Hydrostatics and Stability
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Module No. # 01
Lecture No. # 27
Dry Docking – I

Today's lecture is mainly focused on dry docking, but there is a small section on trimming that I have to finish. It takes some 10 minutes. I will just finish it off and then we will go into what is called dry docking.

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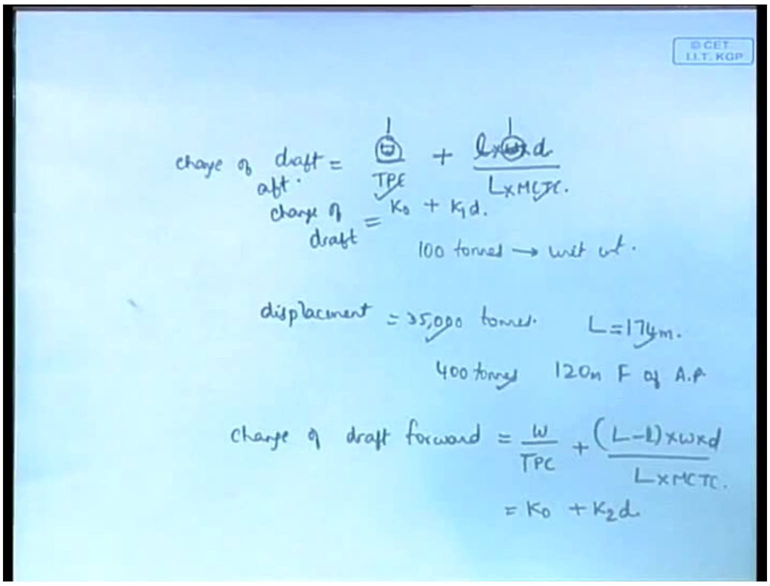

So, what we are left with is that we said that we can have trimming aft and trimming forward. Now, as a result of that we can have - I told you that the change of draft can always be given by w by TPC, which is the parallel sinkage plus the small l into w into d divided by capital L into MCTC.

This gives you the total change of draft as a sum total of the weight by TPC and that is parallel sinkage and the trimming. So, the two of them give rise to the total draft.

Usually there is a way of writing trims; means you have the trims at different, What we say is that see the trim will change as a function of the weight of the or the cargo that is added to the ship.

So, what we usually do is we can say that this is the trim for a unit weight. Trim depends on lot of factors as we have seen. (Refer Slide Time: 02:11) One of the factors, as this equation we have given below shows - that is the w by TPC, this thing - shows that it is the function of w here and here. So, it is directly proportional to w; in fact, the total cargo in the ship, it is proportional to that. One simple way of writing this system would be that you can write it in terms of unit weight. What we call as unit weight here? It is just a convenience. We call 100 tonnes as unit weight.

First, we can give a table for all the trim values. It means trim as you can see depends on many other factors as well other than the w. it depends on You know that as the draft changes, which means as the ship keeps sinking MCTC actually will change. Though I have said it to be a constant, it actually changes with draft. Usually we talk about draft in the range of few centimeters. So, probably MCTC does not change. but when there is a big change These tables are usually made this It is called actually a trim table. So, these tables are usually made for a very large variation of draft. You start from a draft of the whole; the depth of the ship is probably 8 meters means, you start from four to probably 7 meters like that. draft

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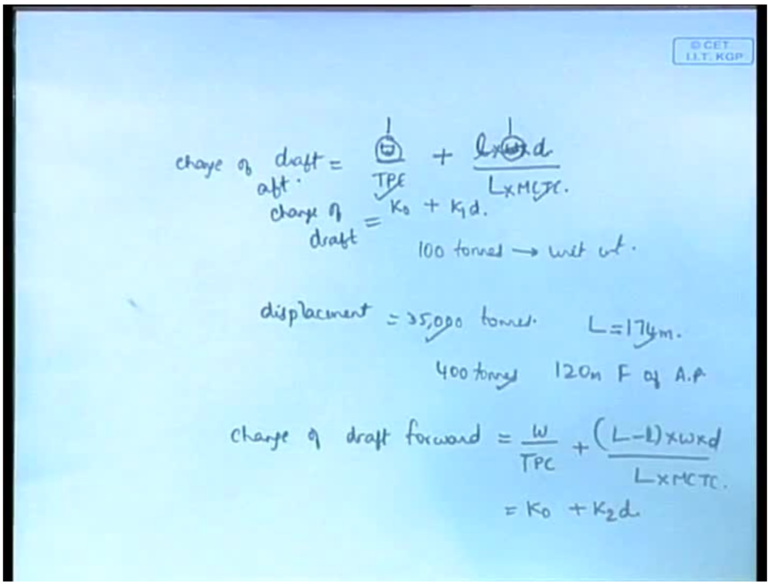

So, in steps of 10 that is how a trim table is made. Actually, I cannot show you right now, because in the computer I do not have the complete form of the trim table, but it is called a trim table and it is usually written like, what is the trim at a particular draft, in certain particular conditions for unit weight. It is written in terms of unit weight. The advantage is that if you want to calculate for any particular weight, let us say 400 tonnes, all you need to do is multiply this draft with 4. This is for 100, as you can see it is directly proportional to w. So, all you need to do is multiply by 4 and therefore you will get for 400 tonnes, 350 you multiply by 3.5.

For instance, let us look at this problem. It says that suppose that there is a ship which has a displacement of These are the particulars of the problem. A ship has a displacement of 35000 tonnes and the length of the vessel is given to be 174 meter.

Now, you are asked what is the change of draft if 400 tonnes is added 120 meters forward of AP. (Refer Slide Time: 05:41) Now, the same problem is given here and the same thing you can write it like this. See the change of draft is equal to w by TPC plus this.

If you write it in terms of unit draft, this becomes we will call it 1 for the time being. It is 1 and this also becomes 1. Now, see it becomes 1 by TPC; 1 by TPC is like a constant. It is true that when the draft changes the TPC can change, it happens, but that is not needed because we are talking about change of draft, probably a few centimeters. So, it is ok. MCTC so we will assume that For this course, I think you can assume that MCTC and TPC are constant for a ship, but just know that with different draft, it can change. So, this 1 by TPC is like a constant. Let us call it K 0. It is some constant plus this l is the distance between the aft perpendicular and the center of floatation. We have already defined that. Capital L is the length of the ship, MCTC is the moment to change (….) Now, all three are again constants for a ship. So, we can write this as a K 1 into d, d is the distance through which the small weight w is moved.

Therefore, you see that the change of draft can be written as K 0 plus K 1 d. Note that this d is usually measured as a distance from the center of floatation. So, this change of draft can be written as change of draft is equal to K 0 plus K 1 d where K 0 and K 1 are constants and the only variable is d; therefore, it is a linear variation with d.

Now, this is actually the change of draft from aft. If you use this small l, it is actually change of draft from aft side. If you want to find the change draft forward, it will be this - w by TPC plus L minus l into w into d by L into MCTC. This is very similar to what we described for a change of trim; there also the same formula comes.

So, w by TPC plus this, will give you the change of draft forward. This also can be written as K 0. If you are writing it in terms of unit weight, it becomes 1 by TPC plus L minus l into w into d by L into MCTC. So, K 0 plus K 2 into d. This can written in same thing; this is forward, that is aft.

In this particular problem given here, displacement is given as 35000 tonnes, this is given. Now, you are told that 400 tonnes is added 120 meters forward of AP and you are asked what will be the change in draft.

If the weight is loaded, Small d is the distance through which weight is moved or it is also the distance from the center of floatation of the point, where the weight is added. Two ways, it is the same thing.

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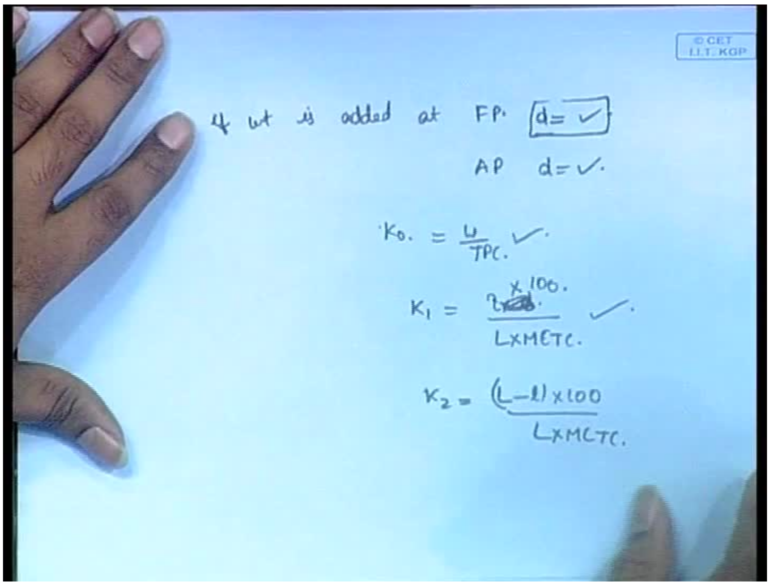

If the weight is added at the forward perpendicular, the distance d becomes this is how you look at it - that is, if it is at the forward perpendicular, distance d will be the distance between the center of floatation and the forward perpendicular.

The center of floatation position is given, though I did not mention it, LCF position is given. Then, you will get something. Similarly, if the weight is added at the aft perpendicular. (Refer Slide Time: 09:52) This d is the distance between the forward perpendicular and the center of floatation - this d and this d will be the distance between the aft perpendicular and the center of floatation.

What you can very simply do is, In this problem, 400 tonnes is added at some point position of forward perpendicular. What we can do is, first we can find for unit weight change and finally, for 400 tonnes, we can just multiply it by 4.

We will do that. First of all, you need to find K 0; that is, we defined it as w by TPC; calculate that. Then similarly, K 1 which is l into w into d by K 1 is just l so this is for unit weight and so, it is l by L into MCTC

This will give you K 1 and similarly, K 2 will give you L minus l. Though we called it as a unit weight, w is 100 tonnes. So, that needs to be put. As you said, w should be put 100 tonnes. We called it unit weight, but it is not 1 tonne, it is actually 100 tonnes.

So, it has to be multiplied with 100. So, 100 here - into 100 tonnes divided by L into MCTC.

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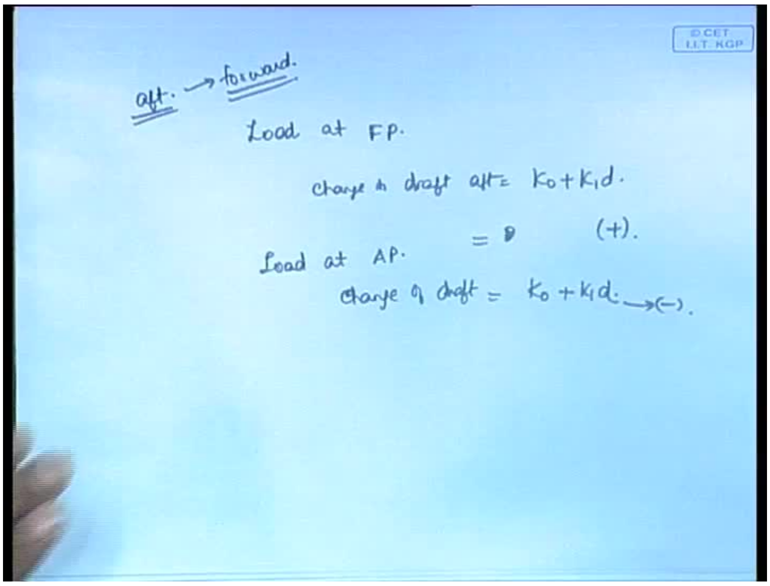

This will give you K 1, K 2. Now, what we do is let us find the aft region. Let us find the change in the draft aft. If you load at forward perpendicular, the change in draft aft will be K 0 plus K 1 d. which is equal to K 0 we have calculated, plus K 1 the only thing is d

You have to calculate the distance between the center of flotation and the forward perpendicular. Now, note one thing; when you are doing this everybody knows, but still one side means when you are taking the distance from forward perpendicular when you take one d in the forward side, you take it as positive and other one you have to take it as negative.

Because see this is 0 - center of flotation is 0 and one side is positive and one side is negative, whichever way. This side is positive; that side is negative or that side is positive but, at any rate one side should be positive and one side should be negative. So, one of them will have a K 1 d, d will be positive; and in the other case, change of draft this is, if you are loading at the forward perpendicular. If you are loading at the aft perpendicular, change of draft will be K 0 plus K 1into d, but this d will be, if this is positive, this will be negative.

So, we are considering two cases, what the change in the draft is in the aft side. There are four cases here, actually. First there is a change in draft aft, there is change in draft forward and for each of these, there is a change in draft due to loading at the forward perpendicular and loading at the aft perpendicular. So, 2 into 2 - 4 cases are here. In the aft, you have loading at forward perpendicular; there will be change of draft aft which is given by K 0 plus K 1 d.

When it is loaded at the aft perpendicular, you will have change of draft which will be K 0 plus K 1 d, but it is the new d - it will be a negative d. Similarly, you do the same thing for forward.

Now, we have actually 4 cases as I mentioned; 2 for aft and 2 for forward. We can make a kind of straight line. That is, for any one of these cases, we can say that if the weight is loaded at any point in between, it will be somewhere in that straight line. It means we have d here, it is a straight line. All you need to do is change the d, it becomes a straight line; it will be somewhere in that straight line. If you just draw that straight line between the aft and forward, like d can vary from this minus, which is the aft point to plus, that is the maximum point.

So, that d variation you know. Now, just draw a complete graph and what you can do is, if you are told it is loaded at some point, you just look at the distance from the center of floatation whether it is forward or aft and then you just choose in that graph. That is all.

That graph in a way is like the trimming graph or the trimming table. The table associated with that is called the trimming table and it is drawn for a unit draft. So, two things you have to do later. Once you have the trimming graph or the trimming table, you just look at the table and first you will see what is d and you will directly read from that. For that particular d, what is the draft and number 2 is, you have to multiply by the weight. This is for 100 tonnes. You have said that in this particular problem, 400 tonnes is added; therefore, you just multiply it by 4.

So two things when you (Refer Slide Time: 16:19) See, we have the load here and you have 2 equations. Actually, you have 4 equations. This is in the aft side and similarly, in the forward side. So, totally 4 equations - K 0 plus K 1 d and K 0 plus K 2 d; d has 2, in the forward and the aft side; so, totally four. So, four such equations and just make graphs of those; make 4 graphs. Then you and now that is the problem. You are told that what will be the change in draft, if 400 tonnes is loaded at some point in the forward perpendicular.

You see what the distance is of that loaded point from the center of floatation. This is number 1 point. Read from the graph and you will get for unit weight, what will be the change of draft. Then you multiply by 4, you will get your total change of draft.

So, that is the way in which you solve this using trimming tables or trimming graphs. That is the importance of these graphs.

So, that kind of concludes our session on trimming. Next, is a process known as dry docking. What I thought was, you have to have some idea of what is dry docking.

In this course, we are not concerned with the physical processes as such, which probably you will do in other courses like may be even marine construction and welding you might do some of those, but we have to have some idea of what it is.

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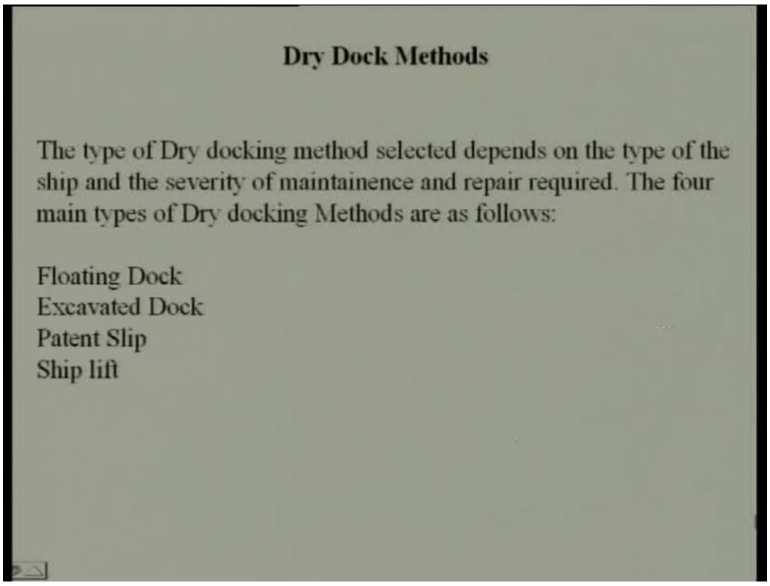

We will take a look at that. Some of these we will explain. Now, dry docking means you know that every ship has to, at sometime get repaired or some work has to be done on it at some time or the other.

So, always the ship has to be brought to land or to the shore at some point or the other. Therefore, there are different ways We will be mostly doing the repairs on the underwater part of the ship. So, that has to be brought up and this is a way of doing that and that is what is meant by dry docking,

You are actually bringing the ship up to the shore. That is meant by dry docking. and you do it when you have maintain In fact, there is a rule you know SOLAS; they say that every ship has to be dry dock at least twice in 5 years. There is a rule like that.

That is a requirement. So, that means at least two times it has to come every 5 years - it has to do. Now, there are a couple of ways in which you can dry dock a ship. These are the 4 methods given here. The most common or the most used is probably called a floating dry dock and something very similar to it, is something called as excavated dry dock; it is almost same as the floating dry dock.

We actually have some figures. Then there are two other methods, which are similar to it, which are called as slip method and another is lift method.

As you can see, patent slip and ship lift. These four methods are the ways in which you can bring a ship to the shore. It is just a physical process.

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Let us see this. now instead doing this I will show you a picture. what is this Actually the figure is not very clear, but see this figure. What is usually a fly floating dry dock? It is really a box. This floating dry dock, it is actually a box which is open in one side.

As you can see, the one facing the seaway is open, the other three are closed and it is floating. Let us look at the explanation. We call these kinds of structures as pontoons and there are some walls. These kinds of walls, we call as sponsons; it is just walls, nothing more than that.

So, you have this box. what they will do is now this is inside, Part of it will be inside water. What we can do is I have already told you about the process of ballasting. The thing is if you see these sides, the sponsons as they are called, are filled with tanks.

When you fill it with water first, because of the weight, the thing will go down and when you remove the water and when the walls are opened, due to ballasting it goes up.

So, it can either go down or go up. It can sink. There are rails and different kinds of equipments here. You bring the ship here. into the first it is sinking It is in a highly sunk condition. The ship comes and stays over and then you lift it up. That is all.

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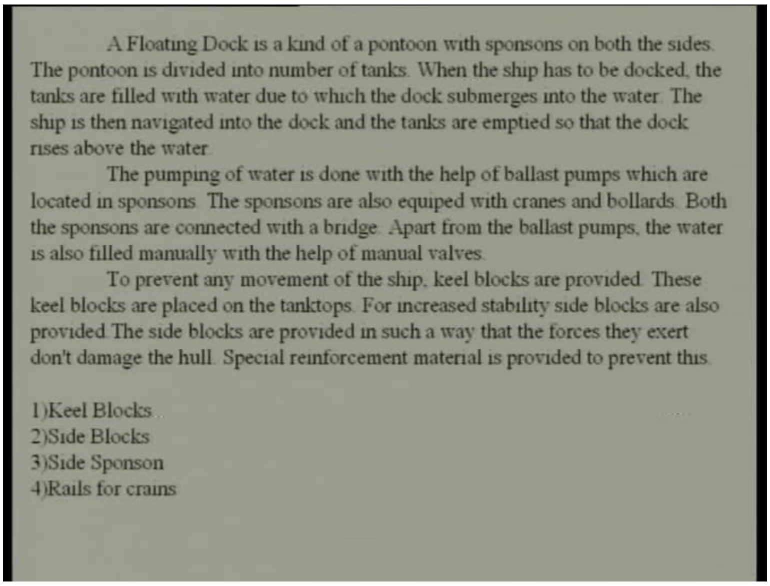

Ballasting, the whole thing is lifted up and you just bring it out of water and this is known as a floating dry dock. In fact, India also has floating dry dock in many places. One of the main thing is theone in Andamans - dry dock of the navy.

The pumping of water is done with the help of ballast pumps. that is what There are pumps on it which are located in the sponsons on the sides and there are cranes and all that, if you have to move something on the ship.

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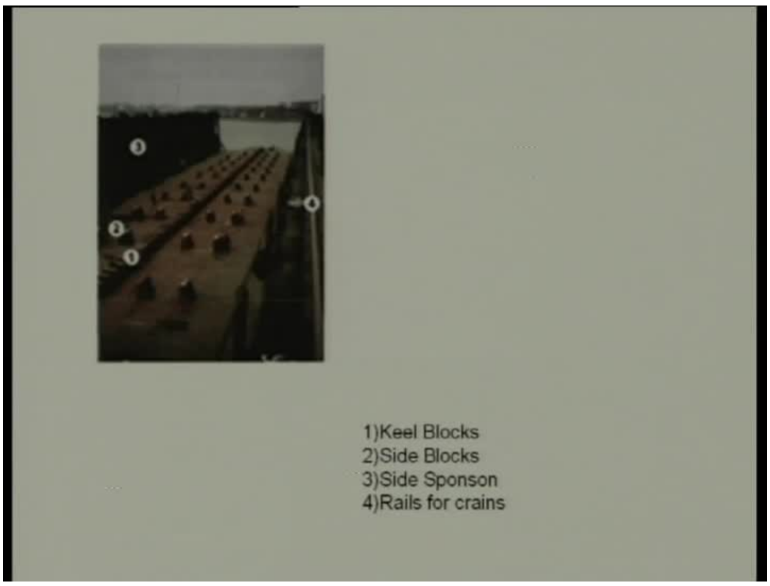

Now these are some of the things, just for your information. There are something known as keel blocks and side blocks. This figure is not at all clear, but if you look here it is better. These are known as keel blocks. It is like the block on which you finally place your ship. So, you bring the ship and it will finally come to rest on that keel block and some other things, there are rails and side sponsons.

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These are two pictures. This picture actually, I think you can understand what it is. You can see the 4 sides; one side is closed on the close to the shore.

So, ships come there. First it will be in a sunken condition and then it will be lifted up. As you can see, when it is lifted up, the ship will come out.

Actually, it is not very clear if there is a ship, but I do not think there is the ship.

Is there a ship there? No, right.

Yes. No.

See some people are saying yes and some people are saying no. Actually, I am also not sure.

Sir, why do you need ballast pumps to pump out the water?

How else will you do?

It is open on one side. So, when the ship enters the box like thing, automatically water will flow out.

How will you lift it up? By cranes, no that is not that lifting up is the problem, know.

So, that is why you are doing ballast. You see these tanks are there. When the weight goes out, it will lift up.

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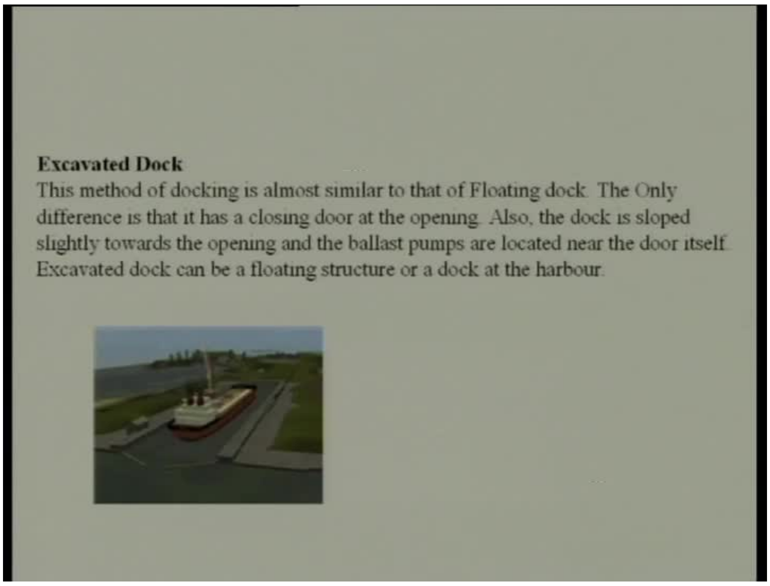

Then next one is known as Till now, the important thing is floating dry dock. Then the next one is called as an excavated dock. It is actually similar. As you can read, it is very similar to a floating dry dock; in that they close the door. It is not much of a difference. It is just the same thing.

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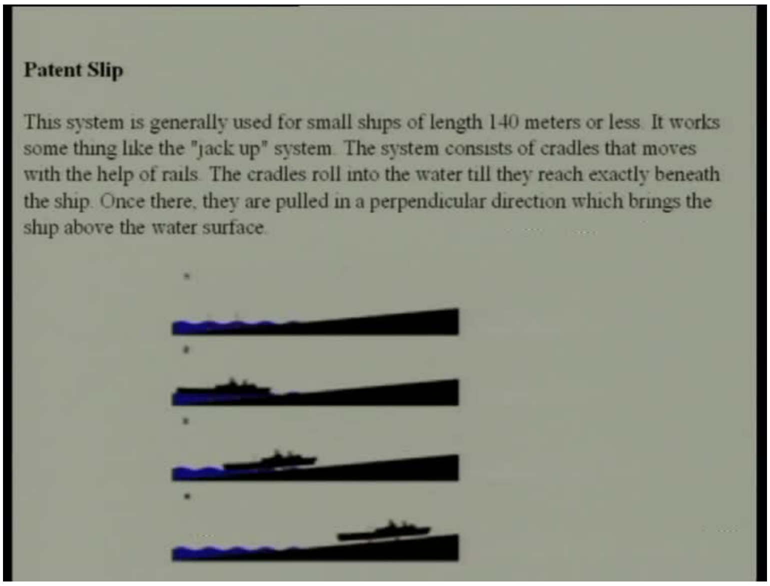

Now, this is slightly different. This thing is known as a slip way.

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Actually this figure says bottom is not very clear but, what It is really a rail kind of It is there on the shore. (Refer Slide Time: 24:56) It is there like this; you can look at 1, 2, 3, 4.

One is the top most one; so, 1, 2, 3, 4. You can see that comes down here and then it is attached to the ship. Then this rail goes up in this ramp and the ship is moved up.

This is of different kind. of this is not a dry dock It is a dry dock, but it of a different kind It is a dry dock of course, we are talking about dry docks only, but it is not a floating dry dock.

Then so this is It is called a slip way, in fact. That is the name used. It is very much like a jack up system. Have you done something on. Nothing, elements of ocean engineering is next year

So, you will talk about difference types of systems in the oceans like difference kinds of things. You will see these things.

(Refer Slide Time: 25:52) So this gives you a figure of what happen This is a real picture. It goes up and it is pulled up.

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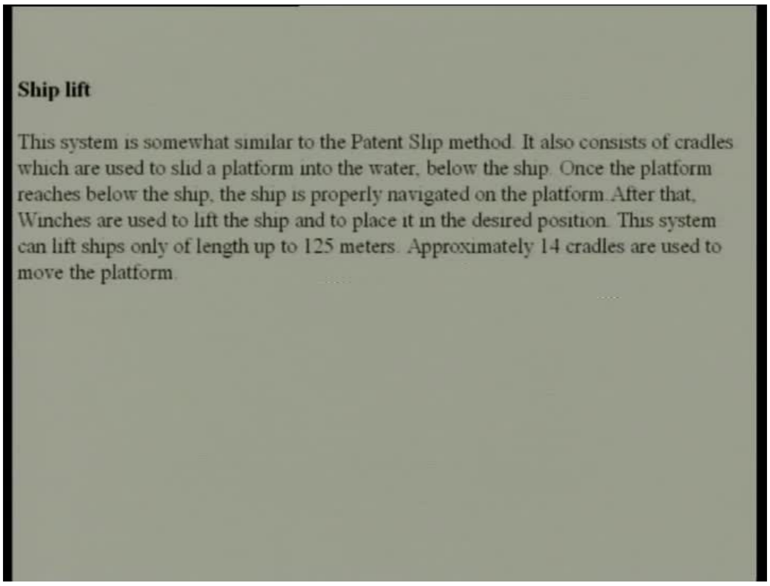

The last one is again something called as a ship lift method.

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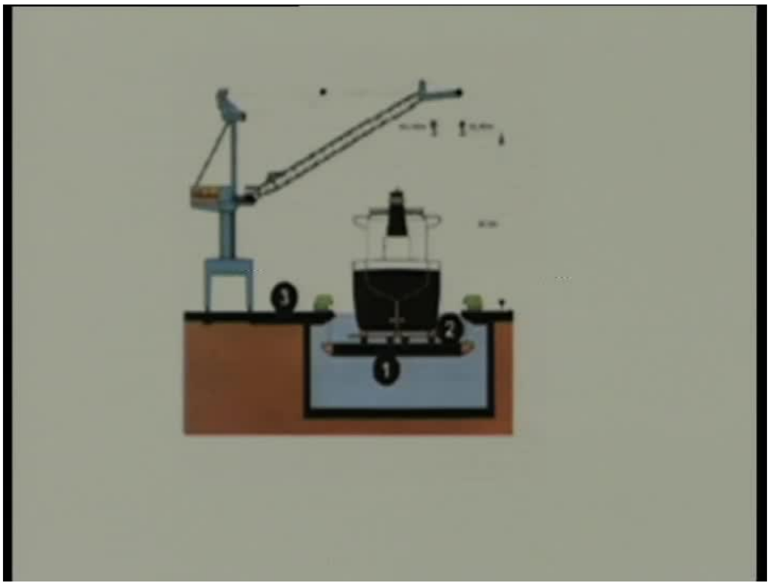

Actually, the figure will explain much better. Something is brought under the ship.

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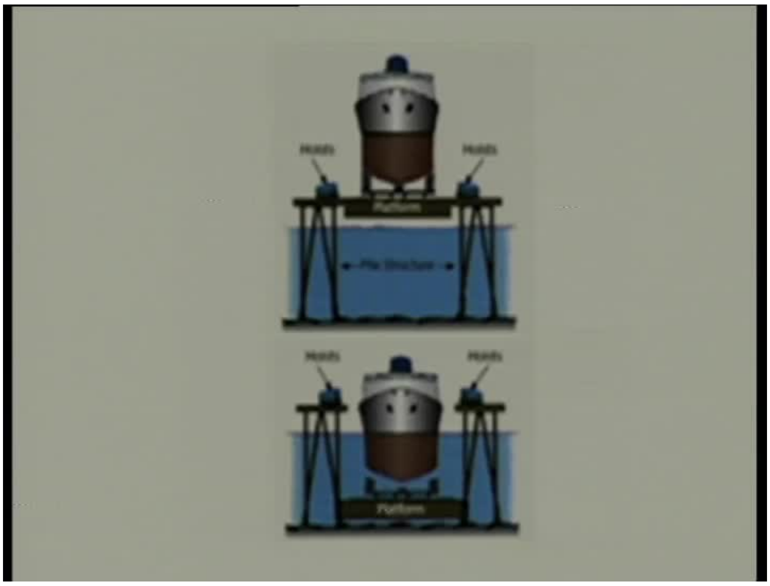

In this case, you have the ship here. This is the first case; the bottom one represents the initial case. That platform is brought under and then with a winch it is pushed up, it is jacked up like this and the ship goes up. You come here and you can make the repairs.

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The problems that we are going to be interested in this course is mainly associated with this thing - dry dock and this is roughly what we are talking about, what we mean, when we say dry dock.

Now, you have an idea. Let us go into the chapter as such.

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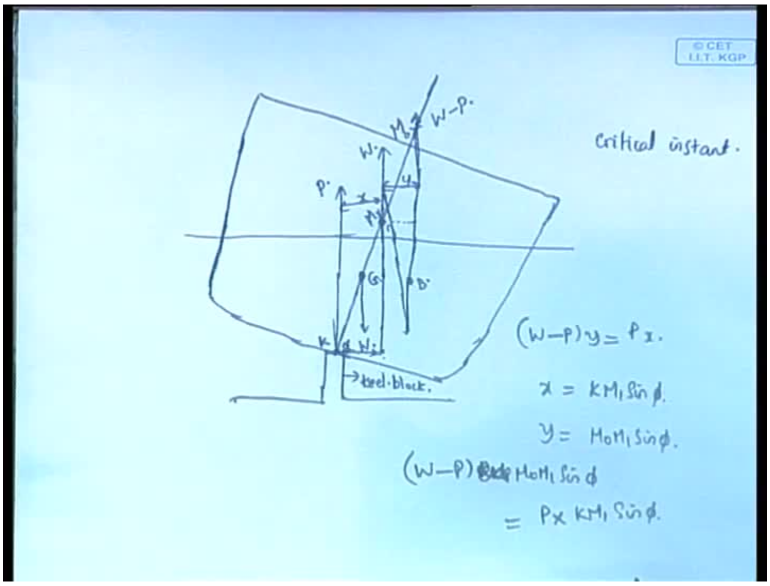

Let me draw this figure. As we saw in this figure, what really happens is, first the water level keeps falling because this thing is rising up. The water level around the ship keeps falling and at one point the ship touches the block - we saw keel block.

The vessel touches the keel block and once it touches the keel block, then they bring in different kinds of clamps to make it secured.

Once that happens, it is ok. The problem is, when you are lowering the draft - means actually, when this is lifted up and the draft is being lowered.

I think somewhere in the statical stability, I think I talked about a change in draft. That is when the draft keeps decreasing, you will see that the stability keeps decreasing and there was a region, we defined as a critical draft, where the ship actually capsizes. It means GM becomes negative.

Anyway, this is known as a critical draft. As this keeps rising up, the point where the GM becomes negative is called as a critical draft.

So, it is important, while you do the dry docking that you make these calculations. You make sure that the critical draft is not reached. Before it reaches the critical draft itself, the floating dry dock should reach the bottom of the keel block in fact, should touch the vessel, the bottom of the ship and it should clamp it. Once it is clamped, when you raise it, it does not matter. The ship will be in an upright condition, but till that keel block is reached, it is dangerous.

In fact, it is different for each ship itself - means as you can see the critical draft depends on the hydrostatic data or the hydrostatic particulars of the ship itself.

Which one?

….keel block reaches the ship, the draft will not…..

You make sure that the keel block is that high. That is, the keel block touches the bottom, the moment the draft reaches slightly above the critical draft and then you clamp it immediately.

The meaning is that the dry dock should be designed such that the ship should be safely clamped before the draft goes below the critical draft. That is what we are trying to do, always.

Here, we are going to do the mathematics, all the details of the process. This is the keel block and this is the keel. Therefore, you will have What will happen is that, as you can see, as the ship keeps decreasing, first of all its buoyancy keeps decreasing because the volume is decreasing and the moment it starts reaching the touching the block, a reaction force comes from the ground – from the keel block.

Now, it will become such that, if P is the reaction from the ground, P plus the buoyancy is equal to the weight. It does not become buoyancy equal to weight now; it becomes P plus buoyancy equal to weight. There will be your equation of Therefore, you can get the buoyancy itself by, when it has touched, buoyancy itself can be given by W minus P, where W is the weight of the ship and P is the reaction from the keel block.

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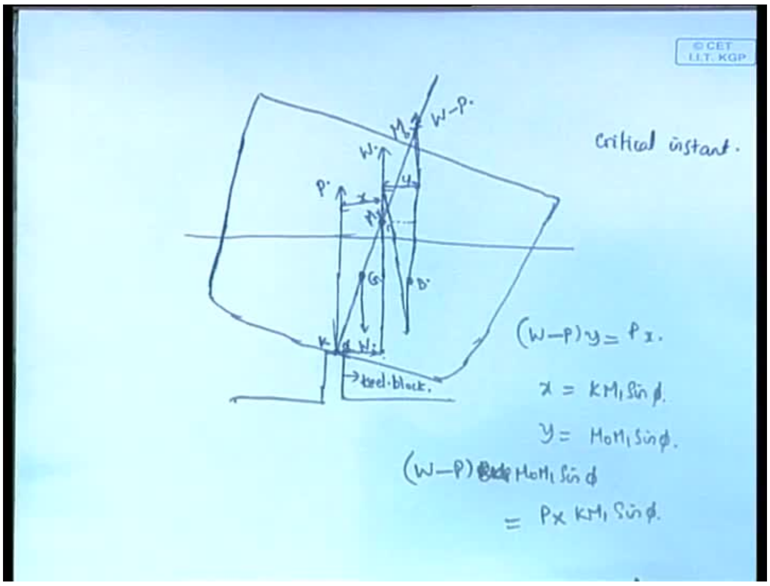

From here, you will have a force acting vertically upwards P, the reaction from the ground and let us say this is the waterline. Then at some point, you will have G. Let us assume, it is in the midship section. It is exactly there, it is G. Then at G, you will have the weight acting vertically downwards, W and somewhere in this region, you will have the center of buoyancy and it is actually vertical and straight. So, here you will have the buoyancy acting, which is given by W minus P. It is given like that.

Here, you have the center of buoyancy B. Now, as you can imagine, this point is very much like the vessel heeling only, though there are some external conditions, it is just like a vessel in a heeled condition.

So, this actually represents your metacenter M and the resultant of this W minus P and P which is a total of W, I am talking about the upward force, it will act at some point. It means, there is a W acting here up and there is W minus P acting vertically here up. So, the resultant weight P plus W minus P will act somewhere in the center of gravity, not center of gravity of the ship, I am saying at the center of gravity of the force. Two forces are there, its centroid, it will act there. Somewhere here, I will call it here, the center, at this point another force will act which is the weight W. It is at the centroid. means You can very easily find P into this distance will be equal to W minus P into this distance.

So, it is just the centroid. This force W is acting here and now, you can imagine that this metacenter M 0 is now reduced to this point M 1. This is what is happening. It is a reduction in your metacentric height, which means the M is coming down. Initially, the M which was here because just due to heeling it is M is there but, because of this P coming because of it touching the keel block another P coming W minus P

Because of the change or redistribution of buoyancy, the metacenter has come down here, to this point M 1. Therefore, let us find the values. Let us take this distance to be x; this distance is x and this distance is y. Therefore, we can do that W minus P into y equals P into x. (Refer Slide Time: 35:48) This is K. This figure is not very clear, but still, this distance is x, this distance is x just look at the figure. This is K, this distance is x, this one - it is the distance between the vertical here, this P and this.

So, this distance is x. Let us complete this triangle. You will see that x is equal to KM 1 sin phi, where the ship has heeled through an angle phi. Just look at the figure. This is K, this is M 1 and KM 1 sin phi is this distance x; it is because of this triangle; one is 90 degrees. Similarly, y is equal to y is this distance, it is M 0 M 1, this is phi, it is the angle through which the ship has heeled or the angle through which the ship is heeled at the time, when the thing touches the block - the ship touches the block. Actually, that is called as a critical instant.

I mean, just a term in dry docking. These people call it like that - critical instant. That is when the ship keeps raising, the moment at which the ship touches the block, that time is called critical instant.

Then x is KM sin phi and y is M 0 M sin phi. If you just put in this equation, it becomes W minus P into M 0 M 1 sin phi equals P into KM 1 sin phi.

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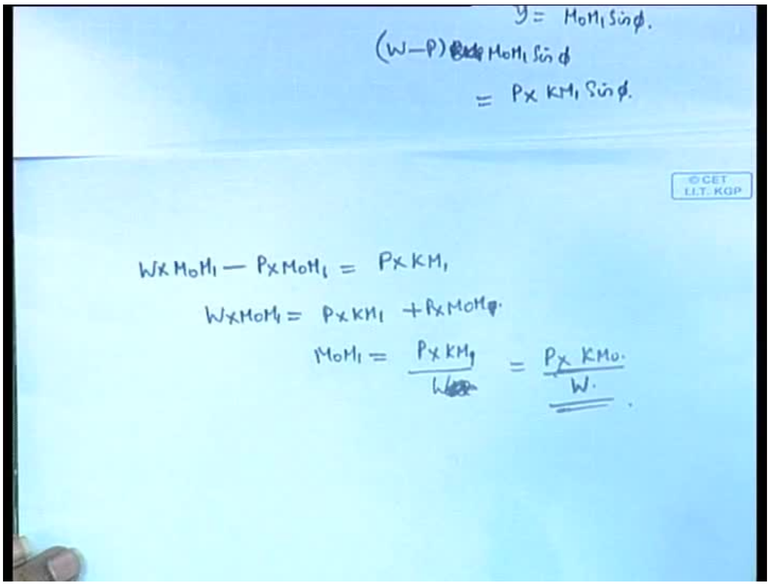

Therefore W into M 0 M 1 minus P into M 0 M 1 equals P into KM 1. You just removed this sin phi or cancelled the sin phi; it becomes this or W into M 0 M 1 equals P into KM 1 plus P into M 0 M 1.

M 0 M 1 is equal to P into KM by W. Let us see P into MoM1 into KM or is W plus P or W minus P. Denominator seems like W minus P. I think it is W minus P.

(…)

Otherwise, what will it be?

KM 1 and M naught M 1, I think they have added and made it KM naught.

That also you can do. I think that is what they have done. Ok, you can do that. KM 1 and M naught M 1 can be added to make it KM naught. That is correct. P into KM naught divided W that is the P into KM naught by W. That is better.

So, this will give you a value P or W minus P is the buoyancy, so P is that change in buoyancy from the weight difference between the initial displacement and Actually, this P you can find in many ways. Obviously, there is no way to calculate directly the reaction force from the ground. So, the way is, if you remember, when we are doing the hydrostatic data, hydrostatic particulars and all hydrostatic curves, we did a curve between draft and displacement means, every hydrostatic curve is between draft and something, draft and TPC, anything whatever it is or draft and LCB, LCF like that.

So, the first of these was a curve between the draft and del. What we can do is, as the draft keeps changing, we can keep measuring the del. means For every ship, there is a particular hydrostatic curve; it is particular for the ship. It will be there in the ship mostly. You can just look at that curve and you can say for this particular draft that is your value of del; that is your displacement. From that, you can find P. del is the buoyancy. From del, you will get the buoyancy which is W minus P.

You will get it in volume, you convert into weight - multiply it with the density of water, you will get the weight. W minus P you get, from that, you get P. That is the way in which you usually measure P. Once you have P, KM 0 is the metacenter that is also a part of the hydrostatic particulars - it is not particulars as such, but it will be part of your data. When you design a ship, your metacenter you will have. Then, W is the weight of the ship. So, this gives you a way of calculating the shift in the metacenter because of the change in draft.

Sir, the (..) which is used to derive W minus P into y equal to P x is that the angular momentum is conserved.

No. If the torque total torque 0 so that it will remain stable.

What happens to the weight of the ship which is acting through the gravity? We have not considered that.

No. I am just saying that if there is a weight W acting, it is not about. That is, if there is a weight acting W 1 acting at one point and there is a weight W2 to acting at d 2 you can assume that there is a weight W 1 plus W 2 acting at its centroid. Do you understand?

This is just for the buoyancy. There are two upward forces: one is from the buoyancy and one is from the reaction. If one is acting here at P, another is acting W minus P, you can assume that total W is acting somewhere in between. In addition to that, there is a weight W acting down.

There are two ways: one acting up and one acting down. Is it clear? This will give you M 0. What will happen is that, as you keep increasing P keeps once P becomes very high, you will see that, most of the weight of the ship is taken by the keel block now.

The buoyancy does not play much of a role. From that when the draft keeps decreasing then the buoyancy becomes smaller and smaller and after one point, you can assume it is to be very small and negligible.

That is the way, in which it is proceeds. This is another way of doing the same problem. Let us see this.

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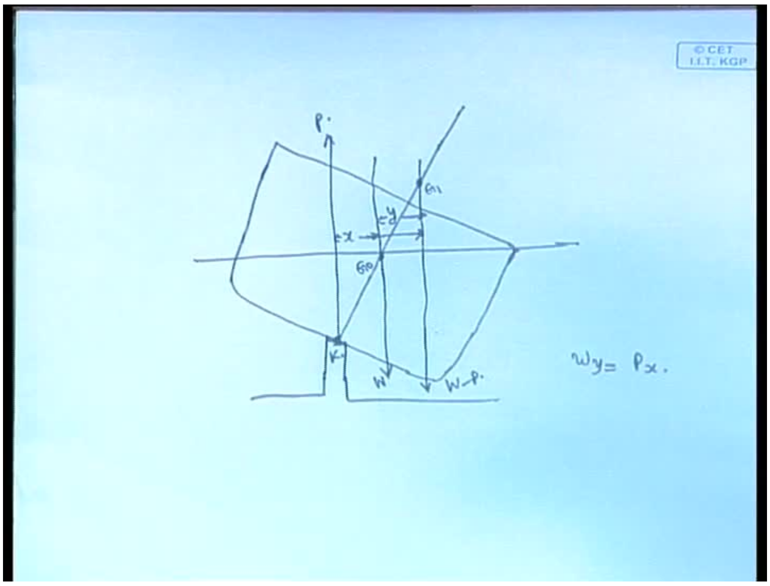

Now, another way to look at this problem is this. Let us consider the slightly extreme case when it happens – that is, once it has come down, the buoyancy is now very small.

So, you have the weight P acting as before, as the reaction force. The weight W acting here. Then therefore, that difference in weight W minus P

Now, W minus P is the resultant weight. Now, the final displacement of the ship it is like the net displacement of the ship after it has touched. That means, first there is an up thrust and then the weight W; the resultant of this is weight acting through G 1 above G 0. Then this is y and this is x. W into y is equal to P into x. That is, you have the initial G 0; that is, the weight of the ship is acting there. These are the weights acting down. If you add an additional weight, it is like a shift in G. Just like that at P, a force is added in the opposite direction of weight. It is not in the direction of weight; it is a reaction force in the opposite direction of weight. As a result of which also, the G will shift. It will go up, if it is weight added and it will come down and it depends on where it is added.

(….)

I will just leave this for the time being. I will just do this problem.

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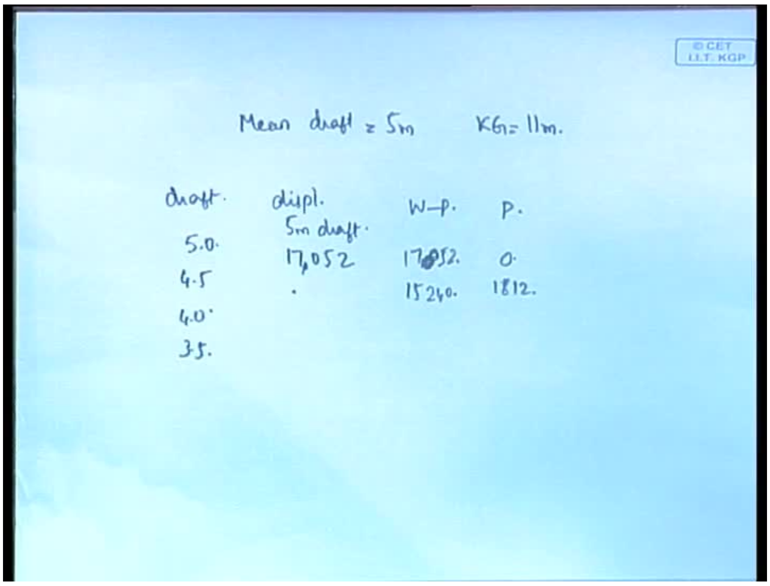

That is, you are told that a vessel is to be dry dock. You are told that it has a mean draft of 5 meter and KG equal to 11 meter and now that you know how to find the reduction in K, reduction in M or the decrease in M and because of that decrease in M, you can find the new GM.

So, the question is, in this problem, first you have some data given. We will see what data is given. Provided some hydrostatic data is given, you finally, have to figure out at what point the ship becomes unstable.

The way to do that is to figure out at what point GM becomes negative and to do that, you have to figure out at what point to see GM you have to find GM at each step and that will be possible, if you find out the position of M at each step or the distance through when you know the distance through which M is shifted, that is the change in either KM or GM. In our derivation, there was no shift in G; there was a shift in M. From that, you can find change in GM. This is first of all, how you will get the data - draft, then displacement at 5 meter draft, then W minus P. See, what you have to do first is, you will have a table like this. This is what is meant by hydrostatic data like 5 or hydrostatic curves 4.5, 4, 3.5. Different drafts will be given and for different drafts, you need to find the different displacements.

It is just given. you have to read from the means As the ship keeps coming down, the draft keeps changing and as the draft keeps changing, what is P or you keep measuring W minus P and from this, you get P; that is the next column.

It is like this. You keep reading 5, in this case, it is given as 17052 tonnes. In the initial case, P is 0 because the change in buoyancy is 0. Initially, it is at the 5 meter draft. Now it starts coming down, means the water level starts coming down and P starts increasing.

As the draft keeps decreasing, the P starts increasing and W minus P, you just read, it will become some value. Initially, it will be 0 then this will become probably 15240 like this and correspondingly, your P will become 1812, like this. W minus P is 1752 P is 0 and W minus P is 17052.

So, at each draft from the hydrostatic curve, you read out the value of P and you keep doing this for each draft. and then Actually, since the time is up, we will stop here. From this, you can find your different values of M. That is our next step. We will do it in the next class.

Thank you.