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A Study of Steel Structure Detailing Process

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ABSTRACT: Steel structures and use of steel in building construction is not new, efforts have been put in finding better ways of using steel since 1855 with the work of Sir Henry Bessemer on Bessemer Method for steel production. In recent years, more effort is put into figuring out various ways to better manage large steel structure projects. Use of the latest software technologies is a major game changer for the steel construction industry. This paper makes an effort to review and highlight recent direction of research in the steel construction industry and elaborates on the lifecycle of a typical steel structure project detailing process.

KEYWORDS: Steel Structure, Project Detailing Lifecycle, Software, WBS

I. INTRODUCTION

Conventionally the inner structure that supports the building's load is made of reinforced Steel concrete; however, there is a new trend to use structural steel to construct a framework instead of RCC. Structural Steel construction has been going on for decades in countries like America, Canada, the Middle East, etc. India is a relatively new entry to the list. Recent projects like Amritsar Airport, Rabale station in Mumbai are making use of this technology. This drift from RCC to structural Steel construction has taken place due to some unique qualities of steel structure e.g.,Structural steel is durable, long-lasting, and can be recycled. It has immense qualities, strength, and capability to be moulded in different shapes. Field construction can be carried out in any season, unlike the limitations associated with concrete construction. Onsite erection is a faster process as steel is fabricated off-site.

Paper does a review of recent research work in the area of steel structure projects with a focus on the lifecycle of a steel structure project. Different methods of project management are also briefed in the review.

Paper is organized as follows. Section II Related work describes recent research efforts being done in the steel structure industry. The flow diagram of typical steel structure project lifecycle is discussed in Section III along with the role of software in steel structure projects. Finally, Section IV presents the conclusion.

II. RELATED WORK

Brooklyn Bridge was completed in 1883. Construction of the Eiffel Tower was finished by 1889. So, the use of steel structures in the building construction is not new, but a lot of research effort is put into this type of building construction even today. This section enlists some of the recent research efforts in this field.

The paper [1] emphasizes that a sizable spatial structure is one of the fastest-growing branches of steel structure. Different practical projects are presented in the paper, and it is established that one must take special care of the effects of internal forces and deformation in the design in searching for large projects. Analytical methods and construction schemes are discussed in the paper to ensure the stress and deformation of the design meet the requirements given by the designer. Paper concludes with the necessity to make good use of software to provide a practical reference for the construction analysis.

[2] The paper elaborates on different components of Management and the importance of the project management tools for the project's success. Based on the study of different project management systems, the top five most-used components are listed, and a web best project management approach is proposed.

[3] Using the example of China World Trade Centre tower 2, this paper elaborates on the specifics of the installation process as well as the lifting methods. The paper focuses on determining the number of layout problems specific to two Bolt group designs for the high-rise steel structure node with the help of computer technology.

[4] This paper takes project planning and management to the next level by introducing IoT and data models to construct large steel structure projects. Paper highlights the problems and efficiency loopholes in the construction process and the

management of the quality and cost of the projects. The paper advocates using real-time data collected from IoT-enabled devices to help manage decisions and create data models to further help with collaborative project management.

[5] Paper intricates the implementation architecture of steel structure bridge construction life cycle. It highlights the use of building information modelling (BIM). A case study is presented in the paper to verify the viability of the proposed methods. Paper highlights the use of advanced computer technologies like IoT to further help in the project execution. Use of computer technologies to increase the efficiency of construction projects is coming out as a Trend in recent steel structure projects.

[6] Paper elucidates that planning, scheduling, and control of various activities and resources is a big challenge in the construction process. From the research of the past few years, it is evident that computer simulation can help a lot in resolving such difficulties. This paper illustrates a hierarchical model that allows the simulation of complex construction scenarios. The proposed simulation method in the heavy project breakdown in a hierarchical and modular manner, which in turn helps in identifying the critical parts to control the project execution duration.

[7] The Paper highlights that the waste generated at various stages of construction is the primary barrier towards sustainable building. The Paper presents different material selection criteria and techniques to achieve the development of green roofs. The paper also explains the detailed analysis of the material is essential at lowering the cost and preventing environmental hazards from the construction process.

[8] Paper states that to boost the accuracy of project planning, WBS plays a vital role. Paper also says that to tackle future problems like cost overruns or time overrun, WBS is the best solution to sort out the thing in the very beginning in a straightforward way. For practical project management Software, effort estimation is an important activity. WBS improves the accuracy of the project. The Paper concludes that the combination of WBS and software makes the management task very simple and helps in every stage of the project. The work breakdown structure is essential for proper project planning execution and control during the life cycle of the project.

[9] The Paper discusses that in the total lifecycle of the project, WBS structure is essential.WBS starts with a hierarchy of tasks and levels that help identify how the project flows within a designed timeline set by the project manager. The project management institute defines the WBS as “Representing the sum total decomposition of all work that the project encompasses, from beginning to end.” The Paper concludes that WBS defines and organizes the total project scope very accurately and precisely. Every employee in the WBS structure is clear about what he/she must do. WBS helps in monitoring, controlling, and tracking. WBS makes the final product more precise and concrete so that the project team knows what exactly must be done.

[10] Paper advocates for a generic 100% product-oriented work breakdown structure (WBS) that can be tailored to any system development project. It also describes how the proposed WBS can facilitate sound system engineering. Paper specifies that different stakeholders of project organization should await the definition in cases where system design is not chosen, especially in early stages of the project.

Review of recent research work in the area of steel structure project construction, management and execution is done in this section. Next Section describes the lifecycle flowchart of a steel structure detailing process.

III. STEEL STRUCTURE DETAILING PROCESS

As established in the previous section, active research is being done in the field of steel structure projects. Planning is the most important step in any steel structure project as all the material is prepared offsite and only the erection process is done onsite. Thus, it is very important that none of the details are missed in the design and planning phase. That is why steel detailing has a very important role to play in the success of steel structure projects. This section goes in detail explaining the workflow of the steel detailing process.

Steel detailing is the preparation of shop fabrication drawing from structural and architectural design documents. The detailer is the interpreter of the engineering design translating the designers into the standards of the steel fabrication industry. This interpretation involves the analysis, evaluation, organization, and communication of the structural design. Each detail of steel fabricators scope is defined from every bolt, weld, and dimension to the assignment of an identifying mark for each component to facilitate member placement.

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Flow chart diagram [1] summarizes the steps involved in a steel structure detailing process. To start detailing for any project, the detailing firm requires some documents, which are a set of Contract Drawings generally known as Structural Drawings and a set of Architectural Drawings, these are necessary for Commercial Jobs.

Structural drawings are used by structural engineers to communicate information with contractors, fabricators, and steel detailers. These drawings describe the details of an object supporting members, such as beams, and columns designed by the structural engineer. Structural steel drawings contain all the necessary information on the size, shape, material, and provisions for connection and attachments for each member. Structural drawings show the location and position of various components in the finished structure. It includes structural shape designations for each framing component, key dimensions showing centreline dimensions locating beams and columns, end reaction loads, general notes, and north arrow for reference. They are accommodated in the field when they show the approximate weight of heavy pieces and the number of pieces. So, structural drawings are essential to give a perfect view of your building before actual construction.

Structural Drawing set includes General Notes, Foundation Plans, Framing and Details. General Notes show the material grades, bolt types, weld types and connections etc. Foundation plans give the information about column footing of columns, location, footing elevation and profile / sizes of Columns. Framing and Details provides the overall dimensions of the structure including locations of columns, beams, angles and other shapes sizes of structural members sections and details in the form of cross sections, special connections required, column schedule, splice and base-plate detail, brace elevations etc.

Architectural Drawing, which is required for commercial projects, is the backbone of the building design and plays a critical role in translating a conceptual design to a feasible structure. It demands accurate rendering of the system, traditionally on paper. It is used to acquire a complete view of the building as a set of different building blocks. Architectural Study Drawings is the first source to provide a basis for understanding the primary means of visual thinking used in the creation of these drawings.

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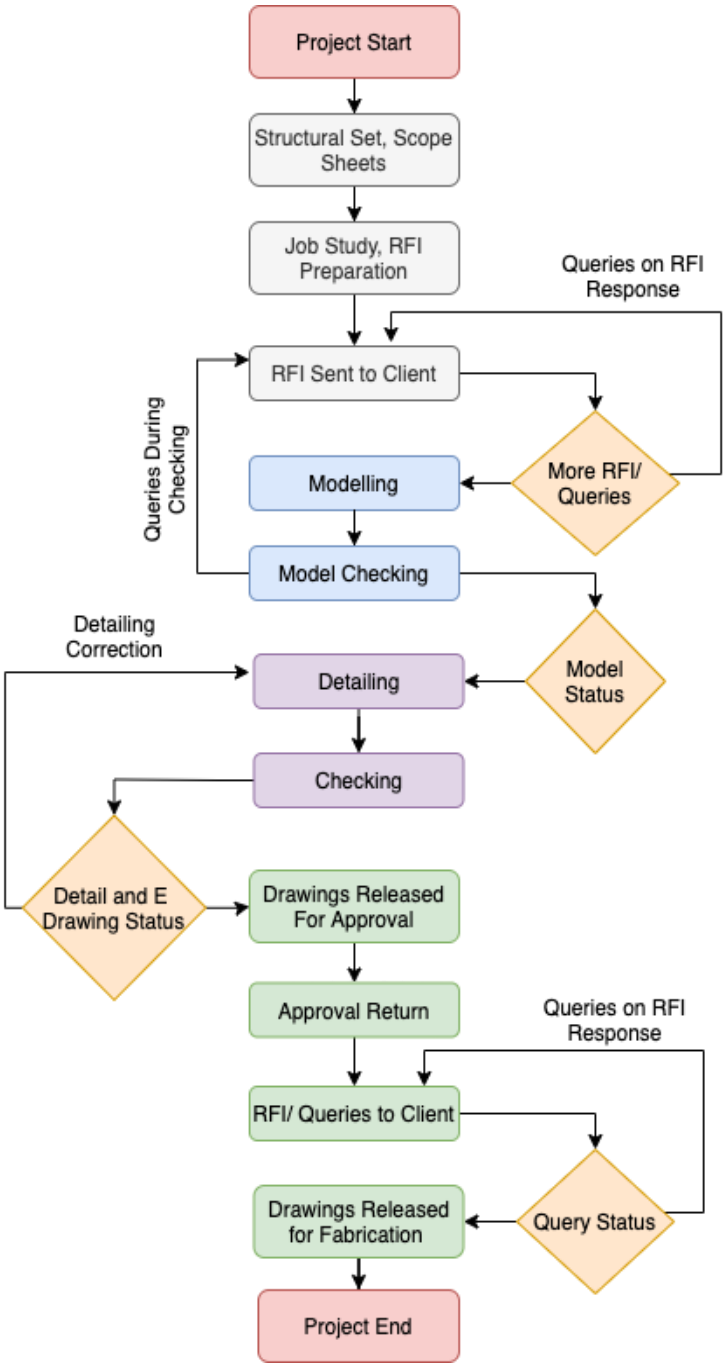

Figure 1: Steel Structure Detailing Process

Once the Structural Set and Architectural Drawing is received, the process of job study and RFI preparation starts. Job study involves understanding of the structure requirements, general notes and notes provided on each sheet. Design drawings are then reviewed to identify any missing information such as grid to grid dimensions, elevations, miscellaneous items, and connections details etc.

When design documents are incomplete, steel detail drawings cannot be prepared in the required order. Due to their stringent nature, shop detail drawings must be prepared to meet a zero-defects standard. This ensures speed in fabrication, erection process and in turn makes the process economical. RFI - Request for Information, is used as a formal process to construct a paper trail of information. RFI is also known as ECM - Engineering Clarification Memo or DEO - Documentation of Errors and Omissions. In short, a question is asked due to missing and ambiguous information on the design documents, and an answer is needed to clarify the missing and incomplete information. It is

common practice for any response to include relevant answers from parties to whom the RFI has been forwarded to contribute to the response. e.g. RFI-01, RFI-02, RFI-03, RFI-04

The modelling process starts after all the queries are answered. Software like SDS2, Tekla etc. are used to create a three-dimensional steel frame model based on the design prepared by the structural engineer. This model can be made from data input by detailer or data imported from the design software. The model assists the detailer in visualizing connections during the development of shop drawings.

The detailer takes the information from the design documents, develops the mill order and fabrication drawing, and provides other required supporting services. The data is presented in a format required by the fabrication facility and members of the construction team. There are different stakeholders involved in the detailing process viz. Owner, Architect, Structural Engineer, Steel Detail Engineer, Fabricator, Structural Steel Erector. There are two types of steel detailing; one is American - US detailing & the other is British, which is usually referred to as Metric detailing. Majorly steel structure jobs/projects are categorised in two types viz. Industrial and Commercial. The industrial structures are further divided into two types viz. onshore structures and offshore structures. An oil refinery is one example of an offshore structure. Commercial structures consist of the construction of buildings, bridges, airports, schools, and chapel.

Steel shop drawings are specialized, precise instructions to the fabricator. Therefore, the checking is essential, as the entire building geometry is generally in the control of only one steel detailer. The Checker reduces the chance of individual error to a commercially acceptable level. After the drawings are cleared by the Checker they are sent to the client for approval. Client approval affirms that the detailer has correctly interpreted all contractual requirements. **C**lient checks the drawings and comments on it and sends them back to detailers, then details the comments, and then the fabrication package is created and sent to the Client.

IV. CONCLUSION

A lot of active research is being done in steel structure projects. Planning and design are very important phases of any steel structure project as design, fabrication and erection are all done in different locations. Use of software plays a significant role to keep all stakeholders in sync during the lifecycle of the project and also to manage WBS effectively. For the success and timely completion of the project, the detailing process needs to be closely monitored, softwaresuch as SDS2, Tekla makes it easy to manage the detailing process. Steel structure projects are getting traction in India and has the potential to bring revolution in Indian construction industry.

REFERENCES

1. Limin, Tian and Jiping, Hao and Yuan, Wang, “The Analysis of Construction Mechanical Simulation of the Large-Span Steel Structure” International Conference on Information Management, Innovation Management and Industrial Engineering, 2009 10.1109/ICIII.2009.43
2. Shaikh, Tabish Hanif and Khan, Faisal Latif and Shaikh, NoorAli Alimuddin and Shah, Haidarali Nadir and Pirani, Zainab, “Survey of Web-Based Project Management System” International Conference on Smart Systems and Inventive Technology (ICSSIT) 2018 10.1109/ICSSIT.2018.8748784
3. Suhua, Yin and Yanli, Wu and Zhongqi, Dong, “Steel Structure Construction Technology of China World Trade Center Tower II” Seventh International Conference on Measuring Technology and Mechatronics Automation 2015 10.1109/ICMTMA.2015.246
4. Ding, Kai and Shi, He and Hui, Jizhuang and Liu, Yongjian and Zhu, Bin and Zhang, Fuqiang and Cao, Wei, “Smart steel bridge construction enabled by BIM and Internet of Things in industry 4.0: A framework” IEEE 15th International Conference on Networking, Sensing and Control (ICNSC) 2018 10.1109/ICNSC.2018.8361339
5. Fuqiang, Zhang and Bin, He and Jizhuang, Hui and Bin, Zhu and Jinlong, Zhang and Yongjian, Liu and Gao, Cheng, “Smart management for steel-structure bridge industrialization construction” IEEE 15th International Conference on Networking, Sensing and Control (ICNSC) 2018 10.1109/ICNSC.2018.8361340
6. Sawhney, A. and Mund, A. and Marble, J., “Simulation of the structural steel erection process” Winter Simulation Conference Proceedings. 'Simulation - A Bridge to the Future' (Cat. No.99CH37038) 1999 10.1109/WSC.1999.816803
7. ur Rehman, Ubaid and Iatisam, Muhammad and Younas, Waqar and ul Hassan Tariq, Noor}, “Review on the role of sustainability techniques in development of green building” International Conference on Energy Conservation and Efficiency (ICECE) 2017 10.1109/ECE.2017.8248832

| ISSN: 2395-7852 | www.ijarasem.com | Bimonthly, Peer Reviewed & Referred Journal|

| Volume 8, Issue 3, May 2021 |

8. Lee, Wen-Tin and Hsu, Kuo-Hsun and Lee, Jonathan and Kuo, Jong Yih, "Applying Software Effort Estimation Model Based on Work Breakdown Structure" Sixth International Conference on Genetic and Evolutionary Computing 2012 10.1109/ICGEC.2012.68
9. T.Rajani Devi, V.Shobha Reddy / International Journal of Engineering Research and Applications (IJERA) ISSN: 2248-9622 www.ijera.com Vol. 2, Issue 2, Mar-Apr 2012, pp.683-686
10. Ruskin, A.M., "100% product-oriented work breakdown structures and their importance to system engineering" IEEE Aerospace Conference Proceedings (IEEE Cat. No.04TH8720) 2004 10.1109/AERO.2004.1368217