Construction technology of installation and support system of high-rise prefabricated steel structure plant

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Abstract: The standardized plant project of Hongqi Industrial Park of Internet of things in Hefei adopts the composite assembled structural system of steel structure and laminated plate. In this paper, the project is mainly carried out from the perspectives of assembly construction and installation, rapid support system design and finite element analysis of angle steel truss, reflecting the advantages of assembly structure, the rationality and enthusiasm of the construction mode, and it's favorable for the development of buildings in China.

1. Introduction
With the rapid economic development in China, the high-rise prefabricated steel structure plants have been vigorously popularized and applied, and the pilot projects of the high-rise prefabricated steel structure plants have been emerging all over the country. The selection of steel structure frame structure of high-rise factory building assembly structure system is known as one of the "green buildings" in the 21st century because of its comprehensive advantages such as light weight, low cost of foundation, good seismic performance, convenient installation, short construction period, quick return on investment, less construction environmental pollution and less overcapacity. Engineering Situation.

The standardized workshop project of Hongqi Industrial Park of the Internet of things is located at the intersection of Xingfu road and Gaoliang Road, Yaohai District, Hefei City, with a total construction area is about 100,000 square meters. Among them, 1 and 2 buildings are two 20 storey steel structure industrial plants, the main structure is steel column and steel beam, the floor is 6cm laminated board + 7cm cast-in-place laminated floor. The project adopts the composite assembly structure system of steel structure and laminated plate of high-rise factory building, which can save the construction period, realize the green energy conservation and environmental protection, and realize the synchronous construction of cast-in-place concrete floor and steel structure.

2. Prefabricated laminated plate installation
(1) Design and installation of support system for laminated panels.

The floor height of this project is 5.4m, 4.5m and 4.2m. The bracket support system is in the form of an angle steel truss. The support system is in the form of angle steel truss, which is formed by welding L50×4mm and L40×3mm angle steel. The upright pole is supported by steel pipe with the wall thickness of 2.5mm and U-shaped jacking (as shown in figure 2). The upper chord of the truss is fixed with a 2.5cm thick wood square as a wood keel through adhesive tape to adjust the height of the laminated plate. As the level of the steel beam has been adjusted in the previous installation, the bracket is
supported on the upper flange of the steel beam, and the flatness requirement of the laminated plate installation can be met even if the height difference of the bracket is not adjusted.

![Figure 1: Bracket support system](image1)

![Figure 2: U-shaped top support](image2)

(2) Installation of laminated plates\(^{[2]}\).

① After the component is basically horizontal and all the lifting nails are stressed, lift the component off the ground.

② According to the component position shown in the drawing and the arrow direction, observe the relative position between the reserved hole on the floor and the water and electricity drawing.

③ The short side of the component installation is 10mm deep into the support, and the long side of the component and the beam or plate and plate are installed in accordance with the design drawings.

④ After lifting the laminated board, someone must check the difference in height of the seam at the bottom of the laminated board, and the difference in seam height is not more than 3mm.

3. Design of Fast Support System for New Stacked Plywood

The new type of fast support system of laminated floor slab (hereinafter referred to as "support system") consists of three parts: H steel beam, angle steel truss, and U top bracket, as shown in figure 3. The angle steel truss element is welded into a truss shape by angle steel processing\(^{[3]}\). The end of each angle steel truss element opens the bolt hole symmetrically every other distance. Two pieces of angle steel truss form truss support frame through bolt connection, and different span adjustment is realized by adjustable bolt, as shown in figure 4. Then, according to the structural characteristics of steel structure H steel beam, the adjustable top support is arranged along the direction of steel beam on the lower flange plate of U steel beam and the two ends of the Angle steel truss are fastened to the upper flange plate of the steel beam with u-shaped brackets to form a stable support system\(^{[4]}\). The u-shaped top bracket can adjust the length and height, and the adjustment range can reach 20cm, as shown in figure 5.

![Figure 3: Support system components try](image3)

![Figure 4: Angle steel truss scene splicing](image4)

![Figure 5: Adjustable U-shaped jack](image5)

4. Finite element analysis of Angle steel truss

4.1. Finite element model

4.1.1. Model Foundation

In order to verify the safety and reliability of Angle steel truss, Ansys software was used for modeling,
As shown in figure 6~7 the angle steel truss welded by L40×3mm、L50×4mm ,Steel material Q235,The upper chord and the lower chord are L50×4mm Angle steel, The rest are L40×3mm Angle steel, U-shaped jacking adopts Q235 members with a diameter of 30mm and The size of the supporting steel pipe is Ф48 × 2mm. The main force of the truss comes from the axial force of each member element. The closer the member bar is to the center line of angle steel truss support frame, the greater the axial force. The support system of one span angle steel truss with the largest bearing load is taken as the calculation unit for checking calculation.

4.1.2. Load combination
In addition to considering the member's own weight, the dead loads (Upper composite slab+Cast-in-place slab) and live loads (Take the Upper panel to 2 KN / mm²) acting on the upper part of the angle steel truss also need to be considered. Material properties of each component are the same, The details are as follows,Material:Q235; Elastic Modulus:2.06×105N/mm²; Poisson's ratio:0.30;Linear expansion coefficient:1.20×10-5;Mass density:7850kg/m³.

1)1.20 dead loads+ 1.40 live loads
2)1.35 dead loads+1.40×0.70 live loads

4.2. Calculation results and analysis
4.2.1. Stress calculation
According to normative inspections based on computational analysis models. The test results show that the structure can meet the requirements of bearing capacity calculation. The calculation results of model stress ratio are shown in figure 8~9. The strength, rigidity and stability of each component meet the design requirements[5].

4.2.2. Displacement calculation
The displacement of each working condition is shown in figures 10~11.
Figure 10 Mid-span displacement under the first combined load

Figure 11 The mid-span displacement under the second combined load

It can be seen from figure 10 that the displacement of mid-span under the first combined load is 0.5129 mm, which meets the design requirements; from figure 11, it can be seen that the mid-span displacement under the second combined load is 0.4408 mm, which meets the design requirements.

References

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