Marine Construction & Welding

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Module No. # 01

Lecture No. # 06

Bulkheads

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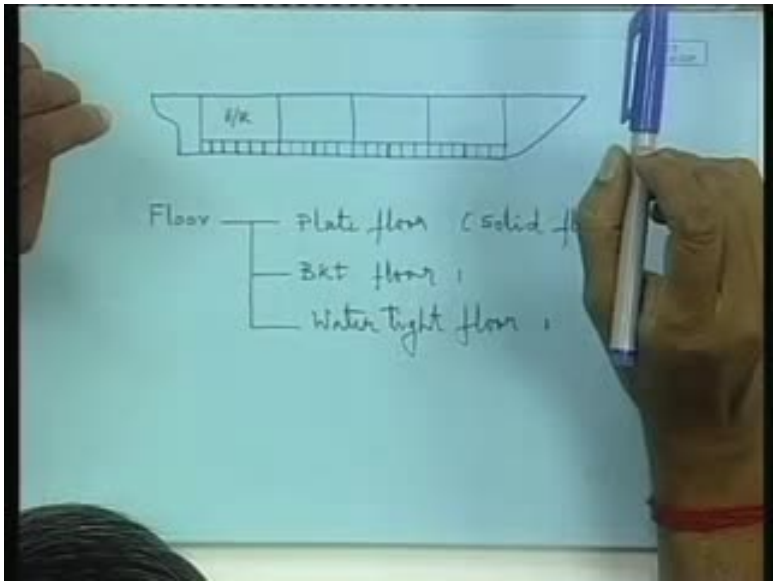

Today, we will be discussing about the bulkheads. Before we go into the topic of bulkheads, let me tell you few words about floats, which we started yesterday. But possibly could not complete everything regarding floors,

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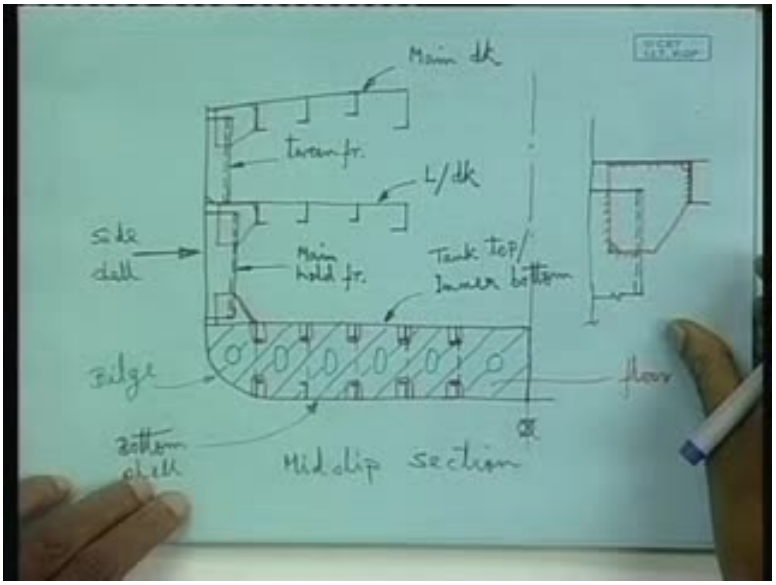

That floor what I was telling you it is a structural member in the transverse plane. This particular member as you can see, this particular member means if I hatch it, it would look something like this, the part, which is hatched in blue, this is a plate in the transverse plane. This is referred to as floor.

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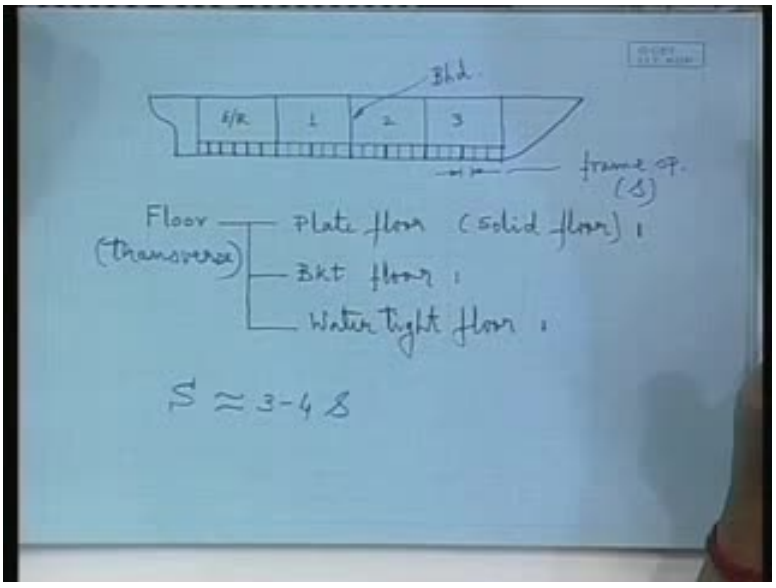

So, this floors we have like in this figure you can see in the profile, this is a profile of a ship. This double line is the inner bottom plating; that means, we have the double bottom running all along the length of the ship. In the double bottom, one of the important

structural members is this floor. So, what I have tried to show you here is some green lines, some reddish lines and some blue lines. Why, just to distinguish on the type of the floors, they are within double bottom.

This particular spacing as we can see the two lines we have drawn this space this is what is referred to as frame space. One of the basic things that we are talking about stiffeners we are talking about stiffening arrangement. That inter thing depends on where you are going to put the stiffeners. Now unless you have a frame of reference you cannot put it; that means, that you will have unless a particular frame of references is fixed that next item putting it or aligning it will be difficult.

So, that essential frame of reference is the frame spacing; that means, a particular spacing will decide before you go about designing the whole structure. That is what is called a frame spacing means what will be the spacing between the stiffeners, primary spacing. Anyway so what do we see that at every frame space there will be some kind of floor, some kind of transverse member. This floor is a transverse member; that means, it is in the transverse plane. We have three types of floor: one is referred to as plate floor also it is called as a solid floor, there is another type which is bracket floor and then there is a water tight floor.

So, if we refer to this profile, we will see the floors with this particular color somewhat reddish black. That is actually plate floors, the green ones I have mentioned is that is the bracket floors and the blue ones are the water tight floor. Obviously, the floor below the bulkhead will be water tight because the whole purpose of these bulkheads. These are the bulkheads and what bulkhead that the sub division bulkheads, there is a sub dividing the entire hole in several water tight compartments. So, below that the floor what is coming should be water tight one. Otherwise you cannot really make to water tight compartments. So obviously, the floors below the sub division bulkhead will be water tight and in between these two water tight floors, you will have a combination of plate floor as well as bracket floor. So, what I have shown here is as if the third floor is a plate floor. So, what happens.

These are all cargo holes, this is hole number 1, hole number 2, hole number 3. Where as in engine room I have shown that all with that same color means indicating all plate floors.

Generally in the engine room all the floors are plate floors. Why all floors are plate floors because they are much more concentrated load comes. Heavy machineries main engine are there. So, we need a more rigid structure whereas, in the cargo holes, there is no concentrated load as such distributed load. So, you can have a little lighter structure and thereby we have at intervals plate floors raise the bracket floors. What are the intervals? Intervals are just the spacing of plate floor if it is capital S that is generally taken as 3 to 4 frame space S is the frame spacing small s, 3 to 4 frames; that means, as if every third or fourth frame will be a plate floor.

This S frame spacing it can be 500 millimeters, 600 millimeter, 800 millimeter, 1000 millimeter depending on what is the type of the size of the vessel. So, this just a kind of a thumb rule that it is every third or fourth frame space the classifications society rules they prescribe what would be the minimum spacing.

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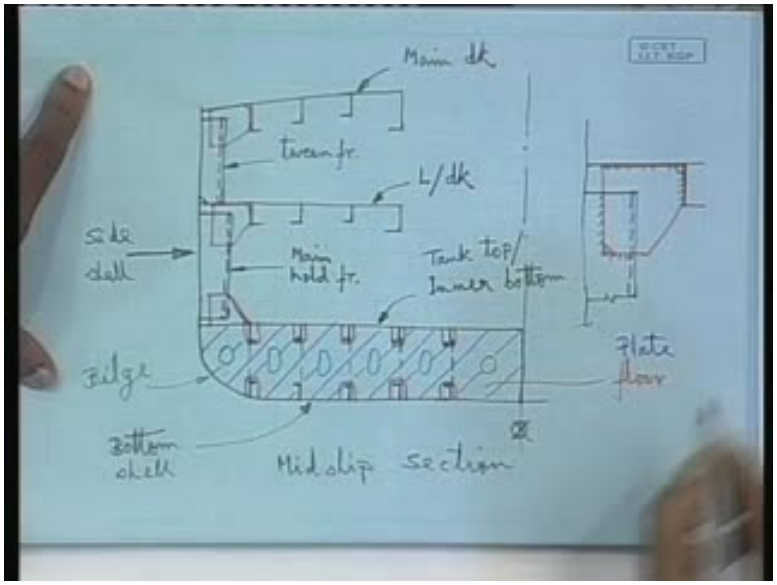

So, what are these plate floors or bracket floor what are the difference? Which one is refer to as plate floor and which one is bracket floor. The one which we have shown here this is actual example of a plate floor this is a plate floor or also referred to as solid floor; that means, you have a full plate there, though it has several openings for some purpose, but other is a full plate.

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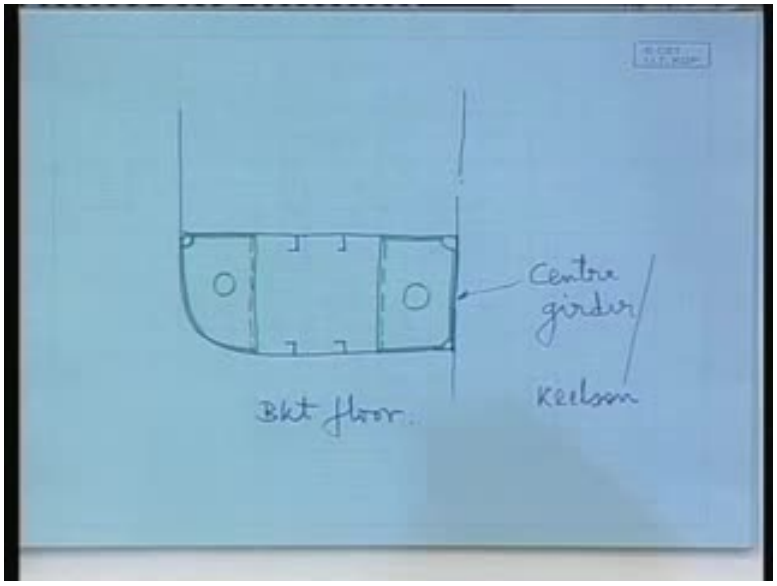

If the floor is of this type I am once again drawing another mid ship view and only highlighting the double bottom position. In some cases it is only like this. Obviously, the drawing is not to scale. Only it has been enlarged too much on the vertical length not that much in the breadth. This green outline whatever I am drawing is your bracket floor will look like this.

Here also you will have a small cut out. So, this a case of bracket floor. Here your if the double bottom is longitudinally stiffened, then yours stiffening members would be like this. Bottom shell is longitudinally stiffened in a bottom plating is also longitudinally stiffened and at the end here you have a continuous plate running which is referred to as center girder or also referred to as center keelson, a vertical plate.

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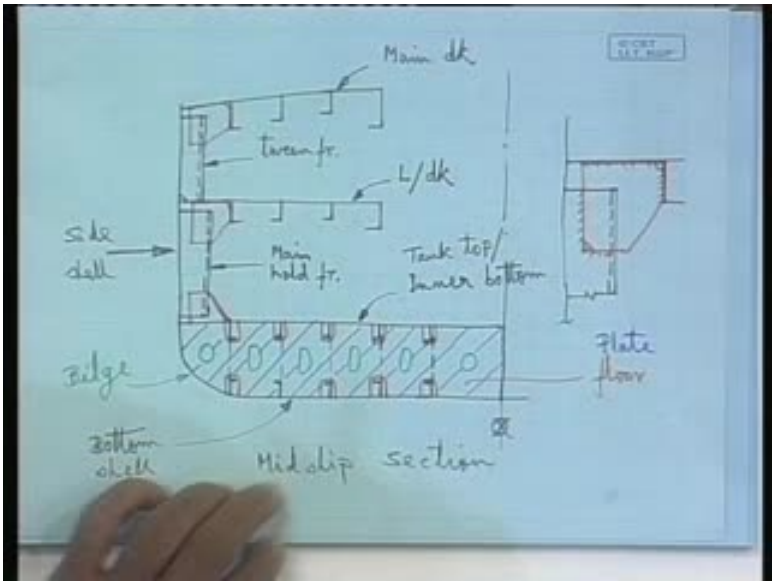

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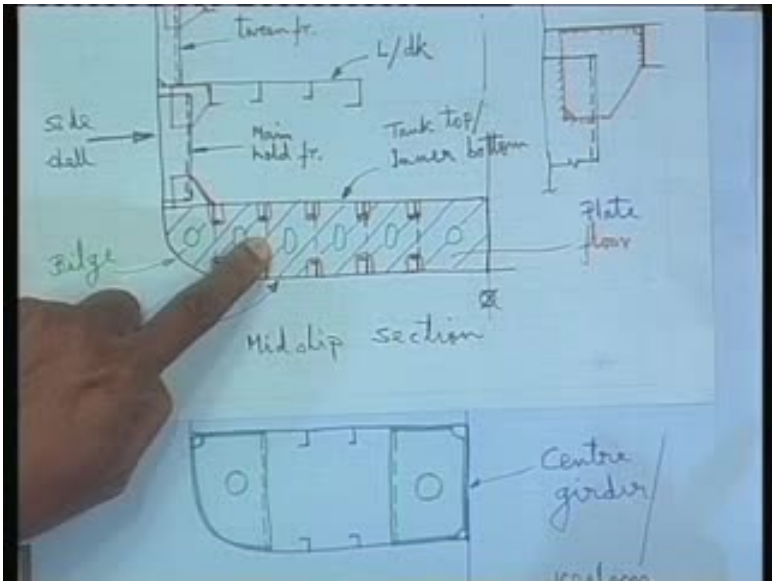

So, what is the difference between this plate floor and a bracket floor. This is a case of a bracket floor and this is a plate floor; that means, what has happened is as if these two the of the entire plate floor only the two hints I have kept, rest of the plate I have removed. It is nothing but as if only this part and this part is there rest of the plate is not there, it is empty.

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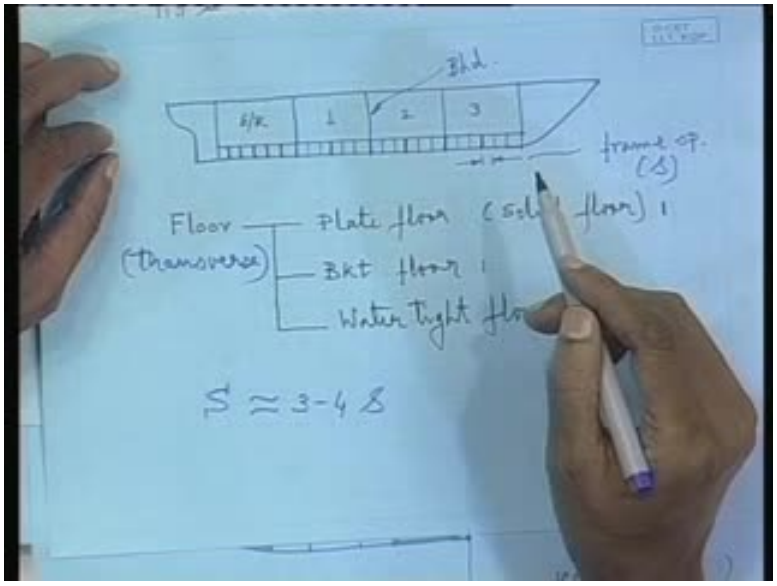

That means only two brackets have remained at both the ends. So, that is why this arrangement is referred to as bracket floor arrangement, bracket floor and this is a plate floor. Obviously, in case of bracket floor, you can see the strength of this is less the rigidity is less, here rigidity is much more. Now since more rigidity is needed in engine room to support all kinds of concentrated load so, engine room it is recommended that all the floors are plate floors.

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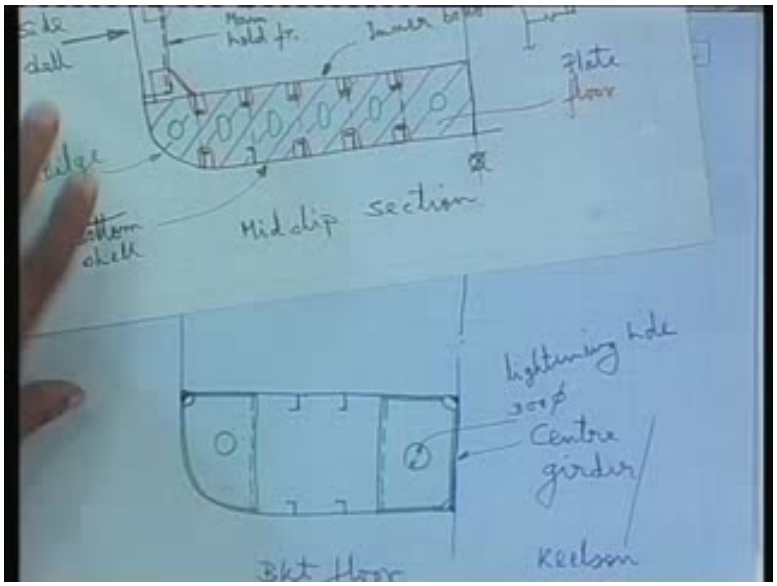

Whereas in the cargo hold, every third or fourth frame location like I can give a plate floor rest all are bracket floor. Now if you come to this the details of this, these openings we have talked about that is the scalps such that it facilitates welding of the inner bottom plating and the center girder. Here it facilitates the welding of the side shell and the inner bottom plating and these openings this circle I have drawn is basically an opening.

They are generally not necessarily such openings are 300 phi, means diameter is 300 millimeter. They are referred to as lightening holes, means it has no other function just lightens the structure. If you cut out from the middle portion, it does not affect much on the strength because the material near the neutral axis is being removed. So, infact strength to weight ratio improves.

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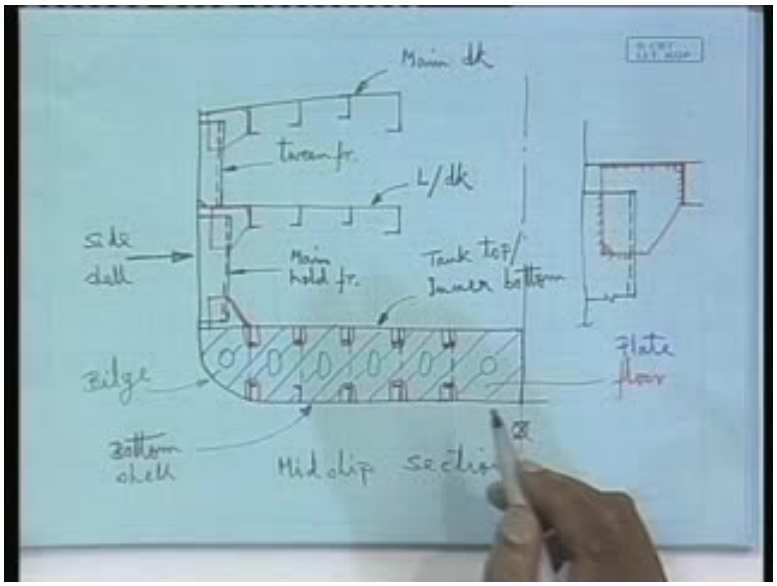

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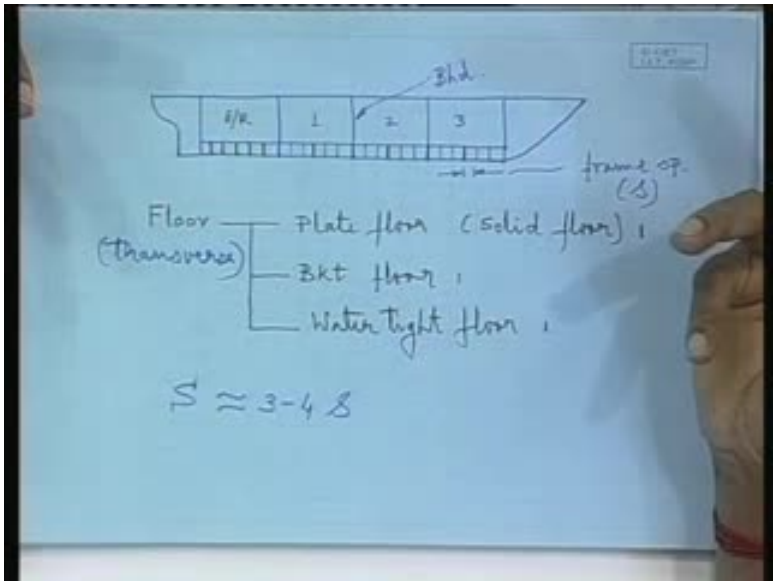

That is the idea. That is why these holes in this. Why these holes here what I have try to show is that this 300 phi, but this I try to show little bigger elongated, what is the purpose of these holes. Also same thing lightening hole that is number 1, but why bigger ones because it will also provide human access because you have seen in this particular space is referred to as double bottom space.

Now, this double bottom space will be used for it is not used for carriage of cargo, but it is used for carriage of fuel oil, fresh water for ballasting purpose. For these purposes this spaces are used and you will have to have accessibility to all spaces, for reasons of to inspect whether everything is alright because if anything goes wrong inside, the ships securities that is take I mean there can be a structural failure getting initiated from there. That is one way; that means, every place should accessible to for inspection not only from structural integrative point of view, but also from other requirements like whether you are carrying any contravene goods they are concealed. So, in the border customs people may check it. So, accessibility is there.

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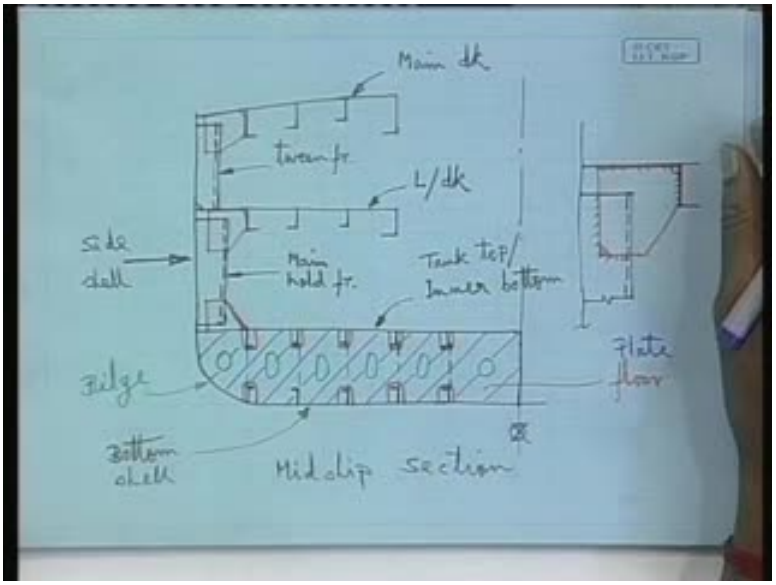

Now it is heavily structured so to say this door bottom spaces as you can see there are various this inner bottom longitudinals, bottom longitudinals then the floor will come at every frame space; spacing between the floors could be say 800 millimeter. See it is a quite a clumsy area quite a structure place.

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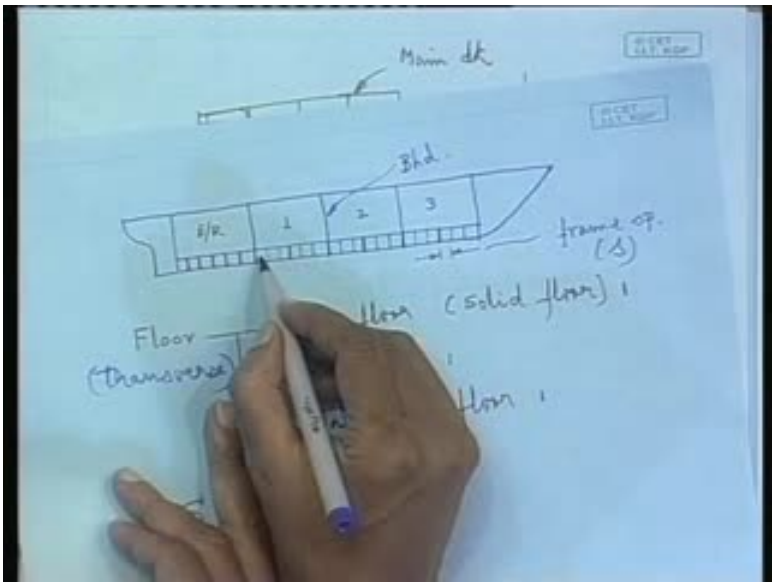

So, there if you will have to… a person should be able to, that person can be inspector, can be a survivor, can be a welder; he should be able to move through the double bottom space in side. So, that is why you will have to access through this floors.

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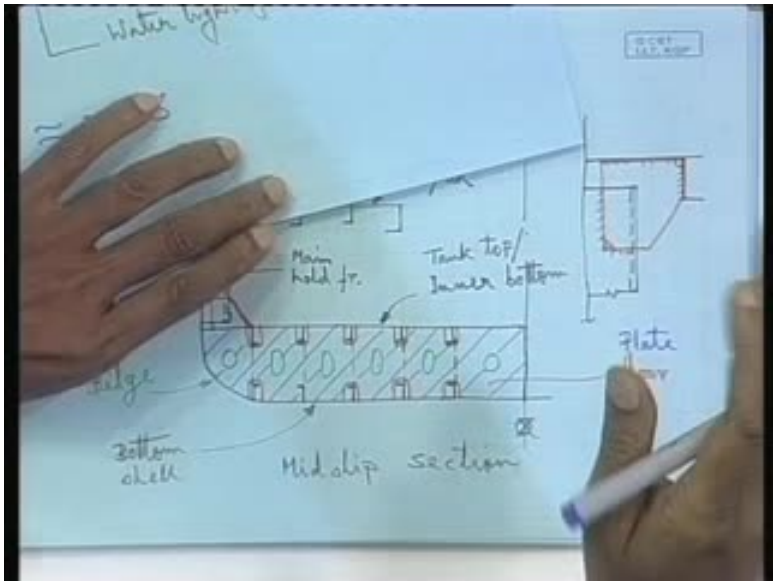

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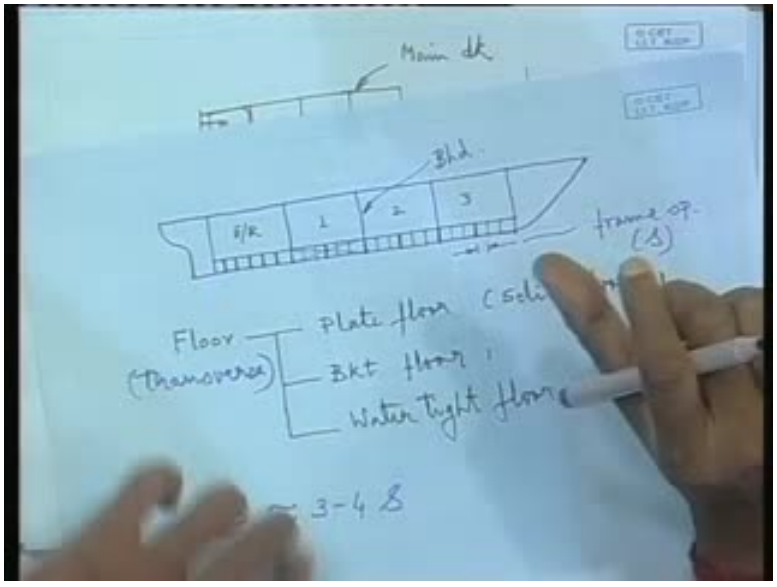

So, these openings they will serve the purpose of lighting the floor as well as access through that and thirdly as I have said this space could be used for this entire space could be used for suppose you want to carry fresh water there because on the ship will be sailing, you need to have fresh water with you if you do not get that at sea. So, this space can be used for fresh water for example.

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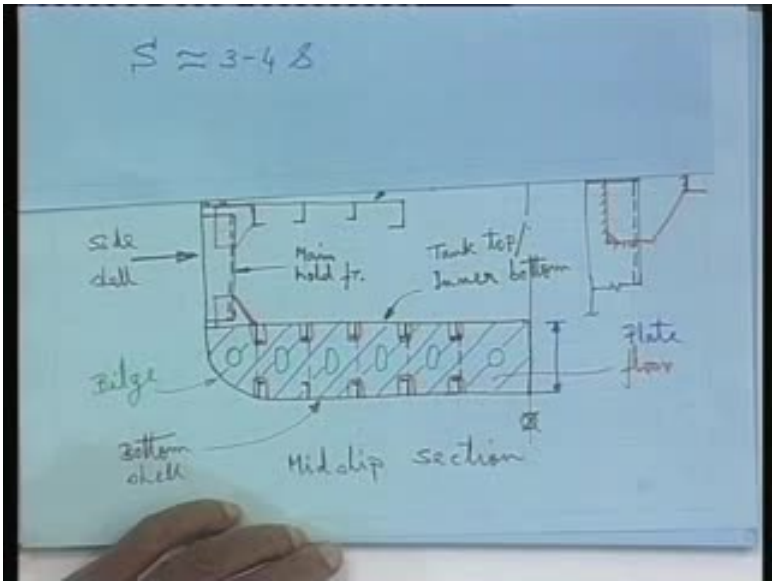

So, that entire double bottom space accesses a tank. So, there should be this holes they will I mean serve the purpose of the fleet to flow naturally at normally. So, that is how these openings, this openings generally they are how the size of 300 by 600 millimeter the sufficiently big opening such that a person can squeeze himself through those openings, it can be 400 by 600 depending again on the depth of the double bottom because this is what is the depth of double bottom that is also prescribed that it should be minimum this much depending on the size of the vessel because this constitutes the back bone of the ship you can say. And here in this the angle, the stiffness at there and the red line that is nothing but a cut out through which the stiffness are passing through.

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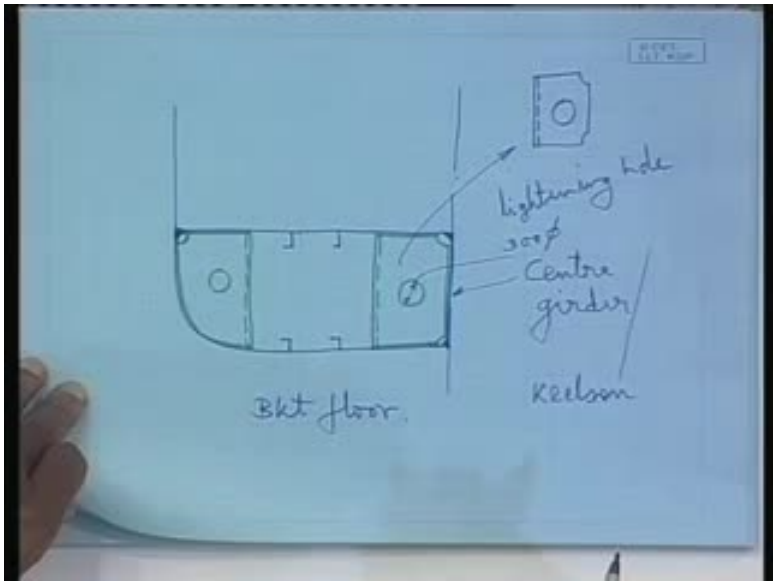

Cut outs in the floors. So, a floor if I want to see bracket floor like this. So, the bracket floor is nothing but two pieces of plates; this side bracket floor I am drawing. So, it is nothing but say one plate like this which is having a flanged hint. So, this is actually this particular. So, this is a plate.

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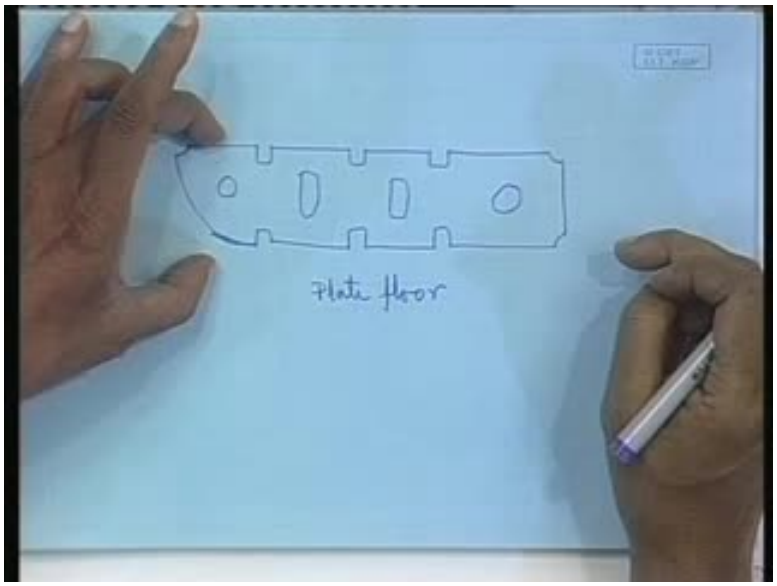

Similarly when I see a plate flow, it would be like this it will go. It may look somewhat like this; that means, from a flat piece of plate, this will be cut out. This is my plate floor, this is a piece of plate this drawing will be there already.

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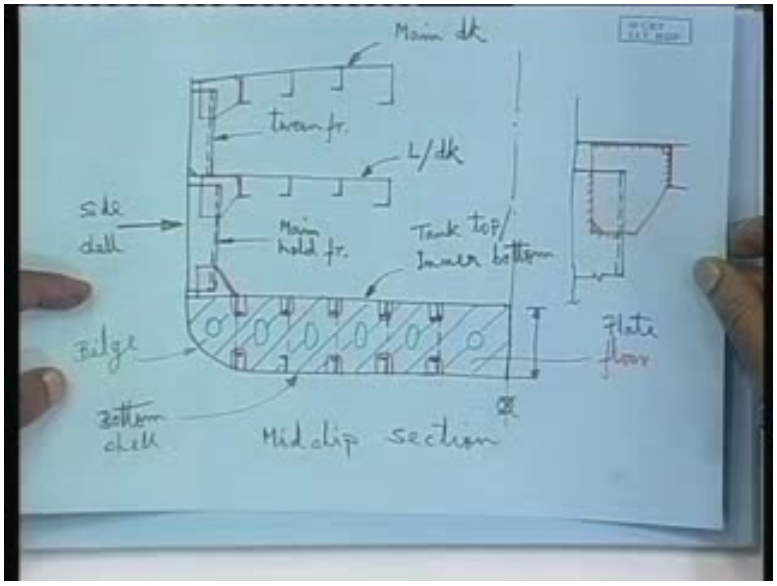

So, based on the drawing using a frame cutting machine anyway you will control the frame machine will cut of the plate. So, you have the floor ready. Now if we again go back to that drawing and we see.

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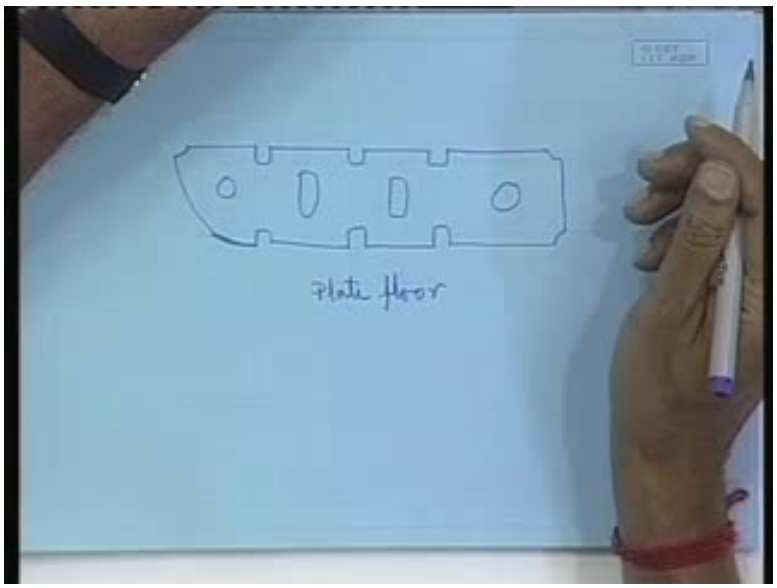

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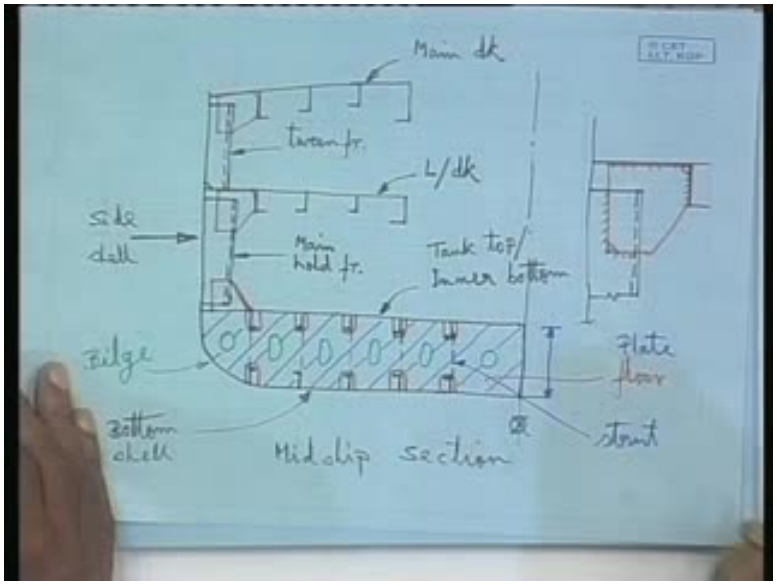

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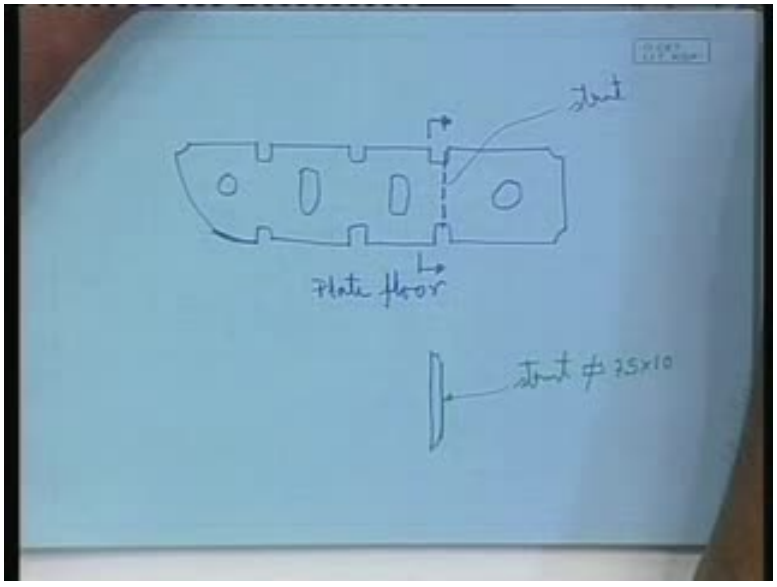

Here I have drawn some these green dotted lines. What are those lines, some lines are drawn here. They are actually called struts, this green lines they are referred to as strut. They are nothing but stiffeners, flat plate stiffeners connecting the inner bottom longitudinal to the bottom longitudinal. So, that is basically a stiffener is welded here. If I take a section, it is nothing but you have the floor plate and a another flat plate welded. This is my strut is a flat bar stiffener like this 75 by 10 flat bar stiffener. Why this stiffeners, what are the function of this so called struts.

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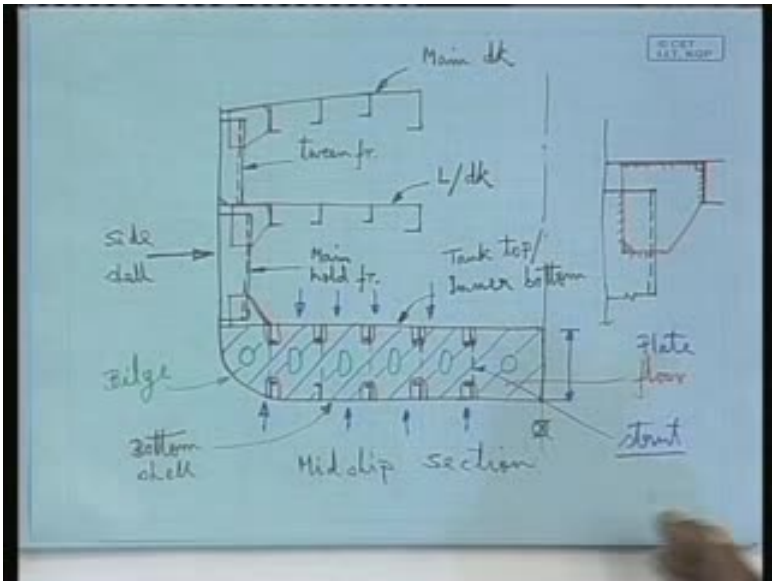

They have atypical name like we have inner bottom longitudinal, bottom longitudinal, side shell frame, twin frame deck longitudinal; they are all stiffeners having depending on their location depending on their use we have assigned a name. So, this also a stiffener. Here the requirement section requirement is less. So, I am giving strut flat bar stiffener. If it becomes more I will make a bulk section or angle section whatever. Here we understand why these stiffening all these things have been done because the loads are coming to sustain the load what are the function of this vertical stiffener. I get the same thing the here you have the load coming in like this is not it on the tank top this is the load of the cargo load.

And from the bottom you have the buoyancy force acting. So, you can see the floor plating is directly under compression and if this double bottom height the depth goes on increasing, goes on increasing means for a big ship it may 2 meters. So, imagine a 2 meter plate if it is impeller compression if it does not have enough section modules, it will buckle. That is why these stiffeners, this vertical stiffeners which are referred to as strut.

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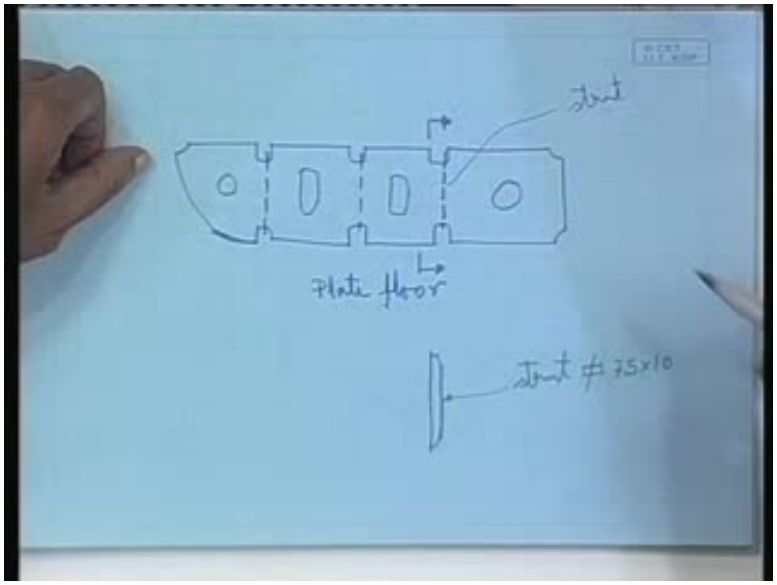

So, they provide stiffness to the floor. So, the floor is one of is that of providing strength in that of transverse plane. We have talked about longitudinal strength, transverse strength, local strength etcetera. So, floor being a transverse member it provides strength in the transverse plane; that means, it provides for transverse strength of the structure. Now if it is itself does not have the necessary strength, what support it will provide. That is what it is; that means, that is why this struts are welded which stiffened the structure, which stiffened the floor itself. Then the floor intern provides transverse strength. So, that is how.

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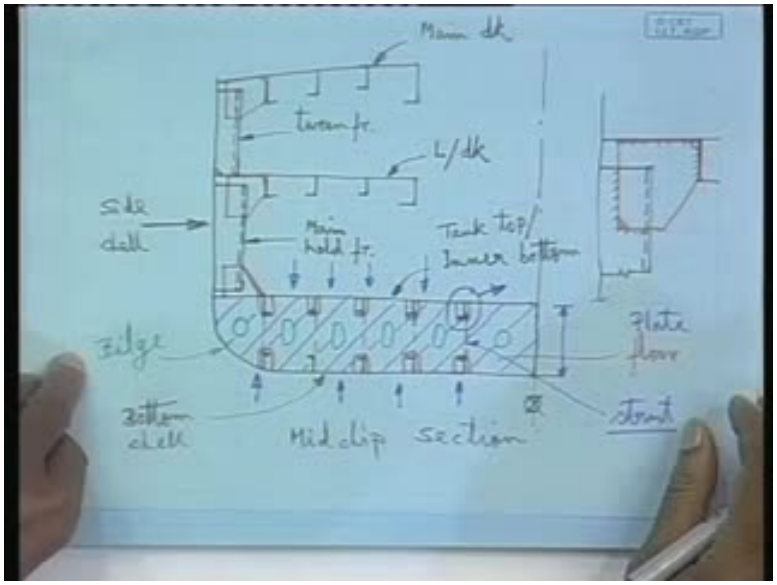

So, this is a floor I mean schematic of the floor arrangement in case of longitudinally framed system.

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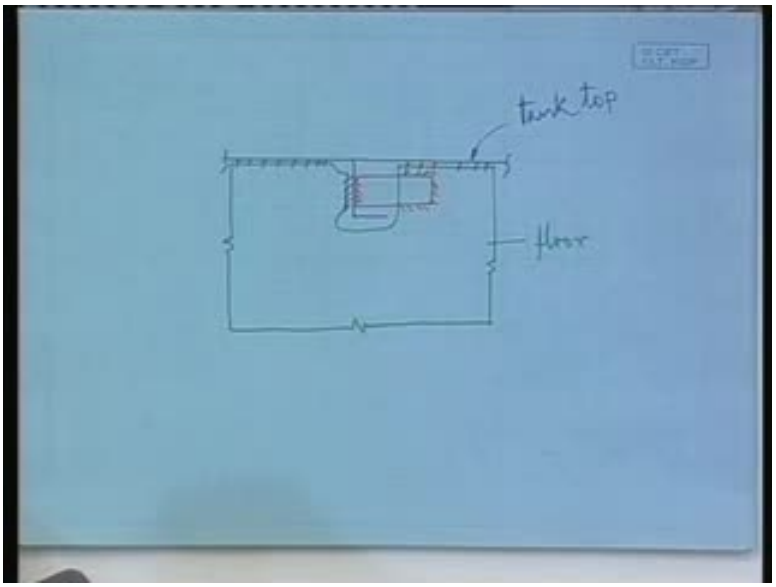

Well may be little bit of these detail we can see how this looks like, I mean what is this particular detail the intersection, if we look into the intersection this is a part of the inner bottom plating, you have the inner bottom longitudinal and then let us draw the floor plate. The actual detail look something like this, the floor plate will come that U type of cut out what we have shown in reality the cut out is of this fashion. This is my floor, the top line is the tank top or inner bottom plating, this is my tank top longitudinal. So, how the connections are? The floor is welded to the inner bottom plating, this is welded here. In addition to that, we provide an additional piece of plate like this which is also welded. So, what is been done?

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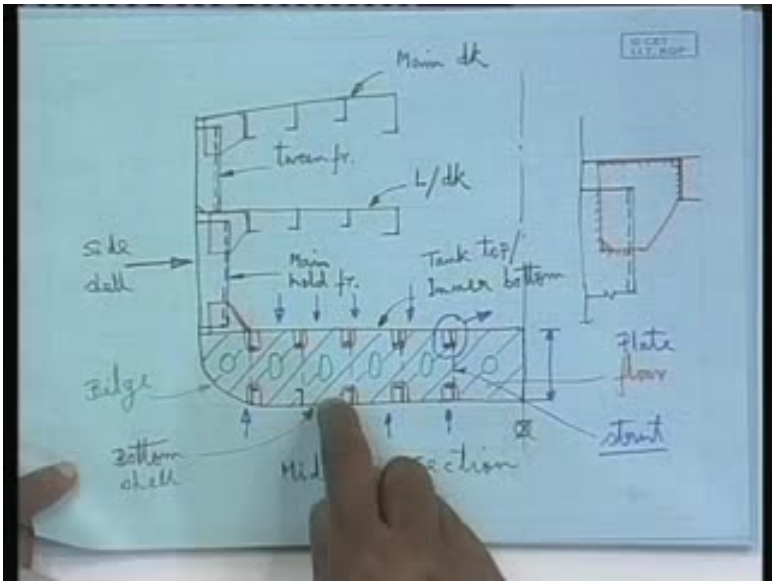

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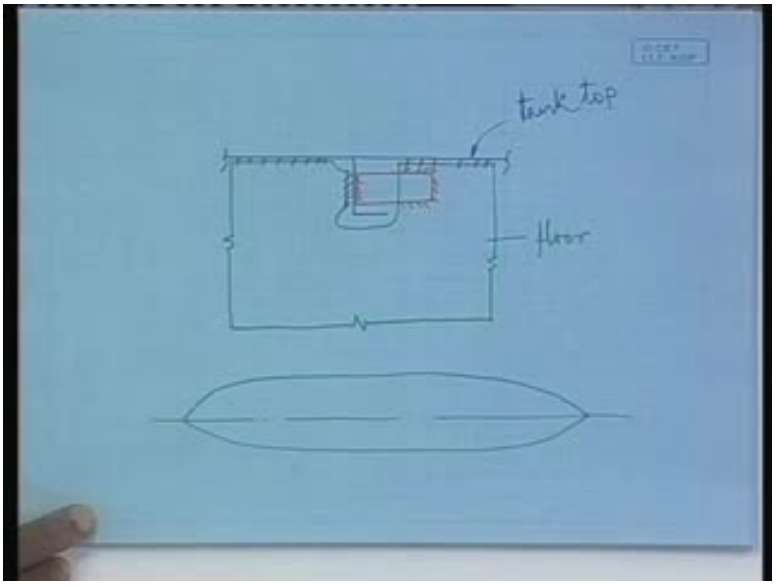

So, this is the join detail. All these joints, all these the detail is like this. So, what is the other purpose of the floor?

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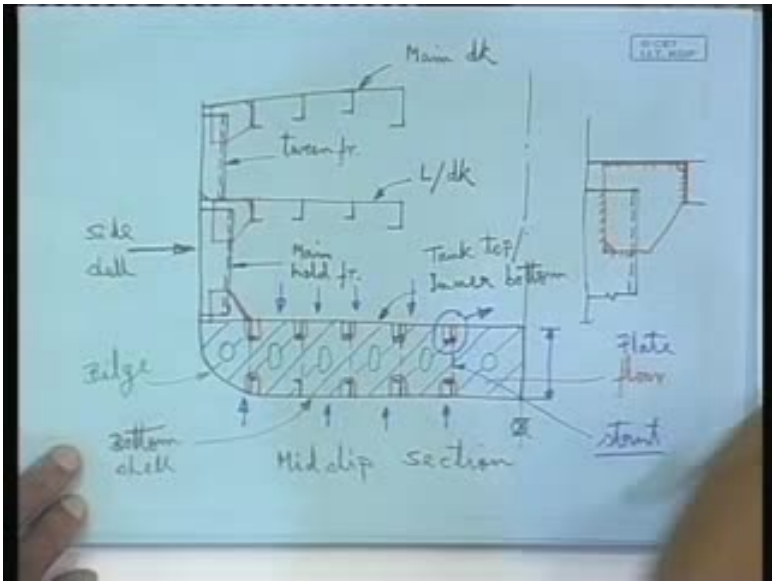

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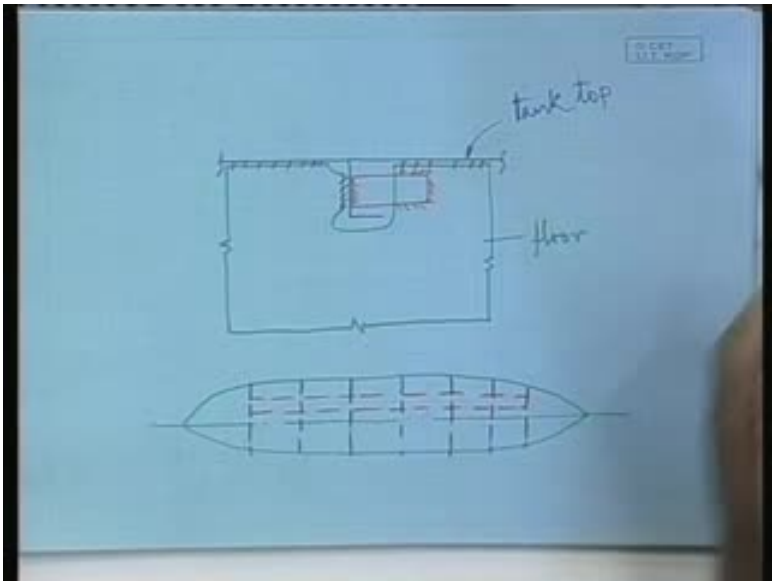

If you see this, I am drawing the plan view of the tank top, this is my tank top, tank top plating. Plan view of tank top means can you understand this plate this plate if I look from top how it will look like that particular water line at the tank top level.

Now, I have drawn tank top having what you call your longitudinal framing system. Let us assume that our transverse, the floors are here, the bulkheads are I mean the water tight floors this is my water tight floors; that means, they are nothing but the bulkhead locations. And also let us assume that this is my plate floor I am only drawing one per

volt. There will be many definitely. Rest are all you are brackets floors. Now the stiffeners let us stiffeners means the inner bottom longitudinal. They will come like this. Now how do we calculate for the section modulus of this inner bottom longitudinal. See now water longitudinal will come like this the red ones. How do we get the section modulus of this inner bottom longitudinal?

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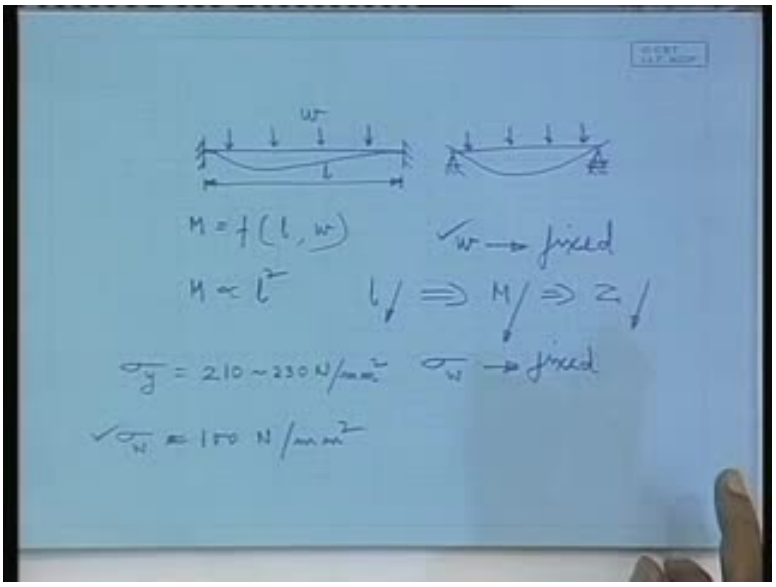

Suppose same thing is true for deck longitudinal, for twin deck longitudinal, for anywhere they are; that means, what is the function of this; that means, they are supposed to sustain the load; that means what? If I take a part of the inner bottom longitudinal any part this much or this much or this much whatever, if you see what it is in a simplified version, simplified form, it is either this or it is a case of this depending on which part of the longitudinal I am taking, which are the end connections I am considering, it is or the either a simply supported beam type of thing or end clank type of thing whatever and what is the effect, it will be subjected to a deflection, it will be subjected to a bending movement basically causing deflection. So, essentially we are bothered about the bending movement. So, how much bending movement; instead of going exactly how much, let us see what it is.

Because if I ask you how much, you will immediately you will try to recall the formula. Instead of think about the formula, think what happens, why the bending movement, why need to be more when it will to be less. So, but it is directly related to tell me in this

situation, M is a function of length span, first and for most and obviously, function of the load that w is a uniformly distributed load or a constant load whatever. These two and also the end fix it is. So, for the timing if I just take, it is essentially M it is proportional to l it is not actually l squared in this case is not it.

It is a function of l, how that functionality relation, it is to the square proportional to the squared. Now our case is w is fixed; that means, we cannot play with w. Why, because the customer owner has told that I have to carry 10000 tons of wheat, I could have only designed the ship. So, that fix is my w, what I mean to say is; that means, load is given to you. So much loading will come. So, designer will have to arrange the structure, device the structure which will be able to sustain that load.

So, in our formulations, w is fixed. Only variable is l. If I minimize make the span less or my bending movement becomes if I can reduce l, my M reduces. If M reduces what does it mean? If M reduces for the same working stress level, your section modulus reduces. Your Z reduces because again working stress is fixed. What is that working stress?

Working stress is nothing but the permissible stress; that means, somebody has told you that it cannot go beyond the stress level. That means, there would be some statutory requirement based on certain kind of fact of safety because as far as my steel is concerned, normal strength steel what is the yield point? sigma y any idea? Normal strength steel means the steel which is not specially harden or specially tough and all anything. Normal strength steel low curve normal strength steel. It is of the order of, tell me (( )) what is that? There is some number you have said, tell me the units. I have go in meter square anyway let us see where the you what I am writing matches you. It is around 210 to 230 Newton's per millimeter square. That means, if the load is for a given span, for a given load, the stress comes to this range, it will start yielding. It will not fail it may yield some power and deformation take may take place, but depending on the design requirement we may or may not allow this.

In most of the cases, we do not allow the structure to reach to the yield point. So, it generally has a factor of safety. Very generally speaking, the working stress level used for normal strength steel in ship building is around 100 Newton's per millimeter square; that means, roughly 2 is taken as factor of safety. Anyway so, this is fixed I have to design a structure where in sigma w should not exceed 100. So, that is fixed w is fixed.

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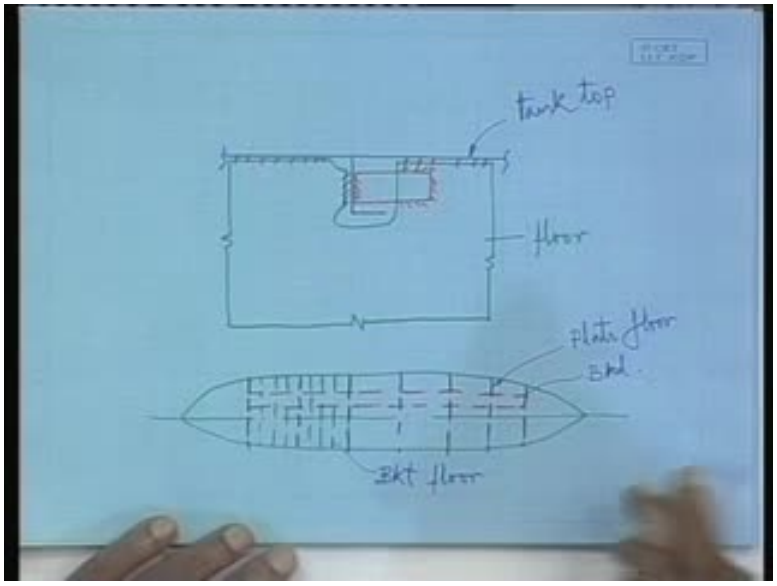

So, what I do I chose a suitable l such that my Z is less or in other words, if I reduce the span my section modulus will be less. What does that mean, my weight of the structure will be less for the same strength. So, that is what it is when we calculate the section modulus for say this longitudinal, if this longitudinal I will have to simplify it and modulate. So, how do I take? What is the span of this particular longitudinal, which distance I take the span this full length or only this much? That means, because here I have said this is my plate floor and this is my bulkhead.

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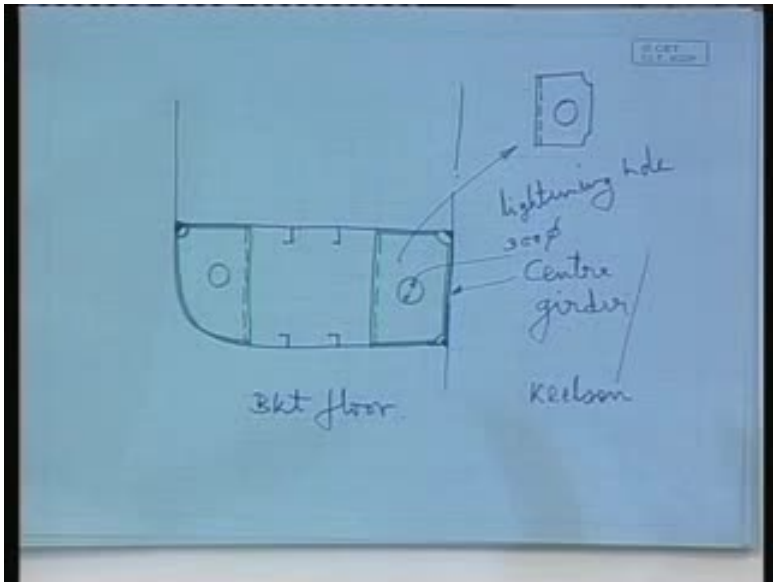

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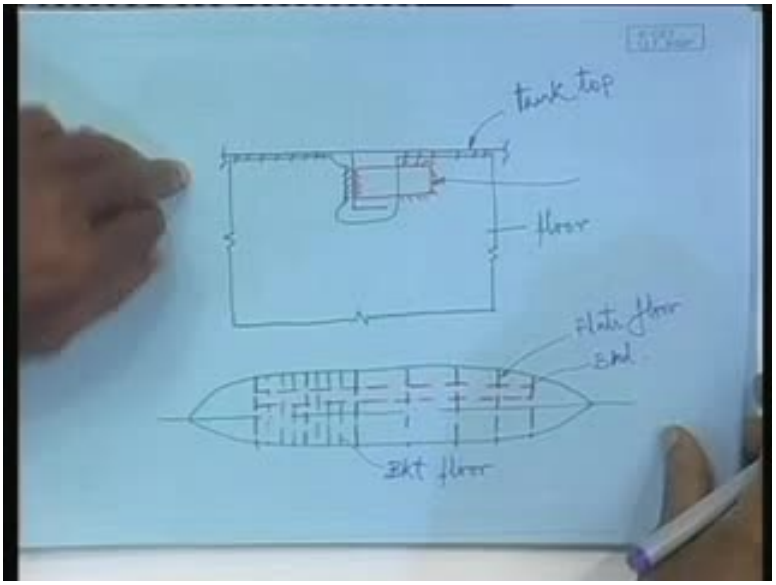

In between I had bracket floors; this green lines are bracket floors and you have seen that in the bracket floor configuration your longitudinals are so called lifted large; that means, they are not supported nothing, but in case of the fleet floor you see that kind of support. It is not only on this side it is welded, on the other side again you put additional small piece of plate.

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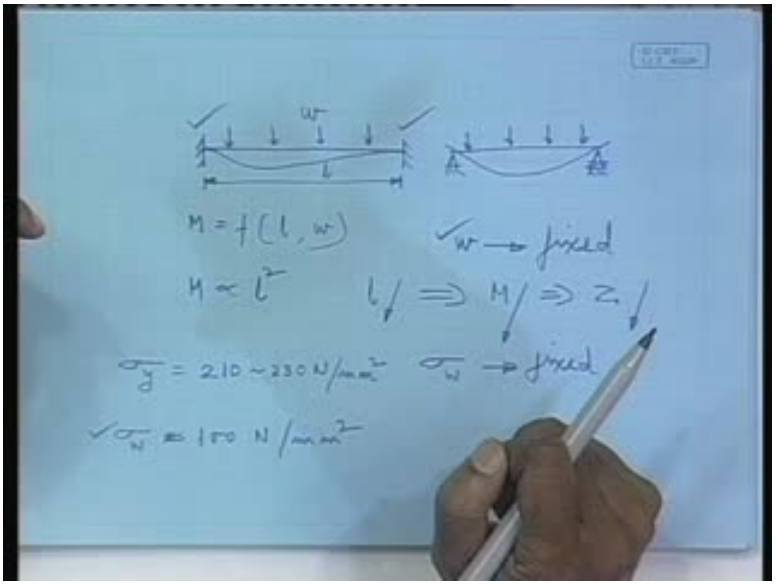

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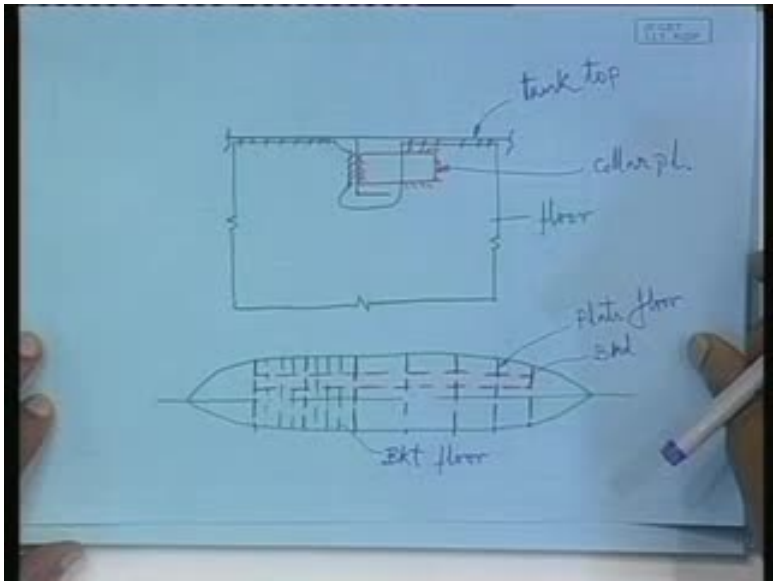

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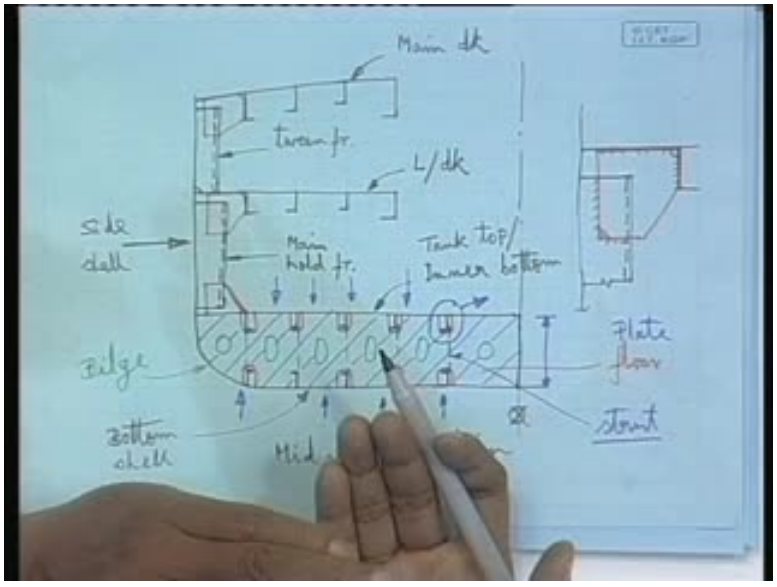

And additionally weld it; that means, give a proper support come to a closer situation like this. Come to a situation closer to this end fixed. The end is fixed means it can sustain more load more bending movement. So, this particular plate is referred to as collar plate. So, that is how are the your so called end connections or the supports; that means, what do you see here is the structural members. When you have this is a longitudinal framing system, in the longitudinal framing system primary structures are the longitudinals which is supported by the transverse structures. This longitudinal is running along the length in the transverse plane at intervals, there are floors or

transverses in deck there will be transverses. So, they will provide the support there by this span will be less.

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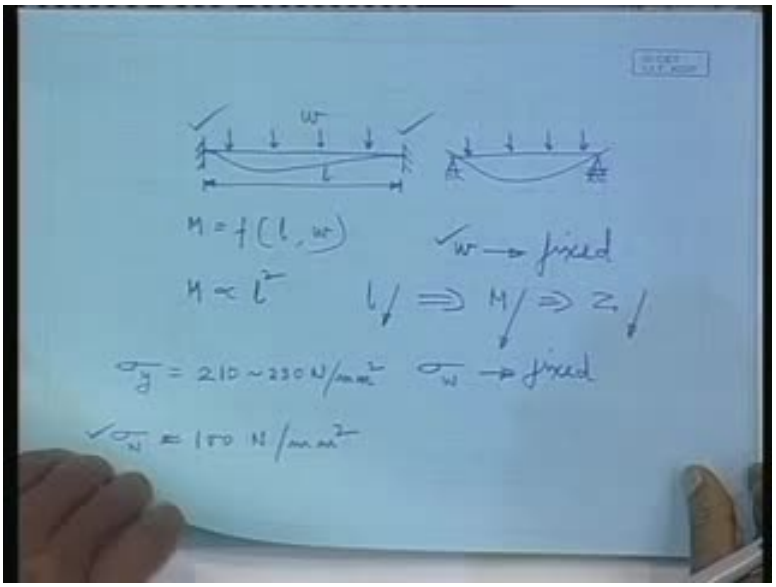

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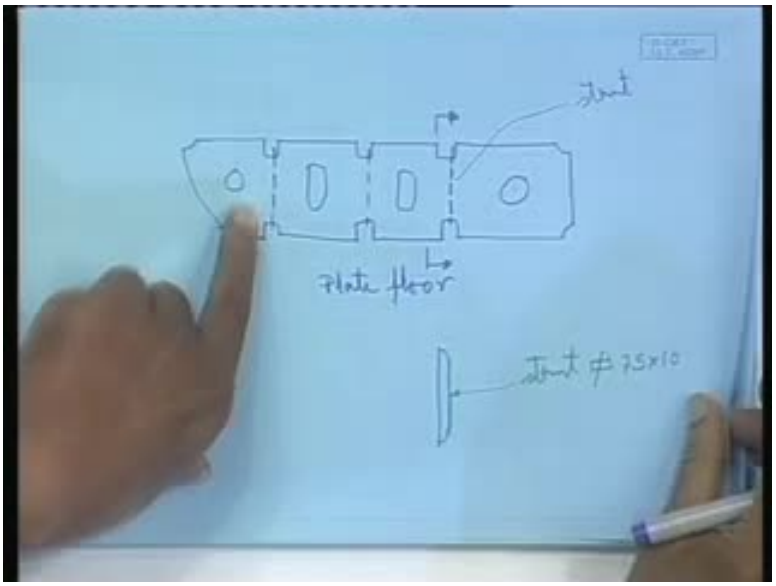

And yours scantlings will be less. So, that is what the floor is. In case of water tight floor, we have talked about the bracket floor and this is a plate floor. In case of water tight floor what will happen this holes will not be there simple; obviously, and what about these openings? These openings are needed for fabrication because the sequence of fabrication is you have the plate, you put the stiffeners and then bring and fit the floor.

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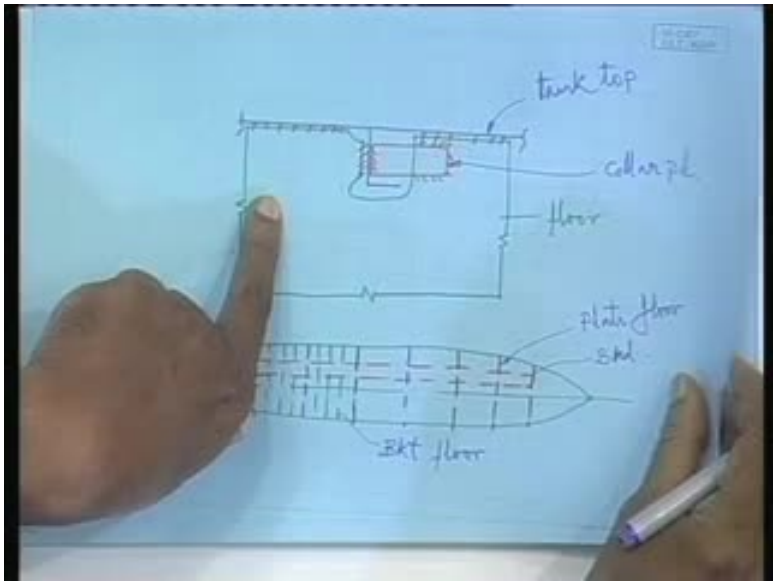

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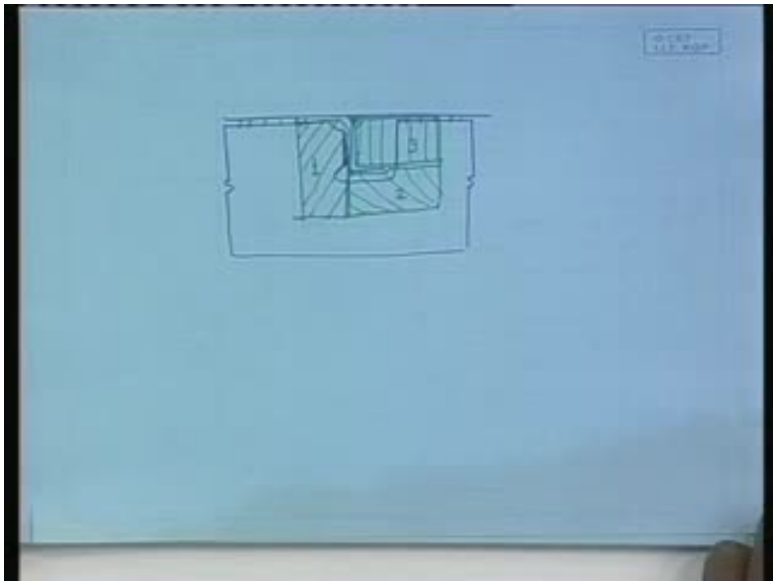
That is why these big openings are cut such that it fit in nicely and easily over the frame. You just put it the frame is there like this you put the floor, it will fit in that cut out. Now in case of water tight floor the same detail will become what this collar plates will be much bigger in three pieces you will put one on this side, another on this side and this just to ceil it off.



Essentially it is ceiling off maybe we can see one sketch, it was like this the floor. Now you provide these are all welded obviously, and then what you do is, here it is welded. Now you will have to literally cut a plate of this fashion. So, three pieces of plates.

It may not be very nicely visible. Three pieces of plates in this fashion are welded; means essentially a blanking of that hole that opening was cut to accommodate the longitudinal. You will have to blank it off and other those openings of access etcetera are not there because you are not suppose to cross from one water tight compartment to the other water tight compartment through that if you make an opening you cannot keep it for tight. So, other openings are not there at all. So, that is what. There are of course, some more may be it seems we are talking.

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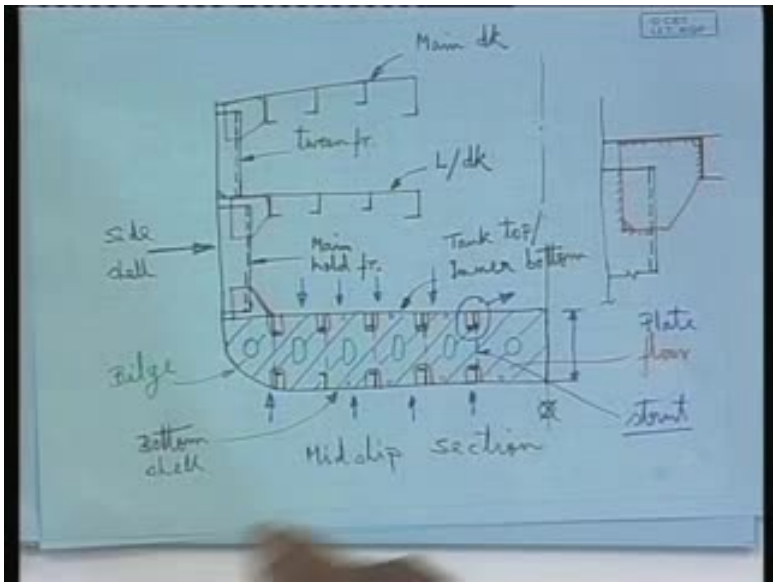

Here you have small openings also both at the bottom and at the top. This small openings are the top ones are the air holes bottom ones are the drain holes. Such details are also there.

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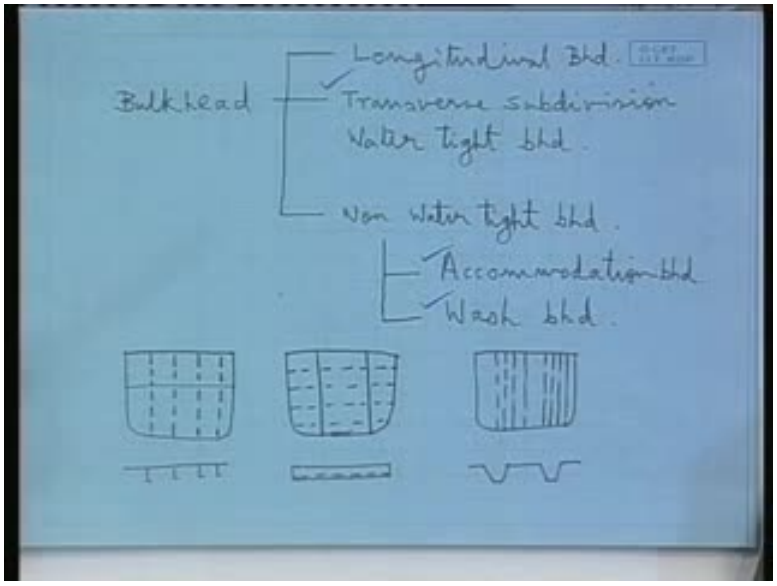

Air hole and drain hole any way. So, that is what at the floors. Then let us come to the bulkhead as well as bulkheads are concerned as I have said there are three types primarily two types of bulkheads: one is transverse sub division water tight bulkheads which sub divides the ship in water tight compartments. And there is a non-water tight bulkhead. What are those non-water tight bulkheads? They are generally the bulkheads in the accommodation region referred to as accommodation bulkheads. There are bulkheads in some other region which are referred to as wash bulkhead that is how their named wash bulkhead is nothing but providing strength. So, transverse and there can be another type. That is longitudinal bulkhead.

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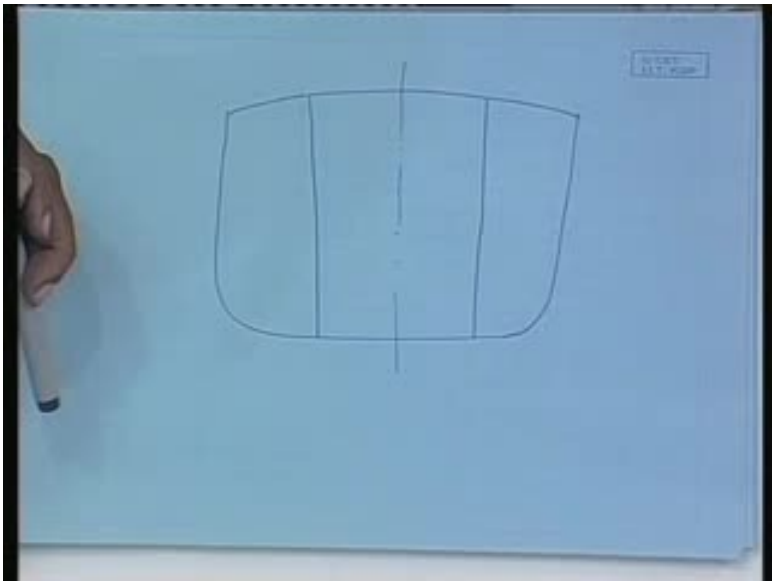

This longitudinal bulkhead comes in case of oil tankers where you have oil tanker an oil tanker section I mean we are not going in the other structural details, just the outline section. Oil tanker will have additional longitudinal bulkheads. So, what it is doing this longitudinal bulkheads?

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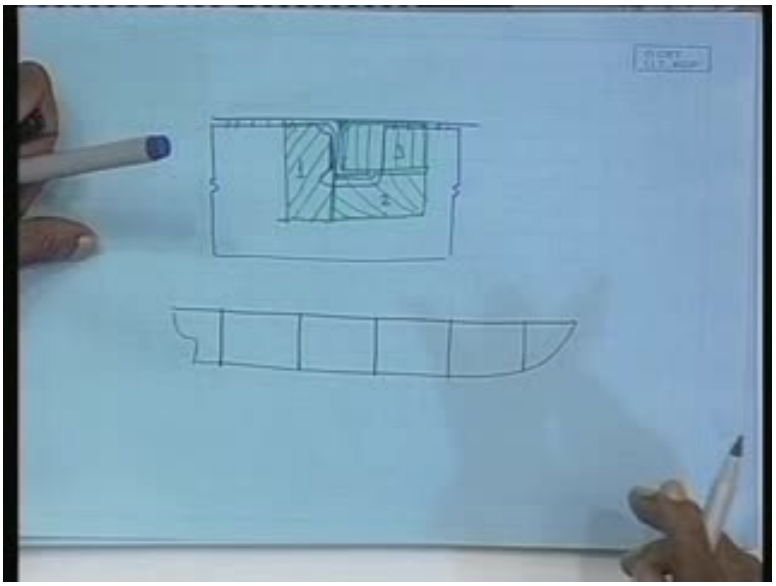

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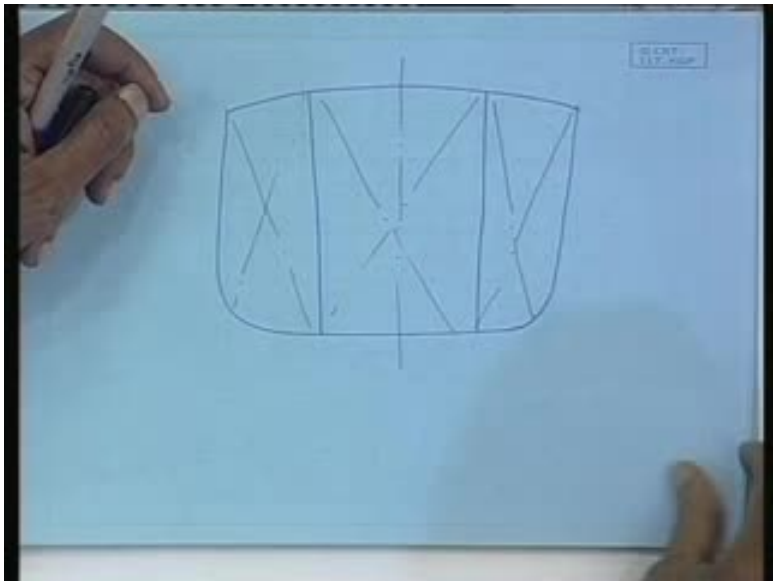

Till now we have talked about transverse sub division bulkheads thereby we are sub dividing the ship in several water tight compartments. That is what we have done. This is the transverse sub division of water tight bulkheads, these are longitudinal bulkheads sub dividing the vessel longitudinally sorry I mean in the transverse plane in three water tight compartments.

These are longitudinal bulkhead. The purpose is to sub divide along the length and different water tight compartments if I have central one then two compartment to port and end support, we have three compartments for a specific reason this is done.

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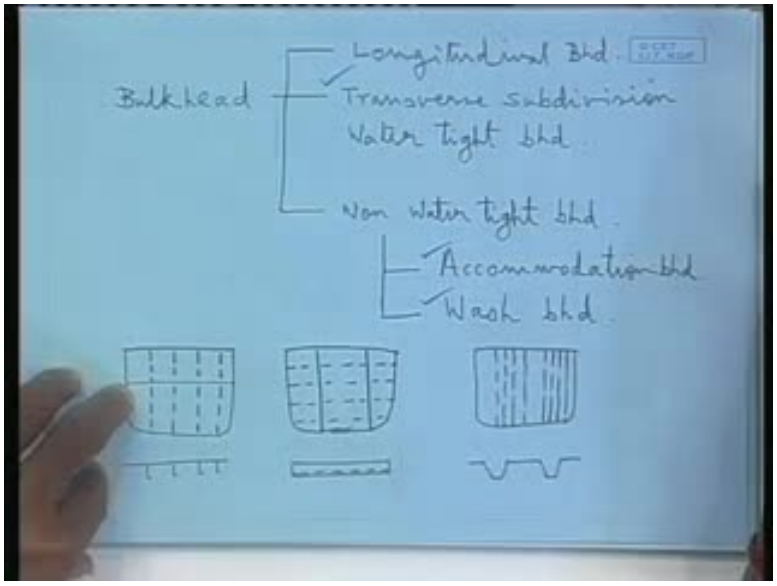

So, again going back to this, we have a transverse bulkhead that is water tight other one are non-water tight is a fundamental difference is one is water tight other one is non-water tight. (( )) Wash bulkheads I mean that just a name, they are also a kind of non-water tight bulkhead like the bulkheads used in accommodation region. Accommodation region means the Kevin the walls of the Kevin's they are also referred to as bulkhead. They did not do water tight, they are not for sub dividing the vessel they need not do be water tight.

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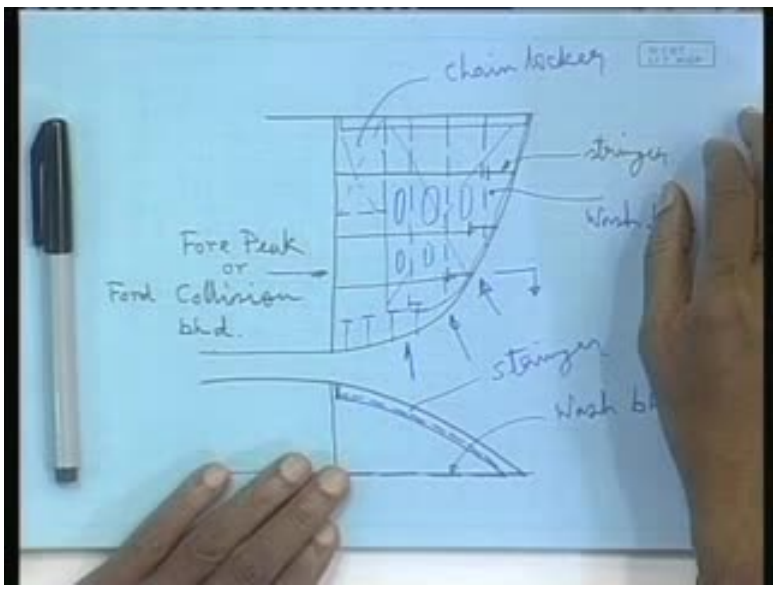

Similarly wash bulkheads what happens is in the fore part of the ship, this is the fore part this is my forward peak bulkhead; that means, the forward most bulkhead which is referred to as fore peak bulkhead or forward collision bulkhead. It is either referred to as fore peak bulkhead or forward collision bulkhead. This nose of the vessel as if this part, it is generally heavily strengthened. It has several deck strengthening features, additional girders here. See here we are putting t girders no problem can we put t not necessarily t, it can be angle whatever depending on the strength requirement. These are referred to as stringers. This will run along the side; that means, if I draw the section, this stringers are nothing but I mean stiffener running like this in different plane. This is the plane you have drawn all along A stringers are nothing but stiffeners along the side shell in the horizontal plane. They are longitudinal members, but they are in the horizontal plane.

So, stringers then here you will have floors, then here are some compartment we can have here which is generally chain locker. Chain locker means on the deck we have the anchor windless anchor handling machine. Anchor handling winch which is called as anchor windless you hold up the anchor, then where does the chain go. Chain also huge chain the chain goes in inside the hall, there is a space meant for it chain locker where the chain drops inside. So, it has to be properly stiffened, strengthen etcetera. And then also here what one can have is or like an additional centerline bulkhead. This vertical lines I am drawing, they are the stiffener for the centerline bulkhead. There can be such openings in the bulkhead; this opening is nothing but for keeping the structure lighter. This particular centerline bulkhead is referred to as wash bulkhead. It is in the centerline bulkhead means I am provided here wash bulkhead.

At the center of the fore peak, this region is referred to as fore peak. Also referred to as fore in construction this arrangement fore in construction, it is a typical I have shown there can be many other arrangements of stiffening arrangements. Why this is important, where from the load is coming here, why I am providing a centerline bulkhead also I mean basically what centerline bulkhead means what; it is a heavily stiffened plate. Well it has some openings I have tried to made it lighter because I do not need water tight compartments divided. The whole point is here I am providing additional stringers in the side shell who in other cargo area or other places it is not there. Why, how come the load is more here because it is one is waves means waves you see, it is not truly waves because waves the ship generate. In a calm sea when it moves, it generates the waves. In

a turbulent sea, water can come and hit worst is in turbulent sea, it will start executing motions. So, the slamming affects primarily the slamming effect it hits the water surface. So, huge loading may come. And next point is in the event of collision that is why it is called forward collision bulkhead. In the event of collision, hidden collision it should be able to take the entire shock, but up to the bulkhead means this entire thing may collapse. But nothing will happen beyond that it will combo, but the entire ship will remain safe; that means, this nose may get bothered you know, but you are safe. That is how that is why it is called forward collision bulkhead and that is why that all that story of Titanic would not have been there had the captain not changed his course. You know how Titanic sank. How?

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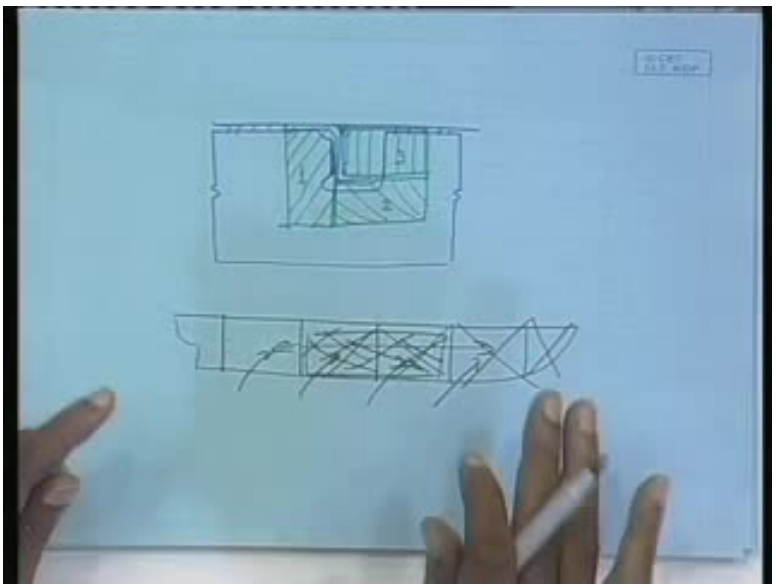

From the side, it hit iceberg from the side and if it hits iceberg from the side, what happened? This plate got torn off almost I mean several compartments got torn off. Had it been only one compartment or two compartment nothing would have had happened. Several compartments the shell got torn off. So, simultaneously the water increase was there in all the holes and obviously, it sank because the captain could see some iceberg. So, well without out of panic or whatever decision was to avoid that without realizing iceberg you cannot avoid because you only see that tip that is only probably 10 percent or even less or you see the compare the density, you can make out. A huge amount is

below. So, if you see a small berg and you think I will just grace passed no you do not do that because the huge one is below and that is what happened. Instead if you would have gone and ramped head on, this would have got collapsed. If not the next compartment also nothing would have had happened, it would have floated safely because ships are built that is how this subdivisions are done such that your ship will remain safe in the event of adjacent compartments getting flooded means suppose this compartment and this compartment gets flooded, two adjacent compartments getting flooded means they are no more contributing any buoyancy. Still the ship remains a float then we call it two compartment standard. If three adjacent compartments get flooded, still it is safely floating. Safely floating also has a definition; that means, the deck should not go under water.

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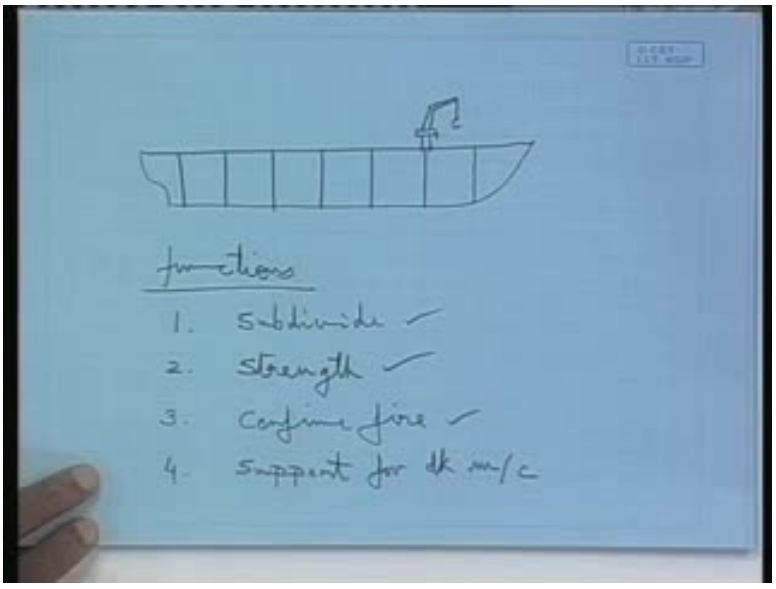

So, we call it three compartment standard. So, those are determined by the arrangement of these subdivision water tight bulkheads.

How the water tight bulkheads are deployed, how closely or how wider spaced. So, that way we will see that these bulkheads had functions, certain very important functions. What are they? One is to subdivide the vessel in several water tight compartments because depending on that in how many water tight compartments I am subdividing, it will be the one compartment standard or two compartment standard or three compartment standard and so on. So, that is from the flooding point of view, from the

damage stability point of view. Number two is they provide strength. Which strength? Transverse strength because it is a purely a transverse member transverse strength.

Third, it should be such so designed the bulkheads should be able to confine fire, in the event of fire in any hold the fire will remain confine there. So, that is also a function important function of a bulkhead. So, these are the things; that means, they should be able they subdivide the hall in several water tight compartments, not only compartment water tight compartment. They provide transverse strength to the structure transverse strength means what; that means, that raking phenomena strength against raking will not take place. They will be able to confine fire in the event of fire it will provide sort of it will confine the fire and lastly one can say that it provides support for any deck machinery support for deck machinery wherever applicable. What is that like in case of a cargo ship, a bulk career like you can have a say the cranes, deck crane you will have to provide a crane there. So, that is heavy machinery on the deck. So, that is fitted just above the transverse water tight bulkheads because the bulkheads being a itself a strong heavy structure, it will provide the necessary support for the relevant deck machinery what is there on top.

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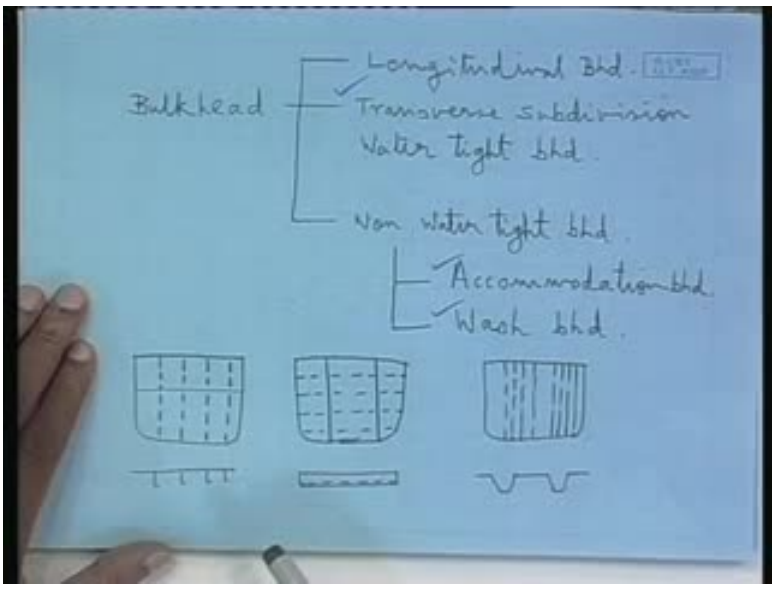

For example the deck cranes. So, in next class, we look into how this bulkheads are made of we have through this cases we will see that they will be vertically stiffened or horizontal stiffened or corrugated bulkhead; that means, this bulkheads can be this water

tight bulkheads or different non-water tight bulkheads, they can be either stiffened flat plate stiffened bulkhead or corrugated bulkhead.