International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 06 Issue: 03 | Mar 2019 www.irjet.net p-ISSN: 2395-0072

Study on Economic Sustainability of Industrial Buildings

Shashank Pattanshetti [1], Prof. Sachin M. Kulkarni [2]

[1]Planning Engineer, Hombale Constructions & Estates Pvt. Ltd., Bangalore, Karnataka, India
[2] Assistant Professor, Department of Civil Engineering, Jain College of Engineering, Belagavi, Karnataka, India

---

Abstract - *Continuous depletion of resources due to rise in demand by society has affected the environment resources. This paper emphasis on the idea of sustainability with respect to material resources and steel happens to be one of the primary material resources in the construction industry and its demand is soaring every day. Past studies conducted between conventional steel structures and pre- engineered buildings to compare the structural weights have been used to follow up the work on economy and sustainability studies [1]. A construction schedule prepared on Microsoft Projects has assisted to approximately estimate the duration and budget needed to establish both the structures. The economy and sustainability of the structures has been reported and discussed in terms of cost and duration required to construct the structures.*

Key Words: Sustainability, Economy, Steel, Project Management, Microsoft Projects.

1. INTRODUCTION

Construction industry is on the rise and the need for material resources has increased. Steel being a major material for construction is in great demand and its production from iron ore mined from the earth is leading to depletion at a considerable rate. To maintain the demand of steel and balance the ecology, sustaining steel and its forms is a major factor that needs consideration. Sustainability emphasizes on methods to reduce depletion and conserve natural resources that are available in finite quantity to maintain an ecological balance and meet the demand of the industries to a certain level and limit at the same time. Sustainability includes social, health, environmental and economic concerns related to life cycle. Buildings generate and consume more than 40% of carbon dioxide and materials resources in the society; hence they have been a major focus for sustainable development.

The main principles to achieve sustainability in construction are as follows:

- Optimize resource usage
- Recycle and reuse of waste resources
- Protect the environment by reducing pollution
- Quality operations and maintenance

Sustainability can be achieved by the following three methods:

1.1 Sustainable Design

Sustainable design is a method of creating models and plans of physical objects, environments and services with a conscious of social, economic and ecological stability. The idea of sustainable design is to eliminate negative impact on environment and generate long term benefits. Good design and proper decisions taken during the initial planning stages are the basic fundamentals to achieve sustainability.

1.2 Sustainable Construction

Sustainable construction focuses on practices and processes that make use of resource efficiently and are environmental friendly throughout the service period of a building. The idea of lean techniques which are methods designed to identify and lower the waste occurring and produced during the construction phase of a project is well suitable to define sustainable construction. Understanding material properties, adopting established construction standards, etc. the sustainability in construction can be achieved.

1.3 Sustainable Recovery

When a building has completed its service period and when it is not possible to increase the same, demolition is necessary before it affects the surrounding environment and health. Sustainable recovery involves methods to efficiently disposing the structure by generating minimal pollution and effectively recovering, recycling and reusing the waste developed. Recycling and reusing waste offers greater advantage to the environment and sustaining the resources efficiently.

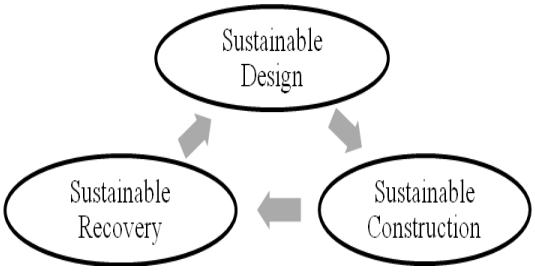

Fig -1: Sustainability cycle

Sustainability in construction industry is important to make the best and most effective use of resources according to a project requirement to decrease wastages and conserve them efficiently for future utilization. The need to achieve project objectives with resource optimization presents a great challenge i.e. to achieve goals within minimum duration, minimum cost expenditure and with less impact on environment.

2. METHODOLOGY

The study intends to compare the construction duration and budget between conventional steel building and pre-engineered building to determine which structure proves to be more sustainable. The present study makes use of the same industrial building designed in the previous paper to conduct comparative studies on structural weights [1].

The study will be carried out with the preparation of a construction schedule of conventional steel building and pre-engineered building on Microsoft Project 2013 (MSP) software. A schedule has been planned considering all the activities to be involved till completion. The scheduled activities have been assigned relationships in order of the activities to be executed. All forms of resources (manpower, materials and machineries) have been considered and assigned to each activity as per the required quantities. The summarized construction plan of will be compared for total construction duration and overall budget between the two structures.

3. PROJECT MANAGEMENT

The present demand for resources required for construction is high. Due to inflation, growth of economy and scarcity of resources the cost is increasing by the day. It is possible that, during the course of execution the overall resources to be employed and the budget invested may vary from the estimated quantity by large or small difference. To maintain the execution cost of the project within desired limits of the budget planned, optimize the usage of resources and reduce wastages, management of the project in every possible way is necessary.

Project management is the application of knowledge, skills, tools and techniques to meet project requirements which is an individual or a collaborative effort set to execute interrelated tasks for a definite period of time for a certain cost along with other constraints to achieve a particular aim. Project planning helps to achieve the set goals by completing tasks that contribute to objectives and further fulfill the scope of work.

Planning is the process of scheduling the course of activities along with resources required to achieve the set objectives within a defined budget and duration. Purpose of planning aims to:

- Better understand the scope and objectives of work.
- Optimize time and resources.
- Improve efficiency of operations.
- Provide bases for monitoring and control.
- Provide early warnings to issues and problems and take precautions.

3.1 Project Management Software

Project management software's enables to drive their projects intelligently and efficiently. The software's are designed to handle simple & complex projects, robust in nature and are easy to use tools for planning and evaluating programs. They help to organize, schedule, track, allocate and share resources, communicate, provide decision making suggestions, document projects and recognize problems effectively. The software also includes support for:

- Setting individual or multiple dependency relationship between activities.
- Setting a path to monitor activities regularly.
- Tracking and updating.
- Accounting for cost.
- Early warning on risks that might occur during execution.
- Optimum utilization of available resources.
- Instant communication between teammates and collaborators.

3.2 Microsoft Project (MSP)

Microsoft project is a management software application that has been designed to schedule, assign resources to activities, track work progress and analyze various other management parameters. The management software calculates project budgets based on activities involved, durations assigned and resource cost. The software application records and summarizes all data and provides results in form of graphs and charts for easy documentation and overall view of the current and future status of the project. The application helps sharing of reports between collaborators and provides options to restrict specific data between personals.

4. OBSERVATIONS AND RESULTS

Table -1: Construction Duration for Conventional Steel Building and Pre- Engineered Building as obtained from MS Projects

Type of Structure	Construction Duration (days)
Conventional Steel Building	115
Pre- engineered Building	89

Table -2: Construction Cost for Conventional Steel Building and Pre- Engineered Building as obtained from MS Projects

Type of Structure	Cost of Resources		Total Cost (Rs)
	Material cost (Rs)	Labour & Machinery cost (Rs)	
Conventional Steel Building	10,78,478.00	15,36,737.00	26,15,215.00
Pre-engineered Building	8,49,577.00	9,10,499.00	17,60,076.00

The difference in construction duration between conventional steel building and pre- engineered building was found to be 26 days. It was observed that the duration required constructing the structure from foundation level to plinth level and activities like flooring & roofing works are almost identical and hence do not contribute to any lead or delay in construction duration. The construction of super structure causes a significant time difference in execution between the buildings. This is due to the components of conventional steel structure are fabricated at site as per required measurements, erected and finished which tends to consume a couple of days more than pre- engineered components which are only assembled at site and does not consume time for fabrication purpose.

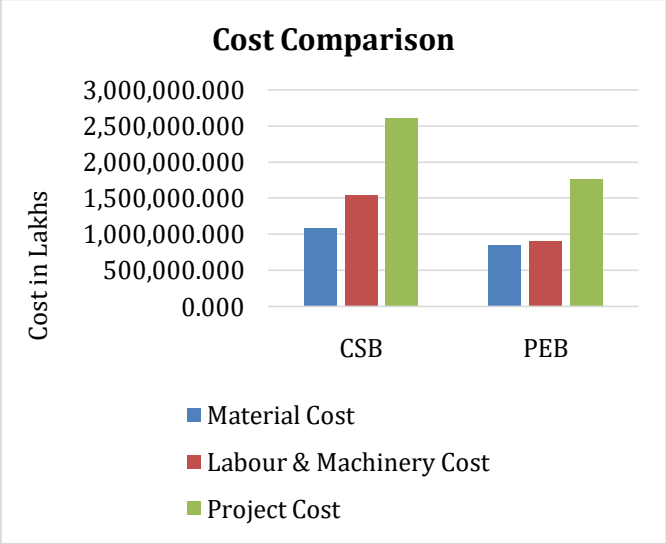

Chart -1: Cost comparison between Conventional Steel Building and Pre- Engineered Building

The above graph compares the cost involved to construct the two building in different forms. The main factors that contribute to project cost are steel quantity, construction time and resources (materials, manpower and machineries). Hence, the results shows that the overall budget of pre-engineered structure is way less than conventional steel structure and proves to be economical.

5. CONCLUSIONS

- The following study showed that the duration required to construct a conventional steel building is more compared to pre- engineered building. This lesser duration to construct pre- engineered building is due by eliminating the fabrication of structural components at site which accounts only for assembly time.
- The conventional steel building components are fabricated on site as per required measurements. This accounts to development of material and cost wastage as the unused sections are to be sold as scrap. Whereas the components of pre- engineered building are manufactured in factories as per design requirements accounting to zero material wastage and hence no loss in cost.
- The results pertaining to construction cost shows that pre- engineered buildings are found to be most economical. The difference in cost achieved is 32.69 % between both the structures. The low cost for pre-engineered building is due to low steel quantity in superstructure, lesser days required for construction and hence fewer resources employed during the construction period.
- The energy required to produce unit weight of steel for both structures is not the same as the cold formed steel sections used in pre- engineered building are produced at lower temperatures compared to hot rolled steel. The overall embodied energy of pre- engineered buildings is much less compared to conventional steel building as the total resources employed for construction of pre-engineered buildings is less hence leaving behind a low carbon footprint.
- The total quantity of steel produced and utilized to construct both the structures are completely recoverable with very minimum losses, e.g. corrosion. The steel material recovered is easily recyclable and reusable for numerous cycles. This property of steel proves to be environmentally friendly, helps maintaining the demand of steel in various sectors and proves itself to be sustainable building resource for the future.

REFERENCES

[1] Shashank Pattanshetti and Prof. Sachin M. Kulkarni "Comparative Study on the Economy between Pre-Engineered and Conventional Steel Buildings", International Research Journal of Engineering and Technology (IRJET) Volume: 04, Issue: 07, July- 2017.

[2] Havva Aksel and Ozlem Eren, "A discussion on advantages of steel structures in the context of sustainable construction", International Journal of

Contemporary Architecture "The NEW ARCH" Vol. 2, No. 3 (2015).

[3] S.D. Charkha and Latesh S. Sanklecha, "Economizing Steel Building using Pre- Engineered Steel Sections", International Journal of Research in Civil Engineering, Architecture & DesignVolume 2, Issue 2, April- June, 2014, pp. 01-10.

[4] Mrs. Archana K, "A conceptual Study of Sustainable Development in the Era of Globalization", International Journal of Scientific and Research Publications, Volume 3, Issue 5, May 2013, ISSN 2250- 3153.

[5] J. K. Yates and M. ASCE, "Design and Construction for Sustainable Industrial Construction", Journal of Construction Engineering and Management ASCE, 10.1061, 2014.