Computer Methods of Analysis of Offshore Structures
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Module – 02
Lecture – 06
New Generation Platform (Part – 01)

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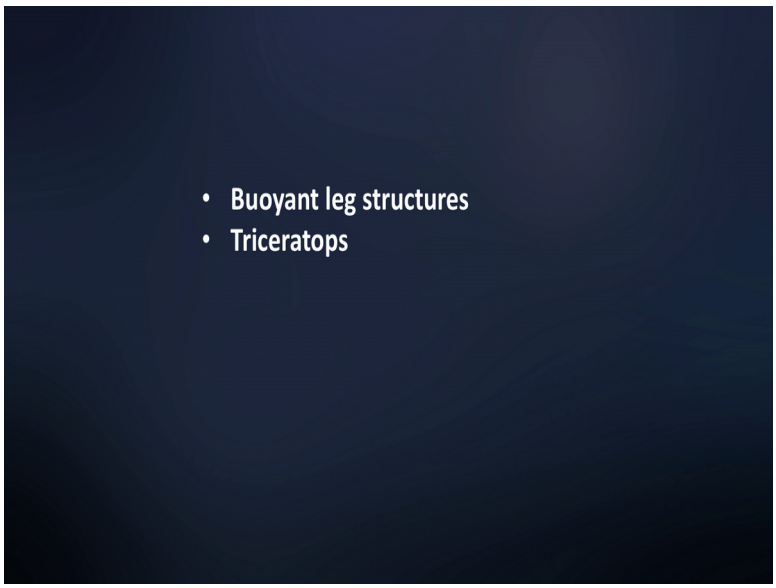

Friends, welcome to the sixth lecture in module 2. Where, we will talk about some innovative structural forms which are addressed as new generation platforms.

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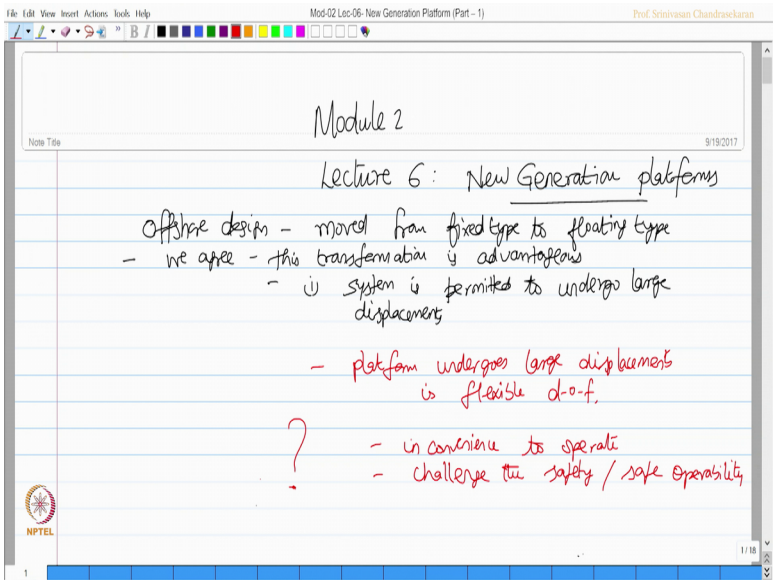

Let us quickly understand that offshore structural design moved from fixed type to a floating type. Once we agree that this transformation is advantageous, as we know there are some difficulties in this. The foremost difficulty is the system is permitted to undergo large displacements. Now this can be a demerit in sense when the platform undergoes large displacement, in flexible degrees of freedom. This may cause inconvenience to operate. Sometimes it may even challenge a safety or I should say safe operability.

So, then what we should do to address this problem. So, the issue is very simple.

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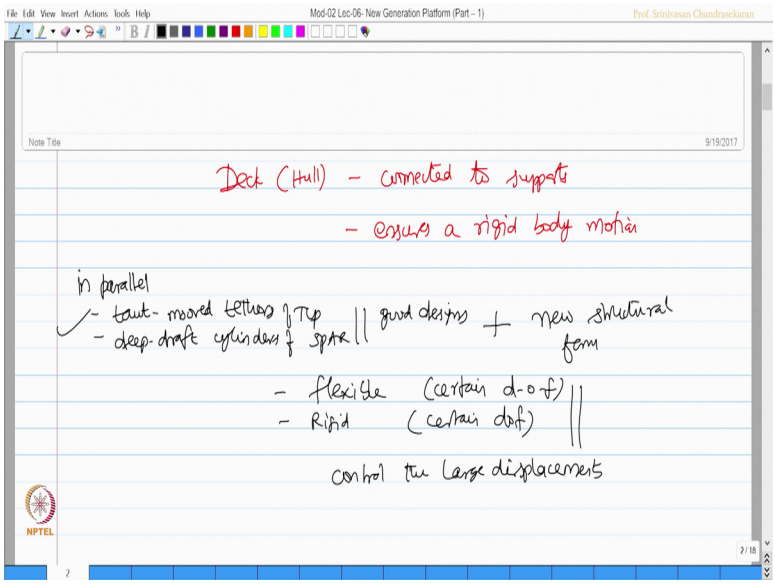

Deck or the Hull is connected to supporting system which ensures a rigid body motion. In parallel we also understand the taut moored tethers of TLP, and deep draft cylinders of spar are good designs. We agree that, because we saw the advantages of these points. So now, I want to capture this advantage into a new structural form.

I want to maintain the structural form to remain flexible on certain degrees and remain rigid on certain degrees of freedom. At the same time I want to control the large displacements. So, that is the motive now. New generation platforms address this problem, let see how.

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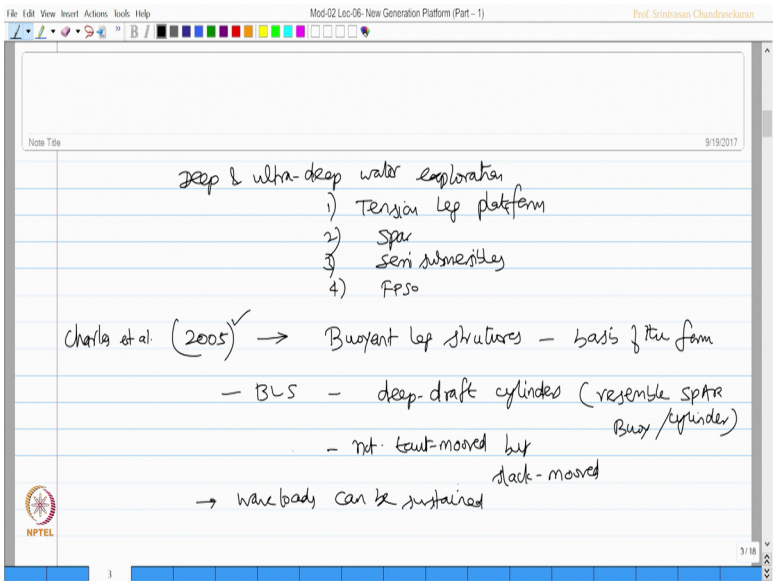

So, deep and ultra deep waters exploration, demand, various types of structures such as: tension leg platform, spar, semisubmersible FPSOs. In addition a new concept was initiated in 2005 based on something called buoyant leg structures [FL]. A new concept was introduced by Charles et al in 2005 which is based on buoyant leg structures. So, that becomes the basis of the design of the geometric form.

Now what are buoyant leg structures? Buoyant leg structures in simple terms are actually deep draft cylinders which resemble spar cylinder or spar buoy, which are not taut moored because we know spar is not a taut moor system, but slack moored. They can be useful to sustain wave loads.

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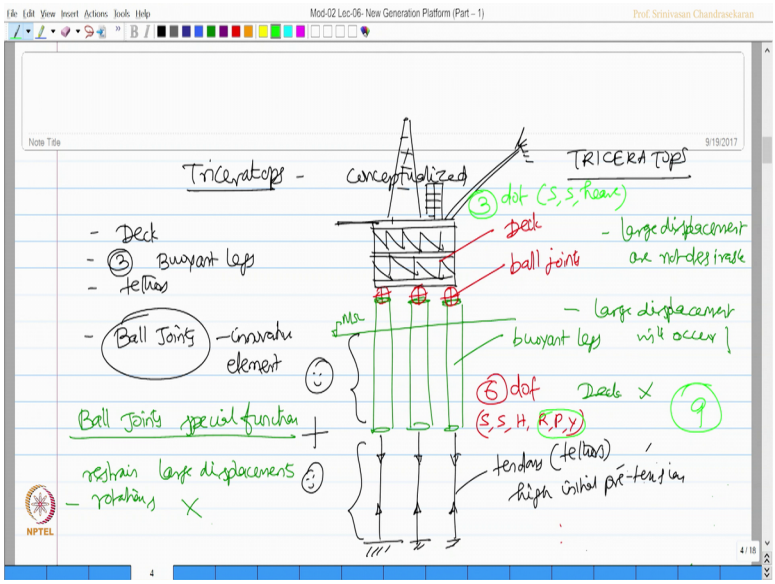

Having said this, a new system by name triceratops is conceptualized which consist of a deck 3 buoyant legs.

Now, the deck and buoyant legs need to be connected. We connect these deck and buoyant leg using ball joints. So, this is my deck, this is multi tire; this is one tire middle tire and upper tire supported by a truss system. And it will have all topside detail like a flare boom, like a drilling derrick, like an helipad, like a living quarters.

Now, the buoyant legs which have a deep draft this is my water level should be now connected further to the sea bed. So, the sea bed is connected to the tether of to the buoyant legs with initial three tension tethers. These are either called tendons or tethers which has very high initial pretension.

Now friends, let us recollect some important facts what we studied about TLP and spar. A deep draft cylinder like a spar is advantageous. A tension leg taut moored system like a TLP is advantageous. These two advantages are combined to form a triceratops. So, triceratops is conceptualized by supporting a deck by a buoyant leg which is further anchored to the sea bed using tethers. Now the buoyant legs and deck are connected by ball joints. Now these ball joints is an innovative element in triceratops.

What exactly it does, very interestingly. These ball joints have a special function; let us see, what is a special function? We already know large displacements are not desirable,

they are not desirable. Now let me ask you a question; where these large displacements will occur, where they will occur. It is expected they will occur on the deck. So, large displacement on the deck is not desirable.

So, what we should do with the ball joints is the ball joint should be able to restrain large displacements. The moment you say large displacements what kind of displacements are harmful; usually rotations, they are undesirable.

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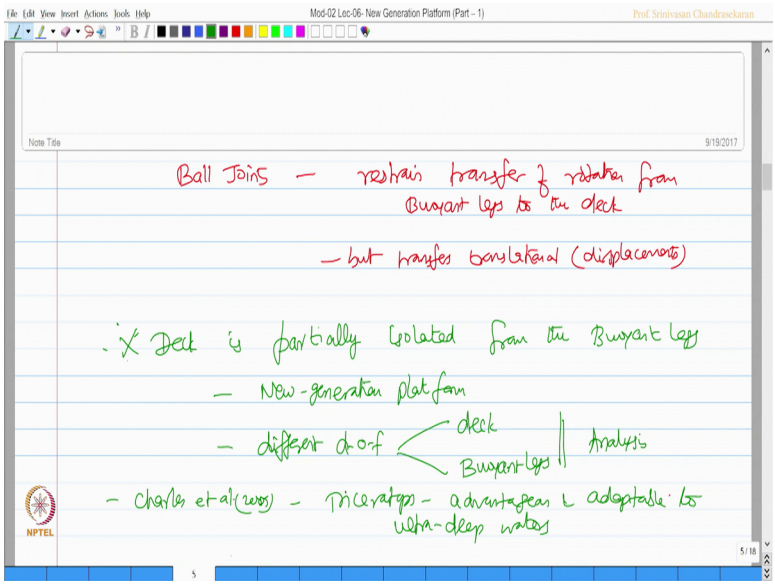

So friends, ball joints are designed to restrain transfer of rotations from buoyant legs to the deck, but transfers translational degrees or displacements. So, I should say now deck is partially isolated from the buoyant legs. So, that is the very important advantage which makes this platform as a new generation platform.

So, when we do analysis we must account for these degrees of freedom. So, let us say what would be the degrees of freedoms we will have for the system. Let us take the system. The buoyant legs will undergo all 6 degrees of freedom which will be, surge, sway, heave, roll, pitch, and yaw. Out of which roll, pitch and yaw will not be transferred to the deck. So, the deck will have only 3 degrees of freedom namely; surge, sway, and heave. So, 3 rotational degrees of freedom will not be transferred to the deck. So, in total system will have 9 degrees of freedom: 6 for the buoyant legs and 3 for the deck.

So, the system will have different degrees of freedom for the deck and the buoyant legs which we must account in our analysis. So, conceptually Charles et al 2005 stated that triceratops are advantageous and adaptable to ultra-deep waters.

So, that is the conceptual figure which was a new geometry tried and attempted.

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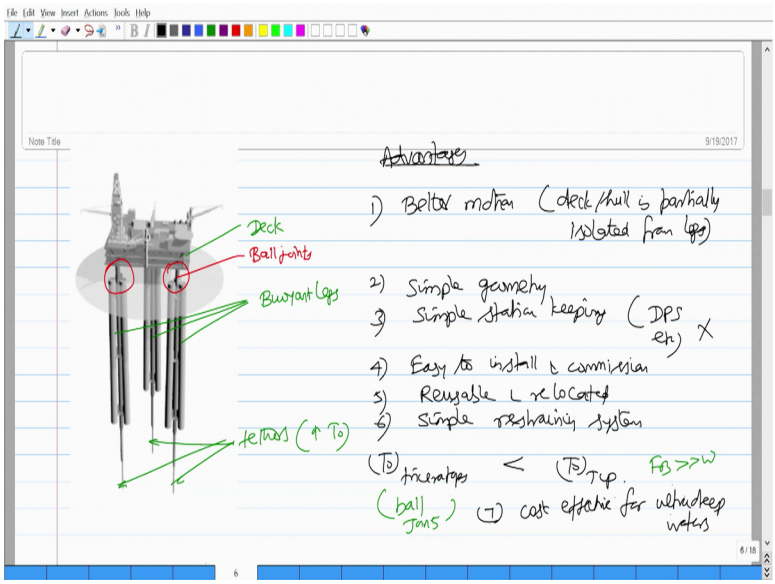

We can see here this is the deck, which contains all details as that of a conventional platform. All these three are buoyant legs, these are tethers which have very high initial pretension, and these are the ball joints which connect the tether sorry; the buoyant legs to that of the deck.

So, what are the characteristic advantages we have in this structural form? We can say it has got better motion characteristics, because the deck or the hull is partially isolated from the buoyant legs; that is an advantage. Secondly, it is a simple geometry. Thirdly, it requires a very simple station keeping, it does not require a complicated dynamic positioning system etcetera; does not require.

You can see from the concept itself it is easy to install and commission. It can be easily reusable and relocated. It has call a simple restraining system because, studies show that the T 0 value of that of a triceratops is far lesser than T 0 of a tension leg platform. Because, by design TLP has buoyancy exceeds the weight, whereas in triceratops this is partially taken care of by the connection.

So, the initial pretensions in tethers are far lesser compare to that of a TLP, so that is an advantage. And therefore, all this will make triceratops as cost effective for ultra deep waters.