Computer Methods of Analysis of Offshore Structures
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Module - 02
Lecture - 03
Offshore Structures - 3 (Part – 2)

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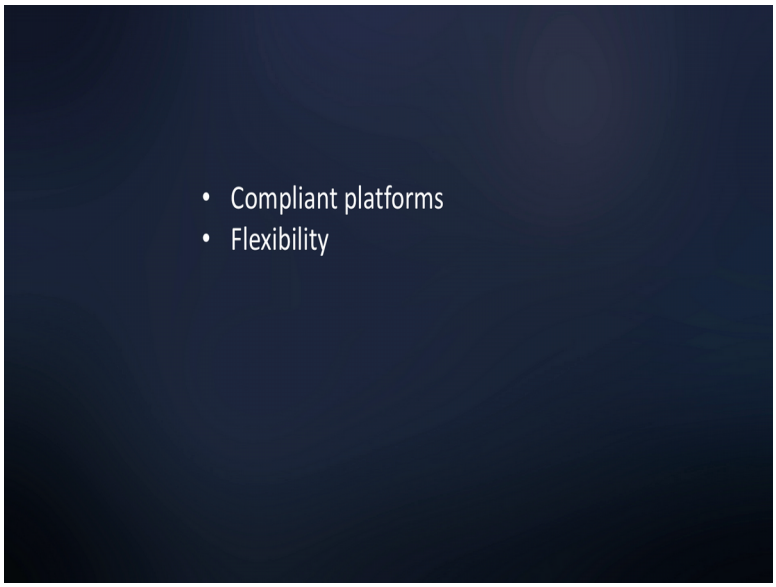

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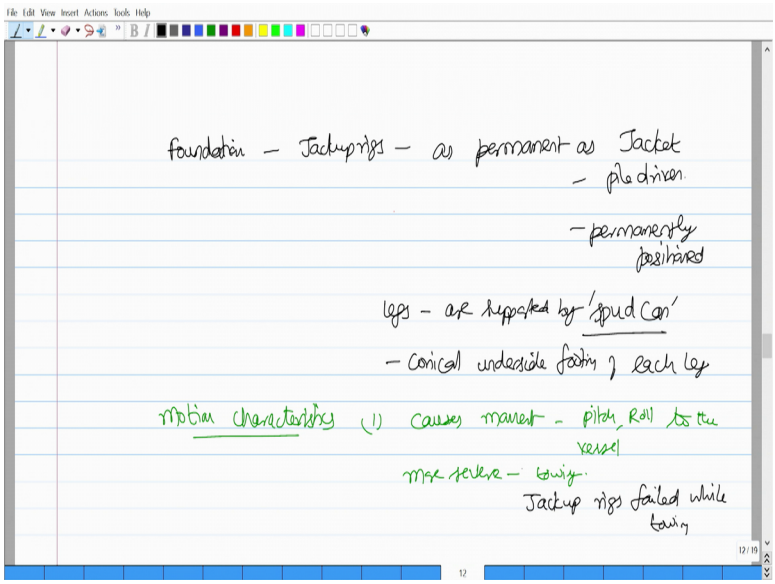

The next type of platform which comes into play is compliant type platform.

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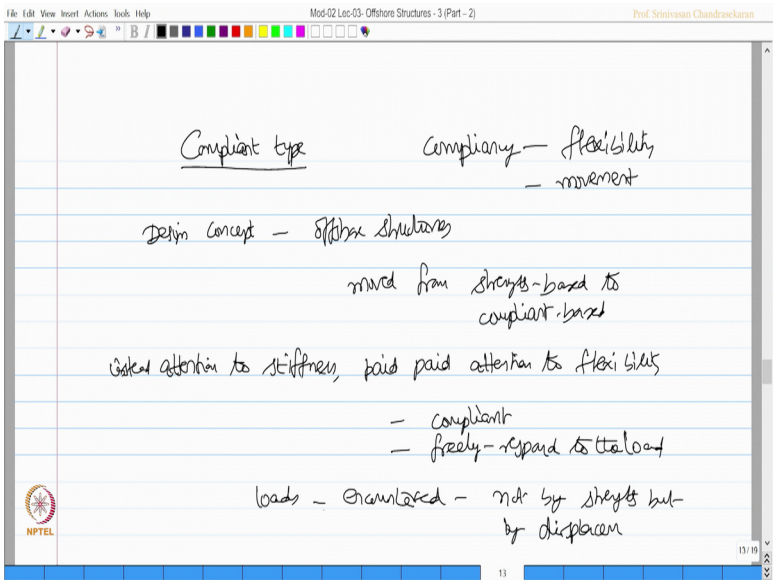

Compliancy is a term related to flexibility, movement. So, friends the design concept of offshore structures moved from strength based to compliant based, that is instead of paying attention to stiffness, people paid attention to flexibility. They made the system design compliant, freely responding to the loads.

So, now the loads are encountered not by the strength, but by displacement. Now displacements can be of two types.

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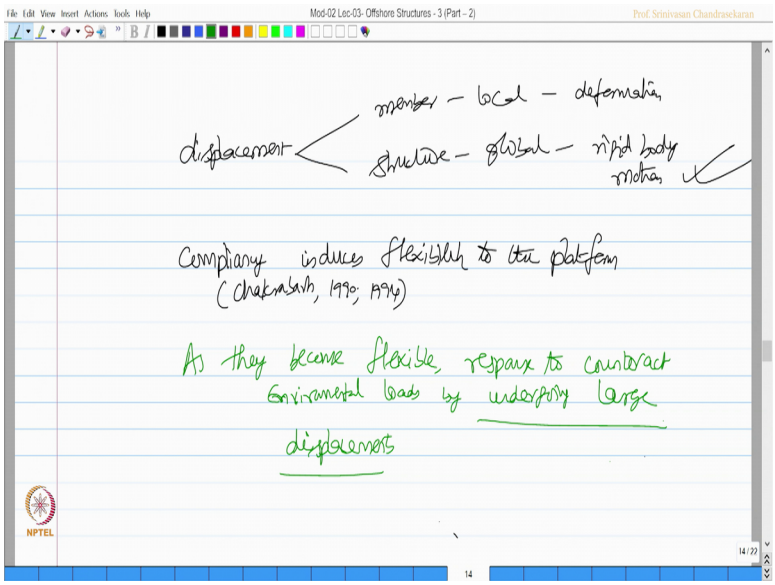

Which happens at the member level, which happens at the structure level? So, this is global, this is local, this is otherwise called deformation; this is otherwise called rigid body motion. So, compliant structures are designed to have large rigid body motion. So, the strength is replaced by deformation characteristics.

So, compliancy induces flexibility to the platform. So, this is verified by various studies available in the literature Chakravarthy 1990; 1994 etcetera. Now as they become flexible, response to counteract environmental forces by undergoing large displacements.

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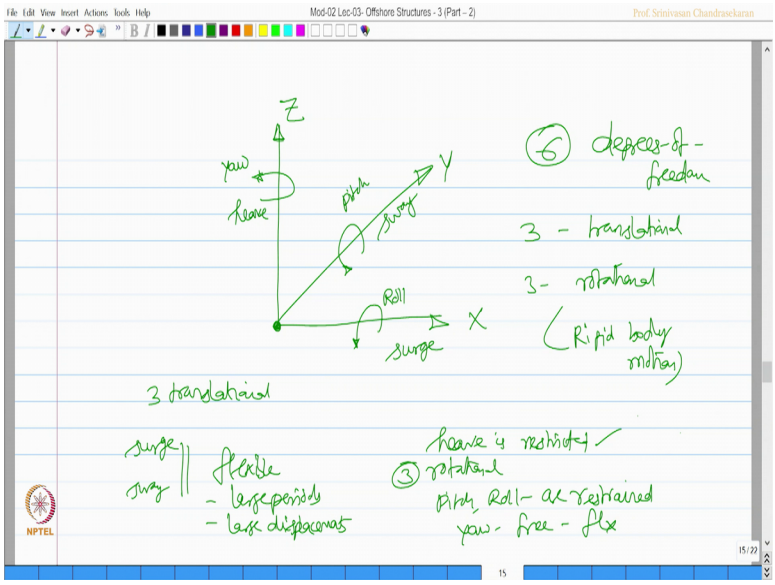

So, they undergo large displacements; the moment I say they undergo large displacements, then it happens in different degrees of freedom. Let us take three axes X, Y and Z for any body in space it has free displacement in all the three axis surge, sway and heave. These are displacement degrees of freedom along X Y Z axis respectively. Now put your thumb towards the arrow of your right hand remaining four fingers of right hand will show you an arrow direction. You mark that direction that is called roll about X axis, pitch about Y axis and yaw about Z axis.

So, there are 6 degrees of freedom, 3 translational, 3 rotational; all are rigid body motion. The whole system displaces in this type. So, amongst the 3 translational surge and sway are kept to be highly flexible; it means they will have large periods, they will undergo large displacements in surge and sway, but heave is restricted. Similarly in 3 rotational;

when surge and sway are free rotation about surge axis and rotation about sway axis that is pitch and roll are restrained.

Since heave is restricted rotation about heave that is yaw is free is flexible.

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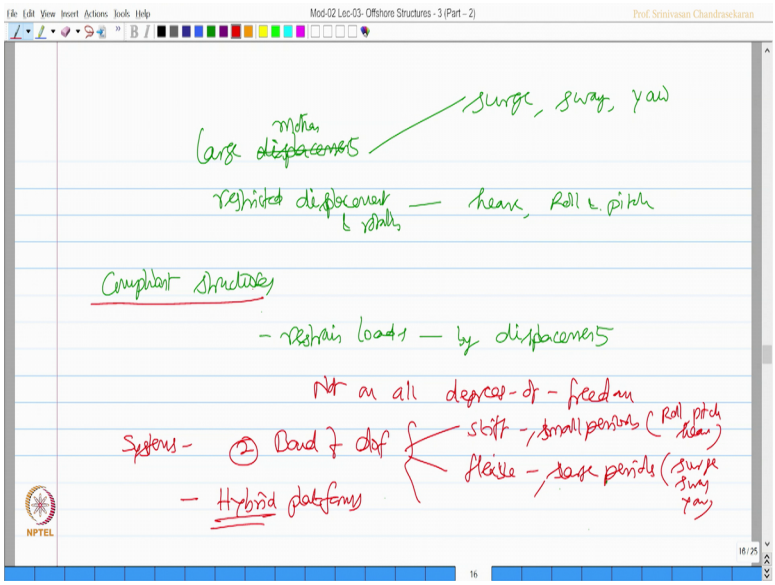

So, the platform has permitted of large displacement in surge, sway and yaw. They have restricted displacements and rotation; I should say motion, large motion and rotation in heave, roll and pitch. So, friend's compliant structures restrict or restrain loads by displacements, but please note not on all degrees of freedom. So, systems which have two bands of degrees of freedom, that is stiff and flexible. Stiff will have very small periods, flexible will have very large periods.

For example, surge, sway and yaw; small periods will have roll, pitch and heave or combined in single platform, such platforms are called hybrid platforms. Hybrid because two bands of frequencies or periods, which are either very large or very small or combined on the same design and such designs are called hybrid platforms. So, compliant structures restrain loads by displacements not essentially by restrains, but the flexibility which refers to compliancy does not happen in all degrees of freedom certain degrees of freedom are restrained in motion by certain degrees of freedom are highly compliant and flexible in motion.

So, such a unique combination gave rise to new type of structures, they are called compliant structures.

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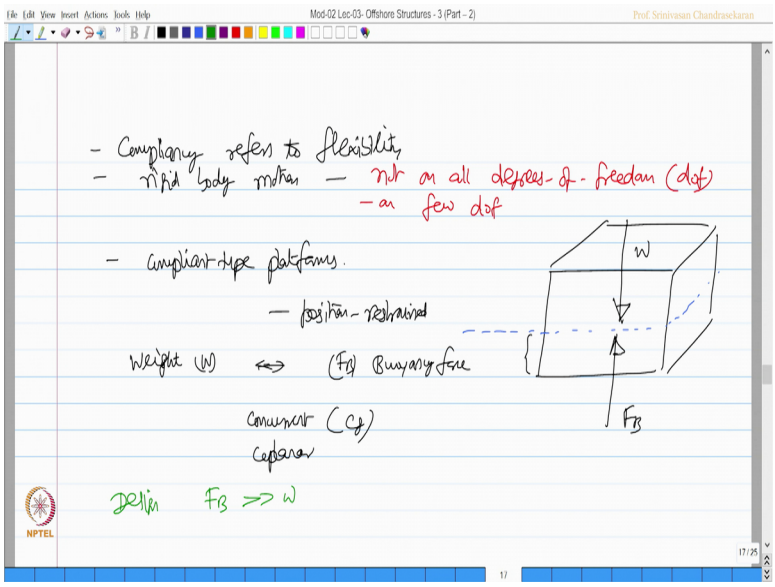

So, compliancy refers to flexibility, they have flexibility in rigid body motion, but please note not on all degrees of freedom, only on few degrees of freedom. Now, the question comes; when such compliant structures are to be installed for oil exploration they should be position restrained, how it is achieved. So, let us take a simple floating body of three the floating body has the water level up to this. The floating body has a weight which will act through the C g of the body. The displaced volume of the body will also give an opposing force to the top weight which is called buoyancy force.

So, now weight and buoyancy force are opposite each other. They will be concurrent about C g coplanar, but the design is the design of compliant structures is buoyancy will exceed the weight; it means the tendency is always to push the body out of water or above the water level. So, what is the use of such kind of design philosophy? It is interesting if you have a system whose buoyancy is much larger than the weight the body will freely float. Once the body freely floats it is easy install the body. You do not need not required special type of cranes etcetera. The body will freely float.

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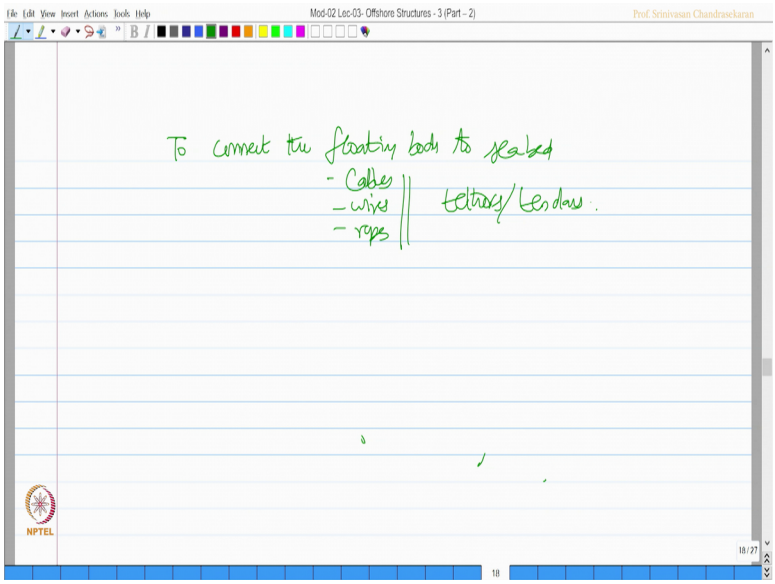

Now how to restrain this motion you have got to connect this body to the sea bed, but not restrain the body on the sea bed.

So, to connect this body to sea bed one can use cables, wires, ropes they are all called as tethers or tendons. There are varieties of compliant platforms which are constructed; concepting what we just now discussed.

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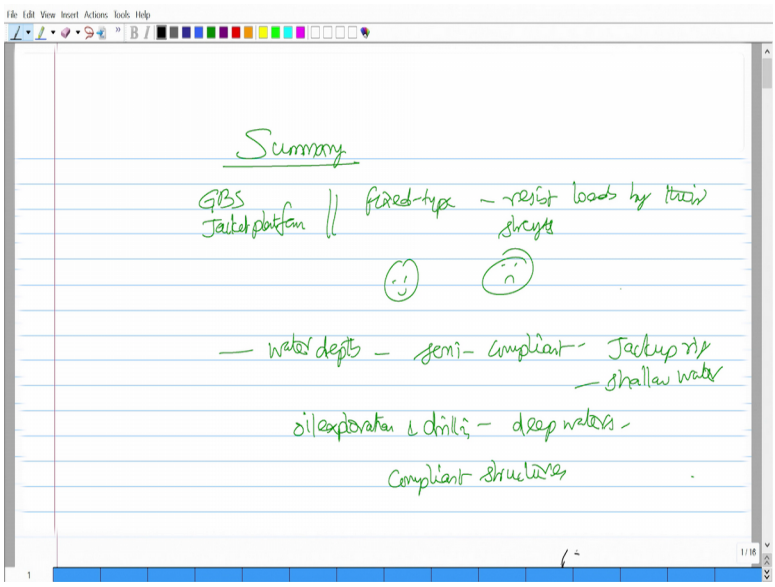

So, let us see them in the next lecture; let us see what the summary we have learned in this lecture is? We understood that the gravity based platforms; jacket platforms which

are essentially fixated type platforms resist loads by their strength. They have certain merits and certain demerits which makes them non suitable for larger water depth.

As we go towards increase in water depths people prefer semi compliant structures jack up bricks came into play, but they are not meant for deep waters they are meant for shallow waters. Now to perform oil exploration and drilling in deep waters; researchers started using compliant structures resist loads by displacement by enlarge and not by their strength. So, interesting friends' strength is not considered as a design parameter; whereas, displacements are considered.

So, in next lecture we will talk about different types of compliant structures and the merits and demerits and the response behavior under wave loads. And then we will come to a better understanding, how offshore platforms are conceived from the fixed type to a completely a floating type as of presence today.

Thank you very much.