Marine Construction & Welding

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Module No. # 01

Lecture No. # 13

Structural Details

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What that will continue with that sections, mid ship sections of different vessels. We have already done general cargo carrier. We have done about talked about bulk carrier and obo carriers. Let us take a break today and look in to some of the pictures some of the photos where in, may be you will have little better idea about those structural details.

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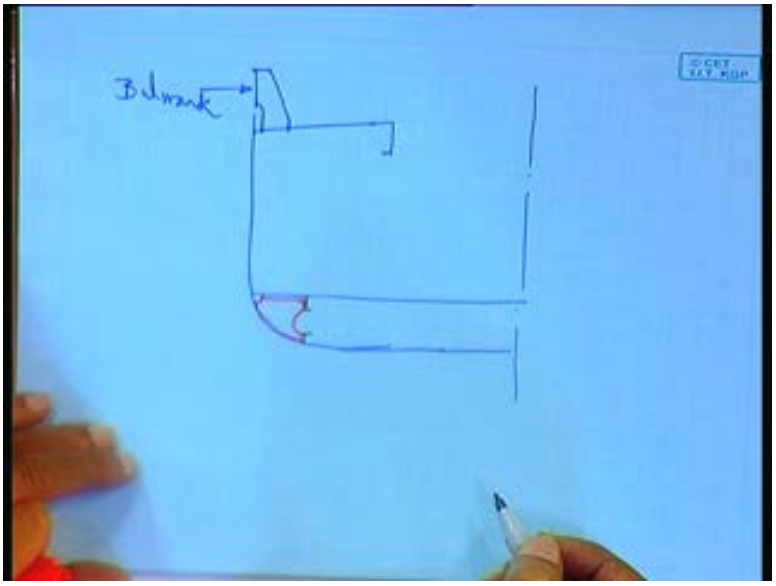

To start with say, we have talked about well the general section when whenever you have drawn, you have seen it like this; say a mid-ship section, you have the double bottom, this is your say hatch side girder and then here I showed one item like this.

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Which I referred to as Bul work, this called Bul work. This is nothing but a sort of a railing on the side of the along the ship because you will have to have some so called railing so called protection otherwise you go overboard is not it Bul work. So, this is

what is essentially Bul work; that is how it is named. So, if you look into this, you can see this structure, this particular plate is the Bul work.

I do not know about we can make it out if I so you. Can you correlate the picture I drew, this particular plate is the Bul work plate and this particular bracket which is supporting the Bul work is the Bul work stay that is what is referred to as Bul work stay. It is making the Bul work stay at its position. This is your deck the deck of a ship and here you have the side shell terminating here. There is a gap in between. This gap is purposely kept for some reason the water should drained out. So, this is what your Bul work stay is.

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Next we will see, we have been taking about double bottom, we have been taking about floors. So, this is a typical section of course, the double bottom what we have seen, we have drawn, there we have seen only well the bottom shell and we have seen the tank top plating. Now here it is a some special purpose vessel where they made some additional structural arrangements that is not I mean for some functional requirement, this changes have been done. Otherwise this is your double bottom forget about what has been shown here as a separate member, but you can see, these are the longitudinal; inner bottom plate longitudinal. Here a section the bulb sections have been used bottom shell also some of the longitudinal are visible.

Bottom shell is also longitudinally stiffened. That is what is longitudinally stiffening arrangement. Here one plate which is not very clearly visible that is my side girder one

of the side girder. And see this part. Well here somewhat changes have been done, but otherwise this is what is the floor. You have those big openings small openings for some reason the openings have been made in this way the whole purpose of these openings are essential to make the structure lighter.

Now, lighter means if you cut further it will become further lighter of course, but at the same way lose strength. So obviously, what is done is generally cut the material nearer to the middle plane of the plate because that contributes minimum to the section modulus. Generally it is done so, which here you can see all these holes are cut almost at the mid depth region. So, thereby you make the structure lighter as well as you provide for a continuity within the tank because these are all basically used for tank head space, for carriage of ballast porter or fuel oil or whatever. So, there should be a flow of liquid. So, that helps this opening that helps that.

Now, you see these some vertical members, can you see that, this vertical members connecting the top longitudinal; that means, the tank top longitudinal to the bottom longitudinal. These are struts nothing but struts. The whole function of this is to strengthen the floor plate because you can imagine the floor plate; this is in the transverse plane. The floor is in the transverse plane, these are the longitudinals in the longitudinal direction.

Now, this floor plates the loading of the floor you can see it is under compressive loading. The loading coming from the tank top whatever cargo will be kept there over this tank top right and load from the bottom shell. That is basically your pressure of water buoyancy force. So, the plates will be in plane compression. Now if it is in plane compression already they are not stiffened in that plane, it will buckle.

For that purpose this struts are there. They are basic function. So, you can see the struts are stiffening the floor, floor is stiffening the double bottom, and double bottom is stiffening the whole ship.

It is that way. So, these are basically struts and now as you can see the spacing between this longitudinals is what we call frame spacing. They are equally spaced whatever is the frame spacing that is how they have been spaced and then the struts are also connected on those frame spacing; that means, you do not fit any stiffener arbitrarily. These are old in for old practical purpose, stiffeners will be located I mean the spacing between the

stiffeners will be either equal to that of the frame spacing or multiple of frame spacing. For some specific requirement at some specific location, you can have in between some stiffener otherwise everything will fall in line with the frame spacing like we can see here also the struts are there. It is connected to the top longitudinal and to the bottom longitudinal.

Why this connected because that gives a better end connectivity, better end connection. The load path becomes well I mean the load flow becomes greater. And also you can see the there is some upper deck here something whatever it can be upper or some lower in between deck. These are my deck longitudinals the spacing of them is also same.

That means if I cut a vertical plane here, you will find this longitudinal is coming, then this, then the strut and then the bottom longitudinal. If a vertical plane cuts across the length of the ship, all will be in one line. Similarly if I cut across a transverse plane also this thing will be in one line see the deck transverse.

It has a much higher scantling, much higher depth compared to the longitudinals. See this supporting the longitudinals. Side shell is also longitudinally stiffened, here you can see the longitudinals running there. So, you have this again your web frame supporting the longitudinals.

So, you see here you have the deck transverse, the web frame and in the same plane this floor. That is what I was saying that it will come the floor, web frame, deck transverse; it will go in the same plane. Now here you can see the entire hull is longitudinally stiffened.

The deck is longitudinally stiffened, entire side shell is longitudinally stiffened of course, this part of the side shell. We are seeing here that double bottom is longitudinally stiffened; that means, it must be a vessel where only liquid is being carried. It is basically an oiler, an oil tanker not a huge one, but a medium sized. So, a medium sized oil tanker is called oiler.

I mean these spaces will be used for probably some liquid carriage etcetera. As I said, that had it been a general cargo ship. So, you can fill if the side shell is longitudinally stiffened, you see here the side shell is longitudinally stiffened, then so much of space is wasted.

That means for cargo storage you have space from here to this place. But the depth of these from the shell to this; that space is wasted if it is general cargo ship. There is a reason why in general cargo ship we do not have longitudinal stiffening in the side shell means. If you have longitudinal stiffening you will have to have transverse at interval transverse frames, web frames at interval which will support those longitudinals. So, this is what is the arrangement of the double bottom; you can see longitudinally stiffened deck, longitudinally stiffened side shell, deck transverse side shell, web frame we call that web frame, plate floor and then here these two faintly visible two members, can you see them? There is one and this is another. This is the bracket floor it has been cut like this.

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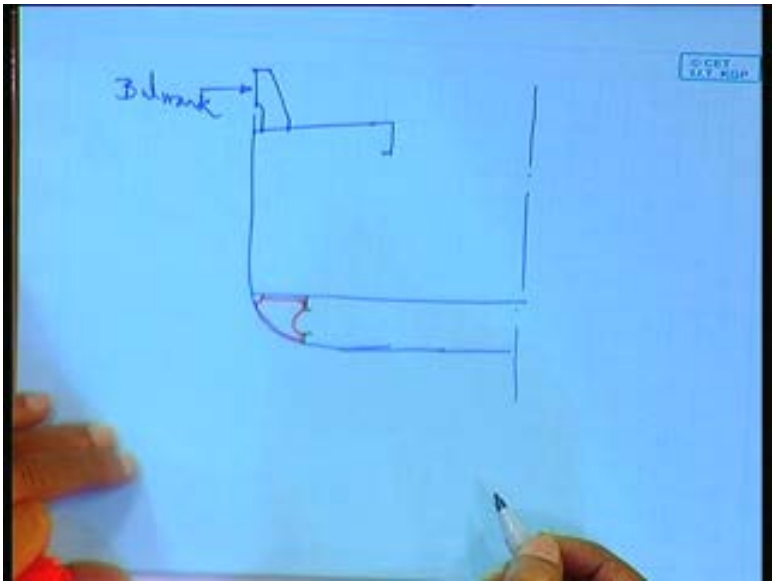

Cut necessarily I could have kept it straight. There is no harm the whole idea is it is just only a bracket the bracket floor connection means something like this.

The last two longitudinals as you can see and here you have this kind of connection they have made, something like this.

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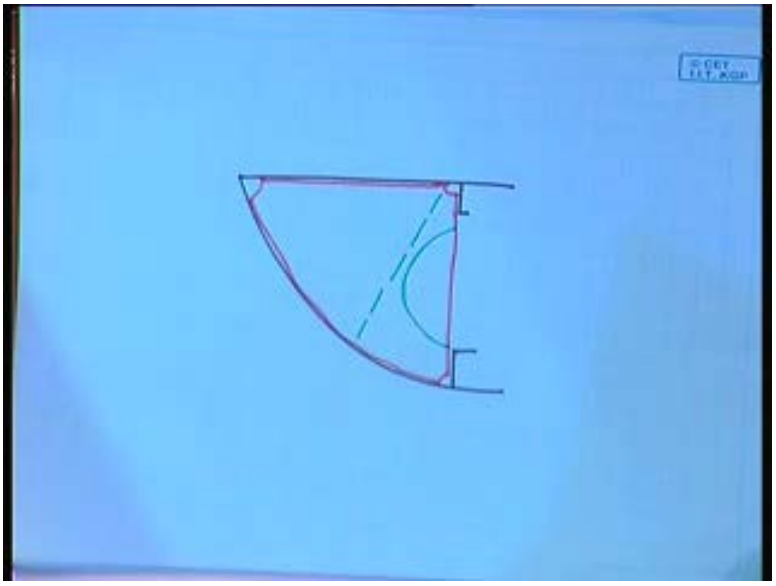

Instead, I could have also; say this is my tank top well little drawing enlarged view, bottom same, the bracket floor could have been like this also. This is my bracket floor. It could have been this also. Anyway here what they have done is that they have further made it lighter, further made it smaller by cutting a part of the plate here. That is all. There is no specific requirement as such. I can as well keep it straight.

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And also now this is what is the bracket floor. Concept of bracket floor it is nothing but it connects the immediate two longitudinals. That means, this corner part is further

stiffened; that means, you have this floor at intervals at interval of 4 or 3 frame space; at a interval of as well a v s it says that it cannot be more than 3.65 meter, the spacing between transverses spacing between plate floors cannot be more than 3.65 meter.

So, if you have a separate spacing of say 800 millimeter; that means what, 4 frame space makes you 3.2 meters. So, you can have every fourth frame, a transverse or a plate floor. So, that is what it is. These are that an in between difference, you have this bracket floor arrangement. Now again this bracket floor means nothing but a piece of plate which is connecting the inner bottom plating, the well, the bilge plating here basically it will come in the bilge end only and the two immediate longitudinals.

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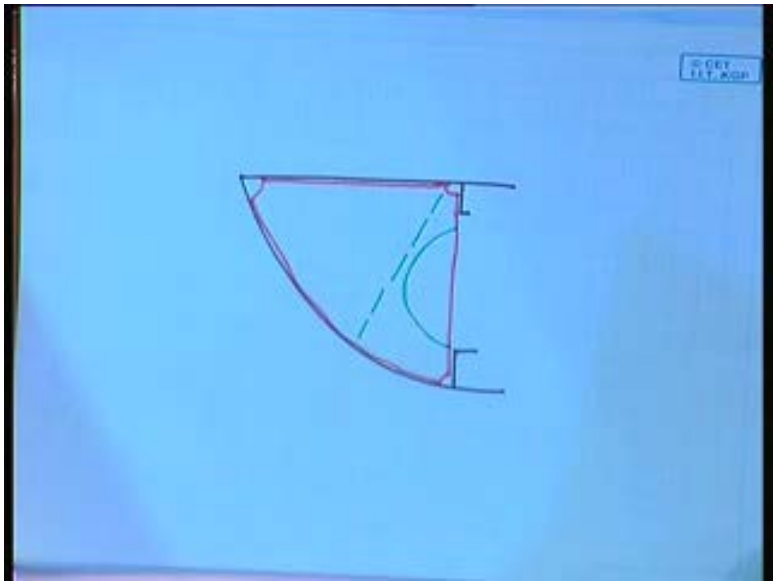

Longitudinal of the inner bottom plating and the longitudinal the bottom shell plating. So, it is connecting and here you can see something not very clear that is nothing but again a stiffener because your this thing can be this plate is getting under completion this bracket may buckle.

So, to stiffen it well, a stiffener has been provided. But here you can see as I was telling you that all stiffeners or members are generally placed on some frame spacing or multiple of frame spacing, but here it is not so because this space itself is only one frame space.

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So, within that this plate has to be stiffened. So, you just provide a at certain angle a stiffener. Just to and the stiffener is also it has the same function as that of a what do you called strut basically a strut. So, well may be next one let us see.

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Same thing, the same picture well a little may be certain things are little clearer yes keel blocks are not very visible here. It is sitting on the keel blocks. This is what is one block has been erected.

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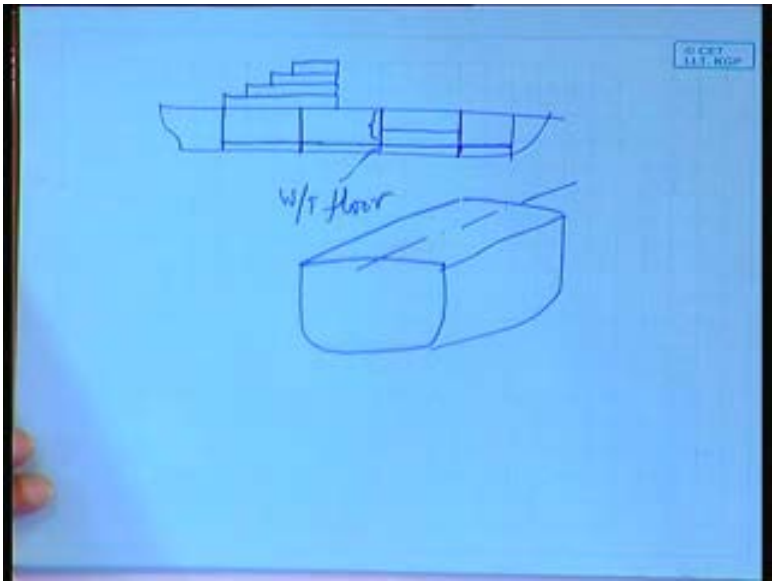

You know I mean one block means as I said, when you do the construction say your complete ship may look something like this, say it is going like this. Now the whole ship how do you build, where from you start. Like I said we start with the splits and profiles sub-assemblies assemblies and then units, then blocks like that. So, this is one of that semi block unit.

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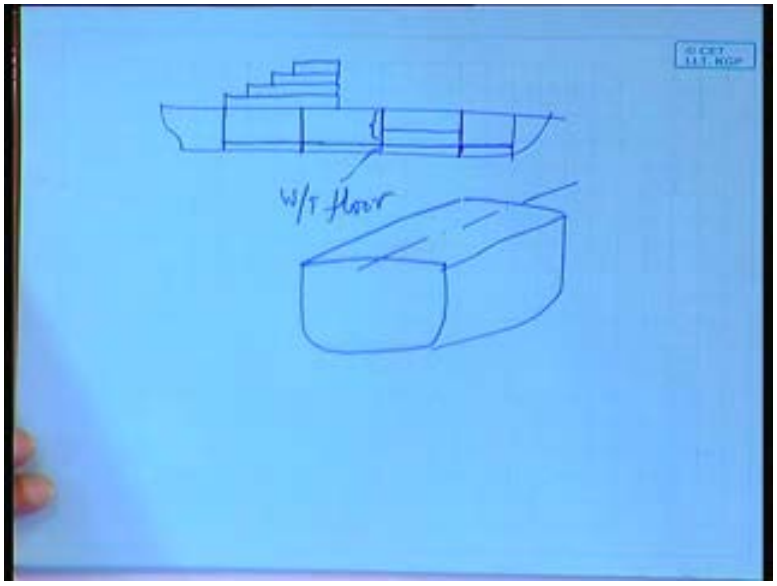

And block in between you can say or unit you can say not the full generally conventionally block is the full section say this is one block means, you have the entire section the up to the top deck. That means, bottom shell and this is my top deck, up to the top deck you have the… So, which is what generally is referred to as block; that means, a full part of a ship, the super structure block, the entire super structure.

Aft end block, the entire aft end with all feedings. So, here well the picture what you are seeing, it is not necessarily a full, but it is probably up to this much. Let me say unit, quite a big unit because whether you will fabricate the whole block or what size of unit you will fabricate that like in depend on your handling capacity because this has to be physically shifted and put in the erection bar.

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Anyway. So, here once again we see all those the structured item and here not but very clearly seen, but you can see there is a opening in the floor and through which the penetrating through the longitudinals. Same thing in the transverses, may be some pictures will have where it will be little better.

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This is a closer view of the same thing. You can see those struts, the longitudinals, there is the opening cut in the floor plate through which it is passing through, these are the two bracket floors, that bracket floor it is itself is stiffened by a strut that way.

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This is one of the double bottom unit just the double bottom unit, inner bottom plating, bottom shell plating and here this is a floor, but you see there is no opening at all water tight floor.

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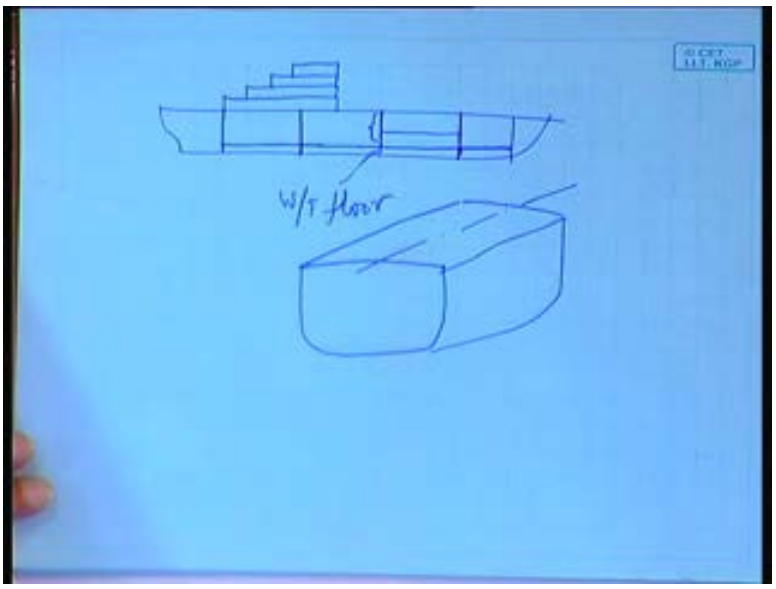

Because you have the ships well as you, the well the double bottom is there and the ship is divided in various compartments water tight compartments. That means, each of these compartments are individually water tight or in other words any damage in any compartment, the flooding whatever will take place, will remain confine to that

compartment. That will not spread to the other compartments; that means what, these bulkheads should be able to withstand that force.

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So obviously, where I have the bulkhead water tight bulkhead just below that, I should have a water tight floor, then only I divide the whole ship in individual water tight compartments because the ship in between is divided by this what you call tank top or the inner bottom plating by in two spaces of the whole spaces and the double bottom space. So, what happens, this part is the bulkhead and then the bottom part is the floor, this is the water tight floor. So, this is my water tight floor. This is not a bulkhead what you see here. It is a it is a water tight floor basically.

And since it is a water tight floor so you do not have all those lighting holes and all that it is all closed. Of course, it does have those struts on the other side, it is there you do not see. This side means they are there on the other side and here you can see the entire shell and the inner bottom plating is longitudinally stiffened. This is longitudinal framing system. Everything is longitudinally stiffened because in double bottom it is preferable to have longitudinal framing system. So, whole thing is longitudinally framed; that means, this floor will have cuts openings through which this longitudinal will come, but then subsequently there will be blend off by so called collar plates.

Because you will need to have the openings otherwise you cannot run the longitudinals. When the longitudinals are not terminated there, they are running continuously. So, there

will be opening through which the longitudinals will be there and then they are sealed off by pieces of plates which are referred to as collar plate.

Another thing you can observe the color of the steel plate. It is quite nicely I mean not reddish brownish color what is this. It is painted; it is painted by a primer coat. This is what is called primer; coat primer coat means the paint should have a quality which will not interfere.

Other fabrication operations because now the thing is under at a fabrication stage, it is not the final product, it is a fabrication stage. So, you will have fabrication operation like thermal cutting will be there, welding will be there. So, if I now paint it with the with the final coat of paint or such paints which if I subjected to welding or thermal cutting that may adversely affect the process. Basically give raise to gas and they will be porosity in the welding.

So, this is a kind of paint which is referred to as the primer coat, generally zinc based primer coats are used. Steels I mean before you put to use for fabrication their surfaces cleaned those things little more in detail will take in later lectures, the surfaces are cleaned off whatever rust or mill scale whatever is there and they are subsequently I mean the moment they are cleaned immediately they are protected by a coat of this primer paint, primer coating and it is color is somewhat like this. So, it looks. So, nicely I mean the whole purpose is this primer coat should be able to protect the plate till the fabrication is over.

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That means it should have enough life. So, they will protect the steel from the further corrosion, rusting till construction is over and give it a final coat of paint. Well these are some of the closer views. Here is the side shell longitudinals, it is a longitudinal framing system this is the side shell is of ford part which is becoming v. You imagine the forward sections of the ship.

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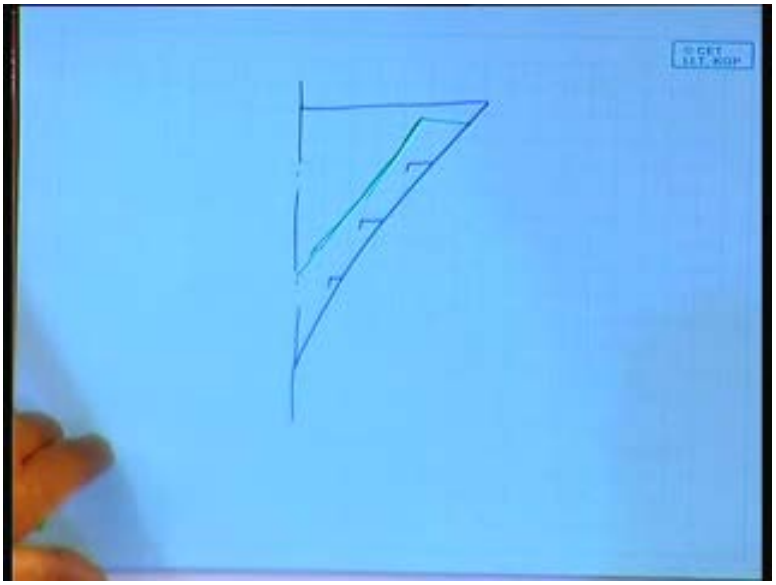

The fore forward sections if we draw, the forward sections have become like this sharply v type. So, this is my one of the I mean in the forward section where I have the side shell longitudinally stiffened.

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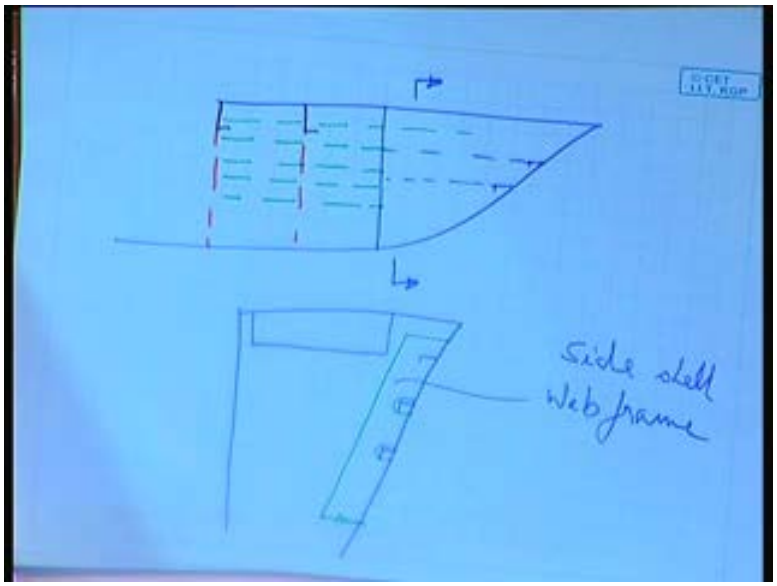

And you have this, what you call no this is web frame side shell web frame is going like this. Side shell web frame. This stinger will be this is a section may be this is a forward part stringers are in this plane. This is my stringer and they are running up to the forward peak bulkhead on the side shell. What I am drawing here is a section here, let us assume the section here is becoming quite fine and well it has longitudinal stiffening. So, it goes like this and since if it is longitudinally stiffened then obviously, you will have to have at intervals, transverse frames. You support the longitudinals because the longitudinals are running like this.

This is my well these are the longitudinals. If the side shell is longitudinally stiffened; it will look like this is not it. It will run along the length, this green lines all along the length and then you will have to have this transverses at intervals side shell transverses.

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Side shell web frames rather I mean. Deck transverse here you will have the deck transverse and here you have the side shell web frame and here you have the deck transverse. So, that is what you can see the deck transverse is this.

And this is a side shell web frame. This is forming a wing at the below. You will have the plate floor and other frame space you see like in the double bottom, you had bracket floor. That means, instead of the entire floor only end bracket same thing at the top corner this top corner. Here you see the brackets.

That means this is my frame spacing. So, here you can see one in between, there is another; that means, every third frame they are putting a web frame. This is a side shell, this is some deck is there which is also longitudinally stiffened; side shell is also longitudinally stiffened. So, the immediate two longitudinals off the deck as well as of the side shell they are connected by a bracket.

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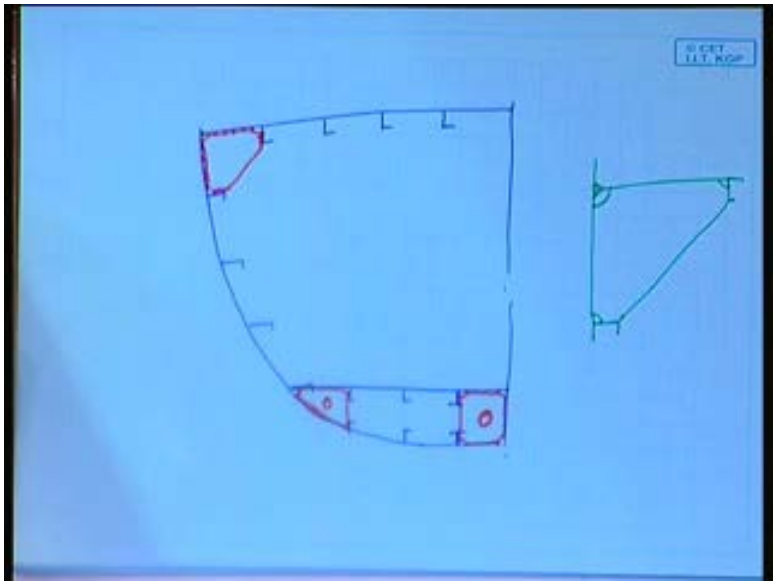

Similarly, as that of in the double bottom like I will show you. Say it is like this. Now in way off a section taken in way of bracket floor what we will see? We will see the bracket floor like this.

With these red lines, I am drawing the bracket floor. Also I can provide a small opening there, I mean a lightening hole. Similarly here you will have you see this is referred to as bracket floor, but it is essentially two pieces of plates. This together this arrangement is bracket floor arrangement like plate floor you have a literally one plate which has that all sorts of those cut openings as you have seen. But a bracket floor is not one piece of plate; it is two pieces of plates. Actually these two taken together it derives the name bracket floor. They are essentially bracket. So, essentially bracket floor is an arrangement is a bracket floor arrangement. There are two pieces of plates; one at the centerline connecting the immediate two longitudinals and the center girder. Another at the corner connecting the two longitudinals one of that of the bottom shell and the inner bottom plating and this corner assume that the side shell is longitudinally stiffened. So, in this plane when where I have in bracket floor also I have a kind of a bracket arrangement here. Like this. Another plate welded at the corner. So, these are welded to the deck, to the web of the deck longitudinal, here to the web of the side shell longitudinal and to the side shell. They are welded. So, this is what would be the arrangement in way of in between two floors or in between two transverses.

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This is the arrangement and where there are they are the transverse will come, then the arrangement is like as you can see, this is the web frame of the side shell, this is the deck transverse. They are connected here and this is another small piece of plate is nothing but another additional bracket to make the connection between the transverse as well as the side shell web frame. More stronger a better connection. So, another bracket is welded, another piece of plate with flange stains entries bend means, it is giving a flange. So, thereby it is providing further stiffness of that bracket. So, it is just only to enhance the connectivity between these two. So, this bracket is connected. So, that is basically is the idea; that means, such re-structures will be there at every three four frame space and in between you will have this arrangement; that means, only at the corners you put the brackets because this corners are more vulnerable.

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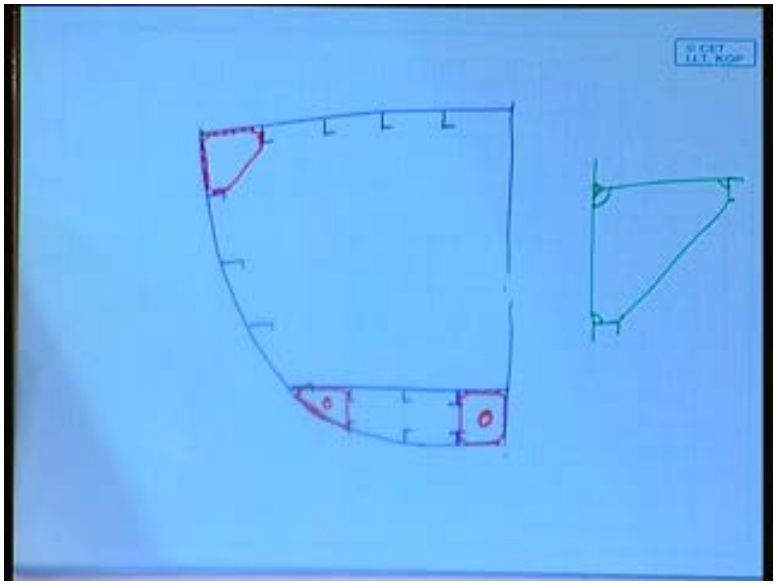

So, load path is being implemented basically whatever load is coming on the deck is getting transmitted to the side shell. So, it is helping in the transmission process. You assume this bracket is not there. So, as if the deck, the entire load is being transmitted through this joint at the corner. Only then this joint of the deck to the side shell. So, what would have happen, this is the side shells, this deck plate it is welded here.

So, only that part. Instead now, I have a I take help of this another additional plate which contributes to the further connection which contributes towards the load path; whatever load is coming it gets transmitted better. Same thing, whatever load is coming are getting transmitted better to the bottom shell.

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This is actually a picture of you can see from one this thing opening you can see some other member inside. It is like this, it is a case of what you call a floor, bottom shell longitudinals, struts and here this perpendicular to the plane of this if you can make out this inside red one; that is a side girder.

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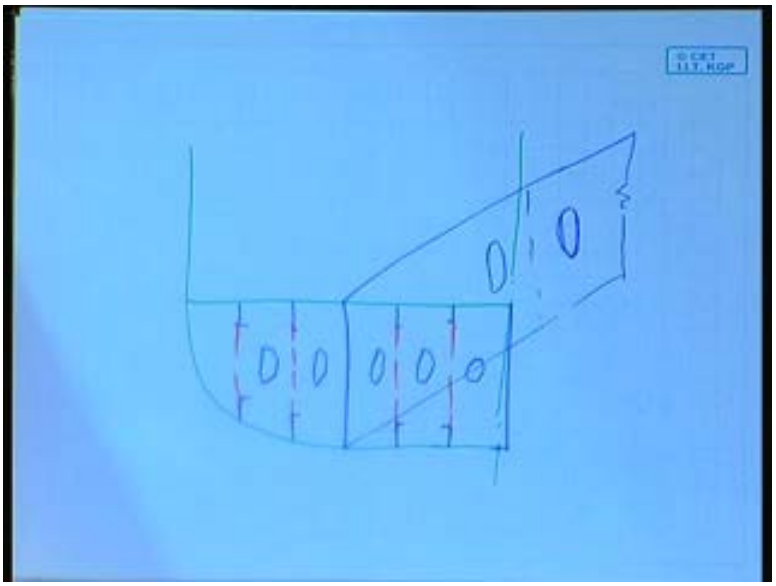

A side girder it is. This is a floor, this is a side girder means you have the… See your double bottom and then you have longitudinals and inner bottom longitudinals. You have a side girder, this side girder this side. So, the floor is there.

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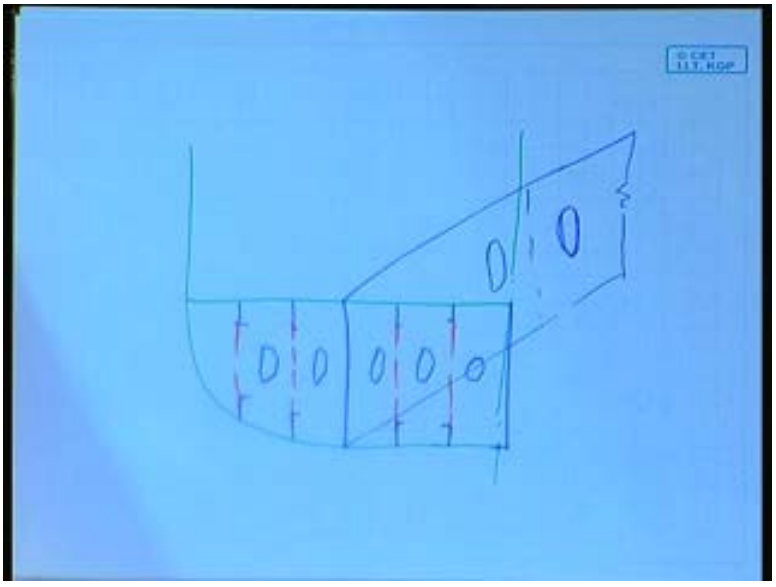

Here you have the center girder. So, this plate is the floor, the transverse floor with the struts. The struts you can see there. The struts welded to the inner bottom plating as well as to the bottom plating and you have this openings for the floor and they are in the perpendicular to this is a side girder; this vertical line this is going along the length.

This is in that fashion along the length and side girder is also as I said is generally not water tight. There is openings are there. So, these openings I can see also they it will

have its own stiffening arrangement of struts, following the same logic as that of the floor.

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So, it is one of those pictures which is showing this. So, these are some of the things we have.

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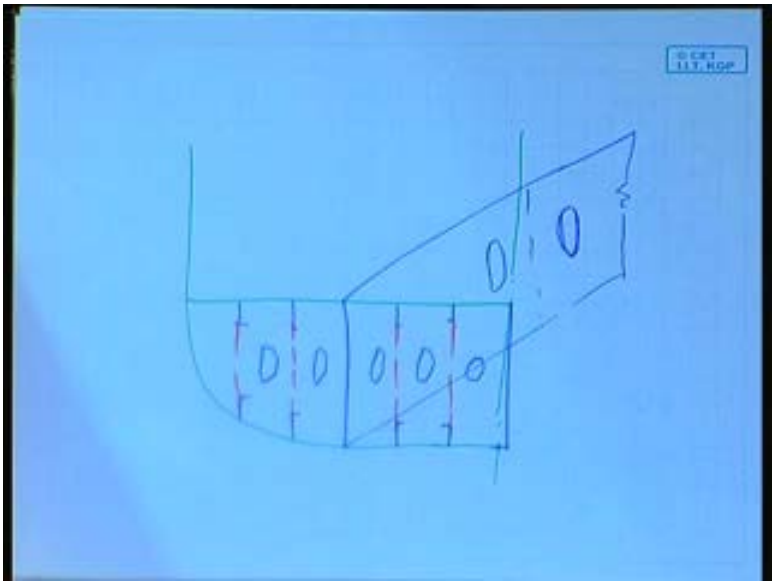

Generally side girder is not a water tight girder, a center girder is generally water tight why because then you have a port side tank a starboard side tank.

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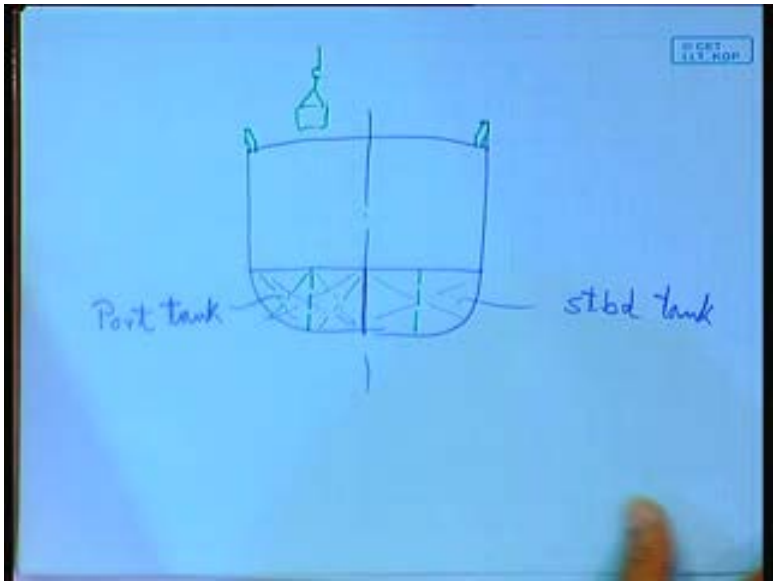

Because what happens if you see a section, full sections say this is my double bottom, you have a center girder. So, in that case you have a port tank, a star board tank. Port starboard you know I believe.

Say this is my starboard tank and this is my port tank. So, they are well independent tanks. I could have made it one tank also. That means, could have made a one free surface, but you know you will learn about that in any floating object there is a free liquid surface that adversely affects the stability, stability of that floating body.

You know any floating body should have should be in a what in a stable equilibrium position otherwise if it is not stable, then what may happen if there is any untoward heeling moment. So, it will continue to heel if it is in a unstable equilibrium position; that means, when it is just floating up right, it is stable means it is in equilibrium, but if it is a unstable equilibrium, give a heeling force it will continuity heel till it capsizes. So, anyway those things you will learn. So, there you will see that if free water surface that imparts instability or reduces the stability parameter, it imparts I mean it may affect the stability to that extent that the floating object becomes unstable. So, having a free surface one we will have to be very careful, one we will have to prior information about that; that means, you will have to whenever you are designing any tank meant for carriage of liquid, you will have to check whether the free surface effect is not adversely affecting your stability.

So, that is one reason we why this center girder is always made water tight thereby automatically I break the one white free surface into two small free surfaces.

Because effect of individual this is not the same as that of one. So, that is why we will see in tanker oil tanker we will see the mid ship section, we have longitudinal bulkheads. Till now we are only talking about transverse bulkheads. We are sub dividing the vessel in transverse I mean along the length by transverse, at by transverse planes, transverse bulkheads. In case of oil tanker will be dividing longitudinally by longitudinal bulkheads for this reason.

Anyway. So, generally the center girder is water tight and if there is any side girder, they are generally not water tight. There is no rule that you cannot make water tight. If you make water tight, and then again this becomes again smaller tanks.

Say there is some requirement that you will have to divide the space into individual tanks, provide water tight side girder; nobody stops you. And the whole point of providing non water tight side girder is, it is lighter because you will have big big openings, you make the structure lighter, you save I mean save weight, you do not save material as much, save weight and the purpose of side girder is fundamentally as a stiffener.

How many side girders will be there? It is depended around what is the breadth of the vessel. If the breadth is less than something then no side girder is retained. If the breadth is less than greater than this not less than something, again one each port starboard and so on. These are all structural requirements because they are providing strength. So, that is what the side girder is.

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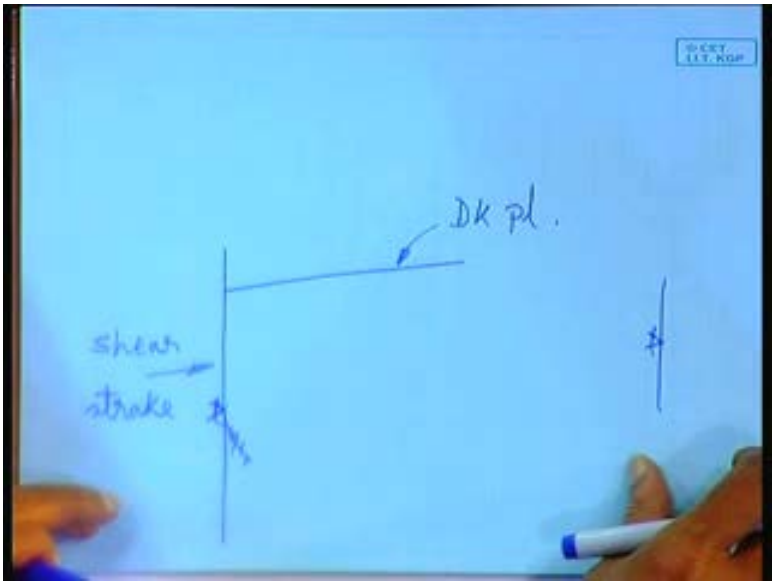

Again get back to this first slide. Well here I thought there will be one this simple things may be of interest. Here if you see a little close up of the construction, it is always like this, the deck this is my deck plating. This is the side shell plating, this part of the side shell is referred to as shear strake. This particular plate is has a special significance.

This symbol what I have drawn may be you can see better that source this is the sim line or bulk line whatever the welding line. Shear strake is being connected to the plate below. No though have turns shear strake can be connected to bilge plate, shear strake

will come to the side shell plate and eventually to bilge plate; this only I mean enlarging that part.

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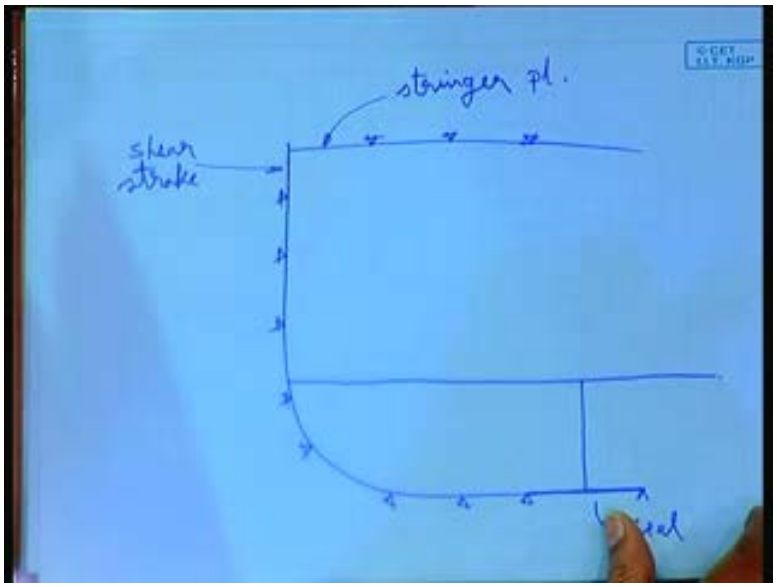

Because you are actually it would be somewhat like this. These are my welding lines, the top most is the shear strake that is also a part of side shell, but a special name is given because that is the plate which is connected to the deck plating. Shear strake also in the deck plate it will be several pieces of plates welded together. So, this part of the plate is also has a special name stringer plate. This is has nothing to do with the stringer you have seen in the fore end construction, this is stringer plate.

This is shear strake and of course, the rest side shell plate in the bilge plate, bottom shell plate, then center plate in at the bottom is the keel plate. So, they are named like this.

What is a speciality why stringer and shear strake; different name has been given. Because that is the one of the most powerable joint whether deck plating is getting connected to the side shell plate because anything goes wrong in the deck say a crack has developed, that crack may get propagated, strike the side shell plate and then gets propagated through the side shell the whole ship will break in two.

So, this is a very critical joint. So, one will have to well that is to be taken special care of. So, always you will find the shear strake thickness, the stringer plate thickness will be higher compared to the rest of the plating's. You will find the plate will be of higher of

higher quality even means having higher strength property mechanical properties not only retains strength, but impact properties.

It may have a higher fracture toughness property. All those things special aspects are there for the shear strake and that is why what should be the width of the shear strake is also prescribed. That means, you will have to keep minimum that much of width. That is prescribed by classification society how much what would be the breadth of the shear strake plate.

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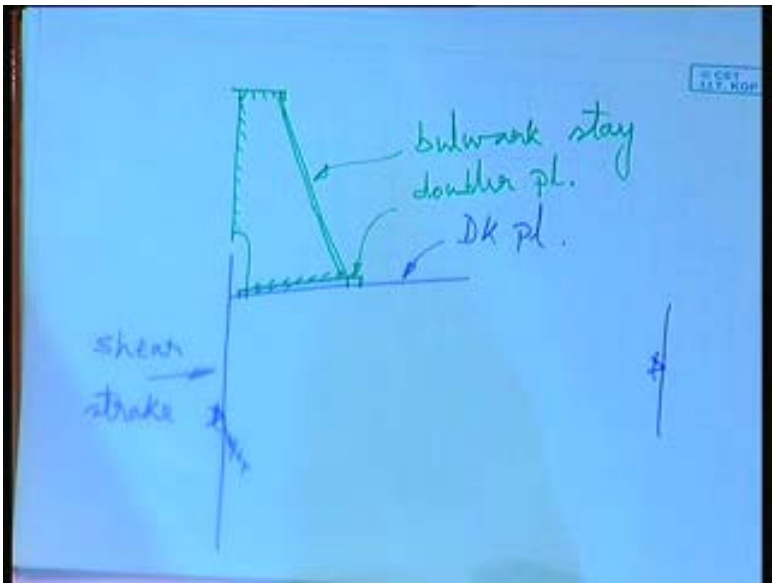

Some minimum is prescribed you will have to provide because that plate is a bit of special plate with I mean additional strength and superior mechanical properties. Any way. So, that is what is this shear strake and the deck plating connection. So, here then you have what you call this Bul work because Bul work is nothing but again just a plate having some support at the top and is connected by it is like this. So, this is a bracket, this is connected to the deck. So, this is a vertical plate, this vertical line. This vertical line is this vertical plate which is the Bul work and this bracket as you can see this bracket. That is my Bul work stay.

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And here of course, you provide a flange; a double line indicates that it has been flanged at this end. So, that provides me the necessary strength stiffness of this bracket. So, this is Bul work. Now what I have drawn here that is what is important; that means, there is another line I have drawn here.

Not very clearly but somewhat visible. Something is there; that means, that is a doubler plate; that means, this stay is not directly welded to the deck plate. It is welded to a, an additional plate has been welded to the deck which is referred to as doubler plate; that means, a additional small piece of plate is welded. On top of that this Bul work stay is welded you can somewhat visible here. This is a small piece of rectangular plate welded on the deck and the stay has been welded further on that.

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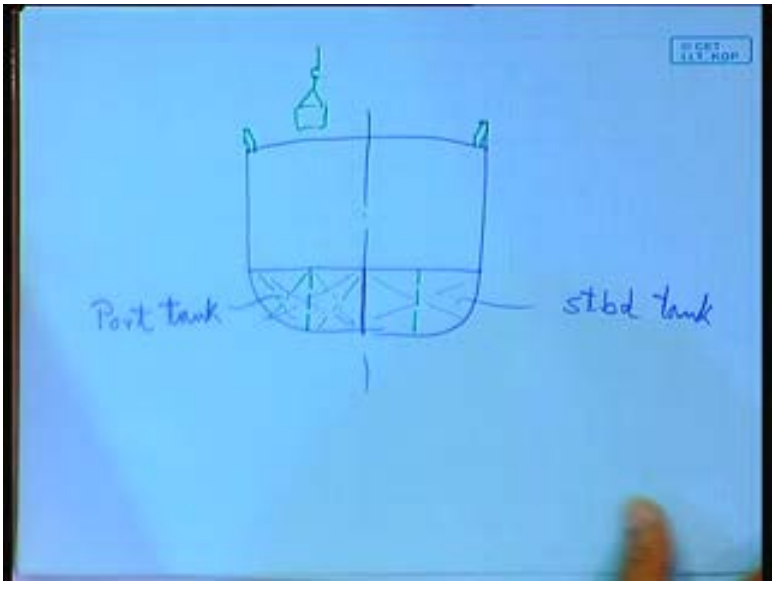

Can you tell me why this? Yes it is not exactly maintenance problem what happens because this Bul work is on the deck. And now say in the event of cargo loading and unloading, this is like this, you have the Bul work coming like this. The whole purpose of Bul work is to provide support I mean it is for safety reasons for the personal working on board other they may fall off.

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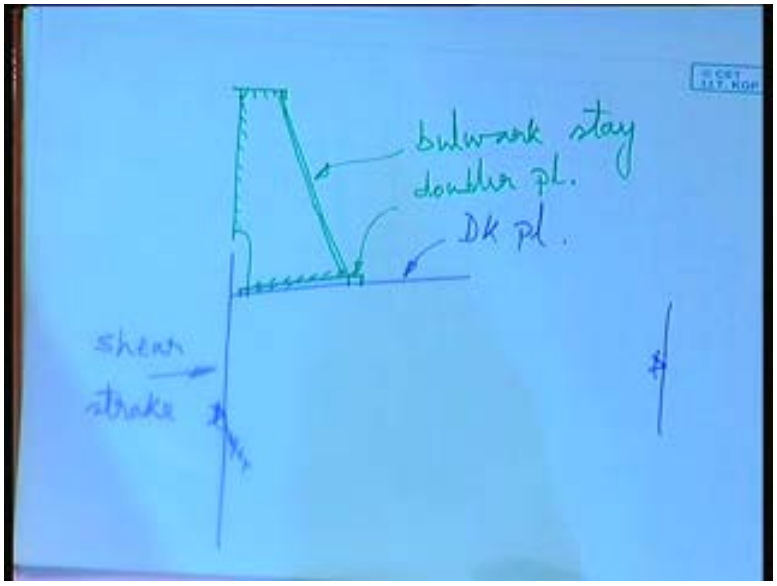

And now while loading and unloading some cargo hits this, the Bul work it may get hit accidentally. So, it may break off. If it breaks off then it will tear of the deck plate. If the stay is directly connected to the deck, there can be a possibility that it will tear of the deck plate and deck getting torn off is a quite a serious damage to the vessel which is not sort of permissible.

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So, that is why this is a kind of a safety fuse you can say, a safety device kind of that if it hits, it is slightly that it will tear of the doubler plate and not the deck plate. So, that is

what later I will show you and these are other feedings and various sounding pipe etcetera. Anyway those things we will see later. Let us see some interesting pictures.

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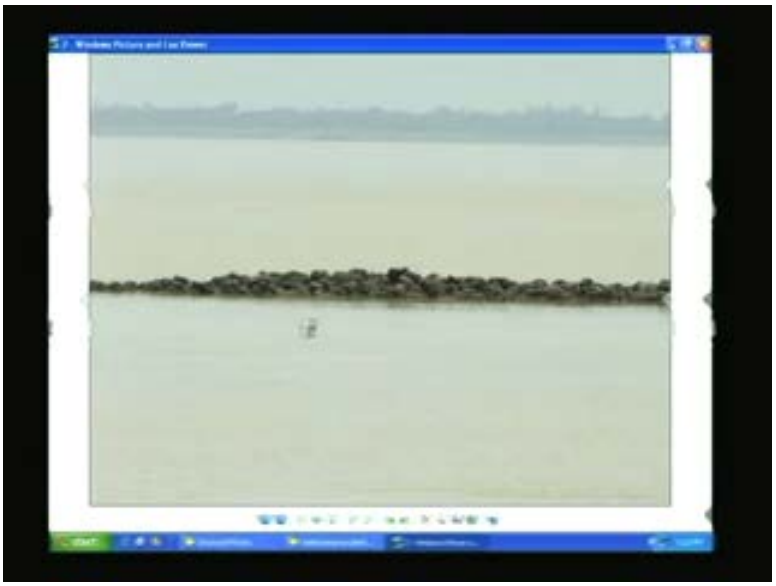

So, here you can see this is a view in sunder bans area. This small lining can see, that is nothing but both sides are water and little bit of there a kind of a long narrow island you can say. You can feel the breath of the island it is not worth calling island, it just sand as got I meant well.

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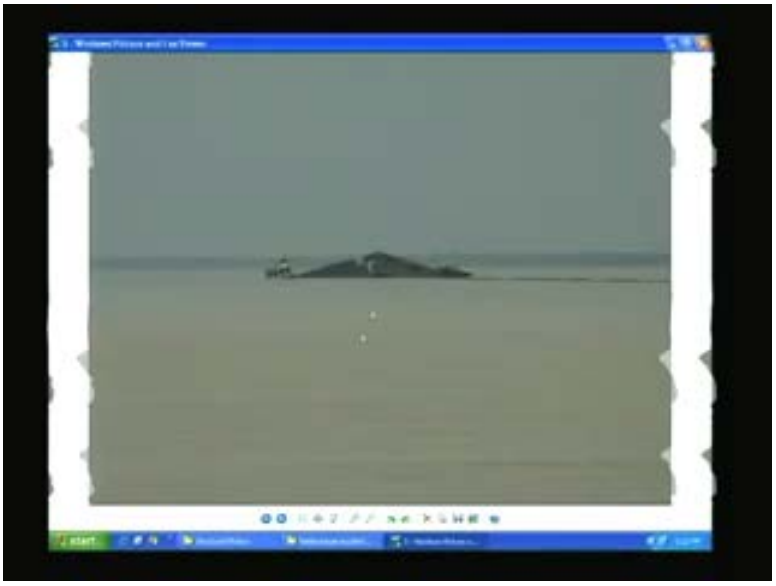

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So, of the depth is not there at all some bid of again if we go back you can see, this is no island as such, but both side waters are calling it as an island. It is stones, this side is the Sunder bans or the Haldia side whatever. We will see in be there you can see far away a ship lying, there is visible broken into two pieces over that steep of land they are in the horizon is the Haldia those petro chemicals.

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Here you see the condition of the vessel. This gone this horizon is the Haldia. See now, this is vessel O B I W T C Bangladesh Inland water Transfer Corporation. It was carrying see what does happened it is a barge I think. So, it was an it is a 6000 turner barge not a very big vessel, but for inland thing it is sufficiently big. It is carrying fly ash, it is got grounded in this.

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Means in high tide, it entered that and then for somehow the water receded, it got supported in this rib, in this what I was telling a very narrow island kind of thing and see what it can cause. This is what is called grounding of a vessel.

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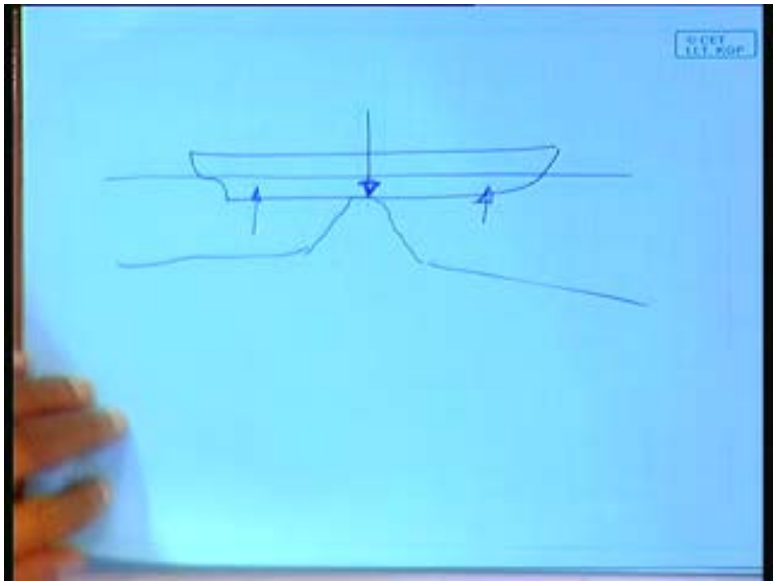

Grounding of a vessel means you have… so, what is happening when it is floating. You have huge buoyancy working here and where it has got grounded, the entire load works here.

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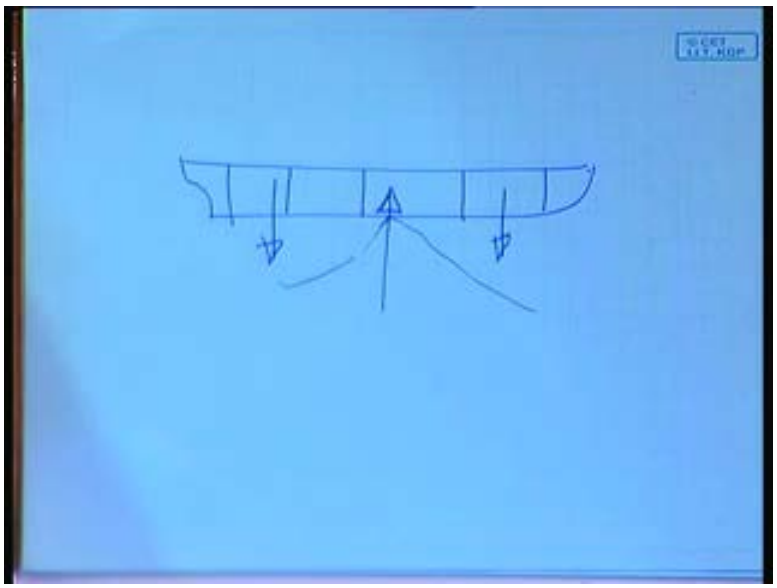

Sorry just opposite way I have shown, there buoyancy is working well the moment it gets grounded, the moment it has got grounded means; the entire load is working downwards. So, the reaction force, total reaction force, here you have the engine, also you have the holes are full.

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So, total load is working like this, big cargo see it is the worst case of loading and the result is this. So, this is what you can see, this is gone in the water both the sides. So, you can see; that means, these are my those hatch coming stays; you can see this.

This is the hatch coming; this is the hatch coming stay. Some crack developed at the end of the hatch coming stay because those are the vulnerable points and that crack got propagated and torn of the entire side shell.

So, this kind of disaster, it happened just in last month in July. So, we end here today. Next we will take up container ship.