Integrating Traditional Construction Project Management With Lean Construction Management Concepts

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Abstract- *Theconstruction industry has traditionally been one of the second largest industries in India but productivity has been lower than other industry. Construction industry has lots of wastage like time, material and resources. Reason behind this problem is improper traditional management strategy. So it is necessary to explore this problem in construction industry. Lean construction Management is an excellent in managing the construction process. Main aim of Lean Construction Management is eliminating wastage of material, time and resources. Generally eliminating wastage are Overproduction, Substitution, Waiting time, Transportation, Processing, Inventories, Movement at construction site. A field study is conducted to evaluate the effectiveness of some lean construction techniques including last planner, increased visualization, daily huddle meetings, first run studies, the 5S process and fail safe for quality. The data collection methods include direct observations, interviews, questionnaires and documentary analysis at construction site.*

Keywords- construction wastage, traditional construction management, lean construction management, filed study, questionnaires survey.

I. INTRODUCTION

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 numbers of contingent problems that wear bounded to be resolved since the past time. The chronic problem of construction are well knows such as Low productivity, poor safety, inferior working condition and insufficient quality and the phenomenon of the poor performance and conditions in construction had long been witnesses and recorded by academics and practitioners throughout the world.

Now a day, increasing foreign competition, the scarcity of skilled labor and the need to improve construction quality are the key challenges faced by the construction industry. Responding to those challenges impose an urgent demand to rise productivity, quality and to incorporate new technologies to the industry. A lack of responsiveness can holdback growth and to development of the needed infrastructure for the construction industry and other key activities in the country.

With the lean construction paradigm, construction industry had started to be reviewed and evaluated in the possibilities of implementing these new lean perspectives of production concept in the construction processes to optimize the overall construction performance on construction stage as well as design stage. Performance improvement opportunities in construction can then be addressed by adopting waste identification/ reduction strategies in the flow processes in parallel with the introduction of new management tools and with proper trainings and education programs. Unfortunately, these new lean construction concept especially those on wastes and values most of the times are not well understood by construction processes while non-value adding activities such as inspection, delays, transportation of materials and others are not recognized as waste. As the result of that, the productivity of construction industry cannot be fully optimized due to the narrow interpretation on the concept of waste current adopted. In this case, substantial education programs need to be arranged for all related parties involved in order to implement the new process improvement strategies successfully throughout the construction process cycle.

II. NEED OF STUDY

It is presumably that construction industries in India are facing the same generic (process-related) problems/ wastes on construction activities which was also faced by their counterparts regardless those in development countries or developing countries. However, the main problem is the lack of clear indication on quantitative parameters to assess the extent of those problem/ wastes to have been impacted on the overall performance and productivity of local construction industries. To date, there have not been many well-documented quantitative studies and records on to process

related problems/wastes which arisen on construction site. As a result of that, the introduction of the concepts and framework of new lean construction ideology are seen as an opportunity to address the existing problems in local construction industry and utilizing concepts and framework of new lean construction ideology can then go further to formulate the extent of impacts of those problems/wastes on a more structured and quantitative basis.

Prior to assess the severity of the process-related problems/ wastage which existed in the construction processes for the local construction industries, the differentiate of traditional and new production/ construction concept will have to be drawn prior to further investigation and evaluation on any project performances. New measurement parameters such as waste, value, cycle time or variability that was not covered under traditional concept are to be introduced into this study as accordance to the lean construction ideologies and the subjects in this case; the local construction personnel will be subsequently examined with those new parameter to review the level of understanding and practicability in local construction industry compare to the requirement and the concepts set forth by lean construction philosophy.

III. OBJECTIVES

1. To study different type of buildings and their management system.
2. To establish their conventional management system problems.
3. To study lean construction management system concepts.
4. To give suitable lean construction management concepts for different types of buildings and improve in time.
5. To propose lean concept.

IV. SCOPE OF STUDY

Future scope of study will be to check feasibility of lean construction project technique which is use in building to identify wastage of construction projects.

V. LITERATURE

What is lean construction management? Mr. Howell and Mr. Ballard light on this concepts. They said that it is a new way to manage construction. Born in manufacturing, the goals demand a new way to coordinate action, one that is applicable to industries far removed from manufacturing. Implementation requires action be shaped by a deeper understanding of the goals and techniques. This paper explains the implications of the goals and key production principles, and how when taken together they result in a different way to manage construction. Implementing lean in construction then becomes a matter of developing and acting on this new knowledge. Advice on implementation is offered.

Lean thinking is a new way to manage construction. Many people object on first exposure because lean thinking appears to be the application of a manufacturing technique to construction. The goals of lean thinking redefine performance against three dimensions of perfection: (1) a uniquely custom product, (2) delivered instantly, with (3) nothing in stores. This is an ideal that maximizes value and minimizes waste. The principles of lean thinking and production: (1) Stopping the Line, (2) Pulling Product Forward, (3) One-Piece Flow, (4) Synchronize and Align, and (5) Transparency, are techniques which support the goal.

Lean Construction has existed in its own right for more than ten years. At the same time the five lean principles as outlined by Womack and Jones have gained a firm foothold in the manufacturing industries, and the term lean has thus become a household term in manufacturing. This paper tries to establish the basic ideas of Lean Construction Management. The paper sets out by pointing to the fact that the lean concept in general is a western interpretation of the Japanese production philosophy. It then extracts some fundamental principles from the works of Shigeo Shingo as one part of the basis for Lean Construction. It proceeds by establishing a new understanding of construction as a special kind of production, which in its nature is very different from that found in manufacturing, which was the basis for the work of Womack et al, and by that it identifies and analyses the concepts behind Lean Construction.

Construction is obviously a production, and Koskela (2000) establishes a theory for production and demonstrates its use in construction. A general definition of the nature of construction from a production point of view may thus be:
"Construction is a complex production of a one-of-a-kind product undertaken mainly at the delivery point by cooperation within a multi-skilled ad-hoc team."

The above definition of construction indicates at least four characteristics. Construction is production and it produces a one-of-a-kind product, it is also complex and undertaken through cooperation.

- Construction as Production: Koskela (2000) introduces three basic conceptualizations of production: transformation, flow and value generation. Bertelsen and Koskela (2003) consider these three aspects from a management point of view as outlined in the following.

- Managing Transformation: Managing transformation is the kind of project management most project managers are familiar with. It takes place by managing contracts, establishing quality and safety requirements and procedures, and it frequently leads to what seems to be an increase in productivity but in truth is sub-optimization only.

- Managing Flow: Managing flow in the construction industry introduces several new management activities. One should be to establish a closer cooperation along the supply chain – Supply Chain Management has this been coined in the manufacturing industry. This kind of cooperation should not only comprise cooperation between main contractor and trade contractors, but should comprise the manufacturers and suppliers of construction materials as well. Another activity should be setting up the logistics for materials and information.

- Managing Value Generation: The concept of value is probably the most difficult to approach in the new way of managing construction projects. Green (1996) proposes an understanding of the value generation during the early design phases as a learning process between the client and the design professionals. Both parties learn and through this a joint understanding of client's value parameters and their realization in the design is reached.

The movement of Lean Construction away from the manufacturing interpretation of the lean concept has led to several new management approaches. While the transformation-flow-value theory broadens the understanding of project management, the perception of construction as a complex phenomenon opens up for the introduction of completely new approaches to project management. The ordered approach which gave rise to what can be called management-as-planning and management-as organizing should be reinterpreted and supplemented in future project management. Management as co-operation and as learning comes into focus.

VI. DATA COLLECTION

Lean construction management include many objectives. Main object of lean construction is focus on material, time and resources. After study on literature review next step is data collection.

A quantitative research approach was adopted for the thesis requiring development and dissemination of questionnaire survey. Sampling for specific cadre of respondents is conducted by using sampling technique which involves the assembling sample managerial personnel with known experience and expertise in managing construction projects.

The survey is conducted though structured questionnaire containing both open ended and closed ended questions. The respondents were approach though their companies and firms namely like Shivalik and Shilp group, shlok developers as client and Hi-Tech project Pvt Ltd. As contracture. These companies were approached amongst other in the filed due to their immense experience, type of projects they handle, location of the site which have been included in the study and permission to visit their respective site to conduct survey.

Purpose of the survey-

Survey was conducted to

- Determine and document the general planning and management system of projects.
- Identify wastage in terms of Time, Material and resources.

The result will then integrate into research process as the key area to focus while managing construction projects, so as to come up with a model based on Lean construction management concept.

Structure of questionnaire

There are 2 part of questionnaire prepared:

1. Questionnaire send to client firm to their respondent and
2. Questionnaire send to client firm to their respondent

Both questionnaire divided in following group:

Table 1-Type of questionnaire

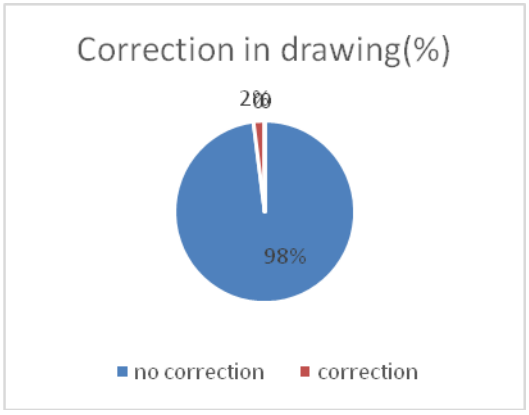
Clint group	Contractor group
Drawing	Drawing
Material (Reinforcement, Concrete)	Material(formwork)
Time	Manpower
	Resources
	Physical checking

In both site material (cement and steel) are under the client firm. So the affected parameter of material purchasing related include in client firm questionnaire.

RCC, masonry and plastering work under to Contractor Company. So resources, material (formwork), manpower related questionnaire attached in contractor firm.

Drawing correction

Sometime there are correction in drawing because of some miscellaneous problems. Drawing correction also affect work progress. In this project 2% correction required during project progress.



There are required correction for discrepancy in structure and architectural drawing. If correction in minor level, it was possible to discussion with structure consultancy. Sometime correction was not possible to saw site actual condition. This is effect on the progress of project generally 1-2 days.

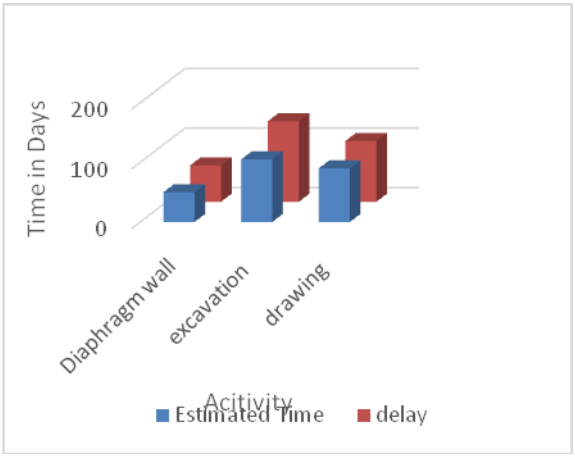


Figure 1-Activity Delay

Total time delay data of project

RCC work is main part of project.so delays in RCC work majorly effect on construction process. Planning and management department always try to minimise delay in RCC work but there are many factor affected to work progress. Mainly delay due to fault material, rework, manpower and equipment planning and management.

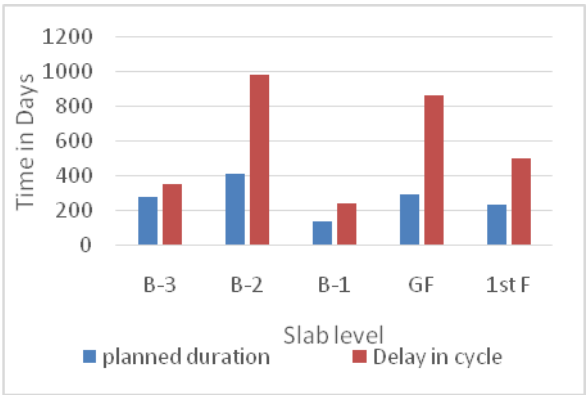


Figure 2- Total Delay of project

Material

Project progress depend on the material. Proper management of material is good sign indicate for project progress. Generally reinforcement, concrete and formwork are main material requirement for project progress. If planning and management team are not their work properly, wastage of material, delay in work progress, accident and Rework problem generated.

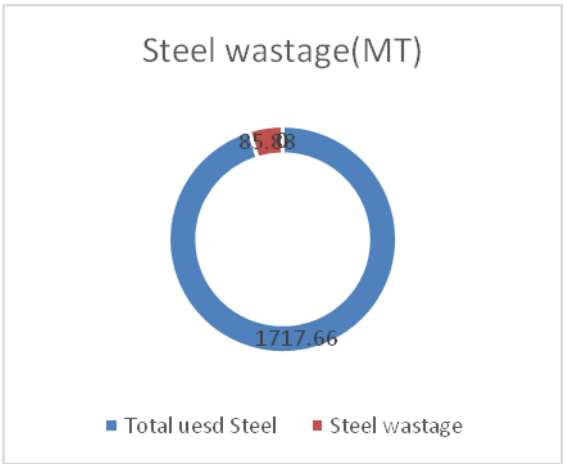


Figure 3- Total Steel wastage

Rework

In slab

Total 10 sqm area required rework due to steel arrangement in 2nd basement roof slab level.

1. 7 sqm area required rework due to laping of steel bars
2. This was two major rework affect work progress of project on site and take total 9 days delay.

Beam

At ground floor roof slab level there are 5 beam change due to design changing

1. 230 x 785 dia beam was total 4
2. 450 x 600 dia beam was total 1

There was also wastage of steel due to rework.

Rework in Concrete

Following 2 major rework affected work progress of project

Table 4.5 Element of Rework

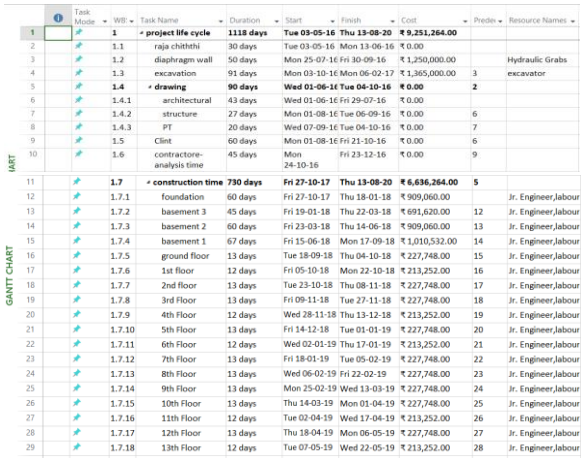
Sr. No.	Elements	No of element	Dimension (mm)	Wastage (cubm)	Delay due to rework
1	ST Column	3	230x2150x2500	3.70	5 days
2	Ramp Column	6	900x900x1000	4.86	8 days

Data Analysis for define delay time

There are many objects to affect construction industry. Construction delivery delay is major problems in every site. Generally, Time, resources and material are main cases behind delay work. They all are co-related to each other. There is not one factor affect to whole project but many objects affect partially or fully.

Delay analysis in Monthly planning

Generally, planning engineer prepaid monthly planning schedule for construction progress. They used overall progress report to make monthly planning schedule. So monthly planning depends on the overall site planning report. Generally daily planning schedule follow on the site. Daily planning schedule prepared using weekly and monthly planning. Site engineer follow daily planning schedule to achieve work progress on site. I have present overall site planning schedule using MS Project.



	Task Mode	WBS	Task Name	Duration	Start	Finish	Cost	Predec	Resource Names
1		1	project life cycle	1118 days	Tue 03-05-16	Thu 13-08-20	₹ 9,251,264.00		
2		1.1	raja chiththi	30 days	Tue 03-05-16	Mon 13-06-16	₹ 0.00		
3		1.2	diaphragm wall	50 days	Mon 25-07-16	Fri 30-09-16	₹ 1,250,000.00		Hydraulic Grabs
4		1.3	excavation	91 days	Mon 03-10-16	Mon 06-02-17	₹ 1,365,000.00	3	excavator
5		1.4	drawing	90 days	Wed 01-06-16	Tue 04-10-16	₹ 0.00	2	
6		1.4.1	architectural	43 days	Wed 01-06-16	Fri 29-07-16	₹ 0.00		
7		1.4.2	structure	27 days	Mon 01-08-16	Tue 06-09-16	₹ 0.00	6	
8		1.4.3	PT	20 days	Wed 07-09-16	Tue 04-10-16	₹ 0.00	7	
9		1.5	Clint	60 days	Mon 01-08-16	Fri 21-10-16	₹ 0.00	6	
10		1.6	contractore-analysis time	45 days	Mon 24-10-16	Fri 23-12-16	₹ 0.00	9	
11		1.7	construction time	730 days	Fri 27-10-17	Thu 13-08-20	₹ 6,636,264.00	5	
12		1.7.1	foundation	60 days	Fri 27-10-17	Thu 18-01-18	₹ 909,060.00		Jr. Engineer,labour
13		1.7.2	basement 3	45 days	Fri 19-01-18	Thu 22-03-18	₹ 691,620.00	12	Jr. Engineer,labour
14		1.7.3	basement 2	60 days	Fri 23-03-18	Thu 14-06-18	₹ 909,060.00	13	Jr. Engineer,labour
15		1.7.4	basement 1	67 days	Fri 15-06-18	Mon 17-09-18	₹ 1,010,532.00	14	Jr. Engineer,labour
16		1.7.5	ground floor	13 days	Tue 18-09-18	Thu 04-10-18	₹ 227,748.00	15	Jr. Engineer,labour
17		1.7.6	1st floor	12 days	Fri 05-10-18	Mon 22-10-18	₹ 213,252.00	16	Jr. Engineer,labour
18		1.7.7	2nd floor	13 days	Tue 23-10-18	Thu 08-11-18	₹ 227,748.00	17	Jr. Engineer,labour
19		1.7.8	3rd Floor	13 days	Fri 09-11-18	Tue 27-11-18	₹ 227,748.00	18	Jr. Engineer,labour
20		1.7.9	4th Floor	12 days	Wed 28-11-18	Thu 13-12-18	₹ 213,252.00	19	Jr. Engineer,labour
21		1.7.10	5th Floor	13 days	Fri 14-12-18	Tue 01-01-19	₹ 227,748.00	20	Jr. Engineer,labour
22		1.7.11	6th Floor	12 days	Wed 02-01-19	Thu 17-01-19	₹ 213,252.00	21	Jr. Engineer,labour
23		1.7.12	7th Floor	13 days	Fri 18-01-19	Tue 05-02-19	₹ 227,748.00	22	Jr. Engineer,labour
24		1.7.13	8th Floor	13 days	Wed 06-02-19	Fri 22-02-19	₹ 227,748.00	23	Jr. Engineer,labour
25		1.7.14	9th Floor	13 days	Mon 25-02-19	Wed 13-03-19	₹ 227,748.00	24	Jr. Engineer,labour
26		1.7.15	10th Floor	13 days	Thu 14-03-19	Mon 01-04-19	₹ 227,748.00	25	Jr. Engineer,labour
27		1.7.16	11th Floor	12 days	Tue 02-04-19	Wed 17-04-19	₹ 213,252.00	26	Jr. Engineer,labour
28		1.7.17	12th Floor	13 days	Thu 18-04-19	Mon 06-05-19	₹ 227,748.00	27	Jr. Engineer,labour
29		1.7.18	13th Floor	12 days	Tue 07-05-19	Wed 22-05-19	₹ 213,252.00	28	Jr. Engineer,labour

Table 2- construction planning schedule

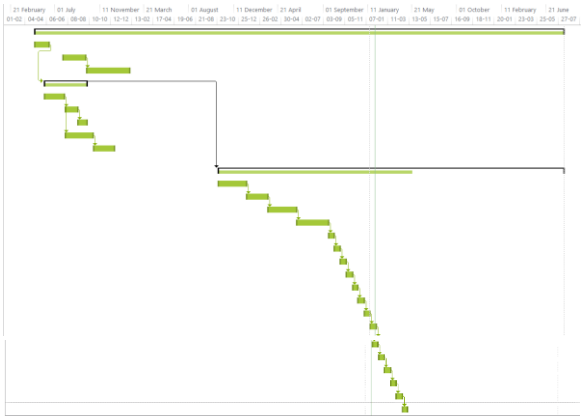
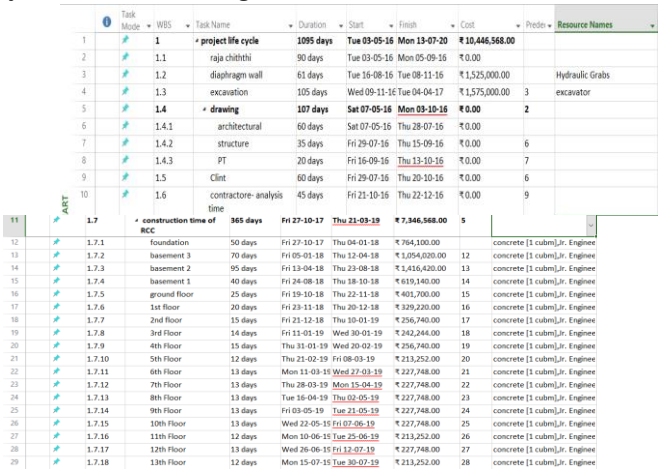


Figure 4– construction planning Gantt chat

Construction site has some delay but this time delay does not include in their planning schedule. Some major delay analysis show in following table.



	Task Mode	WBS	Task Name	Duration	Start	Finish	Cost	Predec	Resource Names
1		1	project life cycle	1095 days	Tue 03-05-16	Mon 13-07-20	₹ 10,446,568.00		
2		1.1	raja chiththi	90 days	Tue 03-05-16	Mon 05-09-16	₹ 0.00		
3		1.2	diaphragm wall	61 days	Tue 16-08-16	Tue 08-11-16	₹ 1,525,000.00		Hydraulic Grabs
4		1.3	excavation	105 days	Wed 09-11-16	Tue 04-04-17	₹ 1,575,000.00	3	excavator
5		1.4	drawing	107 days	Sat 07-05-16	Mon 03-10-16	₹ 0.00	2	
6		1.4.1	architectural	60 days	Sat 07-05-16	Thu 28-07-16	₹ 0.00		
7		1.4.2	structure	35 days	Fri 29-07-16	Thu 15-09-16	₹ 0.00	6	
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9		1.5	Clint	60 days	Fri 29-07-16	Thu 20-10-16	₹ 0.00	6	
10		1.6	contractore- analysis time	45 days	Fri 21-10-16	Thu 22-12-16	₹ 0.00	9	
11		1.7	construction time of RCC	365 days	Fri 27-10-17	Thu 21-03-19	₹ 7,346,568.00	5	
12		1.7.1	foundation	50 days	Fri 27-10-17	Thu 04-01-18	₹ 764,100.00		concrete [1 cubm],Jr. Enginee
13		1.7.2	basement 3	70 days	Fri 05-01-18	Thu 12-04-18	₹ 1,054,020.00	12	concrete [1 cubm],Jr. Enginee
14		1.7.3	basement 2	95 days	Fri 13-04-18	Thu 23-08-18	₹ 1,416,420.00	13	concrete [1 cubm],Jr. Enginee
15		1.7.4	basement 1	40 days	Fri 24-08-18	Thu 18-10-18	₹ 619,140.00	14	concrete [1 cubm],Jr. Enginee
16		1.7.5	ground floor	25 days	Fri 19-10-18	Thu 22-11-18	₹ 401,700.00	15	concrete [1 cubm],Jr. Enginee
17		1.7.6	1st floor	20 days	Fri 23-11-18	Thu 20-12-18	₹ 329,220.00	16	concrete [1 cubm],Jr. Enginee
18		1.7.7	2nd floor	15 days	Fri 21-12-18	Thu 10-01-19	₹ 256,740.00	17	concrete [1 cubm],Jr. Enginee
19		1.7.8	3rd Floor	14 days	Fri 11-01-19	Wed 30-01-19	₹ 242,244.00	18	concrete [1 cubm],Jr. Enginee
20		1.7.9	4th Floor	15 days	Thu 31-01-19	Wed 20-02-19	₹ 256,740.00	19	concrete [1 cubm],Jr. Enginee
21		1.7.10	5th Floor	12 days	Thu 21-02-19	Fri 08-03-19	₹ 213,252.00	20	concrete [1 cubm],Jr. Enginee
22		1.7.11	6th Floor	13 days	Mon 11-03-19	Wed 27-03-19	₹ 227,748.00	21	concrete [1 cubm],Jr. Enginee
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24		1.7.13	8th Floor	13 days	Tue 16-04-19	Thu 02-05-19	₹ 227,748.00	23	concrete [1 cubm],Jr. Enginee
25		1.7.14	9th Floor	13 days	Fri 03-05-19	Tue 21-05-19	₹ 227,748.00	24	concrete [1 cubm],Jr. Enginee
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29		1.7.18	13th Floor	12 days	Mon 15-07-19	Tue 30-07-19	₹ 213,252.00	28	concrete [1 cubm],Jr. Enginee

Table 3- Actual Construction planning

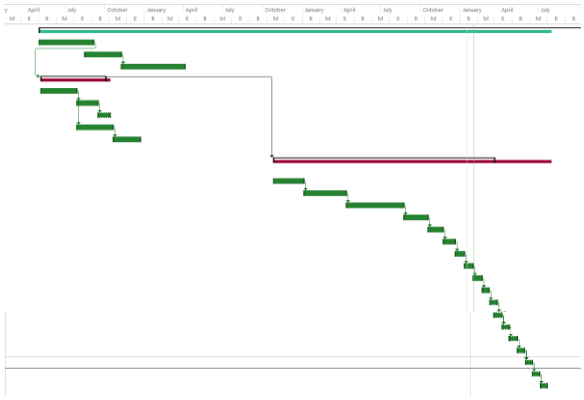

Figure 5- – Actual planning Gantt chat

In this study, we define main cases of delay in construction industry. Lean concepts are used to improve traditional construction management.

After study of literature, **Last planner**system is more suitable for improve management system. In this concepts, main aim is improve planning system. In planning system include site manpower to define progress of project. Last planner system basically improve planning system of project. Generally, planning engineer not include site engineer or supervisor for monthly planning system. So, planning was not work properly. Some problem on site not define by planning engineer. So they do not know define properly.

VII. CONCLUSION

This paper was able to establish the fact that the employed or existing project management models and strategies have not been able to deliver projects on time and as a result have created wastes in the construction industry through a comprehensive literature survey. The paper also discussed LC, its principles and wastes in the industry. The authors demonstrated that LC presents a new and robust approach to dealing with the waste in the construction industry. This was illustrated with some highlights of the importance of LC application (Why LC).Finally, the paper established that, the application of lean tools and techniques by project teams and industry's practitioners will minimize or eliminate waste, enhance performance and lead to a great cost savings for the industry as well as the society. It is expected that the fundamental knowledge provided by this paper will contribute to the knowledge and practice from delay control or waste elimination and also serve as a benchmark for continuous improvements of performance in construction industry.

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