Analysis of the Key and Difficult Points in the Engineering Construction Technology of the Steel Structures of a Super High-rise Building

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Abstract: In recent years, with the rapid development of the economy of China, the traditional building structure has not been able to meet the current people’s demands and the super high-rise building has become a symbol of a city. In the current period, the research on the super high-rise building in the architectural industry of China is late and the technical blanks exist in some construction difficulties in the super high-rise steel structures. Based on the above, a brief analysis and discussion on the difficult construction technology in the steel structures of a super high-rise building and some measures are presented for reference of the relevant personnel in this paper.

1. Factors to be considered in the deepening of the design
For considering the machining and making process of the steel structure, before the deepening of the design, the design deepening personnel and technicians should be familiar with the drawing of the structure, collect the information in the drawing, analyze the making process of the key parts, determine some points such as special plates, plate width requirements and test requirements, etc. and present the relevant suggestions.

1.1. Disposal of the transitional node structure of the variable section
In order to assure the quality of the members, the transitional node of the variable section should be made by the machining factor. In order to assure the steady force transmission of the steel column, not less than 1:6 transitional section should be established between the round tubes with the different diameters, shown in Figure 1.

![Figure 1. Disposal of the Transitional Node Structure of the Variable Section](image)

1.2. Reinforcing design of the foundation bolts
In the installation of sill anchors, the embedded bracket and locating plate should be set, the locating bracket column is made of angular steel, on it is set the double-layer locating ring plate. In the
deepening, the checking calculation of the force stability should be made first to assure the rational structure, with the detailed form shown in Figure 2[

![Figure 2. Design and Checking Calculation of the Sill Anchor Locating Bracket](image)

1.3. Design of the temporary support for installation of the truss on the site
An engineering truss has the high weight and big span, so it should be hoisted in the sections. The lattice column is used as the temporary bracket for closure. In order to assure the stability of its installation, the form, dimensions and quantity of the lattice bracket should be taken into account in the deepening and the checking calculation of its forces should be carried out. The form of the bracket is shown in Figure 3[

![Figure 3. Design and Checking Calculation of the Sill Anchor Locating Bracket](image)

1.4. Cooperation with the electromechanical specialty
The holes for the electromechanical equipment, screen wall and decoration should be reserved and the relevant reinforcing measures should be taken. All the specialties should be cooperated to set the connecting parts and temporary fixing parts, etc. to the steel member, shown in Figure 4[

![Figure 4. Setting of the Reserved Holes](image)

2. Assembly of the steel member
The purpose of pre-assembly is that the member may not be smoothly connected on the construction site due to the accumulated errors on the premise of meeting the standard because the errors are inevitable in the machining. In order to assure the installation accuracy on the site, for the part with more connecting rods, the member should be pre-assembled before it leaves the factory, the machining accuracy should be tested and production should be guided according to the pre-assembly result[

3. Transportation of the member
The general thought of transportation is taken into account from the perspective of safety and rapidness according to the features of the steel member and the transport experience of the similar members. It is suitable to transport all the steel members on the land. The special transport team
should be organized to be responsible for loading and unloading of the steel member and the transport company with the rich transport experience and complete big-part transport vehicles for the long-term cooperation should be chosen[2].

Typical member transport method: in order to assure the transport safety and prevent the steel member from being damaged, in addition to the strict implementation of the loading, reinforcing and binding scheme, the special personnel should be designated to escort all the transport vehicles. For example, the packaging forms of some typical members of a project are as follows: the steel columns and small steel beam bearing plates are bundled and packaged, shown in Figure 5. The truss should not be packaged in the transport, shown in Figure 6. Some parts such as high-strength bolt anchor of the connecting plate, etc. should be packaged in the packing box, shown in Figure 7.

4. Analysis of the key and difficult points in the installation and construction of the steel structure

4.1. Deepened design of the steel structure
For the complex structures of the ring truss nodes of a project, a lot of screen wall steel structure coordinates and more difficulties in the disposal of the intersection nodes, the relevant resolution is to be carefully familiar with the structure of each node, build the model according to 1:1, determine the making, welding and installation processes, take full into account each welding seam of the nodes, assure the worker’s operation space, consider the making, transport and installation aspects in the deepening and achieve the deepening of the guidance of the production.

4.2. Making of the truss nodes
For more intersections of the truss node members of a project, which brings about more difficulties in the assembly and welding, the relevant resolution is to build the 1:1 model before the members are machined, use the models as the reference to make the detailed and rational assembly and welding sequence, take into full account the welding operability; set some deformation resistance measures such as welding bonding plate and welding bonding support to assure the dimensional accuracies of the members.

4.3. Pre-assembly of the steel structure
For the complexity of the steel structure of a project, it is required that the steel structure should be pre-assembled before the steel structure with the complex construction process leaves the factory so as to assure that the machining accuracy and interface should meet the installation requirements on the site.
4.4. Truss installation
Because the ring truss installation of the project has the big workload and more difficulties in the construction, the annex roofing truss structure span is installed at the elevation of 22m and the construction and safety protection are difficult, the relevant resolution is to carry out the pre-assembly of the entity after the truss machining is completed, assure the completion of the installation on the site once, set the special piling and assembly site, complete the assembly of the truss on the ground, reduce the overhead workload, connect the steel beams between the trusses after the installation of the roofing truss is completed and carry out welding and fixing after the settlement is stable[6].

4.5. High assembly and installation accuracy of the screen wall steel structure
The screen wall steel structure of the project is the 3D structure, with a lot of coordinates and complex form, high making accuracy requirements and installation accuracy, the simulation analysis of the deformation of the structure as a whole is made via the infinite element before the installation, the reversible deformation is made to offset the down deflection value; use the 3D laser scanner for pursuit in the whole process of installation and compare the scanning result with the model and achieve the adjustment of the deviation at any time.

4.6. Measuring accuracy control
In the installation of the steel structure, the structure is affected by not only the wind load but also some climatic changes such as sunshine and temperature, etc., making the structure in the state of dynamic change all the time and presenting the high requirements for the measuring control method and measuring accuracy. The relevant resolution is to make use of the laser collimator to pursue and test the verticality of the steel column in 24 hours; use GPS for rechecking in the different weather conditions at the different time, test the influence of the temperature difference on the building and take the corrective methods to eliminate the structural deformation caused by the environment.

4.7. Construction safety protection and management of the super high-rise steel structure
In the construction of the steel structure, the pertinent laying of safety protection measures and the safety management of operators are the key points of the construction; in the construction of the super high-rise steel structure and the high altitude dropping and welding fire are the key points of management. The “three-level education” of personal access and safety publicity and inspection should be strictly implemented; the horizontal channel, external protection and steel column hoisting protection measures, etc. should be set on the site; the fire protection measures should be taken in the welding of the steel structure and some measures such as application of fireproof asbestos cloth and fire basin, etc. should be taken[2].

5. Conclusion
On the whole, the occurrence of the super high-rise buildings has resolved the sharp contradiction between the rapid increase of the population in the world and intense supply of land resources and continuous increase of the prices. The development of the super high-rise buildings will make people develop toward the high altitude. Therefore, it will promote the economic development and greatly improve urbanization.

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