

Study of Factors Affecting Productivity of Pumped Concrete for Multistory Buildings

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Abstract— A study is made to find factors affecting the efficiency and productivity of the pumped concrete and utilization of pumping equipment resources in the cast in situ concreting of buildings. The study involved elaborating general information about pumped concrete, factors affecting productivity of concreting in high rise building, equipments and machineries required for pumping and requirements of pumped concrete. Other factors affection the placing rates have also been studied. Other factors affection the placing rates have also been studied. A relation between height of building and speed of concrete placing is derived using the observation, during the project the methodology adopted was to visit site and collect data and further analyze it to draw conclusion. The study is similar to project carried out in Hong Kong, Japan , with some addition about factors that cause loss of productivity of concrete pumping and the information about the pumping equipments . In Hong Kong, project the speed of placing of pumped concrete was found out.

Keywords- *efficiency; productivity; pumping equipments; pumped concrete*

I. INTRODUCTION

Concrete occupies unique position among the modern construction material. Concrete has played an increasingly important role in the efforts of architects and engineers to find a satisfactory and economical material for high-rise multistory buildings. The use of concrete in high-rise buildings has increased significantly in the last 20 years mainly owing to improvement in all of the technologies associated with this material: admixtures, pumping, transportation and elevation methods, etc. thus the successful production of concrete at the construction site is of prime importance.

Cement concrete is only next to water in terms of the amount of material used on our planet. Over hundreds of years, concrete has become the material of choice for constructing residential and commercial buildings, infrastructural facilities such as highways, dams and bridge, canals , ports and other important facilities .The popularity of concrete owes to its economy ,ability to the cast into any shape ,ability to be fabricated practically anywhere and last but not least , its inherent durability innumerable historical land marks in concrete speak volumes about its durability and versatility.

For small height buildings (up to 3 -5 storey) the concrete whether it is site mix or RMC is transported and placed by using hoist ,wheel barrows and pulleys or sometimes cranes are also hire for the purpose of transportation of concrete. But when the building goes higher and higher, placing concrete with the hoist and wheel barrows method is become time consuming as it is not a continuous

process and it hampered the productivity of concrete works. One of the techniques that have helped the construction industry tremendously is pumped concreting. Pumped concreting is an alternative method to placing the concrete using concrete pump. Most standard construction mixes can be pumped with little or modification .However several factors affect the pumpability of the concrete mix and job factors such as aggregates available, conveying line size and pumping equipment to be used must be considered when designing a concrete mix for pumping.

Machines and equipments used in concrete pumping such as concrete pumps are mainly used to transfer wet concrete into the building formwork. A concrete pump offers many favorable advantages, such as increased productivity. The pump delivers high volume in short period and at the places where access for human is difficult. The demand for concrete pumps varies with the performance measures as well as the type of pump Various structures from tallest skyscrapers to the smallest convenience store require concrete and concrete pumping is great way to get it where it needs to go. Increase productivity is important because it means faster completion allowing the owner to receive a return on their investment sooner.

A productive crew and construction site benefits everyone involved in the project. With the concrete pumping, crew members can be working on the aspects of the project, because they don't have to use shovels and wheelbarrows to mover the concrete where it needs to go.

II. OBJECTIVES

Recent years have seen a substantial increase in the use of pumped concrete, especially in infrastructure projects in the country. Ready-mixed concrete (RMC) suppliers have played a major role in popularizing the concept of concrete pumping in India. Concrete pumps have been known for more than 50 years. In modern times, large quantities of concrete can be transported by means of pumping through pipelines over appreciable distances, often to locations that may not be easily accessible by other means of delivery.

This main objective of the report is to gather information about the factors that influences the productivity of pumped concrete.

- A. Collecting information about requirements of pumped concrete.
- B. Understanding pumpability of concrete
- C. Gathering information of types of pumps used for pumping concrete
- D. Identify the factors affecting rate of productivity.

Productivity on a site depends not only methodology used for placing but also the supply of materials such as RMC at site. The optimum solution for the use of resources, talking both supply and placing into account ,will clearly not be one in which every site completes its pour in the shortest possible time . The RMC industry would have to be equipped with massive resources if every site could command ideal service, and those concrete supply resources would then be underutilized. The site productivity therefore is influenced not only by placing method and other site factors but also by inevitably imperfect concrete supply.

III. METHODOLOGY

The approach involved in this work has been divided into four different phases. The details of the work in phase are narrated below.

Phase-I:-

- 1) Study of available literature on pumped concrete productivity.

Phase-II:-

- 2) Access to construction site and collect detail information and data from the site.
- 3) Observation of methods and workmanship used for placing concrete.

Phase-III:-

- 1) Identification of direct circumstances on which the overall productivity of pumped concrete depends.
- 2) Identification of indirect circumstances which also affects the productivity of pumped concrete.

Phase-IV:-

- 1) Make conclusion on the base of collected data and the identifications.
- 2) Report preparation.

IV. THEOROTICAL CONTENTS

A. Pumping of Concrete

Placement of concrete in inaccessible areas has necessitated the use of pumps in today's construction. Especially with the growth of ready mixed concrete across India, the need for pumping has increased manifold. While the ease of pumping depends on the type of pump available, the distance over which concrete is to be pumped, and the properties of the concrete, a number of finer aspects can affect the operation. [8]

Pumping is very efficient and reliable means of placing concrete, which makes it a very economical method. Sometimes a pump is only way of placing concrete in ascertain location. Such as a high rise building or large slabs where the chutes of the concrete truck can't reach where the concrete is needed. Other time the ease and speed of pumping concrete makes it the most economical method of concrete placement.

B. Requirements of Pumped Concrete

- Concrete mixture should neither be too harsh nor too sticky; also, neither too dry nor too wet
- A slump between 50 and 150 mm is recommended (note that pumping induces partial compaction, so the slump at delivery point may be decreased)
- If the water content in the mixture is low, the coarse particles would exert pressure on the pipe walls. Friction is minimized at the correct water contents. The presence of a lubricating film of mortar at the walls of the pipe also greatly reduces the friction
- High cement content in concrete is generally beneficial for pumping
- Water is the only pumpable component in the concrete, and transmits the pressure on to the other components
- Two types of blockage to efficient pumping could occur: (1) Water can escape from the mixture if the voids are not small enough; this implies that closely packed fines would be needed in the mixture to avoid any segregation. The pressure at which segregation occurs must be greater than that needed to pump concrete. (2) When the fines content is too high, there could be too much frictional resistance offered by the pipe. The first type of blockage occurs in irregular or gap-graded normal strength mixtures, while the second type occurs in high strength mixtures with

fillers. In order to avoid these two types of failure, the mixture should be proportioned appropriately

- Other mixture factors that could affect pumping are the cement content, shape of aggregate, presence of admixtures such as pumping aids or air entrainment. Air entrainment is helpful in moderate amounts, but too much air can make pumping very inefficient
- When flowing concrete is being pumped, an over-cohesive mixture with high sand content is recommended. For lightweight aggregate concrete, pumping can fill up the voids in the aggregate with water, making the mixture dry.[8]

C. Pumpability of Concrete

The pumpability of concrete is not an easy concept to define and requires the introduction of notions such as stability and mobility under pressure to do so. In general, concrete pumpability is defined as the capacity of a concrete under pressure to be mobilized while maintaining its initial properties. The research efforts reported over the last decade on the pumpability of concrete usually focus on either the stability of concrete under pressure, or on its mobility under pressure.

D. Types of Pumps Used for Pumping of Concrete

- I. Line Pump: Line pumps are versatile, portable units typically used to pump not only structural concrete, but also grout, wet screeds, mortar, shotcrete, foamed concrete, and sludge. Pump manufacturers offer a variety of different line pumps to meet a wide variety of needs. Line pumps typically employ ball-valve-type pumps. While the smaller models are often called grout pumps, many can be used for structural concrete and shotcreting where low-volume output is suitable. They're also used for repairing underwater concrete, filling fabric forms, placing concrete in heavily reinforced sections, and building bond beams for masonry walls. Some hydraulically driven models have pumped structural concrete at outputs exceeding 150 cubic yards per hour.[9]
- II. Boom Pump: Boom trucks are self-contained units consisting of a truck and frame, and the pump itself. Boom trucks are used for concrete pours for everything from slabs and medium high-rise buildings, to large volume commercial and industrial projects. They range from single-axle truck mounted pumps used for their high maneuverability, suitability for confined areas, and cost/performance value, to huge, six-axle rigs used for their powerful pumps and long reach on high-rise and other large-scale projects. Booms for these trucks can come in configurations of three and four sections, with a

low unfolding height of about 16 feet. This low unfolding height is ideal for placing concrete in confined areas. Longer, five-part booms can reach up or out more than 200 feet. Because of their reach, boom trucks often remain in the same place for an entire pour. This allows ready mix trucks to discharge their loads directly into the pumps hopper at one central location and helps to create a more efficient jobsite traffic flow.[10]

E. Factors Affecting Rate of Productivity

Concrete placing productivity is influenced by many factors. The placing method is major determinant of the speed of placing, but the shape of the pour and its location are technical factors that also influence the productivity. The skill and enthusiasm of the placing gang are obviously relevant as is the timely supply of concrete to the site. The latter involves good coordination with a RMC supplier, The preparation needed for the pour to be completed on time, accurate estimation of the quantities of concrete and truck mixer movements and parking arrangements that bring about an uninterrupted supply at the truck mixer discharge point. Site congestion and other access conditions can make uninterrupted supply difficult or impossible, even when the concrete supplier is able to maintain a regular delivery.[11]

V. CONCLUSION

This report concludes that pumping productivity is affected by various factors such as, shape of the pour and its location are technical issues, as well as knowledge and skill of workers, fails in fulfilling requirements of pumpable concrete. Also improper RMC trucks activities causes psychological effect on site productivity. For improving productivity the focus should be given to such activities. The report also shows how the use of pumping of concrete for high rise buildings and commercial buildings results in faster, economical. Labor requirements are also less than other traditional placing method. And if the procedure of placing is followed properly it offers convenience and accuracy in pouring than other old mix and pour methods.

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