Placing Concrete by Pumping

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Abstract

Concrete is a composite material obtained by mixing cement, sand, aggregates with water in suitable proportions. Concrete after mixing has to be transported at the final positions before setting takes place. Placing of concrete at its final position by keeping properties of plastic concrete intact is most important, as the quality of concrete depends of placing, at most care is needed. There are number of equipment's used for transportation and placing of concrete. In case of high rise structures and mass concreting works continuous flow of concrete at the desired height is essential, in such situations pumping concrete by concrete pumps is a common solution. Concrete pumps are the versatile equipment's having number of advantages. Since the concrete is placed under pressure no segregation, bleeding takes place, honeycombing is avoided so superior fishing quality of the concrete product is possible. With proper utilization of resources, speed and economy in concreting can be achieved. The timely completion of the project and reduction in site overheads helps in improved cash flow.
Keywords- Concrete, Quality Control, Pipeline, Placing, Torque, Agitation, Segregation, Bleeding

I. INTRODUCTION

Concrete after mixing is transported at its final position by number of methods. It is desirable that the concrete should be placed directly in to its position, but this not always possible every time to place it directly. The Pacing should be done in such a way that the desired quality shall be maintained. Pumping the concrete by concrete pumps is one of the methods used for placing. The concrete pumps are versatile equipment's which may be truck mounted or trailer mounted and operated on diesel or electrical power. By pumping method the concrete can be transported and placed quickly up to a height of 500 m and through a horizontal distance of 2000 m with an output of 150 cum/hr. It is placed under pressure, quality in entire placing operation can be maintained and a good quality finish with strength can be obtained.

II. PUMPING AND PLACING CONCRETE

The diameter of pipeline through which the concrete can be transported is between 100 mm to 180 mm, generally 125 mm diameter is preferable due to its suitability. The pumps have hydraulic systems which can take pressure up to 200 bars. The pumps are quite durable and designed with adequate protection against adverse uses. The pumps are sturdy and easy to maintain and operate. The control system of all the pumps is fully hydraulic, compact and dirt sensitive. The hydraulic pumps are output regulated and hence optimized power use with ideal pressure and speed is possible. The outlet part of pump is tapered with clamping device connecting the pipeline. It is very easy to clean with side swing. The agitator keeps the concrete in agitated condition in between the two batches of concrete. Higher torque drive provides a constant rotation even for stiff and rough concrete mixes. The systems of valves that are used in concrete pumps are-

1) 'C' valve system
2) 'S' trunk system
3) Flat gate valve system

The pump conveying equipment's are mounted on truck chassis and the drive of the pump is directly driven by the truck engine. A water pump is fitted to water tank, used for evacuating the pipeline with water under pressure and cleaning of concrete pumps.

The swivel pipe system is generally truck mounted; the perfect balancing of movements is possible. This system has improved pumping capacity. The flat gate system is generally used for harsh or oversized concrete.

Fig. 1: Trailer Mounted Pump

Fig. 2: Truck Mounted Pump

A. Precautions in Concreting

1) Compaction of concrete should be carried out speedily so as to match the rate of placing.
2) The design of formwork should such that, it should take pressure of concrete.
3) The reinforcement layout should be modified so as to allow the lowering of flexible hose nearing to the placing point.
4) Proper selection of combinations of various equipment's should be done.
5) The starting output rate should be kept between 30 cum/hr to 40 cum/hr

B. Capacity of Pump

1) The capacity of pump is expressed in cum/hr. It depend upon factors like,
2) Distance of transport of concrete.
3) Size of aggregate
4) Maximum line pressure.

Fig. 3: Placing concrete at congested reinforcement pipeline, vibrator with placing crew

C. Output of Concrete Pumps

The output of pumps depends upon several factors,

1) Length of horizontal and vertical pipe
2) Number of bends, specially shaped bends.
3) Diameter of delivery pipe
4) Slump of concrete.
5) Types of aggregates used
6) Cohesiveness of concrete
7) Length of flexible hose.

D. Pipeline

It is a seamless pipe made up of high quality precision steel. The pipeline consists of straight sections as well as bends which are connected to each other by couplings. The inside diameter of the pipe varies from 80 mm to 180 mm and the length varies from 0.5 m to 3 m.The various bends at angles 90,45, 15,30 & 60 degrees are also required. The diameter of pipe is selected based on the factors like distance –horizontal and vertical to which concrete is transported, Size and type of concrete pumps, concrete quality and the maximum size of aggregates.

The effects due to rise, bends and flexible hose can be determined in terms of length as mentioned below.

1 m vertical rise =2 to 3m horizontal length
One 90 degree bend =3 m horizontal length
One 45 degree bend =3 m horizontal length
One 30 degree bend =3 m horizontal length
1 m rubber pipe =2 m steel pipe.

E. Blockages

- The blockages in pump and pipeline may takes place because of following reasons,
- Defective concrete mixes
- Failure of pump
- Defective pipeline
- Lack of proper mixing.

Fig. 4: Concrete Pump with Boom

III. ESTIMATION OF PRESSURE-GUIDELINES

1) Start up pressure required =20 bars
2) For every 20 m horizontal pipeline=1.00 bar
3) For every 4 m vertical pipeline=1.00 bar
4) For every 90 degree Elbow=1.00 bar
5) For every 45 degree Elbow =1.00 bar
6) For every pipe coupling=0.1 bar.
7) For every 5 m of end flexible hose=2.00 bar
8) For the safety factor =10% of total pressure.

For hydraulically driven pumps the working pressure shall not exceed 90% of the pressure indicated by the manufacturer. Other factors like pipeline diameter, job layout, concrete proportions and pump out put required are considered for calculating pressure.

IV. SITE PLANNING AND MANAGEMENT

- Design a Proper mix design
- Use good quality materials
- Provide Minimum number of bends while laying the pipeline.
- Keep pump on firm ground with proper drainage facilities.
- Give free access to the truck mixers by removing obstructions.
- Maintain flow of water for washing pipeline and pump.
- Calculate the maximum distance of pumping in horizontal and vertical direction.
- Estimate the rate of pumping which is compatible with the of rate of production of concrete and rate of placing.
- Start concreting at farthest point and proceed work by detaching a length of pipeline as concrete work progresses.
- Keep proper planning and coordination between pump operator and placing team.

Fig. 5: Finishing quality by pumping method of placing

V. ADVANTAGES

1) Concrete can be transported under pressure in horizontal and vertical directions.
2) It has good cohesion, high workability and better finish, better quality control and hence Better Strength and durability is possible.
3) Variation in workability and mix consistency can easily be detected.
4) Pump act as quality control equipment which refuses to handle unduly harsh, improperly mixed, and non-cohesive and lack of consistency concrete
5) Pumping method can be used for mass concreting without cold joints.
6) Better finish is obtained because of cohesive and workable concrete.
7) Speedy construction, better management of site resources, reduction in site overheads and hence reduction in cost of construction.
8) Very less space requirement for pump and can be easily extended and removed.

VI. DISADVANTAGES

- Not affordable for small works.
- Skilled manpower is required.
- Proper site management and coordination among teams is required.
- Blockages may take place.

VII. CONCLUSION

This is one of the best situated methods of placing concrete. The concrete can be placed under pressure therefore it requires little compaction. Pumped concrete can be used for large quantity concrete works where continuous flow required. It can be used in inaccessible areas. The output of the pump can be controlled to get maximum efficiency. Considering the overall advantages of pumping method of placing concrete, it proves to be an effective method in achieving homogeneous, superior finished & best quality concrete. It can also achieve overall economy in construction.

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