International Journal of Emerging Trends in Science and Technology
6 (2) December 2020, 01-07
http://www.publishingindia.com/ijetst

Review Paper on Safety Induction, Quality Control, Productivity Calculation for Residential Building

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Abstract: The Aim of project is to find the Productivity for finishing works in the Construction Industry and suggest some ideas to overcome the delaying factors. In this project, we include safety induction, planning, and finishing activities work procedure, quality control, productivity and rate analysis. Every organization requires more productivity which increase their profit, quality and to reduce cost and time. Therefore, we have collected productivity data for certain finishing activities (Block Works, Cement Plastering,) from the industry for 30 working days. We could also able to learn the importance of Safety both inside and outside the site through the video screened and the Safety Practices by the Industry. From the Quality Control we have learnt the test to be carried out for different materials and works.

Keywords: Finishing activities, Productivity, Quality control, Safety measures.

I. Introduction

Labour productivity has a major impact on cost, time and quality of a construction project. In this respect, evaluation and identification of factors that affect the labour productivity become a crucial issue for industrial practitioners [Agwu, M. O., 2014]. Therefore, the factors affecting the productivity are grouped into different categories and they were analyzed.

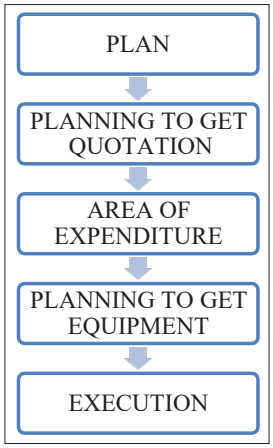
The measurement of labour productivity in construction is very important. Productivity improvement and Construction performance are the key focus in construction industry. In construction projects, there are three basis planning elements such as time, cost and quality. The Collection of data is done by work study method, for labour productivity highly important factor is skilled labour. From the analysis of collected data it is observed that quantity of labour productivity is useful in saving the cost of project as well as time of the project without hampering the quality of work [Attar, A. A. *et al.*, 2012]. (1) Explains labour productivity has a significant impact on time, cost and quality of a construction project. In this respect, identification and evaluation of factors that affect the labour productivity become a crucial issue for industrial practitioners. Therefore, the factors affecting the productivity are grouped into different categories and they were analyzed [Choi, J. *et al.*, 2006]. (2) Explains the importance of measurement of labour productivity in construction. Construction performance and productivity improvement are the key focus area in construction industry for any nation. In construction projects, there are three basis planning elements such as time, cost and quality. The data collection is done by work study method shows skilled labour as highly important factor affecting labour productivity [Huang, A. L., 2009]. From the analysis of data collected it is observed that measurement of labour productivity is helpful in saving the time of the project as well as cost of project without hampering the quality of work [Lindsay, C., 2004]. (3) Determines productivity of building craftsmen in wall plastering activity and explores the possibility of establishing productivity norm for accurate estimation of manpower requirements. The variability of construction labour productivity for wall plastering activity in the state is indicated by sample standard deviation and variance values. (4) Concluded that the productivity is one of the many factors that directly affect a firm's profitability is worker productivity [Odesola, I. A., 2015]. The purpose of this research is to measure and study variability of construction labor productivity in building construction project and to demonstrate the conceptual benchmarking principles for construction labor productivity, by the use of indices and measures of benchmarking in labor productivity [Odesola, I. A., 2015]. (5) Explains the labour productivity of floor tiling works in selected construction sites. In this paper the study variables were computed using conceptual model of labour

productivity measurements. It also explains the accomplishment that represents the finished work. It was found out that the values of daily labour productivity to the baseline productivity better the labour performance this was evident with some of the projects that performed this was evident with some of the projects that performed well which had low project waste index values [Odesola, I. A., 2016]. (6) Explains the work process and statistical analysis of data obtained during the work study. It is concluded that variability in construction labour productivity of blockwork activity during the period of the study is assignable to weather conditions and delay in supply of materials. Therefore ample considerations should be given to the effect of adverse weather condition during labour cost estimation by taking into cognizance the period of execution of the project [Odesola, I. A., 2019]. Similarly, adequate planning of construction resources will help in enhancing labour productivity on building projects.

II. Planning

Objectives of Planning

Planning is an important stage for the construction to complete the work within in a given timeline and cost. At first stage margin amount should be fixed for the minimizing the loss in the project.



Expenditure is of two types. The direct expenditure amount will be claim from the owner for the executed work. However, in case of indirect expenditure they cannot claim from the owner because they spent the amount for temporary structures, drinking water facility, labour bank charges, safety equipment, provident fund etc.

III. Safety Induction

A. Objectives of Safety Induction

- Promote the health safety and welfare of people at work
- Protect people against risk
- Identify, asses, eliminate and control hazardous
- To make the job safe

B. Safety Measures

Construction is a great challenging job, which includes various measures to overcome. The first and foremost important thing is safety. They had a policy called EHS (Environment Health and Safety) and HIRA (Hazard Identification and Risk Analysis) for the workers safety. Workers selection process includes

- Collecting the details about the workmen
- Visualisation by site engineer
- Medical check up
- Safety induction class through video
- Provision of orange helmet for the new workmen

After the refresh training and analysis of workmen completed, yellow helmet will be provided

- Safety equipment
- Safety helmet for the protection of head
- Face shield for the protection of eyes during welding
- Goggles used while concreting
- Nose mask while doing cleaning activities
- Shoes
- Different types of hand gloves such as
  - Cotton gloves used while shifting of materials
  - Leather gloves while wielding
  - PVC and rubber gloves while using chemicals and concreting
- Ear plug, ear muff for ear protection from the entry of dust and high sound
- Safety belt has to be used while working above 3 m height. It should be tied above the head
- Safety net should be provided above 6 floors
- Scaffolding has a tag system
  - Red colour (not allowed to use the scaffolding)
  - Green colour (allowed to use carefully)
- While using crane and other machineries to lift materials, two florescent signal man should be at the site for proper signalling
- Safety measures to start the work
  - Installation of wire nets with rope
  - Following standard operating procedure including warnings in floor openings, lift shaft, floor edges, temporary hand rails etc.
  - Wearing safety belts
  - Height pass will be given for the workers who works on the elevation part of the building
- Electrical safety measures

  - Residual current circuit breaker is installed in electrical equipment to prevent workmen from the electrocuted
  - Red helmets are provided with workmen who are working with electrical works
- Fire safety measures
  - Fire accident may be possible to occur at the site, in such cases certain precautions to undertake such as fire extinguisher. If the fire extinguisher cylinder is maroon it is acetylene and if it is a red it is a LPG.
  - Fire can be classified based on the material undergoes fire
    - Class A - fire from clothes, wood
    - Class B - fire from wax, fuel
    - Class C - fire from gases
    - Class D - fire from metals
- DCP cylinder can be used for class A, B, C, foam type extinguisher for class C, CO_2 cylinder for class B, C.

IV. Quality Control

A. General

Before starting the construction work, the quality department should give the method of statement for each work. In the quality control laboratory, construction materials are check for its quality. I got some ideas about the test listed below. For cement, they check the fineness test, physical inspection for any lumps present in it. Compressive strength is check by preparing mortar cube and check it for 3, 7, 28 days, initial and final setting time test to fulfil the IS requirements. For fine aggregate and coarse aggregate, sieve test, bulk density test, abrasion test, impact test are carried out for analysing the zone. Specific gravity and so on. For cement blocks compressive strength should be check as per IS 2185 Part-1. Concrete cubes are prepared as per the design mix procedure and check the compression test as per IS 456 requirements. When the work is at the initial stage, the quality control should be there for inspection and give approval for the further work. For gypsum and cement plastering work material, button mark, mesh fixing, mix ratio should be check. For water proofing works leakage test is carried out by checking the waterproof coating, rounding of corners and final water tightness test. For doorframe moisture content, dimension, clamps, plumb level and painting should be check. For tile, water absorption and compressive strength should be check.

B. Concrete Works

In all the concrete works such as beams, columns, shear wall, foundations are completed. Structural concrete works are done using RMC (Ready Mix Concrete) and SCC (Self Compacting Concrete). RMC mix done using both 12.5 mm and 20 mm aggregates. SCC mix done using 12.5 mm aggregate. During SCC, concrete shutters can be removed after 24 hours of pouring the concrete. It does not require any vibrators for compaction. Based on the loading and structural analysis different concrete grades are used for every floors such as M40, M30 etc. M20 grade concrete is used for vacuum dewatered flooring in basement. M15 grade screed concrete is used in master bedroom.

V. Productivity Calculation and Rate Analysis

Productivity is the measure of the efficiency of a person, machine, factory, system, etc., in converting inputs into useful outputs. Productivity is computed by dividing average output per period by the total cost incurred or resources consumed in the period. Productivity is a critical determinant of cost efficiency.

A. Objectives

- Productivity shows direction for all the work.
- Productivity comprises all the control.
- Productivity is the best tool for comparing management effectiveness across the enterprise.
- Setting effective productivity with a team is the starting point for success.
- Productivity objectives set or formulated with the people who are going to do the work.
- To study and discuss various factors affecting labour productivity in construction industry.
- To statistically analyse the factors affecting labour productivity.
- To make recommendations to improve labour productivity in labour construction.

B. Productivity Calculation for Block Work

Before starting the block work the surface should be cleaned properly. Hatching made on the concrete surface about 4 mm for effective bonding. The Survey reference line will be mark by using the plan given. Mortar of 1:3 mix is prepared manually. Then the layout block work is done. Gap of 12 mm should be maintain between every block. After completing the layout, quality control will verify the work. Once they get an approval from the QC, they proceed for further block work. Successive layers to be construct with staggering of vertical joints. The sill level and concrete is provided above 1 m from the floor finish level for about 75 mm thick. In the lintel level, 150 mm thick mullion concrete is to be provided for door frames and joints. Then the end of beams or slabs 20 mm gap should be provided in case of deflection occurs, it will be filled with concrete admixed with floadd-1 along with 6 mm to 8 mm aggregate. Productivity for block work as shown in Table I. At the end of block work date is to be mentioned on the wall. Fig. 1 shows the productivity for block work for days. Curing should be done for 7 days.

TABLE I: PRODUCTIVITY FOR BLOCK WORK

Sr. No.	Description	UDM	Quantity	Productivity
1	Block work	Cu.m	6.00	3.00
2	Block work	Cu.m	8.00	8.00
3	Block work	Cu.m	12.50	6.25
4	Block work	Cu.m	7.50	3.75
Total quantity			34.00	
Productivity per man day			5.25 Cu.m	

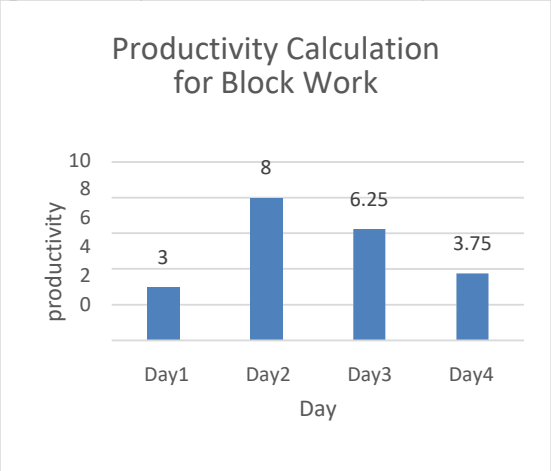


Fig. 1: Productivity for Block Work

C. Productivity Calculation for Cement Plastering

Before initiating cement plastering MEP (Mechanical, Electrical and Plumbing) clearance should made. In the process of pre check, hacking should done on the concrete surface and the surface should be dampen before 10 hours of plastering work start. After completion of pre check, right angles should be check and the button mark should kept for about 10 mm thickness. In the joint areas and conduit line galvanized iron mesh of 300 mm width (150 mm from the joint on both sides) need to place for the prevention of cracking. The cement mortar of 1:4 mix is prepared and used for plastering. The plastered surface should be smooth and even. After completing plastering, the plastered date should mentioned. Productivity for cement plastering shown in Table II. Curing should done for 7 days. Fig. 2 shows the Productivity of Cement Plastering.

TABLE II: PRODUCTIVITY FOR CEMENT PLASTERING

Sr. No.	Description	UDM	Quantity	Productivity
1	Cement Plastering	Sq.m	9.08	9.08
2	Cement Plastering	Sq.m	10.50	10.50
3	Cement Plastering	Sq.m	10.90	10.90
Total quantity			30.48	
Productivity per man day			10.16 Sq.m	

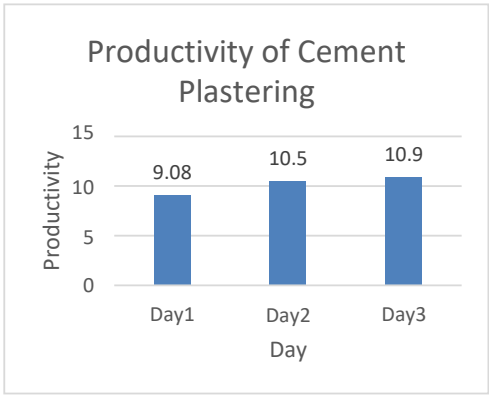


Fig. 2: Productivity for Cement Plastering

D. Productivity Calculation for Gypsum Plastering

Before initiating cement plastering MEP (Mechanical, Electrical and Plumbing) clearance should made. Gypsum plastering is done only for the internal walls. SAM GYPLAST is used to get a smooth finishing surface on the walls. The right angles should be check and the dhada is placed which is a button mark for gypsum plastering. The concrete surface should coated with bond max chemical before 24 hours of plastering work starts for the effective bonding. Fibre mesh of 300 mm width (150 mm from the joint on both sides) need to place for the prevention of cracking. The gypsum mix of 1:1 (one part of cement and one part of water) is prepared for plastering. Productivity for Cement Plastering shown in Table III. Gypsum plastering have a thickness of 10 mm to 15 mm. Fig. 3 Shows the Productivity of Gypsum plastering for days. This plastering is done only in non-wetted areas and it does not require curing.

TABLE III: PRODUCTIVITY FOR GYPSUM PLASTERING

Sr. No.	Description	UDM	Quantity	Productivity
1	Gypsum Plastering	Sq.m	40.00	10.00
2	Gypsum Plastering	Sq.m	29.77	7.44
3	Gypsum Plastering	Sq.m	20.64	10.32
Total quantity			90.41	
Productivity per man day			27.76 Sq.m	

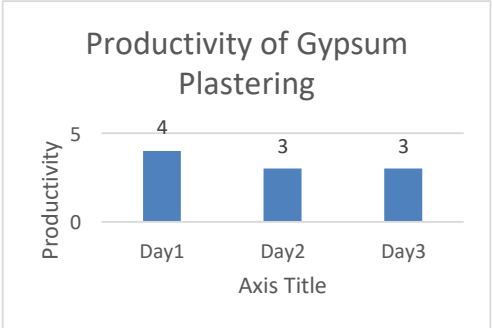


Fig. 3: Productivity for Gypsum Plastering

E. Productivity Calculation for Flooring

Before starting floor tiling all the wall dado should be completed and the surface should be cleaned. Mark the 1 m level from floor finishing level. Prepare cement mortar of 1:4 of PPC and lay it for the required level. Then cement slurry having consistency of 3.30 kg/sq.m is coated over the bed of cement mortar for proper bonding and lay the tiles. Grove of 6 to 8 mm to be provided. Fix the PVC spacer for maintain the proper alignment. Clean the joints with brush to remove mortar and dust. The flooring surface should be checked for every 2 m. Grouting is done for the joints. Productivity Calculation for flooring as shown in Table IV. Cure it for 7 days and hollowness should be after two days. Fig. 4 shows the Productivity for flooring. Bubble sheet should be laid on the floor tile to prevent it from cracks.

Table IV: Productivity for Flooring

Sr. No.	Description	UDM	Quantity	Productivity
1	Flooring	Sq.m	3.63	3.63
2	Flooring	Sq.m	3.63	2.27
3	Flooring	Sq.m	3.63	3.63
Total quantity			11.8	
Productivity per man day			2.95 Sq.m	

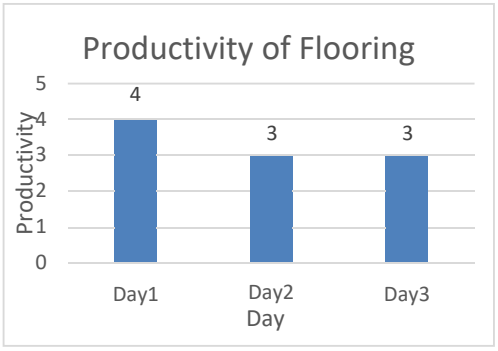


Fig. 4: Productivity for Flooring

F. Productivity Calculation for Frame Work

Before initiating framework, check the frame without any cracks or defects. If any defects occur, it should be rectified properly. Then check the moisture content of the frame and inspect the frame head and leg joint connection by wooden raw plug. Door frame is fixed by using mild steel clamp, wooden screw and coach screw for main door, 4 clamps are used and other doors 3 clamps are used. After fixing the door frame, check the plumb level. Productivity Calculation of framework as shown in Table V. Primer coating is done and allow it for 24 hours to dry. Fig. 5 shows the productivity for framework on days. Then two coats of painting is done and clean the sprinkling of wallpaint.

Table V: Productivity for Frame Work

Sr. No.	Description	UDM	Quantity	Productivity
1	Frame work	Sq.m	4.00	4.00
2	Frame work	Sq.m	3.00	3.00
3	Frame work	Sq.m	3.00	3.00
4	Frame work	Sq.m	3.00	3.00
Total quantity			13.0	
Productivity per man day			13.0 Sq.m	

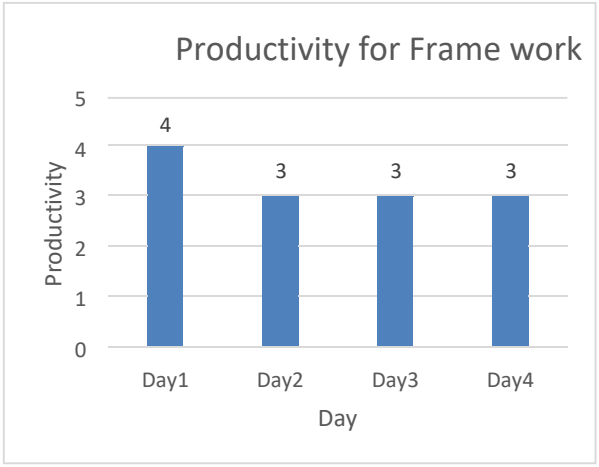


Fig. 5: Productivity for Frame Work

VI. Results and Discussion

The average construction labour productivity in the Tamil Nadu zone based on work nature as given in Table VI.

Table VI: Average Productivity

Sr. No.	Description	Productivity for One Person per Man Day
1	Block work	5.25 Cu.m
2	Cement plastering	10.16 Sq.m
3	Gypsum plastering	9.03 Sq.m
4	Toilet flooring	2.95 Sq.m
5	Frame work	3 No's

The variability of construction labour productivity for some activities in Tamil Nadu indicated by sample standard deviation and variance values as shown in Table VII.

Table VII: Variations in Productivity

Sr. No.	Description	No. of Days	Standard Deviation	Variance	Mean
1	Block work	4	0.78	0.61	0.91
2	Cement plastering	3	1.99	3.97	2.5
3	Gypsum plastering	3	1.08	1.16	1.44
4	Toilet flooring	4	0.34	0.12	0.36
5	Frame work	5	0.49	0.24	0.5

VII. Conclusion

The delaying factor can be identified by due to Skill set of labour, Labour personal problem, Misunderstanding among labours, Overtime, Material transportation, Lack of housekeeping, Drinking water problem, Climatic condition, Time constrain in hoist, Communication.

Remedial measures to increase the productivity are the Stream line production, Invest in capital equipment, Invest in employee training, Providing hoist material and labour transportation, Provide drinking water facility in alternative floors, Safety training, Scheduling of material and labour transportation in hoist.

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