Elements of Ocean Engineering
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Lecture - 38
Structural Analysis of Jacket Platform (Contd.)

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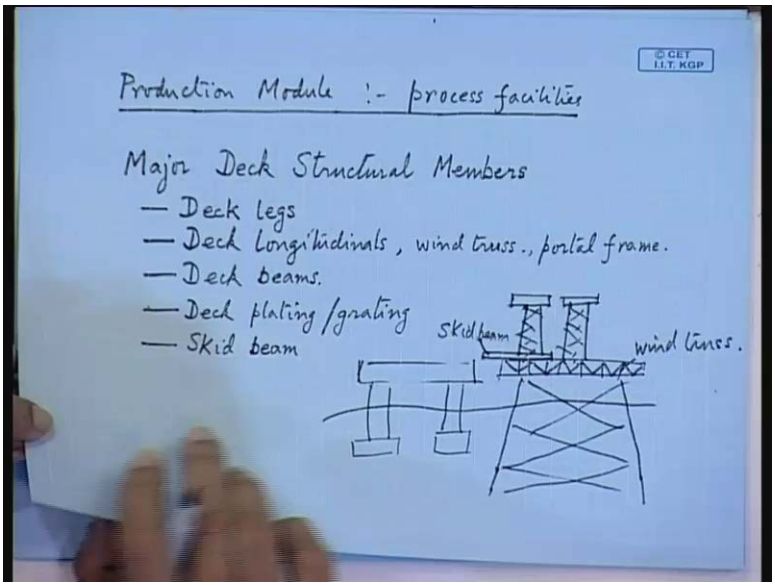

So, we start about the a load that we are discussing, so before that we are major deck structural members, now you have ships, now you have will expose to what are the structural members in a ship is not it. So, similarly we have the structural members of these are deck we have the major structural members in deck legs, then you have longitudinal or this are called deck longitudinal, the wind tress, portal frame were these are some of the components of your deck.

Then of course, if we have deck longitudinal then you should have deck beams, of course these are items for open deck, close deck also there will be no wind stress, but then you should have or is called the side shell, then the plating. So, sometime this is also called a grating, last one is a skid beam, now what is skid beam, that two under deck, now sometimes you will find in this platform, there see this is your deck, and there is one weak say weak is position on the deck.

Now, this is a main crust, now what happens? Another platform may come, and skid another rig on to the deck. So, you may have two drilling rigs normally you see in this

Jacob platforms, so this is called a skid beam, this is very heavy structure, when you can slide another drilling rig. You can take this drilling rig out, onto another say another platform will come say another platforms comes along side this jacket, floating platforms slides another rig say submersible will come.

So, this is called a skid beam, you can see offshore activity you not find only fixed platforms, so normal of platform types will into plate then may be another fixed platform, say some around here, I told you some two or three platforms in a given say oil field, so this were is skid beam. So, all this things have to design, so in case of the module support frame, you have to design these are called wind tress, where this is exposed to wind. And not the underwater tress which is exposed to waves and current, so this is the major deck structural items, which has to be design, and after this you design what is called the tower which is also called a jacket.

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Jacket somewhere this is also called a tower, what is this called sometimes they called this is a template, so this what are major structural components of this, so first one is you write is your jacket columns. So, these are calls legs, so these are normally larger in diameter than the next one which is called braces, now the tress that is a wind tress that you will design and also the braces. There is a systematic arrangement for doing that, do not, do it, have it is not it, that will give you rise to undersign able tresses, now braces can be vertical, it can be horizontal and it also can be diagonal, now next is joints.

So, these are intersection of legs and braces, now this has to be done very carefully, because most of the structural failure occurs a joints, launch runners or these also called launch tresses. Then you have skirt piles leaves, then you have appurtenances, appurtenances are similar to your auxiliary fittings on the all of the ship, like your order than your bill scheme value these are called appurtenances. Appurtenances are boat landings, then you have barge bumpers, conductor bracings and other similar items, these are called appurtenances.

Now, your main piles say these are all this called main pile housing are driven through the jackets legs and columns, or than the main piles are fixed to the tower or the jacket on and top of the deck comes, so this are actually the main piles of the larger diameters piles and this are the smaller piles. So, you may find that the main corner piles of columns piles are not sufficient to hold on the structure on the sea bed, then you have to drive smaller piles along on the periphery of the columns.

So, these are called skirts piles, so large number of piles are driven to the sea bed now here, so this the main either is called the last one, you can say this is there is mud mat. Now, if you do not have the mud mat the whole jacket can go and below this sea bed even a mud mat, actually this is the area for your to spread out the vertical load, so the mud mat is an essential component of the tower of template.

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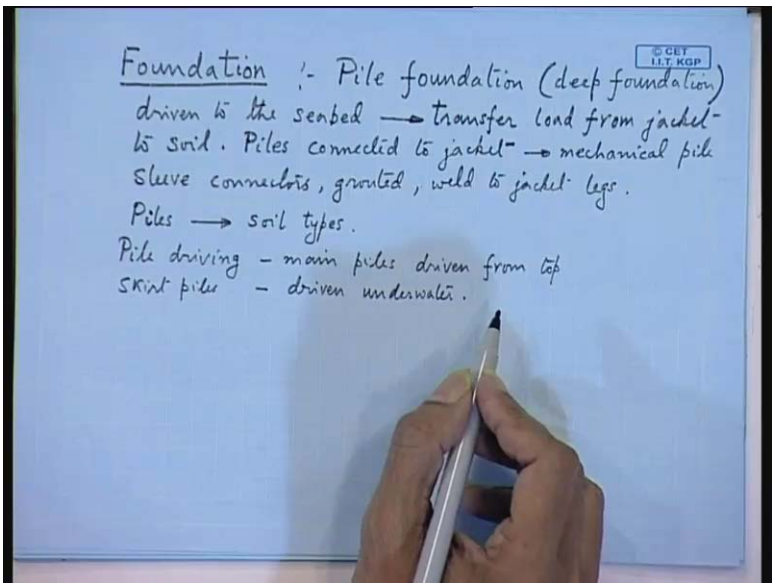

So, this are the main components of jacket template, now after this you will have what is the foundation, so what is your jacket structure, what is the type of foundation, foundation is your this is called a pile foundation. Now, in civil engineering they also they call this as a deep foundation, as oppose to another type of foundation which will come across in gravity platform, these are called wave foundations or shallow foundations.

Now, pile foundations we whenever talk about this you come across this, so there are two types of pile one is called a long pile and short pile a short pile, actually rotates that this types of foundation do not rotate about themselves. So, these are called deep foundations, so here these are driven to this seabed, now what are the function of this piles, this huge piles of the main columns piles diameter can be more than 1 meter 500 millimeters to 1 meters, this is a pile size.

So, what they are doing pile thickness, we say can be as larger say 25 meters pile thickness, so what is the function of pile foundation. This main function is transfer load from, this coming from where from jacket to soil, so that is the main function of pile, now the piles are connected to the jacket. Now, if you do not do this, then there be lot of vibratory loads coming on to the jacket, now this is done by mechanical piles sleeve connectors or you can grout there is you do some concrete grouting or you can weld to jacket legs.

Now, in ships marine structures the golden rule is do not keep any items loose, whether it can be cargo or any structure item you will lose items are always dangerous, because they can go outside the ship fall outside or they can bang in some other structure. So, that is one of the, that is why? You go for grounding grouting and welding other, where you device to or vibratory tools from waves.

Now, the coming into the a plies pile foundation piles, you will find they are grossly dependent on soil type, now if it is a very hard type of soil hard bottom, the rocky bottoms, you cannot drive piles here pile is going to twist look enormous force from pile driver. So, then you have to go for a gravity type of structural, you are not discussing at present this is your discussing a pile from foundation, but this is grossly dependent on soil types.

And the other types problems that are going to come else greening, pile driving, so because these are large diameter of piles, we require lot of affording. So, piles the long pile, that is the main piles you can drive from the deck of the platform by means of piles hammers and pile drivers, but what about the shorter piles, there is a skirt piles. So, main piles driven from top, skirt piles driving under water, so even the these are very costly operation any underwater operation do is fraud to with danger.

First of all you have to be very cautious about the installation and the positioning of the pile driver, because as soon as you leave water you are going acted upon by buoyancy and boiling buoyancy. So, that situation you will come, so this under water piles driving is another important aspect the, we have next is the load variety. So, load variety I have already talk about, but if you want I have this in detail say this is your jacket platform, see first thing that is you will come on the deck.

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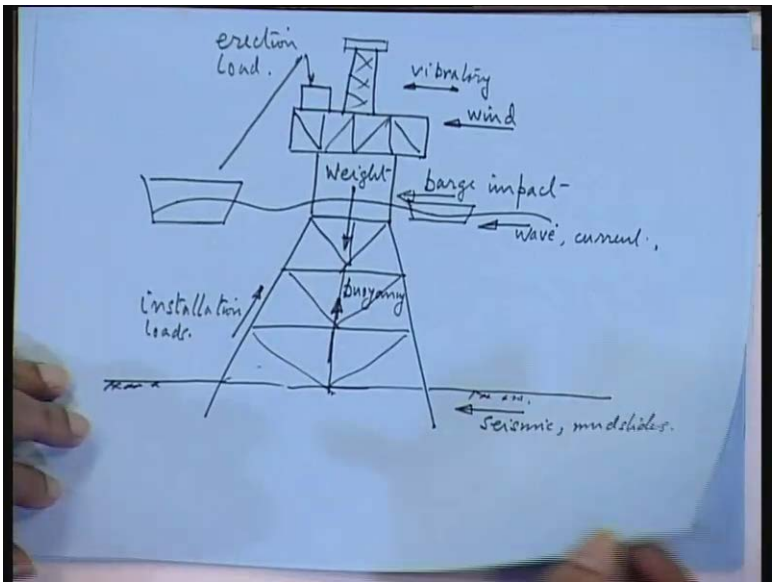

Now, deck will have say this is your module support frame, and this is your rig, so you may have this kind of load, so this is called vibratory load, then you have wind, so wind age area is another crucial here. Now, you can have a structure like this, and then you have the tower, so this is under water trust correct, now there are two things which will come say this your wave.

So, from here you get wave current you will get, now sometimes here you will get barge impact, so you have to do extra strengthening at the bottom line, because of this. Bargain

waves also comes here, then you may have direction load, then you can have installation loads, so weight is going to come down from here, what is going to act buoyancy. Now, your structure is below the sea bed, so here you will find seismic coming from earthquake mud slides, these are the load the different types of loads and normally act on the jacket platform. So, these are all classes of loads, and from this you can have an idea of functional loads, then you have deck equipment loads.

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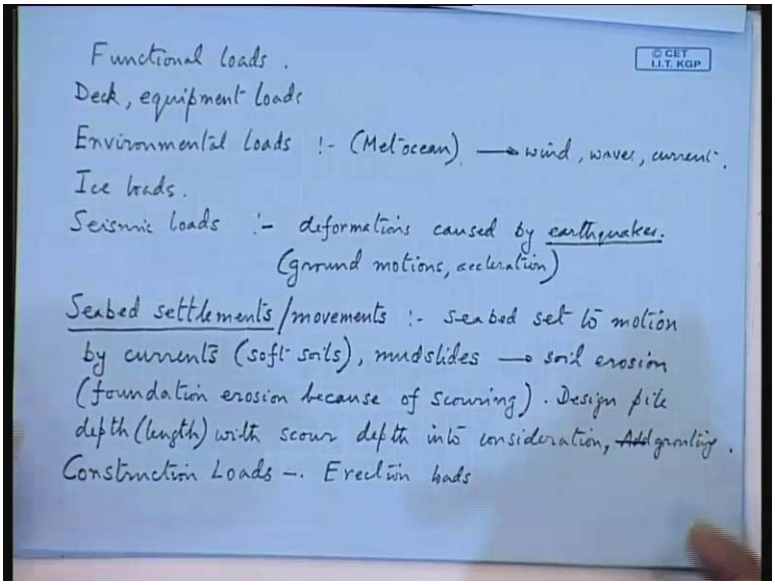

these are already talked about there is a equipments which are based on the deck, and other is the self rate of the deck, now next is the other type is environmental legs. So, environmental you come from met ocean, so wind waves and currents, so ocean engineer has to be thorough about, this is called met ocean, ice we are not getting, you can get in the Artic seismic.

So, these are the fix structure, you will get earth quake loads, so deformations cause by earthquake, now these are called in structural dynamics, they are called ground motions ground is placements and acceleration. So, the structure if it is in located in the seismically active zone, then the foundation has to take care of this not only the foundations, but you have to give a thought of these joints.

So; that means, this structure is going to twist about of this joints, the normally earthquake design they make the foundation as a spring mass system, so this your foundation basic term. Normally, you will be damping is not there number of spring this

is your based, you one thing may be do the other thing is this joints, that joints you do not have much your most of these joints are welded anyway.

Now, in buildings actually joints may make it this, they can have some kind of rotation, and earthquake from areas they make this type of joint, here actually normally where that is not done, because the joints are the fixed, because of the large amount of force is comings from waves. Now, if you make this is the rotation, then your whole structure is going to show like this, so that thing cannot have here, and the other problem is here, now here what is done is actually the mud mat.

The mud mat you make it extra strong and thing, because the base earthquake from area you try to distribute on mud mat this mud mat will have a, this is your sea bed, then this is your mud mat. So, you modified your mud mat, accordingly make it more heavy strong it is dimensional all things you cannot do. So, these are immediately this is an earth quake, there is a bleakish of your column, because this will come because of what this because of frictional failure, so that means, we have design this structure in such a way.

That it will take large amount of bending moments, the maximum failure will be occurs because of two things in case of this fixed structure, one is the flexor other is what other is because of buckling. So, failure normally occurs, because of flexor blocking and also because of a this fatty a normally cause of Ferrier in jacket platforms the failure, normal occurs this joints, so those are to be prevented.

Anyway, so this is some of the area, so other is you foundation of discussing the other is what is called seismic, we have done seabed settlements, so how you conquer this, your structure is not a floating structure. So, is neither or shift for a semi submersible ((Refer Time: 28:41))it is connected to the seabed settlements, so the seabed is not stable along stable ground, and which we are standing and sitting is unstable, then what you are seabed settlements movements.

So, here sea beds set to motion by what by currents, so at the foundation of the platform, you may not find waves, the waves are normally you find the sea level. That is the surface a large amount of sea bed is going to be swept away by currents, so normally this will occurs in soft soils very lightly to the loaded loosing means pretty high in this type of soil.

Now, currents mud slides mud slides is also very dangerous mud slides are normally caused by earthquakes in different location, or it may be caused by driving for another platform. So, mud slides is going to have their soil erosion, for sometimes these are called foundation erosion, because of scouring, scouring is going to take place, scouring is just disturbing the seabed around the foundations.

So, at the foundation you will find in a nice holes has come, where you have drilling the columns, so when what we are you going to do so; that means, design pile depth, length of pile with scour depth into condensation this is one thing you can do. So, the pile actually the depth on the length of the pile that you are going to design, the main thing that you are going to do is to resist the horizontal wave length, that is coming on to the pile.

Now, you design the length of the pile which is going below the sea bed, is seabed actually is not going to be like this, so in case of scouring it will come like this, so this is your sea bed. So, there this much extra length of pile we have to give, so this is called scoured depth, so normally you increase the length of pile, the other thing that you can do is what you pole concrete you try to grout this portion, concrete portion put some rocks and concrete you make a foundation like this.

So, this is called grouting, so this comes under geotechnical engineering, so this is some of the prevention majors you have to take, when you do for foundation engineering. So, mut mat is your conductors and next scour depth into consideration, and or you can go, I am just around writing grouting our think is structure engineer construction loads. So, mainly comes from erection, then you have transportation loads, so here you design tide downs design, you installation loads.

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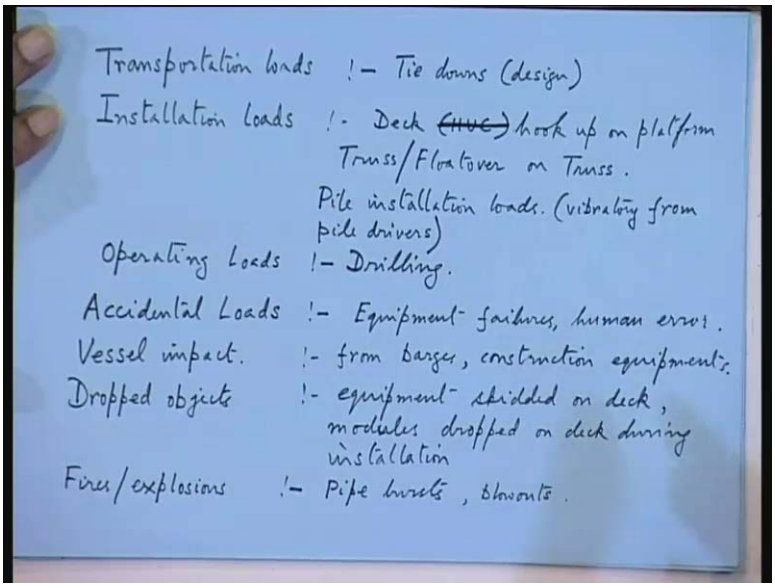

So, hook up major or what you will write hook up on platform trust or float over, so loads that are coming on to the trust from installation on deck, pile installation vibratory from pile drivers. So, you have the main jacket as to take this loads vibratory from pile drivers pile have us, so these are called installation loads, operating loads, drilling is your major of place then you have accidental loads.

So, there is only loads categories, which will come we will segregate between which are static and dynamics, so this is coming mainly from equipment failures, human error, vessel impacts from barge construction equipments. Here, lot of construction activities taking place, so you may then have dropped objects impacts this some, then you have dropped objects equipment skidded on deck.

Modules dropped during construction or rather you write during installation, the deck module can be can way if you 100 comes this our dropped objects, now last category is fires and explosions then this might also occurs. So, these are cause by pipe burst blow outs, so how you control blow outs, so in the new zero found out that disaster in the gaffer Mexico. So, blow out is another cause from the fire and explosions by cannot these are not going to much help, because in case of any go out occurs the whole platform is going to be end of by fire.

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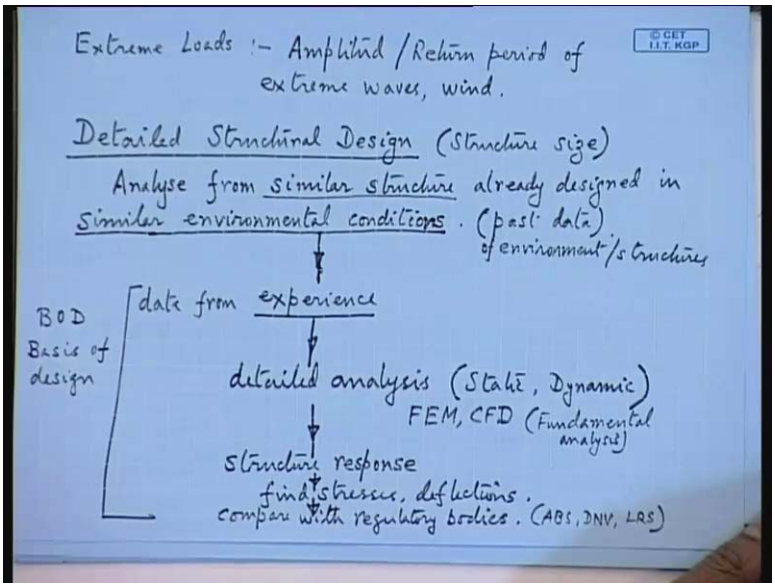

So, this you can control only small explosions, large explosions are beyond the control the other is here extreme loads, now extreme loads how you want to tsunami or frequent or has forming. So, here you have to find out amplitude return periods of extreme waves, storms, wind here find is out from past history, whether that particular environment, side is there any chance of this havening, so in the ocean engineering the extreme load calculation is also very important.

Now, after this all this thing has been the load has been categorized carefully analyzed then what you do, then you go for a detailed structural design, so by this time you are the load history is complete. Now, how do you start from you analyze this similar to your ships from, similar structure already designed, so this is your basic design actually, in what in similar environmental conditions.

Now, this is very important, because your jackets structure is going to the fixed unlike ships, you just in the design the basic shifts having small great depth draft. And from that you select your design ship, but here actually this is very important, you try to find out a similar structure you studies similar environmental conditions. So, here you will find out this you can find from you kind or design all kind here you have find out now in the big offshore company, you must have done worldwide contract thing, so we have this data.

So, this we have to build up on past data is required environmental data, and past data of environmental structures build upon this is the first job you do next job experience. So,

new entrant in to this field may be foreign it will be difficult, but say offshore contractor offshore companies, which have wide experiences, they can draw upon their experience beside on structural design is stricture sizes.

So, back drom or axom there have been, so many offshore structure that can tell, you that have foreign new field whatever structures you are going to do that. So, that is data of and knowledge from experience this is your similar environmental conditions, similar structures, so this is your basic structure, after this what will do make a detailed analysis then itself. So, these are mainly from experienced and past data, from that we do not stops, so detail analysis you make your static dynamic responses, static and dynamic analysis has to the ((Refer Time: 47:56)).

This year studying structures engineering, in our systems based on FEM CFD, the all this mathematical tools are normally employed here, calculate structure this first find point there stresses deflection etcetera, compare with regulatory bodies. So; that means, in case of offshore structure design, you have to do lot of fundamental analysis, so this is your fundamental analysis you cannot escape this, and when you put this to your server for your approval.

So, here you find ABS, DNV, LRS, you come and aspects your drawings or put there, see drawings that you produce here, now they will ask for this all this calculation also method of calculating here structural members, from your fundamental analysis. And you explain what ever software you used for defiance and the etcetera, so now, there are lot of software for your film of your under water trust foundation analysis, which have difference of to it. So, all this things are done and then you have to corporate with the survey, so this is the what is called after you do this.

So, this is called basis of design, or in short this is called BOD, Basis Of Design, now after this all things have done, next class I will tell you about there is small problem, where you have to select the pile sizes or other next class we will try to do about selection of member sizes.

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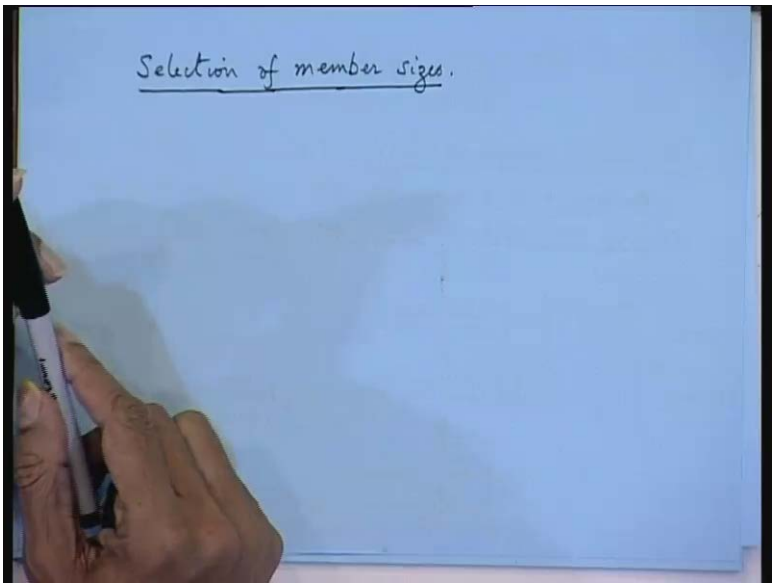

So, these are main job from structural design, now in ships I think in previous semester, you have done, what is the ships strength calculation, from that what you have calculated that is the plate thickness that is luxuries size or luxuries size of this. Similar, here you have to find out member sizes, but here analysis of jacket structures are unlike, this is different from your that ships strength or strength calculations. I cannot do it that ever thing here, because the structure is vertical it is not trussing on two case along structure box there are.

So, here you have to do a lot of fundamental analysis, so selection of member sizes are done from your FEM calculation. So, if you want to go in off shore you have to this stormy the FEM and the fields, but of course, you start from a basic design, not only basic design is important, but you have to draw upon your pass experience. Experience is also very important, because in obedient field lot of carrier are afferent, because the offshore contractor did not have sufficient experience for that type of field operation, so that is the crucial, so next before we do this before you go to foundation analysis.