

Operational Feasibility of BIM Applications in Indian Construction Projects

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Abstract

Background/Objectives: To conduct online survey on Indian BIM organizations. Secondly, results of 4D and 5D BIM applications are to be evaluated and compared between 5D BIM technique and traditional technique. **Methods/Statistical analysis:** The methodology adopted in this research is based on BIM software. For 4D analysis, software like Navisworks Freedom and Navisworks simulation are used. The data collected from MSP file forming a Gantt chart which is further exported into Navisworks for time evaluation. In case of 5D, BIM Revit software is used for calculating cost and then comparison is made between Sigma estimate and traditional cost estimate technique. **Findings:** This research concludes that 4D and 5D modeling techniques play an important role in designing work of any construction project. It helps the owner or designer for gaining accurate work progress, planning a short-term arrangement in less time, construction planning and to develop high economy at low scale for small level projects. This study evaluates the difference in time and cost taken by traditional construction techniques of residential house building and 4D and 5D BIM techniques. Traditional techniques require more time than BIM technique because it reduces time up to 80% for the same project. The cost of project by using 5D BIM technique decreases 20-30% after comparing with traditional technique which helps the Indian construction projects to maintain overall budget of project and increased economy. **Improvements/Applications:** BIM serves several applications which include: Better cost scheduling, recognition of time based clashes, estimation of cost during whole project lifecycle, clash detection and MEP BIM coordination etc.

Keywords: BIM, Construction Planning, Construction Technique, 4D, 5D Modeling

1. Introduction

In, India many organizations which are involved in public sector or procurement area the designer and contractors needed an advance technology for fastest progress of work in construction area which is an essential tool for developing any country. India is an emerging country which has been suffering from economic issues regarding the construction projects to know this fact design or plan statements must be changed from 2D to 3D interface in construction industry¹. People who join with the firm do not have full information regarding the project which creates clashes between owner, designer, contractors or any other party joined with the work. To solve this problem

BIM, implementation is the best option which provides productivity, quality of work by reducing lifecycle cost of whole project².

BIM is a closed collaboration of people which involve digital storage of all types of project. It provides integrated project delivery (IPD) in a project which combines people, structures, and systems in a project work automatically with each other. It also produces dramatic transformation in business practices for all stakeholders and provides modern status of BIM for project sustainability^{2,3}. Since the implementation of BIM is increasing in Indian Construction Industry with each passing year, it can solve these types of issues very efficiently. Union Nations have also undergone with different changes in

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construction techniques which provide solutions to evaluate different problems faced by Indian Construction Industry. The Construction of Nagpur metro station in Maharashtra is the best example of execution of BIM new project work in India. It is monitoring the raised area mainly known as 5D BIM which helps the project team for reducing the cost as well as time and reduce legal actions from 20,000 Crores budget.

Nagpur Metro station project is based on digital project management policy which is integrated with SAP i.e., including the live project recording to a virtual model during entire project lifecycle which converts old transport system into new transport system and uplift the BIM level in Asian countries^{4,5}. 5D BIM technique helps the project manager to create different models to show how the changes involved in metro design work, construction material and layout which can increase the quality of project delivery. It is a multi dimensional action of activities which analyzes project feasibility. Nagpur Metro station consists of 38 km of route and work is under progress at 22 km. BIM adoption at level 5 develops a prospective solution of forming a potential teamwork during whole project with OHS (occupation health and safety measurements). BIM model is generated in diverse proportions in which 3D to 7D stages are included⁶.

In India, the most important factor in construction project is cost and time. To manage these factors, India needs 4D and 5D BIM that generates a solution key against these problems by applying VDA and IPD (visualization design application and integrated project delivery) techniques⁷. The construction project of 4D BIM technique visualizes the animation work and develops a sequential phase which shows the critical path between process and model schedule. On the other hand, 5D BIM process reduces the engineering cost which firstly generates bills of calculating items and then evaluates financial scenarios of the project work. To solve this problem 4D progress tracking system is used to evaluate cost and change objects into earned value. All over the world software like Revit, Free CAD, Navisworks, and Tekla structures, Glue, Bentley ConstrucSim, Vico office suit etc. are used as BIM software⁸. Autodesk Revit is most commonly used BIM software which is adopted by Indian construction industry.

Usually, AEC industry uses Autodesk Revit for their BIM applications which contains architectural design

features and Mechanical Engineering Plumbing (MEP) is used for structural engineering designs. For, any successful BIM project, cost simulation factors (CSFs) are necessary to evaluate⁹. Formation of 4D model for construction work, Revit generates 3D model which creates geometrical design and transfer digital information to the project manager. To import this 3D design model, Revit software directly links with the Autodesk Navisworks utility tool which permits the consumer to open and combine 3D model with time and cost factors. Tekla is second mostly used BIM software in Indian construction project. This software provides user to create or manage 3D models with concrete or steel which evaluate design and analyze level of development (LOD). Various groups of designers, engineers, producers, architectures and contractors offered BIM technology in initial or final stage¹⁰.

The major problem arises in the adoption of BIM due to lack of software information and high operation cost. But it provides lot of advantages in cross section of different construction projects¹¹. That's why construction industry of India prefers traditional techniques for construction process because manual work is easier than the work with lack of knowledge about software. Practice of these traditional techniques is not an issue in India, but the delay in work effects the budget and time schedule which affects the economy of project work. Therefore, it is necessary for Indian construction industry to adopt BIM techniques for construction projects.

1.1 Analyzing usage of BIM Applications in Last Few Decades of Indian Construction Industry through Online Survey

In this research, the online survey is conducted to know the range of BIM applications used in India till now. To know this fact, the numbers of questionnaire are asked from different associations like IBIMA and some other BIM consultancies. The output arrived from the reviewers of shown in online survey.

The number of questionnaires asked from IBIMA and various BIM associations by conducting online survey which is working for Indian construction projects. Some of these questionnaires are shown in (Figure 1).

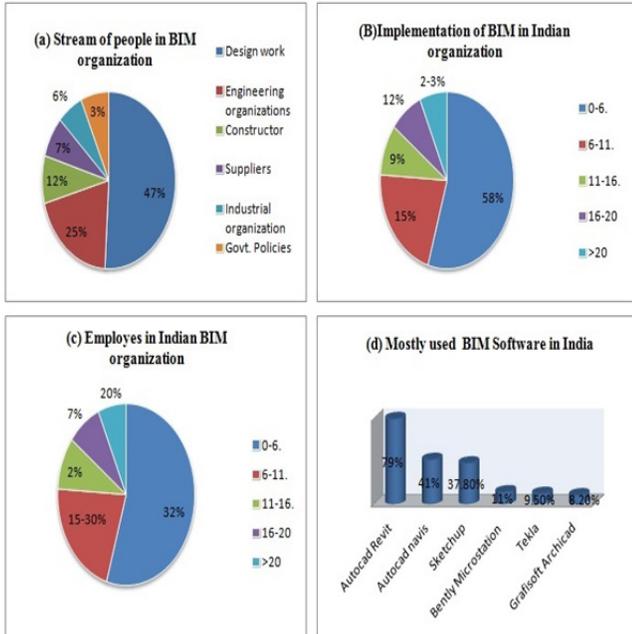


Figure 1. Usage of BIM applications in last few decades of Indian construction industry as analyzed through online survey. (a) Stream of people in BIM organization (b) Implementation of BIM with organizations (c) BIM employs in different organizations (d) BIM Software usage in India.

In India, numbers of BIM software are trending in markets which are now used by private Indian companies in different sectors. Design technology of BIM came with lot of advantages which are supported by private investors and it is not exactly possible to judge the level of work done by companies through BIM techniques because of its digital work. But it is necessary to evaluate how BIM project manager creates good condition at the workplace. BIM creates better condition of project by excluding wastage of time and cost¹². The level of interest shown by Indian government policies, private investors, architectural and construction industry towards BIM is extremely essential.

The 4D and 5D BIM applications used by IBIMA and other BIM companies and Government policies in Indian construction projects are done by conducting online survey. Some of these questionnaires are shown in (Figure 2).

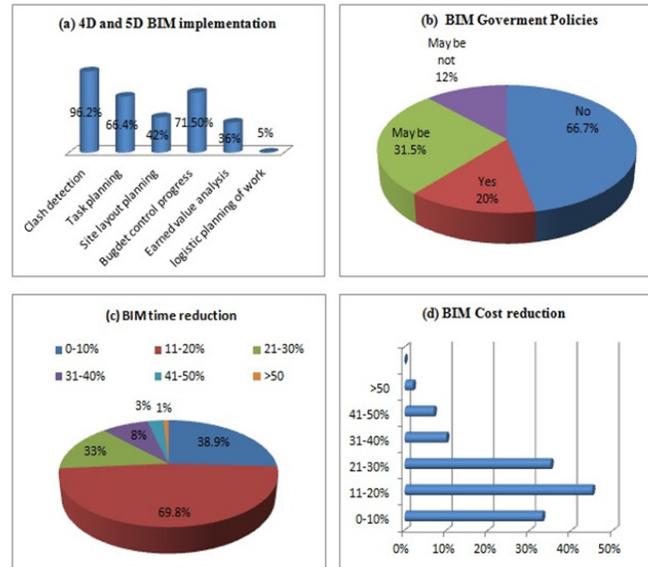


Figure 2. Usage of 4D and 5D BIM applications used in Indian construction projects. (a) 4D and 5D BIM implementation in India (b) BIM Government policies (c) BIM time reduction (d) BIM Cost reduction.

The ability of BIM to manage the cost and time factor which are known as 4D and 5D BIM techniques are utilized by the project manager in the primary stage i.e., In 1st stage of project the construction progress of work is extremely high so that good decisions taken during running project minimize the cost of work with time. The project is totally depends upon the user involvement in project work and project delivery methods for developing automated earned value in BIM project. Both cash inflow and outflow, can be measured precisely which is based on contract type work¹³. In Indian construction industry, people still adopt traditional technique among BIM. In every BIM projects, project cost manager is necessary during every phase of project and for them the technical knowledge about BIM applications is essential.

Design of project by applying real time cost throughout its complete design work and progress level creates a valuable series for project clients. It also helps project manager to analyze virtual model information with overall cost details. The major challenges are balancing information and maintain interdependency with the functional models in construction project. Hypothetical methods and experimental data are used to evaluate useful options of project

work by using multiple criteria evaluation technique¹⁴. This system represents the model shift technique. The motive of this system is to utilize the information all around and interlinking the information in hierarchical manner in a construction company which is increasing day by day.

1.2 Proposed Methodology and Stages of Implementation of BIM Technique in Research Work

This research is based on some proposed methodologies and divided into 3 main stages for exploration of research data. Exploration criteria are preceded only by taking secondary data of different elements. Decision making is essential for the establishment of 4D and 5D BIM technique in the project work. For that, the system may be divided into various different stages in a systematic way.

For successful BIM implementation, review analysis and Critical Success Factor (CSFs) play a necessary role in construction industry. CSFs help the country in different ways in which design collaboration, easy and early 3D visualization, engineering, structure stakeholders and improvement in safety design are involved. It was observed that 60 percent cost of whole project work has gone under operation and maintenance work¹⁵.

In this research paper the BIM applications are divided into different stages for calculating overall progress of work.

The flowchart of overall progress of work includes research discovery, questions, objectives, methodologies and three stages of projects with their description under which online survey, formulation of 3D model in different software and 4D and 5D BIM applications are shown in (Figure 3).

To understand the 4D and 5D BIM technique it is essential to know about significant details of BIM packages of

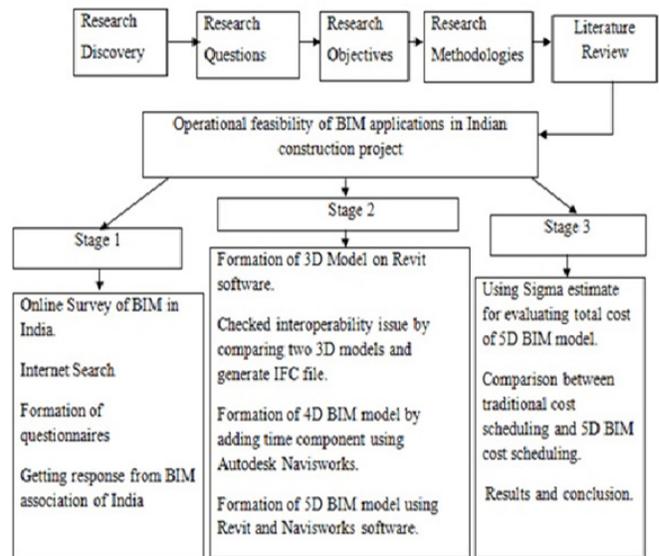


Figure 3. Tree structure of BIM research work.

work at construction project site. The lack of knowledge creates economic issues. The system required a detailed chart which evaluate the overall package of work and analyzed the different factors which are related to BIM. This level of significant details ranges from insignificant to crucial stages which are properly defined by systems. The implementation of BIM in India is not as simple as there is a lack of awareness about software and digital technology knowledge. Rarely people know about BIM it is necessary to take an initiative and use this technology for emerging development of our country. In this research paper different BIM software's are used for evaluating cost and time factor.

The 2D Plan and 3D View of Residential house building model is created on Autodesk Revit. This model helps in designing and operating different part of projects at various stages of construction project during construction as shown in (Figure 4).

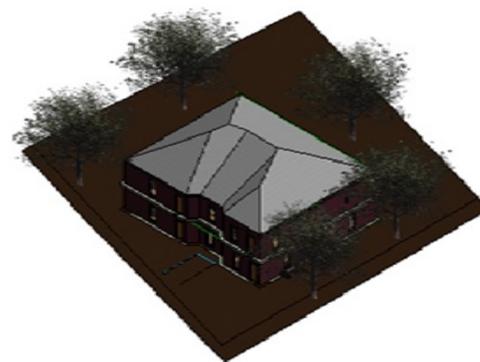
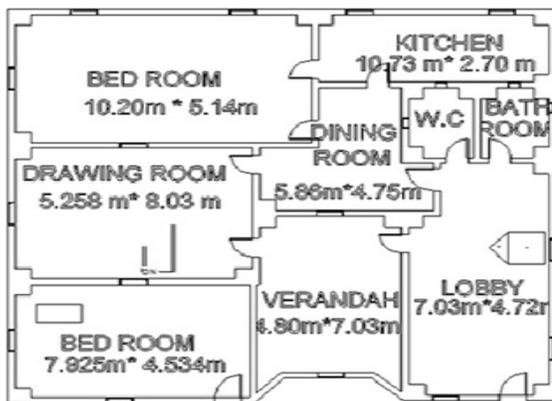


Figure 4. 2D Plan and 3D view of residential house building model created on Autodesk Revit.

In this research paper the focus is properly based on 4D and 5D BIM techniques for the progress of realistic part of the research work. Three different categories of BIM software are chosen for the formation of 3D residential house model and analyze this 3D model with reference to time and cost variances i.e., 4D and 5D modeling system.

One of the main issues considered in software designing is to check interoperability between software. When we want to export the IFC files from one system to another system the whole thing gets messed up with each other and the model is not exactly same as we created at first software. To understand this problem, in this research work, two different models were created on different software. Software like Autodesk Revit and Free Cad software are used for evaluating the interoperability issues. The overall information provided by application model describing their links with multi model and also with collaboration processes¹⁶.

3D two story residential house model is created on Autodesk Revit and Free Cad. After importing these models into each other it is observed that the few

elements of the construction projects are missing during interpolation and it provides us a digital error report after process is done. For exporting these models with each other Industry Foundation Classes file format is used.

2. Illustration of 3D House Model with IFC File

In any BIM software IFC is the only single opened 3D object oriented system which contain ISO certificate. It generates 3D geometrical view for all components of model which store data and standards of every part of designed model. The applications used by different softwares are quickly identified and filtered by IFC databases.

The Residential house model made on Revit software and FreeCAD software with formation of IFC files generated during transformation / exporting of data in different software is shown in (Figure 5).

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ISO-10303-21;
HEADER;

/*****
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* Module: EDMstepFileFactory/EDMstandAlone
* Creation date: Wed May 09 18:33:03 2018
* Host: hp
* Database: C:\Users\SONALI-I\AppData\Local\Temp\{710F51A8-5653-44B9-A600-C47F8A515DC3}\ifc
* Database version: 5507
* Database creation date: Wed May 09 18:32:45 2018
* Schema: IFC2X3
* Model: DataRepository.ifc
* Model creation date: Wed May 09 18:32:48 2018
* Header model: DataRepository.ifc_HeaderModel
* Header model creation date: Wed May 09 18:32:48 2018
* EDMuser: sdai-user
* EDMgroup: sdai-group
* License ID and type: 5605 : Permanent license. Expiry date:
* EDMstepFileFactory options: 020000
*****/

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FILE_NAME('Project Number', '2018-05-09T18:33:03', (''),('','The EXPRESS Data Manager Version 5.02.0100.07 : 28 Aug 2013', '20161205_1400(x64) - Exporter 17.0.503.0 - Alternate UI 17.13.0.0', ''));
FILE_SCHEMA(('IFC2X3'));
ENDSEC;

DATA;
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#9= IFCARTESIANPOINT((0.,0.));
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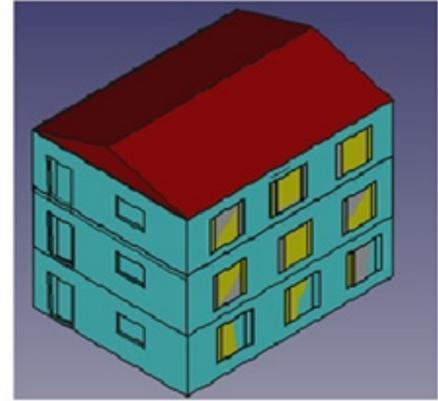
(a)



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FILE_SCHEMA(('IFC2X3'));
ENDSEC;
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#12=IFCDIMENSIONALEXPONENTS(0,0,0,0,0,0);
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#19=IFCUNITASSIGNMENT((#13,#14,#15,#18));
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#29=IFCCARTESIANPOINT((-4.470503066151,6.009102661659,-2.55781406804226));

```



(b)

Figure 5. Illustration of Autodesk Revit 3D Residential House Model and Free cad model with IFC files. a) Revit Residential House model generated IFC file after exportation. b) Free Cad Residential house Model generated IFC file after exportation.

It shows that the models creating in different software are not capable of transferring their own elements or data during importing or exporting process. It excludes some elements from its place or deletes some data during process either importing or exporting the file in different software.

3. Data Analysis

3.1 4D Simulation of Work using Navisworks Freedom

The objective of this research paper is to discover the 4D and 5D BIM advantages in construction projects and to study about major six aspects of work which are cost

and estimation, 3D organization, construction planning, 4D and 5D visualization, validate model and monitoring process. BIM is integrated project system which provides discipline at construction site and creates a huge picture of project work with collaborative team efforts and visualization. Indian Construction Industry has adopted critical path method and bar charts for scheduling and construction planning activities. If we adopt handmade scheduling technique it takes a lot of time or expanded the work of project manager. They never join the activities straightly with construction project; hence it is essential to adopt 4D BIM technique for construction project to make easier task work. It helps to connect 4D models manually with 3D elements which provide more useful schedule process and make it smooth for running project. The

important and special component of the system transfer models and records after interlinking them with each other. New BIM tools generate sustainability in design and improved interoperability^{16,17}. This research paper illustrates 4D techniques by using Autodesk Navisworks Freedom software for evaluating time scheduling of residential building model.

3.2 Illustration of 4D Model

The procedure of analysis of 4D BIM i.e. time analysis is not too long. The first step of illustration of 4D BIM model contains design of 3D model in any software. Here in this research the AutoCAD Revit is selected for 3D design work. The 3D model named as residential house model is constructed on Revit software. Then software named as Navisworks is used for further time analysis pro-

cess. Navisworks contain three utility programs in which Navisworks freedom, Navisworks manage and Navisworks simulate are used for 4D analysis. The 3D model which is design over AutoCAD Revit is imported in Navisworks Simulate. Then overall data of MSP file and other CSV file is transferred into Navisworks Simulate which contain time liner and it include task, activity, name, status, planned start, planned end, actual start, actual end, task type and total cost columns are inserted at one side and other side the data from activities containing regular Gantt chart.

For 4D analysis of Revit, 3D House Model software like Navisworks Freedom, Manage and Simulate are used by importing MSP files data of project into Navisworks Simulate and forming Gantt chart of overall construction project with time factor i.e. (3D + time) which is shown in (Figure 6).

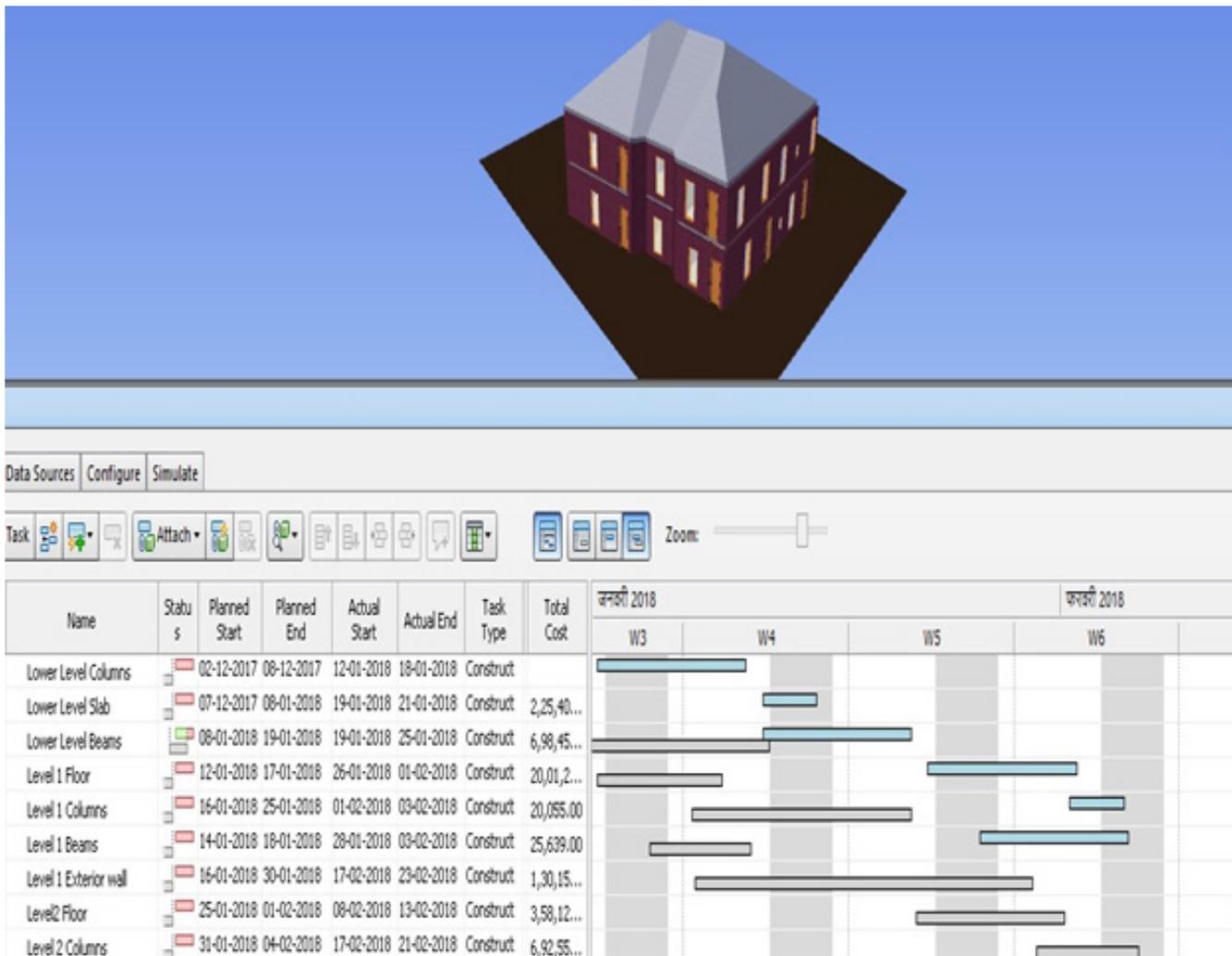


Figure 6. 4D analysis of Revit 3D House Model on Navisworks Freedom

The main advantage of using Navisworks is that it navigates Revit files very easily. Designers with basic knowledge about Revit software can understand the language of Navisworks software. It allows imitation of work and investigation, communication of design and creates constructability. It permits sharing review of many models at different software backgrounds Revit, Solidworks, Sketchup, Robot, Allplan and many more. The major motive of this research paper is to show how we can make construction tasks easy by using 4D and 5D BIM techniques and their software + either they are large project as well as small projects in India. The core of Navisworks is to protect the project from clash detection. It allows the manager to look forward, detect and solve the problem in a model before starting of projects to reduce cost, changes and delay of project work at the site. Navisworks utilizes planning of project generate 4D simulation using time liner. This software combines construction planning with spatial coordination, permit the simulation task and after analyzing supervise the changes for construction growth.

3.3 5D Cost Analysis of Residential Building House Model

After formulating the time schedule, another important aspect of BIM is cost estimating which is next essential feature of building process that provides lot of benefits regarding building information. This research paper uses Autodesk Revit for estimating cost analysis which is known as 5D modeling in BIM. Digital cost estimating automatically accounts for different deductions in estimation by quantifying them digitally i.e. it take measurements directly from the model.

In handmade scheduling, about 50–80% time is required for scheduling. However, this problem is properly eliminated using BIM 3D model. Reduction of manual work in project saves money, time and eliminates a human error which delays the project work. It is identified that considerable amount of research is done during different project phases and there is need of forming new procurement technique which forms sustainability in project. The output of project comes during construction stage without BIM is at moderate scale but the information regarding work is still not up to the mark^{17,18}. It automatically quantifies the values and allows the estimator to work on another task. There are different applications in BIM to get systematic cost scheduling work (5D) and material takeoff. Some

of these are: API (Application programming interface), Open Database Connectivity (ODBC) connections and Output to Excel. API creates direct link between Revit and costing system. BIM create common language for all people who join with the firm and develop integrated system. ODBC database access the information of building model and export 2D and 3D CAD files into software which connect the dimensional information. In next approach it creates material takeoff in Revit software and after that forming a data output on excels spreadsheets and then handover to the customer of the project.

3.4 Cost Estimation Analysis in Autodesk Navisworks

The main advantages of Autodesk Navisworks is that it is not only used for 4D factor but also used for 5D i.e., cost factor analysis. Navisworks freedom defines the task work properly after analysing the time and then at the same time it evaluates the total cost factor of project.

The overall cost of 3D design model can be evaluated by analyzing different component of model and generated cost of that component. The cost scheduling of 3D Model on NavisWorks Freedom is shown in (Figure 7).



Figure 7. 4D analysis of Revit 3D House Model on Navisworks freedom.

Cost data can be evaluated by importing data of Revit Autodesk and time data can be evaluated by importing MS Project data in Navisworks 2 for superior visualization and simulation design purpose. After visualizing and simulating the building model 4 variety of simulation color are obtained:

Green: - Which shows the project is within the cost and earlier than time schedule.

Grey: - Which shows the project is within cost and after the time schedule.

Dark Grey: - Which shows the project is more than the cost and earlier than the time schedule.

Blue: - Which shows the project is more than the cost and after the time schedule.

3.5 Cost Estimation Comparison between Traditional Technique and 5D BIM Technique

To know about the cost difference between traditional v/s BIM technique; estimation of residential house building model can be evaluated by both manual

technique and software technique in which the cost estimated by Revit software analyzed further again Sigma estimate software to generate total cost of project.

The comparison between Traditional estimate amount and Sigma estimate amount of different components of 3D model is shown in (Table 1).

Table 1. Cost estimation comparison between traditional technique and 5D BIM technique

Sr. No.	Description of Items	Quantity	Unit	Rate	Traditional Estimate	Sigma Estimate
1.	Excavation in foundation trenches	385.42	m ³	₹115.30	₹5788.00	₹5,699.69
2.	Cutting in earth work	80.64	m ³	₹59.55	₹4,802.00	₹4,755.40
3.	Filling in plinth with sand under floors	10.07	m ³	₹213.70	₹2,151.95	₹1,399.20
4.	Providing formwork with steel plate					
i.	Foundation, footing base of columns etc.	28	m ²	₹63.60	₹1,794.00	₹1,764.00
ii.	Flat surface i.e. soffits of roofs, suspended floor	111.53	m ²	₹134.10	₹14,956.17	₹12,770.90
iii.	Column, pillar, struts etc of floor, roof, landing etc	77.76	m ²	₹112.40	₹8,740.22	₹7,296.00
iv.	Beam, girder, lintel etc not exceeding 1.00 mtr.	172.91	m ²	₹108.30	₹18,726.15	₹18,576.00
5.	Staircase with stepped soffit excluding landing.	13.3	m ²	₹91.50	₹1,217.00	₹1,170.00
6.	i) Edges of slab and break in wall under landings.	71.2	m ²	₹35.10	₹2,499.00	₹2450.00
	ii) Providing and laying cement conc. 1 : 6 : 12	30.38	m ²	₹91.50	₹27,779.77	₹27,153.00
7.	Providing and laying cement conc. 1 : 4 : 8.	3.24	m ³	₹1,048.70	₹3,399.00	₹3,395.52
8.	Providing and laying M20 grade cement conc.	11.22	m ³	₹1,765.20	₹19,805.54	₹19,768.00
9.	Providing and laying M20 grade suspended floor roof	14.68	m ³	₹1,794.67	₹26,345.75	₹26,335.92
10.	Beam, cantilever lintel etc. G/F plinth beam.	1.2	m ³	₹6,689.00	₹8,026.80	₹8,026.80
11.	G/F slab level beam.	1.1	m ³	₹6,755.89	₹7,431.47	₹7,430.50
12.	1 st floor slab level beam.	48.3	m ²	₹108.30	₹5,230.89	₹5,230.89
13.	Staircase ground floor to 1 st floor.	18 No.	Each	₹86.50	₹262.86	₹260.26
14.	Providing M.S tor steel reinforcement for R.C.C.	59652. 2	kg	₹20.70	₹1,2345796	₹1,23,47,96.40
15.	Rubble masonry coursed with hard foundation.	36.97	Kg	₹1,455.90	₹53,824.63	₹53,824.62
16.	Precast conc. Block with solid conc. Block C.M 1 : 6	11.52	m ³	₹1,570.40	₹18,091.00	₹18,059.60
17.	Precast conc. Block in partition wall with C.M 1 : 3 : 6	51.27	m ²	₹163.00	₹8,357.00	₹8,313.00
18.	G/F front and back	89.96	m ³	₹163.00	₹14,663.40	₹14,507.00
19.	Providing and fixing prelaminate board 12 mm thick	24.46	m ²	₹1,383.80	₹33,847.74	₹33,828.18

20.	Providing and fixing commercial board 19 mm thick	14.2	m ²	₹977.25	₹13,876.95	₹13,873.40
21.	Providing 12 mm thick pelmet 25 * 3 mm	12.92	M	₹144.70	₹1869.52	₹1734.70
22.	Providing M.S grill in wooden frame in window	516.8	Kg	₹29.20	₹15,090.00	₹14,987.20
23.	Providing aluminum handles					
i.)	250 * 10 mm	36		₹35.00	₹1,260.00	₹1,260.00
ii.)	150 * 10 mm	104		₹30.40	₹3,162.00	₹3120.00
24.	Providing wooden doors and window 0915 * 2134 and 0915 * 1830 mm	49		₹128	₹6272.00	₹6,272.00
25.	Providing oxidized M.S single spring hinge	4		₹78.50	₹314.00	₹312.00
26.	Providing and fixing M.S Hook.	52		₹6.30	₹328.00	₹327.00
27.	Providing and fixing screws 115 mm	12		₹7.50	₹90.00	₹90.00
28.	Providing and fixing door stopper	18		₹26.95	₹485.00	₹504.00
29.	Stone soiling filling dry hand packed in under floor.	28.24		₹303.10	₹8,559.54	₹8,484.00
30.	40 mm thick C.C flooring 1 : 2 : 4 laid aggregate	3.96	m ²	₹97.00	₹384.12	₹368.60
31.	Apply cement slurry on R.CC slab & plain conc. wall.	138.5	m ²	₹10.90	₹1,510.00	₹1,504.20
32.	Provide readymade glazed wire gauge window frame	1470.68	Kg	₹40.45	₹59,489.00	₹59,535.00
33.	Painting two coats with ready mixed finish oil	94.11	m ²	₹21.20	₹1,995.00	₹1,974.00
34.	Steel work welded with steel section	6.40	qnt	₹3,127.30	₹20,015.00	₹18,762.00
35.	Applying prime work over wood work section	91	m ²	₹10.50	₹956.00	₹910.00
36.	Painting two coats on new wood with enamel paint	91	m ²	₹22.10	₹2,011.00	₹2,002.00
37.	15 mm cement plaster in single brick wall	122.82	m ²	₹38.40	₹4,716.00	₹4,636.00
38.	White washing with lime ceiling	124.04	m ²	₹2.40	₹298.00	₹297.60
39.	Distempering the wall with branded material	481.34	m ²	₹13.00	₹6,257.00	₹6,253.00
40.	Providing under layer for plinth protection 75 mm	28.95	m ²	₹70.00	₹2,027.00	₹2,023.00
41.	Providing W.C 580 mm size	2		₹385.75	₹772.00	₹760.00
42.	Providing and fixing PVC pipe 45 mm size	10		₹16.15	₹162.00	₹161.50
43.	Providing and fixing cast iron pipes	28.6	M	₹89.40	₹2557.00	₹2,536.00
44.	Providing and fixing cast iron trap	78.1	M	₹20.85	₹1,628.00	₹1,560.00
45.	Constructing roof with roof rafter with suitable pitch	15.68		₹1,112.25	₹17,444.00	₹17,440.08
46.	Providing and placing brick layer	100		₹5.00	₹500	₹440.65
47.	Excavation in drain chamber up to 20 mm excavation	13.34	m ³	₹75.95	₹1,013.00	₹975.00
				Total	₹12808574	₹1680,800.2

4. Result

This research shows that 4D BIM technique evaluates overall time scheduling task of small scale residential house model only in 5 months which is from 3-11-2017 to 23-3-2018 in spite of traditional time scheduling technique which takes more time to complete the task. Timeliner tool in Autodesk Navisworks links the file with 3D model and creates 4D simulation at earlier stage before the work is started.

Importing the project information or schedules in Navisworks which is taken before and during project forming a Gantt chart to provide view of all project activities with time. 4D BIM has an ability to estimate and look forward towards the problems before they actually occur in the project which helps the small scale budget projects to complete the task at proper timeline and save money by reducing the economic issues which are generally visualized in Indian projects. Another focused area of research paper is to gather information about 5D BIM. BIM helps the project incharge to complete the project successfully rather than traditional technique. 5D BIM technique used in Indian construction project helps the people to save time and money and also take an initiative for the development of country by increasing economical demand of BIM usage. Generally virtual project development technique is used for 3D simulation of model which avoids collapse of structure and generate 5D environment at site.

By evaluating cost estimation of same project i.e. Residential house building project in both ways. It is noticed that the total cost of project is calculated by traditional or manual technique is ₹12808574.00. Total cost evaluated by same project with 5D BIM technique is calculated ₹1680800.20 which means the total reduction of cost is ₹11127774.00. According to specifications which are provided by budget house builder or govt. sector in India the cost of construction of residential house building should come across around ₹1500 /- sft up to 2000 per sq ft. including all charges like structural design cost, architectural design cost, building construction cost as well as external cost i.e. lump sum rate etc. These can be evaluated simply by govt. sector or housing builder (1500*12274) will be ₹18,411,000 including overall cost of building. At any construction project the full information is the necessity of people linked with that project from starting to end point. The various surveys conducted on

industrial projects area status that 50 percent of problems generated in project due to site problems which affects designing work¹⁹.

But working with 5D BIM application which is based on IFC standards helps the project manager to work on 600 types IFC entities and made the task easier for project designer. This research shows that by dividing the project into BOQ items and then applied standard measurement methods by using digital information helps to control cost scheduling problems. It is estimated that the overall cost of BIM residential building is higher than the Indian traditional design but it is favorable if we use cost control process i.e. simulation based approach with time and cost trade analysis. In this project the overall cost of project is reduces up to 25–30%. For evaluation of 4D and 5D BIM analysis simple criteria is used:

1) Calculate actual cost of 2D drawings elements by using traditional technique and named as **CA1** (Cost analysis 1).

2) All elements of BIM residential house model are taken in to the account and compare this 3D model with actual cost estimated by traditional technique and name this **CA2** (cost analysis 2).

3) Actual cost evaluated on spreadsheet by calculating all preliminary and secondary data of project **CA3** (cost analysis 3).

By using Budgeted Cost of work performed analysis (BCWP) variance of the project can be determined:

$$VA1 = CA1 - CA3$$

$$VA2 = CA2 - CA3$$

Further these values can be compared by results of research work.

5. Conclusion

BIM creates efficient and effective developing method which is intensively required by any industry to improve the progress performance by reducing the cost and budget issues, time issues, lack of information issues and issues related to delayed services of project work. By using 4D and 5D BIM technique, number of problems in construction industry can be solved easily. It properly removed unbudgeted changes that may arises during project at different levels which gives 80% time reduction and 20–30% cost reduction of measured cost schedule which is far better than the manual construction technique adopted by Indian construction projects.

4D BIM creates great impact on construction project against traditional techniques. In country like India where visibility of construction progress work is not so clear it provides much better visualization and communication of project work which provide great efficiency. It eliminates rework and clashes happened at construction site by detecting the problems of work at earlier stage which helps Indian construction companies to remove budget regarding issues and increase economical factor. However, the lack of knowledge about BIM creates problems to the society although creating 4D and 5D models with small elements is also very expensive. But this problem can be solved by budget control process. Vital area of the project can be stabled by 4D and 5D simulation tools by knowing the time and cost factor which helps the project committee for making good decisions regarding the small or large scale projects.

6. Acknowledgement

SP thanks the Chandigarh University Punjab to carryout BIM research work.

7. References

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