Enhancement of Productivity and Minimization of Waste using Lean Construction Techniques

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Abstract— the construction industry has demonstrated a decline in productivity when compared to other industries over the past twenty years. Lean concepts have caused a revolution in manufacturing design, supply, and assembly. Applied to construction, lean concepts can change the way work is done throughout the facility delivery process. This project studies the lean construction concepts and its application in concrete construction projects at both operation and project levels. In conjunction with a concrete contractor, actual concrete construction projects were observed and problem areas contributing to delay and other wastes were identified. At the project level, lack of coordination among contractors was cited as one of the major factors contributing to project delays. This paper proposes the use of the Last Planner concept and Linear Scheduling Method (LSM) to improve communication and short-term scheduling effort. Related software was developed for implementing the proposed scheduling method. At the operation level, a systematic approach of waste identification, operation re-design, and employee training was applied to eliminate wastes in the field operation. A case study on bulkhead installation was used to demonstrate this approach. A 3D animation was created for employee training.

Key words – Lean, LSM, NMC

Introduction

Although there are still debates about whether the productivity of the construction industry is increasing or declining, the performance of the construction industry is widely perceived as unsatisfactory compared too many other industries. The lack of improvement in the industry can be contributed to a number of factors, including industry fragmentation, lack of trust between key participants, the traditional contracting environment, craft-oriented culture, increased regulations, safety issues, and lack of process innovation. Contractors are under enormous pressure for continuous improvement to enhance their productivity and competitiveness locally and internationally. To achieve this goal, construction companies are looking to other industries such as manufacturing to examine the effectiveness of their measuring, monitoring, and improvement techniques. Lean is a production management strategy for achieving significant, continuous improvement in the performance of the total business process of a contractor through elimination of all wastes of time and other resources that do not add value to the product or service delivered to the customer (Womack et al. 1996). Lean concepts have resulted in dramatic performance improvements in manufacturing, the principles behind lean concepts have been effectively applied to construction, as shown in many previous studies, such as those published in the annual conferences of Lean Construction Institute. Lean construction design and Improve value on projects and uncovers wasted resources. Lean construction Last Planner® system members to discover ways to reduce waste and add value in there project performance culture by encouraging team to work together in more transparent collaborative way.

- Wasted time.
- Wasted movement.
- Wasted human potential.
- Better time productivity
- Reduce safety hazards
- Cost saving

I. OBJECTIVES OF RESEARCH

The two subsequent sections describe the observations obtained from the above mentioned concrete construction project and solutions developed to facilitate implementation of lean principles at the project level and the operation level respectively at institutional level,

- To identify the source of wastes classified under lean construction industry.
- To examine general perceptions of the construction industry with the lean construction principles of practices.
- To enhance productivity and try and minimize waste.
- To study reducing and eliminating wastes as classified under development of Last Planner System as a technique of lean construction implementation and to evaluate the effectiveness of implementing last planner to increase plan reliability.

- Examine the relationship between lean construction and performance improvement programs in construction organizations
- To analysis economic benefits by minimizing the waste.

II. NEED OF THE STUDY

CONSTRUCTION INDUSTRY IS A WIDESPREAD INDUSTRY SERVICE PROVIDING INSTITUTION NEED TO MANAGE FINANCIAL BALANCE AND PROVIDE GOOD QUALITY SERVICES TO THE BENEFICIARIES. LEAN MANAGEMENT CONCEPT IS USEFUL AT PROJECT LEVEL AS WELL AS INSTITUTIONAL MANAGEMENT LEVEL ALSO, THIS MAIN TWO FACTOR ARE CONSIDER WHILE STUDYING THIS CASE STUDY WORK. INTRODUCTION OF ADVANCED TYPE MACHINERY IS INCREASE THE PRODUCTIVITY OF LABOUR IN UNHYGNIQUE CONDITION OF WORKING. CONSTRUCTION WASTE IS REDUCED IMPLEMENTATION OF PROPER TECHNIQUES OF MANAGEMENT OF CONSTRUCTION WASTE, PROPER TECHNIQUES OF CONSTRUCTION WASTE MANAGEMENT WE CAN REACH OUR GOAL OF REASONABLE CONSTRUCTION COST.

- The study aims to help the institution to minimise annual maintenance cost on the system by authority.
- The study also aims to enhance the living standard of the people by introducing new system over old one.
- The study is to be conducted to enhance the productivity of working labour at site by Introduction of advanced type machinery
- Problem of wastage of space on site by construction waste can be solved by construction waste management
- The study aims to avoid and reduce various environmental issues.

III. DATA COLLECTION

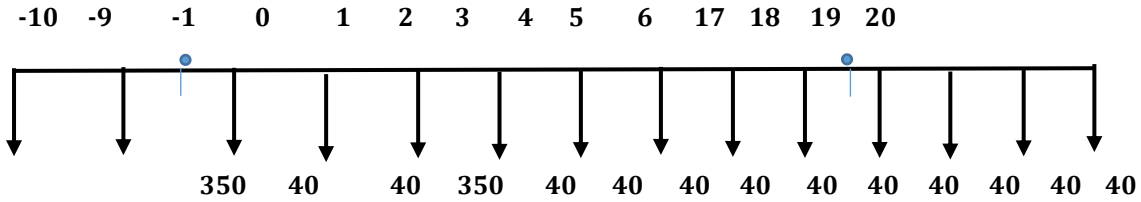
Name of project	Providing and construction of R.C.C. Open Gutter and pipe drainage line at Phule Nagar in NMC Limit Area.
Name of organisation carry out work	NMC
contractor	Megh Nsk.
Area of project	18.56 hector
Population of area	16,000 no's
Population density	=16000/18.56 = 865 / ha
Sanctioned tender cost	Rs 744.68 lakh.
Time limit	18 months
Population density	=16000/18.56 = 865 / ha
Sanctioned tender cost	Rs 744.68 lakh.
Works Highlight	1)R.C.C. Open Gutter (size 0.45 x 0.60) - 7320 Rmt 2)R.C.C.Pipe Drain (400mm / 300mm) - 2950 Rmt Total length - 10270 Rmt.

IV. DATA ANALYSIS

Assume pipe drainage system in area was constructed at cost of Rs 500 lakh to be useful life of 30 years its salvage value is zero. Present Annual maintenance cost is around 40 lakh per year remaining life of system is only ten year as there huge damage to system due to local issues. While considering too many no. of complaint to maintain system is received to NMC it is decided to replace the system with new R.C.C. Gutter of size 0.45 x 0.60 m. with provision of R.C.C. precast cover over it. The estimated cost is around 744 lakh with useful life of 30 years. But its annual maintenance cost will be decrease because in open drainage system cleaning is quite easy and operational. As considering more suitable R.C.C. Cross section with provision of steel will provide better life cycle to system. Considering annual maintenance cost @ 10 lakh per year and the rate of interest is @ 12 % calculate the both maintenance and provision of new R.C.C. Gutter is compared as follows.

Alternative with present annual maintenance cost

Implementation cost – 500 lakh. (Before 10 years), Salvage value of system – 00
Remaining life of system – 20 years, Annual maintenance cost – 40 lakh, Assume Rate of Interest – 12 %
The cash flow diagram of the present drainage system is

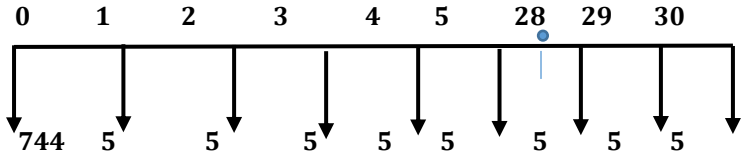


Cash Flow Diagram For Alternative 1

The annual equivalent cost is computed as
AE (12 %) = (P – F) (A/P, 12%, 20) + F X i + A
= (500 – 0) (0.1960) + 0 + 40 =**Rs 138.00 lakh**

A) Alternative with provision of new R.C.C. Gutter

Cost of new R.C.C. Gutter work = 695 lakhs, Salvage value of system – 00
Remaining life of system – 30 years, Annual maintenance cost – 5 lakh, Assume Rate of Interest – 12 %
The cash flow diagram of the present drainage system is



Cash Flow Diagram For Alternative 2

The annual equivalent cost is computed as
AE (12 %) = (P – F) (A/P, 12%, 30) + F X i + A
= (695 – 0) (0.1910) + 0 + 5 = Rs **137.74 Lakh**

(In this case the provision of New R.C.C. Line is feasible from Economical point of view. As the existing pipe drains are get chocked up by pouring solid waste in pipe line use of less quantity of water does not properly flow drains. Also rat, goose like ground animal moving around excavating nearby slum foundation and get chock the drain line. As this problem is practically faced by client provision of new R.C.C. drain is also justified from point of view of public health of area people)

Analysis of Data Collected from the case study

In construction industry productivity is usually taken to mean labour productivity.

Labour productivity = Output / Labour Cost

Cumulative Productivity = Total work hours charged to a task / Total quantity installed

Productive management Index (PMI) = Cumulative productivity – baseline productivity/ Base line productivity

Fig No	Description
1	Start of work
2	During working
3	With RMC self-load machine
4	Low Productivity work
5	Part Completion of work

Fig no 1

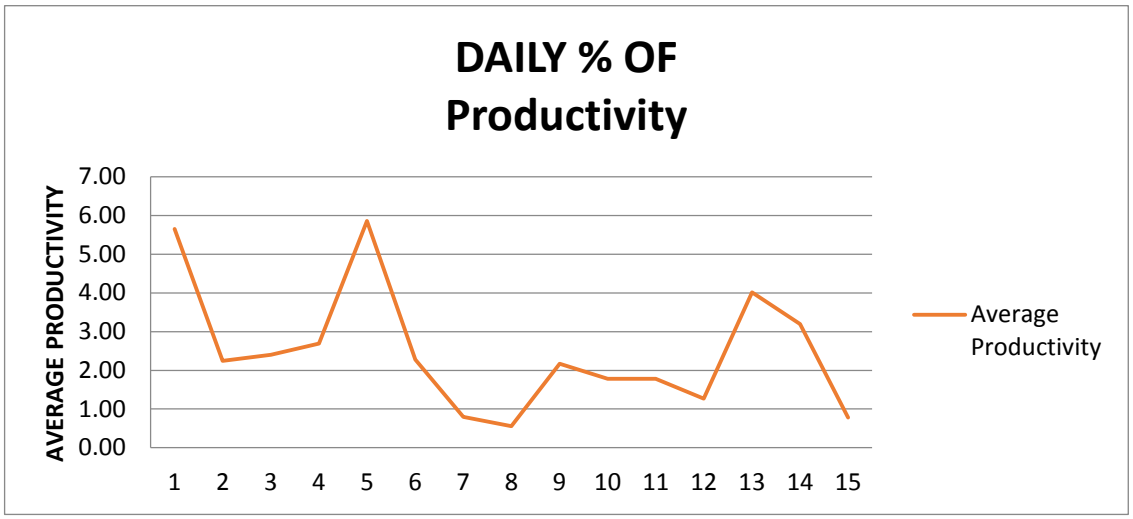
Fig no 2

Fig no 3

Fig no 4

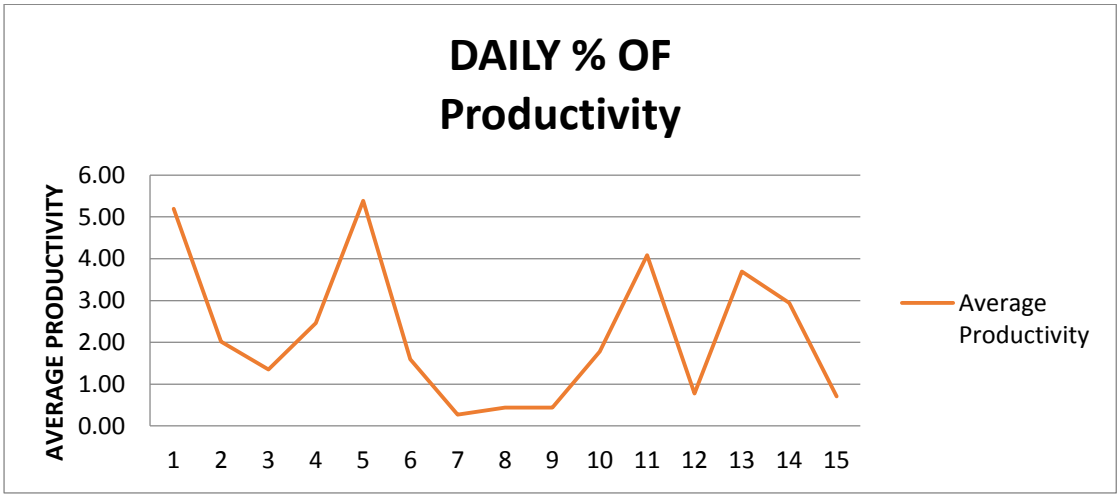
Fig No 5

Alternative 1: work without advanced 2.50 cum capacity RMC plant productivity of labour



Graph No 1 showing work without advanced 2.50 cum capacity RMC plant Avg. productivity

Alternative 2: work with advanced 2.50 cum capacity RMC plant productivity of labour



Graph No 1 showing work with advanced 2.50 cum capacity RMC plant Avg. productivity

(This graph shows that at the start of work productivity of labour is more because there is no work in muddy water condition? Once the dismantling of drainage line starts the productivity is lower down due to unhyginique condition labour productivity comes down)

V. RESULT AND DISCUSSION

Followings are the Findings from the project implementation and data analysis.

1) Improvement in environment and living standard of people in area.
2) Minimize maintenance cost and complaint to local authority.
3) In general slum area deposition of solid west practice is more often. Hence easily cleaning system is preferable for such area.
4) Project area is slum area pipe drain system requires more use water to flow system properly.
5) Implementation of open drains productivity of labour is less while working in running drain system.
6) Contractor need to plays an important role for implementation of proper work system.
7) Over-reliance on sub-contractor is a major cause of Construction Waste for such project.
8) It is very important to study material losses and productivity calculation while approaching such type of work. Accordingly tender rate should be quoted.
9) There should be awareness on Construction Waste Management.

VI. Conclusion

Waste may occur due to economic as well as construction material Sources of waste can be categorized in following categories:

- Design of old improper system of drains.
- Improper use of system coveys more maintenance cost.
- Handling of materials and transportation.
- Operation in congested work place
- Residual usages.

The barriers to implementation of Lean Construction identified from literature and confirmed by industry practitioners.

- Fragmented nature of the industry.
- Extensive use of subcontractors.
- Lack of long term relationship with the suppliers.
- Delays in decision making.

- Waste accepted as inevitable.
- Management of rash working environment and theft of material.

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