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"A study on pre-engineering building construction project using the scheduling techniques"

RAJ KAMLESHKUMAR MODI
Training and Placement Executive
Training and Placement Department
P P Savani University
NH 8, GETCO, Near Biltech,
Dhamdod, Kosamba,
Surat, 394125,
Gujarat, India

Second Author
Mr Himanshu Lad
Assistant Professor
School of Liberal Arts and Management
P P Savani University
NH 8, GETCO, Near Biltech,
Dhamdod, Kosamba,
Surat, 394125,
Gujarat, India

Abstract:

The process of constructing buildings and structures can be quite intricate. Historically, buildings were constructed using traditional methods which have been enhanced by new technologies. Properly scheduling activities is a vital aspect of such projects. Various new technologies have emerged to assist in activity scheduling. Mainly, the Critical Path Method (CPM) and Gantt chart methods are utilized for scheduling in building construction. The duration of each activity is predetermined. This allows for the creation of critical network diagrams or Gantt charts for all activities. Consequently, parallel activities can be easily recognized and completed, ensuring that the entire project is finished within the designated time frame.

Keywords: Construction, Scheduling, CPM, Gantt chat

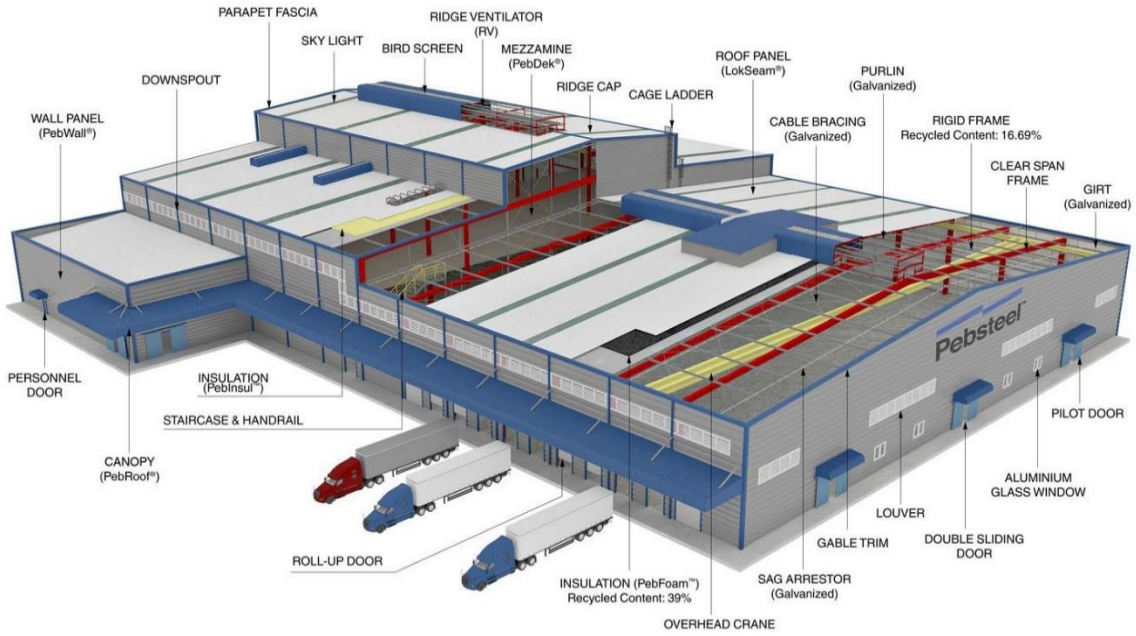
Introduction:

Pre-Engineered Buildings (PEB)

Pre-Engineered Buildings (PEB) are constructed off-site and then assembled on-site, typically using steel structures. Precisely measured built-up sections are created at the factory, transported to the site, and connected with bolts. This structural concept is commonly utilized for Industrial Buildings, Metro Stations, and Warehouses. The utilization of PEB instead of traditional steel building design has led to several advantages, such as cost-effectiveness and simpler fabrication processes. These types of building structures can be customized internally to suit various functions, making them suitable for low-rise building designs. Examples of Pre-

Engineered Buildings include warehouses, Canopies, Factories, and Bridges. They are constructed using a mix of built-up sections, hot rolled sections, and cold-formed elements to create a steel frame, which can then be covered with single skin sheeting or insulated sandwich panels for roofing and cladding. This concept aims to provide a complete building system that is energy-efficient, airtight, lightweight, cost-effective, and tailored to the user's needs.

These Pre-Engineered Steel Buildings can be equipped with various structural features like mezzanine floors, canopies, facias, and crane systems. Special mastic beads, filler strips, and trims are utilized to ensure the building is waterproof. This flexible building system can be internally finished to accommodate different functions and externally designed to achieve unique architectural styles. Pre-engineered buildings are typically used in low-rise constructions, with eave heights reaching up to 25 to 30 meters. They are well-suited for offices, showrooms, shop fronts, and other low-rise structures, offering benefits like cost-effectiveness and efficiency. The application of pre-engineered systems to low-rise buildings is economical and quick, allowing them to be built in significantly less time compared to traditional structures. Low-rise buildings with ground floor, two intermediate floors, and a roof are a common and cost-effective option. These structures can be constructed swiftly in various geographic locations, including extreme conditions like cold hilly areas, high rainfall regions,



and hot climates.

Project process:

Primary system

The main structural framework of a pre-engineered building consists of I-shaped members, commonly known as I-beams. The I beams in pre-engineered buildings are typically created by welding steel plates together to create the I section.

Secondary System

PEB structures rely on secondary building members to bear the main loads and ensure stability. These components also protect the buildings from external forces like wind and earthquakes. Examples of secondary building members include purlins, bracings, tie rods, angle bracings, high tensile bolts, and washers.

Wind Bracing System

A mechanism utilized to reinforce structures to withstand wind pressure. Wind braces are inclined braces that connect the rafters of a roof to prevent swaying. In ancient roof constructions, these braces are curved and stretch from the main rafters to secure the purlins. There are two variations of wind bracing systems employed depending on the architecture and layout.

1. Structural support using rods.
2. System with a series of interconnected frames.

Roofing & Cladding System

A roofing and cladding system is a comprehensive set of materials designed to work in harmony to ensure stability, longevity, ventilation, and defence against moisture, pests, and the elements. Metal roofing and cladding components consist of metal coils or sheets, which are lengthy continuous metal rolls treated or coated with paint.

Finishing

Primary structural elements are usually treated with shot peening, sandblasting, and two layers of anti-corrosive primers, followed by two layers of paint according to specific guidelines. Secondary elements are either painted following sandblasting or galvanized to 275 gsm or higher as needed.

Literature Review:

1. M Kuzhin and B Kuzhin discovered that specialization drives construction and leads to a more efficient organization of construction production. Figuring out the optimal size and quantity of work units is crucial when planning tasks at a construction site. In creating the workflow structure of construction, it is vital to establish the characteristics of the flows first and then ensure they align with each other. Key parameters to consider include the interval between flows, the pace of the flows, the number of work units, the processes involved, and the teams needed for each task.
2. Xue Li, Jing Xu, and Qun Zhang discovered that the conventional approach to managing construction schedules is subject to disruption or hindrance due to factors such as natural, objective, and subjective environments. Utilizing the BIM model and BIM5D software in construction scheduling not only allows for advanced awareness of resource, equipment, and financial requirements for the next stage, but also enables real-time monitoring of progress, budget deviations, and fund utilization during the actual construction process.
3. Anamika Sharma discovered that project schedules play a crucial role in conveying the ideas and strategies of the management team to stakeholders in construction projects. Conventional project scheduling tools have now become essential for managers in different project-based sectors to monitor schedules, budgets, and resource needs, as well as generate reports, offer online project information access, and communicate with team members. Revolutionary parametric CAD software is transforming the methods through which architects, engineers, and contractors operate, leading to a notable enhancement in construction management efficiency by reducing the manual efforts needed for computerized construction scheduling.

Research Objective:

1. The goal is to distinguish the various tasks involved in pre-engineering construction building.
2. Determining the length of time for each task and their order is a key objective.
3. Exploring various scheduling methods to ensure the project is completed in the most efficient manner is crucial. Sure, please provide me with the text that you would like me to paraphrase.

Ideal Time Period for the Construction of a Pre-Fabricated Structure:

One of the primary reasons why PEB construction is preferred is because of the quick construction time it offers. For a PEB structure spanning fifty thousand square feet, the ideal timeframe for completion is just three months, or ninety days.

Day 1 – Starting construction project

The construction project kicks off on the first day. Once that is done, the anchor bolt grafting drawing is completed. Next, the grafting is submitted to higher authorities for their approval. The drafting of anchor bolts must include specific details such as diameter, radius, area, and projection of each component. Additionally, information about the land layout is also necessary.

Day 5 - Acceptance of Anchor Bolt drawing and start GA drawing

After approximately five days, approval for the anchor bolt drawing was obtained. Following this, efforts were directed towards developing the General Arrangement drawing.

Day 10 - Acceptance of the GA drawing and start civil work

Start civil work based on the approved General Arrangement drawing on the tenth day after receiving acceptance, following the finalized designs.

Day 20 - Finishing the fabrication drawing and ongoing construction activities related to the infrastructure

Upon approval of the General Arrangement drawings, they commenced work on the Fabrication drawings. These drawings are derived from the General Arrangement drawings and are worked on concurrently with the civil construction activities.

Day 28 - Starting of the fabrication work

Fabrication work will commence on the twenty-eighth day, alongside the civil work that is already in progress. The construction site has now received the necessary building materials to continue with the project.

Day 52 - Casting the Anchor Bolt

The construction work for the building is complete by the fifty-second day. Anchor bolts, consisting of nuts and washers, have been cast and are used to attach various elements to the concrete structure. The casted material is left to cure for a period of five to seven days after the casting process.

Day 62 - Erection

The elements of structures are produced in factories with expert supervision, utilizing cutting-edge technology to ensure high standards of quality. The erection process begins on the construction site after sixty days, utilizing nuts and bolts. It typically takes between twenty-eight to thirty days to finish the erection process.

Day 90 - The project is completed

After nineteen days, all tasks have been completed. The final project is now finished and prepared for delivery to the client.

Concept of Scheduling:

Scheduling involves the organization, management, and enhancement of tasks and workloads within a manufacturing process. Enterprises employ both backward and forward scheduling techniques to assign resources for plants and machinery, strategize human resources, streamline production processes, and procure materials.

Scheduling involves organizing manufacturing work to achieve the best possible output and maintain control over the entire process. It entails assigning work to the plant with specific timeframes for each operation and determining the sequence in which they should be completed. Manufacturers use both backward and forward scheduling to allocate resources, plan workforce, and coordinate production processes and material procurement.

Scheduling involves creating plans for production over a short period of time, ranging from daily to weekly. This type of short-term planning is unnecessary in continuous or mass production systems, such as assembly lines or large batch production.

Advantages of Scheduling:

1. Simpler to strategize
2. Enhances efficiency of workforce
3. Reduces idle time
4. Facilitates allocation of extra tasks
5. Improves chances of completing tasks ahead of schedule
6. Seamlessly connects with various systems

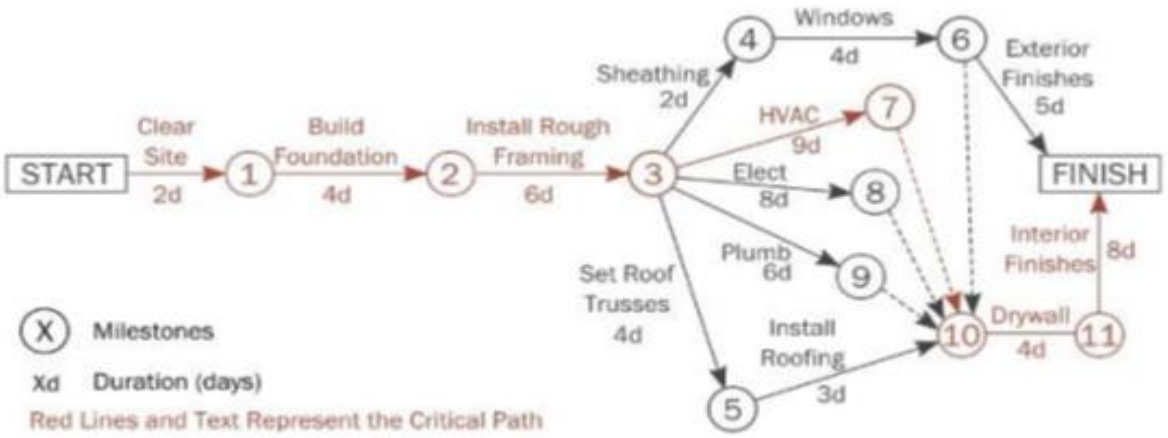
Project scheduling techniques:

1. Critical path method (CPM)

The main goal of utilizing the critical path method (CPM) is to calculate the maximum and minimum durations for completing a project. This method consists of three fundamental components, namely: The tasks required to complete the project

- Which activities are contingent on the finishing of previous tasks.
- Predictions of the amount of time needed for each task.

Identifying the activities that must be finished before teams can move on to other activities can assist in sequencing all the tasks in the project and predicting a range for the time needed to complete them.



Gantt chart

A Gantt chart is a visual tool utilized by project managers to plan and schedule tasks. It simplifies the organization of complicated projects by representing each task on a horizontal bar chart with start and end dates, along with deadlines, dependencies, and task owners incorporated. The visualization provided by Gantt charts can assist in tracking project progress and understanding the relationships between tasks.

Activity ID	Activity Name	TIMESCALE (WEEKS)																			
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
WBS 1 : GROUND WORKS																						
1	Excavation																					
2	Backfill and Compaction																					
WBS 2 : STRUCTURAL WORKS																						
3	Reinforced Concrete Works																					
4	Steel Works																					
WBS 3 : FINISHING WORKS																						
5	Brick Laying																					
6	Wall Plastering																					
7	Painting																					
8	Floor Covering																					
WBS 4 : ELECTRICAL WORKS																						
9	Conduit Works																					
10	Cable Pulling																					
WBS 5 : MECHANICAL WORKS																						
11	Plumbing Works																					
12	Fittings																					

Conclusion:

The initiation of pre-engineering construction involves a variety of tasks such as levelling surfaces, laying concrete slab foundations, installing water and sanitary systems, placing underground electric cables, setting up electrical systems, and connecting internal power circuits to appliances. The testing of all electrical systems and the assembly of water tanks in different locations also play a crucial role in this process, involving excavation, backfilling, foundation work, and the installation of air conditioning units.

The successful completion of pre-engineering construction work is heavily reliant on the proper sequencing of activities. It is vital to identify the correct order in which these tasks need to be carried out to ensure efficiency. Utilizing methods such as the critical path method and Gantt chart can assist in determining the optimal sequence of activities, ultimately leading to the timely completion of the project.

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