Natural Hazards
Prof. Javed N Malik
Department of Earth Sciences
Indian Institute of Technology, Kanpur

Lecture - 34
Flood and Related Hazards Part III

So, welcome back. In the previous class, we were talking about different type of channel forms and we discussed about straight, a meander and braided.

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So, usually what we see the braided channels or the braided rivers are bit dangerous in the sense because they have the typical coarse-grained the carry. And they are generated where you are having in steeper slope or the channel or stream entering in from the steeper slope to the gentler one.

So, the initial conditions will be different here and usually what happens is that it will try to dump all the material or the bed load which has been carried from the uplands in the region.

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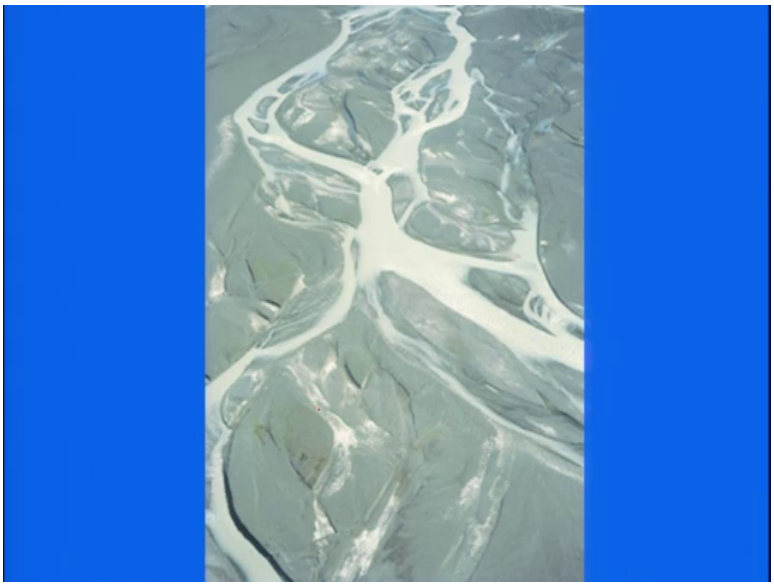

But this is typical of the braided system and the landforms or the features which are seen in between are your braid bars.

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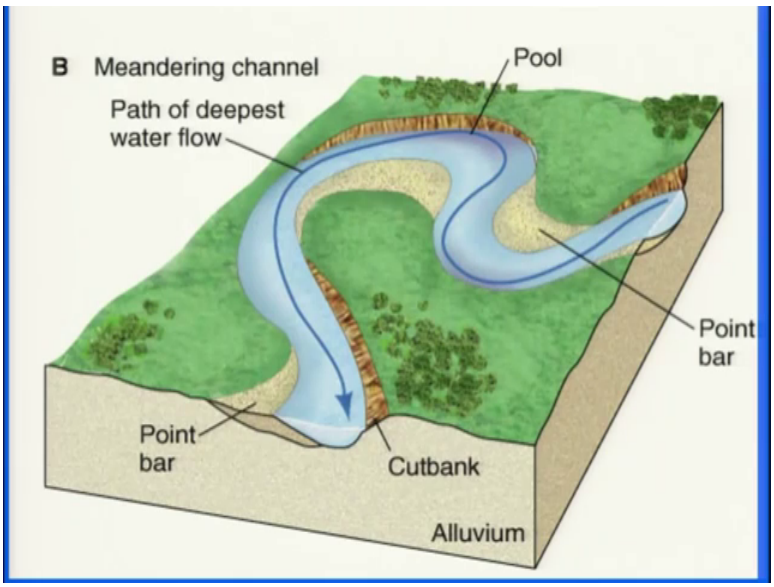

Another one is the meandering pattern as we discussed in the previous one that the outer side will be erosive and the inner side will be depositional side which we call as an point part.

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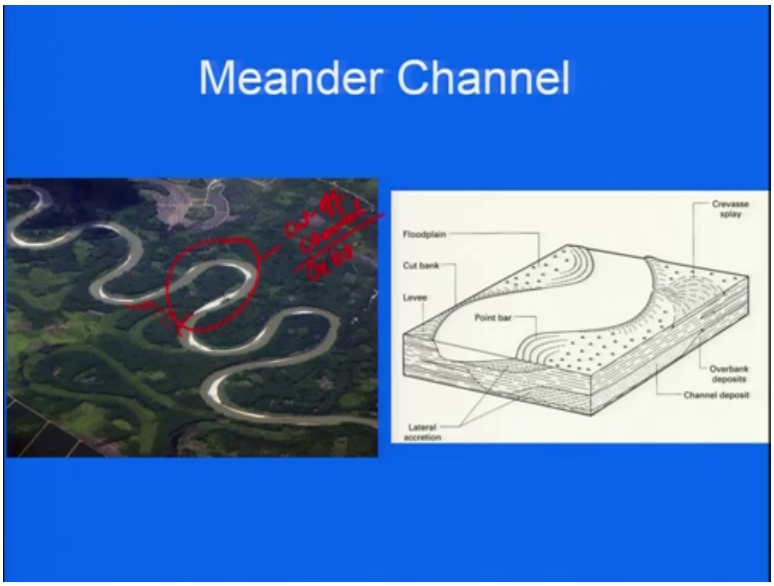

And in this type of channels are mainly seen in the alluvial plain areas and in particular if you take in terms of the Indian side, we have we can see this in the Indo-Gangetic Plain. So, the channel has a tendency to even like they produce the cut off banks which have been seen here. This is one of the example of the it is palaeochannel which we say as in cut off bank because the outer side is both erosive and the time will come which will keep move closer to one another and this portion will be left out.

So, for example, the this is an erosive side, this is also an erosive side, the time will come and this channel will join here leaving this portion as an cut off channel. And having this shape we also turn this shape as an Ox bow or feature as an Ox bow Lake.

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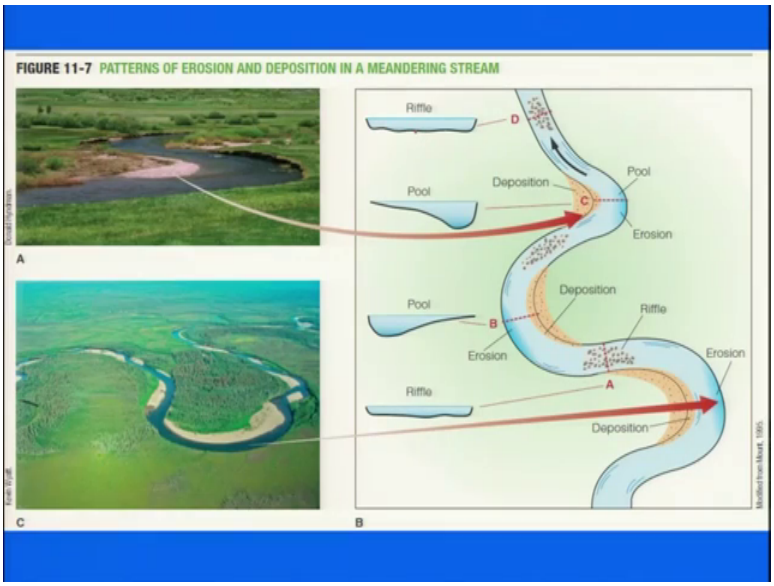

Now, if you take the overall cross sectional view or the of mainly the meandering channel, which also includes of course, some part will be the straight.

So, what we learn from here is that this portion will be the deeper part with a higher energy condition. And the inner side will be the depositional side. Whereas, the straight channel as we discussed the pool area of will be in the center part where will be the deeper as well as it will have the maximum energy relations.

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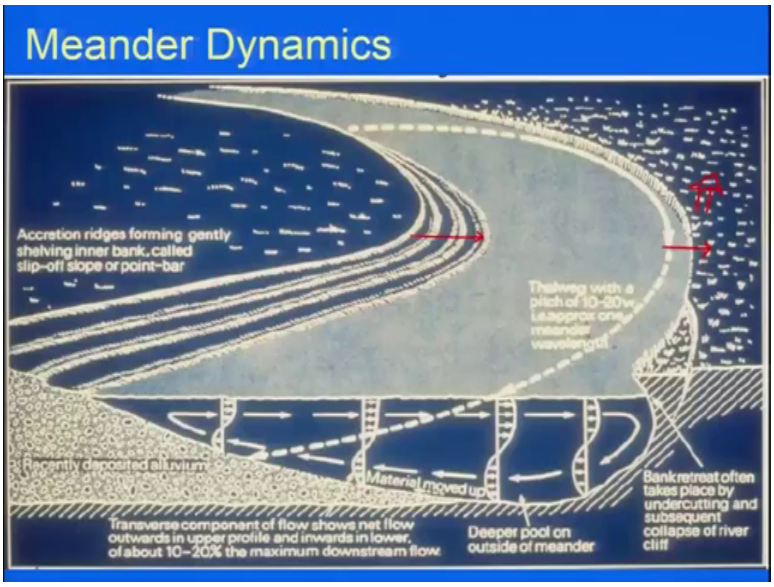

Meander Dynamics if we take in the same part which we discussed in the previous one. So, the depositional will keep on taking place over here and the channel will keep migrating from this in this direction whereas the erosion bank will also migrate towards the side.

So, as we were discussing in one of the slide that if we have the urban settlement sitting on the top of this one, this is not an ideal situation because this bank is an erosive side. So, it will keep on eroding during the peak flood.

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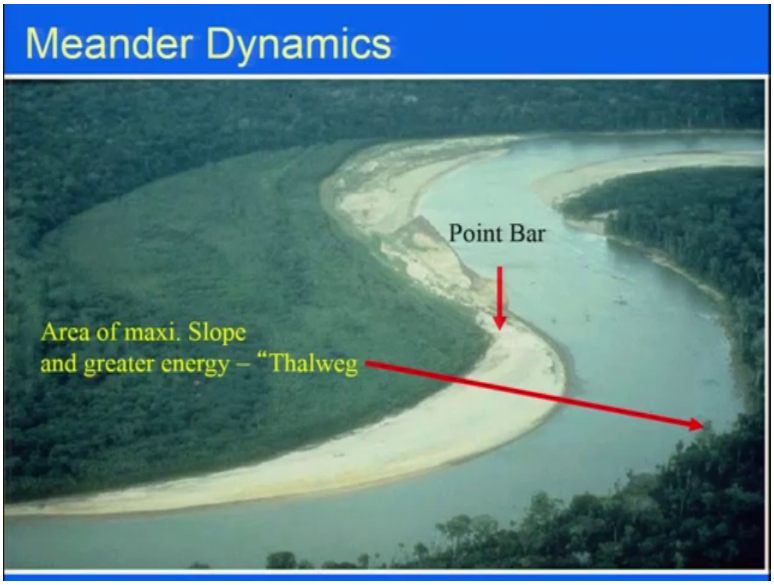

So, we have the maximum energy conditions over here which is termed as the Thalweg, that is the area of maximum slope and higher energy whereas, this portion which is the inner side is termed as Point Bar.

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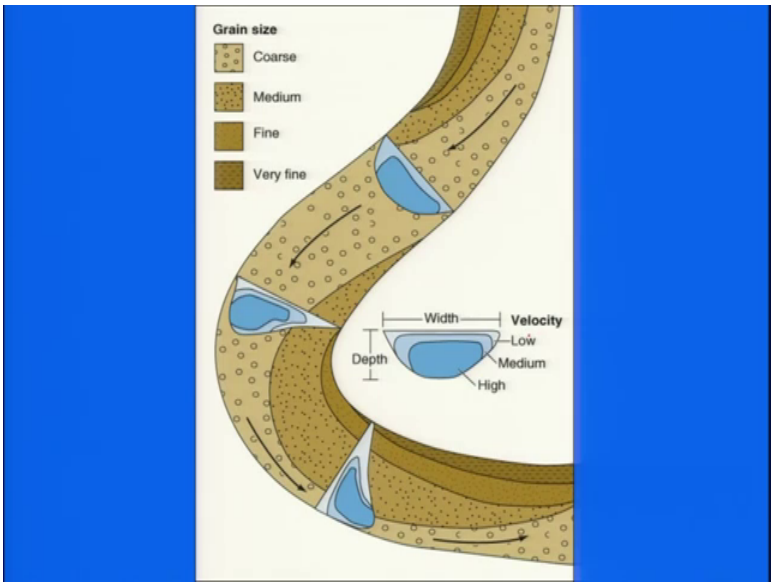

Another important aspect of this is in of course, in terms of the cross sectional areas as well as in terms of the grain size. If you see then we will have the coarser grain size in the straight channels, whereas, if you have the meander where you have the sinuosity then you have inner side most you will find is the finer deposits. Where is in the deeper side that is an outer side you will have the coarser material setting. And of course, the velocity conditions will also vary from this straight to meandering side.

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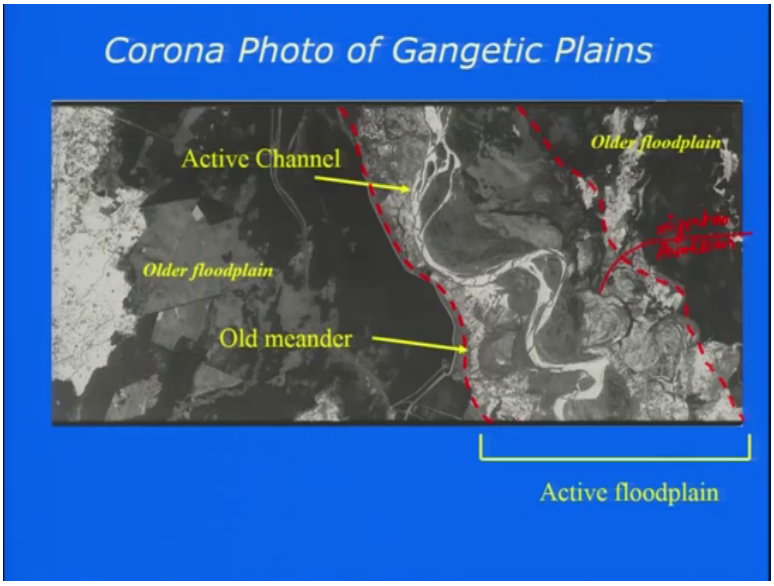

There is an high resolution satellite data of Indo-Gangetic Plain which marks the different segments. And this particular interpretation helps us in identifying the different flood zones or theflood hazard zones in the region because we should not allow for example, to go for any or allow any construction within the active floodplain. So, we have the older floodplains in this region; this portion whole portion is an active floodplain. So, river will have an tendency to migrate that is what we are looking at the river migration or avulsion. So, this will be in common tendency of the channel meandering channel to migrate from one place to another place leaving behind the palaeochannel.

So, you can see within the active floodplain we have a lot of mending scars that has older channels or palaeochannels we can say. And they will be later we will get converted into or the oxbow lakes whereas, this part is an older floodplain. So, the older floodplain after detail identification and classification one can go for the urban settlement in the older floodplain. And with an understanding that what will be the peak flooding conditions or the, or the flooding condition during the peak discharge.

So, basically one should avoid this region for coming up with any sort of an construction.

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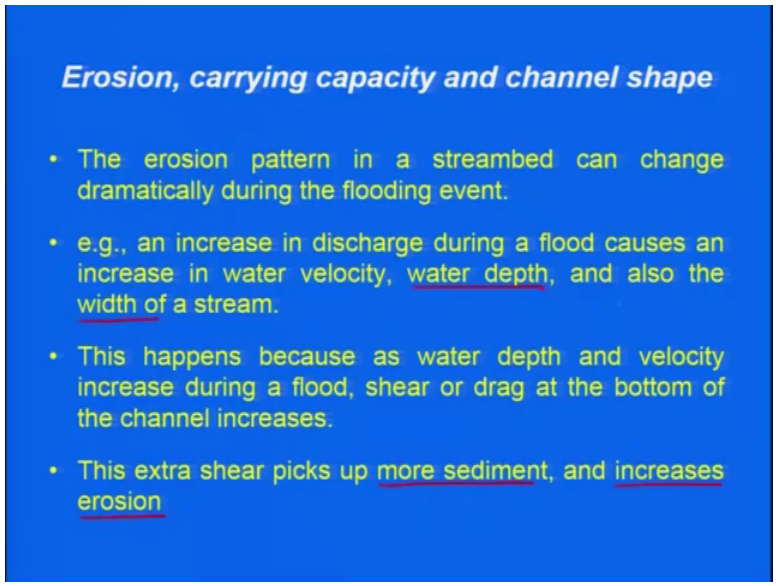

So, we have one example we will talk later from Himalaya and partly I think we discussed in one of the class we were talking about the landslide. And that example is from Dehradun. So, erosion carrying capacity and channel shape, the erosion pattern in

the stream bed can change dramatically during flooding events. Example an increase in discharge during a flood causes increase in vital water velocity, water depth and also the width of the stream.

So, during flooding floods or in the monsoon season the channel morphology will be slightly altered in terms of the depth and in terms of the width also. And that will also depend on the carrying capacity of the channel. So, this happens because as water depth in the velocity increases during the flood shear or the drag at the bottom of the channel increase. And this will result into the deepening of channel at places. So, this extra shear picks up more sediments and increase the erosion. So, you can remember that during the floods you will have increase in erosion as well as more sediments you will have and the bottom of the channel I will also be increased ok.

So, water depth will increase and the width will also increase of the channel.

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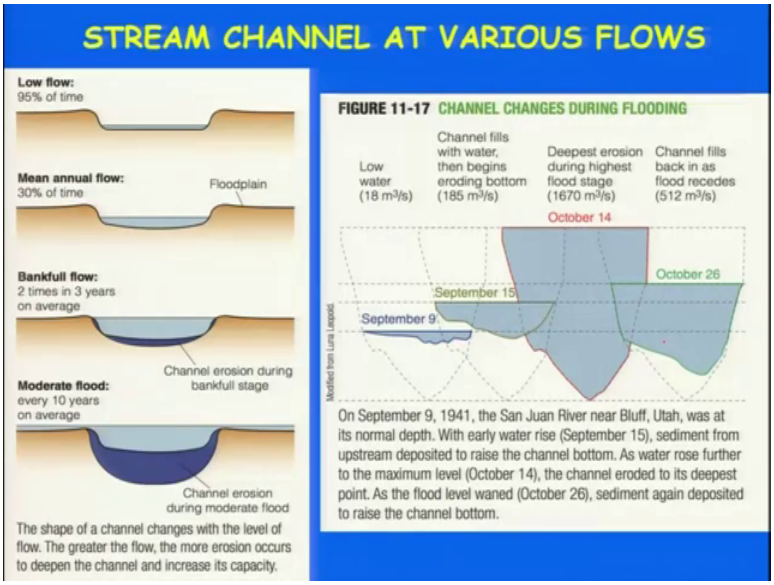

So, if you look at this figure it talks about that how the channel dimensions will change over the time. So, here what it shows this is an example of San Juan river from US and it shows that it has an low water flowing through it during September 9 1941 and then the this was it is normal depth, but with early water rise that was on September 15 was during the same year sediment from upstream deposited to raise the channel bottom.

As the water rose from further to the maximum level that was on 8 October 14, that was a time when the channel eroded to it is deepest point. So, this is the deepest point and usually to use to remain here. So, you can understand that the water amount has increased even the channel cross sectional area has increased. As the flood level when at the time when the water came down at that time that is on 26th October sediment again got deposited. So, channel pattern or channel shape will change during the flood before the flood and it will be different after the flood.

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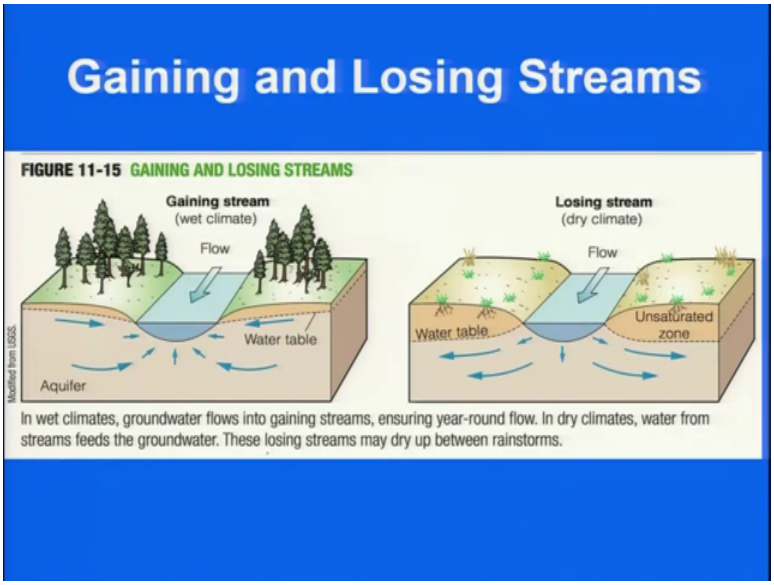

Now, there are two types of channels usually are been seen in different climatic zones. If you are having an wet climate, then mostly what we see is that channel is getting recharged from the surrounding water which is getting into the channel that is based on of either you can say the recharges from the watershed areas through underground a movement of the water, but in case of the tri climate you continuously lose the water because you have and a thick zone of unsaturated units. So, this have been termed as gaining steams where the water is continuously gained whereas, this one is you are losing stream.

So, in wet climates groundwater flows into the gaining streams ensuring year round flow will be available here, whereas, here in the dry climates water from stream feeds the groundwater. So, you will continuously keep on losing and this losing streams may dry

up between the rainstorms. So, you will not find this stream having our carrying water throughout.

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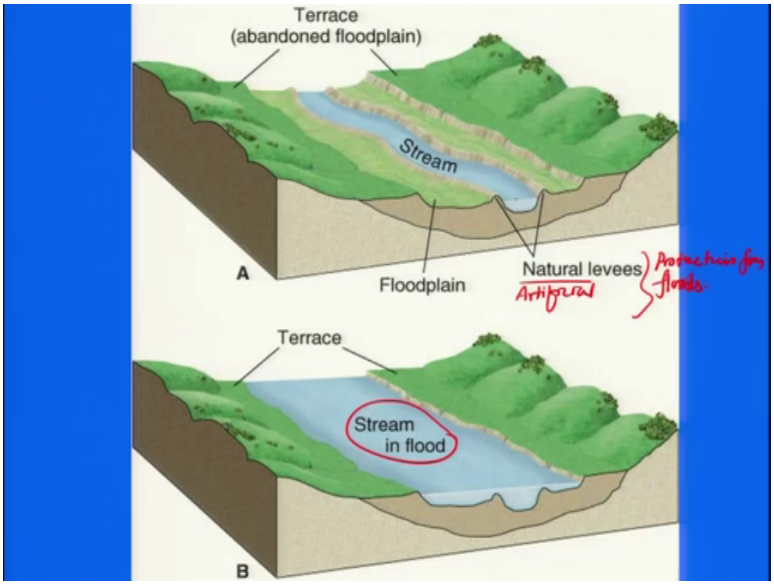

Now, apart from that the gaining and the losing streams of the important part is your land forms which are associated with this. So, we were, we looked at the point bars we looked at the deeper part in the meander, but here what we this is very most common land from which is which will be available through the valley and these are termed as terraces.

So, terraces are nothing but the abandoned flood plains of the same stream. And then there is slightly elevated portion which will be observed in most of the areas along the stream will be your natural levees. So, if you take the profile here which has been shown you have the channel boundary or the base or bed of the channel. Then you are having the elevated portion and then it slopes away from the channel; so, both the sides. So, in some areas if this natural levees are not available, then people try to construct artificial levees and this is mainly done for protection from floods.

So, in that case what has been done of course, if the flow or the stream when it is in the flooding state if it the water depths are so, high that it can inundate the close by flood plains or the terraces which usually we also term this as an younger terrace. And this is an older terrace or you can say on younger alluvium floodplain sorry and the older floodplains. So, in if we understand that this region may get inundated in near future,

then one should avoid putting the construction in such areas that is what is we can also talk about the active floodplains.

So, these are very young terraces which can be which can get inundated. So, with an understanding that such landforms about the landforms a one should go for the ardent planning.

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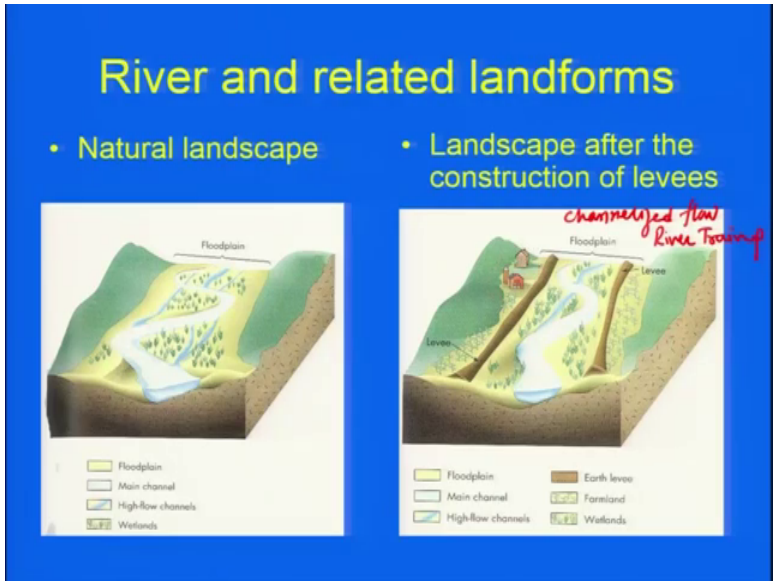

The river and related landforms; so, if you have for example, known natural levees are available over here, but then also we need to utilize or acquire the floodplain areas for our urban settlements and of course, for the having the farmlands. So, what best we can do is we can go for an artificial construction of levees.

In most of the countries, and in some cities in India we have done this to protect the this surrounding or the adjacent area or the floodplain from the flooding state. And what we can also say this as that we have channelized the flow or river training. So, we have tried to train the river and the forced the river to flow within this zone. It will not all flow of course, with an understanding that the peak floods have never crossed this level in the past and during the historic time. So, with that understanding, we can allow people to occupy the older flood or the younger floodplains and also use the area for agricultural purposes.

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Now, advantage of natural levees, of course, as we have discussed that we can, we will be able to utilize the fertile land. That is the floodplains and if you see this photograph which shows that there is an construction of an levee and this whole patch has been used for the urban development. So, houses are built on natural levee along a channel and floodplain in the decision from the Mississippi river.

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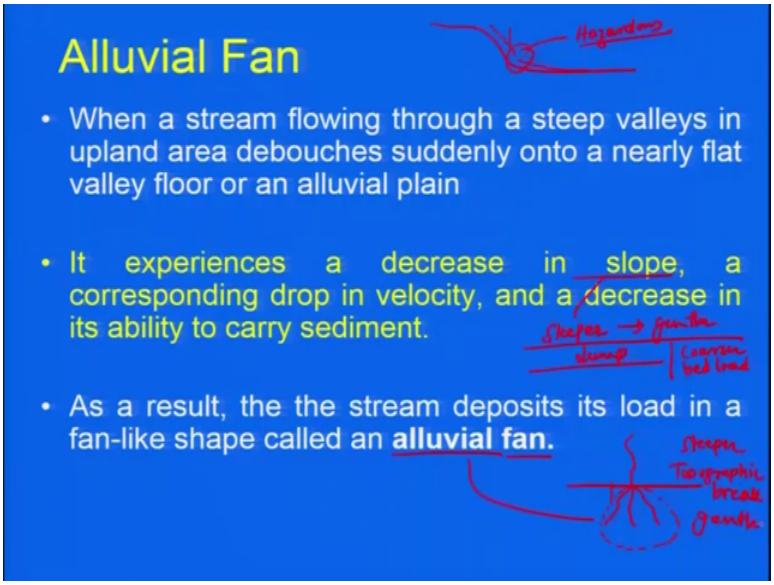

Now, this land form is important, but we will quickly move to what exactly the role it plays in the flooding events. And we will talk about the features where exactly they are available.

So, similar to the deltas this, the alluvial fan feature is mostly seen close to the river front; sorry the mountain front. So, where you have this steep valleys and then suddenly the elevation the gradient changes to floods. For example, we are having the Himalayas and then we come down to the flood area. So, we will flowing from here gets into the plain areas. So, this will be the portion where you will, the river will experience that is a decrease in the slope from the steeper to gentler and the corresponding drop in the velocity also will be observed and decrease in the ability of the carrying sediments.

So, when way if there is like cloud burst or in and sudden outpour of the water in such regions, then this portion becomes very dangerous or hazardous. Because it will as soon as the slope changes from steeper to a gentler, then it will result in to other as what we were talking about that the there is an decrease in its ability to carry the sediment. So, what it will do it will just dump the material. And since it is coming from the sleeper side it will tend to carry coarser bed load.

So, sudden outpouring of the course of bed load in this region will affect the settlements and any structures which have been put across it. So, as a result the stream deposit is slowed in fan like shape. So, when as soon as it comes out and comes away from the front area, it will remain confined here. So, there is an elevation change. So, if we will try to dump the material and the shape which has been seen is typical like an fan, hence it has been. So, you have a loose material and the shape is fan like and is termed as alluvial fan and the reason. So, this will be in topographic break. And the slope here will be steeper and this side it will be gentle.

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Few examples of the alluvial fans; his one is extremely beautiful which typical. So, you have an confined channel and then as soon as it the pouches into or onto the flat areas, where the slope is reduced it will spread out in multiple channels and deposit the material in a fan shape.

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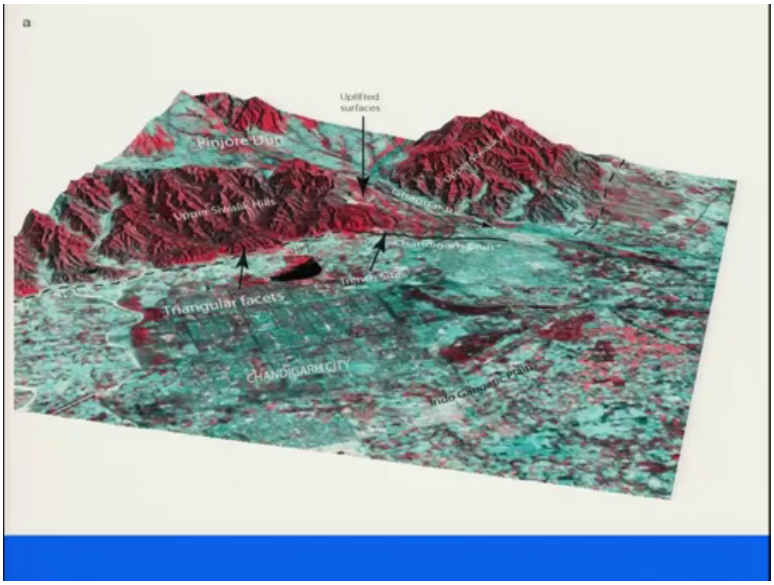

Are this example from India where you are having the mountain front here and there is Siwaliks and you have an Indo-Gangetic Plain.

So, the alluvial fan has been deposited over here in close to you can Chandigarh area.

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So, one of the best example again, but you have an confined channel from here there is a kosi and then you have the channel which takes the outer boundary of the fan area. So, if you if we draw the fan here, then it will be something like that. So, you have an alluvial fan. So, this kosi alluvial fan and on the fan this would kosi fan what we see clearly is multiple channels.

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So, we have the some channels with little what otherwise most of the channels are the dried up channels and these are all palaeochannels of kosi.

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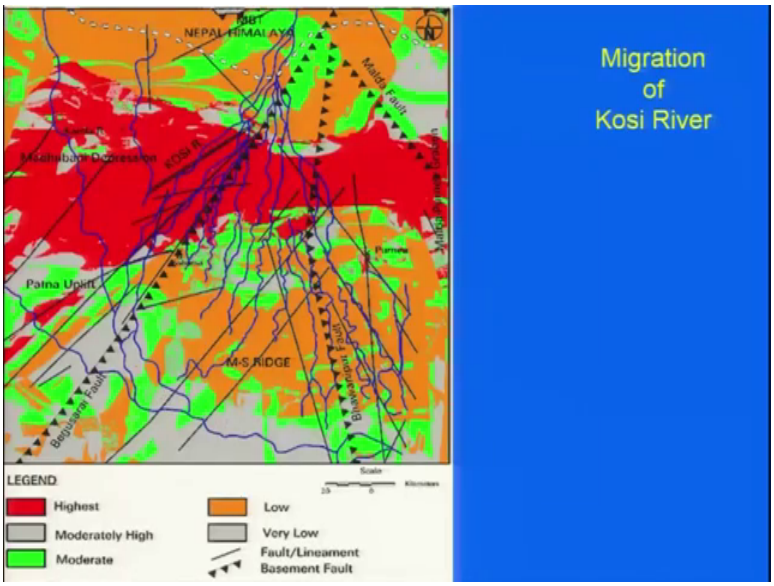

So, you have one is the alluvial fan and this kosi river has experienced or has an tendency of migration from one channel to another one. Some people believe that this fan shape of the kosi is because of the two faults in the region which has resulted into the or played an important role and shaping of the of the fan land from fan like land form.

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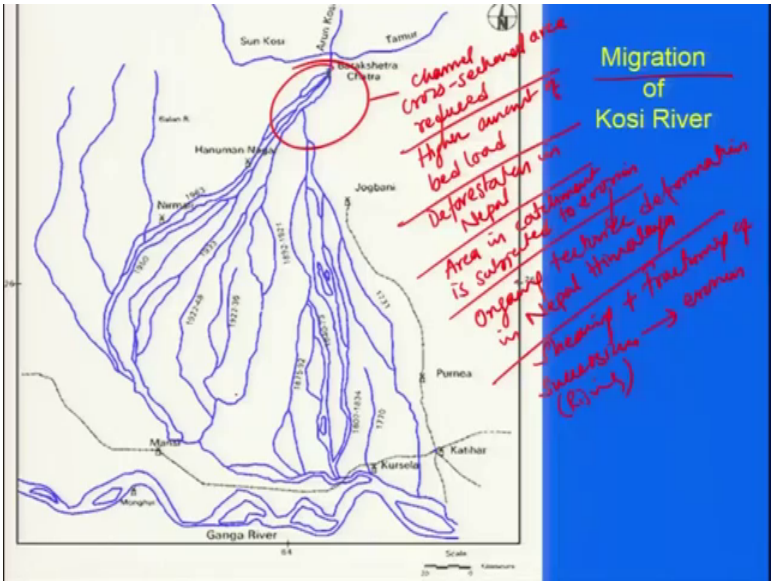

But what we if you go back into the history, then you will find that at some point of time this channels were been occupied. Like for example, we have 1922 to 48 1948 the river flow to the kosi flow taking this path. Whereas, recently it is flowing along this one since

1983 and this one is 1950, but in some years it also flowed through like this is if I am not wrong is 1231 and then you are having 1770, 1807 to 1834 and so on.

So, it has the it has an tendency to migrate from one place to another place. And the reason for this usually what we see is that the cross sectional area, over here of the of the channel; so, channel cross sectional area is reduced over the time or it has been reduced. So, the reason for this is the higher amount of bed load. And this could be related to the deforestation in Nepal whereas most of the area in catchment is subjected to erosion. So, the erosion we will result into the more of the bed load, but this is one reason, but another reason could be the ongoing tectonic deformation in Nepal Himalaya.

So, in Nepal Himalayan mainly we have many fault major fault system and ongoing deformation will and definitely result in to more sharing as fracturing of succession triggering more erosion because Himalaya is rising continuously. So, there are few things which are important and we with this understanding then this river has an capability or tendency to migrate from one channel or it has an tendency to reoccupy it is own palaeochannels, we need to be careful allowing the people to settle down along such channels palaeochannels.

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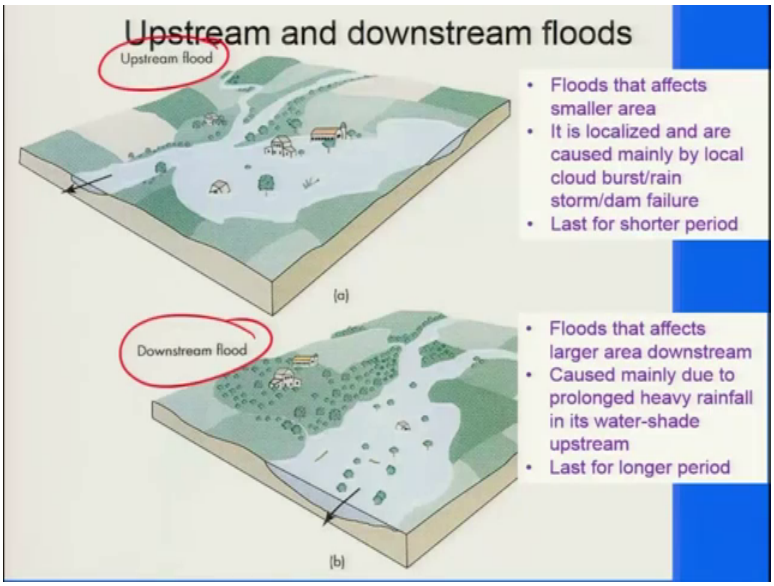

Now, coming to the another, the flooding pattern in the upstream and the downstream. So, usually we can classify this as an upstream flood and downstream flood. So, floods that affect smaller area or the upstream floods they are localized and are caused mainly

by local cloud burst, rain storm or damp failure. Then you have that the time it will last for, it will be for a very short period. Whereas, the floods that affects larger area that is an our downstream floods they will affect large area in downstream caused mainly due to prolonged heavy rainfall in its water-shade upstream. Last for longer period.

So, are two important part that usually where exactly we are located is important. So, upstream flood and downstream floods.

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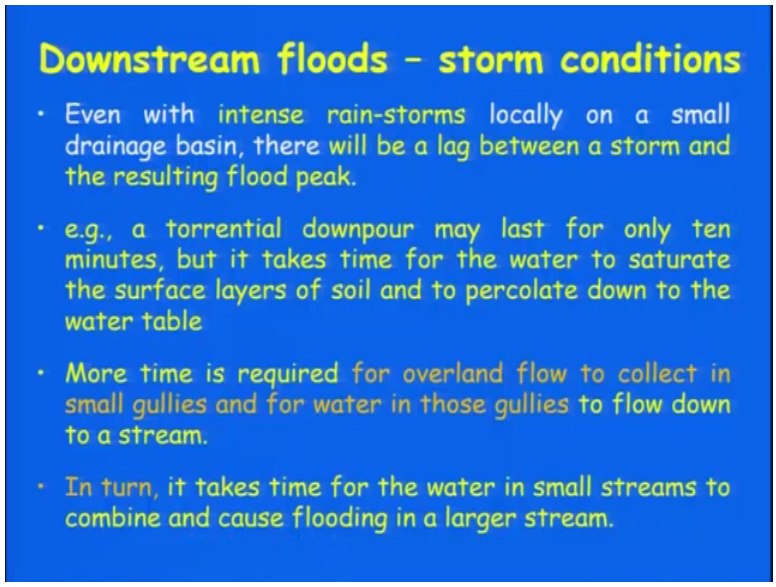

Downstream flood and storm condition even with intense rain-storm locally on a small drainage basin there will be a lag between a storm and the resulting flood peak. Because how fast the stream will enter into the flooding state. So, this is the intense rainfall locally on a small stream or the strong drainage basin, there will be a lag between storm and the resulting peak.

Example a torrential downpour may last for only ten minutes, but it takes time for the water to saturate the surface layer of soil and percolate down to the water table which will what we were talking about the gaining stream and all that. More time is required for overland flow to collect in small gullies and for water in those gullies to flow down to a stream that is the small tributaries getting in the water into the main stream. So, more time will be required for the overland flows. In turn it takes time for the water in small stream to combine and cause flooding in a large stream. So, if you are having more

streams available then you may have the flooding quickly and the largest streams that is in trunk streams which we are talking

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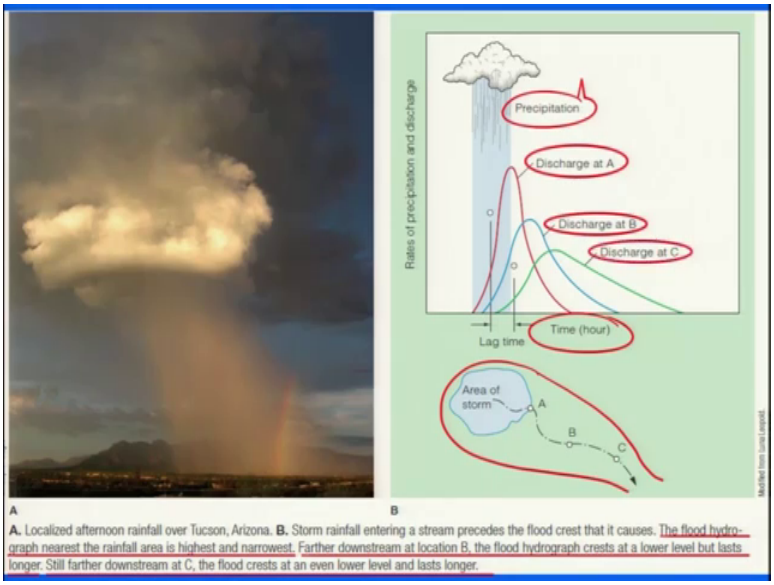

So, this is an example which has been given for, but if you are having in torrential rain precipitation in this area the lags will be different the discharge A at a discharge at B and discharge at C. So, localized rainfall oh this is an example from Tucson Arizona and this figure which shows about the strong rainfall entering a stream precedes the flood crest that is caused this is the flood crest actually the peak. So, the flood hydrograph nearest the rainfall area is highest. This was close to the area where there was an excessive pouring out of. So, this region will have the highest and the narrowest peak. So, very quickly you will have the area getting into the flooding state whereas, farther downstream at location B over here the flood hydrograph; so, what we are looking is basically the time here and the amount of precipitation, the rate of precipitation and discharge and the time taken between the first peak, now the getting into the flood state and the last one. So, at location B the flood hydrograph crest at a lower level, but last longer. So, what we are able to learn here is that in, the upstream area it will quickly die out, the flood we will definitely enter into the, channel will definitely enter into the flooding state and we will have higher discharge, but it will last for very short period. Whereas, this one it will last for longer one the further downstream it will last for further longer.

So, the C that still further downstream at C the flood crest at an even lower level and last longer. So, within the drainage basin where exactly you are located is also an important role. So, you have an drainage basin like this. For example, and where exactly you are located either you are located in the upstream area or the downstream area or middle part or the downstream area then accordingly you will be able to see this peaks.

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So, drainage Basin evolution and morphometry, drainage pattern; we will discuss quickly. So, we will stop here and we will continue in the next lecture.