Marine Construction & Welding

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

Lecture No. # 15
RO – RO Ship

Today, I thought we will do oil tanker, but I see in the title RO-RO ships, so let us do RO-RO ships, next time we will take up oil tanker. So, what is this RO-RO, any idea? Roll on, roll off, right.

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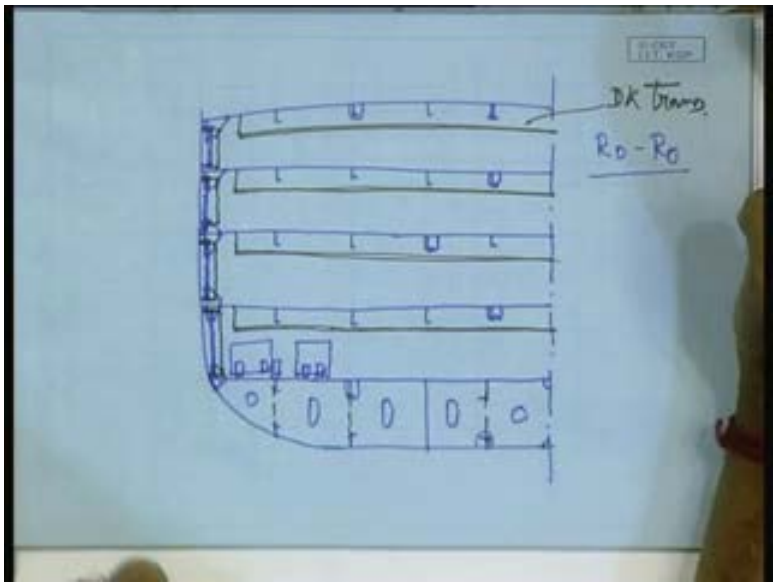

So, roll on, roll off, again that same concept came, because automobile is one of the commodity, which is very highly traded, right. There are countries, which are big producers of these automobile cars and some countries are big consumer of automobile cars.

Like Japan is a big producer, US are big consumer, so that is how all this game started. That means they are producing at their own land and transporting, exporting to US that is how it all started. So, again here the cargo is somewhat different, like we have seen cargos, general cargo, liquid cargo, bulk cargo, containerized cargo, these are automobile

cargo. A cargo which is by itself is mobile, it can move of its own, right. So those vary aspect, that means, the cargo itself can move - so that aspect has been taken advantage in designing these vessels, why? Again, same aspect of loading and unloading, right. So here the whole concept is that a vessels. This cars, the automobile or the cargo will roll on the vessel, the vessel will sail with the cars at the port of destination, it will roll off right that is how roll on, roll off.

So, what we need for this? That means, we need proper storage spaces for the cars, we have seen what kind of storage cargos to its spaces required for general cargo ships, for bulk carrier, right, for container. Now, for the cars, we will have to - this vessels are dedicated for carrying car only, RO-RO vessels; well car means car automobiles.

So, what do you think would be from your common sense that what would be the configuration of these vessels? Multi deck, straightway multi deck, because here we do not need a hold as such, because here the cars cannot be really stored in bulk, you will have to store them very nicely one after another. Here, we are seeing that we take help of its own propulsion power, means own engine to drive in instead of putting them through the cargo hatch. So, obviously hatch opening - there is no concept of hatch opening, we do not need hatch opening, right. So, we will have some other arrangement through which the cars will enter, right. First and foremost is it is a multi deck vessel. Now, before you go for the multi deck, we do the - we draw the basic minimum, which is common for all vessels; that means, the outside hull and the double bottom, right, whatever you do a midship section.

So, immediately first draw the outside hull and the double bottom, so you can immediately do the necessary decoration in the double bottom like this. So, this way you indicate that it has a double bottom with and you are drawing a section at a floor - at a plate floor that is enough. So, it gives an idea, you have one side girder, I have just also added here, so this is done.

Next thing will come from the functional requirement that it is a multi deck vessel. So, it will have several decks, difference between say general cargo ship is also a - can be a multi decker vessel. Generally, it has a only one lower deck, I can also have two lower decks, but generally not more than that but it will be many more. Here, we have drawn at least 1, 2, 3 decks below main deck. It can be more depending on how much depth you

have and how much minimum clearance is needed between two decks. There by you can have this.

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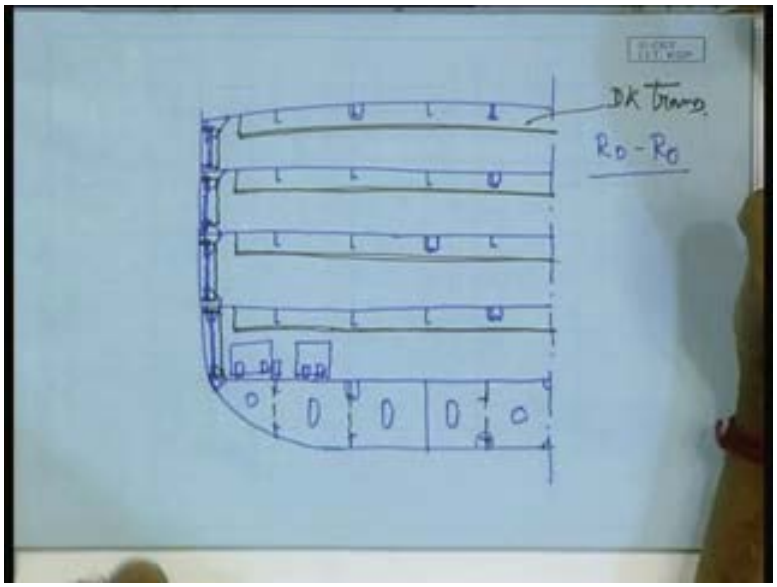

So, straightway multi decks; obviously, since this vessels also will be the primary strength, requirement is longitudinal strength - primary requirement is longitudinal strength. So, immediately I can have all longitudinally stiffened, all the decks longitudinally stiffened, so longitudinal stiffening arrangement for all decks. Since, it is a closed decker ship, means is a kind of a closed construction that means there is no hatch opening. So, obviously torsional strength is not an issue, is not a problem.

So, what do you need is proper strength, longitudinal strength and as well as transverse strength. Now, transverse strength is also very well achieved because of so many decks are already there. So, those decks are continuous from port side shell to the starboard side shell, it is continuous. So, many of them, the whole structure become really is very strong, so strength wise it is not a big problem. Right decks are to be made strengthen enough; because, you will have it, will sustain all the loads, the wheel, vehicles will be there.

Anyway, whatever way you draw, I mean schematically, the vehicles will be there one after another, right. So that is how its main stiffening arrangement will be longitudinal stiffening for the all decks. Again from the same logic of general cargo ship side shell,

will be transversally stiffened. That means in side shell, will use transverse stiffeners, whereas, in the decks will be longitudinally stiffened that is how.

So, these all will be bracketed, these are all bracketed the side shell stiffeners and then again the decks are longitudinally stiffened. That means you will have to have those transverses at intervals, right. They come right; the same to provide supports for those longitudinals that means transverses will be there, at fourth, third or fourth frame spaces like this. Obviously, in all the decks, it will be there. Naturally, once again I am just repeating that these transverses will be there, in the same plane, you will have web frame on the side, frames of higher scantling, stiffeners of higher scantling, right.

They will be suitably bracketed, connected. Also, in the same plane, you will have the plate floor, like we have drawn in between these transverses - will not be there, these web frames will not be there - sides of web frames. Plate floors also will not be there, will be bracket floor that concept of bracket floor.

So, what do you see that every third or fourth frame space, you have a kind of a ring like structure. The ring is you have the deck transverse, this is what your deck transverse is; in the same plane, you get the web frame of the side shell. As you come down, you have the plate floor, go to the starboard side. Again, the plate floor continuous web frame deck transverse, so as if it is a ring.

The ring like structure will be repeated every third or fourth frame space or as per the classification guide lines, right. So, basically that these rings like structure, it is providing support to the longitudinal members, both at the decks, as well as at the double bottom. Also, these ring like structures are providing the necessary transverse strength. So, these are the members which provide for transverse strength, means members stiffeners in the transverse plane, they are providing for transverse strength of the structure. What else provide transverse strength, which member? The deck itself, well of course because, a continuous plate port starboard also it will provide. But, more importantly, transverse bulkhead - transverse water tight bulkhead, it provides strength only in the transverse frame; it does not provide in the longitudinal strength, right. That is one of the members which are important towards transverse strength.

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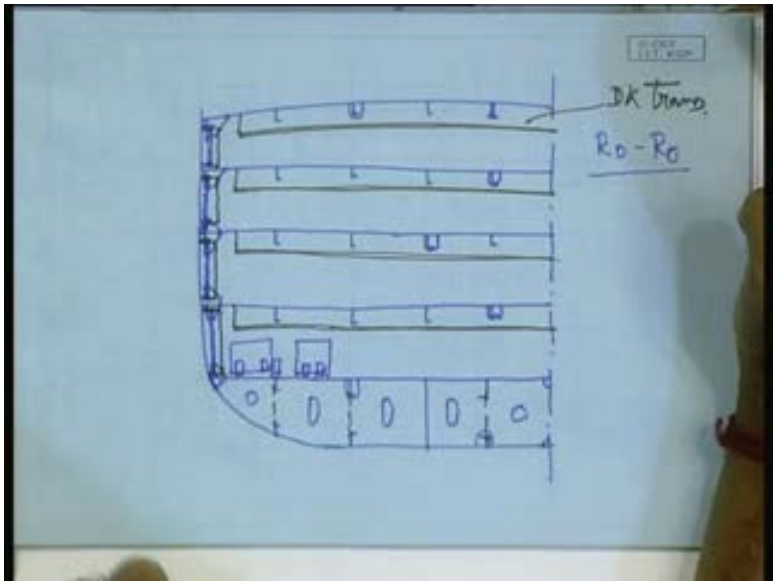

Similarly, for longitudinal strength, the longitudinal members, all the longitudinal, be it deck longitudinal, be it inner bottom longitudinal, be it bottom shell longitudinal, side shell longitudinal, whatever, longitudinals - longitudinal stiffeners centerline bulkhead in case of oil tanker, because, otherwise, you do not have centerline bulkhead that is in specific case. In case of oil tanker, it does provide longitudinal strength, but of course there its purpose is different that is not been put to provide - give me longitudinal strength, it is provided for reducing free surface area. At the same time, it is contributing towards longitudinal strength, so the scantlings of other longitudinal members can be reduced.

So, in general, all longitudinal members' stiffeners, centerline girders, hatch side girders, side girders in the double bottom, they are all stiffening members contributing towards longitudinal strength. Obviously, side shell, bottom shell and deck, they contribute to both transverse and longitudinal strength as such. So that is how we see that this is the general layout or the structural layout of a RO-RO ship.

So, what basically we are seeing is once again the same thing that you need to have a structure, which is strengthened in all this aspects. Longitudinal, transverse, torsional, local, these are the four strength requirement to be satisfied such that the ship can sustain the service loads. So, to do that it is preferable to add up longitudinal framing system, because it gives you better buckling strength. Then, to satisfy your transverse strength,

you will have to have adequate transverse stiffening members, which we are again getting from these transverses, web frames, floors, bulkheads - transverse bulkheads. We will come to that first, just taking a look at the mid ship section, how the section at the midship looks like. So that is how this is - well the arrangement is done, just to sake of compactness, some of this scallops we are drawing that mean there will be as usual those scallops.

It is not only scallop, the details we have shown you, how they are connected, because at the time of fabrication, you need that cut opening to fit it that means to have the what do you call the longitudinal passing through that but you will have to provide suitable welding of the web and add a additional collar plate, so that you get a proper clamping of that. Because, we are saying the span is from one support point to the other support point, so you have to provide for the proper support, so detail of that we have already seen.

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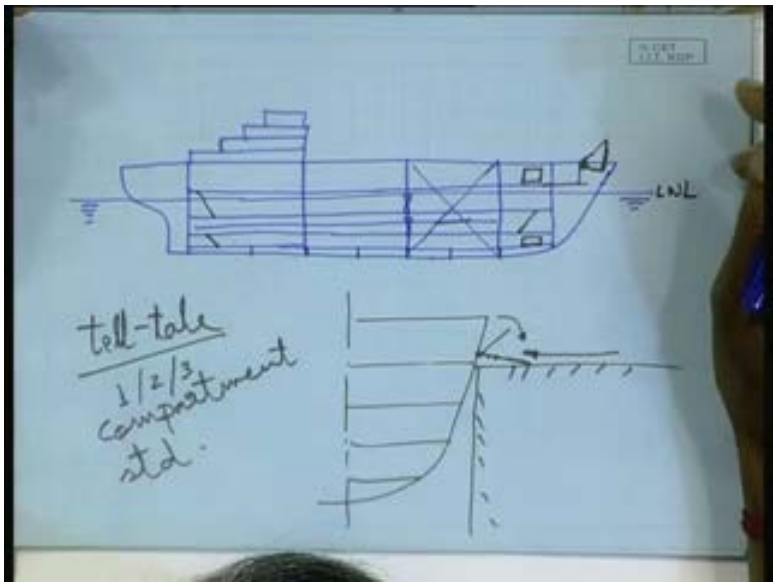

So that is what is the mid ship section. As far as the vessel is concerned, its loading and unloading facilities are something like this. Here, there are certain aspects are there. Well, so we have these two bulkheads, which are referred to has collision bulkheads or refers to as forward peak bulkhead or forward collision bulkhead, up peak bulkhead or up collision bulkhead. Anyway, fore peek, up peak - two bulkheads are there. You have

this double bottom and then we have several decks. I have drawn how many 1, 2, 3, 4, this is one line, is the water line I have drawn.

Anyway, say there are four decks, I mean three under decks, one double bottom right. So that means, this is my - here the cars are not been carried on the weather deck - the expose deck, they are all carried below the main deck. So, you will have the super structure like this, below the main deck all cars carries, so what is the entry point? So, entry generally is from an opening like this, opening at the site, so there is an opening here. Opening means a ramp will be there, the ramp will open up that means it is something, so this is my section, say this is the section at this ramp level. So, here you have, as if a, I mean this ramp level will be say it is docked against a birth.

So, ramp will open up, it opens up like this. So, a car can come straight way, drive inside right; the car can straight way drive inside through this ramp, so it goes in. Now, it travels down and then you have another ramp here, ramp is a sloping this thing, like we have – well, you may have seen. So, only thing at that toped just below the main deck, I mean the weather deck, they are above the water line.

The purpose of drawing this water line is that means, one of the decks or where the ramp is opening up, it has to be above the load water line, you cannot keep the ramp immersed in water. Though this ramp when all cars are loaded, it will close up, it will have a properly water tight closing, but if the part of it is remains under water continuously immersed, ship may start leaking, so you cannot effort to have that.

It is above that that means one of the decks has to be above the load water line, then only you can have ramp there, right. Well, so it goes like this, then again you have another ramp here and a final ramp there. So, a car can travel down entering here, it can park - the first car will park itself here, at this corner, isn't it and then gradually go on filling up. Because, if you park the car right here, then naturally you cannot go, so well it will fill up and the drivers, will of course will come out, there can be if the vessel is like this, then the drivers will leave the cars and leave the ship. A fresh set of driver will come and drive the cars out, if drivers are to stay on board, then they cannot stay in the car.

So, then again it becomes a different issue, will it becomes almost like a passenger vessel, so that is not very feasible because a car carrier capacity could to 2000 car. So, if 2000 drivers you want to accommodate that becomes a problem, right. So, generally

drivers are not staying that means, they leave the car and go out. So that is again another requirement that means how the driver will go out.

You will have to simply walk down, right and come out. Walking down means what? He is walking down through this space, there can be some staircase, some provision, but important is in this enclosed environment. You are driving the car in enclosed environment; whatever be the Bharats norms or Euro norms some emission is there, so various stringed requirement of ventilation is a must. Otherwise, there can be a CO accumulation and that may lead to, when the driver comes down to the last car to board that he may go on conscious.

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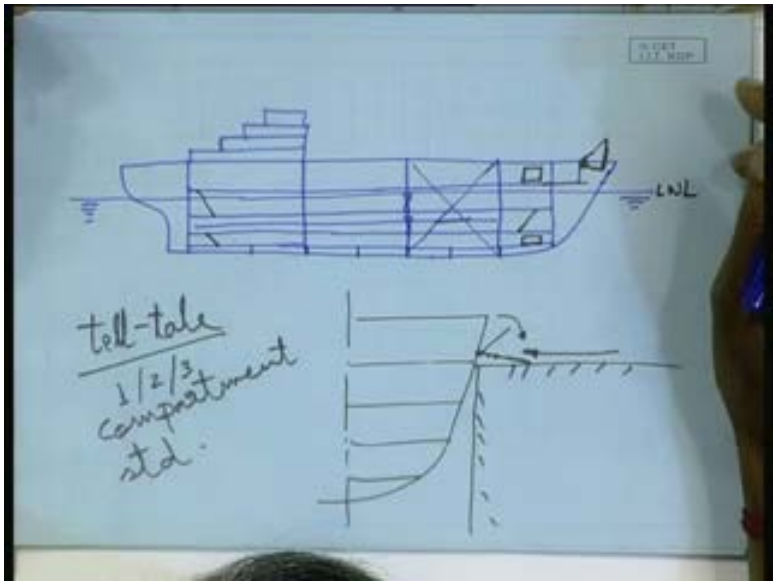

So, one of the typical requirement of this type of vessel that in the cargo hall needs a very stringent ventilation requirement, is there for the cargo hall. Other cargo halls, we have seen for other ships that aspect is not so important, so here is an additional thing. Well that is how the cars are loaded, it is generally side ramp or at times it also has an arrangement like this. Arrangement like this that means this forward part opens up.

This not very correctly drawn, what happens is the forward part opens up, it almost like an opening the mouth. The forward bow lifts up, so you have an entry, so from forward you can enter that is of course that becomes much more difficult construction wise. It is preferable to have the side ramp, so the advantage is generally ships are both side wise and the side ramp opens, you get in. It is easy to say that way, but imagine a situation as

the cars are getting unloaded, it is floating up, right and so what is happening to this ramp? It will go, will start becoming stiffer and stiffer, so all those problems are to be solved. Same thing, when you start, when the vessel is empty and start putting in the cars, it will gradually come down.

So, when the first car go, it will be very stiff, may be, so you will have to have proper ballasting and de-ballasting arrangement, where that stiffness could be very severe. You would not be able to drive up, is not feasible, because there is a draft, change could be in meters, not only centimeters, in several meters. The ramp you cannot make 100 meter long, so that it takes care of that angle no, so ballasting and de-ballasting while loading of the cargo. You will have to have a - that means proper like ballast spaces, in other vessels are needed also, but they are needed primarily for the purpose of adjusting the loading conditions and for all practical purpose in a general cargo ship or in a container ship or in a bulk carrier. Your ballasting, de-ballasting well provisions are to be kept, but they are not that much needed.

For an oil tanker it is needed, why because, their return voyage is empty. Oil tanker always return voyage empty, so when you came back empty your propeller will stick out isn,t it. Because, it is - it will have hardly any weight, so it will float at a very low draft. If the propeller blade sticks out, it would not have proper efficiency, so intentionally sink it further; you will have to put in ballast water there. In this case, this is the specific thing to make adjustment of the ramp, so you will have to take in ballast water, start loading the cars and slowly keep de-ballasting, balance it. So that the ramp angle more or less remains within a limit, so that is an additional requirement. Well, as far as the entry car loading is concerned, the side ramps, it can be in both the side port and starboard.

So, whichever side it parks or it barges, the vessel it can be entered. Some, they have forward loading also, this forward ramp, but preferable is in the side. Whatever whether it is a side ramp or forward ramp, they should have proper so called tell-tale arrangement. You know tell-tale, this term is used. Tell-tale arrangement - tell-tale arrangement means some remote sensing that the door is properly closed, the ramp door has been closed, because if you recall, may be some 5 6 years back, probably or may it is already, it is little more, one such RO-RO ship sank in the harbor itself.

It was fully loaded, suppose to sail the next morning, they find, I mean it is already half immersed. Simple reason what happened, I mean varies for stupid reason that means the cars were loaded; the ramp was not very properly closed.

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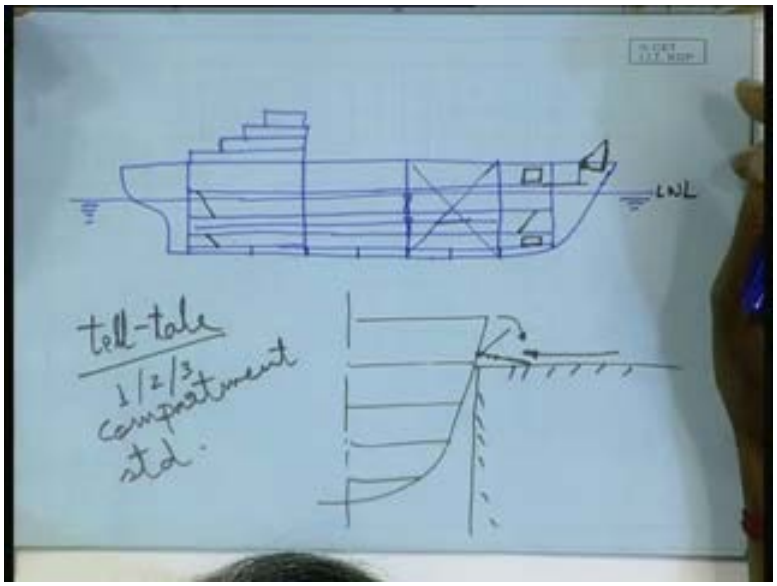

It was not closed properly or whatever, I mean the water tightness was not there. Though it is supposed to be above water, but what happen probably that was a little stormy night, so lot of waves in the harbor even, water started getting in. A good part of the ramp remains open, so that with every waves splashing on the hull, some water is going in. For any ship, the most dangerous thing is taking in water. It is the most dangerous thing, because it takes in water, means it become more proven to take more water, because taking in water means sinking, also generating some free surface somewhere, so stability may get effected. So, it takes in means, it will take more water, means it is doomed.

Basically, so that is what happened and sank. In all probability, this there was no mechanism of checking from (( )) the door was properly closed or not, though these are very simple device or whatever. Now, this is a must that you will have a tell-tale arrangement all that to check that it is properly looked, I mean water tight closed, otherwise, there can be catastrophic damage, so that is what it is. There is another aspect in it, can you tell me? Can you see from these also, say that how it appears different from other vessels, because I had been telling you that structural arrangement is done to well based on, I mean there are two aspect to be satisfied. Obviously, one is the structural

soundness strength requirement etcetera, another is functional requirement; these two are to be properly balanced.

Obviously, on the background or the secondary comes is, you will have to keep in mind the well production point of view arrangement, should be such that I can produce it easily. Arrangement should be such that it you can be better maintained, so those things are also there, but as of now, at this moment, you are primarily bothered with functional requirement and structural soundness strength requirement.

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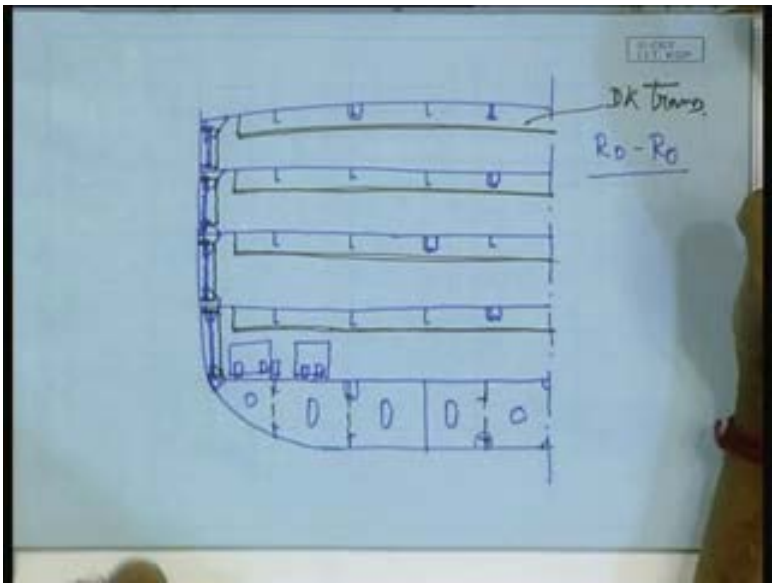

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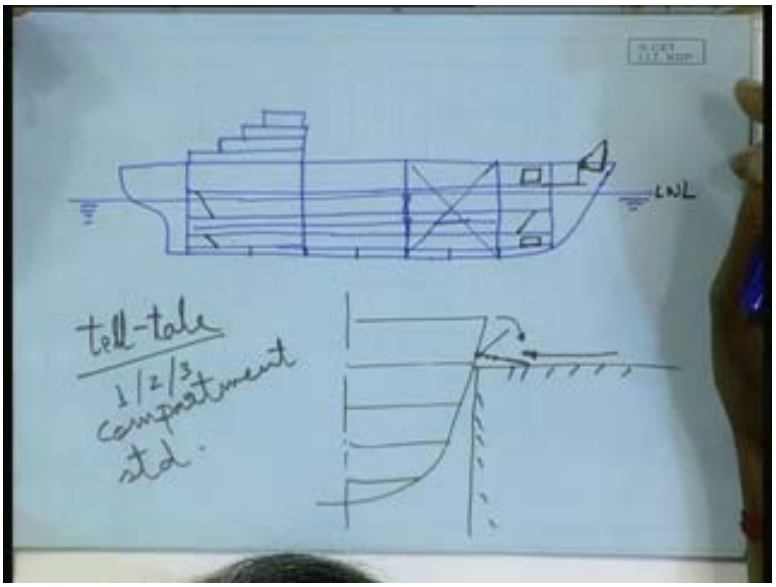

Here, another typical functional requirement is unobstructed movement of the cargo - bulkhead - transverse bulkhead I have not drawn, any vessel you may have observed wherever I draw a profile the first thing like when I was telling whenever you draw a mid ship section you draw the outer hull and draw the double bottom because that is more or less a must. A bulk carrier double bottom is little different, it is shorter may be because other part bottom wing tank but this remains. Similarly, whenever you do a profile you draw the profile main deck and immediately put the bulkheads and double bottom, this is the basic minimum but here the double bottom have given, but bulkhead I have not drawn yet.

This is one aspect, from functional requirement container ship we have seen the main deck is totally opened virtually is totally opened because efficient loading and unloading, here for efficient loading and unloading I cannot have any obstruction in between.

So, what happens then becomes very dangerous vessel and that is what happened that vessel which sank takes in water means water goes it fills up the entire vessel there is no if the bulkhead are there then what would have happened only one compartment is flooded and well the vessels are designed keeping in mind that if it is a there is something called compartment standard.

This term you have heard anywhere? Not yet probably, 1 compartment standard or 2 compartment standard or 3 compartment standard what does this mean? This means, adjacent compartments not one in the forward one in the aft. That means, if two adjacent compartment are filled up with water that means totally accessible to water what does that mean? That means, it is no more contributing towards buoyancy.

Then, if it is a 2 compartment standard then 2 adjacent compartment getting fully flooded, the vessel main deck will not go below water not only main deck theoretically there is a.

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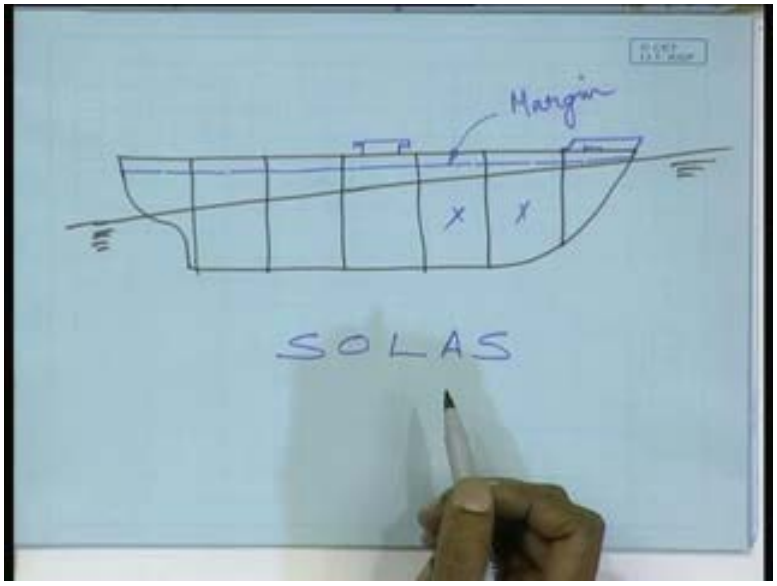

When we are talking about it later better to, so this is my main deck suppose, I am purposely drawing very closely spaced as if bulkheads and let us assume that these two holds have got damaged. So, what will happen? Your water line the vessel will trim like this. This is one thing very interesting in naval architecture we will see that we trim the water plane instead of the vessel, we say the vessel is heeling; actually the vessel we keep up right and water plane we put it in angle, anyway it is all relative and that is easier way that is done.

What is happening is, the vessels is essentially thriving by forward because these 2 compartments are no more contributing towards buoyancy, instead it is waving as if it is adding weight to the vessel in the fore end, so more weight in the fore end means fore end sinks further. That is how you have two methods of calculating this, one is called lost buoyancy method another is called added weight method of calculating for what will happen in flooded condition. What will be the damage stability condition all those things you will do. So, this 2 compartments are damaged either it is not contributing to buoyancy, so if you go by that route, I call it a method of lost buoyancy.

If I go by the other route that I consider them to be added weight to that ship it is sinking that is added weight method. So, it will float like this and this water line not only that it should immerge the deck (()) No, propeller cannot be helped whatever happens when a ship has got damaged you bother about the safety of life, such that life is not stake. So, it

is said that if it is a 2 compartment vessel then the vessel will heel (( )) everything will happen but the final water line will remain tangential to a imaginary line called margin line.

This is my margin line, what is that margin line? Well, imaginary line below the main deck line at side, how much below? Well, I do not remember that, all those things we will learn in our safety and stability class, but something below that is why the name is margin that means, still that much of margin of safety you are having. The moment deck gets immerged again it because very much vulnerable; because deck is immerged means, there can be some access man hole on the deck which is more or less flush. There can be some or you do not know how much part of the deck is getting immerged, there is a hatch opening or say, here you have the four castle like this here the chain locker opening is there.

If the deck is immerged, water will start getting in through different, there can be some leakage points, worst is the hatch coaming that has a minimum mandatory height of 600 millimeter there may be a case that through the hatch though it is hutch cover is there but the part of the hatch cover is getting immerged water may leak, in any case you are not taking any chance that means deck should remain dry that is the idea, so margin line it should remain tangential to the margin line that is the thing.

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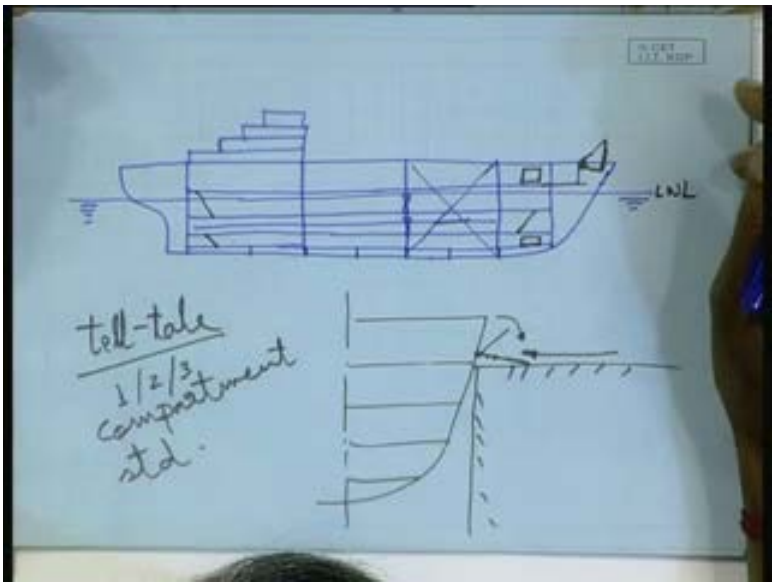

So, that is what is 2 compartment standard, if 3 compartment gets flooded well and also it goes not beyond the margin line it is 3 compartment standard that is what so that is how safety. Now, in case of RO-RO ship if any damage takes place here the entire vessel gets flooded there is you do not have any safety margin.

So, what to do? Well, till previously it used to be like this that means only subdivision was in the double bottom that means, if the double bottom is ruptured then the flooding is controlled it remains confined but not above, any damage above the vessel gets flooded possibly the vessel which sank I forget that is the whole problem the name also I have forgotten the vessel that did not have any bulkhead I believe but now it has become mandatory I think, I am not very sure about I believe mandatory to have bulkheads; you will have to have bulkheads, you will have big water tight doors.

So life has become difficult simple as that life I mean it was very convenient for loading and unloading but now you will have to go on there will be huge doors here in each bulk - in each deck - hydraulically operated doors because otherwise manually probably you cannot handle, so things have become more complicated for essential safety.

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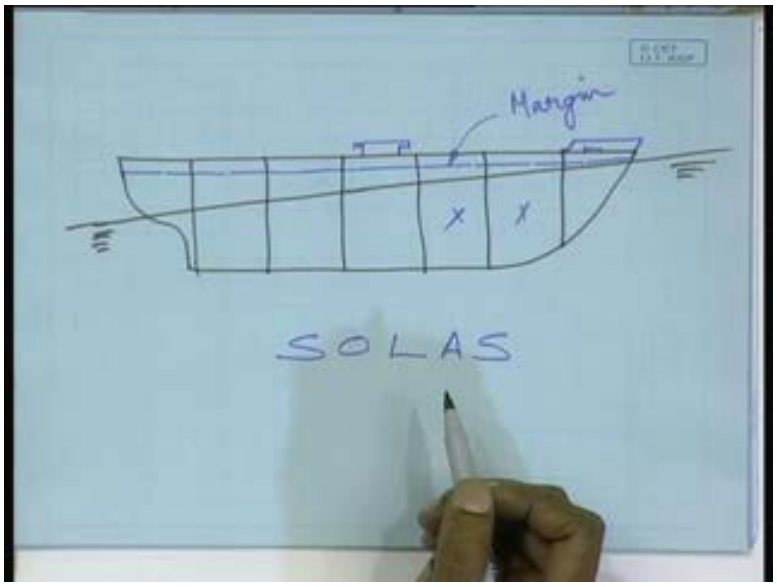

Safety of whom? Not actually for cargo what is that I have heard something Safety Of Life At Sea - SOLAS, from that is called SOLAS there is a SOLAS conventions - I mean - they have a (( )) something like that safety of life at sea that is what is important. All these evolutions are basically for safety; first it started through SOLAS means safety of

life at sea and after that another aspect started that has become important what is that? think what is next more important? So, that is environment.

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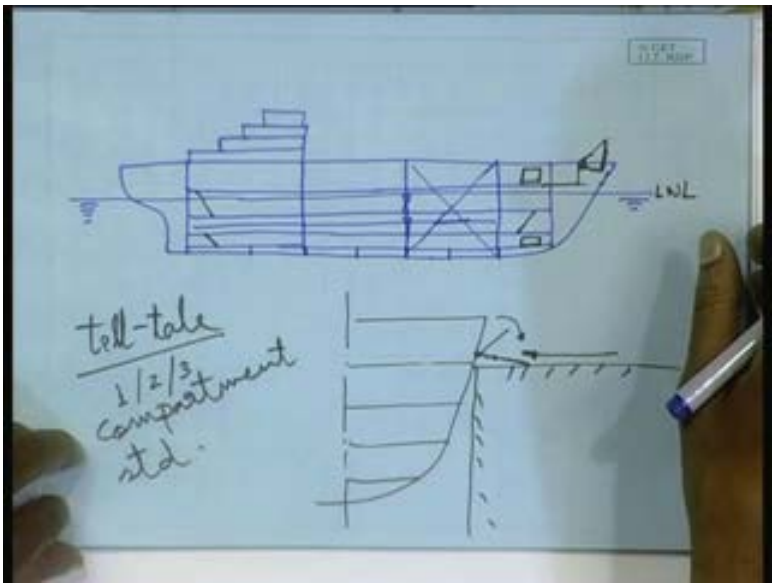

So, what is that from? Marine pollution that has taken this form MARPOL convention, they are the two important MARPOL convention - marine pollution. So, from this marine pollution actually you have changes in design of oil tankers where you have to have a cellular convention we were talking about cellular construction yesterday - first, it started with; it should have a developed, we will talk about oil tanker then we will see. So, they are the main pollution in this MARPOL convention has made whole lot of changes in the design of oil tankers and then even Ballast water management has come in effect.

(())

No, the thing is like this - I mean - the safety aspect was in this fashion, what is happening that either to seal by sealing the entire deck space that if it gets flooded the one deck space get flooded that means, this horizontal their you will have to have mechanism of having a hatch cover or something and close it feasible, but there what happens? There will be a parallel sink edge because you are not sure, if it is in one zone a defect is taking place or a damage then well this much is getting flooded, so that remains to be seen that how much panel sink is it will give.

Then, what happens is your closing this, but well again the same issue here also with the bulkhead door closing that they will be exposed to water, so there can be leakage but once accident has taken place means, it will try to go to the nearest port immediately that is always there, so that could be one way.

(())

Ya, actually what happens is this space - the volume - is much bigger than one hold in the transverse plane that is one aspect; other aspect is, by providing bulkheads I am not only making them safer but also from the strength point of view etcetera also it is helping the transverse strength. Though it gives me good transverse strength in this arrangement but any way probably that is one of the aspect that it eventually came to that you divided in transverse bulkheads one of the reason could be that the volume occupied by one hold meeting two bulkheads, for one damage that will be less compared to the whole deck space from the fore end to the aft that could be a reason.

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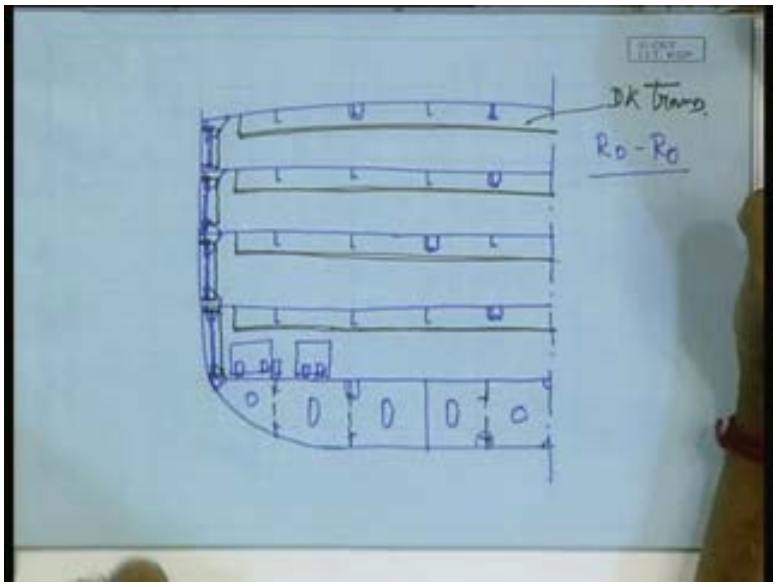

So, that is how what we have now is the bulkhead with big openings with suitable means of closing that is needed, that is how it has been taken care, so that is what is the RO-RO ship.

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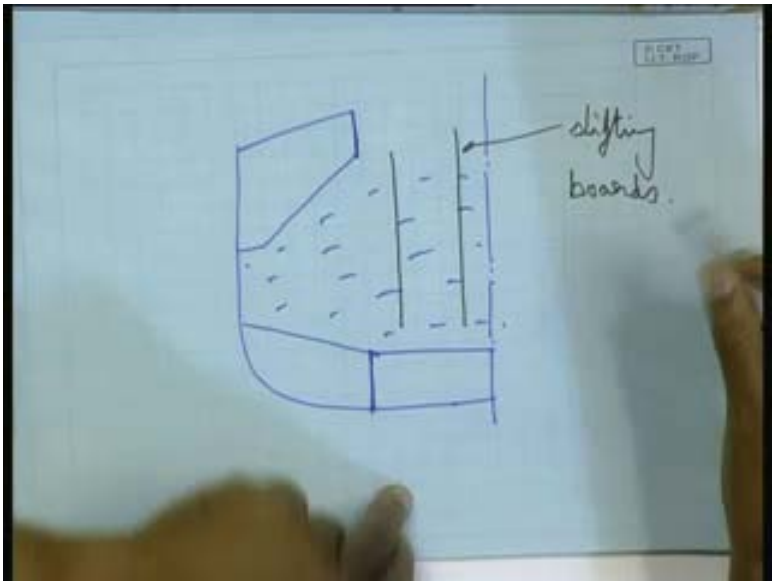

Well, another specific aspect of RO-RO ship is like, in bulk carrier there is as such no concept of securing the cargo. If you see in bulk carrier its only loading the cargo and at destination you unload it, at best there are something called - what is done is you have the we are just little bit going back to the case of bulk carrier.

Whenever you draw try to be proportionate and maintain the basic things, means generally they are in one line, this plate and this plate, so in this bulk carrier what happens? This is the basic configuration of the hold. Now you have the cargo it may be the case that hold is not fully loaded, your carryings a wheat and you meet a stormy weather and the vessel is rolling, so there can be possibility of little bit of cargo shifting.

Cargo shifting is possible, so if the cargo shifts too much on the port side then again when it is oscillating back not necessary the whole cargo will come, so it may remain in a healed condition, so what to do against that.

So, not much can be done, there are some boards that are put inside just loosely, they are referred to has shifting boards, the name of those boards, it somewhat prevents the easy movement of the cargo. Thereby, your abstracting the movement of that cargo because that is needed, otherwise it will remain in healed condition then your maneuvering will become difficult - the vessel maneuvering problem.

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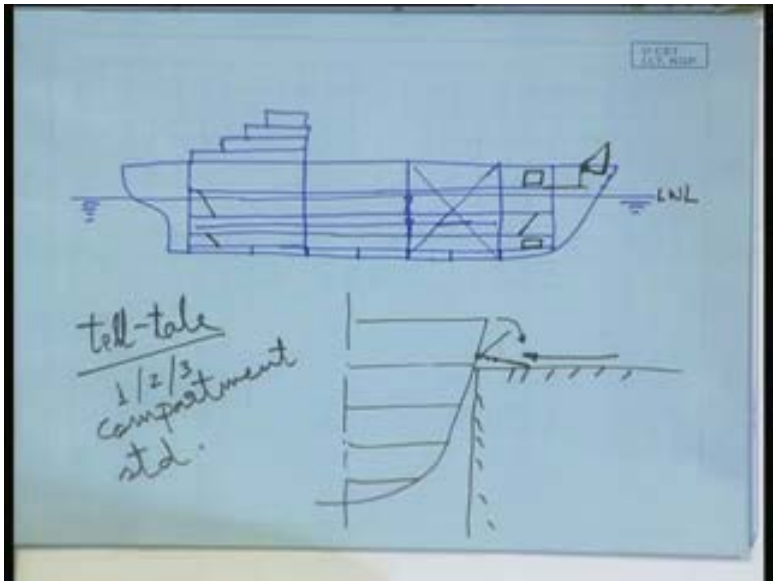

Similarly, in the RO-RO ship there is another aspect that here the cargo that means this vehicle have to have a mechanism of locking the wheels otherwise it cannot put a chain and lock the car, because there is another aspect, the car you cannot damage they are brand new cars, they will go in the market and if it is dented, scratch or damage nobody will buy. So, there is a mechanism that it will drive in and the wheel locks will came up and jam all the four wheels through that it will hold, so these are additional features needed in this vessels.

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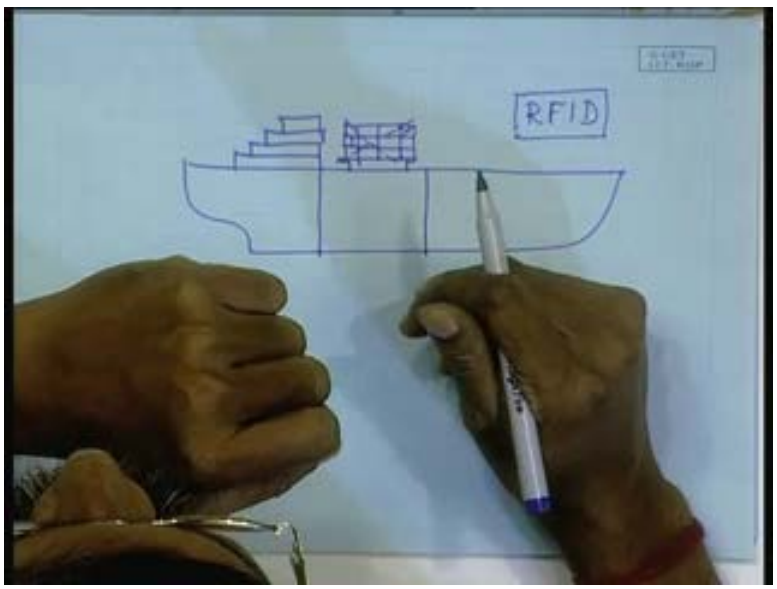

Similarly, in container ships we had been talking about this is for your information, like you have the containers which ever there in the hold things are fine there as such, because they are self-locking type. One container you put and put another container on top of it they lock themselves - I mean - there is some opening are there where a pin goes in - self-locking.

It is stacked in the hold one after another they are closely spaced all those dimensions are there how what would the gap between the containers they are taken together and a proper lashing arrangement, they are to be tight a proper lashing arrangement is to be provided same thing. So, that becomes more critical when you talk about the containers over the deck port, I mean the containers exposed the lashing of this containers. Some lasing mechanism has to be there to keep them secured because the vessel may roll.

Above the hatch means they will experience more acceleration because they are away from the point of center of gravity and it is oscillating, so there are cases of continuously getting washed away because you meet a real rough weather, so huge waves hitting the ship, so all this lash will not work those are accidents you cannot help containers gets washed away.

Taking this advantage some even they there is the other side of the picture you unload it deep at sea and claim it has been washed away and claim insurance this is the unfair thing. So, people are these days trying to track the container movement very interesting problem tracking a container movement.

Your container you are sending sitting here you want to track it where it is continuously out at the sea, how can you do that? Yes, what GPS will do, container will not hold a GPS there.

So, essentially through GPS you know the position of the ship, but say this particular container is used whether that particular container is getting off loaded at mid sea or really getting washed out by storm or even at the port of destination it is sent and it is going somewhere else, so there is something called RFID - you have heard about this?

Such technique people are trying to use with the help of satellite, you have your own RFID embedded in the container which will keep sending signals to the satellite from where again you retrieve and you know what is happening to your container.

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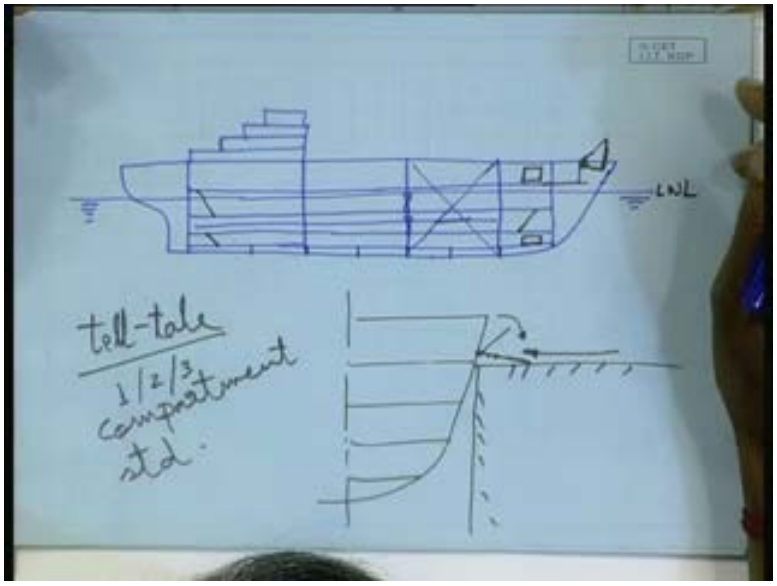

This is not yet done that way but probably there is one of the way to keep track because these are also important it becomes part of the thing. So, that is how we see that this RO-RO ships its specific features are that it is a multi decker ship.

Longitudinally stiffened decks the side shell are transversely stiffen and our specific requirement is ventilation requirement. A stringent ventilation arrangement should be there - I mean - you will have to have a proper forced ventilation that means, ventilation ducting would be there in the entire cargo region.

In other vessels there is no arrangement of ventilation, as such in oil tanker some kind of ventilation is there but bulk carrier as such no elaborate ventilation arrangement, but here it could be elaborate force mechanical ventilation to take the thing.

Then, cargo loading and unloading it is a closed ship because there is no question of cargo hatch opening, so there is not much problem of torsional strength. Loading and unloading through ramps either side loading or front loading and should have proper tell-tale arrangement such that to ensure they are perfectly closed. Though transverse bulkheads is one of the requirement used to be that unobstructed movement of the cargo but that is giving a problem. So, bulkheads with proper hydraulically operated water tight huge doors to be provided in the bulkhead. We stop here, we will take up oil tanker in the next class.