

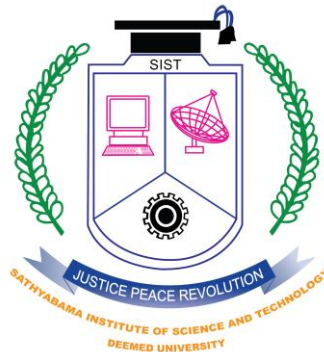
RESOURCE MANAGEMENT USING LOCATION BASED BUILDING INFORMATION MODELLING(BIM) SYSTEM IN A CONSTRUCTION PROJECT

A Thesis

Submitted in partial fulfillment of the requirements for the award of
Master of Architecture degree in Building Management

by

MANJU R (39840013)



**DEPARTMENT OF ARCHITECTURE
SCHOOL OF BUILDING AND ENVIRONMENT**

SATHYABAMA

**INSTITUTE OF SCIENCE AND TECHNOLOGY
(DEEMED TO BE UNIVERSITY)**

**Accredited with Grade "A" by NAAC
JEPPIAAR NAGAR, RAJIV GANDHI SALAI, CHENNAI - 600 119**

MAY 2021



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www.sathyabama.ac.in



DEPARTMENT OF ARCHITECTURE

BONAFIDE CERTIFICATE

This is to certify that this Report is the bonafide work of **MANJU R (39840013)** who carried out the Thesis entitled "**RESOURCE MANAGEMENT USING LOCATION BASED BUILDING INFORMATION MODELLING SYSTEM IN A CONSTRUCTION PROJECT**" under our supervision from January 2021 to May 2021.

Internal guide
(Ar.S.G. Selvendiran)

Internal Panel Member
(Ar. SUGIRTHA SURESH)

External guide
(Mr. S. KAVIN KUMAR)

DR. DEVYANI GANGOPADHYAY
Head of the Department

Submitted for Viva voce Examination held on _____

Internal Examiner

External Examiner

DECLARATION

I **MANJU R** hereby declare that the Thesis Report entitled “**RESOURCE MANAGEMENT USING LOCATION BASED BUILDING INFORMATION MODELLING(BIM) SYSTEM IN A CONSTRUCTION PROJECT**” done by me under the guidance of **AR. SELVENDIRAN** (Internal) and **Mr. S. KAVIN KUMAR, Director, EPMCR** (External) at Sathyabama Institute of Science and Technology is submitted in partial fulfillment of the requirements for the award of Master of Architecture degree in Building Management.

DATE:

PLACE: Chennai

SIGNATURE OF THE CANDIDATE

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I would like to express my sincere and deep sense of gratitude to my Project Guide **AR. SELVENDIRAN** for his valuable guidance, suggestions and constant encouragement which paved way for the successful completion of my project work.

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ABSTRACT

Building Information Modeling (BIM) could be a new conception that has magnified speedily within the construction sector in recent years. The time-dependent dynamic society has affected the expectations and demands of the development trade and resulted within the production of additional complicated and original comes consequently. Building Information Modeling (BIM) conception has become a necessity in today's housing industry in terms of providing integration between project stakeholders and providing the chance of process and storing the project knowledge during a common purpose. there's a good potential to enhance the flow of resources through location on construction sites, termed work flow through location-based building data modeling. Current activity-based programing techniques don't give adequate support for the design of labor flow because of sensible and method reasons. Location primarily based programing techniques mistreatment Navisworks give an alternate resolution to activity-based programing techniques for coming up with of labor flow.

This study proposes a purchase framework supported the implementation of Location primarily based Building Information Modeling (BIM) to attain 'best results' in construction comes. A case study conferred during this study proves the location-based building data modeling is vital for complicated construction project. pre-engineered building (PEB) was taken and created a model mistreatment Revit computer code and Timeline, chase and watching of the project is visually seen in Navisworks, it's simple to spot the gaps in programing and location-based work flow and resources for every activity. If there's any drawback in construction project that may be known before the project starts mistreatment Navisworks. This Navisworks enhance the worth of location-based advancement.

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CHAPTER 1

INTRODUCTION

1.1 INTRODUCTION

Construction companies face the challenge of delivering usually complicated projects to a schedule, at intervals a budget, and hopefully with an affordable ratio. Resource management is that the method of designing the resources necessary to satisfy the objectives of the project, and to satisfy the client's needs. Construction Resource management is the method of designing and allocating Resources needed to satisfy project objectives. correct resource management helps to keep projects on schedule by making certain that the demand of project resources is met and jointly maximizes the employment of resources from project to project.

A Building Information Model (BIM) could be a data-rich, object-oriented intelligent and constant quantity digital illustration of the power, from that views and information acceptable to varied users' wants may be extracted and analyses to come up with data that may be wont to create choices and to boost the method of delivering the power. the most characteristics of BIM embody 3D CAD-based shows and straightforward change and transfer of knowledge within the BIM surroundings. BIM encompasses a positive impact of fabric deliveries, that helps project stakeholders perceive the project, cut back uncertainty and improve certainty of the project.

Building Information modelling (BIM) technology effectively addresses this challenge. The thought of BIM is to model a building nearly before it's designed physically. A BIM model could be a centralized info that contains physical and purposeful data of a project. during this info, data by various users throughout the project lifecycle. employing a BIM model, executive agency professionals perform style, construction, and operation processes, establish potential issues and impacts, and create corresponding changes. Consequently, gratuitous process is eliminated, productivity is dramatically improved, and comes are completed quicker and profitability.

The Location based scheduling (LBS) technique has been developed to assist project managers within the industry with workflows and coming up with. the most philosophy concerning LBS has been to form a tactfulness within the construction comes by as well as each the time of a happening and therefore the location wherever event takes place. the various tasks within the comes got to proceed within the same flow to form a continuing progression while not holdup. the strategy is pictured by a graphical tool supported a way, using Navisworks.

1.2 NEED FOR THE STUDY

- Different Building Information Modeling (BIM)
- Location Based Scheduling in Building Information Modeling using Navisworks.
- Scheduling gap in construction project.
- Resource management in construction project.

1.3 AIM

The aim of the study is to analysis the efficiency of Resource management using Location based Building Information Modelling (BIM) system.

1.4 OBJECTIVES

The objective of the study is to fill the Scheduling gap by analysis the practices of Resource Management and proposing a Location based Building Information Modelling (BIM) system implemented in Pre-Engineering Building (PEB).

- To identify the current problem of Resource Management practices in the construction project.
- To recommend the appropriate Building Information Modelling (BIM) methods for improving Resource management practices in the construction project.
- To understand location-based BIM system and derive required schedule, labour & equipment.
- To implement the location-based BIM system in a live project and analyse its feasibility.

1.5 RESEARCH METHODOLOGY

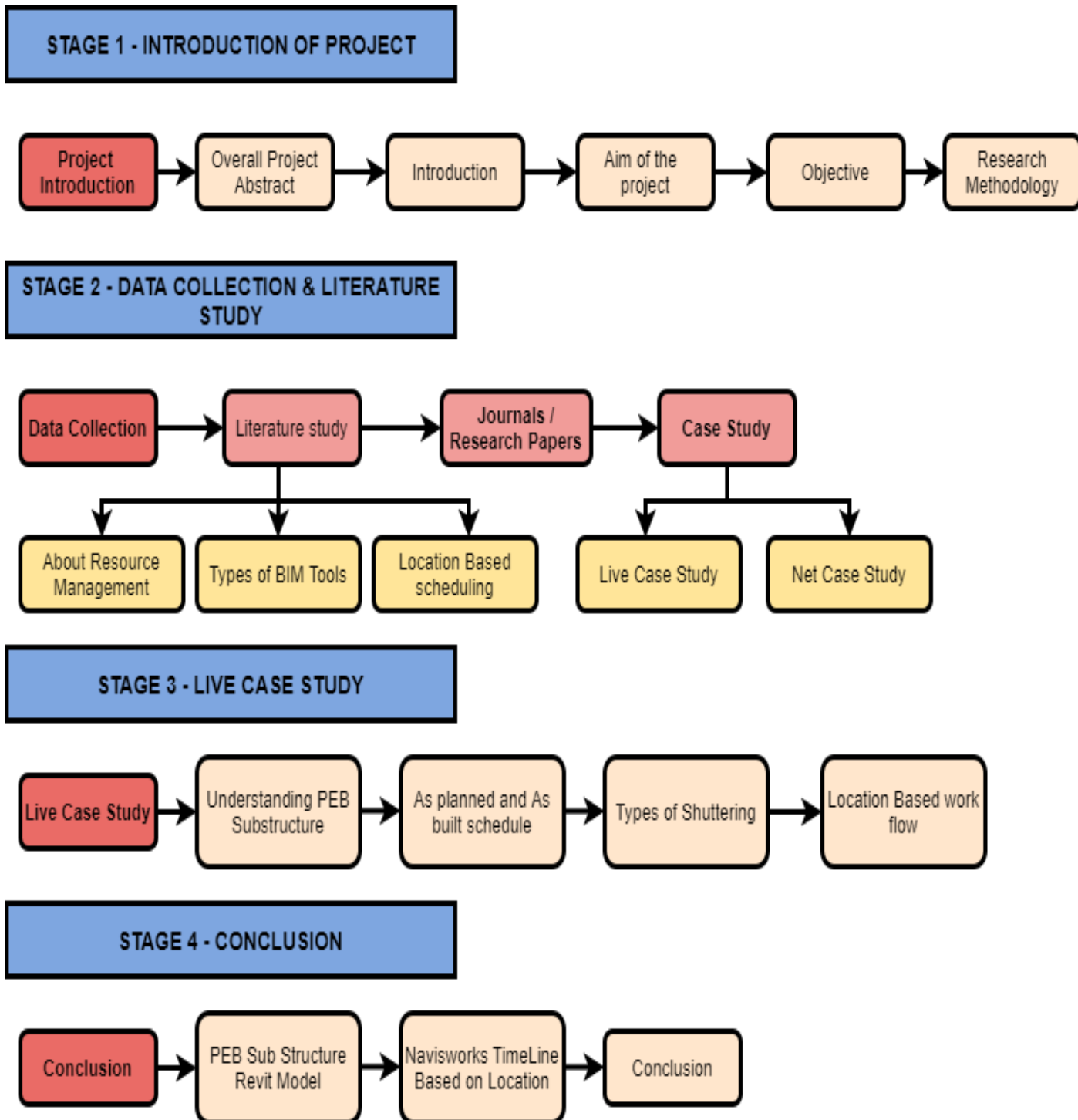


Figure 1.1 Research Methodology

LITERATURE STUDY

2.1 RESOURCE MANAGEMENT

Resource management is the process of pre-planning, scheduling and allocating your resources to maximize efficiency. **Resources** can be intangible – people and time – and tangible – equipment and materials.

2.2 TYPES OF RESOURCES

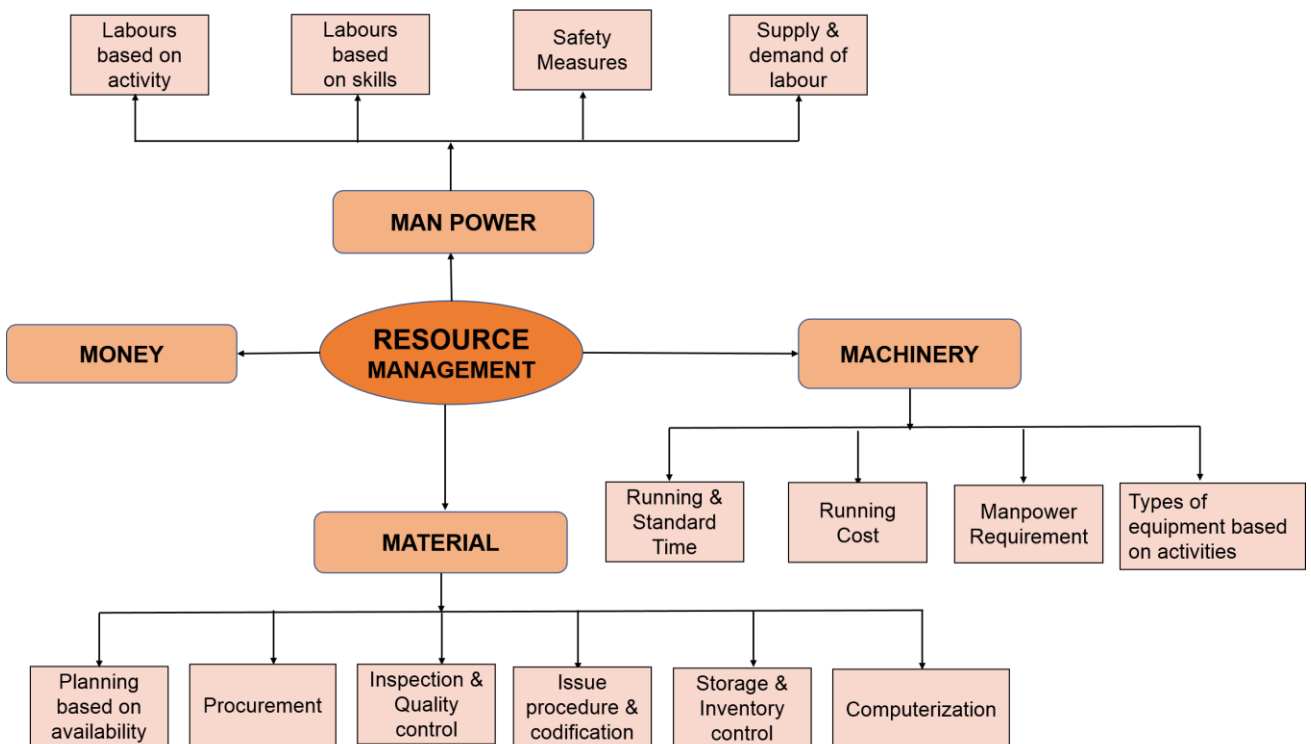


Figure 2.1 Resource Management

2.3 WHY IS RESOURCE MANAGEMENT IMPORTANT?

- It provides you with an overview of everyone and everything involved in your project.
- It enables utilization planning.
- It makes the planning and management process more transparent.
- It helps you see problems before they start.
- It gives you control over your project.

2.4 CHALLENGES IN RESOURCE MANAGEMENT

- **SHORTAGE OF SKILLED LABOR:** Managing a limited workforce against a large project workload is due to create additional strain for construction project. Scheduling your team becomes a complex puzzle of ensuring resources are utilized in the most efficient way without overburdening their schedule and workload.
- **POOR SCHEDULING:** project overload and shortage of skilled labour is perfect recipe for poor scheduling mistakes.
- **MATERIALS NOT DELIVERED ON TIME:** planning and scheduling must be made to ensure that the right materials are delivered at the right time. If delivered too early, they will not be able to be stored securely. If delivered too late, the project can be delayed overall.
- **CHANGES IN PROJECT SCHEDULE AND SCOPE:** One small change in a project can change scope and cause a delay.
- **OUTDATED WORKFLOW:** They use paper forms and spreadsheets for resource management, this manual process is prone to errors and inefficiencies. It becomes easy to miss key resources and mismanage the schedule by working on outdated documents.

2.5 BUILDING INFORMATION MODELLING (BIM)

2.5.1 What Is BIM?

- Building Information Modelling (BIM) is a process supported for the construction project which can be supported by various tools & technologies.
- When a BIM is implemented in a project leads towards a collaborative working environment. BIM is a management approach to prevent all problems which happens in each and every life cycle of the project.

2.5.2 Benefits of Bim:

- Better outcome through collaboration, Enhanced & optimized performance.
- Optimized solutions, Greater predictability
- Faster project Delivery, Reduced safety risk
- Reduce Wastage.

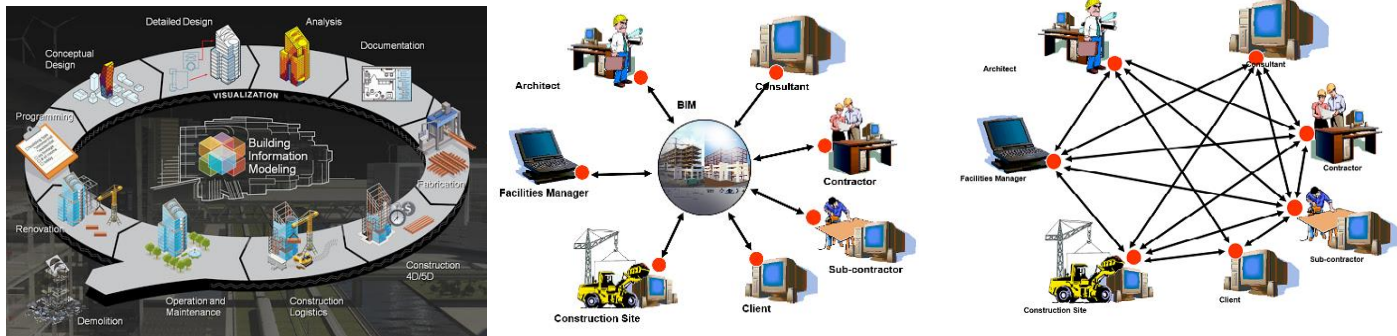


Figure 2.2 Traditional & Bim Approach

2.6 MAJOR ISSUES IN A CONSTRUCTION PROJECT

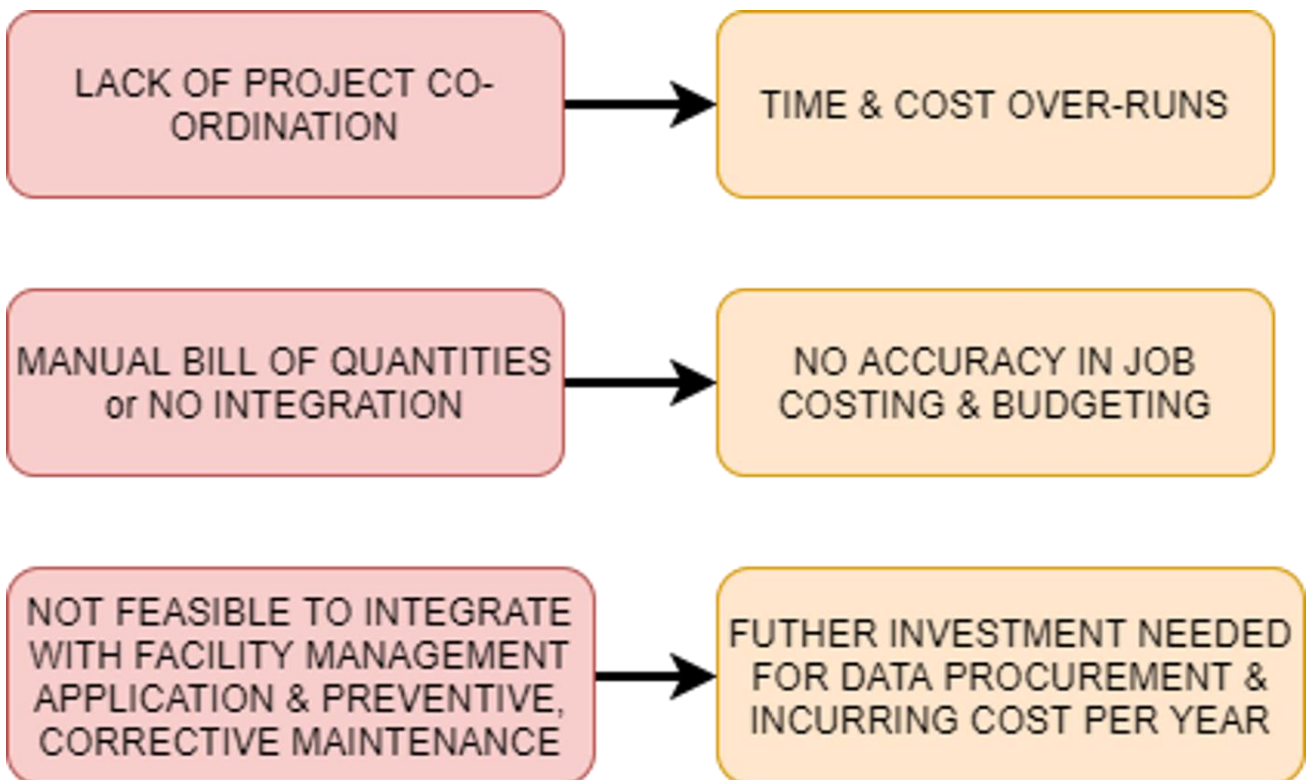


Figure 2.3 Major issues in a construction project

2.7 BIM- INTEGRATED PROJECT DELIVERY

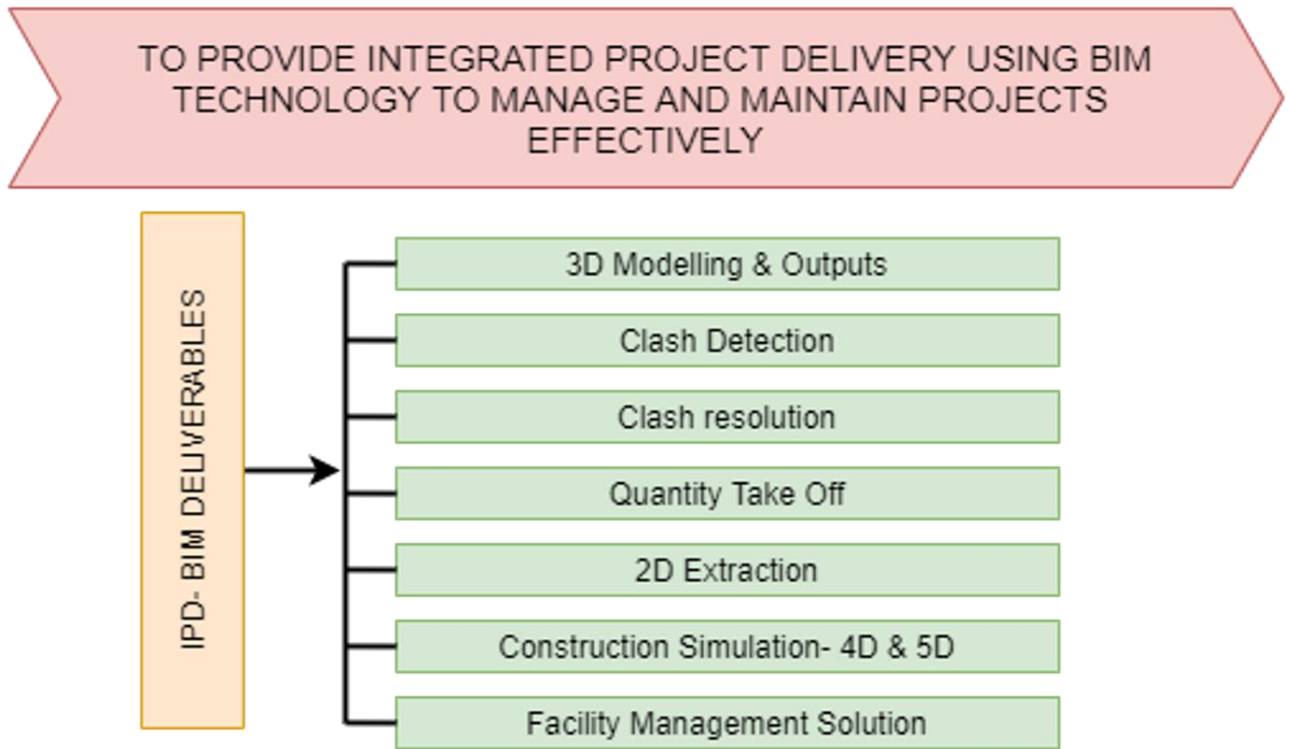


Figure 2.4 BIM- Integrated project delivery

2.8 ABOUT LOCATION BASED BUILDING INFORMATION MODELLING (BIM) SYSTEM:

The Location primarily based programming (LBS) technique has been developed to assist project managers within the industry with workflows and coming up with. the various tasks within the comes have to be compelled to proceed within the same flow to make a relentless progression while not delay.

- LBS is predicated on the elemental coming up with elements: activities, resources and also the link between them.
- The schedule serves as a communication tool to convey the structure of the production progress: what should be done when, which resources should be used, in which order should the tasks be carried out.
- The schedule should work as an overview map of the project, showing the planned way from start to end.
- The schedule ought to make sure that the most goal of the project is archived among the time, resource and qualitative framework applicable to the project.

2.9 UTILIZING BIM 4D CAPABILITIES TO IMPROVE RESOURCE MANAGEMENT

LOCATION BASED SYSTEM WITH 4D SCHEDULING SOFTWARE				
STEP 1	STEP 2	STEP 3	STEP 4	STEP 5
Location breakdown structure (LBS)	Location-based quantities	Task definition	Resource loading	Flowline representation and optimization
Define locations in terms of systems, geometry, levels and zones used in the model. The cost and schedule planning modules use quantities per location to calculate labour, material and equipment amounts and, subsequently, to determine the number of work hours per location.	Quantity take off (QTO) using the model geometry to calculate components within locations. Cost components contain quantities for labour, material and equipment	Define tasks with the use of QTO information. Calculate the amount of work associated with a task by applying a production rate to one or more of the mapped components using the following equation: <i>Component Quantity x Production Rate = Hours of Work</i>	Load resources with LBS optimization techniques. Production can be optimized using a number of methods: adjusting crews; adjusting crew configuration; splitting the work to enable parallel activities	Use flowline diagram for graphical optimization techniques. Dependencies between tasks can be defined graphically in the flowline view by drawing relations between activities

Table 2.1 Location based system with 4d scheduling software

2.10 TYPES OF BIM TOOLS IN LOCATION BASED 4D SCHEDULING



Figure 2.5 BIM- Tools

LITERATURE CASE STUDY

3.1 RESEARCH PAPER-1

Resource Utilization in Construction Projects and Its Impacts of High Ranked Variable During Time Over Run

RESOURCE UTILIZATION IN CONSTRUCTION PROJECTS AND ITS IMPACTS OF HIGH RANKED VARIABLE DURING TIME OVER RUN	
Author	M. Harsha Vardhana Balaji, Dr. Pulidindhi Venugopal.
Keywords	Resource optimization, Material Management, Delay in constructional projects, Stakeholders delay.
Purpose	Time over run is due to improper resource management, the effective resource utilization for the recent decades were less than 60%, improper resource utilization impacts on various quality of the projects, on time completion.
Introduction	Most of the construction industries focus on profits and time. 20% of construction industries were practicing effective resource management system along with proper planning and scheduling. 5-10% of construction industries were aware of it but they are not adopting during practice on consideration of the uncertainties. Remaining 60% of construction companies execute unplanned system only with their past experience or simply by directions for top level management. improper execution without planning and scheduling contains high risk factors, uncertainties and construction contractors were in lack of knowledge about its impacts with time.
Delay In Construction Projects	Critical delays cause high impact in project such as loss of profit margin and time over run, Non critical delay were acceptable and they can be adjusted alteration.
Construction Stakeholders	Stakeholders holds higher responsibility during the early stage execution of the project. Construction Stakeholders even after the awareness on technology they are not adopting innovative system and they controls the organization to be conservative.
Material Management:	• Material management always related with time and cost, • 60% of money concern with material management system in every project • Material management, managing stock produce higher impact on delay of construction projects. • 30% of the projects delay due to improper administration
Equipment Management	• 70 % of delay due to operators, they operated equipment without training. 20% of construction accidents were due to in effective handling of equipment's. Equipment should be selected based on ▪Organization Specific ▪Scope and Nature of the Project ▪Environmental and Climatic factors.
Human Resource Management	Construction industries were lack of human resource like skilled labour. Labour execute their projects only by the direction and instruction of their head without any training or unknowing the purpose of it, cause countable effects in quality wastage of resource. • 7- 10 % of material waste was due to unskilled labour. Human resource which need to noted were, • Engineers (Planning and Design team), Technicians (Execution First level), • Supporting Staff, Skilled Workers, Unskilled , Semi skilled workers
Execution Methods	Construction organization lack in update of technology and they always restricts of application of new strategies.
Conclusion	Constructional industries require periodic review of projects and also technology update. Maintenance of past records improves the methodology in construction projects it steps up the organization to higher level. Construction Stakeholders may adopt new methodology on handling complexity projects, each project have different scenario and modification of organization culture according to it ends in better results.

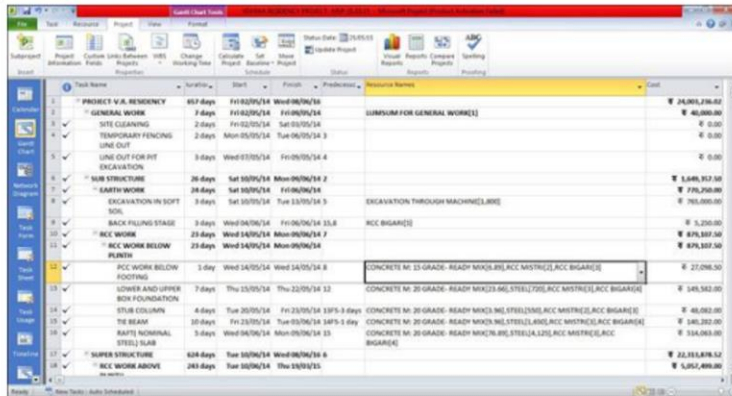
Table 3.1 Resource Utilization in Construction Projects

3.2 RESEARCH PAPER-2

BUILDING INFORMATION MODELING (BIM) A NEW APPROACH TOWARDS PROJECT MANAGEMENT

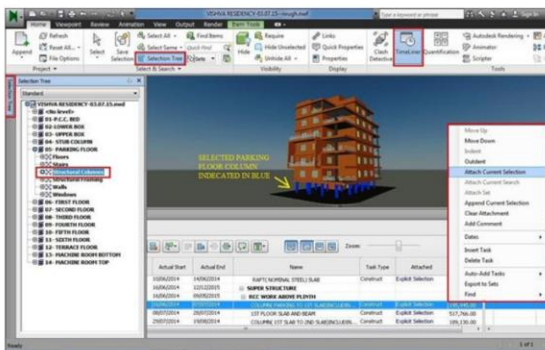
BUILDING INFORMATION MODELING (BIM) A NEW APPROACH TOWARDS PROJECT MANAGEMENT	
Author	Gayatri Dhananjay Jadhav, Madhav Bhalchandra Kumthekar, Jyoti Suresh Magdum.
Keywords	Building Information Modelling, Scheduling, Resource management, Navisworks.
Purpose	The Architecture, Engineering and Construction (AEC) industries have long sought techniques to decrease project cost, increase productivity and quality, and reduce project delivery time.
Findings	Implementation of BIM in the projects throws light on various risks and future challenges for the Architecture, Engineering and Construction (AEC) industries.
Introduction	In the present scenario, the contract has becoming time bond contract. In these conventional contracts all parties have to play a specific an important role. The duties and responsibilities of the contractors are very big and risky because he has to invest huge amount from his own pocket. In BIM he gets the feel of the project in terms of various resources and also in terms of time and cost.
Case study	• Project Type: Residence, G+6 • Location: Kolhapur, India. • Project Status: Ongoing work. • Project Size: 14,400sq.ft • Client: Vishwa • Contractor: M/S. Patki-Joshi Engineers & Contractors.
Work flow of the project	• Creating 3D model in Revit 2014 and extracting quantities from the model • Defining specification for each item of work in the project. • Preparing work breakdown structure in Microsoft Project (MSP), and giving time to each task. • Assigning resources to each task in MSP, and assigning quantity of each task and arriving at duration of the project. • Exporting MSP schedule and 3D model to the Navisworks Manage and creating visual results for planned schedule and actual schedule. • 4D models are developed by adding time parameter to the 3D model.
Quantity extraction, material rate and specification, scheduling in Microsoft project	• Settings before Starting the Actual Work • Preparation of Work Breakdown Structure • Preparation of Resource Sheet • Resource Assigning • Extracting Final Duration
Benefits of bim to reduce time	• The 3D aspect of the BIM makes it a very effective method of communicating between the architect, MEP consultant, contractors and the other project participants • BIM model is effective in Material management. A proper resource management benefit in timely procurement of material .It reduces wastage of time (Quality and Quantity control of material). • The 4D model visualization of the construction schedule helps to understand the sequence of the construction. • The movie clips of the construction sequence from Navis work and saved viewpoints in the model helped stack holders to communicate their ideas faster by reducing the navigation time. • Using software like Revit, Navisworks Manage, Microsoft Project, it is possible to extract accurate and reliable data as and when required
Conclusion	• Building Information modelling has provided a new approach towards project management. • It is an emerging tool for project management which makes use of various tools for visualization, 3D coordination, quantification, resource allocation, construction planning and monitoring these tools results in to expediting the construction process, effective resource management,4D visualization of the construction schedule, identification of unforeseen conditions • These benefits made BIM a successful project management tool.

Table 3.2 A new approach towards project management

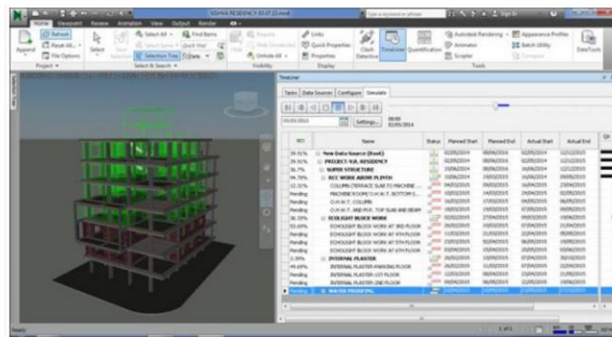


Project Duration Workout in MSP

EXPORTING 3D MODEL AND MSP SCHEDULE TO THE NAVISWORKS MANAGE:



NAVISWORKS MANAGE RESULTS:



Tracing of project Planned Schedule and Actual Schedule on 18/07/2014

Particulars	Quantity	Unit
Excavation upto 3.0m in soft soil	1800	Cum
PCC work below footing(RMC-M:15)	6.89	Cum
RCC column footing (RMC-M:20)	23.66	Cum
RCC column (RMC-M:20)	100.16	Cum
RCC beam (RMC-M:20)	343.00	Cum
RCC slab (RMC-M:20)		
RCC staircase waist slab/steps/landings (RMC-M:20)		

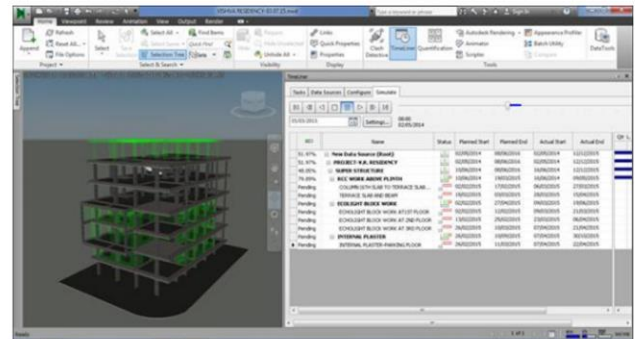
Quantity Take-off

MICROSOFT PROJECT RESULT: The work breakdown structure in Microsoft project find out 222 activities. After assigning resources (material and labour):

Project Planned Start Date	02/05/2014
Project Planned Finish date	08/06/2016
Project construction cost	Rs.2, 40, 03, 236/-
Material and labour cost percentage	57% & 43% respectively

Various charts prepared represents the material and labour allocation required for smooth execution of project. Also the following charts we get for project management.

Chart No 1 : Gantt chart ; Chart No.2 : Task Sheet ; Chart No.3 :Resource Sheet



Actual progress till date 18/07/2014

3.3 RESEARCH PAPER-3

IMPROVE THE PRODUCTIVITY OF BUILDING PROJECT USING BUILDING INFORMATION MODELLING (BIM) BASED 4D SIMULATION MODEL

IMPROVE THE PRODUCTIVITY OF BUILDING PROJECT USING BUILDING INFORMATION MODELLING (BIM) BASED 4D SIMULATION MODEL	
Author	Mr. Swapnesh. P. Raut ¹ , Dr. S. S. Valunekar
Keywords	Building Information Modelling, AEC Industry, BIM software's, Scheduling, 4D BIM
Purpose	This Study is to explain 4D BIM for better co-ordination, communication and share information among project team which is useful for projects in terms of performance and time.
Findings	4D BIM is best alternative to traditional project scheduling tools like CPM networks, bar charts
Introduction	AEC industries have required techniques to reduce project delivery time, decrease project cost, increase productivity and quality, so applying Building Information Modelling (BIM) to assist better the productivity of construction Project Management. The traditional planning method such CPM, Bar chart which is currently used in construction planning is found unsuccessful.
Case study	Project Type: Residence, G+2 Location: Maharashtra, India. Project Status: 2017(completed) Project Size: 15,000sq.ft Client: Vikash.
Steps to develop the 4d model	1. Creating 3D model in Autodesk Revit 2016. 2. Naming 3D components as per scheduled activity. 3. Import 3D Revit files into Navisworks or export files from Revit to Navisworks in NWC file format. 4. Importing 3D model from Revit to 4D BIM tool i.e. Autodesk Navisworks Manage. 5. Selection of sets each element of 3D model, adding task manually in Navisworks, creating schedule which is used for preparing scheduling to 4D BIM tool. 6. Link all tasks to 3D model with help of rules and search sets in software. 7. Configure task is doing which is useful to know elements are still under construction versus completed activities. 8. Simulating 3D BIM objects in model to activities in time liner schedule. 9. Checking the relationship between 3D object and schedule. 10. Once the 4D model linking was completed, play focused time for making animation could be utilized to create videos of the 4D BIM and finally, the video file could be exported as an avi movie format.
Benefits of using 4d bim as project planning tool	More Accurate and Detailed Work Plan: The utilization of 4D BIM allows project stakeholders to produce precise and complete work plan which would be more difficult to achieve with traditional planning methods. 4D BIM Promotes Onsite Safety: The ability of 4D BIM to detect the potential safety hazards even before the construction activities actually start on-site is one of the important factors that helps develop higher safety measures. project managers can see how separate crews may affect one another and therefore accidentally create hazardous situations. Better Communication Between Project Stakeholders: 4D Modelling played an important role in communication between client and planners during the planning phase by showing visualizing the progress of project which achieved in this case study by using Navisworks 4D simulation. Better 4D Simulation with Construction Sequence: The 4D simulation in BIM provides a virtual view of the project status and it helps adjust the project schedule according to any design change. - Green transparent colour while activity in start appearance, yellow transparent colour while activity early appearance and red transparent colour when the activity late appearance.

Table 3.3 Improve the productivity of building project using BIM

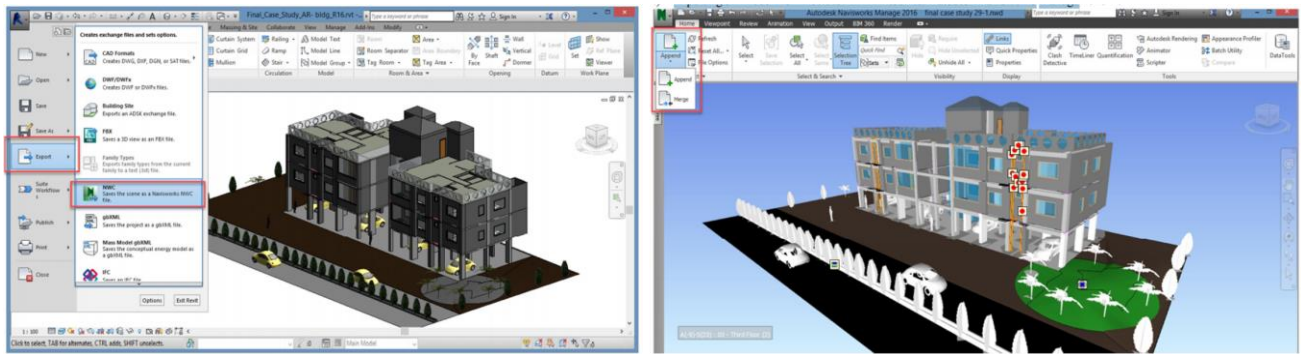


Figure 3.1 Converting Revit file into NWC format

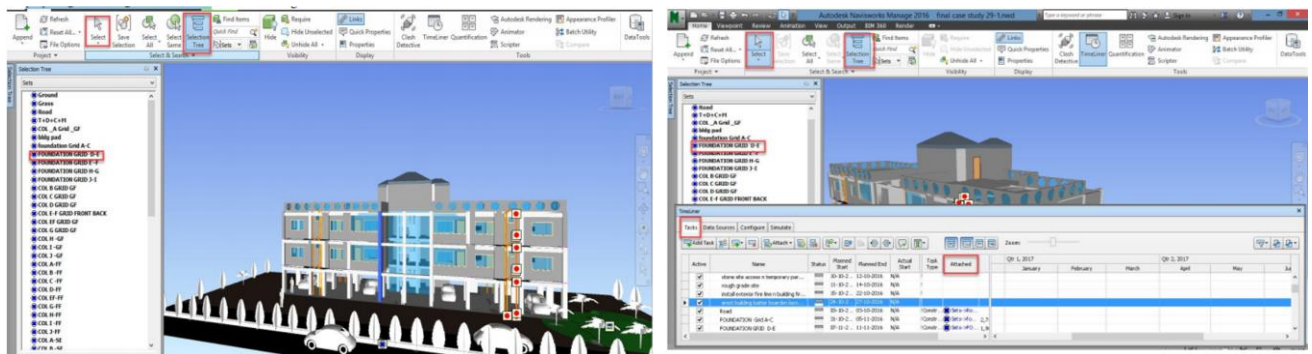


Figure 3.2 Assigning Tasks and linking activities to the 3D model

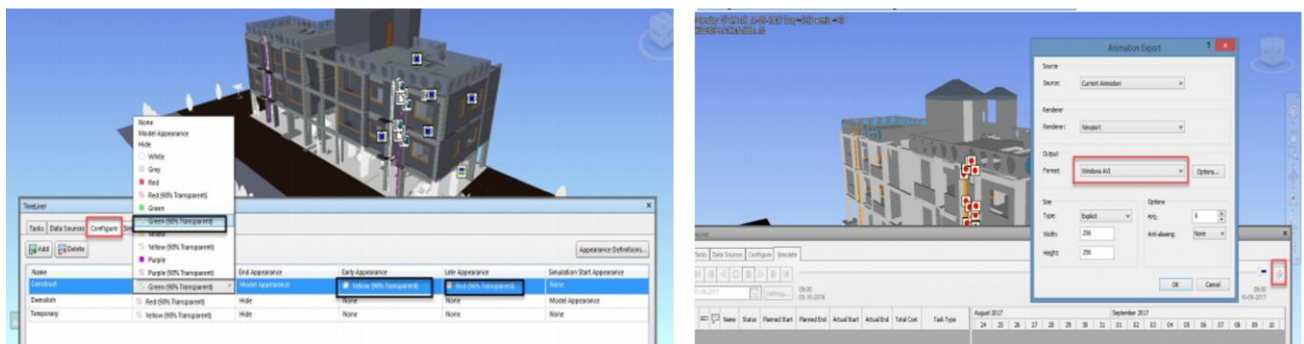


Figure 3.3 Exporting Simulation as Video File

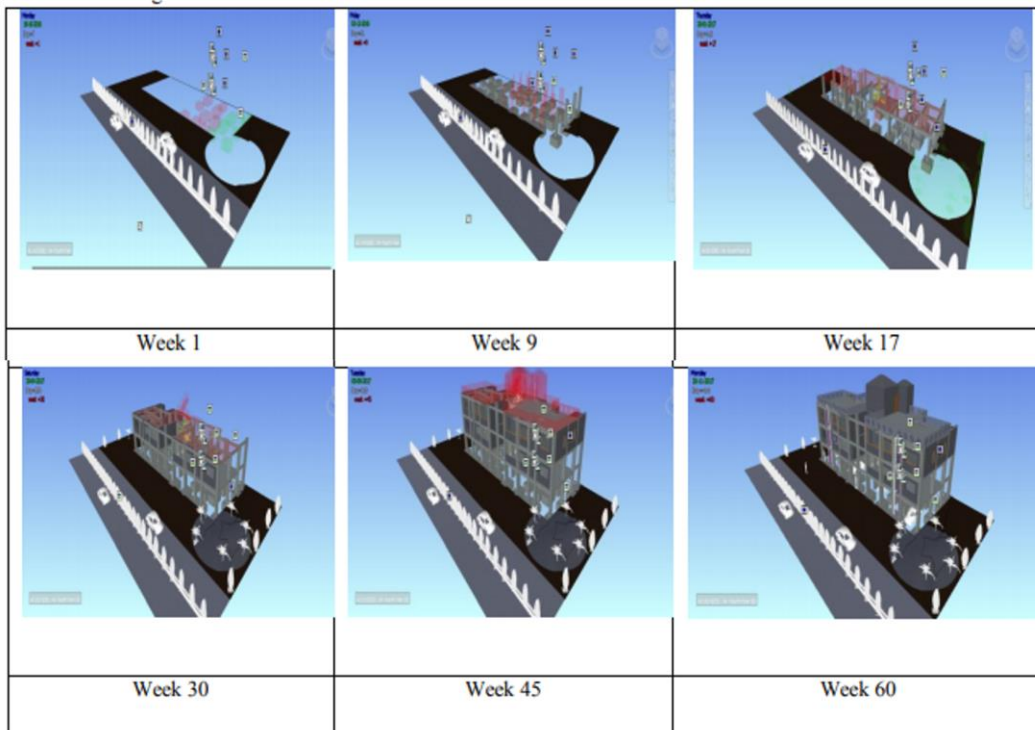


Figure 3.4 The interfaces of Auto-desk Navisworks of 4D Scheduling in BIM

LIVE CASE STUDY

4.1 SS LOGISTICS- LIGHT INDUSTRIAL PARK FOR FLIPKART AT IGGALURU- BANGALORE

PROJECT DETAIL	
PROJECT NAME	SS Logistics- light industrial park
LOCATION	Iggaluru Village- Bangalore
CLIENT	SS Logistics
PROJECT MANAGER	EPMCR, Chennai
STRUCTURAL CONSULTANT	TATA Consulting Engineers Ltd, Chennai.
CIVIL CONTRACTOR	Jyothi Construction
PEB	Niktha
LAND AREA	46251.2842 Sq.m
WAREHOUSE + SCRAP ROOM AREA	9907.693 Sq.mt
TYPOLOGY	Warehouse
PROJECT STATUS	Under Construction
PROJECT START	02 January 2021
PROJECT COMPLETION	21 August 2021
PROJECT DURATION	230 Days
CIVIL WORK- SUB STRUCTURE	
CIVIL WORK START	02 January 2021
CIVIL WORK COMPLETION	21 June 2021
CIVIL WORK – PLANNED DURATION	170 Days (for PEB building alone)

Table 4.1 Project Detail



Figure 4.1 Site



Footing Excavation Work

Figure 4.2 Excavation Work

4.2 DELAY FACTOR IN CONSTRUCTION SITE

- Geo technical report issues, soil in the construction site which is not eligible for construction.
- Footing work got delayed for 20 days in the initial stage of the project due to geo- technical report issues.
- Due to soil condition, 3 layers of soling is laid below footing.
- Pedestal height increased from 1.5m to 2.4m.
- Excavation depth is increased, schedule date got delayed.
- More labour team is required as per the schedule, there is a shortage of labour team.
- Variation in site due to drawing errors.
- Safety issues in night works (Improper Lighting)
- Contractor was slow in completing the work, so 7 days delay in soling & backfilling work.
- Shortage of skilled manpower. More skilled labour required instead of unskilled labour.
- Additional shuttering is required to increase the progress.
- Poor Planning
- Access Unavailability
- Delay due to rain.

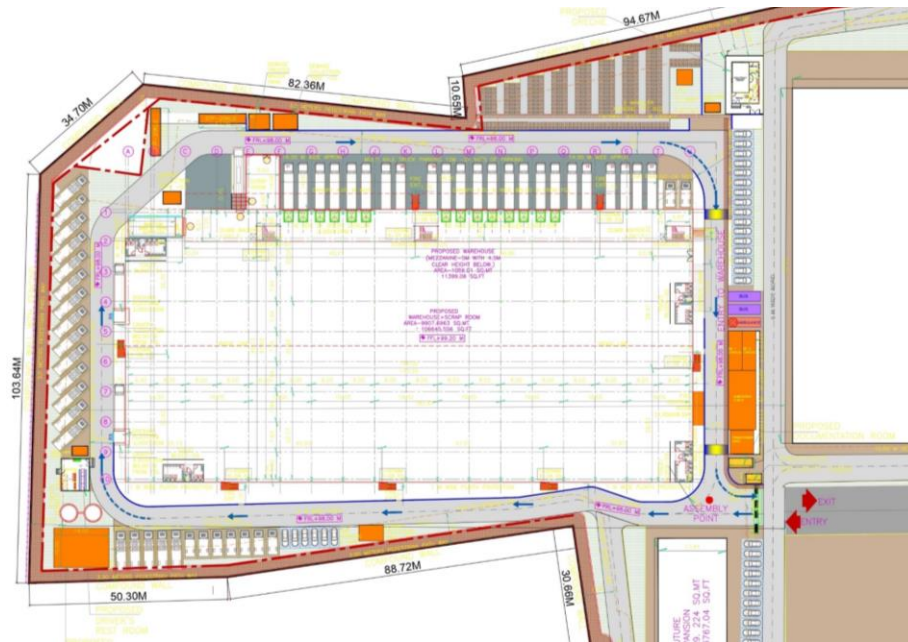


Figure 4.3 Master Plan

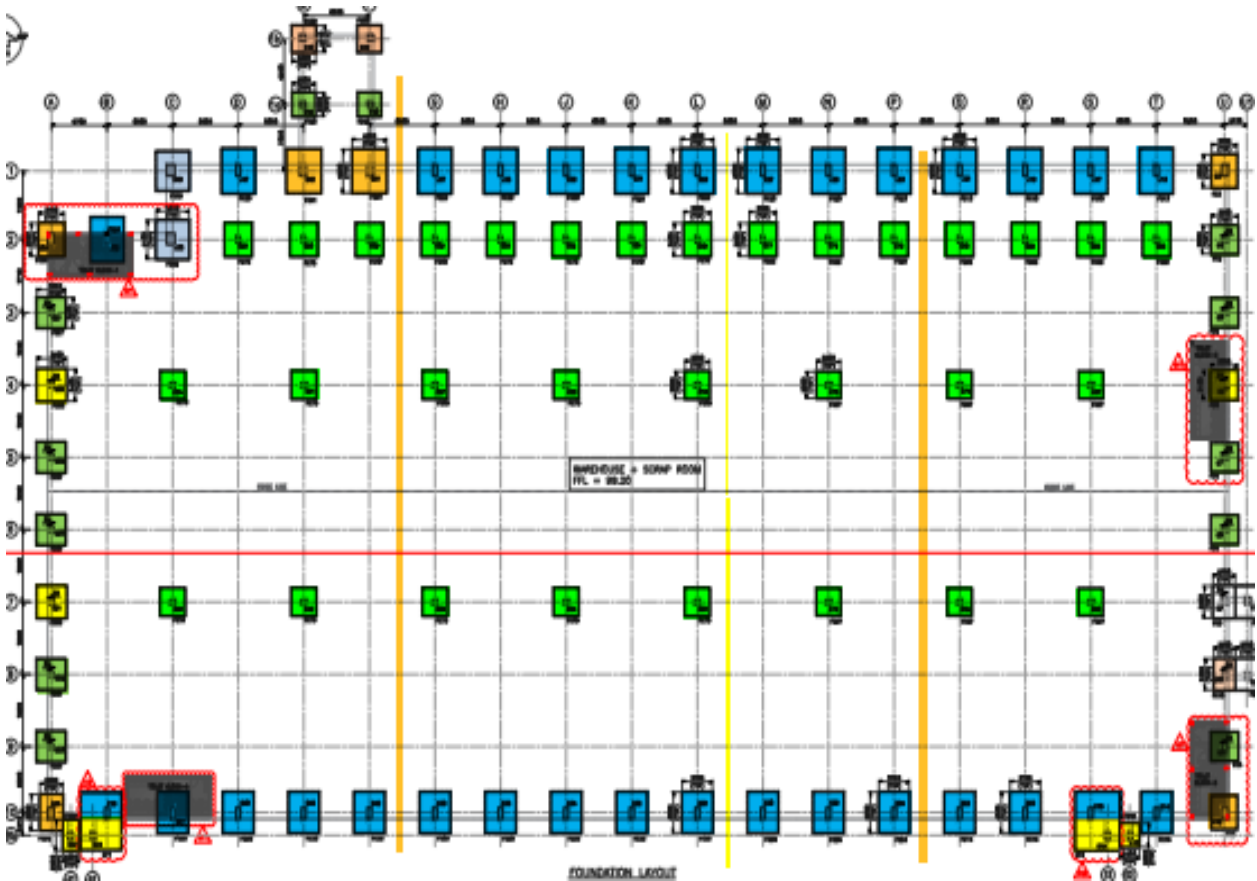


Figure 4.4 Floor Plan



3Layers Soling Work



Footing & Pedestal Work

Footing Rebar Work



Pedestal Shuttering Work

Pedestal 1st Lift Starter & Concreting Work



Soil Filling & Compaction Work

Pedestal 2nd Lift Concrete Work

Figure 4.5 Soling to pedestal 2nd lift



Grade Beam Rebar Work



Grade Beam Shuttering & Concreting Work



Pedestal Anchor Bolt Fixing



Compaction & Levelling Work



Figure 4.6 Grade beam to Compaction

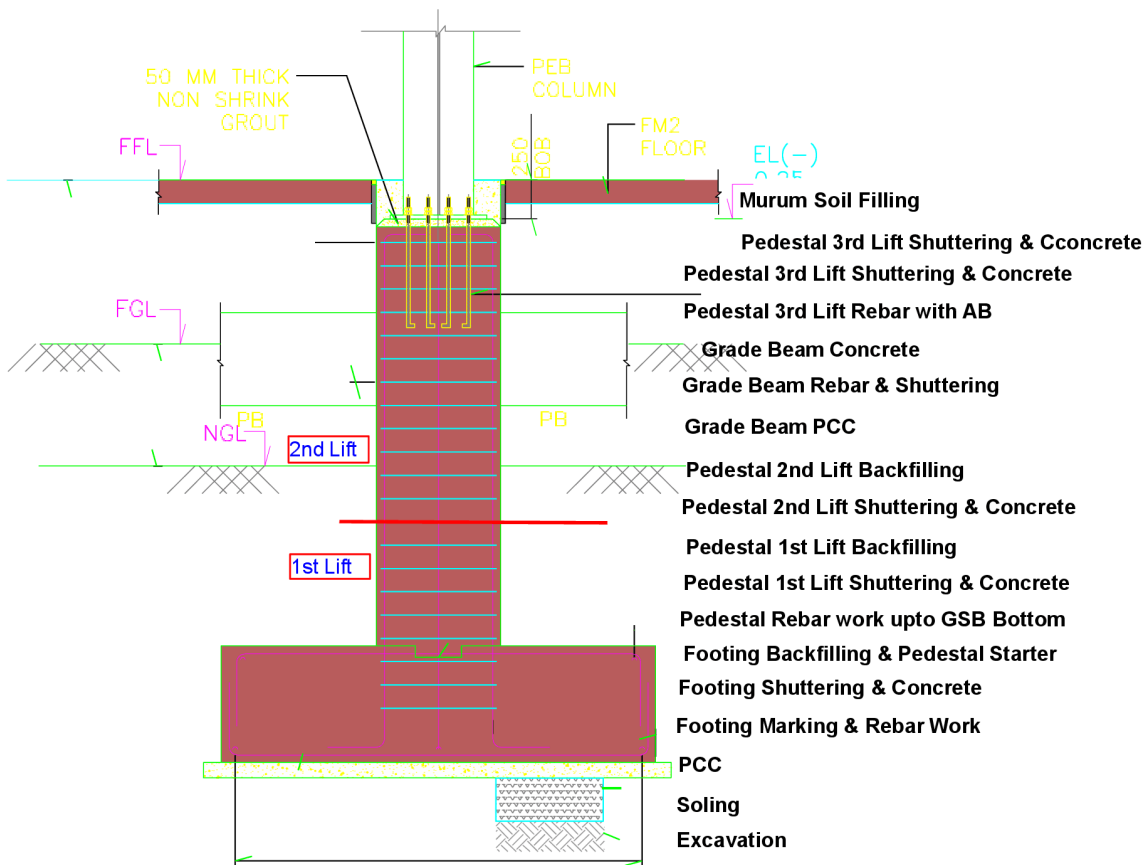


Figure 4.7 Sectional Detail

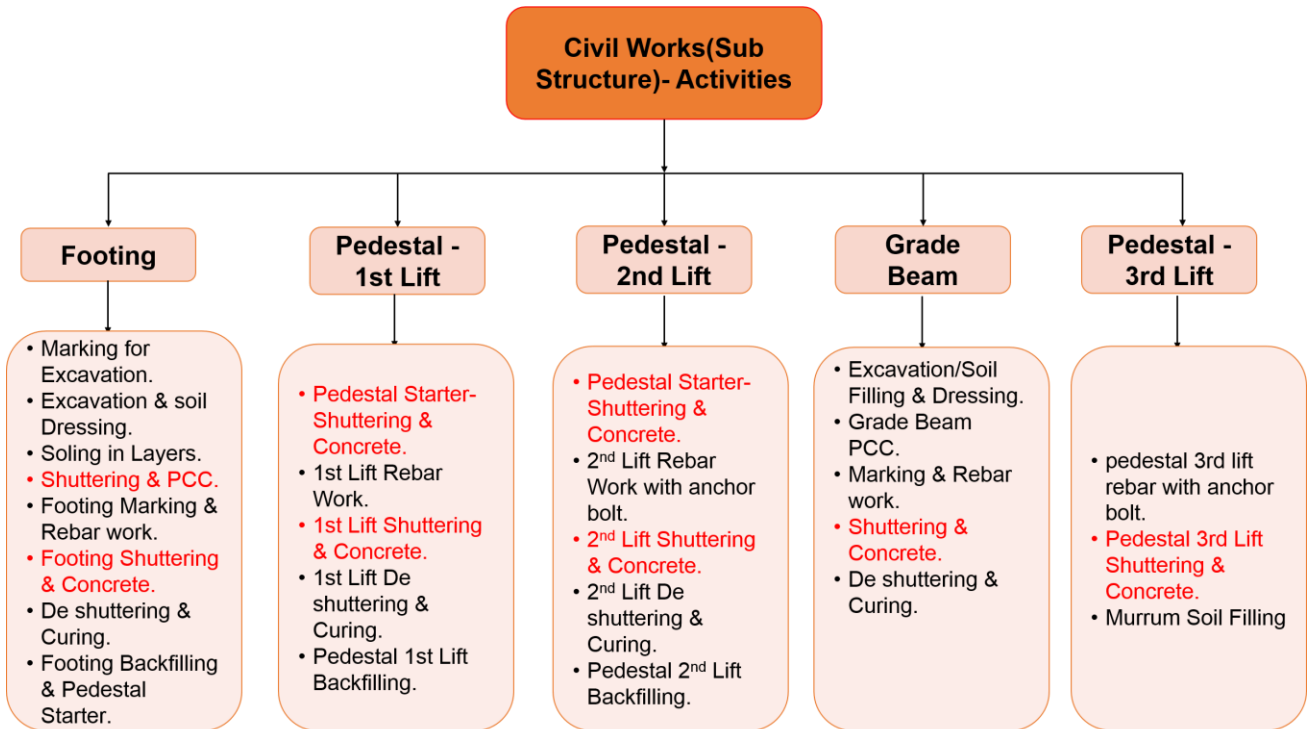


Table 4.2 Civil Work- Sub structure

ACTIVITY	AS PLANNED SCHEDULE-START	AS PLANNED SCHEDULE-END	DELAY DURATION	AS BUILT SCHEDULE-START	AS BUILT SCHEDULE-END
EXCAVATION	22-01-2021	06-02-2021	35 days	20-01- 2021	11-03-2021
SOLING	23-01-2021	15-02-2021	26 days	23-01- 2021	14-03-2021
PCC	24-01-2021	19-02-2021	24 days	25-01- 2021	14-03-2021
FOOTING	25-01-2021	20-02-2021	27 days	27-01-2021	18-03-2021
PEDESTAL -1ST LIFT	01-02-2021	27-02-2021	19 days	02-02-2021	18-03-2021
PEDESTAL- 2nd LIFT	15-02-2021	10-03-2021	40 days	01-03-2021	27-03-2021
GRADE BEAM	11-02-2021	02-03-2021	40 Days	28-02-2021	25-03-2021
SOIL FILLING & COMPACTION	23-02-2021	10-03-2021	30 Days	23-03-2021	04-03-2021

Table 4.3 As planned & as built schedule- civil work (sub structure)

4.3 SHUTTERING

- Shuttering could be a temporary support as a mold for contemporary concrete, during which concrete is poured and solid within the desired form and gain initial strength, hardened and matured.
- Shuttering is employed in several shapes and sizes in step with the development parts within the sort of Pcc, Footing, columns add building.

4.4 Types of Formwork (Shuttering)

Timber Formwork: Timber used for shuttering for exposed concrete work ought to have smooth and even surface on all faces that are available contact with concrete.

- Well-seasoned
- Light in weight
- Easily practicable with nails while not ripping
- Free from loose knots

Plywood Formwork: Resin-bonded ply board sheets are connected to timber frames to form up panels of the specified sizes.

- use of large-size panels, it's doable to have an effect on saving within the labor price of fixing and disassembly.
- The number of reuses are a lot of as compared with timber shuttering.

Steel Formwork: This consists of panels fictional out of skinny steel plates stiffened on the perimeters by little steel angles.

- The panels may be fictional in giant numbers in any desired standard form or size.
- Steel forms are for the most part utilized in giant comes or in a very state of affairs wherever sizable amount.

4.5 PROPERTIES OF FORMWORK MATERIAL:

- Material should be low-cost and reusable.
- It should be much water proof.
- Swelling and shrinkage should be minimum.
- Strong enough to with stand all external hundreds.
- Light in weight.
- Surface ought to be sleek.



Timber Formwork



Steel Formwork



Plywood Formwork

Figure 4.8 Types of formwork

4.6 FORM WORK FAILURE

- There are several factors that may lead to the failure of formwork during and after concrete placement.
- Improper bracing can cause formwork failure since the weight of fresh concrete is no longer supported by formwork system.
- formwork failures can lead to delay in construction.
- Insufficient spacing and size may lead to a formwork collapse during construction as well as damage of the concrete structure.
- Insufficient cross bracing and horizontal bracing of shores are common causes of formwork failure.
- Vibration and impact due to passing traffic, movement of workers and equipment on formwork.
- Lack of Attention to Formwork Details.

4.7 SS LOGISTICS- SHUTTERING

- In this project they have used timber formwork, for different work process like footing, pedestal, Pcc, grade beam.
- The work flow has split into three, work front 1, work front 2 and work front 3.

- Each Workfront, different types of shuttering is identified and split the shuttering material based on the typology.
- Delay has occurred due to inadequate skilled labour.
- Less shuttering materials.
- Increase shuttering team and material.
- Delay due to variation in sizes.



Figure 4.9 Timber Formwork

4.8 FOOTING – SHUTTERING- WF1

WORK FRONT 1- FOOTING- 43 NOS

Typology	Total No of Shuttering	Length x Breadth x Depth
Type 1	10	3.8x 2.8x 0.45 ; 3.5x 3.2x 0.45 ; 3.5x 3.3x 0.55
Type 2	6	3.2x 2x 0.5 ; 3.2x 2.9x 0.5 ; 3.2x 2.9x 0.6
Type 3	1	6.12x 4.85x 0.7
Type 4	8	2.4x 2 x 0.5; 2.4x 2.2 x 0.4; 2.1x 2.1 x 0.4; 2 x 2 x 0.4; 2.2x 1.9x 0.4
Type 5	3	1.95x 1.7x 0.4; 1.95x 1.7x 0.4; 1.8x 1.6x 0.4;
Type 6	4	4.2x 3.6x 0.5; 4.2x 3.5x 0.5.
Type 7	6	4.4x 3.7x 0.6; 4.4x 3.7x 0.6; 4.3x 3.8x 0.6 4.1x 4x 0.6
Type 8	1	4.7x 4x 0.65
Type 9	2	4.6x 4.2x 0.55;
Type 10		
Type 11	2	2.9x 2.8x 0.45
Type 12		

Table 4.4 Footing Shuttering- WF1

4.9 PEDESTAL – SHUTTERING- WF1

WORK FRONT 1- PEDESTAL- 43 NOS

Typology	Total No of Shuttering	Length x Breadth
Type 1	7	0.65 x 0.5
Type 2	4	0.45 x 0.4
Type 3	6	0.45 x 0.2
Type 4	4	1.2 x 0.55
Type 5	4	0.8x 0.6
Type 6	2	0.725 x 0.65
Type 7	12	0.7x 0.5; 1.2x 0.8; 1.2x 0.55; 0.75x 0.5; 1.2x 1.02
Type 8	2	1.2 x 0.55
Type 9	2	1.2 x 0.8

Table 4.5 Pedestal Shuttering- WF1

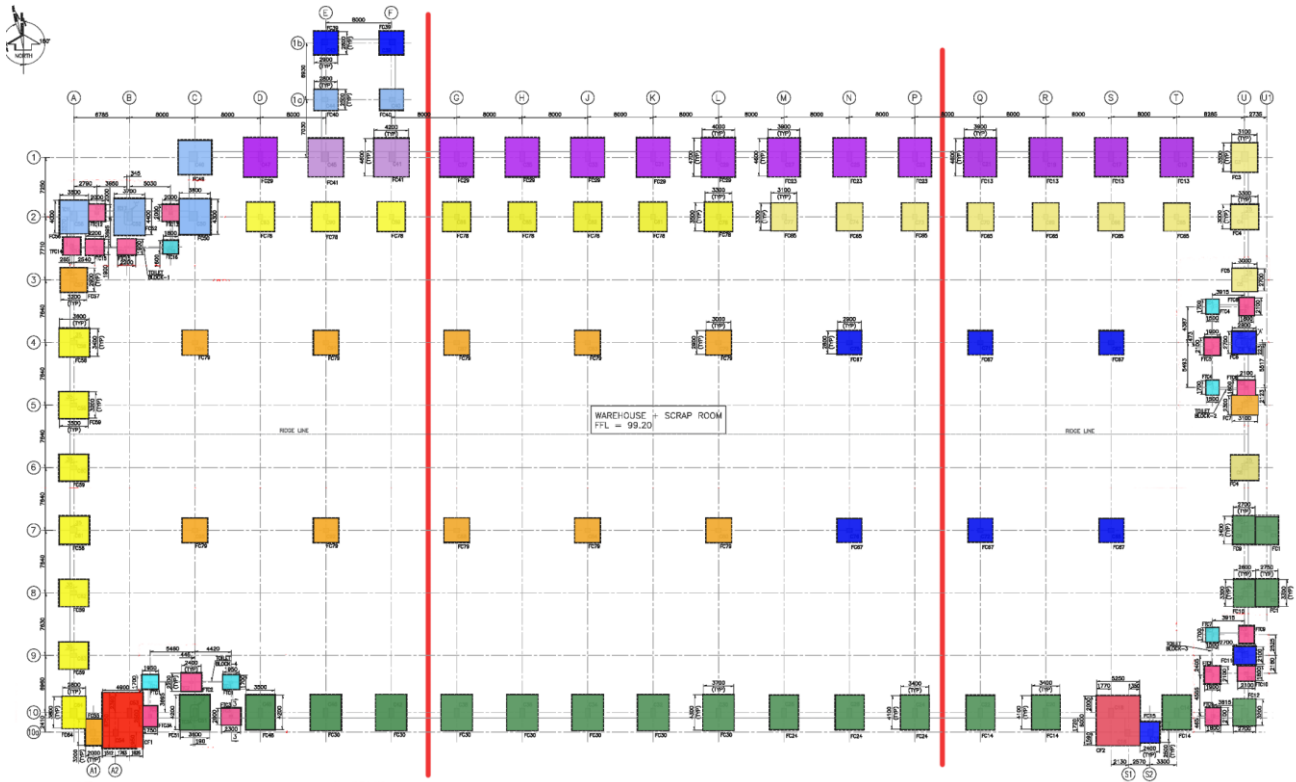


Figure 4.10 Footing Shuttering

4.10 FOOTING – SHUTTERING- WF2

WORK FRONT 2- FOOTING- 37 NOS

Typology	Total No of Shuttering	Length x Breadth x Depth
Type 1	5	3.5x 3.3x 0.4
Type 2	6	3 x 2.9x 0.6
Type 6	9	4.2x 3.6x 0.5; 4.2x 3.5x 0.5; 4.3x 3.7x 0.55
Type 8	9	4.7x 4x 0.69
Type 10	4	3.5x 3.3x 0.45
Type 11	4	2.9x 2.8x 0.6

Table 4.6 Footing Shuttering- WF2

4.11 PEDESTAL – SHUTTERING- WF2

WORK FRONT 2- PEDESTAL- 37 NOS

Typology	Total No of Shuttering	Length x Breadth
Type 1	15	0.65 x 0.55
Type 4	9	1.2 x 0.55
Type 8	9	1.2 x 0.55
Type 10	4	0.65 x 0.55

*Table 4.7 Pedestal Shuttering- WF2***4.12 FOOTING – SHUTTERING- WF3**

WORK FRONT 3- FOOTING- 34 NOS

Typology	Total No of Shuttering	Length x Breadth x Depth
Type 2	1	3.1 x 2.3 x 0.5
Type 4	7	2.1x 1.8 x 0.45; 2.1x 1.9x 0.4
Type 5	3	1.7x 1.5x 0.4; 1.7x 1.5x 0.4;
Type 6	7	4.2x 3.6x 0.5; 4.2x 3.5x 0.5.
Type 8	3	4.7x 4x 0.65
Type 10	7	3.5x 3.3x 0.45; 3.3x 3.3 x 0.5
Type 11	5	2.9x 2.8x 0.45; 2.5x 2.4x 0.4
Type 12	1	6x 5.25x 0.7

Table 4.8 Footing Shuttering- WF3

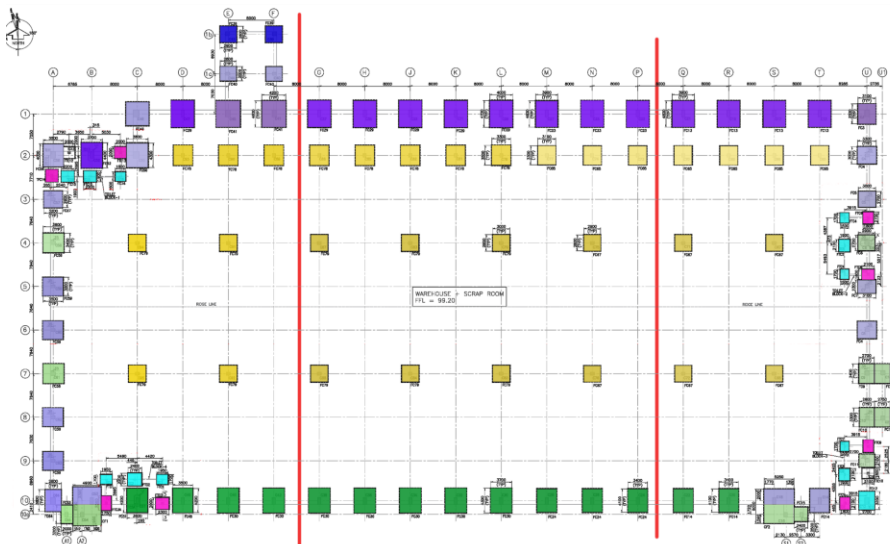
4.13 PEDESTAL – SHUTTERING- WF3

WORK FRONT 2- PEDESTAL- 34 NOS

Typology	Total No of Shuttering	Length x Breadth
Type 1	2	0.65 X 0.5
Type 2	4	0.45 X 0.4
Type 3	6	0.45 X 0.2
Type 4	1	1.2 X 0.55
Type 5	8	0.8 X 0.775; 0.75 X 0.725;
Type 7	6	0.7 X 0.5; 1.2 X 0.5
Type 8	3	1.2 X 0.55
Type 9	1	1.2 X 0.8
Type 10	3	0.65 X 0.5

Table 4.9 Pedestal Shuttering- WF3

PEDESTAL -SHUTTERING



4.14 REVIT- MODEL

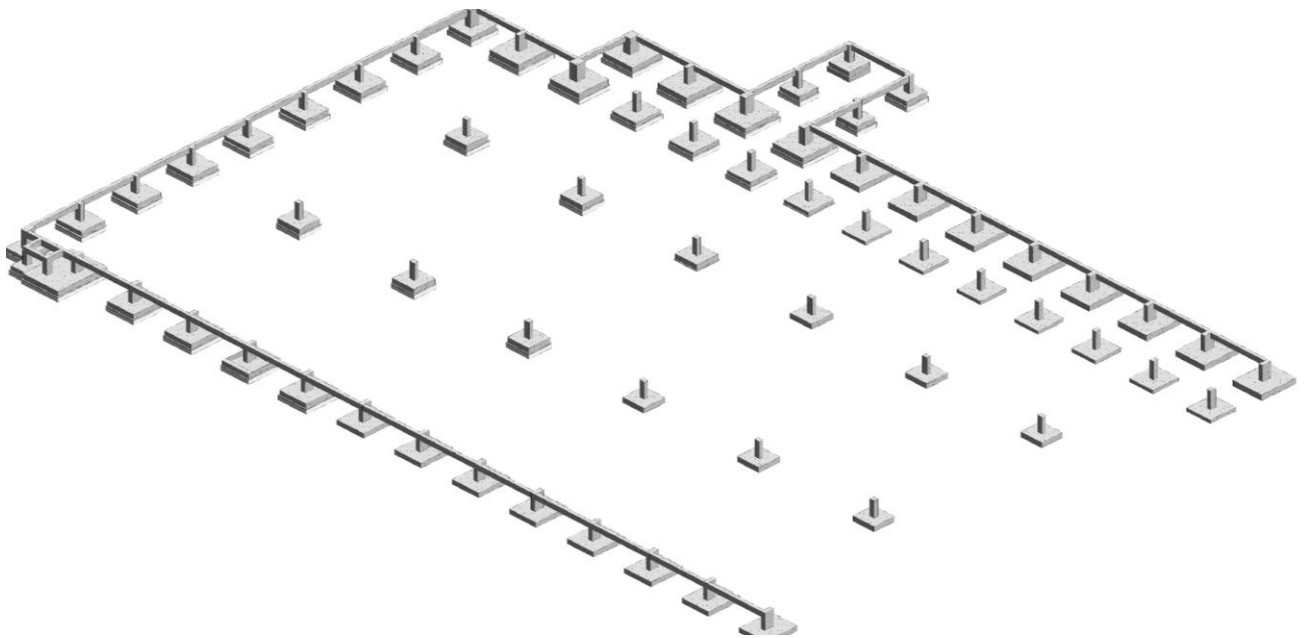


Figure 4.11 Workfront 1 & 2

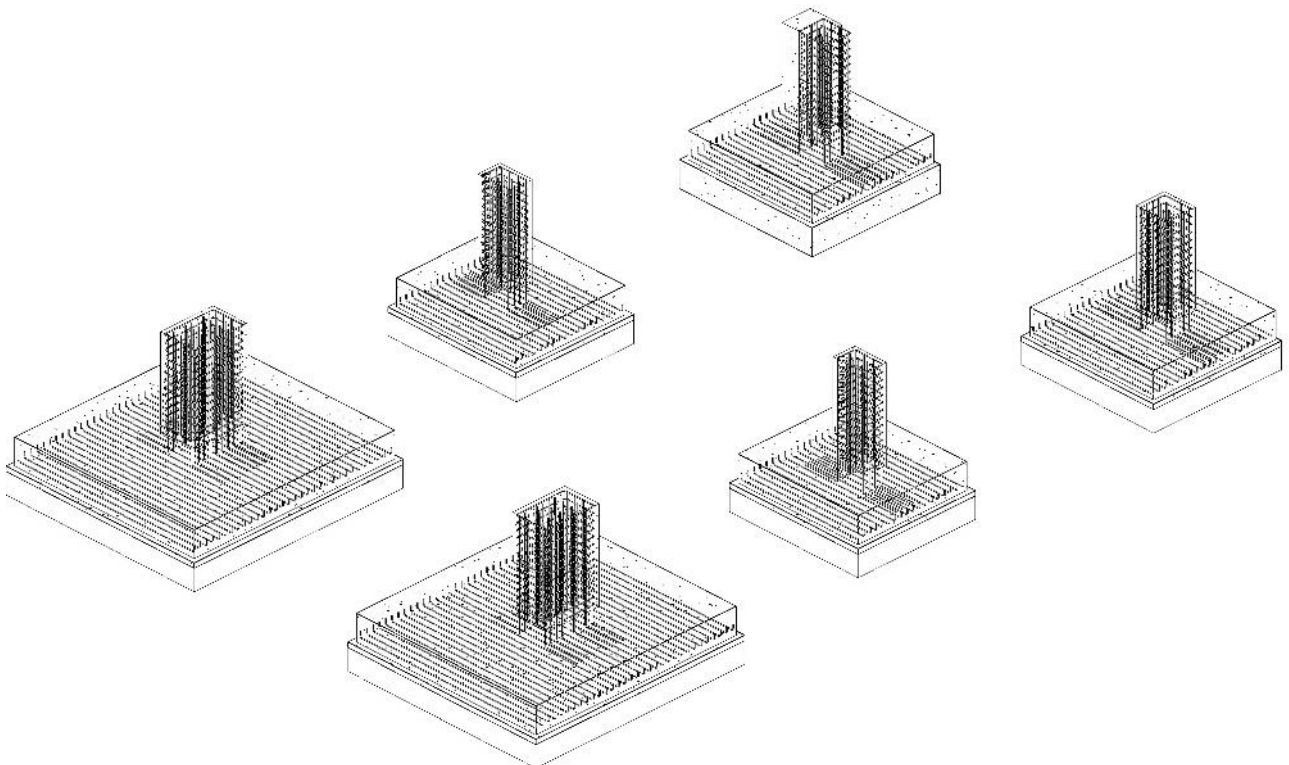


Figure 4.12 Footing & Pedestal Rebar

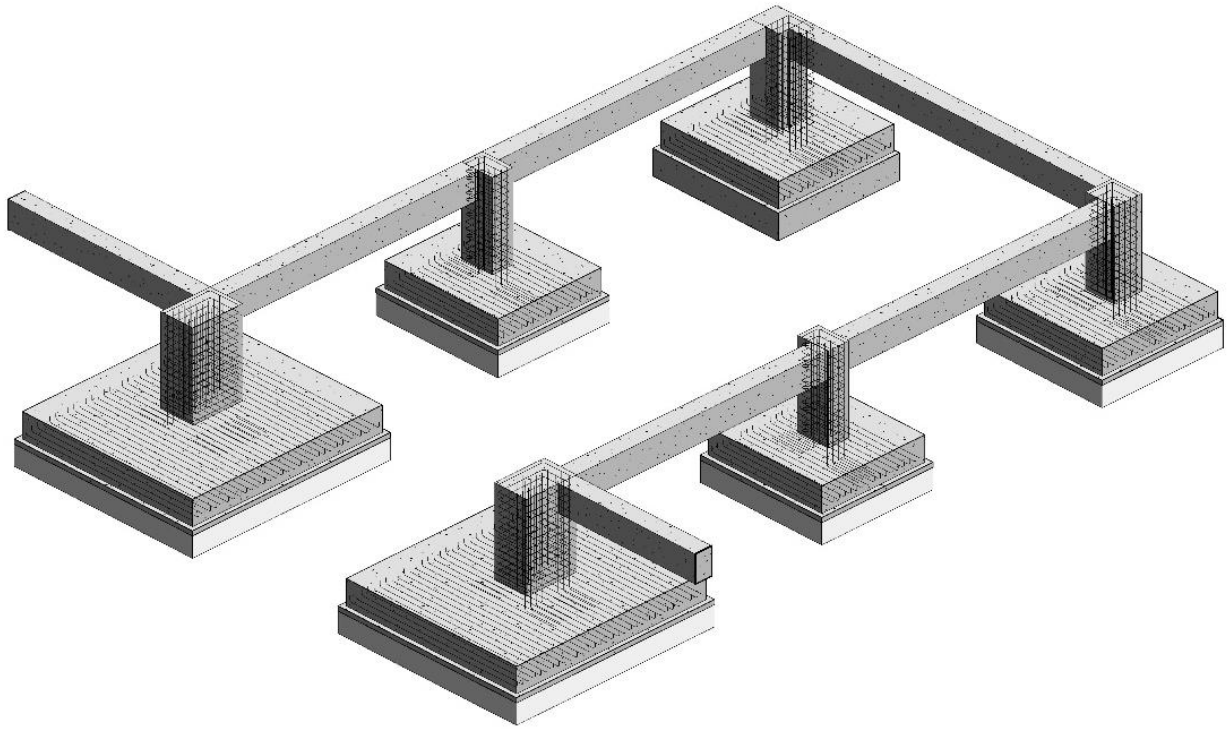
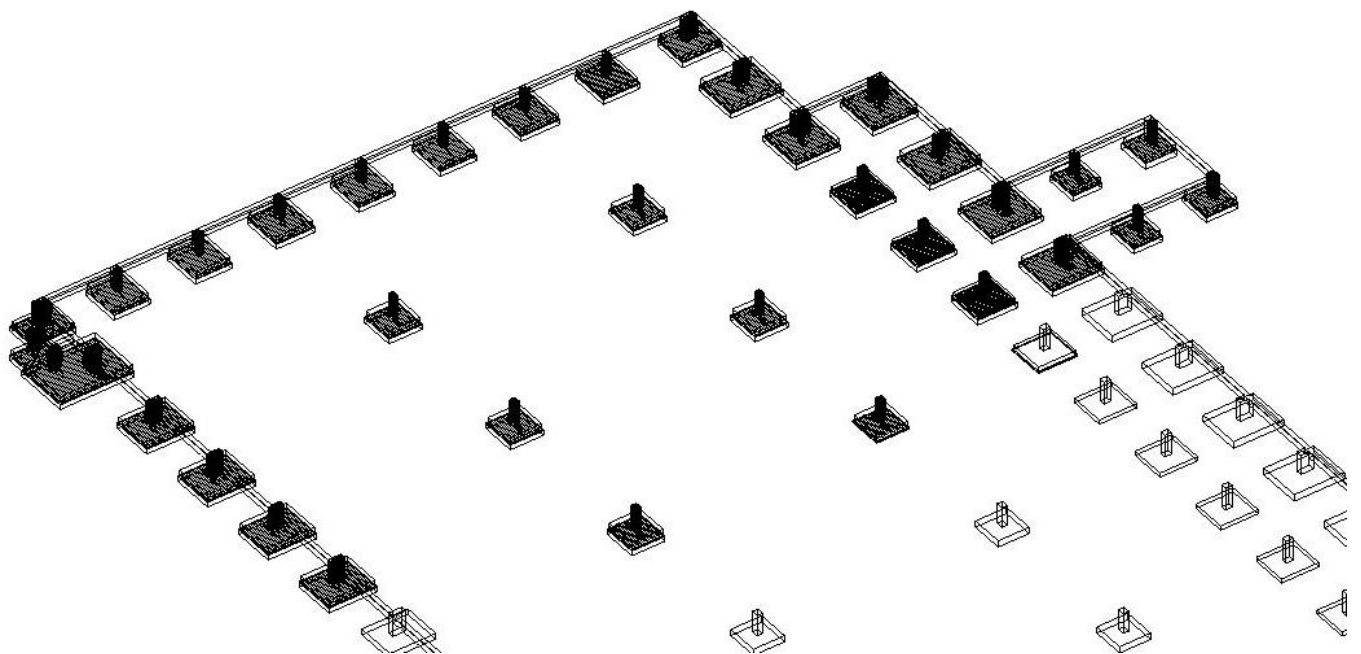


Figure 4.13 Soling, Pcc, Footing, pedestal, Grade Beam



4.15 LOCATION BASED TASK WORK FLOW

TASK ID	WORK FRONT	DURATION	START DATE	END DATE
A	SOLING			
1A	Work Front 1	3	23.01.21	25.01.21
2A	Work Front 1	3	26.01.21	28.01.21
3A	Work Front 1	3	29.01.21	31.01.21
4A	Work Front 1 & 2	3	01.02.21	03.02.21
5A	Work Front 2	3	04.02.21	06.02.21
6A	Work Front 1	3	07.02.21	09.02.21
7A	Work Front 2 & 3	3	10.02.21	12.02.21
8A	Work Front 3	3	13.02.21	15.02.21
9A	Work Front 3	3	16.02.21	18.02.21
10A	Work Front 1	3	19.02.21	21.02.21
11A	Work Front 1 & 2	3	22.02.21	24.02.21
12A	Work Front 1 & 2	3	25.02.21	27.02.21
13A	Work Front 2 & 3	3	28.02.21	02.03.21
14A	Work Front 3	2	03.03.21	04.03.21
15A	Work Front 3	2	05.03.21	06.03.21
16A	Work Front 2 & 3	2	07.03.21	08.03.21
17A	Work Front 2	2	09.03.21	10.03.21
18A	Work Front 2 & 3	2	11.03.21	12.03.21
19A	Work Front 2 & 3	2	13.03.21	14.03.21

Table 4.10 Soling

TASK ID	WORK FRONT	DURATION	START DATE	END DATE
B	PCC			
1B	Work Front 1	2	25.01.21	26.01.21
2B	Work Front 1	2	27.01.21	28.01.21
3B	Work Front 1	3	29.01.21	31.01.21
4B	Work Front 1 & 2	3	01.02.21	03.02.21
5B	Work Front 2	3	04.02.21	06.02.21
6B	Work Front 1	3	07.02.21	09.02.21
7B	Work Front 2 & 3	3	10.02.21	12.02.21
8B	Work Front 3	3	13.02.21	15.02.21
9B	Work Front 3	3	16.02.21	18.02.21
10B	Work Front 1	3	19.02.21	21.02.21
11B	Work Front 1 & 2	3	22.02.21	24.02.21
12B	Work Front 1 & 2	3	25.02.21	27.02.21
13B	Work Front 2 & 3	3	28.02.21	02.03.21
14B	Work Front 3	2	03.03.21	04.03.21
15B	Work Front 3	2	05.03.21	06.03.21
16B	Work Front 2 & 3	2	07.03.21	08.03.21
17B	Work Front 2	2	09.03.21	10.03.21
18B	Work Front 2 & 3	2	11.03.21	12.03.21
19B	Work Front 2 & 3	2	13.03.21	14.03.21

Table 4.11 Pcc

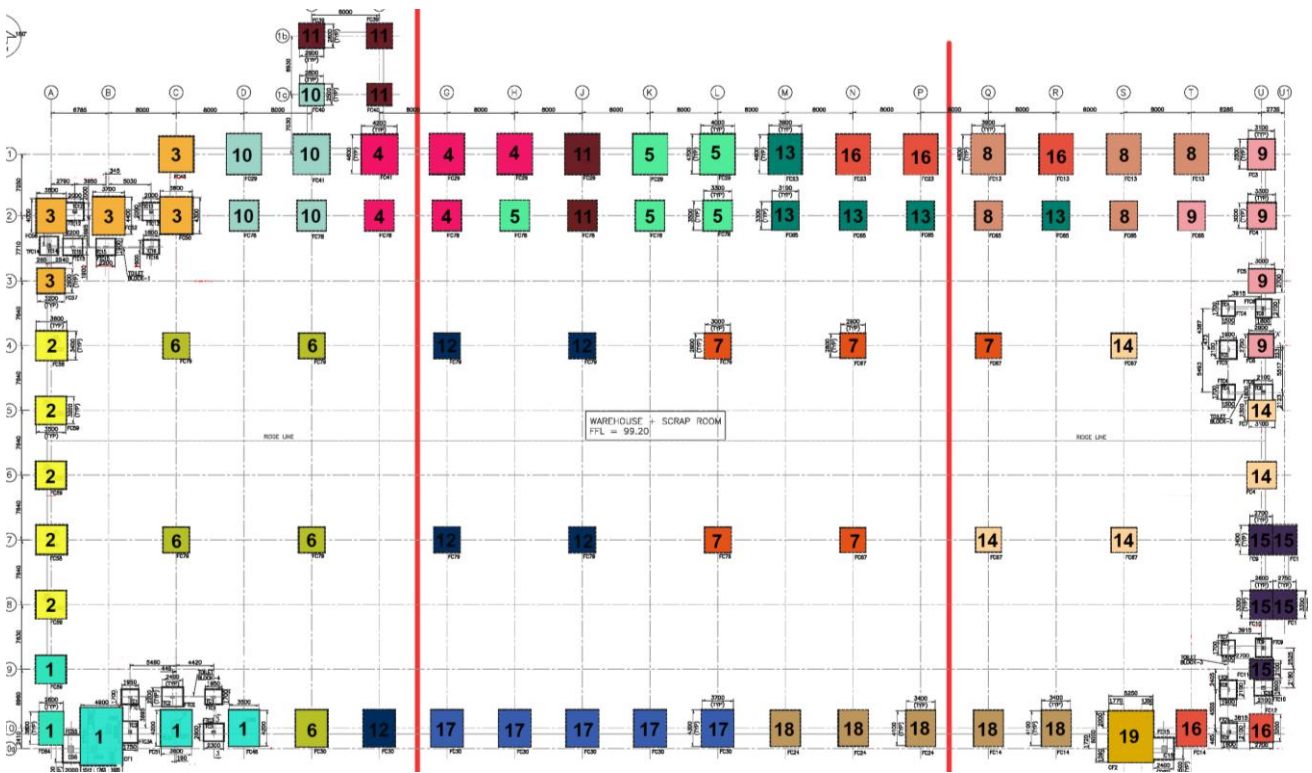


Figure 4.14 Location based tasks

TASK ID	WORK FRONT	DURATION	START DATE	END DATE
C	FOOTING SHUTTERING & CONCRETING			
1C	Work Front 1	3	27.01.21	29.01.21
2C	Work Front 1	3	30.01.21	01.02.21
3C	Work Front 1	3	02.02.21	04.02.21
4C	Work Front 1 & 2	3	05.02.21	07.02.21
5C	Work Front 2	3	08.02.21	10.02.21
6C	Work Front 1	3	11.02.21	13.02.21
7C	Work Front 2 & 3	3	14.02.21	16.02.21
8C	Work Front 3	3	17.02.21	19.02.21
9C	Work Front 3	3	20.02.21	22.02.21
10C	Work Front 1	3	23.02.21	25.02.21
11C	Work Front 1 & 2	3	26.02.21	28.02.21
12C	Work Front 1 & 2	3	01.03.21	03.03.21
13C	Work Front 2 & 3	3	04.03.21	06.03.21
14C	Work Front 3	2	07.03.21	08.03.21
15C	Work Front 3	2	09.03.21	10.03.21
16C	Work Front 2 & 3	2	11.03.21	12.03.21
17C	Work Front 2	2	13.03.21	14.03.21
18C	Work Front 2 & 3	2	15.03.21	16.03.21
19C	Work Front 2 & 3	2	17.03.21	18.03.21

Table 4.12 Footing Shuttering & Concreting

TASK ID	WORK FRONT	DURATION	START DATE	END DATE
D	PEDESTAL SHUTTERING & CONCRETING			
1D	Work Front 1	3	02.02.21	04.02.21
2D	Work Front 1	3	05.02.21	07.02.21
3D	Work Front 1	3	08.02.21	10.02.21
4D	Work Front 1 & 2	3	11.02.21	13.02.21
5D	Work Front 2	3	14.02.21	16.02.21
6D	Work Front 1	3	17.02.21	19.02.21
7D	Work Front 2 & 3	3	20.02.21	22.02.21
8D	Work Front 3	3	23.02.21	25.02.21
9D	Work Front 3	3	26.02.21	28.02.21
10D	Work Front 1	3	01.03.21	03.03.21
11D	Work Front 1 & 2	3	04.03.21	06.03.21
12D	Work Front 1 & 2	3	07.03.21	09.03.21
13D	Work Front 2 & 3	3	10.03.21	12.03.21
14D	Work Front 3	3	13.03.21	15.03.21
15D	Work Front 3	3	16.03.21	18.03.21
16D	Work Front 2 & 3	3	19.03.21	21.03.21
17D	Work Front 2	2	22.03.21	23.03.21
18D	Work Front 2 & 3	2	24.03.21	25.03.21
19D	Work Front 2 & 3	2	26.03.21	27.03.21

Table 4.13 Pedestal Shuttering & Concreting

TASK ID	WORK FRONT	DURATION	START DATE	END DATE
E	GRADE BEAM SHUTTERING & CONCRETING			
1E	Work Front 1	2	28.02.21	01.03.21
2E	Work Front 1	2	02.03.21	03.03.21
3E	Work Front 1	2	04.03.21	05.03.21
4E	Work Front 1 & 2	2	06.03.21	07.03.21
5E	Work Front 2	2	08.03.21	09.03.21
6E	Work Front 1	2	10.03.21	11.03.21
7E	Work Front 2 & 3	2	12.03.21	13.03.21
8E	Work Front 3	1	14.03.21	14.03.21
9E	Work Front 3	1	15.03.21	15.03.21
10E	Work Front 1	1	16.03.21	16.03.21
11E	Work Front 1 & 2	1	17.03.21	17.03.21
12E	Work Front 1 & 2	1	18.03.21	18.03.21
13E	Work Front 2 & 3	1	19.03.21	19.03.21
14E	Work Front 3	1	20.03.21	20.03.21
15E	Work Front 3	1	21.03.21	21.03.21
16E	Work Front 2 & 3	1	22.03.21	22.03.21
17E	Work Front 2	1	23.03.21	23.03.21
18E	Work Front 2 & 3	1	24.03.21	24.03.21
19E	Work Front 2 & 3	1	25.03.21	25.03.21

Table 4.14 Grade Beam Shuttering & Concreting

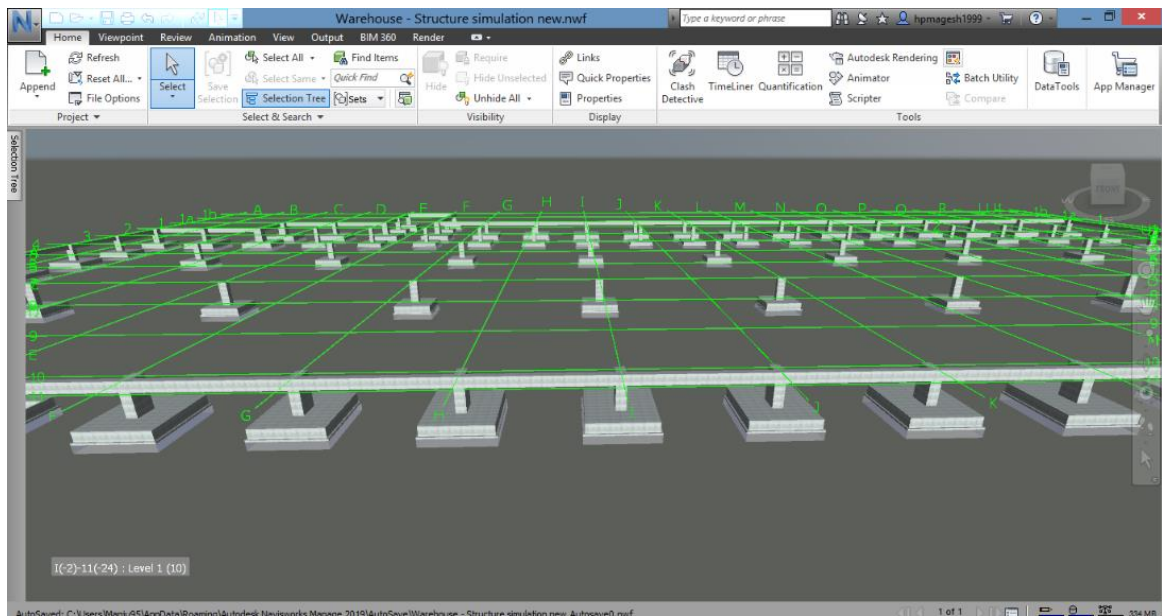
ANALYSIS & RESULT

5.1 REVIT AND NAVISWORKS- WORK FLOW

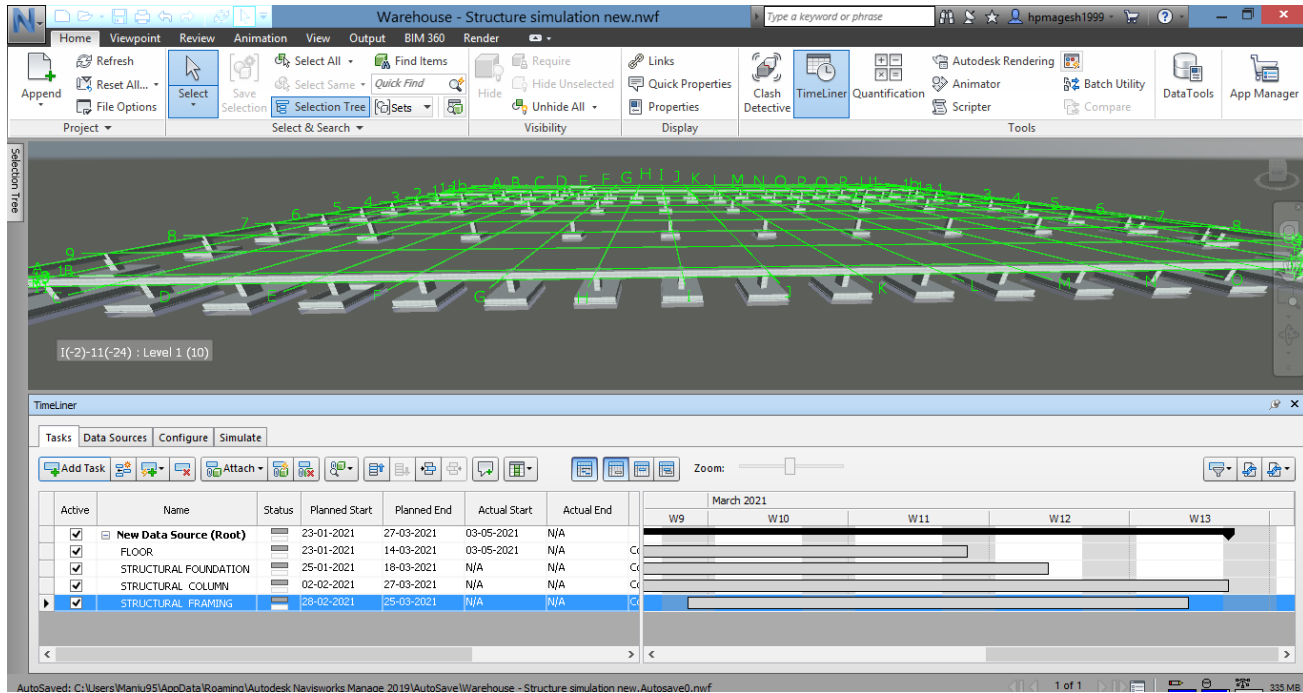
- To perform a 4D simulation of a construction sequence a 3d model should be created first and schedule should be added to it.



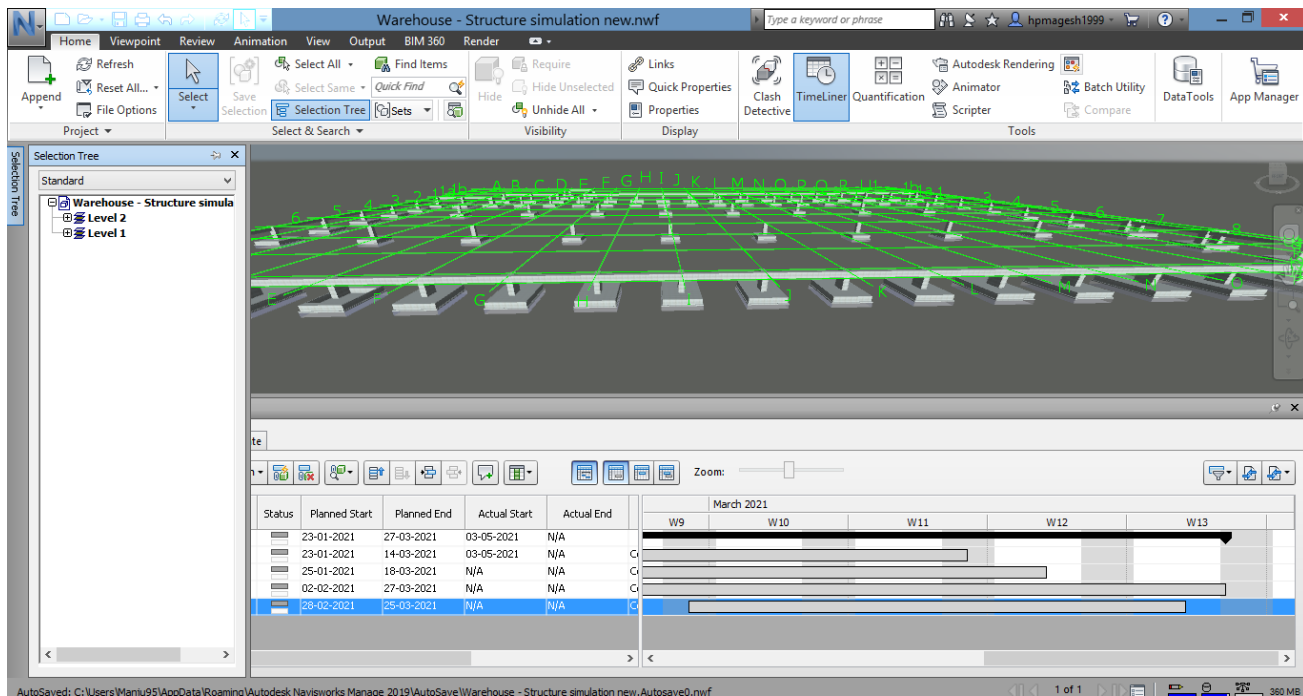
- Revit 2018 is used to create 3D model, Structural template is selected, to develop a model create grids and levels for sub structure.
- Assign task id for each location of works. Once the 3D model is completed. It should be saved in rvt, rfa, rtc format, so that It can be exported to Navisworks manage.
- Using the Timeliner in Navisworks prepare a schedule for the project developed in week for task start date and end date and simulate the task completion as a visual simulation. Record it and save the timeline simulation to Navisworks.
- Open Navisworks, import 3d model and upload scheduling which was created in Ms office.
- Click on Timeliner tool from home menu, now Timeliner dialog box appears



- Select the components by clicking on the selection tree and added them to the Timeliner.

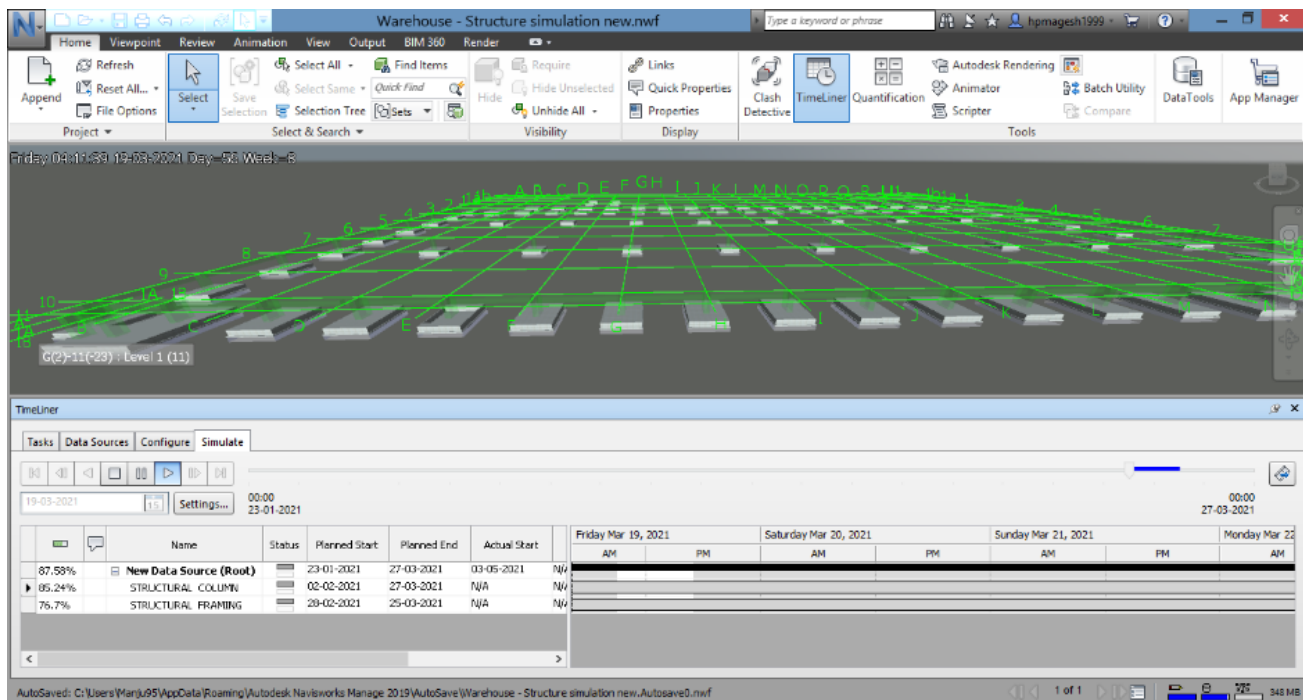
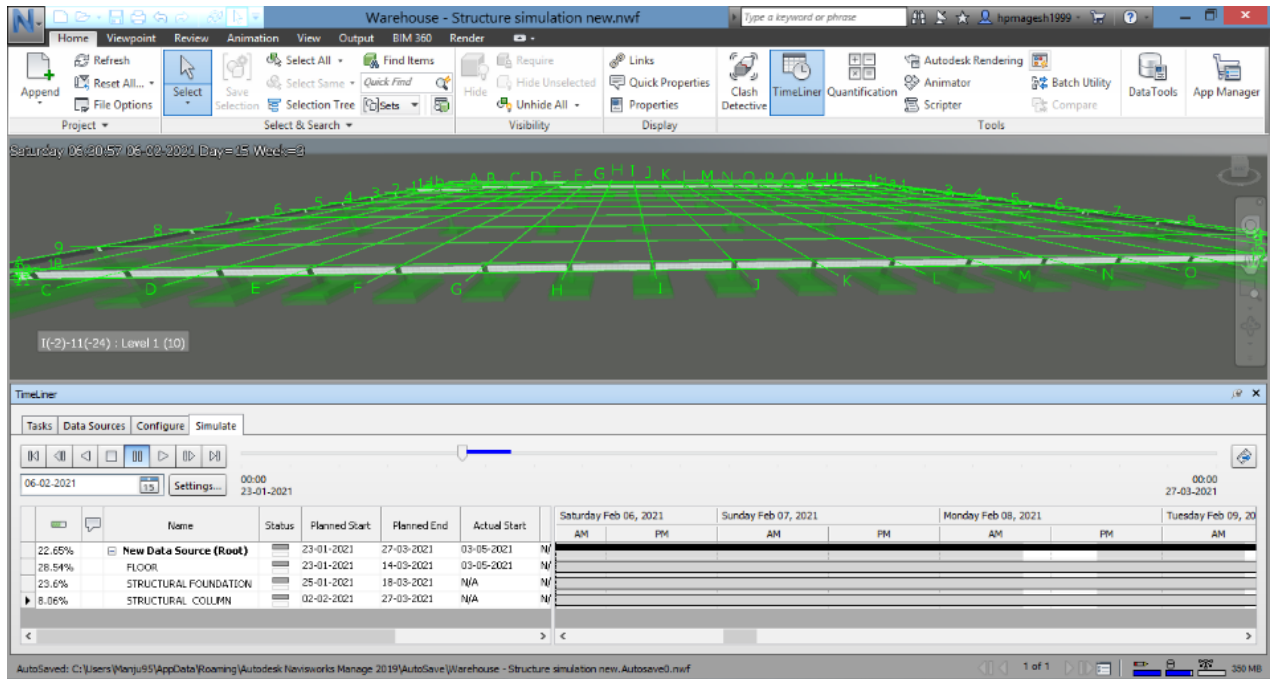


- Click on add task to add the first work in the project, add actual and planned start and end date, and select the task type for construction.

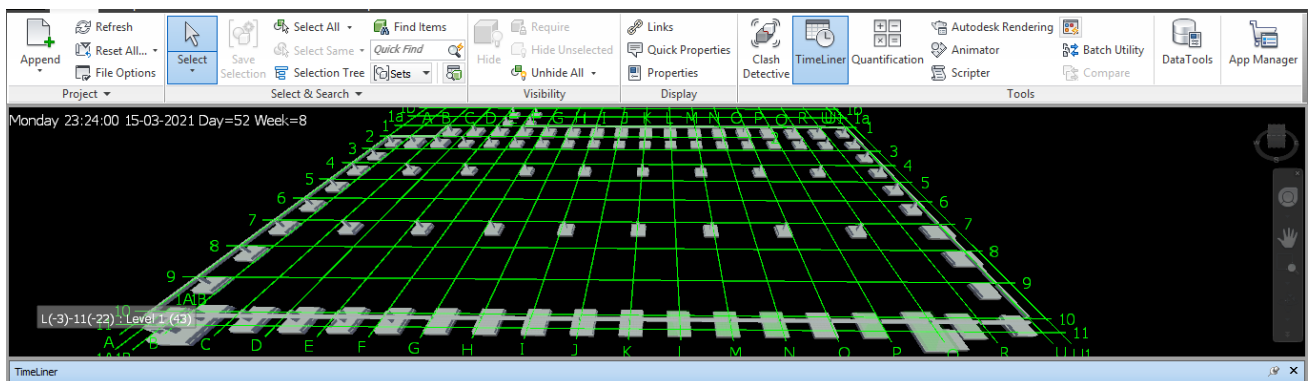
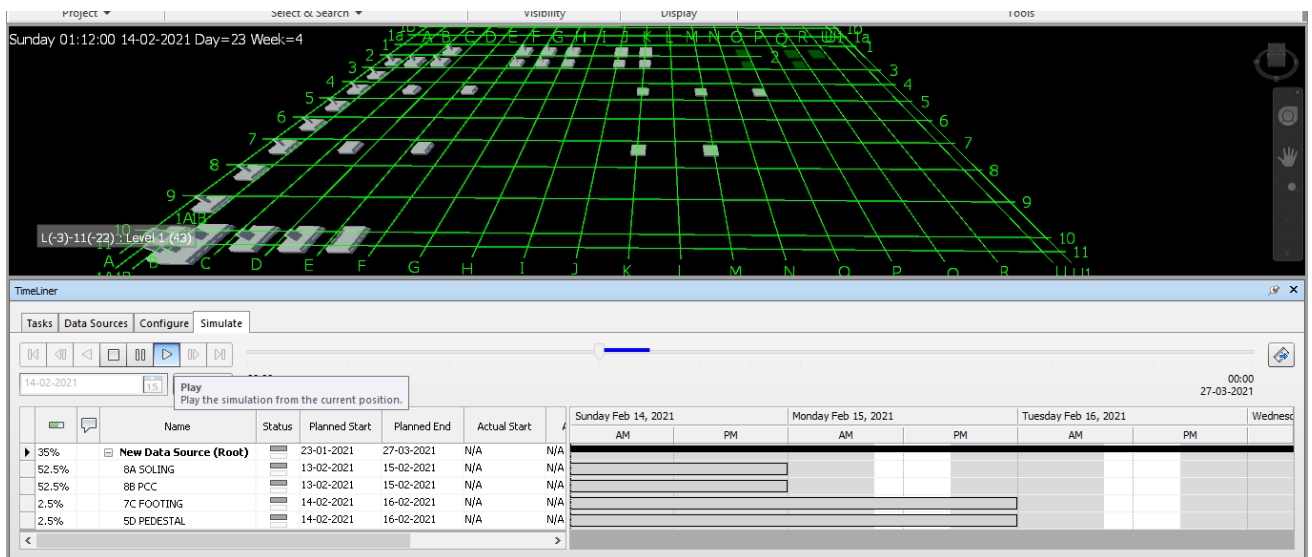
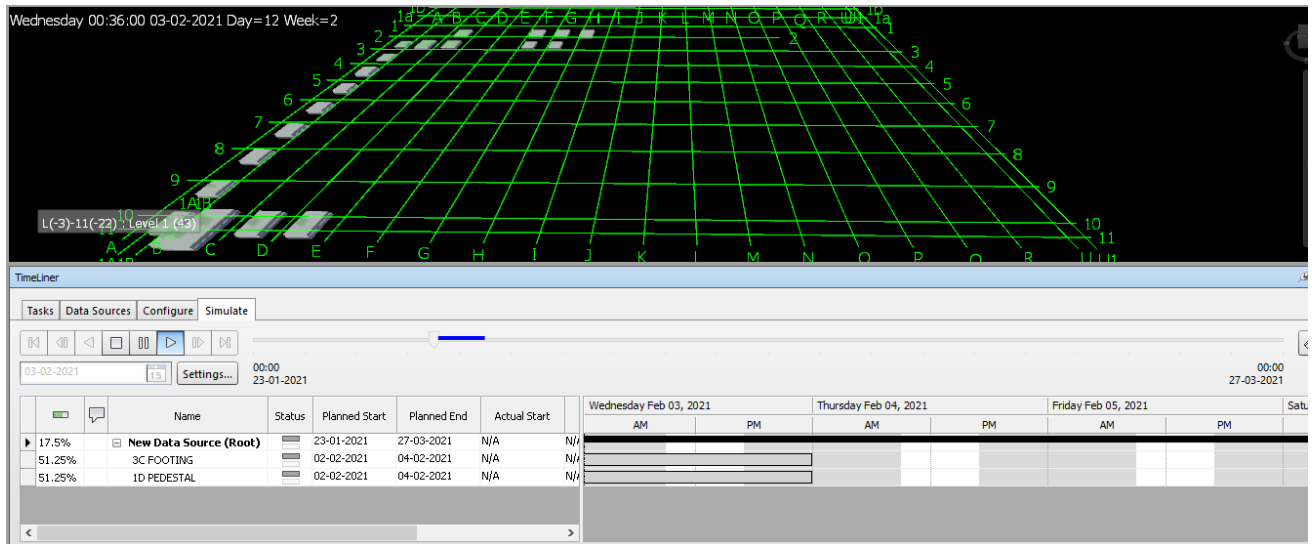


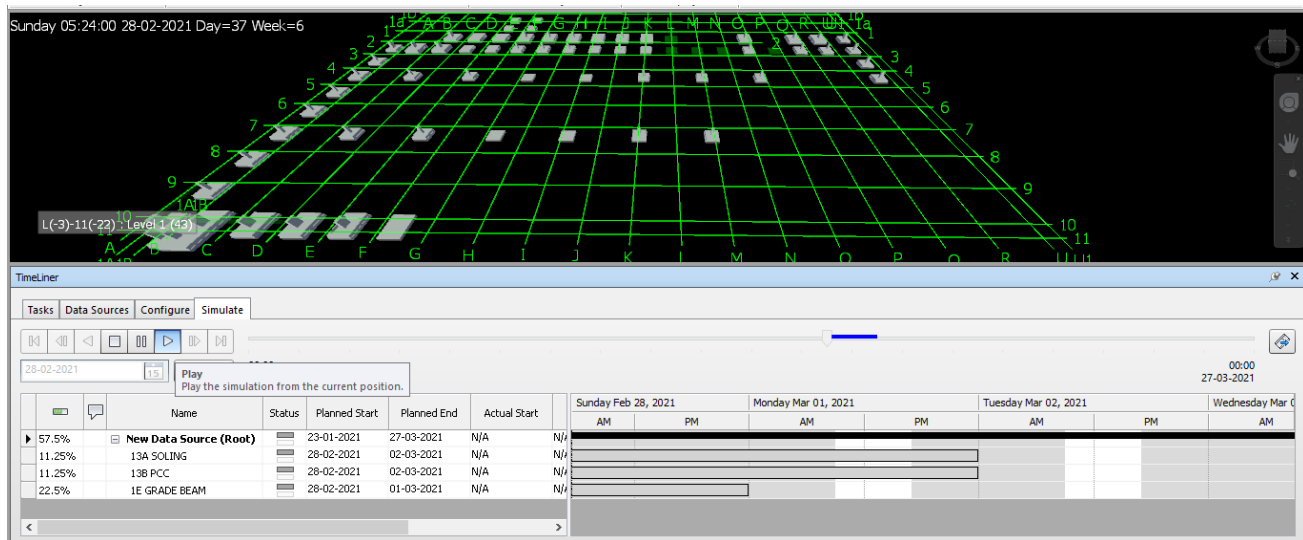
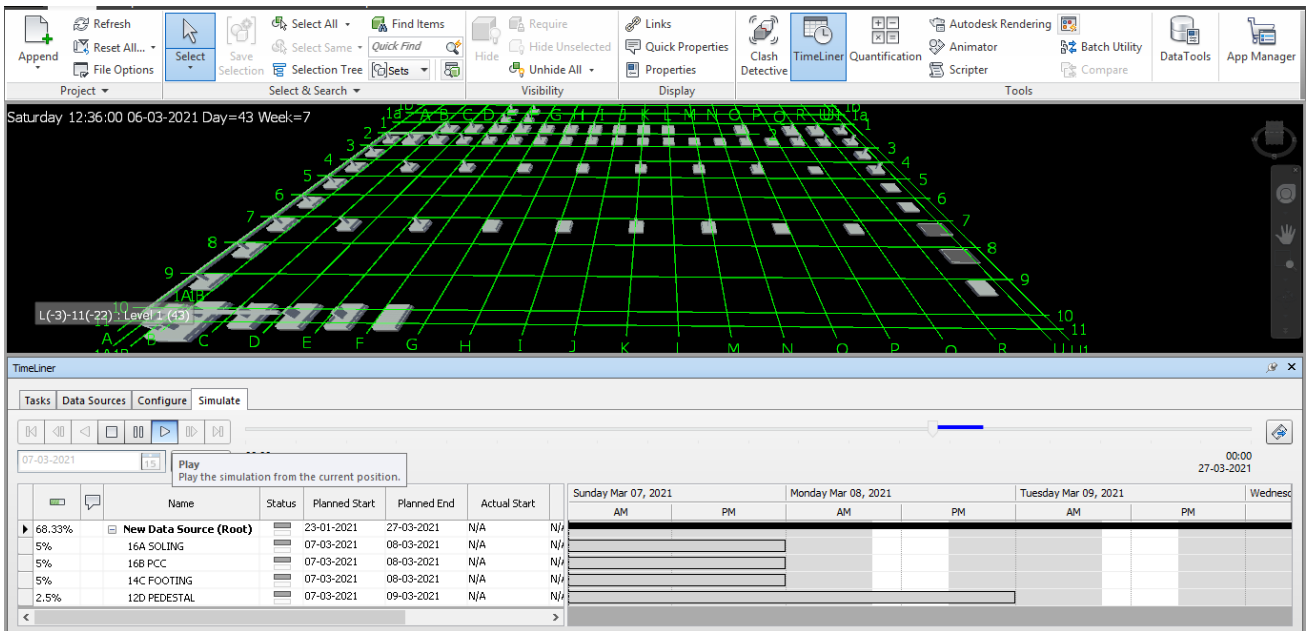
- Select the task and click on attach, the task will be assigned. This process is done for all the tasks. Once model and tasks are linked, click simulate option.

- The simulation begins and we can see the construction from the start date to end date in the form of video.



5.2 LOCATION BASED NAVISWORKS – TIMELINER





CONCLUSION

6.1 SWOT ANALYSIS

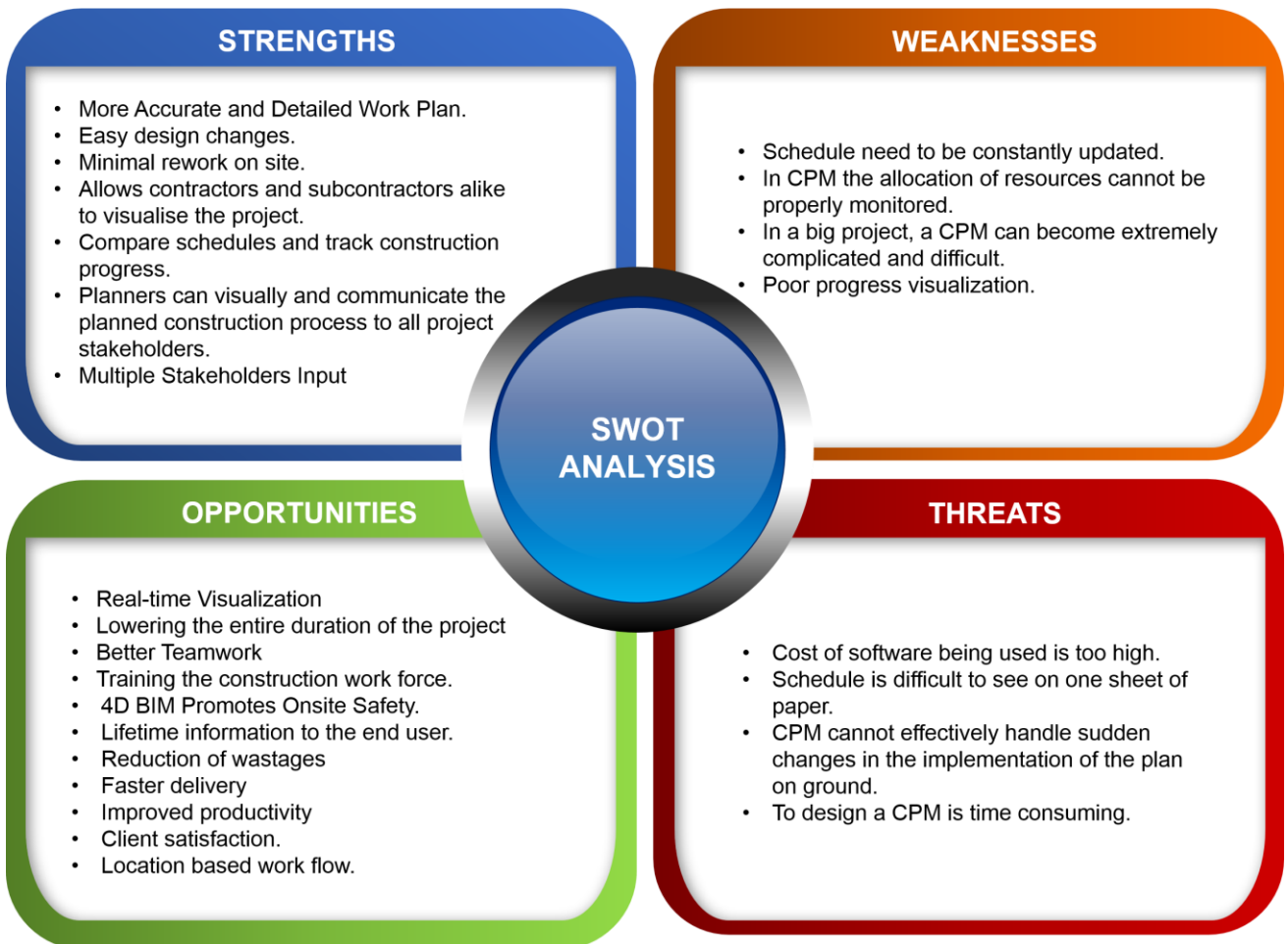


Figure 6.1 Swot Analysis

6.2 CONCLUSION

This study examined the effectiveness of resource management utilizing a location-based building information modelling system, citing 4d modelling (Navisworks) as a promising tool that displays each site workflows based on task allocation, allowing workers to quickly determine which job to begin next after it is completed. Navisworks assists planners and project teams in achieving efficient construction work planning.

BIM is used throughout the construction process, including the planning, design, execution, monitoring, and maintenance phases. Construction schedules aren't well-known in the building sector because of their intricacy and inability to be physically seen before construction begins. This Navisworks is designed to help with pre-construction planning by displaying the construction process over time at regular intervals based on site workflow. In the construction business, BIM helps to realize integrated project delivery, which engages all individuals and stakeholders from the drawing board through the project's completion stage, resulting in better results and increasing the owner's value.

Navisworks has a number of advantages, including the ability to track the procurement status of project supplies, visualize time limitations, and reduce waste in ways that aren't achievable with traditional methods. Most affluent countries had previously embraced BIM, and it was now gaining traction in developing countries such as India and China. Construction businesses in India have been implementing BIM in recent years, and sooner or later, Building Information Modelling will play a vital role in construction projects.

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