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BUILDING CONSTRUCTION LABOUR PRODUCTIVITY IN ARID CLIMATE ENVIRONMENT

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KEY WORDS: Construction, Production, Cost of Labour, building project, weather conditions, target quantity.

ABSTRACT:

Productivity is a significant aspect of construction industry that plays vital role for success and failure of any construction project. This industry generates 11% to 13% of GDP all around the globe and the cost of labour in any building project is 20% to 35% of the cost of Building. On daily basis labour utilizes 30% of time on productive activities rest 70% of the time is ruined in non-productive activities, there are multi factors which are affecting the labour production in construction industry hence this study provides an overview of productivity, Total Factor productivity, method used to measure accurate productivity in construction projects. The objective of this study is find out percentage up to what extent labour production is affected due to weather conditions, however this study is carried out in arid climate region in Month of June 2018, where minimum temperature was recorded 26.0 Celsius degree at 7:30 AM and Maximum was 47.80 Celsius degree at 3:00 PM. A descriptive survey research design approach was adopted using continuous observation method of study. Project work study manual served as the research instrument to collect the data on selected building sites for 30 working days. Data collected were analyzed using descriptive statics. The results show that average monthly production of mason gang was recorded with less production of 28.759%, Carpentry gang with average monthly loss of production 16.74% & steel fixer gang had average monthly loss of production was 12.188. This concludes that prior to signing the contract for construction project. The location, environment, topography of region, capacity of construction operatives must be kept in mind to decide the proper timeline for the successful of project.

1. INTRODUCTION

Construction industry all around the world plays a dynamic role for the prosperity of any country (S. Sohu et al. 2018). This is a versatile industry which generates around 11 to 13% of GDP annually (I.A Bhatti et al., 2018). The cost of labour in any building construction project is 20% to 35% of the cost of Building (Buchan R. D., Fleming F. W., Kelly J. R., 1993). The time utilized by labour on daily basis on productive activities is average about 30% of total time available for construction work. The rest of the time about 70% is wasted on non-productive activities, delays and added activities (I.A Bhatti et al. 2018). Construction projects are unique very few projects are repeated, and experience gained on one site is not necessarily of benefit or directly applicable on other site (Mahamid, I. 2013). Projects locations, site topography, labor force vary from one project to another. Meanwhile this industry faces many challenges like time overrun, cost overrun, construction waste generation and management, health and safety challenges are the key challenges faced by this industry; however there is one predominant challenge of labor production which is the key concern for this industry (Oladiran, O. J. and Onatayo, D. 2019). labour production is severe concern which gives birth to time overrun and cost overrun problems within the construction projects (Gerek, İ. H., Erdis, E., Mistikoglu, G. & Usmen, M. 2015). Construction productivity is affected because of multiple factors and different causes. The intensity of these factors and causes varies from site to site and from day to day (Jarkas, A. M. & Bitar, C. G. 2012). The effect of these factors is to change the productivity. The Aim of this study is to determine the extent to which variability in labour productivity can be explained by variations in arid climate environment. To achieve this aim, it will be essential to develop consistent techniques for measuring productivity and factors which are

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affecting it. This study is conducted primarily in Middle East arid climate region.

2. LITERATURE REVIEW

Every construction project is based on Iron triangle constraint approach which has three basic elements; time, cost and quality. These three constraints are firmly connected together. Labour production is key constraint among these three elements and has direct interrelationship with triple constraints of iron triangle.

2.*1* ***Definition of Productivity****:* when study was carried out in depth, it was found that there is no perfect definition for the word construction productivity. Even when definitions are consistent, different approaches to measuring input and output vary so greatly that a valid comparison between projects is almost impossible. Various definitions of the productivity have been encountered, these include the following

a. Efficiency
b. Effectiveness
c. Performance
d. Production

The general consent is to define the productivity as the ratio of output to input. In view of this, two approaches to productivity measurement emerges total factor productivity where all inputs and outputs are considered and single factor productivity where single factor is taken into consideration (Revianty Nurmeyliandari Nurhendi, Muhamad Azry Khoiry, Noraini Hamzah (2019).

2.*2 Labour Productivity Measurement**:*** There are numerous techniques involved in measuring the labour productivity especially in construction industry. Measurement of labour production is varies according to the nature of Project. Broadly, productivity measures can be classified as single factor productivity measures (relating a measure of output to a single measure of input) or multifactor productivity measures (relating a measure of output to a bundle of inputs). Another distinction, of relevance at the industry or firm level is between productivity measures that relate some measure of gross output to one or several inputs and those which use a value-added concept to capture movements of output (Kazaz, A., Ulubeyli, S., Acikara, T. & Er, B. 2016).

3. METHODOLOGY

A descriptive research methodology approach was adopted using continuous observation method of study. Project work study manual served as the research instrument to collect the data on selected building site for 30 working days. On every working day temperature was recorded twice a day as shown in Table 1. First early in the morning and second it was recorded at mid noon time. Meanwhile the labour production was also going to be recorded simultaneously every day with respect to activity carried out by construction operatives at site as shown in Table 2, 3 & 4.

Table 1. Daily on-site Temperature Record

Morning time			***After Noon Time***		
Date	***Time***	***Temperature***	***Date***	***Time***	***Temperature***
1-6-2018	***Friday***		***1-6-2018***	***Friday***	
2-6-2018	09:00 AM	29.0 ^{0}C	2-6-2018	02:00 PM	43.2 ^{0}C
3-6-2018	09:30 AM	29.3 ^{0}C	3-6-2018	01:45 PM	42.8 ^{0}C
4-6-2018	10:00 AM	32.4 ^{0}C	4-6-2018	01:00 PM	41.2 ^{0}C
5-6-2018	08:00 AM	28.0 ^{0}C	5-6-2018	02:45 PM	42.0 ^{0}C
6-6-2018	07:30 AM	26.4 ^{0}C	6-6-2018	03:00 PM	39.6 ^{0}C
7-6-2018	07:45 AM	26.8 ^{0}C	7-6-2018	03:45 PM	38.3 ^{0}C
8-6-2018	***Friday***		***8-6-2018***	***Friday***	
9-6-2018	07:45 AM	27.1 ^{0}C	9-6-2018	01:15 PM	42.7 ^{0}C
10-6-2018	07:30 AM	27.9 ^{0}C	10-6-2018	01:45 PM	43.0 ^{0}C
11-6-2018	08:00 AM	28.3 ^{0}C	11-6-2018	02:00 PM	41.8 ^{0}C
12-6-2018	09:00 AM	31.1 ^{0}C	12-6-2018	03:00 PM	41.3 ^{0}C
13-6-2018	09:30 AM	32.0 ^{0}C	13-6-2018	03:45 PM	40.5 ^{0}C
14-6-2018	10:00 AM	33.2 ^{0}C	14-6-2018	03:15 PM	40.9 ^{0}C
15-6-2018	***Friday***		***15-6-2018***	***Friday***	
16-6-2018	09:00 AM	32.0 ^{0}C	16-6-2018	02:00 PM	39.8 ^{0}C
17-6-2018	09:30 AM	32.3 ^{0}C	17-6-2018	01:45 PM	40.1 ^{0}C
18-6-2018	10:00 AM	33.0 ^{0}C	18-6-2018	01:00 PM	40.7 ^{0}C
19-6-2018	08:00 AM	30.2 ^{0}C	19-6-2018	02:45 PM	41.2 ^{0}C
20-6-2018	07:30 AM	29.8 ^{0}C	20-6-2018	03:00 PM	40.9 ^{0}C
21-6-2018	07:45 AM	31.0 ^{0}C	21-6-2018	03:45 PM	40.3 ^{0}C
22-6-2018	***Friday***		***22-6-2018***	***Friday***	
23-6-2018	07:45 AM	30.3 ^{0}C	23-6-2018	01:15 PM	42.3 ^{0}C
24-6-2018	07:30 AM	30.1 ^{0}C	24-6-2018	01:45 PM	42.8 ^{0}C
25-6-2018	08:00 AM	31.0 ^{0}C	25-6-2018	02:00 PM	43.0 ^{0}C
26-6-2018	09:00 AM	34.5 ^{0}C	26-6-2018	03:00 PM	47.8 ^{0}C
27-6-2018	09:30 AM	33.7 ^{0}C	27-6-2018	03:45 PM	40.2 ^{0}C
28-6-2018	10:00 AM	34.8 ^{0}C	28-6-2018	03:15 PM	40.7 ^{0}C
29-6-2018	***Friday***		***29-6-2018***	***Friday***	
30-6-2018	07:45 AM	31.2 ^{0}C	30-6-2018	02:45 PM	41.2 ^{0}C

3.1 Labour Production Record on Daily Basis

3.1.1. Mason Gang Production: Mason gang was consisting of one charge hand, five masons and five helpers total ten numbers of operatives were involved in one gang. According to gang and masonry activities targets were already set by the company, there productivity was recorded on daily basis, however only block work activity was in progress on the construction site which was recorded on daily basis as shown in Table 2.

Table 2. Production Record of Mason Gang

Date	*Production by Gang*	*Targeted Production*	*Remarks*
1-6-2018		***Friday***	
2-6-2018	486	700 No of hollow Blocks of 10 cm in size per day (700 x 6 = 4200) per week.	26.071 % less production than the targeted
3-6-2018	510		
4-6-2018	526		
5-6-2018	555		
6-6-2018	492		
7-6-2018	536		
	3105	***4200***	
8-6-2018		***Friday***	
9-6-2018	370	500 No of Solid Blocks of 10 cm in size per day (500 x 6 =2880) per Week	22.966 % less production than the targeted
10-6-2018	385		
11-6-2018	428		
12-6-2018	325		
13-6-2018	348		
14-6-2018	455		
	2311	***3000***	
15-6-2018		***Friday***	
16-6-2018	492	750 No of hollow blocks of 20 cm in size per day (750 x 6 = 4500) per Week	30.008% less production than the targeted
17-6-2018	512		
18-6-2018	545		
19-6-2018	586		
20-6-2018	499		
21-6-2018	512		
	3146	***4500***	
22-6-2018		***Friday***	
23-6-2018	223	400 No of solid blocks of 20 cm in size per day (400 x 6 = 2400) per week	35.291 % less production than the targeted
24-6-2018	241		
25-6-2018	275		
26-6-2018	258		
27-6-2018	275		
28-6-2018	281		
	1553	***2400***	
29-6-2018		***Friday***	
30-6-2018	227	300 No of Blocks	24.33 % less production than the targeted

3.1.2 Carpenter Gang Production: Carpenter gang was consisting of one charge hand, Five Carpenters and five helpers total ten numbers of operatives are involved in one gang. According to gang and carpentry activities targets were already set by the company, there productivity was recorded on daily basis as shown in Table 3.

Table 3. Production Record of Carpenter Gang

Date	*Production by Gang*	*Targeted Production*	*Remarks*
1-6-2018		***Friday***	
2-6-2018	41	48 m^2 is targeted production per day of 1 carpenter gang (48 x 6 = 288 m^2) per week	Shuttering Pad/ Foundation/tie Beam (Fix & Strike) 16.667 % less production than the targeted
3-6-2018	39		
4-6-2018	43		
5-6-2018	37		
6-6-2018	44		
7-6-2018	36		
	240	***288***	
8-6-2018		***Friday***	
9-6-2018	39	42 m^2 is targeted production per day of 1 carpenter gang (42 x 6 = 252 m^2) per week	Shuttering Column (Fix and Strike) 12.301 % less production than the targeted
10-6-2018	35		
11-6-2018	33		
12-6-2018	41		
13-6-2018	38		
14-6-2018	35		
	221	**252**	

15-6-2018	***Friday***		
16-6-2018	51	60 m^2 is targeted production per day of 1 carpenter gang (60 x 6 = 360 m^2) per week	Shuttering for Suspended slab (Fix and Strike) 21.112% less production than the targeted
17-6-2018	55		
18-6-2018	46		
19-6-2018	41		
20-6-2018	48		
21-6-2018	43		
	284	**360**	
22-6-2018	***Friday***		
23-6-2018	43	54 m^2 is targeted production per day of 1 carpenter gang (54 x 7 = 378 m^2) per week	Shuttering for Parapets and Upstands (Fix and Strike) 16.931% less production than the targeted
24-6-2018	47		
25-6-2018	50		
26-6-2018	39		
27-6-2018	41		
28-6-2018	49		
29-6-2018	***Friday***		
30-6-2018	45	54	
	314	**378**	

3.1.3 Steel Fixer Gang Production: Steel Fixer gang was also consisting of one charge hand, Five Steel Fixer and five helpers' total ten numbers of operatives are involved in one gang. According to gang and rebar activities targets were already set by the company, there productivity was recorded on daily basis as shown in Table 4.

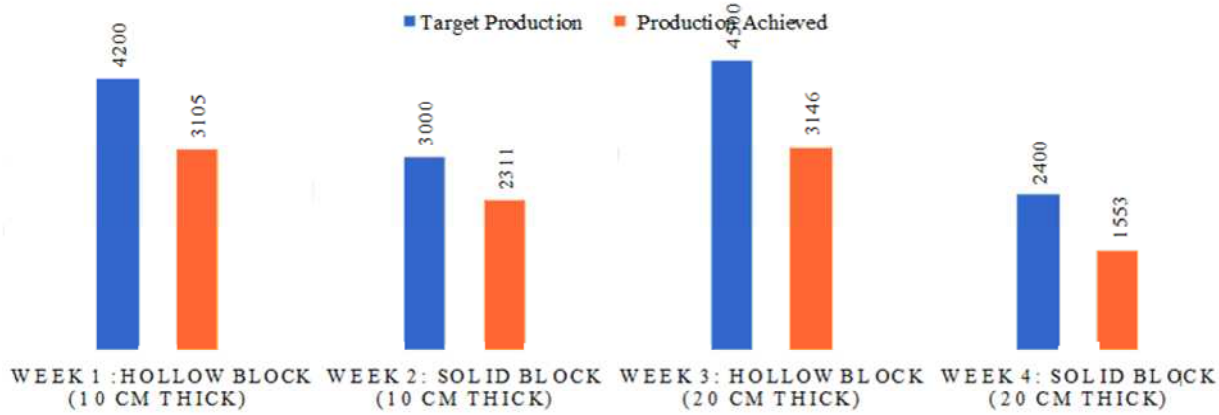
Table 4. Production Record of Steel Fixer Gang

Date	***Production by Gang***	***Targeted Production***	***Remarks***
1-6-2018	Friday		
2-6-2018	1750	2100 x 6 kg	Rebar Fixing to Pads and tie beams 12.087% less production than the targeted
3-6-2018	1820		
4-6-2018	1922		
5-6-2018	1782		
6-6-2018	1875		
7-6-2018	1928		
	11077 kg	**12600 kg**	
8-6-2018	Friday		
9-6-2018	1532	1800 x 6 kg	Rebar fixing to columns and beams 11.120% less production than the targeted
10-6-2018	1720		
11-6-2018	1685		
12-6-2018	1525		
13-6-2018	1652		
14-6-2018	1485		
	9599 kg	**10800 kg**	
15-6-2018	Friday		
16-6-2018	2100	2400 x 6 kg	Rebar fixing to raft foundation 10.819% less production than the targeted
17-6-2018	2112		
18-6-2018	2052		
19-6-2018	2175		
20-6-2018	2225		
21-6-2018	2178		
	12842 kg	**14400 kg**	
22-6-2018	Friday		
23-6-2018	1275	1500 x 7 kg	Floor slabs 14.733% less production than the targeted
24-6-2018	1303		
25-6-2018	1282		
26-6-2018	1325		
27-6-2018	1185		
28-6-2018	1325		
29-6-2018	Friday		
30-6-2018	1258		
	8953 kg	**10500 kg**	

4. ANALYSIS

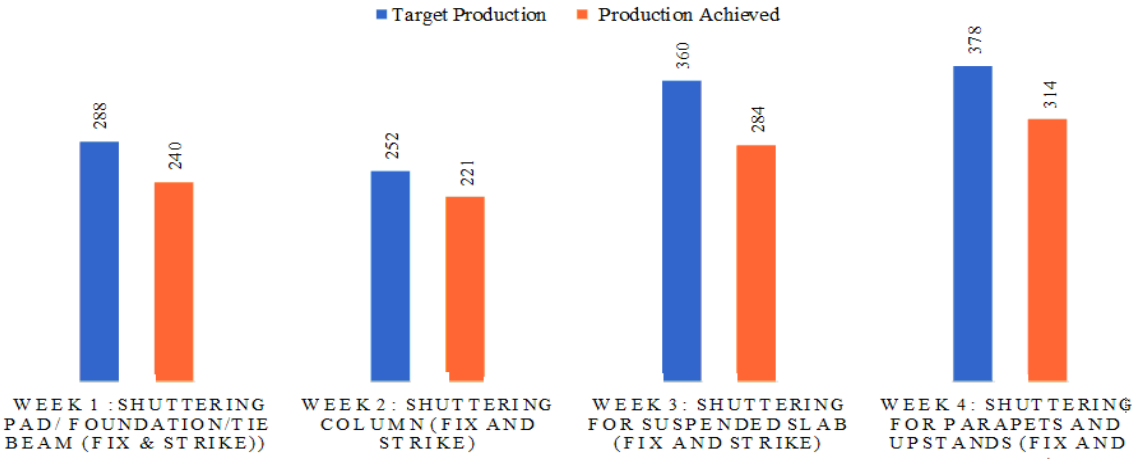
Production of every activity was analyzed based on gangs involved.

4.1 Mason Gang Production Analysis: Based on the targeted masonry activities, productivity of masonry work achieved seems to be keep on deceasing with respect to increase in temperature as shown in Figureure 1. In every week there was a certain decrease in the productivity of mason gang. In first week, it was recorded as 26.7% decrease, 2nd week it was recorded as 22.96%, 3rd week it was recoded as 30.088% & in last week of month it was 35.29% recorded less production. The average monthly loss of mason gang production was 28.759%. This continuous decrease in production of masonry work can lead to extensive delays in completing construction project. There was not a single week, where the mason gang has met their target.



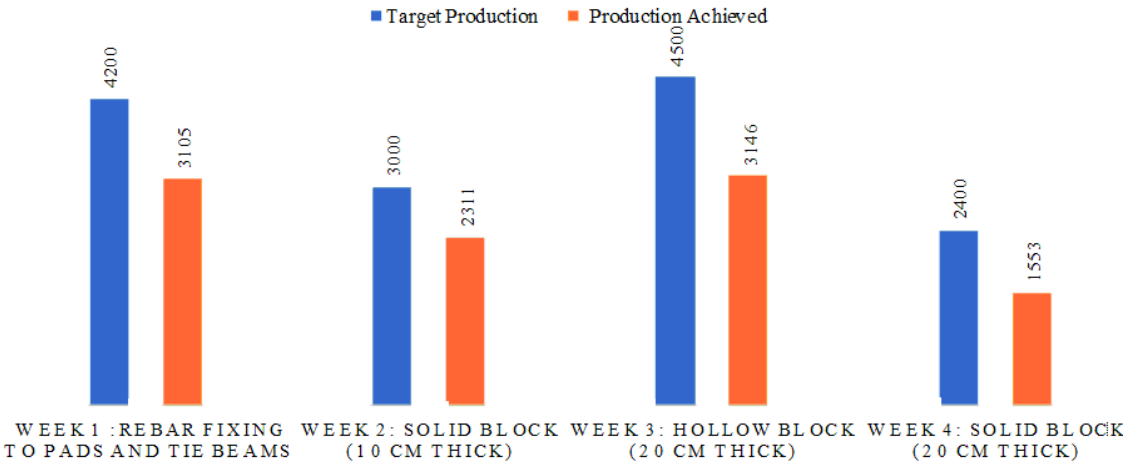
Figureure 1. Masonry Production Analysis

4.2. Carpenter Gang Production Analysis: The production of carpentry gang was also found with descending order. But the productivity of carpentry gangs seems to be more improved as compared to masonry gang. However, there was also loss of production from carpentry gang side with average monthly rate of 16.74%.



Figureure 2. Carpentry Production Analysis

4.3. Steel Fixer Gang Production Analysis: The production of Steel fixer gang was much improved as compared to other gangs as shown in Figure 3. It is found from the results that Steel fixer gang has tried their maximum efforts to meet the targets of company. However, there is also less production with the average monthly rate of 12.188%.



Figureure 3. Steel Fitter Gang Production Analysis

5. CONCLUSION

This study is focused on the arid climate environment. This study concludes that, prior to signing the contract for construction project. The location, environment, topography of region, capacity of construction operatives must be kept in mind to decide the proper timeline for the success of project. It is analyzed above that as the temperature was increasing the productivity of operatives was keep on decreasing. Besides the productivity, environment was also harshly affecting the health of construction operatives.

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