INTEGRATED PLANNING, ESTIMATION OF QUANTITY, AND COSTING FOR AN OFFICE BUILDING BY USING REVIT ARCHITECTURE SOFTWARE

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Abstract - This project aims to study the benefits of BIM for AEC industries and to understand how to make integrated planning, estimation, and costing of complex office 3D building models using Revit Architecture aligning with Indian standards. This study includes preparing the site layout and floor plans for an office building according to Indian standards, assuming that the building is in Visakhapatnam. Additionally, it includes the creation of a 3D office building, architectural drawings, estimating of quantity take-offs and cost of the project, and generating detailed documentation by using Revit architecture software.

Key Words: Estimation and Costing, Office Building, Revit Architecture.

1. INTRODUCTION

REVIT ARCHITECTURE OVERVIEW: - Revit Technology Corporation was founded in 1997 by Leonid Raiz and Irwin Jungreis. The company aimed to develop software that would revolutionize the way architects and building professionals design and collaborate on projects. In 2000, Revit Technology Corporation released the first version of Revit, known as Revit 1.0. This initial release introduced the concept of parametric modeling and building information modeling (BIM) to the architecture, engineering, and construction (AEC) industry.

While initially focused on architecture, the Revit platform expanded to support other disciplines within the AEC industry, including structural engineering and MEP (mechanical, electrical, and plumbing) engineering. This broadened its appeal and made it a comprehensive solution for multi-disciplinary project teams. This includes advancements in cloud collaboration, computational design, and interoperability with other software tools. Today, Revit Architecture remains one of the most widely used BIM software platforms in the AEC industry, playing a crucial role in the design, documentation, and construction of buildings and infrastructure projects worldwide.

PROJECT OBJECTIVES:

- Creating Building planning for a complex office building using Revit Architecture software.

- Optimize the construction documentation workflow, ensuring accuracy and efficiency in generating drawings and schedules by using Revit.

- To achieve precise and automated estimation of quantities, reducing manual errors in cost calculations by using Revit.

- Analyze the software's capability in coordinating and visualizing interior spaces within the architectural design.

- Assess the adaptability of Revit by creating and incorporating custom design elements tailored to the specific requirements of the project.

- Provide valuable insights into Revit's effectiveness in real-time projects.

2. LITERATURE REVIEW

Abid Nadeem (2010): Educators around the world are contemplating various approaches and methodologies for teaching BIM to tertiary students of the AEC disciplines enabling them to apply BIM in their future careers. These approaches are reviewed in this paper along with the initiatives being taken by the Department of Building and Real Estate (BRE) of the Hong Kong Polytechnic University (PolyU) to incorporate BIM in the construction management, building technology, and quantity surveying curricula. Feedback was obtained from questionnaire surveys of students.

Akash A. Patel (2016): This paper presents the Implementation of project management function using the BIM concept in residential buildings. To assess the effectiveness of using 4D modeling to visualize a construction schedule, a case study research project is being performed where a 3D model is being generated and a construction schedule with the aid of a 4D learning module. The 4D modules were developed using two different 4D modeling applications. Finally, a conclusion will be made on whether it is beneficial and practical to apply 4D scheduling in any construction project, and recommendations will be made based on the same.

Astuti Fahmilia (2023): In a toll road project, cut and fill is one of the massive volumes, which consumes a lot of time to calculate the quantity and has a high chance of human error. This research aims to determine the implementation of BIM in cut and fill quantity take-off in the Toll Road Project. Nevertheless, there are still some lack, such as the expensive cost of software, hardware, and training, the need for a long time to adapt to the organization, and also need to collaborate with all of the stakeholders to implement BIM successfully.

Deepa A. Patil (2017): The paper presents the implementation of project management functions using BIM concepts in residential or multistoried buildings. The BIM tool assists especially with design, defining the building form and spaces, and visualization to analyze costs, time, and energy performance.

E. Rakesh Reddy (2019): In this project, they provide a detailed explanation of how they designed and modeled the G+5 commercial building by Autodesk Revit architecture. Use the information-rich models that Autodesk Revit Architecture is useful for making more informed Building design decisions to support sustainable design, clash detection, construction planning, and fabrication Installation. Revit Architecture will clear picture of building excellent visualization by using V-ray software, which is made for Rendering purposes.

Shivaji Yele (2022): In this project planning, modeling, quantity estimation, and scheduling of multi-story residential building using advanced civil engineering applications such as BIM which includes software like AutoCAD, Autodesk REVIT, Primavera, and Microsoft Excel Spreadsheets. The project starts with the planning of the building using AutoCAD, the modeling and quantity estimation will be carried out with the help of Autodesk REVIT, and finally, the scheduling will be done by using Primavera.

Xinan Jiang (2011): In this thesis, diverse BIM tools and applications have been introduced with an emphasis on construction scheduling and cost estimating. Two approaches for 4D scheduling in BIM have been presented: i) BIM tools with 4D capacity, and ii) the use of 4D BIM tools to link the 3D BIM model with the project schedule. For the cost estimating capability, three types of available methods have been discussed: i) export the Quantity Takeoff (QTO) list from the BIM tool to the estimating software such as MS Excel, ii) link BIM components to estimating software, and iii) use QTO tool to extract the QTO list from the model. Based on the available methods, a case study is presented to illustrate the scheduling and cost-estimating processes in BIM based on the BIM model of a three-story training facility.

3. METHODOLOGY

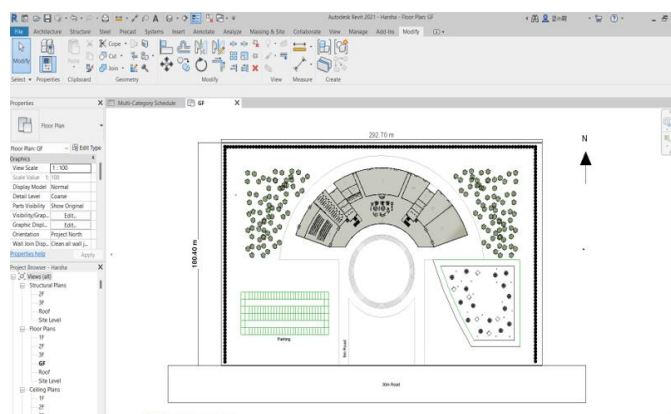**Fig 3.1: Flow Chart of Methodology**

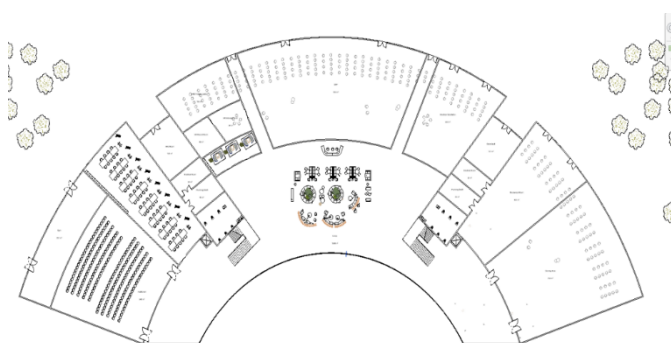## 4. RESULTS AND DISCUSSION

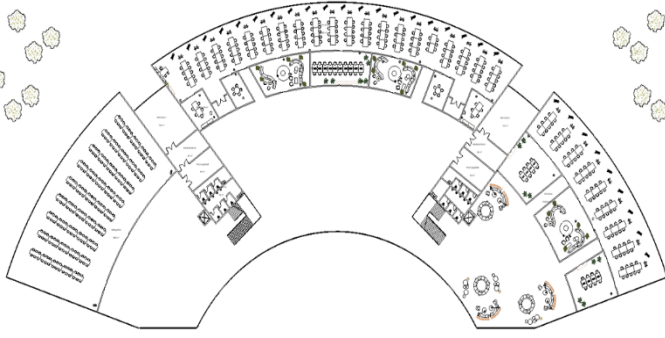**Fig -1: Site Layout**

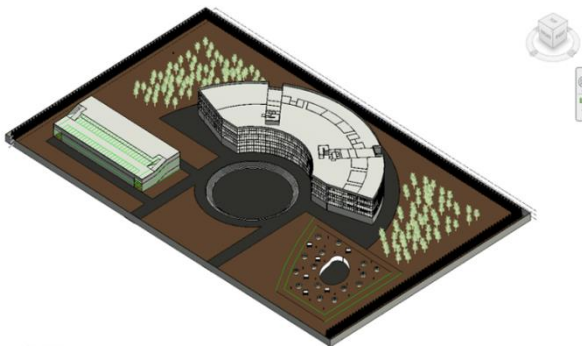**Fig -2: Ground Floor Plan**

Fig -3: 1st ,2nd, and 3rd Floor Plan
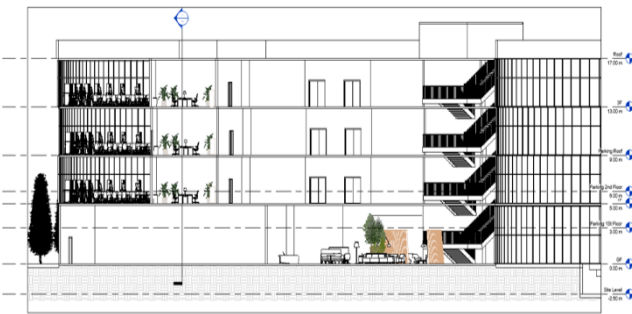

Fig -4: 3D Model of Site with Building
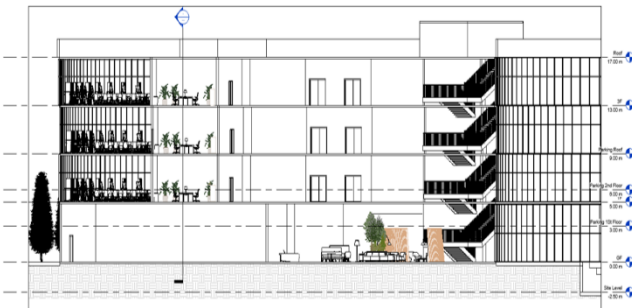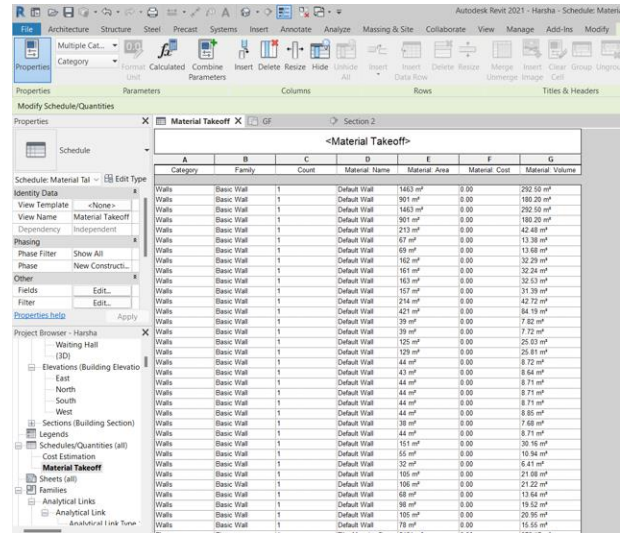

Fig -5: Sectional View -1

Fig -6: Sectional View -2

Fig -7: Material Take-off Schedule

Fig -8: Cost Take-off Schedule

Table-1: Different Spaces on the Ground Floor

Space	Area (Sq.m)	No's Per Floor	Total Floor Area (Sq.m)
Gaming Area	733	1	733
entry lobby	1039	1	1039
STP	833	1	833
Mechanical Room	420	1	420
Electrical Substation	332	1	332
AHU Room	102	1	102
Gym	230	1	230
Washrooms Male	23	2	46
Washrooms Female	14	2	28
Plumbing Shaft	43	2	86
Electrical Room	39	2	78

Auditorium	548	1	548
HRD training Room	166	1	166
HR Interview Room	54	1	54
HR Record Room	48	1	48
O&M Staff Room	101	1	101
Vendor Meeting Room	65	1	65
Lift	6	2	12
GF Work area	374	1	374
Circulation Space			959
Grand Total			**6254**

Table-2: Different Spaces on the Remaining Floors

Space	Area (Sq.m)	No's Per Floor	Total Floor Area (Sq.m)
Working area	1331	1	1331
Homeroom	85	1	85
Homeroom	115	1	115
Meeting	38	1	38
Meeting	32	1	32
Meeting	34	1	34
Meeting	29	1	29
Meeting	109	1	109
Meeting	87	1	87
Conference room	95	1	95
Open collab	636	1	636
Eco cafe	862	1	862
FA store	14	2	28
Washrooms male	23	2	46
Washrooms female	14	2	28
Plumbing shaft	43	2	86
Electrical room	39	2	78
Storeroom	103	1	103
Copy/ print	15	2	30
Lift	6	2	12
Circulation space		1	2390
Grand Total			**6254**

Table-3: Material Take off And Estimation and Costing Sheet

Description	Unit	Quant-ity	Cost per unit	Total Cost
Data We Get from Revit				
Floor's Volume	Cu.m	6234.52		
Walls	Cu.m	3619.92		
Floor Area	Sq.m	41568		
Curtain Panels	Sq.m	4078		
			9,149.32	3,73,10,941.23
Concrete and its Materials Required For Slabs				
Volume Slab's	Cu.m	6234.52		
Wet Volume of Concrete	Cu.m	9601.16		
Cement Bags	No's	79003.84	450	
				3,55,51,728
Sand	Cft	96874.89		
			1,550	15,01,56,079.50
Aggregate	Cft	145312.3	450	
				6,53,90,535
Water	Lt	125497 6	800	
				1,00,39,80,800
Motor and it's Materials Required For Plastering				
Plaster	Cu.m	18114		
Plaster Dry	Cu.m	326.052		
Wet Volume	Cu.m	440.17		
Cement Bags	No's	3169.2	450	14,26,140
Sand	Cft	11658.35		
			1,550	1,80,70,442.50
Water	Lt	158461.2	800	
				12,67,68,960
Masonry Work and its Materials Required				
Wall Volume	Cu.m	3620		
Brick Volume	Cu.m	0.027		
No of Bricks	No's	134074.0741	75	
				1,00,55,555.56
Motor Volume	Cu.m	441.512		0
C Bag's	No's	4227.92	450	19,02,564
Sand	Cft	15550.8		
			1,550	2,41,03,740

Paint	Sq.m	18114	600	50,16,184.62	BluDot_Table_Occasional_Swole	No's	16	32,000	5,12,000
Putty	Sq.m	18114	3.50	20,47,263.39	Coalesse_AM_Seating_Sofa_Circa_30degArmrest_OutsideFacing	No's	33	20,500	6,76,500
Tiles/Marbles	Sq.m	41568	200	8,94,86,842.18	Coalesse_AM_Seating_Sofa_Circa_RoundOttoman	No's	20	31,000	6,20,000
Lifts	No's	2	8,50,000	17,00,000	Coalesse_AM_Seating_Sofa_Circa_StraightArmrest	No's	1	19,000	19,000
Furniture					Coalesse_AM_Seating_Sofa_Circa_WedgeLoveseat_InsideFacing	No's	20	28,500	5,70,000
Door-Double-Sliding	No's	75	45,000	33,75,000	Coalesse_AM_Seating_Sofa_Circa_WedgeSeat_InsideFacing1	No's	23	24,000	5,52,000
Door-Exterior-Double	No's	38	60,000	22,80,000	Coalesse_AM_Seating_Sofa_Circa_WedgeSeat_OutsideFacing	No's	99	12,000	11,88,000
Door-Passage-Double-Flush-Dbl_Acting	No's	6	42,000	2,52,000	Coalesse_AM_Seating_Stool_EneaAltzo943	No's	6	25,000	1,50,000
M_Single-Flush	No's	36	8,000	2,88,000	Coalesse_AM_Table_Conference_Bob_Round	No's	6	21,000	1,26,000
AXTMPANTAPICNIC	No's	15	18,000	2,70,000	Coalesse_AM_Table_Conference_Potrero415Light_WorkingHeight_Rectangular	No's	135	35,000	47,25,000
Block Crystal table	No's	12	21,000	2,52,000	Coalesse_AM_Table_Occasional_Await_Freestanding	No's	9	29,300	2,63,700
Block planter	No's	2	1,500	3,000	Coalesse_AM_Table_Occasional_Bob_Round	No's	9	19,000	1,71,000
Blu Dot - Bousta - Rug	No's	3	11,000	33,000	CONMSHADEPOUFOUT	No's	9	13,000	1,17,000
Blu Dot - Bumper - Ottoman	No's	6	5,100	30,600	Dracaena 1	No's	48	14,600	7,00,800
Blu Dot - Bumper - Tray	No's	6	4,200	25,200					
Blu Dot - Hot Mesh - Table	No's	16	12,400	1,98,400					
Blu Dot - Minimalista - Coffee Table	No's	9	9,000	81,000					
Blu Dot - Signal - 20" x 13" Lumbar Pillow	No's	3	1,500	4,500					
BluDot_Accessory_Decor_Amos_CoatRack	No's	6	20,000	1,20,000					
BluDot_Accessory_Decor_Delicious_Tray	No's	240	9,000	21,60,000					

Extremis - Hopper - Table Picnic W Shade	No's	6	19,350	1,16,100	Potted Homalomena	No's	3	7,000	21,000
Flos - Ktribe T1	No's	24	22,000	5,28,000	Steelcase - Answer Solution - Universal Table - Cabby Leg	No's	24	28,000	6,72,000
Flos_Accessory_Lighting_Arco_FloorLamp	No's	22	19,000	4,18,000	Steelcase - Answer Solution - Universal Table - Round	No's	6	26,000	1,56,000
Grouped Buffet Credenza	No's	6	20,000	1,20,000	Steelcase - Seating - QiVi 428 Series - Collaborative Chairs	No's	281	42,000	1,18,02,000
Mattiazzi_Seating_GuestChair_Solo	No's	810	28,000	2,26,80,000					
Mattiazzi_Seating_Stool_Cugino	No's	11	29,000	3,19,000	Steelcase Coalesse - Await - Table - Freestanding	No's	18	32,000	5,76,000
Mitchell Gold Bob Williams - Alpaca - Pillow 22x11	No's	9	2,600	23,400	Steelcase Coalesse - CH008 Sofa Table	No's	18	22,450	4,04,100
Mitchell Gold Bob Williams - Avery - Chair Barrel	No's	18	32,000	5,76,000	Steelcase Coalesse - Circa - Seating - Straight	No's	9	35,000	3,15,000
Mitchell Gold Bob Williams - Linear - Stripe Embroidered Pillow 21X15	No's	8	3,000	24,000	Steelcase Coalesse - Circa - Seating - Wedge Loveseat - Inside Facing	No's	24	19,000	4,56,000
Nanimarquina rug 2	No's	9	22,000	1,98,000	Steelcase Coalesse - Circa - Seating - Wedge Loveseat - Inside Facing1	No's	18	20,000	3,60,000
OBASPECT58HB 2	No's	3	75,000	2,25,000					
Personal Table	No's	10	39,000	3,90,000	Steelcase Coalesse - Circa - Seating - Wedge Loveseat - Outside Facing	No's	12	20,000	2,40,000
Philodendron Imperial Green	No's	9	9,600	86,400					
Plants - Table - Cylinder 13	No's	3	2,500	7,500	Steelcase Coalesse - Circa - Seating - Wedge Seat - Inside Facing	No's	24	24,000	5,76,000
Pot 11	No's	9	1,000	9,000					
Pot 21	No's	48	1,300	62,400	Steelcase Coalesse - Circa - Seating - Wedge Seat - Outside Facing	No's	9	24,000	2,16,000
Pot 26	No's	9	1,200	10,800					
Potted Cast Iron	No's	42	5,000	2,10,000					

Steelcase Coalesse - Circa - Table - Low Straight	No's	9	14,000	1,26,000	Steelcase_AM _Storage_Syst em_FlexActiv eFrames_Fixe dBoard	No's	3	34,500	1,03,500
Steelcase Coalesse - Lagunitas - Table - Personal	No's	9	32,000	2,88,000	Steelcase_AM _Storage_Syst em_FlexActiv eFrames_Fram eExtension	No's	25	24,500	6,12,500
Steelcase Coalesse - Lagunitas - Table - Personal1	No's	9	34,000	3,06,000	Steelcase_AM _Table_Confer ence_Currency Enhanced_Rec tangular_Recta ngularBase	No's	6	35,000	2,10,000
Steelcase Health - Regard - Cushion - Seat	No's	6	26,000	1,56,000	Steelcase_AM _Table_Occasi onal_Bassline _Round	No's	22	29,000	6,38,000
Steelcase_AM _Desking_Ben ch_FrameOne _DualSided_B ase_Continuou sTop	No's	15	28,000	4,20,000	Steelcase_AM _Table_Occasi onal_Campfire _Personal	No's	33	21,000	6,93,000
Steelcase_AM _Desking_Ben ch_FrameOne _DualSided_B ase_Continuou sTop	No's	12	44,000	5,28,000	Steelcase_AM _Technology_ Collaboration_ Roam	No's	95	35,000	33,25,000
Steelcase_AM _Seating_Conf erenceChair_S ILQ	No's	849	30,000	2,54,70,000	Steelcase_AM _Technology_ PowerMgmt_ Thread_Power Hub	No's	38	12,000	4,56,000
Steelcase_AM _Seating_Educ ation_QiVi_C ollaborative	No's	30	28,000	8,40,000	SteelcaseHealt h_AM_Access ory_Cushion_ Regard_Seat	No's	20	32,000	6,40,000
Steelcase_AM _Seating_Gues tChair_Nooi_F rameLinking	No's	12	55,000	6,60,000	SteelcaseHealt h_AM_Access ory_Planter_R egard	No's	9	12,000	1,08,000
Steelcase_AM _Seating_Offi ceChair_Amia _AirBack	No's	108	29,000	31,32,000	SteelcaseHealt h_AM_Seatin g_Booth_Rega rd_Table	No's	8	29,500	2,36,000
Steelcase_AM _Seating_Otto man_Alight	No's	40	9,00 0	3,60,000	SteelcaseHealt h_AM_Seatin g_Healthcare_ Regard_Arm_ SingleSided	No's	12	44,000	5,28,000
Steelcase_AM _Seating_Stoo l_Karman	No's	3	45,000	1,35,000	TS34401	No's	10	13,000	1,30,000
Steelcase_AM _Storage_Cart _Flex_Board	No's	95	32,000	30,40,000	Universal Personal Locker	No's	24	4,00 0	96,000
Steelcase_AM _Storage_Loc ker_WorkVale t_SingleWide_ 72H	No's	40	92,000	36,80,000	Viccarbe - Aleta - Lounge Chair - Metal Base	No's	18	21,000	3,78,000

WestElm_Desking_Bench_Greenpoint_ContinousTop	No's	282	22,000	62,04,000
WestElm_Seating_ConferenceChair_Sterling	No's	10	34,000	3,40,000
WestElm_Seating_Lounge_Lucas	No's	20	16,000	3,20,000
Wood Screen Curved	No's	23	28,000	6,44,000
Sink-Double-2D	No's	24	5,000	1,20,000
Urinal - Wall Hung	No's	50	12,500	6,25,000
Water Closet - Quiet Flush Tank	No's	48	14,900	7,15,200
Recycle Bin-Round	No's	63	6,000	3,78,000
Construction Cost	Per Sft	41568	5,000	2,23,71,71,054.40
				3,92,83,41,430.37
Grand Total				**392.83 Cr**

5. CONCLUSION

- Revit facilitates accurate quantity extraction and cost estimation for office building projects.
- Integration with the Revit model enhances collaboration and coordination among project team members.
- Real-time updates and revisions are facilitated, allowing for optimization of project outcomes.
- Utilizing Revit for estimation schedules improves efficiency, accuracy, and transparency in the cost estimation process.
- Compared to manual calculations it was a straightforward and less time-consuming process.
- We can easily and quickly create sectional drawings and elevations with more accuracy.
- Working with 3d models and parametric models will give us a good understanding of space in. relation to other elements.
- Any changes in planning will be updated in all other drawings, so it consumes much less time compared to AutoCAD software.

- And also, we have some drawbacks like while scheduling quantity summarizing the data was not good.

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