Ocean Structures and Materials
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Module - 2
Lecture - 3
Construction Techniques

Ladies and gentlemen, welcome to the lecture 3 on module 2 on the course Ocean Structures and Materials. In this lecture, we will discuss about different construction techniques has applied to construction of ocean structures.

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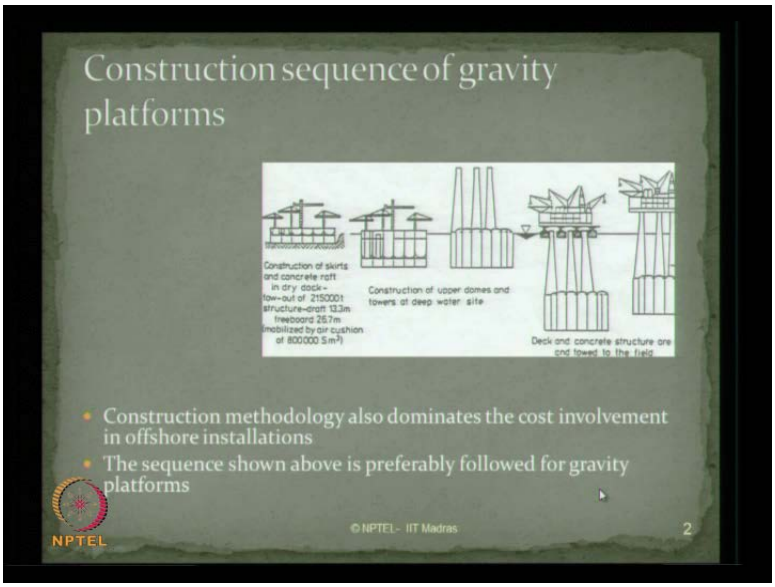

If you look at the construction sequence of one of the type of offshore structures - that is gravity platforms. The picture shown on the slide will explain you the construction sequence of gravity platforms. For example, starting from the left, the construction of skirts and concrete raft in dry dock which has been showed here is stored down. Then once it is stored down on a specific achievable draft then the construction of upper domes is done and the towers at the deep water site are constructed. Then the deck mating that is top side of the concrete structure are then constructed which have been towed on else and brought to the field. The construction methodology generally dominates the cost involvement in offshore installation. The sequence shown above is preferably being followed for gravity type of the platforms.

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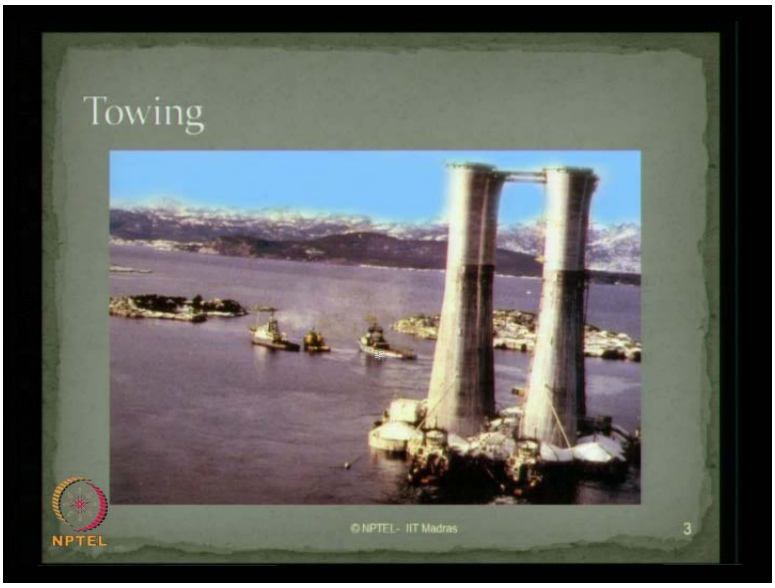

Let us quickly see some of the photographs which have been actually saying these construction and installation operations in different stages. The photograph what is see here essentially is showing, the towing of the platform with that of the boats.

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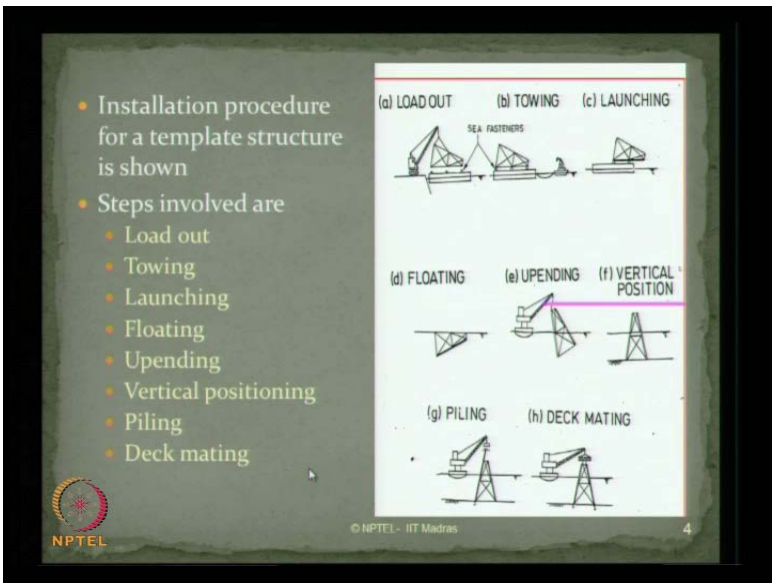

There is different sequence of operation which generally carried out in case of the installation of offshore structure. The first operation as you see here is what we call as load out; where the template structure is kept on the barge load out on the sea fasteners, then it is towed down to the site then it is being launched on the rollers, once it is

launched, it starts getting floated. Then using a special barge green, it is upended to a vertical position so what we call this as vertical positioning. Once it is positioned then the pile is driven as you see in this figure. Then ultimately what is a jacket is stabilized then the top side that is the deck mating is done sequentially. So, the steps involved in installation procedure of a template structure of the following in the same sequence. Load out, towing, launching, floating, upending, vertical positioning, pilling, and finally deck mating.

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Let us quickly see, these different stages of jacket platform in detail. So, now, this photograph shows you the transportation of jacket platforms on a big barge as you see here. This is the jacket structure which being transported.

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Followed by which the jacket structure is launched, so the photograph shows the launching of the jacket from the barge of the tilting the barge. So, this is the jacket template structure which is being tilted from the barge.

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One side is tilted then the piles are being driven using a special type of the barge, which has got the loading capacity of the pile driving capacity here.

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Once the pile is driven and the bottom is stable then the top side is being installed what we call deck mating. The deck mating is done by lifting the deck using an offshore special type of green barges, which is installed on the bottom structure as you see here.

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If you look at the construction or installation sequence in terms of jacket platforms, which was see in previous slides. The current slide shows you jack up with platform in a raised position. You can see here these are the jack up legs and this is the platform in a raised position.

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Then the jack up drilling well is again helping or it is actually doing drilling in the jacket structure. The jack up is doing drilling in the well of the jacket structure as you see in this photograph.

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This photograph shows you the dry tow of the semisubmersible. So, this is the semisubmersible kept on a barge and being go to site for exploratory drilling. So, we call as dry tow operation of semisubmersible.

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We can also do a wet tow operation of transportation. Now the figure what is see here show wet tow transportation of a tension less platform. So, this is the tension leg platform with top side details are see you here. So, these are all being guided by the duck board of lead barges and it is being wet tow to the site of installation.

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This is again a dry tow operation of a SPAR platform. This is actually a SPAR, which is being kept on a big barge, and therefore this operation is called dry tow. Ladies and gentlemen, it is easily recognize that when the body of the platform is not immersed in

water then we call this as dry tow transportation. Alternatively, when you use the same vessel for transporting directly by the floatation principle then we call that as wet tow transportation.

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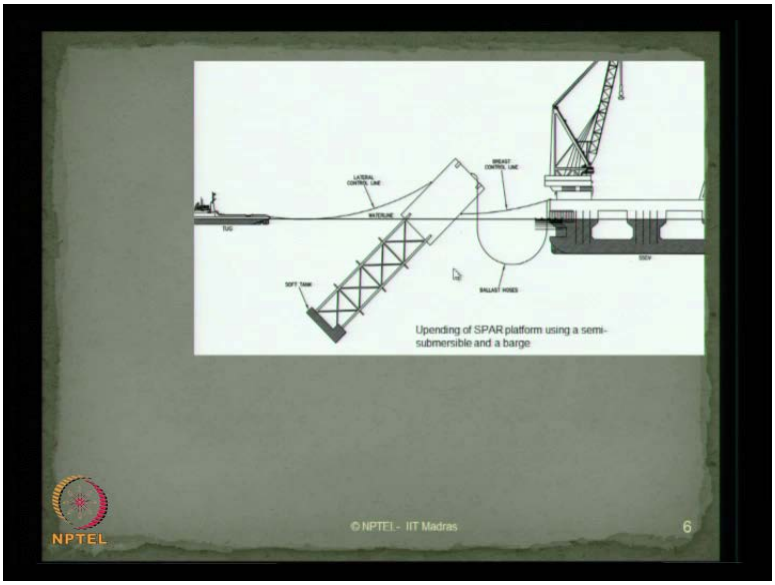

Now the photography you see here is a wet tow transportation of a SPAR platform. Once the SPAR is towed to a desired location using a dry tow operation, then the SPAR is upended from the barge or semisubmersible and a barge and this upended to form a alignment as you see in the photograph here. This is being controlled while upending using a lateral control line which is being anchor to a duck board on one side. The Brest control line is again done from semisubmersible itself. The semisubmersible is housed with the special type of crane, which can hold it vertically up side. So, that the ballast hoses this keep on ballasting the chamber, so that the upended SPAR can become erect as the ballasting is being done on the ballast chamber of this spare platform.

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Once the spare is install vertically then the top side details are attached to the SPAR what we call deck mating of a SPAR using a floating type special kind of crane as you see in this picture.

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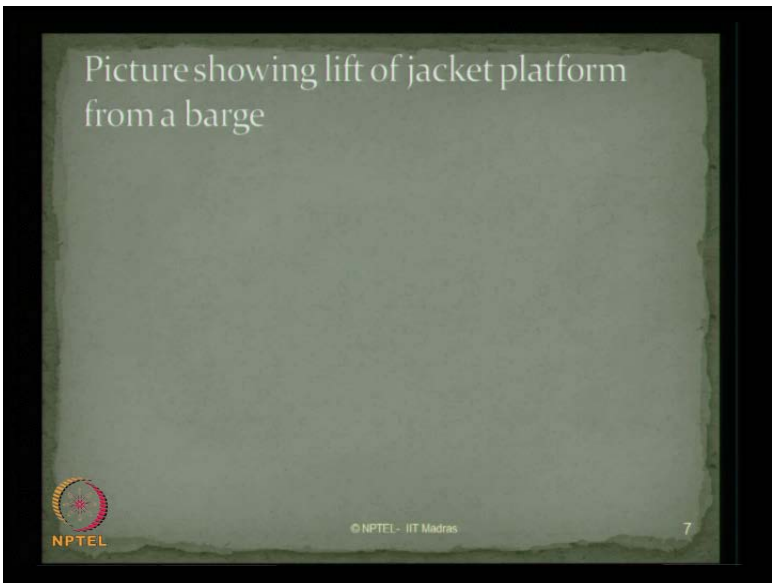

I will show a picture, which can lift jacket platform from a barge at the end of this lecture.

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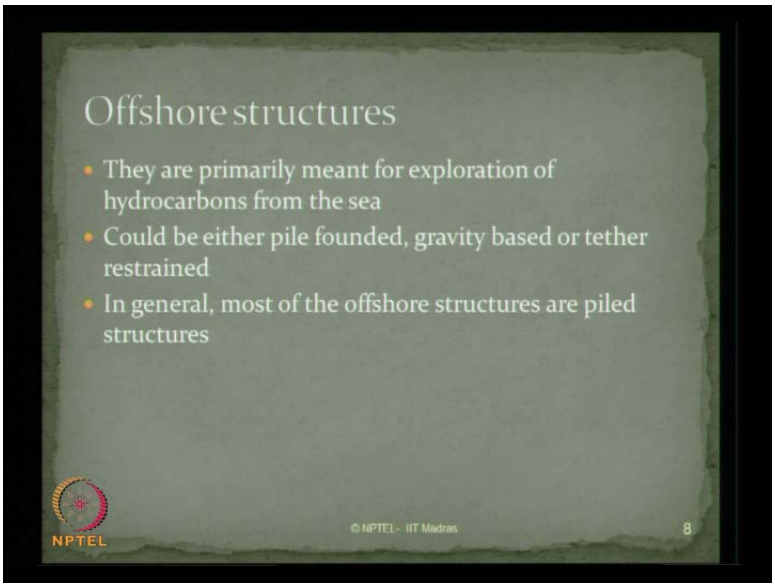

Now let us quickly see what are those special kinds of equipments which are required for construction and installation of offshore structures. As we all understand ladies and gentleman, offshore structure are primarily meant for exploration of hydrocarbons from the sea. It could be either pile founded, can be gravity based or it can be rather restrained structures. In general, most of the offshore structures are piled structures.

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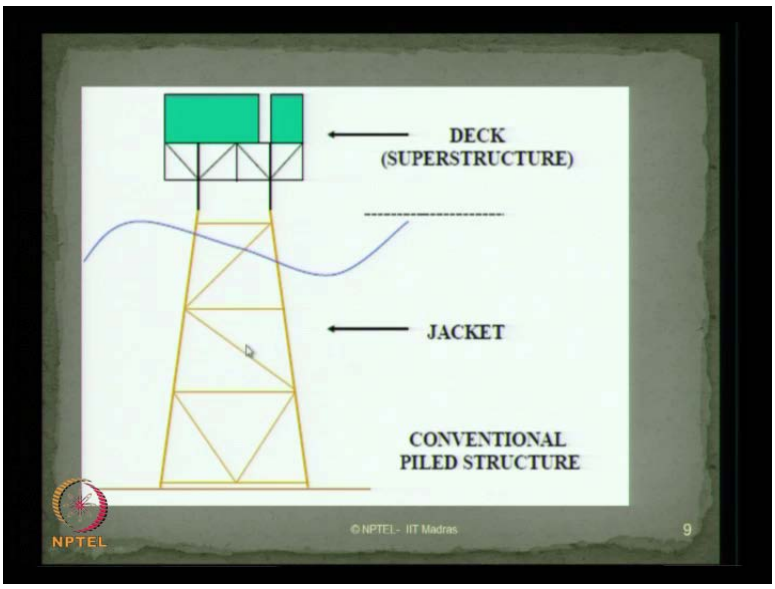

Now the sequence of figures what you see now will tell you the sequence of construction and installation procedure of a conventional piled structure. So, it is the deck which you

see on the top side in green color which we call in the super structure this is supposed to be a mean sea level this is we call as a jacket. This is a photographs are schematic view of a conventional piled structure.

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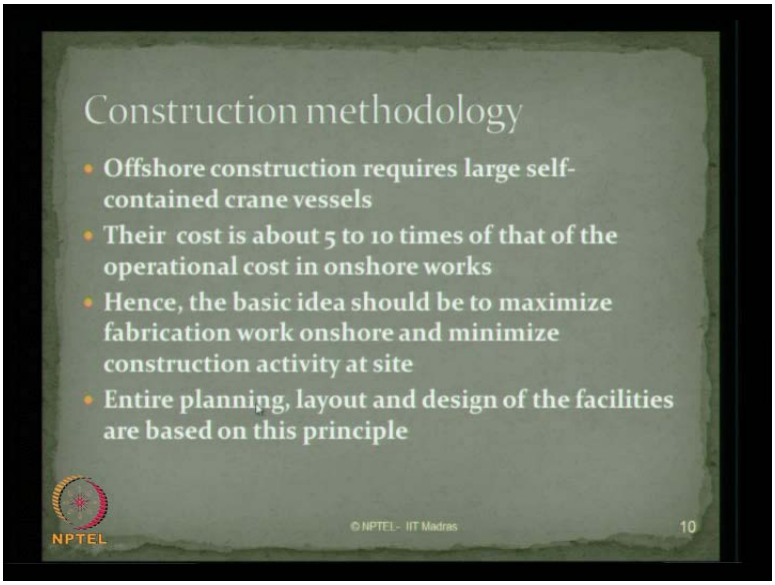

Let us quickly see a construction methodology which is generally adopted for these kind of template structures. Offshore construction actually requires large self-contained crane vessels. Their cost is about five to ten times of that of the operational cost in the onshore works. Hence the basic idea of offshore construction methodology should be to maximize the fabrication work onshore and to minimize the construction activity at site. Therefore, entire planning, layout and design of the facilities are completely based on this specific principle on maximizing the fabrication onshore and minimizing the construction activity at site.

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This is a special kind of crane vessel as you see here which is being used for erection or installation of a template type offshore structure.

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This is again another kind of special crane which you see here is called SSCVThialf a special kind of crane which is being used heavy duty crane which is being used for installation of template structures.

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We can also have a crane barge whether barge can housed different specialization of crane, which can be also use for holding the jacket structure in position during driving. You can also have a crane barge with a special kind of equipments as you see in this photograph.

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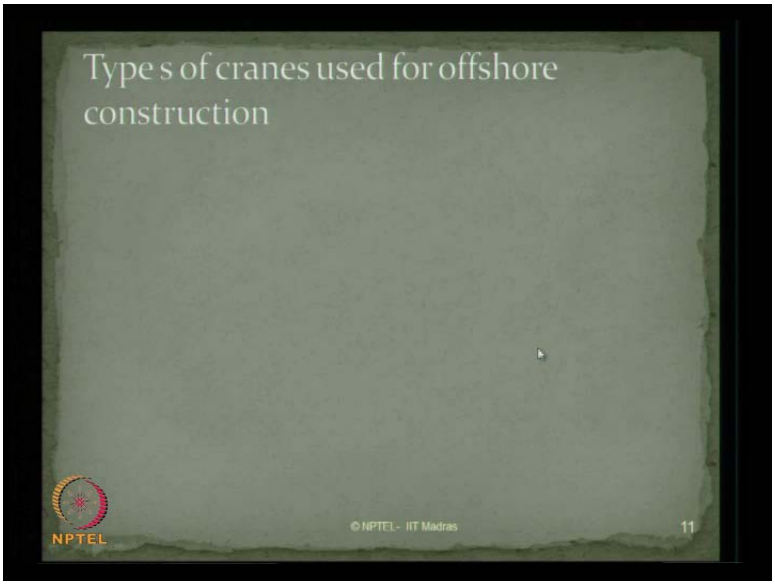

There are different types of cranes generally used for offshore structure construction.

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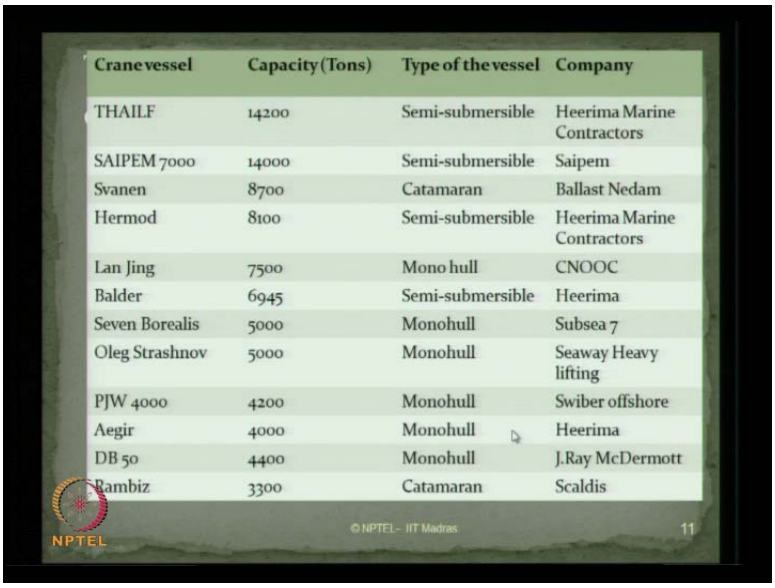

The table gives you a comprehensive layout of different kinds of cranes with their capacity, the type of vessel where there are housed and the name of the company which owns this type of crane. As seen in the photograph earlier THAILF is the very heavy duty capacity crane which can has a capacity of about 14200 metric ton which is generally housed on a semi-submersible which is owned by Heerima marine contractors. Alternatively, SAIPEM 7000 is also another kind of crane vessel which has a close capacity about 14000 metric ton which is also housed on a semi-submersible which is owned by a company by name SAIPEM. Svanen is a another category of crane vessel which can has a capacity above 8700 tons; Hermod, Lan Jing, Balder are all in the same range of capacity which are varieties of crane vessel some mounded on semi-submersible and some mounded on Catamarans. Of course, you also have lower capacity crane vessels ranging from 3000 tons to 5000 tons, which are usually mono hull type of vessel, which are owned different company in this table.

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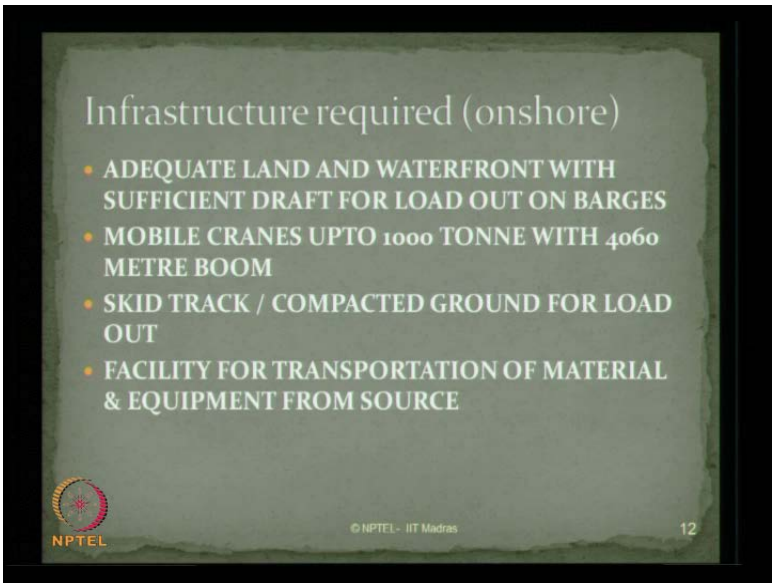

If you look out an overview of the infrastructure of required onshore to make a platform executable offshore. You must have adequate land and waterfront with sufficient draft on load out on the barges. So, your infrastructure on land should have land area and very large waterfront because water you fabricate on the yard load should be loaded out on barges in front of your adequate land. Mobile cranes are generally used which has a capacity up to 1000 metric tons with 4060 meter boom length. They also should have skid track arrangement or a compacted ground for load out facility, because load out facility can become simple when you have a skid track arrangement, the fabricated jacket structure can be skid to load out on the barges. The facility for transportation of material and equipment from source is also required onshore to have adequate fabrication convenience for the jacket structure.

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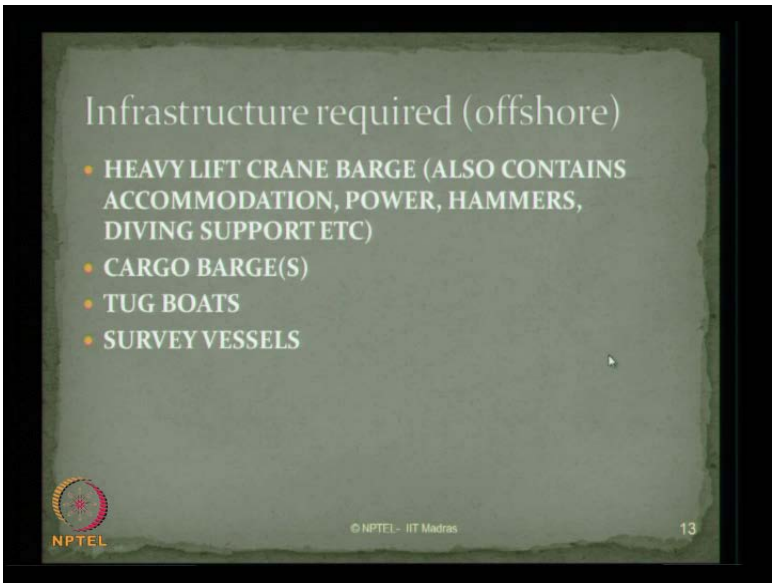

Adding to it, heavy life crane barges as you see in the previous slides, which also contains accommodation, power, hammers, diving support etcetera which are available on the crane barges should be made readily available during installation of jacket structures. You should also require cargo barges, tugboats, survey vessels etcetera of during installation of template structure.

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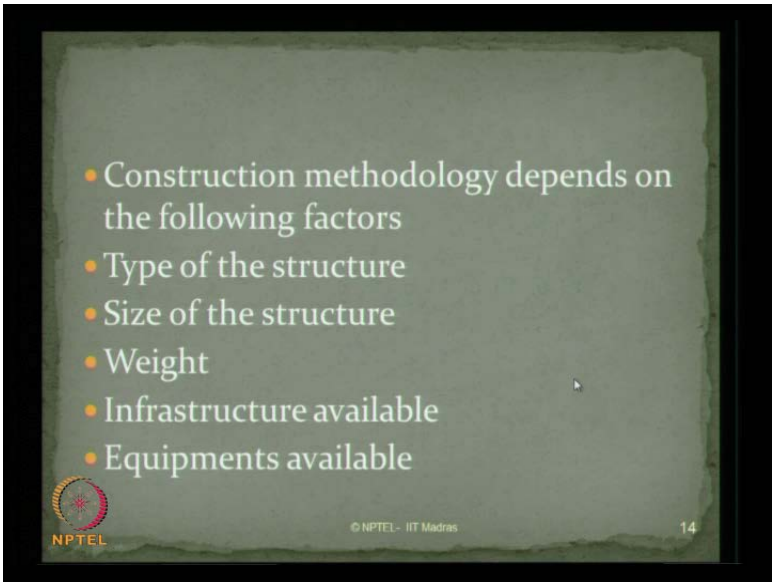

Therefore, ladies and gentleman, the construction methodology of a template structure mainly depends on many factors I am highlighting some of the critical factor as you see

in the slide here. It depends on what type of structure you are going to install. It depends on the size of the members, the overall dimension of the structure; it of course, depends on the weight, because you got select the crane and other equipments which can cater to erection of this kind of structure. And it depends upon what infrastructure do you have at site, so the availability of infrastructure, what is availability at site also plays a very critical role in deciding the construction methodology for your template type of structures. It also depends upon what is the facility of equipment your have in your factory or in your yard for installation.

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There are different alternatives available for load out operation in jacket structures. In your screen, hydraulic transporters can your skidding out your arrangements instead of load out. Specialized cranes are generally used for lifting heavy loads in terms offshore construction. Largest crane vessels are often catamaran or semi-submersibles with increased stability as you saw in a previous table. Catamaran is a geometry stabilized ship, usually multi-hulled and they are engine powered, which are generally used for installation as crane barges. The photograph what you see here is the Salem ferry catamaran and which is a multi- hull which has got equipments of higher capacity for lift.

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They are alternative arrangements are also available for jacket installation. Can either do lifting or launching; it can also do alternatives for deck installation as lifting or float over.

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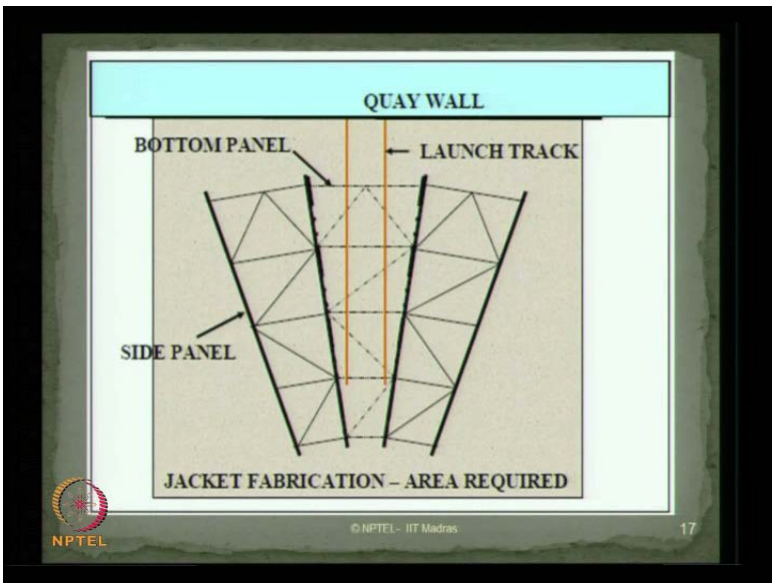

Now let us quickly look at some series of pictures that shows me what are all different steps involve in jacket launching and installation and commission. The jacket fabrication is the picture what you see here which requires large area of the fabrication yard. For example, this becomes a launch track and this is what we call as the quay wall, at the

center of launch track at either side you can start fabricating the side panels and of course, you also have the bottom panels fabricated on the yard.

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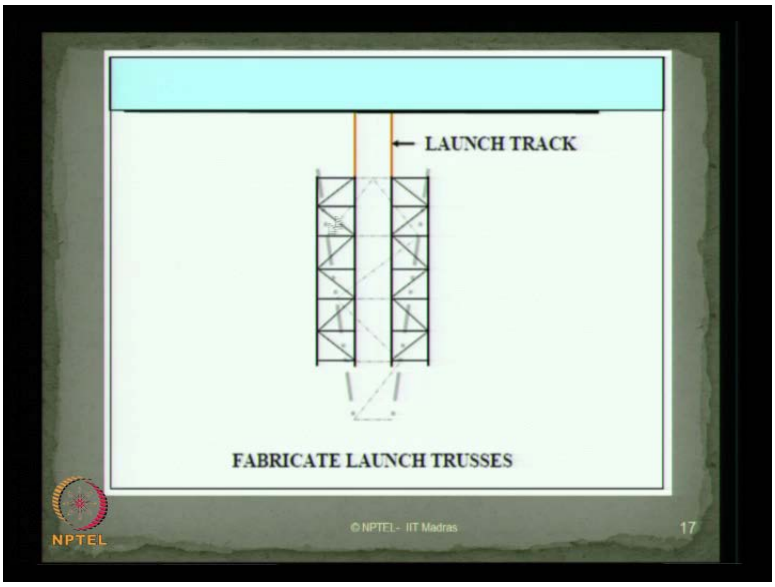

Once the fabrication is done then the launch track is ready and the fabricated launch trusses are broad to the launch track.

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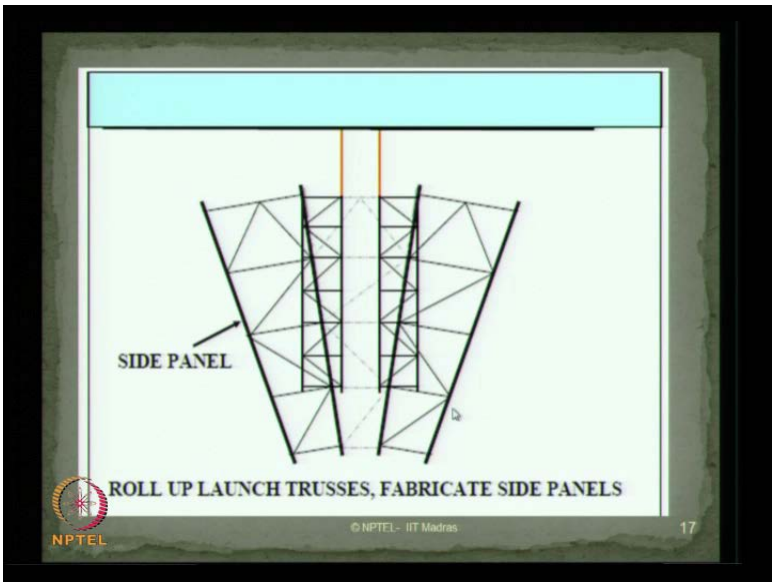

Then you roll up the launch trusses and fabricate this side panels. These are the launch trusses and now the figure shows the fabrication of the side panels.

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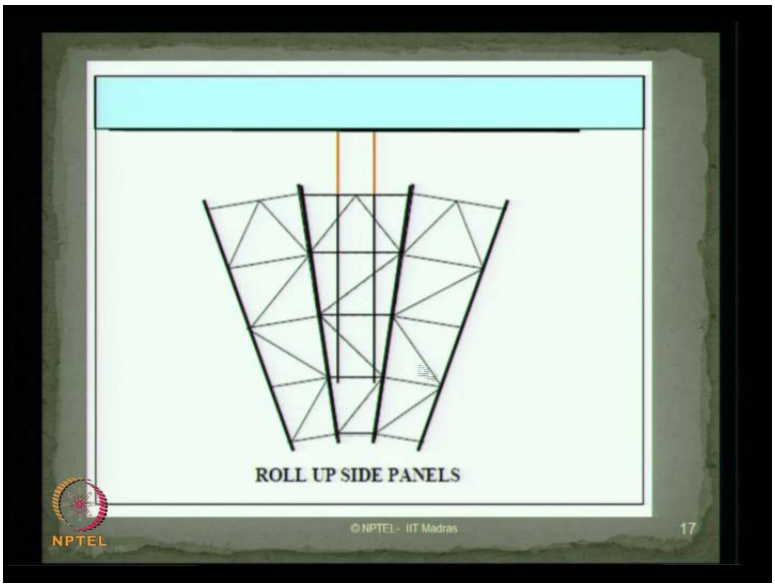

Once the side panels are ready then roll up the side panels to the proper required alignment as you see in this figure.

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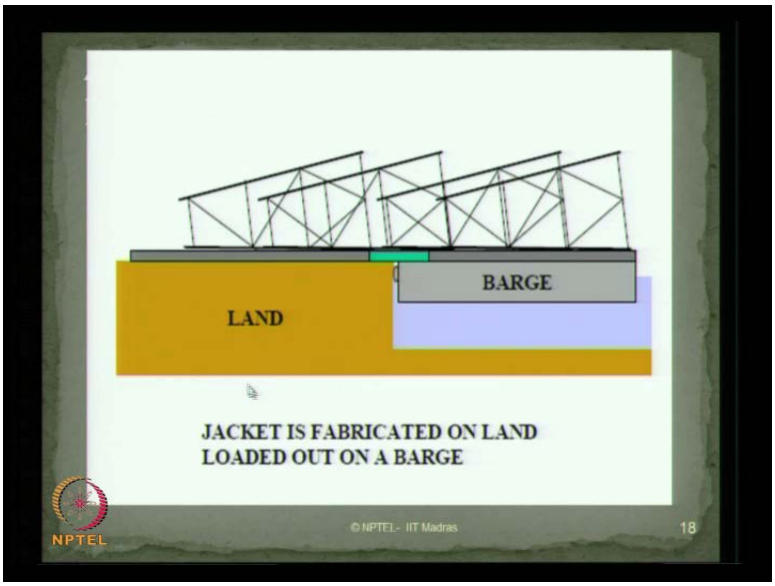

Now you have completed the fabrication and it is ready for load out. After fabrication is now complete, we will think about the steps about launching. So, you place it on a barge, because this is a land where you fabricated. These are the steps sequence of steps involved in moving the fabricated truss or the jacket template to the barge jacket. The

jacket is now fabricated on land and load out on the barge the operation of shifting to the jacket barge is what we call as load out.

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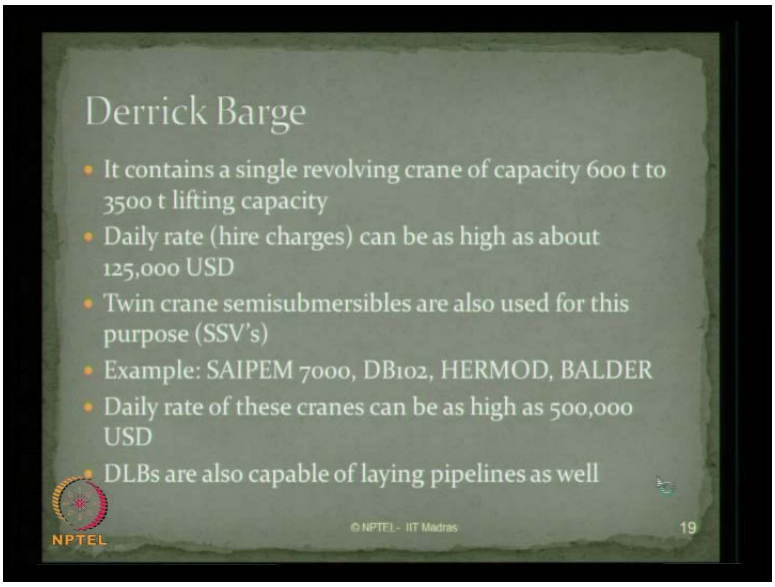

Once it is loaded out on the barge, you can have different kinds of barges, which can contain this kind of template arrangements. Derrick barge is a single revolving crane of capacity 600 tons to 3500 tons lifting capacity. The daily rate or the hire charges are these kinds of barges are phenomenally high, it can be as high as 125000 US dollars per day. You can also have twin crane semisubmersibles which can also be used for jacket launching. For example, SAIPEM 7000, DB102, HERMOD, BALDER are different types of twin crane semisubmersible vessels which can be used for launching jacket structures. The daily rate of these kinds of cranes can also be as high as 500000 US dollars. DLBs are also addition capable of laying pipelines as well.

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SAIPEM is now in operation in the photography see here in Malaysian water. This is actually a type of a crane barge vessel which is loaded on a semisubmersible which is used for erection of the jacket structure as you see here. SAIPEM 700 is a special type of crane barge which is loaded on semisubmersible which is now in action to access the installation and erection process of the jacket structure as you see in this photograph. SAIPEM 7000 is helping for installation and also you have been parallely the jack up rigs are available for exploratory drilling on the platform. We can see here in this photograph SAIPEM is being short during installation jacket as you see here.

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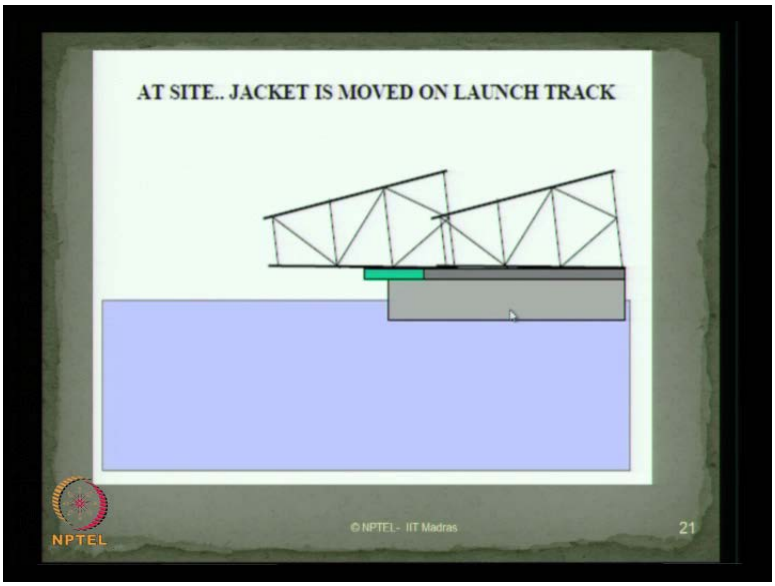

At site once, the jacket is moved on the launch track, now the barge is grab to the side and then subsequently the jacket is tip over what we call the rocker arm. Over a rocker arm the jacket is tipped down.

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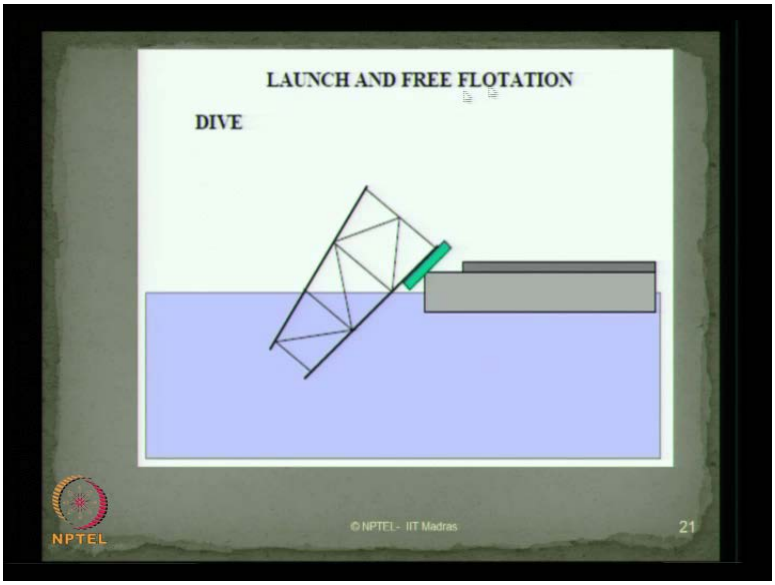

There are two terminology available here; one terminology where the jacket is being tipped off is what we call diving, this operation is totally called launching and free floatation.

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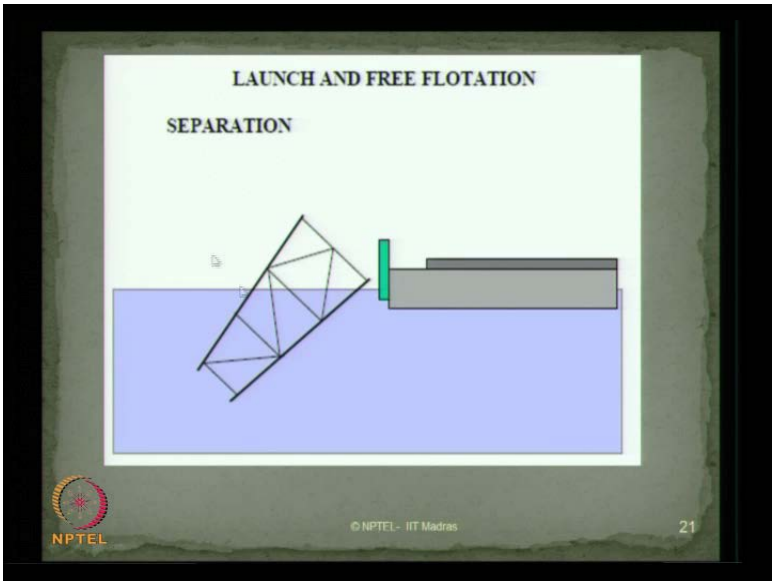

Once it is made to dive then the separation takes place and the jacket template gets away or gets this disconnected from a rocker arm of the barge, so this is what we call as separation.

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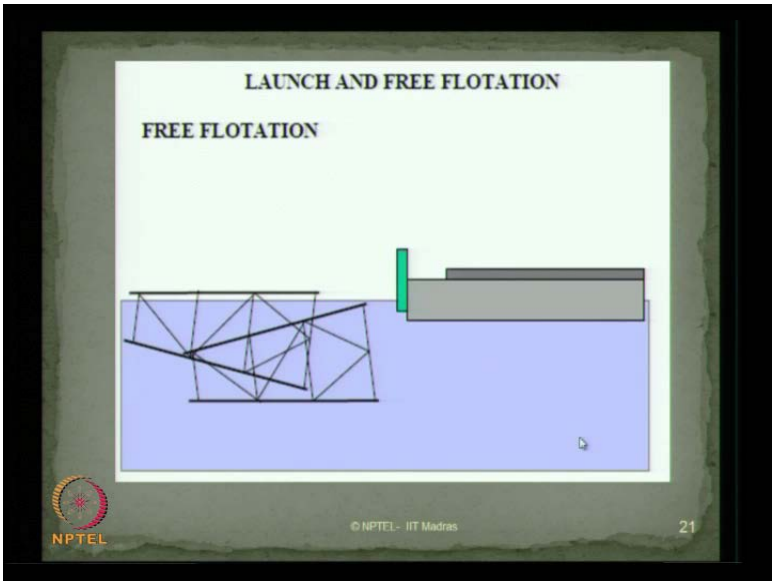

Once it gets separated, it starts free floating, because of this design of in terms of buoyancy it is starts free floating.

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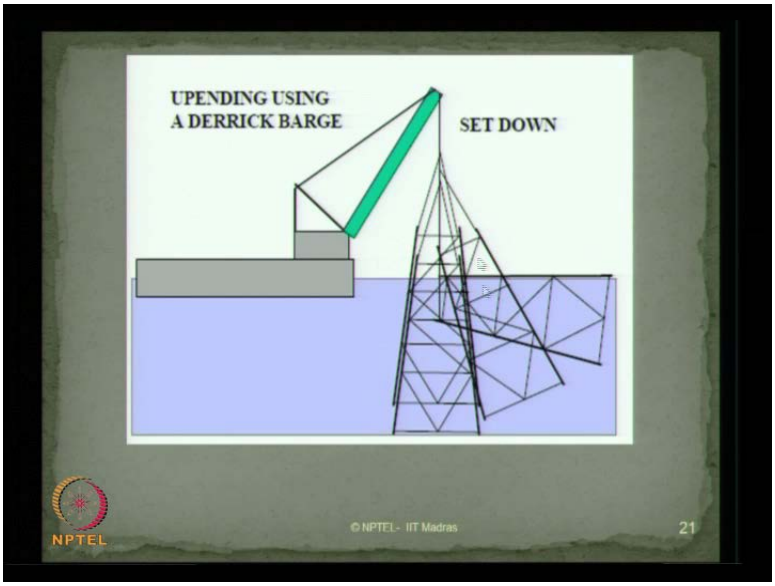

Once it starts free floating then I am going to use a special kind of crane or a semisubmersible for example, SAIPEM 700 which can do the upending operation.

Upending is related to making the offshore jacket in a vertical position. This is the original position as it was floated. Now it is be lifted up and made erect this is what we call as set down operation.

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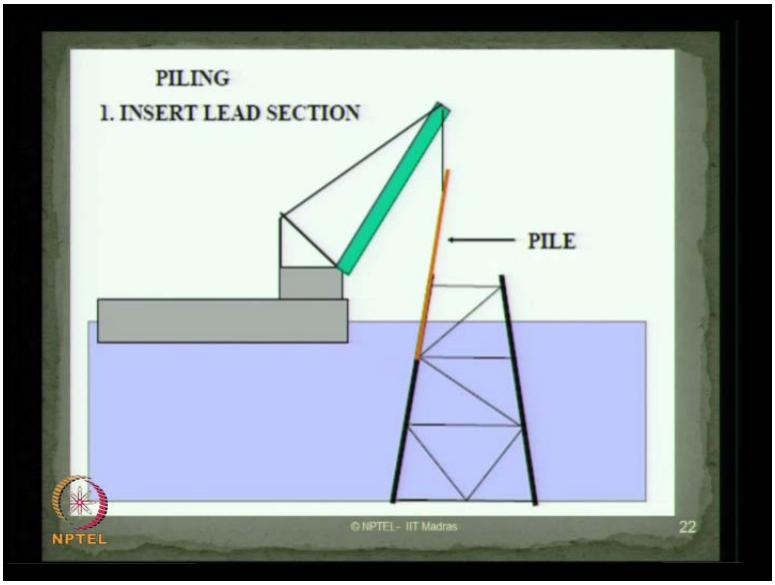

After set down is done, piling is got to be done to whole the jacket in place. So, the first step is insert the lead section which has got to be pile into the sea blow. The orange color section what you see here is what we call a lead section. The insert of the lead section into the template area.

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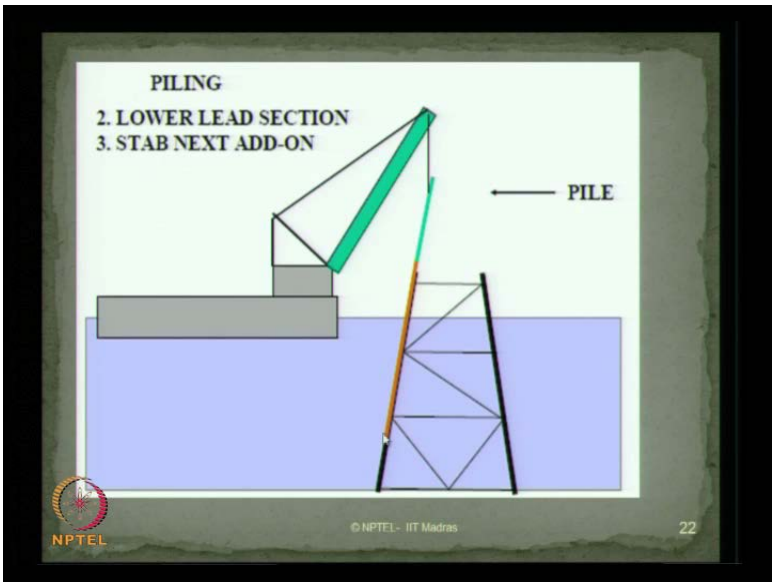

Then the second step will be lower the lead session and then add on into the next session. I am keep on loading the lead session and adding the sub sequence section to the lead section, so what we call as piling operation.

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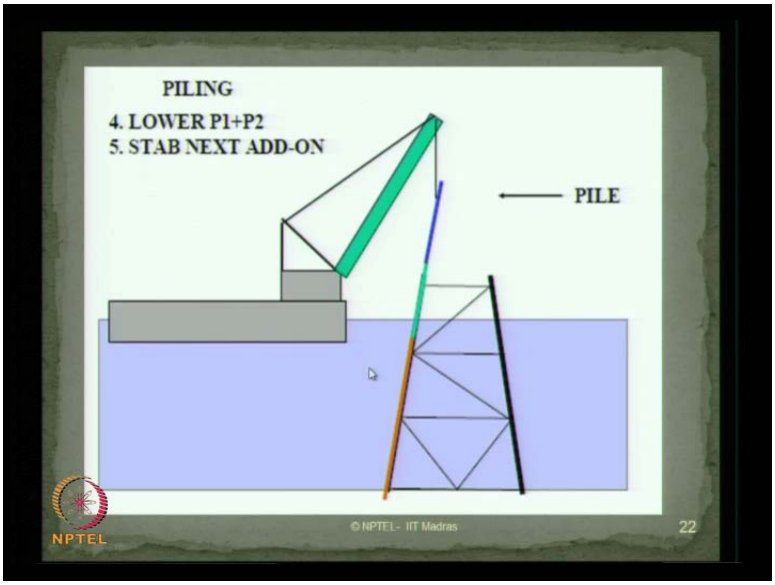

Once the P 1 and P 2 are lower then keep on adding as many sections what we do depending upon the length of the platform or height of the jacket structure.

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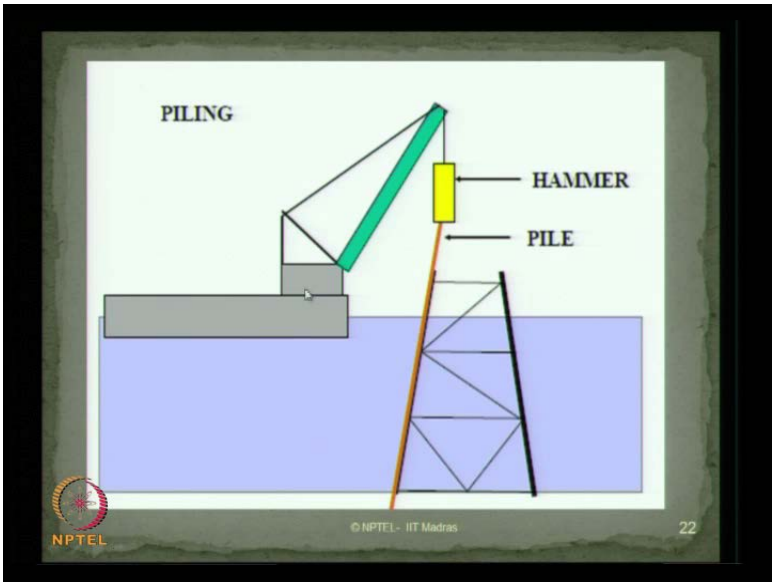

Once it is completed then you drive a hammer and starts driving a pile of this specific leg into the sea floor, using a special kind of crane barge, which has a capacity of pile driving.

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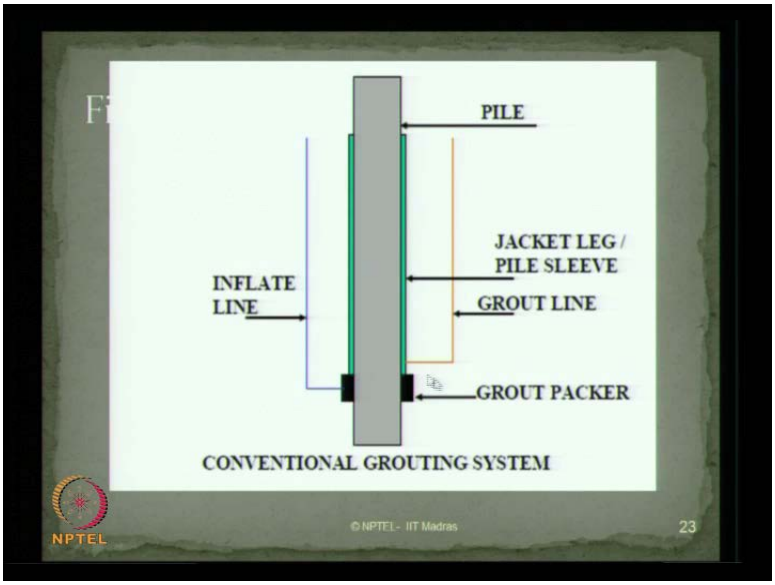

Once you driven a pile then we are got do to what we call finishing with grouting. So, this is the cross section of what you see as a pile here. The outer layer what you see is I am calling as jacket leg or pile sleeve. So, this peon color what you see along the periphery of the pile is what we call as the grout line. To avoid leaking of the grout and have a stability of grout, we have what we call as grout packer and then in the packer, I may say inflated line. So, water may be collected at the grout and we will get pack here and this is what we call as conventional grouting system.

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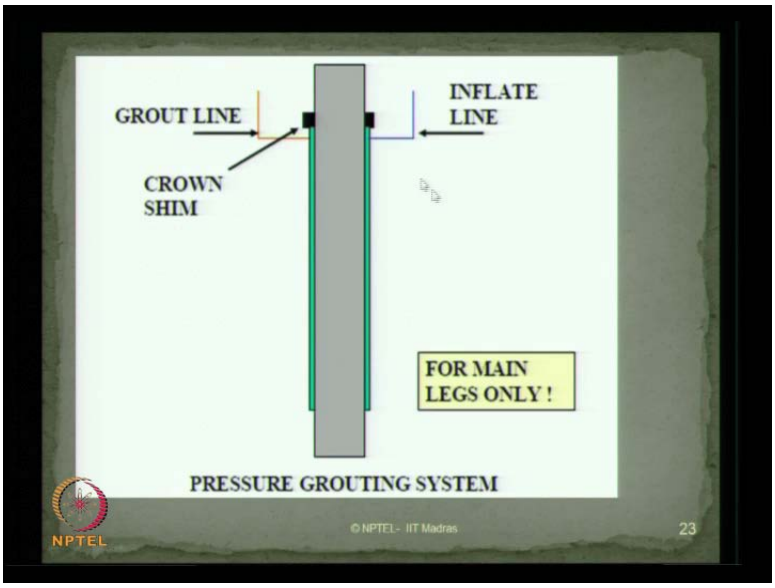

You can also have a different type of grouting system for the main legs of jacket what we call as pressure grouting system. In that case, I have a crown shim on the top and keep on doing a pressure grouting from an inflated line, what we call as a grout line keep on grouting from the grout line, and of course, keep on releasing the pressure from the inflated line as you see in the schematic view.

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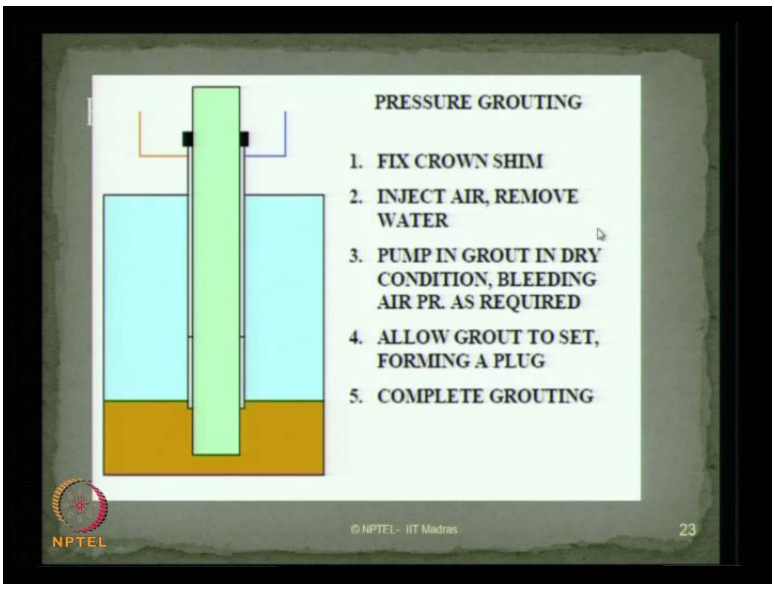

Pressure grouting as the following steps as you see in this picture; first fix the crown shim, second inject the air and remove the water may be locked inside the liners, pump

in the grout in very dry condition. So, this is the grout line, you pump in the grout in dry condition allow bleeding to happen in a specific pressure requirement as decided by the construction authority. Allow the grout to settle or set forming a plug at the bottom then complete further grouting. So, that the pile is position properly in this site.

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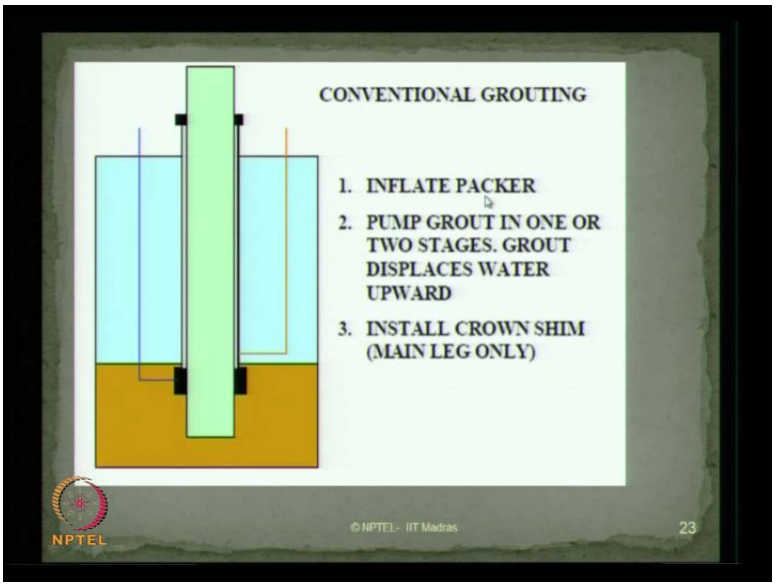

The conventional grouting as different kinds of steps in contrast to that of pressure grouting. First you do the inflation packer then pump the grout in one or two stages. The grout will displaces water in the upward direction install them subsequently the grown shim only for the main legs. Let us talk about the super structure installation once the jacket is launch jacket is upended, jacket is rolled up from the rocker arm an upended and held in the position then the grouting is done then I am talking about the installation of super structure.

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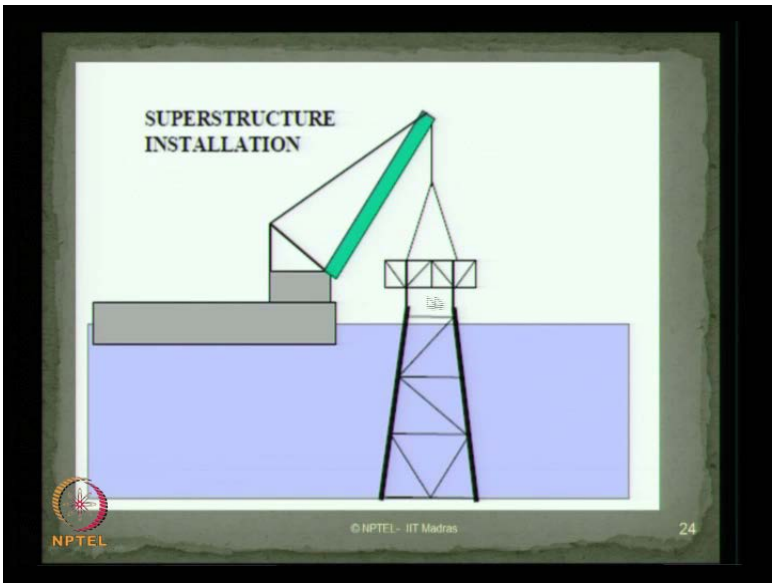

Then I am bringing the top deck, which is brief fabricated from the yard using a barge using a special kind of crane vessel, I lift this specific facility and do the connection of the facility to that of the jacket this is what we call as deck mating in the operation.

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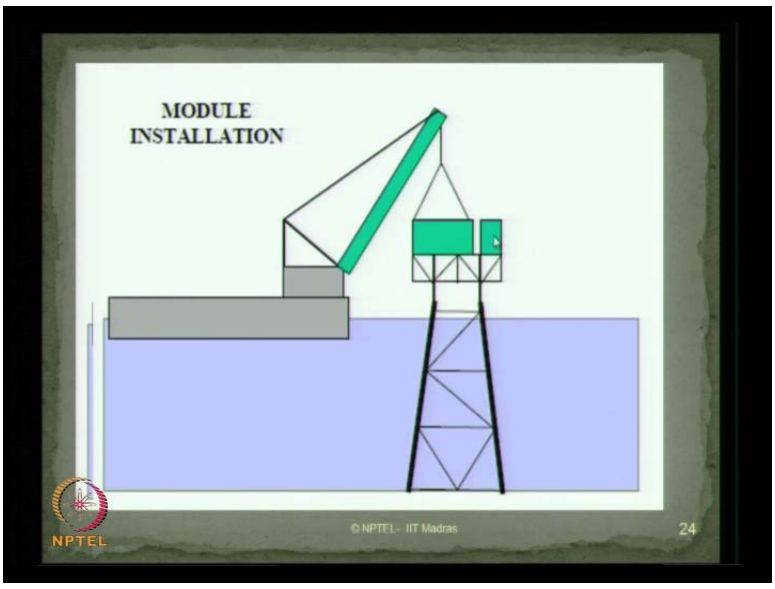

Once I completed the deck mating, I also keep on adding additional modules, which we call as module installation. This modules can we living quetzals, can have operational module, can have process modules etcetera are depending upon top side design of the

platform. So, the super structure installation is very simple as you see in this photograph, but in reality it is very complex because the whole operation is checking place offshore.

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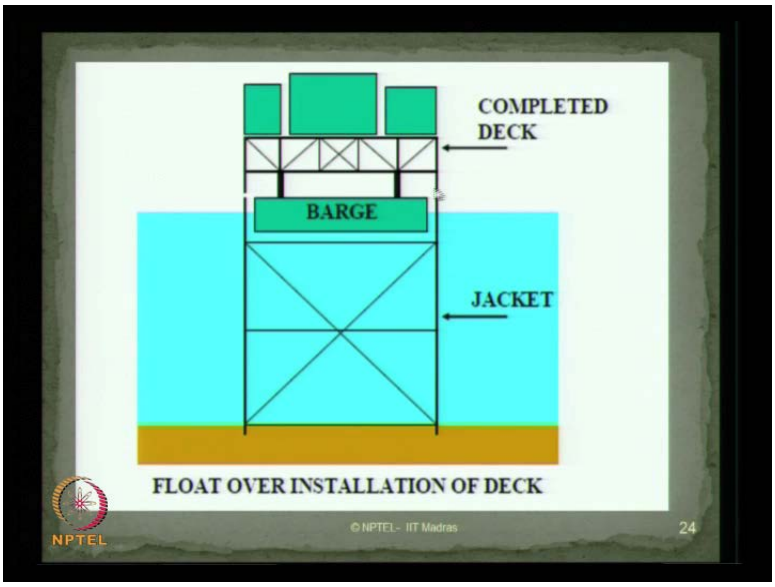

This is how a completed deck will look like. The float over installation of the deck can also be done using a barge and then it replace. You see here this is the float over deck as you see here this being brought to the site on a barge and then it is fixed to the bottom jacket as you see in the picture. So, alternatively instead of doing the assembly of super the structure or a top side layer by layer offshore can also fabricate whole deck as you see in this picture. Bring it on a barge then you can connect it to the jacket as you see in this picture, if we do that this call as float over installation of the deck, because the whole deck is floated over the barge and then broad to the side for proper installation in sit.

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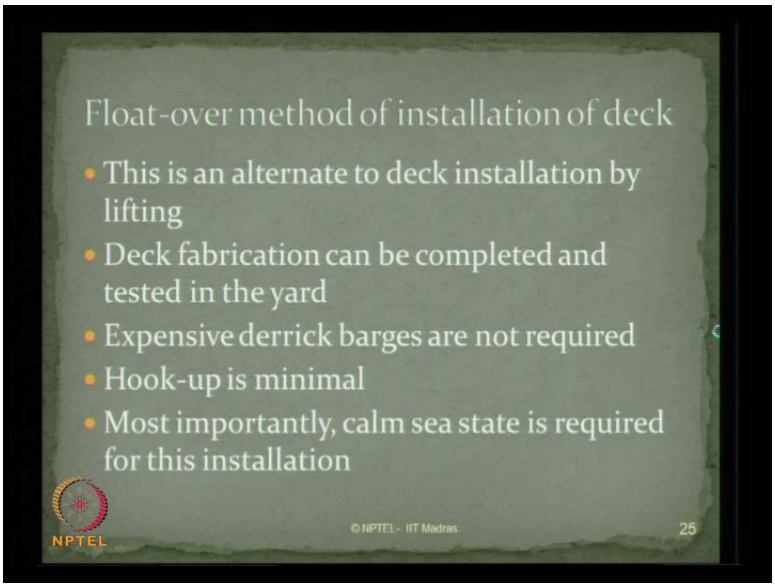

If you look at the float-over method of installation of deck, this can be seen a very successful alternative the deck installation by lifting, because if you are planning to do the deck installation by lifting, you require a special kind of cranes and crane barges which are very expensive in terms of cost and operational safety. You can always alternatively do deck installation by float over method which is comparatively cheaper in with respect to that of the lifting technique. The deck fabrication can be completed in the yard; therefore, can have good quality control on the fabrication of the top side. The expensive derrick barges in this case are not required. The hook-up time will be as minimum possible. Generally, in case of critical whether the hook-up time is maximized, it can cause lot of accident possibility. So, in a float over method the hook-up time is kept minimal, therefore, float over technique can be considered as safe in installation operation compare with lifting technique for deck type structures.

Most importantly in calm sea state is very important that you can do the float over installation only when the sea state is relatively calm. If the sea is rough weather you are not advice do a float over installation of the deck. Ladies and gentleman, we have seen a series of slides and presentation where we have understood how a jacket type structure or a template type structure is constructed and install. Now we will quickly see some equipments and method are used for submarine pipelines.

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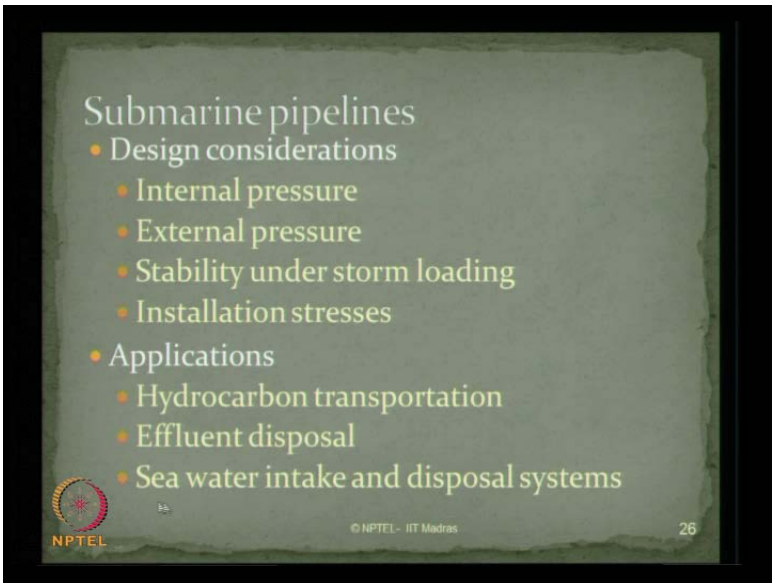

If you look at the design consideration based on which the pipelines are designed, the following factors are very important. The internal pressure on the pipeline, the external pressure exerted by the hydrodynamic force on the pipeline, and it is depends upon at what level we are installing the pipeline. It also affects the stability under storm loading. And of course, one should take care of the stresses developed during installation process. Submarine pipeline has have different levels of application; they can use for hydrocarbon transportation, and they can be use effluent disposal. Now-a-days increasingly, they are used for seawater intake and disposal systems.

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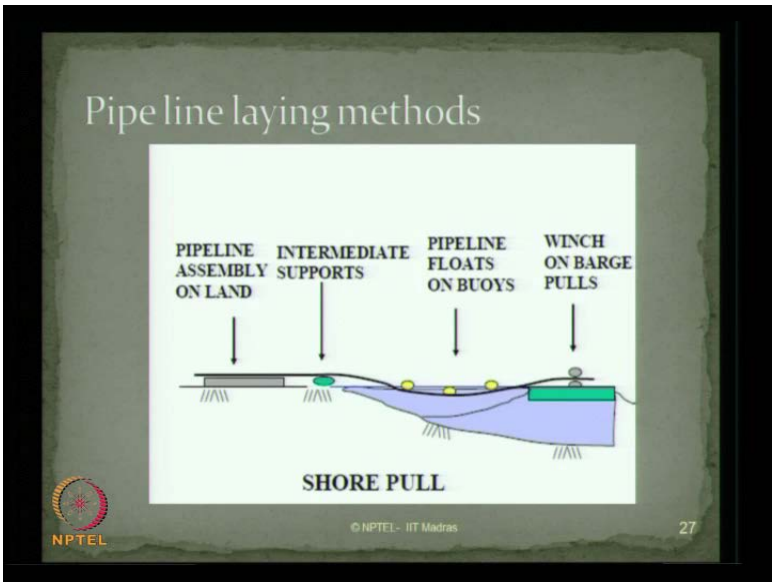

Now let as quickly look at what are different laying methods by which I can deploy pipelines offshore. There are different laying methods the fore most one is what we call the shore full technique. The pipeline assembly is kept on the land then it is made to lay on intermediate support as you see here. Then the floats are attached which is nothing but buoys, and therefore, the pipelines has attached float sea in the yellow color they keep on a floating the pipe as you see in this line. Then other end of the pipe is kept on the barge which can be then pull is what we call as shore pull technique in laying of pipe. The pipe is kept or fabricated on the land assemble, supports and intermediate supports attached to the floaters or the buoys the pipe is being pull on a barge that way we call this as shore pull method on pipeline laying.

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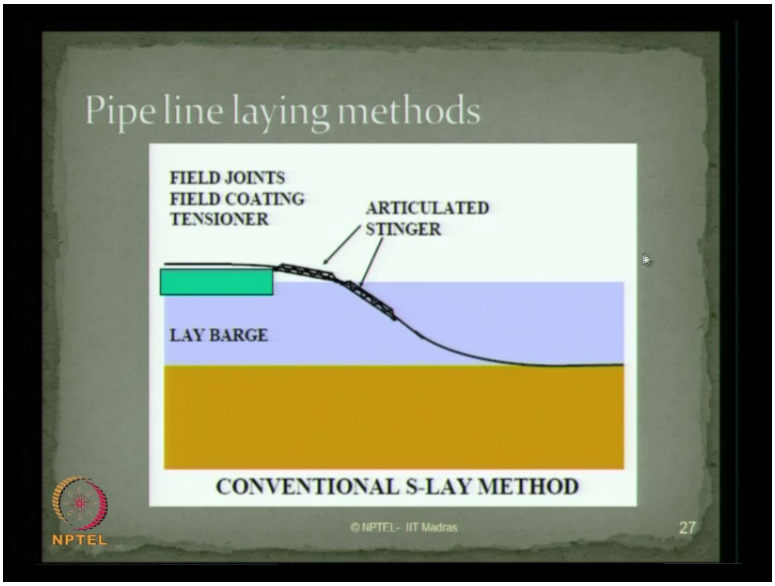

Alternatively, you can also use what we call s-lay method. The field joints, field coating and tensioner are all connected to the pipeline, and then the pipe is laid on a barge which we call as a lay barge. Then it is being articulated in a stinger and the pipe is laid as you see here. Since the profile of the pipe during laying forms a shape similar to S, we call this is S-LAY method of pipe laying.

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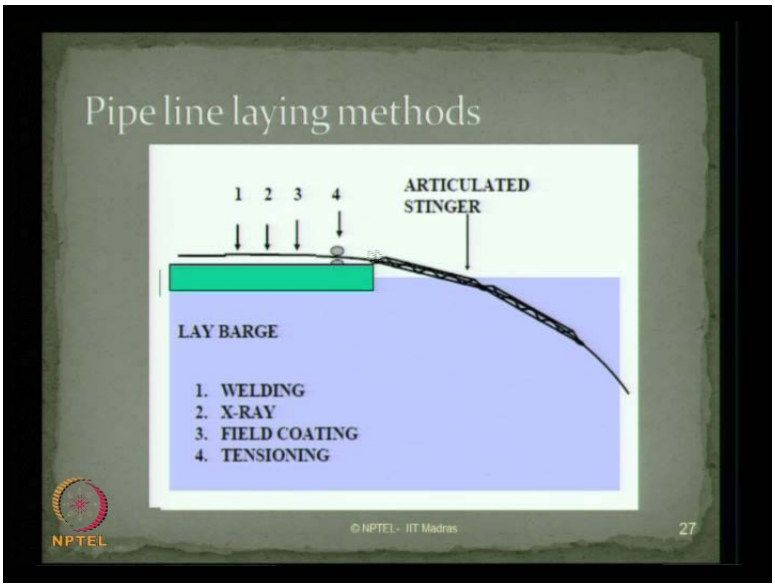

So, they are different process takes place in the laying of the pipe once you lay the pipe or once you keep the pipe on a barge which we call as a lay barge. Then I have to first do welding of barge then I have to check the welded joint using x-ray diffraction techniques then I will do apply field coating on the fabricated joins at the entire pipeline then I have applying tensioning system before it draft the pipeline using articulated stingers.

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Ladies and gentleman, we have seen a construction method for jacket structure. We have seen a method for pipeline laying. Now let us look at some of the important aspects of

offshore construction which are physical and environmental aspects. Ocean environment generally dominate the method of construction, equipments, support systems and procedures to be deployed for construction and installation of offshore structure. Most important parameters in offshore construction is to cater to the influence of environment on the construction, is very important.

If you do not understand the interaction of environment with that of the structure what we are constructing then offshore construction process will become very tedious and complex. It is very important there go to understand the uniqueness in the design of offshore structure you may wonder why we talk about uniqueness in design when we discussing about construction equipments and construction methods. Ladies and gentleman, please remember, design of offshore structure is highly based on the ability of design to construct. Probably offshore structures are one of unique characteristics of the order which are governed by the ability or constructability which governs design a philosophy.

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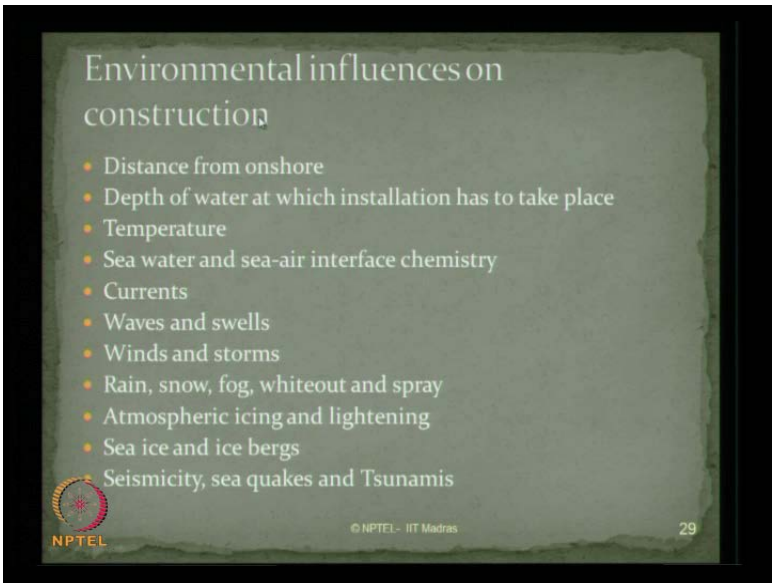

Environmental influences on construction is also plays an important role. Distance from onshore is a major task to understand;. depth of water at which installation has to take place. You also have to speak about the temperature where you doing a construction. Sea water and sea-air interface chemistry; currents, waves and swells; winds and storms, rain fall, snow, fog, whiteout and spray are also important, because they cause serious is

influence on the construction methodology and process. Atmospheric icing and lightening effect, sea ice and icebergs are also constructing the important parameters that influence construction. Of course, the most importantly seismicity quakes and tsunamis are also important and you must have these parameters are estimated before hand before you plan for construction of a offshore structure in a specific site.

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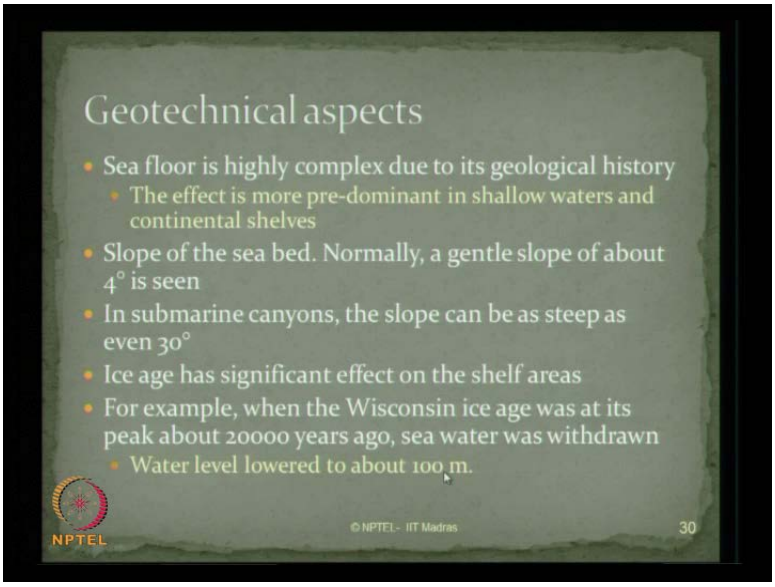

They are some geotechnical aspects which are also important for us to understand. Ladies and gentlemen, sea floor is highly complex due to its geological history. The effect is more pre-dominant in shallow waters and continental shelves. Interestingly the slope of the seabed is generally having a gentle slope of about 4 degree, but there are instances in submarine canyons where the slope as gone steep as even 30 degrees. Ice age also has very significant effects on the shelf areas. For example, when the Wisconsin ice age was at its peak about 20000 years back seawater was withdrawn as the result of which the water level lowered to about 100 meters.

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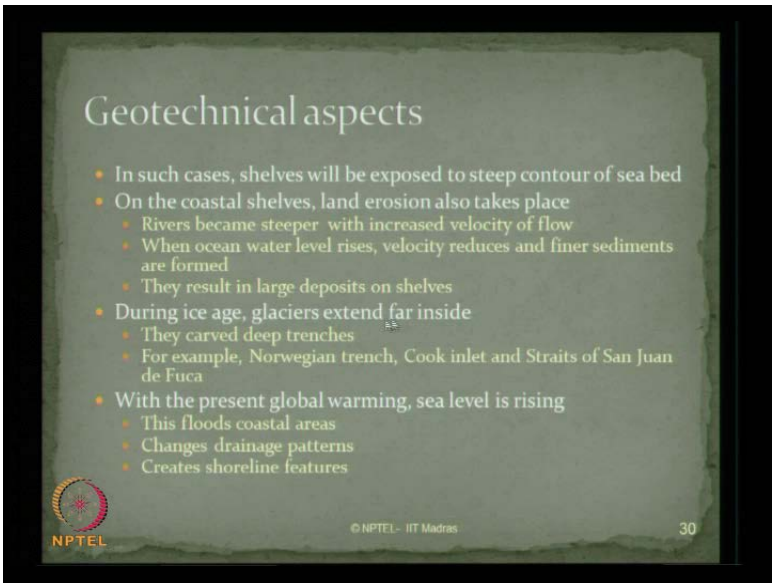

In such cases, the shelves will be exposed to steep contour of the seabed. On the coastal shelves, land erosion subsequently also takes place; rivers became steeper with increased velocity of flow. When the ocean water level raises this velocity got reduces and finer sediments are formed, they result in large deposits on the shelves. During ice age, glaciers extend far inside the sea, they carved deep trenches can see for example, the Norwegian trends, the cook inlet, the straits of San Juan de Fuca are all example of carved deep trenches which has been formed, because of extension of glaciers for inside the sea. With of course, the presents of global warming sea level is now rising, this floods coastal areas and it causes serious of changes in drainage patterns and create shoreline features and existing shoreline.

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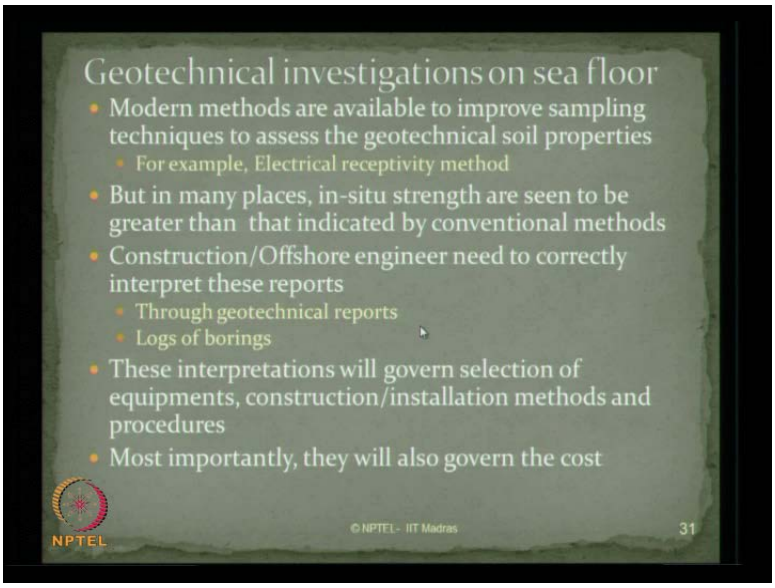

If you look at geotechnical investigations, it is generally carried on sea floor based on which by design and construction methodology will depend on. Thanks to the modern methods which are available to improve the sampling techniques to assess the geotechnical soil properties. Unfortunately, even with the advance methods of electrical receptivity available, in many places in-situ strength are generally seem to be higher or greater than that indicated by the conventional methods. Therefore, it is very important that construction or as offshore engineers are clearly understood to interpret the geotechnical investigation reports.

Investigation reports can be available, but you must interpret them through logs of boring are what we call bore hole data. These interpretations will govern essentially the selection of equipment, construction installation methods and of course, the procedures. Most importantly, they will also govern essentially the cost of a construction, therefore as an offshore engineer have the clear idea how to interpret they existing geotechnical reports and bore hole data because based on this we will able to design on construction and installation methods an equipment procedures which will be followed in installation.

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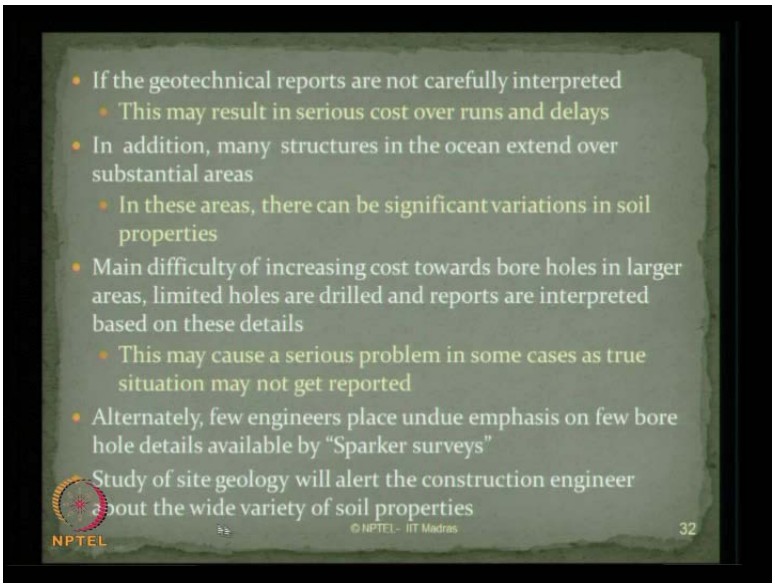

If the geotechnical reports are not carefully interpreted, this may result in serious cost over runs and delays in this project. In addition, many structures in the ocean extend over substantial areas, therefore, in these areas there can be significant variation in soil properties. So, one should account for these properties also in addition to what we have already spoken and what we already have on site of installation. Main difficulty of increasing cost towards the bore holes in larger areas, basically leaves and restriction on number of bore holes drill, therefore reports are generally interpreted based on existing data. Sometimes this may cause a very serious problem in some cases as true situation may not get reported in the borehole data. Alternatively, few engineers place undue emphasis on few bore hole details available by sparker surveys, they are not that important so that one has due emphasis and this can a special report.

So, ladies and gentlemen, it is very important for an offshore engineer to have very clear study on the site geology, because site geology study is can alert the construction engineer about the wide variety of soil characteristics, which are helpful for even in designing the method of construction etcetera for an offshore structure.

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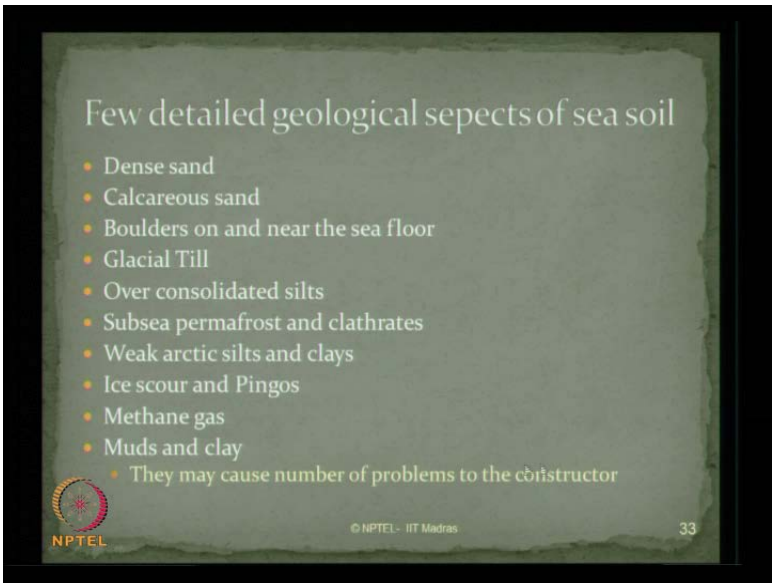

They are some few details of geological aspects of sea soil which are very important. Dense sand, calcareous sand, boulders on and near the sea floor, glacial till over consolidated silts, subsea permafrost and clathrates, weak arctic silts and clays, ice scour and pingos, methane gas, muds and clay. Muds and clay actually cause series number of problems to the constructor in offshore facility.

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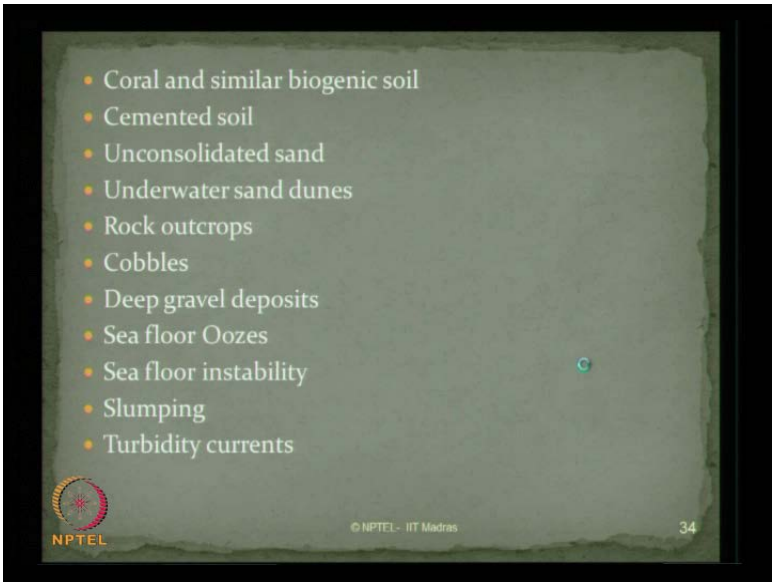

In addition, coral and similar biogenic soil, cemented soil, unconsolidated sand, underwater sand dunes, rock outcrops, cobbles, deep gravels deposits - four serious

problems for the constructor in offshore structures. If you look at the sea floor oozes and sea floor instability and slumping, they are also four serious challenges for construction installation methodology especially during pile driving.

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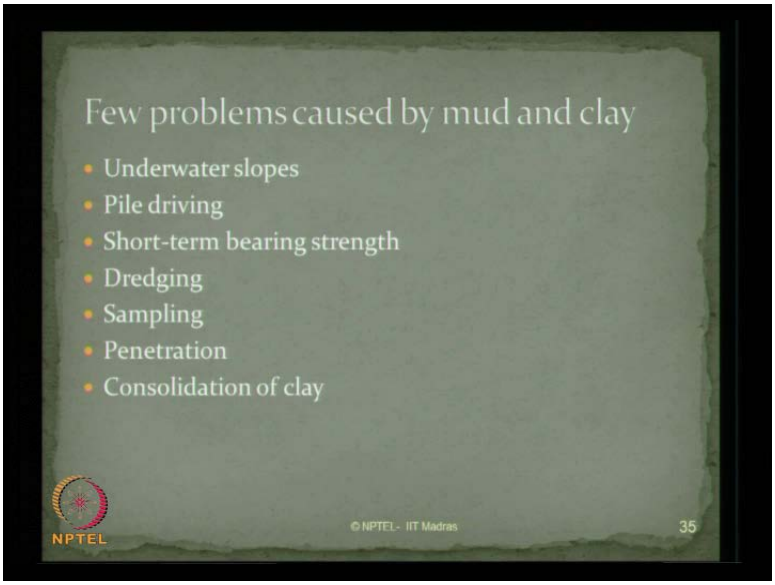

There are few problems which are caused by mud and clay, because underwater slopes are predominantly managed by this kind of mud and clay. Pile driving can be a very challenging task. Short-term bearing strength can be a very major challenging task in terms of problem associated with mud and clay. Dredging of course, can be becoming a problem and off course sampling of bore hole data which I said in previous slide also cause a serious worry or serious problems for installation. Penetration of piles and consolidation of clay can also cause serious problems, because of mud and clay.

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Look at the constraints on offshore construction and installation. There are severe constraints are available which are posing challenges. Foremost constraint is emphasis laid to protect the natural and built environment. Unfortunately, interaction issues with man-made structures in ocean and natural ecology were studied only after plans were made. This resulted in amelioration instead of integration. Current legislation is therefore, made more stringent due to the above negligent pattern followed in offshore projects. These implications are even causing serious delays during construction of ongoing offshore projects.

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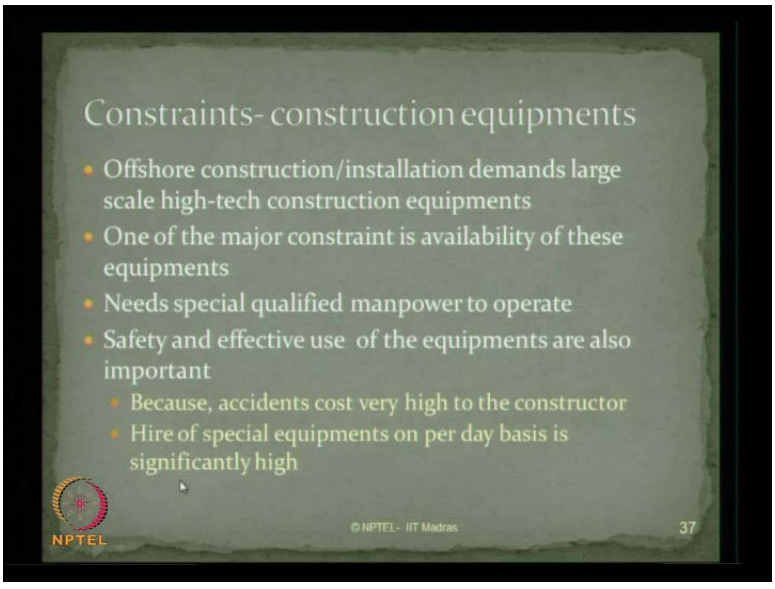

There are some constraints which can also be happening because of constructing equipments. Offshore construction installation demands large scale high-tech construction equipments. One of the major constraints is availability of these equipments when you need them. They also need special qualified manpower to operate this equipment. Safety and effective use of the equipments are also important, because accidents cost very high to the constructor, as well as the hire of special on per day basis is phenomenally high.

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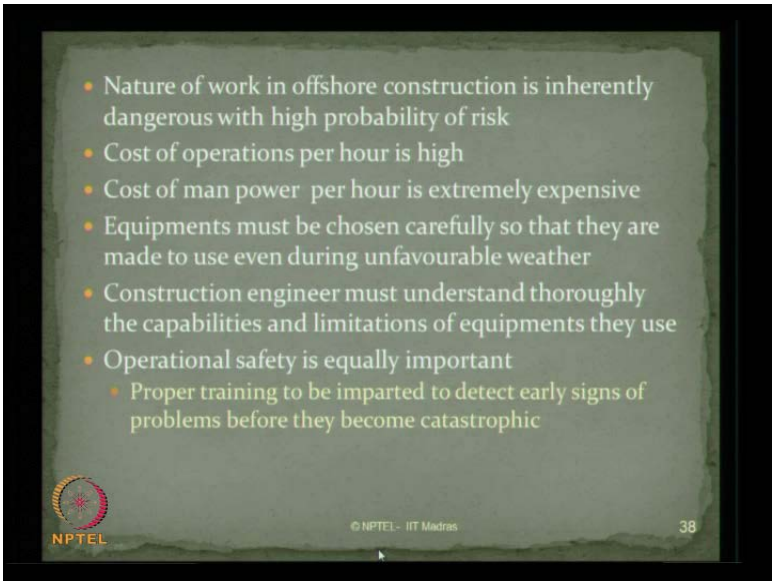

The nature of work in offshore construction is inherently dangerous with high probability of risk. Therefore, the cost of operation per hour is very high; cost of manpower per hour is extremely expensive. Equipments therefore must be chosen carefully, so that they are made to use even during unfavorable weather that is very important in underline point here. Construction engineers therefore, must understand thoroughly the capabilities and limitations of the equipments what they deploy during installation process. Operational safety of course, is equally important. Proper training is to be imparted to detect early signs of problems before they actually become catastrophic in nature.

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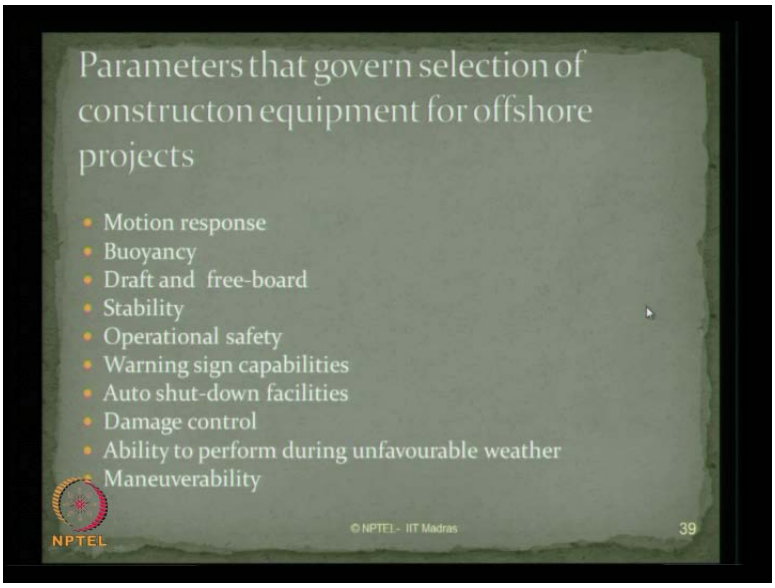

There are certain parameters that govern selection of construction equipments for offshore projects. Motion response, buoyancy, draft and free-board, stability and operational safety can be parameters that govern selection of constructor equipment for offshore projects. Of course, the operator should be equip with understanding the warning sign capabilities is extended by the equipments and of course, equipments should be selected, so that they should have auto shut-down facilities in case of any emergency situation. Most importantly equipments should be selected in such a manner that they have ability to perform even during unfavorable weather which safety and highest priority during operations and these equipments and barges should have high degree of maneuverability as well.

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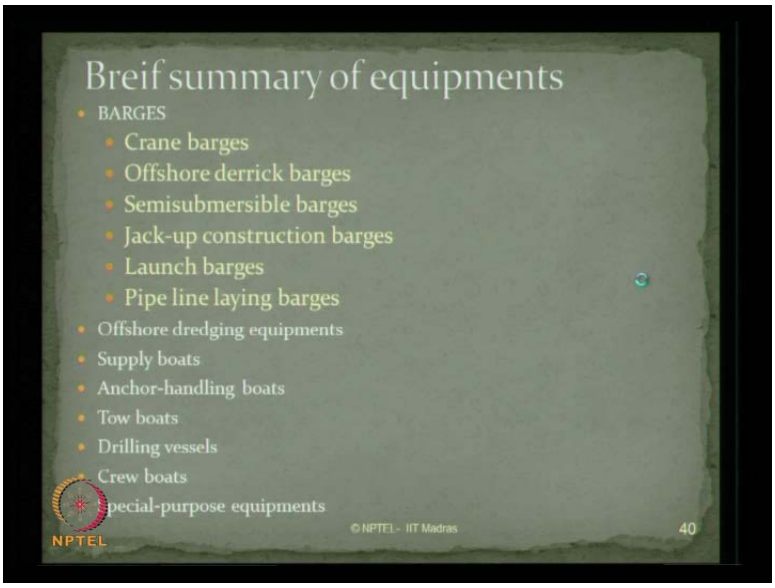

Let us quickly see the brief summary of equipments, which are generally used for offshore construction process. We can use barges like crane barges, offshore derrick barges, semisubmersible, jack-up barges launch barges and pipe line laying barges. Also offshore dredging equipments are used in case of in this kind of methodology, supply boats, anchor-handling boats, towboats, drilling vessels, and crew boats are some of the important summary of equipments are generally used for offshore project.

In this lecture, ladies and gentlemen, we gave a brief presentation of what are different kinds of construction methods and equipments involved; what are the different kinds of cranes and their capacity and their manufacturer types and models. What are different stages of operations in load out and launching of jacket template structure, what are different methods followed in pipe laying. And of course, what are the geotechnical aspects which are important for selecting equipments for offshore construction process. I hope this lecture would have helped you to understand the construction aspects associated with offshore projects.

Thank you very much.