BIM: Challenges and Its Implementation for Light Gauge Steel Framed Buildings

Project Guide: Mr. Sharif Shaikh
Sharif.shaikh@raisoni.net

Student: Amol Satyanarayan Sadul, M.Tech
amol.sadul.ce@ghrcem.raisoni.net

Department of Civil Engineering, G H Raisoni College of Engineering and Management, Pune (India)

Abstract

Study of challenges to implement the Building information modeling (BIM) for Light gauge steel based project throughout the India. It is very important aspect for various kind of projects such as a Residential, commercial, hospitality and Public sector buildings. As far as central government of India is trying level best to implement the BIM successfully for public sector projects such as National highways, Metro projects, Air ports, Tunnels and so on despite its implementation challenges through Private sectors where usage of Light gauge steel is used at large extent for non-load bearing wall partitions. The study revealed that BIM implementation challenges can be categorized into two themes: BIM-related challenges and project-related challenges. BIM-related challenges which include knowledge, infrastructure, modeling, adoption, and awareness issues. Project-related challenges include funding, communication, team management, cooperation, timeline, coordination, and change order issues. These findings imply that although BIM offers numerous advantages, its implementation introduces specific challenges that differ from those faced in traditional construction projects. These challenges often revolve around technological adoption, data management, changes in project workflows, and team dynamics. Therefore, investigating the specific challenges in BIM-based Light gauge steel construction projects is crucial for achieving project success. This study adds to the existing knowledge by providing valuable insights into the challenges faced during the pre-construction phase of BIM-based building projects. The insights can be used to develop strategies for ensuring BIM-based construction projects are ready for the construction phase.

Keywords

Building information modeling (BIM), Light gauge steel, Challenges, Methods, Implementation, benefits, Results.

1. INTRODUCTION

A building information modelling (BIM) is defined as "a digital representation of physical and functional characteristics of a facility" that serves as a "shared knowledge resource for information about a facility forming a reliable basis for decisions during its life cycle from inception onward." BIM is both a tool and a process, and one cannot realistically exist without the other.

The introduction of BIM technology has transformed to AEC industry with its 3D visualization, BIM collaboration, real-time synchronisation of all disciplined models and accurate scheduling, and other advanced features. Though many AEC firms want to capitalize on these BIM advantages, the major challenge comes in the form of planning and BIM implementation. The impact of BIM drives optimum utilization of the resources as well as greater productivity and profitability. The Indian Civil construction industry is catching up with the utilization of BIM technology, but it has its fair share of challenges. BIM is no longer new, but expertise is required for BIM Implementation to get the most out of the project cycle.

Light gauge steel construction projects required mandate of BIM implementation for the projects, BIM is playing an Vital role in order to execute the Light gauge steel construction project successfully, as it has usage of BIM from inception onwards until to fabrication, assembling, erection of Light gauge steel based projects.

2. OVERALL CHALLENGES

The future for BIM is bright- Building Information Modelling (BIM) - it is a new paradigm in the AEC industry, its exciting initially and challenges are fully involved. In many developed countries such as an U.A.E, Malesia, Singapore, Australia governments have mandated BIM to use for public projects. And yet, despite its heightened productivity, collaboration and cost reduction advantages, there have been notable challenges of implementing BIM in India. Light gauge steel construction industry is in boom from last couple of the years because of its durability, sustainability and speed of construction. At the same time there been an multiple challenges as well in order to implement the BIM process for Light gauge steel based projects.
Following are few of the challenges which can highlighted:

a. No standardized mandates for BIM

Many of the countries still don't have an any Mandate for the BIM, BIM mandates are crucially requiring for its successful implementation for the projects. Until now, only a few countries have BIM mandates, and even then they are not strict or required for all project types.
As it is not mandatory to implement for the projects, the demand from the Private sector clients of smaller projects or organisations has been very low, the most of the Public sector organisations are not having willingness to implement the BIM for public sector projects hence a challenge for an orderly uptake of BIM.

b. Technical Challenges

One of the primary challenges in BIM implementation is the technical aspect. Integrating BIM software with existing systems and workflows can be complex, requiring significant time and resources. These challenges range from the software integration problem, data management complications, and legacy system issues. BIM requires the integration of various software applications, such as CAD, project management, and analysis tools. Inside this process, there are other complex problems, like file formats, data structures, and software versions, that can all impact the successful implementation of BIM within an organisation. Additionally, BIM projects also generate large amounts of data that includes 3D models, schedules, cost estimates, and other project information. Efficiently managing, storing, and accessing this vast amount of data poses a technical challenge, especially for large-scale projects, that makes the BIM implementation difficult for some companies. Lastly, some organizations may have existing legacy systems, such as CAD software or project management tools, that need to be integrated with the BIM workflow.

The integration process can be complex and time-consuming, requiring additional resources and expertise which are bit expensive as comparted to traditional CAD engineer. Most of the times its been observed that there is limited skillset available for BIM engineers.

c. Cultural and organizational Hurdles

BIM implementation often requires a significant shift in organisational culture and mind-set, and the resistance to change, lack of understanding, and fear of new technology can slow adoption. The construction industry is often resistant to adopting new technologies and processes, as they can disrupt established workflows and practices. Overcoming the inertia of traditional methods and convincing stakeholders to embrace the benefits of BIM is a significant challenge that every organisation must face in order to fully realise the potential of this innovative technology. With the existing organisational culture, implementing BIM can be difficult for them since it requires a collaborative and integrated approach. And to overcome these cultural and organisational hurdles, it often requires a comprehensive change management strategy, which is not an easy thing to do for them.

d. The Unwillingness of All Stakeholders

Another significant challenge in BIM implementation is the unwillingness of all stakeholders to fully embrace the technology. This unwillingness can come from many different sides. It can come from its practitioners, like architects, engineers, and contractors. It can also come from the industry itself and even from the client side. Architects and designers may be reluctant to adopt BIM due to concerns about the impact on their design process and creative freedom. They may perceive BIM as a constraint on their ability to explore and experiment with design ideas, and overcoming the perception that BIM limits design flexibility is the challenge itself. Without clear and consistent BIM requirements, stakeholders may be less inclined to invest in the technology.

e. Client Demand

Client demand for BIM deliverables is a driving force behind its adoption. However, not all clients may be familiar with BIM or understand its value. The recent study, stated that 73% of smaller companies having five staff or less have been cited as having no client demand for BIM.

f. BIM is not a part of many Architecture and Engineering curriculums

Many of the Architecture and Engineering curriculums doesn't have BIM basis, its advantages and so on which is very unfortunate truth is that BIM has not been extensively taught as part of the curriculum for, especially during undergraduate studies. Only the basic knowledge of BIM is covered, any more than that is very rare. Undergraduate students may be familiar with software like Revit and may have used it for their coursework. But let it be clear that Revit is not BIM; it is just a tool with and for BIM technology.

3. METHODOLOGY

With the BIM methodology each Discipline will going to have a Separate 3D model such as Architectural, Structural, Mechanical, Plumbing, electrical and Fire Fighting system of the corresponding section and retains control and responsibility over it.
All these sub-models are combined in a central coordination model that contains all the information together. This information gives meaning to objects and describes them in terms of properties such as energy efficiency, material type or mass.
In addition, these 'BIM objects' can be associated with information external to the model, such as a product specification or a detailed drawing.
Using this central coordination model as a basis for team allocation, collaboration, management of the design process, construction and operation improves transparency and communication.
Methodology of the using of BIM process is to create a Clash free design development and Construction documentation phase drawings in stipulated timeframe. Further the compiled models to be used to detailed extraction of quantities for all the A to C grade building items, define the proper specifications to each and every building items within the BIM to track them identify them through creating of different kind of schedules.

a. Integrated BIM Modelling:

As the technologies behind BIM continue to expand, so do the opportunities for specialization, so you will need to pick and choose strategically to focus the efforts and direction for the BIM based projects.
BIM models to be fully integrated with all the aspects keeping in mind, The BIM models should not be only used for visualisation of spaces, it should include the aspect of using the same BIM models for clash detection and resolution, Quantity extraction, Time Management, Cost management and Facility management are truly cutting edge.

b. LOD for BIM Modelling:

The LOD (Level of development/Detailing) is an indicator that marks the level of development that is or should be done in a BIM or infrastructure model's. Through the LOD, it is possible to know what level of data, parameters and geometry the BIM model has.
This can be seen directly in the visual representation of the resulting with 3D BIM model, but not all parameters are visible in the virtual model and may need to be interacted with to get the depth of the development level (e.g. data on the supplier of elements or installation instructions, manufacturing, the product family to which the elements belong, etc.). LOD helps to decide the efforts required to execute the LOD based BIM models for all Disciplines, LOD's will help Stakeholders to decide the Pricing for BIM consultants based on the level of detailing executed for BIM based Project. These LOD's are usually linked with design based stages, LOD's starts from LOD 100 to LOD 500 and Design stages starts from Concept level to As built level. These Design based stages were used from last 4 decades in Civil construction industry. Easiest way to understand the LOD linking along with design phases as mentioned below,

LOD's		**DESIGN PHASES**
LOD 100	**-**	**CONCEPT LEVEL**
LOD 200	**-**	**SCHEMATIC LEVEL**
LOD 300	**-**	**DESIGN DEVELOPMENT LEVEL**
LOD 400	**-**	**CONSTRUCTION DOCUMENTATION/FABRICATION**
LOD 500	**-**	**AS BUILT MODELS**

Light gauge steel based Projects usually go through with all the above mentioned phases from LOD 100 to LOD 500 or starting from Concept level to as built model level

c. Advantages of BIM technology:

The BIM methodology is increasingly demanded by many stakeholders in Light gauge steel construction projects as it has enormous advantages when it comes to designing and improving processes. There been an huge advantages an using the BIM technology for Light gauge steel based project as everyone knows it required high level of

accuracy with the modelling and detailing, Fabrication level drawings and CNC output mainly required for the machine only can be achieved using of BIM process,
Here are some of the main advantages of the BIM methodology:

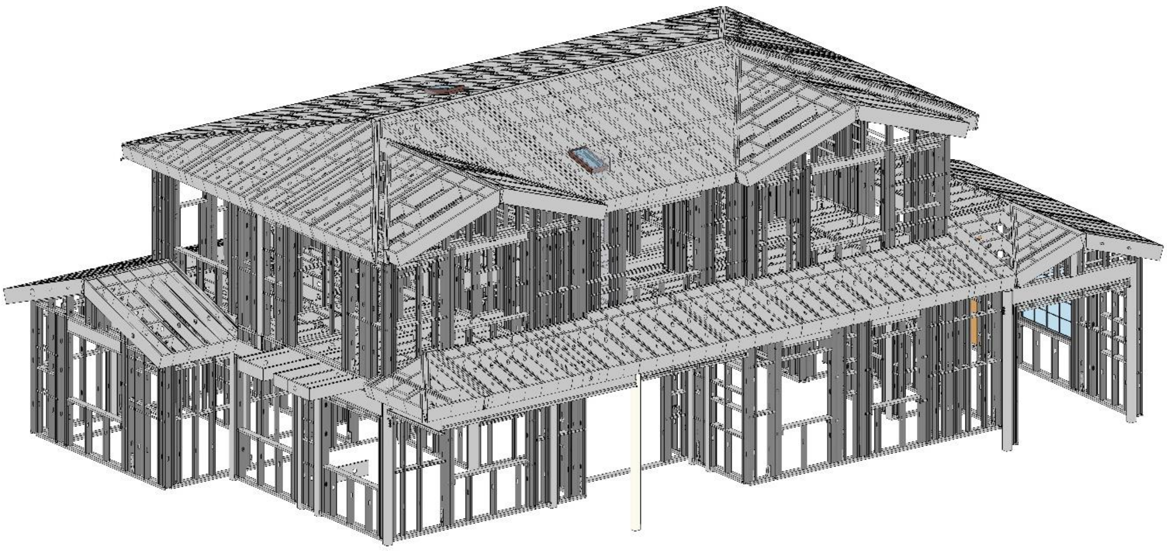
1. **Detailed view of all project elements**

BIM simplifies and improves the design process for Light gauge steel construction projects. All specialists involved to feed information about their work into the project as a whole, which greatly reduces the risk of errors and facilitates information for all stakeholders. Such as Architect required to use the BIM as it will be helpful for Light gauge steel manufacture utilise the same model to build the Light gauge steel BIM model. Such as Architectural BIM model can be used to create an finalise the general arrangement of wall layouts which can directly will going to impact on its fabrication work.

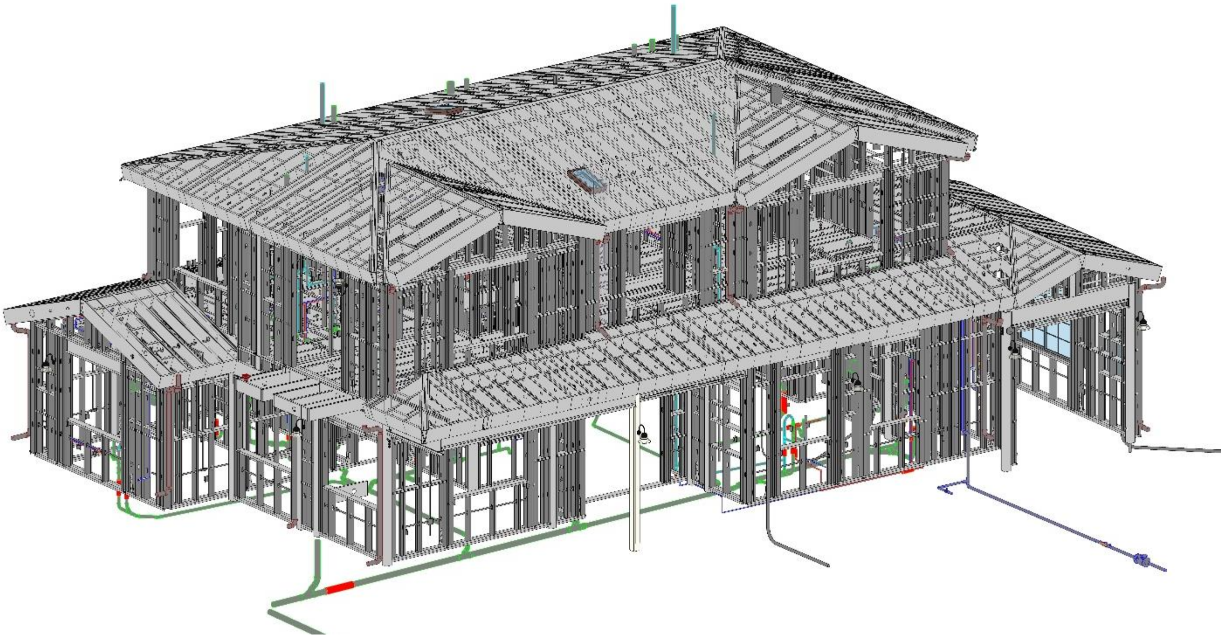
2. **Reduction of potential conflicts and errors**

In Light gauge steel construction project there are many participants and interactions between required between Architect, structural engineer, MEPF consultant and Light gauge steel Manufacturer. The use of BIM methodology for Light gauge steel construction projects is one of the best ways to detect potential conflicts, avoid disputes and save time and money in the process.

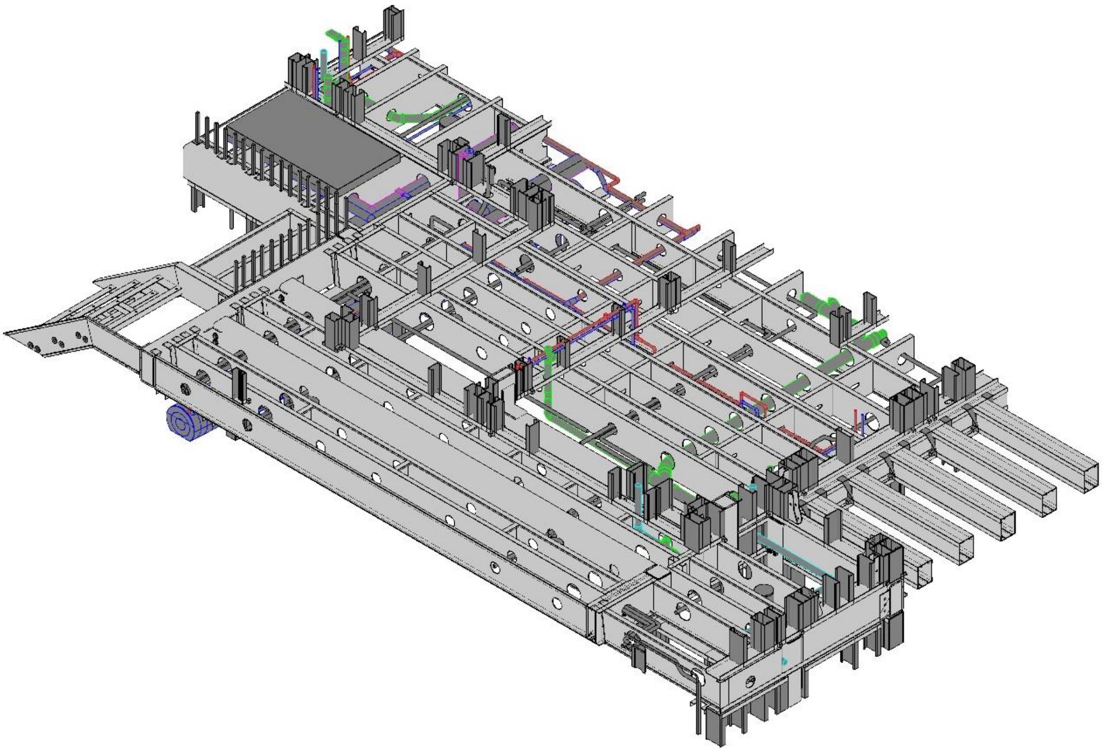
Below Image shows the Light gauge steel model



Below Image shows the Light gauge steel model along with all MEPF Services



Below Image shows the Detailed over view of Floor panels for Light gauge steel along with all MEPF Services the way all of them managed well

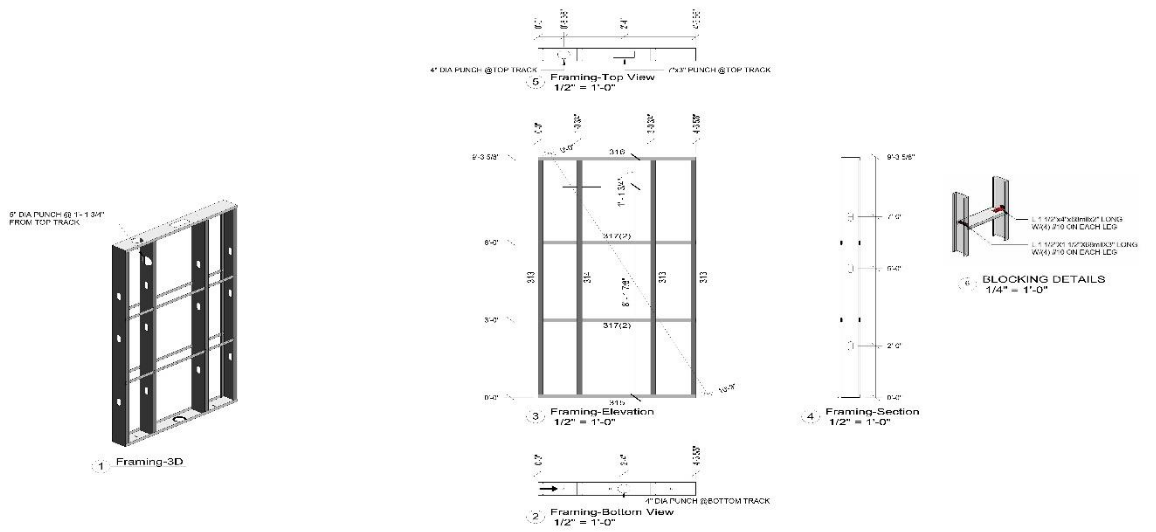


Using of BIM light gauge steel models can be more efficiently integrated along with Hot rolled steel model which will help Hot rolled steel and light gauge steel can be intergrade well in order to reduce the errors and for better integration.

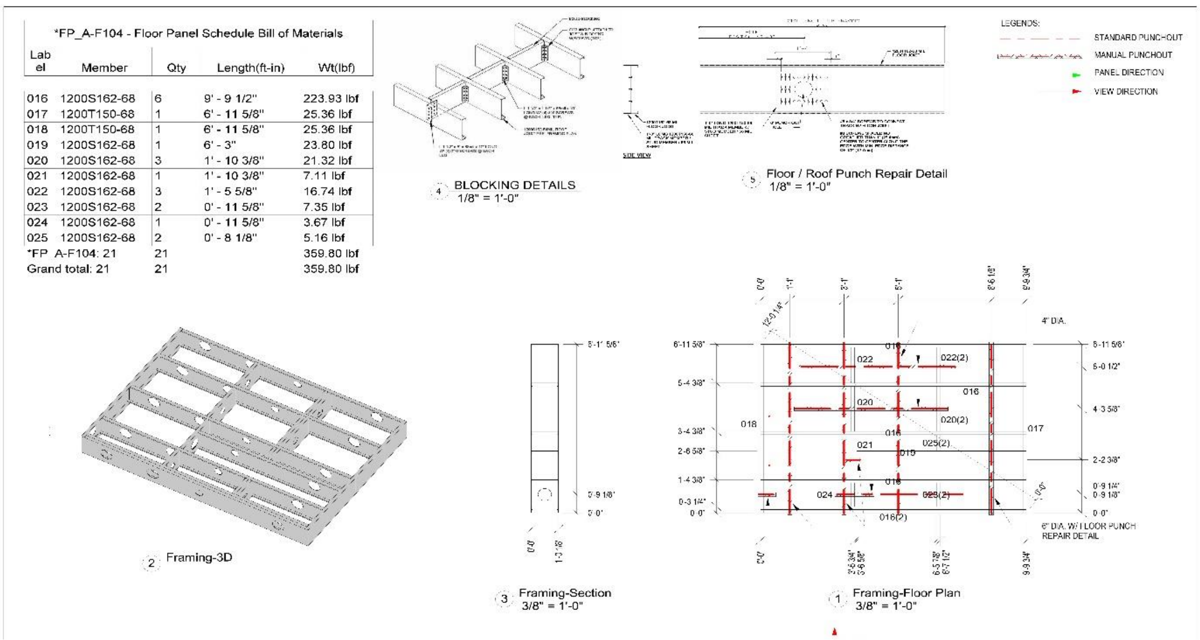
Integration of BIM for Light gauge steel projects will help to extract the Fabrication drawings for Light gauge steel wall panels, Floor Panels, Roof panels, stair panels, columns, beams which can be clash free and help us to speed up the Fabrication, assembly of panels in order to speed up the erection work at site for Light steel construction based projects,

Wall Panel Fabrication Drawing

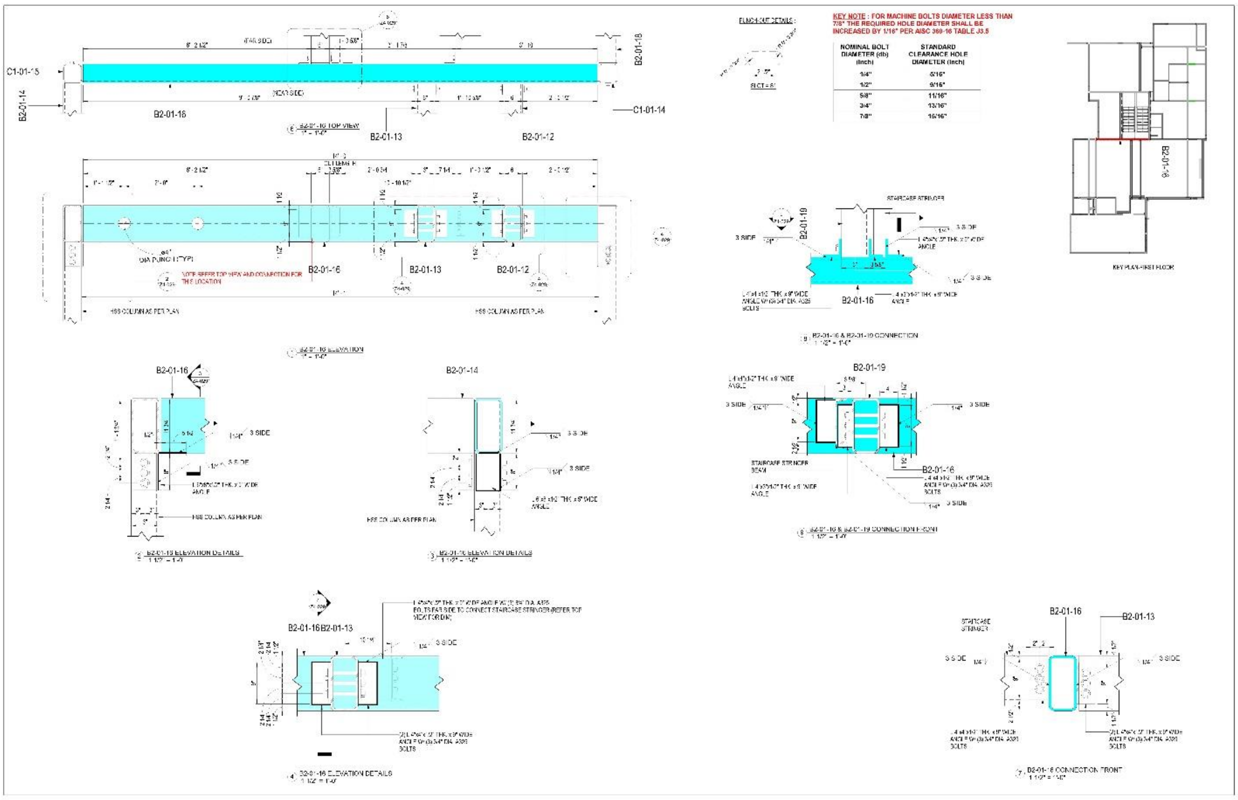
Floor



Panel Fabrication Drawing



Column Fabrication Drawing along with Its connection



All these well-coordinated BIM fabrication drawings will help to extract the CNC output from BIM models which will be input for the machines to manufacture the wall panels, floor panels and stair panels

3. BIM boosts productivity

Finally, architects, Structural engineers, MEPF consultants and other industry experts consider BIM technology to be one of the best innovations that increase their productivity and guarantee a higher return on investment specially for Light gauge steel based projects.

4. BIM Software's available in the Market:

- *Revit - Architectural, - Mainly can be used to create an Architectural 3D BIM models starting from LOD 100 to LOD 500*
- *Revit - Structural, - Mainly can be sued to create a Structural 3D BIM models starting from LOD 100 to LOD 500*
- *Revit – MEP – Can be used to create an 3D BIM models for MEPF disciplines starting from LOD 100 to LOD 500*
- *Navisworks Manage – Can be used to assign an TIME and COST parameters to 3D BIM models in order to execute the 4D, 5D dimension, also will be useful to execute the Clash detection and resolution activities*
- *FrameCad Structure – Can be used to create an Light gauge steel models 3D BIM models which is aligned to Frame Cad machines*
- *Sketch up – Can be used to create an Architectural, Interior 3D BIM models which can be used to extract the Renders, Walkthroughs from it*

- *Tekla Structures – Steel and Precast – Can be used to create an 3D BIM models for Light gauge steel and hot rolled steel structures in order to extract the Fabrication drawings along with CNC output for the machines.*
- *ArchiCad – Can be used to create an Architectural, interior 3D models which can be used to extract the Design development/Construction documentation stage drawings.*

5. Difference between 3D CAD and BIM modelling for LGS

CAD and BIM processes are similar in that they present and communicate the design and construction intent of an AEC project through a graphical representation, so that project participants can understand what to build and how to build it.

The difference between 3D CAD and BIM modelling is that while both processes provide a geometric representation of buildings and infrastructure, the BIM process goes beyond geometry and captures the relationships, metadata and behaviour inherent in the actual building elements.

In order to execute the Light gauge steel based projects successfully from concept to Site execution the BIM is essential, CAD based platforms cannot be used where linking of 3D based BIM models to CNC machines are essential.

6. Advantages of BIM for Light gauge steel based projects

The BIM process creates and manages information throughout the Light gauge steel project lifecycle, integrating construction and design documents from different sectors into a single data set. Because data can be accessed in multiple views, from 2D and 3D to tables, the information is much more accessible and connected than in the dispersed data sources associated with traditional CAD methods.

The BIM methodology is one of the most widely used working methods in building construction for obvious reasons and is constantly improving. It would not be surprising if in the future it becomes a global standard, and in fact the institutions of the main countries already regulate and require the use of this methodology in their public works projects.

4. SOLUTION APPROACH

After the review of more than fifteen shortlisted publications with regards to BIM Challenges and its implementation its seems that most of the Review papers were explained well about the common challenges for BIM implementation however no Project review paper were found which explains in details about the BIM challenges and its implementation related to Light gauge steel construction based projects, this project review Paper used to identify the BIM challenges and its implementation specially for Light gauge steel construction project in India. The studies analyzed well about BIM challenges and its implementation in the countries of the US, Finland, Australia, England, United Kingdom, and India.
As per the Project review Paper, most of the barriers to BIM implementation were associated at an organizational level. The three most commonly identified barriers as per the literature were "Time needed for hiring/training people to use BIM for Light gauge steel construction projects, cost of hiring or training people to use BIM, and No official standard or process to evaluate the use of BIM for Light gauge steel construction projects." All of the top three barriers were associated with the organization as per the applicability of the challenge. Lastly, the three least commonly identified barriers as per the literature were "More time needed to send and receive back files between

stakeholders, Fear of the unknowns of BIM will lead to failure, and Some believe BIM is not suitable for their projects." Two of the three least commonly identified barriers as per the Review paper were perception based. All of the least three barriers were equally distributed between the organization, project and both (Organization and Project) as per the applicability of the challenge.

5. CONCLUSION

The study aimed to identify barriers associated with BIM Implementation for Light gauge steel projects, after a thorough review of the literature. Most of the challenges, including the ones most commonly established in the Project review, were determined at the organization level. This indicates that Light gauge steel manufacturer companies have to overcome higher resistance regarding BIM implementation than projects. Most of the significant barriers dealt with the training of employees with the software's such as FrameCad, Vertex BD, Revit MWF, lack of national standards for BIM in overall globe, management of data, and interoperability of the software. If these barriers are not tackled at the earliest by various public and private entities associated with the construction industry, there is a high probability that these obstacles could start impacting at the project levels and the overall BIM adoption within the industry. In addition, two of the three most commonly identified barriers "Time needed for hiring/training people to use BIM specially who knows better about Light gauge steel modeling and detailing work , and Cost of hiring or training people to use BIM for Light gauge steel construction projects" dealt with economic conditions of the company and its ability to invest in maintaining innovativeness and competitiveness. These two barriers can be crucial for small and medium sized design and construction companies. Also the cost of software's such as FrameCad, Vertex BD and Revit MWF is substantially pretty much higher for Light gauge steel manufacturer which substantially increase the cost of Light gauge steel construction project for stakeholder.

The study provides design and Light gauge steel manufacturer companies that either possess low BIM maturity or are yet to adopt BIM for Light gauge steel based projects the ability to identify and prioritize challenges. This study emphasizes the need for software's such as FrameCad, VertexBD or Revit MWF which has higher cost impact on BIM implementation for Light gauge steel construction based projects that is interoperable as one of the important aspects of continued BIM implementation within the Light Gauge steel construction industry. Future research also needs to be conducted to ascertain the severity of the identified challenges from the perspective of stakeholders such as design firms, construction firms, owners and others. This analysis is important as each of the identified challenges can be perceived differently by each stakeholder, regarding the severity. Therefore, a severity analysis of the identified challenges from stakeholder perspective is recommended, in the future. Researchers also believe that each of these barriers can be grouped into broader categories, such as interoperability, education, hiring, technology, legal issues, and others to identify groups that encompass maximum challenges. Furthermore, the researchers expect that in the course of time due to technological advancements some of the problems might be eliminated. Moreover, the need for a constant update of the challenges associated with BIM implementation at the project and organizational level is deemed essential for Light gauge steel construction projects.

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