Fresh Concrete: Batching, Mixing, Transportation, Placing

Lecture No. 07
Transporting : Mortar Pan

- Use of mortar pan for transportation of concrete is one of the common methods adopted in this country.
- In this case, concrete is carried in small quantities.
- While this method nullifies the segregation to some extent, particularly in thick members.
- Greater loss of water, particularly, in hot weather concreting.
Transporting : Wheel Barrow

- Wheel barrows are normally used for transporting concrete to be placed at ground level.
- This method is employed for hauling concrete for comparatively longer distance as in the case of concrete road construction.
- If concrete is conveyed by wheel barrow over a long distance, on rough ground, it is likely that the concrete gets segregated due to vibration.
Transporting: Wheel Barrow
Transporting: Crane, Bucket and Rope way

- A crane and bucket is one of the right equipment for transporting concrete above ground level.
- Crane can handle concrete in high rise construction projects and are becoming a familiar sites in big cities.
- Cranes are fast and versatile to move concrete horizontally as well as vertically along the boom and allows the placement of concrete at the exact point.
- Cranes carry skips or buckets containing concrete. Skips have discharge door at the bottom, whereas buckets are tilted for emptying.
- For a medium scale job the bucket capacity may be 0.5 m³.
Transporting: Crane, Bucket and Rope way
Transporting: Crane, Bucket and Rope way
Transporting : Truck Mixer and Dumpers

- For large concrete works particularly for concrete to be placed at ground level, trucks and dumpers or ordinary open steel-body tipping lorries can be used.
- As they can travel to any part of the work, they have much advantage over the jubilee wagons, which require rail tracks.
- Dumpers are of usually 2 to 3 cubic metre capacity, whereas the capacity of truck may be 4 cubic metre or more.
Transporting: Truck Mixer and Dumpers
Transporting: Truck Mixer and Dumpers

Email: cherrytruck@gmail.com
Transporting : Belt Conveyors

- Belt conveyors have very limited applications in concrete construction.

- The principal objection is the tendency of the concrete to segregate on steep inclines, at transfer points or change of direction, and at the points where the belt passes over the rollers.

- Conveyors can place large volumes of concrete quickly where access is limited.
Transporting : Belt Conveyors
Transporting : Chute

- Chutes are generally provided for transporting concrete from ground level to a lower level.

- The sections of chute should be made of or lined with metal and all runs shall have approximately the same slope, not flatter than 1 vertical to 2 1/2 horizontal.

- The lay-out is made in such a way that the concrete will slide evenly in a compact mass without any separation or segregation.
Transporting : Chute
Transporting: Skip and Hoist

- This is one of the widely adopted methods for transporting concrete vertically up for multistorey building construction.

- At the ground level, mixer directly feeds the skip and the skip travels up over rails up to the level where concrete is required.

- At that point, the skip discharges the concrete automatically or on manual operation.
Transporting : Transit Mixer

- Transit mixer is one of the most popular equipments for transporting concrete over a long distance particularly in Ready Mixed Concrete plant (RMC).

- In India, today (2000 AD) there are about 35 RMC plants and a number of central batching plants are working. They are truck mounted having a capacity of 4 to 7 m³.

- In one, mixed concrete is transported to the site by keeping it agitated all along at a speed varying between 2 to 6 revolutions per minute.

- In the other category, the concrete is batched at the central batching plant and mixing is done in the truck mixer either in transit or immediately prior to discharging the concrete at site.
Transporting:
Transporting: Pumps and Pipeline

- Pumping of concrete is universally accepted as one of the main methods of concrete transportation and placing.

- Adoption of pumping is increasing throughout the world as pumps become more reliable and also the concrete mixes that enable the concrete to be pumped are also better understood.

- The first patent for a concrete pump was taken in USA in the year 1913.

- By about 1930 several countries developed and manufactured concrete pump with sliding plate valves.

- The modern concrete pump is a sophisticated, reliable and robust machine.
Transporting Concrete Pumps

- In the past a simple two-stroke mechanical pump consisted of a receiving hopper, an inlet and an outlet valve, a piston and a cylinder.
- The pump was powered by a diesel engine.
- The pumping action starts with the suction stroke drawing concrete into the cylinder as the piston moves backwards.
- During this operation the outlet value is closed. On the forward stroke, the inlet valve closes and the outlet valve opens to allow concrete to be pushed into the delivery pipe.
Transporting Concrete Pumps
Transporting Concrete Pumps

- The modern concrete pump still operates on the same principles but with lot of improvements and refinements in the whole operations.

- In this concrete placed in a collecting hopper is fed by rotating blades into a flexible pipe connected to the pumping chamber, which is under a vacuum of about 600 mm of mercury.

- The vacuum ensures that, except when being squeezed by roller, the pipe shape remains cylindrical and thus permits a continuous flow of concrete.

- Two rotating rollers progressively squeeze the flexible pipes and thus move the concrete into the delivery pipe.
Transporting Concrete Pumps

Diagram showing the components of a concrete pump, including:
- Vacuum pumping chamber
- Rotating rollers
- Planetary drive
- Collecting hopper
- Rotating blades
- Delivery hose (pressure)
- Pumping tube (suction)
- Rollers farcing concrete through delivery hose
Transporting : Pipelines and couplings

- It is equally important to have correct diameter of pipeline with adequate wall thickness for a given operating pressure and well designed coupling system for trouble free operation.

- A poor pipeline can easily cause blockages arising from leakage of grout. Pushing of abrasive material at high pressure, through pipeline inevitably creates a great deal of wear.

- Continuous handling, frequent securing and releasing of couplings creates wear at joints.
Transporting: Pipelines and couplings

- Generally almost all pumped concrete is conveyed through 125 mm pipeline.
- General rule is that the pipe diameter should be between 3 to 4 times the largest size of aggregate.
- Concrete has been pumped to a height over 400 m and a horizontal distance of over 2000 m.
Pumpable Concrete:

- A concrete which can be pushed through a pipeline is called a pumpable concrete.
- It is made in such a manner that its friction at the inner wall of the pipeline does not become very high and that it does not wedge while flowing through the pipeline.
- Pumpable concrete emerging from a pipeline flows in the form of a plug which is separated from the pipe wall by a thin lubricating layer consisting of cement paste.
- For continuous plug movement, the pressure generated by the flow resistance must not be greater than the pump pressure rating.
Pumpable Concrete:

- However, if the concrete is too saturated at higher w/c ratio, the concrete at certain pump pressures may be such that water is forced out of the mix, creating an increase in flow resistance and a possible blockage.
Design Considerations for Pumpable Concrete:

- Excessive frictional resistance
- Marginal (pumps at high pressure)
- Marginal (tends to segregate)
- Excessive segregation and bleeding

Diagram showing the relationship between cement content and aggregate void content for pumpable concrete mixes.
Placing Concrete

- It is not enough that a concrete mix correctly designed, batched, mixed and transported, it is of utmost importance that the concrete must be placed in systematic manner to yield optimum results.

- Placing concrete within earth mould. (example: Foundation concrete for a wall or column).

- Placing concrete within large earth mould or timber plank formwork. (example: Road slab and Airfield slab).

- Placing concrete in layers within timber or steel shutters. (example: Mass concrete in dam construction or construction of concrete abutment or pier).
Placing Concrete

- Placing concrete within usual from work. (example: Columns, beams and floors).

- Placing concrete under water.
Placing Concrete

Concrete spread evenly across the subgrade by the paver before consolidation and finishing.
Placing Concrete

Curb/Curb and Gutter

- Concrete deposited into hopper of slip form curb and gutter machine which then extrudes the concrete into the desired shape.
Placing Concrete

Concrete Pump

- Placing concrete by pump and placing boom.
Underwater Placement Methods

- Tremie, Pump, Bottom dump buckets, Grouted preplaced aggregate (specialized), Toggle bags, Bagwork, Diving bell

Basic Recommendations

- Water velocity $\leq 3$ m / min.
- Water temperature $\geq 5^\circ$C
- w/c $\leq 0.45$
- Cementing materials content $\geq 390$ kg/m$^3$
- Slump range 150 to 225 mm
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