

“CONFLUENCE OF LEAN AND OFFSITE CONSTRUCTION”

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Abstract - The project confers a significant piece of guided independent research on a topic sympathize between the student and their supervisor. It customarily includes a literature review and an appropriate form of critical analysis of sources of primary and or secondary data. The project shows evidence of wide reading and understanding of critical analysis and/or appropriate use of advanced research techniques in lean and offsite construction. The purpose is to enable the student to develop deeper knowledge, understanding, capabilities and attitudes in the context of the program of study. Estimation of the project would be as per NTCC Guidelines. The project customarily involves study the concept of Offsite construction and the lean benefits achieved through offsite construction. In general this study will include an exhaustive literature review on lean benefits achieved through offsite construction globally. In specific, this study will analyze Indian case study where offsite construction has been adopted.

Key Words: Lean construction principals, Offsite construction, wastages in construction

1. INTRODUCTION

Offsite construction is a type of construction in which different elements of building are being manufactured in factory as per the design, plan etc. and being assembled on site. It also referred as Offsite manufacturing, Offsite production, and Offsite Fabrication. It is also called as manufactured construction; Pre fabricated construction, or Modular construction. Offsite construction is a proven method of construction with improved safety at work, lower cost and faster builds time. Offsite construction can be used for residential, educational, health care and commercial projects. Comparing to the conventional construction time saving is the biggest advantage of offsite construction shown time cut up to 50%. When it comes to sustainable development offsite construction plays an important role as the production in factory will be stated as construction work starts on site. Resulting in an accelerating work progress, reduce the construction waste which is being produced on site; reduce the impact of noise on site, ground disturbance and less vehicle movement etc. Enhanced techniques, methodology which produces a high quality end product which reduced the cost of rework, repair etc. It is very difficult to evaluate amount of contribution offsite construction made to the construction industry, but it has shown many advantages as well as disadvantages. However

offsite construction has shown working in more specialized manner, working with high end technology, technically advanced product, and skilled manufacturing and construction of buildings. LEAN is the term which stands for development which is effective, high performance and sustainable in nature fulfilling their main purpose in the most efficient and effective way for the sustainable future. It seeks to minimize the waste, ensure right things should happen at first time only, reducing time scale, reducing cost etc. Lean helps to improve the competitiveness and raise the standards, enable overall growth by minimizing the use of resources and reducing its impact on environment. According to Toyota production system the 14 lean principals are [1] Long term philosophy. [2] Process flow. [3] Avoid overproduction. [4] Level of work load [5] Stop and fix the problems [6] Continuous improvement/standardize work process [7] Use of visual control [8] Use of reliable technology [9] Grow leaders. [10] Develop team with exceptional people. [11] Respect the network. [12] Understand the situation. [13] Slow decision but rapid execution learning process/Become a learning organization.

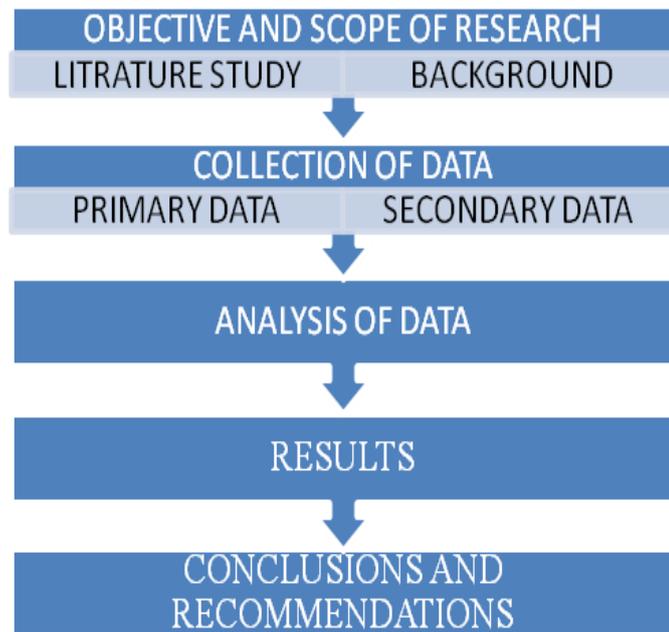
1.1 Benefits of Offsite Construction

Offsite construction has shown many benefits as compared to the conventional construction method. Time saving is the biggest advantage of offsite construction. Offsite construction shown time cut by up to 50%. When it comes to sustainable development offsite construction plays an important role as the production in factory will be stated as the construction work starts on site. It is like the just in time. Resulting in an accelerated work progress, reduce the construction waste which is being produced on site, reduce the impact of noise on site, ground disturbance and less vehicle movement etc. All the component of the building is being manufactured under a controlled environment system in factory rather than building it outside, at a particular height, exposed to unpredictable weather conditions. Offsite construction made it more safer working space as compared to conventional working conditions. Enhanced techniques, methodology which produces a high-quality end product which reduced the cost of rework, repair etc. It is very difficult to evaluate the amount of contribution offsite construction made to the construction industry, but it has shown many advantages as well as disadvantages. However off site has shown working in more specialised manner, working with high end technology, technically advanced product, and skilled manufacturing / construction of the buildings.

1.2 Importance of Study

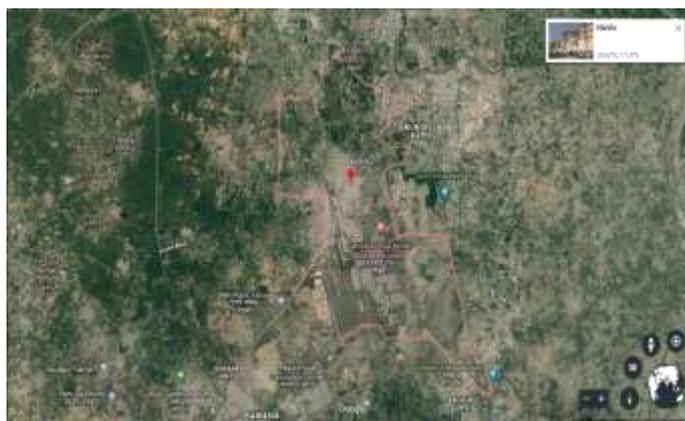
Proper management of time required. Controlling wastages and costs. Improve the quality of the work. Improvement in employee engagement in overall work. Distributing and levelling the workload for increasing the overall output. To reduce the future risk in advance. Strategies are to be developed and implemented by understanding the situation.

2] Methodology of the work



3. Data collected from Delhi Development Authority

Location of site



Narela is sub city which located in Delhi-Haryana border. As a planned urban extension this sub city would be a combination of different things such as affordable housing, environmental, sustainable etc. Narela is the third mega sub-city project of DDA.

Project Details:- Area: 9866 ha.

Area of urban development: 7365 ha (rest 2501 ha is planned for green belt to make project environment friendly).

Commercial space:- 1) 392 ha accommodate infrastructure and commercial space.

2) 247 ha accommodate Narela Udyog Vihar which already exists.

Residential	42.98 %
Commercial	5.30 %
Public and Semi-Public Facilities	11.88 %
Manufacturing	6.56 %
Utility	4.48 %
Government	0.21 %
Recreational	13.98 %
Transportation	14.66 %

Delhi Development Authority is also focusing on increasing green belt along with the area of land they have acquired and developing. In Narela Delhi Development Authority under the Urban Development Delhi Development Authority is developing 7365 ha area of land out of 9866 ha rest of which 2501 ha is planned for green belt to make project environment friendly.

Confluence of Lean on Site

LEAN is the term which stands for development which is effective, high performance and sustainable in nature fulfilling their main purpose in the most efficient and effective way for the sustainable future. It seeks to minimize the waste, ensure right things should happen at first time only, reducing time scale, reducing cost etc. Lean helps to improve the competitiveness and raise the standards, enable overall growth by minimizing the use of resource and reducing its impact on the environment.

The Seven Types of waste

Over production

Over production has a high impact in terms of cost, material consumption, use of resource, productivity etc. to a manufacturer or to a manufacturing plant. Over production results in excessive lead time, inventory storage cost, defects detection cost etc. To overcome the problem of overproduction the simple and easiest solution is close the tap. The main purpose is to be schedule and produce which will be produced Just in Time.

Transport

Transporting the final product form manufacturing plant to site location which adds no value other than cost to the manufacturer. Handling without care or movement may cause damages which are opportunity for quality failure or repair work. For reducing the cost related to transportation mapping out the product flow can help.

Movement

This type of waste is generated due to unnecessary or excessive motion which takes place on the site. Unnecessary motion or movement can cause health and safety related issues. The task which are taking or require excessive motion are needed to be redesigned so that we can minimize the excessive motion on site and reduce the waste.

Over Processing

Many of the organization use heavy machineries where in simple tools would be used and work can have done. Over processing results in higher asset utilization for a particular work which results into high operational cost with consuming more time which will result in to the other type of waste. Work is already in process or being in process is an example of over processing.

Waiting

When materials on the site are not moved or no involved in any work process it will cause the waste of waiting. This waste will cause more time consumption also costing more money to the organization. Work is already in process or being in process is an example of waiting.

Inventory

Inventory which is more than the requirement will cause many problems on site such as lead time increment, consumes extra productivity, consumes space etc. By conducting a smooth work flow with site this problem can be minimized. Inventory waste is associated with cost.

Defects

Quality defects mainly results in to rework, repair or scrap which will cause a big cost to the company which includes of inventory, man power, time, productivity etc. With the help of Continuous Process Improvement (CPI) waste generated from defects can be reduced further.

4. DATA ANALYSIS

To understand the confluence of Lean and Offsite construction in an Indian Construction Industry case study of urban development of Delhi Development Authority is taken.

Principal No.	Content	Applicability	Compatibility
1	Long term philosophy	Decision to invest pre cast construction	High
2	Continuous process flow	Problems highlighted quickly	Medium
3	Avoid over production	When things are going off planed schedule	High
4	Level of work load	Improving the way work is scheduled	Medium
5	Stop and fix the problem	High reliability organization	High
6	Continuous improvement	Standard operating procedure for different work packages	High
7	Use visual control	Improving work quality	Medium
8	Use of only reliable technology	Pre cast for low cost, sustainable, low risk	High
9	Grow leaders	Formal pipeline to train people	High
10	Develop	Developing	Medium

	team	people	
11	Respect network	Performance improvement activities	Medium
12	Understanding situation	Understanding process regularly	High
13	Slow decision but rapid execution	Leadership transformation initiative	Low
14	Continuous learning	Problems in getting information	High

Reduction of Wastages

Over production

Over production is minimized in offsite construction to the considerable amount. Which has shown amount of saving in cost, material consumption, use of resource, productivity etc. on site. It has also minimized lead time of the project, inventory storage cost, defects detection cost etc.

Transport

In offsite construction site logistics plays an important role which reduces waste generated due to excessive transportation. On site Transportation waste is minimum as compared to conventional or traditional method of construction. Being manufacturing plant near to site transportation cost was minimized. Material or Panels were being handled with care and excessive movements which may cause damages which are opportunity for quality failure or repair work are eliminated. For reducing the cost related to transportation on site proper mapping out the product flow designed.

Movement

Movement waste generated on site is because of unnecessary motion of a person. While on site all equipment were placed in a systematic manner to eliminate the unnecessary motion of a labor or a person doing the work. For each building block separate tower crane is provided to minimize waste generated by movement. The tasks which are taking or require excessive motion are redesigned so that we can minimize the excessive motion on site and reduce the waste.

Over Processing

In offsite construction all the panels required are manufacture in manufacturing plant under controlled conditions. Panels are being casted using heavy machineries which reduces over processing waste, material waste, main and foremost is water saving as pre cast requires less amount of water for curing. Over processing results in higher asset utilization for a work which results into high operational cost with consuming more time which will result in to the other type of waste. Work is already in process or being in process is an example of over processing.

Waiting

Waiting waste is minimal in offsite construction because material and panels are provided on right time at right place in right quantity. Waiting waste causes more time consumption also costing more money to the organization. Work is already in process or being in process is an example of waiting.

Inventory

Inventory which is more than the requirement will cause many problems on site such as lead time increment, consumes extra productivity, consumes space etc. By conducting a smooth work flow with site this problem can be minimized. Inventory waste is associated with cost.

Defects

Waste generated by defects was less on site as maximum part of building is manufactured in manufacturing plant. Quality defects mainly results in to rework, repair or scrap which will cause a big cost to the company which includes of inventory, man power, time, productivity etc. With the help of Continuous Process Improvement (CPI) waste generated from defects can be reduced further.

5. Conclusion

The main objective of carrying out this project study is to understand Confluence of Lean and offsite construction with the help of an Indian case study, understand offsite construction and its practices, its benefits, its presence in the construction industry and barriers which are affecting offsite construction. The study is carried out by literature review, real time on site visit, and industry experts and professional’s reviews from site. The study shows offsite and lean both are still in experimental stage in Indian construction industry, people are having less knowledge about offsite and lean, organization culture and human attitude is the main basic reason behind not adopting lean and offsite construction, lack of awareness and understanding, lack of proper field training about lean and offsite, lack of top management commitment is seen particularly for adoption of lean, fragmentation and subcontracting is the another main issues which

construction industry is facing, lack of updated and modern building byelaws and codes, the main barrier is lack of well established and successful example form the construction industry is not available so that people are not getting the actual benefits of lean and off site they are just heard of the benefits. By analyzing the data and site visit it is observed that offsite has confluence with lean with having various advantages and disadvantages on the same hand. Off site is profitable for only large scale project it's not suitable for small scale project , all the principles of lean can be implemented on offsite construction site, waste generated on site is minimal on off site as compared to conventional constructed site.

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