Computer Methods of Analysis of Offshore Structures
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Module - 02
Lecture - 03
Offshore structures - 3

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Friends, let us discuss the details of offshore structures as lecture 3, where we will also try to recollect some information what we studied in the last two lectures? And add more information to this lecture in terms of understanding response behavior of offshore structures.

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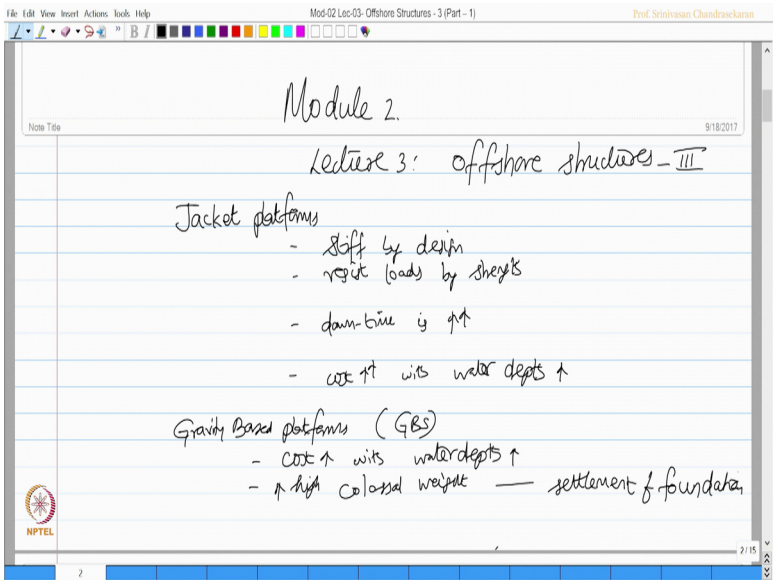

We said that; jacket platforms are stiff by design, they resist loads by strength. The downtime taken to construct is higher and the cost will increase; with increase in water depths. As far as gravity based platforms are concerned; they also have increase in cost with increase in water depth. They have a very high colossal weight; this has a demerit it can result in settlement of foundation.

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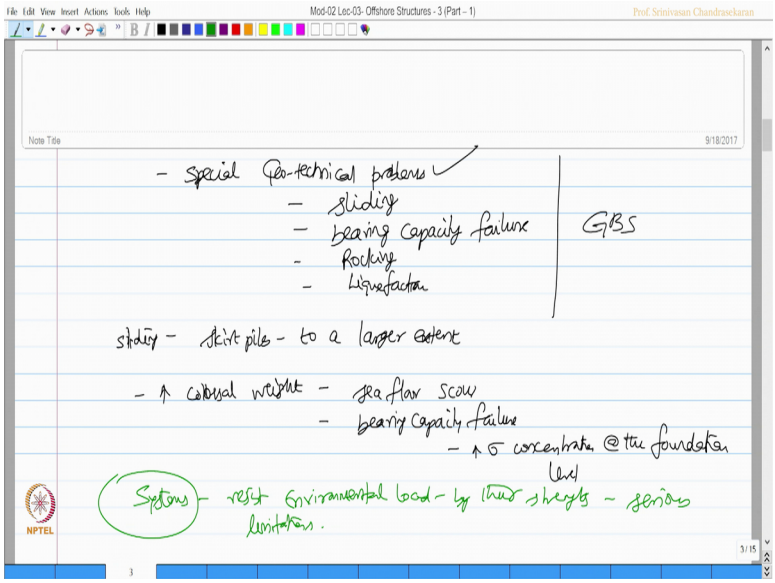

It can also cause special Geo-technical problems.

One important issue; which is caused by gravity based structure could be problems from sliding, problems due to bearing capacity failure; problems may arise due to rocking and due to liquefaction. So, this can be very special geo-technical problems which can be associated with gravity based structures. Of course, sliding can be addressed; with the help of skirt piles to a larger extent by providing skirt piles sliding can be controlled to a larger extent, but the high colossal weight of the platform can result in sea floor souring. It can also cause bearing capacity failure; this is because due to high stress concentration at the foundation level.

Friends structural systems which resist environmental loads by their strength has some serious limitations; it means the structural form or the geometric form of structural systems meant for offshore structures needed some innovative approach.

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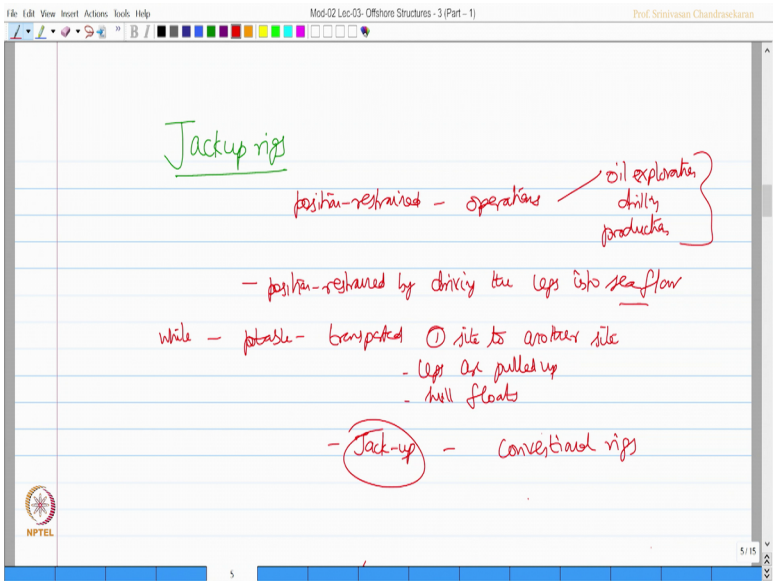

So, that is what we now understand. Jack-up platforms were constructed.

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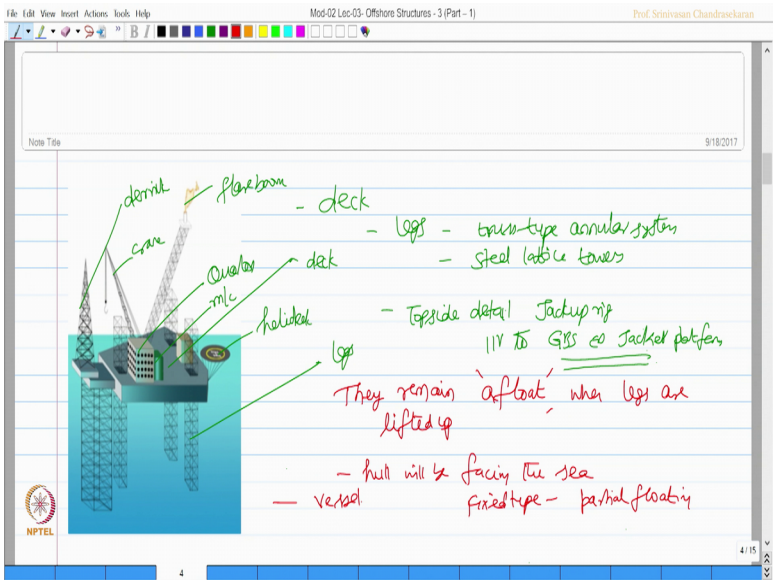

They are conventionally called as jack up rigs a typical jack up rig is what you see in the figure which is shown here. It essentially consist of a deck which you see here, it consist of legs; essentially truss type annular systems which is seen here they are essentially steel lattice towers, the top side detail of a jacket or jack up rig is actually similar to that of a GBS or a jacket.

It contains a flare boom, it contains crane, it contains living quarters, helideck, it contains machine floor, it also contains the drilling derrick which are also common to the top side facilities which a conventional platform has. Then the question comes, what is the difference in this geometric form compared to the earlier fixed type platforms? The most important difference is they remain afloat they remain afloat, when legs are lifted up. Hull actually will be facing the sea. So, it acts actually as a floating vessel.

Now, friends; interestingly from a fixed type the analogy of geometric form moved to a partial floating type. Now, we agree to a common statement saying the structures which are meant for floating should be anyway position restrained, they should be position restrained for performing any operations. For example; oil exploration, drilling production, for performing any such operation they need to be position restrained. So, interestingly they are position restrained by driving the legs into sea floor. So, why they are portable or transported from one site to another site, legs are pulled up and the hull floats, that is why the name jack-up comes into play.

So, they are actually conventional rigs, which are used for land based drilling except that the legs will be pulled up and the hull will remain afloat. Now, interestingly when the legs are down driven into the sea floor they should be connected to the sea bed.

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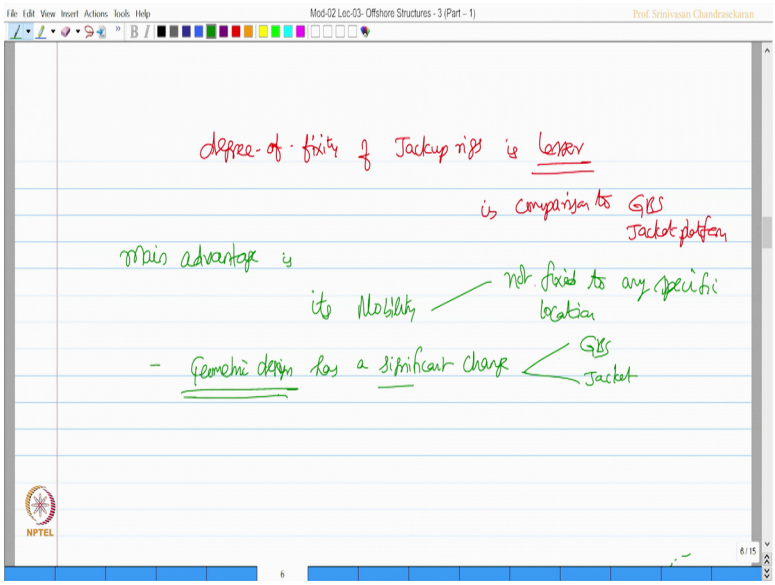

So that, they are firmly resistant in the sea bed; while operation is going on. So, the degree of fixity of jack up rigs is lesser in comparison to gravity based structure or jacket platform. So, degree of fixity is lesser that is true, but the main advantage is its mobility. So, they are not fixed to any specific, they are highly mobile they can be installed and commissioned in any geographic location where exploration has to take place.

Therefore, the geometric design has a significant change compared to GBS and jacket. There is a significant change in the geometric design, because the other platforms are completely fixed whereas, this remains afloat when it is not under operation. A typical jack up rig is what is shown in the figure here which you already saw.

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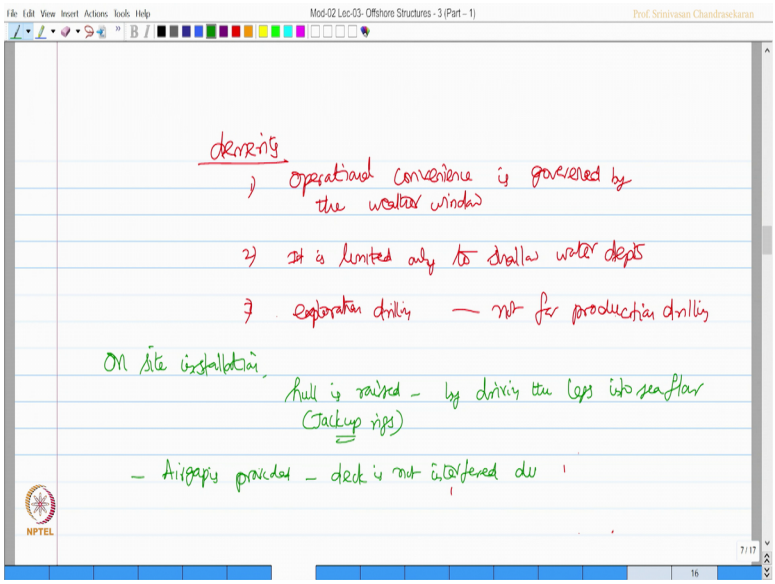

These are the parts which are really important. Jack-up rigs have few demerits; their operational convenience is governed by the weather window; that is first demerit. Second it is limited only to shallow water depths. So, we can say they are essentially meant for exploration drilling and not for a production drilling. So, onsite installation hull is raised by driving the legs into sea floor, that is; why it is called jack-up rigs.

A sufficient air gap is provided, so that the deck is not interfered during high tides.

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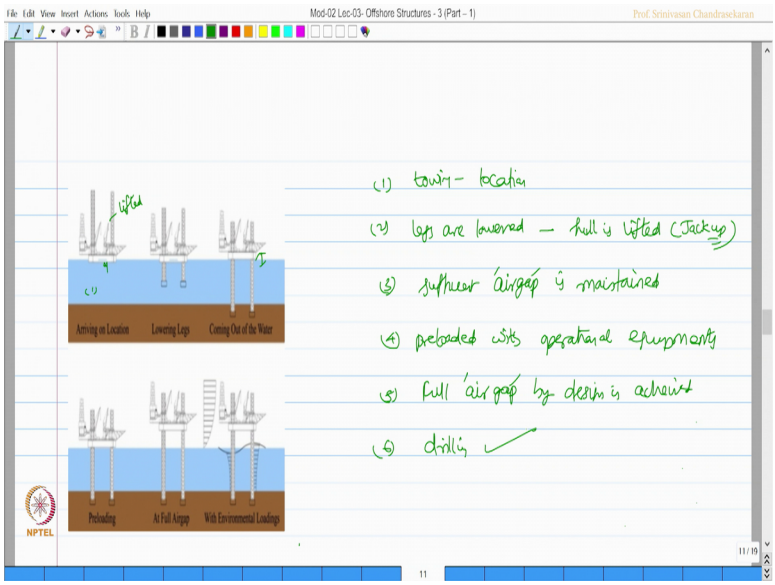

Let us quickly see various steps involved in commissioning a jack-up rig. The first figure shows the jack-up rigs arise at the location we can see here the hull is floating and the legs are lifted up, the moment it reaches the site. So, first is towing to the location, the second could be once it reaches the location the legs are lowered. In fact, I would put it the other way the hull is lifted; that is why I call this as jack up rig.

So, then an air gap is maintained, sufficient air gap is maintained. Then it is preloaded with operational equipments; once it is done a full design air gap is achieved.

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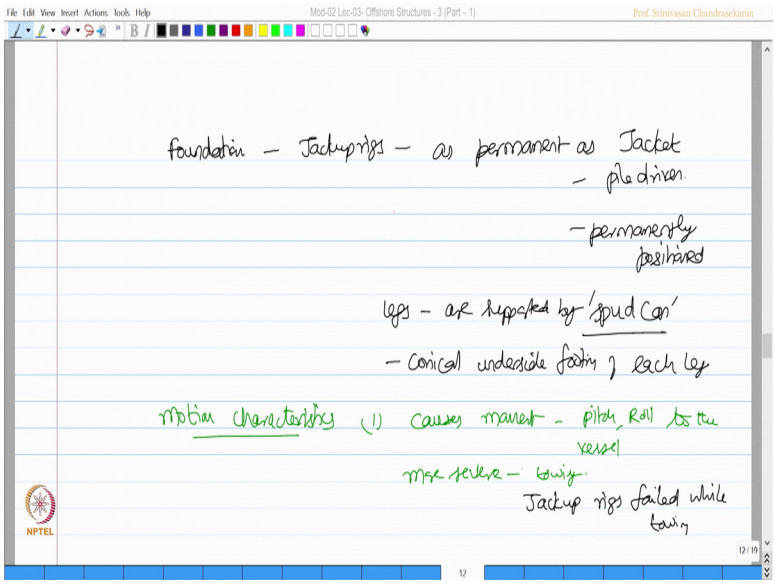

And now, it is ready for drilling. Foundation of jack up rigs cannot be as permanent as a jacket platform, because in jacket platforms you remember; they are actually pile driven. They are permanently positioned whereas, jack up rigs are highly mobile, they need not be permanently positioned, but they need to be installed onsite to do the operation. So, these legs are supported by a spud can; which is a conical underside footing of each leg.

Now, what are the motions? What are the motion characteristics of a jack up rig? As you now understand; the hull contains lot of aerodynamic attractive features therefore, it causes movement that is; pitch, roll to the vessel. This is more severe when actually it is towing. So, there are instances where jack up rigs failed while towing, because the moments are very high as result of which they fail under wind loads.