5D Applications of BIM in Construction Management

Pathan.Md Rafi, K.J.Brahma Chari

Abstract: ***The innovation of roots to develop the construction projects are rapidly growing because of the availability of technologies adopted to build the construction. In the way of construction projects facing some crucial problems between owners, contractors, consultants that are more aspects from the present scenario. In BIM (building information modeling) projects to provide what is need of buildinga simulation from endeavor through getting better results. Moreover, in every stage of construction is communicating of good collaboration and coordination for making of a decision in a comprehensive analysis and solving. In this paper,research work was carried out on implementing the 5D applications of BIM (3D, 4D,and 5D) with basic parameters to approach the development of projects, systematic planning, scheduling, and cost estimation to overcome barriers on the project. The overall process of meeting the quality in the construction industry can be achieved. In the present study, a model has been designed for implementing the project.***

Index Terms: ***Building information modeling, 5D applications, Revit Architecture, Primavera, Construction techniques.***

I. INTRODUCTION

Within all the total estimation of the construction industry required to development of project Techniques. Although the largescale construction enterprises advantages gradually emerged, it is common of low management efficiency, low profitability, backward construction management and risk response ability, no expert's delivery project, poor time scheduling delivered before construction timings and other reasons. Construction firms gain the projects through completion of and good quality work, dazzling sustainability, time to completion of projects and no fluctuations of financial stability. This reasons forthe running of the construction firm's internal core competitiveness but there is no standing not been taken seriously which resulted in the weakness of the construction firm's management capacity [1]. However, India has become third largest construction market with the rapid development of construction industry, because it is expected India's urbanization rate will increase by 2052.

Therefore, the usage of BIM technology all over the world is adopting to ensure given dazzling result in AEC (Architecture Engineering Construction) firms of construction industry, the bottleneck of rapid development [2], the construction integrated information redundant and real-time variable, the important construction and construction process between the effective exchange of communication information and coordination collaboration difficulties. However, to know the realization of the actual demand construction industry ofbuilding information and intelligent, it becomesthe development of construction industry hot and trendy.

The necessary requirement corporation and no corporation firms are becoming following of BIM technology applications; this is more adequate integrated information of construction detailed explanation of data full fill of the comprehensive solutions and analysis of the project problems [3]. The BIM 5D application of 3D, 4D, 5D dimensions more accurate of project report data. 3D is fully virtual design and construction, 4D is time or schedule-related information and 5D is cost estimation problems of the project. These three dimensions make the beauty of result in the building information and survive more and longer to help full of the construction industry [4].

The importance of BIM in construction management**:** In BIM technology various standards exist to regulate construction quality management in construction practice. Although these standards vary from country to country, their core is invariable in that inspections must be conducted after each major construction procedure through collaboration among stakeholders of the project i.e. the contractors responsible for the check, and the supervisors and the owner or developer are responsible for a recheck and double recheck responsible respectively [5]. Acceding to a recent MC Graw- Hill construction report (2012), BIM adoption in the USA expanded from 49% in 2009 to over 71% in 2012. In the UK, the government introduced a progressive program for mandated use of fully collaborative BIM for government projects by 2016 to reduce project delays and cost overruns as part of overall economic development (UK GOVERNAMENT, 2011). Fig. 1 is Project delivery process of all phases.

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Pathan. Md Rafi, PG student, Department of Civil Engineering, KoneruLakshmaiah Education Foundation, Vaddeswaram, Guntur, Andhra Pradesh, India – 522502

K. J. Brahma Chari, Assistant Professor, Department of Civil Engineering, KoneruLakshmaiah Education Foundation, Vaddeswaram, Guntur, Andhra Pradesh, India – 522502

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In Singapore, the government provides BIM funds to promote a broader usage of BIM technology Singaporegovernment 2013.BIM for 3D,4D,5D: In BIM (Building Information Modeling) provides a digital representation of physical and functional characteristics of building facilities through intelligent AEC firms (architect, engineering and construction) the insight and tools to more efficiently plan, design, construct and manage building and infrastructure. In the process of developing BIM, dimensions are different to BIM maturity dimensions 3D is revolves the information about building infrastructure around an integrated data model and communicatethe design intent[6]. 4D BIM (Four-Dimensional Building Information Modeling) utilization of during project lifetime can be representing what happens to the schedule in case of the project. 5D BIM (fifth-dimensional building information) is used for budget tracking and comprehensive cost analysis and solution related activates. Moreover, the building parametric parameters starting to end of project objective life cycle implementation procedure happen to the cost estimation progress of their activities and related cost over time [7].

This3D, 4D, and 5D dimensions are playing a key role in the construction management and more efficient to develop the project in the way of plan, design, construct, and overall maintenance of construction activities use to ensure they reduce waste, save energy and reduce workload.

3D(Third-Dimensional building information modeling): In BIM 3D add operate progressive plan explanation of integrated model from which various stakeholders such as architect and civil engineers, structural engineers, MEP engineering building manufactures and project owner can extract and generated the views and information according to their needs. Moreover, the whole process is running automatically update these views along the project lifecycle and accurate data can be collected along the project lifecycle. BIM 3D helps participants to manage their multidisciplinary collaboration and coordination project efficiently in a comprehensive analysis and solving problem before predictive models allowing resolving issues proactively[8].

4D (Fourth-Dimensional building information modeling): 4D adds scheduling data of the construction site even before planning related activates. This enables teams to analyze events sequentially using project allows participants to extract and visualize the progress of activates through the lifetime of the project. The utilization of 4D BIM technology can result in improved control over conflict detection or over the complexity of changes occurring during the construction project. It gets built will lead to a reduction of waste in money and obviously in time.

5D (Fifth-Dimensional building information modeling): 5D BIM is used for budget tracking and cost analysis related activates. This allows automatic generation of quantities to proceed quicker, provides more accurate data and the estimator to explore new ways of providing efficient design performance and cost integrated BIM with 5D CAD simulation models enables the development of more efficient, cost-effective and sustainable construction[9,10].

II. RESEARCH SIGNIFICANCE

The focus of this paper is to improve decision making in the project before the construction performance across the building physical and functional characteristicsbyproviding lifecycle of building infrastructure.This information is more useful in project communication of design and with the respect of co-ordination and multidisciplinary collaboration more effectively in modeling and comprehensive analysis and solution.By using this technology, we allowparticipants to extract and visualize the progress of their activitiesthroughout the entire period of the project

III. METHODOLOGY AND MODEL DEVELOPMENT

The methodology has been developed for integration of REVIT and PRIMAVERA for preparation of 5D applications of BIM in construction management construction scheduling and cost estimation of the project. Figure 2 shows various steps involved in model development.

Collection of 2D drawings. All structural design drawings and 2D plans of the multi-level car parking building which is being constructed must be collected. Forgettinga better good result, it is mandatory to have plans at different stages of construction procedure.

Simulating BIM modeling: The use of BIM is the digital communication and informs information easy way of collaboration and coordination of project stakeholders. The BIM provides to design, construct and operate a building virtually will prove the increase of building productivity at the same time improve the quality of work.

Create 3Dmodeling structural design building: By using REVIT Software design structural building for getting the better output of 3D modeling. This data use of building design, construction and maintenance information combined in one convenient model to share with all the stakeholders

4D Scheduling: The backbone of the project schedule is using of PRIMAVERA Software for accurate getting better results. That is mainly depended on the projectoverrun of cost.

5D Cost Estimation: cost estimation is also by using of PRIMAVERA Software development of project grate result. The overall project developed by runoff providing the number of facilities. This is totally dependent on project scheduling and providing facilitation of PRIMAVERA software and understanding. Fig. 2 indicates Comparative cost analysis with primavera and manual estimation.

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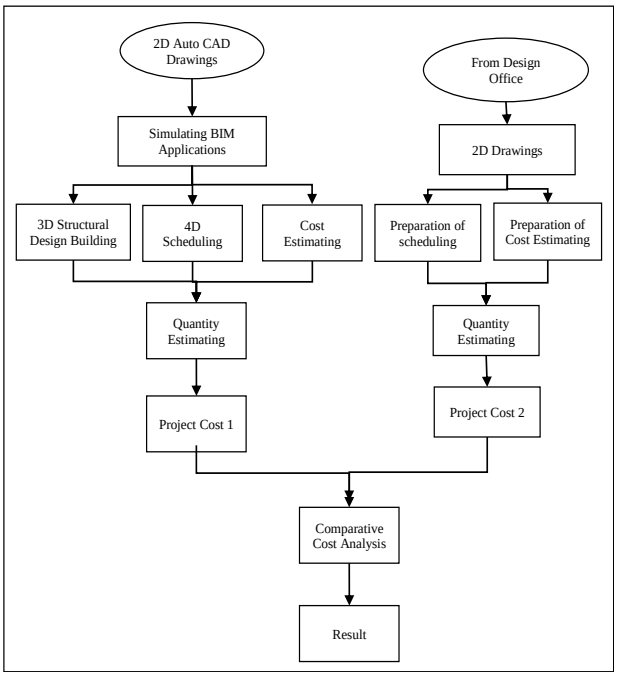

Fig. 2: Comparative cost analysis with primavera and manual estimation

Quantity Estimation*:* The project cost estimation will be Quantity estimation. It can be done using REVIT software and PRIMAVERA software by interlinking both construction schedule and cost estimation.The project management uses PRIMAVERA for preparation of the schedule which shows start dates and end dates, along with critical paths and activity sequences and interrelation between activities can also be shown. Another side the schedule like start date, end date timely updating of schedules created in planning software must be updated periodically and the quantity estimation is done by comparing both AutoCAD drawings and 5D BIM.

Preparation of Final 4D outputs: The scheduling of the project is being carried out using PRIMAVERA software and visualization of the project can be done using BIM software. Fig. 3 is project break down structure.

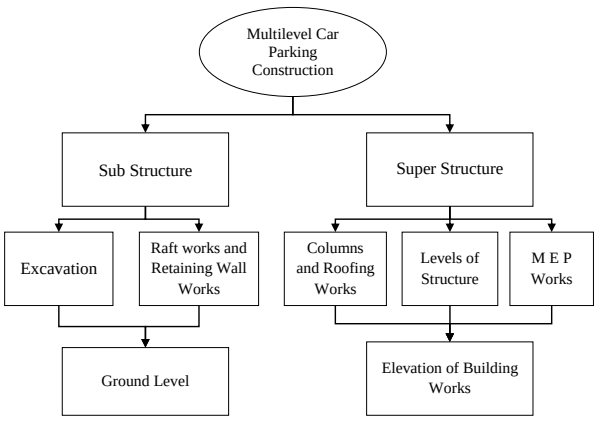

Fig. 3: Project Break Down Structure

IV. MODEL STUDY AND RESEARCH AREA

The study area is located at KL University, Vijayawada, Andhra Pradesh state (A.P.). which isa multi-level car parking having 10 stories. First five floors are used for car parking purpose, and the additional 5 floors are used for commercial purposes. The total built-up area was 2878.58 sq. m. The whole plan of the building is developed in AUTO CAD software, scheduling and cost estimation is done by using Excel sheets

3D Structural Building: The present study deals with converting of 2D drawings into 3D modeling simulation using REVIT Architecture 2014 for construction of structural building information model. This helps us to visualize the inside structure and make changes before starting construction. Fig. 4 indicates Modeling of Building in Revit Architecture Software.

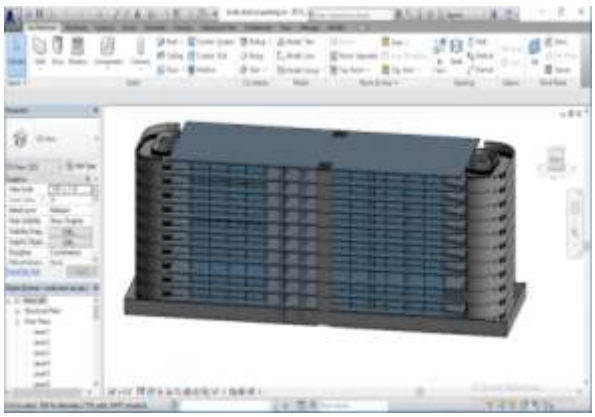

Fig. 4: Modeling of Building in Revit Architecture Software

4D Scheduling*:* The scheduling of the project can be done using REVIT architecture scheduling, PRIMAVERA P6,and micro soft Excel sheet. The scheduling of the project mainly depended on quantity take off by preparing 3D model simulation works. 4D model scheduling should allow for a certain expected level of interactivity, graphical representation, detailed planning of the project and dynamic interaction. Fig. 5 indicates Activities in Project Developed in Primavera (P6).

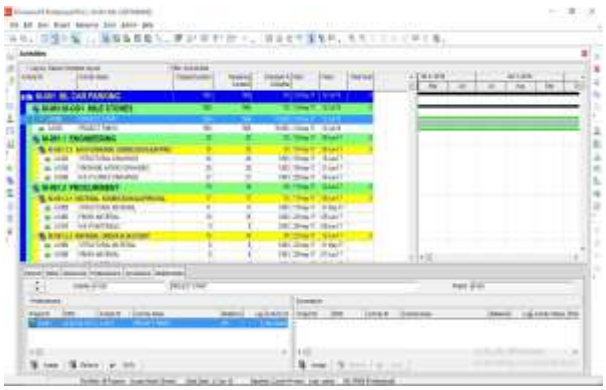

Fig. 5: Activities in Project Developed in Primavera (P6)

5D Model-Based Estimation*:* The cost estimation is done by approaching stakeholders involved in estimation areas by using REVIT Software. The process of estimation is simple and can be controlled easily if the estimation is done by

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perfectly suited to some costing workflows. In the process of cost estimation, estimating the quantities take offstakes a lot of time approximately 50%- 80% of the time required for cost estimation.

Use of Applications: Proper scheduling and planning of construction projects are necessary for construction outcomes for reduced and less dominant delays of the project. Proper scheduling of activities is required to track the project during its execution. The main aim of this study unit is to set up, schedule, monitor, and track the multilevel car parking project with the facilitation of PRIMAVER As of tware and understanding of results generated and its potential tocounselthat methodology is appropriate for chosen multilevel car parking 10 stored building.

Work -Breakdown Structure (WBS): Different types of activities are involved in a work-breakdown structure (WBS). the WBS on a significant role in construction planning and scheduling.Scheduling indeed cannot be a work breakdown structure is laid out. Work break down the structure starts the levels of project deliverable and further divided into sub activities by using outline performance project structure. WBS is part of the project planning and scheduling because is a key role to guides the project comes toa good output. Details of Project are shown in Table I.

Table I: Details of Project

Anatomical parameters	Structural details
Site location	K L University, Vijayawada, A.P.
Building area	2878.58 sq. m.
Total cost of the project	10 cores
Project duration	2.5 years
Total constructed floors	G+10 floors
Materials	Concrete, steel, manpower
Purpose of the project	Multilevel car parking and commercial purpose
Software Used	Auto CAD, Revit, Primavera(P6)

V. DISCUSSIONS AND RESULTS

Integration of PRIMAVERA and REVIT has been done to develop 5D applications which providebetter visualization of the construction progress of the projects. This linkage between scheduled activities and respective drawings in REVIT helps in identifying construction sequences and also in detecting logical errors that occur in project schedules. 4D scheduling in REVIT tool has various advantages which have been increasingly used to not only incorporate spatial relationships but also analyze and visualize space across time.5D cost estimating in REVIT has become particularly essential in areas where REVIT is needed for predicting dimensions across time. Apart from5D BIM applications more accurate to give better result in construction management. Figures 6-9 indicate the 2D-Plan of the building in REVIT software, Scheduling of the project WBS to develop the structure, Design of structural building development and floors of the building and Creation of scheduling and track of building a family.

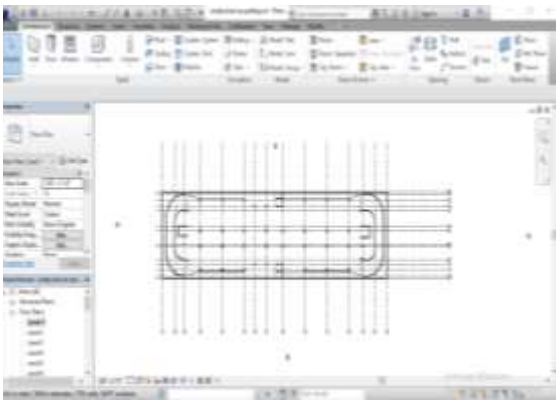

Fig. 6: 2D-Plan of the building in REVIT software.

Fig. 7: Scheduling of the project WBS to develop the structure.

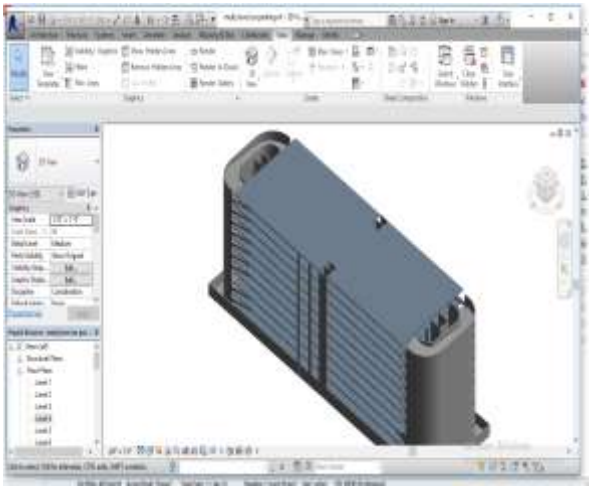

Fig. 8: Design of structural building development and floors of the building.

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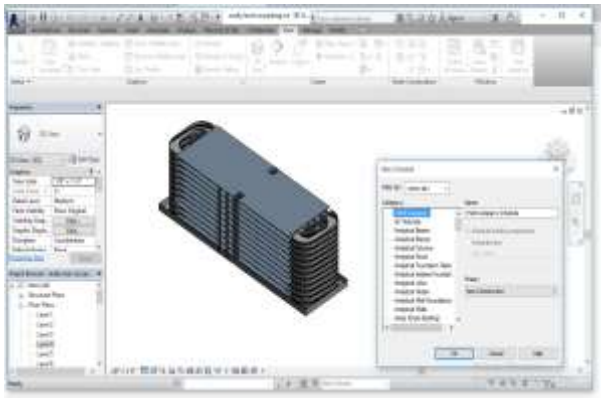

Fig. 9: Creation of scheduling and track of building a family.

From the results, it is concluded that the integration of BIM involves three aspects. First, BIM is used for evaluating the activities and its duration and the materials involved in a Construction site. Second, is that resources should be allocating of resources properly so that the effects of the project get increased. Third, is that the visualization of the project using 5D applications of BIM in construction management. But implementation of the BIM in the construction industry is very far.

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AUTHORS PROFILE

Pathan.Md Rafi PG Student, construction Technology Management, Department of Civil Engineering, Koneru Lakshmaiah Education Foundation (Deemed to be University), Green Fields, Guntur District, Vaddeswaram, Andhra Pradesh 522502.

Mr. K. J. Brahma Chari, M.Tech in Structural Engineering, Working as Assistant Professor and Research Scholar, Department of Civil Engineering, Koneru Lakshmaiah Education Foundation (Deemed to be University), Vaddeswaram, Guntur, Andhra Pradesh, India. Research interests are Composite materials, Analysis and design of RC structures. I've published 4 Scopus indexed papers in various reputed journals. Also, Professional life member of Indian Society for Technical Education (ISTE), International Society for Research and Development (ISRD), International Association of Engineers (IAENG) and ASTM International.

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