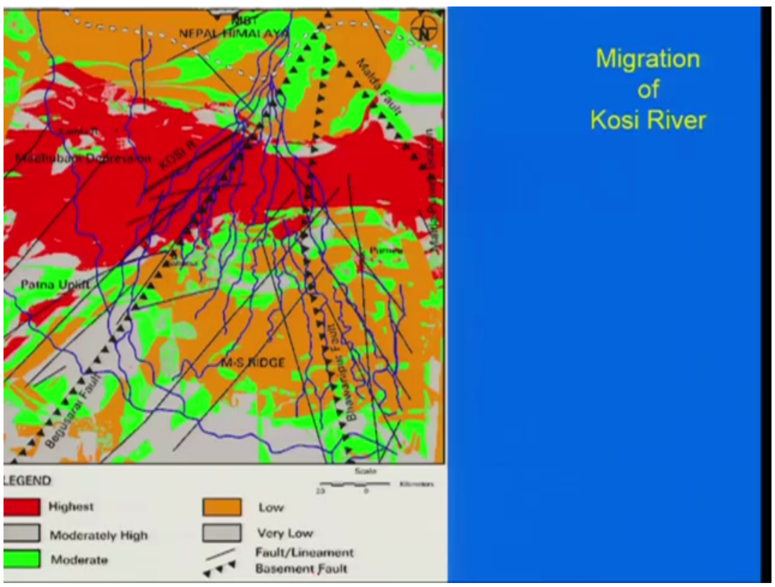
Earth Sciences for Civil Engineering Part-2
Professor Javed N Malik
Department of Earth Sciences, Indian Institute of Technology Kanpur
Flood and related hazard (Part-2)
Module 4
Lecture No 19

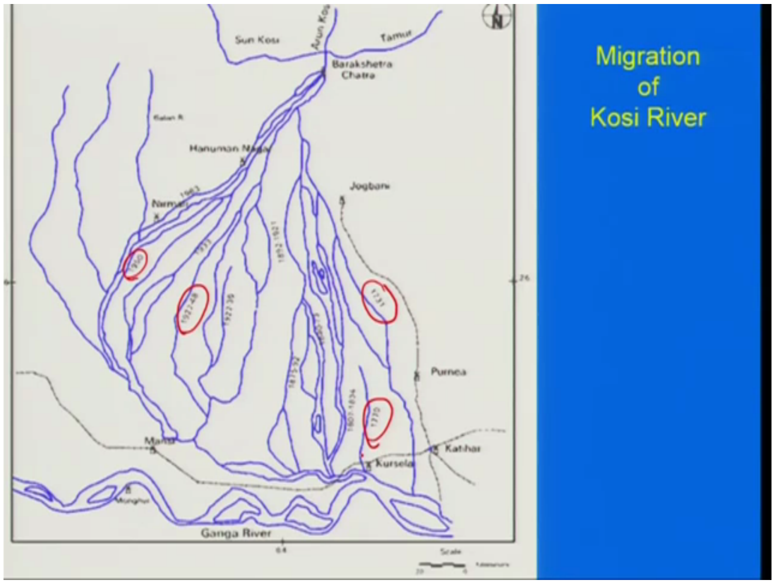
Welcome back.

(Refer Slide Time: 0:25)



There are theories which are been given or the probably the the faults or the lineaments in the basement close to the front okay are responsible for the formation of this fan shape landforms okay.

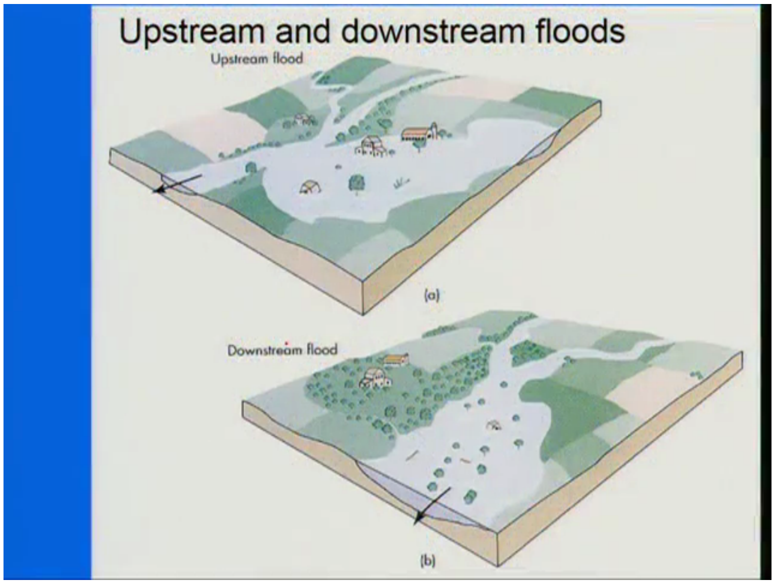
(Refer Slide Time: 0:41)



And if you see back into the history of this okay, what is that has been noticed that the river has migrated and reoccupied its own channel in last 50 or 60 years okay. So like in 1950 flowed that the same one as it is flowing now. In 1923 to 48, it flowed through this one okay and further if I take here or if I am not wrong here, here is 1731 or 37, it it flowed through path okay and in 1770, it was flowing through this okay so likewise, it has been swinging (al) across this area and it has reoccupied the its own channels at number of points. We have to be extremely careful in putting the settlements along these channels okay and we need to have the understanding that why and when this shifting will take place okay.

It is bit difficult to predict but of course, as we have talked in the beginning that sediment load, increase in sediment load and any influence by the human activity or climate change or tectonic activity can result into the change in the river coast okay. But in this case of Kosi, we have the Kosi (ha) is having the availability of its own channels which it keeps on reoccupying again and again okay.

(Refer Slide Time: 2:31)



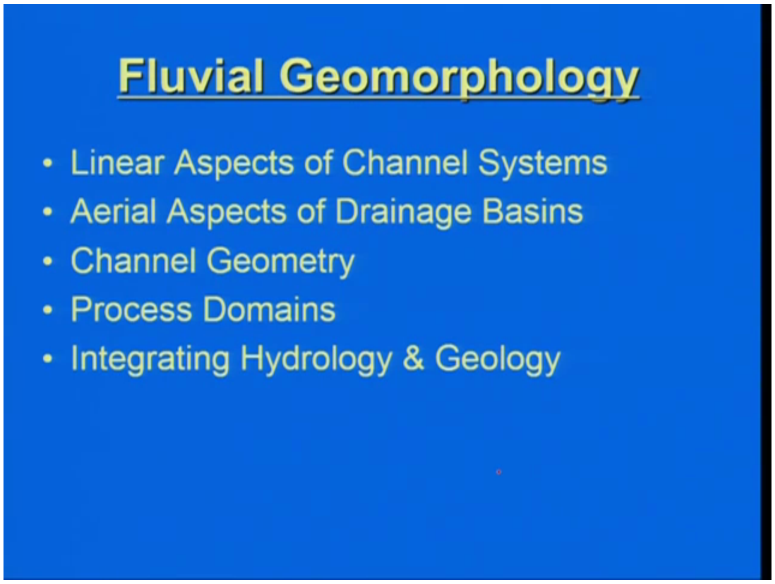
Now if we talk about the upstream and downstream floods particularly, what we will able to see here is that the upstream floods okay, floods that affects the smaller areas, it is localized and caused mainly by the local cloud burst okay or the rain storm or dam failure in the upstream region and it will last for shorter period. Whereas the downstream floods okay in the low laying areas will affect every large region okay in the downstream side and it will be mainly due to the prolonged heavy rainfall last for larger period okay, so time span between the upstream and the downstream floods will be quite different okay.

The another part you can even talk about that because in the upstream, this the gradient is quite steep so it will allow the water to flow through very fast so run off will be faster but in the low lying areas okay in the downstream side, you will not have that facility available because you are having very low gradient okay and more area will be covered okay. So this is the main difference between if you have to classify the upstream floods and the downstream floods okay.

(Refer Slide Time: 4:07)

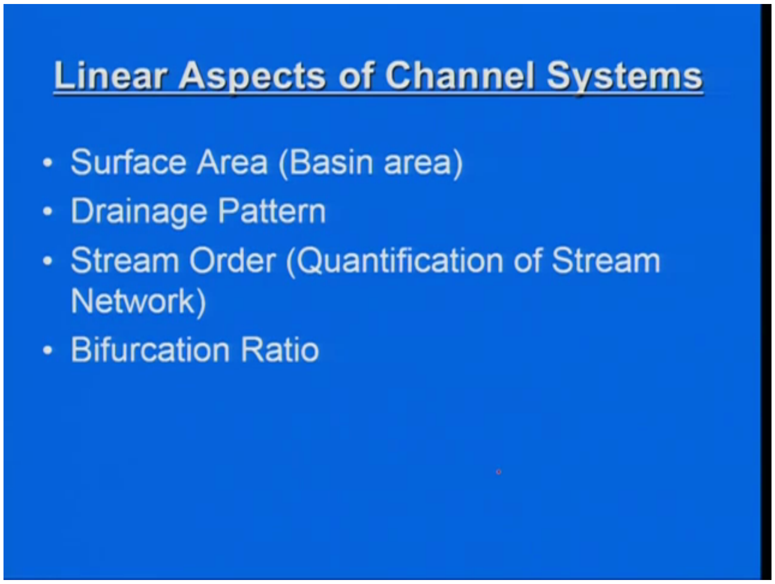
Now this is another important parameters which we usually consider. we are not going to discuss all but few of them which are important, we are going to talk in this one okay. That is the drainage basin evolution, then morphometry and drainage pattern okay.

(Refer Slide Time: 4:24)



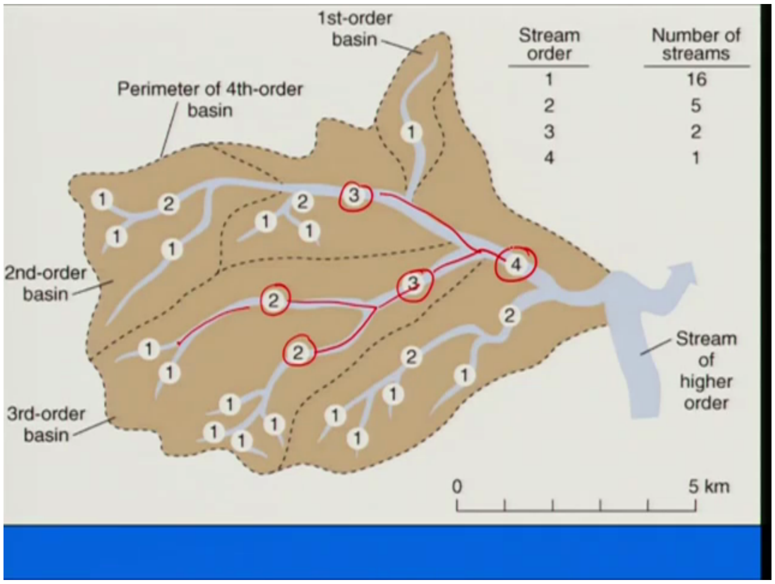
Quickly look at the fluvial geomorphology; it's a leaner aspect of channel systems okay. Arial aspects of drainage basin then we have channel geometry and then we have processes which in different domains, then integrating the hydrology and geology so how this all affects the the flooding condition okay and how it can be helpful in understanding the flooding conditions.

(Refer Slide Time: 4:52)



Now leaner aspects if we take of the channel system okay then we consider this as an surface area or the basin area, then we say talk about the drainage pattern, then we talk about the stream order, that is the quantification of stream network, bifurcation ratio, this is extremely important because when we are talking about that what will be the the what shape of the hydrograph, we will be expecting in different basin, basin alluvials okay that can help us in this. And then drainage density okay and drainage density will be affected based on the the geology of the of the area.

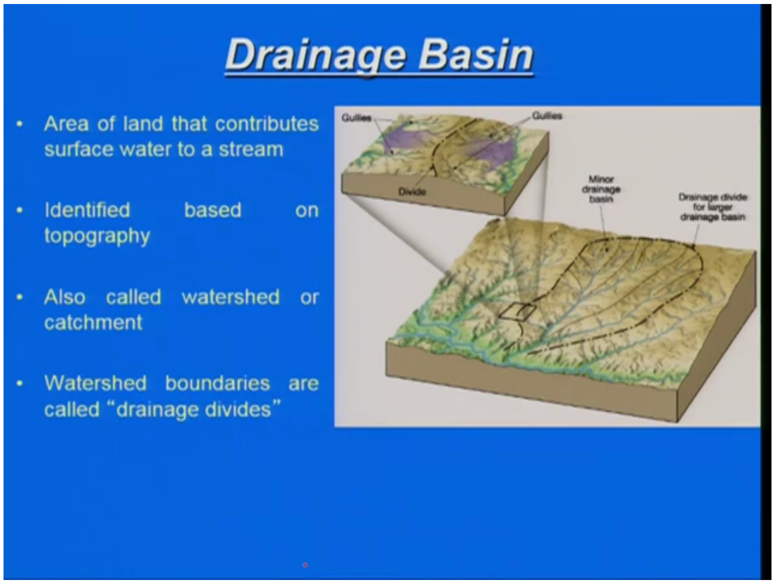
(Refer Slide Time: 5:34)



Now this is one the very general classifications which are been given that if you are having the we have to order the stream okay and try to find out the bifurcation ratios of that because this again depends on the drainage density okay and what is the order of your stream, main stream or or your have order of the of the tributaries, you can do the classification very easily. Now the software's are available which can quickly give you if you are using the digital elevations models okay so you the ordering of the stream can be done in in few seconds okay.

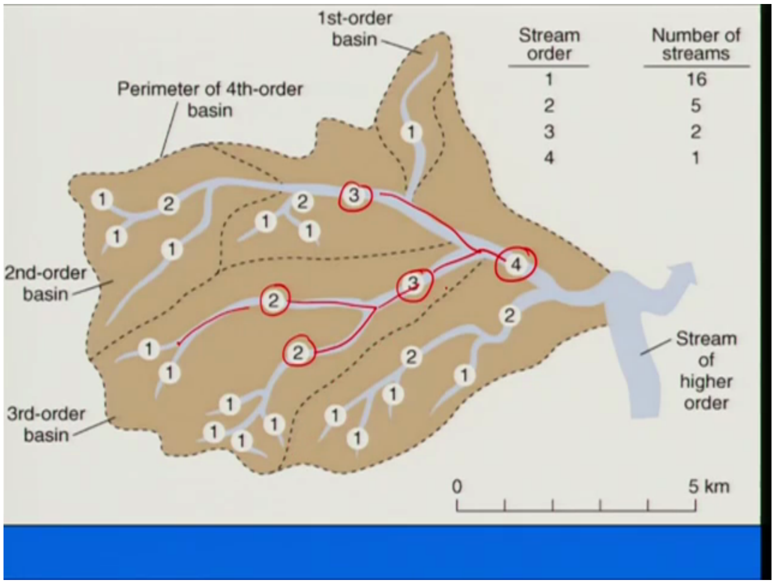
So you are having like 2 lower order streams are meeting at one point, the further downstream will become the second order and then if 2 second order streams meet at a point, the downstream um stream will become the third order and similarly to 3rd order streams means here then the main trunk stream will be numbered as your 4th order stream.

(Refer Slide Time: 6:48)



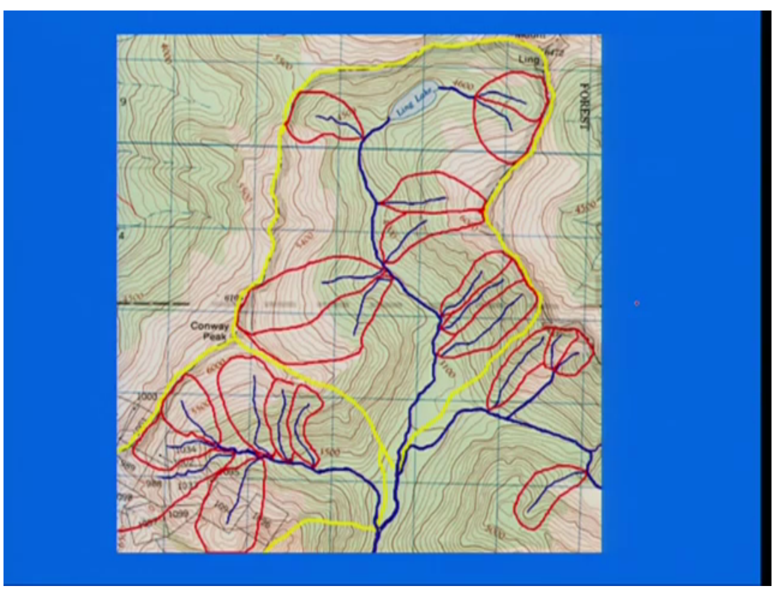
Now drainage basin, particularly we have in the beginning also we have talked about that this is what so if you if you take this the close up of this and before going to that if if you look at that this is the trunk stream of here and this is another trunk stream and there are some sort of an higher elevated region okay which allows the the stream to flow in this direction and other side on this direction so this is what we can say the rich line okay. That will make your the basin boundary and this whole area will be considered at that basin of this particular trunk stream okay. If so we have the main or we can see the major basin area and then which are also which will also have minor basin areas again.

(Refer Slide Time: 7:49)



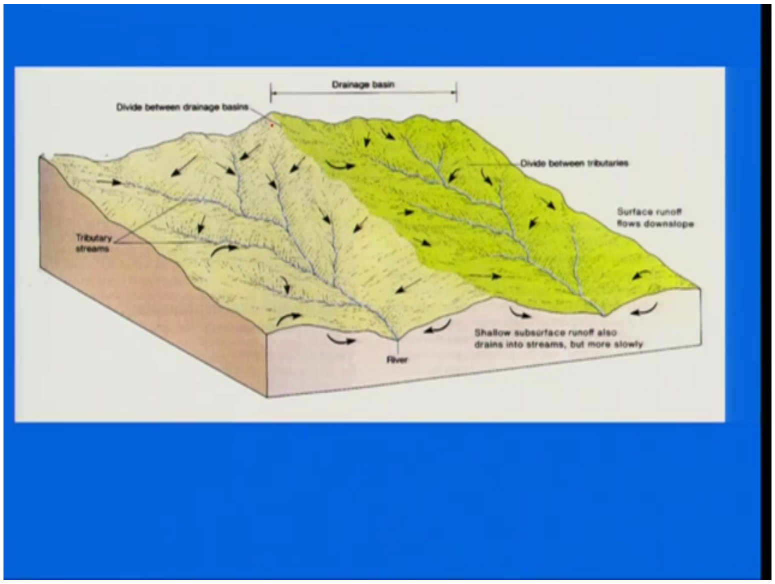
Likewise which has been shown here okay so you have the smaller basins here of this tributaries and then you are having the major basin of the this trunk stream, that is the 4th order okay.

(Refer Slide Time: 8:02)



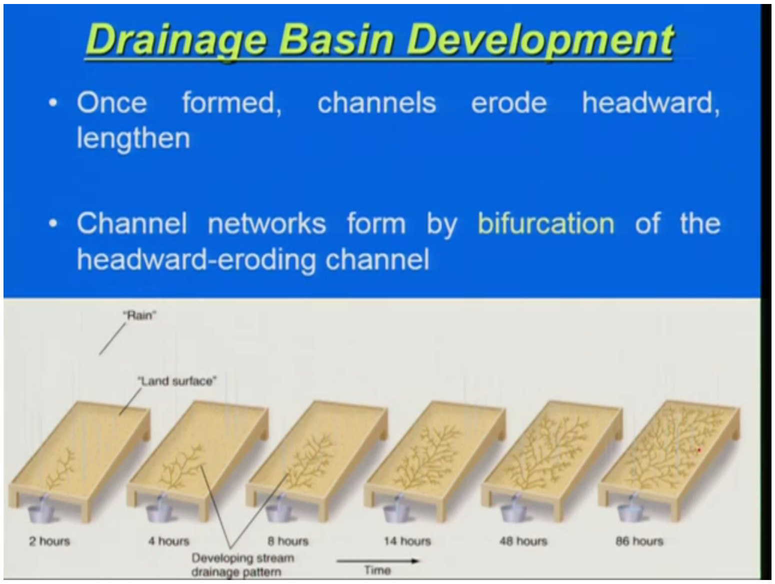
So this again shows the similar one so you are having the main stream and you are having some sub basins okay and this whole area will be marked as an major basin of that particular trunk stream.

(Refer Slide Time: 8:17)



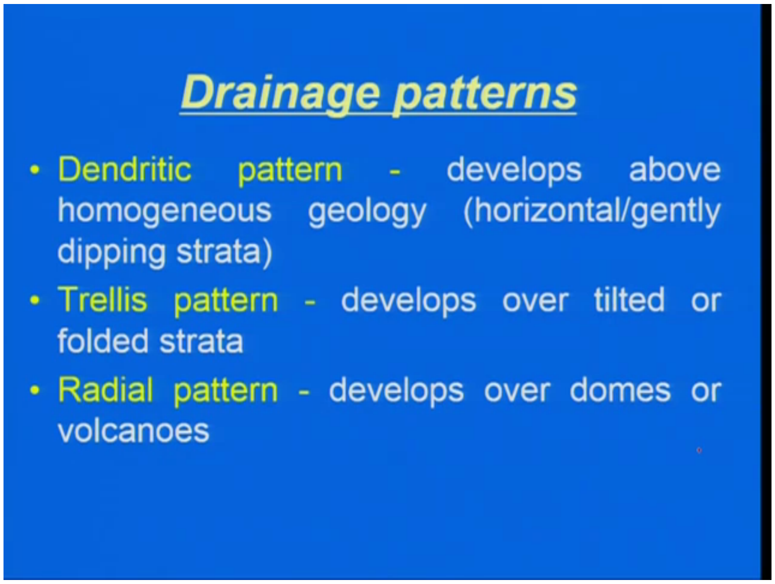
Again in example of the drainage divide we are having so this is the portion which will mark the drainage divides and which allows the or forces the water to flow and on either directions okay.

(Refer Slide Time: 8:32)



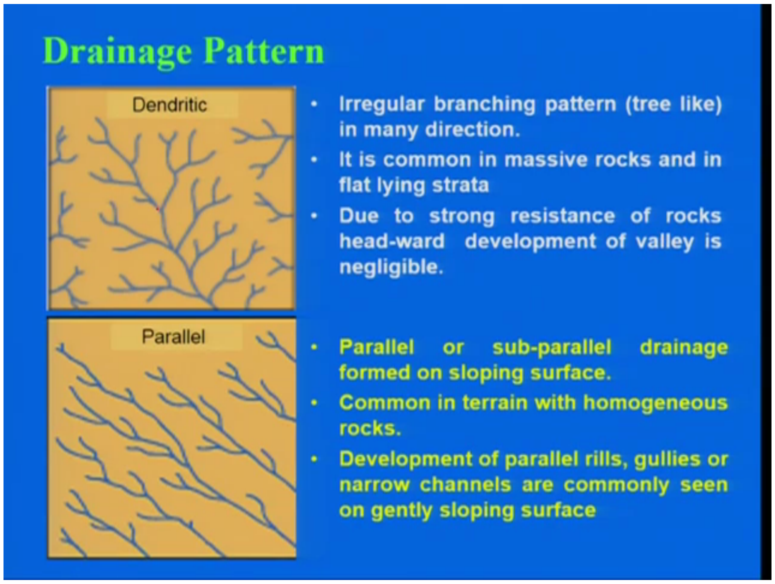
Now usually what has been seen that once the the (bas) the if you are having slope, you are having the the precipitation and if you keep the precipitation constant, there is an experiment which was conducted which shows that how the drainage basin grows okay. So the drainage basin will grow towards the headword side okay and this is what we see that you are having this as the fix point here but the drainage basin has eventually formed on the upstream side that is what we call the headword areas okay so channel networks forms by bifurcation of headward eroding channels okay.

(Refer Slide Time: 9:14)



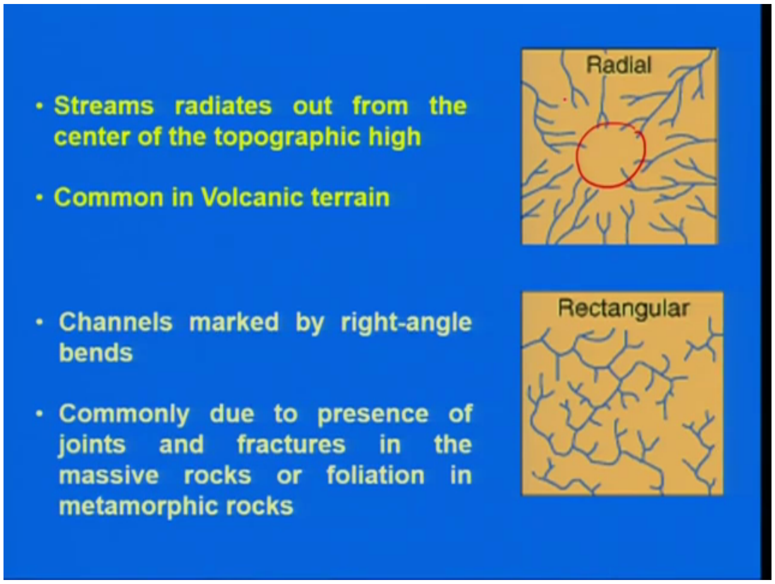
Now coming to the drainage pattern, there are few which are important. One is Dendritic pattern which develops above the homogenous geology so you can identify, you can know the subsurface geology also based on the drainage pattern. Then another is Trellis pattern which develops over the tilted or folded strata. Then you are having radial pattern which develops over the domes or volcanic cones okay.

(Refer Slide Time: 9:42)



Let's see quickly what are the different patterns okay. It looks like something like the ub the the irregular branches of trees okay. It will be in different directions. It is commonly seen in massive rocks and the flat line stratas okay. Due to strong resistance of rock headward development of the valley is negligible okay whereas the parallel drainage usually is seen along the slope, sloping surfaces commonly the terrain with homogenous rocks developed development of parallel drills or gullies or narrow channels are commonly seen on gentle sloping surface also.

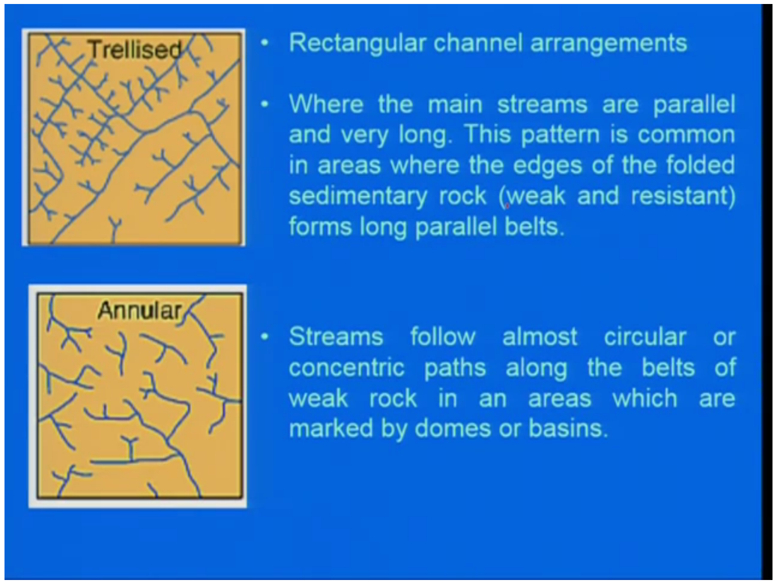
(Refer Slide Time: 10:29)



Then we have radial patterns which shows that the the center point is comparatively higher and all streams are flowing away from this okay. So this an typical of the high topography in the center okay and then rectangular drainages are marked by right angle bends so you will see the right angle bends here so smaller streams coming and taking bend almost at right angle commonly due to the presence of jointed rocks, fracture in the massive rocks or in the metamorphic rocks which are having foliations okay.

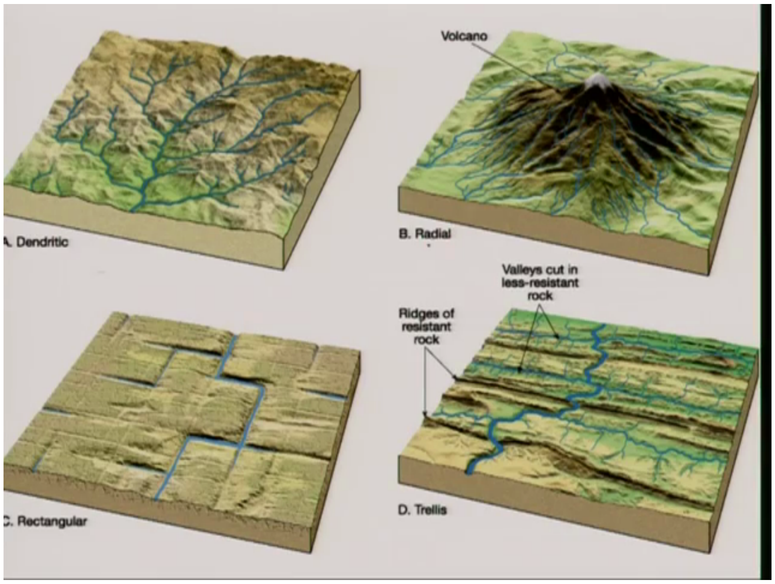
Now this patterns which are trying to understand can also helps us in understanding that what will be the pattern of run off in that particular region okay. If you are having massive rock sub surface then you will have very quick run off okay, so high run off will be there and suppose you are having rectangular drainages, its possibilities are high because the area is having fractures or joints then the percolation will be comparatively faster okay.

(Refer Slide Time: 11:41)



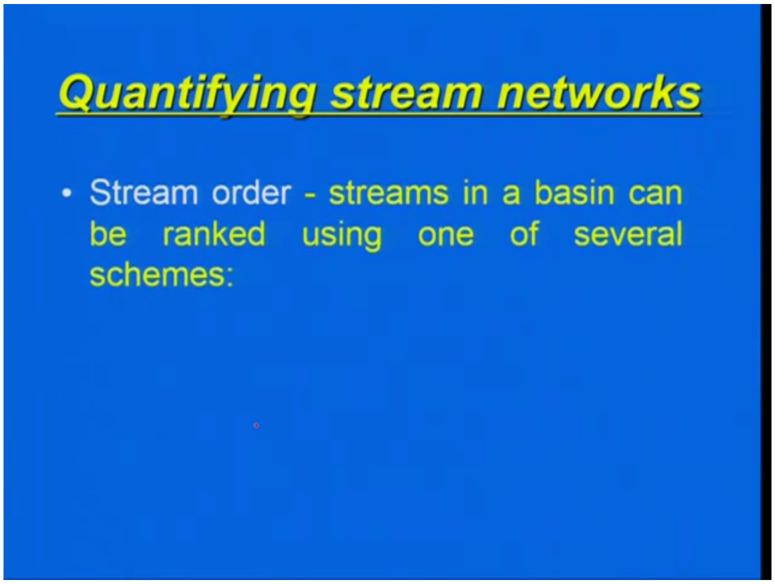
Now coming to the trellis one, these are seen in the areas where we are having the folded sedimentary rocks okay and another one is annular one. The stream follows almost circular concentric path and mostly seen in the areas where we having domes and basins okay so you can also understand that what will be the flow, trend in these regions based on that and also try to know and you can know the subsurface geology okay so these are the examples of the dendritic pattern, how it looks like okay. If you are having radial, how it looks like.

(Refer Slide Time: 12:16)



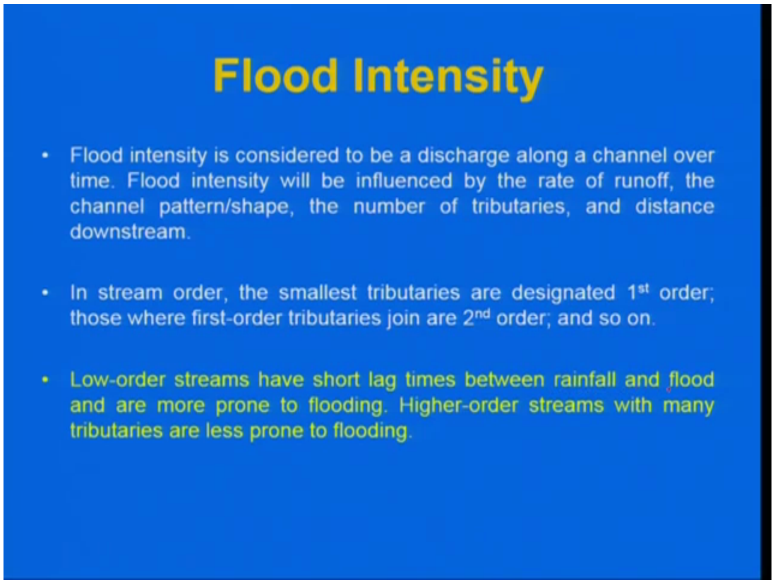
And if you are having trellis in the in the folded sedimentary terrains where you are having weaker and like stronger rocks okay then you will have this type of drainage system and then if you are having the fractured ones then you are having the rectangular drainage.

(Refer Slide Time: 12:42)



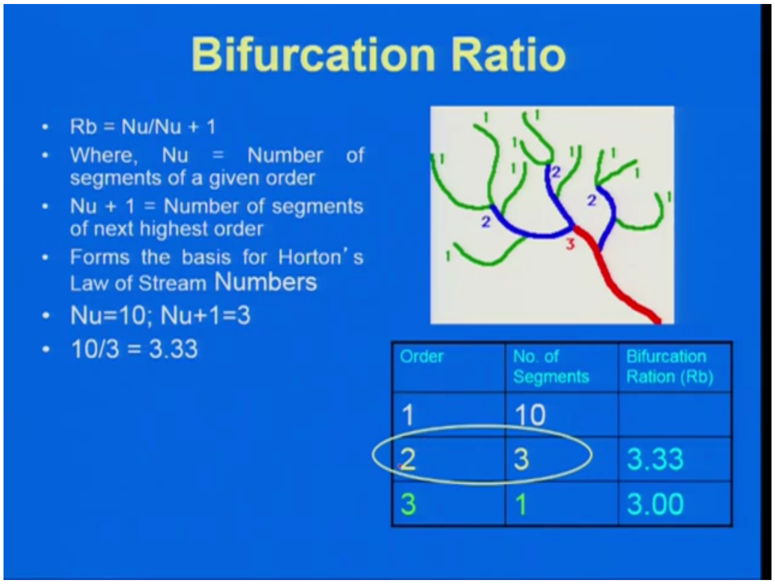
Now, quantifying stream networks, stream orders, streams in the in a basin can be ranked using one of the several schemes okay.

(Refer Slide Time: 12:50)



Now flood intensity if you take okay, the flood (inse) intensity is considered to be a discharge along a channel over time okay. Flood intensity will be influenced by the rate of run off, channel pattern shape, the number of tributaries and distance downstream. In stream order, the smallest tributary are designated as first order, those were first order tributaries joined together are will be the second order and so on as I explained in the previous slide okay. So low order streams have short lack time between the rainfall and the floods okay and are more prone to flooding so if you are having like for example dendritic pattern in the area then you will have the likelihood of having very quick flooding event or the flooding in that particular area okay and the higher order streams okay with many tributaries are less prone to flooding.

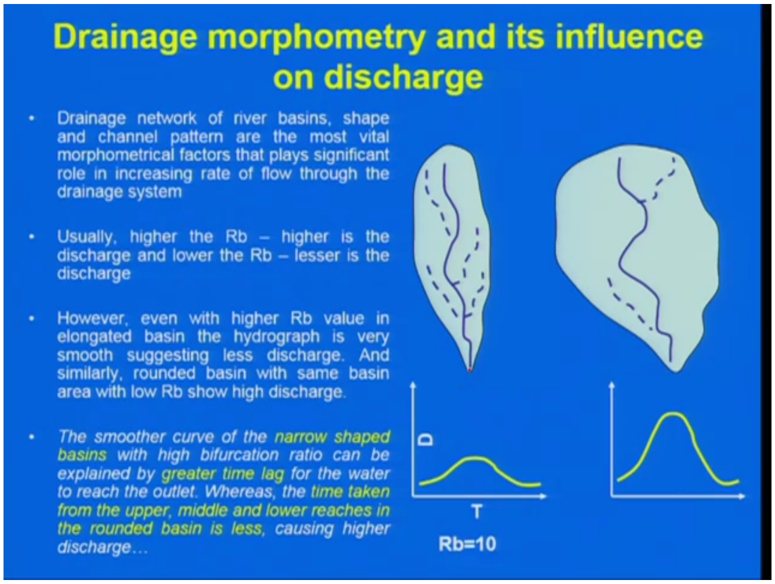
(Refer Slide Time: 14:10)



Now coming to the bifurcation ratios as we were talking about that if you have 2 lower order streams meeting at one point then the next one flowing down will become the higher order stream and so on okay so we are having 2 single order streams and then getting into the second order and to second order, getting into the third order okay. And the bifurcation ratios is been given in the very simple equation, NU by NU plus 1 okay so where NU is your number of segments of a given order and then next one is the another higher order segments okay so based on that you can have the bifurcation ratio. For example, here NU10 okay is for the first order you are you are having so you are having 10 stream and then second one is you are having 3 that is the next higher order okay.

So you have the bifurcation ration between these 2 is around 3.33 okay so this to some extent helps us in understanding that what type of um the run off you will expect or the hydrograph you will expect in that particular basin okay so this is given for the second order that is the ratio between the first and the second one okay.

(Refer Slide Time: 15:44)



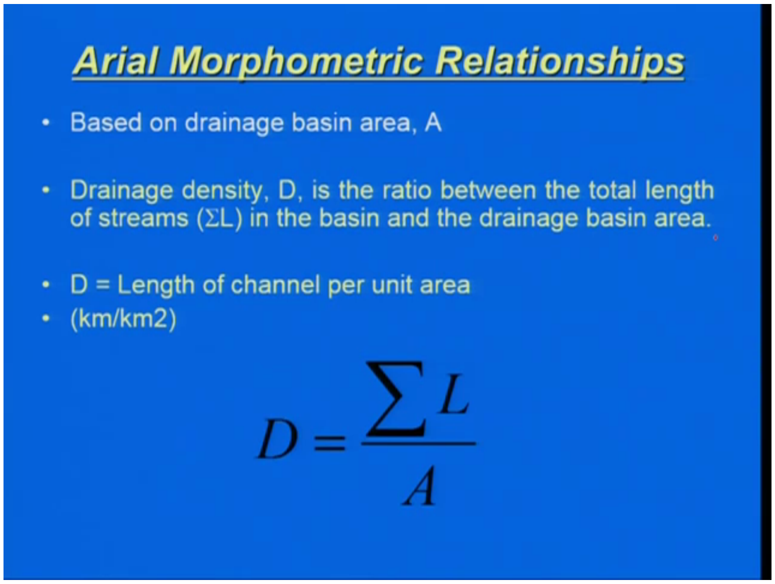
Now drainage morphometry if you take okay so drainage network of river basin, shape and channel pattern are most vital morphometric (parame) factors that play significant role in increasing rate of flow to through the drainage system. That is (with) what we are talking about the run off okay and it has been seen usually that if you are having higher bifurcation ratios, higher will be the discharge and if you are having lower bifurcation ratios, you are having lesser discharge okay. However for example which has been shown here okay. You are having one elongated shape of basin and other one is round in shape okay and the area is more or less similar but if you look at the hydrograph of this one, they varies okay.

So what one can expect based on this that this area will yield a very quick or may be less discharge here but what we have found was that the the elongated one because the the travel time which has been taken here will be different than this one okay so what has been seen here that even the bifurcation ratio so one is the shape, another is the bifurcation ratios which we consider here so if you have the that what we talked, higher RB values, higher will be the discharge. Lower RB, lower will be the discharge. However, even with the higher RB values in the elongated basin okay, so this basin had very high density and higher RB values okay.

The hydrograph is very smooth okay. Suggesting less discharge okay, and the rounded one which almost like having the same basin area with low bifurcation because the streams are not much okay. That means the the run off will be very low but it shows very high discharge okay. The reason is that the smoother curve of the narrow basin okay, this is this one, elongated one with higher bifurcation ratios which is around 10 for example okay can be explained by greater time lag okay.

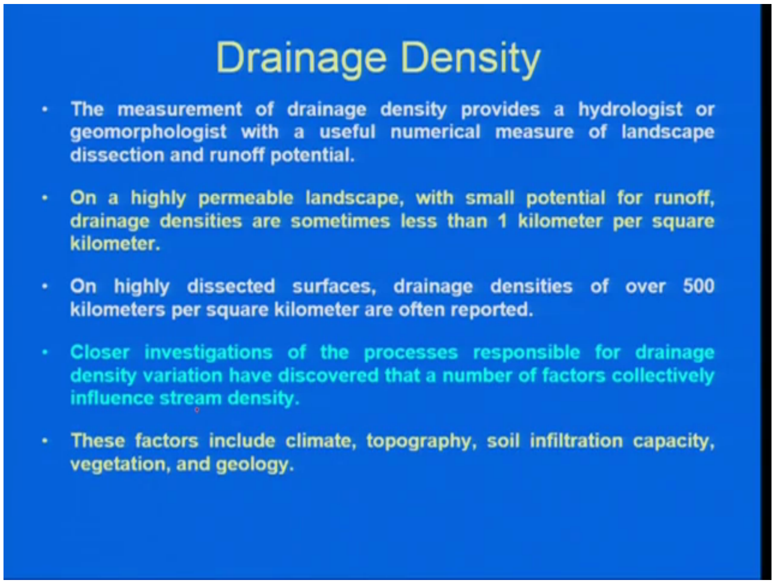
So even this basin had an higher bifurcation ratio, the shape played an important role here okay so it took longer time to put pour out the water at this point okay hence the hydrograph which has been seen was quite smooth okay. Whereas in the case of the the rounded basin which had the bifurcation ratio very less, hence we should have expected lesser discharge here, we got very high discharge here okay and this mainly due to that the time taken from the upper ridges, middle part and the lower ridges of the rounded basin. It was less time which was been taken causing higher discharges in the region okay.

(Refer Slide Time: 19:02)



Now another important one is that based on the drainage basin area, you can talk about the drainage density okay. So you have the drainage density which is given as T is the ratio between the total length of the stream okay, so all streams you add in. The length of the streams in the basin and the drainage basin area. That will give you the total drainage density of that particular region in kilometer per kilometer square okay.

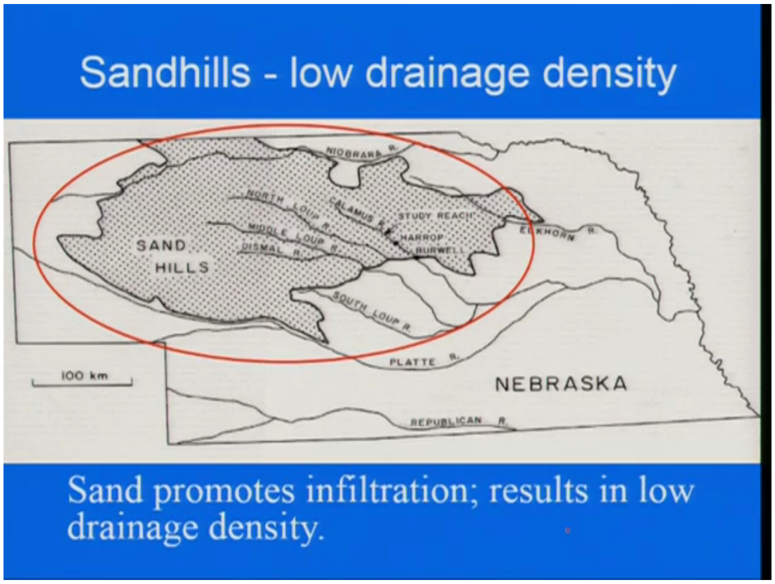
(Refer Slide Time: 19:34)



And it has been seen that the measurement of the drainage density provides hydrologist of a geomorphologist with a useful numerical measure of landscape dissection and run off potential because the drainage density will be the (ru) (drain) or run off potential of that particular area okay. Of course you will also be able to make out that what type of material is available because that on for example, on an highly permeable landscape with small potential will have will have a small potential of run off okay. In that area the density, drainage density are sometimes less than 1 kilometer per kilometer square okay.

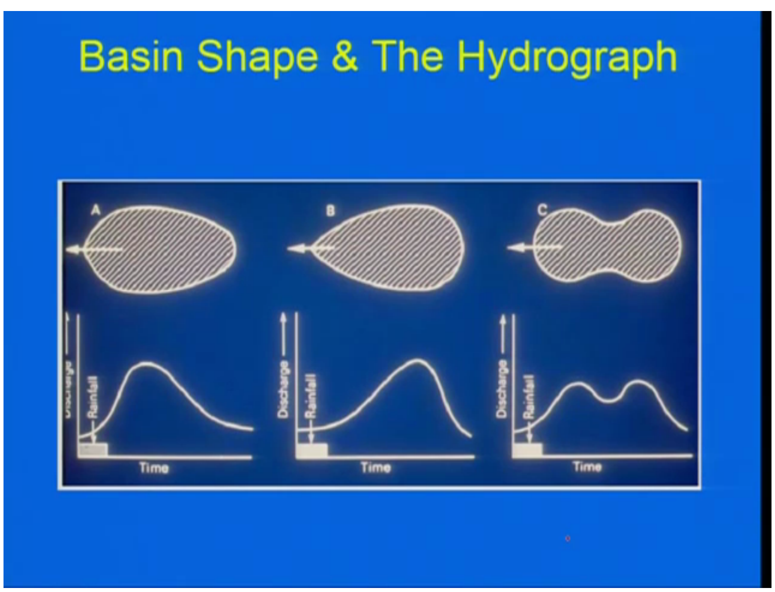
On the highly dissected surface okay, drainage density of over 500 kilometer per square kilometer are often reported okay. Closer investigation of the processes responsible for the drainage density variations have discovered that number of factors collectively influenced this stream density or drainage density. And these factors include climate, topography, infiltration, vegetation and the geology okay. If the infiltration dominates over run off, it tends to have lower density in that particular area.

(Refer Slide Time: 21:07)



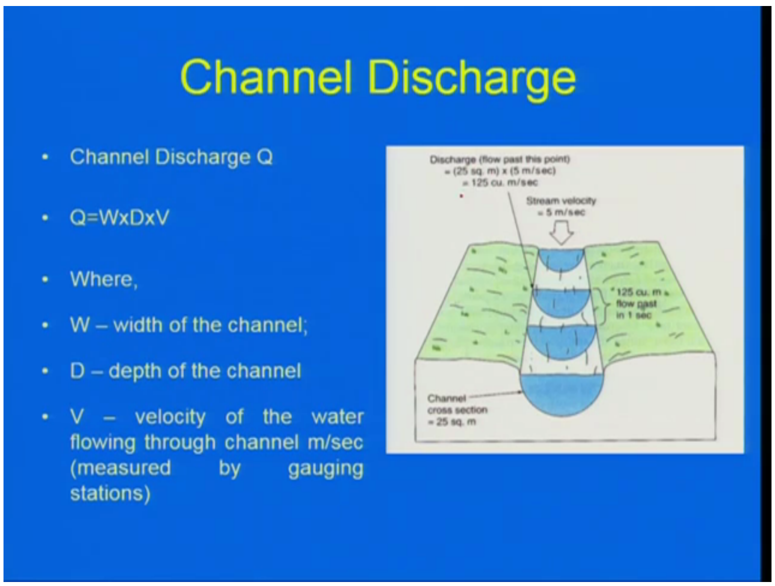
Now for example here, this basin, in this particular area, the drainage density is quite low and the reason is because the area is comprised of sandy hills okay so you have very fast infiltration in this particular region okay. Hence you will have lower drainage density in that (part) area okay. Okay.

(Refer Slide Time: 21:32)



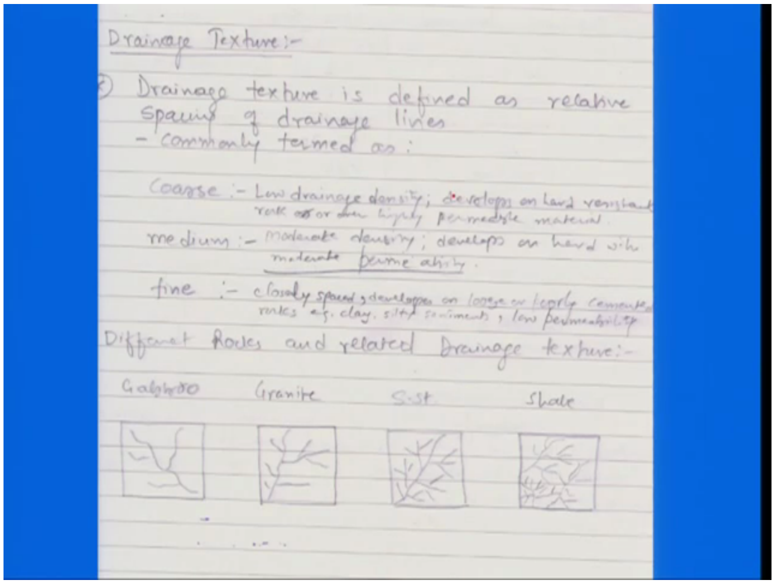
So basin shape even if you take, the hydrographs will vary from place to place okay. Even if when you keep the rainfall almost constant in for all the basins okay. So you will have lower discharges here, very high here. In this area, you will higher here, lower here and you will have lower higher, these types of basins okay. So shape of the basin and drainage density helps us in identifying () that which area will have peak flows or run off and amount of run off in that particular region okay.

(Refer Slide Time: 22:14)



Channel pattern if you take okay or channel discharge you have to take, you have you need to have certain parameters like width of the channel, depth of the channel and the velocity of the water flowing through the channel meter per second okay. So this is what you are having okay fine. For example, you are having the cross sectional area is 25 square meter and you are having the the discharge here is okay is 5 meter per second and then you are having the total discharge if you take, it will be around 125 cubic meter per second okay.

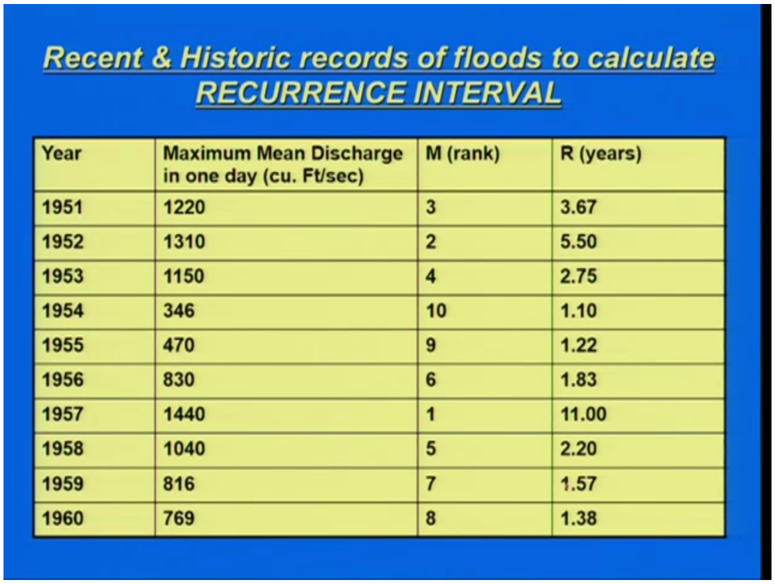
(Refer Slide Time: 23:04)



Further this is one sketch which I would like to discuss here is the drainage texture okay so if you are having different type of rocks okay like you are having gabbro, again these are all um the igneous rocks, granites and then you are having sedimentary rocks like sandstone and shale okay. The drainage texture will vary okay. Like for we can classify this as an coarse, medium or fine okay so coarser will be low drainage density, developed some hard and resistant rocks okay. Like for example here, which we will have coarser, we can classify this as an coarser density okay or drain texture.

Medium is moderate density, develops on hard with moderately permeability or permeable rocks okay then you can have something like this okay. You are having medium and if we are talking about the fine then we are having where low permeability is there where you are not allowing much of the water to percolate down okay then you will have the the very fine drainage texture okay.

(Refer Slide Time: 24:21)


Recent & Historic records of floods to calculate RECURRENCE INTERVAL

Year	Maximum Mean Discharge in one day (cu. Ft/sec)	M (rank)	R (years)
1951	1220	3	3.67
1952	1310	2	5.50
1953	1150	4	2.75
1954	346	10	1.10
1955	470	9	1.22
1956	830	6	1.83
1957	1440	1	11.00
1958	1040	5	2.20
1959	816	7	1.57
1960	769	8	1.38

Now this is one of the method which has been followed to talk about the recurrence interval of the floods okay. Like for example here, what has been given is the one is you are having the years then maximum mean discharge and then you are having, based on that, you have ranked those events and then you have calculated the recurrence here okay. So for example you are having the maximum discharge in this list is 1440 we can rank 1 and then 2 and then 3 and so on okay.

(Refer Slide Time: 25:06)

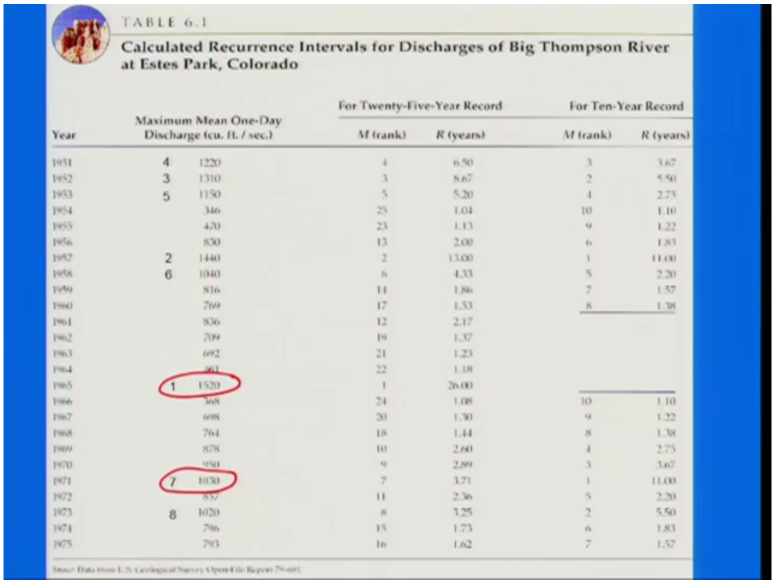


TABLE 6.1

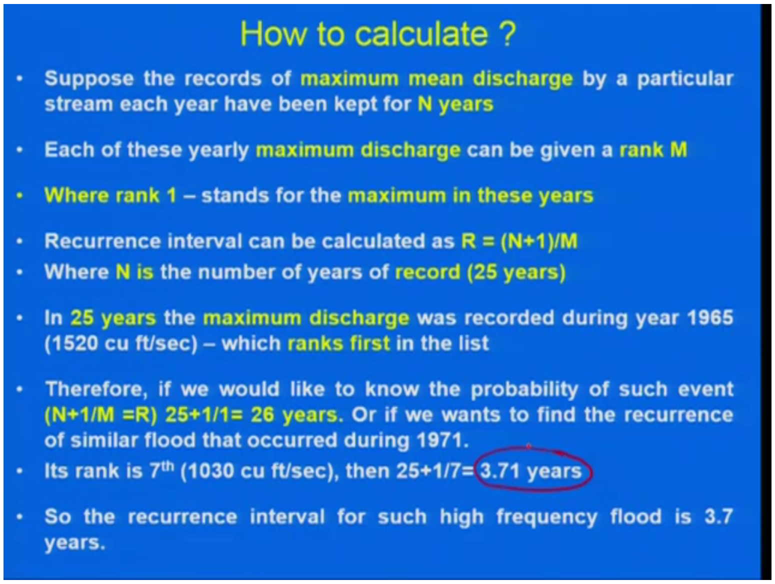
Calculated Recurrence Intervals for Discharges of Big Thompson River at Estes Park, Colorado

Year		Maximum Mean One-Day Discharge (cu. ft. / sec.)	For Twenty-Five-Year Record		For Ten-Year Record	
			M (rank)	R (years)	M (rank)	R (years)
1951	4	1220	4	6.50	3	3.67
1952	3	1310	3	8.67	2	5.50
1953	5	1150	5	5.20	4	2.75
1954		346	25	1.04	10	1.10
1955		470	23	1.13	9	1.22
1956		830	13	2.00	6	1.83
1957	2	1440	2	13.00	1	11.00
1958	6	1040	6	4.33	5	2.20
1959		816	14	1.86	7	1.57
1960		769	17	1.53	8	1.38
1961		836	12	2.17		
1962		709	19	1.37		
1963		692	21	1.23		
1964		361	22	1.18		
1965	1	1520	1	26.00		
1966		368	24	1.08	10	1.10
1967		698	20	1.30	9	1.22
1968		764	18	1.44	8	1.38
1969		878	10	2.60	4	2.75
1970		950	9	2.89	3	3.67
1971	7	1030	7	3.71	1	11.00
1972		857	11	2.36	5	2.20
1973	8	1020	8	3.25	2	5.50
1974		796	15	1.73	6	1.83
1975		793	16	1.62	7	1.57

Source: Data from U.S. Geological Survey Open-File Report 79-681

Now if you look at this is the data which is available from the the Colorado and Thomson river where you are having the the number of so it's almost like 25 years if I am not wrong okay. For 25 years and based on the discharges, one can classify this so you are having maximum discharge which was experienced in 1965 and 1520 cubic feet per second and then you are having second, third so we these are so on you can classify these okay based on the discharge and if you want to find for example the recurrence here so we have shown in the next slide for this and if I am not wrong for this one okay. So in the next slide, we can see the the recurrence okay for that okay so if we look at the finally, this one okay so how to calculate.

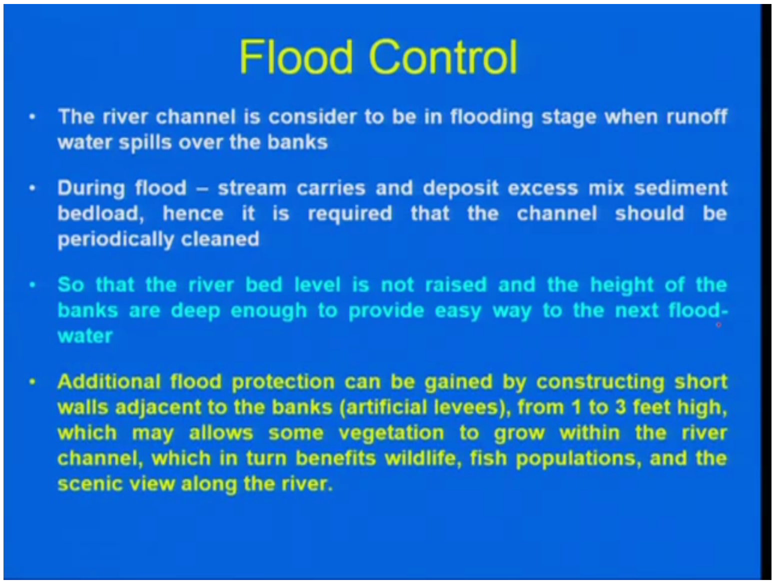
(Refer Slide Time: 26:16)



Suppose the record of the maximum mean discharge by a particular stream each year have been kept for any years okay. Each of this yearly maximum discharge can be given a rank M okay where rank 1 stands for the maximum in these years okay. Recurrence interval can be calculated as R equal to N plus 1 by M okay. So you are having, for example, where N is the number of years recorded so you are having the data of 25 years for example and then 25 years, the maximum discharge was recorded during year 1965 okay. That was along the along the Thomson river okay. That is 1520 which ranks first. Therefore if we would like to know the probability of such even then what we can say that we can have N plus 1, that is 25 plus 1 by 1 so every 26 years, you will have this type of events okay.

Now for example, another event like we are taking into like 1971, remember the previous slide okay so the discharge which was around 1030 okay and we are not, that was been ranked as 7^{th} okay so then we can have 25 plus 1 by 7 so the recurrence of similar event will be in a time gap of 3.7 years okay. So this is how we can talk about the the recurrence interval of that particular event provided the rainfalls remain same and provided the landscape doesn't change okay fine but that is not possible okay but can try even, one can think of having this information okay.

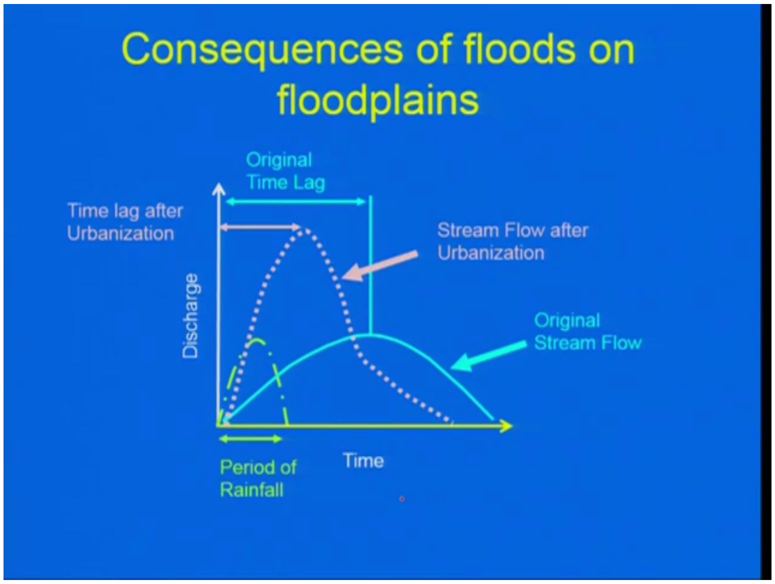
(Refer Slide Time: 28:05)



Now flood controls mainly what we do it that the river channels or channel is considered to be in flooding stage when (ru) run off water spills over the banks okay. During floods, stream carry and deposit excess sediments, sediment bed load hence it required that the channel should be periodically cleaned and this is one of the reason in the Kosi region where we are having lot of sediments which are been poured in the downstream during monsoon and we are having less and less cross sectional area okay.

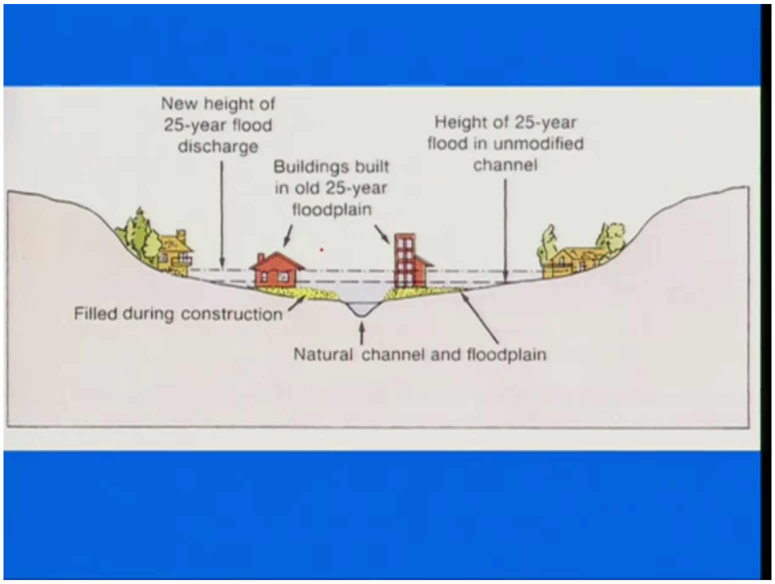
So that the river bed, bed level is not raised and the heights of the banks are deeper enough to provide easy to way the next flat water to pass through and through okay. Additional flood protections can be gained by constructing shorter walls adjacent to the bank what we are termed terming as the artificial levees from 1 to 3 feet high which may allow some vegetation to grow within the river channel which in turns benefit the wildlife also, a fish population and scenic view along the the river okay.

(Refer Slide Time: 29:31)



Now this is the hydrograph which shows that what happens if you keep on having construction close to the riverbanks okay. So this you are having the the period of rainfall. You are having and this is the hydrograph original hydrograph of the stream flow but after the construction what happens is that you are having very fast steam flow okay. That is because of urbanization okay so this is the the original time lag between the the 2. Okay fine. And this is the time lag after the urbanization so you will you are leading into or um urbanization, you are covering more area, not allowing the the water to percolate down okay and you are putting more run off so very quick discharge, very quick run off is will be experienced if you are having after the urbanization.

(Refer Slide Time: 30:41)

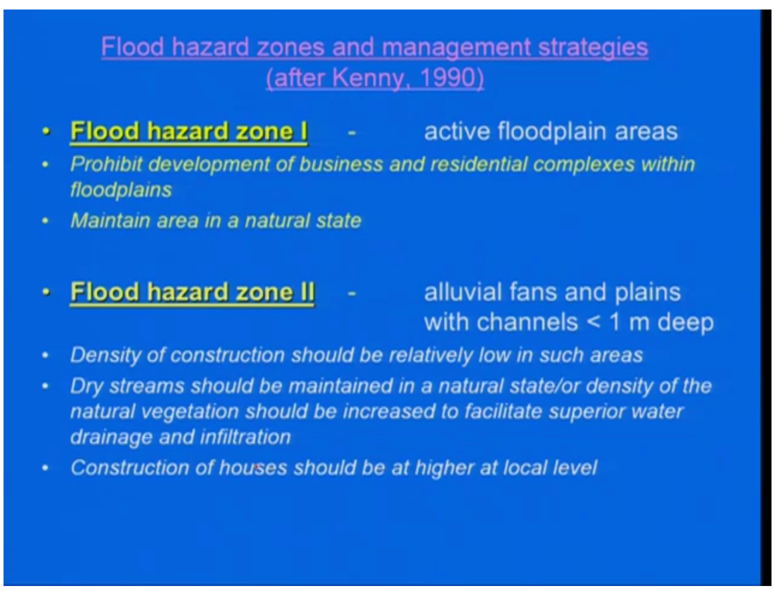


Now this is an example for that okay which shows that the (oc) the areas close to the banks were occupied by fill during the construction so you had the initial, that is the first, you can say the this is the natural channel and then you are having the height of 25 year flood in unmodified channel okay so this was during an unmodified channel. Now after this area was been occupied so buildings built in all 24 years floodplain okay so you have occupied this because you never experienced flood in during last 25 years so you occupied this having safe place and all that but the discharge has gone so new heights of of the discharge here after 25 in 25 years so this will be the new one okay and then we keep on crying that we are we are been affected by the flooding events okay.

(Refer Slide Time: 31:47)

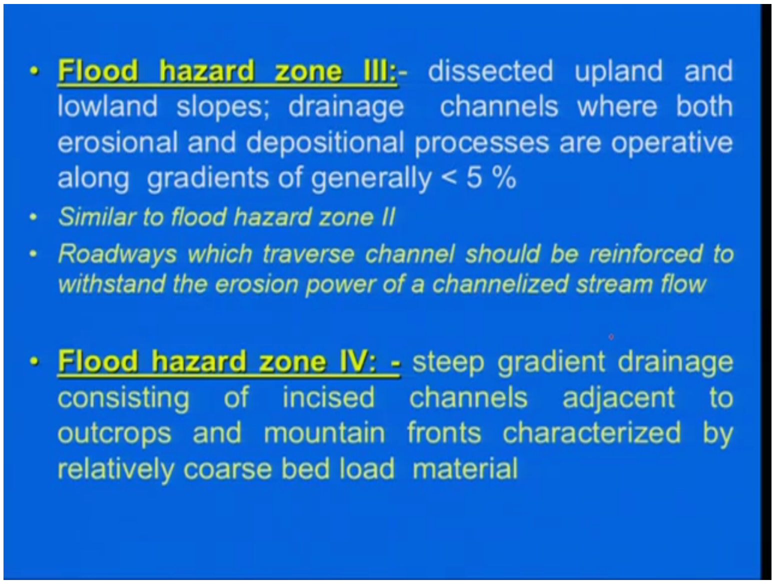
This is an example from the city in Gujarat, in Ahmadabad. In no time you we we experience the flooding on streets okay so there are ways to do that okay.

(Refer Slide Time: 32:01)



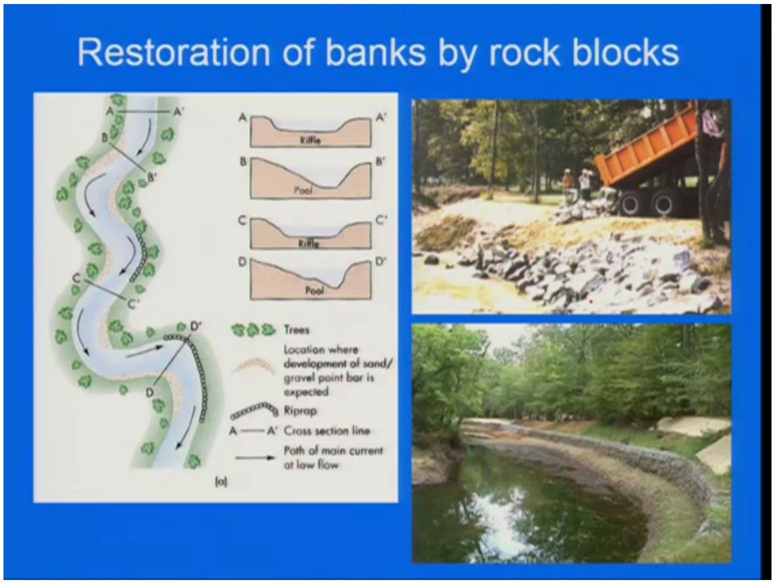
So flood hazard zones and management strategy if you take into consideration then flood hazard zone one which we consider as an active floodplain areas okay, we should prohibit development of business and residential complexes, maintain area in a natural state okay. In zone 2 alluvial fans and the plain areas so these are the the areas where we will put as an zone 2 okay and with the channels having depth less than 1 meter. Density of the construction should be relatively low in such areas. Dry stream should be maintained in a natural state or the density of the natural vegetation should be increased facilitate superior water drainage and infiltration in that particular region. Construction of houses should be at higher at local level okay. That is at higher levels, one can construct the this thing okay to avoid the the flooding due to such shallower streams okay.

(Refer Slide Time: 33:15)



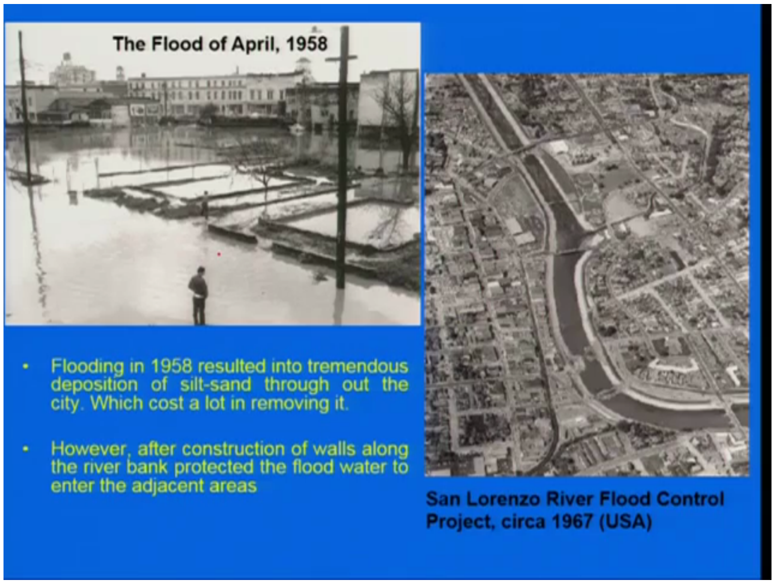
Then coming to the flood hazard zone 3, these are the areas which are dissected uplands and lowland slopes, drainage channels where both erosion and depositional processes are operative along gradient of generally less than 5% okay. Similar to flood hazard zone 1, you can apply that those conditions. Roadways which traverse channels should be reinforced to withstand the erosion powers of a channelized stream flows okay. And then flood hazard zone 4 which includes the steep gradient drainages consists of incised channels adjacent to the outcrops okay mountain fronts characterized by the relatively coarse bed loads okay. This is what we were talking about the the proximal part of the the alluvial fan regions okay or the cliffy region along the fronts.

(Refer Slide Time: 34:19)



So for example, restoration, there is a very well followed practice okay so this is before the restoration, people have done. Okay the erosional sites have been restored and and put with the the rock blocks which restrict the erosion further and then later, what you see is something like this okay so this photograph has been shown before and this is after that okay so you have channelized the flow.

(Refer Slide Time: 35:03)



Then further there is an example from the if I am not wrong the yeah, this is from US okay which shows the CD in the flooding condition in 1958 but in 1956, after the the channel was been like (cons) the flow was channelized okay so what they have difference between these 2, you can easily make out that you can do this to channelize.

(Refer Slide Time: 35:20)

This is from Tokyo that you are having the major streams flowing across the this major city okay where the channel is almost like the the flow is channelized in this region okay.

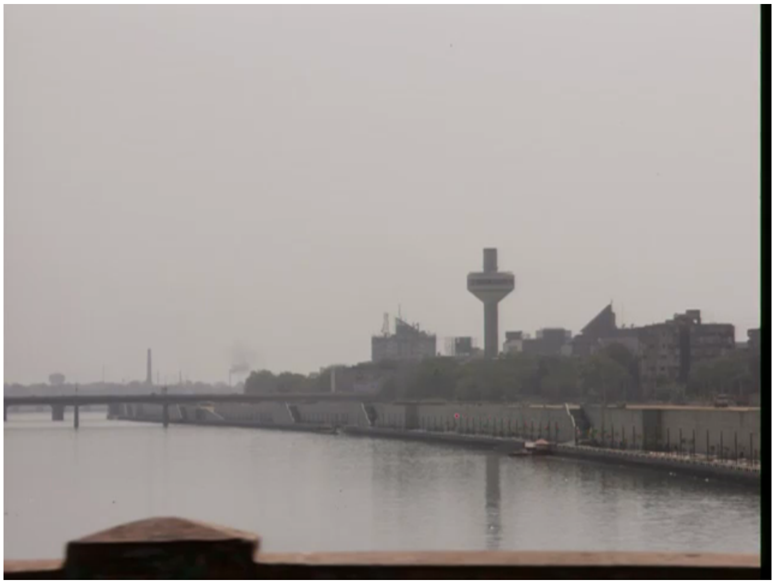
(Refer Slide Time: 35:36)

Further, this is from Ganga in the in close to Kanpur. It is again, you are you may (fa) keep facing the the flooding in the low laying areas.

(Refer Slide Time: 35:52)

And one of the example, this is from Gujarat along the Sabarmati river or the (hum) these areas again was experiencing the floods every year okay so this area is been channelized completely and what you see during the construction.

(Refer Slide Time: 36:09)



This is what they they called the river front now and the beautification has been done.

(Refer Slide Time: 36:20)

And you can see the present day is something like this okay. Okay fine so you are having. You have created some good facilities and the for the people as well as you have channelized the flow okay so one can do this to avoid the areas getting into the flooding conditions okay.

(Refer Slide Time: 36:39)

Now this there are some examples which shows that what happens if you are having the breach in the dams.

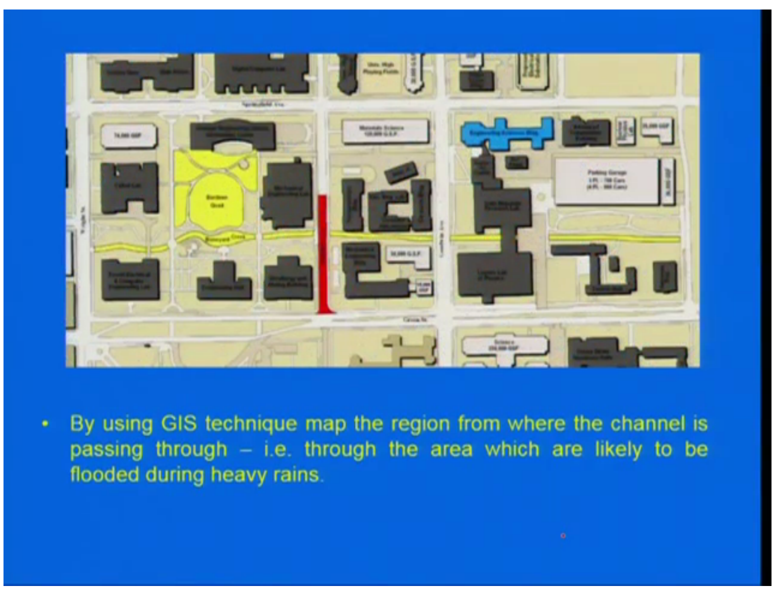
(Refer Slide Time: 36:46)

And this is a construction of artificial levees you are having but at the same time, if you if this (art) the levees are breached, you may have problems in the adjacent areas okay so these are the elevated portion okay close to the bank and then further you are having the low laying areas okay.

(Refer Slide Time: 37:07)

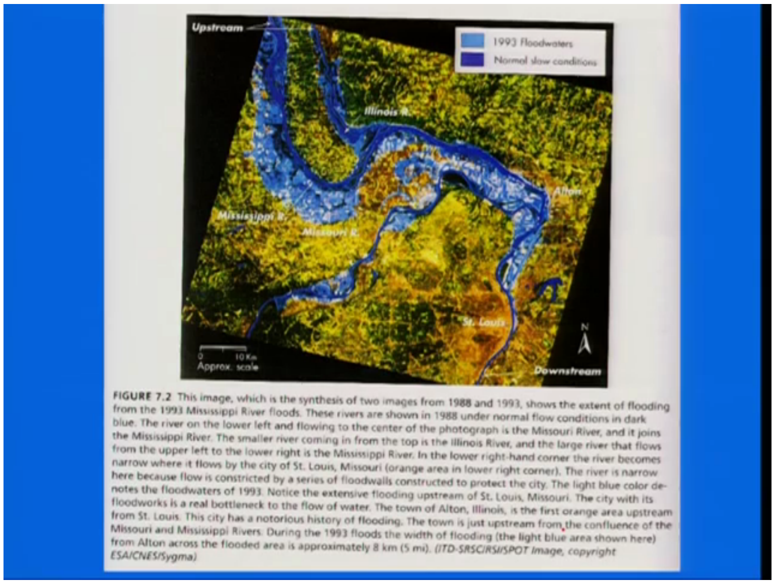
So this is again an example which shows the channelization of the the river which you can see here and which you can see here after the the flow was been channelized okay.

(Refer Slide Time: 37:21)



So even one can generate GIS maps okay to find out that which areas are low laying areas and then come up with the flood hazard maps okay.

(Refer Slide Time: 37:37)

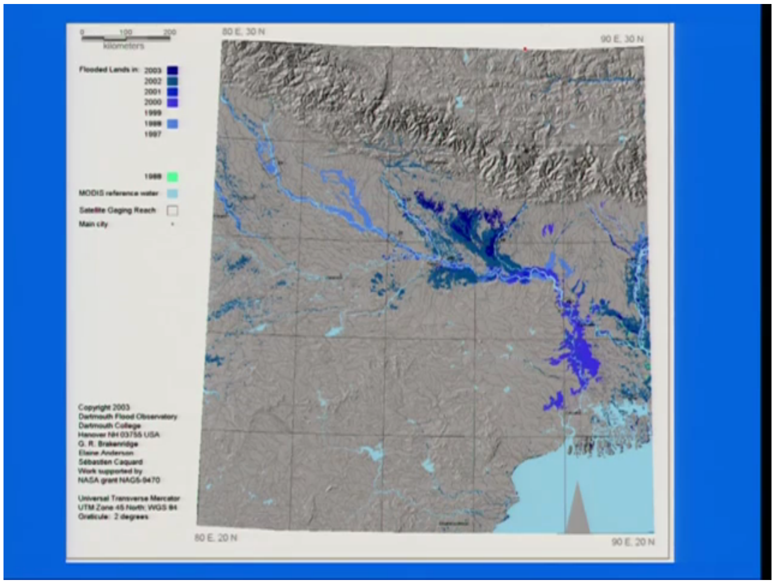


Now coming a bit quickly here, this is an example which has been given the Mississippi river which marks the the inundation during the flooding events okay so this is the normal condition and this is during the the flood event which happened in 1993 okay.

(Refer Slide Time: 37:57)

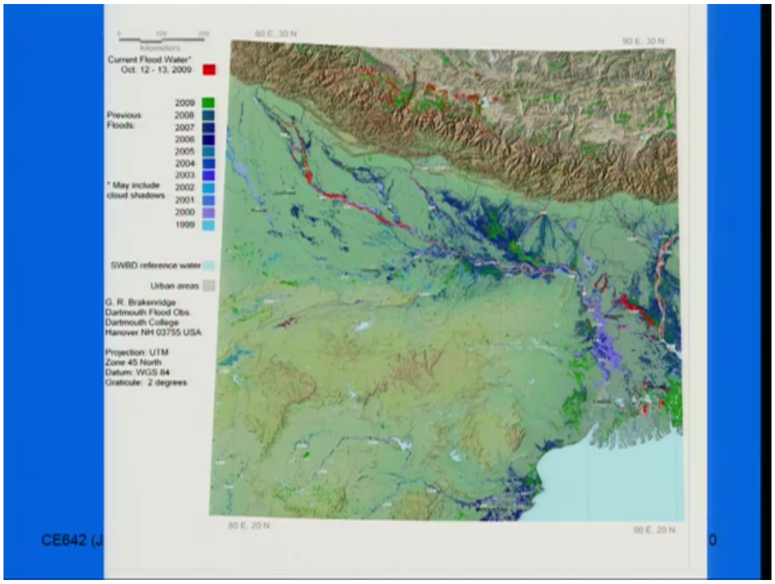
So you can mark easily that which areas were been affected okay so another most common method to control floods are by construction of dams in the upstream hill, hilly terrains and small barriers or the embankments in the plain region okay.

(Refer Slide Time: 38:14)



This also we discussed towards the beginning that if you are having the detail of inundation of different season. One can easily come up with an very detail inundation map or the flood hazard maps in this region okay.

(Refer Slide Time: 38:32)



And this is what I was talking about now this was been occupied in 2008 okay so this color if you take this is this one which has been shown here so in 2008, this area was been affected in the flood events okay. So I will stop here and we will continue it in the next lecture.