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IMPLEMENTATION OF BIM TECHNIQUE IN GLASS FIBRE REINFORCED GYPSUM PANEL BUILDING

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Abstract— The building construction using Glass Fibre Reinforced Gypsum (GFRG) panels could be an entirely promising and rising building era. GFRG wall panel is another artefact to switch bricks or concrete blocks. By the implementation of BIM in GFRG panel, we can achieve a cost-effective residential building, and we can construct the structure with less duration of time. On this project, BIM tools and programs have been added with an emphasis on production scheduling and value estimating. Autodesk Navisworks Manage is a BIM tool used to simulate construction schedules in 4D to reduce delays, aligning problems & perceptibly communicate and analyze project activities. This paper clearly explains the impact of 5D BIM on time and cost parameter of GFRG building project. 5D planning in the construction industry can be easily studied with the help of this research paper.

Keywords— AutoCAD, 5D, Revit, MS Project, Navisworks manage, Simulation, Quantification

I. INTRODUCTION

With the increasing quality of construction comes and absence of resources, there is a desire for higher, many refined tools for building coming up with and manage. There is a desire for systems that run a lot of with efficiency (save time and cash, needs less resources and while not compromising the quality), that facilitate higher coordination and communication among project team members & additionally communicate an equivalent plan of the project to all or any stakeholders concerned within the life cycle of the project.

GFRG panels are building panels appropriate for cheap mass housing with the benefits of cost-effectiveness and rapid construction. These panels are created out of mineral for the most part on the market in the Asian nation within the style of phospho-gypsum a waste by-product of the chemical industries. These panels are presently factory-made to a size of 12m length, 3m height and 124mm thickness, at FACT, Kochi and RCF, Mumbai. GFRG panels include mobile cavities many of the outer flanges and consequently the inner ribs, which may handily be whole of concrete and strengthened with metal bars, if wanted, to acquire the desired capability as load- bearing partitions. Homes designed victimization this era (with none columns and beams) will cross all the approaches to 8 to 10 storeys in low to slight volatile zones, and lesser pinnacle in excessive unstable zones. The empty cavities within the panels can be used for concealing electric wiring and opportunity plumbing works. In a very ordinary constructing, all components, as well as partitions, slabs, staircases, or even parapet walls can be created victimization GFRG. This technology conjointly has the extra benefits of property and energy potency attributable to the employment of stuff and conjointly because of considerably less consumption of energy-intensive or rare materials, like cement, steel, sand and water. IIT Madras has been concerned within the analysis and development of this technology for the past twelve years. GFRG was approved as an artefact appropriate for construction by BMTPC (Building Materials & Technology Promotion Council, Government of India), and the joint effort by BMTPC & IIT Madras has resulted in the event of a 'GFRG design Manual' for the structural style of those buildings.

The construction enterprise is emerging with numerous new improvements being included in each approach used. In advance, stakeholders used to appoint the second approach to get the buildings done. This exercise required 2D drawings for dimensional details of all of the construction factors, which in flip needed the get right of entry to any individual documents. This technique became now not of excellent use as it turned into prone to human mistakes, mistakes and bulky. Those reasons paved the manner for other correct and simplified alternatives to overcome the problems skilled with the aid of a professional the use of the second approach. The improvement of efficient techniques, which could be engaged during the lifecycle of a construction undertaking, was instead required. Researchers and engineers global have made their valuable contributions to this field continuously. These days, building information modeling (BIM) has been developed and gaining a reputation in this vicinity.

The 5D BIM is a great version, which allows taking choices across the challenge lifecycle. BIM is the first virtual illustration of a 3D building and its intrinsic bodily and useful characteristics, which forms a reliable foundation for decision making all through the existence-cycle of a creative project. Its miles a database and creates a great platform to proportion knowledge and speak statistics between challenge individuals. The time period of BIM does no longer sound extraordinary and has to turn out to be a quintessential a part of the construction industry. BIM is a beautiful, wise, item-

orientated and statistics-rich technology wherein the precise information can be extracted and analyzed in keeping with the want of a person who then makes choices to enhance the technique of delivering the facility. Within the light of the above rationalization, BIM is not merely software; however, it is for an aggregate of both method and software, which makes giant adjustments within the workflow and assignment transport strategies.

From the perspective of a software program, BIM is an assignment simulation, which is made out of the 3D model of the task additives containing links to all the required statistics of the venture making plans, layout, construction or operation. BIM can also be visible as a digital procedure that merges all elements, disciplines, and systems of a facility inside a single, digital model, allowing all of the team individuals together with proprietors, architects, structural engineers, contractors, subcontractors and providers to collaborate more meticulously and efficiently than traditional strategies. The group contributors ought to continually refine and modify their work quantities in keeping with assignment necessities and design changes to make sure the version is as accurate as feasible, while the translation is being created. This can be completed manner earlier than the bodily begin of the task.

In current years, the various technologies like 3D (which represents and visualizes an object by top, period and width in an area coordination machine) and 4D (4D is a mixture of 3D coordinates and the time as 4D) BIM had been employed in many creation initiatives wherein extensive improvements in those gear to decorate the building manner have been discovered. Even though 3D and 4D strategies improve the execution of production in the multidisciplinary and multi-organizational field to a top-notch volume, however, the use of this gear on a real undertaking is a complicated manner in which a tremendous deal of coordination is needed. Those troubles have paved the way for lots of new principles together with 5D BIM, which is the mixture of 4D and cost estimation as 5D.

II. OBJECTIVE OF THE STUDY

i. To plan and design a low-cost G+10 residential building.
ii. To generate a model of the residential building using Revit software.
iii. To integrate and simulate the 3D model, 4D time and 5D cost factors using BIM technique.
iv. To achieve a cost-effective residential building using BIM techniques.
v. To achieve building modeling & quantities statistics, construction process simulation and energy consumption analysis, respectively

III. METHODOLOGY

The following methodology (Fig. 1) shows that with the developing complexity of construction initiatives and absence or availability of sources there may be a need for better, extra state-of-the-art equipment for creation planning and control. In that way, the literature review is done for GFRG AND BIM and the implementation of the 5D BIM technique in GFRG building is studied in detail. Various BIM software is available in the market among these AutoCAD, Autodesk Revit, MS Project & Autodesk Navisworks Manage are used in this project to model a ten storied GFRG building. Planning and modeling are done through Autodesk Revit. Time and cost scheduling is done through MS Project. The process of 4D simulation, clash detection, quantification & 5D models is performed through Autodesk Navisworks Manage.

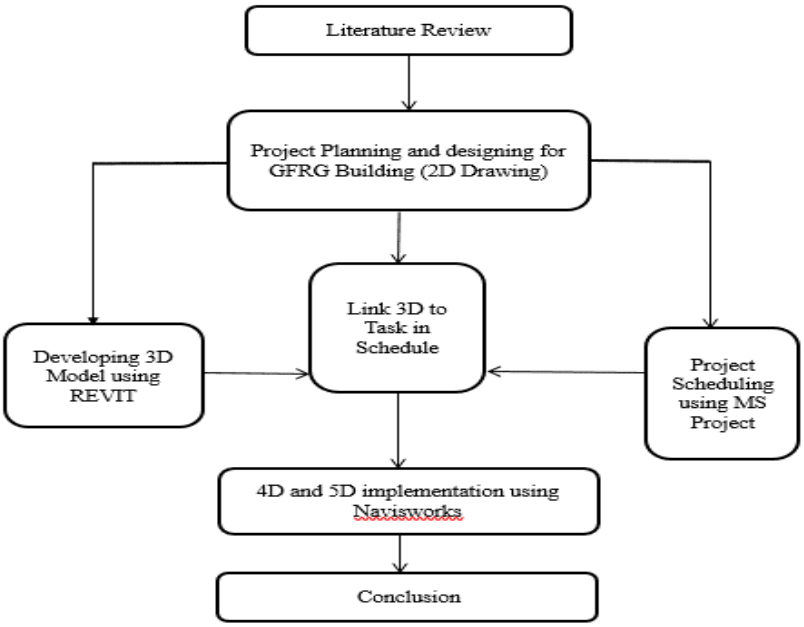


Fig.1 Flow Chart for Methodology

IV. RESULT AND DISCUSSION

A. *Project Planning*

A Computer Aided Drafting software called AutoCAD is used for planning GFRG panel building. Using CAD, you will draw one thing once and duplicate it tons of, or maybe thousands of times. Drawings may be shared in a flash across space or maybe around the world over a network. With the help of this software, the 2D plan of the building can be drawn which is shown in Fig. 2.

1) Details of the Project:

- Type of building: G+10 Residential
- Building area: 4,320 Sqm
- Area of a particular flat: 1344 Sqft
- No of flats in one floor: 4 flats
- Total number of flats for one apartment building: 44 flats
- The height of plinth level is about 0.12'.
- The height of a single floor is 9.84'.
- The sill level is 2.46'.
- The lintel is 7.38'.
- The depth of the slab is 0.67'.
- The height of parapet wall is 4'.

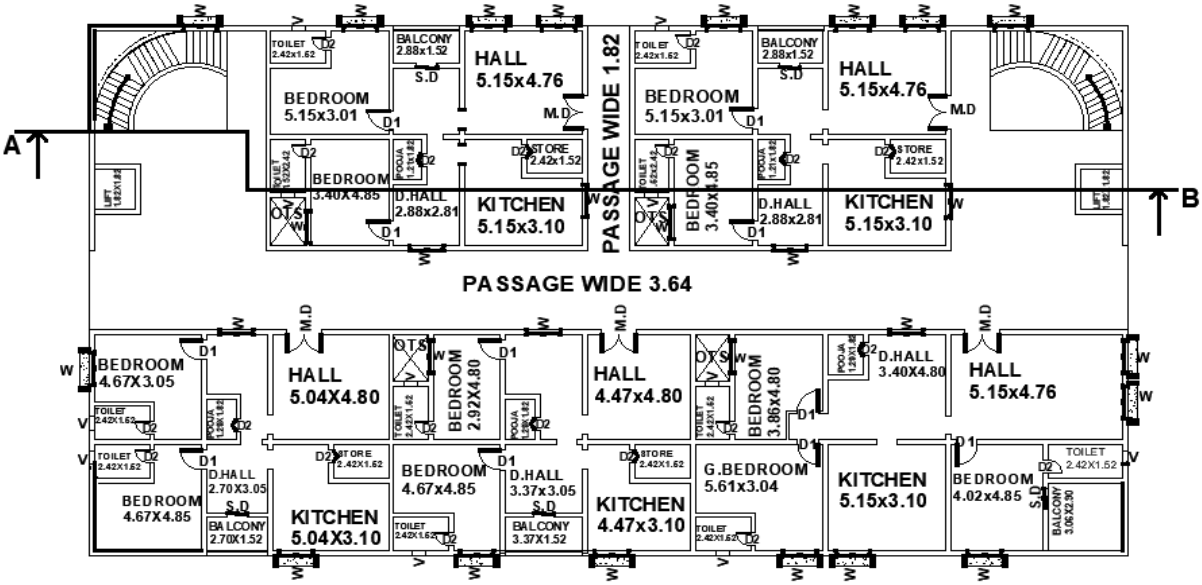


Fig. 2 Ground floor plan

Fig. 3 Elevation of the Building

B. *Creation of 3D Model*

The Revit platform for building info modeling could be a design and documentation system that supports style, drawings, and schedules needed for a building project. In the Revit model, each drawing sheet, 2D and 3D view, and schedule could be a presentation of knowledge from the same underlying building model info.

1) Plan View: For creating the 3D view of the building, we add a different level for each floor with the help of Revit software, a default view of the structure is created as a floor plan.

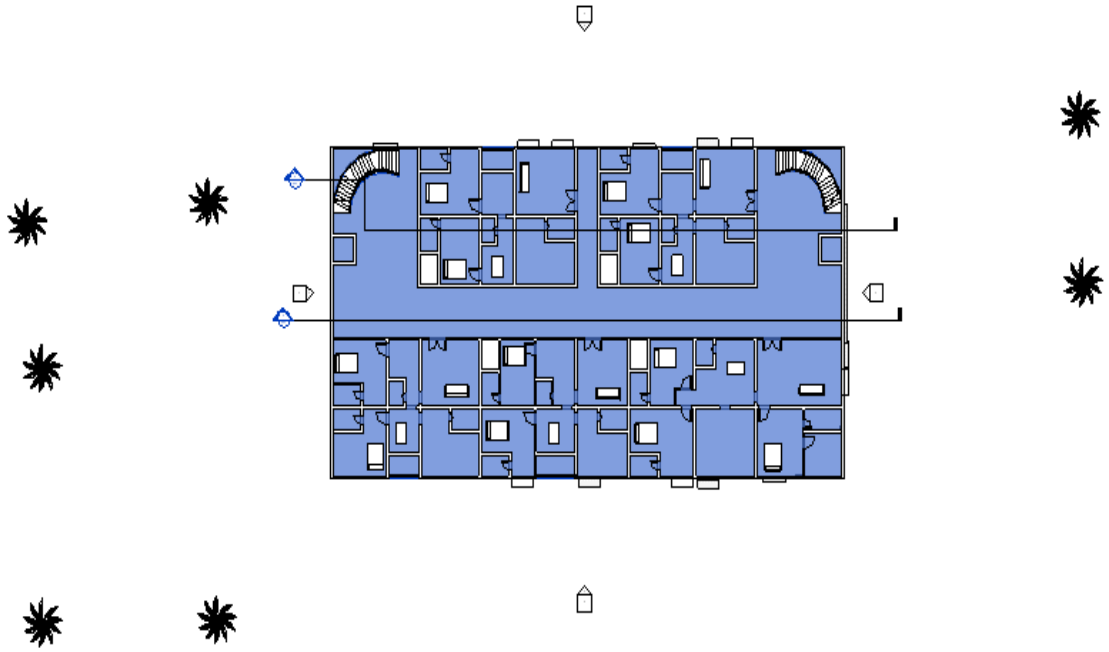


Fig.4 Floor Plan View

2) Rendering: We will use Revit architecture to generate a time frame rendered view of a building version mistreatment the sensible visual trend, or you can create a photorealistic picture of the version mistreatment the rendering device. Revit architecture renders 3D perspectives with numerous consequences and content material, which includes lights, plant life, decals, and people. The real-time rendering read presentations solid substances and textures. Either of those, rendering designs will be accustomed gift the look to shoppers or share with team members. The various views of the building are shown in figure 5 & 6.

Fig.5 Rendered View of a Building when material is applied

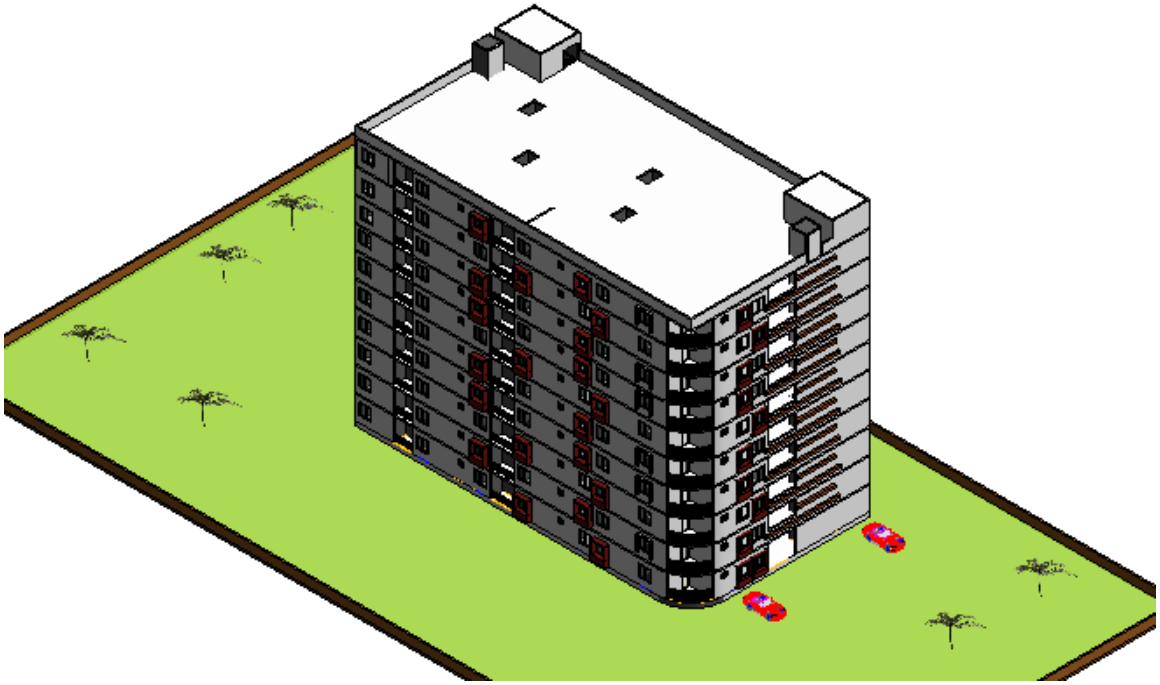
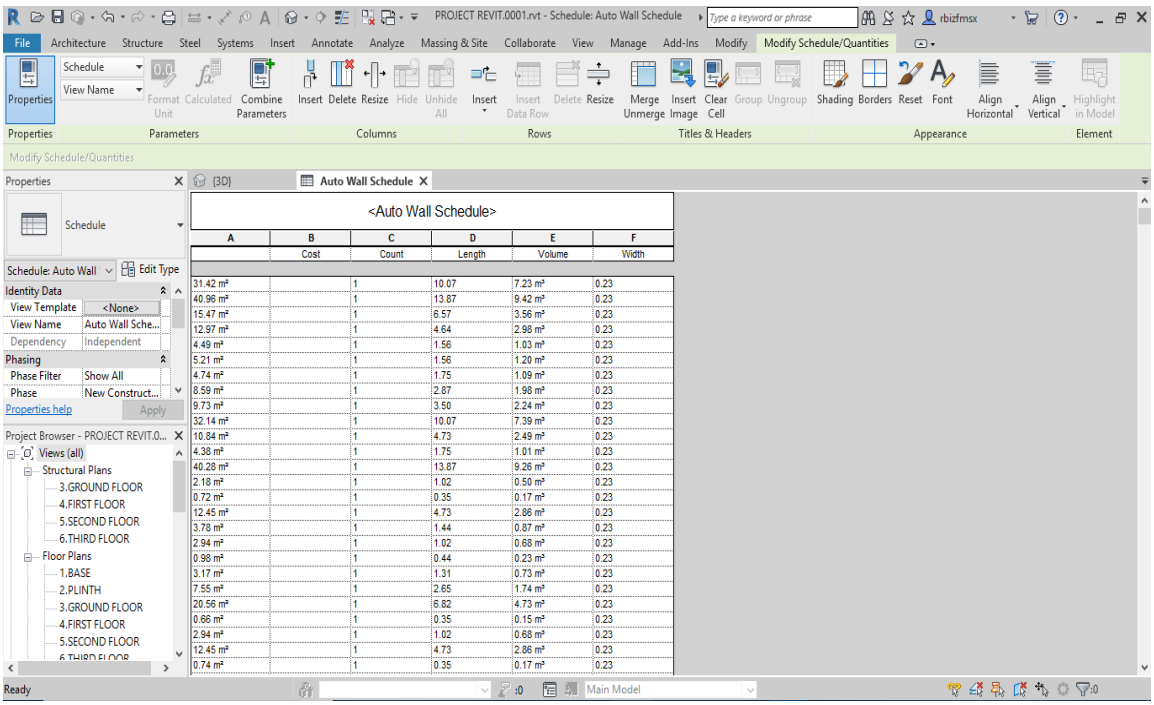


Fig.6 Rendered View of a Building

3) Automatic Generation of Schedule in Revit: Schedules are simply another view of the Revit design model the schedule are auto generated within the Revit. An amendment to a schedule view is mechanically mirrored within the each alternative views and the other way around.



A	B	C	D	E	F
	Cost	Count	Length	Volume	Width
31.42 m²		1	10.07	7.23 m³	0.23
40.96 m²		1	13.87	9.42 m³	0.23
15.47 m²		1	6.57	3.56 m³	0.23
12.97 m²		1	4.64	2.98 m³	0.23
4.49 m²		1	1.56	1.03 m³	0.23
5.21 m²		1	1.56	1.20 m³	0.23
4.74 m²		1	1.75	1.09 m³	0.23
8.59 m²		1	2.87	1.98 m³	0.23
9.73 m²		1	3.50	2.24 m³	0.23
32.14 m²		1	10.07	7.39 m³	0.23
10.84 m²		1	4.73	2.49 m³	0.23
4.38 m²		1	1.75	1.01 m³	0.23
40.28 m²		1	13.87	9.26 m³	0.23
2.18 m²		1	1.02	0.50 m³	0.23
0.72 m²		1	0.35	0.17 m³	0.23
12.45 m²		1	4.73	2.86 m³	0.23
3.78 m²		1	1.44	0.87 m³	0.23
2.94 m²		1	1.02	0.68 m³	0.23
0.98 m²		1	0.44	0.23 m³	0.23
3.17 m²		1	1.31	0.73 m³	0.23
7.55 m²		1	2.65	1.74 m³	0.23
20.56 m²		1	6.82	4.73 m³	0.23
0.66 m²		1	0.35	0.15 m³	0.23
2.94 m²		1	1.02	0.68 m³	0.23
12.45 m²		1	4.73	2.86 m³	0.23
0.74 m²		1	0.35	0.17 m³	0.23

Fig.7 Creation of wall schedule from Revit

C. Preparation of Schedule in MS Project

Microsoft Project is a management software program, developed and sold-out by Microsoft, that is meant to help a project manager in developing an idea, distribution resources to tasks, following progress, managing the building budget, and analyzing workloads.

1) Gantt Chart: Gantt charts are widely employed in business to explain and monitor every kind of comes in line with the foundations of project management. They are obtained from Microsoft project, etc. Here, we tend to seek advice from

such applications as Gantt applications. Completely different Gantt applications have different options and capabilities: within the discussion below, we tend to describe a lot of common ones. The first factor we will need before fixing a Gantt chart could be a particular project set up. A project set up could be a series of mutualist tasks that require to be performed during a specific order. Project plans have a particular begin date, resembling the beginning of the primary task, and a specific date of finish, resembling the top of the last task.

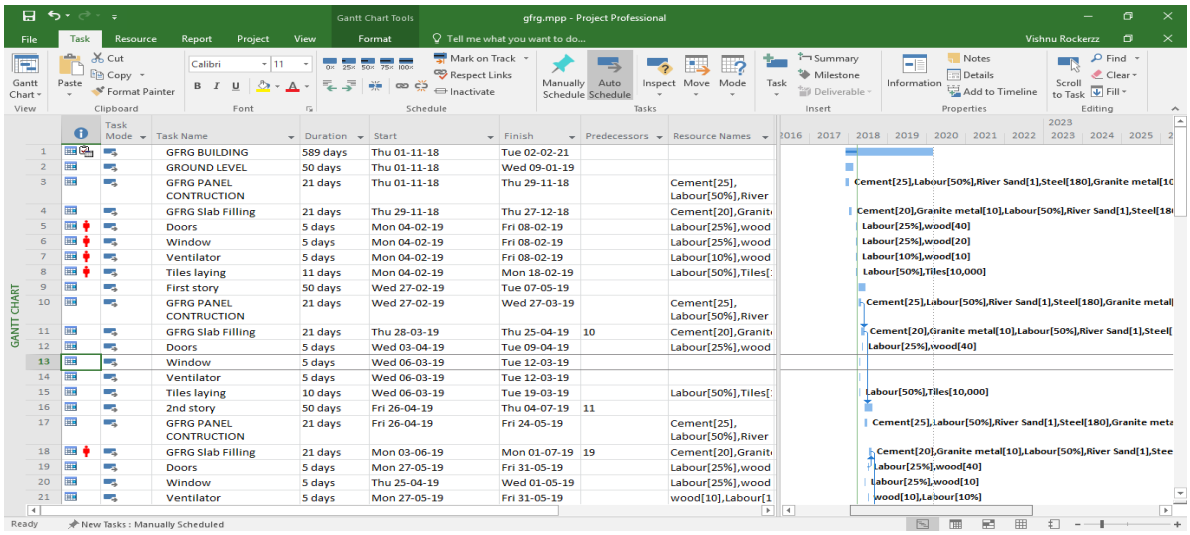


Fig.8 Gantt chart

2) *Work Overview of the project: Some of the overview of building works are shown in the figure 9 & 10.*

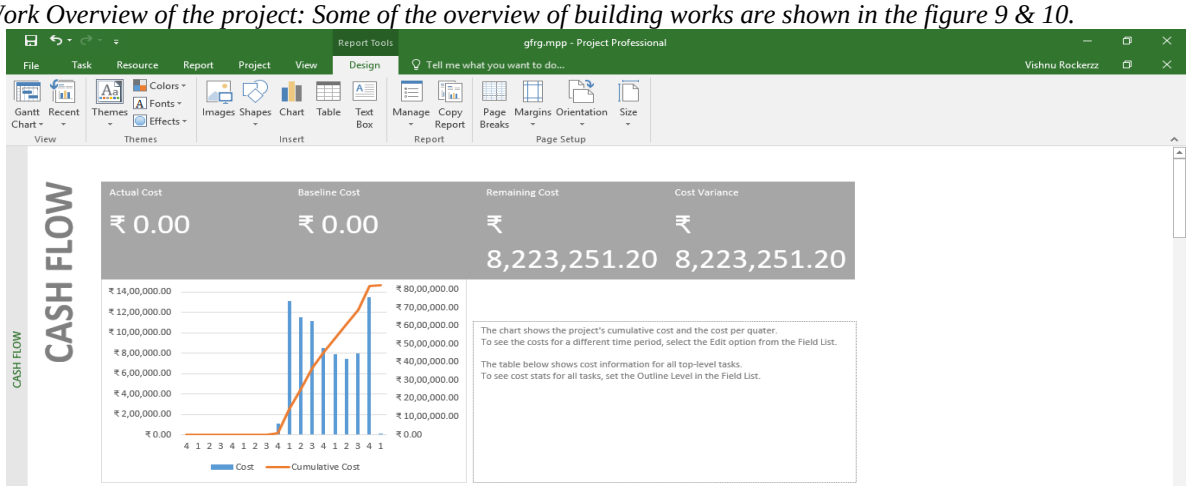


Fig.9 Cost report of the project

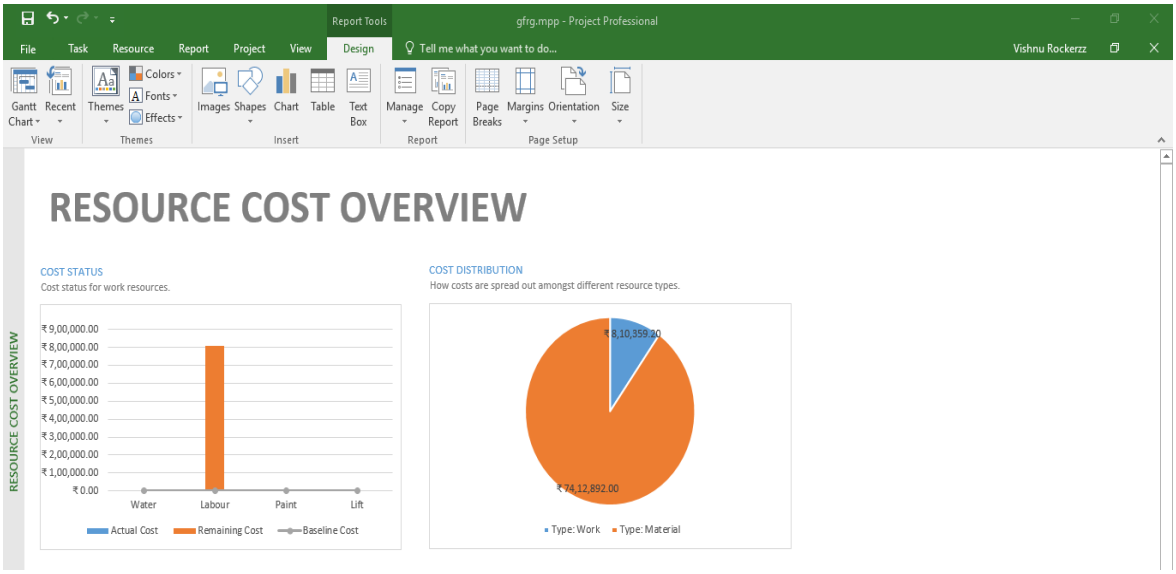


Fig.10 Resource Cost overview report of the project

D. Autodesk Navisworks Manage

Autodesk Navisworks Manage may be a software package application providing a complete task assessment decision that helps coordination, analysis, and communique of fashion rationale and constructability. It permits integration of multidisciplinary style knowledge created in numerous BIM style applications to one project model. It additionally provides interference management and clash detection functions to anticipate and avoid potential issues within the project, which might eventually minimize delays and reworks. Furthermore, it supports 4D and analysis by combining constant models with the project schedule and prices. The format of the Navisworks will be NWD and DWF formats.

1) Creation Of 4D Models: 4D models can be created by appending 3D models into Autodesk Navisworks manage 2018 software. The program mechanically aligns rotation and resize the units during which every file is hooked up to show the groups. 3D model and MS Project schedule is foreign in Autodesk Navisworks animal disease to creating a 4D model.

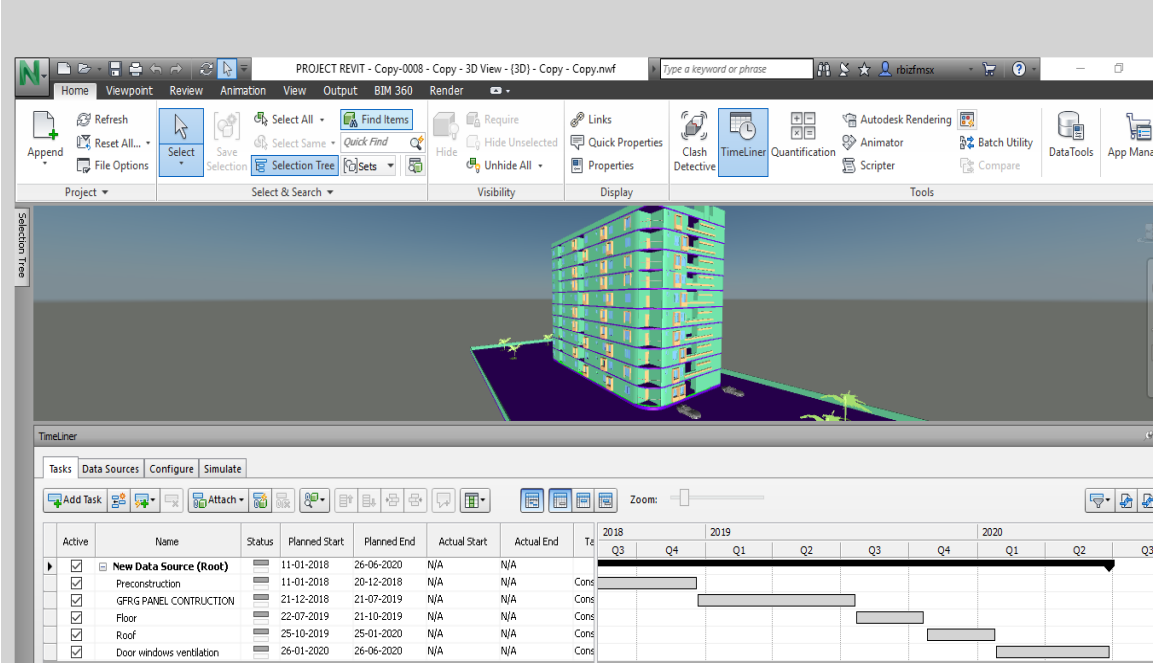


Fig. 11 Merging 3D model with Microsoft project

2) Clash Detection: Clash detection is crucial for errors-loose creation challenge facilitates to optimize time within the construction time table. Clash detection, which minimizing costly delays and reworks clashes between numerous disciplines will be known before construction and delays at the site will be eliminated. The structure may be redesigned when the clashes are reviewed and approved.

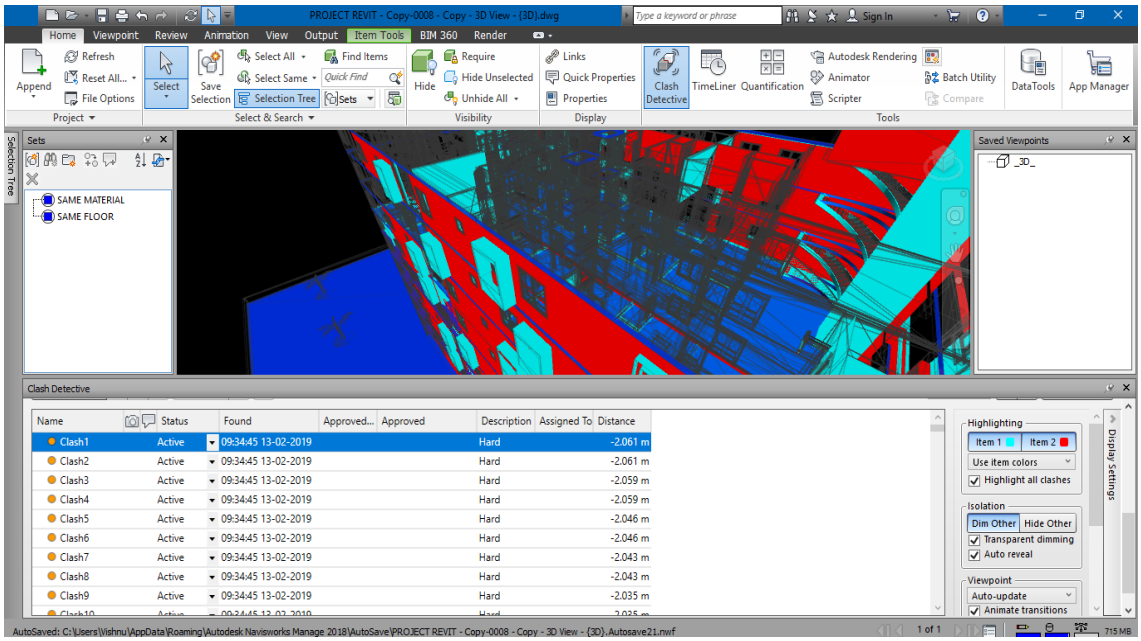


Fig. 12 Highlight of clashes

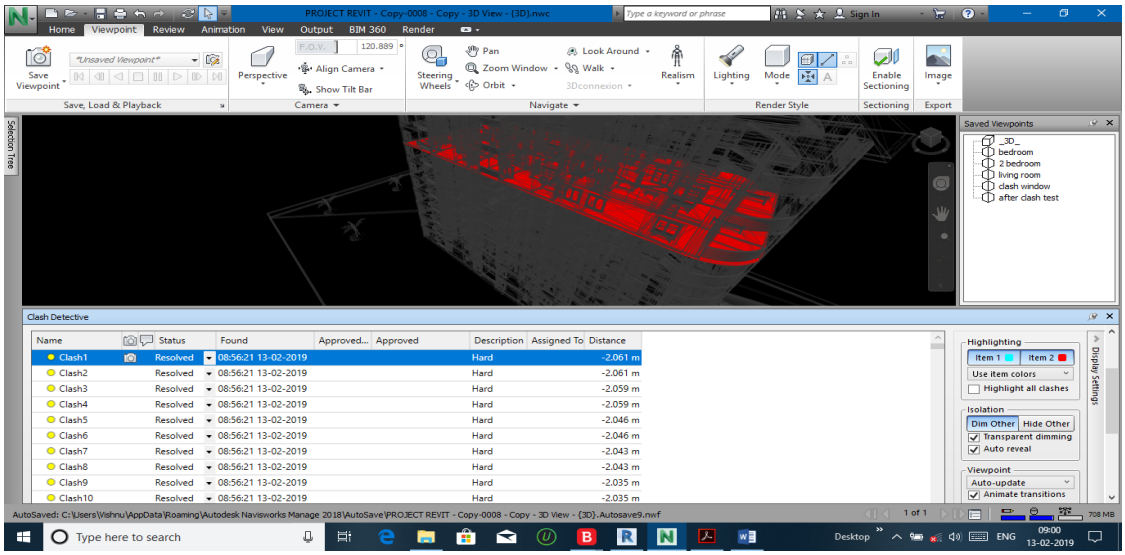


Fig. 13 Resolved clashes

2) *4D Simulation:* The software automatically rescales its units when MS project is attached to the 3D model; this process is known as 4D simulation. The simulation that involves starting and end date of the current project.

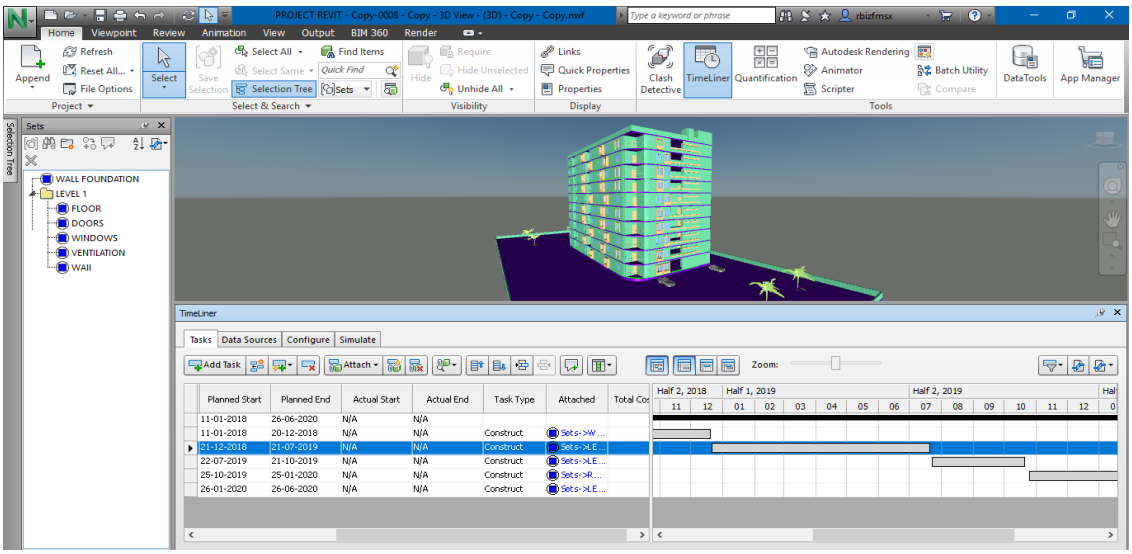


Fig. 14 Timeliner for simulation

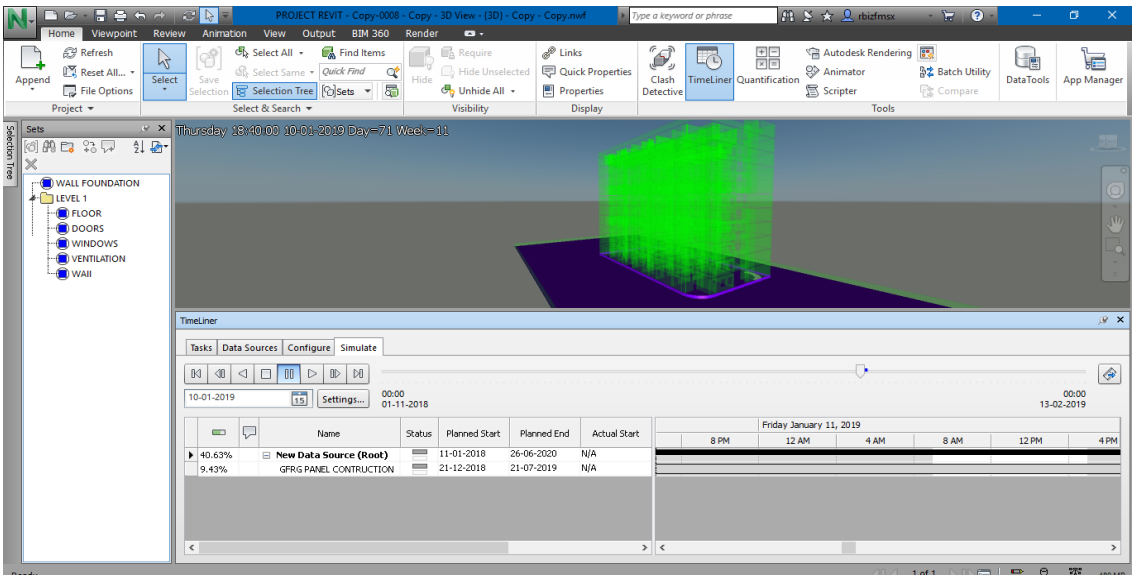


Fig. 15 Building simulation

4) Creation of 5D Models: The 5D model is the integration of 3D model with construction cost and time of project length. This process is also known as quantification. The 5D model is formed by attaching the 3D model and the MSP schedules (time and cost) in Navisworks manage software system 2018. The 5D model explains regarding the image, planning, scheduling, and monitoring, time liner and clash detection the least bit stages of pre and post- construction method of the building.

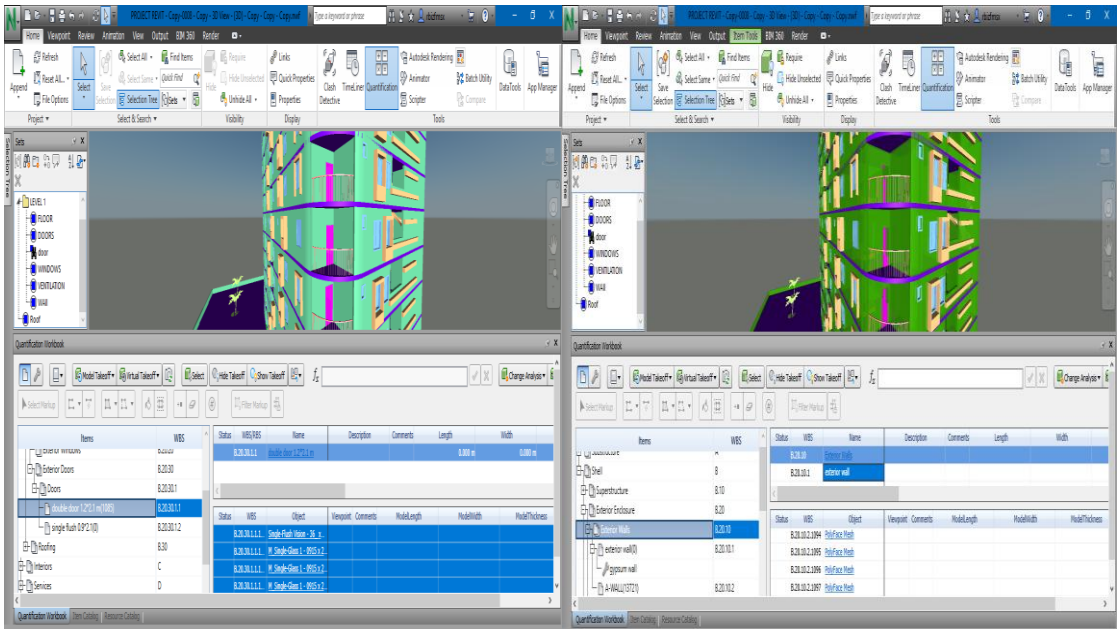


Fig. 16 Quantification process

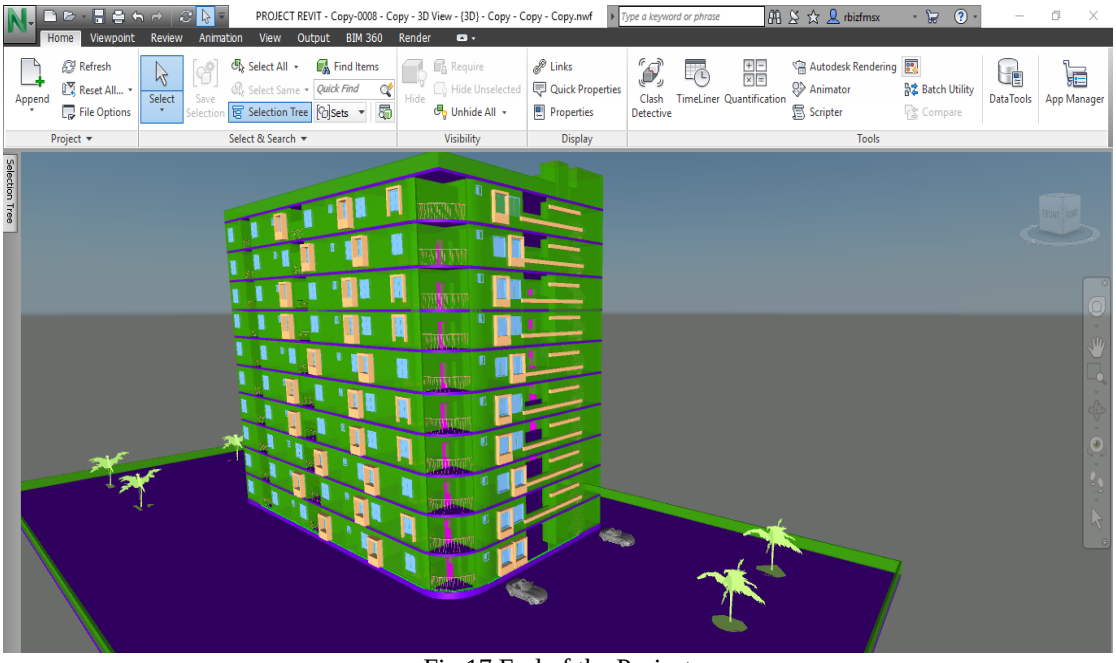


Fig.17 End of the Project

V. CONCLUSIONS

GFRG building is a useful construction technique. This can be used for the entire superstructure of buildings, including all walls, slabs, staircases, parapets, and so on. This constructing framework has numerous points of interest over conventional structures. The 5D and 4D model of BIM is integrated with all the information, which includes the 3D model, time schedule, and cost, which is imported in the Navisworks Manage 2018 software. By the implementation of BIM in GFRG panel building, we can achieve a low-cost structure with the help of clash detection, time liner and quantification. Clash detection is crucial for errors-loose creation challenge facilitates to optimize time within the construction timetable. The 5D BIM offers an ideal visualization that allows watching the day nowadays work progress of a building. By mistreatment, this technology the time, cost, material and labour management becomes smooth and possible. It conjointly helps the user to come up with the income forecast timely, hourly, monthly, weekly, or maybe daily within the simulation method that is extremely tough to get within the conventional way.

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