



INTERNATIONAL JOURNAL OF ADVANCE RESEARCH, IDEAS AND INNOVATIONS IN TECHNOLOGY

ISSN: 2454-132X

Impact Factor: 6.078

(Volume 7, Issue 4 - V7I4-1542)

Available online at: <https://www.ijariit.com>

Software for implementing different dimensions of BIM in the construction project

Omar Ahmed Khan

guddu91@protonmail.com

Heriot-Watt University, Edinburgh, Scotland

ABSTRACT

Essentially standard set of building construction measure was reverse to appropriate assignment programme and arrangement for the proceeding project work at the construction site, which was bringing about imperfect observance for the complete cycle. The current investigation on the idea of Building Information Model (BIM) infers the objectives where whole data of each unique element of construction activity is incorporated basically. It helps the Constructors, Designers, and Engineers for anticipating what should be created in the synthetic surroundings and to perceive potential plan, development or operational issues. The system is expanded by BIM into drawings of 3 dimensional (3D) with three dimensional depth (d), height(h) and width (b), with 4 dimensional time (4D) and with 5 dimensional (5D) time. For setting up the standard process, BIM displays 5D model to save more amount and time. The project management activities are executed using the concept of the BIM is presented in this paper. The BIM apparatus is to help particularly for configuration, characterizing the building capacity and structure, look over the expenses, execution of energy and timing. Hence BIM is a construction management device which is a process of simulating all kinds of proceeding construction building projects.

Keywords: Visualization, BIM, REVIT, Navisworks Manage, Microsoft Project, 5D

1. INTRODUCTION

Undertaking the project management has become a significant field of concentrate since mid 80's and it is acquiring consideration from that point onward. The executives assists with arranging, plan, track work and report; thus it has discovered applications in different business areas. The civil engineering field is engaged with various sorts of ventures which are complex and huge in nature. Venture arranging and planning are urgent elements that influence the execution interaction and go about as vital piece of the management. The way from planning to arranging includes different advances of human translation and information control. Manual strategies for arranging measure have end up being dreary and tedious

contrasted with use of programming's and current methods that have been utilized for overseeing purpose (Mudasir Amin Chowdary et al., 2016).

Development project arranging presently includes a few strategies and procedures that have model conditions also, pattern of exercises associated with the undertaking. Bar outlines, time-change graphs, Critical way technique and network charts are a portion of the strategies. These procedures are not having the limit of displaying and normal punch as far as both concatenation and performance example of exercises. The partners utilizes 2D AutoCAD drawing device for arranging and planning the structure. This apparatus doesn't provide amazing data and explanation about the arrangement for the customers. Thus it is troublesome in comprehension for the customers. Utilizing Building data model idea has beat the disadvantage of 2D AutoCAD drawing and acquired prevalence in the construction field (Atul Porwal and Kasun N. Hewage, 2013).

Building data model (BIM) apparatus is utilized by the experts which encourages them to give proficient data about the venture concept in documentation, construction assessment, planning, arranging, and booking, and so forth. Dealing with the interaction of development as indicated by plan furthermore, inside the assessed cost is demonstrating significant benefits by utilizing this BIM device. This BIM instrument works step savvy, and the levels from establishments to completing of the structure. Part by part the levels are shown independently from sections, radiates, chunk, dividers, entryways and windows and so forth. The BIM is planned so that we can see 3D representation, observing and delivering of the ideal arrangement. BIM technique oversees and gets the information all through the existence pattern of the development. Thus the BIM passes on idea to customers in an extremely simple persuading way. The instrument proficient utilizations this model to make project into the 3D viewpoint for delivering and representation. Subsequently the venture director utilizes the 4D BIM device for genuine reproduction of real venture. BIM has changed altogether in the method of undertaking conveyance; it presents new plan, development and has

computerized portrayal of the cycle. By utilizing this device numerous inventive undertakings has finished effectively and there is advantage to the expanded in quality plan, improvement in quality and furthermore diminishes time delay just as it decreases cost (Kim, H.S, etal., 2012).



Fig-1 Building Information Model Stakeholders

2. BUILDING INFORMATION MODEL

BIM is an apparatus which is arranged in consecutive request that permits dividing information about project among different applications which will be later addressed in 3D structures, 4D Time and 5D cost and up to nD. This all the data usage of the proprietor/proficient keep up the all through lifecycle. After such countless long stretches of examination and advancements in the development industry, it is being received. BIM models are utilized by various experts in the industry of construction across the world.

The colleague changes this work partitions concurring to development necessities and changes in plan to succeed the model towards the precision as much as could be expected. While the model has been made, this could be accomplished previously actual beginning of project in construction.

Building Information Model (BIM) Dimensions

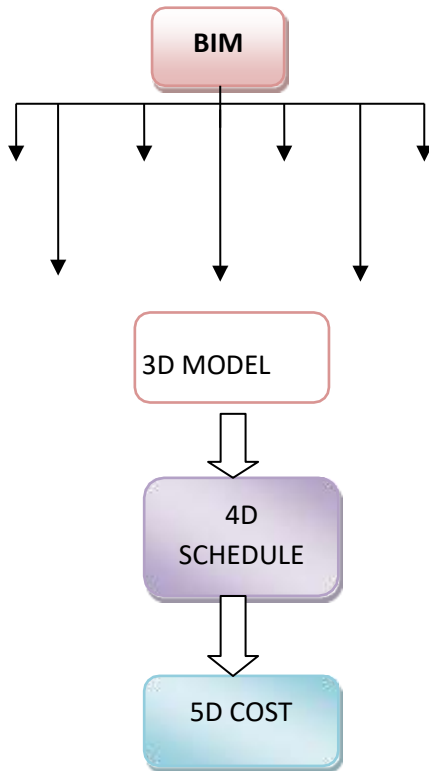


Fig-2 Building Information Model Dimensions

5 DIMENSION BIM

5D model characterized by the model of 3D which is connected with cost and scheduling of time by utilizing appropriate programming. This aides in getting forecast and also increment in execution during the stages of construction.

3 DIMENSION BIM

3D model is characterized as the three dimensional space that is (length (l), height (h), and width (b)) geographic data of building and calculation. By utilizing 3D model planning the mistake due to reliable drawings of 2D are recognized and wiped out.

a) Design model: site models, underlying, MEP (mechanical, electrical also, plumbing) and Architectural.

b) Construction model: Break out the plan models into the construction patterns.

3 DIMENSION BIM

4D model is characterized by model of 3D. The construction project is joined time plan by utilizing reasonable programming program, which give the clients to virtual recreation of construction project as 4D condition and furthermore pictured like a different building exercises at specific time term which is seen in model of 3D.

The time booking includes the project of construction for planning day by day and month to month exercises, so the part of customer pull in towards a BIM of 4D. The information about model of the 4D BIM can be put away to such an extent that it tends to be utilized for the whole undertaking planning. In the model of 5D, the expense of the undertaking can be determined to the monetary exhibition rate of the task during the genuine stages of construction.

4D/5 D BIM NEEDS

- 1) Trouble has been noticed utilizing the customary booking and checking techniques like Critical way technique. This strategy isn't simple and quick running, since it will be sensible on the management on construction boundaries like quality, cost and time by the decrease of profitability of the construction business industry.
- 2) Development project consistently starts from an wrong plan, inappropriate development arranging and then absence of correspondence. This will performs unsuitable work and results in long task span and high cost.
- 3) The Critical way strategy consists of scheduling which considers as priority requirements and time. Hence, these customary strategies are utilizing in construction arranging and it is discovered to be powerful.
- 4) The construction orders are executed by the site engineer, he should connect the planned data with the modelling of threedimensional. It is a troublesome while there will be some changes in the activity. Hence it is influencing the general project of construction.

Imulation Activity Of 4D/5D BIM

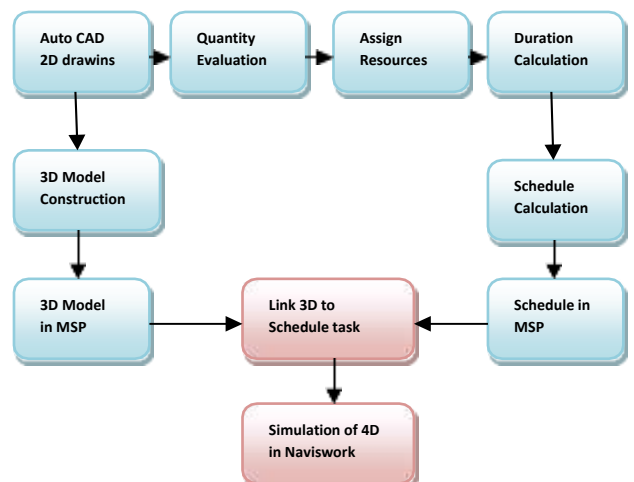


Fig-3 Simulation Process of 4D/5D

1. 3D model of Revit AutoCAD is set up the programming of Naviswork Mange. The documents are append with the Miniature Soft Project. This makes the 4D of the structure data demonstrating examination time.
2. There will be one ideal bar alternatives for the software of Naviswork Mange, in this choices adding planning action document which will be brought up from the Micro-Soft Project. Each action is refreshed with model of 3D setting up document. Utilizing recreation video alternatives which is seen in the different building action's in model of 3D.
3. More ideal will naturally refresh the simulation if timetable or model change.

3. LITERATURE REVIEW

Mudasir Amin Chowdary et al. (2016) clarify that the different displaying and venture arranging of designs by executing 5D model BIM method. Akash A. Patel et al. (2016) clarifies about the execution of venture the executives capacities with utilization of Building Information Demonstrating idea in Building of Residential. Raiyan Mansoori et al.(2016) clarify the Building Information Demonstrating and Methodology application. Prakash Chandar (2015) examined about the incorporation of construction plan action with 3D model outcome, and it is as 4D arranging. Sagar M. Malsane et al. (2015) clarifies the Recreate construction booking utilizing BIM allocation of 4D for tracking the advancement. Nisarg M. Mistry et al.(2014) examines about the unique programming and the Building Information Modeling (BIM) utilized for management of project in construction and checking in the business of construction. Vijay Kumar et al. (2013) clarify the Building Information Model based undertaking planning and progress observing in Construction Industry, Architects and Engineer. Manish Goyal and K.N.Jha (2007) zeroed in investigate model of 4D produce by linking 3D model of mathematical with planning information, that guarantee task partners for picture to following construction process with the help of advancement in time. This investigation was essentially pointed toward building up this program which will empower the clients to annihilate every one of the blemishes at any moment of the undertaking and furthermore before the project execution. Despite the fact that the construction project test was over and however the outcomes are came promising and large assisted with improve in the project procedure and planning. Atul Porwal and Kasun N. Hewage (2013) have investigated that execution of BIM is as yet a test for the construction industry of North American. The construction industry of Canadian, conversely, is well suited in the U.S. at the appropriation rate of BIM. Ability and selection of BIM depending upon the customer and the proprietor in the building project. Local area customers frequently feel that the market isn't prepared for selection of BIM which is reluctant for expanding costs of project by carrying out BIM in restricting rivalry. Besides, if the worker for hire isn't included the undertaking in the plan stage, BIM has restricted force. Hence, in the paper favors 'BIM cooperating' based local obtainment structure for guarantee good an incentive in the project of construction. The contextual investigation depicted in this paper affirmed BIM plausibility and obtainment with freely subsidized development projects. This paper recommends that the authoritative course of action for the project which brought about rework, improved efficiency, diminished blunder and better coordination.

Hexu Liu et al., (2014) introduced definite expense assessment what's more, development project planning utilizing an incorporated system dependent on BIM. This work was accomplished by building up a BIM item model utilizing

Autodesk Revit programming. The writing in regards to BIM cost assessing and booking were contemplated and overviewed prior to proposing the undertaking structure. A basic structure project was utilized as a contextual investigation to encourage the result. Byungjoo Choi et.al (2014) This paper orders work space by the capacity and portability and proposes a structure for a work-space arranging measure which contains five stages, involving (BIM) 4D age, work-space necessity distinguishing proof, work-space issue distinguishing proof, work-space occupation portrayal and work-space issue goal. The arranged system in this paper will improve the exactness of status of the work-space portrayal and work-space issue recognizable proof by presenting the work-space occupation idea and the coordinated work-space arranging measure which considers qualities of action, work space, and development plan. Likewise, this paper plans to improve the work-space arranging measure through way examination and formalized work-space issue goal measure. To approve the proposed approach, a case project is tried. The outcome shows the productivity and viability of the proposed structure on improving the work-space arranging measure. In light of the consequence of this investigation, an undertaking director will be ready to forestall conceivable work-space issues and their negative consequences for project execution by making a appropriate plan of work-space during the stage of preconstruction. Prakash Chandar, Dhivya Shree (2015) led an examination which was centered around benefits that project of construction chief and the business of construction will draw from doing the 4D arranging. The stage depended on coordinating parts of 3D model with scheduling time which produce 4D arranging system which altogether have end up being successful in on-time-conveyance of the venture. Reanalysis of the undertaking was finished in customary strategy by utilizing 4D wanting to dodge all the inconsistencies of the equivalent project. Jiang Xu (2016) access the examination dissects the current circumstance of the improvement of the business of construction and the development period of the task the executives issues and likewise it investigations the application standard of Building data displaying innovation and the demonstrating stream of 5D BIM. Jing Jiaa et.al (2016) expects to cover this hole by contemplating the use of BIM on private structures' plan stage under the regularly utilized mode of DBB (Design-Bid-Build). Through the assessment and interest of a few ventures, this paper builds BIM application esteem framework counting explicit carrying out plan and conveyance structures in light of the mode of DBB. The framework covers the periods of plot plan, fundamental plan, drawing plan of construction and point by point plan and includes the expert fields from general format, refined enhancement, metropolitan office, scene, Mechanical, Electrical and Plumbing (MEP), design, and structure. Xue Lia et.al (2017) through helping the structure data model and 5D BIM programming in the plan of construction the management not just asset the prerequisites, hardware interest and capital necessities can be distinguished yet additionally in the genuine process of construction. Timely observing, the budgetary reserve deviation measure, Opportune managing, check quality, security issues, fixing the deformities and afterward the undertaking checking should be possible in the genuine process of construction.

4. METHODOLOGY

4D/5D Model Creation Steps

STEP1:Architectural Design Creation

The plans of the project of construction are made by utilizing software of 2D AutoCAD drawing.

STEP 2: 3D Model Creation

The development of building is seen by the model of 3D which is made by utilizing Architecture of Autodesk Revit. The 2D AutoCAD drawing is brought into Design of Autodesk Revit by utilizing joining the option CAD.

STEP 3 : Different Types of Drawing Creation

In the event that the drawing is made independently in AutoCAD, they are brought into programming of Autodesk Revit utilizing embed choice. It encourages programming of Revit Architecture to play significant part in identifying conflicts between different segments of the task. Go to help in overseeing, arranging and get the project gauge at stage of arranging.

STEP 4: 3D View Creation

In the programming of Revit Architecture squeezing a home shape button in the see tabs, the diverse 3D view is seen by turning the block. It is shown different segments are appended in the projects. It help clients to see genuine virtual of the projects.

STEP 5: Export Autodesk Naviswork Manage By 3D model

For a planning of 4D model, made the model of 3D is traded to the Software of Autodesk Naviswork Manage.

STEP 6: Process of Scheduling Initiation

The Software of the Miniature Soft Project is utilized as a scheduling apparatus. It plans the different exercises as distinguished the structure of break down work. It is utilized as timetable for the project of construction, shows the beginning and completes dates, finding basic ways and buoys seasons of the exercises and furthermore shows the succession, the different exercises interrelationship. And furthermore shows the each activates expense.

STEP 7: 4D Model Creation

At the point when 3D model document is brought into programming of Naviswork Oversee, the program naturally adjust revolution what's more, units rescale wherein every record is appended to show units. Import project plan of Micro-Soft and 3D model in the Autodesk Naviswork Mange for making the model of 4D.

STEP 8: 3D Activity Model Linking

Import the project plan to the software of Naviswork Oversee information source in the tab of time liner for production of the model of 4D, exercises from the plans of Micro-Soft Project are connected with the elemental model of 3D.

STEP 9: Project Simulation

The 4D model is envisioned by the undertaking through beginning the reproduction. In the recreation interaction the sum of work done on the different work exercises and seen in the view of 3D. It helps in task perception, arranging furthermore, overseeing and so forth. Likewise cost of the different exercises are seen in the project of Micro-Soft. This provides the buildings complete undertaking cost.

Steps To Follow While Setting Up And Running 4D

1. Micro-Soft Project imported into the programming of Naviswork Oversee. In the bar of time liner characterizes a few task i.e., default types like development, wreck, transitory.
2. Connection action ID with related component of 3D model.
3. Ensuring that all the movement ID's are connected with fitting 3D component of 3D model.
4. Building data model of 3D is made in Autodesk Revit to incorporate with the plan of Micro-Soft Task for the simulation of visual.
5. The model of 4D is made in different quantities of levels inbriefly, from the upward flat level of the longitude zone of construction during the plan phase to the itemized fill in as a feature of huge undertaking coordination during thestage of construction.
6. The methodology is proceeded to the model are refreshed and keep up that refreshed which interface between the timetable and model of 3D. The recreation changes found in the model of 3D.
7. The model of 5D is a mix of model of 3D with the cost of construction and timetable of undertaking term.
8. 5D model clarifies about the perception, arranging, booking, checking and conflict recognition by any stretch of the imagination building phases of pre-development and post-development interaction.

5. RESULTS AND DISCUSSION

Project Details Includes

- Project Name
- Location
- Number of Storey's
- Area of Site
- Area of build up
- Estimation Cost
- Planning Started
- Planning Finished
- Duration of Project Planning

2 D AutoCAD drawing

2D Auto CAD drawing is inserted to the software of the 3 D model.

2 D drawing imported to 3D model in the architecture of Autodesk Revit:

The displaying interaction of Autodesk Revit Architecture including stages of arrangement connected for every task at Microsoft Scheduling by the software Naviswork Oversee.

Micro-Soft Project Office Schedule

Building cost and span of various action task is made in the Micro-Soft Project programming. The highlights of the given functions are like begin to begin, begin to complete, finish to begin and complete to complete and so forth.

1. Residential project planning and scheduling utilizing bythe Microsoft Project programming.
2. Standard Calender is utilized.

MImporting 3D model and schedule MSP in the software of Naviswork Manage to create model of 4D/5D

1. Exporting model of 3D Architecture Revit to file of DWF record into the software of Naviswork Mange.
2. Exporting timetable of Micro-Soft task to programming of

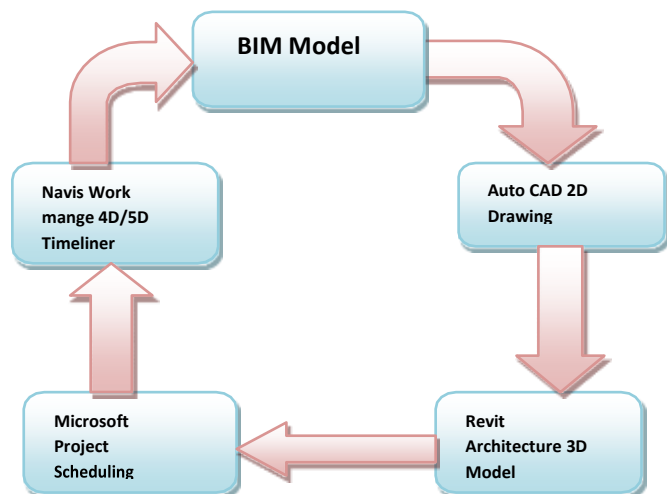


Fig-4 Development Process of BIM Model

Naviswork Oversee.

3. Connecting the model of 3D with exercises in the span plan.
4. Refreshed between model of 3D and timetable of Micro-Soft relationship in a records of set up.

4D/5D visualization and simulation in the software of Naviswork Manage:

1. Simulation of 4D involves bit by bit building development. Thus connection of MSP office to the component of the building.
2. Work timetable incorporation and 3D model is completed in the programming of Naviswork Manage.
3. When all the movement undertakings from the timetable of Micro-Soft are connected or appended to the relating component model of 3D, thus seen the 4D recreation.
4. Simulation of 4D shows the task progress on the basis of day by day.
5. The planning and execution is shown and dates are enabled.
6. A simulation video is created from beginning to end dates for providing a client a project demo.
7. Different building task for the specific building is Utilized by the simulated video options which is seen in the model of 3D. Finally the cost is seen in the file of MSP which is linked in the bar of timelier.

6. CONCLUSION

Micro-Soft Project is the helpful programming to prepare planning and pattern.

- Creating the spending plans dependent on the asset rates and task term. A schedule is arranged and allotted for every asset and the asset is allotted to different assignments depend on its accessibility.
- The software can't take care of issues and oversee the complex problems. The application assists with making diverse way timetables and levels the assets naturally if necessary. It gives data and shows results in a type of Gantt and bar charts furthermore, pie charts and graphs, and so on.

In this paper, it reveals 3D model displaying and model of 4D time management in the construction project. Therefore, the various perspectives are forms like,

- 1) A wonderful representation apparatus for screening the task progress and it accelerates the planning of construction.
- 2) It is simple and suitable instrument for utilizing the cost of construction, and asset executives.
- 3) All the means of constructions are changed and overseen anytime by just tapping on the action and component.
- 4) Using this innovation, work, cost and time executives becomes smooth and attainable.
- 5) These are easy to use and is handily received by project administrators, amount assessors and engineers, etc.
- 6) In request to diminish the time and expense, rework of 5D BIM which is a used as a proper device for the management resource and the construction cost. All things considered, more examination ought to be zeroed in on the advancement of useful model of 5D BIM.

7. SCOPE OF FUTURE WORK

The application of 4D/5D model BIM is additionally added for the different bases of information from the various fields like Mechanical, Electrical, Plumbing and so forth In the innovation of 5D BIM – "fourth D" is a period plan and "fifth D" is an expense, further which is explained by different measurements like an activity, supportability, security, assets,

material and so on and it tends to be expanded up to nD.

8. REFERENCES

- [1] Abhijit .N. Bhirud and Pravin B. Patil "Application Of Building Information Modeling For The Residential Building Project" International Journal of Technical Research and Application Volume 4, Issue 3 (May-June, 2016), PP. 349-352.
- [2] Akash A. Patel, Dhruv B. Chaudhary, Prof. Umanag Sheth, " Simulation of Residential project using BIM concept " (2016), International Journal for scientific Research and Development, vol.4, page no. 1203-1205.
- [3] Ales Tomek and Petr Matejka, The impact of BIM on risk management as an argument for its implementation in a construction company, Procedia Engineering 85 (2014) 501 – 509.
- [4] Amol A. Metkari and Dr. A. C. Attar, Application of Building Information Modeling Tool for building project, International Journal of Science and Research (IJSR), Volume 4 Issue 5, May 2015.
- [5] Atual P., Kasun N., "Building information modelling partnering framework for public construction project" (2013), Journal of Automation in construction, vol. 31, page no. 204- 214.
- [6] Byungjoo Choi, Hyun-Soo Lee, Moonseo Park, Yong K.Cho ,Hyunsoo Kim "Framework for Work-Space Planning Using FourDimensional BIM in Construction Projects" J. Constr. Eng. Manage., 2014, 140(9): 04014041.
- [7] Chandar, P., Dhivya Shree, G., "Integrating Building information modelling (BIM) and construction project scheduling to result in 4D planning for a construction project with Relevant Illustration "(2015), International Journal of Emerging Engineering Research and technology, vol. 3, page no. 67-74.
- [8] Chau, K.W., Aanson, M., and Zhang, J, P., "Fourdimensional visualization of construction scheduling and site utilization"(2004), J construction Engg manage, page no.598-606.
- [9] Deepa A. Patil, Amey A. Kelkar Rohit S. Malawade "Application of Building Information Modelling Software's for Planning and Scheduling of Multi- Storeyed Building" International Research Journal of Engineering and Technology Volume: 04 (2017) 2775- 2782.
- [10] Fernanda Leite, Semiha Kizihias, "Building information modelling partnering framework for public construction project" (2011), Journal of Automation in construction, vol. 20, page no. 601-609.
- [11] Gamayunova, O., Vatin, N. BIM- technology in architectural design (2015) Advanced Materials Research, Vols. 1065-1069, pp. 2611-2614.
- [12] Hartmann T., GAO, J. and Fischer, M., "Applications of 3D and 4D models on construction project"(2008), Journal of construction Engineering and management, page no. 776-786.
- [13] Hexu Liu, Ming Lu and Mohamed Al- Hussein "BIM-based Integrated Framework for Detailed Cost Estimation and Schedule Planning of Construction Projects The 31st International Symposium on Automation and Robotics in Construction and Mining (ISARC 2014).
- [14] J. J. McArthur, a building information management (BIM) framework and supporting case study for existing building operations, maintenance and sustainability, Procedia Engineering 118 (2015) 1104 – 1111.
- [15] Jing Jia, Jiayue Sun, Zhiqing Wang and Tongrui Xu "The construction of BIM application value system for

- residential buildings' design stage in China based on traditional DBB mode" *Procedia Engineering* 180 (2017) 851 – 858.
- [17] Jiang Xu "Research on Application of BIM 5D Technology in Central Grand Project" *Procedia Engineering* 174 (2017) 600 – 610.
- [18] Kang, L.S , Moon, H.S., Park, S.Y., and Lee, T.S., "Improved 4D CAD system for visualizing construction work by using WBS as interface code" (2010), *KSCE journal of civil engineering* , vol.14(6), page no. 803-814.
- [19] Kim, H.S, Moon, H.S., Kim H.Y., and Kang, L.S et al. "Development and Application of BIM system for construction project by project phase focusing on Bridge project" (2012), *journal of Korea Institute of construction engineering and management*, vol. 13(2), page no. 11- 24.
- [20] Manish Goyal "Development of a 4D model for Application in construction Management" (2007), 24th international symposium on Automation and robotics in construction, page no.289-294.
- [21] Menglin Wang "Building information modelling: Site - Building interoperability methods" (2011), *Interdisciplinary construction project management*.
- [22] Moiz Tarar, "Impact of 4D (fourth dimension) modelling to a construction planning process" (2012), *University of Technology*, page no. 1-46.
- [23] Mr. Satish A. Pitake and Prof. Dhananjay S. Patil, Visualization of construction progress by 4D modeling application, *International Journal of Engineering Trends and Technology (IJETT) – Volume 4 Issue 7- July 2013*.
- [24] Mudasir Amin Chowdary, Dr. Rajendra.S, Vijay.K, Vidyashree .M, "Modelling and project planning of a structural by implementing 5D (fifth dimension) building information technique" (2016), *International Journal of innovative Research in computer and communication Engineering*, vol.4, page no. 6969-6976.
- [25] Nisarg M. Mistry, Hiren A. Rathod, "Software for BIM project management and controlling" (2014), *International Journal of scientific Research and Development*, vol.2, page no.720-724.
- [26] Prakash Chandar. S, Dhivya Shree. G, "Integration building information model (BIM) and construction project scheduling result will be in the 4D planning for a Construction Project with Relevant Illustrations" (2015), *International Journal of Emerging research and technology*, Issue 4, vol.3, page no. 67-74, ISSN 2349-4395.
- [27] Pravin, B., Patil, and Abhijit, N., Bhirud, "Application of Building information modelling for the residential project" (2015), *International Journal of Engineering Research*, vol.3, page no. 13-18.
- [28] Raiyan Mansoori, Mudassir Zahid Pakhmore, Prathamesh P. Gawade, "Application of Building information modelling to civil Engineering project" (2016), *International Journal of Engineering Research*, vol.5, page no. 123-125.
- [29] Roshna T. Mohd. H, and Nawawi.A.H, " Building information modelling (BIM): new paradigm foe quality of life within Architectural ,Engineering and construction industry (AEC) International" *procedia social and behavioural sciences*, page no.23-32.
- [30] S. M. Dodiya and S. Hariharan, Evaluating effectiveness of BIM application in Construction Projects, *International Journal of Engineering and Computer Science*, Volume 4, Issue 9, Sep 2015.
- [31] Sagar M Malsane and Amey Z Sheth, Simulate construction schedules using BIM 4D application to track progress, *International Journal of Mechanical and Production Engineering*, ISSN: 2320-2092, Volume3, Issue-6, June- 2015.
- [32] Smith D, "An introduction of Building Information Modelling (BIM)" (2007), *journal of building information modelling*, page no. 12-14.
- [33] Vijay Kumar, Saini, Mhaske, Sumedh, "BIM based project scheduling and progress monitoring in AEC industry" (2013), *International Journal of scientific Engineering and Research*, vol.1, page no. 94-96.
- [34] Weldu, Y. And Knap, G., "Automated generation of 4D building information Model through spatial Reasoning" (2012), *construction Research progress*, page no. 612- 621.
- [35] Xue Li, Jing Xu and Qun Zhang "Research on Construction Schedule Management Based on BIM Technology" *Procedia Engineering* 174 (2017) 657 – 667.
- [36] Yuan, J., Li, X., Ke, Y., Xu, W., Xu, Z. and Skibnewski, M. (2020), "Developing a building information modeling-based performance management system for public-private partnerships", *Engineering, Construction and Architectural Management*, Vol. 27 No. 8, pp. 1727-1762. <https://doi.org/10.1108/ECAM-06-2019-0328>.