Engineering Geology
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Lecture - 38
Preparation of Geologic Sections

Hello everyone and welcome back. We are going to get into the first laboratory session of this course today.

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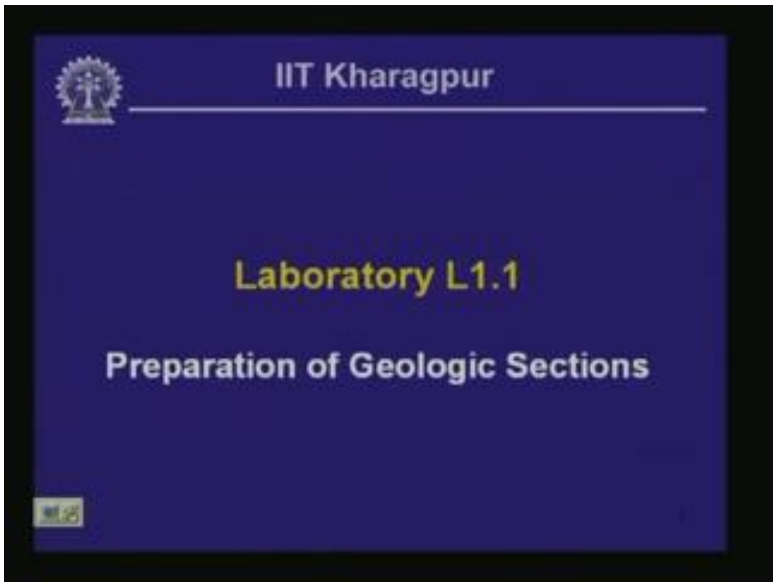

And we are going to talk about preparation of geologic sections from geologic maps in this particular laboratory. We have already looked at the salient features of geologic maps and geologic sections earlier in one of the theoretical lessons. Today, we are going to have a practical demonstration on this business of preparation of geologic sections. I will also take this opportunity of wrapping up the question set of the previous lesson before we begin with the preparation of geologic sections.

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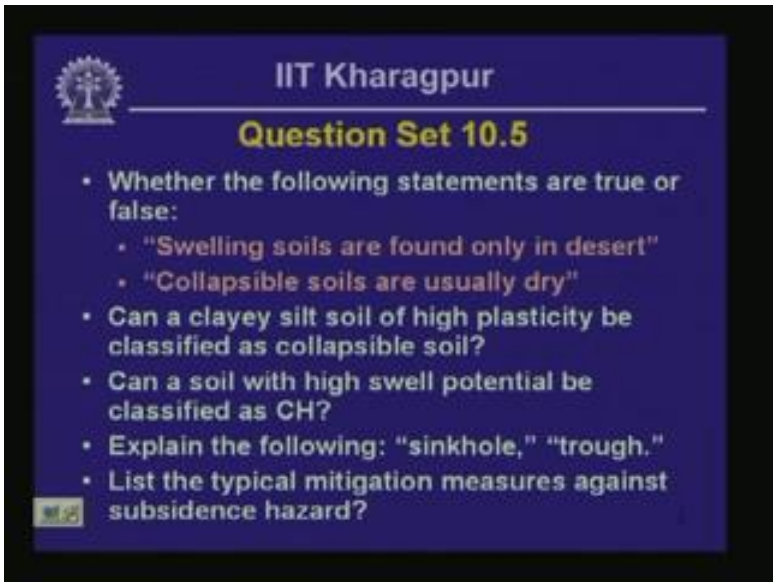

This is the question set of the previous lesson. The first question that was asked was whether the following statements true or false. The first statement was swelling soils are found only in desert. This is more often than not is true; however, swelling soils are also found in non-desert environment particularly in fine grain soils where there is a lot of smectite minerals present. Swelling soils could also be present in situations where there are a lot of clay minerals between rock joints. In such situations, also there could be a lot of potential for swelling in the shallow layers near the ground surface.

And these geologic settings are not necessarily found in desert; they are also found in other hydrometeorologic environments. The second statement that was given was collapsible soils are usually dry. This statement is true, because collapsible soils are usually found in situations where the natural moister content is relatively low, and the soils exists in a moist to dry state. This type of soil typically comprise of situations where you have got weak cementation bond because of deposition or activation of different type of chemicals at the inter-particle contacts, and these cementatious accretions, they tend to get destroyed very easily if the soil is disturbed a little bit.

And as a result, the soil leads to volumetric collapse if you recall from what we have discussed earlier in the previous lesson and earlier in this particular course. The second question that I asked was can a clayey silt soil of high plasticity be classified as collapsible soil? If you recall the subject matter of previous lesson, then you will see that

typically collapsible soils are usually not classified as highly plastic fine grain soils, and they are typically in the low plasticity regime.

Then let us move on to the third question; can a soil with high swell potential be classified as CH? This is a possibility; this is indeed a possibility. Highly plastic soils comprising a lot of active clay minerals such as smectite, they form a very large chunk of soils with high swell potential. So, CH or clay with high plasticity can indeed be a likelihood of the classification of a swelling fine grained soil. Then moving on to the next question; explain the following terms sink hole and trough. If you recall from what we discussed in the previous lesson, sinkhole is a situation where a soluble channel forms at some depth near the surface within a volume of soluble rocks such as poorly compacted limestone.

In such situations if a cavern forms very near to the ground surface, the over burden above the cavern cannot sustain, it is unstable; it cannot sustain its own weight or the structure that is supported on such covering above the cavern. And as a result, the over burden usually collapses into the cavern as a result sinkholes develop. Trough on the other hand is a little bit widespread phenomenon where the sinking or subsidence occurs over a relatively wider distance scale at the surface of the site. And this occurs primarily as a result of the collapse of the large aerial extent of underground openings such as mine workings. And as a result, the relative movement or relative settlement within the inner portions of the trough is relatively small.

On the other hand near the margins of the trough, the relative settlement relative subsidence or the vertical displacement expressed as a proportion of the horizontal distance from a benchmark is quite large only near the margins not near the middle portion of a trough, okay. Finally, the last question; list the typical mitigation measures against subsidence hazard. We gave a list of a number of possible mitigation measures. This could be avoidance of the hazard, identification of the areas that have a potential for subsidence and avoiding those areas for development, then there could be structural measures such as filling up of the unstable caverns using inert fills or using grouting.

So, there three were several measures that we talked about in the previous lesson when we were considering mitigation of subsidence hazard, okay. Now let us move on to the subject matter of today’s laboratory demonstration.

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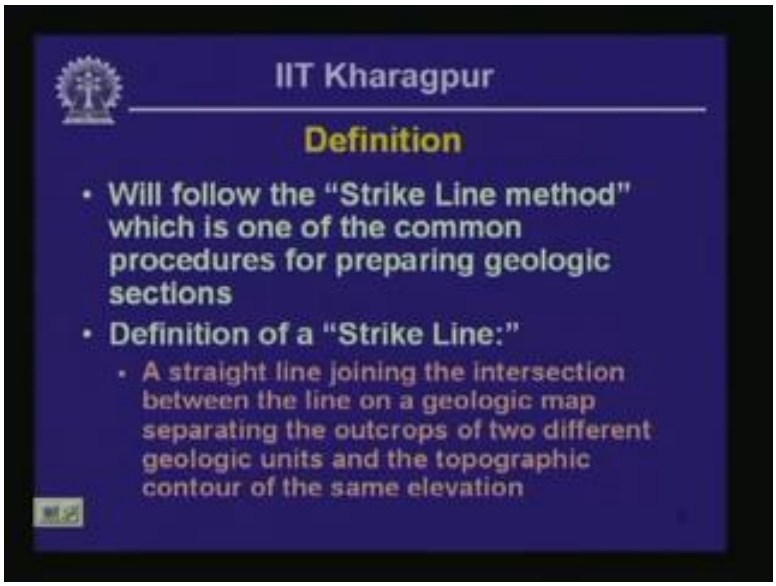

What we are going to do? We are going to take a couple of geologic maps in this particular lesson, and we will be trying to form or prepare the geologic sections along two of the transepts across these two geologic maps. Now what we are going to do? We are going to follow one of the several methods that are used in preparing geologic sections, and this particular procedure is going to be based on strike lines. So, we begin with looking at the definition of a strike line.

Strike line is essentially a straight line joining the intersection between the line on a geologic map separating the outcrops of two different geologic units and the topographic contour of the same elevation. Okay, just look at that definition and that will become more clear when I take the example of the geologic maps that we are going to consider little bit later. This definition is for your records. Now let us move on to the geologic map first the one.

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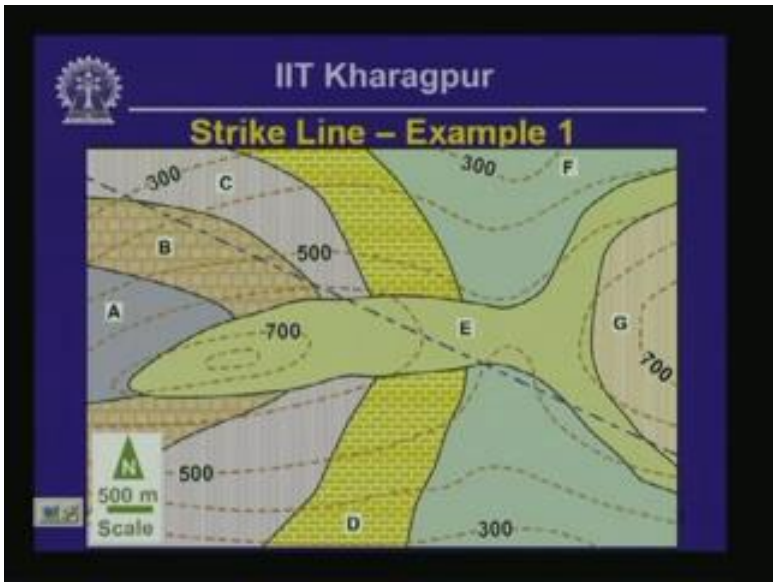

So, this is the geologic map; all the different geologic units are labeled on this particular map. We are going to hand draw the geologic sections along the thick dash dot line drawn in blue from near the left top corner of this particular map to near the bottom right corner of this map. And actually, before we get into drawing the sections, let me first explain what I meant by strike lines. So, you just consider the two points which are marked over there by two circular symbols separating geologic unit's c and geologic unit d.

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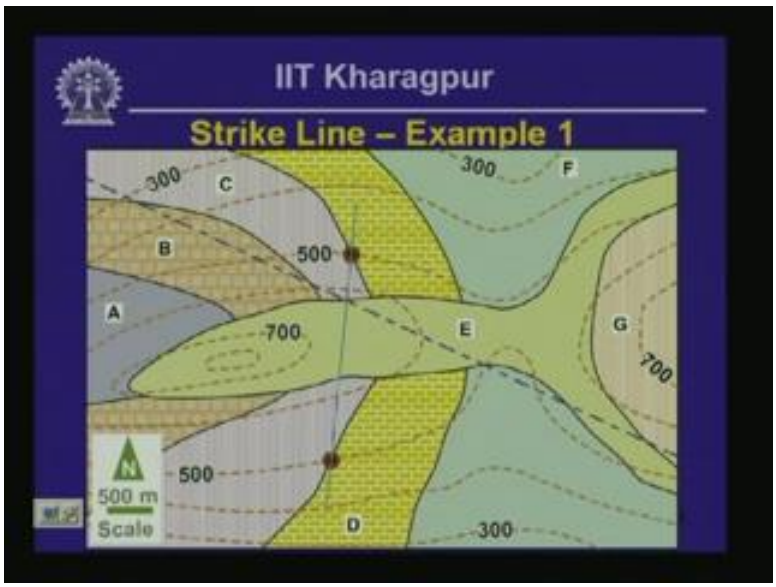

These two points both of them, they are at an elevation of 500 meter as is evident from the intersection of the line separating geologic sections c and d and the 500 meter topographic contour. So, we first mark such points that are available on the geologic map. And then we draw a line connecting each one of these pairs of points, and these lines are called strike lines. And we are going to make extensive use of strike lines particularly the interception of the strike line and the line along which we are trying to draw the section as you will see in the next little bit. So, this is the definition of or this is the example of a strike line.

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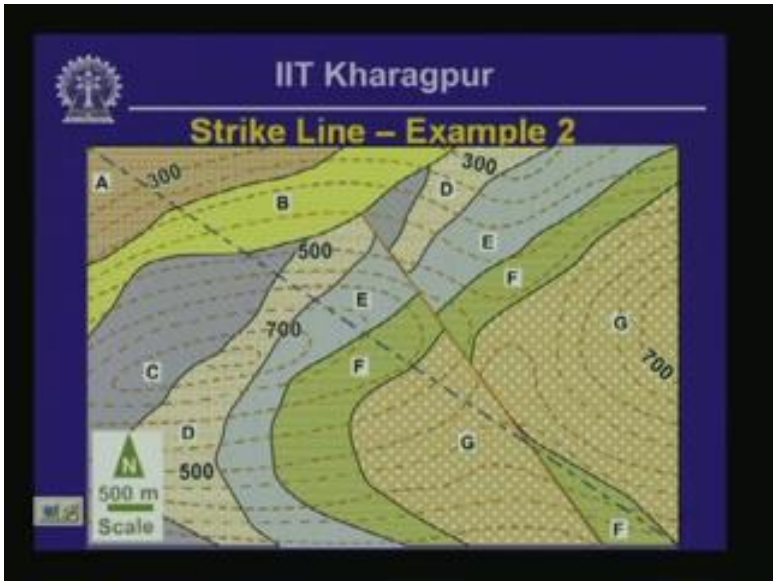

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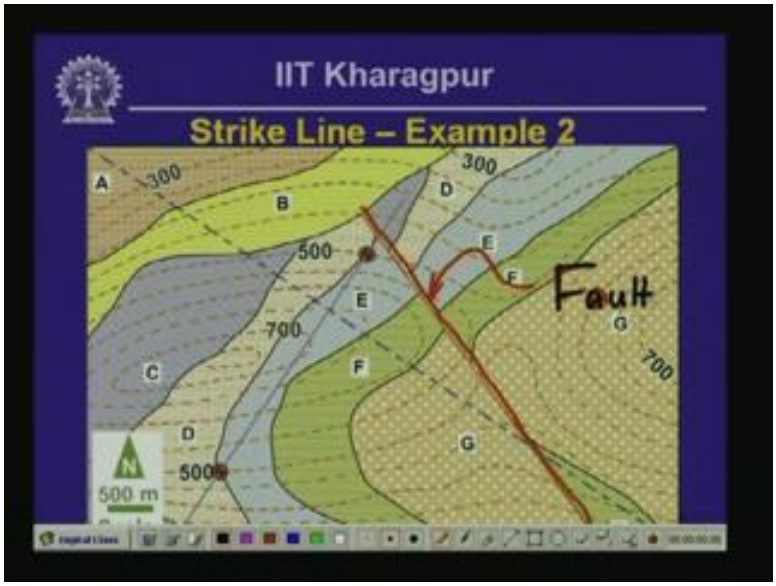

Now let me also put up the second geologic map that we are going to consider. Here the section that we are going to draw will be for the dash dot line which actually comes almost exactly from the top left corner of the map to the bottom right corner of the map, and in this case, let me show you a strike line. So, here we have got these two points which are again at 500 meter topographic contour, and they are on the separation between the outcrops of geologic unit d and geologic unit e. And again as we did before, we just connect these two points to construct the strike line.

Now this particular example is different essentially from the previous example in that in here we are going to consider a non-conformal contact which is shown by a thick orange line. And I am going to highlight this particular line here. This is the line that denotes a fault, and we are going to see how we handle a fault contact in this particular example. So, this is the fault that we are going to see when we look at this particular example, okay.

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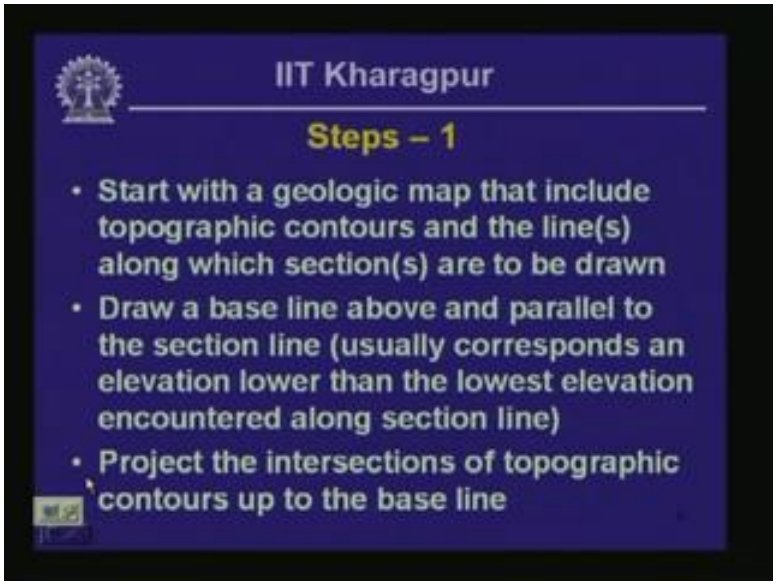

Now before I move on with today's demonstration, let me note down let me actually formalize the steps that are going to be involved in the drawing here. This is for your records. It will not be very evident, but these steps will become clear when we start hand drawing the sections. So, what we are going to do? We are going to start with the geologic map, and this map should include the topographic contours as well as the lines along which the sections are to be drawn.

Then the in the first step, we are going to draw a base line above and parallel to the section line. This is going to correspond to an elevation which is lower than the lowest elevation encountered along the section line. Then we are going to project the intersections of the topographic contours and the section line up to the base line.

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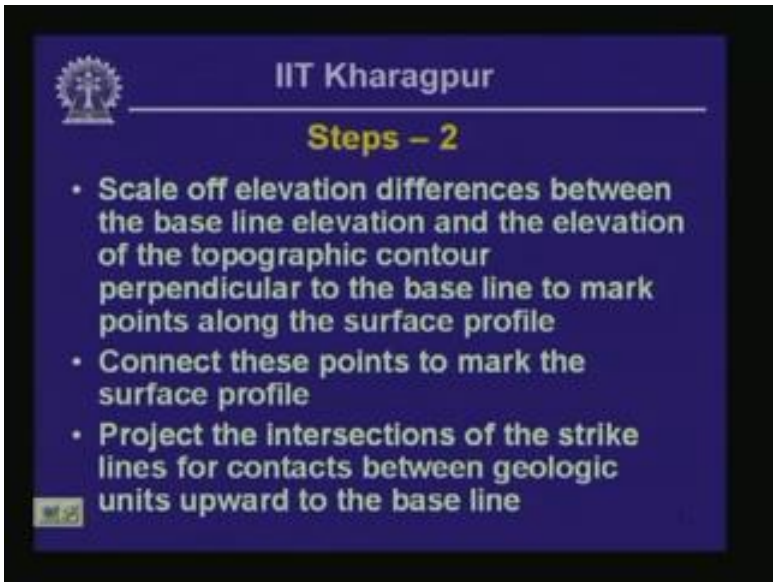

Then we are going to scale off the elevation differences between the base line elevation and the elevation of the topographic contour perpendicular to the base line to mark the points along the surface profile, connect these points to mark the surface profile. Then we are going to project the intersections of the strike lines which I illustrated a little bit before for contacts between all pairs of geologic units possible upward to the base line.

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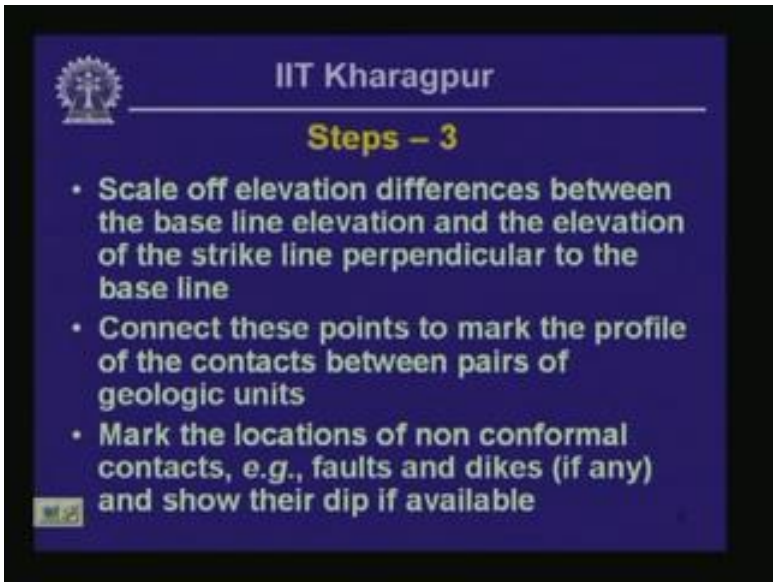

Scale off the elevations of the differences between the base line elevation and the elevation of the strike line perpendicular to the base line. Connect these points to mark the profile of the contacts between the pairs of geologic units. And then mark the locations of non-conformal contacts such as faults and dikes if any and show their dip if available from supplementary data. Now these are just a few statements; this slide as well as the previous two slides, these actually give you a synopsis of what is going to happen in the next little bit when we start drawing the geologic sections.

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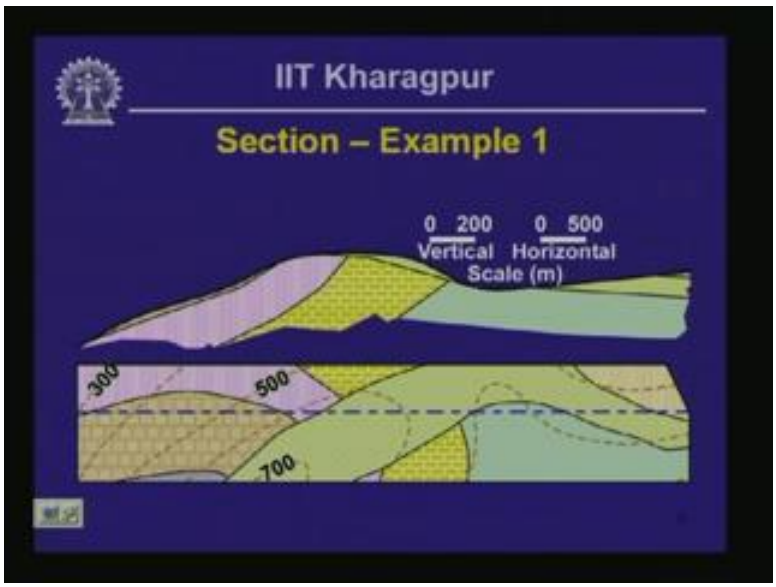

So, now I am going to also show you the result that we are going to get. So, this is the first example that we are going to consider. And here I have rotated the map, in fact, so that the section becomes horizontal actually on this particular slide, and the geologic section that is going to be prepared from this particular drawing is shown up above of the geologic map.

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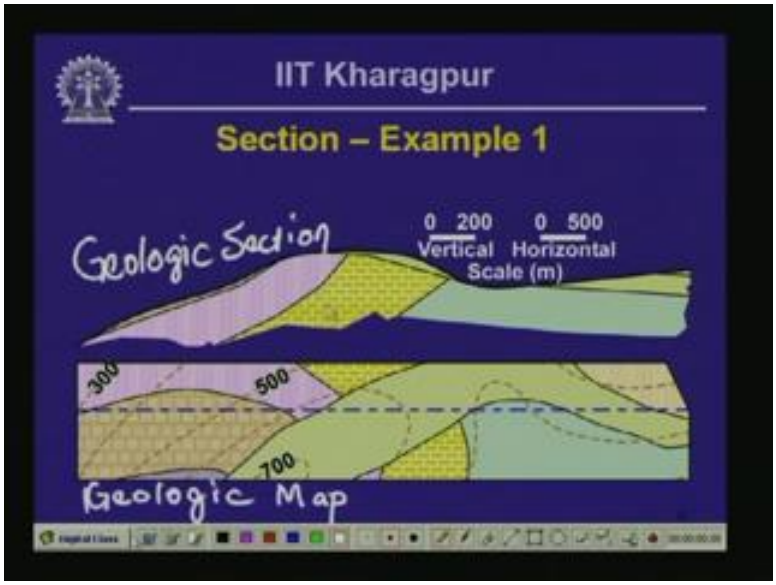

So, this one here is the plan or geologic map section of the geologic map and up above is the geologic section that we are going to draw in this demonstration geologic section. So, this is the first example.

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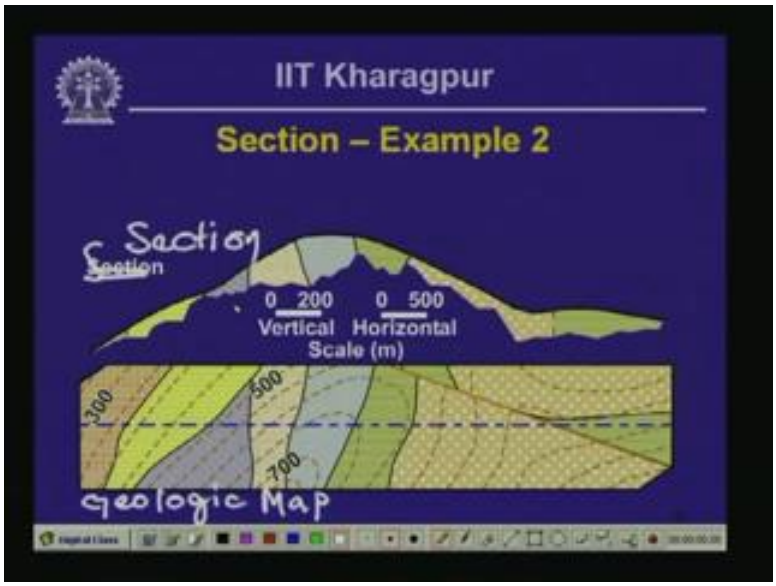

Then in the second example we have this geologic ma the one that is shown at the bottom. So, this is our geologic map of the second example, and the section is shown up above. This is the geologic section that we are going to prepare in the next little bit, okay. So, with that, I am going to wrap up the presentation part that comes really as a preamble to what we are going to do next. And just now we are going to start drawing the geologic sections; you just hang on with us, you just keep watching what is going on. I am going to keep explaining what goes on during the preparation of the geologic sections as it happens. So, we are going to wrap up the first part of this presentation with this, okay.

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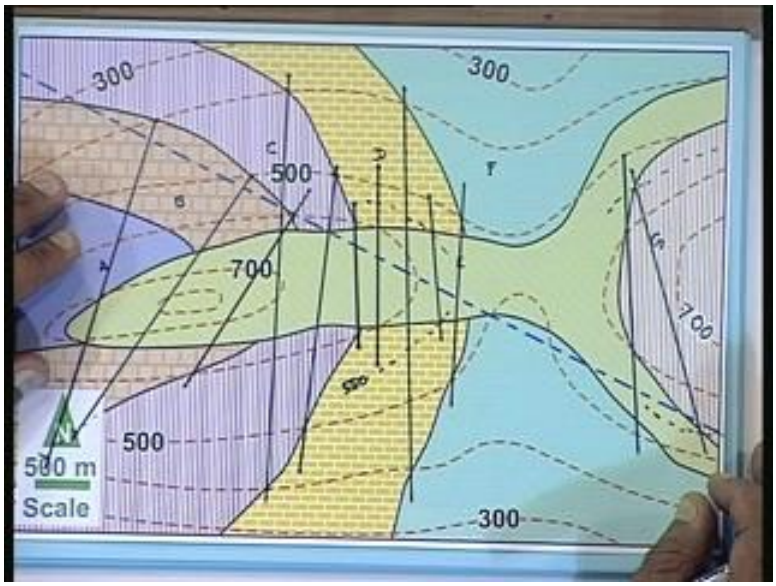

So, here is the drawing of geologic map that you have already seen. And what we have done in order to save a little bit of time, we have already drawn the strike lines and we will begin with labeling the strike lines in order to let you understand what was done before.

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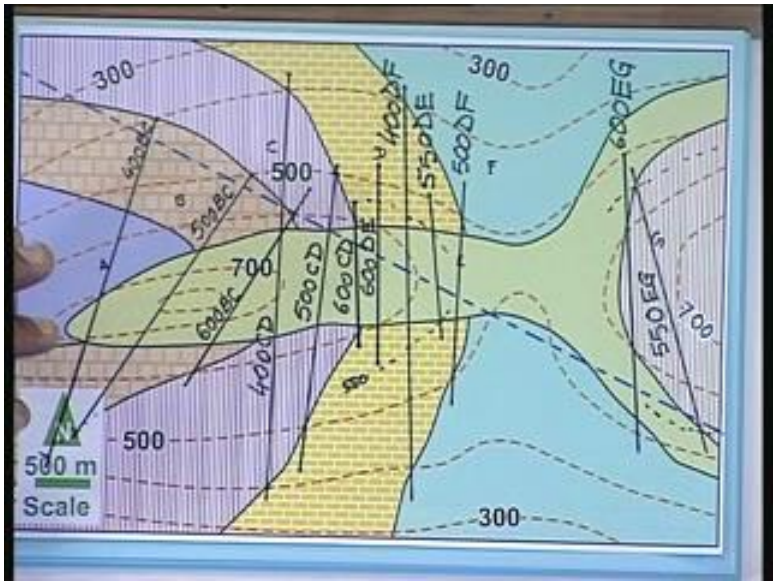

So, for example, the strike line on the left here which I am going to label, it connects the interface between b and c at elevation 400. So, let us label this one as 400 b c, then you can tell what is the next one. The next one actually connects again the interface between

b and c, but that is at an elevation of 500 meters. So, this one is going to be labeled as 500 b c. Then moving on to the right; the next one up is the interface again between b and c and that one is at elevation 600. So, we are going to label this particular strike line as 600 b c.

And then we move on to the interface between unit c and d. So, here the first one is the strike line at elevation 400. So, we are going to mark that one as 400 c d. Then moving on to the next point on the interface between c and d is the strike line at elevation 500. So, that is going to be 500 c d further to the right is 600 c d. Then we move on to the inter phase between unit e and unit d. So, here the first strike line is at elevation 600. So, this one is going to be 600 d e.

What we have done here for the next one is that is actually the interface between d and f unit d and unit f; the strike line is at elevation 400. So, accordingly, we are going to write that one as 400 d f, then further down to the right is again back to the interface between unit e and unit d. So, for this one, actually what we have done is to interpolate between contours of 500 and 600 meter elevations to obtain a subsidiary point at 550 meter elevation. So, accordingly this particular strike line is 550 d e.

Next one up is the interface again between d and f. This strike line represents elevation 500. So, we have got 500 d f, then a little bit further to the right is the interface between units e and g, and this particular strike line represents elevation 600. So, this one here is going to be labeled 600 e g. And then the last one here is again between interface of unit's e and g, and for this one, again we have interpolated between elevation 600 and 500. So, this one again is going to be noted as 550; like the earlier interpolated contour, it is going to be noted as 550 e g. So, that is all about the strike lines.

So, now let us move on to the preparation of topographic surface. So, for that, we are going to use a tracing sheet like this one which is a graphical tracing sheet really. So, what we are going to do? We are going to club this one on with the map like this so that the graphical markings they are parallel to each other that they are parallel to the section; just paste it. And now we proceed with the drawing first of the surface of this particular section.

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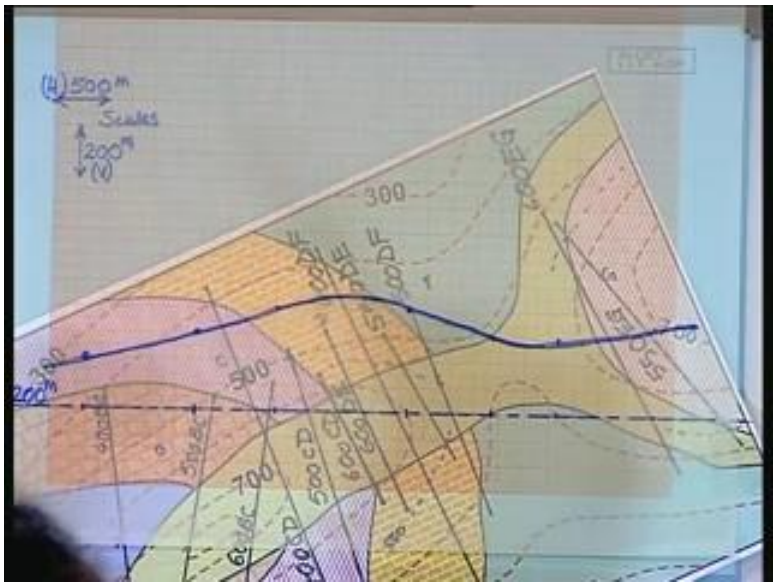

So, let me position this map a little bit.

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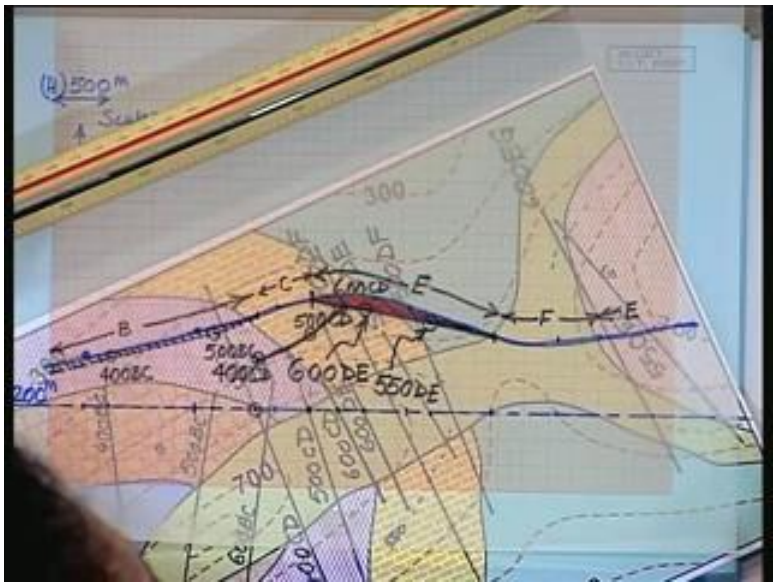

So, base line here is going to be along the section line itself, and since, the minimum elevation that we encountered along the section line was 300 meter within the main body of the geologic map. So, let us consider this particular base line to be at an elevation of 200 meter, and then we are going to use a scale of 10 millimeter equal to 100 meter in the vertical direction. And in the horizontal direction, we are going to use a scale of 10

millimeter equal to 250 millimeter. That is going to give us a little bit of exaggeration in the vertical direction and in order to enhance the topographic features a little bit.

So, you should realize that in the vertical direction, we are going to use a scale like this. So, this one here is going to be in our case 200 meter, and in the horizontal direction, we are going to similarly have this much of distance equal to 500 meter. So, these are the scales that we are going to use in this particular section. So, this one here is horizontal, and this one here is vertical, alright. So, this here as we have mentioned, the base line itself represents 200 meter. So, we are going to base our construction accordingly, alright.

So, let us now begin by marking the locations of the topographic contours. So, first intersection of the topographic contour is at the corner at the area which is a little bit outside of the range of the camera. So, let us begin with the intersection between the section line in the geologic map and the topographic contour at elevation 400. So, that is this particular point here. So, 400, then is going to be as far as our scale is concerned; it is going to be at an elevation of at a vertical offset of 20 centimeter according to the scale that I have drawn. So, that is going to be the point on the surface there.

Then next one up is the 500 contour and 500 contour is it intersects the section line and the base line at this location here. So, we are going to project that one upward 30 centimeter, and accordingly, we are going to have a point on the surface out here. Actually let me yeah that is right; it is going to be right about there. Okay, then next one next intersection between topographic contour and the base line as well as the section line is out here, and this one represents the contour at 600 meter elevation. So, that one is going to be at this location on the section line.

Going further to the right, 600 meter elevation contour again cuts the section line and the base line at this location. So, we project that point up to obtain another point on the surface at this location, then we get to the topographic contour of 500 meter elevation. And that is at this location project it up just like what we were doing before, and we get a point out here. Again we get an intersection between the section line and topographic contour 500; at this location, project it up and we get another point here.

And finally, we may consider the interpolated contour of 550 which approximately cuts the topographic contour at this location, and thereby, we are going to get a point which is

going to be approximately at this location. So, that is then we are going to join these lines these points to obtain the surface profile by a smooth line actually to obtain a surface profile like this. And that is going to be how the surface is going to like of this particular area on the section drawing, alright.

Now let us mark up the outcrops which are going to appear on the section. So, what we are seeing here is that up to here, we are actually intersecting we are transecting unit b. So, unit b is going to continue all the way from left on this section to this point here, then we get a little bit into unit c and project the area or the length of the section line which is covered by unit c and we get to there. So, this part here is going to be unit c, and after that, we move on into unit e, and we remain in unit e until we reach this point. So, from here to here, we are going to see exposure of unit e at surface.

Then we get a little bit of unit, which unit is this; that one is unit f. So, we are going to see a little bit of unit f up to this point at the saddle portion of this topography. So, this is unit f, and finally, we get into unit e. So, those are the outcrops that are going to be visible at the surface. Now let us start projecting upward the intersection between the strike lines and the section line. So, what we are going to get? The first one is 400 b c. So, that is the intersection between unit's b and unit c and it is at an elevation of 400. So, that is at this location here. So, that one there is going to be right near the surface.

So, this particular point, we are going to mark again as 400 b c. So, that is going to give us the interface between units b and unit c, and that is at an elevation of 400. So, then since it is such a thin layer, actually we have got other points of the interface between b c. We have got another point here which is at 500 meter elevation. So, we move up to here approximately, and that is going to give us 500 b c. And, in fact, we have got one more and that is at 600 meter elevation, and that is between c and d; sorry, we are going to just connect the interface, the outcrop, the line separating the outcrops of b and c between these two projections of the strike lines, and that is going to give us the interface between units b and c.

So, unit b is going to be at the top, and unit c is going to be underneath that, okay. So, this is going to be the shape of unit. So, this is going to be unit b the one that I am hatching right now, the thin one, thin veneer, and underneath that, we are going to get unit c. So, let us now delineate the bottom of unit c. So, let us look at the interface

between unit c and d. So, in order to do that, we are going to follow exact same procedure.

Now we are going to project the strike lines that represent the interface between unit c and d upward. So, let us start doing that. So, the first strike line that represents the interface between unit c and d is this one here, this one that is the intersection between the strike line and the base line as well as the section line. So, let us project this particular point up, and this is the point corresponding to 400 meter elevation. So, we are going to go up to here, and that is going to give us a point at the interface between c and d and at 400 meter elevation. So, we are going to mark that one as 400 c d.

And then we move on to the other point representing the interface between c and d, and that is the location of the strike line where it intersects the section line as well as the base line in this case. This represents elevation 500. So, project that one up to 500 meter elevation and we come to a point which gives us the interface between units's c and d at 500 meter elevation. So, that is going to be 500 c d. Then we have got another point which represents 600 meter elevation at the interface between c and d, and that is the point where the strike line corresponding to this elevation cuts the section line as well as the base line. So, that is at elevation 600.

So, this is going to be 600 c d; it is becoming a little bit busy now with so many points appearing on the section. And I think that is the last one on the interface between c and d. So, we are going to join those three points, and what we get is a line like this one. And below that is going to be unit c, and above that is going to be unit d. Now you will ask, what is going to happen to this particular line? We are not going to project this line all the way to the surface in this particular case, because along the section line, unit d is not going to be visible. And it is going to be covered actually if you see the geologic map, then it is going to be covered by a thin veneer of unit e.

So, this particular line which separates unit c and d is not going to move on to touch the surface, and it is going to intersect the interface between d and e instead. So, now what should we do? We are going to start marking up in a similar manner the interface between the profile of the interface between d and e. So, this is the strike line intersection for elevation 600 and the section line. So, project that one up to 600 meter elevation. So,

we come to this point, and this is going to be 600 d e. So, in fact, if you realize that is going to be demarcate the top surface of unit d, okay.

Now let us move on to the next strike line demarcating the intersection or the interface between d and e, and that is this one here. This represents the interpolated contour of 550. So, let us project it up to 550, and we come to a point which is roughly here. So, that is where we are going to get 550 d e. So, this one is going to give us 550 d e, interface between d and e at elevation 550. So, let us connect that one also. So, that is going to demarcate the top of unit d.

And we can actually project this particular line backward because we know that unit e starts from this location because that is the interface that is the limit of the outcrop of e, and we also know that the outcrop of e ends at that point. So, we can connect those two points, and above this particular line is going to be unit e; let us level this one up so that it is visible. So, this one here is going to be unit e; that is how unit e is going to look on the section, okay.

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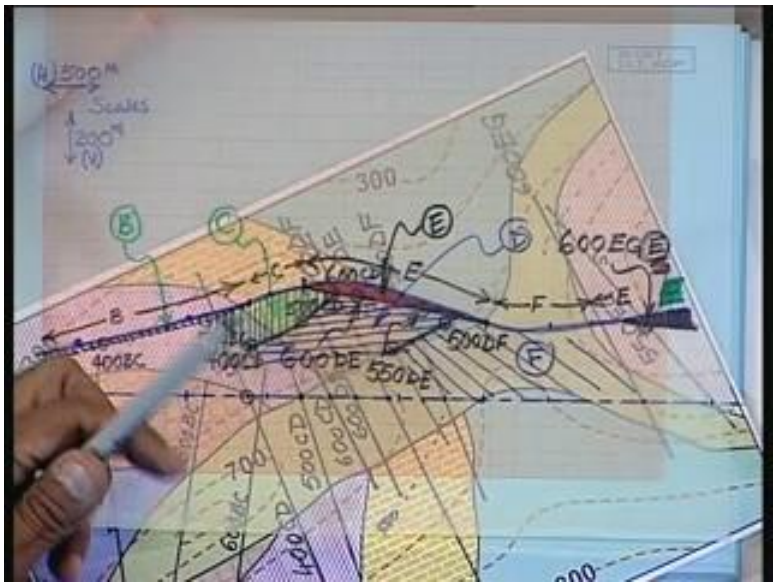

Now back to the other interfaces. Now we are going to get another one to the further right, and that is going to be between e and g. So, let us consider those strike lines. So, this is the strike line at 600 meter elevation between e and g and project this one up to 600. So, that is going to be the point where e and g is going to be separated. So, this is going to be 600 e g. And we have got another point further right that is going to be at 500

e g, and that particular point is going to be further to the extreme right of this particular section.

And if you join that, then we are going to come up with the profile of the interface between e and g; above this particular interface will be e. So, this one marked by green hatching is going to be unit e, and underneath that is going to be unit g, alright. Now let us go back and see whether we can get any more information from this particular; let us first actually crosshatch the unit c. So, I am going to use green in this particular case. So, this is going to be our unit c. So, it will look like this. So, that is our c.

B is out here, e is back there, and actually unit g is to the right; no this is actually unit e, sorry. This one is unit e, and unit underneath this one is going to be let me have a look what we took, okay, underneath that one, underneath g; sorry, this one is going to be g. This one is going to be g, and underneath g is going to be unit e. So, that is how it works. So, further actually this is going to be g I think. This one here I labeled it in a wrong manner, is it. This one here is going to be which unit is this f and then we are getting back into unit e, sorry. So, that is the way it has to be.

So, we are going to get a little bit of unit e for that to derive. So, this is going to be our unit e and that is not unit g. So, this is going to be unit e. So, unit e is going to be here and here. So, these are the units that we are looking for. So, this one is unit e. So, unit e was near the middle of the section and as well as further to the right of this particular section, alright. Now we could actually get another strike line if we interpolate some of the topographic contours for the interface between actually unit f, and underneath f is the major unit here is at the top of f actually.

So, we have got a few more strike lines actually; we have got the strike line here which we missed which separates the units d and f, and this one was at elevation 500. So, let us draw this one. So, that is going to be one two three, this one here. So, that is 500 d f. So, that demarcates the top of unit f, and we have got another strike line corresponding to the interface between d and f, and that is this one; this is at elevation 400. So, we come to the point here. So, that is going to give us the interface between units d and f. So, above this one is going to be unit d, and underneath this one is going to be unit f. So, this one is going to be our unit d, and underneath this one is going to be unit f, okay. So, that kind

of completes the section whatever information we could get for the example that we considered to begin with. And now let us move on to the next example.

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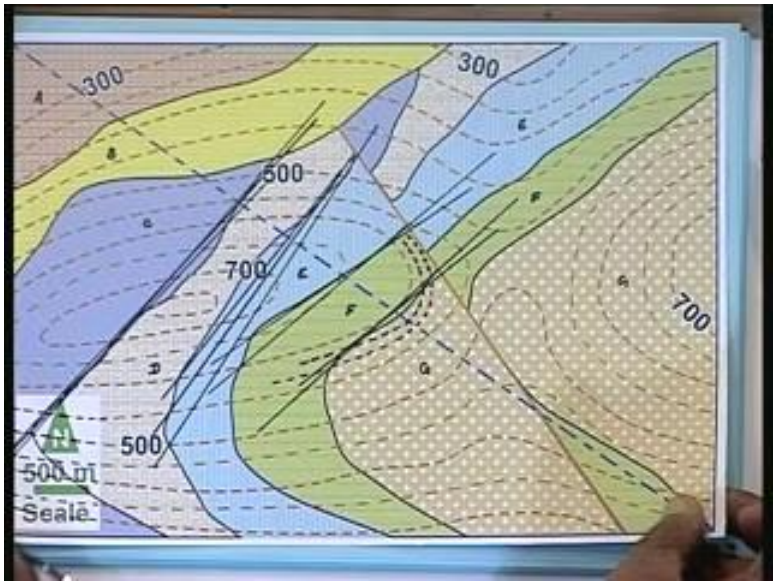

So, here again we have marked the strike lines, and again, you have to actually label the strike lines and project the strike lines up the appropriate values to demarcate the interfaces between units c and d in this case.

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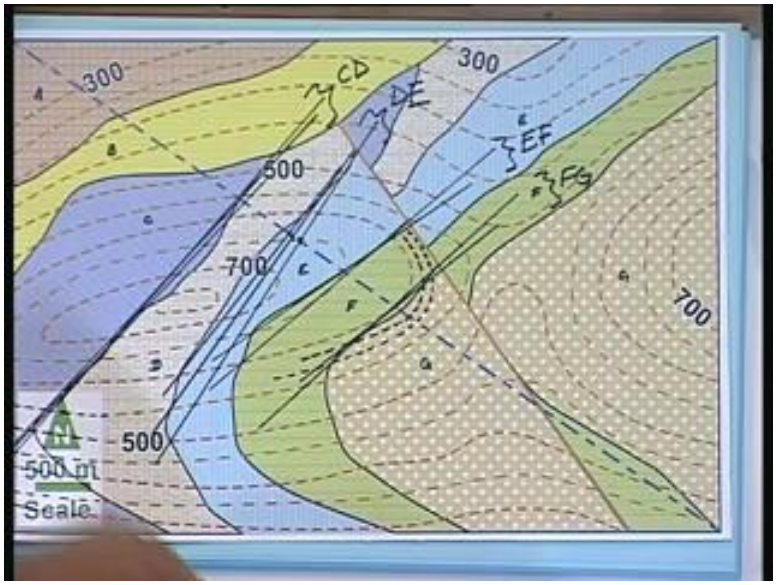

Because the strike lines that are bunching here they represent the interface between units c and d, and the strike lines that bunch out here they represent the interfaces between

units d and e. So, you have appropriately label the strike lines, find out the intersection of the strike lines and project it upward to appropriate elevation. Similarly, here you have got the strike lines giving the demarcation between unit's e and f. And finally, what we have got here are a couple of strike lines obtained after interpolating the available topographic contours, and that gives us the interface between f and g.

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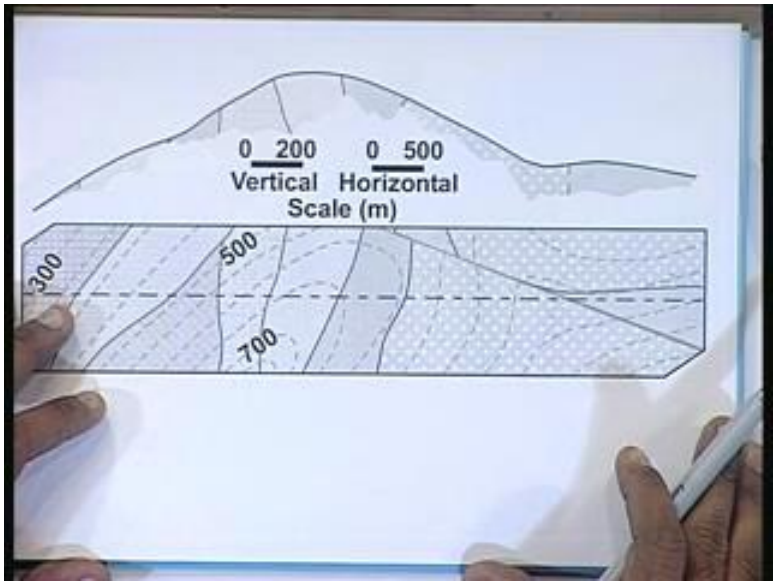

So, we follow the exact same procedure as I explained in the preceding, and what we are going to get in the process by doing the necessary exercise is to construct a section like this one. And what you can see here is that the available information is rather tenuous, so that we could actually draw the sections only to little bit limited depth in this particular case. So, let us mark the units anyway on this particular section.

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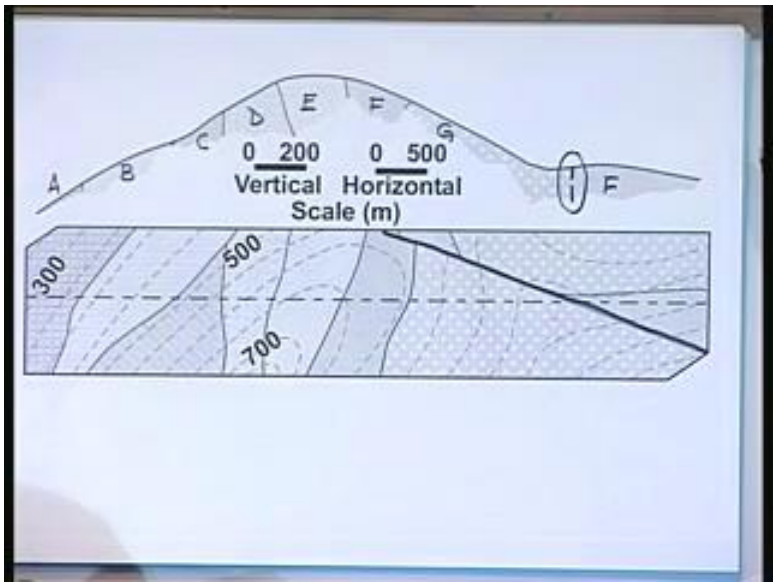

So, this one is unit a, and after that, we got into unit b. And then this one is unit c and d and e, f and g, and then we hit the fault line, and finally on the other side of the fault line, we get back into f. Now you notice here that we have drawn the fault line in a vertical manner because that is going to be most probably the case, because in this particular section, the fault line actually follows a straight geometry in plan. And if that happens, then more often than not the fault line actually dips very steeply. As a result, we assume that the fault line in this particular case is vertical, but in general in order to resolve the dip of the fault, you need actually some additional sub surface boarding information in order to confirm the inferred dip of the fault line. So, this gives you some idea actually about the geologic map preparation.

And I left the large part of the second example for your practice. So, you try to use this as an exercise and try to get; I gave you the solution as well. So, you try to complete the section at your own leisure and try to see whether your solution matches what is provided on this particular example here, okay. Thank you very much until we meet the next time, and that is going to be an outdoor session where we are going to demonstrate the laboratory procedures and some of the few procedures for characterizing soil and rock samples.

Until then thank you and bye bye.