Geomorphic Processes: Landforms and Landscapes

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Lecture – 22
Fluvial Processes and Related Landforms (Part VIII)

Welcome back. So, yesterday we discussed in the previous lecture about the drainage pattern and by now you must have must got the clear idea about that what is the difference between the patronage pattern and channel pattern. So, but let us quickly look at the different drainage pattern which of course, we have briefly discussed. As so,

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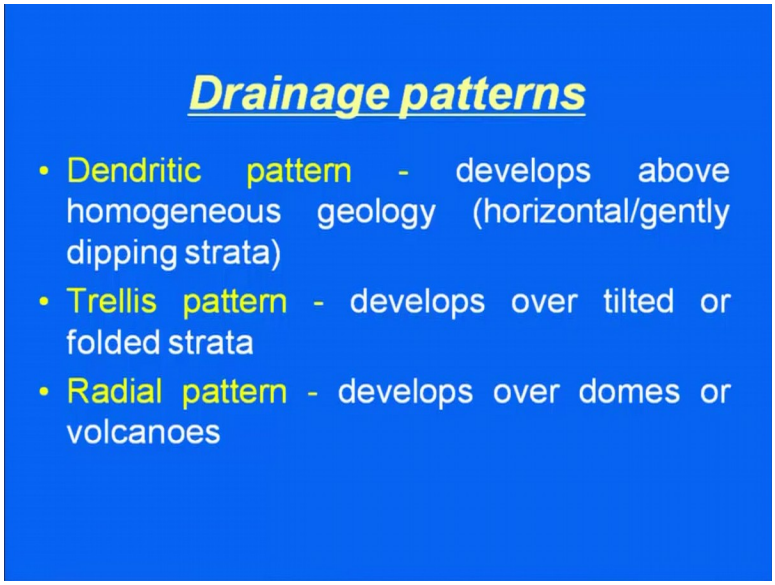

Most commonly seen drainage pattern across more in most of the regions, you will see that you have dendritic pattern You have to release pattern and you have parallel drainage and all that and more in most of the regions you will also see the rated pattern. So, these are one of the few most common commonly seen drainage patterns on the Earth's surface. So, dendritic pattern develops about homogeneous geology release pattern developed over tilled or folded strata radial pattern develops over domes or volcanoes.

So, we also saw some examples of radial drainage and dendritic pattern also, I will show in some examples from Himalaya where the some Himalaya showing very dense training network. So, Drainage pattern

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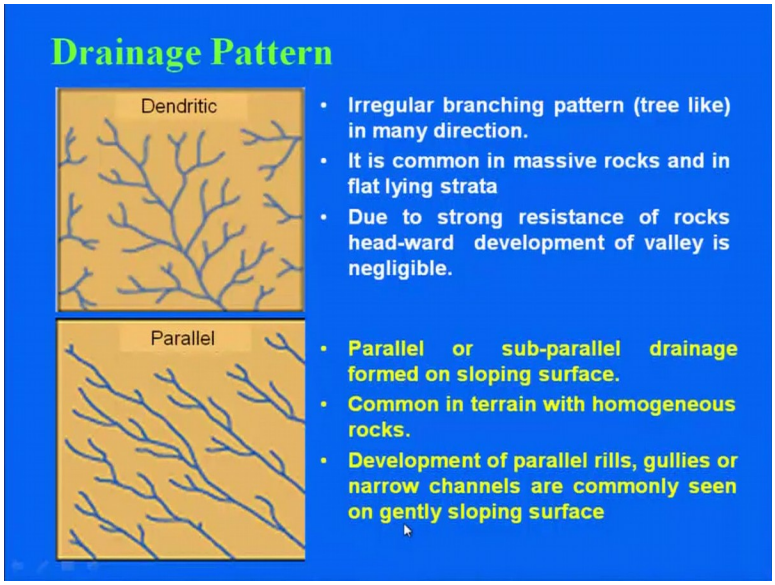

Drainage if you take is a regular tree like features you will be able to see and they will be flowing in many directions. Of course, they are they will meet the smaller streams, which are generated by our have developed and in the source area will join, but they are that they are in many directions common in massive rocks or flat line status and such drainage is developed. Due to strong resistance of rock hardware development of Valley is negligible.

Stay tuned will keep on developing at the same place then we have parallel drainage. So, parallel or sub parallel drainage formed on smoking surface, common in terrain with homogeneous rock and develop development of parallel drills gullies or narrow channels, commonly seen on gently smoking surface. Now, this gently smoking surface could be a natural surface or a two tectonic to formation. So, this example

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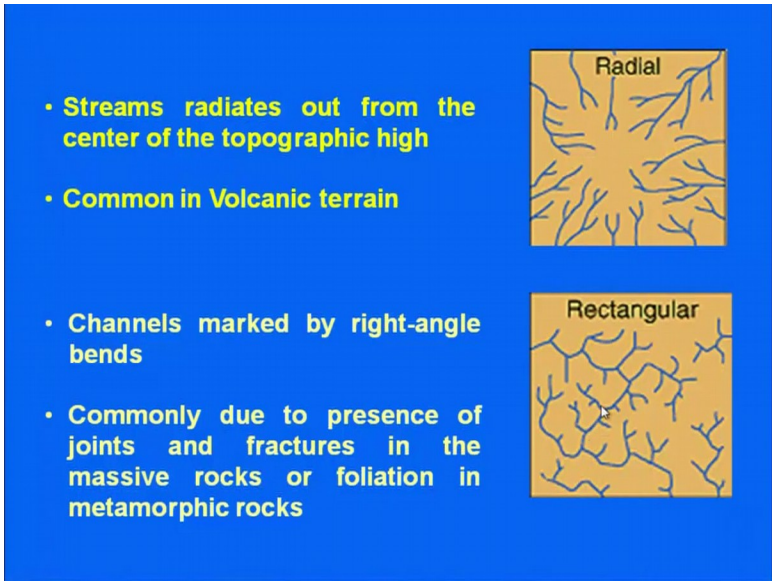

I was showing from in Jordan or close to Chandigarh, where the satellite photo on which we are showing you the parallel. Now, coming to the radial drainage, what you see is the centre portion you do not have any development of any drainage, but the streams are flowing in all direction and again similar example, I have shown from higher Himalayas as well as in the foothills zones, which we discussed in the previous one.

So, mainly the stream radiates out from the centres. So, it is in topographic high, so, central part will be higher. And so either it is not volcanic cone or tumble areas or even war area because of the tectonic to formation which will result into the formation of radial drainage. Rectangular drainages are commonly seen due to prisons of joints and fractures. If you are having the fractures and jointed regions are the areas.

In ways you have massive rocks or Fallston in metamorphic rock. Then you will tend to see the formation because they will be there what we can also say that they are this type of drainage are structurally we control drainage. So, due to the fractures and joints are formed because of weathering also, but most of the places it will be related to the ongoing deformation.

So, such fractures can control the flow of the planets, because the streams are the water when the stream will try to flow and take the least resistance path as they if they the find the channel the way through which the water can flow easily and those are the fractures or joints

then they will start flowing and then and try to develop a rectangular drainage. Then trellised drainage

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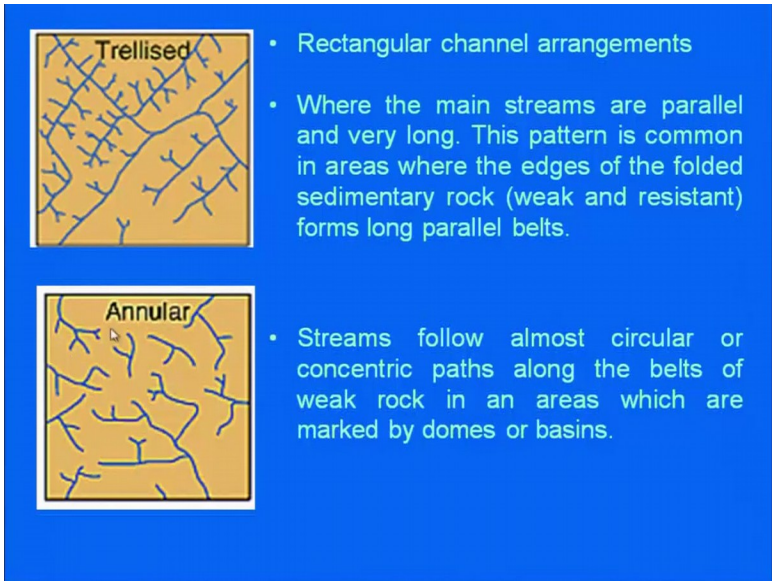

Again a rectangular drainage arrangement where you will see and the mainstream is this one where is the tributaries, mostly urban scene that they will join at almost at right angle to the mainstream. So, they are from in the region where the mainstream are parallel and then very long this pattern is common in area where the edges of the folded sedimentary rock. So, it will it flows across the folded sedimentary rocks.

And sedimentary rocks usually are been seen in combination of weakened resistance rocks and form a very long belt and annular drainage stream flows almost circular in fashion or any concentrate path along the belt of weak rocks in an area which is marked by domes or basin, so, very much says somewhat similar to regional drainage. But, this will give an impression of concentric path or the pattern or almost said circular pattern. So, again

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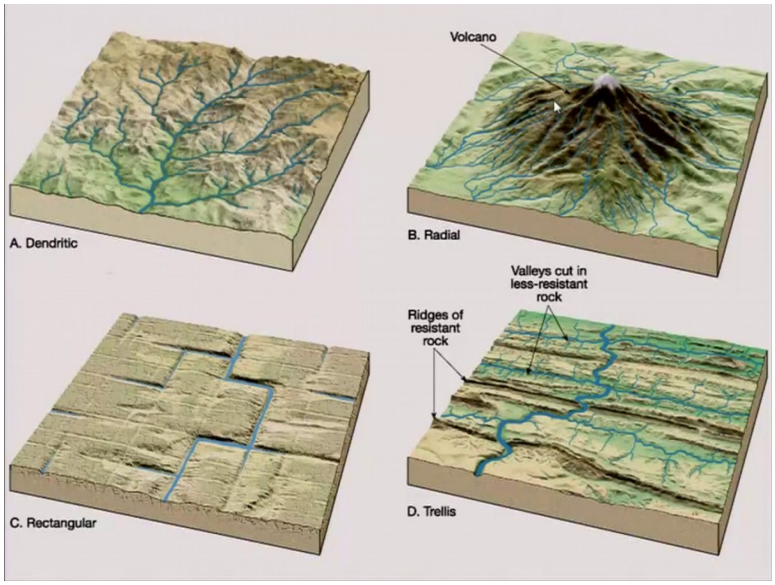

This figure if you remember, so, you have to trellis pattern to tree like the will have the density of patronage will be higher density here is less rectangular drainage and trellis pattern as what we see is that you are the main stream is flowing across the resistance rock or the ridges, folded ridges. And this terrain is mainly the sedimentary terrain and then in the list Distance rock in the Valley area.

What we have is the basically the parallel drainages which are joining the mainstream and then we have the radial drainage which has been seen in the volcanic region or in the areas which are what are we see dome. So, in Central Ocean is the high higher area and then it flows away from all strange flows away from the centres. Now, quantifying

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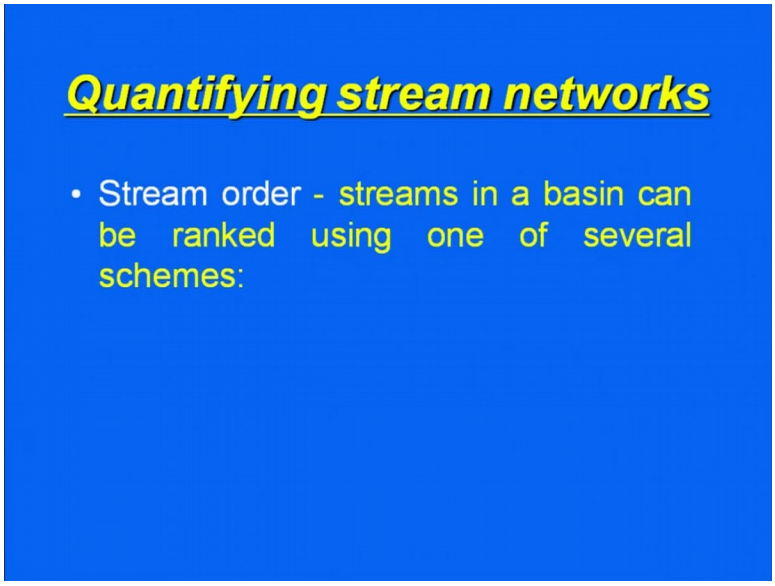

Stream network mainly this stream order in a basin can be ranked using one or several schemes. So, there are several schemes which are available which helps us in identifying identification is not difficult part but is ordering one has to be careful because that will help us in getting the bifurcation ratio between the higher order stream or we can say the lower order stream and the next higher order stream. So, these are the two

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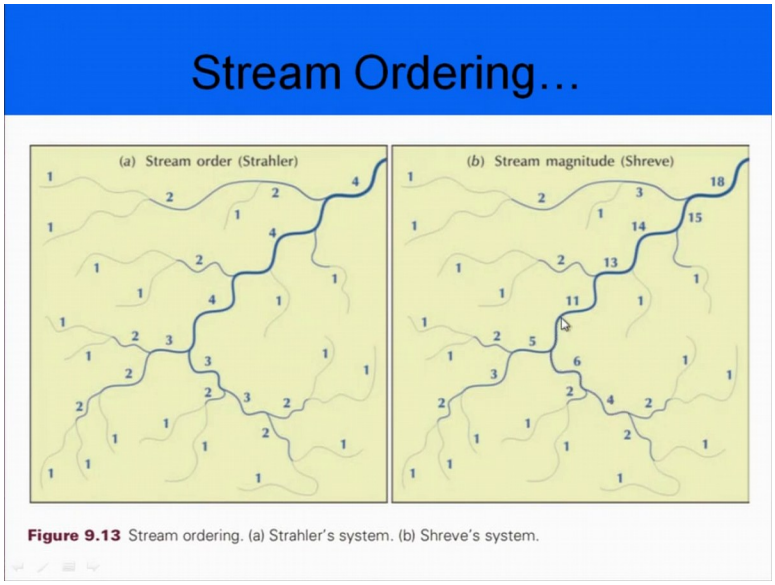

Most commonly erupted ordering methodology given by Strahler and Shreve. Now, the difference is not much, but, if you see here that initial like the first order the smaller order streams which are the source area or the in appliance where the river originate or the drainage starts in the heat water area and then to lower order stream meet. Then it will result into or the next order will be the higher order that is second order.

And then even the second order remains because they need if this becomes higher the next stream where it call it go and joined will become higher order only when there is an next higher order than then first or two second order streams meet, then it will become third order and if you see this here, then you will be able to understand. So, two first our stream gives the second order stream and two second order stream gives a third order stream.

And two third order stream will have like the further downstream will have the fourth order stream. So, now, the fifth order will come when two fourth order stream will meet, so, even any lower order then the then this order, if it means it does not change the order does not change the order remains the same. So, finally, what we can say that you have the smaller sub basins.

So, the up to this point you can say that this base and sub base in his third order stream, where is this one from here, if you take this one is the second order stream and then final the trunk stream is a fourth order So, we can say that this is fourth order. So this is after Strahler and ah after Shreve what we see here is that to first order. Very much similar to the Strahler a meet the result into the higher order.

Second order and then even if the any one lower order needs then it becomes the third order, but this will keep increasing the order exponentially like what you see final here is that even in the short distance, where the morphology of the channel does not change, the main channel remains the main channel. But, the because of the ordering pattern, this final order of this base in is 18th order which is too high.

So, this was this is not commonly followed and Strahler classification is mostly erupted. So, what it does here is that even if you see here this is what you have is that the two first order becomes second order and then this becomes the fifth Order and much higher. Because you have fourth order here and all that. So, the classification is very random here and that is one of the reason why this has not been used actually. So, considering

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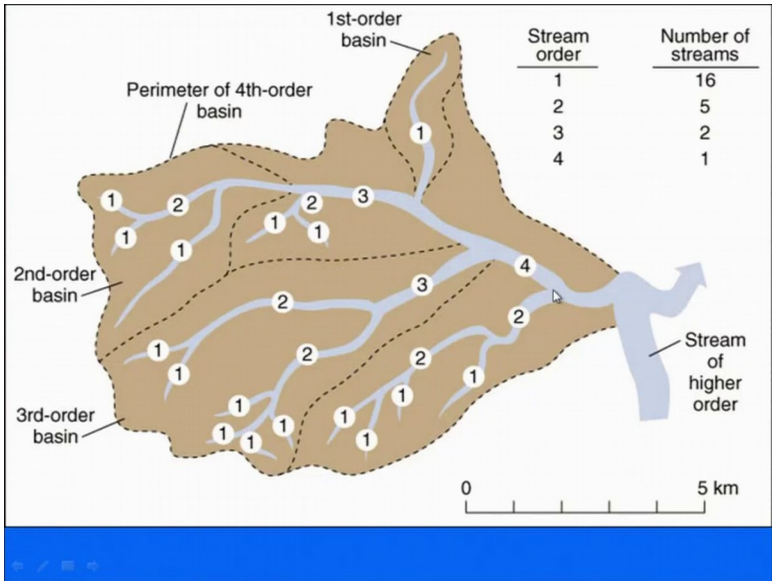

The Strahler classification of stream ordering, if you look at then we have the first audio stream we have second order and first order and second order meeting still it remains second order, but to second order when it means it becomes third order and so on. So, two second

order becomes third order and to third order streams results and to the fourth order. So, if you count the strange.

So, what it has been marked here is that the final trans stream why because this is the outlet here and if this stream goes and meet like fourth order, and they higher order stream meets here, then the this stream will become higher order, but if we take only this area of the basin drainage basin then this becomes the fourth order basin, whereas the sub basins which are been marked by the dotted line.

It shows that these are the second order basin and this one is the third order basin and even this is second order basin this one is first order basin. So, if you count these three model because this will require this number is required for bifurcation reach to calculate the bifurcation ratio. So, then you have the stream order a number of streams here, so you have one first order they have 16 streams.

If you count here 1,2,3,4,5,6,7,8,9,10,11,12,13,14,15 and 16 and so on. The second order is five, third order is two and fourth order is one. So, fourth order is the final. So, ratio you will get between the first order for example, and the second or second order and the next higher order stream. So, bifurcation ratio

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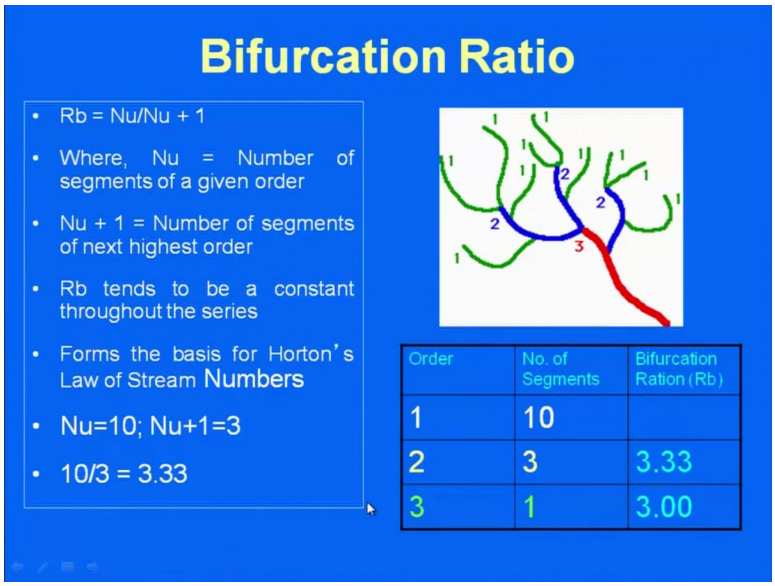

Again if you take it has been given by RB where and RB is equal to Nu by Nu plus one and u is a number of segments of given orders. So, these are the number of segments we have, as we were discussing in the previous slide. The Nu plus one is your number of segments of

next higher order. So, you have, for example, 10 first order the next higher order is three here. Something like that and RB tends to be constant throughout the series.

Now, it forms the basis of hurt and slaw. So one is the stellar very much similar to that. We also call this as that it forms the basis for heartens law of stream numbers and this has been given so this is for bifurcation ratio. So, ordering is very much similar to what we were talking about the Strahler. So, here what you have is the ten number of streams are first order. So, 1,2,3,4,5,6,7,8,9,and 10 and the second next higher order is three that is second order.

So, you can have the ratio is 3.33 this is the bifurcation ratio. So now this number is important because this will usually the hydrologist uses this number for flood analysis mainly. So, flood intensity

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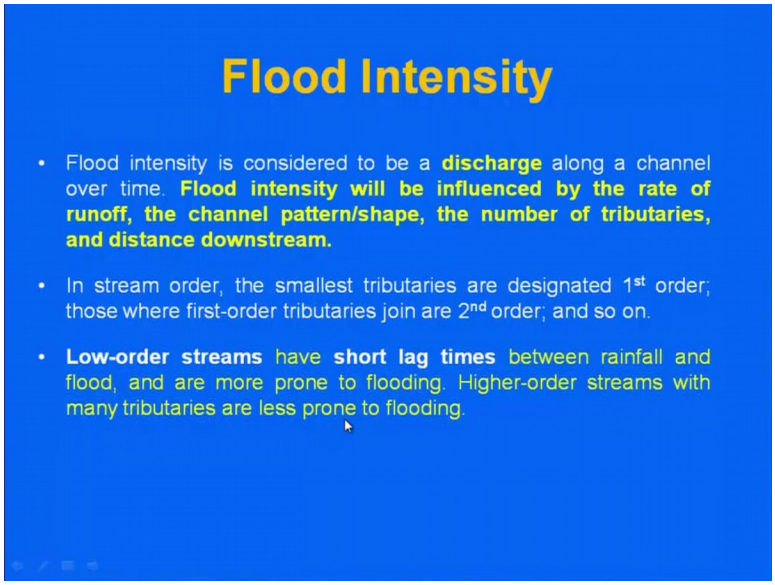

is considered to be a drainage what sorry discharge along the channel because whenever there is an old bank flow or the flow discharge is higher than the capacity of the channel to siphon it out the water the excess water and then the river will be an overflow and that overflow or over bank flows will such as our clearly indicate that the stream or the channel is in flooding state.

So, the flood intensity is considered to be discharged along the channel over the over time. Flood intensity will be influenced by several parameters and one is your rate of runoff, then the channel pattern and shape the number of tributaries and distance downstream. So, this is

very important, where you will be able to figure it out that the runoff then the channel pattern, drainage pattern and tributaries.

This all will be controlled or will be affected by the subsurface geology and the geological structure. So, this is very important and if you understand this and you will be able to talk about the in better way, about the flood hazard. So, in Shreve model the smallest tributary are designated at first order that what we have seen and those were the first order tributaries joins our second order and so on then you have thought order and all that.

So, lower order stream have short lag time, this lag time is that one of the example we discussed of Yuta River that in Yuta that the lag is basically between the times of precipitation that is the rain and the flooding state. So, between so, it the smaller streams will have very short lag time. So, if you have more number of smaller streams or lower order streams the flooding will be very fast.

So, what it says is that low order stream have short lag time between rainfall and flood. So, this part is important, because this will tell you whether the area will come into the flooding state faster or slower if the if there is a heavy rainfall. So, lower order stream have short lag time between rainfall and flood and are more prone to flooding. Higher stream higher order stream with many tributaries are less prone to flooding.

Because highest stream higher order streams are wider and the pattern or the shape will be different than the lower order stream and it will in terms of the length also it is comparatively longer say it will take even with the with many tributaries lay they are less prone to floods. So this is another important point

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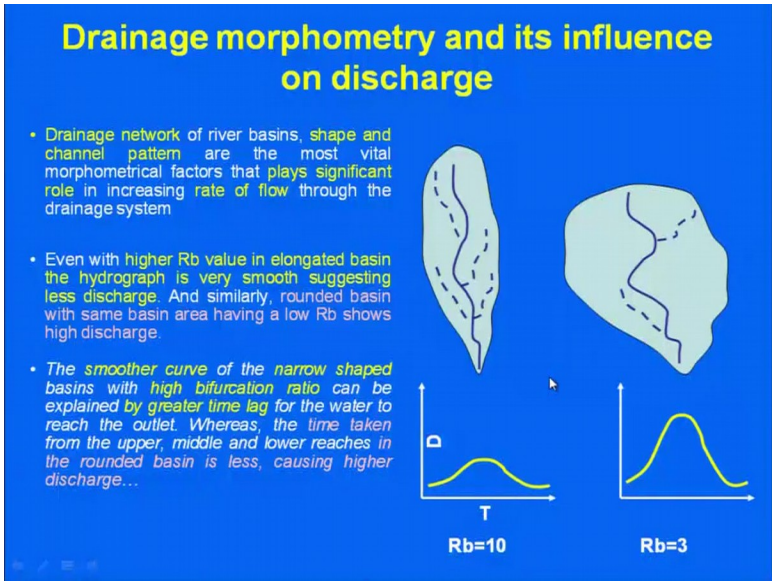

Which you should remember. So, drainage morphometry and it influence on the discharge. Now, the drainage shape or basing safe is also plays it plays an important role. So, drainage network of drainage River Basin, shape and channel pattern are most awaited morphometrically factors that play a significant role in increasing rate of flow through the drainage system.

Even with higher bifurcation value and this is the example which ah we are trying to show you for two basins, where you have one is elongated basin and analysis and rounded basin. So, even if the there is the RB values are higher in elongated base in hydro graph is very smooth suggesting less discharge and similarly rounded basin with same basin area. So, basin area of the rounded basin and the elongated basin is very much similar or it is same.

Having a low obvious bifurcation ratio shows high discharge. So, this is what has been shown here. So, you have the elongated basin and then you have the higher bifurcation ratio here and then you have the rounded basin and the bifurcation ratio here is less. So, the hydro graph that is a discharge and time which shows the time which has been taken to bring the channel the main channel in flooding state.

It is very smooth here. Now, in the other case, where the bifurcation ratio is low that is the rounded basin with same basin area having a low vibration, but it shows very high discharge and this has been this can be seen based on the very sharp because this hydro graph is very smooth and time taken is very a different as compared to this one, but the discharge is high here even when the RB value is three.

Whereas here the bifurcation ratio so, you have more number of streams here as compared to this one so, what is the reason for this, the reason is if you compare the distance that is very important. So, the length along which the drainage has been spreader out, that is very important to smooth curve of narrow shaped basin. So, this one is the narrow shaped basin with high bifurcation ratio can be explained by greater time lag.

Or, the water to reach the outlet. So, the smoother curve over here and the narrow basin with higher bifurcation ratio can be explained by greater timeline. So, the timeline which has been taken as greater as compared to what you see and then now around the basin, so, the greater time lag is there for the water to reach the outlet. So, it takes time to travel through this longer distance.

Whereas, the time will take from the upper middle and lower reaches and rounded basin is comparatively less. So, as soon as that this is basically what we are looking at is the shape of courses their distance and they run off. So, the run of time which has been taken by the water in the elongated basin is higher as compared to the rounded basin. So, the water which is coming into the base.

And the time taken from the upper middle and lower riches in the rounded basin is less and that is the reason which causes higher discharge. So, the discharge is much higher with RB value three and the discharge is much less as compared to I want this in this case of the elongated. So, basing shape and drainage density in influences the shadows.

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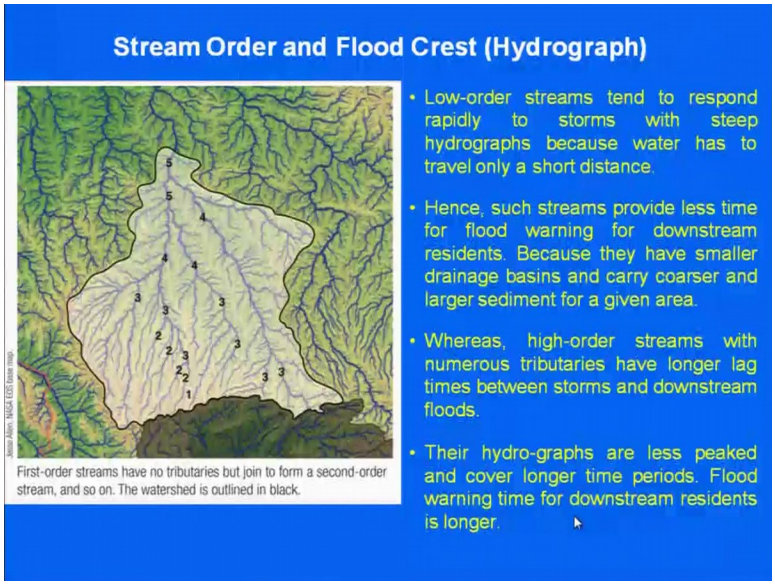

So, stream order and flood crest or the hydro graph if you see this is what we discuss the first order streams have no tributaries, but join to form a second order stream and so on. This is what we discuss and which is mentioned here. So, what it says that the lower order stream tends to respond rapidly to strong or heavy rainfall with steep hydro graph. So, it will get into the flooding state very fast.

Because, water has less water has to travel only a short distance, but in case of the higher order stream and has to travel the longer distance. Now, this is the reason that such streams provide less time for flood warning for downstream residents. So, if you are having more number of lower order stream then it is dangerous in terms of the flooding for the downstream residents.

Because, they have smaller drainage basin care ah and carry coarser and larger sediments for a given area. So, this is the Another disadvantage of having a lot of higher order of lot of small smaller order streams in the region whereas the higher order streams with numerous tributaries have longer lag time between the strong or the rain and the downstream flood. Their hydro crabs are less peaked and covers longer time period.

So, it they gives enough time to issue the warning. So flood warning time for the downstream residence is longer. So, ah we will stop here and we will continue in the next lecture talk few more examples of flood. So this ah topic. I hope it helped you and understanding the

morphology of the floral landscape and also its importance for understanding the flood hazard. Thank you so much.