Coastal Engineering
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Module - 3
Coastal erosion protection measures
Lecture - 5
Coastal erosion protection measures - V

As we have seen in the earlier class, earlier lectures, the groins are perpendicular to the shoreline.

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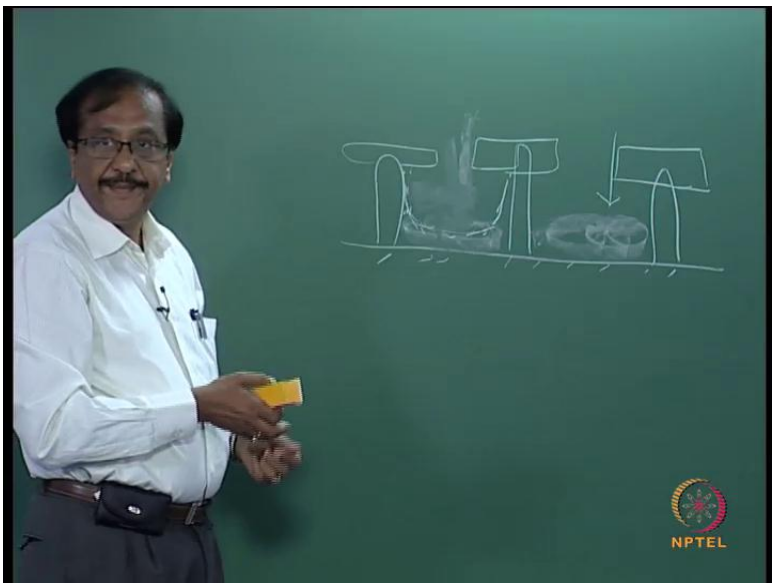

What will happen in such a case is that also I have mentioned it to some extent when you have a groin like this. So, what we expect is that the sand will come and get accumulated in this area that is, these are the compartments. As long as it comes under stays here, it is getting trapped between the groins, but then it has to be retained.

If it is retained, then you have the cumulative deposition coming from the ocean, and then you can have the beach build up. So, certain locations most of the locations this is possible, but at locations where you have predominant on shore off shore also, then what might happen is sometimes this sand will be removed, and then it will be transported

towards a off shore and after sometime again that a bar which is formed here again it will be washed off.

So, sometimes during the monsoons the sand is removed and non monsoon again it will come. So, now, you see all although this is trapped in between the groins because of the activity of the monsoons this will be removed or deposited, removed and deposited. So, you see that there is a kind of an oscillation of the beach itself. But if you want to have some kind of a sustainability of this beach which is getting formed then you can think of some other means of having some kind of t groins. This is one example as you see in the second picture here or may be like this.

So, that this when the sand is trying to get back, it will not be allowed. So, you see that what will happen is because of this t groins what will happen? This will go like this the shore line will get form formed like this, you understand this sand the amount of sand getting back are going back in to the ocean will significant will be reduced because of these two projections. So in that way the shapes also shape of the groins also play an important role.

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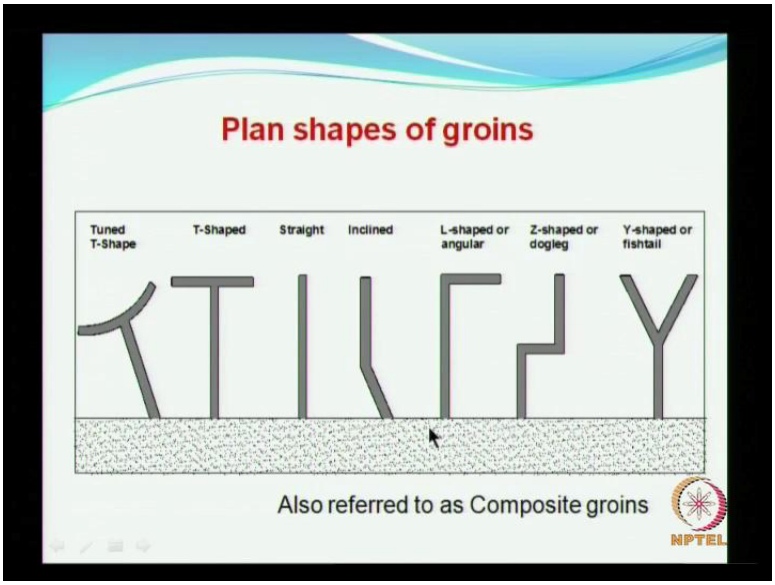

For example, here you see the different shape this of course, we have already seen you can have something like this or like this or you can have l shape but among or the y shape or the z type. But among all these things T groins has been widely used.

So, whenever you do not have groin with just a one arm like the stick groin. The other kinds of groins together can be referred to as composite groins. See later we will have a slide clearly mentioning what are all the advantages of having a composite grains. But in the case of composite groins although there are some advantages it is a bit expensive compare to the other straight groin.

So, and also this is bit difficult because the construction wise it has to be done a bit carefully. If you do not do it and if enough care is not taken there can be catastrophe near the head of the groin. In fact, that will happen, even in the case of straight groin but here it has to be more care has to be taken in the case of that T groin.

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Groins as I said has been in used for several centuries in fact we have seen that 15 o 3 was a oldest groin in visingan in Germany right, sorry in Netherlands not Germany. So, now, in this is a groin somewhere in the Baltic sea of Germany where you see that a logs of woods, very cheap way of protecting your beach or allowing the beach for to be formed by construction of the groins.

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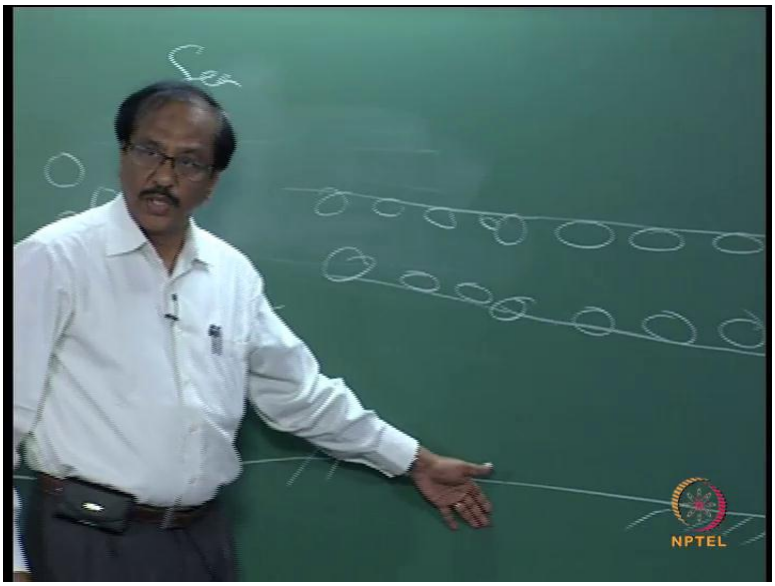

What did they have done is they have given logs of wood as in an alternate staggered manner. So, what will happen? You see that the transport which is so, this is a sea. Now, when you have the long shore sediment transport these being trapped and this is going to act as a groin. So, this also shows the advancement of the beach. So, this is nothing but just driving, but one you once you try to adopt this kind of cheaper way of construction of coastal protection measures as a form of a groin. You have to be careful that when you are trying to use these kinds of logs of wood, make sure that when you have an obstruction that you try to have it normal to the shore.

The idea is to trap the long shore sediment transport you understood, but there are instances in our own there are some instances where they have I will explain elaborate on this later, where they try to drive this kinds of logs of woods, and then you have the shore line here, and they try to have it on a continues basis on a continues, and here it is parallel to the shore line. So, but this kind of stuff has, this kind of method has really fail at several locations. The idea is to reduce the energy before it reaches the shore line it is partly achieved, but then if this, itself can be used as some kind of detached break water which I will try to elaborate on this later. This can, may be much effective in advancing the shoreline. Of course, you have to think of this when you have a long shore sediment transport, significant long shore sediment transport.

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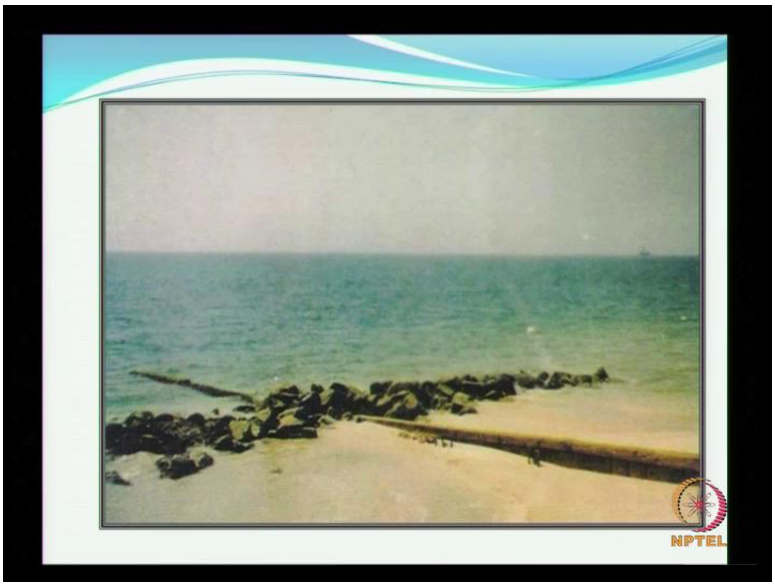

So I will elaborate on this again but then this slide shows that cheaper type of materials can also be used for the construction of the groins. This is a T groin somewhere in a somewhere in the US in the Florida coast, where you have an impermeable groin here. You see that so, this to protect a hotel by name breakers; this is in the US, where they have adopted an impermeable groin as you can see here in order to protect the hotel along the shoreline.

So, it has given some amount of relief, but then they wanted to retain the sand which it getting filled in within the compartments. So, in order to retain the sand you have they have then later this la later thought where they have constructed a horizontal arm so, forming has a T groin. This has allowed the formation of the beach, and also try to retain the sand is that clear.

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So, there are other types of groins as you have seen here. So, we will so, you have a groin something like a hockey stick here or v shaped as you see this are all straight groins all in some way or other control the wash away of the sand into the ocean. So, it is trying to retain, then this is the fishtail groin, which we have seen which has been adopted in the field. And, then here you have the zigzag type of groins this adopted somewhere in UK.

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So, there are other types of groins which you can see here in Florida you have the rafts being used as which has been used. And then here counter fort so, like you have the counter fort wall right. So, this is something like that where in it is it this also acts as a straight groin, and the material used in all these cases can be timber ok. So, this is not an ice sore in that part is not an ice sore when compare to the usual rubber mound of stones. So, these are all groins where you know about Venice.

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So, you look at the number of groins constructed here. And these groins the strip of land is very very important for them. So, in order to make sure that it is protected and the sustainability of the cost is ensured they have a number of groins here which is now facilitating the beach formation and retention of the sand. So, as I said earlier when it is used for protecting the coast, we call it has the groin field. Now, the same area now, the type of the structure way they have used here, you look at this there are 2 arms getting into the ocean so, from the land so, these are called as now. What are they called as now? Can we call it as a groin? Why not? Recollect what I have told in the last class. What have what are they supposed to be called? Training walls, so, these are supposed to be actually training walls.

What it does is it prevents the sand the formation here and also facilitate the, facilitates the continuous exchange of sea water with this a lagoon. So, this is this gives an idea about the different kinds of structures, groins. All though I am just referring to groins

here I am referring to this. But then you also have this to training walls that pair of training walls 3 pairs of training walls, just to give an idea the difference between the training walls and the groin field is that. So, what happens when a wave is passing groin? A T groin for example, which is quite popular here.

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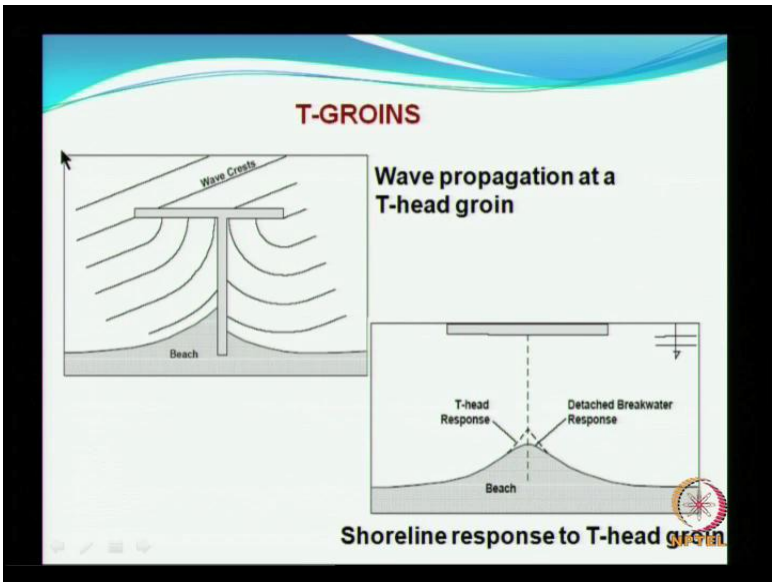

So, here you see that the bending of the wave crests takes place at the tip of the break water. So, the there is a lateral diffraction of the wave energy, and which is trying to penetrate in to the sheltered area as I have said earlier. So, this area will be of waves with lesser magnitude so, and this is referred to as the lee side of the breakwater. So, the wave height here on this side is much less than the insulin wave height. So, what will happen? The energy here where the energy somewhere at this location or somewhere here, the wave energy will be almost same as that was the deep I mean insulin wave energy provided it is of a constant water depth.

It is not of constant water depth, but it is kind of a phenomenon which will be going on will be either shoreline or combine shoreline, and you have the reflecting taking place. But nevertheless, whatever happens even if there is a change in the wave height due to refraction. The wave height here the same kind of a change will be taking place here because of the variation in the bathymetry. But in addition to the variation in the bathymetry, you will also have the reduction in the way height, because of this presence of this obstruction which is termed as your diffraction.

So, what will happen? The sand since, the energy is higher here the sand will be moved, and naturally it will moved to areas of lesser wave energy. Hence, the sand will start moving, and it will start forming as the beach which will be slowly propagating towards the sea or towards the breakwater towards the groin. So, this is how, you would have the beach formed. And this is the due to the, this is only for single groin single T groin, what I have we have seen there. Suppose if we extend this as to a number of T groins with a gap in between.

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So, the number of T groins is as we have seen earlier. What will happen? Now, you will have the, this area will be almost higher energy. So, you will have some kind of a thumbhole formation as you have seen here, no no I will explain not like that. This is in the case of, if you remove this, if you only the detached breakwater, what will happen? You will have the sand formation here, because you have the on the lee side on the breakwater you have the lesser energy. So, this will propagate as I have explained earlier also. So, then you will have something like this, the formation of it will go I mean it will advance towards the breakwater I am not talking about the stem. If the stem is there, then you see that this will be acting like this.

So, you will have the formation of the beach advancement towards the breakwater of towards the T groin. So, similar to what we have done? What we have seen in the case of

a groin field? Due to a grain field, it will be like this, and due to the breakwater it will be like this. The combination would be looks something like this.

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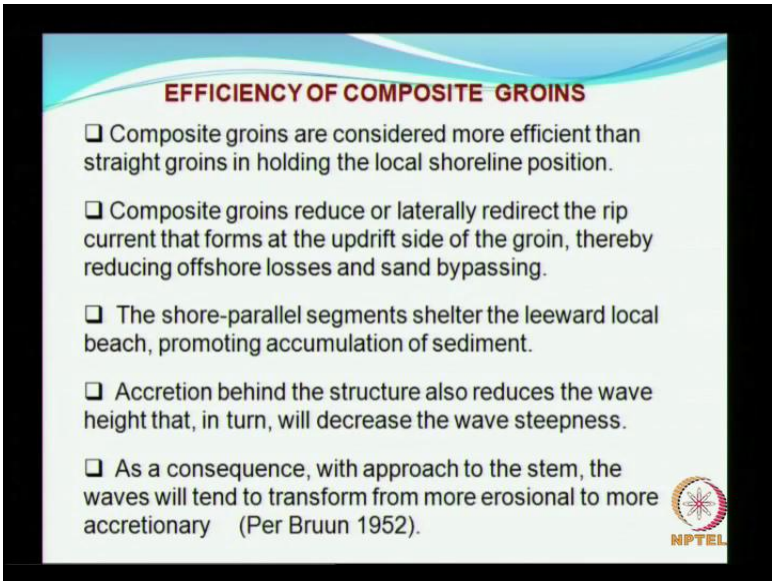

So, now I have told said earlier the when you use groins which are not straight, but which has some kind of arms then we in general refer to as composite groins. I have already explained the purpose or the action or the advantage of having the composite breakwater I mean composite groins. The composite groins are considered more efficient than straight groins in why the more efficient in what? In holding the local shoreline position, all though I am saying holding the local shoreline position in the sense the shoreline itself will be advancing towards the ocean.

And, in order to ensure this moving the boundary towards the groin; this will this if you have a horizontal bar coming up with which is now being termed as composite breakwater a composite groin, this will be more help full in preserving the beach. Preserving the beach which has been last, and one after construction of the T groins you understood. Then the composite groins reduce or laterally redirect the rip current that forms at the up drift side of the groin, thereby reducing the offshore losses and sand bypassing. This is what I have said because.

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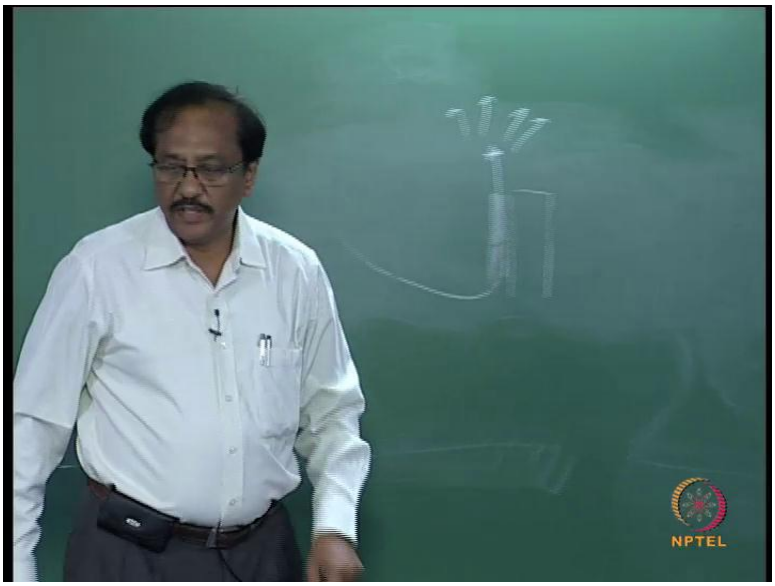

If you have straight groins, we have already seen what happens when the flow takes place, and then the current goes into this. So, there is a strong current here which it called as the rip current. And then after some distance it gets diversed, but then when it is moving like this there is a possibility that that may be a some amount of cover taking place here. And the stability of the groin also might become questionable etcetera, because, if the two of the groin gives way, then the entire groin can collapse.

So, composite groins can reduce this kind of currents which we have seen. Now, the shore-parallel segments shelter the leeward local beach, promoting accumulation of sand sediment. This I have already explained because you have the horizontal bar so it does not allow you the sand to go into the ocean. Accretion behind the structure also reduces the wave height that in turn will decrease the wave steepness this also clear.

Finally, as a consequence with approach to the stem, the waves will tend to transform more from more erosional to more accretionary. The same thing what we have said earlier, once you say that the wave height is decreasing because of presence of some kind of an obstruction. In this case, if you have a composite break water, composite groin then you see that this will promote the personal beach. This will facilitate deposition even in an area where you can anticipate erosion. That is why it is called as coastal protection measure is that clear.

So, although I have explained the phenomenon of the long shore currents how they are generated? What are all the depended variables on which the magnitudes as well as the direction depend? And, what are its effects along the coast etcetera, but I do not think it is nothing can be better than showing them through animation. So, let us try to understand the generation of long shore currents, as well as the movement of the sand. And what happens to the coast when the sand is moving along the coast.

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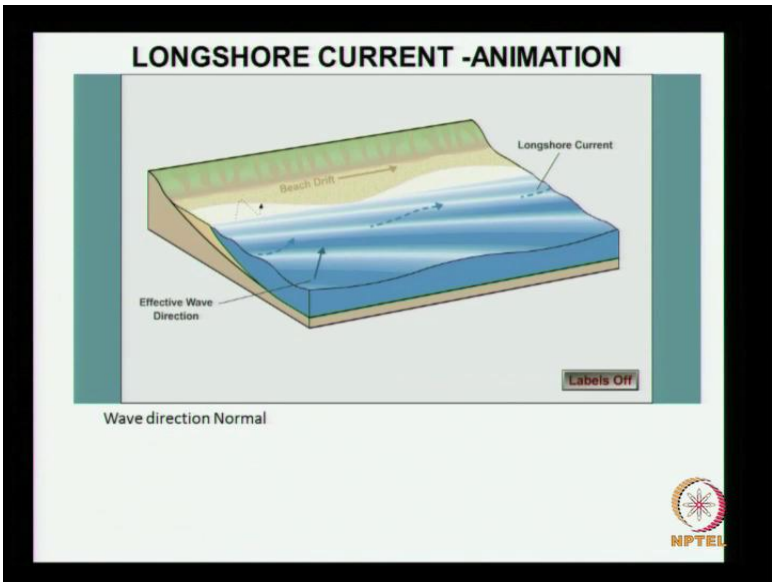

So, these animations will be now helping us to understand. So, a wave is propagating at when you have an, a wave direction that is when the wave is inclined or it is approaching a coast in an oblique direction. Then you see what will happen is? This will have a component in the direction along the coast as well as a direction normal to the coast as we have seen earlier or as I have explained earlier.

Now, you see this is how once a waves break, you have the flow taking place because of the generation of the long shore currents due to the breaking of the waves. This I have already told you that the long shore current will be directed along the coast. And these are basically the wave induced long shore currents is that clear.

So, next so, when you have when you have a wave approaching the coast normal to it when the coast is like this. And when it is approaching the coast like this, then you see then there is no component in this direction. So, when there is no component in this direction naturally you expect q to be 0 that is the quantity of sand moving is 0. And the,

and if it is slightly higher it is slightly inclined like this it is higher, and then if it is much inclined. So, the quantity of the sediment transport will increase as the angle between the shore line.

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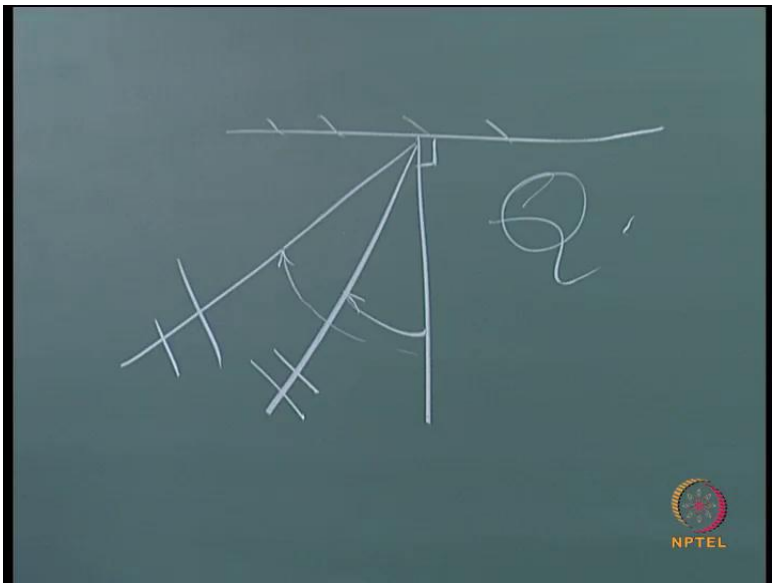

And this is the wave, and this is the shore normal; this is the shore. So, as this angle keeps on increasing, you as the wave as the obliqueness of the waves keep on increasing, you will see that Q is going to increase. And that is what the illustrated with the help of this animation. Next, we move on to understand what happens to the what is the physics or what is the phenomenon that it takes place when you have the long shore current moving along the coast, and when you when and when it meets obstructions. So, let us the most commonly adopted coastal structures which can intercept the movement of sand or the groins jetties as well as the break waters.

So, what I will do is I will just show you the, we are now, this is in the open ocean where you see that the waves are moving. And you have the long shore sediment transport taking place. That is there is no interception to the sand, and the sand is slowly moving along the coast. And now, the moment you add groins. So, we have 2 groins, 3 groins. So, you see how the flow is going to take place. And this flow is going to drive the sediments. And the sediments are going to advance towards the head of the groin. Each of the groin, you look at the variation of the shore lines.

So, shore line will be building up on the on up drift side that is on this side, where as it will be eroding on the down drift side. So, you will have the alternate zones of erosion, and deposition as I have already told you. And then once it reaches the tip of the break water. Then you will see, let us the examine; this is the, what would happen? What would happen in the case of once it has reached the.

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Tip of the break water, tip of the groins, you will see that this is the final scenario that can be expected off. But it has to carefully planned the spacing as well the length of the groins all this things play an important role in the design of this kind of coastal protection measure.

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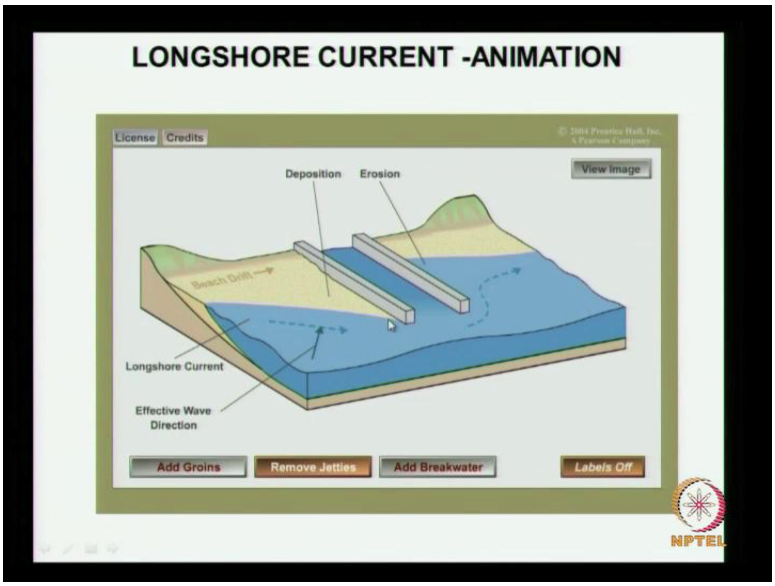

Now, we will close this. Now, what will do is, we will add jetties. Instead of this, now we have a pair of jetties, the pair of jetties are this will serve as an approach channel. Now, you see that you have the advancement of the shore line the direction of the flow is seen in this animation; you have the erosion taking place. And now, because this is sheltered now, the ships can the vessels can go through this approach channel. And that is the reason why the jetties are planned for. And this is the kind of advancement, and the recession of the shore line.

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And let us look at the image; the kind of image can be something like this. So, when whenever you have sand moving dominantly in this direction this has to be longer than the other groin. So, because there are certain areas where such as a coast where you will have all the way direction is.

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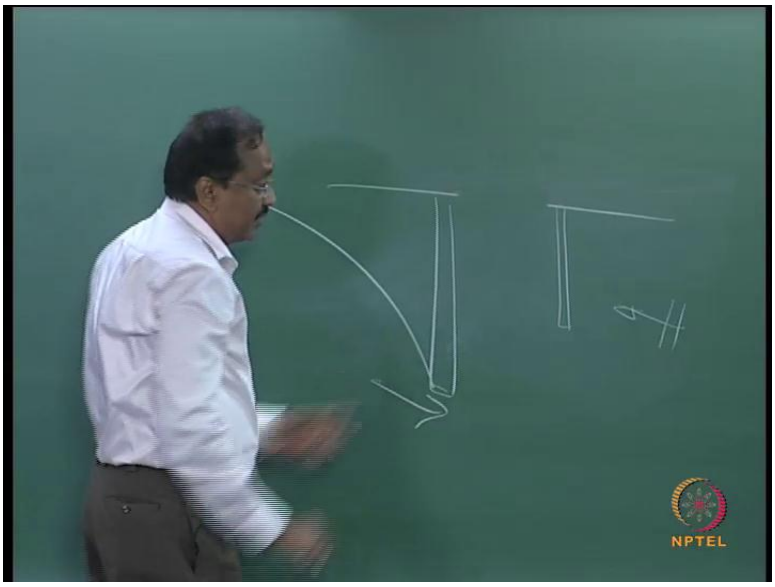

Towards predominantly towards the north, there can be some amount of sand or the wave direction in this direction also. So, hence in order to take care of this, you have you might have to going for a smaller groin. Otherwise, if you do not have this the sand will come and deposit here and this will close. So, you have a pair of groins. And now, this is what is shown in this picture also. You see that the advancement of the shore line takes place. And you will have the beach formed, and this beach can be used for so many other purposes. There are a number of examples for this kind of phenomenon.

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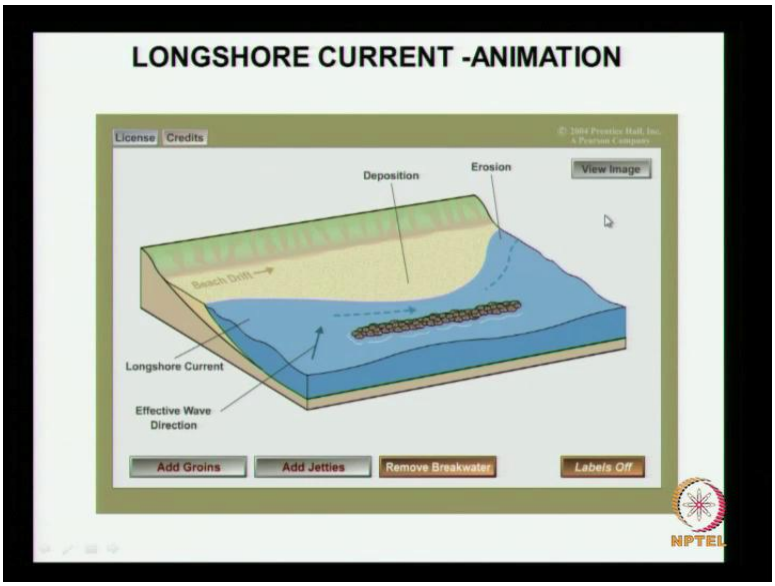

So, now having seen this, we will now, so what we have seen is groins, a pair of training walls. Now, we will move on to the break waters. So, when you have an off shore break waters as we have already seen what happens to off shore break water. When you have break water like this, you see that the sand is the beach is advancing towards the break water, because the energy on the lee side of the break water is going to be less. So, the energy form this end is going to drive the sediments, and this sand is going to be deposited on the lee side. Such formation until it reaches the break water is called as saline as we have already seen. And once it touches the break water we call it as thumbhole. So, let us look at this, let us look at the image.

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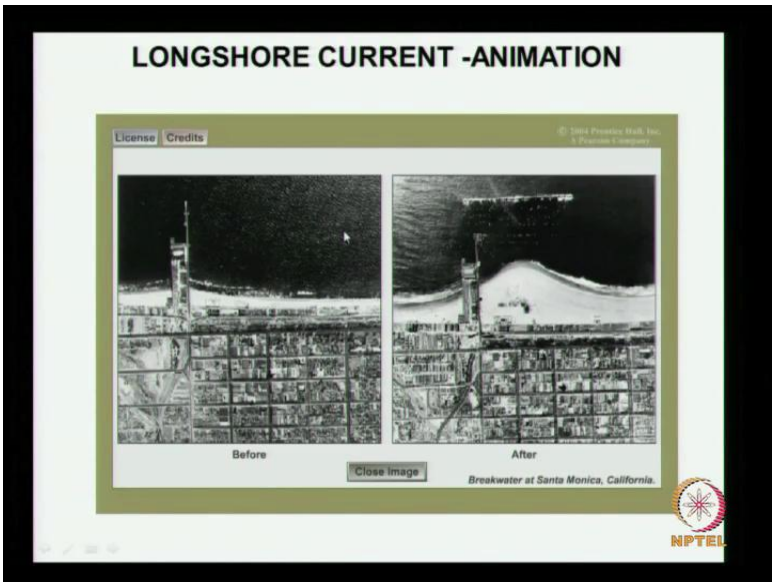

So, you see that you have saline, you have an off shore break water here, and you see the saline being formed we have already seen number of pictures similar to this. So, this I have a taken it.

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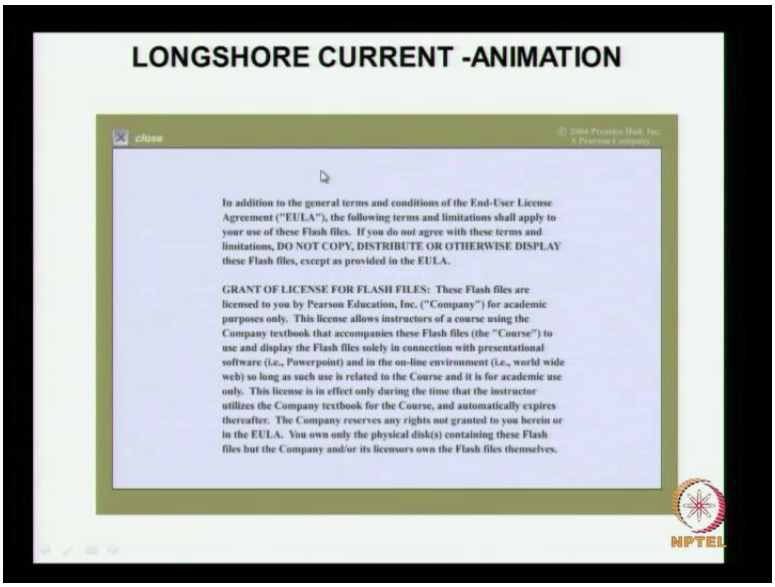

From this, I would like to project this grant of license, this is only for this. These animations I have taken it from some sources, and the sources displayed here. And with this, I will I am sure that this has helped us under in understanding the physics behind long shore current. And its effect on structures new shore structures, because it is always

better to have a look at some of the pictures, in order to understand the effect of these groins.

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So, this is somewhere in a north Germany in the North Sea, where the island of Nordeney, it is it belongs to Germany, where you the entire island it is a tourist place. And the entire island is protected by groin field as you can see here, and because of which you have.

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I have another picture. So, this shows better view about how the groins are functioning as coastal protection measure. So, you can see the beach here, otherwise if this has not been there. Then you can imagine that the island itself can get atleast the significant portion of the island itself could get washed away is that clear.

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And, this picture illustrates yet another view of the coastal protection measures. And the reason why I am I have put here some of the instruments here is it is extremely important to monitor the behavior of the coastal protection measure on a continues basis. When it is coming to the question of I mean the groin field it is always better to understand how the wave climate looks like, how the wave climate inside groin field or the flow field etcetera, how it changes. Because, see here that is what is being done here, you have the flow meters, and the pressure sensor here to get to measure the pressures from which you can derive the wave elevation.

So, from all these things, if you measure the velocities in the 2 direction, you can also get the direction within the direction of the wave within the groin field. See later, when you are talking about the sediment transport, there you will see the direction of the wave is extremely important on in determine in determining the effect of structure or even in that is even in the absences of structure, you need to have a the information about the sediment transport.

So, the quantity of sediment transport is one important aspect but added to the magnitude, the direction is also important which I have already explained in terms of gross sediment transport, and net sediment transport. This is very important. So, if you want to have some kind of information about the performance of the groin field. It is always important to have monitoring program within the groin field. So, coming back to India there are several locations where construction of groins has been done. See, if for example, Kerala; Kerala there has been number of groins with that has been constructed few decades back. But somehow, the information is completely lost, but we do not have much of information about these groins and one of these groins is.

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Groin is somewhere in the cape of in Indian peninsula.

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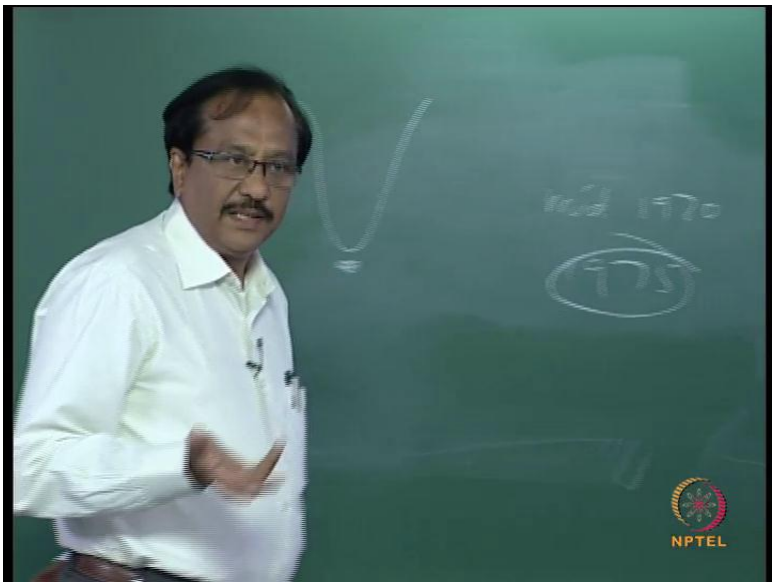

Somewhere here that is cape comorin. So, tip of Indian peninsula, where the groins were constructed as early as February no no, this was constructed some time mid of seventies, mid seventies it should be around 1975. So, this was constructed by the public of department of government of Tamilnadu. And you see that there are some of a 7 groins there. And all the groins do exists even now, there is absolutely no problem the stability of the groins are not questionable. But the purpose for which it is constructed is certainly to retain the sand. So, this is very important when you are planning for groin, groins are more effective as I said earlier along the shore if you have long shore sediment transport.

And if you have more quantity of sediment transport then the groins are going to yield very yield fruitful results within a very short time. Although it is called as a coastal protection measure there is no point in having these groins in a location where there is not much of sediment transport. So, later we will be talking about the case studies as well as the quantity as well as the how the sediment transport takes place along the east along the coast of India. There I will highlight about where exactly the sediment transport takes place.

So, in the cape comorin, you see that this estatus is not much, it does not have much of sand the littoral drift is not much. So, in such a location when you have this kind of groins, it does not really serve any purpose. So, what we have done is during the, so you see that there is not much of beach at all. There only small narrow beach which has been

formed because of these groins. But during the 2004 tsunami, what was what had happened was; this area you had lot of ingress of water, sea water. And there was a sizeable damage done to property as well as boat.

And this is the location where there is a somewhere far away from this about may be about 100, 200 meters from this. There is a small jetty, jetty facilitating the birthing of small craps for the local fisher man. And this is somewhere it is slightly far away from this local village. So, this people where parking there vessels in that particular near the other jetty, slightly this side, slightly away from this kind. So, this resulted in a big conflict between these 2 villages, because these guys they would not like to have other people coming and parking their vessels. So, during the tsunami that was one problem, but and again during the tsunami, the damage caused was quite high here. So, looking at both the problems, the problem was referred to us. And what we had we looked at number solutions options during some numerical, modeling etcetera. And then finally, what we decided is, it was decided that one of this groin that we have 7 groins. The first groin can be extended by about 350 meters I think. Not only that we have also given a small bend here.

This is because; this is for the reason is even in the case of in the event of tsunami. This can act as an obstruction, and can reduce the speed of the tsunami before it reaches the village. So thus, it is kind of a safety measure, and tsunami is not going to come tomorrow or day after tomorrow but it can all it can be anticipated even tomorrow. But when till such an event comes as this is only a precautionary measure against tsunami. But at the same time it should be the investment should be justified. The investment here has justified for the simple reason that this can be, this is being used as the small harbor by the local fisherman. Now, the conflict between these 2 villages is not there and not only that this village is having a small sand bar sand beach formed and that is being used for parking the vessels.

So, now you see that how coastal engineering can be useful. It is not just engineering alone there are lot of social aspects also built into this field. So, when you are planning a kind of structures which we have been discussing, you have to consider you should have a holistic view of all the parameters, and other aspects which are involved while you are developing. There can be a situation where you plan a structure. The structure can serve as a coastal protection measure for the structure the coast which is getting eroded. So, as

such you would have solved that problem. But the existence of that very structure can create some problems downstream of the area, which you have which you claim that it has been protected you understood. So, all these aspects have to be considered before you really invest some money. So, this is yet another view showing how groins can be used.

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This picture just because, you can you see that groins or very nice in protecting as served as a good protection measure at least at locations where you have long shore sediment transport. That does not mean that you have to keep constructing groins after groins. So, if you keep on doing that without any aim.

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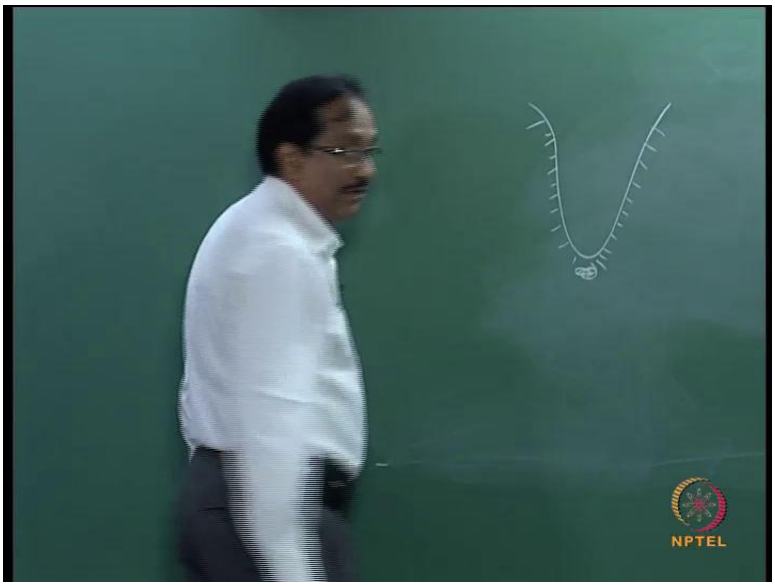

Then what will happen? The whole coast will be looking like a fish thorns. So, that is not the idea. And another thing, so along the coast, there are areas, where there are number of agents is involved number of departments involved.

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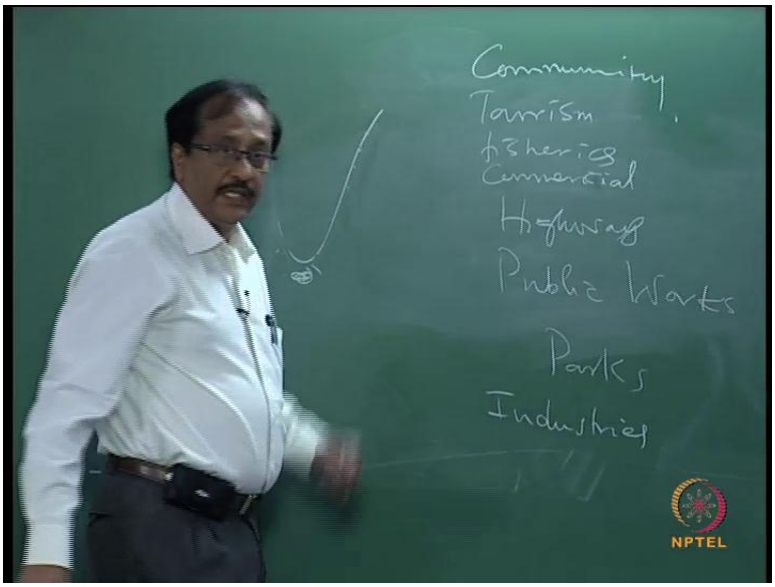

For example, there are there is a system like tourism department is there, fisheries harbor is there, commercial harbor is there. Then there are so many other coastal highways. So, highway department is there, highways which deal with coastal highways. Then you

have a public works department, may be the departments that are responsible for generating parks. Then the most important is coastal community so, and industries.

Ports and anyway ports and harbors are coming into and under commercial harbors, fishing harbors commercial then there are so many other departments or agencies which are which look to the ocean for their benefit or livelihood etcetera. So, you cannot neglect the importance of any of these agencies. If one department does not really interact with other department, other departments, and they then they go ahead with construction of some groin. Then that leads to unplanned sequence of construction. So, unplanned sequence of construction can result in some kind of situation as shown here. So, this is not a correct attitude.

So, now if you want to have planned kind of construction, so this is one example where, so look at this. This is completely planned. There are other projects that have been, that have taken place, the reason for particularly in the UAE, in the Middle East in fact, in the Middle East. So, there are some projects which we may have, if we have time, we can we will try to see. So, this is something like sea groin. Look at this, how it is serving the location, and not only that it has also generated lot of commercial, it is of huge commercial value.

So then you have also the palm tree, etcetera, which I am not going to cover here. But the, what I am trying to say is that, the planning of coastal structures particularly the coastal protection measures has to be done in, and with a scientific basis, with scientific basis. And also consider all the aspects of functional, environmental as well as aesthetics. If all these aspects are considered, then that would result in a good coastal protection measure.

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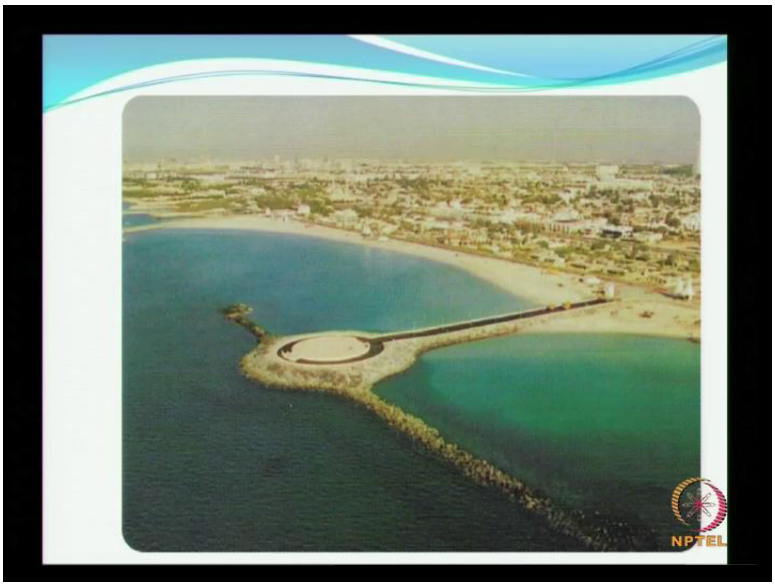

These are closer view of same location.

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So, as I said earlier, we had a picture for training wall. Now, here is the picture which shows that, so look at this, this is adjacent to river. Look at the vertical cuts here. So, that means that much of significant erosion takes place, it is all vertical cuts. And of course, the plantations etcetera, you keep on losing your plantations. So, how do you protect, so you protect not to groins, it is called as T spurs. Now, you see the T spurs here. The principal is same. The flow field takes place, and flow field brings in sediments, and

sediments get deposited and the erosion of the bank is protected, is prevented. Is that clear?

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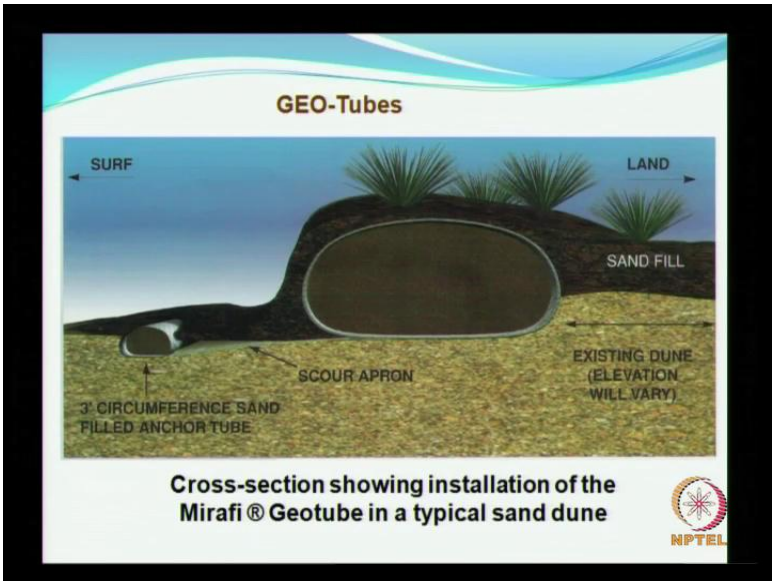

The other thing is using the geo tube. So, this can also be used as a groin which as shown here.

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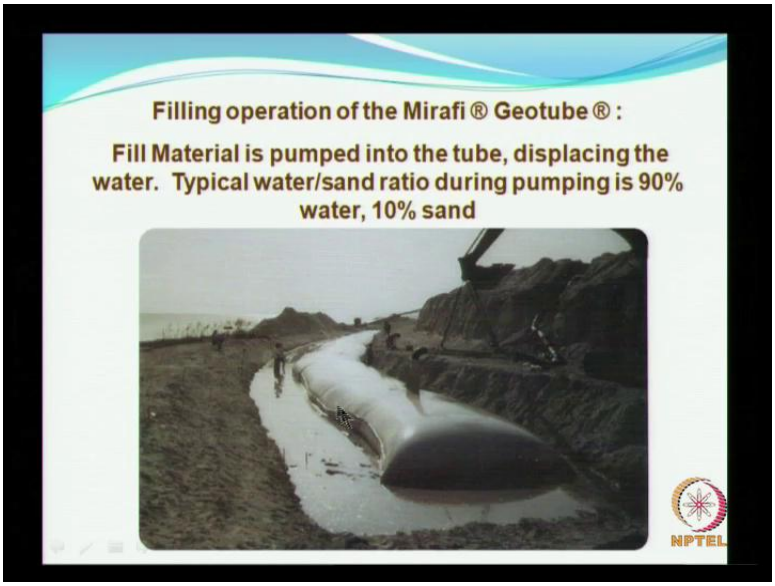

So, this groin, here in this case, it is used as a geo tube is used for protecting the bank. But this can also be put in a normal direction, normal to the shoreline and that will form

as groin, so this is all geo synthetic material. I will try to cover separately about the geo synthetic material.

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There are another different organizations, different companies they have different material. But basically all these things are made out of geo synthetic, geo synthetic material. Are there any doubts?

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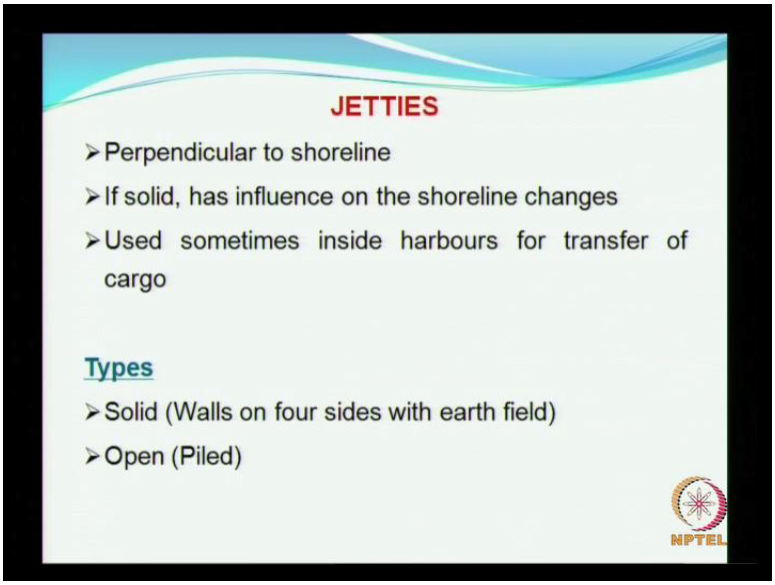

I think we have had enough about groins. Now, all of you are familiar with groins, right; Sea walls also very clear. So, now we will move on to jetties. Jetties are also

perpendicular to the shoreline. If solid has influence on the shoreline changes, used sometimes inside harbors for transfer of cargo. You have 2 types, solid walls on four sides of the, with earth field or open. So, let me give you an example of Gopalpur port. Gopalpur port is situated along the east coast of India. This is only an example to show what is a jetty?

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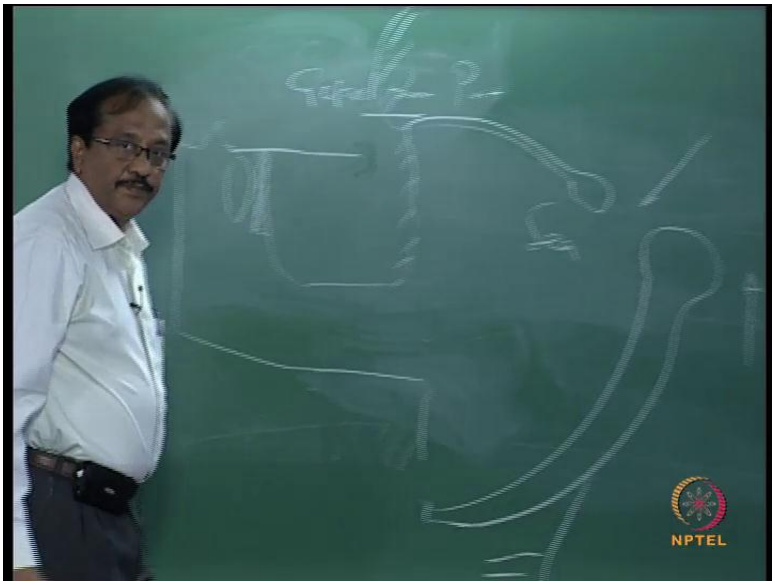

So, here in this is the ocean; this is the birthing area, where in you have the vessels coming on birthing here. These are all land. Now, this is the shoreline. So, on the assumption that this is sea, on the assumption, that this is open for example. How do we generate a breakwater? How do you construct a harbor? You can construct a harbor with a breakwater like this.

The vessels can come into this and then go into that. But when you have like this. So, you will have the advancement of the shoreline here, because as we will see later. The sand will always be moving in the north. The net movement of sand is always towards the north along the east coast. Because of which, you will have the advancement of the shoreline on the south. And then on the north, you will have the erosion taking place. So, instead of having a permanent obstruction to the movement of, movement of the sand, the other possibility is to construct approached vessel. What is meant by approach vessel?

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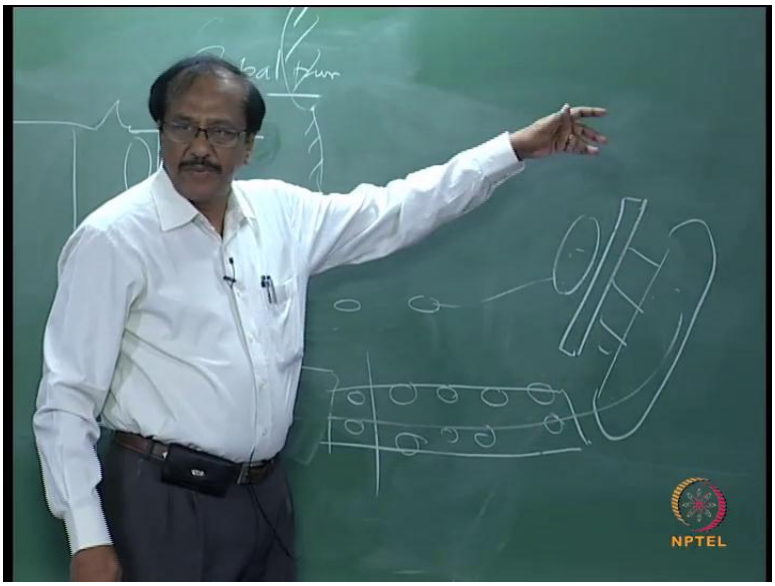

This is a pi, this is a jetty supported on piles. This is in plan. So, this is supported on piles. So, you can walk over it, or you can have the vessels going into this, and then here, I shall have a breakwater, for example. And then, I can have a birth here, where in I can bring in deep size vessels, birth here and have we have the cranes, so unload the cargo. Once it is unloaded, it can be transported through your jetty or the approached vessels to your land.

Or the other possibility is, to you have the supply vessels, small vessels, so which will transfer the cargo, and then bring it and birth it and you can. So these are some of the concepts which we can think of. The idea here is, when we have the piled jetty, the sand is not the movement of sand is not affected. You are not disturbing the shoreline. And after all what you need? You need only the tranquility conditions for birthing of the vessels for which you want to have a breakwater. But whether this size of the breakwater is good enough for the required tranquility, because if the tranquility is not there. What will happen to the ship? It will be oscillating, then how do you load or unload? It becomes very difficult.

So, that is why you always have a breakwater here. But how long it has to be, and how effective it will be, in providing you the required tranquility is a question, which needs a detailed investigation before implementing. So, this was the original idea of the

Gopalpur port. But I will not cover this is only to illustrate to you, how and where you can have a jetty.

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But, then there is another picture, which I can show you in the next slide, which will explain to you which will explain to you the difference between earlier we, had the difference between a picture showing you directly the difference between groins and training wall. Now, here, this is going to explain to you, the difference between a jetty. Because this can also be referred to as jetty, because it is allowing the, this is the approach channel where the boats going through this. And then it is unloading or loading is taking place inside the harbor. So, this forms as a part of the harbor. So, we call this as a jetty. Or sometime people all also call this as a breakwater, I had training wall also but when it is associated with the harbor, we call it usually as a jetty.

A jetty is another, so see in this particular case what I would like to highlight to you is, that look at the phenomenon of the sand or the abolition of the shoreline. Because of this, the shoreline has advanced up to this. That means the sand is moving from bottom to top. Sand is moving in this, from this direction to this direction. So, because of which you have the advancement of the shoreline, but on this side you have the erosion taking place where in order to control that you have the groin field. Now, this slide shows you the combination of jetty and your, so another thing is the other.

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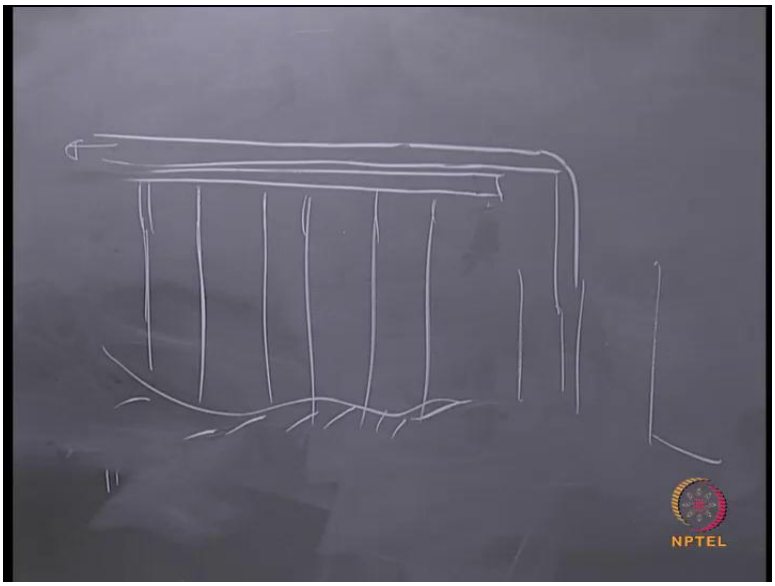

So, jetties can also be for example, it can be supported on piles, only a representation. So where in I can have a pipeline. I can have a pipeline which is going into an intake well, to suck sea water, may be for aquaculture of a coolant purpose or thermal power stations etcetera. So, now the pipeline is made to rest on the jetty. So, a pile should action. You understood? So, this is the pipeline through which the water is sucked in. So, this entire system you have a an intake well, a pipeline, and then a kind of a sink, where in you collect a water for your purpose for the purpose, for which it is all these things are late. Now, this is called as, this is a very old kind of a structure where they have used a cellular type sheet pile, steel sheet pile jetty, as earlier as 1965.

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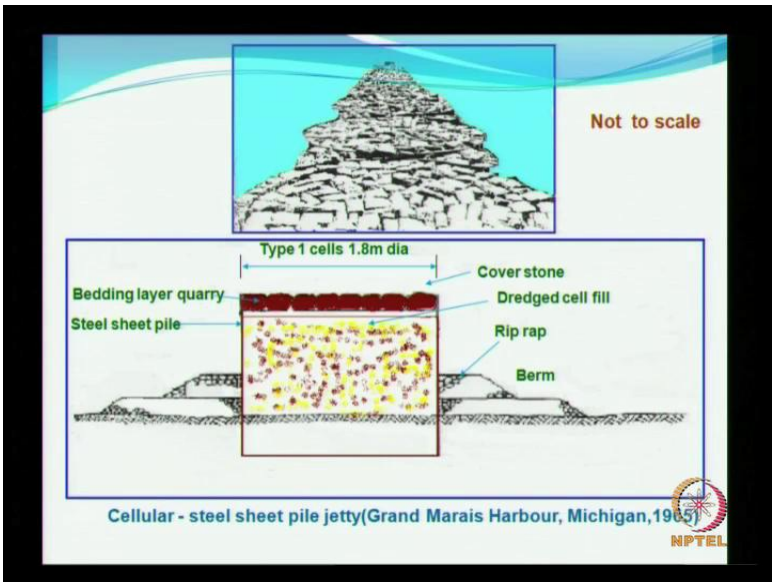

So, the details are shown here, where in, you have the sheet pile, then the dredge cell fill. You fill the, they have filled the dredged spoil and then they, so it increases the gravity, and then takes in to the ocean. Now, with this I will stop.