we have to determine what will be the dispersing agent correction that is Cd. Now we have to calculate that what should be the particle size diameter.

Now as I explain you earlier that particle size diameter also can be determine within the equation and that is particle diameter let us say that particle size diameter is equal to D, that is particle diameter.

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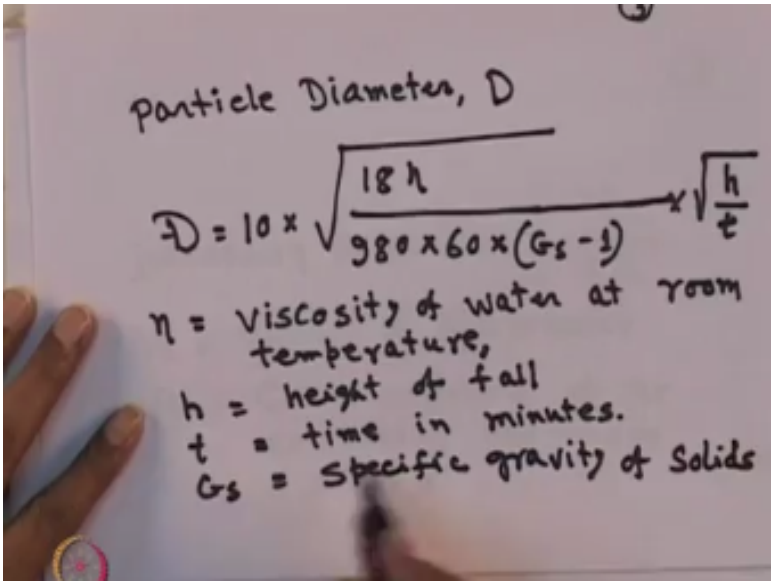

So D = 10 x √18 η/ 980 x 60 x (Gs- 1) x √h/t so this particle size diameter we can be express like this, so here η is the viscosity of water at room temperature, and h is height of fall and t is time in minutes. And Gs is specific gravity of solid you know how to calculate the specific gravity of the solid. You can also calculate that what will be the percentage finer N.

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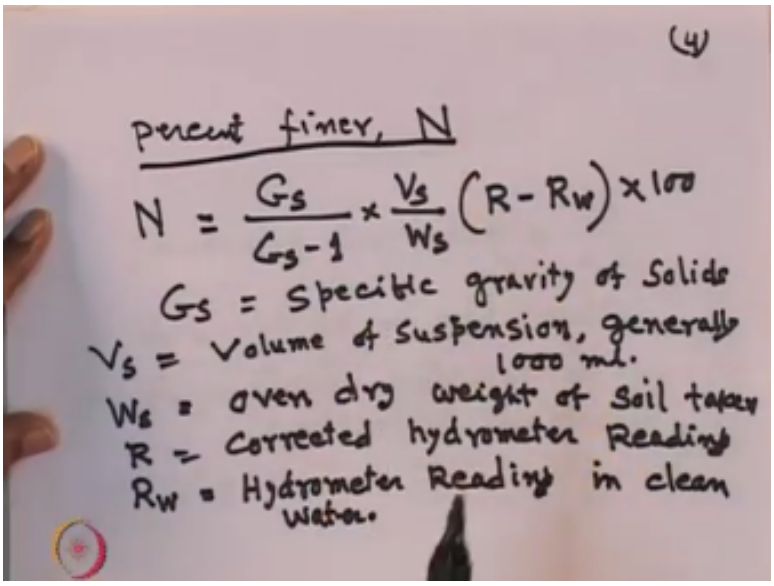

So percentage finer N say that percent finer N so percent finer N also can be determine within this reason N= Gs / Gs -1 x Vs / Ws X(R - Rw) x 100 what Gs is specific gravity of solid you know what Gs is specific gravity of solid and Vs is the volume of suspension it generally taken about 1000ml. and Ws is oven dry weight of soil taken.

And R this R=corrected hydrometer reading and R_w =is hydrometer reading in clean water so this is an important to calculate final you can use the equation to the gs_1 *vs./ws for the specifies gravity of the soil and here the balloon of the suspension you take about the mm and w is obtain the weight of the soil taken and this are corrected hydrometer reading and rw is the hydrometer in the clean water combined of this regional

.

And the analysis we have to calculate the to contribute the percentage is final so final in can be completed in the hydrometer analysis is modified to that mean that modified to Indus of jazz / 100 so this modified Indus here to calculate so this is shown in specimen calculation .

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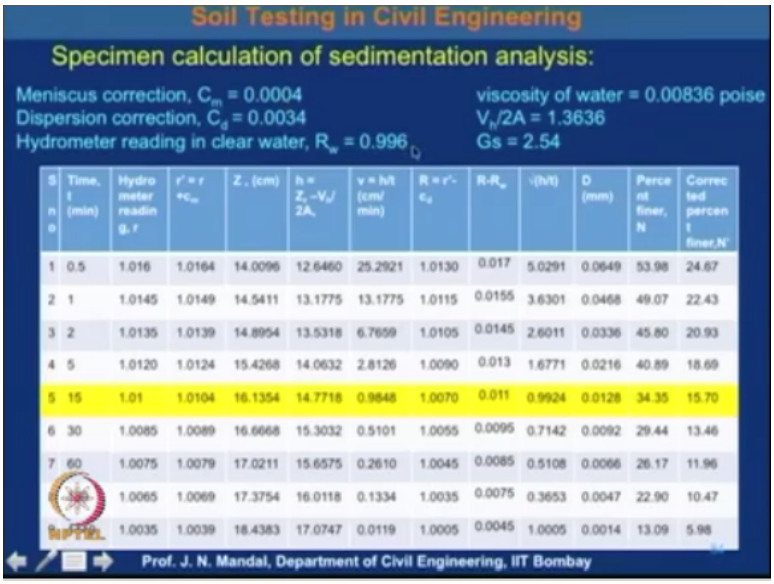

S no	Time, t (min)	Hydrometer reading, r	r' = r + C_m	Z, (cm)	h = Z + V_h/2A	v = h/t (cm/min)	R = r'- C_d	R-R_w	(h/t)	D (mm)	Percent finer, N	Corrected percent finer,N'
1	0.5	1.016	1.0164	14.0096	12.6460	25.2921	1.0130	0.017	5.0291	0.0649	53.98	24.67
2	1	1.0145	1.0149	14.5411	13.1775	13.1775	1.0115	0.0155	3.6301	0.0468	49.07	22.43
3	2	1.0135	1.0139	14.8954	13.5318	6.7659	1.0105	0.0145	2.6011	0.0336	45.80	20.93
4	5	1.0120	1.0124	15.4268	14.0632	2.8126	1.0090	0.013	1.6771	0.0216	40.89	18.69
5	15	1.01	1.0104	16.1354	14.7718	0.9848	1.0070	0.011	0.9924	0.0128	34.35	15.70
6	30	1.0085	1.0089	16.6668	15.3032	0.5101	1.0055	0.0095	0.7142	0.0092	29.44	13.46
7	60	1.0075	1.0079	17.0211	15.6575	0.2610	1.0045	0.0085	0.5108	0.0066	26.17	11.96
		1.0065	1.0069	17.3754	16.0118	0.1334	1.0035	0.0075	0.3653	0.0047	22.90	10.47
		1.0035	1.0039	18.4383	17.0747	0.0119	1.0005	0.0045	1.0005	0.0014	13.09	5.98

That is the sedimentation analysis how to calculate the specimen calculation analysis okay. So here we calculated the.

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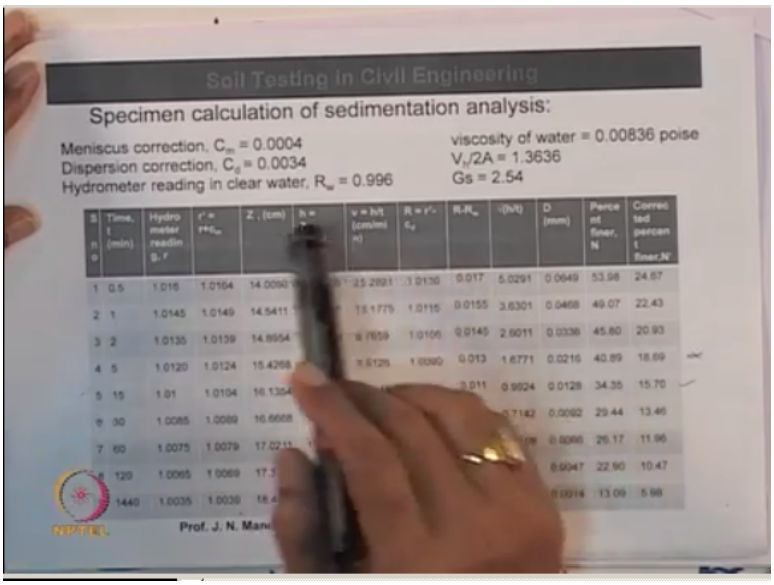

Let us cl how to calculate the specimen calculate the 0.004 and dispersion correction is the c4 hydrometer in the clear water at w is . 996 mand vscocity of water 0.004 and vh /2a 1.3636gs =2.5 so we have to take the reading at the particular time so it is starting minutes then after then 12515 16v 20 49 like that we have to so we have inserted the continent cylinder then we can reading given in the line so for the example the 16.5 1.016 or for and the example 1.05b then we have to take us minisus scorrection that means miniscus correctio =0.004 so you can act that is a0.001 and so you wil add as 101014 okay.

Then we have to calculate the I mention I can show you the mention that is 16. 16 54 and h will be =to zr and then you calculate the vr this is va va2 66 is so this is =to zr that is if we calculate the zr is this minus you can have 14 .777 t you can calculate what is the time and time it is the height so you can calculate yhe wat you did this is the centimeter of d this is r and c d so the dispersion correction is c4 r wil equal to thje address we are having the adjust 0.0014.

And this minus correctio 0.004 band we can calculate you can know the value of the tropical this will be equal to the address at this to will 70 so r_rw so you know that r value and in the clear water 0/996 so if you subside the 996 from the this r you can add this value o.oo1 now this is * of 8/t so you know that 8/t the root by 8/t 0.9924 and then I told you about the equation t it is related with this you can determine what will be the diametyer of the particle and then you can determine the percentage of the equation and then you can correct percentage finsall you can calculate depends on so youand allit aquation in this linear quation we have seen so this one you

can calculate the specimen calculation specimen analysis we are so later and qualient how you calculate from this that thank you.

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