Port and Harbour Structures
Professor R. Sundaravadivelu
Department of Ocean Engineering
Indian Institute of Technology Madras
Module No 08
Lecture 39: BOQ and Cost Estimate

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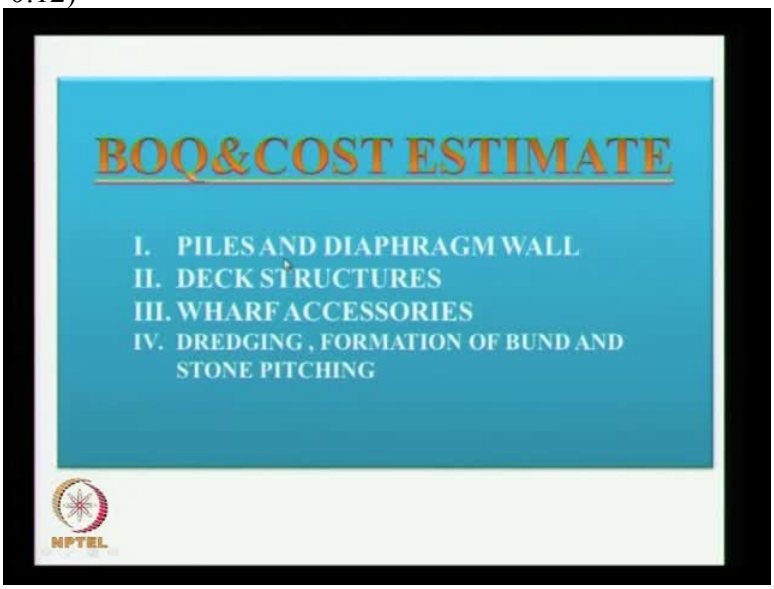

In this class we will discuss about will of quantities and cost estimate for a typical berthing structure. This cost estimate is based on the rates in 2010 and it gives an idea how to calculate the cost estimate. Bill of quantity we are now discussing and there are mainly 4 components. One is the piles and diaphragm wall. The cost of this element is more than 75 percent in any berthing structure. Other things are deck structures, wharf accessories and if we have dredging and then if you want to form the bend or stone pitching, that also comes under some miscellaneous items. That also we will discuss. We will discuss this cost estimate under these 4 categories.

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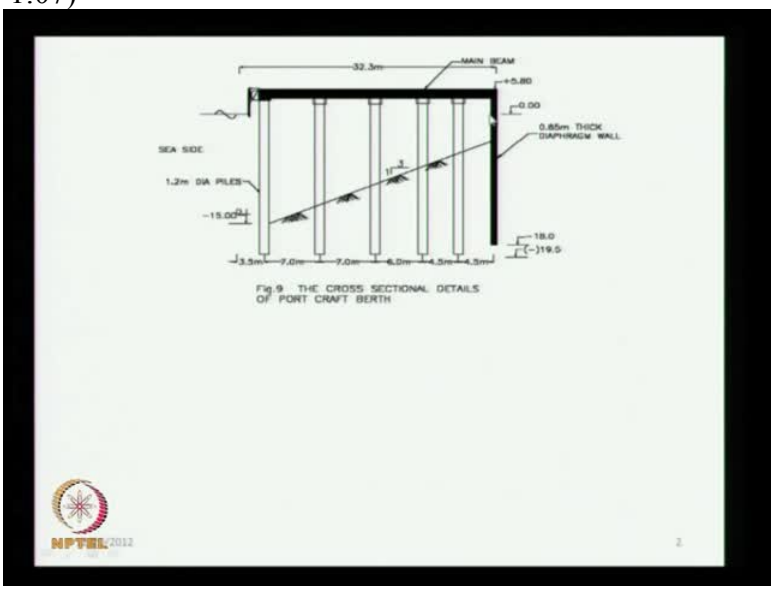

This shows a typical berthing structure. The dredge level is minus 15. There are 1, 2, 3, 4, 5 rows of pile and here we have the diaphragm wall.Ground level is somewhere here at this point. Originally, the whole structure can be built on land and then you can dredge or you can build only the breakwater on land, other things if they are already dredging is carried out, we can do this construction. Stone pitching is required if the diaphragm wall design has to be optimised.

So the piles and diaphragm wall is one section, 1st section, then we have the deck superstructure. Then the fenders, Bullards, that is the 3rd section, dredging and stone pitching is the 4th section. These are the 4 sections under which we will be giving the rates for ports.

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This shows a construction site at Chennai port. This is a 2nd container terminal. So we have typically about 4 rows of piles here, 1, 2, 3, 4, sorry 5 rows of piles. 1, 2, 3, 4 and 5. There is a tube which is transporting the, there is a walkway in which there are concrete is transported through the tube and we are see what we are seeing is the piles here, then we have the pile cap. And major time taken is for the piles.

After construction of this piled jetty, they want to fill up this whole area with sand and then they want to give a pitching below the deck system. These are the construction equipments, floating barges that are used for construction purpose. Here what we are seeing is piling gantry. There are 2 gantries here, this is a 2 pile gantry and this is a 3 pile gantry. These are moving ahead. As they are going forward, they will be driving the piles.

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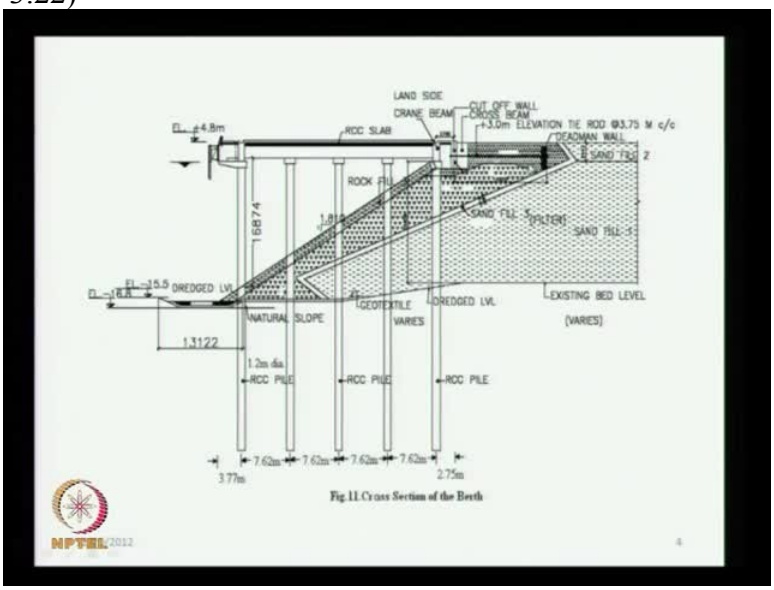

This shows the filling up of the sand behind the berth. Here you are seeing the 5 rows of piles. Then we have the stone pitching that is being carried out. Here we have one anchor Rod also to tie back the system and here we are having the fenders which are fixed at (())(3:44). The dredge level is about minus 15.5 and here we do not have any diaphragm wall. We are having a landfill, then we have a rope tow embankment.

This natural slope virtual form will be about 1 is to 3 and we make it steeper, 1 is to 1.8. Deck system consists of basically some beams, then a RCC slab and we have crane beams. One crane beam here and another crane beam here which we will show in the next slide. Centre to Centre spacing between crane beams for container operation is about 30 metres.

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So once we construct the pile and the pilecap, then we have some integration between the precast beams and the pile using these rods. So when you use the precast beams, a U-shaped beam with reinforcement inside and supported on the pile cap, you should make it integral with the pile reinforcement. There is a gantry here. This is more than 30 metres span which is moving on top of the extreme rows of piles and this will lift these precast units and place it wherever it is required. What you are seeing here is a steel liner which is used for construction of piles.

Normally they will add the cost of the gantry and other things into the individual components because the contractor will not be paid for this gantry and all which is very expensive. Last class, I told about the bracing that is required. So this is the type of bracing which they do it. Though it is inside the harbour, they still have connected this bracing. They have placed the beams here and only piles are driven here and they will be placing the beams afterwards.

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This is the barge which is used to dump the sand which is taken from elsewhere, from an airway berth they will take it on a barge and take it very close to the berth under construction and fill it.

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This is the finished completed we the 2nd container terminal. What you are seeing is a 30 metre span in which you have the rails which are fixed. These are the fixtures that is coming into picture. There are some Bullards which are used to tie the vessel and you may see some fenders also below the water level. This comes under wharf accessories.

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Now we will go section by section. 1st section is the piles and diaphragm wall. We have to 1st position and set the piling equipment. Then we have to make the liner for the pile, then we have to bore through the liner into the into the soil up to reaching the founding level. Then we have to tie the reinforcement, keep it ready and lower it into the bore. Then we have to make the reinforcement for pile muff and do the concreting either in situ or precast.

Then we do the concreting of the piles. Though we can use precast and cast in situ pile but mostly in situ concrete is used for piles for berthing structures because these piles are large diameters, typically 1000 to 1300 millimetres. Then we have to dressing of pile muff, that is the pile we have to dress so that we remove some clean concrete at the top, then we use the precast concrete for pile muff. So pile muff is made in 2 stages. One is the precast and another is the cast in situ.

So once we complete the pile, we do some pile test, both low strain and high strain integrity tests or static load test. Then we will see the diaphragm wall. Diaphragm wall compulsion is somewhat similar to the pile construction. There is a separate equipment for doing the diaphragm wall. These are the 11 items for which we will see how the cost estimate is being carried out.

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You are seeing one tripod here. This is a conventional wench is used, this is time consuming. Whereas this is called as a rotary rig which will drill through the liner. Typically, the liner is about 6 millimetres in thickness. It is rolled from a plate and made a circular section and we make in 6 metre or 3 metre pieces and then build it circumferentially. Each liner plate is welded longitudinally also.

Then we will be lowering it, then we will bore through this and add the liner, like that it goes right up to the founding level. Sometimes, it will not go up to the founding level. When rock is there, they will stop at the rock and then they use bentonite slurry to bore through the rock. Or even stiff clay or dense sand, they may not provide the liner right up to the bottom.

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Now we are seeing the liners which have been completed. Earlier days, they used the liner also by gantry. Gantry means there is a platform for which we have the piling rigs. This is used to drive the liner. In this particular project, they have a floating barge using which they have completed the liner to make it faster. These are the bracings that has been made to connect at the top providing stability. Once they complete the liner, they provide the reinforcement inside.

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Then they concrete the pile and when you want to provide a fender, the cut-off level, what is called as the cut-off level? This is the cut-off level here. It is higher for other places whereas

when you want to put the fender, the cut-off level is lower because the fender should be between the low tide level and the high tide level. So here they are using the in situ concreting above the precast pile muff.

So what you are seeing is a precast pile muff with a circular portion inside, hollow. So this portion will be done in situ for the pile cap and this is the precast pile muff. We are providing sufficient eccentricity because from the Central line of the seaside pile to the face of the berth is about 3.3 metres or more than 2.5 metres. Port specifies that this distance is 2.5 metre so we have to provide a very large cantilever. And for the precast units, we should provide sufficient bearing on either side.

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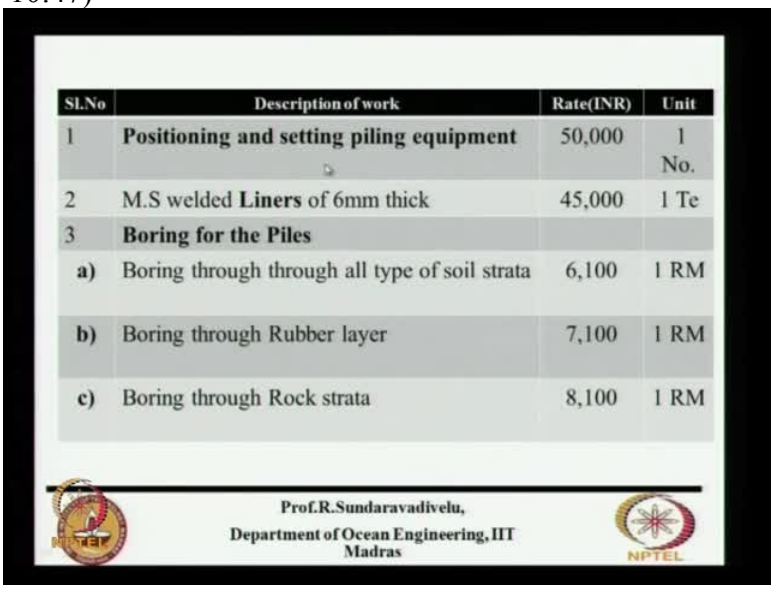

So for a typical berthing structure, if we have about 300 piles let us say, for each pile when they go and start pitching the liner, for each number you have to give a rate. So here we are given the serial number, the description of the work, what is the rate in Indian rupees and the unit in which it is measured. So here, it is in number. Then we have to provide the liners which is 6 millimetre in thickness. Per tonne you have to calculate and then you have to find out the rate. This rate is 2000 tonne, 45,000.

Now it may be Rs. 54,000, it depends on the cost of the steel plate. Plus about Rs. 6000 per tonne is the fabrication cost of the liner. Then we have to bore through the soil. So the soil strata differs

from sand, clay, rock and all but here we have given 6100 for all type of strata, except rock and rubble. There is a mistake here, it is rubble layer.

So there the cost is higher, that is 7100 and this is 8100. This is for running metre. So this is for a particular diameter of the pile. So it may vary depending on the diameter of the pile and type of soil strata.

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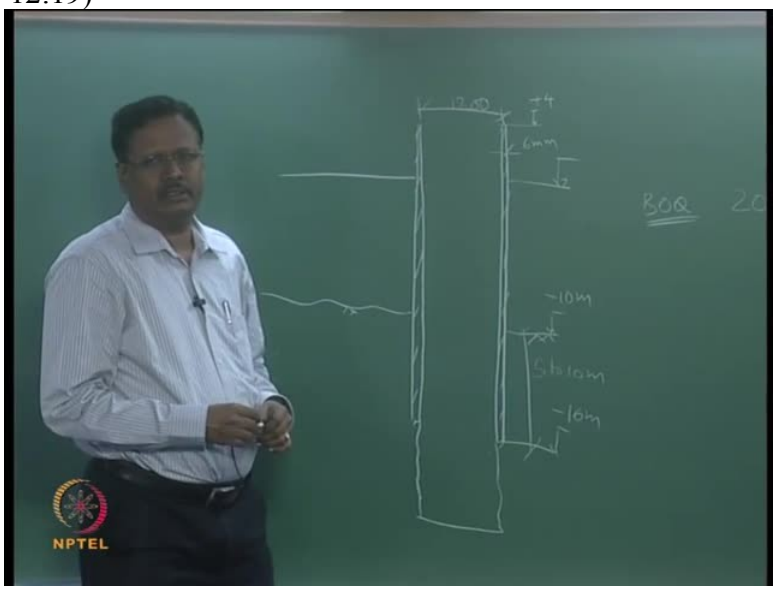

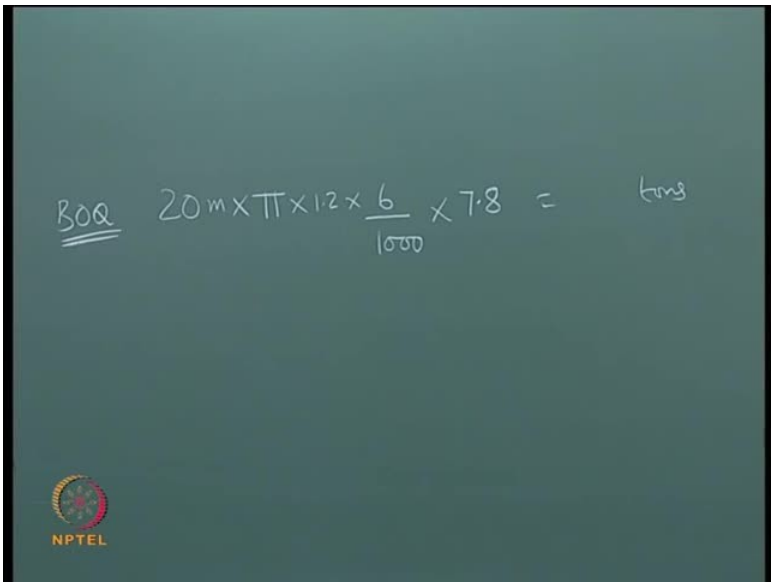

So this is the liner what you are watching. Now this is your water level. This is your water level. Let me take it to the hot strata. This depth is typically 5 to 10 meter. Suppose the diameter of the

pile is about 1200 millimetre, right means liner weight is per tonne. Suppose this top level, the liner is about plus 4 metres, the bottom level of the liner is about minus 16 metres, mid-level is about minus 10 meters. Let us say for example that this is the data what we are getting.

The length of the liner is about 20 meters. Then the circumferential area is pi into diameter is 1.2 metre into 6 mm is the liner thickeness. This gives the volume of liners. Suppose the thickness is about 6 millimetre. Pi D into T that gives the circumferential area into length of the liner is about 20 meters, this gives the volume multiplied by 7.8 tons per cubic metre.

I made everything in cubic metre. So this will give some tonnes. So per tonne when the weight is given, this is how we calculate the bill of quantity per pile knowing the liner bottom level, liner top-level, diameter of the pile we will calculate what is the rate of the line. That we will multiply by the rate what is given.

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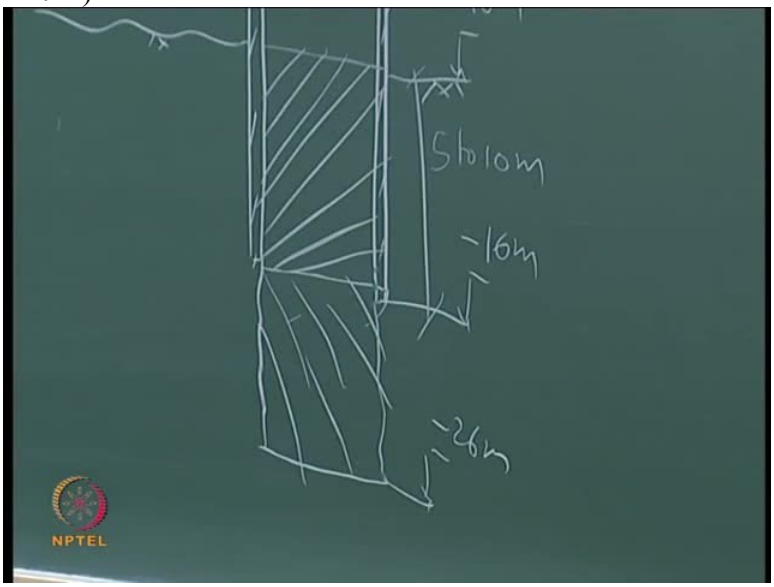

Then when you are boring through soil, so this is the level at which you have the soil. So you have to bore through this. Suppose this is a soft soil, you have one rate. This is a hard soil, this is another rate. So here, the depth is about 6 metre. Let us say the founding level is about 26 metres let us say and this is 10 meters. So boring through in this particular project, there is some rubble layer already existing because of some old construction.

That is why we are given this item. Otherwise if it is rock strata it is Rs. 8100 per running metre. This is how the cost has to be per tonne. So bill of quantity, if this is 6 metre, this is 10 meter, if the rubble layer is not there, we will not include that layer. This is the boring cost for the pile.

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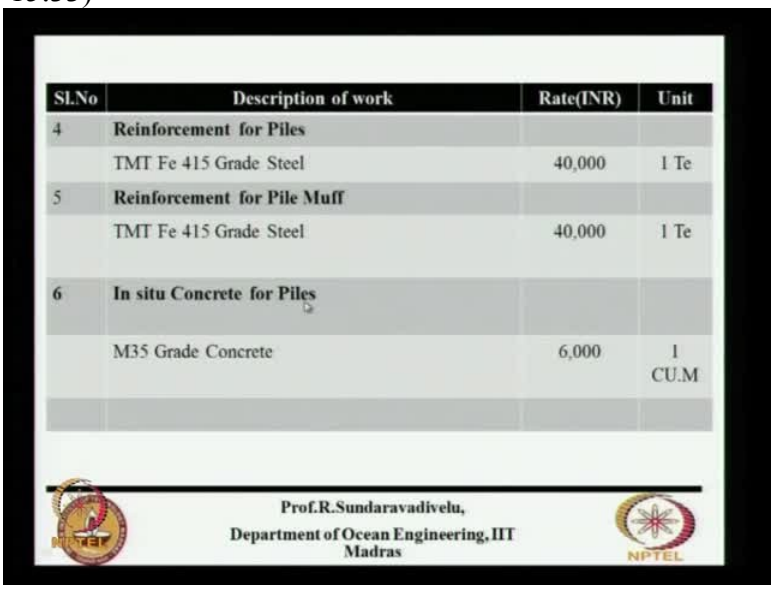

Next is reinforcement for the pile. So you calculate how much reinforcement you are putting and per tonne the rate is given, use that. Similarly, reinforcement for the pile muff, the rate is almost same. Then we put the concrete for piles, that is Rs. 6000 per cubic metre. Sometimes they will ask more cost for this. It depends on the grade of concrete. So what is the BOQ for concrete?

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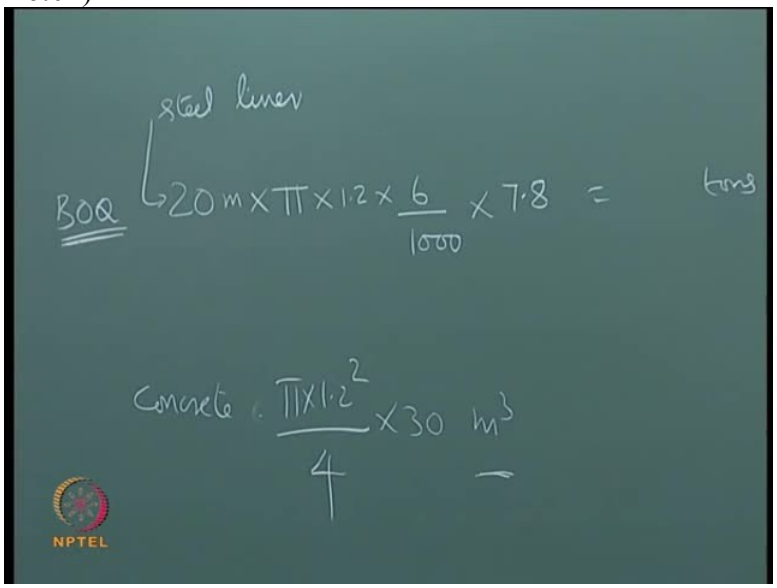
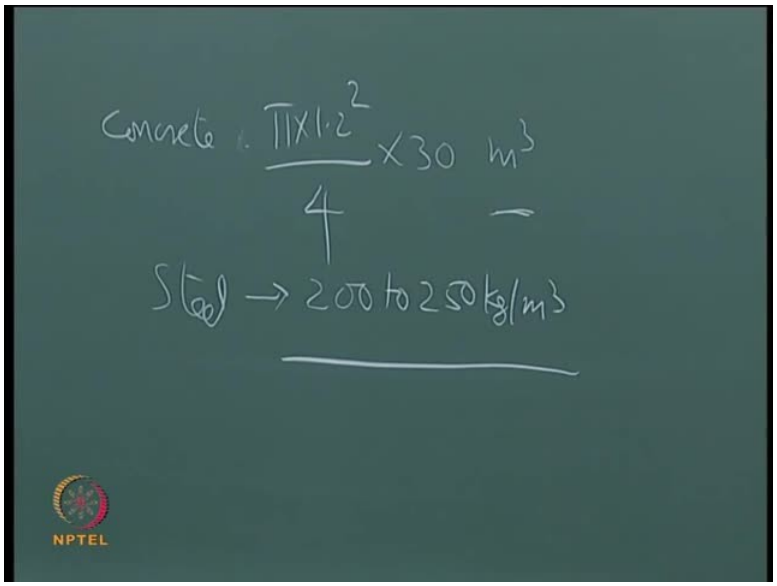
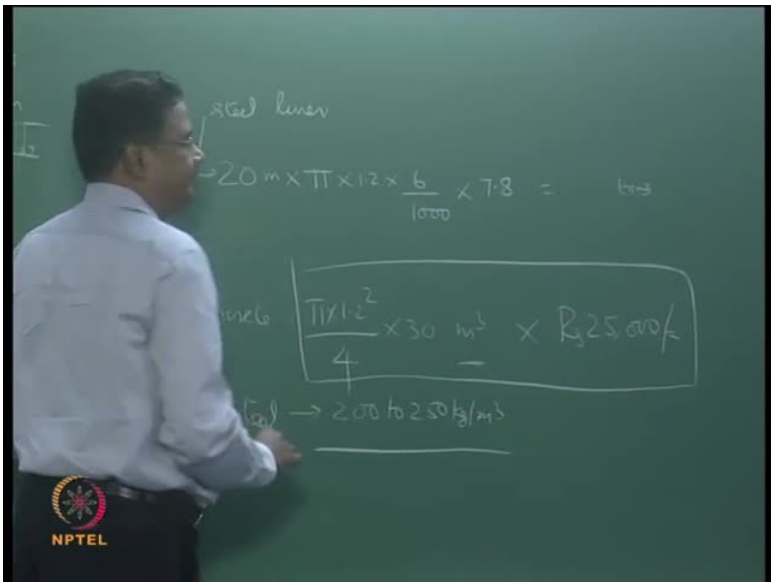
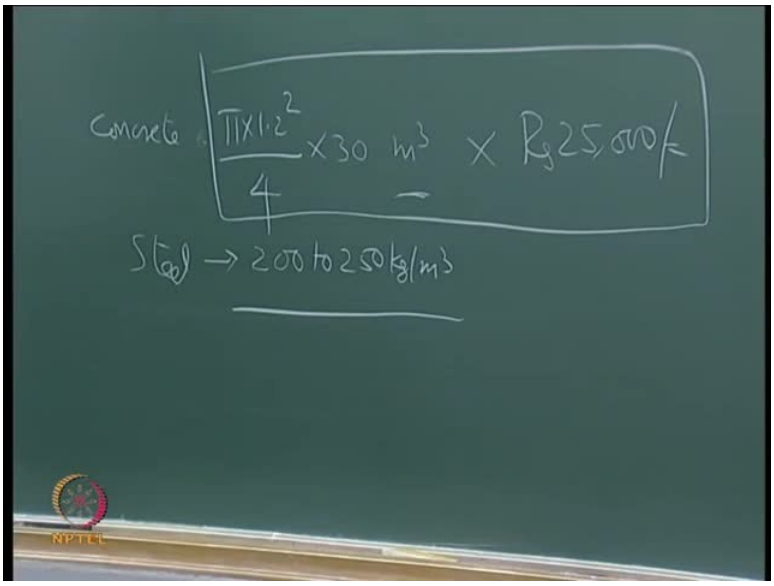



Concrete : $\frac{\pi \times 1.2^2}{4} \times 30$ m^3
Steel → 200 to 250 kg/m^3
NPTEL


Steel Lintel
20 m × π × 12 × 6/1000 × 7.8 =
$\frac{\pi \times 1.2^2}{4} \times 30$ m^3 × Rs 25,000/-
→ 200 to 250 kg/m^3
NPTEL



This is for liner, steel liner. Suppose you want to get the BOQ for concrete item, that is equal to pi into 1.2 square by 4, this is the cross-sectional area into the length is about 30 metres. This will be in cubic metre. Calculate per pile how much it is. So based on this, you can get the concrete quantity. The reinforcement steel for pile is typically in the initial planning stage is assumed between 200 to 250 kg per cubic metre. This also you can calculate. Once you know the cubic metre for each pile, based on this, you can calculate how much is the cost.

There is some you can including the steel, liner, boring, reinforcement, if you want to get some approximate cost, whatever concrete quantity comes, you multiply by Rs. 25,000, you can get approximate cost estimate. Suppose you do not want to go through all this exercise, steel weight separately, steel liner weight separately, concrete cost separately, reinforcement cost separately, boring, equipment shifting and all, you can do it like what I have discussed.

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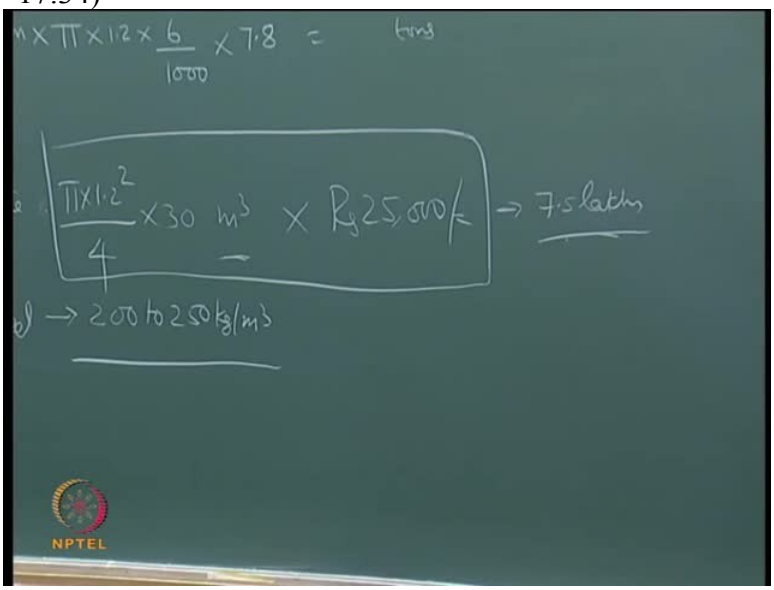

But if you want to get an approximate cost, concrete cost will be concrete quantity multiplied by Rs. 25,000 per cubic metre will approximately give the cost of this pile. So This approximate this will come around 300 cubic metres. That means it will come around 7.5 lakhs per pile. Cost of pile will be approximately I think it is coming 30 cubic meters. Pi D square by 4 will be approximately 30 cubic metre it will come. 30 cubic metre into this value is approximately 1, pi D square by 4. So 30 cubic metre into 25,000 will become 7.5 lakhs per pile. So this gives approximately the cost.

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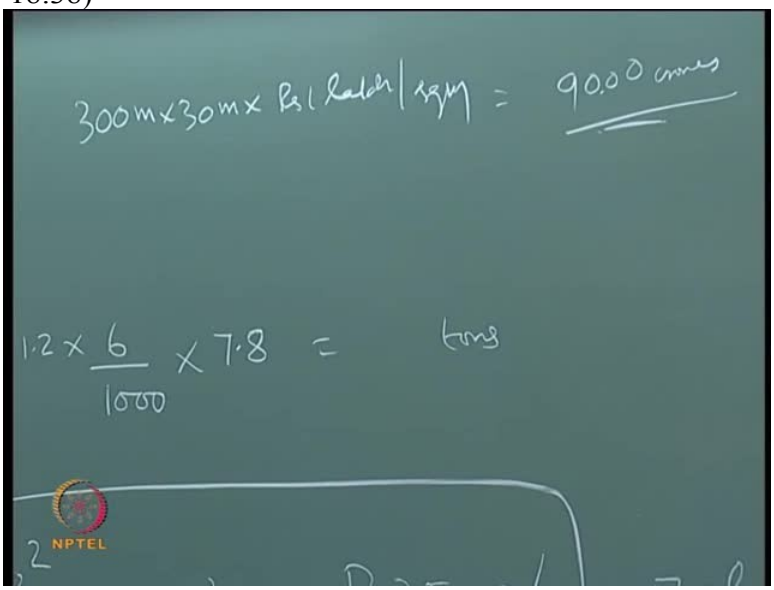

One more block cost estimate is there. Suppose the berth size is 300 metres by 30 metres approximately the cost is about Rs. 1 lakh per square metre. That means this will be about 90 crores. This is the approximate cost for a typical berth of length 300 metres and width 30 metres, the approximate cost will be 90 crores.

So after doing this exercise, we get the exact cost. Otherwise we can calculate like that also what I have written. So that 1 lakh per square metre includes all the elements.

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So here we are seeing the reinforcement cage. What are these pieces? What is this?

Professor-Student conversation starts

Professor: Hmm, what is this, this white colour thing?

Student: Cover blocks.

Professor: It is called as a cover blocks.

Professor-Student conversation ends.

So when you lower the ring from the top, we should have adequate cover for which we do it. Thisis thehelical stirrups which are provided at this is the reinforcement cage. You see the people wearing helmet and all, safety is very important in any berthing structure. So even when you go for site visit, you are supposed to wear the safety helmet. Here you can see the cover blocks which are kept, the spacing in which it is provided.

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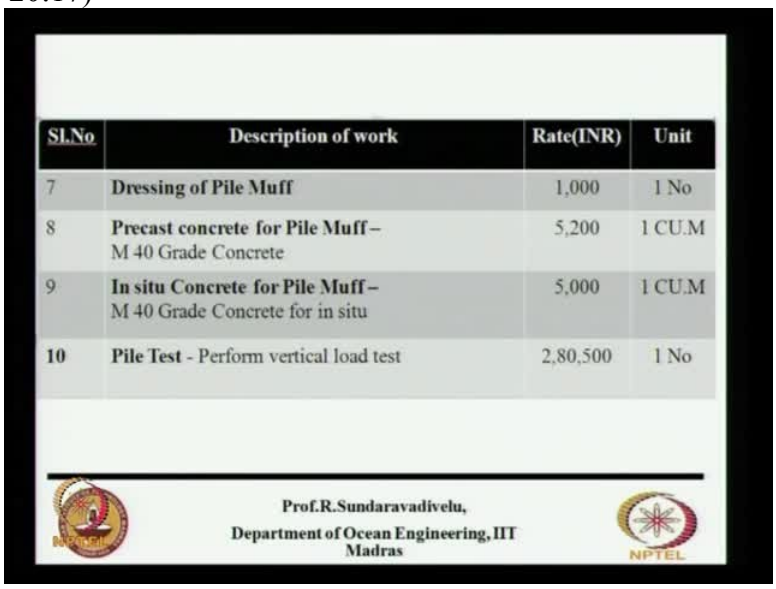

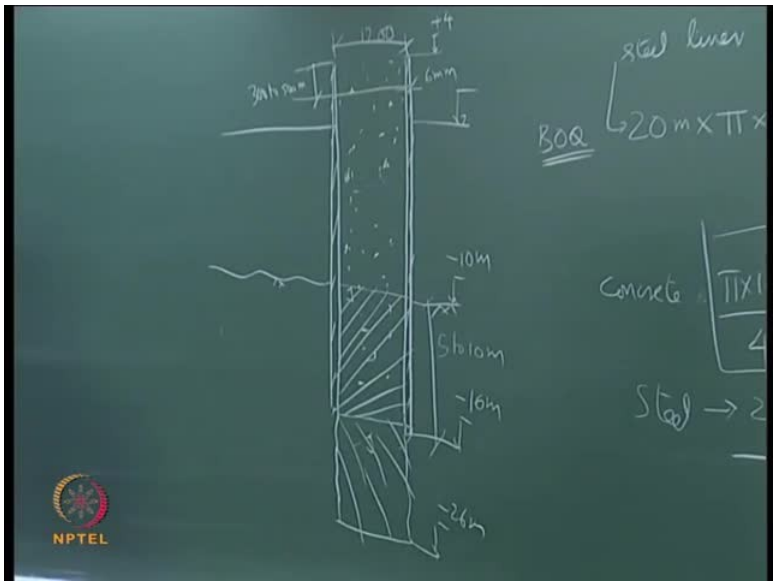

Then we have to dress. Dressing of pile to place the pile muff. It is not dressing of pile muff. So that each pile number is about Rs. 1000. What we do is we do a trummy and we do the concreting. The concreting is done right up to the top. So once you complete the concreting, they remove about 300 to 500 mm of concrete. Suppose this is your cut-off level, they cashed about 300 to 500 mm above and then remove this concrete because when you do with bentonite slurry, the concrete at the top will be very loose.

Then they do the precast concrete for the pile muff, that is 5200 per cubic metre. Then they have in situ concrete per pile muff. Then we do the pile load test. For that also we have to indicate the cost. Number of pile test will vary depending on the number of piles. Some percentage of total number of piles is to be carried out. We do a low strain integrity tests. That also can be included.

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Here we are seeing the deck element. There is a (())(21:39) given here. So when you have the precast and in situ construction, there should be some integrity between the precast and in situ that is given by the sheer stirrups what is provided here like this. And this is how they stack it because space is limited and this is a U type construction which is made for the beams with reinforcement in between. So this cost is going under precast and inside what is going is in situ.

Professor-Student conversation starts

Professor: Why do we do precast and in situ construction?

Student: Easy to do.

Professor: Hmm?

Student:(())(22:15)

Professor: What is it?

Student: (())(22:17)

Professor: No, why do we do precast and in situ? Why not we do in situ itself?

Student: (())(22:23)

Student: (())(22:25)

Professor: The speed of construction. Not the easiness or anything else.

Professor-Student conversation ends.

Speed of construction. You can make the precast elements beforehand and complete the work and form work can be avoided. So in see, we cannot put any form work and other things. So for that reason, we do this. Then the integrity is to be ensured, that is the main thing that is to be done. The main thing is to make the construction fast, eliminate the shuddering required.

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So here, you are seeing this precast pile more. There is a opening here inside which will be done in situ concreting. There are some pedestals which are projecting above, this is used to support the cranes. You are seeing another pedestal here. This is to support the beams. There are 2 beams, one is the crossbeam, another is the longitudinal beam. Crossbeam depth may be more and longitudinal beam depth may be less.

So to place the longitudinal beam which is having a smaller depth, we may provide a pedestal like this. So you put one beam here, another beam here, another beam here, another beam here more, then we concrete the inside portion. We take the reinforcement from the beam inside here and inside here and do the construction.

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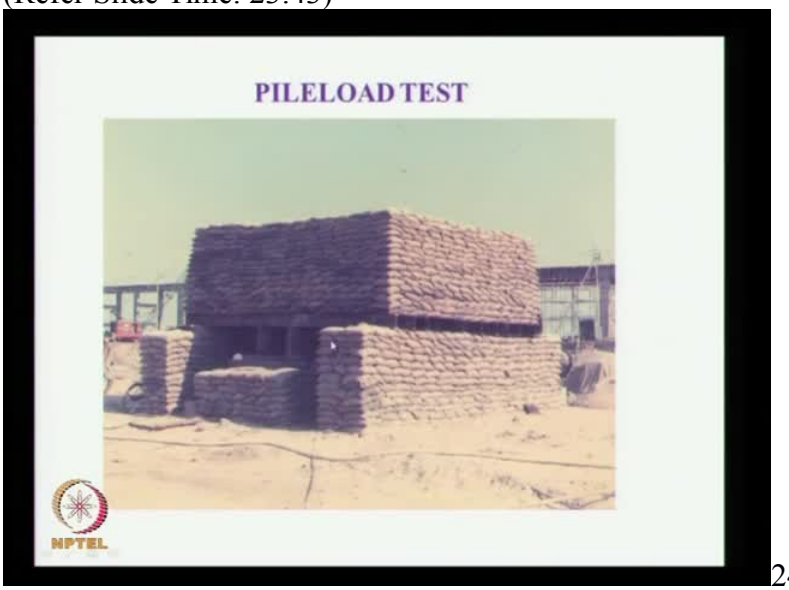

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This is a similar this is some procedure for doing the pile load test. So here what we have done is, we have put the weight required. Suppose the capacity of the pile is 400 tonnes, we have to test it for 1.5 times 400, that is 600 tonnes. You stack the weight of 600 tonnes and use a below and then apply the load. Otherwise you can test this pile and use this as a reaction pile, that is also possible.

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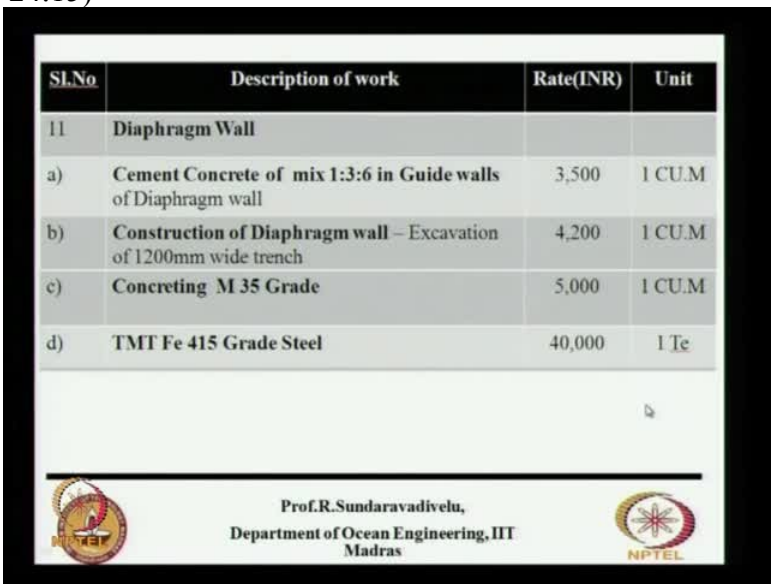

Then diaphragm wall. So when you want to construct a diaphragm wall, the diaphragm wall is a continuous wall.

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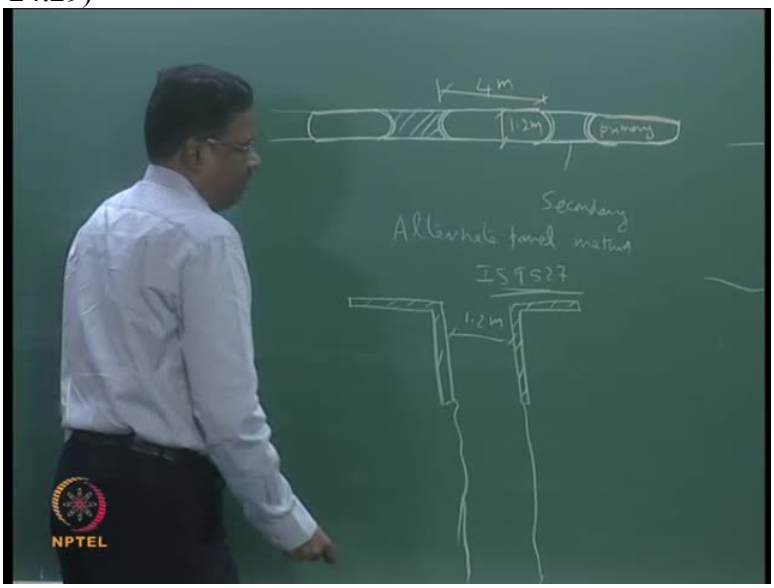

So what we do for diaphragm wall again, so this is a continuous structure which is going all along the berth. What we do is, we do what is known as a primary panel. This is done 1st. Typically the panel size is about 4 metres, the thickness is vary from 1 to 1.2 metres and they will do this continuously, then they will come back and do the other panels like this. So they will 1st complete the primary panels, then secondary panels.

So these are primary panels. These panels are secondary panels. This is called as alternate panel method. We have IS code for construction practice which is IS 9527. So here in cross-section, they construct some pre-trench wall. This width is 1.2 metre, then they will bore through this right up to the bottom. So the other direction is, they continuously bore this direction. Then they will lower the reinforcement cage and then they concrete it.

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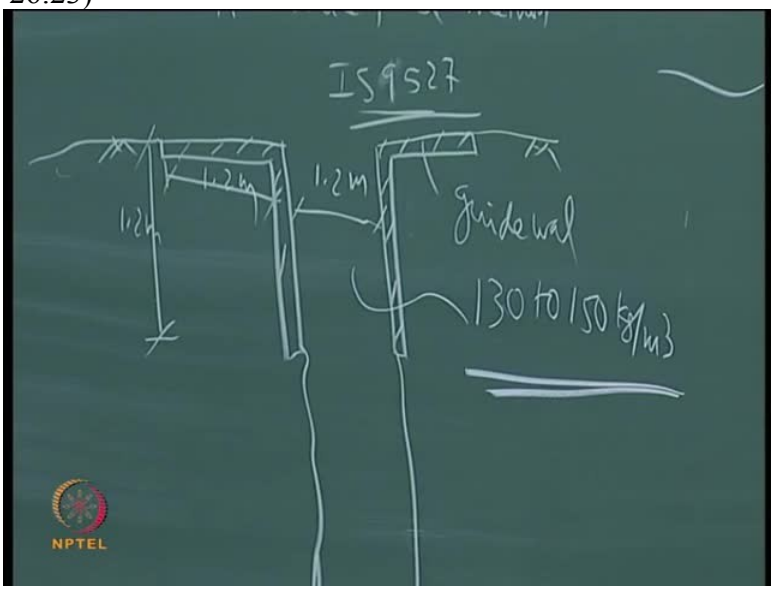

This is called as the grid wall. So this is your ground level, typically this goes for about 2.2 metre it will be for 2.2. Or it can be 1.5 by 1.5 also. So this grid wall is given in terms of cubic metre. Then the excavation is also done in cubic metres. Whatever is the excavation quantity will be the concreting quantity , that also will be given. Then we have the steel. There are different grades of steel. 415 can be used or 500 can be used depending on the type of steel.

Typically for these diaphragm walls, just like piles I have written, the steel quantity will be about what we are inserting will be about 120 to 150 kg per cubic metre of concrete. Then only we will get the optimum design. For pile, you can have slightly higher reinforcement steel, 200 to 250 kg whereas for diaphragm wall, it is 130 to 150 kg per cubic metre.

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Then we will move onto the next item, deck structures. We have a precast concrete. There are 2 items here, one is to make the concrete, another is to place. So this placing is for lifting it from the yard and placing it at the exact location. It is a combination of precast and in situ concrete. In situ concrete, you have to put, then we put some lean concrete on top of the deck structure. Then we may put some wearing coat, then reinforcement bars, then supplying and laying. These are the items which we have to see.

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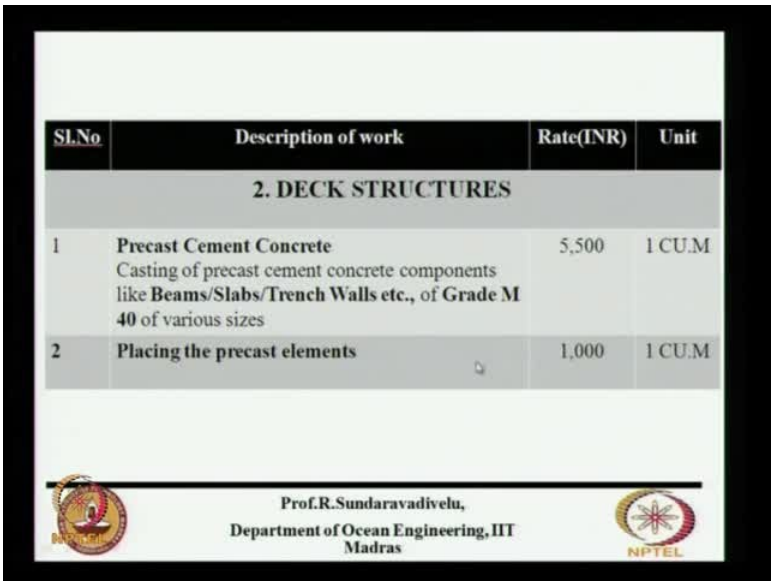

So here we are seeing the reinforcement bars which are given here. These are the gantries which are used. This is for the in situ concrete, bars coming in two different directions. Then, precast cement concrete also in terms of cubic metre. This is for beams, slabs, trench walls depending on the grade. Then pacing of the precast elements, each element when you are lifting and placing. These items are given separately because as soon as they complete the precast concrete, that payment will be made.

Once they bring it and placing it in the exact location, then this payment will be made. This item rate contract we prepare so that the contactor will get the money as and when he completes the work, particular item of work. That is why this concrete rate is given. This will ensure the cash flow for the contactor.

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This shows the precast yard. There also we have the cranes, we have the beams which are cast.

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And here we are seeing the beams which are placed here and then the slab reinforcement, some concreting completed.

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Here we can have the junction detail how the junctions are there from precast elements with the pile cap.

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Here we get, this gives a better view where we have the place where concrete is being taken for in situ portion. This is a U type precast elements which are placed.

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Then some portion of the deck slab is finished here, then another portion will be done subsequently.

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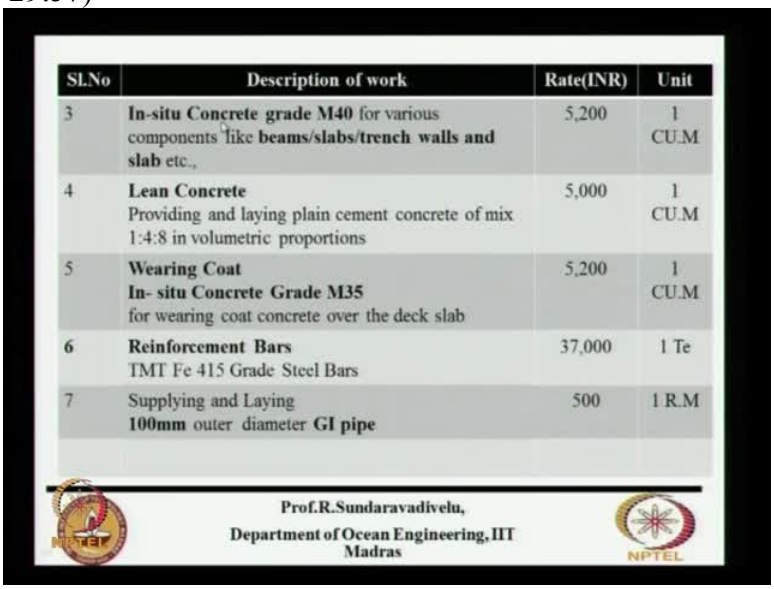

Then we have the other components, the same Precast item like that in situ concrete. Then we provide a lean concrete, wearing coat, then reinforcement bars, then supplying and laying of GI pipe. This is for draining the water from the deck slab and other items.

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Then we have the wharf accessories, the 3rd system that is the Fender, Bollard, ladder, mooring rings, safety chains, expansion joint, the expand joint, laying bitumen sealing compound and fixing of MS inserts, this is either for conveyor system or for cranes, this is insert (())(30:43). So these are the various wharf accessories. This we have to design and accordingly we have to provide this in the estimate for various items.

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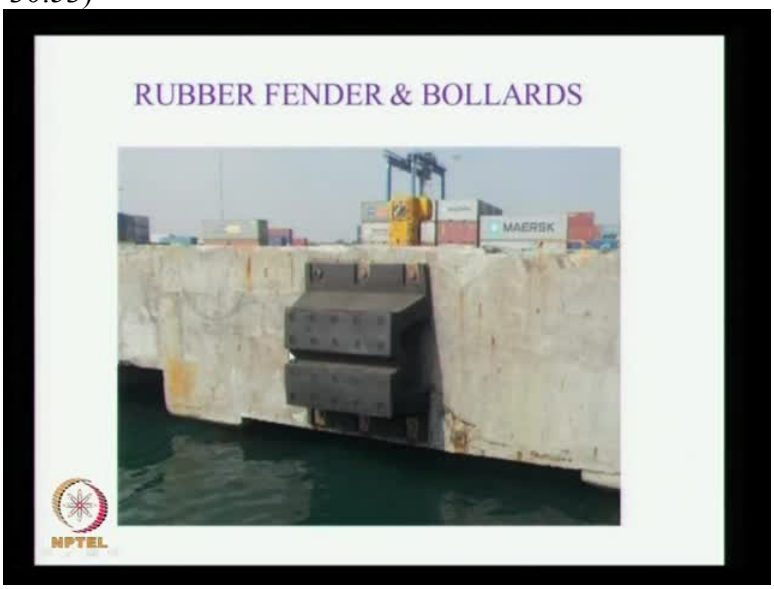

This particular figure, you are seeing the Fender. This Fender is placed. You are seeing certain some damage to the structure here what you are seeing. This is one of the berth in India where

after 10 years of construction, this whole Galatia wall has got completely corroded because of poor quality of concreting. You can see the leaching of, not leaching, the reinforcement strain which is coming from the reinforcement bars.

And here, there is a crack also that is taking place. We are now carrying out the study to find out what is the repair procedure that can be carried out. This repair procedure is typically about Rs. 10,000 per square metre. If we take 1 square metre of area, the cost of repair is approximately around Rs. 10,000. It depends on the type of repair which you are doing. There are different types of fenders. That we will discuss in a separate class. And these are the bolts which are used to fix the Fender.

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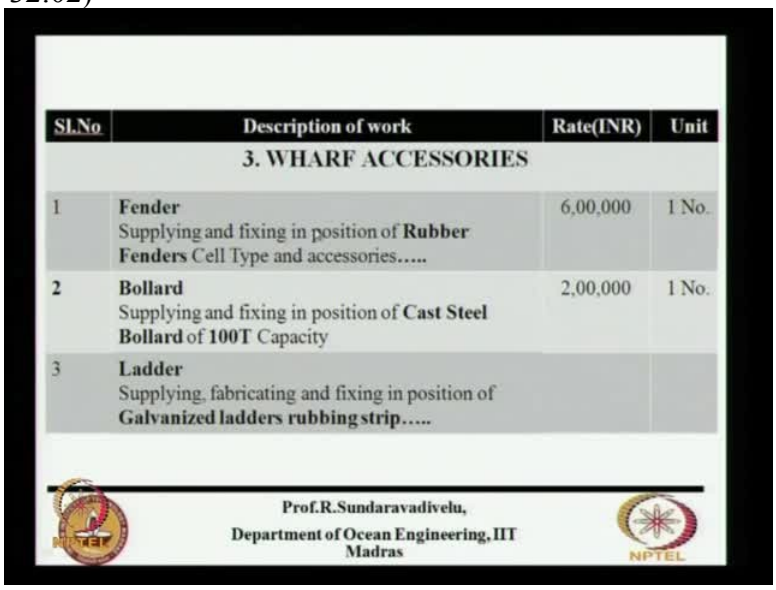

Sl.No	Description of work	Rate(INR)	Unit
a)	**Ladder**	20,000	1 No
b)	**Marine rubbing strip** of 300mmx300mm	15,000	1 No
4	**Mooring Rings** Supplying, fabricating and fixing in position of M.S Galvanized **Safety Chains** of 32mm diameter	2,000	1 No
5	**Safety Chains** Supplying, fabricating and fixing in position of M.S. Galvanized **Mooring Rings** of 12mm diameter	1,500	1 RM
6	**Expansion Joint** Supplying and fixing in position pre joint filler in the expansion joint		

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Department of Ocean Engineering, IIT Madras

Sl.No	Description of work	Rate(INR)	Unit
a)	**M.S angles and Plates**	60,000	1 Te
b)	**Bituminous Pad** 20mm thick	1,000	1 Sq.m
7	Supplying and laying **Bitumen Sealing Compound**	500	1R.M
8	Supplying, fabricating and fixing in position **M.S inserts** consisting of **M.S flat** in service trench	50,000	1 Te

Prof.R.Sundaravadivelu,
Department of Ocean Engineering, IIT Madras

Supplying and fixing position of rubber fenders, this is for a cell type. We have to give the dimension and other things. The cost varies from 6 lakhs to 12 lakhs depending on the size of the Fender. Then we have the Bullard of 100 tonne capacity which is about 2 lakhs. Then we have the ladder. Then the cost is given for the ladder here, 20,000, marine rubbing strip, 15,000.

Mooring rings, safety chains, expansion joints where we fix the MS angles and plates, bituminous pad 20 mm thick, Rs. 1000 per square metre, supplying and laying bitumen sealing compound, Rs. 500 per running metre, this MS insert consisting of MS flat in service trench, that is about 50,000. This is to provide the services in the service trench.

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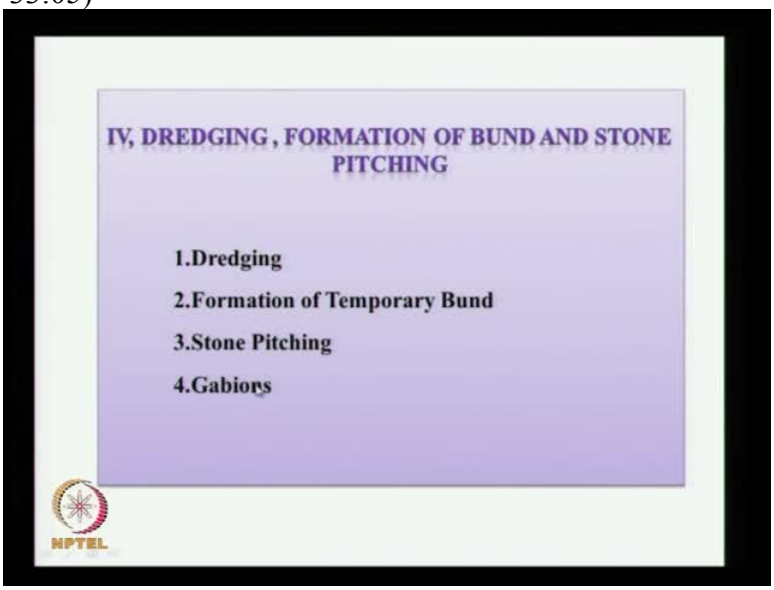

Then we have another major item nodes coming here, that is dredging, formation of temporary bend, stone pitching, and if you are using gabion box, you should give separate rate for gabion box.

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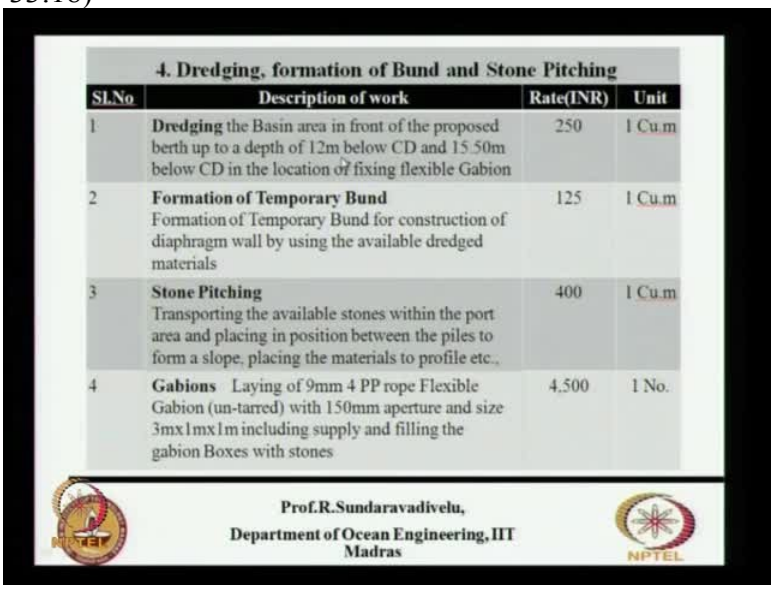

So the dredging rate is about Rs. 250 per cubic metre. You have to say what depth you have to put below CD. In some places, we are putting a gabion where we have to go deeper 15.5 metre. Then, formation of temporary bend if we are doing it, then it will be Rs. 125 per cubic

metre.Then if you are using a stone pitching, Rs. 400 per cubic metre. If you are putting a gabion box, it is Rs. 4500 per number.

The size is about 3 metre by 1 metre by 1 metre including supply and filling the gabion box with stones. These are the various item that may be required when you do the dredging.

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In this figure what you are seeing is a dredger which is dredging in between the main crossbeams. There are piles below this. This side is the landside and that side is the sea side. I will tell you why we have to go in for this type of dredging.

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Then, this is another mechanical excavator, a cutter section dredger with teeths here. It is used for rock dredging.

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This is used for Clay dredging.

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You can see the teeths here. So this shoes will be removed once in a way so that we can cut through the rock even up to M20 25 grade compressive strength rock. Similar to M 25 grade concrete can be cut using this cutter. So this coming to the dredging is a very important component of any berthing structures. Sometimes dredging is given as a separate contract, but sometimes it is included in the berth contract itself especially when you have to form a rope tow embankments below the berth with various types of cross-section for a berthing structure. If we use a diaphragm wall, we do not have to do the rope tow embankments.

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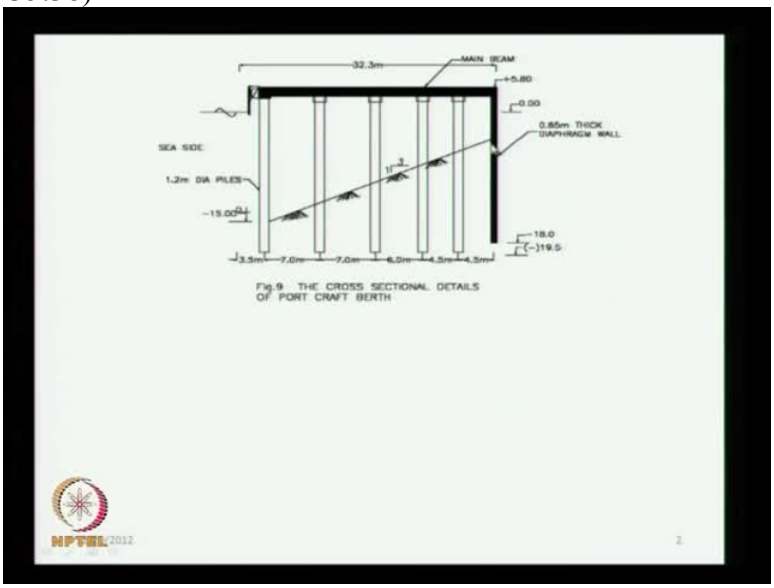

Otherwise we have to, suppose this type of structure you are using, you can dredge it here and leave the slope like this. There is no synchronisation required.

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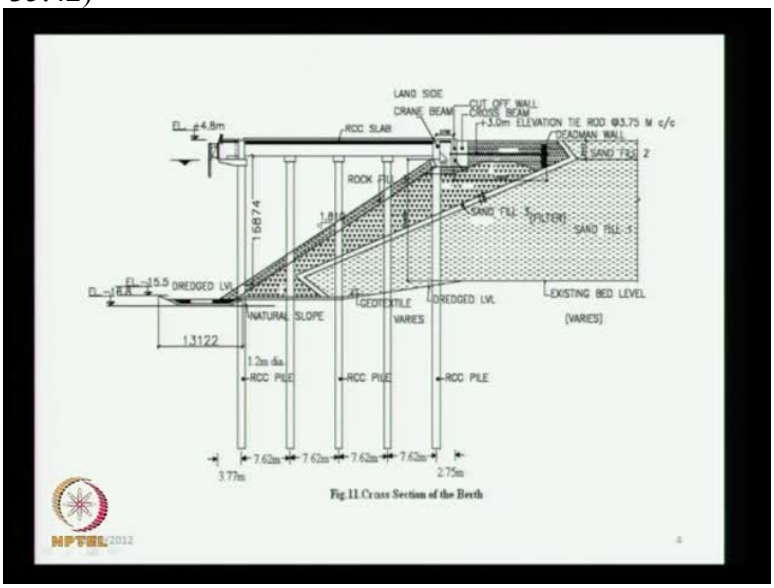

Suppose you use this type of construction, so when you are dredging the slope at this and you are filling the sand here, you get a sandfill like this then you put the rope tow embankment. Sometimes they build it on the land and then they will start dredging here. In such a case, the slope will not be formed.

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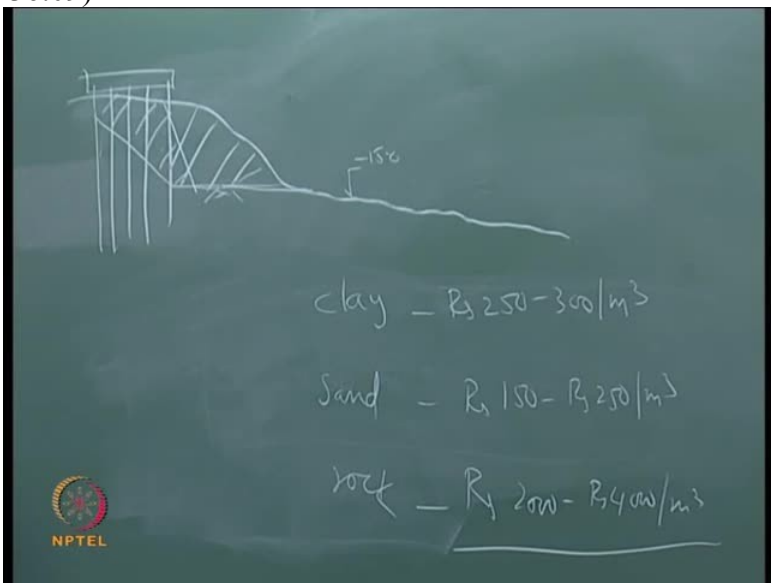

See this, there is a project in Cochin where they were building a structure on the land, this is the structure which they want to build it somewhere here, the berth will be built here. Then afterwards, they will dredge it up to this level. This is the dredge level which is required, minus 15. They will remove the soil subsequently. When they started removing the soil subsequently like this, this does not form a slope like this. This was forming a slope like this.

We assume a slope like this when we dredge. If it is a clay layer, it becomes nearly a vertical cut but suddenly it will collapse. Then it will fall down here. To avoid that, we have to remove this soil in the slope using that slide I have given, a mechanical excavator in between the pile bends, you have to do that. We have 3 types of soil. One is clay, another is sand, another is rock. These are the 3 types of soil which we will encounter.

Normally for Clay, it may be around Rs. 250 to 300 per cubic metre, sand it may vary even 150 to 250 cubic metre. For rock, it may vary from 2000 to Rs. 4000. So this is the rate with which you have to do. If it is a rock, the cost will be about 10 times that of sand and clay. Clay, the cost is more mainly because for Clay, we have to use some other type of if it is in the open sea when you are dredging, it can be very low-cost but if you have to dredge it below the berth to form a slope, the clay will be very expensive.

Sand is a very good material for dredging. If you dredge the sand, it can be used for reclamation also. And it can be disposed also without turbidity and it is very easy to transport through pipeline also. Rock dredging is the most difficult thing. If the quality of the rock is very similar to M 20 or 25 grade of concrete it can be done through a cutter section dredger. But if the rock as of higher strength, then we have to do some pretreatment of rock.

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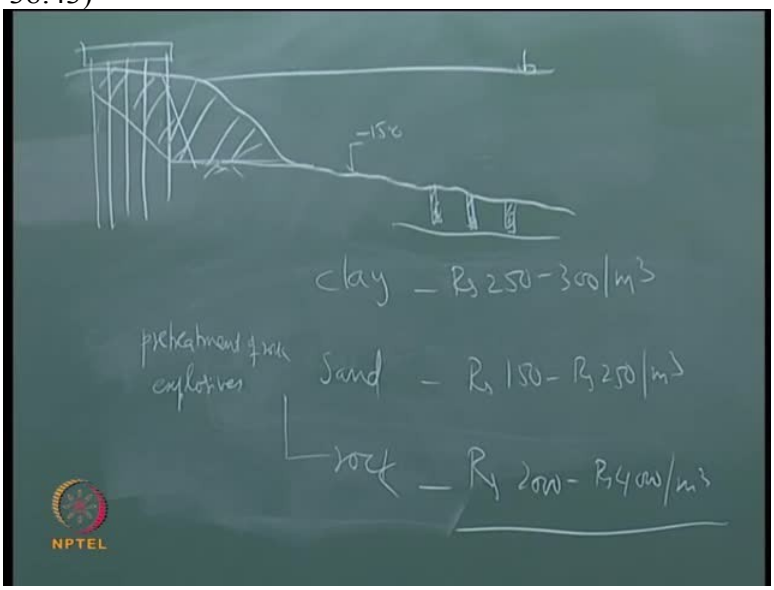

This is done by explosives. So we will lower the explosives in pre-drilled holes. Suppose you have the rocky strata here, what they do is, they drill some holes. This is your water level. They drill the hole through this, they lower the explosives here and then they blast it and then they loosen the rock, then they use the cutter to remove the rock. So in that case, the cost will go up to Rs. 4000 per cubic metre. These are the various methods by which we do it.

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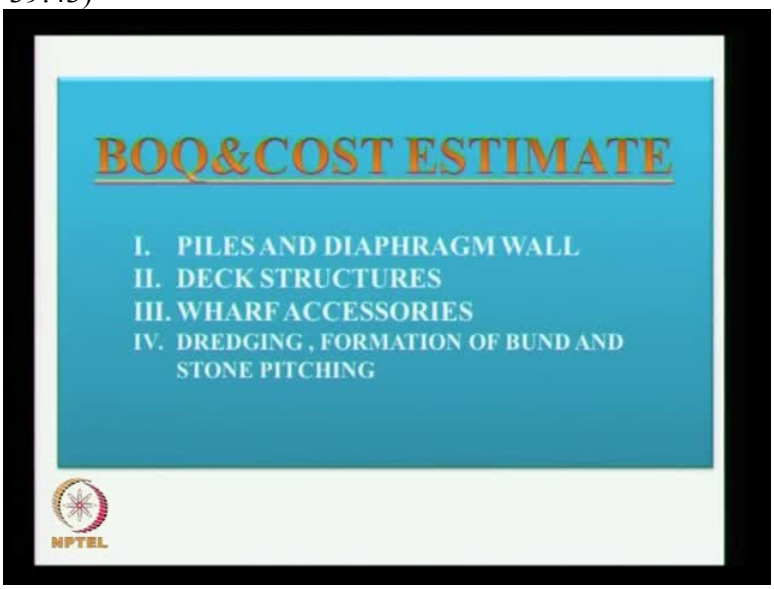

So the bill of quantity is a very important exercise that you have to do because the cost of structure depends very much on the individual items what you are estimating. Here there are certain requirements.

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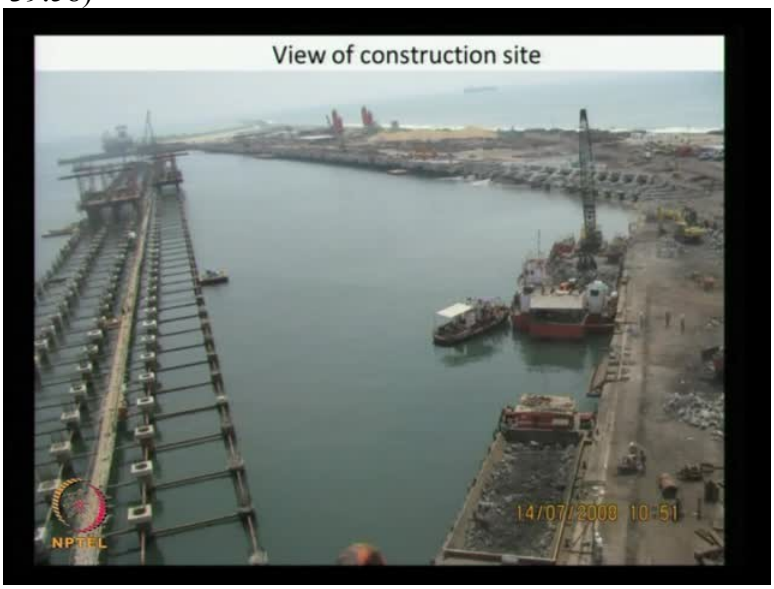

Suppose you want to construct this structure, this is done in 18 months period for a length of about 900 metres and a width of 30 metres. So if you want to do this construction very fast, what are all the things that is required? You need the equipments. So they have a floating raft with a piling rig like this which was driving the liner so that the piling rig is not required to drive the liner. Liner is already available means the piling rig will come and start boring it.

So we have about 5 rigs in this , 3 rigs in this gantry and 2 rigs in this gantry and 2 floating barges to drive the liner. These equipments are required to finish the berthing time. Suppose you have 900 metres of the berth and you have 5 rows of piles at every 7 meter centre to centre, what is the number of piles required?

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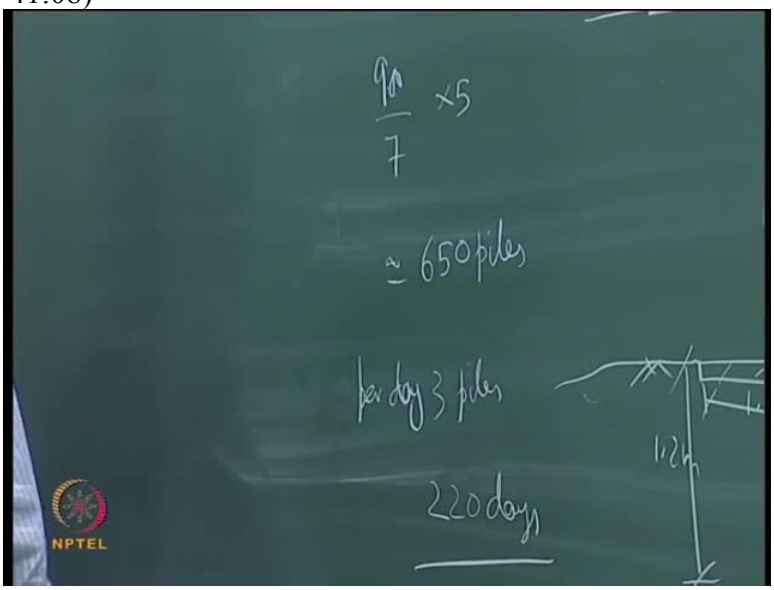

Let us say length of the length is about 900 metres divided by 7 into 5 approximately about 650 piles. This piling gantry with 5 rigs approximately we can do per day at least about 3 piles. Then you need about 220 days for driving 650 piles. So this per day if we can make 3 piles, to make 650 piles we need 220 days. Once you are completing the pile, you can bring the deck system from behind and then start doing the operations.

But this number of piles per day to 3 numbers cannot be achieved initially because piling rig, setting and gantry erection and all will take about 3 to 4 months. Then towards the end after completing the pile, it will take another 6 months to fill back the area and put the deck slab and accessories. So about 9 months you have to add. This is about 7 months. 9 plus 7, 16 months is required to do this operation. But they found it very difficult to achieve the target.

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So what they have done is there are 2 ends for this. Starting from this end, this is the southern end, this is the northern end. In addition to these 2 gantries, they started from the other end also with another 2 gantries to achieve the target. So time is essential for project for which you have to mobilise these equipments. And the space given for them is somewhere here only for precautious. They do not give good space. So the space management also is becoming a problem.

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And this type of gantries which is made of 30 metres running on the rails is also essential. So once they complete this piles, pile caps and precasts units like this, then they can pour the

concrete, then they can continue the deck slab they will place between the beams, then do the in situ concrete. There are certain requirements for doing the construction because concrete will take 28 days to attain the strength.

So the gantry can be moved only after 28 days is realised for the pile. Similarly you can lift the precast elements only after 28 days but sometimes they lift even after 15 days. Then once they finish the slab, on top of the slab, if they want to move the equipment, that also strictly we have to do after 28 days but they do calculation how much time is required for that and then accordingly what is the strength achieved after 14 days or 21 days, they allow that.

So once the structure is completed, then they have to remove the gantry also and there are certain supports taken from the existing piles, that also has to be finished.

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So once you finish it, there are certain components like rail fixing and cranes also will come not by road, it may come by barges only. That they will unload it here, then position it at this location, then fix the Bullard, this fenders and other things. So totally about 18 months is typically considered for this type of construction. Okay, thank you.