Analysis and Design of High Rise Building Using Etab Software and BIM Technique to Differ the Cost of Building

[1]Mr.Niraj Avhale, Mr.Atik Mujawar, Mr.Pranad Khanzode, Mr.Yash Tidke
[2]Prof. Gauri Patil. Sinhgad Academy of Engineering, Kondhwa (Bk), Pune-48

Abstract*—one of the most promising advances in the architectural, engineering, and construction (AEC) industry is building information modelling (BIM). BIM technology creates a digitally created exact virtual representation of a building. When finished, the computer-generated model will include precise geometry and important data to help the building's construction, manufacturing, and procurement activities. BIM also accommodates many of the tasks required to model a building's lifecycle, laying the groundwork for new construction capabilities as well as changes in project team responsibilities and relationships. When used correctly, BIM allows for a more integrated design and construction process, resulting in higher-quality buildings at cheaper costs and shorter project timelines. This chapter opens with a discussion of current construction processes, as well as the inefficiencies that these practices entail. It then goes on to describe the technology underlying BIM as well as how to effectively take use of the new business processes it offers throughout a building's whole lifecycle. It finishes with a discussion of the numerous issues that may arise while transitioning to BIM technology.

Index Terms*—Refractory Casting Cement Waste, Partial Replacement, Aggregate, Concrete, Sustainability, Waste Management, Mechanical Properties, Durability.

I. INTRODUCTION

BIM (Building Information Modeling) is a relatively new technology in the Architecture, Engineering, and Construction (AEC) industries around the world. In the construction sector, each project is unique, and each project is completed on time and on budget. BIM technology provides users with precise and consistent building data, as well as the functionalities required to model the structure and a virtual picture of the building model. From the beginning to the end of the project, the overall planning, control, and coordination strives to meet the needs of the clients and ensure that the project is completed on time and within budget. Owners, Designers, Contractors, and Engineers all use Building Information Models during the project lifecycle.

A BIM is distinct from a 3D model in that it is object-oriented. This indicates that the models have been placed in the digital realm and are related to one another. A 3D model of a building that creates a graphic representation of the structure but is not as intelligent as a BIM; material, weight, colour, temperature tolerance, unit cost, and assembly time are all examples of intelligence that can be carried in BIM objects. A BIM can generate bills of quantities, time schedules, and cost estimates, according to theory. All papers generated from the BIM are affected by changes in the model.

Building Information Modeling is a shrewd model-based procedure that gives assistance to design, structure, develop, and oversee structures and foundation. BIM gives knowledge to singular structure parts (for example windows, dividers or chillers) just as giving framework and building-wide data and mindfulness (framework streams or building loads).

One of the most typical issues with paper-based communication throughout the design process is the significant time and cost involved in generating critical evaluation information about a proposed design, such as cost estimates, energy-use analysis, structural details, and so on. These evaluations are usually carried out last, when it is too late to make significant adjustments. Because these incremental improvements do not occur during the design phase, value engineering must be used to correct discrepancies, which frequently leads to cost overruns violates the design's original intent

Design and building in virtual reality (VDC) Because they show computer-based descriptions of the project, BIMs are virtual. The BIM project model emphasizes those aspects of the project that can be designed and managed, such as the product (typically a building or plant [and infrastructure]), the organization that will define, design, construct, and operate it, and the POP (product-organization-process) that the organization teams will follow. These models are logically integrated in that they can all access shared data, and if a user highlights or changes a feature of one, the integrated models can highlight or alter dependent parts of related models. In the sense that they reflect the architect, engineering, construction (AEC), and owner of the object, as well as important sub-disciplines, the models are multi-disciplinary.

The models are performance models in that they can forecast certain aspects of project performance, track many that are important, and illustrate projected and measured performance in accordance to specified project performance objectives. Some organizations are now implementing the first steps of BIM modelling, and they have repeatedly found that doing so improves their business performance." Companies are also considering developing BIMs in various levels of detail, because depending on the use of BIM, more or less detail is required, and constructing building information models at various degrees of complexity requires varying modelling work. Necessity of Building Information Modelling

Better Collaboration and Communication

Advanced BIM models consider sharing, working together, and forming that paper drawing sets don't. With cloud-based instruments, for example, Autodesk's BIM, BIM cooperation can happen over all orders inside the undertaking. The BIM biological system permits groups to share venture models and facilitate arranging, guaranteeing all plan partners have knowledge into the undertaking.

Model-Based Cost Estimation

Numerous Architecture, Engineering and Construction firms understand that incorporating estimator's prior in the arranging stage takes into account progressively compelling development cost estimation, which has prompted the development of model-based expense evaluating. Utilizing BIM instruments, for example, Autodesk's Revit computerizes the tedious undertaking of evaluating and applying costs, permitting estimators to concentrate on higher worth components, for example, distinguishing development congregations and calculating dangers.

Preconstruction Project Visualization

By utilizing BIM, one can design and envision the whole undertaking during preconstruction, before the scoop hits the ground. Space-use reenactments and 3D perceptions permit customers to encounter what the space will resemble offering the capacity to make changes before development start. Having a more prominent diagram from the earliest starting point limits costly and tedious changes later.

Improved Coordination and Clash Detection

BIM permits to more readily facilitate exchanges and subcontractors, recognizing any MEP, inner, or outside Clashes before development starts. By keeping away from Clashes, decrease in the measure of adjust required is accomplished on some random activity. BIM gives the chance to design it directly before you construct nearby. Evading a minute ago changes and unexpected issues by empowering simple exploring and remarking over numerous controls.

Improved Scheduling/Sequencing

Similarly that a significant number of these advantages set aside cash, they spare time by decreasing the hour of task cycles and disposing of development plan mishaps. BIM permits plan and documentation to be done simultaneously, and for documentation to be effortlessly changed to adjust to new data, for

example, site conditions. Calendars can be arranged all the more precisely and conveyed precisely, and the improved coordination assists ventures with being bound to be finished on-schedule or early.

Expanded Productivity and Prefabrication
BIM information can be utilized to in a split second create creation drawings or databases for assembling purposes, taking into consideration expanded utilization of construction and particular development innovation. By planning, enumerating and fabricating offsite in a controlled domain, you can lessen squander, increment effectiveness, and diminish work and material costs.

Uses of BIM during Construction
Development Phase: During the development stage the observing, investigation and assessment of the undertaking plan are basic to the capacity of the CM to comprehend and decipher venture progress, current status, and pending timetable improvements. With 4D planning, this ability will be upgraded and refined according to the accompanying focuses.

LITERATURE REVIEW

Shrikant Bhuskade, Building Information Modelling (International research journal of engineering and technology), 2021
Shows that the Building Information Model are created, the amount takes off can be produced to give cost estimations on a development venture. BIM based 4D booking helps comprehension of the development parts and calendar progress than thus results better development arranging. At the end of the day, BIM gives time and cost reserve funds and yields better quality development items.
The research shows how BIM technology will benefit for Architect, Engineer and Contractors for estimating and schedule and cost controls. Autodesk Revit is BIM software for architects, structural engineers, MEP engineers, designers and contractors. It allows user to design a building and structure and it components in 3D, annotate the model with 2D drafting elements, and access the building information from the building models database.
The followings are the Findings from literature Review:
To study on-going rise of the BIM and the assessment of the virtual structure and development in the engineering, building and development industry are on a very basic level changing the procedure by which structures are planned and built. This information models can be utilized by different individuals from the plan group to organize the creation of the structure contrast frameworks. This has various points of interest in offsite development space including speed economy, maintainability and security.

Mejlaender-Larsen, “BIM to follow up milestones in a project plan”, WIT transactions on built environment, (2020)
This study assesses how object status in a BIM can be related to milestones in a project plan. The paper examines how a project plan can be connected to a BIM, focusing in the benefits and possibilities of adding status to objects in the BIM and how project progress can be reported and visualized using BIM. By defining control objects in the BIM and adding quality levels that measures status related to milestones, control objects can be connected to activities in the project plan. Status on each activity related to each milestone can be obtained directly from the BIM. This paper has presented control items and how the quality levels on this are characterized utilizing distinctive status definition. Right quality levels on each control object for each order to every achievement in the plan stage can be reached by satisfying significant agenda.
The followings are the Findings from literature Review:
A venture plan is made with number of exercises that ought to be estimated on the status line identified with achievement the exercises portray control object with important quality levels.
It will at that point be conceivable to follow how far orders have come. The emphasis isn't on the exercises that experience however on those to be finished.
Shows how every movement identifies with venture progress can be made. This is done on customary premise for the situation ventures.

Noor Akmal Adillah Ismail, Hazwani Ramli, Elma Dewiyana Ismail, Raja Rafidah Raja Muhammad Rooshdi, Shaza Rina Sahamir, and Nur HidayahIdris Science direct (2019)
This is a review work that mostly drew on established journal articles, conference papers, books, and other sources for its information. The main subject of Green

BIM includes previous studies to track the progress and current implementation of the Green BIM approach, Green BIM concepts that interpret the doctrine of green and sustainable design and construction, BIM fundamentals on its digitalized models to improve visualization and coordination in building design and construction, and the combination of both green sustainable building and BIM technology to intensify the processes and mechanization in building design and construction the process of development

Nam Bui, Christoph Merschbrock, Bjorn Erik "BIM for developing countries" JUNE 2019, Elsevier Ltd
They have highlighted increasing interest of developing countries in BIM. Amongst 135 developing countries which they have studied, BIM implantation studies were only reported in China, Malaysia, India which indicates research gap regarding other 132 developing countries. The followings are the Findings from literature Review:
They found that developing country firms view BIM as risk investment since its business value remains unclear. BIM should be bolstered by customers, temporary workers, Government in creating nations.
It prompts infer that more work is expected to grow new BIM arrangement that better location the setting of neighborhood development enterprises in creating nations.

E. Papadomikolaki, R. Vrijhoef, J.W.F. Wamelink "BIM based supply chain (SC) model for AEC" (WIT transactions on the built environment), (2019)
This paper proposes a model to integrate the construction supply chain through BIM. The various information flows in the construction SC are not cleared. BIM is an aspiring integrator of information that could potentially improve search multi-disciplinary information flows. The paper presents a method to bridge information gaps and integrate the team using BIM based SC modelling. The author studied that, BIM in support of the-

- Material flow
- Cash flow
- Information flow
- Stakeholder network.

The proposed multi model framework for SC integration identifies an analysis the organizational, operational and technical complexity and utilizes full potential of BIM technology and SCM theory, by using BIM as an information integrator and SCM as a trust in collaboration environment respectively. The building process data combine stakeholder's information and joins to a structured representation and analysis framework for the AEC SC.

A Anderson O. Akponeware and Zulfikar A. Adamu "In investigation into coordination problems in 3D BIM" IJRET August 2019
This paper investigates the root causes of clash avoidance as proposed in PAS 1992-2 design phase specification for UK. Empirical data from BIM coordinators around the world was collected and analyzed using explanatory sequential mixed method.
The current design practice and construction delivery has traditionally suffered from poor coordination and irregularities in the way that multi-disciplinary teams manage an exchange project life cycle data. Clashes have been categorized into hard clashes, soft clashes, and time clashes. These are most popular amongst several classifications of clashes in AEC industry.
It was found that-
Isolated working was the prime cause of high occurrences of clashes linked to mechanical, electrical and plumbing (MEP) 3D BIM systems.
There is a linked between non-BIM specific training of design practitioners with high incidence of clashes.
The creator built up a composite information and thinking structure which joined standard of estimation in the part of vital plan measure development issue and tasks and support prerequisites to distinguish and resolve various sorts of impedances in mechanical, building and plumbing framework.
The study has established a key fixing important to accomplishing conflict free 3D BIM models is to dishearten disengaged working.
It was discovered that the preparation and experience of creators is vital to the successful utilization of conflict locations innovations yet the equivalent could apply to any present or future innovation that help conflict evasion.

Edger Preto Berdeja, "Clash analysis in a BIM based design" WIT Transactions, 2018
The development of engineering design requires the participation of several parties involved in different disciplines, where each discipline conducts its own

project in a somewhat disconnected manner from remaining, therefore requiring project compatibility.
This paper presents study to evaluate the practical capabilities of the BIM concept in the Clash analysis between building services (mechanical, electrical and plumbing (MEP)).
To demonstrate the advantages of BIM in the conciliation and coordination between different agencies, as well as the benefits of its application in clash analysis in an engineering design.

Mr. Swapnesh P. Raut, Dr. S.S. Walunjkar "Improve the productivity of Building Construction Project using clash detection application in BIM" March 2018
The author surveyed that the productivity of construction industry has traditionally been much lower than that of other industries because the main reason for this shows to be the incapability of new technologies.
The major reason for not using BIM here is the lack of technical expertise. Author concluded that Indian construction industry is not applying the true potential of BIM tools. Indian AEC industry is not aware about BIM technology and its capacity.
He studied the survey which shows that only 22 percentage of respondent currently use BIM.

Bahriye Lihan, Hakan Yaman "BIM and sustainability in construction Projects: A case study", AUGUST 2018
The Author plans to inspect supportable development ventures for a setting up a sub structure to fill the hole of BIM combination with guidelines of feasible development by directing a contextual investigation, For a successful reaction to the examination destinations , the exploration procedure incorporates four primary advances :
Preparing the principle points to be talked about and the inquiries
Determining relating members to lead the contextual investigation and interview
Performing the fundamental meetings and information assortment,
Data examination and assessing the outcomes; the creator discovers the connection among BIM and maintainable development venture as the initial step of an utilitarian model for this combination by looking at the status of firms that complete reasonable activities in Turkey.
The consequences of the examination show that BIM isn't utilized altogether for supportable undertakings including all structure creation forms because of absence of distributed spending plan for proficient BIM use and qualified staff.

AIM
"To study clash detection and minimisation of project time and cost of a commercial building using BIM system"

OBJECTIVES

- To study Revit Software & Building Information modelling
- To find conflict between building services (MEP) by using BIM.
- To identify clashes that occurring during design & execution phases of commercial building.
- To reduce overall cost & time of project.
- To compare with or without clash detection by using BIM in commercial building.

PROBLEM STATEMENT

"To find out clashes occurring using BIM system, during designing phase and execution phase and reducing cost through scheduling for a commercial building in Pune region."

RESEARCH METHODOLOGY

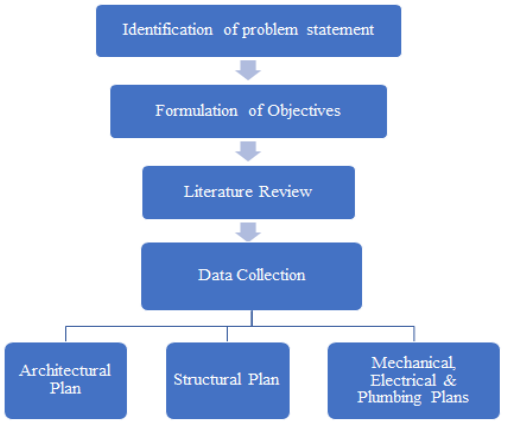


Figure1.1 Flow Chart of Methodology

➢ What is Building Information Modelling?

The process of creating and managing all the information about a project mostly associated with design and preconstruction, allows projects to be built

virtually before they are physically completed. Eliminating many of the inefficiencies and problems that arise during construction process

- Why BIM is used?

Before the BIM was introduced the construction process was carried out using conventional planning methods in which the coordination between the agencies was not made.

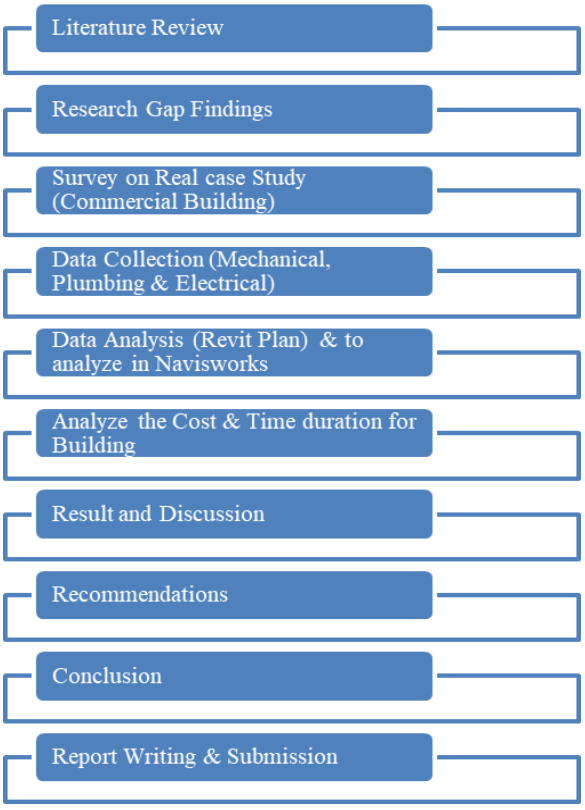
With BIM designers create digital 3D model that include data associated with physical and functional characteristics. Thus giving everyone better insight into how their work fit into overall project ultimately helping them to work more efficiently

The following flowchart explains the sequences of creating the 4D model.

Scope of the project work

- To provide 5D representation of the building for better understanding.
- To decrease in rework by bringing out proper coordination which results in reduction of cost and time
- To provide simplified and standardize solution for clash detection process

Proposed Process Design



Determination of the site

- ✓ The assortment of the information with the end goal of the task is completed for making a 3D model.
- ✓ Business working in the Pune district is the location to be chosen.
- ✓ To accomplish the destinations of the undertaking; the information from the locales is gathered which have the accessibility the accompanying plans:
  - Architectural Plan
  - Structural Plan
  - Mechanical, Electrical and Plumbing Plans
  - Analysis in Navisworks

The site is chosen based on mechanical arrangements that is Ducting, electrical and plumbing. Each part of the MEP necessity ought to be present.

DATA COLLECTION

Autodesk Revit Architecture 2014:

It is a BIM design tool for architects, structural engineer, MEP engineers, designer, and contractor. Autodesk Revit Architecture can capture the design concept and provide the virtual view of the building design. It allows the users to design a building, structure and its components in 3D view. If we have 2D Auto CAD plan we can import the 2D plan in Revit software. It annotate the model with 2D drafting elements, and access BIM from the models database. It is capable with 4D BIM tools to plan and track various stages in building lifecycle from construction to demolition

Revit is used as very powerful tool between different disciplines in the building design. The different disciplines that use this approach the program from perspective. Each of these perspectives is focused on completing disciplines task. Companies that adopt the software first examine the existing work flow process to determine if such elaborate tool is required. Revit allows user to manipulate whole building or 3D shapes in family editor. Modeling tool is used with pre made solid objects or imported geometric model. There are many categories of objects which are divided in three groups

Microsoft Office Project 2013

Microsoft Office Project 2007 is the project management software used for construction planning. It is used for the time schedules in the project. It

defines the activities, duration and sequential relationship. The final schedules have been imported in Autodesk Navisworks Manage in order to create the 4D model.

AUTOCAD 2017

CAD (Computer Aided Design) is a tool that can be used for drafting activities. Since it uses the computing power of a processor, CAD drawings are faster, better and more accurate than their manually drafted counterparts.

Currently AUTOCAD is for a few different things. Depending on the scale and the complexity of MEP flow diagrams and one-line diagrams, CAD uses to develop and manage them. BIM template has views set up for legends for all of fittings.

Anytime old detail will convert it to Revit and change all the line types and clean it up. Then it will be put into Revit details library file, archiving the old CAD detail. So, it is still being used to bring in details until ending up is done by going through them all. CAD is used extensively in BIM process but as for MEP and Architecture, it gets farther and farther away from it with each release of Building Design Systems as they add features that reduce the need for CAD."

Revit Architecture and MEP 2017

Revit is database structure and object definition modelling; is effective modelling software the preferable work practice is of course when all the modelling is performed internally within Revit. In order to satisfy the specific needs of the diverse types of specialist for Revit, Autodesk distributed the product into three types – Revit Architecture, Revit Structure and Revit MEP. Revit software gives clash detection abilities where objects clashes with each other are highlighted for improvement. This capability is however, limited in that it does not develop report; trace Clashes, Status Clashes, Set Rules, Custom Clash Test, and Clearance Tests, Time Based Clashing or track changes.

Autodesk Navisworks Manage 2014: Navisworks is a 3D design review uses primarily in the construction industries to implement 3D design. Naviswork allow users to open and compliment 3D models, navigate them within time and review the models using a set of tools including rendering, comments, viewpoint and measurements. A selection of plug-in enhance to the package adding interference finding, renderings, 4D time simulation, and pdf publishing. A project review software that supports intelligent 3D model-based designs with, collaboration, visualization and scheduling tools.

The Autodesk Navisworks product provides three different versions:

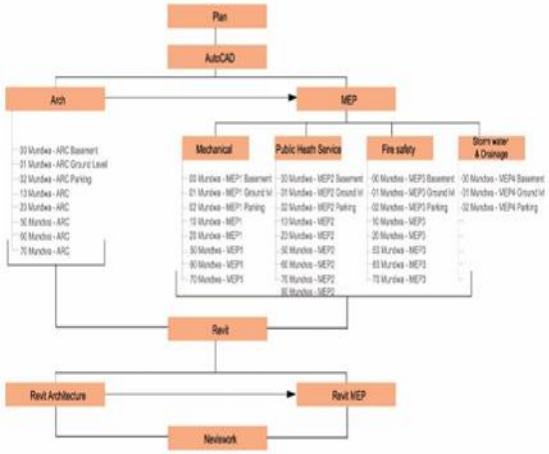
(1) Autodesk Navisworks Freedom,

(2) Autodesk Navisworks Simulate and

(3) Autodesk Navisworks Manage. This version is used to implement the practical part is Autodesk Navisworks Manage 2014. It includes all features of the Simulate version and it can be enough for 4D BIM purposes. Autodesk Navisworks Manage 2014 is BIM design review tool with 4D BIM capabilities to the integration of Timelier function. It is having other useful functions, such as, clash detection for project coordination.

Navisworks is not conceiving to provide the opportunity to modify a model, coordination and simulation tool. The Time-liner function in Navisworks is mostly used in projects. It is having a built-in scheduling application to manage tasks, although it has mentioned a more powerful tool.

Flowchart of the workflow of software's used for creating the BIM Model to bring out the clash detection in the office building



Building Services of the commercial building

This case study consists of following Building Services system of the workspace:

A. Mechanical Ventilation System
B. Public Health Engineering Systems:
   - ✓ Domestic System
   - ✓ Drainage System
   - ✓ Sanitary Fixtures

C. Fire protection System

Clash Detection

1. Clash detection is a component of the Building Information Modelling (BIM) process and is the realization of conflicts or clashes, whether structural or MEP, through an automated and computerized approach.
2. Clash detection can be carried out on multiple 3D models and is an invaluable tool for designers, architects, builders, engineers and contractors to determine clashes or conflicts in the structures.
3. Clash detection is used for checking completed/ongoing work and reduces the risk of human error during model inspection.

Type of Clashes

1. Hard Clash - When two objects pass through each other. Most BIM modelling software eliminates the likelihood for this using clash detection rules based on embedded object data.
2. Soft Clash - Work to detect clashes which occur when objects encroach into geometric tolerances for other objects (for example, a building being modeled too close to a high tension wire).
3. 4D/Workflow Clash- Clash resolves scheduling clashes and abnormalities as well as delivery clashes (for example, work crews arriving when there is no equipment on site)

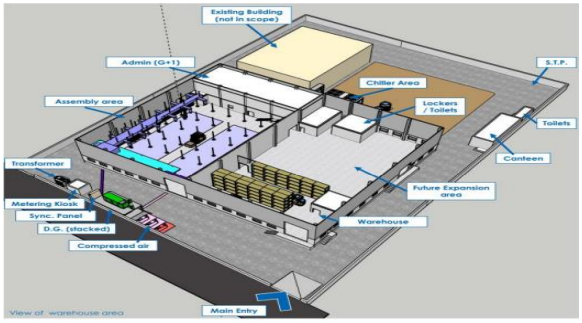
CASE STUDY

- Name of Construction Company: FSIPL, Pune.
- Location of the Project: KAIDB, Kondhwa, Pune.
- GMAP– Lat; Long : 13.260774977662916, 77.5644935979936
- Building Type: Residential Building.
- Number of Stories: G+18.
- Number of Phases : 1
- Name of the Project Head: Mr. Aniruddha Kshirsagar.

AutoCAD Plan

Project Area

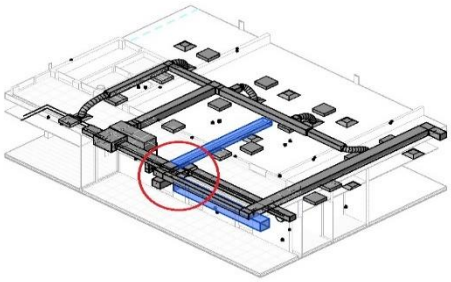
- Production Area
- Admin / Office Area
- Utility Area
- DG Area
- Substation Area
- Future Expansion Area
- Canteen
- Electrical Panel
- Machine Floor



WHAT IS BIM – VDC / Digital Construction Introduction

BIM is a process of generating and managing building data during its complete lifecycle, from conceptual design through operation of the building information modeling (BIM) is an integrated workflow that enables architects, engineers, and builders to explore a project digitally before it is built.

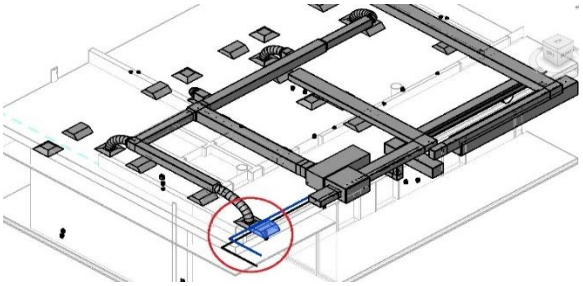
Clash of Structural member and MEP component



Building information modeling (BIM) is a process supported by various tools, technologies and contracts involving the generation and management of digital representations of physical and functional characteristics of places.

Building Information Modeling (BIM) is a digital representation of physical and functional characteristics of a facility. A BIM is a shared knowledge resource for information about a facility forming a reliable basis for decisions during its life-cycle

Clash between the beam and the duct



A validated analytical model is used for generating natural frequency data for different dimensions of rectangular ducts

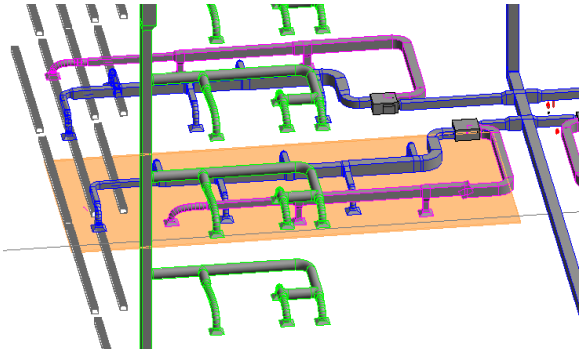
In addition, the categorization methodology allows prioritizing on the most costly clashes, and draw lessons learnt for further projects. This schema opens the path towards a systematic methodology to appraise the benefits of different BIM uses or processes

Interference Between Air Terminal and Ceilling

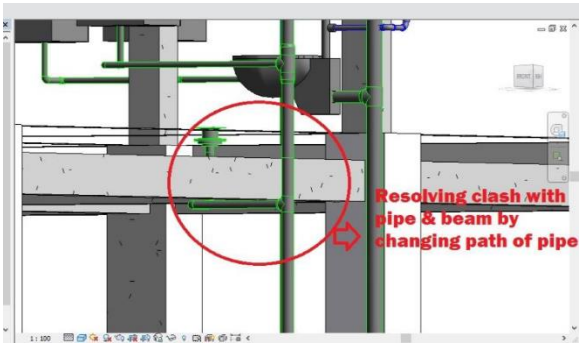
Total air is defined as the mixture of primary air and entrained room air which is under the influence of supply outlet conditions.

This is commonly considered to be the air within an envelope of 50 fpm [0.25 m/s] (or greater) velocity.

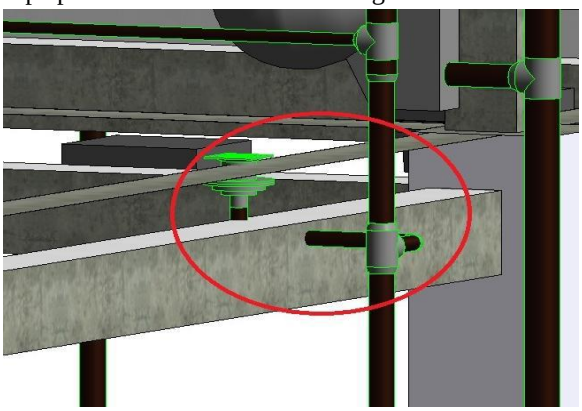
The temperature difference between the total air and the room air creates buoyant effects which cause cold supply air to drop and warm air to rise.



Resolving clash between pipe & beam by changing length of pipe



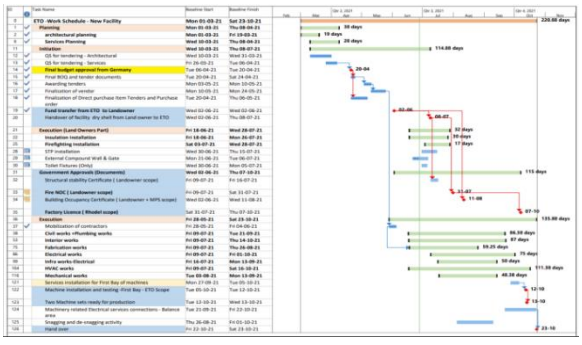
Pipe position before clash resolving

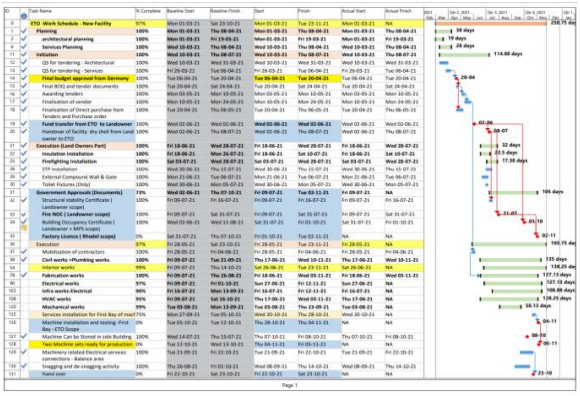


Steel tubes are produced to very strict tolerances. Tubular undergo several dimensional quality checks, such as straightness, roundness, wall thickness, surface, during the manufacturing process. Mechanical strength is a major concern for tubes.

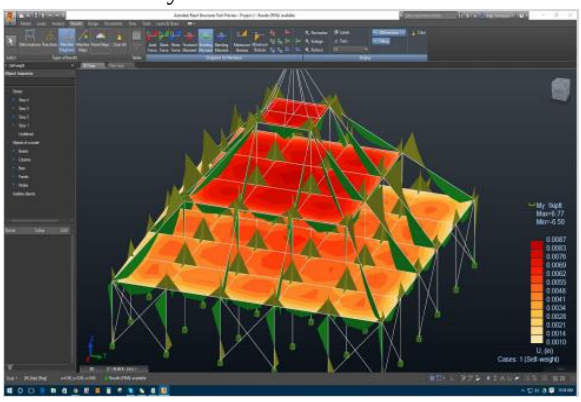
Tubing is available in carbon steel, low alloy, stainless steel, and nickel-alloys; steel tubes for mechanical applications are mostly of carbon steel

ETO Project – BASELINE PLAN

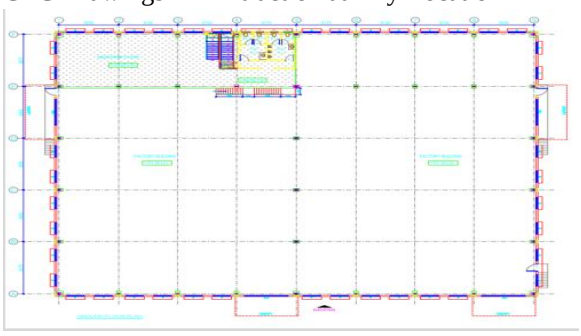




Structural Analysis Of Model



GFC Drawings 2D Extraction at Any Location



Design of G+9 RCC Model Design

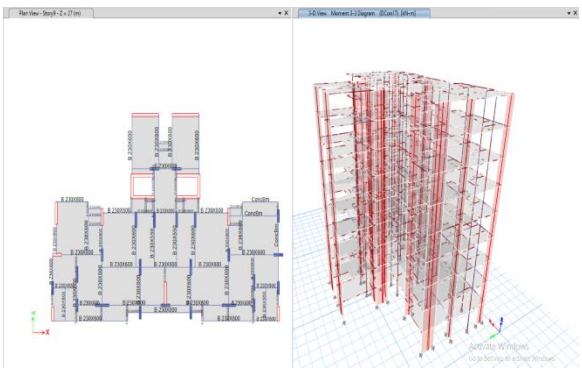


Figure: BMD & Plan of G+9 RCC

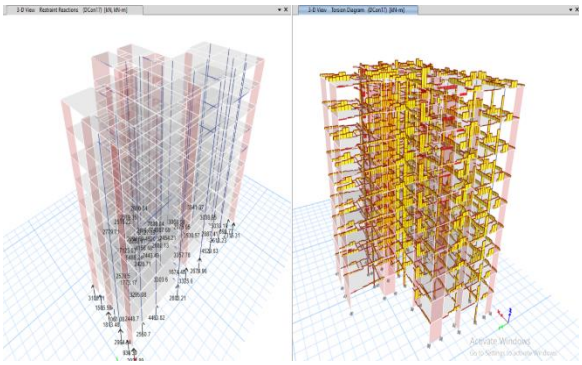


Figure: BASE reaction and torsion reaction of G+9 RCC

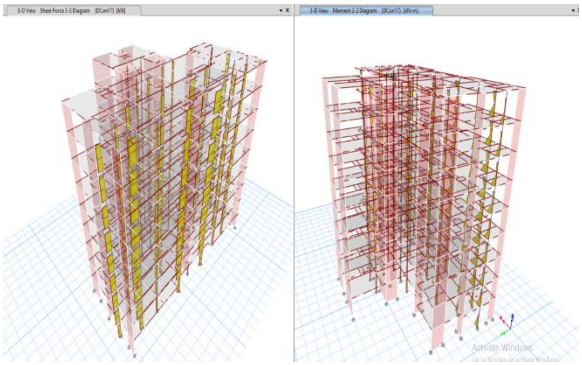


Figure: SF 22 AND BM 33 of G+9 RCC Model

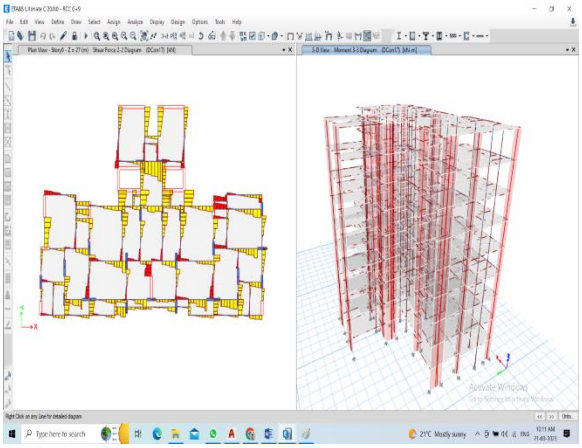


Figure: SF AND AXIAL FORCE of G+9 RCC Model

CONCLUSION

- Building Information modelling shows great results on project in terms of performance, time and cost.
- Implementing of clash detection tools is useful to decreases coordination errors, human errors so that

result in high level of accuracy of models. So this will avoid re-construction.

- This can be done by accessing clash detective tool from where Batch tab can be accessed by software work users.
- One of the most important tasks of software users is to effectively recognize the clashes and then group them according to their similarity.
- When clashes are grouped together according to their potential to create obstacles for AEC professionals in construction, it becomes easy for them to understand the nature of the clashes.
- BIM is a relatively new technology in an industry typically slow to adopt change. Yet many early adopters are confident that BIM will grow to play an even more crucial role in building documentation.
- By Doing this Seminar - found while working on above Project: Improved visualization.
- Accurate quantities extraction for estimation and tendering
- Realistic Construction Timeline Management
- Increased errorless coordination of construction documents.
- Reduced costs – Faster design analysis & No Rework at Construction site.
- Future Use of Model in Facility Management, Demolition, Asset information record. ◦ BIM also contains most of the data needed for building performance analysis. The building properties in BIM can be used to automatically create the input file for building performance simulation and save a significant amount of time and effort. Moreover, automation of this process reduces errors and mismatches in the building performance simulation process.

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