Labor Productivity Analysis of Building Construction Industry

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Abstract- *With the continuous decline in profit margins and increased competition in construction projects, construction contractors are finding ways of eliminating waste and increasing profits. Although numerous approaches have been developed to improve efficiency and effectiveness of construction process, implementing statistical techniques offer the promise to minimize, if not eliminate non value-adding work. The construction industry is one of the largest industries in any economy. It makes a significant contribution to the national economy and provides employment to large number of people. Time and motion study (also referred to as motion and time study, the terms are used interchangeably) is the scientific study of the conservation of human resources in the search for the most efficient method of doing a task. Time and motion study is carried out to asses' human effectiveness by improved planning and sound incentive schemes to its employees.*

Keywords- Labour productivity,time motion,work study,regression analysis

I. INTRODUCTION

Work profitability is a significant financial marker that is firmly connected to monetary development, aggressiveness, and expectations for everyday comforts inside an economy. Work efficiency speaks to the all about volume of yield (estimated as far as Gross Domestic Product, GDP) delivered per unit of work (estimated as far as the quantity of utilized people) during a given time reference period. The marker enables information clients to evaluate GDP-to-work input levels and development rates after some time, in this way giving general data about the effectiveness and nature of human capital in the creation procedure for a given financial and social setting, including other correlative sources of info and advancements utilized underway Given its handiness in passing on significant data on a nation's work showcase circumstance, it was one of the pointers used to quantify progress towards the accomplishment of the Millennium Development Goals (MDGs), under Goal 1 (Eradicate destitution and yearning), and it was incorporated as one of the pointers proposed to gauge progress towards the accomplishment of the Sustainable Development Goals (SDG), under Goal 8 (Promote continued, comprehensive and reasonable monetary development, full and profitable business and not too bad work for all). Development execution and profitability improvement are key centre territories in development industry for any country. Indian development industry frames a fundamental piece of economy. Development establishes 40% to half of India's capital consumption on ventures in different segments, for example, parkways, streets, railroads, vitality, air terminals, water system, and so on and is the second biggest industry in India after agribusiness. It represents about 11% of India's GDP. Improving efficiency is significant worry for any benefit arranged association. By and large terms efficiency is named as proportion among info and yield. Appropriate administration of accessible resource can help in improving efficiency. Work is the most significant advantage for a development organization.

1.1 Aim Of The Present Work

To analyses labour productivity for residential building site

1.2 Objectives: Labour Productivity And Uses

- To improve the work process in terms of production time and to identify the parameters to increase productivity
- To measure the work content of a job by doing work sampling for construction activities.
- To find correlation various human activities related to concreting and establish regression equation between them for concreting slab work.

II. LITERATURE REVIEW

In development ventures, there are three fundamental arranging components: time, cost, and quality. These ideas are in a cozy relationship with one another. Work profitability is additionally a key idea of development arranging endeavors and has an immediate interrelationship with the triple

requirement referenced previously. (SerdarUlubeyli, AynurKazaz, BayramEr., 2014). Lower work execution is unequivocally identified with the nearness of progress of work, disturbances and modify. On normal 30% loss of proficiency happens when changes are finished. The most critical sorts of interruptions are absence of materials and data and playing out the work out of succession. These interruptions bring about every day loss of proficiency in scope of 25% - half. (H. Randolf Thomas & Carmen I. Napolitan). Work efficiency is likewise one of the exhibition markers to survey the achievement of the development venture. Since development is a work escalated industry, it very well may be contended that the work power is the predominant profitable asset. Therefore development efficiency is principally subject to human exertion and execution. Work efficiency is significant list in light of grouping of work expected to finish explicit work. (Wen yi& Albert P.C.Chan, 2014). Profitability is for the most part proportion of yield to include. In type of condition it very well may be appeared as follows:

Productivity = Output ÷ Input
= Total output ÷ Total work hour.

III. METHODOLOGY WORK STUDY

So as to comprehend the job of work study, we have to comprehend the job of technique study and that of time study. Technique study (additionally now and then called Work Method Design) is for the most part used to improve the strategy for accomplishing work. It is similarly appropriate to new openings. At the point when applied to existing occupations and existing employments, technique study intends to discover better strategies for carrying out the responsibilities that are conservative and safe, require less human exertion, and need shorter prepare/set aside time. The better technique includes the ideal utilization of best materials and proper labor with the goal that work is acted in efficient way prompting expanded asset usage, better quality and lower costs. It can consequently be expressed that through technique study we have a precise method of creating human asset adequacy, giving high machine and hardware use, and utilizing materials. Time study, then again, gives the standard time, that is the time required by laborer to finish a vocation by the standard strategy. Standard occasions for various occupations are important for legitimate estimation of

- manpower, machinery and equipment requirements
- daily, weekly or monthly requirement of materials
- production cost per unit as an input to better make or buy decision
- labour budgets
- Worker's efficiency and make incentive wage payments.

3.1 Method Study Procedure

The following general steps describe the procedure for making a method study.

1. Select the job – on which method study is to be applied.
2. Obtain information and record.
3. Examine the information critically.
4. Build up the most functional, prudent and successful strategy by thinking about genuine impediments of the circumstance.
5. Install the new method as standard practice.
6. Maintain the standard practice by regular follow up.

IV. PROBLEM STATEMENT

- To find the productive and non productive time by using the correlation and regression method and detect the cause of low productivity.
- Higher productivity in organization leads to national prosperity and better standard of living for the whole community. Improving productivity through time and motion studies is used in construction sector and allied industries. Work study consists of 2 aspects, method study and measurement which when applied effectively results to higher productivity. The main problem of constructions productivity depends upon how labors are utilized. Labour productivity can be higher or lower depending on factors like availability of work load, material, working tools, availability of power, work efficiency, level of motivation, level of training of working condition (comfortable or poor) etc.
- For above objective 5 days observation are recorded from site Sinhgad Guardian, Paranjape Broadway Wakad & Pristine Equilife.

Fig 1 Study Area 1- Sinhgad Guardian

Fig 2 Study Area 2 - Paranjape Broadway Wakad

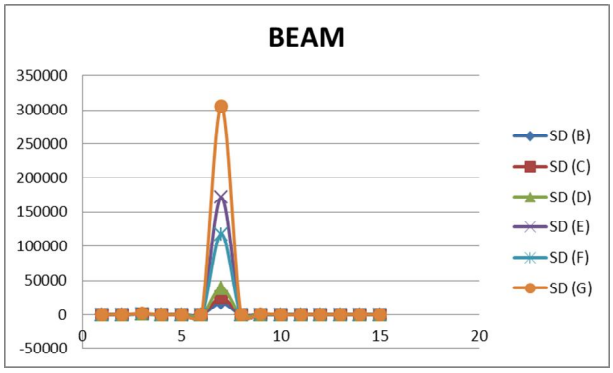
Fig 3 Study Area 3 - Pristine Equilife

V. RESULT AND DISCUSSION

5.1 Study Area 1 - Sinhgad Guardian

Table 1 Data Analysis – Beam

DATA ANALYSIS						
SD (A)	SD (B)	SD (C)	SD (D)	SD (E)	SD (F)	SD (G)
163.7442288	132.710777	159.715267	196.871139	414.2902978	342.431025	552.4501879
MAX(A)	MAX(B)	MAX(C)	MAX(D)	MAX(E)	MAX(F)	MAX(G)
900	1300	633	870	1200	990	1895
MIN(A)	MIN(B)	MIN(C)	MIN(D)	MIN(E)	MIN(F)	MIN(G)
240	68	0	-58	0	0	0
VAR(A)	VAR(B)	VAR(C)	VAR(D)	VAR(E)	VAR(F)	VAR(G)
26812.17246	17612.1504	25508.9664	38758.2455	171636.4508	117259.007	305201.2101
MEDIAN(A)	MEDIAN(B)	MEDIAN(C)	MEDIAN(D)	MEDIAN(E)	MEDIAN(F)	MEDIAN(G)
564	250	350.634669	181	534.8404847	450.248367	1476.965075
CORRELC12	CORRELC13	CORRELC14	CORRELC15	CORRELC16	CORRELC17	CORRELC23
0.460133563	-0.061716	-0.0482352	-0.1994474	-0.19779076	-0.19235934	-0.270617238
CORRELC24	CORRELC25	CORRELC26	CORRELC27	CORRELC34	CORRELC35	CORRELC36
-0.22997646	-0.3192295	-0.3192294	-0.1294783	0.394306435	0.52660145	0.523347574
CORRELC37	CORRELC45	CORRELC46	CORRELC47	CORRELC56	CORRELC57	CORRELC67
0.254633193	0.74029292	0.74099685	0.41864456	0.999899351	0.56890321	0.57004491



Productivity Table

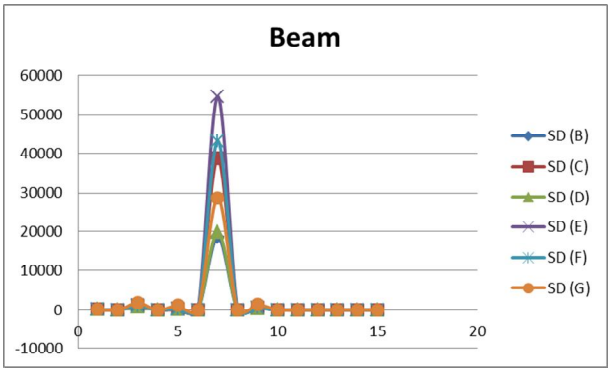
ACTIVITY	NO.OF WORKERS	NO.OF OBSERVATIONS	NO.OF SAMPLES	EXPECTED PRODUCTIVITY	PRODUCTIVE WORK %	NON PRODUCTIVE WORK %
1	6	9	54	89%	80	17.7
2	6	9	54	89%	79	21
3	6	8	48	89%	80	20

After observation of the all activities on the Sinhgad Guardian and from the above productivity table we conclude that on site there are 21.14% are non-productive work and 78.86% are productive work done on site.

5.2 Study Area 2 - Paranjape Broadway Wakad

Table 2 Data analysis –Beam

DATA ANALYSIS						
SD (A)	SD (B)	SD (C)	SD (D)	SD (E)	SD (F)	SD (G)
1757.3607	136.02522	196.68060	140.70795	233.882243	207.77931	169.247496
MAX(A)	MAX(B)	MAX(C)	MAX(D)	MAX(E)	MAX(F)	MAX(G)
7372	990	1025	775	1120	995	1825
MIN(A)	MIN(B)	MIN(C)	MIN(D)	MIN(E)	MIN(F)	MIN(G)
400	381.80427	105.18530	265.63403	320.062442	284.34118	1131.35708
VAR(A)	VAR(B)	VAR(C)	VAR(D)	VAR(E)	VAR(F)	VAR(G)
3088316.62	18502.861	38683.260	19798.729	54700.9040	43172.243	28644.7149
MEDIAN(A)	MEDIAN(B)	MEDIAN(C)	MEDIAN(D)	MEDIAN(E)	MEDIAN(F)	MEDIAN(G)
2194.37302	534.95648	544.38148	458.33146	598.723589	531.90176	1412.90469
CORRELC12	CORRELC13	CORRELC14	CORRELC15	CORRELC16	CORRELC17	CORRELC23
0.22652001	0.5491647	0.8120500	0.7058192	0.70581920	0.3041601	0.54582946
CORRELC24	CORRELC25	CORRELC26	CORRELC27	CORRELC34	CORRELC35	CORRELC36
0.25772636	0.6515340	0.6515340	0.6690494	0.59934483	0.83091761	0.830917606
CORRELC37	CORRELC45	CORRELC46	CORRELC47	CORRELC56	CORRELC57	CORRELC67
0.498517794	0.73693404	0.73693404	0.3455069	0.432211	0.65605199	0.656051992



Productivity Table

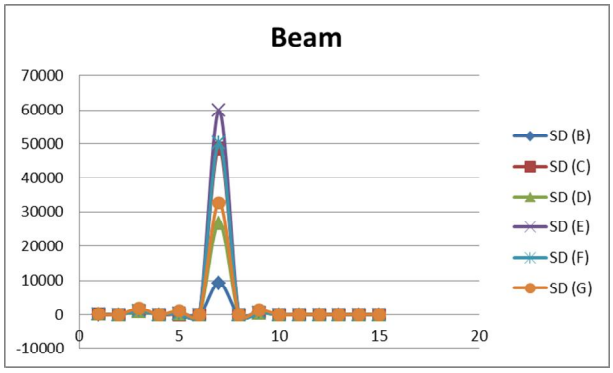
ACTIVITY	NO.OF WORKERS	NO.OF OBSERVATIONS	NO.OF SAMPLES	EXPECTED PRODUCTIVITY	PRODUCTIVE WORK %	NON PRODUCTIVE WORK %
1	6	9	54	89%	80	17.7
2	6	9	54	89%	79	19
3	6	8	48	89%	80	20

After observation of the all activities on the Paranjape Broadway Wakad and from the above productivity table we conclude that on site there are 20.54% are non productive work and 79.46% are productive work done on site.

5.3 Study Area 3 - Pristine Equilife

Table 3 Data analysis –Beam

DATA ANALYSIS						
SD (A)	SD (B)	SD (C)	SD (D)	SD (E)	SD (F)	SD (G)
1729.87815	96.462329	220.27369	163.23448	244.537293	224.29873	180.839790
MAX(A)	MAX(B)	MAX(C)	MAX(D)	MAX(E)	MAX(F)	MAX(G)
7372	1100	1125	900	1200	1100	1950
MIN(A)	MIN(B)	MIN(C)	MIN(D)	MIN(E)	MIN(F)	MIN(G)
503.277592	560	105.18530	338.1	380	335	1208.84729
VAR(A)	VAR(B)	VAR(C)	VAR(D)	VAR(E)	VAR(F)	VAR(G)
2992478.41	9304.9809	48520.498	26645.496	59798.4879	50309.921	32703.0298
MEDIAN(A)	MEDIAN(B)	MEDIAN(C)	MEDIAN(D)	MEDIAN(E)	MEDIAN(F)	MEDIAN(G)
2574.89093	671.73977	591	517.6556	708.685597	591.14912	1509.67898
CORRELC12	CORRELC13	CORRELC14	CORRELC15	CORRELC16	CORRELC17	CORRELC23
0.27475841	0.5888981	0.7842360	0.7565093	0.71358284	0.3116472	0.61584285
CORRELC24	CORRELC25	CORRELC26	CORRELC27	CORRELC34	CORRELC35	CORRELC36
0.27384630	0.6645119	0.6980063	0.6831981	0.51544829	0.8552950	0.86610974
CORRELC37	CORRELC45	CORRELC46	CORRELC47	CORRELC56	CORRELC57	CORRELC67
0.51993376	0.63081006	0.58410372	0.22548571	0.995729927	0.64034498	0.660266425



Productivity Table

ACTIVITY	NO.OF WORKERS	NO.OF OBSERVATIONS	NO.OF SAMPLES	EXPECTED PRODUCTIVITY	PRODUCTIVE WORK %	NON PRODUCTIVE WORK %
1	8	7	56	88%	79	18
2	8	7	56	88%	80	20
3	8	7	56	88%	79	21

After observation of the all activities on the Pristine Equilife and from the above productivity table we conclude that on site there are 21.2% are non-productive work and 78.8% are productive work done on site.

Table 4 Labour Productivity

S/N	Trades	Unit of Measurement	Average Trade Productivity
1	Formwork *(Tableform for slab/beam)*	m^2/man/hour	2.3
2	Mesh placing and fixing *(Slab)*	kg/man/hour	142
3	Concrete placement *(Slab, using stationary concrete pump)*	m^3/man/hour	1.85
4	Drywall *(12 mm thick board)*	m^2/man/hour	2.25
5	Painting *(Emulsion 3 coats, using roller)*	m^2/man/hour	5.5
6	Timber door installation *(Dimensions 2100 mm x 950 mm)*	num/man/hour	0.34
7	Wall tiling *(Using adhesive to lay ceramic tiles)*	m^2/ man/hour	1.02
8	Floor tiling *(Using adhesive to lay ceramic tiles)*	m^2/man/hour	2.03
9	Suspended ceiling *(Exposed grid system)*	m^2/ man/hour	5.04
10	Air-con ducting *(Metal)*		
a)	Formed and insulated on-site	m^2/man/hour	2.9
b)	Pre-formed and pre-insulated	m^2/ man/hour	4.2
11	Electrical conduit installation (20 mm diameter uPVC electrical conduit fixed to ceiling)	m/man/hour	2.71
12	Water pipe installation (20 mm diameter copper pipe concealed in wall)	m/man/hour	1.65

VI. CONCLUSION

- A comprehensive study can be conducted for different activities for e.g. like flooring, excavation and painting etc.
- It is also possible to use work study concept for different activities of construction for work sampling and improving the productivity on site.
- Study can be conducted on motivation, improving techniques of work, use of good machineries, and Work conflict through questionaries' and sample surveys for implementation for improving the productivity.
- as per analysis in all case studies for beam, creation of Bottom Shuttering require more time than other activities (SD B)
- After observation of the all activities on the Sinhgad Guardian and from the given productivity table we conclude that on site there are 21.14% are non-productive work and 78.86% are productive work done on site.
- After observation of the all activities on the Paranjape Broadway Wakad and from the given productivity table we conclude that on site there are 20.54% are non productive work and 79.46% are productive work done on site
- After observation of the all activities on the Pristine Equilife and from the given productivity table we conclude that on site there are 21.2% are non-productive work and 78.8% are productive work done on site.

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