Building Materials and Construction
Prof. Dr. B. Bhattacharjee
Department of Civil Engineering
Indian Institute of Technology, Delhi

Module - 3
Lecture - 3
Concrete: Production (Contd.)

Welcome to this module 3 lecture 3, last lectures we talked about part of the concrete production that is mixing and batching and mixing of concrete, in this one will be talking about transporting concrete transporting concrete.

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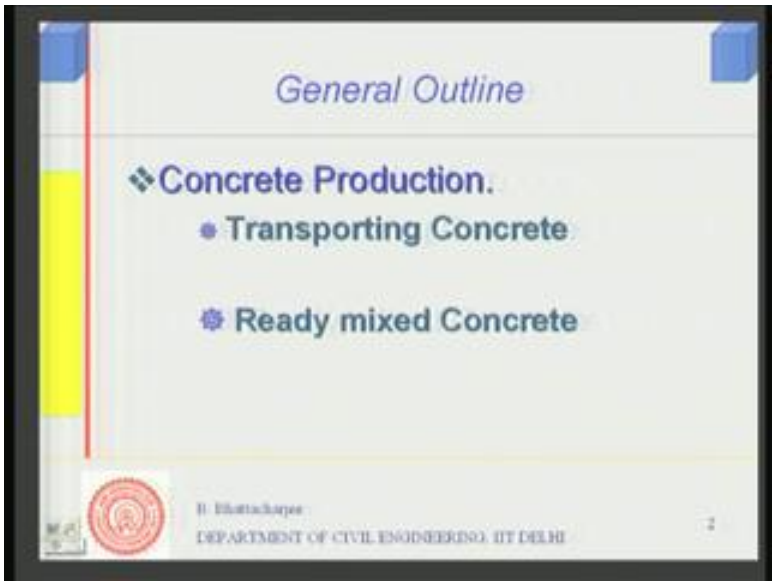

So, general outline of to this lecture would be first we will talk about transporting concrete, and then will also talk about special a process that combines both mixing and transporting called ready mixed concrete.

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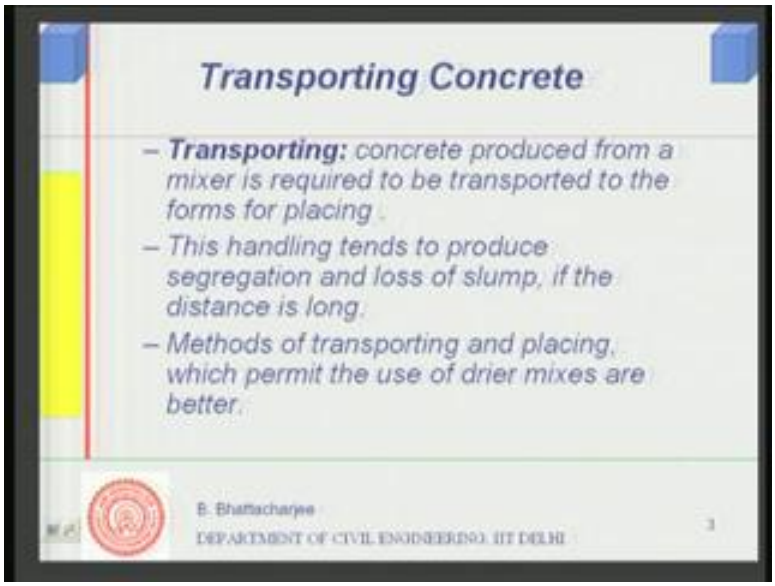

So, this is the 2 things mainly discuss today let us look at transporting concrete transporting concrete there are various method, but essentially concrete produce from the mixture is required to be transported to the forms for placing, because you cannot have the mixer right onto the polymer and usually there is some distance that could be very short very small, some cases it could be even very long. So, you go to transport the concrete produced from the mixture to the form for placing. This handling of concrete that is transporting the concrete from the mixer discharge point to the form can lead to segregation if the hall is very long. And it can also lead to loss of some amount of the slump.

So, these are the 2 issues involved with transportation loss of slump and segregation of the concrete. I mentioned about segregation in the last lecture that is, it is the separation of the ingredients which you actually put together to make a homogenous mix. So, methods of transporting in placing which permits the use of drier mixer are better. This reason is very simple drier mixer means less water and therefore your water cement ratio is low, which means cement you are consuming less and the strength is higher.

So, the method which is capable of actually transporting drier mixer is always better method, and of course 1 has to select considering economy and appropriateness of the side 1 has to select a particular method of transporting based on those kind of consideration, such as economic consideration and appropriateness to the side.

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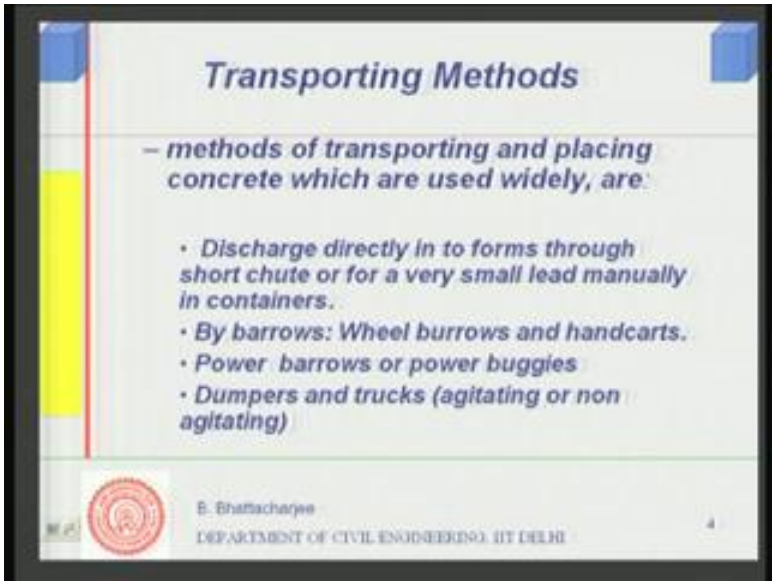

So, let us see what are the transporting methods? These methods are number 1 discharge directly to the forms, through head load or using short chute or manually using containers. This is very common in most of the construction which are semi engineered in a properly engineered construction, manual would be restricted to only very short distance and to specific height as we shall see. But, this is still there is method a second method could be by means of barrows, wheel barrows; load the wheel barrows from the mixture and then transported to the place where you want to transport also handcarts, power, burrows and dumper trucks or power buggies.

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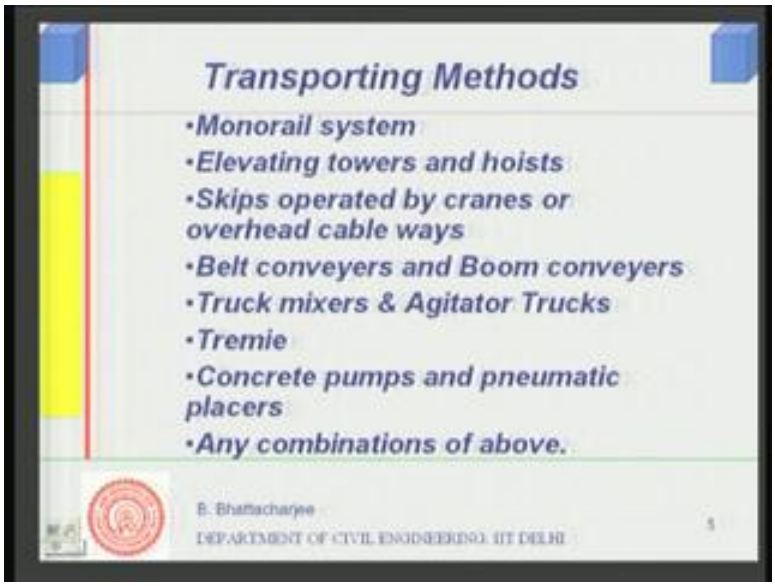

So, these are the 1s through which 1 can transport concrete, then dumper trucks or tipper trucks which could be either trucks could be agitating or non agitating, then there are systems like Monorail system. There have been used for concrete transporting from mixer to the placing you know for placing of concrete, then for vertical rise, elevating tower and hoists for 3 dimensional distribution of concrete 1 can use cranes and sometime, overhead cable ways in rival vary projects we will discuss them 1 by 1.

So, then small location there can be belt conveyers or conveyers attached to boom of a in case of hoist or cranes or similar places belt conveyers and boom conveyers over small distances. Then 1 of the method which actually combines mixing and transporting together is the ready mixed concrete which is the truck mixers. So, the truck mixers as well as transport the concrete, then the third variety agitator trucks in this same 1 truck mixers and agitator truck, then termite concrete methods of transporting concrete is used for placing concrete under water.

So, pumps and pneumatic placers pump is the very versatile equipment concrete pumps that can transport the concrete and the placers as well. So, pump is on 1 side it is meant for transporting concrete, from the mixture to the delivery point to placing or it can

directly place onto the forms straight away. So; therefore, it is a it has got dual role very versatile equipment we will discuss about concreting through pumping placing of concrete transporting and placing concrete and pumping, and then finally you can have any combination of the above.

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So, let us look at this method of transporting 1 by 1; what are their implications in concrete, final production of concrete. First one let us look at direct discharge, I said direct discharge is not desirable through you know normally head load by manual means and then dump it straight onto the form where it is to be placed. Now, this is not very desirable in most of the places and it should never be discharged more than over a 2 meter height. The drop should be more than 2 meters, the reason is very simple when you draw a plastic mixture of concrete from a height more than, let us say about 2 meter.

What will happen? It will just reach the location of placement by a thud and in the process the quaracer particulate system particulate matter, will spread all around leaving the soft or wet paste material closed to the place where it has been actually drawn? So, the uniformity of concrete finally would be lost or you know there will be tendency to segregation if you try to drop it from height more than 2 meters. So, this should be

avoided short chutes with proper lower end treatment are of course simple to use and of course they are economical.

Sometimes they are absolutely essential with appropriate slope the problem of the chutes is that, when you are trying to actually transport a concrete through a slope using a chutes. The wet material, wetter material rather the paste if it is a special wet concrete paste would have a tendency to flow ahead of the aggregates. So, aggregates will be lacking behind and this may result in unless the mixture is highly quasacive. This may result in some sort of the segregation; so short chute is still because the mixer can go almost homogenous as possible and again, the lower end discharge should not by a thud but it should get spread well over the place in a homogenous mix form.

So, it is quite economical use in short distances over small distance over small height and through small slopes. Usually, the chutes are metallic half round and stiffened at places so that; it can withstand the load that is coming from the wet concrete and can handle about, 1500 meter cube of concrete. You know, economical anyway long chutes are not desirable that, is because I said the segregation and if it is very long some places. The materials will stick some place you know, it will stick and therefore, obviously; you need cleaning all the time after use the chute has to be cleaned and in the long chute, this problem might be more and there could be problem of segregation and drying out of the mix as it go through over a long. So, long chutes are not desirable small short distance chutes are always in use. They can be used together with many other methods of transporting concrete some of the examples we will see later on.

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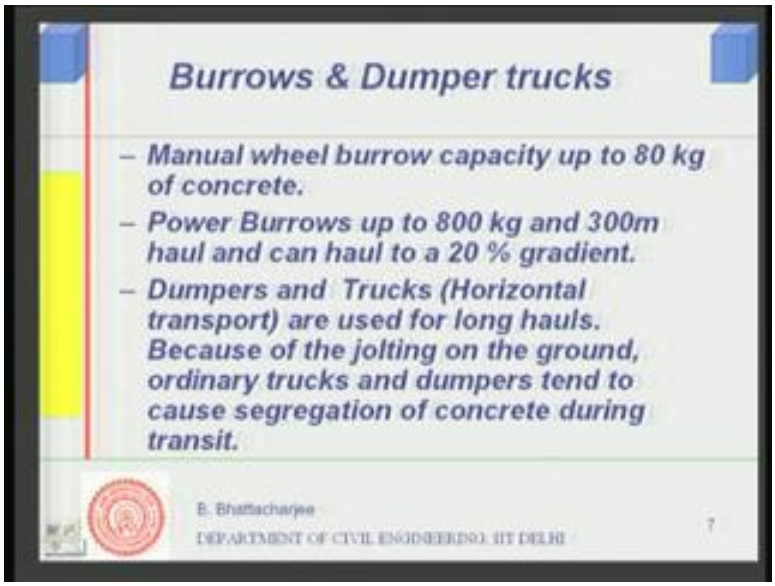

Then let us come to, Burrows and Dumper trucks chutes are used as an just before placing in a foundation. For example, in a foundation in somewhat below the earth 1 can easily use it or you are dropping it over a small height in multi storey construction from a form, a hoist or even from a pumps a small chutes is used. But if you want to haul it over a long distance, relatively longer distance horizontally, then you can use manual wheel burrow this is manual. You know, wheel burrow you dump the concrete and then carry it over up to eighty kg of concrete can be carried in manual wheel burrow.

This can have some problem, if you do not take the full mix full discharge from the mix batch should be taken in a single burrow and carried. Otherwise, you might have if it is coming from part of the batch, is on 1 burrow and part in the other burrow there can be problem because uniformity of the concrete. First 1, which is coming from early from the mixer machine may have more of you know cement and things like that wet material. Some other materials, which may not be same almost the composition may not be same for 2 different half the discharge of the mixture and half the discharge of the mixture.

There it is preferable, then 1 complete batch or discharge from the mixer is taken in wheel burrow and transport also. The discharge should be through the bottom of the

mixer you know there is certain discharge methods anyway we shall look into that sometime later on, power burrows can carry actually up to 800kg and all over 300 meter distance and even haul to 20 percent gradient. So, power burrows are used over a large quantity of concrete involves all quantity of concrete you might use wheel burrows manual ones. There are some a little bit of problems both with these burrows as well as dumpers and trucks these are also all these means of horizontal transport.

The wheel burrow the manual ones can be used on the top of the multi storey building over a bridge trucks, where the concrete is lifted by other means as moisture many other things towers and things like that, but the horizontal distribution is through manual wheel burrow. Similarly, power burrows are doing the same thing dumper trucks also, do a similar sort of thing. They are used for long hauls dumpers and trucks, but both dumper trucks and power burrows if there is too much of jolting, the jolting will result in the larger size aggregates to come up at the top and cement to go down this jolting can result in sort of some sort of segregation.

So, jolting has to be avoided in case of all these horizontal sort of horizontal transport of concrete. So, dumper and this bakkies also the power burrows they can result in segregation 1 has to be careful about it; especially, in the long hauls never the less, there has been used quite often in many places. So, typical dumper truck will look something like this a dumper trucks is there also used in mining and earth war.

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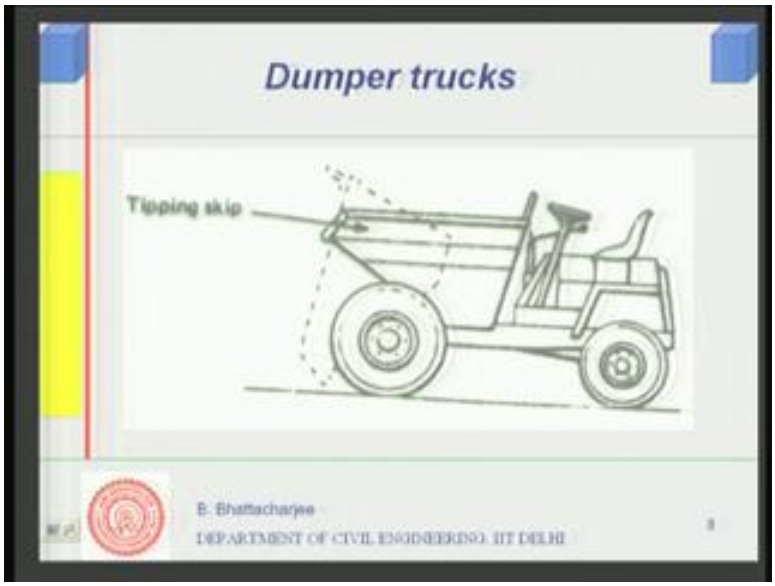

This is the dumper truck there is the concrete here and it discharged by tipping the skip tips and discharges well.

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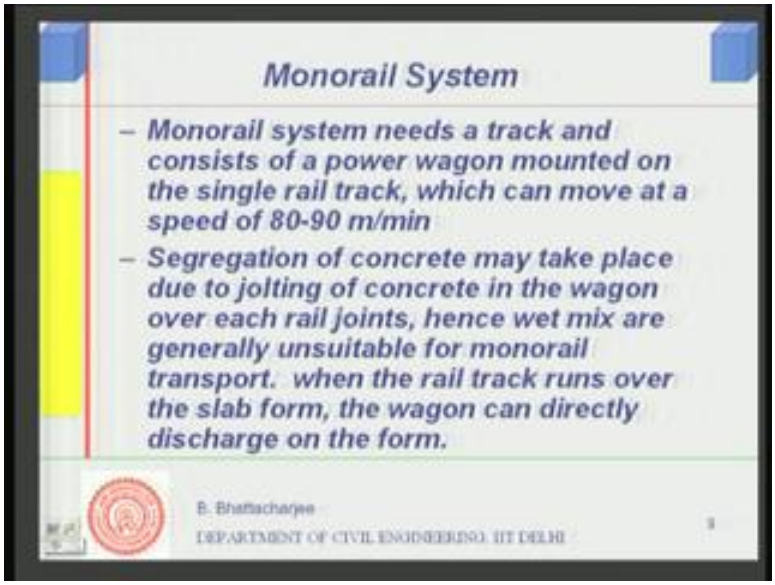

Next look at look to monorail system; this has been also used monorail system is also been used but, it needs a track and consists of power wagon mounted on the single rail track that, can move at speed around 80 to 90 meter per minute. So, monorail system

carrying a skip or bucket sort of thing, and then transport it these are they find quite often used in tuneral construction also, construction of dams and things like that; particularly, in tuneral construction they are very useful.
But they to have some problem of segregation the reason being concrete can you know during jolting again same like your dumper trucks here of course during rail joints. When the wagon is crossing from, 1 rail to another rail through a join there can be some amount of jolting and this can result in some sort of segregation. So, 1 has to look into aspect of segregation and the mix has to be selected accordingly both for dumper trucks as well as for monorail system.

So, mix has to be selected keeping in consideration of this aggregation while choosing the system for transport. 1 has to look into the type of mix you like to handle both, in case of dumper truck I mentioned earlier if it you know flat slab or something like this or in this case when, the rail runs over the track runs over the slab form in case of flat slab or rough foundation or similar sort of thing, it can directly place monorail as well dumper trucks can tipper trucks they can directly discharge a concrete to the form. So, the job of placing can also be done.

However, this can only be done if the structure is the kind of slabs or ruffed similar sort of situation. On over which the transporting vehicle can run over it, when, it is possible that it trans over it you can directly place this concrete also.

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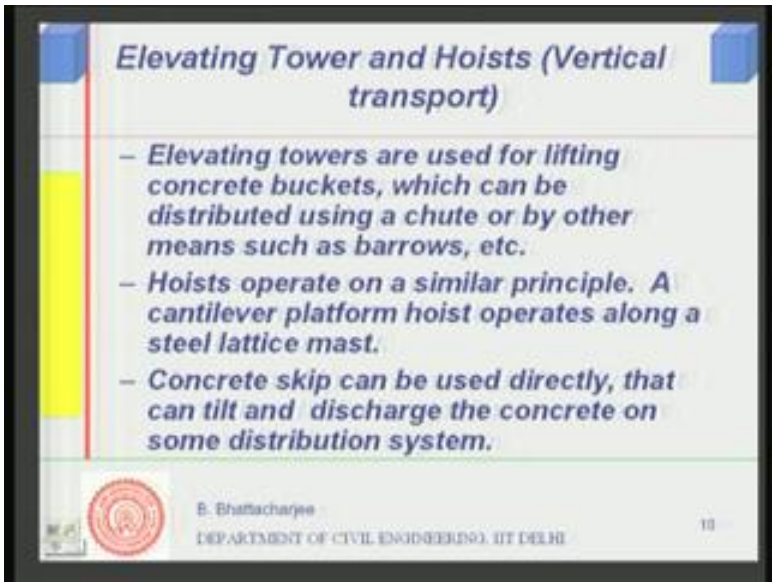

So far we looked into horizontal transport; let us see, how do vertical transport of concrete elevating towers are used for lifting concrete buckets concretes are lifted. In buckets, and then they can be distributed using chutes or by other means such as burrows etc or horizontal distribution quite often, in the bridge truck construction 1 can use these towers in multi storey buildings 1, use this towers the bucket will be lifted through winch or similar other devices; you can lift the bucket full of concrete right up and then there again it needs horizontal distribution.

So, however you need a horizontal travel or transport of concrete from the location where it has been, mixed and discharge from the mixer to the point where the tower. So, this is essentially means for vertical transport. Hoists operate on a similar principle, a cantilever platform hoist operates along a steel lattice mast and we have a diagram of the same. So, concrete skip can be used directly that can tilt and discharge the concrete on some distribution system, for horizontal distribution system the skip can tilt and directly discharge onto it. Now, if it towers usually does not go directly onto the form it is usually not sometimes it does, when it does skip can directly tilt and discharge onto the form itself.

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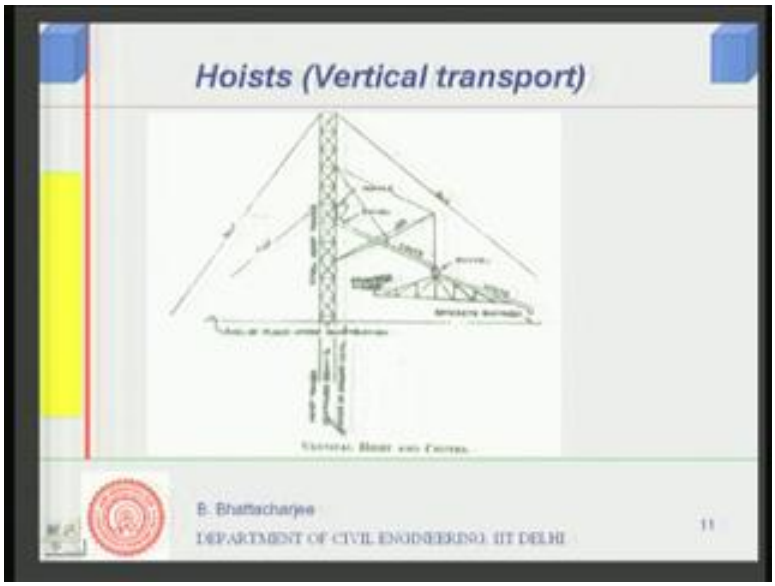

This diagram shows the diagram of a vertical hoists right and this is the, hoists the mast the bucket or the skip comes up to this swells and discharges concrete through this chutes and this can again distribute horizontal chute. This is the system for multi storey building construction where it can actually distribute the concrete even horizontally a combination of chutes and the hoists can distribute you know concrete both vertically as well as horizontally.

The vertical lift is through this bucket which lifts to the towers, and then it is distributed through this chute and since this can swell it can rotate about final discharge here. This is the transistor which supports the chutes through this chutes actually it can discharge over a larger space both horizontal as well as vertical transportation is covered here to support. The mast guide, support and this is the system this is 1 system which 1; can use in multi storey building or similar sort of situation as I said bridge other situation for distributing the concrete horizontally after lifting it vertically upward.

Cranes and cableways they are basically cranes is essentially 3 dimension distribution system, it lifts up and distribute the concrete over a circle of its radius of you know, within the radius of its operation. So, distribute the concrete both horizontally as well as vertically.

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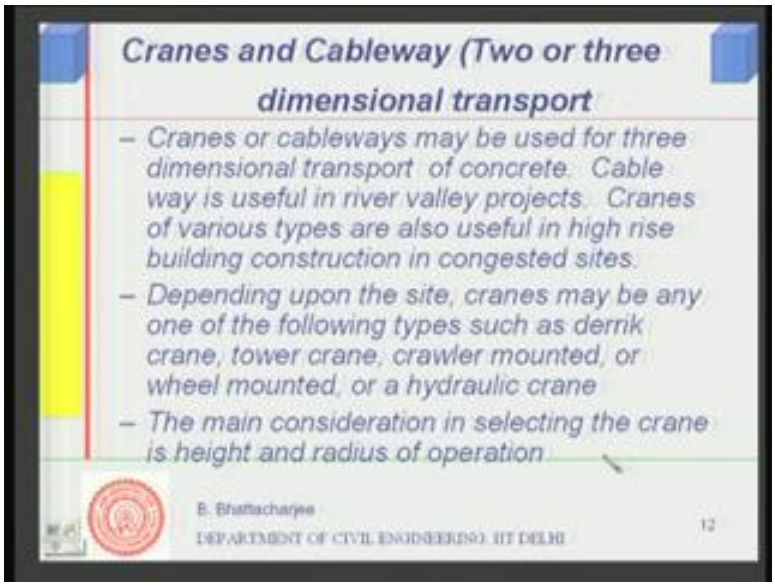

Now, cranes and cableway are used for 3 dimensional transport, cableways are essentially used in river valley project and cranes can various type can be useful in high rise building and many other kind of construction also. Especially when cranes are used for some other purposes, lifting materials or possibly well sinking.

Once the well sinking is over, the bridge construction when well sinking is over the same cranes can be used or when, it is not actually doing the operation of well sinking. You know, when it is idling not really used in used in some other operation it can be used in a concrete transporting operation. So, it can lift it up the bucket can lift up by the cranes, and then distributed over a horizontal position and somewhat on the vertical rise resistance above the grade level as well.

So, they are useful high rise building construction especially in congested sites there can be various type of cranes depending up on the site like you can have derrick crane, tower crane, crawler mounted tower cranes are very often used in multistory building construction. And then crawler mounted or wheel mounted crawler mounted 1 or you know, quite used in depending on the terrain you have. You can have wheeled mounted

crane or hydraulic crane or several varieties are possible. They quite versatile they are 3 dimensional types. The main consideration in selecting the crane is the height and radius of operation right, main consideration is of course the height and radius of operation.

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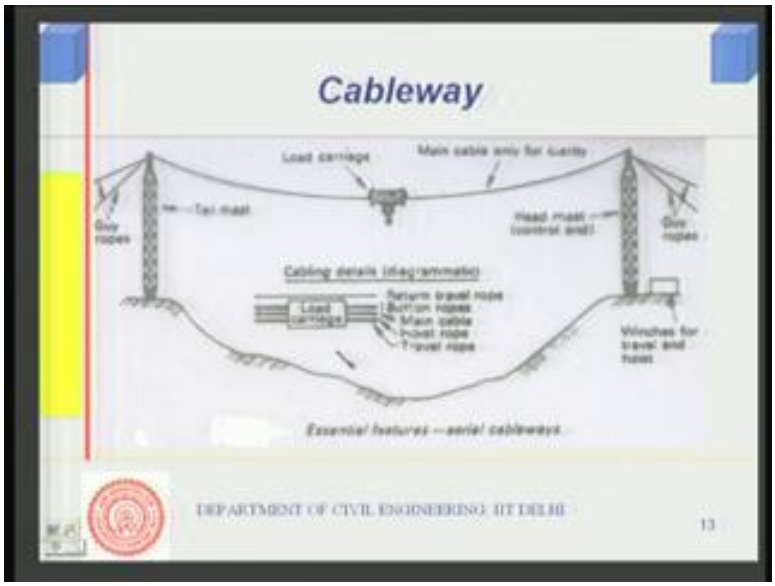

Let us see this is the picture of sketch of the cableway especially, used in river river valley projects. So, you have this side you have the head mast and this is called tail mast you have the control. You know, this is the control head and this is of course the other side. So, cable through the cableways through which you can actually transport the concrete and discharge it lower it down discharge somewhere at the P-R level. If it is the bridge construction and similar sort of situation they are very useful in river vally projects and they distribute horizontally as this tackle or lifting system goes town it can actually deliver it somewhat below also.

So, both for example and vertical movement is possible it is also a 3 dimensional system, 3 dimensional transport of concrete is possible in this system. This is aerial cableways they have been used for river valley projects.

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Belt conveyors are used for over short distances not very large distances essentially they require small power, conveyors are very common actually transporting the minerals they transport of mineral is over large distances but, in case of concrete we transport it over a short distance. It can transport as much as 115 meter cube of concrete per hour. You know, the main consideration of course, this can go together with other sort of system.

Now, there is a little bit of problem associated with this it cannot go beyond 30 degree elevation. So, we can have small elevation not very large elevation and horizontal distance small about, 5 meter 10 meter distances you can cover through this. For wet mixtures the capacity of the belt is reduced in inclination because it cannot go through high inclination wet mixture have a tendency to wet mixture have a tendency to come down. You cannot elevate through a same 30 degree. If it is wet mix may be restricted to about 12 degree inclination right this is lower all.

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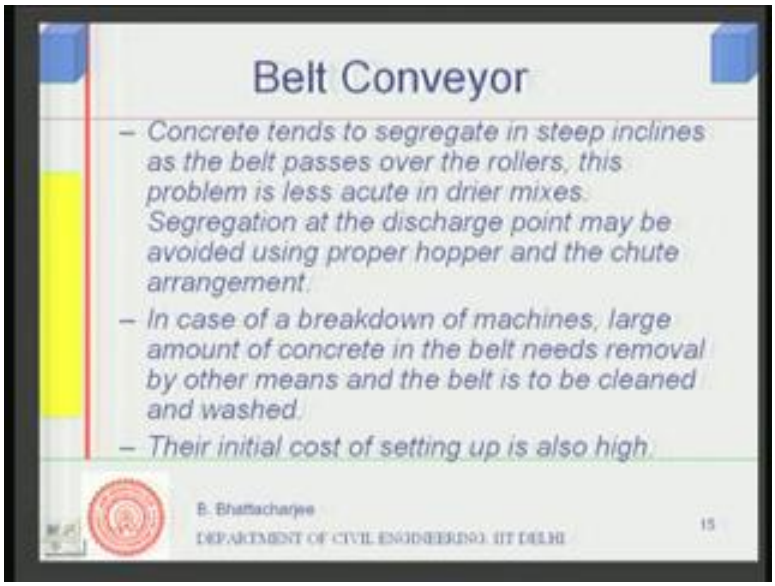

So, concrete can segregate, because in case of belt it is turf and it moves over rollers. So, as this belt moves over the roller, passes over the rollers a little bit of jolting and this can result in some material the aggregates in dryer mixer aggregates going up and the rest of the material remaining in the belt itself, resulting is kind of segregation. So, this is you know in case of somewhat wet mixers this is somewhat dryer mixer is relatively less and segregation, of course the discharge point can be avoided using proper kind of hopper chute available.

So, both these issues segregation the type of mixture that you are using conveyor belt you can select depending up on type of mix that you are using. And also over a short distance quite often used in making precast you know prefabricated or precast pipe production and things like that, fix positions also there can be used together with pump or hoist and cranes together with some other system they can be used. So, there is another problem associated with this belt conveyor system; in case, of a breakdown especially if the conveyor is long the whole system is stopped it is stopped, then you have to use some other means; to remove the concrete that has got struck onto the belt and then clean it.

So, this is another problem associated belt conveyor system initial cost of setting up is also relatively high. So, generally used in pre cast you know, factories are pre cast products are produced there it is quite useful.

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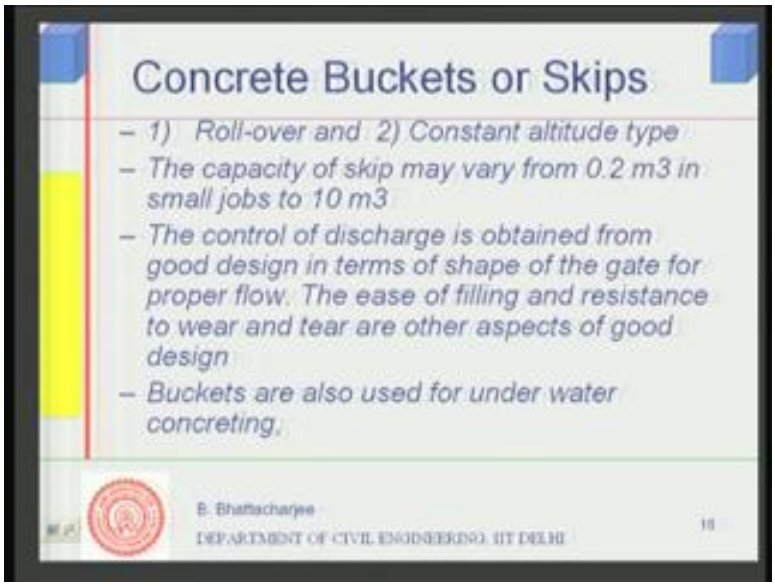

The buckets and skips are very common equipment they are used together with many things some different types of buckets which are used in concrete transporting there are 2 types roll-over and constant altitude type you have some diagram I will be able to show you. The capacity of this buckets or skips may vary over 2 meter cube to 10 meter cube very large bucket can be there depending up on the size, because in bridge deck construction where you are not actually concreting quantity may not be very large you might use small buckets.

But some cases many in case of some structures of dam or something you might use very large buckets, control of discharge is obtained from good design in terms of shape of the gate through which the discharge is taking place. The flow should be proper and it is from the center of the it is from the center bottom. You know bottom opening you know usually, it is the bottom opening not side opening bottom opening and through the center

such that whole of the material has homogenous mix passes through it. The ease of filling and resistance to wear and tear are other aspect consider in good design.

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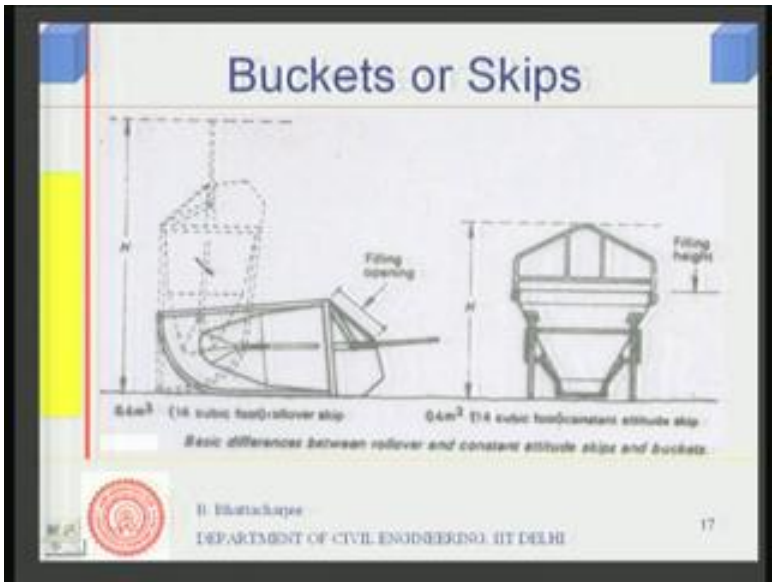

So, some buckets are used for under water concreting also as we shall see later on and these are the 2 diagram of the 2 types of buckets and skips. This is the roll over type of bucket, actually while filling it is in horizontal position through this the filling is done filling is done, through this it gets filled in once it filled in this bottom is closed, once it filled in this lifted up and in the lifted position is something like this, then it can discharge by opening at the bottom while actually discharging, whereas the fixed height not tilting type is something like this kind of. This is the actually the bucket this is the lifting arrangement and filling height is up to this in position. This is filled from the top and lifted using this arrangement and while discharging it discharges from the bottom; usually discharges through the bottom opening. So, this is called constant altitude and this is the roll of the type of bucket.

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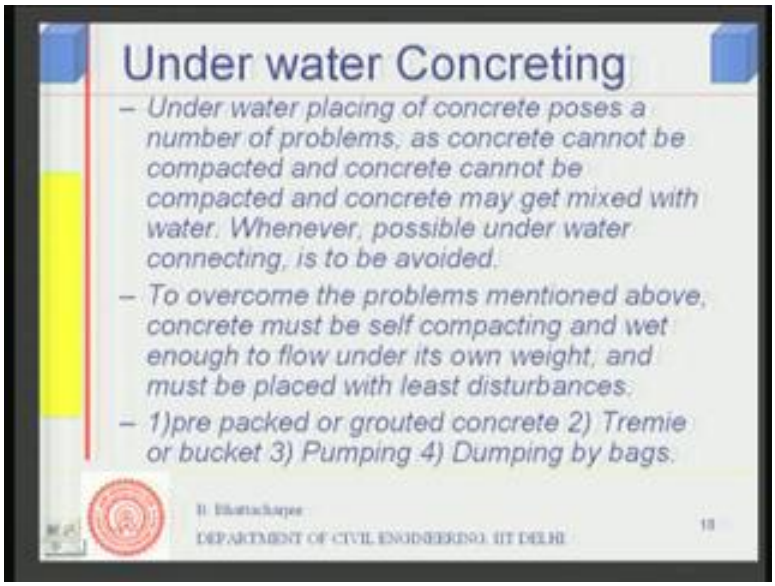

Under water concreting is an important aspect transporting concrete under water. You can have various situations where, you do under water concrete. For example, casting leads pales under water or some construction of walls or something under water. Now, problem associated under water concrete it cannot be compacted; so, you cannot compact it and concrete may be mixed with it may get mixed with water particular the cement at the top, and then which comes in contact with water and there was cement slide can be.

So, if possible 1 should avoid under water concrete there are several other problem associated with, it under water concreting I just mention 1 or 2 when, we look into the diagram. So, the first thing the concrete must be nearly self compacting if not self compacting. You cannot compact it you should actually compacts on its own very flowing concrete is desirable it should be very wet and should be able to flow on its own way and get compacted.

So, it should be placed with least disturbances; so, what are the methods we used 1 of the basis grouting the other is called tremie or using bucket sometime it pump because the pump nozzle discharge nozzle can get go down into the water below. And the pipe carrying the concrete can be loaded and straight away the nozzle discharge at the bottom or sometime dumping by bags.

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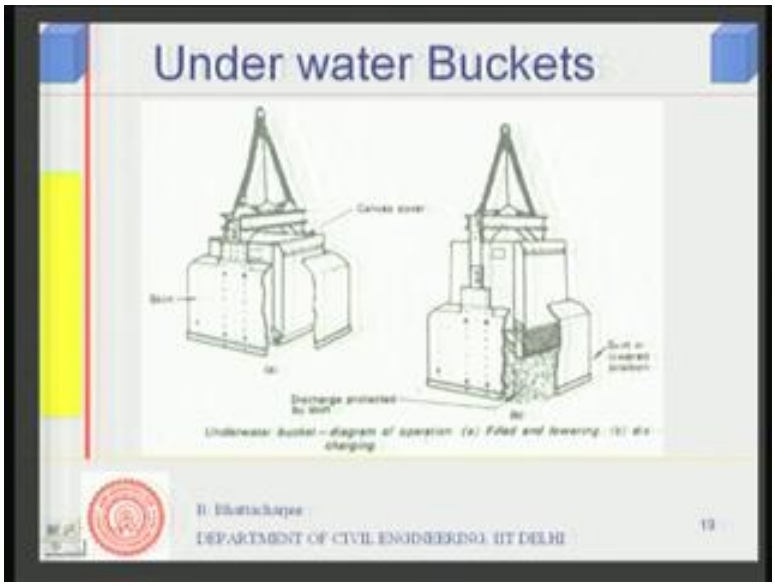

So, we put the concrete in bags and dump into the dump into the water concrete right now, each of these methods are used in different situation. Let me first look at the bucket and bucket that, can be used in this can be lower through crane or something that sort of equipment. This bucket is something special it has got some sort of scarred and this is the actual bucket, it gets filled in from the top lifted it up. And when it reaches the ground where it is suppose to discharge what happens is this portion slightly lifted up the mechanism is there and this opens up through this lever system.

As it opens the bottom is opened like this and from the bottom discharge takes place, but the whole of the bucket gets lifted up a little bit more and the scared is actually touching the ground. So, this scared touches the ground this is the bucket is lifted up beyond scared and concrete is discharged within this scared. So, that it immediately does not come in contact with the water the cement on you know, some portion later on come up as I lift it up, but whole of the concrete does not come in contact with the water. This is 1 mechanism of discharging concrete under water.

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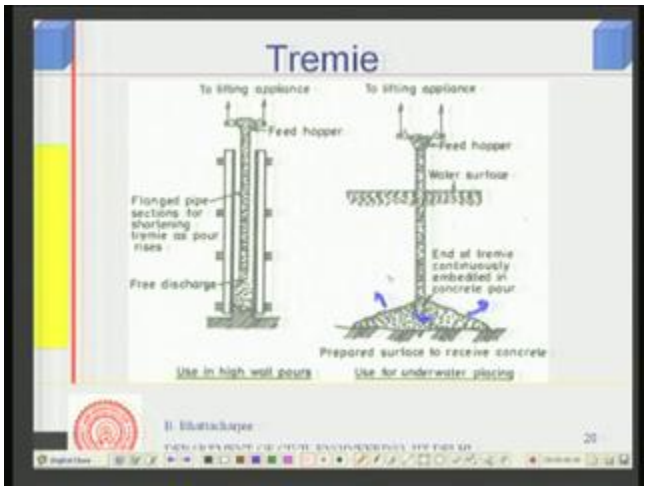

The more common way is through tremie concerting, this is called tremie pipe. What is done is, this pipe is loaded onto this is for example: for retaining wall very deep retaining wall right high wall and this is the concrete being ported not involved just below onto the below water. Now, you load these pipes are called tremie pipe so load piece by piece, and then at the top a little bit load and there is blench through which you connect and you will and lower them down.

As you lower them down, they go down below and within the form and then you discharge. Now in case of this, 1 as you can see the bottom of the tremie pipe is always below the top surface of the concrete. So, concrete will go on building up a hip something like this; you know, along this direction. So, concrete will actually build up a hip because discharge is always at this point and it will build up hip form the bottom. So, only the cement or concrete at the top surface, is in contact with the water this rest of the concrete is at the bottom and not in contact with the bottom.

So, we can effort to lose some amount of concrete which property will be some on, not as good as the bottom concrete. Actually, bottom concrete is what would be used the top concrete will be, but this has to be flowing. So, that it can continuously flow there is flow able concrete is nearly self compacting it should be, but there is other problem associated.

For example: just below the water there is no problem, but if it is just a stranch and there is no frame work. Then you usually stabilize such you know soil, stabilize the surrounding soil by using bentonite and such things like in case of a concentive file.

So, let us say for a bridge foundation of a bridge now these connective files what they do is, they drill a hole through the ground. You know the bed level, and then stabilize this while by putting bentonite slurry. This slurry can stabilize the soil, then this is to be concrete is then tremie pipe is load and concrete is then pore there, but bentonite has to be removed by changing it specific gravity there are washing methods. If you are not done this washing properly bentonite quite often gets contaminated with the concrete and resulting may lead to various kind of problem.

So, generally under water concrete is a difficult proportion in whichever way you are doing. Therefore, it should avoid. But if you cannot avoid it this could be 1 of the methods. The grouting is another method which is quite often used in bridge construction in what is called calgrouting, plugging of plugging of wells sunk well; so, what is done is there bolder is first dumped. Boulders are first dumped something like this. Let us say, the bottom of the well.

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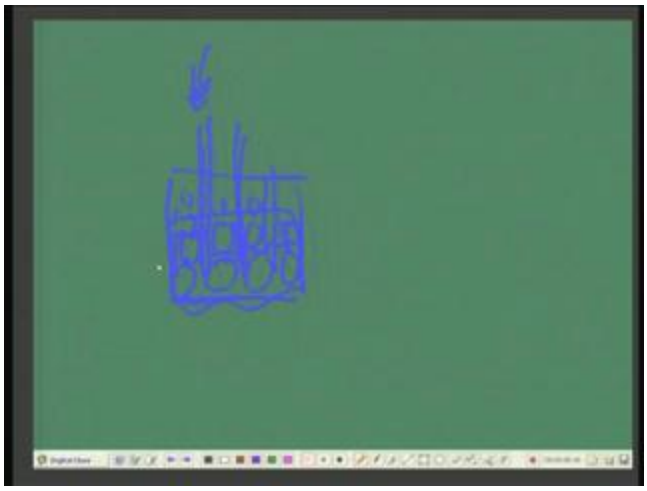

So, you dump some boulder straight away and from the, top and lower pipe before that you lower the pipes. First you lower pipe some pipes small pipes, and then boulders are dumped from the top up to certain height desirable height as by design. Then, through this pipe reach cement sand slurry is pumped or you know, grout is pumped through it these grouts then spread over this position all over these positions making this as a kind of concrete.

This technique is quite often used in bottom plugging of wells. So, grout could be 1 of the ways, grouting of reach cement, sand slurry using grouting pumps. So, actually it is driven down through pumps and then this is open bottom is open this gets spread up as this starts setting the material that the grout start setting, you lift up the pipe continuously and when the slurry is you know filled certain portion you lift it up rise its level, and then again grout the slurry. This is how, bottom plugging is done 1 of the ways of concreting is also grouting through, using various kind of pumps various kind of pips and pumps system this is called calgrouting.

The other variety could be tremie the buckets and then pumping concrete is directly possible because you can lower the nozzle of the pump into the ground, into the below the water, into the location or where you want to place the concrete below the water. And directly discharge; there last fourth method is put the concrete in back and simply dump it. So, this is what under water concreting.

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And then next will come to another method which is, a versatile method combines both mixing can combine both mixing and transporting concrete over a large distance this is called ready mixed concrete. Now, this is used in very much in places where you have congested site and you cannot mix the concrete at the site. So, where site mixing of concrete is not possible you can use ready mixed concrete besides, this has got other advantages the advantage is that, the quality can be controlled better because, concrete is mixed at the factory 1 case of course concrete is mixed in the factory. So, if it is wanted you can actually have a factory like situation where, you can produce the concrete and transport the concrete to the site using this kind of process which is called ready mixed concrete process.

What is this definition? what we understand by the ready mix concrete ready mix concrete production is the process, where by mixing and transportation of concrete can be combined together and the product is delivered to the site at times right in the mould straight in the mould straight away, some cases right to the mould. So, this is basically what, we understand by ready mixed concrete. The IS definition IS 4 9 2 6 is the code which, deals with the ready mix concrete its definition is concrete delivered at site or into the purchaser's vehicle.

So, it is actually concrete is sold it is now separated out from the site activity you can buy the concrete ready mixed concrete can be purchased from ready mix manufacturer like you do many other things you know something like milk or many other thing you can purchase from somebody, and then use it. Similarly, concrete can be purchased from somebody who manufactures concrete, and then he would the producers shall deliver it either purchase a vehicle or to the location in a plastic condition, it is actually delivered in plastic condition and it does not require further treatment before, that can be used or placed in position and then there it is set and harden.

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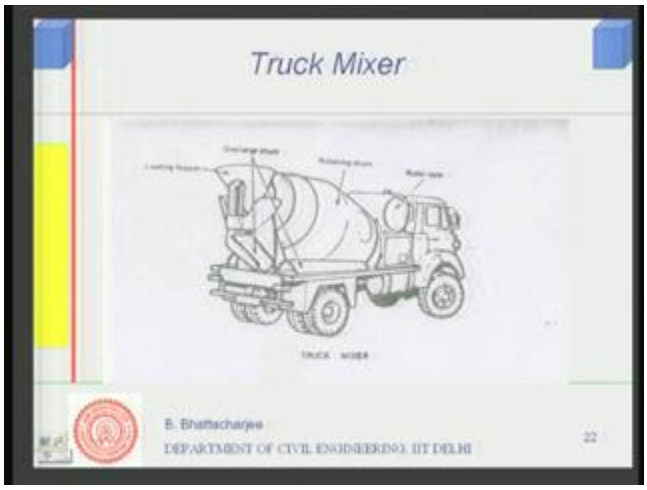

So, you should be doing any processing of the ready mix concrete as defined by this definition. This is what is ready mix concrete, now ready mix concrete can be of 3 kinds; you can have, something called truck mixer in this case at the plant side you do not need a mixing plant because, this truck can serve both the purpose of mixing as well as the transporting the concrete how does it do it. Actually it loads up the dry ingredients and it has got a mixing water tank and at the point when, it once to start mixing this water is transferred to the rotary drum and already, where the dry mixer exists. The mixing process then can start, while traveling and appropriately can be discharged.

So, truck mixer is the 1 which has got a mixer fixed onto it does the mixing job while traveling, on the road it does the mixing both transporting and mixing job is coupled together. And then discharge the concrete at the side this is the loading hopper and this is chute through actually finding the concrete will be discharged can be added up this 1 and it can discharge directly to pump or to a conveyor belt and the pump can straight away place the concrete. Some cases if it is the ground level or such places it may directly discharge the concrete onto the form where it is to be placed.

So, something like slab or foundation rough and similar sort of thing for example a well gap for a bridge, then such situation it can directly discharge through the chute come to the location where it to be placed. Now, there are problems associated with this you need you need a lot of energy to do this. The power required for the machine is very high a good lot of power will be consumed in the mixing process. So, this has to have a very elaborate plate; so, that it does the mixing say rotating drum mixer so it will not be tilting anyway non-tilting type of rotating drum mixer which we discussed earlier, should have a lot of elaborated plate systems; so that the mixing process is done.

So, then payload is relatively less compare to some other kind of system where you do not do the mixing, but then you have avoided the need for a mixer machine. This is not very popular; not very popular the other variety which has been talking about ten minutes later a few minutes later is more popular. Payload is less because it has to carry as separate even space, would be occupied by mixing water; mixing water also occupy some space. So, payload of this 1 you needs high capacity high power force such a machine such a vehicle.

So, that means; first thing you need power for driving the vehicle, and then you need power to drive the mixing process. So, therefore power required is very high not a very popular proposition, but second of doing it is do not mix it on the truck.

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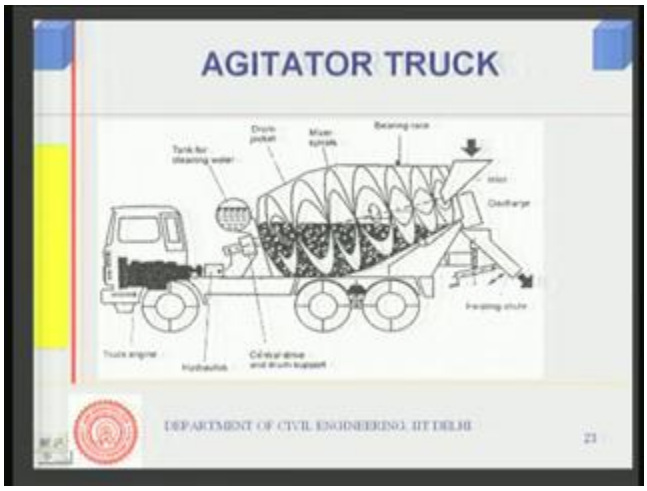

But what you can do is you can gone agitating the concrete where, it is traveling. So, what will happen you mix it in a central mixing plant? So, you have batching plant their previous case in case of truck mixer, you can have only batching plant just batching plant requisites proportional in the material, in weight and load it into the truck. In this case you have batching plant as well the mixing plant.

So, what it does batching plant and then mixing plant; so, what it does batching plant and then mixing plant you get the mix material and then it is loaded onto the truck. So, this truck it is loaded but if you just take it normally on a normal truck without any kind of agitation what will happen it will set, such that it should not set you actually keep the concrete agitating at a slow speed may be about, 3 to 4 rpm or sever rpm or not more than that, agitated during its travel.

The thing is that the concrete is being all from the central plant to the side in earlier cases you are actually handling ingredients mixing process you started somewhere in between, but here mixing is already done, so mix material is being transported. Then loss of slump as well as, agitation should be done in order to avoid any kind of segregation. This of course, has got a small water tank for cleaning purposes later on because site is the water not available you got it cleans it.

So, if you look at such a truck such a truck is called agitator truck an agitator truck is concrete agitating from. The mixing plant to the batching and mixing plant to the side and delivers it through chute etc, in the same manner as stated earlier. This is got a drum a drum agitated drum and this is the blade through, which it actually maintains the agitation activity it rotate to this axis, this is main axis through about which it rotates and keeps keeps the concrete agitating.

This will have high payload because now, the power required will be also less it do not require high power as much as the previous 1 the required will be less; usually, operated by hydraulic system as you can see and this is of course main engine. So, part of the power goes in driving only small part goes in agitating and while discharging of course, there is certain amount of power is used. Loading certain amount of power is used discharging using certain amount of power that time, actually vehicle is stationary. So, this is what is called an agitator truck.

So, this is the second mode the first mode was a truck mixer where, mixing is done on the road itself and appropriate time. The concrete will not halt for a very long time; the chance of slump loss could be somewhat less in case of truck mixer. But you require a high power so therefore, the machine is costly payload is less. So, you cannot deliver large quantity of concrete relatively speaking; the other is central limit concrete truck mixer this is central limit concrete mixing. The concrete centrally and then transporting the concrete to this agitated truck.

The jolting action of segregation due to jolting such thing will be much reduced here because, now you agree you are actually agitating the concrete therefore there will be no much less jolting action. So, this is the second variety, third variety could be called string mix concrete where you partially mixing the central plant and while traveling you do the rest of the mixing all distances etc are important we shall see this somewhat right now.

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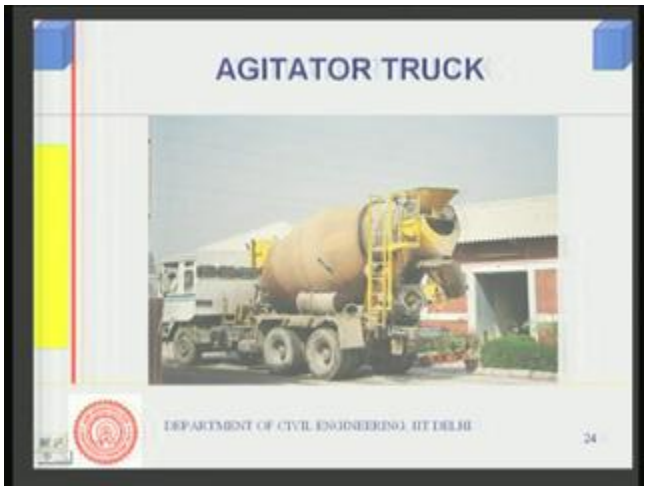

So, agitated truck agitator photograph of agitator truck look like this. This is the loading hopper and the discharge through this of course it will show it another angle and this is the basically; the mixer and this is the basically the, agitator this is the cleaning water. Now, this agitator is covered with a cloth you can see to avoid heating in fact you can color in white in tropical countries or in India, when you are handling in summer this will get heated up very fast. It will observe heat from the you know it will observe heat from the environment and it will start drying the concrete at the faster rate. Therefore, loss of slump could be higher.

So, you can put actually wet gunny bag wet, gunny bag can be kept wet so, that there is continuous evaporation of water from this gunny bag wet gunny bag and thereby it keeps the concrete cool there are various other means of keeping concrete cool, but while transporting it should not get heated up, you might paint color white color to actually reject the radiation, not observing it also you can have wet gunny bag this is actually the wet gunny bag, that is used to keep the concrete cool.

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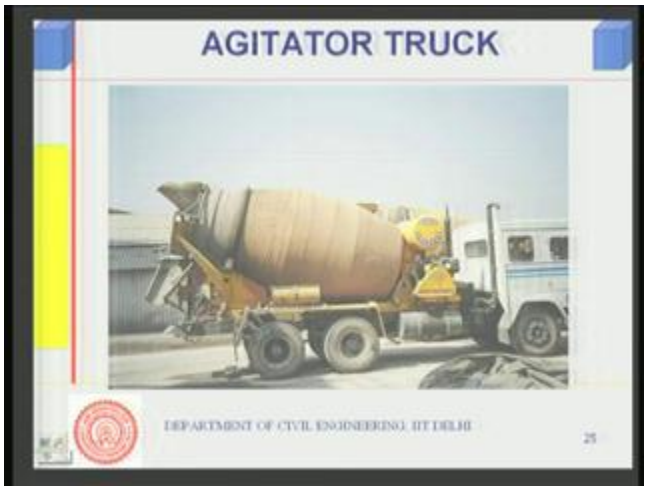

So, this is another view of the same truck now, this shows the discharge chute and you can actually elongate the chute, there is something some additional chute available. This is another view of the agitator truck, main concrete technology concerns are something like this.

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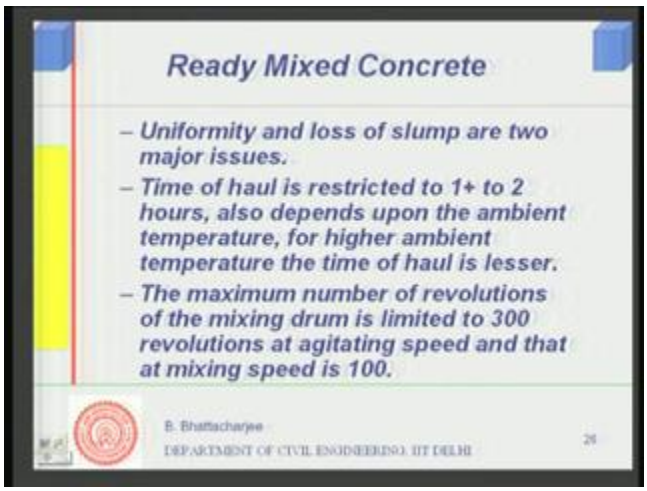

The basic concrete technology concerns are something like this; concrete should be uniform because you are doing mixing or agitating process both here.

So, mixer is taken over at least by parts since you are agitating you are not doing mixing but you are maintaining its uniformity. So, uniformity is very important and it depends up on the kind of blade the maintenance of the mixing part of the mixer part of the truck or agitator truck or the truck mixer agitator truck is much more popular, can all the concrete over the 16, 17 kilometers of distances easily no problem. And there are commercial ready mix concrete available all over the world including the urban centers of India as well.

So, uniformity of concrete discharge should be uniform even after agitation or if it is coming from the truck mixer definitely it should be uniform. So, uniformity is an additional issue there should be no segregation or nothing that should be important issue second issue is of course, is the loss of slump and these are the main issues related to all kind of transportation. So, here also these are the 2 issues and in order that, this is taken care of many codes restrict the time of haul time of haul is restricted to 1 to 2 hours and also depends up on the ambient temperature. If the temperature is high loss of slump will be more because, it will get dry at faster rate.

Therefore, loss of sample will be more; for ambient temperature you might even restrict the haul time, the code does the most of the code does some restriction on hauling time also it restricts the maximum number of revolutions, for you know of the drum is limited to 300 revolution while at agitating speed and if it is at the mixing speed, then not more than 100 ambient; that is why, you know that is what is done again, over mixing is to be avoided this is also an issue. So, both over agitating may result in as we shall see long mixing time, can result in segregation or grinding of the some of the aggregate generating more fines.

So, therefore you cannot have too much of either agitation or mixing that has to be avoided besides that a lot of slump would be there. That is why, most of the code restricts the number of revolutions either in case of mixing or in case of both in case as well as in case of agitating.

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People have studied actually slump loss in RMC this diagram shows what is the slump loss in rmc you know it is the curve like this. So, as the time of haul increases this is the 4 revolution per minute that is what, is an agitating speed you had some hundred percent of the slump this is not even 100 millimeter of the beginning but with time after about, 5 6 hours there could be loss of slump but, then you can use various kind of things. For example you can use the retarder you can use the mixers, which are retards does what accelerator admixtures. You know, there are various kind of chemical admixture I mentioned, when I was talking about concrete as a material. So, there is the class of mixtures which are called accelerators which accelerates, the strength calcium chloride is 1 such accelerator there are various other accelerator.

So, retarders are 1 which actually retire the setting process itself also addening process. In extreme cases, if you add too much of the retarder it can kill the concrete. So, killing of concrete it means it will never set; sometimes these are useful in sites you want to kill the concrete. For example: in a conveyor belt concrete is struck and you want sufficient time time to clean this up. So, you can actually add some amount of sugar; sugar is the good retarder, but of course in case ready mix concrete people do not use sugar but what is used is, some sort of chemical admixture which are retarder various kind of commercial retarder in form of chemical admixtures available.

So, if you use the retarder then this time possibly loss of slump will be relatively less. So, slump loss could be there if you are not used any retarder or even if you use retarder the rate of loss of slump will be less. So, retarder is common practice to be used in case of RMC. So, the loss of slump is of this form so using retarder for 5 and 6 hours effectively, you can actually, 5 6 hours you can retain some amount of slump.

The second way is design high slump in the beginning; in the beginning itself, suppose you need 40mm slump. You design it for a larger slump so that, after loss suppose you know the haul time likely to be 3 hours or something of that kind. So, you design it for high slump with retarder or without retarder whichever way is another the way, design it for higher slump. So, that after the loss of slump actual slump is available at the site is now, what is required slump what is according to the specification. So, slump loss is 1 issue and it can be tackled in various ways by using retarders by using higher slump in the beginning and so on.

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Now, 1 can do something else also one can actually, regitated the concrete at the site, regitated the concrete or remix the concrete by adding a little bit of water, but in such case there is the loss of strength. There is the loss of strength; loss would be there will be

some amount of strength loss when you have done this. And this diagram shows if you are doing retampering with additional amount of water, you add 10 kg of water per meter cube additional and try to retamper it will gain its strength there will be some amount of loss in strength.

So, this is not very desirable way of actually you know taking care of the slump loss. Because slump loss would be there, but if you know the whole situation it depends up on the situation to situation by design 1 can even use this sort of thing. If you know how much loss of strength would be there design the concrete for higher strength in the beginning itself, and then add some water maintain the initial water cement ratio lower at the site you might add additional water. And, then remix it a little bit agitator or mix it higher speed, and then deliver it this will of course of function of temperature it will also depend up on the temperature of the concrete.

Now, the issues there are many other issues associated with this kind of ready mix concrete. First thing is that, while transporting concrete 1 may have to get, 1 may have to emphasize the traffic conditions. So, if it is struck in the traffic conditions then there can be problem this condition that you are operating in; 1 must visualize this condition and accordingly formulate its procedure or process this is 1 issue traffic conditions and things like that.

The second issue of course this concrete if it desire concrete quality can be very high and not only that, the consumer is actually getting read of many sort of headache rather. First of all, you will not have to set a plant of the site mixing plant of the site so space usage would be less, you will not you do not need space for mixing at the site no mixing plant, no batching plant, nothing space will be saving. This can construction activity can generate certain amount of pollution dust and things like that.

So, in some places where there is environmental concerned you may not actually, set off a plant. Set off the plant, elsewhere in industrial area and then get read of purchasing aggregates and things like that and handling, the production process, but there has to be a

good control over what you are getting. So, long you know you have good control over whatever you are getting. You have rigorous scheme of accepting the material or concrete that has come the product that has come to you, then this would be useful thing; also the thing is that quality control can be achieved at the plant provided it is required. You know it is desired if the indention is there, but there is the possibility since it is produced in a factory like position, batching plant can be automated mixing system bind large many thing can be automated and thereby you can produce quality control, quality concrete by this sort of process.

So, as a buyer 1 can buy the quality concrete provided he has got strange excepted system for such product that it is buying. Well can be economic the cost can be a little bit higher if you think of the time saving; you know all handling people handling purchase etc if you consider all these it may come nearly same. You know cost would come nearly same but while setting up cost is there for this sort of plant at the site if it is small concreting you may not require large setting of course.

However; space is 1 of the major concerns why it is becoming popular in India although, the many develop countries many countries like Japan uses consume 70 percent of its cement in ready mix concrete only; many other countries used as large as 70 to 80 percent of their cement produce through ready mix concrete. Small other countries like like Malaysia they use as much as 15 to 16 percent, but India at present it is not very large, restricted to main urban centre where there is a lot of conjunction.

So, the traffic problem is the another problem which 1 has to consider while selecting this kind of concrete, but main problem concerned in urban area environment concerns space, you do not space do have a plant; therefore, to buy the concrete this can lead to a good construction practices and good quality concrete. So, this is all about a transporting and mixing of concrete ready mix concrete is the process, where you have part it combines actually mixing sometime together with transporting.

But 1 most important process of transporting and placing the method, which combines both, transporting and placing, is pumping well. We will have we look into this 1 in the next lecture.

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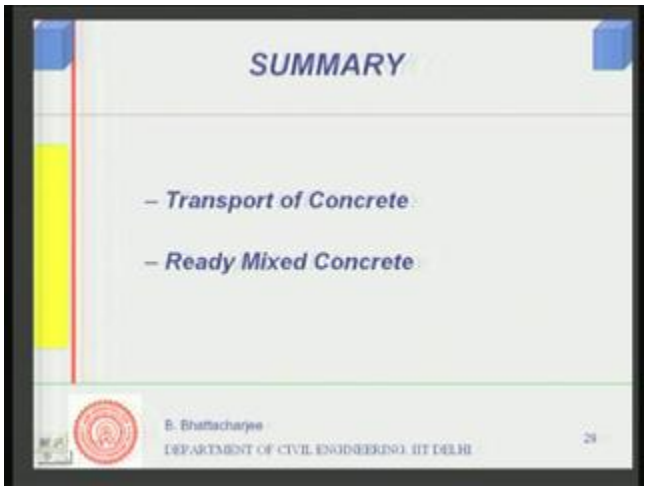

So, now we come to the summary of this lecture and this is what we have discussed we have discussed the various methods of transport of concrete and we have also discussed. The issue of concrete technology issues related to transport of concrete, that is how it is going to effect the properties of concrete homogeneity of concrete, uniformity and homogeneity of concrete and loss of properties like slump lose. Main concerns are of course the segregation and loss of slump.

So, then we have discussed this process called ready mixed concrete which combines sometime it can combine mixing and transporting together, but we have seen that this can be a very useful method in urban areas for congested site and give you a much better quality concrete. Then small non engineer concrete when used judiciously, in the next lecture we look into the most versatile method of transporting concrete that is pumping together, with other components of production process. So, I think this ends our discussion on this.

Thank you very much for listening to this lecture.