Study on Building Information Modeling (BIM) for Structural Design

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Abstract: *BIM is an Digital Transformation of AEC (i.e) Architectural, Engineering and Construction Industry, it is a technology not a software, used to create, manage data during the design, construction and operation process. BIM integrates multi- disciplinary data to create detailed digital representation and are managed in Open Cloud Platform for real time collaboration. The main objective of the project is to plan and Design Structural Truss model in Revit Software and apply changes to the structure and parameter study, also identify potential errors and risks, enhance accuracy and autogenerate drawing using Revit software. BIM concept is applied to handle the analytical model in Revit software and bring the analytical result in Revit using Robot Structure Analysis and Advanced steel Software to create fabrication documents. Limitation Observation (i.e) Identify any loss of data during model transfer from Revit to Robot Structure, Support condition check-verify boundary condition are loaded assigned in structural model, Data transfer using plugin are made using single userface. The major scope is to generate a complete report for structural design model and do the optimization & scheduling and load analysis along with that.*

Keywords: BIM Model, Revit software, Model transfer , Scheduling, connections

I. INTRODUCTION

Building Information Modeling (BIM) is an intelligent, 3D Model - grounded process that helps structural professionals to design, detail, document, and fabricate structural systems. BIM enables design brigades to work more collaboratively–helping to optimize designs, improve accuracy, and connect design to fabrication to deliver projects briskly and more efficiently. Using BIM, structural engineers can make further informed design opinions, automated construction documentation and produce more accurate, constructible design. BIM helps structural engineers optimize and automate designs, reduce errors and threat, and improve accuracy and constructability, while perfecting overall project delivery. Itintegrates multi- disciplinary data to create detailed digital representation and are managed in Open Cloud Platform for real time collaboration. It is the CDE that is the key to the collaborative production of an information model, as it allows graphical models, asset data and documentation to be coordinated and managed effectively throughout the life of the asset. Social inclusive outcomes of BIM are the Effective design leads to improved and economical infrastructure, real time collaborations lead to proper updates on design detailing, improves transparency of project cost and details More advanced modelling tools now allow parameters, constraints and concepts to be attached to the 3D model Dimensions of BIM works on greatly improving accuracy and efficiency, and lowering the possibility that projects will contain flaws.

II. OBJECTIVE

To plan and design Structural truss model in Revit software and apply changes to the structure and parameter study, all the Data transfer using plugin are made using single userface, and identify potential errors and risks, enhance accuracy and autogenerate drawing using Revit software.

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III. METHODOLOGY

Applying BIM concept to handle the analytical model in Revit software and bring the analytical result in Revit using Robot Structure Analysis and using Advanced steel Software to create fabrication documents, and generate a complete report for structural design model and do the optimization & scheduling along with that.

IV. MODEL GENERATION

Revit software is used to plan and design an preliminary model.An Industrial Truss model is created in Revit Structural software-2023 based on grid line of level plan where column are located on the intersection of x-y ranges of grids.

4.1 Structural Model Details

Theses grid line of x-y ranges are placed on the level plan and column are placed on the grids. The beam connection are made of apex haunch. Levels are set with 15ft difference. Connection made between column and beam are bolted connections and base plate is used for connecting column and footing
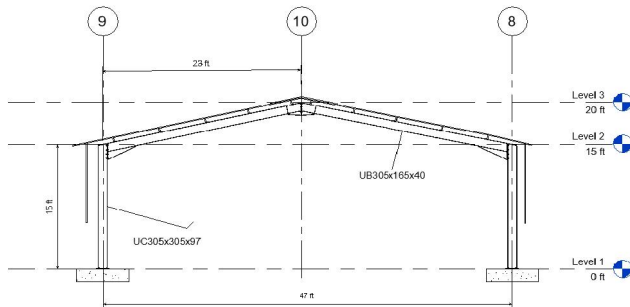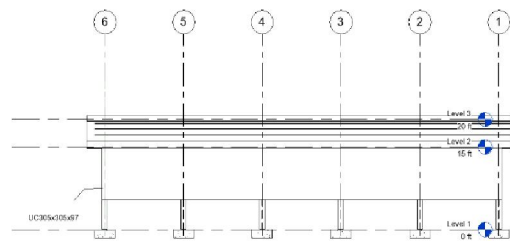

Fig. 1 Structural Model Elevation

Fig. 2 Structural Model Side View

4.2 3D-Model Generation

The structural design model is created and truss are placed on the beam purlin connections, based on the view the visibility of the structure element varies
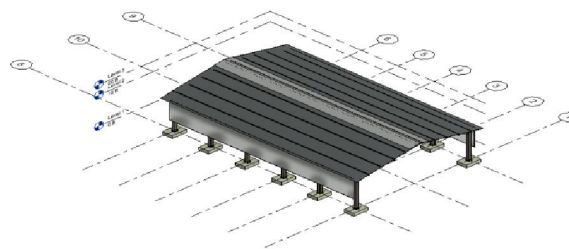

Fig. 3 Structural Model 3D Realistic View

The structural model shows the 3D view of the connection made between the beam-column, between beams and column to footing connections.
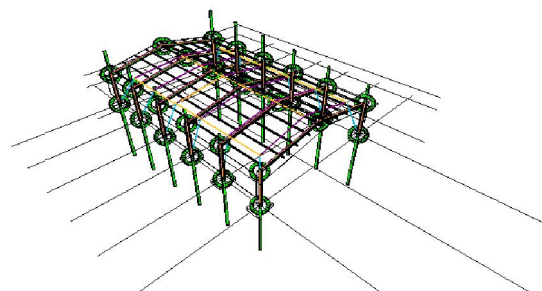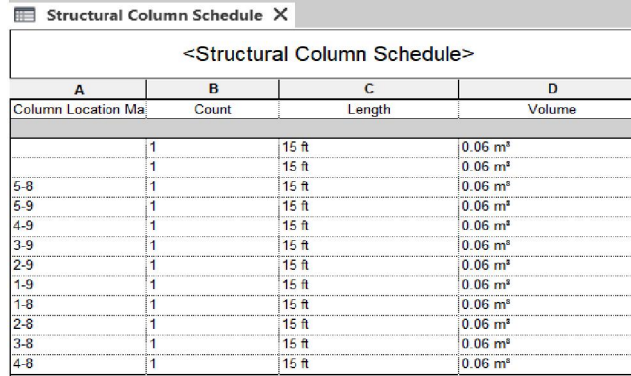

Fig. 4 Structural Model 3D (Showing all the Connection)

4.3 Scheduling of Structural Element

Scheduling of structural element in revit structural software is to Create schedules, quantities, and material takeoffs to quantify and analyze the components and materials used in a project. Another angle of the model is a schedule.
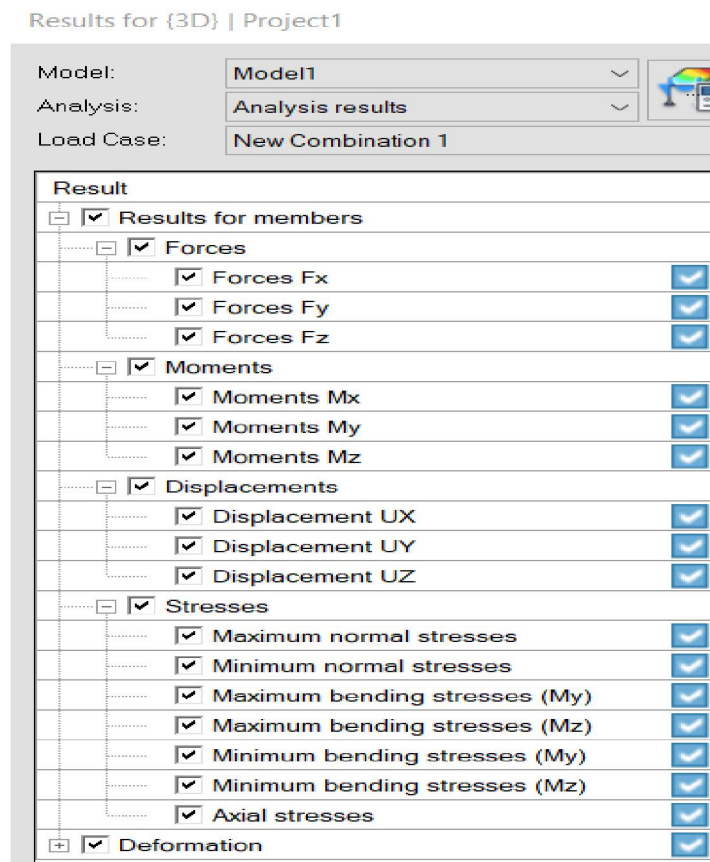

Fig. 5 Structural column Scheduling

Show lists of all model elements in any category.. A schedule is a tabular display of information, extracted from the properties of the elements in a project. Depending on the grouping criteria used by the schedule, a list of instances of the element type you are scheduling may be included in a schedule, or numerous instances may be condensed onto a single row.

4.4 Result Analysis

Result analysis displace of load applied to the structural model is generated in result explorer of Analyse tab in Revit Structures.

Fig. 6 Analysis Result report

4.5 Worksheet Generation

Report sheet generation is that colleting all the works done in the software and putting together for work sharing in cloud platform. The nice thing about this worksheet is that already have sheet setup, view templates and browser dialedin. If the file has work sharing enabled and a center file created, it begin by detaching it from center.

View template are imperative for Revit template. A view template is a collection of view properties view scale, discipline, detail level and visibility setting controlled in the project. In short it create consistency and efficiency of the project. Also Landing page helps serve as a communication vehicle for rest of the plugin software and teams.

V. ANALYSIS STRUCTURAL MODEL

Analysing the structural model using Robot Structure software using direct single user-face in order to transfer whole structural design model from Revit Structure to Robot Structure for analysing. It can help you to produce more flexible, constructible designs that are accurate, coordinated, and connected to BIM.

5.1 Revit-Robot Integration

- Move a structure model between Robot and Revit or vice versa.
- After making modifications to a structure model in another program, update the model in the first application.
- Add the results of Robot's static analysis and any necessary reinforcing to the Revit model.

5.2 Data Transferred from Revit

The structural Model is transmitted from Revit Structural software to Robot Structure software through single user-face where the data's transformed from Revit to Robot. we can transfer connections to Steel Detailing & Fabrication software and this is why we see Revit as a source of truth for connections.

The Model link creates analytical elements with material and section properties,this Analytical Driven Modeling for Revit To Robot introduce a new approach to analytical modeling with enhanced structural modeling capabilities.

Export to Robot is to add loads/combinations etc, and to run the Analysis.

5.3 Error Occurrence

- Load has not been applied to the panel
- Visibility of purlin on beams are not generated, hence separate structure warning is highlighted.
- Internal error while analyzing compatibilities.
- Data error in transmitted structural model from Revit Structural software.

VI. DESIGN GENERATION

6.1 Advance Steel Software

Advance Steel software is used for design generation of the structural model using single userface from Revit Structure. As the design process carrries from Revit to Robot and Advance steel are interlinked using plugin in order to generate a complete report.

Using plugin in Revit Structures the Structural Industrial Truss Model has been Transmitted to Advance Steel Software using Add-in in Revit, in the format of smlx (Steel markup language) in order to transform the model for design generation in Advance Steel.

6.2 Error's Identified

- Exported file from Revit Structures couldn't access in this file format smlx.
- Exporting in smlx format is quite difficult as the country access is not listed in Indian Standards.
- Importing Structural Model from smlx format in ASTemplate.dwt of Advance Steel is little hard as the Structural model visibility is nil in display.
- Even after many troubleshoot and installing additional expansion for smlx format and Advance Steel, the Structural Model couldn't displace its visibility.

VII. CONCLUSION

It is concluded that BIM concept is applied to handle the analytical model in Revit software and bring the analytical result in Revit using Robot Structure Analysis and Advanced steel Software to create fabrication documents. The main objective of the project is to plan and Design Structural Truss model in Revit Software and scope to generate a complete report for structural design model and do scheduling & load analysis along with that. As the Model generation and transferring using single interface is done through Revit software, a complete work sheet is generated. In addition with added plugin and extensions of software Robot Structures and Advance Steel, still we need to install software and some other extension to access the model to get generated in other Autodesk software. Some error occurrence has been rectified when the model is transferred to Robot Structure software to run result analysis, while transferring Structural model to Advance Steel an major error occurs that the exported file in smlx format couldn't access and get generated to visibility as the country access is not listed in Indian standards. Therefore the objective of the project is achieved.

VIII. ACKNOWLEDGMENT

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