A Case Study on Building Information Modelling For Clash Detection

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Abstract- *to providing a strategic frame work with BIM leveraged approach. The key of this framework was the information generation, exchange, collection and management. This study has contributed to existing knowledge with an extensively list of key benefits to derived when BIM technologies are adopted in construction industry. It also points out the silent benefits which relate to sharing of project data. The study shows that BIM is not used thoroughly for sustainable projects including all building production processes due to lack of allocated budget for efficient BIM usage and qualified staff. The benefits provided by BIM software in the designing process are not yet realized by the designer contractor and owner. BIM technology is introduced into construction site material supply management and validates the value of BIM in field of material supply by establishing dynamic model. 4D application ensures timely scheme generation of whole process, which helps manager to better solve site material supply problem. It identifies a new technology envisioned to enable the creation of information model for every kind of building currently in use. It describes the new methodology to develop bespoke information model for existing building based on facilitates management strategy and building requirement. It proves that base model can be created without using costly and time-consuming technology. It describes the process consist of initial data analysis and collection step to develop base model. It allows flexibility to adapt the model to meet changing needs of building operation teams.*

Keywords- Failure mode and Effects Analysis, Constructability, AEC Industry, Contractor, Change Orders, BIM software, Clash Detection, Building Information Modelling, Requests for Information,

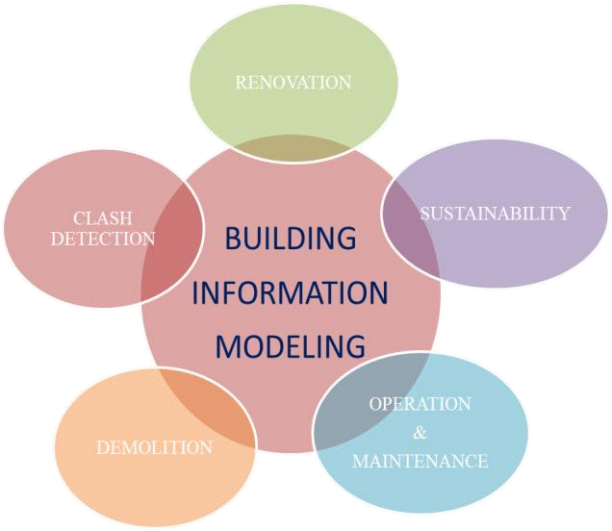
I. INTRODUCTION

Building Information Modeling (BIM) is process that supports virtual design and construction methodologies putting all team members together throughout the entire design and construction process and beyond to the operations in maintenance of the building, during its working life. Typically, BIM is one holistic process using. Real-time, intellectual modelling software effectively working in 3D, 4D (3D + time), and 5D (4D + cost),6D(5D+ facilities management)to improve productivity, to save money and time in the design and construction phases, and to reduce operating costs after construction. Clash detection is one of the tool helps to optimize the time and cost of the construction. The National Building Information Modeling Standards (NBIMS) committee of US defines BIM as, “a digital representation of physical and functional characteristics of facility. BIM is a shared knowledge resource for information about a facility forming is liable basis for decisions during its life cycle i.e. from earliest conception to demolition. This data takes care of an incorporated database, which thus takes care of all structure archives and calendars for the structure venture. At the point when a change is made to the structure model, every single graphical view (plan, height, detail, and other development drawings), just as non-graphical perspectives, for example, the structure reports and calendars, consequently mirror the change.

Necessity of Building Information Modelling

In traditional method organizations prepares activities for the execution stage as establishing contracts with contractors, buying materials, ensuring a good coordination and assembly order of the different systems of a project. The most clashes are recognized when the contractor receives the design drawings and everyone is on-site and working. It is compare with 2D designs to each other to find conflict clashes between the specialty designs. Because the specialty contributors i.e. structural engineers, MEP engineers etc. develop their designs separately, so when comparing these designs on different drawings is a process easily overlook clashes. 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. 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. 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.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. 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. [2]



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. 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.

II. LITERATURE REVIEW

Name: Building information management framework and supporting case study for existing building operations, maintenance and sustainability. (August 2015)
Author Name: J.J. McArthur (Elseveir Ltd)

This paper highlights development of new BIM model for existing building, by presenting a case study and synthesizing framework. The term 7D has been used for referring to a BIM model for facilitates management operation.7D BIM model helps to identify critical information required for sustainable operation, managing information transfer between BIM model and other management tools, managing the level of effort to create the model, handling uncertainty where building documentation is incomplete. It describes the process consist of initial data analysis and collection step to develop base model. Which allows flexibility to adapt the model to meet changing needs of building operation teams.[2]

Name: BIM implementation for existing building for facilities management: A framework and two case study. (October 2015)
Author Name: G. Cardonari, S. Stravoravdis, C. Gausden (WIT transactions on built environment)

It presents the procedure of usage of a structure data model for dealing with a current structure, distinguishing an improvement system and archiving the challenges that happened during execution of starting stages. The examination shows the advantages of BIM can lessen costs, offer help to an increasingly productive undertaking conveyance procedure and improve coordinated effort and information sharing. In any case, it found that for building activity and supervisors, BIM is still generally new point. For existing structure, to make a 3D model sweep to-BIM through 3D lesser checking. It recognizes another innovation imagined to empower the formation of data model for each sort of building presently being used. It portrays the new technique to create bespoke data model for existing structure dependent on the encourages the executives system and building necessity. It demonstrates that base model can be made without utilizing expensive and tedious innovation.[2]

Name: Improve the productivity of Building Construction Project using clash detection application in BIM (March 2017)
Author Name: Mr. Swapnesh P. Raut, Dr. S.S. Walunjkar

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. He studied the survey which shows that only 22 percentage of respondent currently use BIM. 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.

Name: Developing Mobile -and BIM – based integrated visual facility maintenance management system (Aug 2013)
Author Name: Yu-Cheng Lin, Yu-Chih Su (Elsevier Ltd)

It shows the application of BIM technology in FMM both inside and outside of building support maintenance staff in handling FMM via 3D BIM models. It shows, by accessing the mobile device, maintenance staff can obtain the corresponding BIM model of facility and directly access FMM information about facility such as instruction manuals, photos, video of operation, maintenance history. The two mobile devices used in BIM FMM System. The web cam enables tablet were used. The hub centre is an information centre in BIM FMM which enables participants to obtain information. It facilitates easy updating of FMM information in a BIM environment But is also shows its limitations that the BIM models could only be used with PC desktop in office which limits their use onsite during maintenance.

Name: BIM for sustainable construction – a strategic framework for handling challenges of the international green construction code (NOV 2012)
Author Name: Wei Hui Zhou

To manage the effects and difficulties presented by the IgCC, partners will require key casing work. This Paper proposed a BIM utilized methodology. Creator got administrative condition of a manageable plan and development and fruitful execution of BIM in meeting such administrative prerequisite. This key code compline's arrangement was imitated from the compline's arranging assistant(CPA) program coordinated by construction standards help venture (BCAP) and the Texas straight vitality protection office(SECO) in their endeavors to accomplish 90% vitality code agrees to the 2009 worldwide vitality preservation code.IN each period of this code consistence work process the conceivable influence of the task BIM models sketched out and talked about. At last, the vital structures for the IgCC consistence was built up followed by the end and general conversation. This paper talks about the potential difficulties for partners in the AECOO business to meet the consistence of the recently discharge IgCC. The key of this system was the data age, trade, assortment and the board. The establishment to this system was an indispensable undertaking data supply and a hearty coordinated effort entry empowered by BIM. Point by point IgCC consistence rules could be additionally evolved dependent on this key structuregning process are not yet acknowledged by the creator contractual worker and proprietor.

Name: Clash analysis in a BIM based design (2016)
Author Name: Edger PretoBerdeja (WIT Transactions)

Edger PretoBerdeja found that 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)). His work contributes 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.

III. AIM & OBJECTIVES

Aim: To study clash detection and minimisation of project duration of a commercial building using BIM system

Objectives: Analysis an Interpretation of all the data collected in BIM system and removal of the clashes encountered.Cost reduction through scheduling of project. To develop generalize guidelines to avoid clashes between various agencies during construction of a commercial buildings

IV. METHODOLOGY

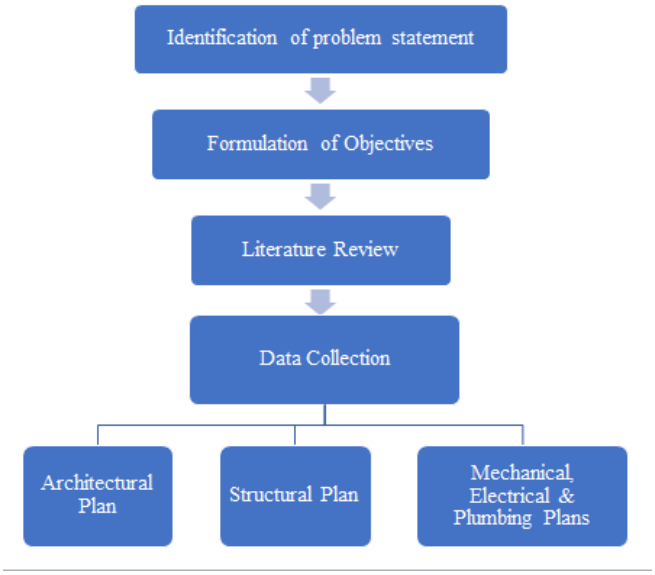
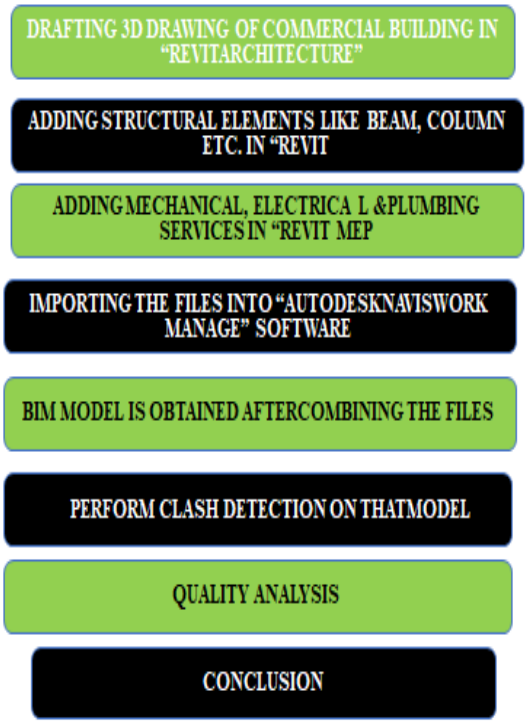


Figure1.1 Flow Chart of Methodology

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. [2]



PROPOSED PROCESS DESIGN

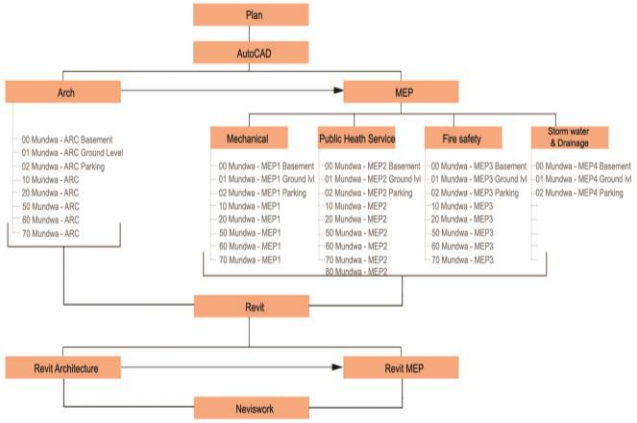
Determination of the site

- ✓ The assortment of the information with the end goal of the task is completed for making a 3D model.
- ✓ The locales to be chosen is business working in Pune district.
- ✓ 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

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

V. DATA ANALYSIS

Flowchart of the workflow of software's used for creating the BIM Model to bring out the clash detection in the office building [2]



Building Services of the commercial building

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

- **Mechanical Ventilation System**
- **Public Health Engineering Systems**:
  - ✓ Domestic System
  - ✓ Drainage System
  - ✓ Sanitary Fixtures

- **Fire protection System**

CLASH DETECTION

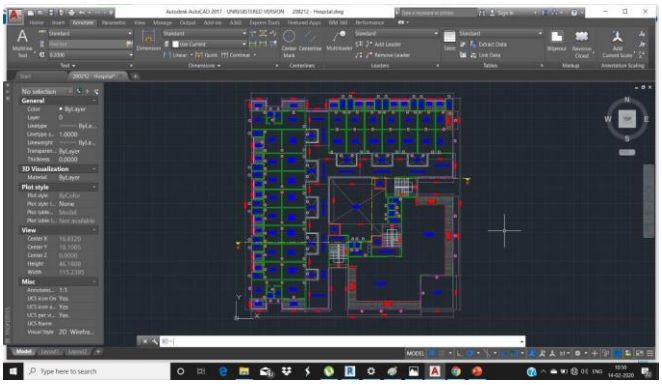
Some BIM coordinators use the term 'clash' to refer broadly to one of several kinds of Spatial conflicts discovered in a BIM, that is, they characterize the clash based on the Nature of its existence. For example, they differentiate 'hard clashes' from 'soft clashes,' And 'time clashes' (e.g., Mangan 2010). Other BIM coordinators highlight clashes, not Only based on their existence, but also based on the process used to act upon them. For Example, Gijezen et al. (2010) use a work breakdown structure and define 'relevant Clashes' as those that lead to change orders. Whichever is the case, clashes point at Conflicts that demand the attention of Last Designers and, as needed, also of others in the Project delivery process.

can be combined and reviewed by all project stakeholders, serving users to benefit from the competitive advantages of building information modelling (BIM) workflows.

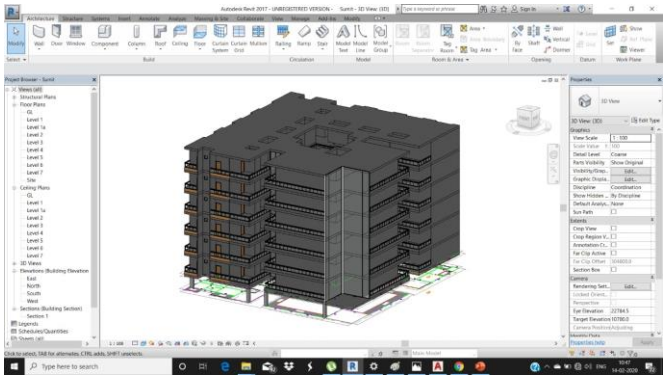
The Autodesk Navisworks software provides a Clash Detection module that checks BIM model and shows any areas where items interfere, or "clash", with each other. This BIM tool allow to set up the rules, identify clashes, Generate Reports, Trace Clashes, Status Clashes, Manage Clashes, Set Rules, Custom Clash Test, Clearance Tests, Time Based Clashing. The Autodesk Navisworks software family offers three products (Autodesk Navisworks Manage, Autodesk Navisworks Simulate, and Autodesk Navisworks Freedom) to provide project stakeholders with the right tools to help collaborate, coordinate, and communicate more effectively.

VI. MODEL,APPLICATION,RESULTS & DISCUSSIONS

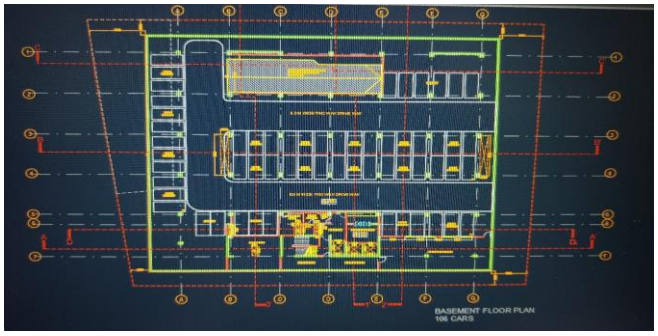
AutoCAD Plan



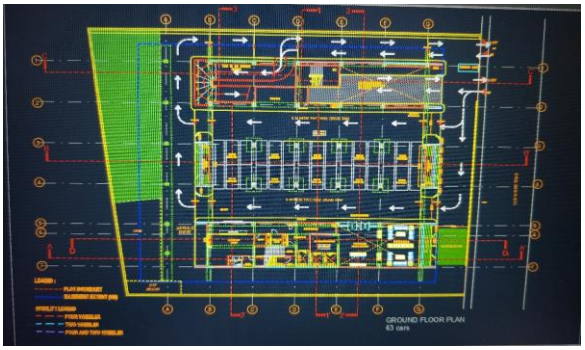
Revit Architecture Model



Basement Floor Plan

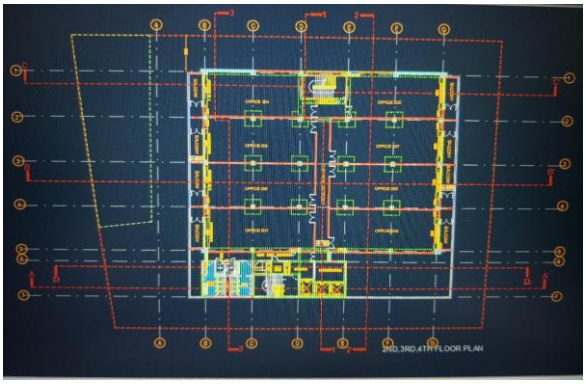


Ground Floor Plan

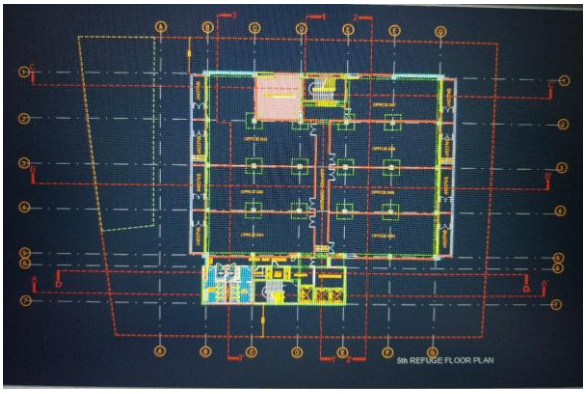


First Floor Plan

2nd, 3rd & 4th Floor Plan

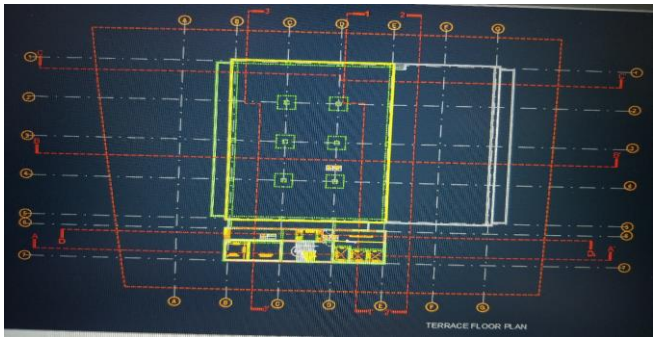


Fifth Floor Plan



Sixth Floor Plan

Terrace Floor Plan



Elevations

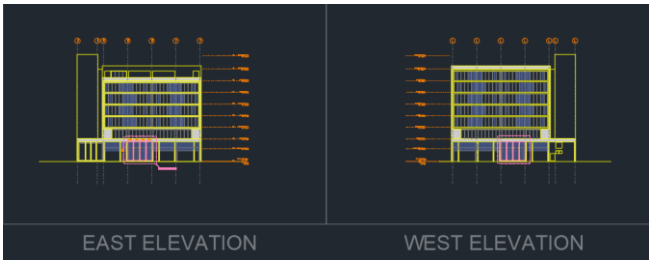


Fig. East Elevation & West Elevation

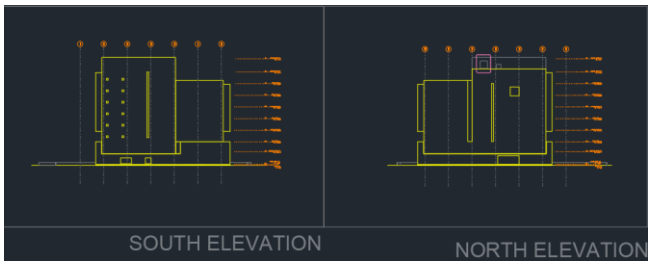
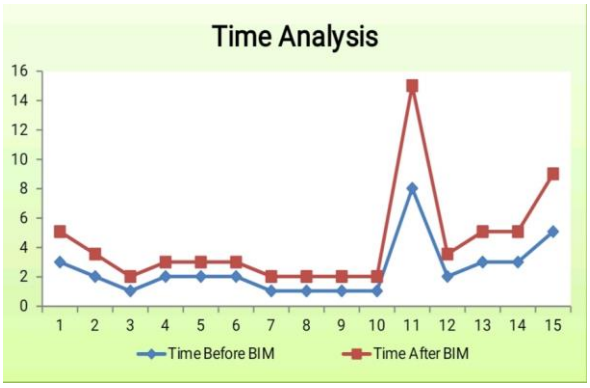
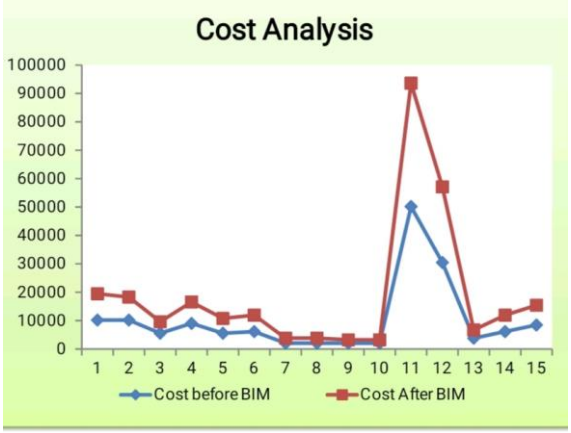


Fig. South Elevation & North Elevation

Sr. No	Name Of Re- Work	No. of floors	Time Before finding Clashes (Days)	Time After Considering Clashes (Days)	Cost Before finding Clashes	Cost After Considering Clashes	remark
1	Clash between beam and duct	2	3	2	10000	9000	Duct position have to change to avoid clash
2	Clash between AC inflow duct and piping	3	2	1.5	9760	8784	Ac inflow and pipe length is changed that may increases cost
3	Clash between air terminal and ceiling	3	1	1	5000	4500	Air Terminal have to change
4	Clash between Duct and Mechanical unit	3	2	1	8700	7830	Mechanical unit place have to change
5	Clash between Duct and Pipe	3	2	1	5400	4860	Pipe length will increase
6	Clash between Duct fitting anddUct	3	2	1	6000	5400	Duct fitting is change
7	Size changed between duct and pipe	3	1	1	2000	1800	Change pipe diameter
8	Clash between Pipe position and beam	3	1	1	2000	1800	pipe positing have to change
9	Clash detection between HVAC and electrical	3	1	1	1500	1350	Pipe length is increase
10	Clash detection between PHE pipe and HVAC duct	3	1	1	1570	1413	pipe length and position change
11	Clash detection between Plumbing and mechanical	3	8	7	50000	45000	At different location this clashes are found
12	Clash detection between Plumbing and structural	3	2	1.5	30000	27000	At different location this clashes are found
13	Clash detection between Electrical and structural	3	3	2	3458	3112.2	At different location this clashes are found
14	Clash detection between Electrical and Plumbing	3	3	2	6000	5400	pipe positing have to change
15	Clash detection between Electrical and mechanical	3	5	4	8000	7200	At different location this clashes are found
	Total		37	28	149388	134449.2	

VII. TIME COST ANALYSIS





VIII. 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.
- The first thing that should be done by software works users before they go ahead with conducting a clash test is to effectively set up the elements or items that they would like to compare during clash detection in the Batch tab.
- 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.

IX. ACKNOWLEDGMENT

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