

Modelling Concept of Sustainable Steel Building by Tekla Software

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Abstract—The steel (I-section) building construction has great advantages to the residential buildings, improving practical and material efficiency, energy efficiency, consumption, impact on natural resources, CO2 emissions due to recycled building material, the system representing the model within multiple disciplines. The steel building creates and maintains in real time multi-dimensional, data rich views through a project support is currently being implemented by Tekla software packages for design, modeling and detailing of the sustainable steel building.

Keywords—sustainable steel building, TEKLA software.

I. INTRODUCTION

Tekla Structural software is a tool for structural engineering design, modeling, detailers and fabrication. It is an integrated model-based 3D solution for managing multi-material databases (Sustainable Steel Structures). The steel structures (I-sections) are used for the structural frame work in application of green building concept, there are guidelines being developed for implementation of green building concepts and the recycled steel is used for structural frame work. Tekla Structure features interactive modeling, structural modeling and design, and automatic drawing creation. It can automatically produce drawings and reports from the 3D model, at any time. The Green Building conceptual drawings and reports react to modifications in the model, and are always up to date. Tekla Structures includes a wide range of standard sustainable drawing and report templates. It can also create the own templates using the Template Editor. Tekla Structures supports multiple users working on the same project.

Green Building Concept

Green building concept, in broader terms, involves a building, which is designed, built, operated, maintained or reused with objectives to protect occupant health, improve employee productivity, use wisely natural resources and reduce the environmental impact by using recycled steel, recycled wood, aerated concrete bricks which mixed with fly ash etc.,

In other words the green building process incorporates environmental considerations into every stage of the building construction. This process focuses on the structural steel design, construction, operation and maintenance phases and takes into the lot of recycled steel design and development of energy efficiency water efficiency, resource efficiency, indoor environmental quality, building maintenance and the building's overall impact on the environment. A few aspects of green building concept are shown in Figure.1 shown below is developed in Tekla software.

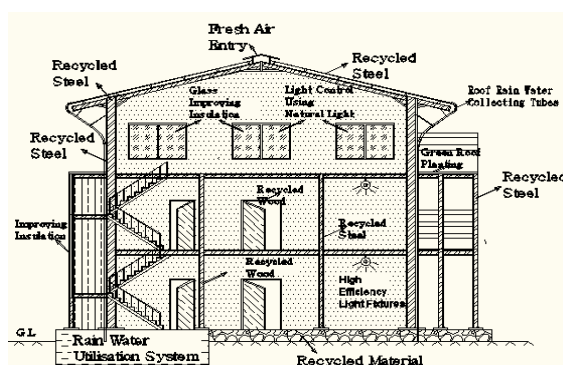


Figure.1 Conceptual Drawing of a Green Building

II. IMPORTANCE OF GREEN BUILDING

During the last 30-40 years we have been sensing the bitter experience of global warming, ozone depletion, resource depletion, energy scarcity, ecological toxicity, human toxicity, acid rains etc. These have alarmed, rather compelled the mankind to change the way they operate on the earth. Though we cannot avoid affecting the environment, the green buildings will aim and contribute towards minimising the environmental impact.

It should also be emphasized that green buildings do not only contribute towards a sustainable construction and environment but it also brings lots of benefits and advantages to the building and the users. It contributes towards lower

development costs, lower operating costs, increased comforts, healthier indoor environment quality, and enhanced durability and less maintenance costs. The most significant fact being that there is very little publicly available data regarding manufacturing process that document energy consumption, impact on natural resources, CO₂ emissions for each building material etc. Therefore, undoubtedly, to a certain degree, the decision making process involves personal and local value judgement. The data collected on Life Cycle value assessments will help overcoming such issues but still this tool is in its early stages and may need a little more time to provide us with accurate and comprehensive data about the steel structural building materials, products and systems.

III. STEEL CONSTRUCTION AND SUSTAINABILITY

The preoccupations of the sustainable development are of particular concern for the construction sector, which is responsible for 25% of greenhouse gas emissions and for 40% of the primary energy consumption. They constitute a major stake for all the involved professionals. Steel is an excellent solution for conserving raw materials, thanks to its recyclability. It can be infinitely recycled without losing its properties and strength. Today, the production of steel consists of 50% recycled metal, reducing the need for ore; for certain products intended for construction, this rate can reach up to 98%. This re-use of the material is in particular made possible by its magnetic properties facilitating the sorting the control of energy and the reduction of carbon dioxide emissions during production have led to vast improvements in developing new steel materials and taking into account life cycle of materials and products.

The designing and of realizing creative projects which integrate values and new techniques. Steel is the mainspring in our quest to improve the quality of our buildings and their impact on our living environment. General principles are established according to three main considerations: ecological, economical and socio-cultural, although the methods for determining their impact have not yet been agreed on an international scale. The sustainability of buildings concerns a range of issues related to choice of materials, construction process, occupation and end of life. These issues may be expressed in terms of specific criteria, such as energy materials use, waste minimization, reduction of primary energy use (and CO₂ emissions), pollution and other global impacts.

IV. BENEFITS OF STEEL CONSTRUCTION

The benefits of steel in multi-storey construction arise mainly from its prefabricated nature, its lightweight and the ability to phase the various activities in series rather than in parallel. In the multi-storey building sector, the benefits of steel construction are largely related to the 'fast track' nature of the construction process, which leads to a wide range of financial and process benefits. Many innovations associated with the construction process have further improved these inherent benefits and have increased efficiency and productivity.

V. TEKLA BUILDING INFORMATION MODELLING (BIM)

Tekla steel structures software comes with excellent tools for structural engineering services which saves time and improves project efficiency in many folds. User get direct output using accurate 3D structural Building Information Models to be used for fabrication, erection phases and manages information from supply to installation and track project status. Structural engineering professionals can collaborate with project participants and using the same shared model.

Speed of construction

Tekla structure is one stop solution BIM solution for structural engineering requirements. It is help full for Speed of construction is the most important benefit offered by Tekla steel software Procedure, which leads to financial, management and other logistical benefits due to Tekla software, many of which can be experienced in economic as well as sustainability terms. The BIM service includes structural design, fabrication drawing and erection planning. The use of Tekla structures for BIM services, for an sustainable steel building, it is found that steel construction is up to 20% faster than reinforced concrete, but, importantly, the construction of the primary frame and floors is up to 40% faster and allows for early start in building services, installation, cladding and other activities. The fast construction process is based on a synergistic use of steel frames, steel decking and braced steel cores.

The financial benefits of speed of construction may be expressed as:

- Conceptual design and Multi material detailing
- Early completion, which leads to reduced interest charges on the borrowed capital and to early return in terms of revenue
- Lower cash flow
- Reduced management costs on-site, due primarily to the shorter construction period, but also due to the fewer personnel employed
- Reduced hire costs of site facilities
- Greater certainty and less risk in the construction process.
- Construction documents and Reports

Save up to 60% of your project costs by outsourcing Tekla steel detailing and BIM related requirements to structural design.

VI. BENIFITS OF TEKLA STRUCTURES STEEL DETAILING

Tekla Structures is revolutionary software catering to the wide variety of needs of steel detailers and structural engineers in the growing steel building and steel construction industries. Tekla Structures software comes with powerful tools to develop a detailed 3D model as shown in Figure: 2 that can further be utilized for producing steel shop and erection drawings and reports automatically with almost 100% accuracy.

Tekla Structures provides an option to share the 3D model such as steel detailing, steel building and structural engineer facilitating simultaneous collaboration on the unique, regularly updated 3D model at every stage of the construction lifecycle. Various disciplines can generate and share a model and complete or verify drawings with ease and efficiency.

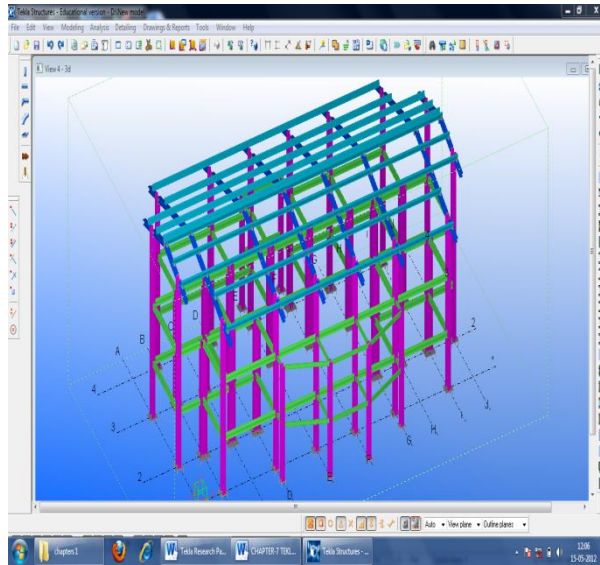


Figure.2 3D Model Steel Structure

1. General arrangement drawings (plan, section, erection)
2. Shop bolt list
3. Tekla 3D models
4. Erection Plans
5. Anchor bolt settings
6. Steel Fabrication drawings
7. Joist and Deck detailing

VII. MAJOR BENEFITS OF TEKLA STRUCTURES SOFTWARE

Get Precision and incisive detailing

Tekla Structures offers steel detailing in a 3D environment making sure error-free collaboration during the fabrication and erection stages with 100% accuracy. Tekla 3D detailed model characterizes the 'as-built' state of the structure in any given condition, if the structure stands well on computer screen, then it will fit on the construction site as well.

The software comes with a comprehensive library of structural steel components right from clip angles, end plates and braces to staircases and handrails allowing detailer to effortlessly model and store company-specific settings for future use.

Obtain output automatically

The steel fabricator can generate required shop drawings and reports automatically from the precisely detailed 3D model. Since drawings are correlated to the 3D model, any modifications in the model get automatically reflected in the output as well.

Efficient and effort-less management

Tekla Structures cleverly handles adjustments made to the structure and it guide for suitable steel connections. On-going corrections made to the model and drawings no longer result in huge delays or costly errors. Itget as the following below

- Always up-to-date drawings
- Related components respond to a change & are updated automatically
- Automatic clash detection

Benefit from Tekla Structure Detailing, 3D Tekla Steel Detailing

Bolted Joints

Steel building failures are most often caused by deficient connections. Tekla software prompts to systematically study joints in all of the projects. Steel specifications allow making precise calculations in order to evaluate the resistance and the rigidity of connections.

Benefits models, spread sheets, schedules, web pages and company databases are all sources of information that can find its way into Tekla's model-based Construction Management solution. Tekla Structures' ability to process large amounts of model and non-model based data, regardless of source, updating and monitoring impacts as change occurs in the projects.

Tekla Structures is revolutionary software catering to various needs of steel detailers and structural engineers. Tekla Structures comes with customized tools to produce a detailed 3D model that streamlines the entire workflow from cost estimation, bidding, conceptual design, steel detailing, fabrication, erection and project revisions. Tekla provides an option to share the 3D model at every stage of the value chain.

VIII. MODELING

New tool for modifying parts:

It is now fast and easy to modify the shape of parts and cuts by dragging the part edges and surfaces using the new Modify tool. The Modify tool makes modeling more efficient as it see the modify result immediately. It can easily make changes without having to enter any part properties.

Connections:

Tekla introduced various Steel connections with a suitable guidance, involving the assembly of elements, such as columns, beams, bracing members, tie members, etc. Because the components of the beam column joint are weak when compare with the column members and beam members. Building envelope floors and partitions are then connected to the principal members. Function of a connection is to transfer internal forces between the members, in a way that is consistent with the design assumptions pinned or continuous connection. When the connections are visible, their aesthetic quality can emphasise the structural behaviour and contribute to the architectural value of the building.

All the floor systems in Section utilise simple connections, where the connections are assumed to behave as nominal pins, not developing significant moments. To realise this assumption in practice, the connection details must be flexible, to avoid moment transfer, and ductile, in order to accommodate the rotation that develops at the connection. In general, these connection characteristics are realised by detailing the connection with relatively thin connection components that are flexible and accommodate rotation. The standard connections and are 'partial depth', the connection detail is approximately 60% of the beam depth. Full depth connections are provided for floor members that are subject to torsion, such as asymmetric beams. For the floor solution, the possibility of torsional loading in the construction stage should be checked, as connections with torsional resistance, or temporary restraints, may be required. The optional suitable connection will guide by the structural steel Tekla software as shown below in Figure: 3.

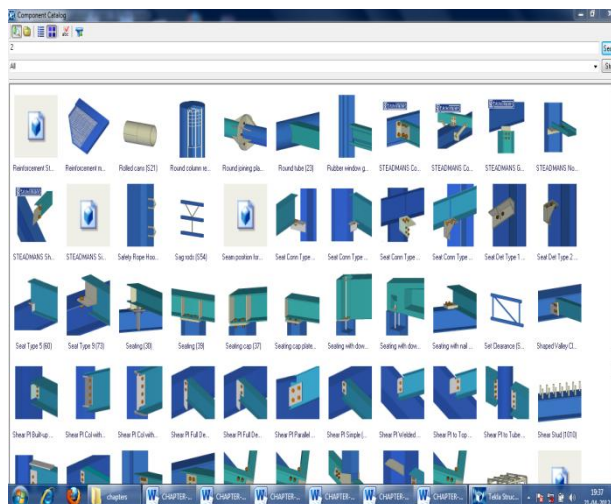


Figure. 3 Connection options shown in Tekla Software

Selecting multiple objects

Tekla software has options to select multiple Base plate with stiffener's objects simultaneously in models and in drawings as shown in Figure:4. To select multiple objects (area selection), of the following:

- Hold down the mouse button and drag the mouse from left to right to select the objects that are completely within that rectangular area.

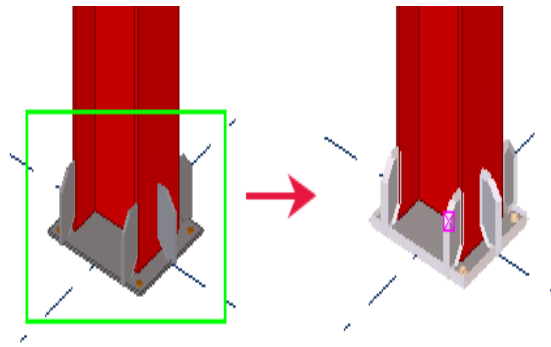


Figure. 4 Selecting Base plate with stiffeners

- Hold down the mouse button and drag the mouse from right to left to select the objects that are completely or partly within that rectangular area.

IX. CLASH CHECK MANAGER

The available clash types are: Inside, Exact match, Cut through, Clash, and Complex clash.

Tekla Structures contains a new clash checking functionality, which helps to manage clash results better. Clash Check Manager provides the following improvements:

- Clashes are automatically classified according to their type.
- It can avail to sort the clash check results.
- It has an option to zoom clashing objects in the model.
- It has an option to change the status of the clashes.
- After removing or modifying objects, it can re-run clash check to see if the clash still exists.
- It can save clash check sessions and view them again later on.

X. ANALYSIS PART PROPERTIES

In Tekla Structures all analysis-related content has been moved from the part properties dialog boxes to new analysis part properties dialog boxes. This makes part properties dialog boxes clearer and facilitates to tasks as all analysis-related properties are now accessible in one dialog box. It can define the analysis part properties within the active analysis model. This means that, for example, to define the supports of members differently in each analysis model. The values defined in the analysis part properties dialog box are used when the analysis part is created in the analysis model. To access the analysis part properties dialog box, select the part and right-click, and then select Properties from the pop-up menu.

Obtain output automatically

The steel fabricator can generate required shop drawings and reports automatically from the precisely detailed 3D model. Since drawings are correlated to the 3D model, any modifications in the model get automatically reflected in the output as well.

Main features in drawings

The Tekla drawing properties dialog boxes introduce a new option for controlling the structural detailing drawing output and view level of each part of the structural member in detailed drawings as shown in Figure: 5 & 6. setting up special representation for objects in drawings or views is easier than ever. Simply set up a drawing or view filter that selects the objects special representation for, then create and save the object property settings to be used for the objects specified by the filter.

Tekla Structures includes the following features for drawings:

- All information comes directly from the model, which minimizes the work to do. In many cases all need to do is to check the predefined settings or do some minor editing.
- Up-to-date drawings. The drawings are actually part of the model. If you revise the model, Tekla Structures also updates the drawings, so they are always up to date.
- Master Drawing Catalog, which is a fast, efficient and controlled way of creating drawings in one centralized location using master drawings.
- Automatic workshop single-part and assembly drawings, and cast unit drawings of selected parts with predefined settings for layout, views, dimensions, marks, and building objects.
- Automatic general arrangement drawings and anchor bolt plans of selected views.
- Drawing cloning capabilities.
- Revision control for drawings.
- Interactive editing tools that can use for adding dimensions, various shapes, texts, additional annotations, symbols, and links in the drawings.

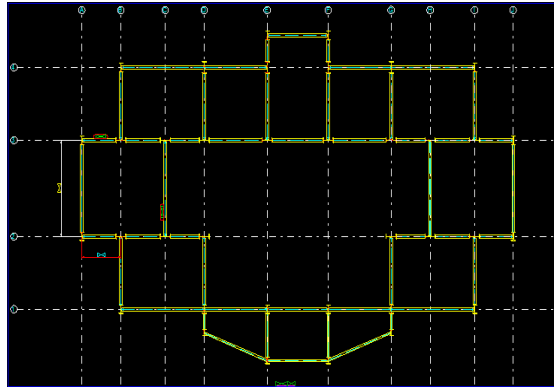


Figure. 5 Tekla Structural work plane

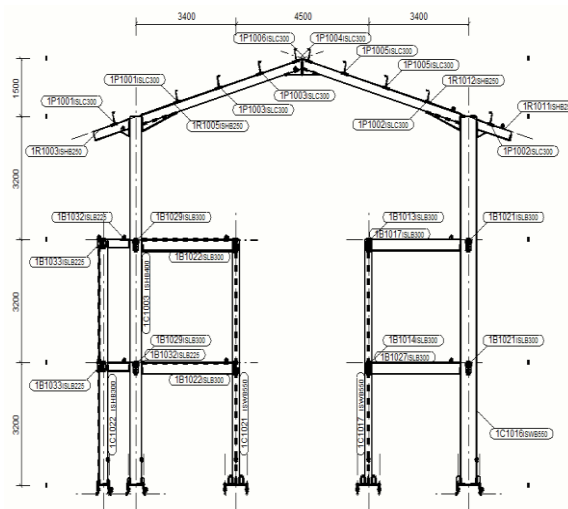


Figure.6 Tekla Structural detailing drawing output

XI. CONCLUSION

The most important feature governing the choice of steel (I-section)& form of construction for any component is its structural integrity. Where as high specific strength and well planned project with Tekla software. It is used to select the steel I-Sections for strength and durability of the building to resist various types of dead loads, live loads and wind loads. Planning for energy efficiency, water efficiency and to improve the indoor environment. Tekla software is used for the steel structure for work shop drawings and it gives the connections guide which is use full for better beam column joints strength, there is today an increasing emphasis on other criteria such as environmental durability, embedded energy. The project has been quite instrumental in designing in green concept the knowledge bringing together to planning, designing, analysis, modeling and detailing for the good environmental design concept.

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