Analysis of Productivity in Construction

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Abstract: **Construction is the world's largest cash flowing industry. The successful completion of any construction project within budget and time is depends on skill of planning manager and control and monitor system of the construction site. The productivity tracking is one of the effective recent methods to control the project workflow with available resource. This paper shows how the project should be monitor by productivity of site with the help of Earned value analysis method. The data which going to analyzed in this paper is real site data and given by respective planning manager for education purpose. The major activity deals the entire site productivity and overall performance is taken into consideration. The result of this analysis shows the deviation of planned and actual work done of activity in site and warning sign to project manager from cost overrun and suggestions to improve productivity in site. It is possible to predict the exact scenario of construction site by this analysis before any major occurrence of loss.**

Keywords: **Site management, Earned value analysis, Monitoring, Productivity, Progress management.**

I. INTRODUCTION

India is the developing country and its economy highly depends on Construction industry. Productivity is one of the critical factors which affect the overall performance of any construction site. It is directly proportional to cost savings and probability of project. There is no standard definition for productivity for construction operations. In general terms, construction productivity can be defined as association between an input and an output. Productivity measurement at construction site enables companies to monitor their expected performance of the project against their site performance. Construction productivity at site level can be grouped under major activities whose can affect entire construction the project. The Earned value analysis is one of the best methods among all monitoring method of construction. The project becomes out of control when there is no control action taken at right place. This analysis method gives current and future state of project.

OBJECTIVES:

1. To Measure the productivity of the construction site by Earned value analysis.

2. To Provide suggestions and recommendations to increase productivity of the construction site.

II. TYPES OF PRODUCTIVITY

1. Single factor productivity:

Productivity calculated for the single activity like reinforcement, Formwork, Concrete is known as Single factor productivity.

2. Multi factor productivity:

Productivity calculated for more than one activity like labour and equipment or material and equipment and concrete is called as Multi factor productivity.

3. Total factor productivity:

Productivity calculations which include all the activity on the construction site is called as total factor productivity.

In this paper we are taken into consideration only single factor productivity

III. EARNED VALUE ANALYSIS

Earned Value Analysis (EVA) is a method of measuring performance .Earned value is a program management technique that uses work progress to indicate what will happen in the future (Bhosekar & Vyas, 2012). EVA is a three dimensional approach and is based on planned value (PV), Earned value (EV) and actual cost (AC). It proves the earn value of a completed work and compares it with actual cost and planned cost to determine the project performance and forecast its future trends. EVA is also described as an integrated, indirect or remote monitoring technique for the complex interaction of time and cost parameters to provide the performance measurement of a whole project. It is an effective and useful project tool that helps the client and as well as contractor to assess the project performance.

IV. DATA COLLECTED FOR ANALYSIS

The analysis for productivity of site needs field data about project. These are the basic data should be collected from the site.

1. Monthly actual work done of the activity from progress report

2. Daily progress report

3. Monthly certified bills

After data collection EVA technique used to predict current state of project and expected future progress of the project to avoid deviation from the planned value of activity and increase productivity.

V. MEASUREMENT OF PRODUCTIVITY

Productivity for individual projects can be measured upon project completion or during construction. In this analysis we using simple equation used by the construction industry development board [CIDB] Singapore to compute the monthly productivity of the individual projects. The Input and Output values are planned quantity and actual quantity for the period of a month. We can calculate any kind of activity whose input and output value are known.

Productivity = Input/Output

VI. CASE STUDY

In order to achieve the objectives, data was collected from the construction site. This case study is a resort construction in konkan coastal region of India. The list of important items about project is,

- Type of contract 'Cost plus'

- Total cost of contract is 66 cores

- Duration of the contract 24 months

The scope of the project is complete finishing of building civil work as per architectural and structural drawing. The project is already delayed due to low productivity.

As it is cost plus type of contract, delay of major activities make impact on the project and productivity of the project. Below table 1.1 shows planned and executed quantity of the all activity. The monthly executed quantity taken from monthly progress report of the site.

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VII.   RESULT AND DISCUSSION

Table 1.1 Planned and Executed quantity of activities for the month February, March, and April 2016

S.no	Description	Unit	Feb-16		Mar-16		Apr-16	
			Planned	Executed	Planned	Executed	Planned	Executed
1	Earthwork	m3	1100.00	488.8	2000.00	0	2470.30	0
2	Rubble soling	m3	276.00	255.5	214.47	96.6	214.47	0
3	PCC	m3	168.00	93.93	103.00	28.5	128.14	9.9
4	Plum concrete	m3	75.00	20.24	150.00	5	260.00	10.2
5	Anti-termite	m2	500.00	10	63.00	0	400.00	0
6	RCC	m3	248.76	199.8	533.91	140.45	429.49	156.3
7	Reinforcement	MT	22.00	24	49.00	16	43.00	14
8	Formwork	m2	909.20	1238.9	3138.70	193.41	3656.04	727.1
10	Masonry work	m2	1300.00	942.19	2300.00	76.67	4001.71	1304.32
11	Wall finishes	m2	1420.00	1299	4350.00	133.33	1064.28	627.86

Table 1.2 Planned and Executed quantity of activities for the month of May, June and July 2016

S.no	Description	Unit	May-16		Jun-16		Jul-16	
			Planned	Executed	Planned	Executed	Planned	Executed
1	Earthwork	m3	3000.00	0	3000.00	144.58	0.00	0
2	Rubble soling	m3	104.76	0	104.76	4.88	66.12	49.93
3	PCC	m3	52.50	16.3	52.50	13.9	40.00	59.2
4	Plum concrete	m3	207.64	42.82	207.64	96.95	60.00	175.53
5	Anti-termite	m2	0.00	0	0.00	0	0.00	0
6	RCC	m3	445.58	246.99	0.00	87.35	166.96	262.86
7	Reinforcement	MT	34.24	8.72	0.00	10.13	17.68	19.08
8	Formwork	m2	3248.40	599.52	0.00	818.16	923.06	1064.1
10	Masonry work	m2	3000.00	295.95	379.25	374.44	851.08	376.43
11	Wall finishes	m2	4050.00	638.24	500.00	1118.82	3533.16	985.46

Table 1.3 Planned and Executed quantity of activities for the month of August, September and October 2016
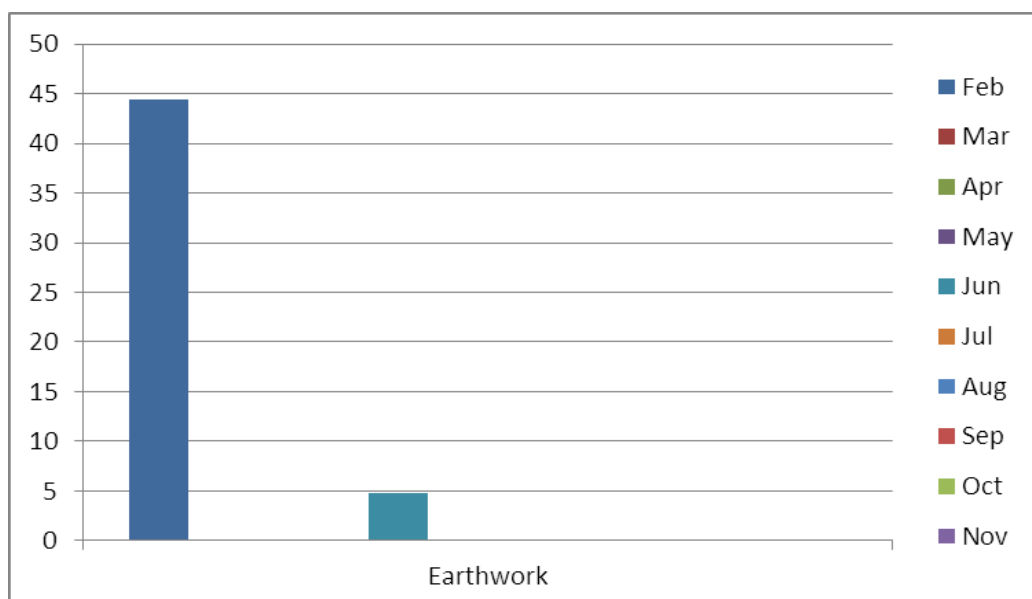
S.no	Description	Unit	Aug-16		Sep-16		Oct-16	
			Planned	Executed	Planned	Executed	Planned	Executed
1	Earthwork	m3	0.00	0	0.00	0	0.00	0
2	Rubble soling	m3	66.11	73.74	0.00	30.97	14.66	7
3	PCC	m3	40.56	13.2	40.00	12.6	13.79	19.8
4	Plum concrete	m3	42.36	2.57	60.00	8.5	26.21	93.7
5	Anti-termite	m2	0.00	0	0.00	0	400.00	0
6	RCC	m3	203.70	33.78	278.49	80.01	400.75	68.84
7	Reinforcement	MT	7.82	5.11	3.54	11.7	43.88	7.72
8	Formwork	m2	965.45	259.23	1031.33	250.89	1790.68	507.39
10	Masonry work	m2	851.08	82.62	774.42	158.83	1684.65	55.47
11	Wall finishes	m2	3533.16	298.65	3533.16	754.57	4273.21	88.79

Table 1.4 Planned and Executed quantity of activities for the month of November, December and January 2016
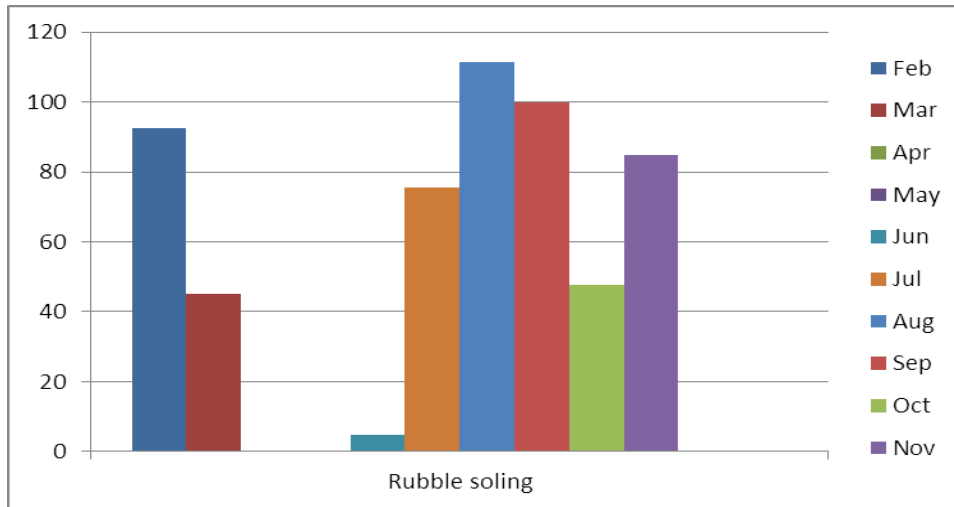
S.no	Description	Unit	Nov-15		Dec-15		Jan-16	
			Planned	Executed	Planned	Executed	Planned	Executed
1	Earthwork	m3	0.00	0	0.00	0	0.00	0
2	Rubble soling	m3	11.66	9.9	1.76	0	0.00	0
3	PCC	m3	13.79	0.9	12.29	16.6	1.59	1.6
4	Plum concrete	m3	26.21	0	70.00	53.3	30.00	0
5	Anti-termite	m2	0.00	0	0.00	0	0.00	0
6	RCC	m3	400.75	27.81	160.17	49.97	110.00	38.51
7	Reinforcement	MT	23.88	7.48	13.95	9.16	9.46	1.14
8	Formwork	m2	838.14	529.14	863.86	328.79	538.76	74.48
10	Masonry work	m2	918.56	523.19	685.42	743.31	273.43	113.97
11	Wall finishes	m2	4273.21	582.42	4128.09	963.48	1377.13	226.58

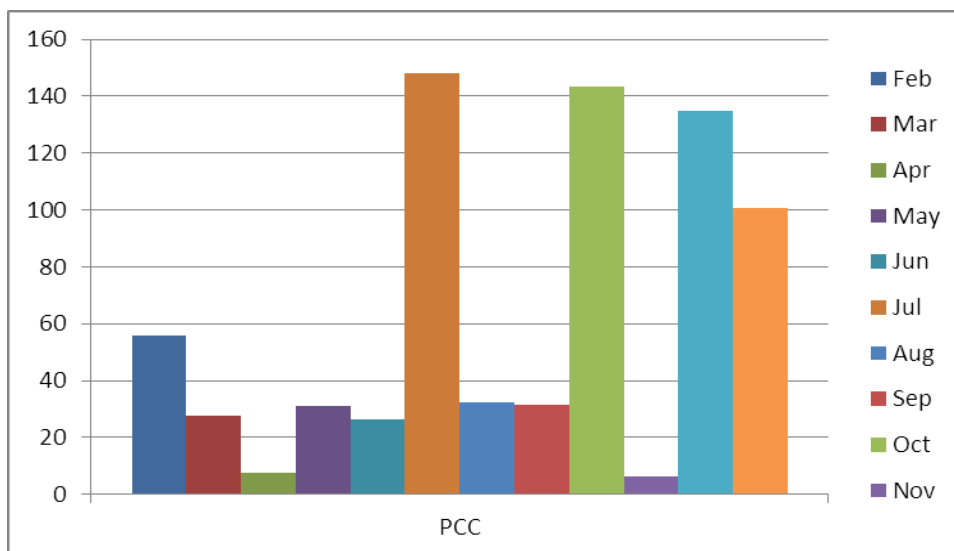**Table 1.5 Productivity of activities for the month of February 2016 to January 2017**

S.no	Description	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan
1	Earthwork	44.44	0.00	0.00	0.00	4.82	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	Rubble soling	92.57	45.04	0.00	0.00	4.66	75.51	111.54	100.00	47.75	84.91	0.00	0.00
3	PCC	55.91	27.67	7.73	31.05	26.48	148.00	32.54	31.50	143.58	6.53	135.07	100.63
4	Plum concrete	26.99	3.33	3.92	20.62	46.69	292.55	6.07	14.17	357.50	0.00	76.14	0.00
5	Anti-termite	2.00	0.00	0.00	0.00	100.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6	RCC	80.32	26.31	36.39	55.43	100.00	157.44	16.58	28.73	17.18	6.94	31.20	35.01
7	Reinforcement	109.09	32.65	32.56	25.47	100.00	107.92	65.35	330.51	17.59	31.32	65.66	12.05
8	Formwork	136.26	6.16	19.89	18.46	100.00	115.28	26.85	24.33	28.34	63.13	38.06	13.82
9	Masonry work	72.48	3.33	32.59	9.87	98.73	44.23	9.71	20.51	3.29	56.96	108.45	41.68
10	Wall finishes	91.48	3.07	58.99	15.76	223.76	27.89	8.45	21.36	2.08	13.63	23.34	16.45

Graph 1.1 Productivity of Earthwork for the month of February 2016 to January 2017

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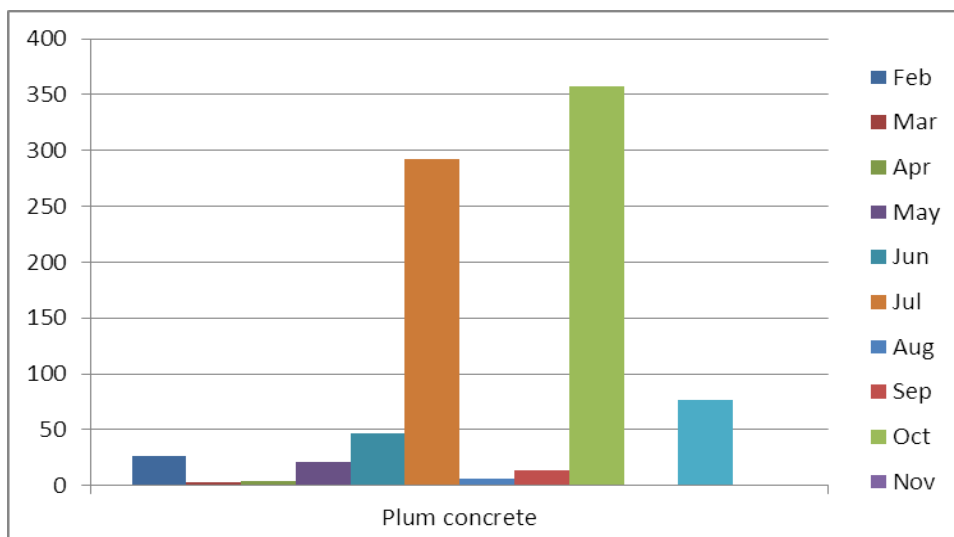
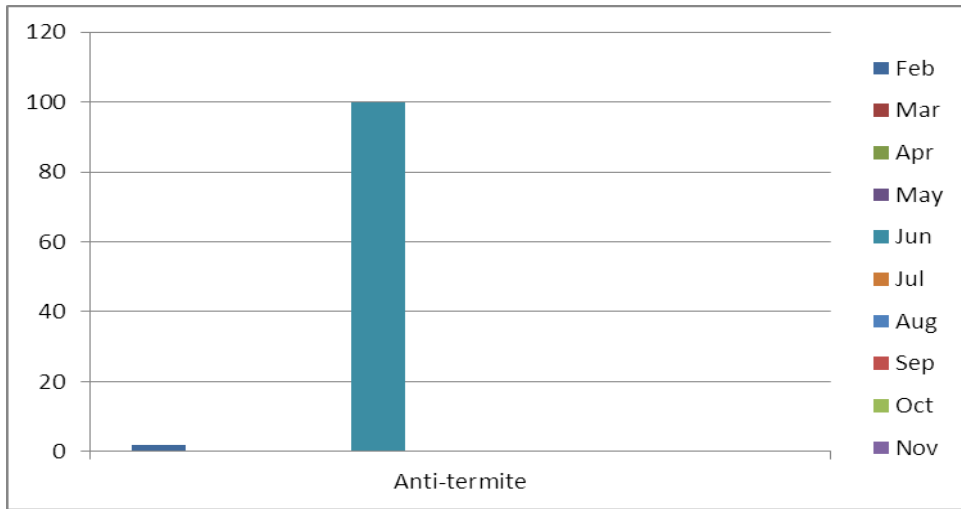**Graph 1.2 Productivity of Rubble soling for the month of February 2016 to January 2017**

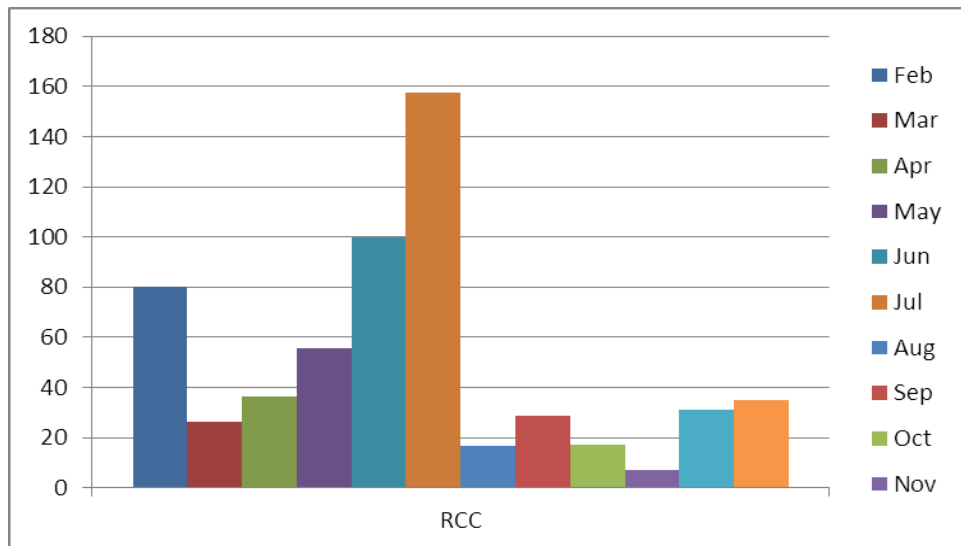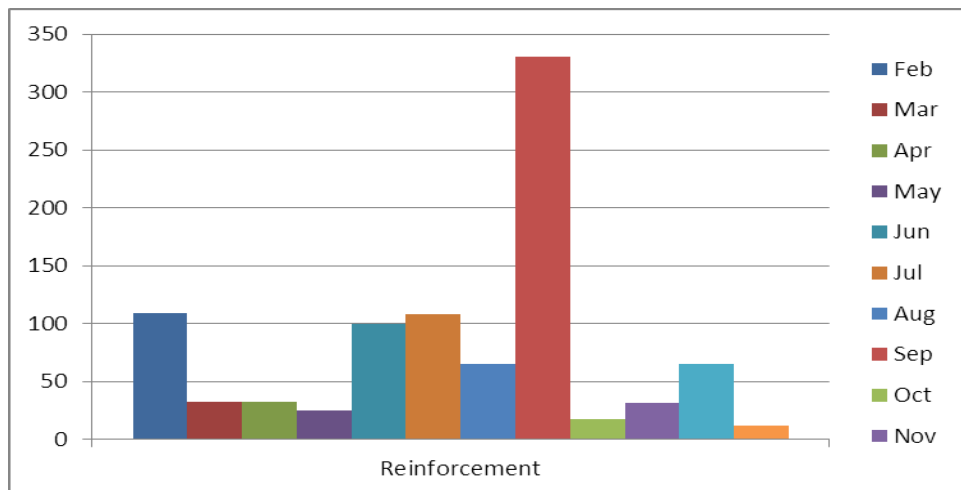**Graph 1.3 Productivity of PCC for the month of February 2016 to January 2017**

Graph 1.4 Productivity of Plum concrete for the month of February 2016 to January 2017

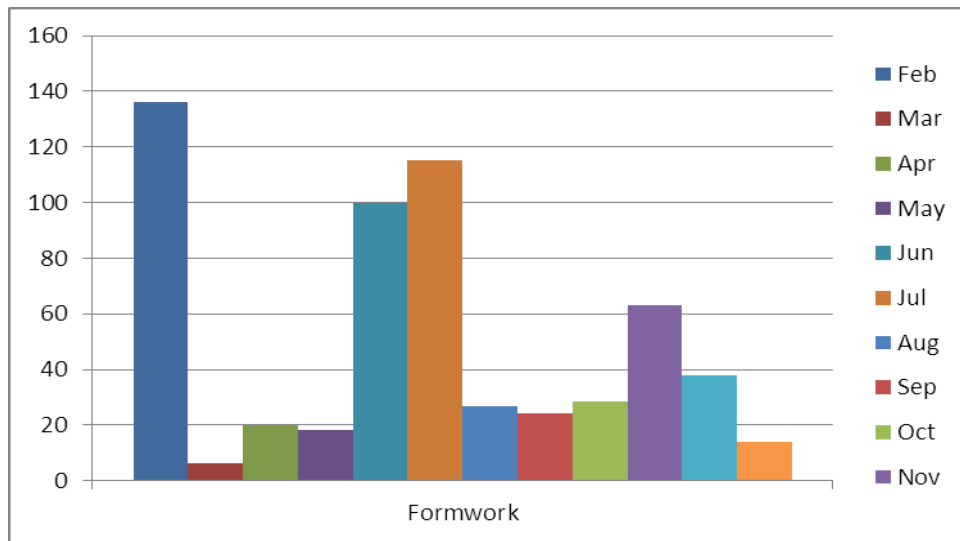**Graph 1.5 Productivity of Anti-termite for the month of February 2016 to January 2017**

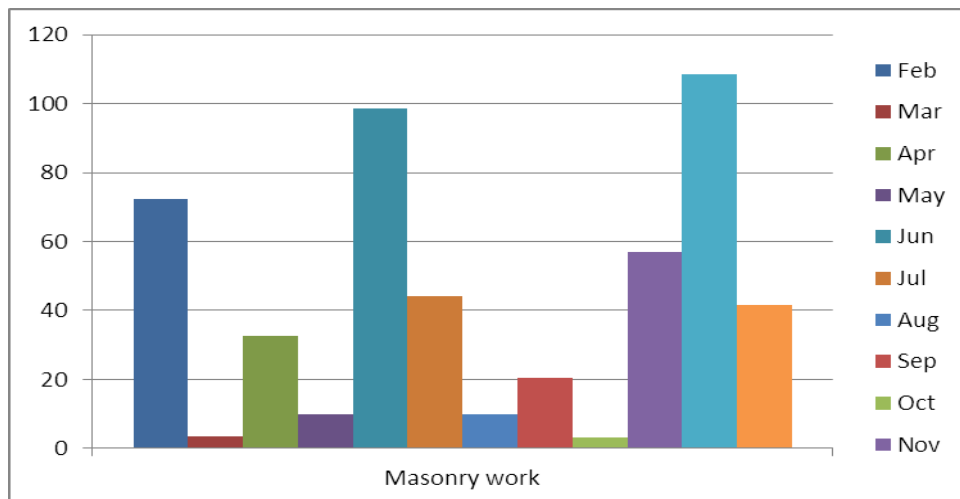**Graph 1.6 Productivity of RCC for the month of February 2016 to January 2017**

Graph 1.7 Productivity of Reinforcement for the month of February 2016 to January 2017
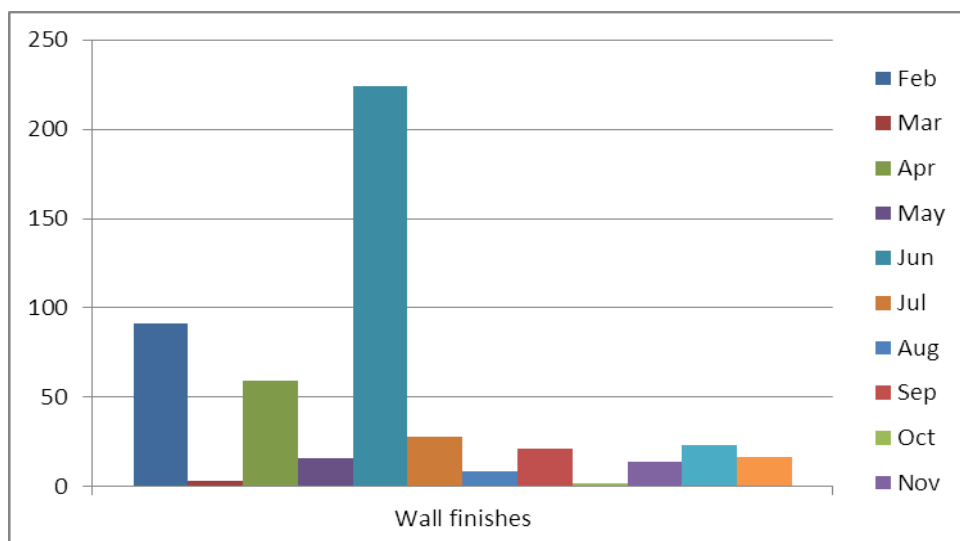
Graph 1.8 Productivity of formwork for the month of February 2016 to January 2017

Graph 1.9 Productivity of masonry work for the month of February 2016 to January 2017

Graph 1.10 Productivity of Wall finishes for the month of February 2016 to January 2017

VIII.   CONCLUSION

Project is already delayed due to low productivity. From the graph 1.1 to 1.10 shows the productivity of all activities for the month February 2016 to January 2017. The expected productivity is 100 % from the site management but it is not achieved frequently. Maximum productivity of the site is 357.5 % that is plum concrete at October 2016 since the activity has high scope at site. Minimum productivity of the site is 2 % that is anti-termite treatment since no scope at February 2016. The Following table 1.6 shows maximum and minimum productivity of activities for the month of   February 2016 to January 2017.

Table 1.6 shows maximum and minimum productivity of activities for the month of   February 2016 to January 2017.

S.no	Description	Maximum	Minimum
1	Earthwork	44.44	0
2	Rubble soling	111.54	0
3	PCC	148.00	6.53
4	Plum concrete	357.50	0
5	Anti-termite	100	0
6	RCC	157.44	6.94
7	Reinforcement	330.51	12.05
8	Formwork	136.26	6.16
9	Masonry work	108.45	3.29
10	Wall finishes	223.76	2.08

IX.   SUGGESTION AND RECOMMENDATIONS

From the result of table 1.5 and table 1.6 the analyst concludes improper planning definitely reduces the productivity so while planning the planning manager should consider the previous month planned and achieved quantity for the activity and the reason submitted by site person for not achieved the target quantity. Site conditions and manpower availability also gives major impact on planning. The substantial recommendations for productivity improvement at site are,

- Appointing potential planning manager

- Use updated and effective planning technique

- Consider site condition and pervious month productivity data while planning for upcoming month

- Conduct Weekly meeting

- Effective record keeping

- Direct inspection of site by planning manager

- Increase involvement site person in planning

- Consider suggestions of site persons in planning

- Allocate Incentive, extra wages for successful target achievement

REFERENCES

[1]   Varma Santosh and Apte (2014) Productivity in Building Construction, IOSR-JMCE Volume 10, Issue 5

[2]   Pramod M, Phaniraj and Srinivasan (2014) Monitoring System for Project Cost Control in Construction Industry,

[3]   International Journal of Engineering Research & Technology (IJERT) ISSN: 2278-0181 Vol. 3 Issue 7, July – 2014

[4]   Mohd Faris Khamidi and Waris Ali Khan and Arazi Idrus (2011) The Cost Monitoring of Construction Projects Through

[5]   Earned Value Analysis International Conference on Economics and Finance Research IPEDR vol.4

[6]   Mostafa E. Shehata and Khaled M. El-Gohary (2011) Towards improving construction labor productivity and projects' Performance Alexandria Engineering journal vol 50, 321-330

[7]   Syed Ali Dilawer (2014) Control the loss of labor productivity IJCSER volume 2, Issue 1, pp: 104-110

[8]   Thiyagu.C and M.Dheenadhayalan (2016) Construction labor productivity and its improvement IRJET volume : 02 issue : 08

[9]   Vaishant Gupta (2014) Improvement of construction labor productivity in chambal region IJRET Volume : 3 Issus: 10

[10]   Yogendrakumar (2013) Productivity Analysis of Small Construction Projects in India Asaian journal of Applied sciences,

[11]   Sudam Chavan and Hemant Salunkhe (2016) A study on labor productivity in construction industry IJER volume no 5, issue Special 1 pp: 247-249.

[12]   Shreyash Raut and Karan Sawant (2013) Effect of Project Cost and Time Monitoring on Progress of Construction Project IJRET,Volume :02 Issue:12