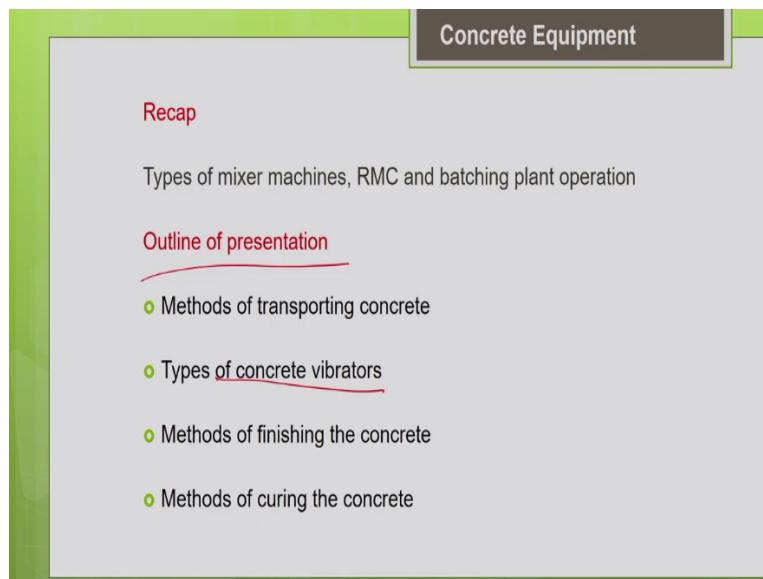


Construction Methods and Equipment Management
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Lecture – 21
Concreting Equipment (Part 2)

Hello everyone, I welcome you all to the Lecture 21 of this course construction methods and equipment management.

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So, in continuation with our discussion in the earlier lecture on concreting equipment, in today's lecture, we are going to discuss about the equipment needed for transporting the concrete, consolidating the concrete and finishing the concrete. So, in the last lecture, we discussed about different types of concrete mixer machines. And also I introduced to you about the ready mix concrete and about the batching plant operation.

So, let us look into the outline of today's presentation. In today's lecture, we will be discussing about what are all the different methods available for transporting the concrete and the concreting equipment involved in that process. And we will also look into what are all the different types of the concreting vibrators which are available for the consolidation process of concrete.

And we will be discussing about the methods of finishing the concrete surface and about the significance of curing of concrete.

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Concrete Equipment

Handling and Transporting concrete

Selection of method of placing concrete

1. Prevention of segregation
2. Placing before concrete attains initial set
3. Economy

General guidelines

- Concrete should be placed within 30 minutes of mixing.
- Greater height of Free fall should be avoided (Height of any free fall limited to 1.5m unless downpipes are used)
- Inclined end discharge should be avoided

So, very commonly, you can see that people put lot of efforts in mix design of concrete and preparation of concrete, but, very often they do not care much about the method of transporting the concrete. So, what happens is, if you do not carefully transport the concrete to the desired place, so, during the transit the concrete may get segregated. So, if the segregation occurs, you will not get a homogeneous microstructure in the concrete.

And that is going to affect your strength and the durability of your concrete. So, that is why we need to put proper efforts even for selecting a method for transporting the concrete appropriately. So, how will you select the method for placing the concrete? So, once a concrete is prepared, our main objective is to transport it to the place of casting. As early as possible without much loss of time, we need to transport it.

Because, as you know, once you add the water to the cement, your cement starts setting because of the hydration reactions. So, before this cement attains its initial set, we need to transport the concrete as early as possible to the casting place. And also, we should not allow the concrete to get segregated during its transit. Because it is a heterogeneous material, it is a composite material.

You know, it is a combination of materials with different sizes. So, the one which is heavier that is a core segregate will always try to settle down. So, it always results in the segregation, if you do not place a concrete as early as possible. So, that is why we need to transport the concrete and place it as early as possible before it attains a initial set and before it segregates.

So, when you select the method of placing the concrete, we should always keep in mind that we should select a method of its own resulting segregation of the concrete.

So, we should place it or transport it in a homogeneous manner only. And we should place it before the concrete attains a initial set. That is also very important. Otherwise, workability will be lost. You will not be able to work with the, you will not be able to consolidate it properly. An important thing is whatever method you are going to choose, it should fit into your project budget or the project size.

So, we should consider from the economy point of view also. So, these are the basic guidelines we should keep in mind when you select the method for transporting or placing the concrete. One is as early as possible we should transport it. We should transport it before it attains a initial set. Then another thing is we should transport the concrete in a homogeneous form only.

So, it should not get segregated during its transit and whatever method you select, it should be economical. It should fit into your project budget. So, these are the general guidelines we should keep in mind while placing the concrete. So, as I told you, concrete should be placed within 30 minutes of mixing before it attains a initial set. And we should avoid greater height of free fall of the concrete.

Your concrete you should not allow the concrete to freely fall over a greater height that will result in segregation. So, the maximum limitation of the free fall height allowed is only 1.5 meter. Free fall means there is no support at all. You are just freely allowing the concrete to fall from a particular height that is called as free fall. But if you are going for some guided flow like we are going to use some pipes, vertical down pipes.

Steel pipes for transferring the concrete. In that case, you can have a greater height of fall. But for free height of fall, the maximum height allowed is only 1.5 meter. So, beyond that there are more chances for segregation. And another important thing you should note is that inclined end discharge should be avoided. Many times you can see that concrete will be allowed to fall.

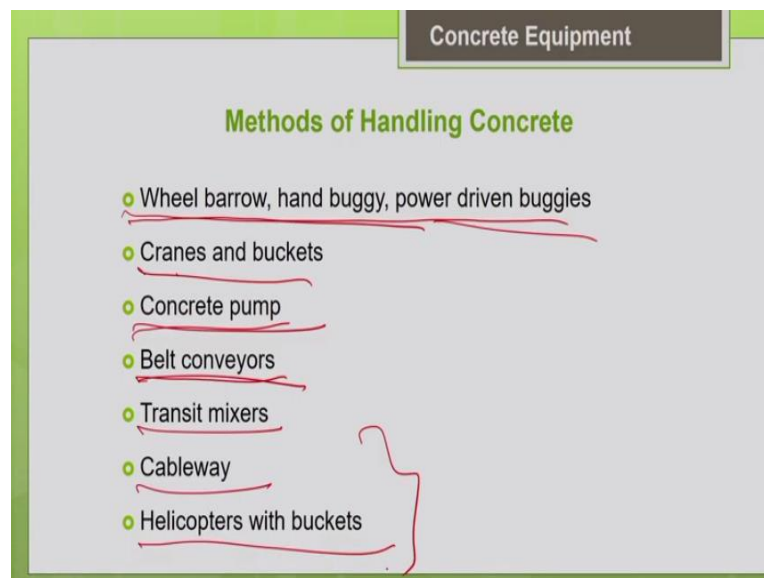
Or, it will be conveyed from one level to another level from a higher level to a lower level in an inclined manner with the help of a chute or pipeline. So, the flow of concrete can be in a inclined manner. But, at the end, when the concrete is discharged, the end discharge should be

vertical. That you should always keep in mind. That the end discharge should be vertical you have to make some arrangement in some form so that the flow at the end will be vertical.

This is because when the discharge at the end is inclined if it is going to be inclined, since, as I told you it is material with different sizes of particles. So, you have the heavier coarse aggregate bigger size coarse aggregate. So, the particles with the greater mass will attain greater momentum. So, it will be thrown farther away from the lighter material. So, what happens is when the discharge is going to be in a inclined manner, so, what happens is that heavier particles will be thrown farther away.

So, that means the coarse aggregate will be thrown farther away from the remaining mortar. So, this will result in segregation. That is why at the end we should ensure that the discharge should be in vertical manner. So, for that you can use some vertical downpipes and to facilitate the vertical end discharge.

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There are different methods of handling the concrete. So, starting from very simpler method like wheel barrows and hand buggies to advanced methods like concrete pumping, belt conveyors. So, there are a range of options available. So, depending upon your job productivity requirement depending upon your placement rate needed. So, depending upon how much horizontal reach you need to cover?

Or, how much vertical reach you need to cover? According to that, you have to make the choice of the method of handling the concrete. So, we have the simple option like a wheel barrow,

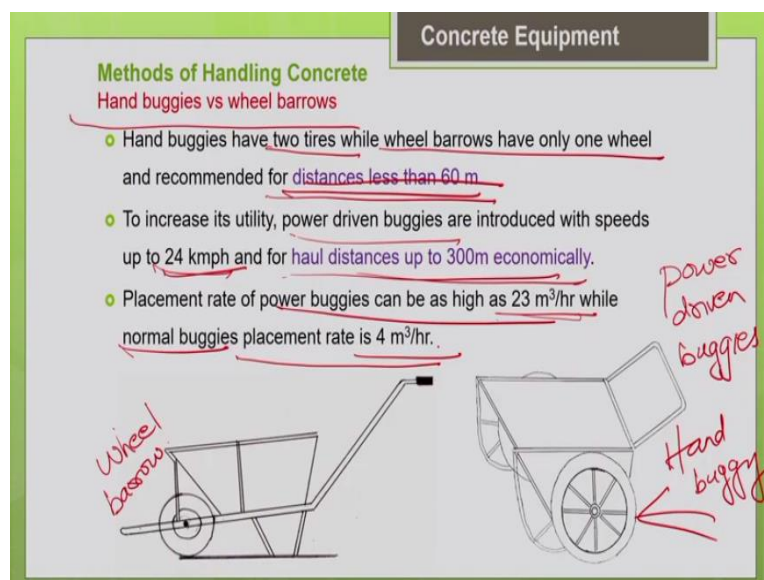
hand buggies, power driven buggies. And also we have this option of cranes and buckets. So, particularly when you want to do the concreting at a higher level, say, I want to do the column concreting at a particular floor say 6th floor or 8th floor.

So, to reach greater height, so, generally we go for cranes with buckets, concrete buckets. So, that will facilitate you to reach any vertical height. So, another commonly adopted method nowadays is pumping. Pumping is the most I can say the fastest method or the quicker method of placing the concrete. When compared to the other conventional methods. So, and we also have the belt conveyors.

So, when you want to place very huge quantity of concrete over a large distance, you can go for belt conveyors. Transit mixers which we use it for transporting the concrete from batching plant to the job site. Cableway with concrete buckets, helicopters with concrete buckets, so, these can be used if you are going to have a construction over a the river valley where the mobility of other equipments are not possible on the ground.

Then you have to carry your concrete in a cableway with a concrete bucket. Or, you have to carry the use a helicopter to carry the concrete bucket. So, depending upon the location of your job site, so, you have to make the choice of the equipment.

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So, let us discuss about all these methods one by one. The first is we are going to discuss about the hand buggies and the wheel barrows. So, these are the simplest mode of transport of concrete. So, I cannot say this is the best method. But, still we can very commonly see in many

project sites using where they use hand buggies and wheel barrows for transporting the concrete.

So, what is the basic difference between the hand buggy and a wheel barrow? Hand buggy you can see that it will have the 2 tires. It has 2 tires. This is your hand buggy. And this is your wheel barrow with a single tire or single wheel. So, obviously, the stability of the hand buggy is more when compared to the wheel barrow. So, when compared to a wheel barrow this will buggy will have a better placement rate.

But all these are economical only for feasible or applicable for only for a shorter haul distance. So, the economical haul distance with these wheel barrows and hand buggies are less than 60 meters. So, but since you if you want to increase haul distance, then you have to go for power driven buggies. Nowadays, these are also very popular. Power driven buggies, which will have a better speed which will give you a higher speed.

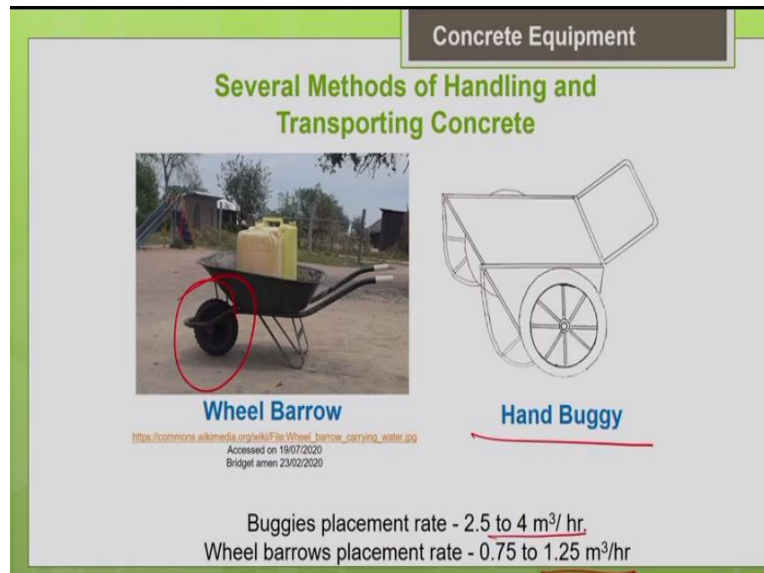
Say, you can have a speed even up to 24 kilometer per hour and that will give you a very better placement rate of say 23 meter cube per hour when compared to the normal buggies which can give you only a placement rate of 4 meter cube per hour. So, when compared to normal buggies your power buggies can give you a very high placement rate of 23 meter cube. I mean relatively 23 meter cube per hour.

The power buggies can cover a haul distance of up to 300 meters when the normal buggies can cover a distance less than only 60 meters. So, according to your requirement job requirement and the productivity requirement of the placement rate needed and the economy everything have to take into consideration and make the choice of the machine. So, let me summarize.

So, your hand buggies have 2 tires while your wheel barrows have only one wheel. And these are recommended for a distance less than 60 meters. So, if you want to increase your utility of your buggies you can go for the option of power driven buggies. So, they can have a speed up to 24 kilometer per hour. And they can have a haul distance up to 300 meter, so, when you go for power driven option.

And the placement rate if you compare, power buggies can give you as high as 23 meter cube per hour when compared to the normal buggies whose placement rate is only 4 meter cube per hour.

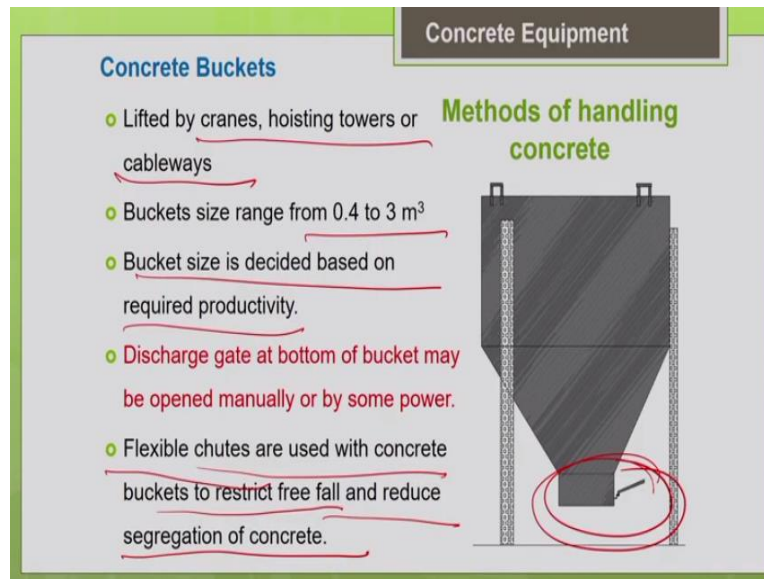
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So, this picture again shows you the comparison of your wheel barrow. This is a wheel barrow with single wheel and hand buggy with 2 wheels. So, you can compare the placement rate your buggy is giving you a placement rate of maximum to 4 meter cube per hour. But wheel barrow can give you a placement rate maximum 1.25 meter cube per hour only. So, the best thing is to have a better productivity.

You should go for power driven buggies which can give you a better speed and better placement rate.

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So, next is about the concrete buckets. So, very commonly we use this concrete buckets lifted by crane particularly for the high rise buildings. You can see that the cranes are used to lift the concrete buckets to the particular floor level to do the concreting work. So, not only the cranes, we can also make use of the hoisting towers or you can even use a cableway as I told you depending upon the job site location.

So, I can use any lifting device and with the help of the concrete bucket, you can reach the particular height needed. So, there are different sizes of buckets ranging from 0.4 meter cube to 3 meter cube. So, generally for very massive construction like dams we go for a very big size bucket so that you can reduce the number of cycles and increase your productivity. So, your bucket size is decided based upon the required productivity.

So, your concrete buckets will have the discharge gate at the bottom. So, there are options like you can open the gate either manually or with some power mechanism. But mostly the bigger concrete buckets we cannot open it manually. So, there will be some power mechanism to handle the gate. And also some flexible chutes are provided. Chutes are nothing but a pipe kind of thing, so, which will help you to guide the flow of concrete.

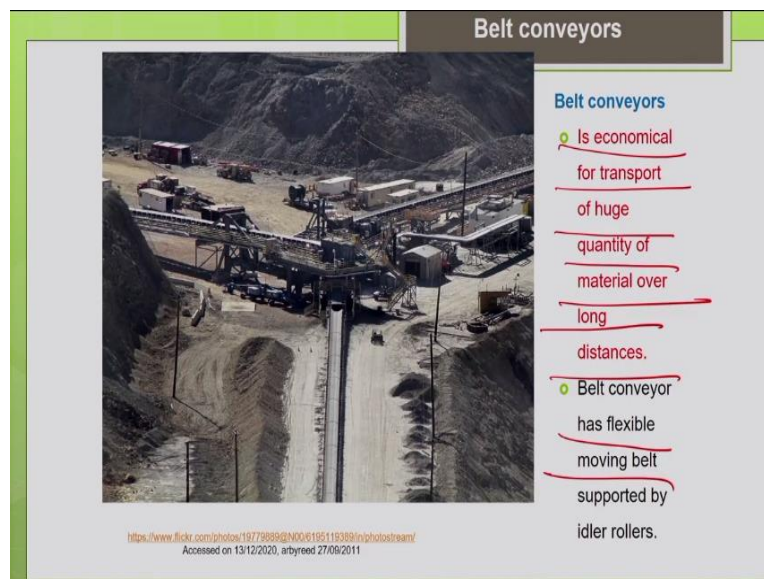
Instead of having a free fall of concrete from the bucket, you can guide the flow of concrete from the bucket with the help of a chute. So, flexible chutes are used with the concrete buckets to restrict the free fall and to reduce the segregation of the concrete. So, whenever you have a guided flow of concrete, there you can see that the chances for segregation will get reduced. That is why we should try to avoid the free fall of concrete as far as possible.

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So, this picture again shows a concrete bucket lifted by a crane.

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So, the next is about the belt conveyors. So, earlier belt conveyors were used only in the mining operations or tunneling operations. But nowadays, there are different ranges different configurations of belt conveyors. So, belt conveyors are very commonly used for material handling. We have portable belt conveyors, series conveyors. So, you can commonly see it in the RMC batching plant or asphalt batching plant or aggregate production plant.

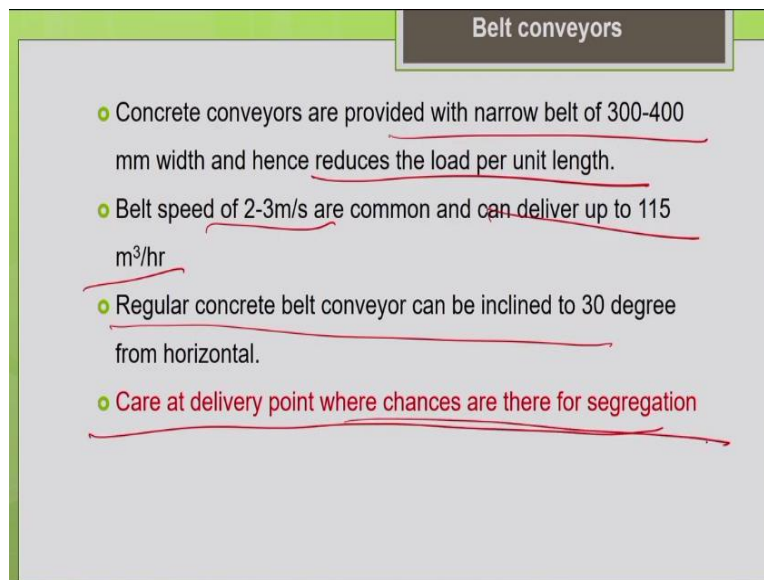
You can see that application of belt conveyors very commonly. So, generally we can go for belt conveyors when the placement rate needed is very high. Say, it is economical for transport of huge quantity of material over long distances. So, when you want to transport the concrete

over a long distance and you need to handle huge quantity, in that case, a belt conveyor will be economical than other modes of transport.

So, any way, you have to work out the economics and justify the cost associated with the belt conveyor. So, basically say for example, if you want to go for a concreting of a very huge foundation of a massive industrial plant industry. So, it is a very massive foundation, in that case your belt conveyor will be economical. So, you need to work out the economics to justify the selection of the belt conveyor.

So, what is a basically this belt conveyor will be having a flexible moving belt. As everyone knows there will be a moving belt operated by a motor. And this moving belt will be supported at intermittent intervals with rollers supported by idlers or rollers.

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The slide is titled "Belt conveyors" and contains the following bullet points:

- Concrete conveyors are provided with narrow belt of 300-400 mm width and hence reduces the load per unit length.
- Belt speed of 2-3m/s are common and can deliver up to 115 m³/hr
- Regular concrete belt conveyor can be inclined to 30 degree from horizontal.
- Care at delivery point where chances are there for segregation

So, when compared to the belt conveyors which are used for the used for handling the other material. So, there are some differences in the belt conveyor which are used for conveying the concrete because a concrete is relatively denser material. So, generally we prefer to go for narrow belt. We restrict the belt width to say 400 mm. So, but commonly you can see a belt conveyor with width of up to even 1 meter.

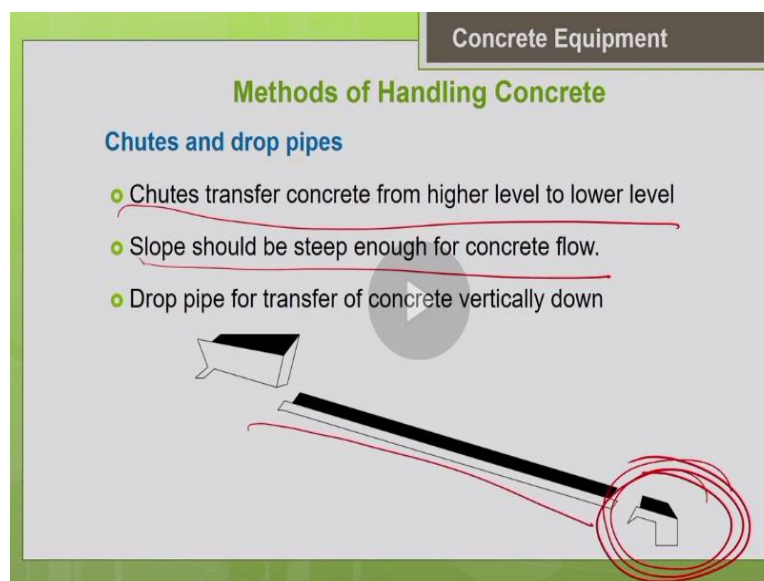
But generally for the concrete belt conveyors, we try to restrict to 400 mm width to reduce the load per unit length so that you can reduce the load per unit length. And you can have a belt speed of nearly 2 to 3 meter per second. So, as you know that higher the belt speed you can

have a higher placement rate. So, you can deliver even up to 115 meter cube per hour of concrete. So, it can give you a very high placement rate.

And the regular concrete belt conveyor can be inclined even up to 30 degree from the horizontal, so, up to 30 degree of inclination. So, it is proved that the material will be stable in the belt. So, but one thing we have to note that is when the though the belt conveyor is going to convey the material in a inclined manner, but at the end, the discharge should be vertical. As I told you, end discharge, you have to make it vertical.

So, you have to have a vertical down pipe which can facilitate vertical discharge of concrete. Otherwise, what happens? Because of inclined discharge, as I told you, your heavier coarse aggregate will be thrown farther away from the remaining material because of the greater momentum of the heavier material. So, that results in segregation. So, that is why make sure that the end discharge will be vertical. So, care at delivery point is needed where there are chances for segregation.

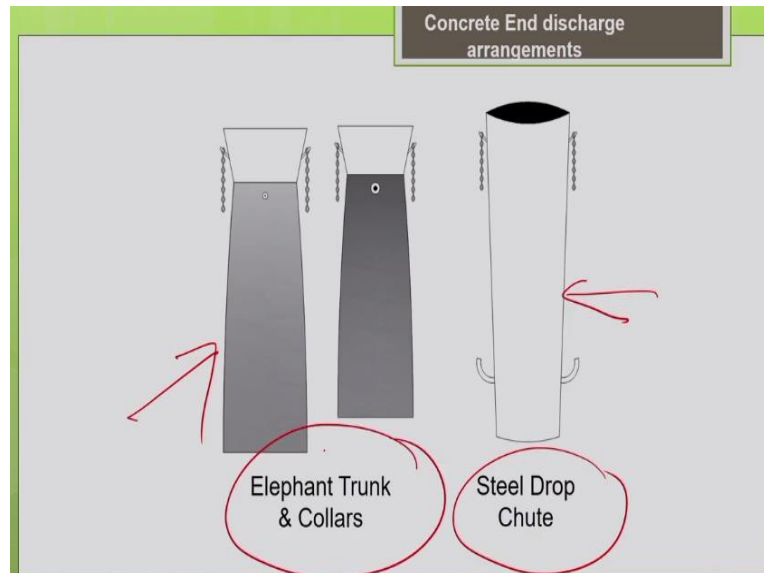
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These chutes are nothing but pipelines, which are commonly used to convey the concrete from higher level to a lower level. So, chutes transfer the concrete from higher level to a lower level. So, you should place it in such a manner that the steepness of the slope should be sufficient to facilitate the flow of the concrete. Slope should be steep enough to allow the flow of the concrete.

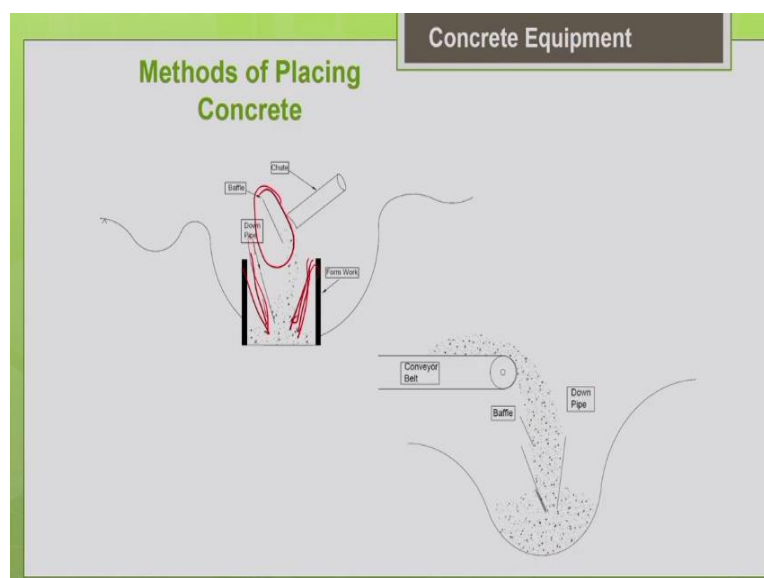
At the end, as I told you, you should make some arrangement for vertical end discharge. So, though the floor will be inclined in manner, but at the end, you have to provide some arrangement for vertical end discharge with a vertical drop down pipe.

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So, these are the devices which we commonly use for the end discharge of the concrete. So, this is nothing but a vertical drop down pipe steel drop chute. It is nothing but a vertical drop down pipe. So, it can be a rigid pipe or it can be a flexible pipe. So, when it is a flexible pipe, we call it as elephant trunk and collars.

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So, these are the schematic pictures which shows the right method of placing the concrete. Say for example, if you want to place a concrete into a concrete column formwork. So, we are going to do the concreting of column. So, you are going to deliver the concrete into this column

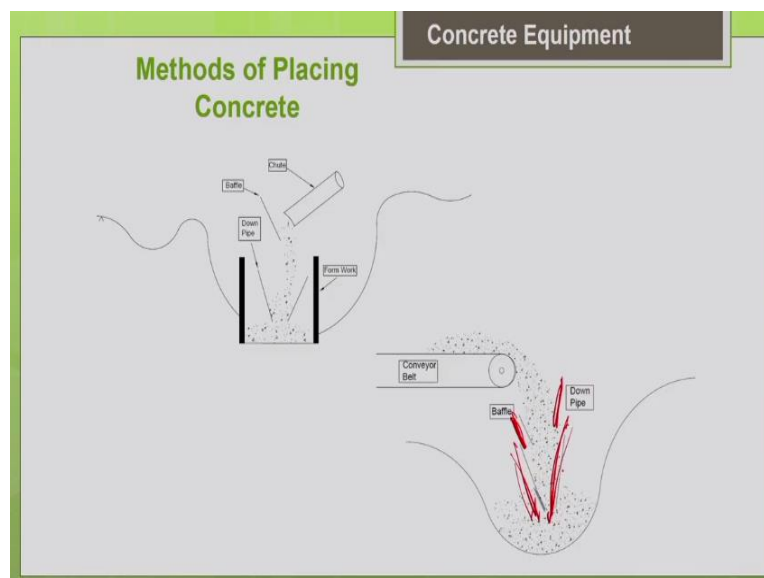
formwork. You should not just dump the concrete directly into the formwork. In that case, what will happen?

You concrete will strike against the formwork and that will result in segregation of your concrete. So, there should be some guided flow of concrete. So, for that, what are you supposed to do? So, the concrete is here in this picture is being delivered from a chute into the column formwork. So, it can be from a chute or it can be from any pipeline or it can be from a wheel barrow or a buggy. So, it can be from a transit mixer.

So, you are just discharging the concrete into this column formwork through a vertical drop down pipe. You can see this is the vertical drop down pipe. So, instead of directly just discharging the concrete into the column formwork, you are putting it into a vertical pipe and allowing a guided flow of concrete. This will reduce the segregation. In addition, you can also use a baffle or a deflector which will avoid the dispersion of the concrete, or scattering of the concrete.

So, all these things are to facilitate guided flow of concrete for prevention of segregation. So, you should use a vertical drop down pipe with a baffle. Similarly, so, when you are discharging the concrete from a belt conveyor, so, as I told you, we should make sure that the end discharge should be vertical.

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So, you should use a vertical drop down pipe with a baffle. So, this baffle will act like a deflector. You can have a baffle here also. So, this baffle will act like a deflector. And it will

help in the uniform flow of concrete into the required formwork without segregation. So, this is your drop down pipe and this is your baffle.

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Concrete Equipment

Methods of Handling and Transporting concrete

Concrete pumps

- Pumping method is smoother and faster than other methods
- Pump may be either truck or trailer mounted
- Pressure applied to a continuous column of fresh concrete in a pipe - Rigid or flexible
- Effective pumping ranges vary from 90 to 300 m horizontally and 30 to 90 m vertically
- Capacities varies from 20 m³/hr to 150 m³ / hr pipe diameters from 4 to 6 inch

So, the next method of transporting the concrete is concrete pumps. Nowadays, pumping method is accepted as a best method of placement of concrete because main advantage with the concrete pump is you can avoid multiple handling with the concrete. Generally, when you prepare the concrete in one lot, you should place it in one lot. That way we can avoid multiple handling that will avoid segregation of the concrete.

With the help of concrete pump, we are able to place it in one lot. So, that facilitates the prevention of segregation of a concrete. So, the pumping is smoother and faster than other conventional methods. So, basically what you do in pumping is you allow the concrete to flow through pipelines. So, how will it flow? You have to apply pressure to the concrete flowing through the pipeline with the pump.

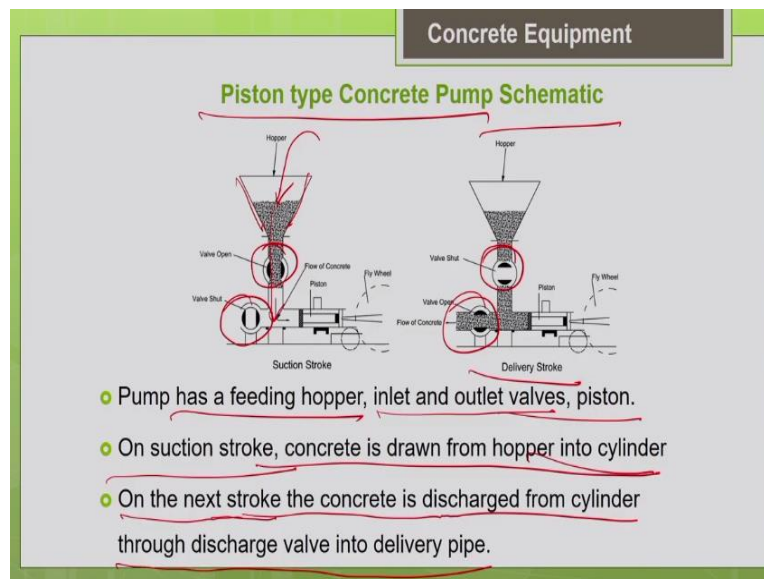
And then allow it to flow through the pipelines. So, based upon the mobility required at a construction site, it can be either truck mounted or trailer mounted. So, basically, what you are doing here is you are applying pressure to continuous column of fresh concrete in a pipe so that the pipe can be either rigid pipe or flexible pipe, whatever. So, you are facilitating the flowing of concrete through pipelines.

And the pipelines will be taken to the actual placement area placement location. So, this can cover horizontal distance of say ranging from 90 to 300 meter horizontally and vertically 30 to

90 meter. Obviously, when you pump against the gravity, so, the reach is relatively lesser when compared to the horizontal reach possible. So, with pumping, I can have a very high placement rate of even up to 150 meter cube of concrete per hour.

So, you can have a very good placement rate that depends upon the capacity of your pump and the diameter of your pipeline.

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So, there are different types of pumps available. The most commonly adopted method is your piston type concrete pump, reciprocating piston type concrete pump. This is a schematic picture of this piston type pump. So, basically these pumps will be having a hopper. This is the hopper. So, into this hopper, you have to discharge your concrete. From your either transit mixer or from a concrete mixer machine or from a chute or anything, you are going to discharge the concrete into the hopper of the pump.

And this pump will be having a piston you can see the piston. There is an inlet valve and an outlet valve. So, based upon the reciprocating action of the piston that is to and fro action of the piston your suction stroke and the delivery stroke will happen. So, what happens in this suction stroke? You can see that the inlet valve will be open, but the outlet valve will be closed. And the concrete from the hopper will be transferred into the cylinder in the suction stroke.

So, now, what is happening in the delivery stroke? Your inlet valve will be closed. And the outlet valve will be open. And the concrete from the cylinder will be forced into the or discharged into the delivery pipeline. So, that is what is happening in the delivery stroke. So,

nowadays, we have 2 pistons acting together so that when one is having the forward stroke other will be retracting so that you can have a continuous flow of concrete in your delivery pipeline.

So, basically, the concrete pump has a feeding hopper, inlet and outlet valves and the piston. On the suction stroke, the concrete is drawn from the hopper into the cylinder. On the next stroke, that is a delivery stroke. The concrete is discharged from the cylinder through the discharge wall into the delivery pipe. So, alternatively a suction stroke and the delivery stroke will happen.

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Concrete Equipment

Methods of Handling and Transporting concrete

Pumping

- Modern piston pump has two pistons, one retracting while other is in forward stroke for continuous flow of concrete.
- Before pumping is started, for lubrication, cement and sand grout is flushed through pump and pipeline.
- A rubber plug is inserted into pipeline and forced along the line due to water pressure for cleaning.

So, when you have the 2 pistons, you can have continuous flow. So, modern piston pump has 2 pistons, when one is retracting other one will have the forward stroke. So, this will facilitate continuous flow of concrete in your delivery pipe. So, another important thing to be noted with respect to pumping, pumping is a little tedious operation because, before you do the pumping of your actual concrete mix, you have to do some lubricating or buttering kind of job as I told you earlier for the conventional drum mixers.

So, otherwise, what will happen is if you do not do the lubricating process, your first batch of concrete whichever is going to be pumped through the pipeline, most of the paste will stick to the sides of the pipeline. And the concrete which is going to be delivered out will be having less amount of paste and more amount of aggregate. So, that batch has to be thrown out. So, that is why to avoid that and also we need some lubrication on the pipelines, which will facilitate the easy and uniform flow of the concrete through the pipelines.