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Study of Actual and Theoretical Labour Productivity for Major Activities in Super Structure

Pranav Shinde¹, Dr.M.P.Kadam², Mr.Pritesh Aher³

PG Student, Department of Civil Engineering, NDMVP'S KBGT COE, Nashik, India¹

Head of Department of Civil Engineering, NDMVP'S KBGT COE, Nashik, India²

Assistant Professor, Department of Civil Engineering, NDMVP'S KBGT COE, Nashik, India³

ABSTRACT: Construction sector plays a leading role in economic growth for countries all around the world. Since construction is a labor intensive industry, productivity is considered a primary driving force for economic development. In India, the economy is severely challenged by the combined effects of rapid population growth and the closure policy imposed on the area since 2007. Owing to this situation, construction projects are characterized by low profit margin, time and cost overrun making labor productivity a key component of company's success and affordability. The main aim of this study is to identify deviation between IS code method and field method for labor productivity in India and to give the suggestion. And also calculated actual productivity for cutting, bending and erection of reinforcement for ground beam, concreting for ground beam and Brick Masonry in plinth is taken from sites. The result shows the factors considered which most affects the labour productivity loss in residential buildings and actual productivity versus expected productivity the cutting, bending and erection of reinforcement for ground beam, concreting for ground beam and Brick Masonry work were calculated.

KEYWORDS: Construction Labour Productivity, Planned productivity, actual productivity, efficiency

I. INTRODUCTION

Construction is the world's largest and most challenging industry. Human resource today has a strategic role for productivity increase of any organization, and this makes it superior in the industrial competition. With the effective and optimum uses of it, all the advantages supplied by the productivity growth can be obtained. In India, one of the greatest challenging faced by the construction industry is to attract and to attain skill labor. Low impact to the construction industry such as cost overruns and schedule delays. In order to expand the economic growth and to compete globally the construction industry has to continuously improving the standards of construction especially regarding quality of labor. Performance because productivity is part of key performance indicator to determine the success of project. Construction is a key sector of the national economy for countries all around the world, as traditionally it took up a big portion in nation's total employment and its significant contribution to a nation's revenue as a whole. However, until today, construction industries are still facing number of problems regarding the low productivity, poor safety and insufficient quality. Productivity is the one of the most important factor that affect overall performance of any small or medium or large construction industry. There are number of factors that directly affects the productivity of labour, thus it is important for any organization to study and identify those factors and take an appropriate action for improving the labour productivity. At the micro level, if we improved productivity, ultimately it reduces or decreases the unit cost of project and gives overall best performance of project. There are number of activities involved in the construction industry. Thus the effective use and proper management regarding.

II. OBJECTIVE OF THE STUDY

- i. To find out the quantities and labour requirement for cutting, bending and erection of reinforcement of ground beam
- ii. To evaluate the quantities and labour estimation for concreting for ground beam.
- iii. To calculate the requirement of labour and estimation of quantities of brick masonry in plinth.

III. LABOUR PRODUCTIVITY

Productivity can be defined in many ways. In construction, productivity is usually taken to mean labour productivity, that is, units of work placed or produced per man-hour. The inverse of labour productivity, man-hours per unit (unit rate), is also commonly used. Productivity is the ratio of output to all or some of the resources used to produce that output. Output can be homogenous or heterogeneous. Resources comprise: labour, capital, energy, raw materials, etc.

$$\text{Productivity} = \text{Output} / \text{Labour cost}$$

Horner and Talhouni stated “A popular concept in the USA, and increasingly in the UK, is the concept of earned hours. It relies on the establishment of a set of standard outputs or norms for each unit operation. Thus, a number of earned hours are associated with each unit of work completed. Productivity may then be defined as the ratio of earned to actual hours. The problem with this concept is in establishing reliable norms, for setting standards. It also depends on the method used to measure productivity, and on the extent to which account is taken of all the factors which affect it. At the project site, contractors are often interested in labor productivity. It can be defined in one of the

$$\text{Labour Productivity} = \text{Output} / \text{Labour cost}$$

Or

$$\text{Labour Productivity} = \text{Output} / \text{Work hour}$$

There is no standard definition of productivity and some contractors use the inverse of above ,

$$\text{Labour Productivity} = \text{Labour cost} / \text{work hour Output}$$

In general, productivity signifies the measurement of how well an individual entity uses its resources to produce outputs from inputs. Moving beyond this general notion, a glance at the productivity literature and its various applications quickly reveals that there is neither a consensus as to the meaning nor a universally accepted measure of productivity. Attempts at productivity measurement have focused on the individual, the firm, selected industrial sectors, and even entire economies. The intensity of debate over appropriate measurement methods appears to increase with the complexity of the economic organization under analysis. There are however, a number of different productivity measures that are commonly used. Choosing between them usually depends on the purpose of the productivity measurement and the availability of data. Productivity measures can broadly be placed into two categories. Single factor, or partial, productivity measures relate a particular measure of output to a single measure of input, such as labour or capital. Productivity measures can also be distinguished by whether they rely on a particular measure of gross output or on a value-added concept that attempts to capture the movement of output. Of the most frequently used measures, capital-labor relies on a value-added concept of output while capital labor- energy-materials relies on a particular measure of gross output. The five most widely used productivity concepts are

1. Labour productivity, based on gross output. This productivity measurement traces the labour requirement per unit of output. It reflects the change in the input coefficient of labour by industry and is useful for the analysis of specific industry labour requirements. Its main advantage as a productivity measure is its ease of measurement and readability; particularly, the gross output measure requires only price indices on gross output. However, since labour productivity is a partial productivity measure, output typically reflects the joint influence of many different factors.

2. Labour productivity, based on value-added. Value-added based labor productivity is useful for the analysis of micro-macro links, such as an individual industry’s contribution to economy-wide labour productivity and economic growth. From a policy perspective, it is important as a reference statistic in wage bargaining. Its main advantage as a productivity measure is its ease of measurement and readability, though it does require price indices on intermediate inputs, as well as to gross output data. In addition to its limitations as a partial productivity measure, value-added labour productivity have several theoretical and practical drawbacks including the potential for double counting production of benefits and double deflation.

3. Capital-labour MFP, based on value-added. This productivity measurement is useful for the analysis of micro-macro links, such as the industry contribution to economy-wide MFP growth and living standards, as well as, for analysis of structural change. Its main advantage as a productivity measure is the ease of aggregation across industries. The data for this measurement is also directly available from national accounts. The main drawback to the value-added based capital-labour MFP is that it is not a good measure of technology shifts at the industry or firm level. It also

suffers the disadvantage of other value-added measures that have been double deflated with a fixed weight Laspeyres quantity index.

4. Capital productivity, based on value-added. Changes in capital productivity denote the degree to which output growth can be achieved with lower welfare costs in the form of foregone consumption. Its main advantage as a productivity measure is its ease of readability but capital productivity suffers the same limitations as other partial productivity measurements.

It's measure of labor productivity which helps to explain the principal economic growth and social development. Productivity commonly defines as a ratio of volume of input use among other. Productivity measure such as multi-factor productivity or capital productivity, labor productivity particularly important in the economic and statically analysis of country. Labor productivity revealing indicator of several economic indicators as it offers a dynamic measure of economic growth competitiveness and living standards within an economy. Labor productivity directly affects construction productivity, it is important to know the factors affecting labor product.

A field study was conducted to highlight the occupational factors to building construction activities in India. A field study was conducted to highlight the workers were mainly performing concreting operation. We whole day work study was conducted on all age type female workers as well as male performing concreting operation on the field. The morning working time calculated as well as rest time was calculated. Activity of labor checks out by camera recoding on site. Therefore a filed study was conducted by continuous operation method on this building construction. Female workers to indicate the work complexity and workloads in actual filed working condition. In India the cost of manpower is very low the working method is mainly dealing with details of working postures, etc. Productivity has been generally defined as the ratio of outputs to inputs. Construction projects are mostly labor based with basic hand tools and equipment, as labor costs comprise 30% to 50% of overall project cost there are many factors that influence the productivity in construction industry.

IV. LITERATURE REVIEW

A new study by Abdulaziz M. Jarkas in Global Construction perspective and Oxford Economics has predicted India will stand as the world's 3rd largest construction market by 2025. The country will have to gear up to add 11.5 million homes a year to become a US\$ 1 Trillion a year market by then. A significant number of international real estate companies have entered India as they see good investment opportunities emerging. More significantly, the Indian government has allowed 100% FDI in realty projects through the instinctive route. Accounting for 11% of India's GDP the construction industry employments over 32 million individuals and the urgent need for country's infrastructure development is contributing to rise in demand for construction workers. But the industry's problem today is not availability of manpower, but the availability of quality labour.

Despite the prospects witnessed, the construction sector is mired in problems. It undergoes from capability constraints, absence of finance, mechanization, trained manpower at the workers' level and performance at managerial levels are way below international standards. The recruitment of construction workers is through a long chain of middlemen (contractors and subcontractors) or roadside recruitment (street corners/Nakas), where workers wait each morning to be picked by contractors and many of these small and medium level contractors have no capacity to upgrade. More than often, workers in the construction sector, the second biggest after agriculture, are generally pickled as second-class citizens with no means to protect their dignity. Construction alone accounts for nearly 65% of the over-all investment in infrastructure.

The sections in the Construction commerce cover, residential, public, commercial and industrial buildings, highways, bridges, tunnels, Roads, sewers, etc. Besides the general, lower construction skills, other specialized skill sets such as carpentry, plumbing, electrical work and painting are very much essential for the industry. As per G. Carmona and J. L. Molina Over 94% of India's labour strength that includes construction workers is employed in the unorganized sector, exposed to exploitation, job and wage insecurity with no legal protection. To further enhance to their woes, there is no appropriate addressing of quality, skills, education, and employability for higher wages, safety, environment and social aspects of these workers.

In addition, the long term market instability and uncertainty has negatively impacted the opportunities and prevented expansion, training and development facilities. Utmost of them are not registered with the Labour Commission and therefore do not have any legal entitlement, with no provisions like social security and remunerations in terms of labour welfare, pension and insurance schemes, financial aids or loans for children education and medical needs or even misfortune and death claims.

Construction requires extensive manual labour. Human performance and productivity are reliant on one another. Therefore, the most frequently used measure of productivity is the constant measurement of construction work done per



work hour. A study by Hendrickson (1998) talked the time consumption of the average construction worker. Only 40 % of a workers time is considered to be productive, with 55 % unproductive time, and 5 % personal time.

V. METHODOLOGY AND DATA COLLECTION

Data required to carry out the research was collected by actual site quantities were taken for the Survey and on this basis the number of labours required for the particular completion of activities are finding from IS 7272 and actual labour-force required or used at site is note down . On basis of previous studies on labour productivity & suggestions from Local Industry Professionals construction labour productivity in Nashik Region. The target population included Civil Engineers from construction firms categorized as contractors. In this study measurement skill of work quantities are carried out at local site at post Korate, Tahsil Dindori, District Nashik. The built-up area of the site is 1248 square foot for this site taking the activities for measurement are as cutting, bending and erection of reinforcement for the ground beam, concreting of ground beam and brickwork in plinth. The Quantities prepared from the actual ongoing bungalow project and on the basis of the it is compared by the IS 7272.

For purpose of finding labour productivity cutting, bending and erection of reinforcement for the ground beam, concreting of ground beam and brickwork in plinth. Requirement of skilled labour and unskilled labours site are the two factors considered for calculating changes in productivity by the method of IS 7272 and field productivity. Data collection was carried out on site. Work study is the systematic examination of the methods of carrying on activities so as to improve the effective use of resources and set up standards of performance for activities being carried out. Work study aims at examining the way in activity is being carried out, simplifying or modifying the method of operation to reduce unnecessary or excess work, or wasteful use of resources, and setting up a time standard for performing that activity Data required from site to carry out the research was collected by time study method. Time study is a work measurement technique for recording the times of performing a certain specific job or its elements carried out under specific conditions. The following table 1 shows the name of activity, quantity of particular activity, labour constant as per IS 7272 and then total number of labours are required are calculated on the basis of labour constant.

Table1: Time Study for activities involved in Residential construction project

Sr. No.	Name of Activity	Total Quantity	Labour constant as per IS 7272	No of Labours at site	No of Labours calculated by IS 7272	Deviation	Percentage Changes of Productivity
1	Cutting, bending and erection of reinforcement for the ground beam 8mm	4.1464 quintal	0.94 quintal per mason per day	2	4	2	50 %
	12mm	3.1039 quintal	0.63 quintal per mason per day	2	2	-	-
2	Concreting of ground beam	4.95 m ³	1.33 m ³ per day per mason	5	7	2	28.57 %
3	Brickwork in plinth	8.167 m ³	0.5 m ³ per day per mason	5	5	-	-

VI. RESULT AND DISCUSSION

Result of percentage completion of activity (Table 1) shows that the total activity are identified for the calculations of Construction method, Availability of material, Availability of tools, Numbers of labours on site.

6.1 Site Details

For research purpose we considered cutting, bending and erection of reinforcement for the ground beam, concreting of ground beam and brickwork in plinth of building with nos. of floors: G + 1 and from varying sizes of footings and columns at Korate Tal. Dindori Dist. Nashik.

Result:

Labour constant for cutting, binding erection and of reinforcement for ground beam without changes = 0.94 quintal per mason per day for 8 mm diameter bar and 0.63 quintal per mason per day for 12 mm diameter bar. The total number of Masons required to complete the activity for 8 mm diameter bar is 4 by IS 7272 and 2 by actual on site. Similarly for 12 mm diameter bar is 2 by IS 7272 and by actual on site for 12 mm diameter bar is 2. As per IS 7272 labour constant the labour requirement is doubled as compare to actual used masons.

Labour constant for RCC of ground beam = 1.33 m³ mason per day. The total number of masons required to complete the RCC of ground beam by IS 7272 method is 07 and an actual uses of Mason are 05.

The labour requirement for brick masonry as per IS code the labour constant is 0.5 m³ per day per mason. The total number of masons required for the activity are 05 masons by both theoretical and actual method.

6.2 Productivity Calculation

To find out the productivity we are using activity oriented model as

Labour Productivity = Output / Work hour

Before application of any changes on site number of cutting, binding and erection of reinforcement for ground beam completed per day 6 masons are required as per IS 7272 which shows that 725.03 kg of steel reinforcement binding used to complete in 8 working hours. From this the productivity can be calculated as from IS 7272 the labour constants are 0.785 quintal per day (i.e. average of 8mm and 12 mm diameter bar) therefore the total quintals are 7.2503 quintals

Productivity = quantity * labour constant as per IS 7272

Productivity = 7.2503 * 0.785 = 5.69 masons say 06 masons

After application of labour constantans it was seen that which shows that 7.2503 quintals of steel reinforcement cutting, binding and erection used to complete by 06 masons in 8 working hours. From this the productivity can be actual on site is 02 masons are required for 8 working hours.

Increase in labour productivity also results in saving cost and time. It can be seen in above calculations. In case of RCC for ground beam the total number of masons required as per IS 7272 is 07 and as actual on site 05 masons are engaged and for brickwork in plinth the total number of labours required as per IS 7272 is 05 and also on field the number of labours are 05.

VII. CONCLUSION

Labour productivity is one of the least studied areas within the construction industry in India. Despite of time-consuming techniques Work study and work measurement are the techniques useful for data collection of labour and improvement in labour productivity.

Skilled labour is a factor which highly affects the labour productivity; since with skilled labour work can be done in less time without compromising quality of work. Changes in site layout affects labour productivity since proper arrangement of material and stacking of material at proper location on site can reduce time consumption for completion of work.

Changing the semi-skilled labour with skilled labour along with change in site layout helped increasing labour productivity for reinforcement binding by 50%. Work measurement are the techniques useful for data collection of labour and improvement in labour productivity. Using this technique it helped to reduce labour cost. Appropriate and well estimated number of labours for completing any activity plays vital role in achieving the labour productivity which further leads to minimization of overall cost of project.

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