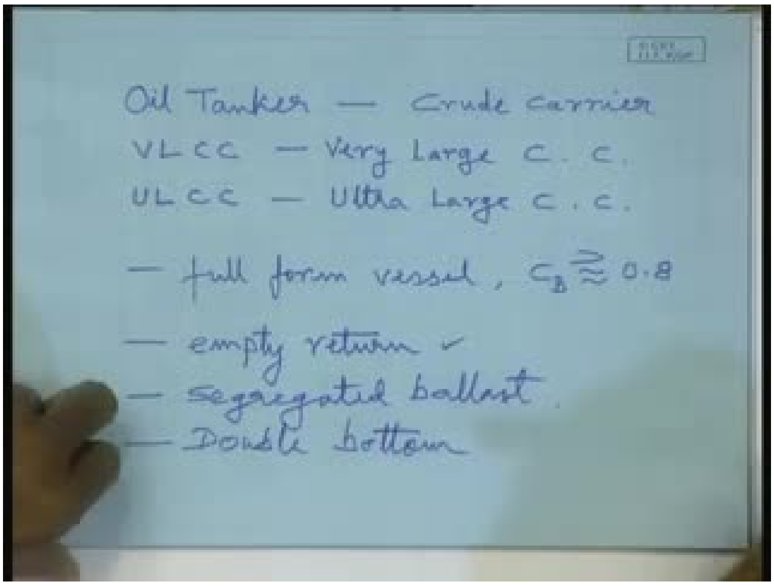
Marine Construction and Welding

Professor Dr. N. R. Mandal
Department of Ocean Engineering and Naval Architecture
Indian Institute of Technology, Kharagpur

Module No. # 01
Lecture No. # 16
Oil Tanker

(Refer Slide Time: 00:47)



Today we will talk about oil tankers. Oil tanker is a specific case of a bulk carrier, essentially because, it also carries cargo in bulk, but only difference is - here the bulk cargo is in liquid form. As far as oil tanker is, it can be a general name - that means it can carry; it can be a vessel to carry any kind of oil, though when we talk about oil tanker, we generally think in terms of crude carrier. Principles are same whether it is an edible oil tanker, refined oil tanker or a crude carrier. Crude oil tanker or crude carrier means crude oil tanker - petroleum crude. So, basically principles are same. Only thing, if it is a crude carrier it is generally very large, very big so we have terms like V L C C or U L C C - that V L C C is for very large crude carriers or U L C C is for ultra large crude carrier; these are just some of the nomenclatures.

Generally you will not have an ultra large edible oil carrier; no it will not be there generally, neither you will have an ultra large, say, refined oil carrier, no. It is only in terms of crude, because this- I mean this business, started because there were oil producing countries, means crude oil producing countries, and there were countries which were importing them.

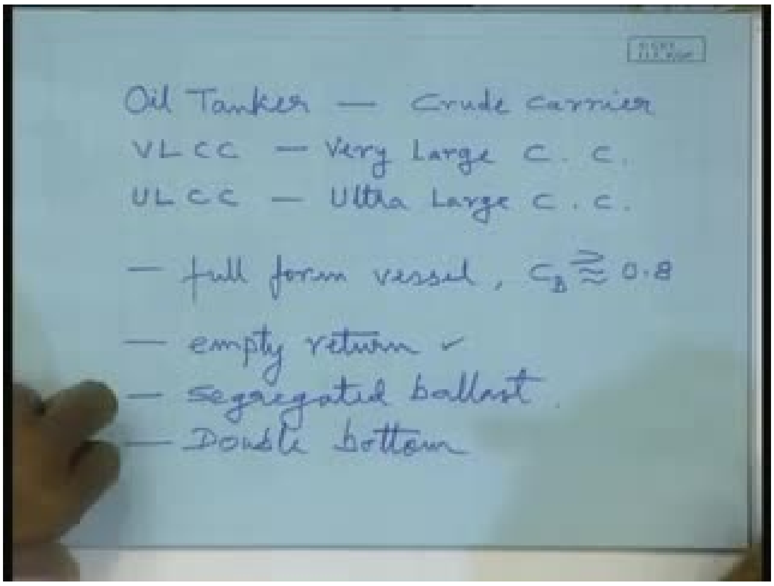
So, that is how this trade became very lucrative and these oil tankers started growing in size - from medium size to big to very large to ultra large. There are cases where some vessels up to 500, 1000 ton capacity where built, but somehow again, that market is no more there because of various global political reasons, etcetera. There was lull in the market as far as these ultra large crude carriers are concerned. Interestingly, I mean this is not right within this scope but still interesting to note - that in 70's this trade became very lucrative in early 70s. One of the countries, Japan, started building these ultra large crude carriers in a kind of a mass scale; mass scale does not mean that in 100's, it was, I mean, quite a number of them. They had orders in the ship yards, so they build ship yards which were specialized to build this ultra large crude carriers and it seems their record time of production was 9 months. In 9 month period they were producing one crude carrier of almost 500 to 1000 tons of capacity – huge, very efficient, fully automated ship yard one can say, but automated to handle only this type of vessel; that is what is referred to as hard automation.

So, the result was, suddenly there was a political problem in the Middle East and all that, and then all those disturbances began, wherein it became difficult to ply these vessels between the exporting and importing countries. The result was, many of these orders were canceled because many of the ship owners, the liners, ship operators, who placed order on these Japanese shipyards - they canceled their orders and the net result was those ship yards went bankrupt all together, to the extent of some of the shipyard owners committed suicide.

That shows what it means, by flexible manufacturing system. This is just beside the point, it is just to take a note of it - that means, one should not go for such kind of hard automation because then your adaptability to the market requirement becomes very small, you become inflexible and suddenly if the market demand shifts, then you cannot adapt to that and if you cannot adapt then, what ever superior most technology you had that becomes redundant - of no use. They were so efficient, they had been producing it -

seems in 9 month or periods that is too much, but in a changed market scenario they became useless.

(Refer Slide Time: 00:47)



Anyways, so that that is how those oil tankers and many of those big oil tankers, I mean, those super large, ultra large oil tankers, some of them have been converted to F p s o and some in jails - floating jail. Worldwide different countries used them as jail to keep the prisoners out at the sea; floating jail is a very good way of utilizing those dumped U L C C's which were no more used for carriage transportation of crude and some yes, that these days also is going on. Instead of building a F p s o, F p s o is what -Floating production storage and operation, it is basically for oil exploration and storage, that is a very sort of a popular concept these days, instead of building a new F p s o it is better if you have an old tanker, convert it to F p s o; that becomes more economic and faster. So, what is this oil tanker - is essentially crude carrier, what are the basic features of this? As we see, it is a full form vessel; till now we have not actually talked about the form. A general cargo ship is in between the c v, the block coefficient, which defines whether the vessel is slender or full, fine form or full form; fine form means that half angle of intrans is more, the c v is less, the water lines will be very slender; a full form water lines will be fuller, means the c v is higher.

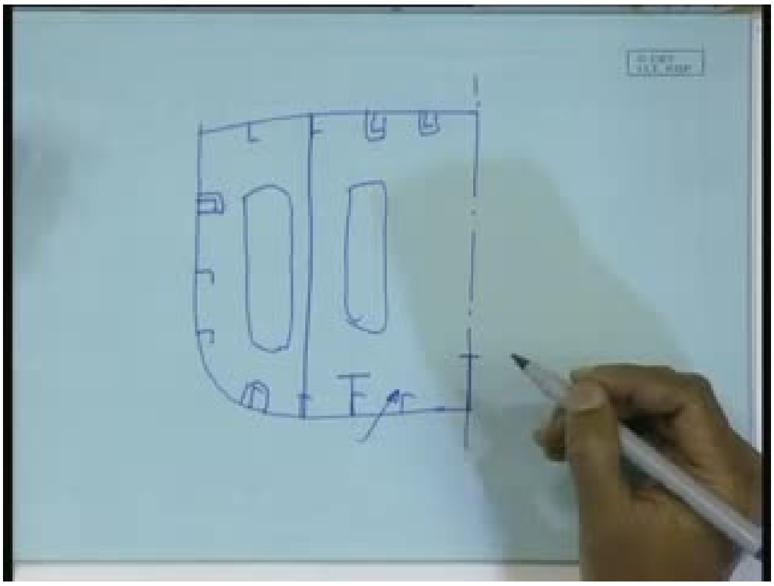
So, general cargo carrier's c v can be in the range of say 0.7, well 0.65 to 0.7; a bulk carrier can be in the range of well 0.7 to 0.75, whereas an oil tanker's c v is greater than

0.8. It is almost a rectangular box, a huge rectangular box almost 0.8 and above; we have not seen oil tankers, such crude carriers below 0.8 - that is one of the very typical feature of these oil tankers. Next typical feature is unlike other vessels, this vessel has an empty return voyage; the return voyage is empty means, these vessels cannot be used for any other sort of transportation or any other cargo so it only goes one way and comes back empty, so the moment it is coming back empty you can well imagine this huge amount of cargo once discharged, it comes up very much, I mean, the draft becomes very less; so from the point of view of propulsion, efficiency as well as stability you will have to ballast it.

Ballasting the vessel means you will put in water, sink it to the required draft, bring it and then again pump out the water for you will again take cargo, so previously it used to be very straight forward, means - cargo is discharged and in the same holes you take in water, ballast water again, come to the port of origin, discharge that water in sea, take in cargo and go, but you are discharging no more just the sea water but a contaminated sea water.

So, that Marpol convention I was talking about, I think, Marpol 78. 1978 Marpol convention declared that this is not permitted, you will have to have a segregated ballast space - that means you will have to have spaces earmarked for ballasting; you cannot carry cargo there. Before that, possibly before that Marpol 78 may be Marpol 73, I do not recall exactly, anyway, some time in that period it also became mandatory for having a double bottom.

(Refer Slide Time: 10:32)



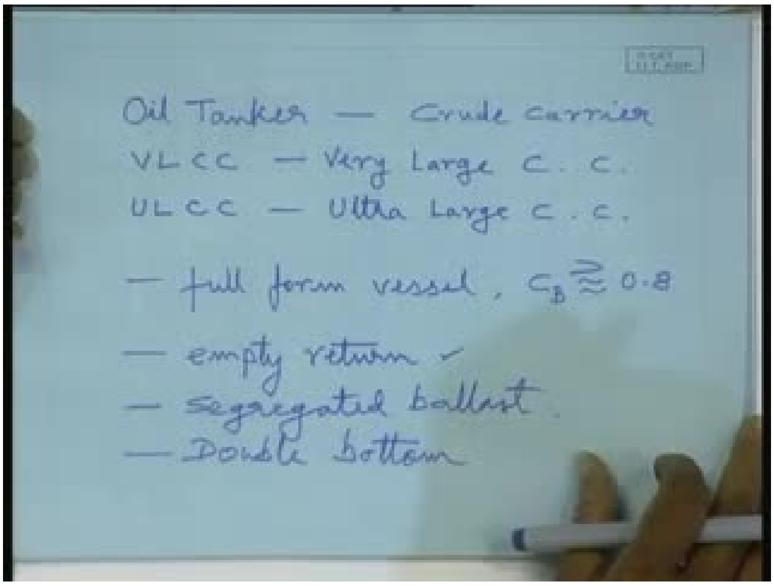
First it became mandatory for double bottom, if we then now go back to our mid ship section, an oil tanker mid ship section can be very well like this. Obviously, this is my half section, just the hull – definitely, inside all kinds of stiffening members are there, but as such there is no necessity of having double bottom in a general cargo ship. You need a double bottom functionally because you need a flat platform to stack your cargo. In bulk carrier you need that because if you do not have a smooth flat platform then in the bottom you will have all kinds of structural arrangement, then unloading becomes difficult; same thing, container ship we need a flat this thing, a row ship we need a flat space.

So double bottom was required functionally also, but oil tanker it was not needed because it is a liquid cargo - you pump in, pump out, so whether there are structures protruding in the thing does not matter. Originally, oil tankers used to be like this - means here you have the necessary strengthening members, I mean, necessary strengthening members as usual; you need not draw this, I am just showing. Say, there is one longitudinal bulk head, this you need not draw because no more of this type is used, but a modified version of this, longitudinal bulk head and there could be additional girders like that and well your transverses, transverse members etcetera. For all practical purpose there is no harm doing like this because I have the longitudinal stiffening because it is a liquid cargo and it is a closed section so strength wise let it be big, no problem.

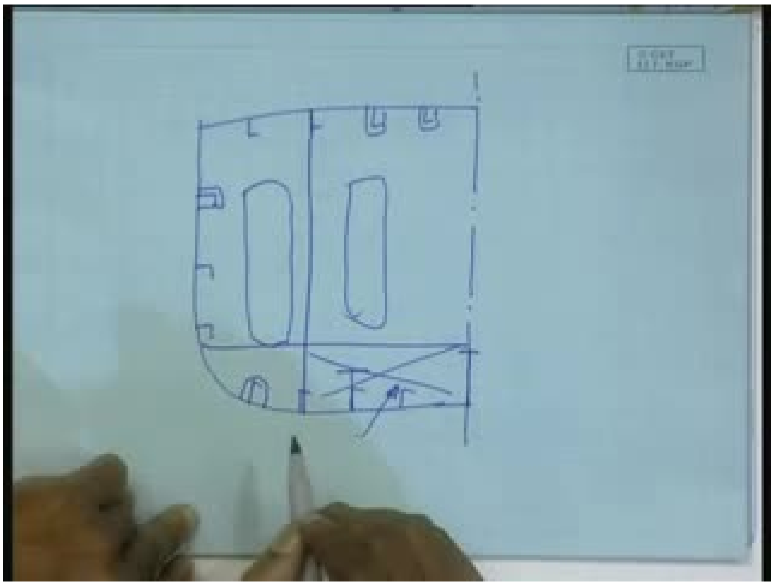
We talked about ultra large crude carrier way back in 70s but in this 2007 also we are still yet to build proper 12000 14000 t u container ships; probably length wise they will be still smaller than U L C C, probably it will be less than that.

Still that is a problem, I mean, that is more challenging than this, because simple, as it was a closed section so strength wise it was not a big problem; so we have that longitudinal strength, the transverse members giving transverse strength, etcetera.

(Refer Slide Time: 13:51)

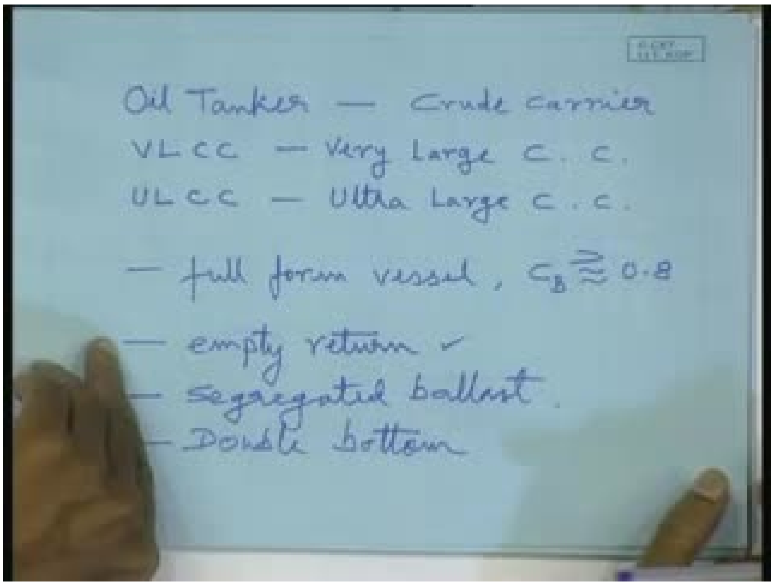


(Refer Slide Time: 14:14)



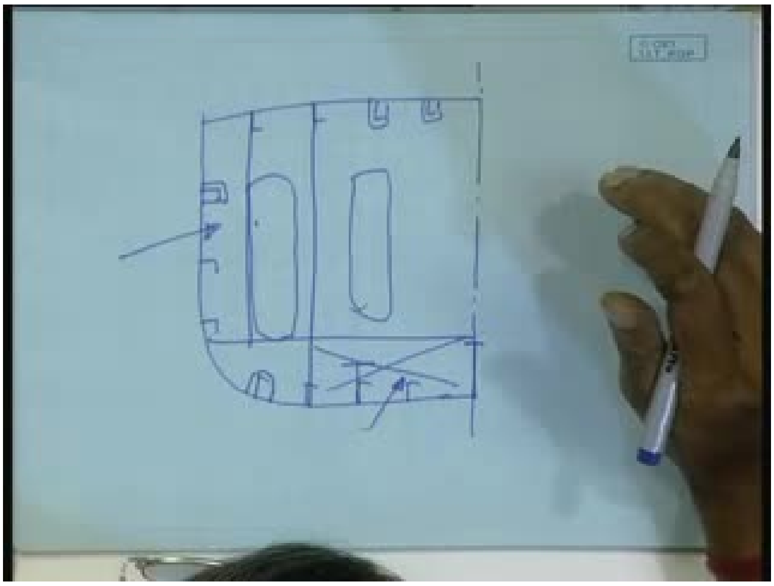
From the point of view of bottom damage and oil spilling out, it became mandatory to have double bottom, that is how first double bottom came and then came the segregated ballast - means you will have to provide a double bottom and you will have to earmark the double bottom spaces for taking ballast; this construction is called single bottom construction. The one which you can see, it is a single bottom construction because there is no double bottom, only the bottom shell so here you do not have any mechanism of even having segregated ballast.

(Refer Slide Time: 14:37)



First the concept of double bottom came and then this double bottom space are earmarked for ballasting, that is called segregated ballast - means ballast water cannot be contaminated with your crude. When we are talking about ballast, another interesting aspect, did you hear anything or have you come across anything to do with ballast water, as the say, ballast water management? I mean till now you see, to start with, it was as far as oil tanker is considered, it used to be single bottom - we load in cargo, we go, discharge cargo, take in water - ballast water, come back, discharge ballast water and then we found its polluting. After it polluted, after lot of things happened, then only it was realized and started putting double bottom and segregated ballast space.

(Refer Slide Time: 15:35)



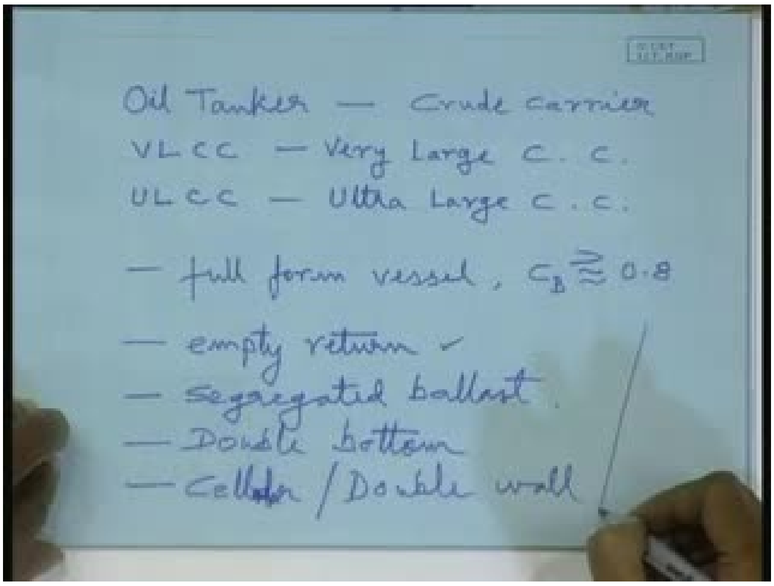
Eventually, now we have even double wall; now probably, it is mandatory to have double wall - like container ship we showed double wall, same double wall; because in case of side damage you have another line of defense so that oil spillage does not take place, because we have seen probably some of the oil tanker disaster and what it means by oil spillage.

From pollution point of view, segregated ballast was done and now people are finding another interesting phenomena; because suppose say what is happening, suppose in middle east - in Kuwait you load the crude and take it down to Alaska and there you discharge it in some refinery there and take ballast water bring and discharge the ballast water in Kuwait. It is a contamination of ballast water - Alaskan water is getting mixed in the middle-east ocean and that is creating problem, which is creating serious problem it seems.

Different parts of the ocean has different microbiology, the ocean biology is different; you cannot go on just; this mixing is taking place in huge bulk because primarily, this oil tanker, they are creating the maximum problem because they take in huge ballast water. Other vessels also take depending on the loading condition to make a different keel to balance the trim heel, etcetera; they can take depending on the putley they have unloaded or putley they have loaded.

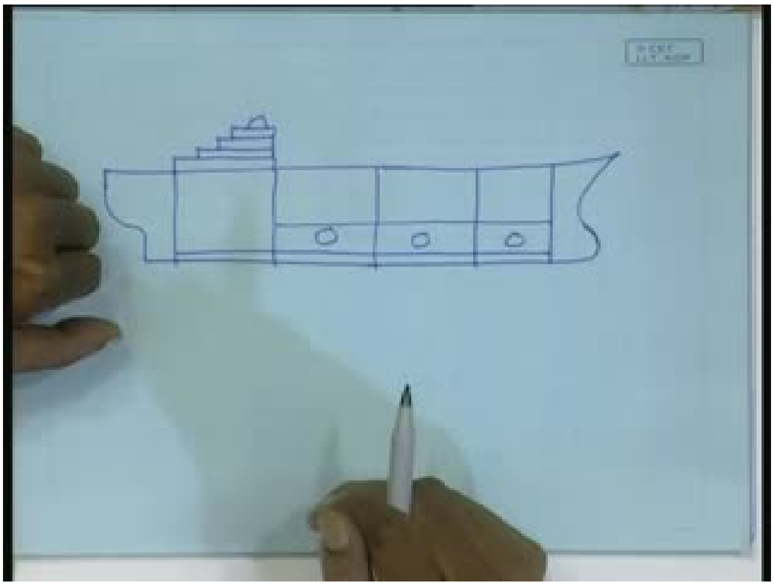
Oil tanker has a huge amount of ballast water, they will take in some from someplace and discharge altogether in a different place, so it seems, this so called ocean flora and fauna is getting affected badly; that is a kind of pollution due to ballast water contamination. Now people are thinking of all kinds of solutions to come out and solve this problem because ballasting is needed, we have to now question - that the water does not get mixed up; so that is also a very interesting domain people are working in.

(Refer Slide Time: 18:39)



Interestingly, these things once they happen, you think that it is so simple and so simple means so obvious, but we did not take care unless and until it happens. Is not it? A vessel is better to have a double bottom, it is so obvious now, but just go back to 70s, hardly few of the oil tankers had double bottom, this is not needed; we can do in a single bottom construction. So that is some of the typical features that it must have - the double bottom and probably now it also must be a cellular construction - that means double wall.

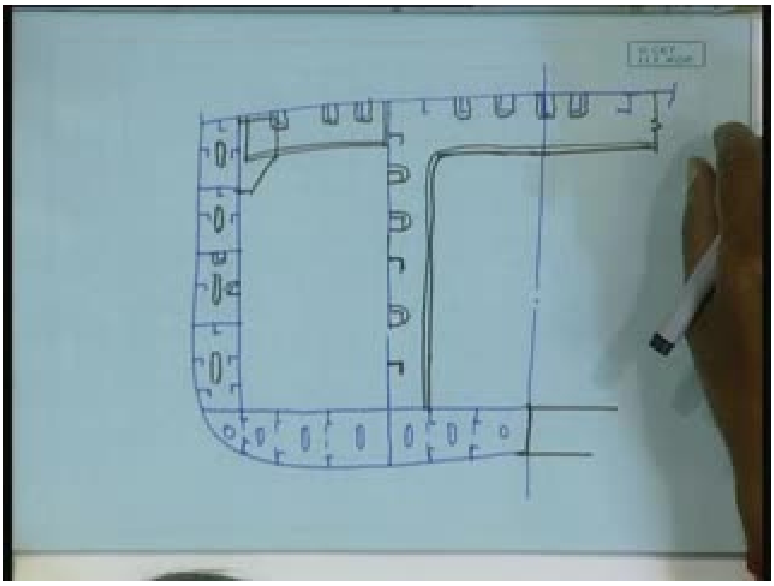
(Refer Slide Time: 19:57)



That is also another typical feature that has become mandatory, that you will have to have a double bottom, a double wall, because then you have it is all stemming from the fact of pollution - ocean pollution and to these added is the ballast water management. That means a system has to be developed such that this huge amount of ballast water does not get mixed up in different places, so these things, people are working on different kinds of systems by which the ballast water will not be transported physically. The vessel will be, think of a system - that when coming in the empty return voyage, you will have mechanism of opening some of the valves, as if, I mean, make the hull through and through open, just think, I mean schematically you think.

Suppose, I open here some holes as I have made, so water is flowing from this side and going out there; so part of the as if buoyancy I am not using any more, I am adding weight, so it is giving me the necessary sink edge and water is just flowing about - so I am not carrying the water, so water contamination is not taking place, but how to do this? This can be a concept, anyway.

(Refer Slide Time: 20:46)



Now coming back to the construction part of it, well, as far as mid ship section is concerned, once again, as I have suggested that we start with the outer bottom. Obviously outer bottom will be the mid ship section, the cell structure will be same as that of any other vessel; then you draw the deck, obviously, there is no question of hatch opening; make the double bottom because double bottom is mandatory; make a double wall, double wall is mandatory, so basic thing has been done. Then, assume that depending on the breadth of the vessel you will have 1 or 2 or 3 or whatever number of side longitudinal bulkheads, if the oil tanker is smaller may be you will have only one central line longitudinal bulkhead, if it is still bigger you may have 2 -1 port, 1 starboard and so on. Let us assume there are two centerline bulkheads - so this is one centerline bulkhead running along the longitudinal, along the length.

We are drawing the typical things, which are very typical of an oil tanker because rest other things are same for all so that is how you will never make a mistake; then you will know, first you go about putting the structural items which are typically required from the functional point of view, rest all are common because rest all are basically from the structural point of view, from the strength point of view. Definitely, these which are from functional point of view also will contribute towards strength, but I am saying thereby you can come to the mid ship section logically.

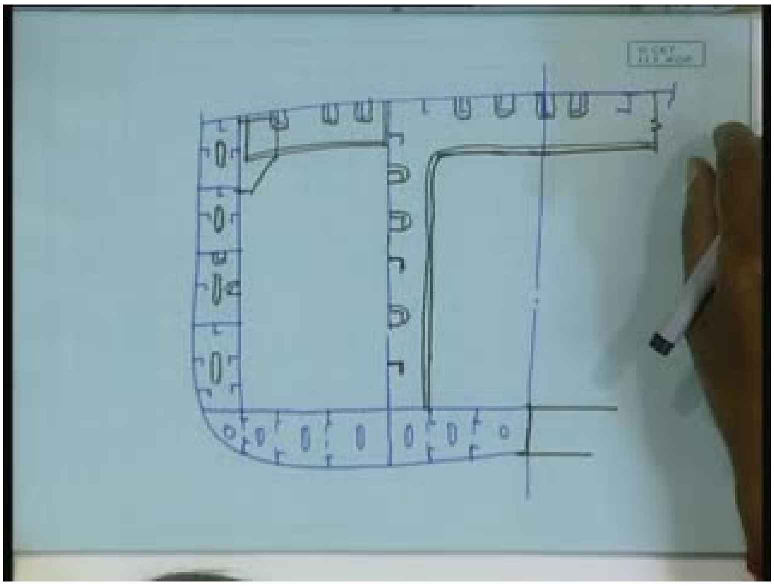
So, here after drawing the shell you know a double bottom is needed, so you put a double bottom, you know a double wall is needed put a double wall and you know that to reduce the free surface effect there are longitudinal bulkheads - assume there are 2 bulkheads, so one you draw say on the port side. Next comes stiffening arrangement, it is same for all other vessels. Here also obviously you go for longitudinal stiffening, more so it being a liquid carrier there is no question of cargo interference so all longitudinal stiffening - deck longitudinal stiffened, your bottom shell longitudinally stiffened and then obviously here you have the floor and all that is same aspect. Where you have the centerline bulkhead you have a side girder, that is how deck is longitudinally stiffened and the double wall, same thing as we have done in container ship, same stiffening arrangement depending on, so like this it goes.

Obviously you will have to have the transverses, now entire longitudinal stiffening has been done - that means it is now sufficiently providing the longitudinal strength. So from this you can see all the members which we have drawn, barring this floor rest of the material contribute towards longitudinal strength, means, the main deck, both the inner and outer walls, side walls, inner bottom, bottom shell, bottom shell longitudinal, inner bottom longitudinal, deck longitudinal and all the longitudinals in the double wall, that enclosure as well as sun line bulkhead, side bulkhead, longitudinal bulkhead, and this longitudinal bulkhead also will have stiffener of its own.

So, this can be vertical longitudinal stiffening arrangement I can provide because this is also a big plate, same thing will be longitudinally stiffened. Now, since this longitudinals are there you have to provide support - produce the span, so provide transverses, in the same fashion you have provided transverse, this floor you have provided in the same plane, these are my transverses. Just by drawing these black oval holes I am indicating that there is a plate with an opening there and these are my scallops as usual.

There is a transverse and what happens here in the whole region also transverses are provided, that means this transverse can be like this, I can provide like this for these longitudinals. This is well bracketed and then here these longitudinals are there so I can provide a transverse of this fashion. Assume there is another bulk head at the centerline or supposing it is not there, does not matter, so then it goes like this. This is continuing on the port side so we have this also continuing, as if this is also a transverse. This double line indicates that there is a flange here, a face plate, these are my scallops.

(Refer Slide Time: 20:46)



As we have talked about, in general cargo ship we said, if the side shell is longitudinally stiffened it will have to provide web frames to support that, so this is as if my side shell of a cargo ship, I mean what example we are giving, then you have the web frame. Now in cargo ship for this reason we do not provide longitudinal stiffening because it will eat up so much of cargo space but here in a similar situation if I just take this centerline bulkhead as the side wall and it is longitudinally stiffened, I will have to provide transverse to support that, but here providing transverse is no problem because you have liquid cargo.

Same thing, that same one plate is being continued like this, not necessarily it has to be in this fashion - it can be cut here and bracketed, that all depends on the practice how you are going to do that. Most important is you provide support, now similarly such transverse we have not provided on the other side - it is not needed, it is needed only this side; here I have not provided, not needed, because the longitudinals are supported inside.

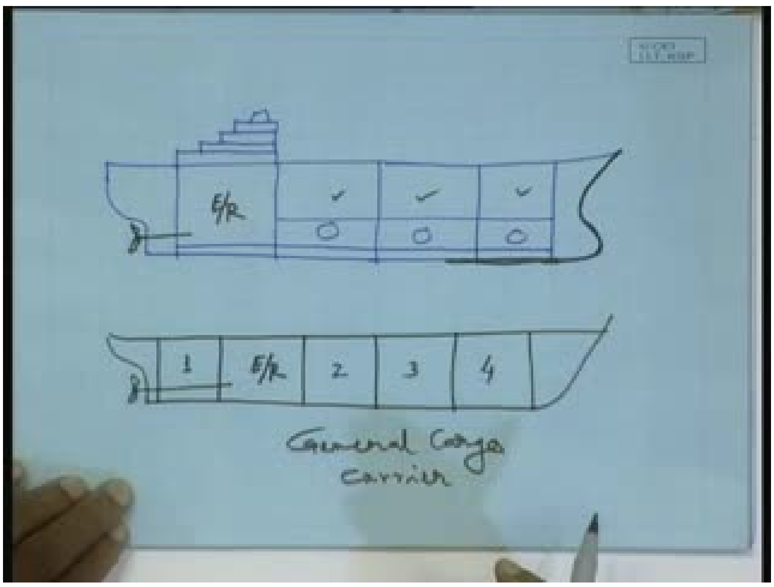
So, basic idea is the stiffening - primary stiffening members are the longitudinals and then to support the longitudinals, to provide support to the longitudinals, to bring the span to the permissible span length which is 3 to 4 frames - first at those intervals we provide the transverse members, thereby we see so this is a kind of a structural arrangement. Only thing, here what we do is suppose these are longitudinally stiffened - this stiffeners can be either angle sections or bulk sections.

What is done is they are the flange - they point downwards, why, because otherwise there will be oil accumulation there. These are some of the small things which one should keep in mind that they should point downwards otherwise they will form like a channel and it will hold the oil, you cannot clean that up, so these are some of the aspects.

Double bottom is, as usual, with a centerline girder at the centerline or provide a duct keel, but obviously a duct keel arrangement is much more preferable than a centerline girder. If it is an oil tanker, well if it is expected that it will be quite big, at least hundred thousand, two hundred thousand tons of crude it will carry, it will be always preferable to have a duct keel not only from the strength point of view but also functionally. Obviously, functionally duct keel is always better for any kind of vessel because the duct remains totally dry and that entire ducting, duct passage can be used for you know those cables, pipes, etcetera.

Their maintenance, their up keep everything becomes very convenient where otherwise they will have to pass through the double bottom space, which may be, it will remain immersed in ballast water or immersed in fresh water or whatever purpose that space is being used

(Refer Slide Time: 33:02)



So that is what is the mid ship section arrangement for oil tanker. Again, just coming back to this profile, what here I have purposely drawn is a bulb. Generally, oil tankers will have a bulb section in the profile for the very simple reason that it is a full form vessel so its powering requirement is also very high, because full form means the resistance towards movement in water is higher - that means you need more power to overcome the resistance.

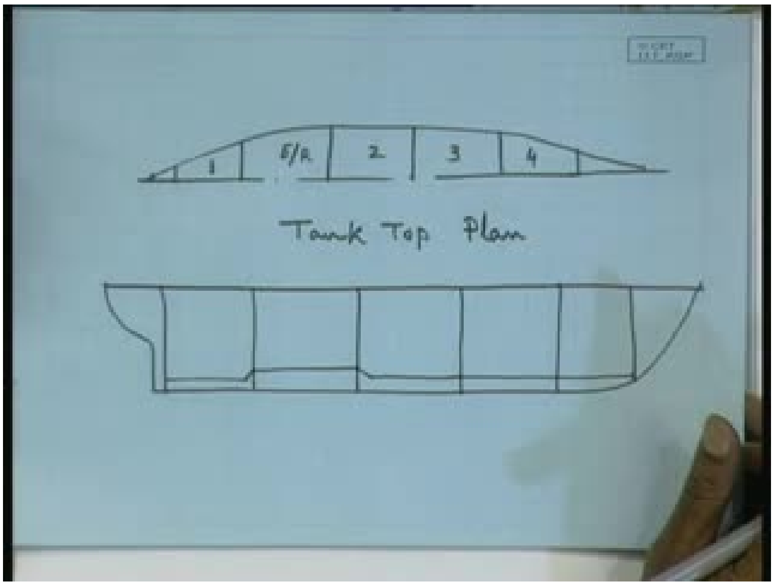
So, by providing a bulb it offsets part of the hydro dynamic resistance, means - reduces to some extent, so generally a bulbous bow, this is what is called bulbous bow, is added to the forward section. Other feature is that in this oil tanker the engine room is always fully at the aft, rest all the holes are all forward of the engine room- cargo holes; same thing is true in case of container ship as well as bulk carrier also - engine room is always fully aft and the cargo holes are forward of engine room.

Whereas in general cargo ship there can be a situation that you have your engine room semi aft, what this semi aft means? Something like this is in a general cargo carrier. Can you tell me why this is happening or why I am emphasizing that all engine rooms are fully aft? What is the harm if I keep it at the mid ship region or keep it in the forward, here? Specifically I am saying that the general cargo carrier is a case that is not fully aft but semi aft - that means definitely that I would prefer to have it as much as aft as possible. Is not it? Why? Simple reason.

Yes, the simple reason is I have the minimum length of the propeller shaft that is the simple reason.

Yes, that is what we are coming to; always our objective would be to keep it as much as aft as possible so that I have my minimum length of propeller shaft. By having minimum length of propeller shaft I have lot of advantage - cost is less, weight is less, alignment is easier, less number of bearing, since less bearing means less vibration - problems of all kinds, transmission loss is less, but the moment it goes little forward, my propeller shaft length is increasing. So why I go here - definitely I would have liked to be in the aft but unfortunately I cannot have. If this is my hole number 1, this hole number 2, 3 and 4 - that means there is definitely some reason why I have to go semi aft.

(Refer Slide Time: 37:19)



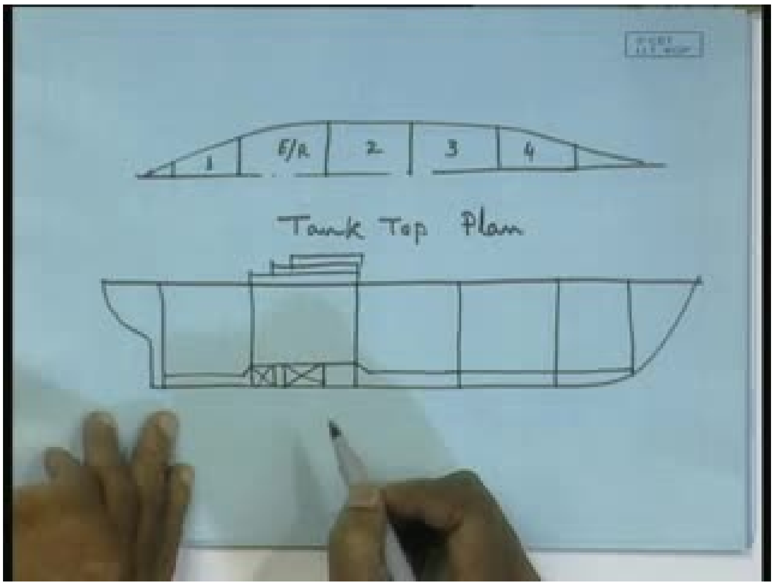
It is nothing, but we do not have enough space in this total aft region to house all the machineries you require, that is why you have to go little forward. What is happening is, I have told you that the c v of general cargo carrier is of the order of 0.65 to 0.7 - that means it is little on the finer side, rather on the finer side, so the water line at the double bottom level or the level where the engine and all those things will be located, the water line could be like this, so this is my aft collision bulk head, let us assume, how many I have drawn there?

This is what I told, hole 1, engine room, hole 2, 3, 4. So this is the plan at the tank top level, say, this is my tank top plan. Tank top plan means it is giving me the idea of what area, flat area, is available at that level; as you can see this one in this region I have a very narrow zone, so I may not have enough space to house all the main engine as well as all the auxiliary machineries - so I have to shift, as I move towards mid ship I am becoming fuller so I have more area, that is how essentially it is semi aft.

Sometimes we will find arrangement like this, say, you have the vessel, these are your subdivision bulk heads and your double bottom is going like this. What I have done? Double bottom in this hole I have raised it, why, because if you raise it you get more area. It may be a case in a particular cargo ship, the kind of lines you are getting that even shifting one hole, going in the semi aft position - that means if I am shifting to the second holed space, still I am not getting enough flat area to house all my engine, all my machineries so I raise the double bottom height, as I raise I get more area because the shell is flaring out.

This is a raised double bottom that can be required whereas in the cargo holes whatever minimum - is required from the point of view of strength as well as other functional requirement. That is how the arrangement of double bottom can depend; these things generally happened in case of ships which are fine form, say, passenger vessel also is a fine form ship because there you expect to have little higher speed of operations so you make it fine form. You can achieve for the same given power higher speed, so there you need this. It may so happen that the engine room to be shifted same semi aft and also it may require raising of the double bottom height.

(Refer Slide Time: 41:18)



Since we are talking about double bottom height, it will not be out of place to talk what decides this height? This is one of the important aspects in the structural arrangement. What is the double bottom height? First and foremost starting point is what is called rule double bottom height. Rule double bottom height means you calculate from the classification rules, say I R S - Indian Register of Shipping; so, for a given size of the vessel the classification rule will prescribe that your minimum double bottom height cannot be less than some value.

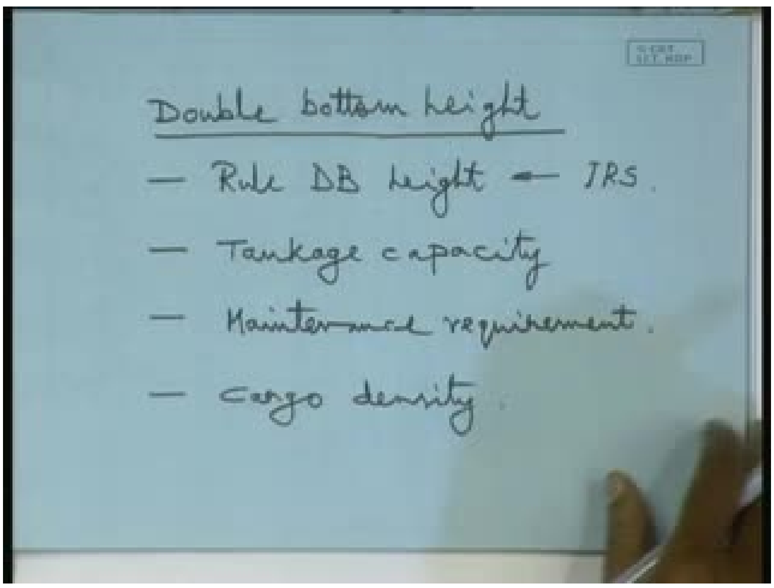
So that is purely from the structural point of view, from the strength point of view, because the primary obligation or duty of classification society rules are to look after your structural soundness not functionality, they may not be bothered about functionality but structural soundness.

So, that will prescribe the rule double bottom height, that is your bottom line - that means you cannot reduce that, you can always increase - we will say need not be less than some value, you can always increase. What we will next check, we will check the tankage capacity.

Tankage capacity, what is that? You need to have certain capacity in the double bottom space because that space will be utilized for your fresh water carriage, some space will be utilized for fuel oil storage, some space will be used for ballasting purpose. So, you will know how much fresh water cubic meter is required, how much fuel oil cubic meter is required or ballasting, so that way you will have to check the tankage capacity, this capacity of these spaces. You will have to work out that where what will remain - may be the space has to be divided in several compartments because the whole double bottom space you are not going to use.

Obviously the space below the engine room - some space you will use for fuel oil, probably some space you will use for fresh water and so on. No point using fresh water here in the forward because then you will have to have a long pipe line to come to this place because your fresh water requirement is in the accommodation requirement. Is not it?

(Refer Slide Time: 44:07)



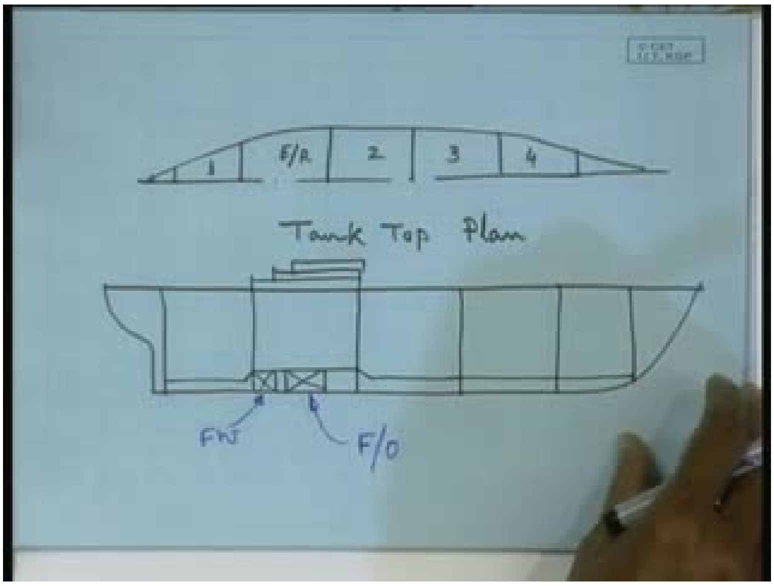
All those tankage capacity you will have to check and accordingly mean it to augment or increase the double bottom height. Another aspect which we over look, that is, from the maintenance point of view - the maintenance requirement.

The double bottom height should be such that it will be maintenance friendly - that means, for serving purpose, for inspection purpose, for repair purpose. A person can comfortably work there as far as possible, so wherever possible you will have to provide sufficient height so that you can work. Obviously, if the vessel is small then you cannot do, that is a different issue - you cannot help, but wherever possible you will have to.

From the tankage capacity point of view, from the rule double bottom height point of view, that is, from the strength point of view we may not need a double bottom height of 2 meters, say 1.2 meters is more than enough, but if they can afford to have 2 meter double bottom height it is better to give that because then apart from satisfying the first two requirements it will also satisfy the third requirement which is very important. That is how basically on these primary three factors you decide on the double bottom height

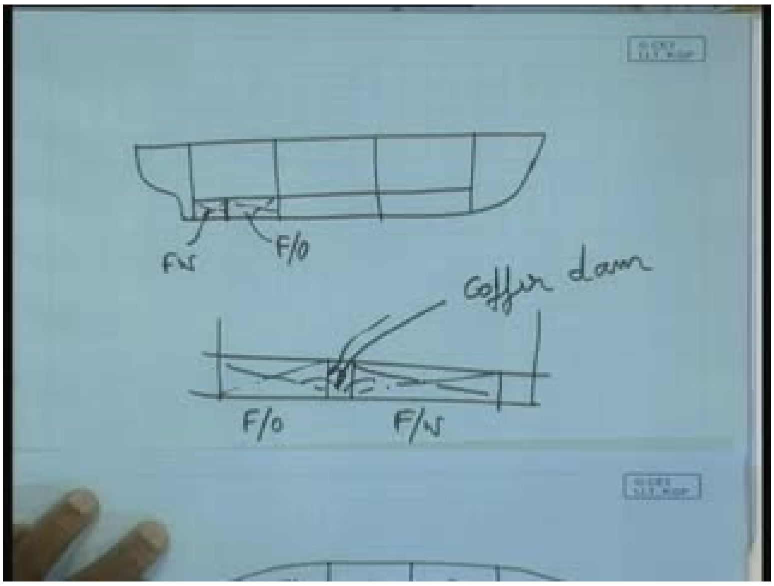
The fourth factor is basically specific case to space, I mean, is not a general issue but it is characteristic of specific case - that is, it depends on the cargo density. We have seen that in case of OBO - OBO-carrier, there are all these super seeding, all these requirements; this cargo density requirement becomes more important and there you have an unusually high double bottom, much more higher double bottom just to take care of the center of gravity, so that is what is the double bottom height.

(Refer Slide Time: 46:36)

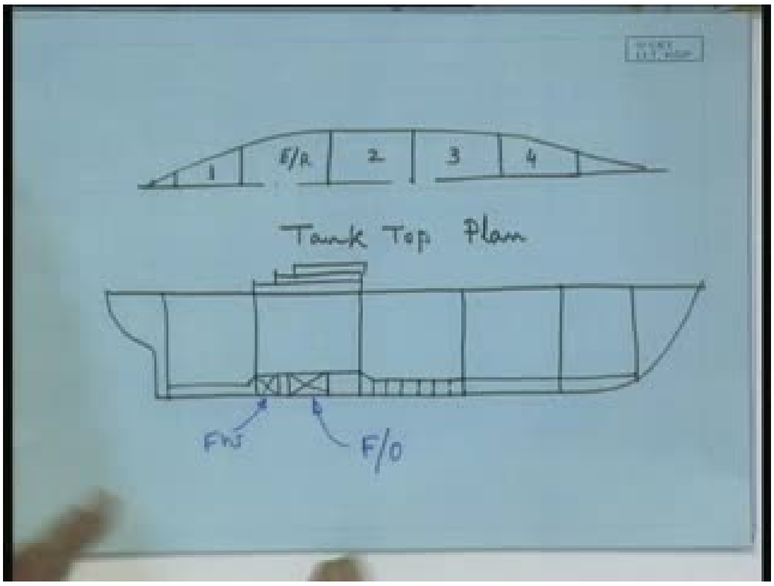


While continuing in double bottom you may see what I have drawn here in this. Suppose, this one is your fresh water and say this is my fuel oil. We can see that there is a gap in between, I have kept a gap in between, so this - the arrangement is, I mean, it could have been as well say you have the well let me so it is a little exaggerated

(Refer Slide Time: 47:14)



(Refer Slide Time: 47:55)



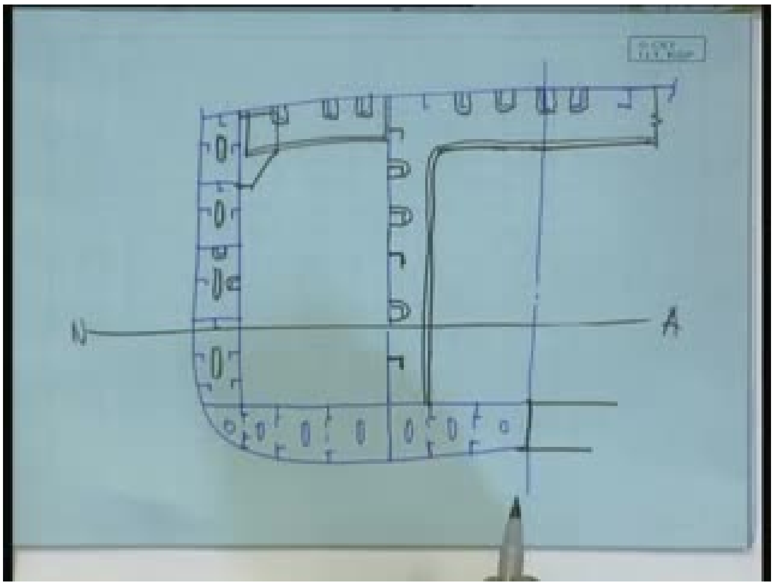
Let us draw, say, this double bottom space. I am dividing in to two halves or two spaces - one is for fresh water, another for fuel oil, but in this way there is no harm doing like this but this is not done. It is always done in this fashion - you keep a gap in between. That means, this is your double bottom space, suppose, up to from some frame up to some distance you provide say for fuel oil and then one frame space gap, this is one frame space gap, and then well may be this tank fresh water. Can you tell me why this gap?

Simple common sense – contamination, again. Contamination means though these particular members, what is that, this is nothing but a floor - a solid water tight floor. In this plane we are having the floors at every third fourth floor - we are having plate floors, rest are bracket floors. Now, depending on your tankage requirement some of these floors I can make make them water tight floor thereby divide the space in different tanks' tankage requirement.

When there are two different kinds of liquids are to be carried, you will have to give a gap in between. This gap is refered to as coffer dam, this particular term is used, coffer dam. The whole idea is that there may be a case of small leakage developing in one of these water tight floors, it may happen that there can be some failure over the usage because of some reason or rather a crack develops and one of the floor starts leaking, so there will be contamination. To avoid contamination you keep a blank empty space in between that is referred to as coffer dam.

Whatever leakage takes place, it remains in that space so thats what the safety point of view of avoiding contamination of liquids being carried in the double bottom. So that is how is this double bottom constructions - these are the other aspects apart from the structural aspect, these are the aspects one has to keep in mind while deciding on double bottom and this is true for all kinds of vessels.

(Refer Slide Time: 50:53)



So, what you see is that whether its a general cargo carrier or an oil tanker, will have same kind of double bottom arrangement. Only thing for all practical purpose, a general cargo carrier, generally we do not put a duct keel, but again it would be a good design practise to provide for duct keel whatever be the ship type. It is good practise to provide for that may add to the cost but functionally may become much more better in the long run for the owner.

Other wise for the mid ship section, this particular thing you keep in mind that whenever you are laying out, mid ship section is very important because that is the backbone of, as far as the structural strength is concerned. The mid ship section members in the mid ship section suffer the maximum stress levels because of longitudinal bending and the moment it suffers maximum stress level all kinds of failure are most likely in the mid ship because the operating stress level is the highest so your fatigue limits are lower, it is more prone to fatigue failure, you are more prone to more structural higher corrosion rate and so on so forth.

That is why when I started I said that there are certain mandatory design requirements which are to be approved by the classification, one of them is mid ship section. Once this mid ship section is done then you will have to infact work out the section modulus, about the neutral axis and check for the stress level at the furthest most members, and thereby again do a few iteration to come to the final scantlings of all the structural members.

So basic thing is you look from the point of view of functional requirement, put all those members and then put the rest members from structural requirements, means you will have to stiffen them so longitudinals, if you support the longitudinals so tranverses, you have to have a proper road path so brackets and so on.

Next will go for structural alignment.