



IJRASET

International Journal For Research in
Applied Science and Engineering Technology



INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 12 **Issue:** III **Month of publication:** March 2024

DOI: <https://doi.org/10.22214/ijraset.2024.59127>

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Integration of Augmented Reality to BIM Model

P. Venkata Ratnam¹, R. Mohan Kumar², P. Tarun Kumar³, T. Bhargavi Devi⁴

Department of Civil Engineering, GMR Institute of Technology, Rajam

Abstract: This study investigates how to seamlessly incorporate augmented reality (AR) with Building Information Modelling (BIM) and its impact on construction efficiency. By overlaying digital information onto physical environment, AR enhances on-site decision-making and spatial understanding. The project emphasizes the practical benefits, such as improves collaboration, reduced errors, and enhanced project outcomes, positioning the AR-BIM fusion as a key driver for construction excellence.

Keywords: Augmented Reality, STAAD PRO, REVIT, AUGIN

I. INTRODUCTION

A. BIM

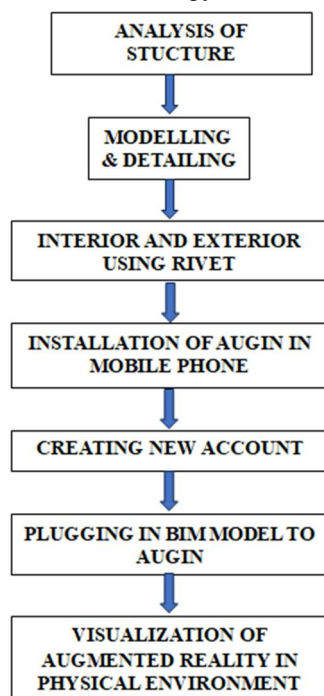
Building information modelling BIM is a process supported by various tools technologies & contracts involving the generation & management of digital representation of physical & functional characteristics of place. BIM can also define as representation of 3D object or any object in digitalisation & visualization format.

B. Augmented Reality in Construction

AR has proved to be quite effective in the building sector as well. Using augmented reality effectively can enhance team collaboration, enable you to win more projects, and even increase safety., AR is having more advantages in construction field, risk of errors & delays reduces, AR also increase safety, reduces risk of accidents and it is more realistic. You can read more about augmented reality's current and potential applications in building below. Additionally, business using AR effectively will be highlighted so that you can be motivated to continue with your own projects.

II. LITERATURE REVIEW AND METHODOLOGY

The main methodology includes three steps to approach the augmented reality on physical environment. The steps include Analysis of structure Modelling and detailing and implementation. After successful implementation the model is executed through augmented reality in physical environment. Flow chart of methodology is shown in below flowchart.



A. Structural Analysis

i) Creating a structural model in staad pro using nodes that is calculated from the particular plan. In this example, the 3d frame model is produced using the choose option and structure wizard on the top. Select the frame model from the model type and click on the bare frame option. A new window will appear with the number of bays in length, breadth, and height. Enter the numbers for the number of bays as per the building design and the number of storeys. The values of each bay are then inputted in accordance with the building's plan view, and the model is imported to STAAD software using the structure wizard option.

ii) Applying various loads

After creating a structural model using staad the model is subjected to different loads i.e. live load, dead load, self-weight and all the requirements. After proper analysis of a model the required results like displacement, deflection, shear force, bending moment are obtained.

B. Creating Revit Model

- 1) *Create Walls:* Go to the architecture tab, choose a wall, then select the properties toolbar, click on edit type, duplicate, and then ok. Next click on edit, specify the wall's thickness and unconnected height, and then click apply. Include doors, windows, slides and all required components.
- 2) *Designing Roof:* Make a roof out of an extrusion or the footprint of the structure. Roofs may be designed in a variety of ways using Revit. Choose the strategy that best meets therequirements of your project design.
- 3) *Create Floors:* Choose Architecture. Choose the floor from the built panel, your floor level, the line from the draw panel, a value for the plinth offset, draw the line at the outer boundaries of the wall, and then choose Finish Edit Mode: Choose floor, then properties tool bar, now click on edit type, now choose duplicate, provide duplicate name, click on edit, then choose second row floor thickness, and finally click on ok and again on ok.

C. Details of Building

These are details of building that is given during implementation.

- 1) Height of the parapet wall - 1m
- 2) No. of storeys of building - G+1
- 3) Depth of the slab – 130.mm
- 4) Inner and outer wall thickness - 4 & 9 inches
- 5) Height of the floor – 3.5m
- 6) Depth of footing - 1.2m
- 7) Footing dimensions -12*12m
- 8) Plinth beam - 0.3*0.25m
- 9) Roof beam - 0.3*0.22m
- 10) Column size - 0.3*0.3m
- 11) Characteristic & yield strength -M25&Fe500.

D. Plugin to Augin

Download the augin software into the mobile phone, login to the software using required credentials. Plugin the document to the software which generates a particular QR. Using tablet or smartphone by scanning the QR the augmented reality of the project is clearly visible on site before construction.



AR Application used

E. Implementation

1) *Staad Pro*: STAAD Pro is a widely used structural analysis and design software primarily used by civil engineers. The software is developed by Bentley systems. The main key application for Staad pro is structural analysis which allows user to perform analysis of various types of structure, including buildings, bridges, towers and other civil engineering structures. Design of structural elements is the second key application in Staad pro, it assists in the design of different structural elements, including beams, columns, slabs, and foundations. Also, the designing phase ensures that those elements meet the required code specifications and safety factors.

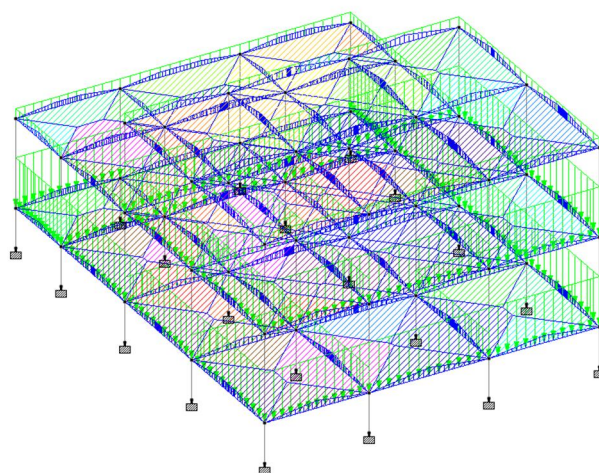


FIG 1: Structure subjected to all loadings

2) *Autodesk Revit*: Designing phase of model is mainly developed in Revit. The floor plan for a G+1 building is drawn and the diagram of a plan is shown below. Interior of the building is added using Revit software by downloading required components from Revit family. The plan of building is shown in below figure 2.

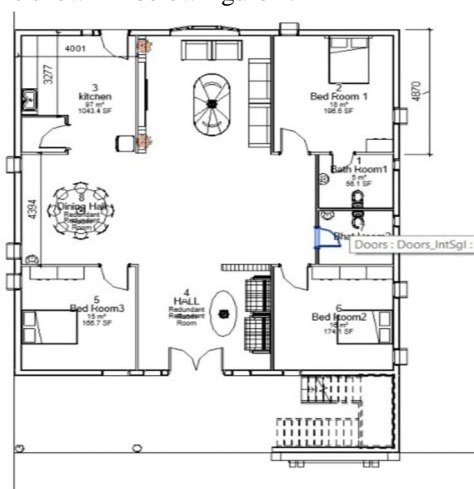


FIG 2: Plan of a building

F. Augmented Reality

The mobile version can simply be downloaded from Google play store, which is readily available. Any android users or IOS users can make use of this application. Once installed in PC, now we've to install the plugin that is readily available in google, which will be directly added to the Revit software in the PC, later it can be accessed upon creation of account and uploading our BIM model. Creating Grid - Once the BIM model is plugged into the software the system is ready to show Augmented Reality in physical environment. Open the Augin software - then open the BIM model which is already plugged in. Once open, click on AR option and then set up the grid in the required area. The required BIM model is observed in the physical environment.

III. RESULTS AND DISCUSSIONS

A. Analyzing Phase

From the phase of analysis the structure is resulted as safe. The required diagrams like displacement, deflection, reactions, shear force are mentioned below in figure 3, figure 4 & figure 5.

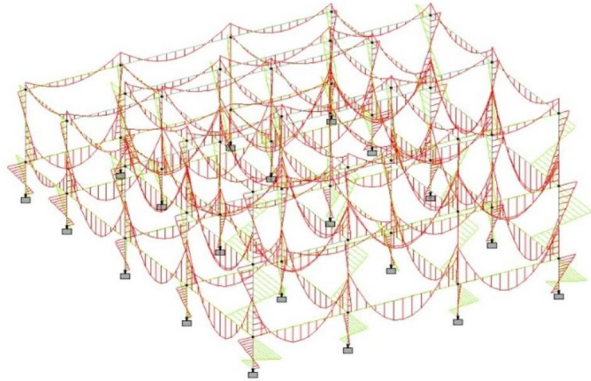


Fig 3: Bending Moment

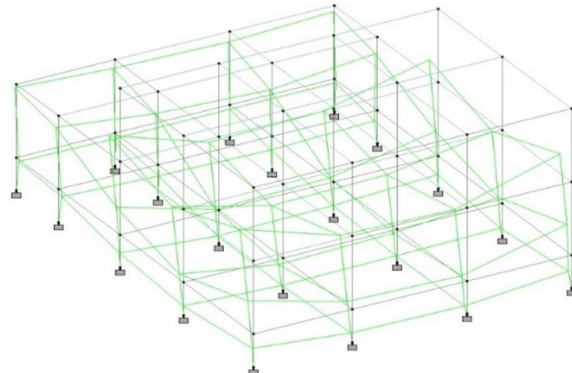


Fig 4: Deflection

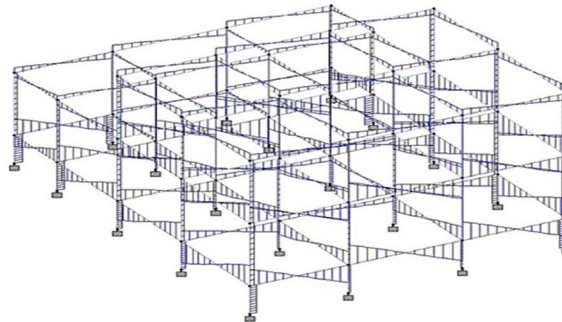


Fig 5: Shear Force

- Maximum bending moment of the structure is 35.216 kN-m which is hogging moment. The max bending moment at beam 55 is shown below.
- Maximum Shear force of the structure is 40.185 kN which is sagging moment. The max shear force at beam 58 is shown below.
- Maximum displacement of the structure is 2.507mm for beam 8.
- Maximum axial force of the structure is 520.76 kN for column 38.

B. Autodesk Revit

3-dimensional view and interior view of a building taken in this study is shown in below figure 6.

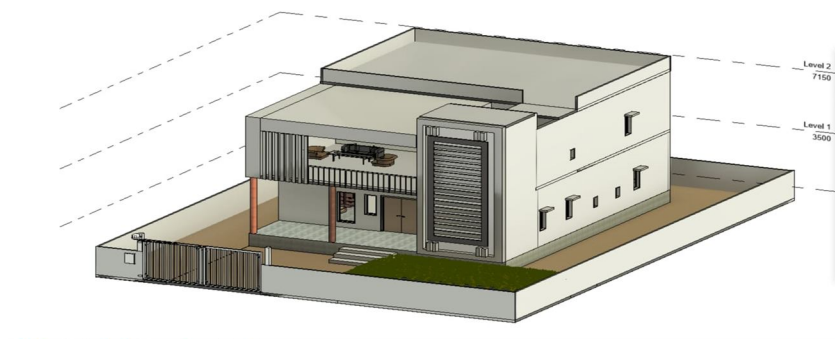


FIG 6: 3D view of a building

Interior view of a building is created using Autodesk Revit. The interior view is shown in below figure 7.



FIG 7: Interior view of a building

Augmented reality of the structure taken in this study is executed in the physical environment using AR software Augin. The BIM model is plugin in to the software and by setting up grids in the physical environment, the Augmented Reality of the building is observed. It is observed in figure 8.

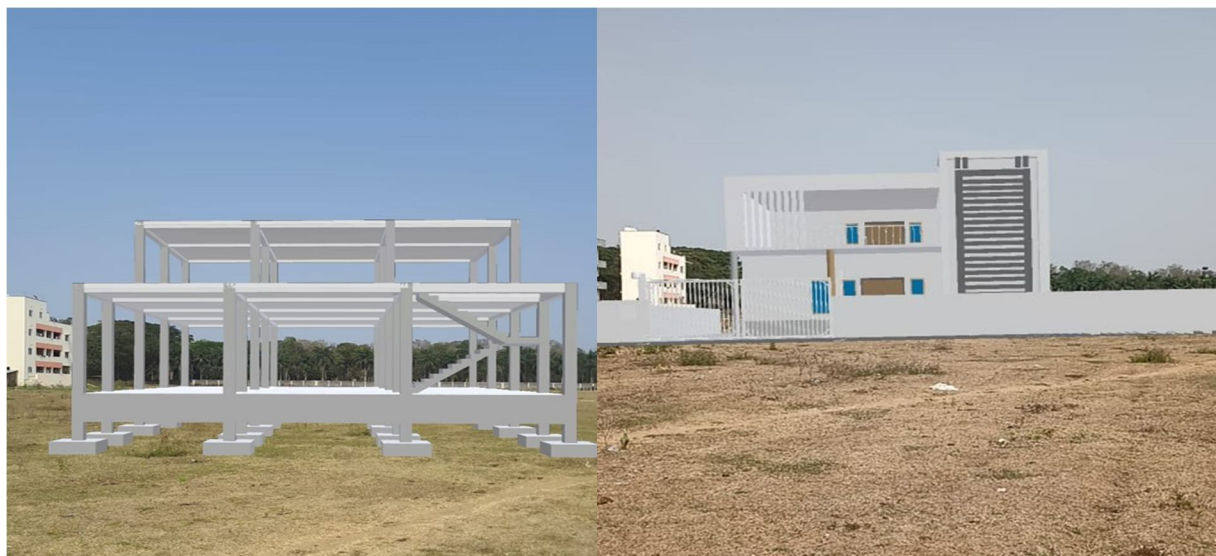


Fig 8: Augmented Reality

Augmented reality showing the elevations of the building model taken in this study is shown in Fig 9 in physical environment

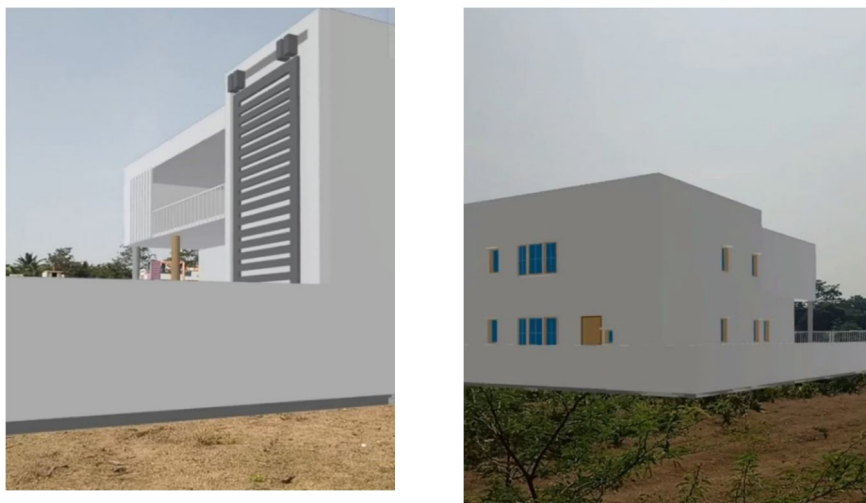


Fig 9: Elevation of BIM Model through augmented reality



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