

Implementation of Lean Construction Method, to ensure effectiveness of a Residential Construction Project

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Abstract: Lean Construction (LC) aims at reducing waste, increasing productivity and health and safety in fulfilling the client's requirements of the construction industry. The desire to provide affordable housing, reduce construction waste and increase productivity has led to the adaptation of the "lean construction" concept. Assessing and implementing the techniques of the lean philosophy has become key for organizations in the industry of construction in the quest for incessant advancements. Lean construction is an approach to improve productivity and sustainability. It is a systematic method for creating buildings with optimal engineering, design, and environmental responsiveness. Lean construction assists contractors in managing risks and uncertainties in the production of residential buildings. In this project, we will discuss how the implementation of a lean construction method can ensure effectiveness on a residential building project. This project provides the fundamental knowledge of LC and highlighted its implementation in residential construction. The knowledge of stakeholders is significant because LC principles are widely used in the workplace. However, stakeholders do not yet understand the basic terms of LC, so they cannot reach their full potential. This project will implement various factors of lean construction in residential construction project to increase its efficiency and affordability. The implementation of LC will prove to benefit the construction industry by maximizing value and increasing sustainability.

Keywords: Lean construction, reducing waste, residential construction, sustainability.

1. Introduction

Construction is a completely vintage industry. The issues of construction are well-known. Construction productivity lags than that of manufacturing. Occupational protection is notoriously worse than in different industries. Due to inferior running conditions, there are work pressure shortages in many nations construction sector. The pleasant of construction is taken into consideration to be insufficient. A variety of answers or visions had been provided to alleviate the continual issues in construction. Solutions are within the shape of improvement of diverse specialized equipment like Critical Path Method (CPM), Gantt charts, Earned Value Analysis (EVA) and many others to plot and manage initiatives that have

proved to be useless for immediate paced and extrade inclined construction initiatives. We pay attention the term "lean" used very frequently today, normally related to lean manufacturing, lean thinking, lean production, and lean construction. There are many arguments and debates on what every of those have in not unusual place, or what their differentiators are. The unmarried simple similarity is that all of them use the word "lean". So, what does "lean" without a doubt mean? The word "lean" has many meanings and uses. One which means is to decrease and do away with waste, that is a not unusual place definition of the word. However, it's far not what's eliminated, however added, this is the maximum defining denominator: price. Another use of the word "lean" is to sway closer to an opinion. This definition can be the maximum relevant for the enterprise use of "lean", as a not unusual place aspect in all lean thinking, thoughts or standards, is that it calls for adopters to "lean" or sway a new direction, and extrade their way of thinking and philosophy. This report will discover lean construction and how advances in generation are making implementation of lean construction practices plausible for the enterprise, with middle capability constructed into the goods as trendy out-of-the-field features. By embedding those lean standards within the software; generation is growing lean equipment that turns into a primary differentiator in shifting the development paradigm, and turning in most price to the enterprise.

2. Need of the Project

The construction procedure is an array of activities, every of that's managed and improved. Conventional managerial methods, just like the sequential approach of the assignment consciousness or the CPM community approach, go to decline flows through violating the ideas of flow design and development. They focus on conversion activities. The resultant issues in construction to compound and self-perpetuate. In assignment control, fire-combating contemporary or looming crises consumes control assets and interest so absolutely that there may be a bit of room for planning, not to mention development activities. As a result, it leads that in non-premier

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completion time for each task has been determined earlier in the phase planning, it is important to check during the weekly work planning session to see if these expectations are in place, deviation from schedule, leading to waste of material, money and time or not

v. *Hold Daily ‘Learning Meetings’ for Last Planners*

The final stage of LPS occurs at the end of each business day. Before leaving the site, the planners finally met to confirm that their tasks for the day had gone as planned. The final planners can solve the problem together and work to get the project back on track. In a lean project, even minor programming errors should be fixed as soon as possible. Learning meetings are the perfect opportunity to do a few different statistical analyzes or to ensure a project is on time and on budget. These must include at least the following:

- **Percent Plan Complete (PPC):** This analysis determines the weekly task completion rate. This can help end planners visualize what happened during the week so they can adjust for the following week.
- **Task Made Ready (TMR):** By measuring TMR, planners can later verify that the phased planning process worked and is being followed. If fewer tasks are prepared than expected, planners should later perform a root cause analysis to determine what went wrong and how they can be improved
- **Task Anticipated (TA):** This analysis simply measures how many tasks have been identified for the next week. This gives late planners the ability to see expected workload week by week and allows them to understand what might have contributed to higher or lower productivity another week.

3) *Safety Management*

Commitment to safety is an important role for workers in their work environment. The need for security is important to life's problems. Some of the rules approved by the management are as follows.

- Limit access to non-essential people.
- Set up controlled entry points to the location.
- Coordinate the activities of different professions working in the same area.
- Provide ground rules of the site and orientation training to all individuals at risk.
- Establish appropriate drop-off areas.
- Everyone has a duty to refuse unsafe work.
- All injuries are preventable.
- All levels of supervision are responsible for safe implementation.
- Our work is never so urgent or important that we cannot take the time to do it safely.

4) *New Technology*

There are many new technologies that are being used more and more in construction projects to speed up construction to complete projects within tight deadlines, bringing high profits. Traditionally, we say that even if we still reduce the total wait time to launch spans by almost 40m, it takes ten days, but as we know it today, there is fierce competition in the construction

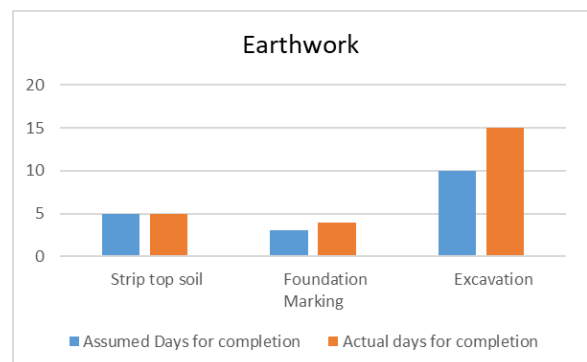
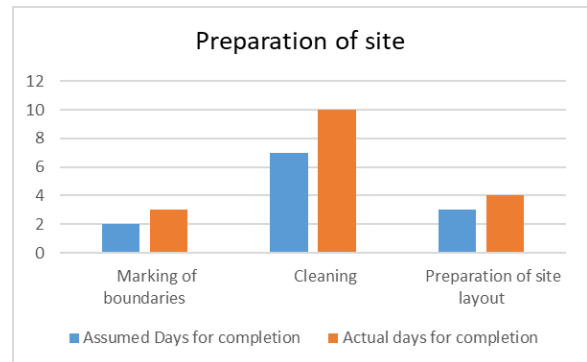
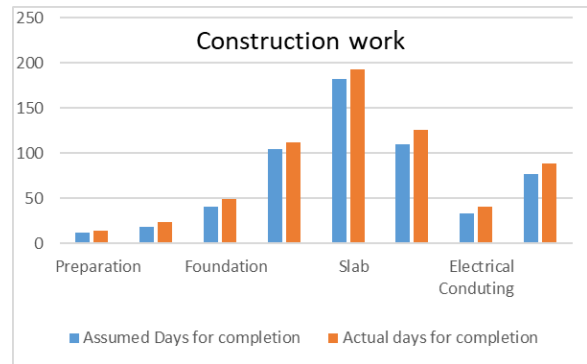
industry, so the contractors were more conscious to complete the project by executing quickly within the limited time.

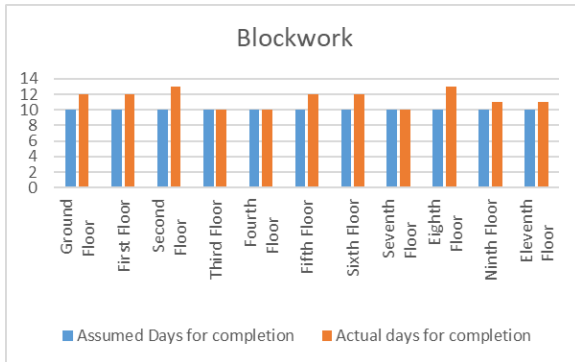
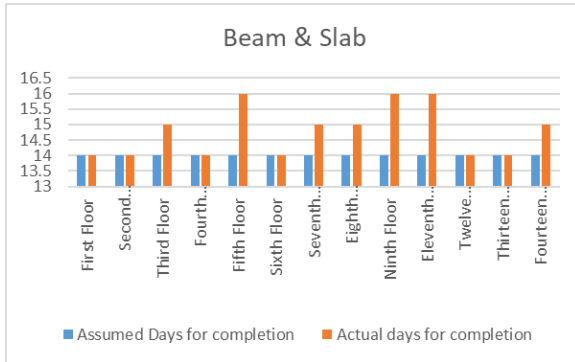
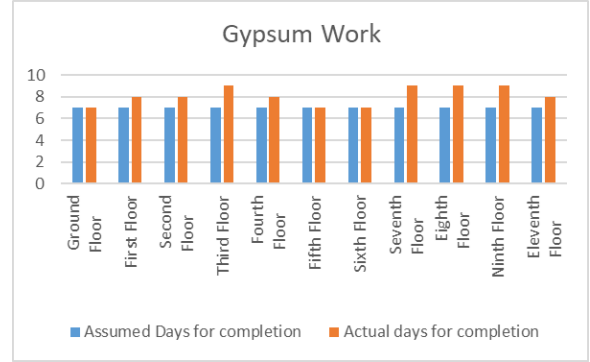
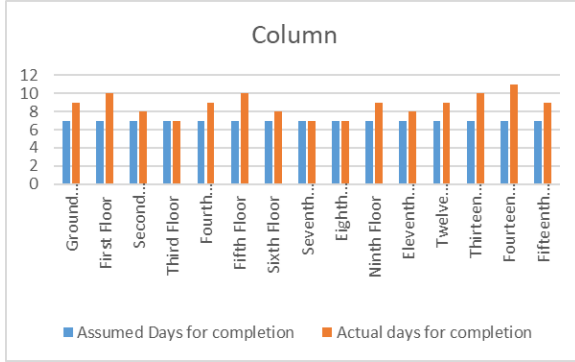
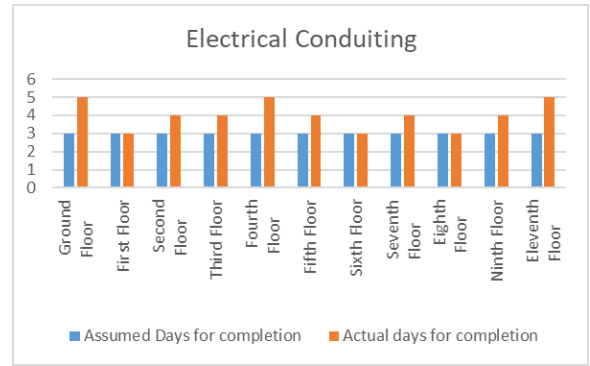
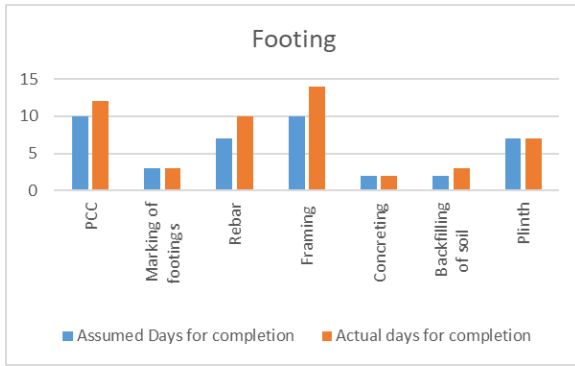
5) *Visual Management*

The visual management is generally done to enhance the quality of the project along with the safety factor. It comes under as a controlling process. The standards are established and the measure of actual performance is taken into account. The actual performance of the work is compared with the standard schedule. The results of the comparison are considered and corrective actions are made to control the prospect. Checking progress improves productivity standards, cost standards, time standards, and quality standards. The supervisor must be able to wield power and be able to manage work with good motivation. The power of motivation can encourage commitment to work with complete commitment. The authorized person is responsible for the safety precautions on the website.

5. Outcomes

A. *Timeline of the construction process*





B. Benefits of Lean Construction

1) The quality of the project upsurges

Implementing Lean practices leads to a cleaner build process, which leads to better overall quality. Indeed, the ultimate goal of lean construction is to identify opportunities for improved communication and execution. In other words, it helps us find ways to make things better as a whole, where everyone is involved. When there is communication between everyone involved in the project, everyone has a clear view of the progress and performance of their project.

- Customers know what to expect and how to expect it.
- Contractor knows exactly what to deliver.

Therefore, focus more on planning and pre-construction. That means a reduced chance of rework and encountering failures along the way. Therefore, quality means improved time, budget and resources.

2) Real-time access to relevant information

As stated earlier, communication between the client and the contractor is key to the project. Lean cultures help establish strong communication. Allows issues or questions to be addressed at any point in the project's lifecycle.

3) Total project satisfaction

This brings us to our third advantage. Knowing which aspects of the project are considered most valuable to the owner allows contractors to make the best and fastest decisions without affecting the outcome. The speed at which issues are resolved is dramatically increased when customers know that their best interests are at the heart of every decision made. A project team that can tackle all the obstacles quickly has a better chance of staying on schedule and on budget. These factors lead to a very happy owner, more contracts and more profits for everyone involved.

4) Fewer costs, greater Return on Investment (ROI)

Effectively save time and money in construction and any other industry. The lightweight construction adds value and minimizes any waste. Any increase in productivity reduces the risk of losing profits and contributes directly to the continued success of the business. Any reduction in waste, whether physical or procedural, translates into overall project efficiency.

5) Waste reduction

One of the main goals of Lean building is to eliminate or minimize waste at every opportunity. Lean construction targets eight main waste categories:

- *Defects*: A defect is anything not done right the first time, resulting in a rework that wastes time and materials.
- *Overproduction*: In construction, overproduction occurs when a task is completed earlier than expected or before the next task in the process can be started.
- *Waiting*: The most common scenario leading to a wait in construction is when the worker is ready, but the materials needed to complete the job have not yet been delivered or the previous prerequisite task has not been completed.
- *Not Utilizing Talent*: Workers in a construction project have many skills and experience. When the right person for the right job is not found, their talents, skills, and knowledge go to waste.
- *Transport*: Waste in transit occurs when materials, equipment or workers are delivered to the work site before they are needed. It can also refer to the transmission of unnecessary information.
- *Inventory*: Materials that are not needed immediately are considered as excess inventory. They cost money, require storage, and often break down when not in use.
- *Motion*: Unnecessary movement, such as the gap between workers, tools, and materials, creates wasted motion.
- *Over Processing*: Overprocessing occurs when features or activities are added that provide no value to the customer. Ironically, this often happens when steps are taken to get rid of other types of waste.

6. Conclusion

A. Advantages of Lean Construction

Efficiency: By defining processes, developing management and implementation strategies such as 5S (Organize, Lean, Shine, Standardize and Maintain), companies can therefore improve its productivity

Speed: With improved efficiency comes increased speed. The more efficient the project, the quicker it is completed. And the sooner a project is completed, the sooner businesses can move on to the next stage, which means more customers!

Less Wastage: This refers not only to product waste, but also to time, energy, and money. Lean construction aims to reduce waste from all aspects of the project.

Safety: Thanks to better organization and standardized strategies put in place via Lean Construction, many companies

have seen a significant decrease in workplace injuries

B. Disadvantages of Lean Construction

Commitment: To build Lean successfully, everyone involved needs commitment and focus. Team unity and sometimes need more training.

Other projects: Ongoing/unfinished projects can be impacted when a company tries to incorporate Lean building and this is something that should be considered before adopting a new strategy.

Time: Accepting anything in a business can be difficult, but more importantly, it can take time. Immediate results are not guaranteed as it takes time to implement new techniques. The results are gradual.

Cut corners: Some oppose lean construction because they believe that for quick and efficient construction, corners are cut. For example, less suitable materials are used and will not last as long as traditional materials, meaning the building itself will not have the same lifespan.

C. Future Scope

Lean construction methods can have a positive impact on everyone on a project, from consulting engineers to general contractors, to the client requesting the work. Adopted to address customer and supply chain dissatisfaction with the construction industry, lean project delivery methods seek to manage projects through relationships, knowledge shared and common goals to circumvent traditional construction-related vulnerabilities. The result of this approach is significant improvements in planning, reduced waste, and ultimately, better overall project delivery and increased value for owners. With the growing popularity of Lean methods around the world, the future of construction and engineering as we know it will change dramatically.

1) Better building designs

Traditional methods require multiple iterations of the same program area and many different feedback loops before the design is considered final. This can delay the process and increase the number of steps required before the design is ready. That being said, iterative design has value. With lean tools and processes, like the Final Planning System for Design, design teams can better manage iterations and improve the quality of information delivered to the field and subject. ownership during the course of the project. Lean approaches can also help a team break the mold of traditional document packages. Existing processes that may require design sets of 200 or more designs can often be made in smaller quantities, reducing waste and time. This may seem like common sense, but if the builder needs more detail for a particular area, the design team should focus on detailing that area at a higher level of detail. The team should focus on what is valuable to the entire project, rather than trying to create less detailed documentation for the entire project to meet arbitrary deadlines.

2) Enhance communication and collaboration

By enhancing communication between end users, program planners, architects, engineers, and builders, the team gathers information from all parties to streamline the design process

and Give decision. A common expression in the lean distribution is: "Go slow to go fast". If we take the time to understand the wants, needs, and constraints of everyone involved, we can begin to see the way forward more clearly in less time than with traditional iterations. This strategy can eliminate potential errors and reduce multiple feedback loops from all stakeholders. Additionally, it significantly streamlines workflows by reducing time wasted drafting a design that lacks critical components. Taking the time to create a common set of project goals helps the project team focus on creating value for end users and owners. These objectives guide the decision-making process and clarify new stakeholders in the project lifecycle. The expectation of transparency also helps create a culture of collaboration within the project team. This allows team members from all walks of life and fields to join to help tackle the challenge, even if it's not directly related to their scope. Since all sectors interact in one way or another, understanding the constraints of other professions can help increase the overall value of the entire project.

3) *Exceed client expectations*

By working with one another, projects seamlessly come together and people between disciplines help each other to achieve the common goals of the project. Respect for people is at the core of the Lean Construction Institute's tenets for lean design and construction. People like to work on projects where they feel respected and heard, while owners benefit from projects that are completed faster than traditionally and with increased overall value all the while driving waste out of the project. Clients will continue coming back to high-performing teams for repeat work because of the success of lean driven projects. To make real change in the industry as engineers, we must continue being technically solid and honing our craft, and we also must embrace collaboration and increase communication with various parties across the board. As Lean methods continue to gain traction and popularity in industry, the

future of engineering and construction will be a more inclusive, streamlined and sustainable environment that better meets the needs of the industry. needs of all concerned.

References

- [1] Alessandro Orsi, Tariq Sami Abdelhamid, Eugenio Pellicer (2021) – "Improving Green Building Project Management Processes through the Lean Approach."
- [2] Sagata Bhawani, John Messner and Rob Leicht (2021) – "Key Planning Steps Enabling Systematic Lean Implementation on Construction Projects."
- [3] Mohamed Watfa and Murad Sawalha (2021) – "Critical Success Factors for Lean Construction: An Empirical Study in the UAE."
- [4] Wassim Al, Balkhy Rateb Sweis and Zoubeir Lafhaj (2021) – "Barriers to Adopting Lean Construction in the Construction Industry, The Case of Jordan"
- [5] Mughees Aslam, Zhili Gao, Gary Smith (2020) – "Optimizing Construction Design Process Using the Lean Based Approach"
- [6] Glenn Ballard, Hajnalka Vaagen, William Kay, Bill Stevens and Mauricio Pereira (2020) – "Extending the Last Planner System to the Entire Project."
- [7] William Power and Darrin Taylor (2019) – "Last Planner System and Percent Plan Complete: An Examination of Trade Contractor Performance."
- [8] Xiuyu Wu, Hongping Yuan, Ge Wang, Shuquan Li Guangdong Wu (2019) – "Impacts of Lean Construction on Safety Systems: A System Dynamics Approach."
- [9] Mohamed Saad Bajjou, Anas Chafi (2018) – "Lean construction implementation in the Moroccan construction industry."
- [10] P. Selva Prasanth, S. Ranjitha, R. Tharanyalakshmi (2018) – "Implementation of lean construction in residential building projects."
- [11] Gaurav D. Ahire, P. D. Aher, M. D. Kale (2017) – "Application of lean technology in small residential construction."
- [12] Mohamed Saad Bajjou, Anas Chafi, and Abdelali Ennadi (2017) – "A Comparative Study between Lean Construction and the Traditional Production System."
- [13] Archana M S, Renuka S M, Karthigai Priya T (2017) – "Identification and Analysis of Lean Techniques in Indian Construction Projects."
- [14] Richard H. Ansah, Shahryar Sorooshian, Shariman Bin Mustafa (2016) – "Lean construction: An effective approach for project management."
- [15] Vinaya D. More, Shrikant Charhate and Madhulika Sinha (2016) – "Lean Construction Techniques in Indian Construction Industry: Some Analysis."