Natural Hazards
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Lecture – 29
Type of Landslides Part II

Welcome back, so this was a last discussion we left, I was a related to solifuction, part of that I have already discussed. And what is solifuction?

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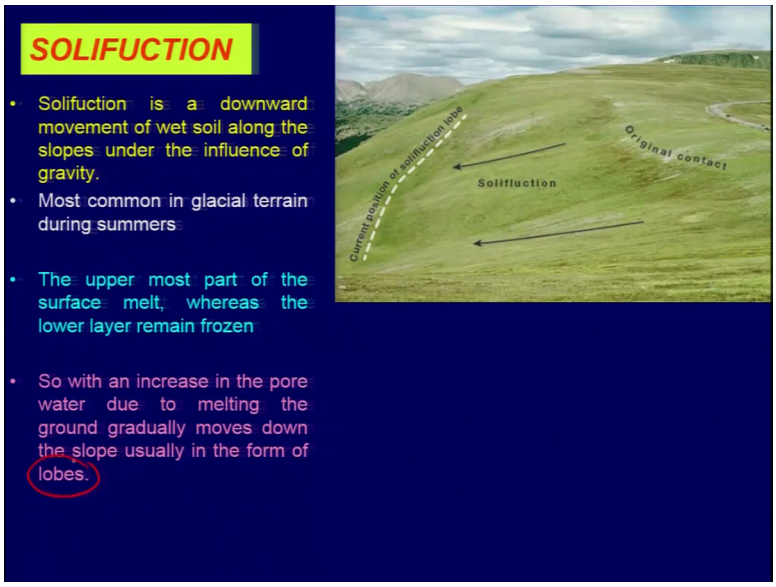

Solifuction is a very slow downward movement of wet soil, along a slope under the influence of gravity. Now as I told on that day also that this is mostly seen in the area where you are having the snow cover or you can say the ice cover mainly in the glacial terrain and this happens during the summer when there is a melting of the there is no cover surface the uppermost surface and it will be in very a slow movement.

So, when so with an increase in the pore water due to melting of the uppermost soil cover because of that the melting of the snow, there will be movement of ground gradually along the slope and this will result into deformation of a typical lobe like structures which you can see in this slide also.

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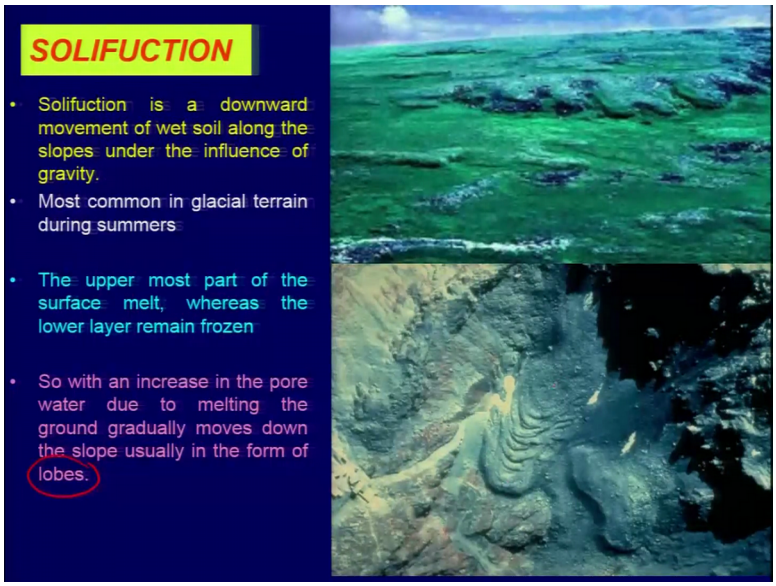

So, you have an low bit structures which are been seen we are moving slowly and this is from the satellite move picture which shows the lobe like feature. So, as an upper most unit which is saturated with water and that saturation is because of the melting of snow.

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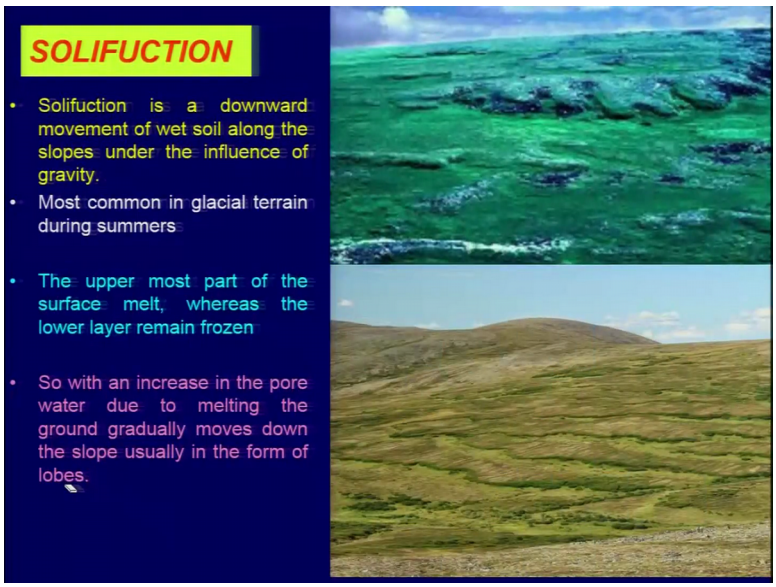

So, you need to remember that this type of movement will be seen in the glacial terrains and this will happen during the summer, where the uppermost part of the surface melts.

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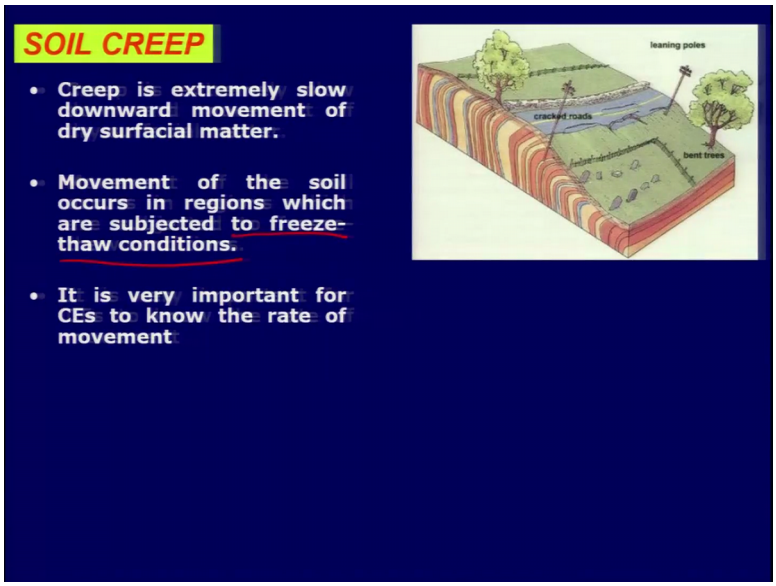

Now, coming to another one is the soil creep; soil creep again is a very slow movement of the material and creep is extremely slow even slower than the solifuction and the movement is downward again of a dry surfacial material.

So, if you see in the section if there is a bedrock and also you will be able to see the bending of the succession, as well as you will see a formation of extensional cracks and either the tilting of the light poles or you will see the bending of trees also. So, these are the indication of creeping. Movement of the soil occur in the region which is subjected to freeze and thaw conditions. So, this is again and very important point for the soil creep and further it is important of course, for any civil engineering structures which have been put on such surface. So, we have to be extremely careful before selecting the site.

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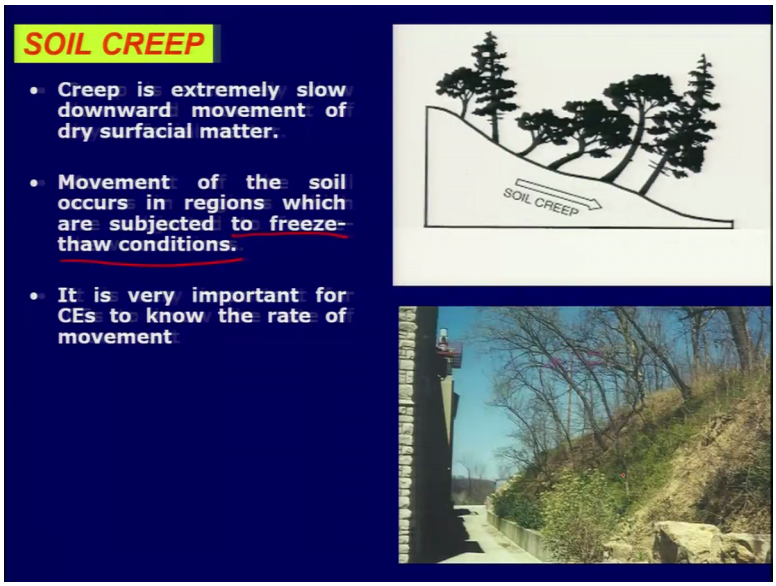

For example if you see in this photograph there is a creeping with just taking place course which can be figured out based on the inclined or the bent trees which are being shown here in the sketch. So, there is an clear cut indication of creeping of this material which is an extremely slow movement. It may take years to slip down the surface or the movement which is occurring along the slope.

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Another example of the rock creep we can say, where the rocky succession is getting bent because of the creeping of the uppermost surface.

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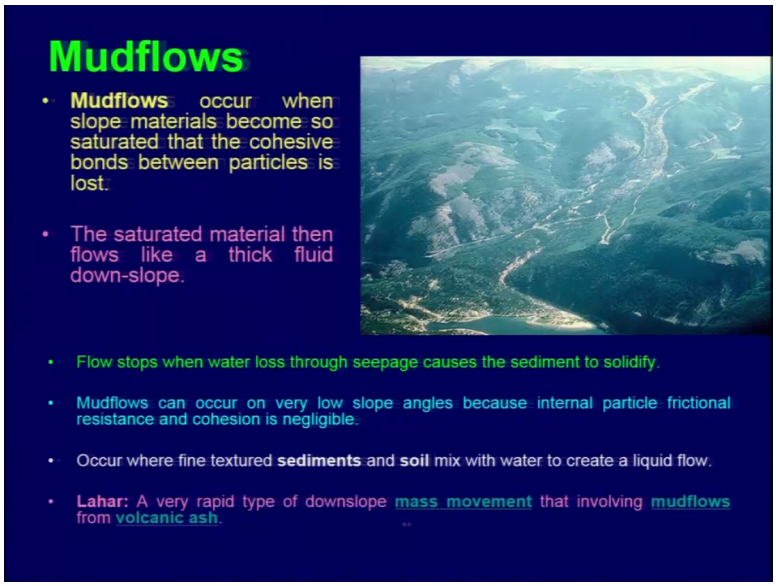

Mudflow again is the movement which is related to the slope material which became saturated and basically what we are talking about that the cohesion bonds between the particle is lost. So, as soon as it loses its shear strength and this will move, but here what main important part which places the cohesionless material and the saturated material because of high precipitation.

So, the saturated material then flow like a thick fluid down slope. Now the flow stops when the water losses through the seepage, so the material will be dumped as soon as the material which is saturated lose out the water or there is an escape of water from the sediments and that solidifies. Mudflows can occur on very low slope angles because internal particle friction resistance and then cohesion is negligible and this will happen when you lose out the cohesion bonds between the sediments. It occurs where the fine textured sediments and soil mix with water to create a liquid flow.

One of the well experienced examples which are also the rapid type of down slope mass movement of the material which involves mud flows along with the volcanic ash which are termed as lahar. And at this part I was discussing when we were talking about the volcanoes capped by snow peaks, then you will have this lahar flows.

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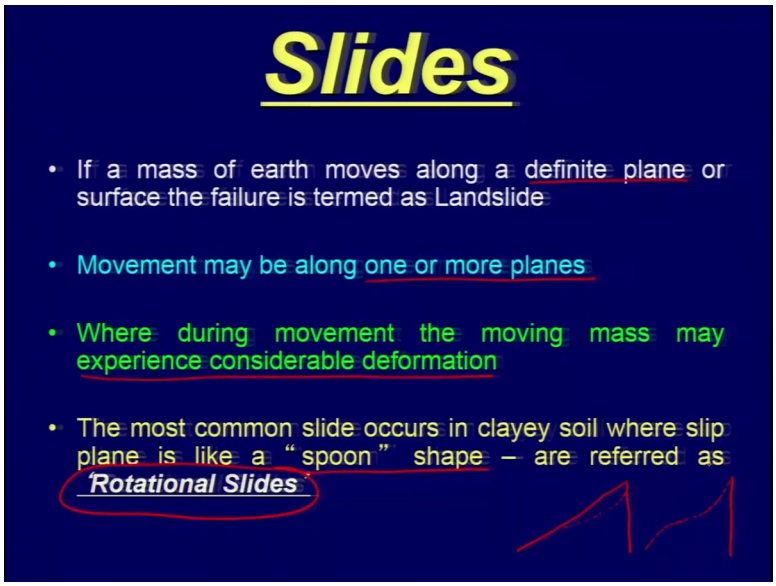

So, slides mainly occurs with an definite plane or the failure surface along which it slips is termed as landslides. So, this part is important, it will move the earth mass, we will move along a definite plane or a definite surface. Movement may be along one or more planes that is multiple planes, where during movement the moving mass may experience considerable deformation. So, when the material is sliding down it may be deformed.

So, this is along a definite plane it may have one plane or multiple planes and it will experience deformation. I will show some examples from this area or where we have a encountered, the movement along a definite plane as well as the deformation. The most common slide occurs in clay soil where slip plane is like a spoon, so the definite plane 1 one or more planes may experience considerable deformation and the surface could be seen as an spoon shape and this type of slides are termed as the rotational slides.

The reason is that when there is a mass movement or suppose you are having an slope here and if the movement is going to take place along a definite plane, then what you see is that you have this movement and the material which is moved along this plane will have the deformation over here. This will be in spoon shape scar and this scar or the plane will be visible sometime otherwise it will be hidden.

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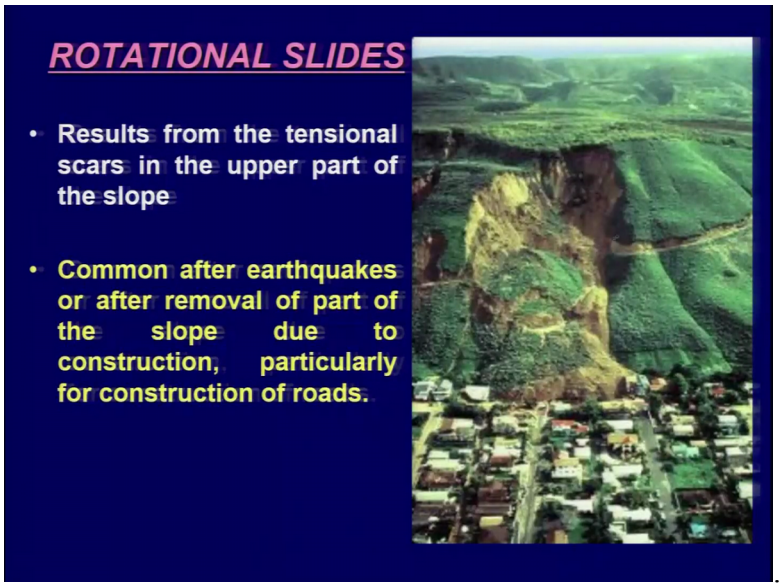

So, rotational slides there is one of the examples which have a very typical spoon shaped surface and this portion that is the two portion has experienced deformation during the movement. So, this could be resulted from the tensional scars in the upper part of the slope. So, you will come across some extensional or tensional scars in this region and deformation that is under compression over here common after earthquakes or after removal of part of this slope for construction.

If you have removed the portion below these slope, that can also result into the rotational slides and this construction is mainly either you are putting roads or rail tracks.

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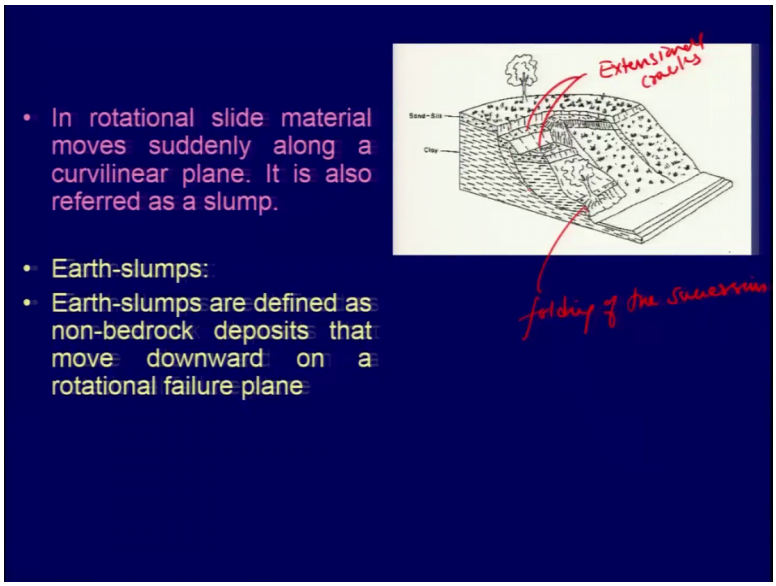

So, this sketch shows the movement along a definite plane here which is typical spoon shape multiple planes not the single, but two and this portion is your scar which is exposed and if you locate here and go and see this portion to find an extension cracks or the tensional cracks and the toe portion will be under compression because of the movement along the this plane.

So, the because of the friction between the material which is moving on the top, along the definite plane will undergo deformation. So, mainly this will show folding of the succession, whereas this portion is showing your extensional cracks or features. So, in rotational slide material moves suddenly along a curvilinear plane or a spoon shaped plane it is also referred as slump; slumps are defined as non bedrock deposits. So, we will not have a bedrock that moves downwards along a plane along which the rotational rotation of the material will take place. Hence we and designate this as an rotational slide because the material has been rotated along this one.

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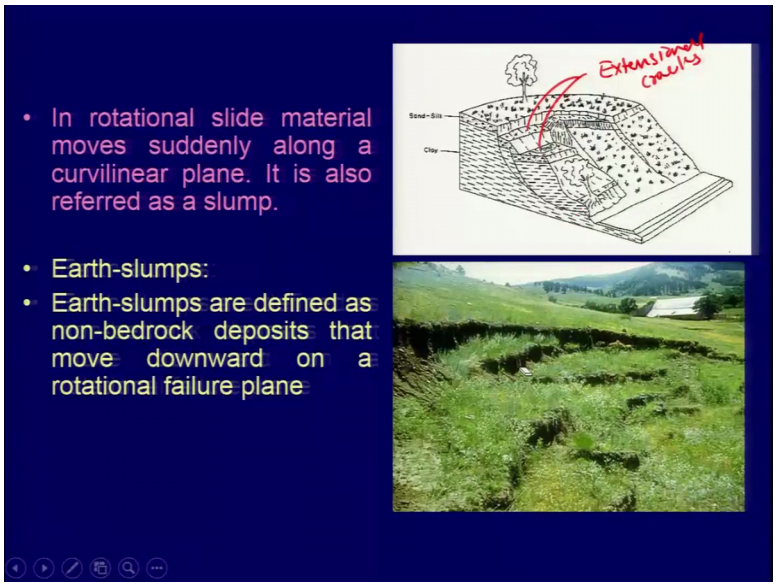

The example of the rotational slide with multiple scars; that means, that there are multiple planes along which the movement has occurred.

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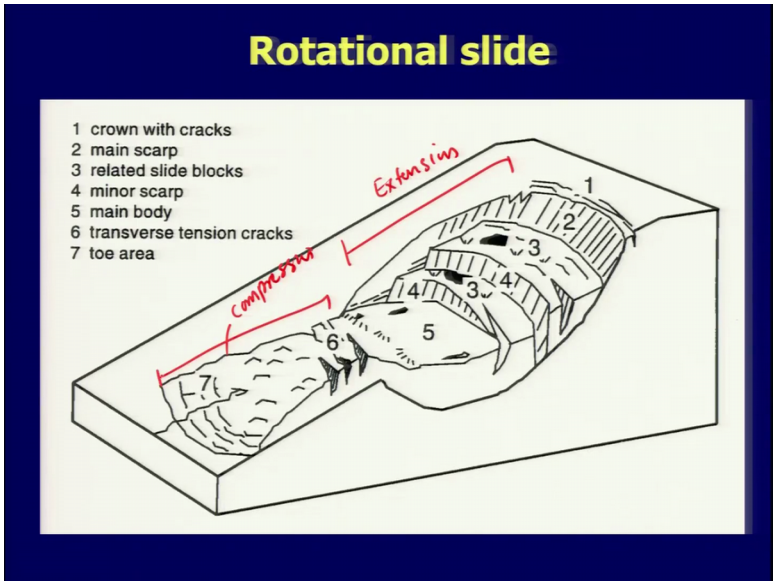

Another example of that, so rotational slide in total if you categorize then what you are having is 1 is the crown with cracks at the top, 2nd is the main scar and 3rd is relative slight blocks along the definite spoon shape, surface minor cracks which will be seen in this portion. And then we have five 5 main body (Refer Time: 12:27) and then transfer tension cracks which will be seen here and toe here. So, this toe area will have the deformation under compression and this region will have the extension.

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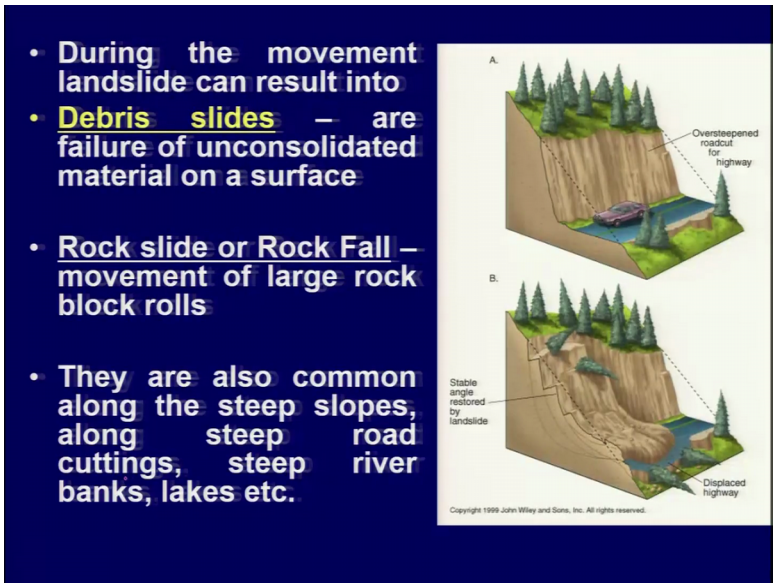

Another example of the rotational slide is talking about that the toe portion will be under the depression and the multiple scars are indicative of multiple plane along which the failure will take place. There is another one which we say debris slide are the failure of

unconsolidated material on a surface, rock slide or rock fall movement of large rock blocks which will roll down in the nearby area.

And they are a long they are also common along the steep slopes, which has been shown here along the road cutting steep riverbanks and lakes. So, this fall on the slide will be common in such areas where we are having steeper slopes and this occurs because of the overstepping of the slope for the construction of road or rail tanks.

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So, what we have learned is that we have the rotational slide which will take place along multiple scars. So, we have the one scar over here then we have another over here and this will be moving along the definite plane and what is happening in the toe here with this material is getting folded. Now this was the this is the what the concept which we are talking about the rotational side, so we have multiple scars and at places we will have extension cracks. And here we will have some compression and these are our definite planes here.

Now can we see this example on surface? The answer is yes, now this photograph which I am showing here is an very beautiful example which we experienced and we were lucky to record this near to the tentacle city. So, we have an cliff here of course, say riverbank the river is flowing over like that.

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So, this is an channel of Ghaggar river and the material which is sitting here is very fine succession which belongs to Siwaliks, so older succession. So, we have the river which is meandering here and we have the floodplain on the side, but what we notice are something unusual or here.

This is the river bed along with the, so river bed is here you can carefully see this, there is some sort of an elevation between this point and this point here; this point in this point here, this is up; this is down; this is up; this is down.

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Now, usually such type of displacement of the surface we see along this line if you, I will draw this is the line here, usually we see such type of deformation of the displacement of the surface when there is any tectonic movement. So, you have an horizontal surface like this and if there is an deformation under compression, then what you see is that some portion is what.

So, this change in elevation could be related to you or the compression, but this was nothing to do with the deformation or act of deformation in the Himalayan region. So, let us see some close up of this and why what was the reason for this river bed as well as the product floodplain getting displaced along this line.

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So, this is the surface or the toe of the landslide; landslide in material, close up of that you can see almost the distance the displacement or the material we just ride it over the surface this is the present day surface and this material has ridded over that ok. So, there was some displacement, there was deformation and the displacement of the surface if you take is almost like 1 meter and more than 1 meter.

So, what was the reason for this we try to gather and identify and understand that what exactly happened here and there is a very typical example of your rotational landslide. So, as we told that we understand that the rotational landslide at the toe portion then half deformation, but if you go to the towards the crown or the top portion part of the slope then you will have an extension, so we look for that and this is what we found.

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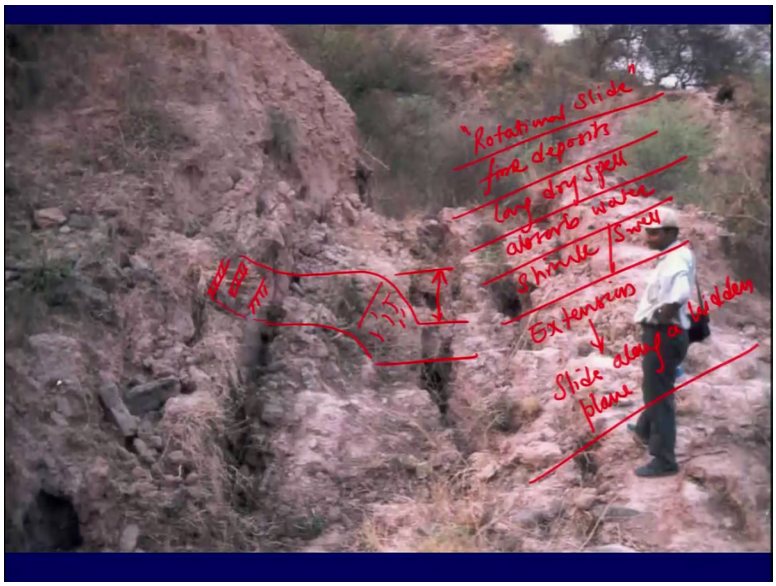

So, they were the extensional cracks we were having scars, these are the scars here there is another scar here and then we have an extensional cracks over here these are all extensional cracks. So, there was an slip along with hidden plane which we were not able to see very clearly in the section. So, unless and until you are not going to open the section you will not be able to see the planes, but of course, these are all scars which explained that this was an typical rotational slide.

And the material which we saw here was very fine deposit and the reason which we gather was that they are worse and very long spell of, a very long we can say dry spell in this region. And depending on the material which has the different properties which it can absorb water and swell that is in typical of clay which we were talking in the previous couple of slides in previous lectures and they have the capability of shrinking. So, they either shrink or swell.

So, the shrinking resulted into the extension and facilitated the slide along a hidden plane. So, this hidden plane resulted into the rotational stick. So, what we saw is that we were having an extension in the upper side and this movement which occurred along this extension cracks resulted into the deformation in the riverbed. So, this was what we were looking at the change in the elevation was because of the rotational side close to changeable area.

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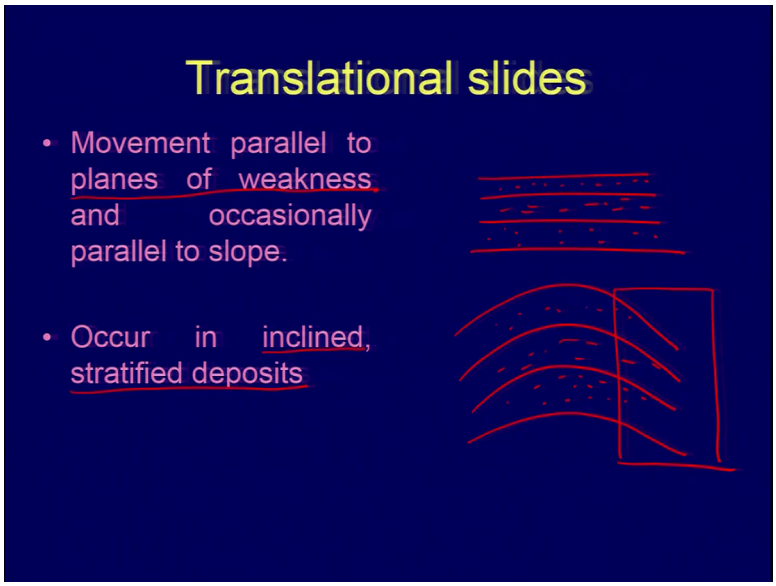

Translation slide: movement parallel to plane of weakness that is what we were talking about on that day that we are having geological structures which are having a definite plane of bedding planes that can result into the land slip and this can occur when you are having inclined stratified deposits. So, as in as in thumb rule all the pollution will take place in horizontal fashion. So, you have the different plane size and we have all, but because of the deformation and some of the regions you will find that there, if you fold this and what you see is that you are having this slope.

So, inclined surfaces along definite if I put here this one sand and you are having clay bed here and then you have a sign here, this portion if you take and you are having the inclined surface. So, if you are having an inclination and if you have stratified deposits and it is quite likely that portion may slip.

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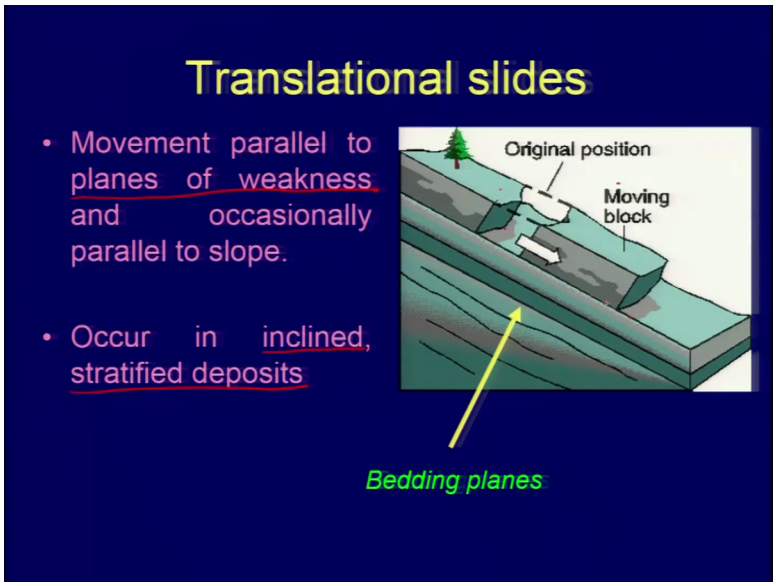

So, if you look at that there is a movement along a definite plane. So, these are bedding plains along which, if they are having an inclination there is a likelihood of having the slip. I will stop here and then we will continue in the next lecture.

Thank you so much.