

Studies on improvement of labor productivity in construction sites using lean technique

R. Hemalatha¹, G. Priyanth²

¹M. TECH Student, B S Abdur Rahman Crescent Institute of Science and Technology
Vandalur, Chennai, India

²Assistant professor, B S Abdur Rahman Crescent Institute of Science and Technology
Vandalur, Chennai, India

ABSTRACT

The developing countries like India have more focus on infrastructure developments and civil construction projects which is major contribution to the national economy. Delay in construction projects causes overrun which affects the country in terms of loss of revenue. Globally, many studies have been carried out to overcome wastage at construction site by implementing lean construction techniques but a very few studies have been carried out in Indian scenario. It is a way to design the minimize of wastage of materials, time, and effort in order to generate the max possible amount of value. Productivity improvement is art of doing the right things better worth and make it a part of continuous process in a construction process. So it is too important to choose a technique where the productivity can be increased by getting profit to both the organisation and to the low level member who is working on the site. Productivity has to be improved with the same resources as planned but without any waste. Labour productivity depends upon how labours are utilised. In this study the time taken by a worker involved in a task, is recorded and variation between cycle are evaluated to determine whether alternative processes would improve production rate or not. Crew balance chart are used to evaluate the work done by the worker correctly. From the analysis, some recommendations are made for improvement of labour productivity.

Keyword: Lean construction, labor productivity improvement, crew balance chart

1. INTRODUCTION

The most challenging issue in construction industry is to improve the productivity of the labor force. Improving the labor productivity does not mean as overloading a person to do all the activities, instead the work has to be divided to everyone keeping in mind that a specific work is allotted to only the skilled labors. In developing countries most of the construction work are done manually without the help of equipment as the contractors don't want to waste money on the equipment. Poor productivity of construction workers is one of the causes of cost and time overruns in majority of construction projects. Construction projects are not often delivered on time and on budget and re-workings are usually required to satisfy customer's needs.

Lean construction

Lean construction is a technology that is scarcely followed in Indian construction sites. This technique mainly focusses on the reduction of waste that arises while doing the construction work. Some of the waste that are mentioned in lean construction are wasting time in transporting, inventory, motion, waste, overproduction and delay.

By reducing all these waste, the time, money, manpower, energy can be saved to a greater extent which results in profit for both the contractor and to the labor.

Tools of Lean Construction

Building Information Modelling (BIM) is a graphical representation of buildings up to 8 dimension. Nowadays BIM is also used to find the future model of the building with virtual reality. BIM software shows every nook and corner of the building with the uploaded data. Not only for building modelling, but it is extensively used in physical infrastructure projects such as construction of dams, road, bridges, tunnels, subway, water and gas utility pipelines. This software gives a better understanding of the structures to be built.

Value Stream Mapping (VSM) is a graph that is used to analyse and design the flow of work required to bring a complete product to a customer without any waste in it in which the process holds both value added and non-value added activities.

First Run Studies is basically a PDCA (Plan, Do, Check, Act) cycle where the improvement is done by adjusting the result with the help of proposing and implementing the change.

Labor Productivity

On any construction site the contractor's financial gain is dependent on completion of the work within the deadline and the productivity of labour has a direct contact with the cost analysis. The factors affecting the performance of labour generally fall into three categories.

- The human capacity for work to be done
- The competence of site management by project managers
- The motivation of the workers to do that activity

Purpose of work measurement studies

The ultimate result of all work measurement studies is to develop a standard and to recommend it. In this study, the time is an extremely an important tool of work measurement studies. The methodology used to determine standard time is to estimate the time required to perform the selected activity. Work measurement helps to identify non-productive work that are done by the labor and to eliminate the non-value added activities that are performed by the labor. Purpose of work measurement studies has the following reasons:

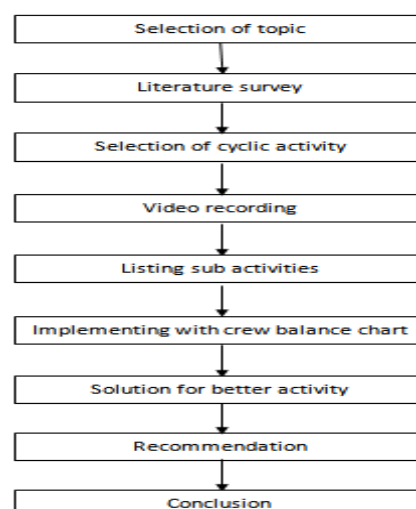
- To eliminate the non-value added activities
- To set a standard time for each work
- To set a long term goal instead of short team goal
- To engage the labor in their specific known activities
- To measure the performance of the crew members before starting of the work

Data collection techniques for productivity analysis

To do a analysis of an activity data has to be collected priorly. That too to collect a data of the construction activity that is in process , is a tedious process and a difficult one. To collect these data some techniques are available for productivity analysis such as

- Questionnaires survey
- Interviews the crew members
- Activity recording
- Productivity measurement studies
- Labor-utilization factor
- 5-minute rating technique
- First run studies
- Time-lapse video
- Direct observations of undergoing work

2. METHODOLOGY



2.1 Crew balance charts

Crew balance chart is the method of a representing the data in the bar chart format which could be easily understood by the people. Crew balance charts are used to compare the various labor activities involved in that activity. These are done for a cyclic activity that happens in a construction site. Some cyclic activities are concreting of slab, plastering of walls and brick laying activity. In this chart the vertical axis represents the no. of labors that are involved in that activity whereas the horizontal activity represents the time taken to complete that activity. An existing chart can be produced by the data that is collected. This chart has more of non value added activities which results in low productivity of the labor. The data collected through video recording. After analyzing the chart, the manager can come to a conclusion how the crew members are effectively worked and gives a remedial action to improve the productivity.

3.2 Case study

The crew balance chart for this case study is done for brick work for a residential building in Chennai region A crew balance study chart was performed for that brick work activity for the crew of 4 members. The process consists of 5 steps;

- Identification of a cyclic activity in a construction site.
- Observation of crew composition and recording of time spent on that particular activity.
- Graphical representation of data collected through crew balance chart
- Analysis of that crew balance chart to identify the areas of improvement and checking whether the time was used productively or not.
- With the help of the existing chart, analysis is carried out to revise the task process and a proposed chart is created for a better productivity.

3.2.1 Initial condition

There were 4 crew members which include 2 mason and 2 helper. On the observation, it was found that out of 2 mason, one was skilled labor and the other was unskilled labor. The helpers were engaged to transport the bricks from the ground floor to the 2 nd floor. The other helper was engaged to transport the mortar and to help the masons for material handling.

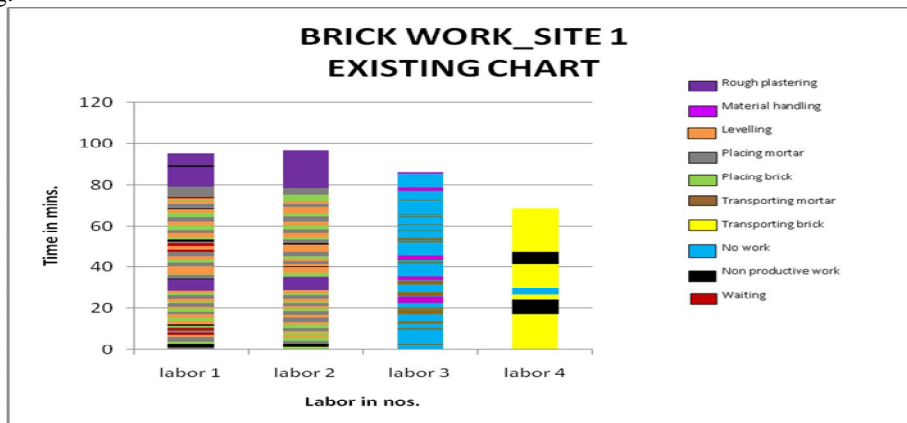


Figure 1 Brick work _Site 1_ Existing chart

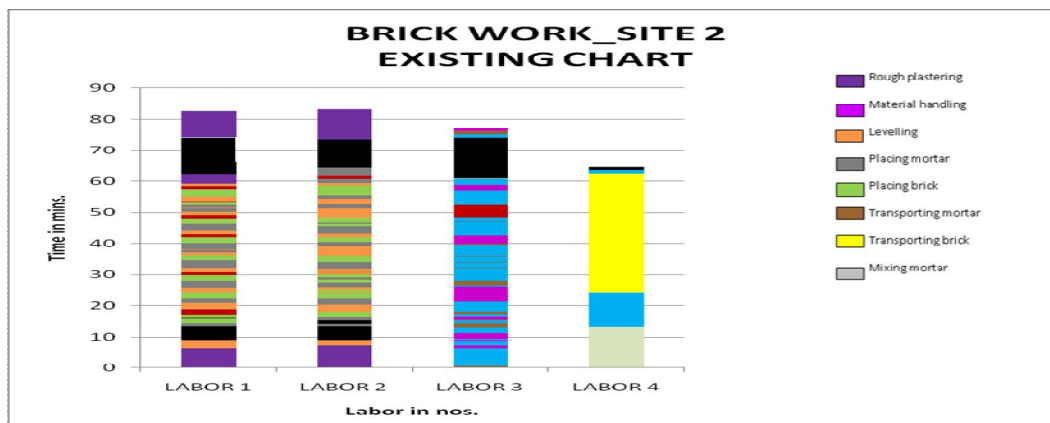


Figure 2 Brick work _Site 2_ Existing chart

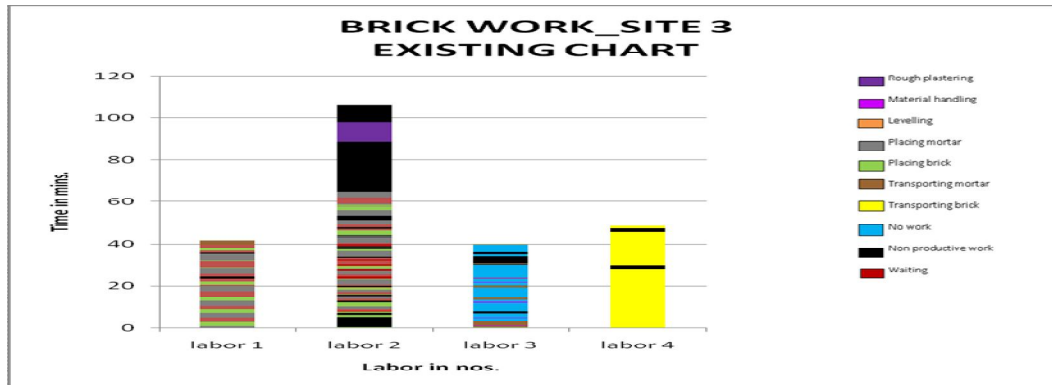


Figure 3 Brick work _Site 3_ Existing chart

As shown in the above figure, labor 1 and labor 2 was the mason. Labor 3 and labor 4 were helpers.

3.2.2 Final condition;

The most important step in the study is analysis of the crew balance chart to identify potential areas for improvement.

The existing chart which is displayed above has more waste that is mentioned in the lean. So after the elimination of the non productivetime , waiting, ildle time a new chart is produced. The labor 2 was unskilled labor where he has wasted more time in levelling and alignment of the layer of bricks. Instead of that unskilled labor, the contractor can change him to a skilled labor. More over he was aged which also factor for the low productivity.

Labor 3 and labor 4 are the helpers. Labor 3 is a lady helper who does the work of transporting mortar and material handling. Labor 4 is exclusively omitted to do transporting of bricks. Here we can eliminate a helper and only 1 helper will be appointed to do transporting of bricks, transporting mortar, and to material handling.

In this case, the labor 3 will be engaged with the above work which reduces the wage of 1 labor. Obviously the productivity will be improved.

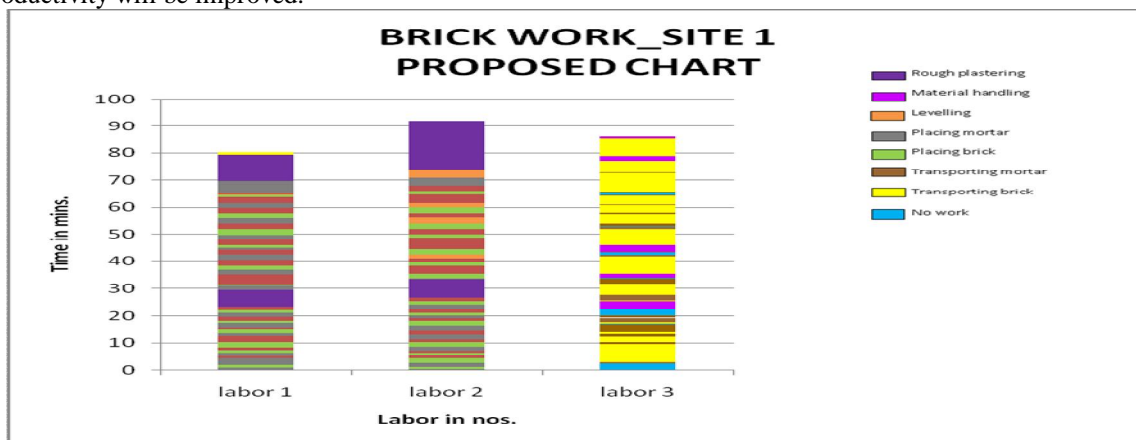


Figure 4 Brick work _Site 1_ Proposed chart

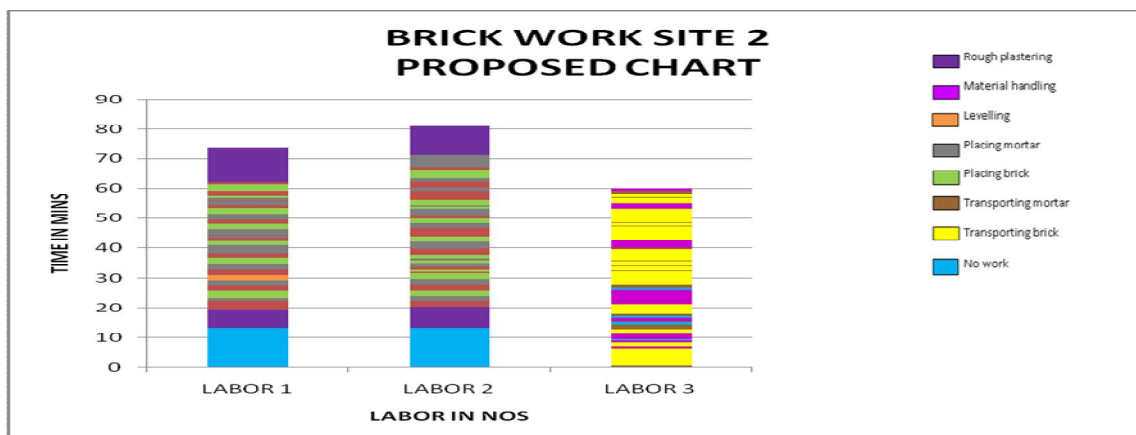


Figure 5 Brick work _Site 2_ Proposed chart

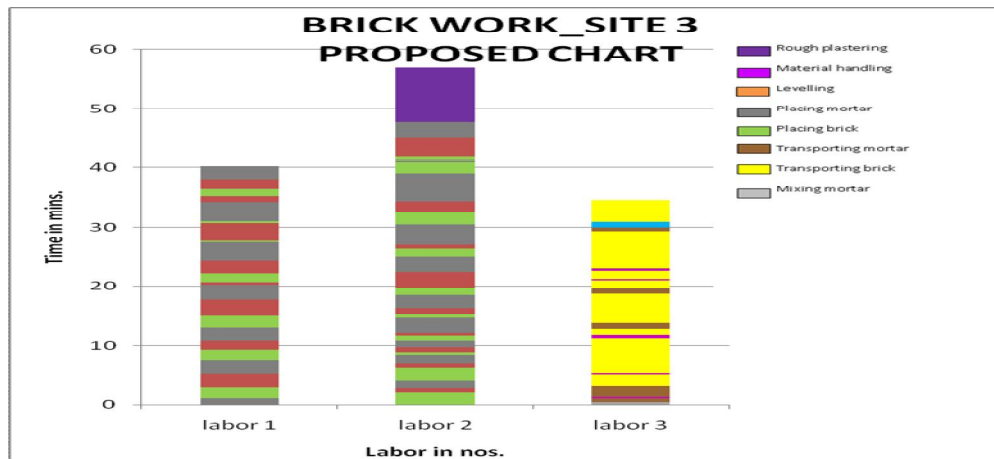


Figure 6 Brick work _Site 3_ Proposed chart

3. RECOMMENDATION

After analysing the crew activities , some recommendations are given for the improvement of the labor productivity.

- Skilled labors must be engaged in construction activity
- Age is an important factor for a better productivity.
- Safety measures must be strictly followed in the construction site.
- Equipments must be available for the need. One must not wait for the equipment to be used by him.
- Even transporting of bricks can be pre planned and transported the before day itself.
- Instead a lift can be used to transport the bricks from the ground floor which reduces the work of helper.

4. CONCLUSION

Construction activities are fully labor intensive work where more human errors will happen without the knowledge of the worker. Each construction activity consumes more time and cost. Apart from conducting work improvement studies on brick work activity, it shows that there were a lot of physical work to carryout that activity because each worker is working manually.

Crew balance chart is the graphical representation of the existing work that is going on in a construction site. This chart to be done by the project managers before hand because this is a great way to find the non value added activities which results in waste of time and money. Project managers has to preplan what activity is going to take place the next day and he has to arrange the labors and materials that are needed to the next days work. Analysis of this chart gives more idea for a better productivity of labors.

Reference

- [1] K.P.Pradeep, Lean construction: Introduction to concepts, principles & practices, February 21, 2014.
- [2] Productivity Measurement and Analysis report by THE UNIVERSITY OF BRITISH COLUMBIA – 2004
- [3] Oglesby, Clarkson H.; Parker, Henry W. and Howell, Gregory A. (1989). Productivity Improvement in Construction, McGraw Hill, New York, New York
- [4] Thomas, H. Randolph and Daily, Jeffrey (1983). "Crew performance measurement via activity sampling", Journal of Construction Engineering and Management, ASCE, 109 (3), p. 309-320.
- [5] Tommelein, I. D., D. R. Riley, and G. A. Howell (1999). "Parade Game: Impact of Work Flow Variability on Trade Performance." Journal of Construction Engineering and Management 125(5): 304-310.
- [6] Koskela, L., R. Stratton, and A. Koskenvesa (2010). "Last Planner and Critical Chain in Construction Management: Comparative Analysis, National Building Research Institute, Technion-Israel Institute of Technology, 538-547.
- [7] Ballard, G., L. Koskela, G. A. Howell, and I. D. Tommelein (2005). "Discussion of "Improving Labor Flow Reliability for Better Productivity as Lean Construction Principle" by H. Randolph Thomas, Michael J. Horman, R. Edward Minchin Jr., and Dong Chen." Journal of Construction Engineering and Management 131(5): 615-616.
- [8] Mossman Alan, 2013 paper "Last Planner 5+1 crucial and collaborative conversations for predictable design and construction delivery."

- [9] Thomas & Maloney has been published in ASCE journal paper “Modelling Construction Labor Productivity”
Thomas, H.R. and Raynar, KA. 1997. Scheduled overtime and labor productivity: quantitative analysis. Journal of Construction Engineering Management, 123 (2): 181- 188.

AUTHORS



R.HEMALATHA is a M.TECH student doing Construction Engineering Management in B.S. Abdur Rahman Crescent Institute of Science and Technology, Chennai. She has completed her BE Civil engineering in Periyar Maniammai University, Thanjavur



G.PRIYANTH is Assistant Professor in the Department of Civil engineering, B.S Abdur Rahman Crescent Institute of Science and Technology, Chennai. for past 3 year. He has worked as a Project Engineer in USA. He has done his BE in Civil Engineering at College of Engineering, Guindy, Chennai. He did his MS Structural Engineering in University of Surrey , UK and another MS Construction Management in Steves Institute of Technology, USA. His area of interest is Virtual Design and Construction using BIM, Collaboration and integrated project delivery, Lean construction.