**Geosynthetics Testing Laboratory**

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**Lecture – 06**

# Drop Cone Test

Now we will perform the Drop Cone Test and which we call the penetration resistance of the geosynthetics material as per specification ISO 134333. So, what is that introduction? That this test method can simulate the stress in the geosynthetics material when a rock fall on it. You know that many of the area where there is a landside even then Bombay, Pune road or many hill side area there is a landslide there is a rock fall. So, is it know that what will be the energy and developed and what kind of the geosynthetics material is required to place and to protect the rock.

So, when a rock fall freely on the geosynthetics material from a height geosynthetics resist; the impact and or damage and consequently gravitational energy developed. So, this gravitational energy if is can be designated as a e; so, e will be equal to m g into Z.

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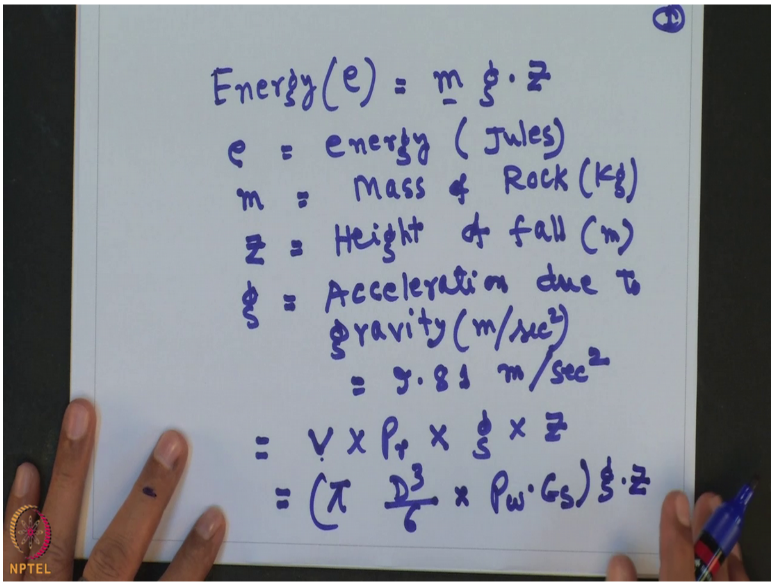


So, this energy; so, this energy e will be equal to m into g into Z. So, you know that what is e? E is the energy and that unit is Jules and m; m is the mass of rock, mass of the rock. So which maybe unit is equal to kg and Z is the height of fall; so, Z is equal to height of fall. So, these height of fall e designated at m that is meter, any height it can fall is may be 100 meter, 200 meter, 300 meter, 50 meter.

And g is the acceleration, acceleration due to gravity, acceleration due to gravity and that is m meter per sec square and that is equal to 9.81 meter per sec. And this equation m g Z also we can write as V there is volume of the rock into rho r into g into Z or again this you can write that is rho r which is the density of the rock and V is the volume of rock. So, this mass is equal to volume into density; this volume of the rock density of the rock and this is g and this is Z.

Again this also we can write pi into D to the power cube divided by 6 into rho w into G of s this into g into Z. So, I am explaining that what is that; the V ok.

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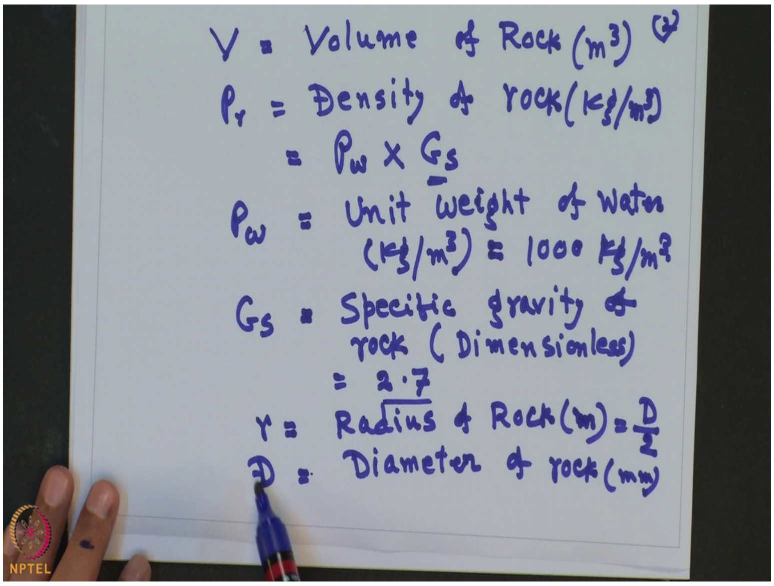


So, V is equal to volume of rock; we can write that volume of rock. So, this volume of the rock can be expressed as meter cube. So, this is the; this is the V volume of the rock and this is the rho r density of the rock. So, you can write rho r is density of rock; so, density of the rock is kg per meter cube; that means, this is will be equal to rho of w into G of s, these density of the rock rho w into G s.

Now what is rho of w? Rho w is the unit weight of water, unit weight of water and that is designated at kg per meter cube is equal to 1000 kg per meter cube. And this G s; G s is equal to specific gravity, specific gravity of rock, which is dimensionless that is equal to 2.7. And you know that r; small r is radius of the; radius of rock which is meter is equal to D by 2, where D is equal to diameter of rock, diameter of rock this is millimeter.

So, that is why this equation has D cube by 6 this is the rho r is rho w into G of s you know what will be the specific gravity of the rock? Which is 2.7; you know radius of the rock that is D by D by 2. So, you can make this pi into rho r will be equal to D to the power cube by 6 into rho w into G s into g into Z. So, you know that what will be the diameter of the rock and what is should be the radius. So, ultimately you can determine that what will be the diameter of the rock D in millimeter.

So, energy e; e you can write from the equation that pi into D by 1000; whole to the power cube this divided by 6 into rho of w into G of s into g into Z.

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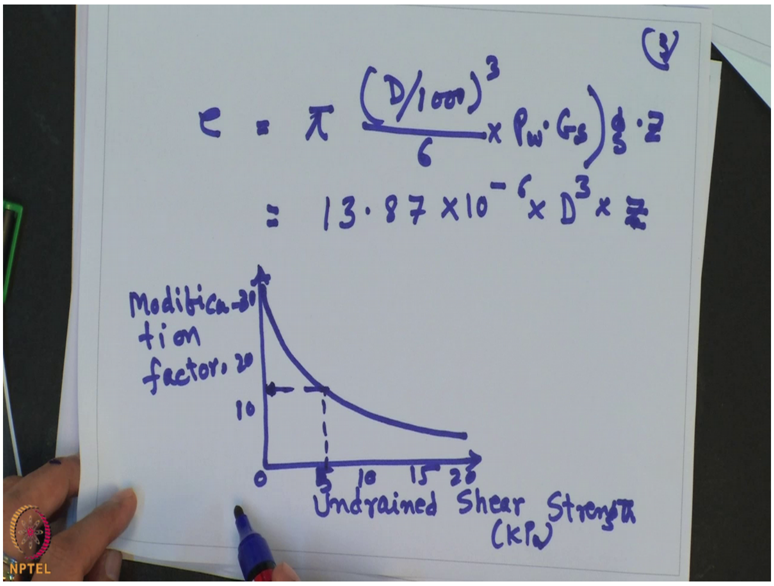


So, this is ultimately you will get the equation for energy and knowing this value of the g; g value is known to you, g value is know to you that is here it is given 9.81, then rho w value is known to you that is given 1000 kg per meter cube and G s also given that is specific gravity of the rock is 2.7.

So, knowing this value you can write this equation energy will be equal to 13.87 into 10 to the power minus 6 into D to the power cube into Z; Z you know height of the fall of this material. So, when the rock fall on the geotextile material; laid on subgrade soil then the geotextile will deform and also resists the high amount of impact energy because is deform it also resist higher amount of the impact energy.

Therefore, it is necessary to determine some modification factor; so, this modification factor is given by the Kohinoor in 2005 and that modification factor you have to take into account for the design. You can draw a a correlation between the undrained shear strength and that is in kilo Pascal. So, this may 0, it may be 5; 5, 10, 15, 20 etcetera and this is the modification factor; modification factor. So, it may be the 10, 20, 30 like that; so you can have a curve is like this.

. So, from this modification factor you have determine what will be the e required; so, you know what is e.

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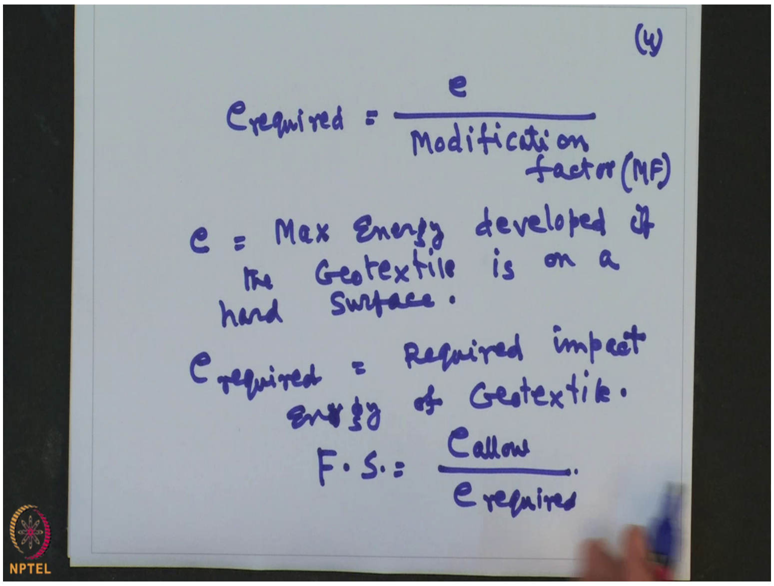


So, so we can write that e required is equal to e divided by modification factor; modification factor that is designated by M of F. So, e is maximum energy developed; if the geotextile is on a hard surface, then e required is required impact, energy of energy of geotextile. So, factor of safety will be equal to e of allowable; this divided by e required. So, you can determine what will the factor of factor of safety from this test.

So, what will be the type of that equipment you require to determine the puncture resistance of the geotextile material?

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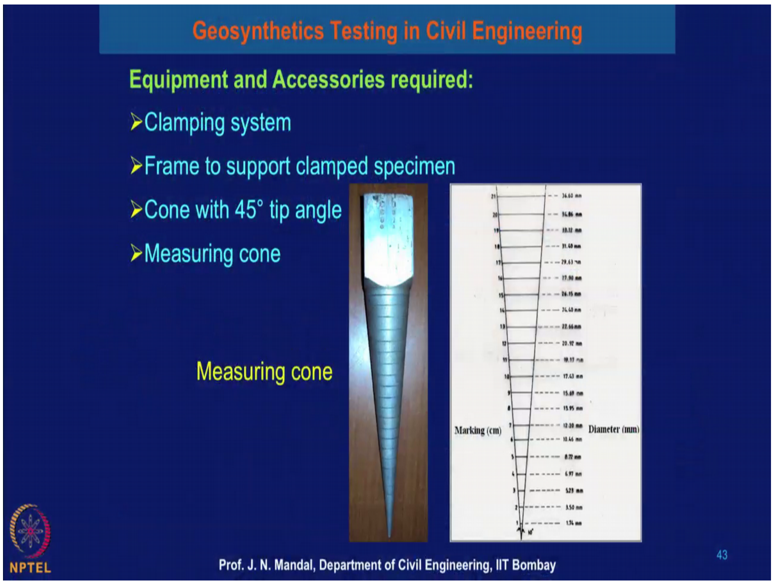


So, you require that clamping system and the frame to support that plan specimen and this is the cone with 45 degree tip angle and measuring cone. So, here you can see that measuring cone and here we can see that here it is given that in dimension.

So, when the when this geotextile material penetrated and then there is a hole in the geosynthetics material; you can insert this measuring cone on to that and you can determine that what should be the diameter of the geotextile material damage. So, this is the diameter in millimeter is given; so this is the marking in which you will be knowing that what should be the damage of the geocentric material.

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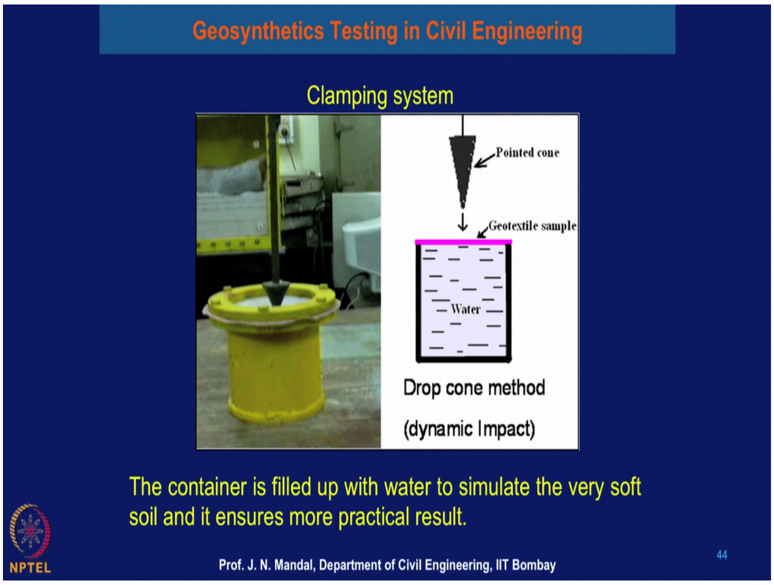


Now this is the type of the equipment in which we perform this test and this is the this is; this is the container this a this is a container this is a CBR mold. And this white color is the geotextile material that then this is clamping arrangement here and this is the cone which is to be dropped at a particular height because there is no soil inside this container.

So, therefore, the container is to be filled with water to simulate the very subsoil and it ensure more practical razor, you can see this is geotextile material is clamping here and this is the pointed cone.

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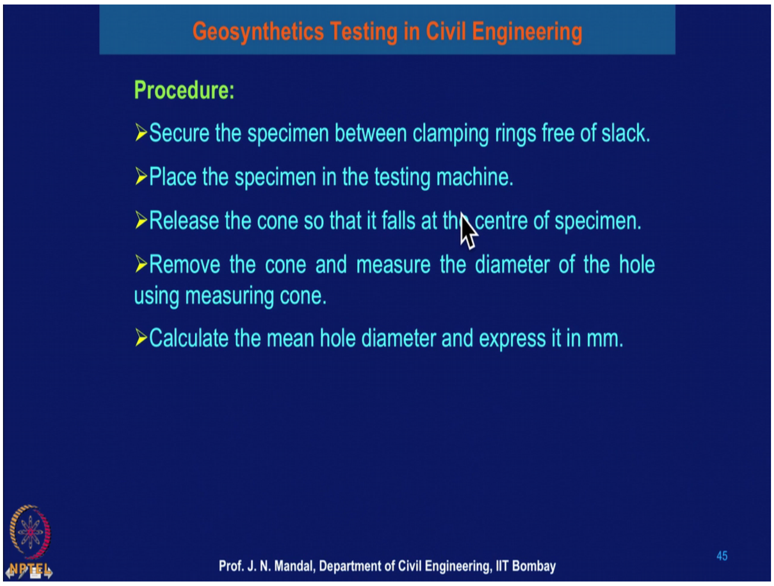

Now, procedure is that secure the specimen between the clamping rings free of slack. And place the specimen in the testing machine, release the cones so that it fall at the centre of the specimen and remove the cone and measure the diameter of the hole using the measuring cone which I showed. Then you calculate the what should be the mean hole diameter and in expressed in terms of the millimeter.

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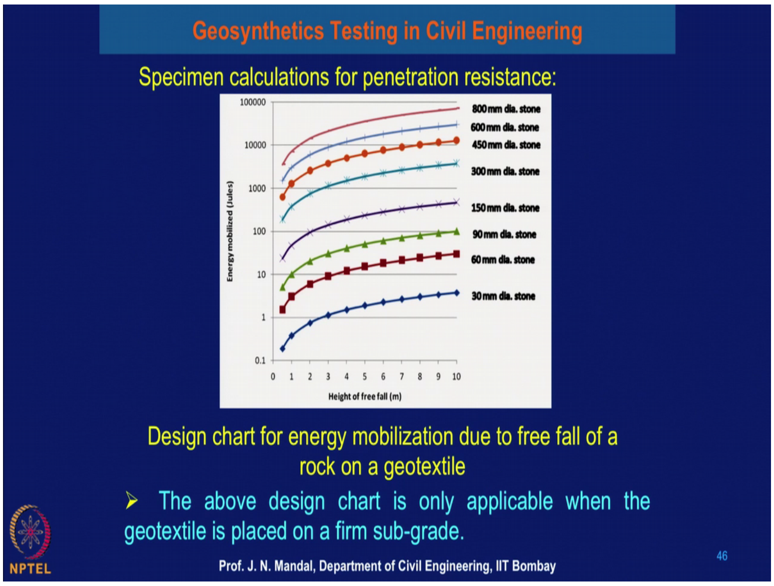


So, from this experiment you can penetration resistance and here in this curve; it is given the relationship between the (Refer Time: 21:25) in it here relationship is given between the height of the fall and energy mobilize in Jules. So, for the different diameter of the stone; it may be 50 millimeter diameter, 60 millimeter, 90 millimeter, 150 millimeter, 300 millimeter, 450 millimeter, 600 millimeter or 900 millimeter.

So, this is the design chart for energy mobilization due to the free fall of a rock of a geotextile material. So, this design chart is only applicable only the geotextile is placed on the firm sub grade soil. So, we know that what would be the diameter of the stone is falling on to the ground for a particular height and then what is the energy developed. So, this chart will be useful for the design of the rock fall system.

I can give one the examples of the rock fall for example, that when the energy is mobilized from a free fall height of the rock.

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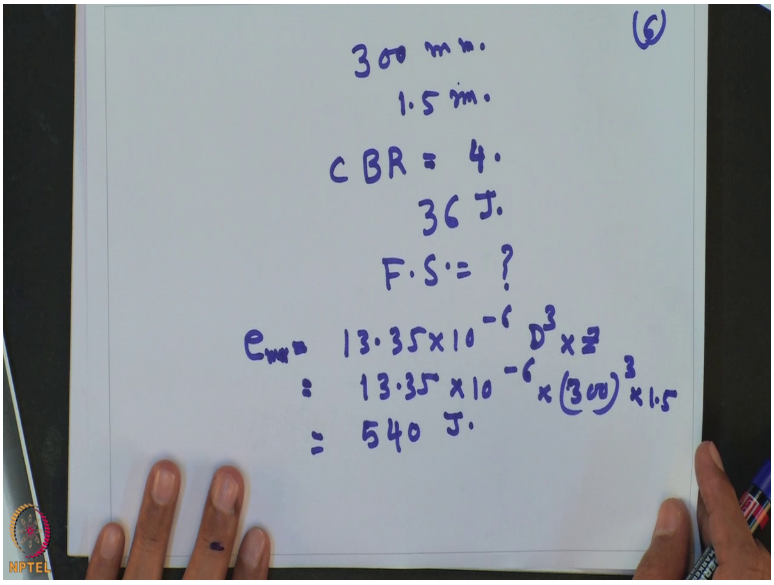


And the height of the rock is size of the rock is about 300 millimeter and it fall from a height of 1.5 meter. So, what will be the energy mobilize by the free fall of a rock which size is 300 millimeter and following on a 1.5 meter on a geotextile. And geotextile is supported by poor subsoil and having the unsub CBR strength CBR strength is about 4; if the geotextile has allowed the impact strength of let us say 36 J. So, this you have to determine what will be the factor of the safety; so this you have to determine.

So, you know that energy equation; from the energy equation you can calculate that e is equal to let us say it is in the terms of the daq and the Z value. So, you can have let us say 13.35 into 10 to the power minus 6 into you know what is the D of cube and what will be the height H. So, from this equation you can determine the; what should be the energy that is energy this is e maximum energy you can develop.

So, this is 13.35 into 10 to the power minus 6 into diameter of the stone let us say 300 millimeter. So, 300 to the power cube and height of fall is 1.5; so this is 1.5. So, e maximum e can determine 540 Jules; so either value is substantial by the design because these rock will fall on to the very soft soil. So, you require what should be the factor of safety and you have to use that modification chart to determine the factor of safety. So, this is the e maximum which you have determine 450 of Jule.

So, from the modification chart from the modification chart just ah; let us say this is the modification, modification chart this is undrained shear strength, but the undrained shear strength mean that is the, what is CBR value. So, from this chart and considering the undrained shear strength of the soil and then you can determine that what should be the modification factor. So, this modification factor for a particular the undrained shear strength of the soil; let us say that 13 is the modification factor for a particular undrained shear strength value; so, 13.

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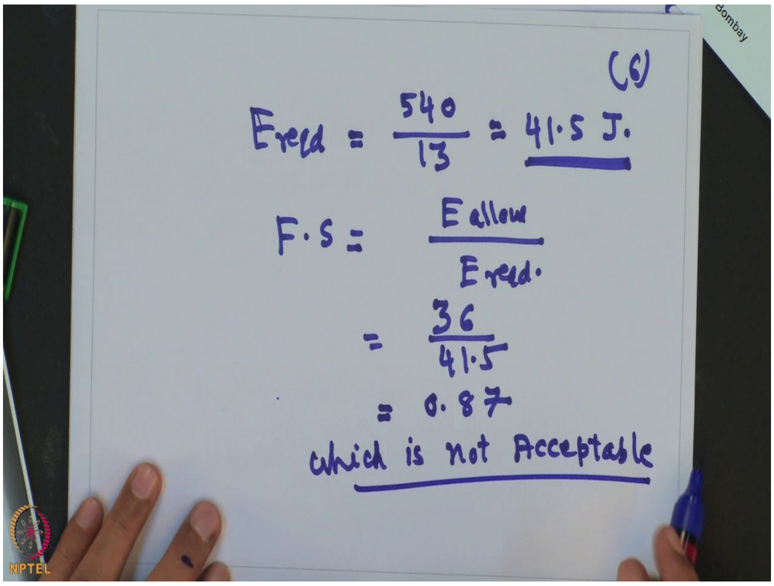


So, what should be the e require? So, e required will be is equal to 540 this divided by 13; so, this will give is about 41.5 Jule.

So, result of the factor of safety you can calculate that factor of safety will be equal to e of allowable divided by e of required. So, this will give you 30 of 6 divided by 41.5 because earlier we calculated that this value that what is given the 36 J. And then you have achieved this e require is this 41.5. So, this will give you that factor of safety 0.87; so, which is not, which is not acceptable. So geotextile material maybe damage; so, you require for some alternative geosynthetics material to protect the rock.

Thank you.