# APPLICATION OF BUILDING INFORMATION MODELING IN CONSTRUCTION PROJECT MANAGEMENT

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*Abstract:* Project management plays an important role in the successful execution of the project. Now the day's selection of the proper project management tool for the project is the key to success in completing the project in a specified time and in a standard manner. It is an emerging project management tool that utilizes different resources for construction planning and monitoring of the outcomes of these methods to speed up the development cycle, visualization, 3D coordination, resource allocation, effective budget management,4D simulation of the construction schedule. It helps engineers, architects to visualize what needs to be designed in a virtual environment and to recognize possible design, construction or operational problems. BIM extends this methodology to three dimensional (3D) drawings in the three primary dimensional width (b), height (h) and depth (d) with time as the fourth dimension (4D) and cost as the fifth dimension (5D). The paper also explains the methodology and uses of various software's to create a 4D model which are Autodesk Revit Architecture (2015), Primavera P6 (R 16.1), Synchro Pro (2017).

*Index Terms* – **BIM, Project management, 4D Simulation, Revit, Primavera P6, Synchro Pro.**

## 1. INTRODUCTION

Project management has become an important field of study since the early 1980s, and has since gained attention. Project management helps in planning, scheduling, monitoring, reporting; hence, the civil engineering sector specializes in different types of large and complex projects. Project scheduling and planning are crucial factors that influence the development cycle and serve as an integral part of the management process. The journey from design to scheduling requires various stages of human perception and manipulation of the data. Manual planning approaches have proven to be time-consuming and time-consuming relative to software applications and modern technologies used for management purposes.

The BIM tool is used by professionals to help them provide efficient planning, design, scheduling, construction estimate, and documentation details about the project concept, etc. By using this BIM method, controlling the construction cycle according to schedule and within the estimated cost is proving to have major advantages. The BIM method works step by step, where the stages can be seen from the foundations to the construction's end. The levels are individually seen part by part from, windows, walls, doors, footings, columns, beams and slabs. The BIM is designed in such a way that the desired plan is visualized, monitored and rendered in 3D.

The BIM technique maintains and secures the data over the entire building life cycle. Therefore the BIM conveys ideas in a very simple and persuasive way to customers. The technology professional uses this model to build rendering and simulation projects into a 3D view. So the project manager uses the 4D BIM tool to simulate the actual project in a realistic way. BIM has dramatically changed the way the project is delivered; it incorporates innovative architecture, construction and has digital process representation. Using this BIM, many projects have been completed successfully, and there is an advantage in improving quality design and reducing time and cost.
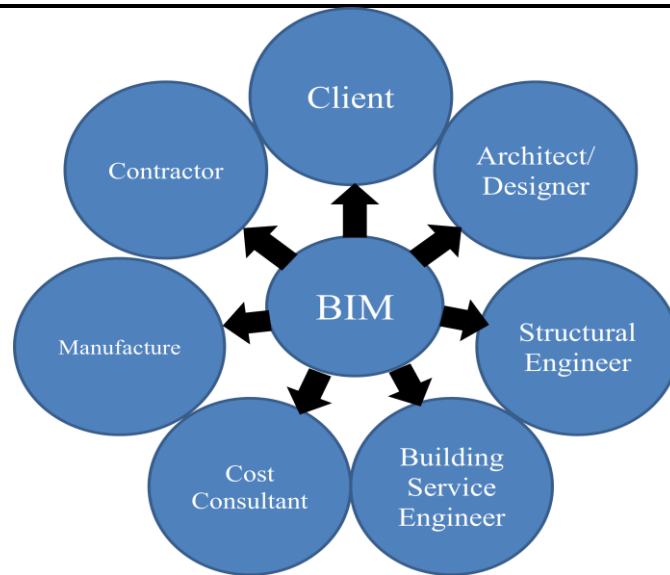
**Fig-1**: Stakeholders in Building Information Model

## 1.1 WHAT IS BUILDING INFORMATION MODEL?

BIM is a sequentially designed tool which allows the sharing of project data between different applications that are later represented in 2D drawings, 3D forms, Time as a 4D, and cost as a 5D up to nD. It has been accepted, after many years of research and development in the construction field. BIM models are used worldwide by numerous building industry professionals.

The team member develops these parts of the work in accordance with the construction conditions and adjustments in design to ensure that this model works as closely as possible. While the model was developed, this could be done before the construction project was physically completed.

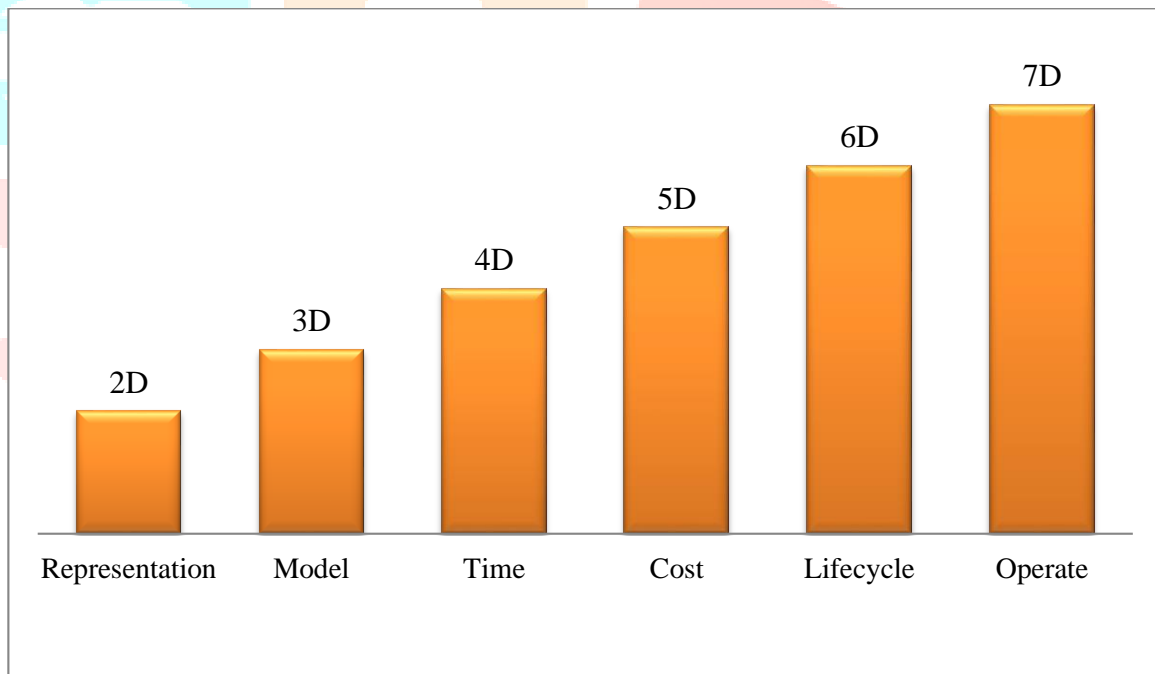## 1.2 DIMENSIONS OF BUILDING INFORMATION MODEL (BIM)



**FIG -2**: Dimensions of Building Information Model

**3D Models**: "3D" model is defined as the three-dimensional space (length (l), height ( h), width (b)), relationship, building geography and geometry details. 3D model recognizes and removes the error configuration due to accurate 2D drawings.

**4D Models:** '4D' model is defined as the 3D model construction project is attached time schedule by using suitable software program that provides users with virtual construction project simulation in the form of 4D. Time scheduling requires the building project for regular and monthly scheduling events to draw the lot of customers to a 4D BIM.

**5D Models:** "5D" model defined as the one in which the 3D model is connected to the cost using the appropriate software. It helps to get budget as well as improve efficiency during construction phases. The cost of the project can be measured in the 5D model to assess the project's financial success during the actual build phase.

## 1.3 NEED OF BIM IN PROJECT SCHEDULING AND MONITORING

- Difficulty is observed when using the traditional scheduling and monitoring method in the construction industry which requires more knowledge of current scheduling and progress reporting practices which need to be improved in quality and efficiency.
- 1n the research construction industry, efforts have to incorporate visualization into scheduling and monitoring has to be failure by using traditional method.
- Using this building information tool which requires less number of engineers and other people who involved in the scope of project within the same radar to get the exact information of the work and observing the activities.
- Project manager and client can summarize the step by step construction activities and also the cost flow can be monitor in the computer. The BIM tool helps in project planning and measuring efficiency of project by involving this model and project schedule.
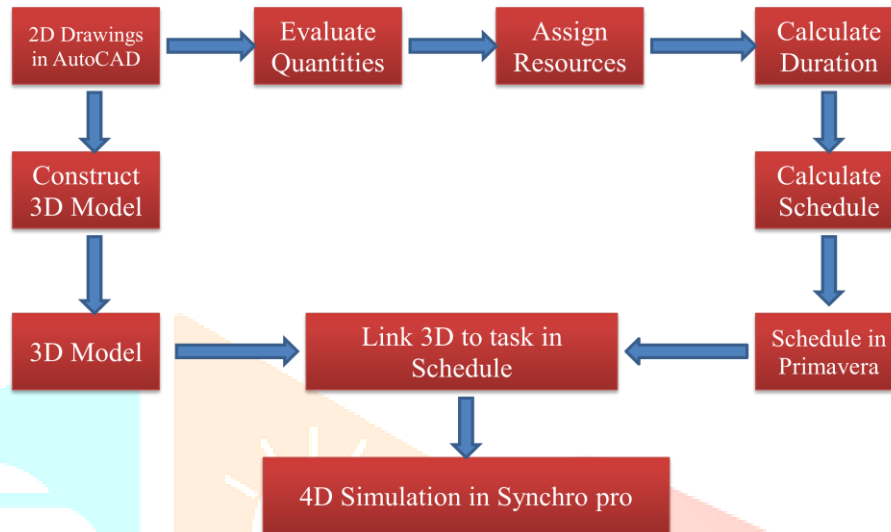
## 1.4 4D BIM SIMULATION PROCESS



**FIG -3:** 4D BIM Simulation process

- Synchro Pro 4D model is establish by connecting 2D drawing and 3D model files attach with scheduling. This creates the 4D of the building information modeling.
- There is one timelier bar option in Synchro Pro Program, this feature adds the plan task file that is imported from Primavera P6. Each activity is updated with a configuration file for 3D element.
- Timelier must update the simulation automatically if model or schedule changes.

## 2. OBJECTIVES OF THE STUDY

- To collect the details of the residential building selected for case study.
- To study BIM concept with respect to scheduling and cost of project.
- To generate and simulate virtual model using design software and project management software.
- To develop a working schedule for execution of a multi-storeyed residential building.
- To obtain estimated cost of construction.
- To assist and track various construction task activities.
- To provide support for decision making process.

## 3. METHODOLOGY
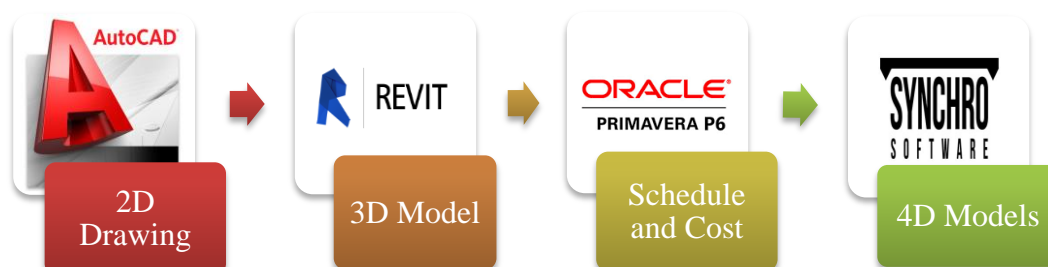
### 3.1 STEPS FOR CREATING A 4D MODEL



**FIG-4:** Process of 4D Model

**Step 1: Creating 2D drawing**: Application of AutoCAD 2D modeling program to develop templates for the building project. **Step 2: Creating 3D model:** Creating architecture is represented by a 3D model that is designed in Revit Architecture. When the drawing is completed separately in AutoCAD, it is imported using insert tool into Autodesk Revit software. This lets Revit Architecture software play an important role in the identification of collisions between various project components. Turn to help organize, schedule and get project forecasting in the planning process.

**Step 3: Export 3D model into Synchro Pro:** Created 3D model is exported to prepare 4D model in Synchro Pro.

**Step 4: Initiating scheduling process:** Primavera P6 Software is used as scheduling tool. It plans the separate tasks to break down framework as established function. It is used as a development project timeline, displays the start and finish days, locates the activity's vital paths and float times and also demonstrates the series.

**Step 5: Developing of 4D model:** As the 3D model file is imported into Synchro Pro software, the system can automatically coordinate rotation and rescale the units to show the units on which each file is connected. In Synchro Pro, 3D model and schedule are imported to make 4D model.

**Step 6: connecting the activities with 3D element:** The project schedule is imported into the data source for Synchro Pro Software in a time liner tab to create 4D models, activities from the Primavera P6 schedules are connected to 3D model components.

**Step 7: 4D Model simulation:** The project visualizes the 4D model by starting the simulation. The quantity of work done on the different work activities and can be seen in the 3D view in the simulation process. This assists with mission analysis, strategy and management etc. Cost of the various operations can also be reflected in Primavera P6. This provides the overall expense of the construction project.
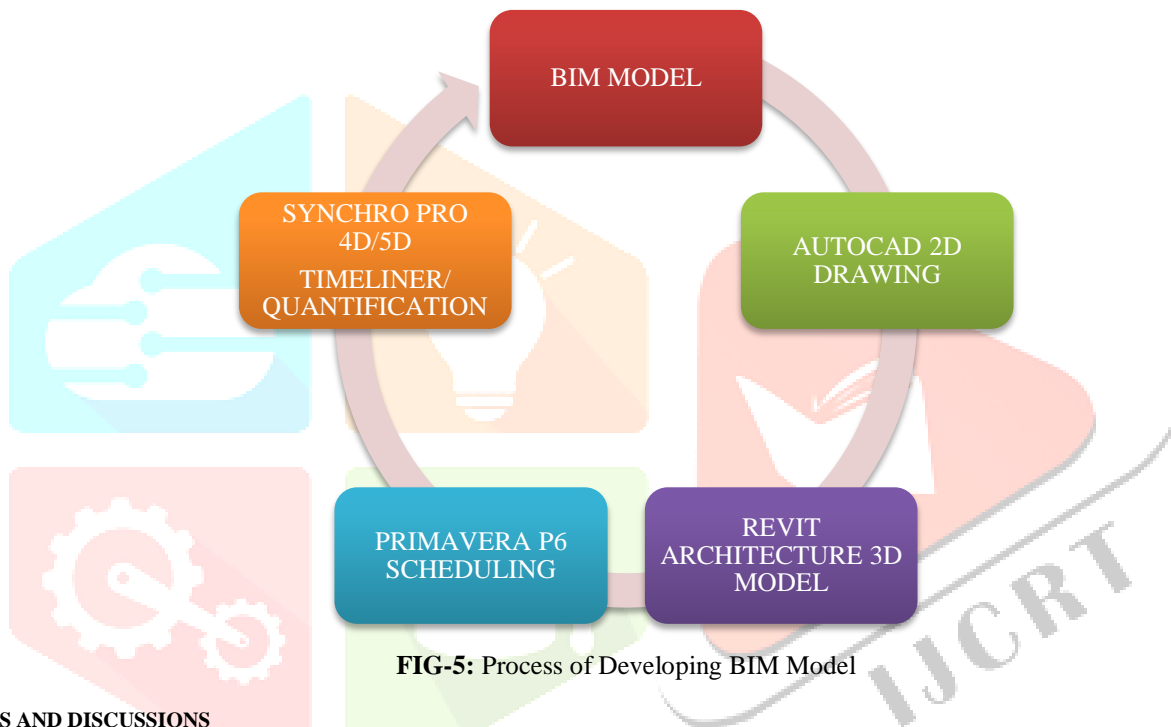


**FIG-5:** Process of Developing BIM Model

## 4. RESULTS AND DISCUSSIONS

### 4.1 PROJECT DETAILS

- Name of the project: Bharat plaza – Residential project
- Location: Shahapur, Belagavi
- No of floor : B+G+ 4 stories
- Site area : 427.35 Sq.m
- Built up area: 1625 Sq.m
- Estimated cost: Rs 4,25,61,000 (As per the developer)

### 4.2 FLOOR PLAN

- The total Built up area is 1625 sq.mts.
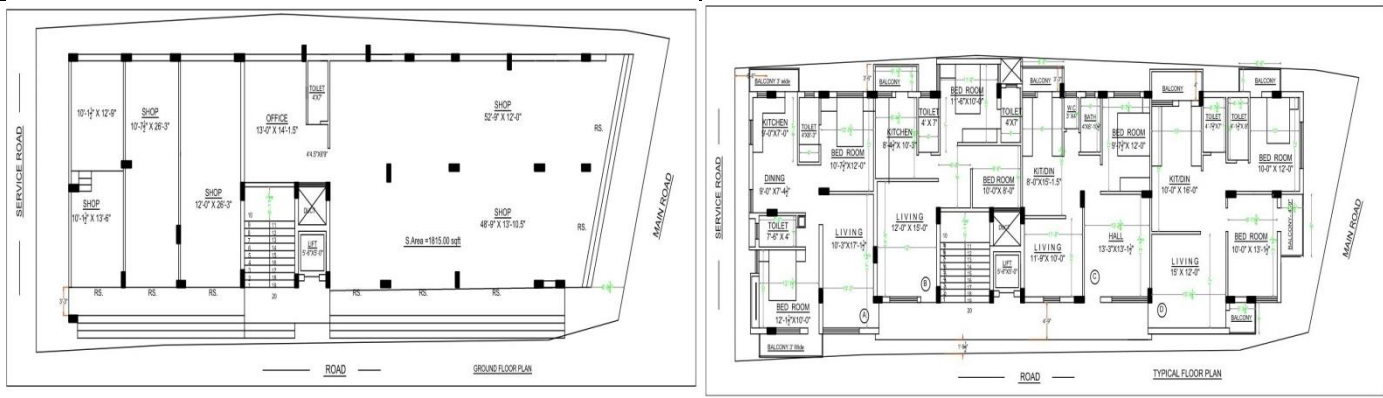- Typical floor plans are as shown below:

**FIG -6:** Ground & First Floor Plan

## 4.3 IMPORTING 2D AUTOCAD DRAWING INTO 3D AUTODESK REVIT ARCHITECTURE

- Setting up the grids and levels in Revit architecture.
- Inserting each layout of plan to corresponding level.
- Building 3D model with Autodesk Revit Architecture built in elements.
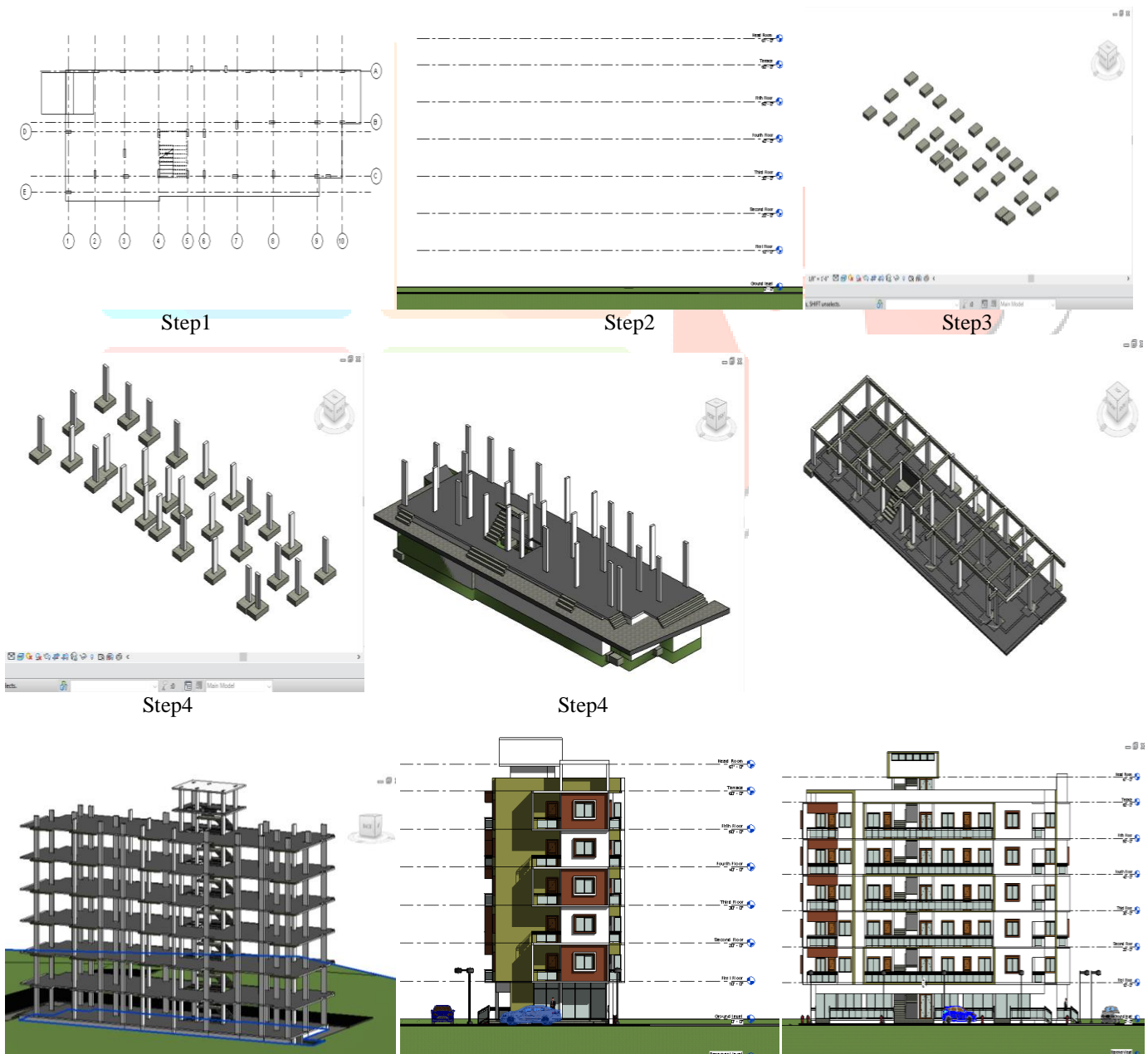- Modify the model.



Step1

Step2

Step3



Step4

Step4



**FIG -7:** 3D model is created in Revit software

## 4.4 SCHEDULING IN PRIMAVERA P6

In Primavera P6, building duration and cost of the various tasks of activity is generated. It has a relationship feature like start to finish(SF), finish to start(FS), start to start(SS), finish to finish(FF).

- In this work planning and scheduling of project (B+G + 4stories) using Primavera P6 software.
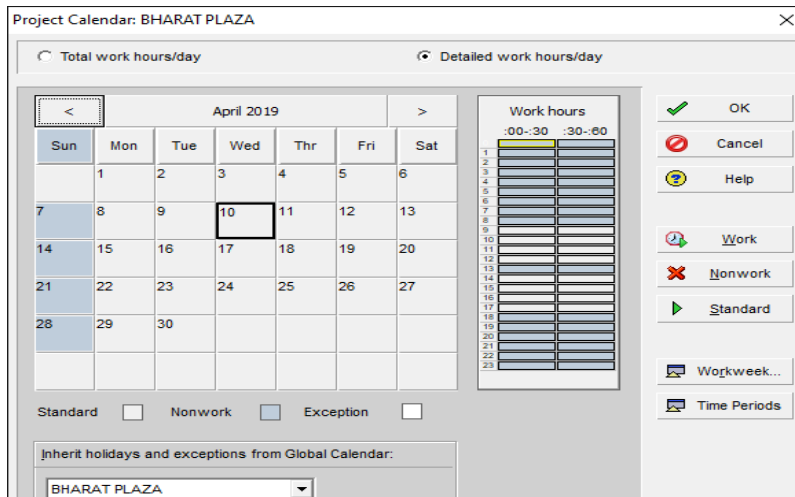- Using standard calendar of primavera P6, working day is Monday to Saturday from 9 am to 6 pm.



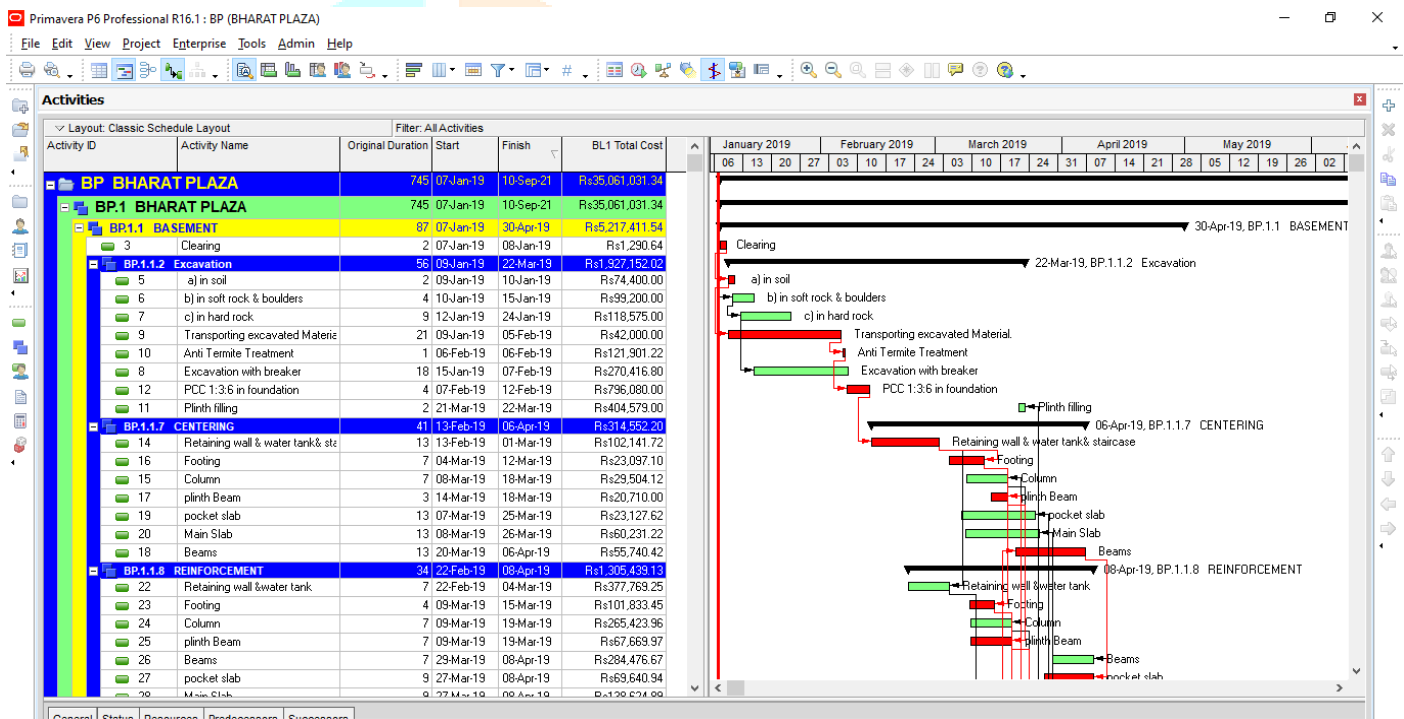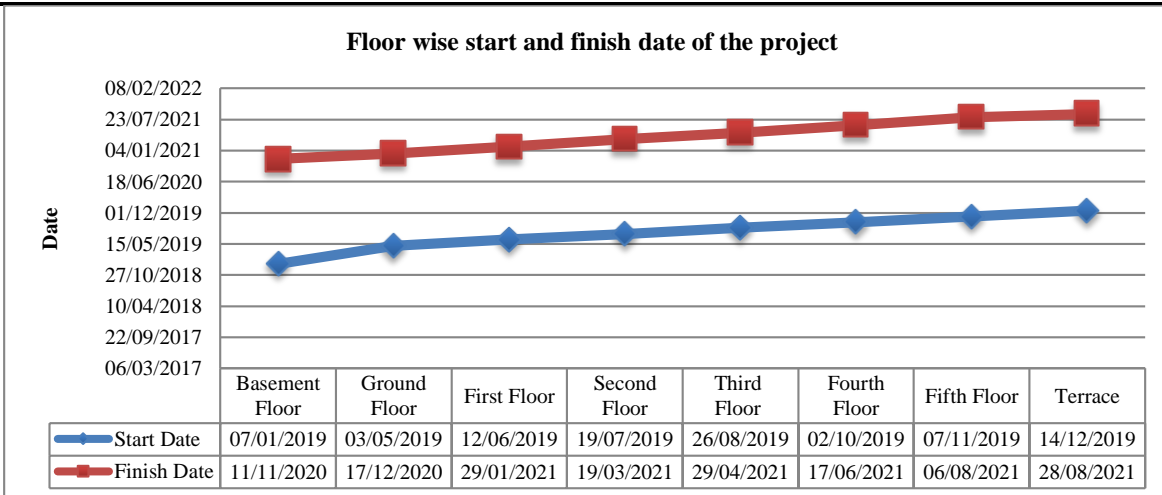**FIG -8:** Project Calendar in Primavera



**FIG -9:** Activities schedule in Primavera P6

**Table- 1:** Primavera P6 details

| Project | Bharat Plaza Apartment |
|---|---|
| Project started | 07/01/2019 |
| Project completion | 10/09/2021 |
| Duration | 745 days |

## 4.5 PROJECT TRACKING

This is the most important application of BIMS platform where the 3D model developed using Synchro Pro and Execution Schedule developed using Primavera are merged to develop a 4D time cost model. This helps in project tracking and monitoring. The steps for generating the 4D model are as below:

**Floor wise start and finish date of the project**



| | Basement Floor | Ground Floor | First Floor | Second Floor | Third Floor | Fourth Floor | Fifth Floor | Terrace |
|---|---|---|---|---|---|---|---|---|
| Start Date | 07/01/2019 | 03/05/2019 | 12/06/2019 | 19/07/2019 | 26/08/2019 | 02/10/2019 | 07/11/2019 | 14/12/2019 |
| Finish Date | 11/11/2020 | 17/12/2020 | 29/01/2021 | 19/03/2021 | 29/04/2021 | 17/06/2021 | 06/08/2021 | 28/08/2021 |

**Graph-1:** Floor wise start and finish date of the project

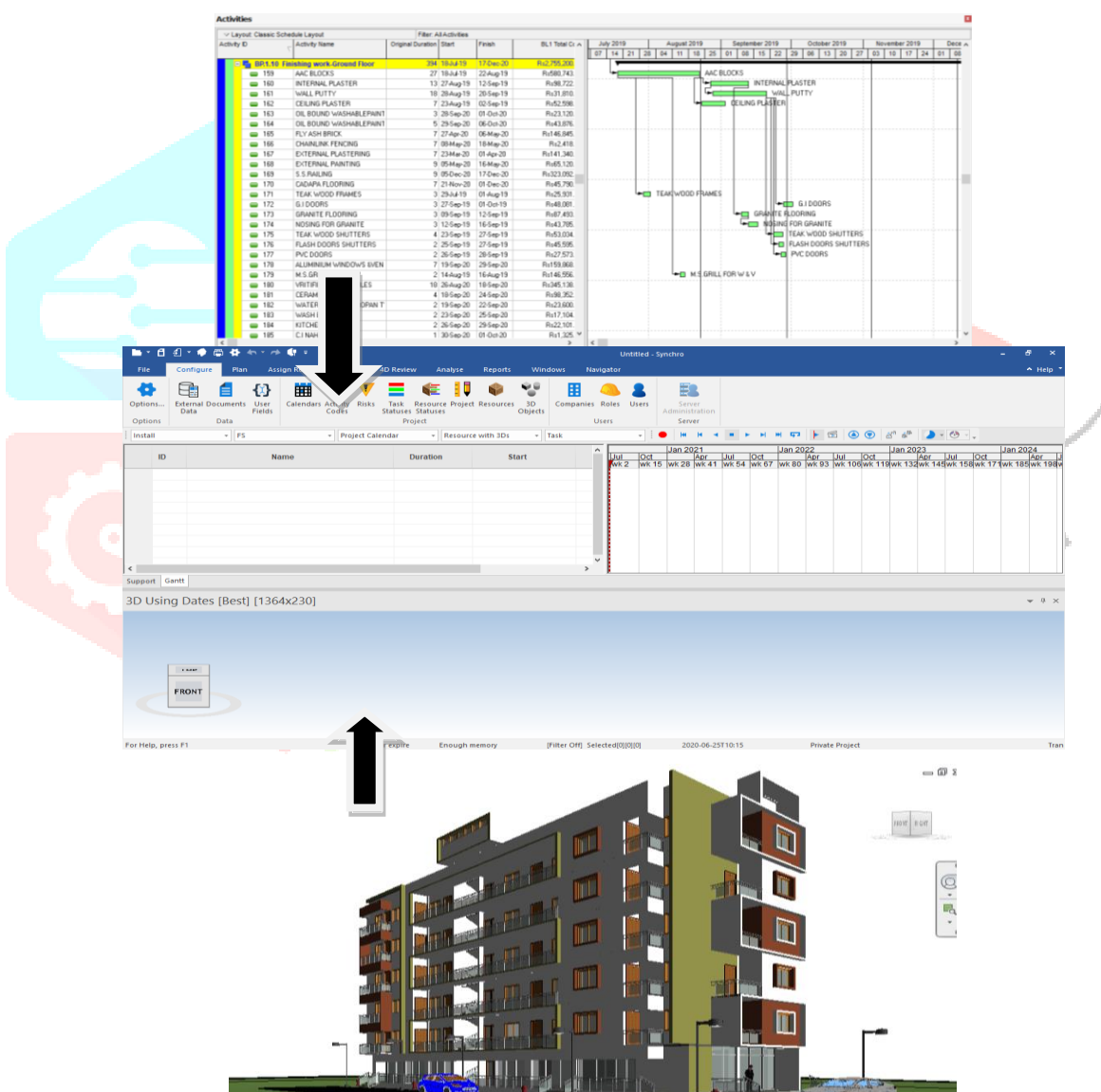## 4.6 DEVELOPMENT OF 4D MODEL IN SYNCHRO PRO



**FIG – 10:** Steps for establishing 4D model

- Export 3D model Revit Architecture to Synchro Pro software.
- Export Primavera P6 schedule to Synchro Pro software.
- Connecting the 3D element with the scheduled activity.
- The 4D modeling requires the design of a building step by step. The role of Primavera P6 is then related to its respective building part.
- This integration work schedule and 3D model is carried out in Synchro Pro.
- After relation or attachment of all primavera operation activities to the appropriate 3D element model.
- The development of day-to-day activities is seen.
- A video of the simulation can be exported from the start to the finish date to give the client a project demo.

- Using simulation video tools, specific construction operation functions can be shown in the 3D model at a particular time point.
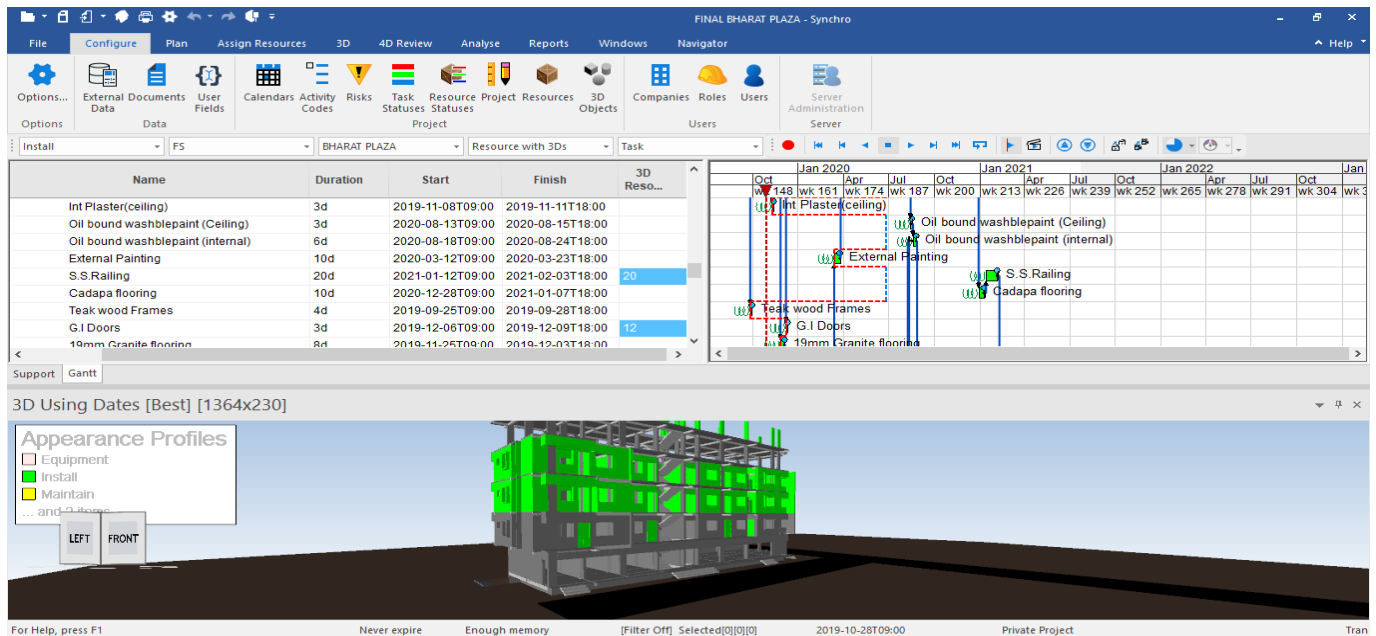


**FIG -11:** Attaching Primavera schedule and 3D model in Synchro Pro Software

This offers a better Project coordination and control. The critical decision making can be aided by this process as this offers a visual description of the details which are to be executed. This also helps in making the necessary changes and implementing them without many difficulties.

## 5. CONCLUSION

The following conclusions are drawn from the study.

- The model developed using Revit Architecture gave a 3D view of the project which helped in better visualization and understanding.
- The application of Primavera helps to develop different path schedules and levels the resources automatically if needed.
- The total duration required for the project completion as per the schedule developed in Primavera was 745 days.
- The Total Project cost obtained is Rs. 4,10,21,082.
- The BIM model uses a full tool to visualize the day-to-day progress of work on a computer monitor and to increase efficiency.
- The BIM tool provides users with real-time representation of projects that improve the speed of construction planning.

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