Academic Journal of Architecture and Civil Engineering
ISSN: 2960-0243
DOI: 10.61784/ajace3006

KEY CONSTRUCTION TECHNOLOGY OF SUPER-HIGH FISH-BELLY CABLE-POINT FOLDING CURTAIN WALL

ShenShen Zhu[1,2,*], YueQiang Cao[1,2], ZhiCheng Bai[1,2], HuiZhou Ni[1,2], ZhenJie Tan[1,2]
[1]China Construction Fourth Engineering Bureau Co., Ltd. Guangzhou, Guangdong 510000, China;
[2]China Construction Fourth Engineering Bureau Sixth Construction Co., Ltd. Hefei, Anhui 230000, China.
Corresponding Author: ShenShen Zhu, Email: 19822660870@163.com

Abstract: With the development of urban construction, large public buildings have become the characteristic symbol of the city and the business card for external publicity. Public buildings with diverse appearances have become the norm in urban construction. Curtain walls are one of the most important forms of displaying the appearance of buildings. "High, large, special, new and difficult" curtain walls emerge in an endless stream, and various complex forms of curtain walls have become the difficulty of curtain wall construction. This paper introduces in detail the process methods of fish-belly steel truss installation, cable installation, broken line beam installation, and glass installation in the construction of ultra-high fish-belly cable-type glass curtain wall steel structure.
Keywords: Fish-belly; Cable; Broken line curtain wall

INTRODUCTION

The steel structure folded beams and fish-belly trusses of the fish-belly cable-type folded-line curtain wall are welded to further improve the lateral stiffness of the front chord of the fish-belly truss. The fish-belly cable-type glass curtain wall has high aesthetics and transparency. The combination of cables and fish-belly steel trusses provides a good view and lighting effect. However, since its construction process is different from that of conventional curtain walls, it has certain construction difficulties. This paper discusses the key construction technologies of super-high fish-belly cable-type folded-line curtain walls based on engineering examples [1-3].

1 PROJECT BACKGROUND

Take the curtain wall project of the east entrance hall of a certain project as an example. The curtain wall of the main entrance of the east entrance hall of this project is 83m wide and 36m high. The east facade adopts a fish-belly truss full-glass point-type tie-rod curtain wall in the form of a single-layer cable net structure. The cable is a stainless steel cable with a diameter of 22mm. The glass curtain wall adopts L0W-E tempered and glued hollow glass (4 pieces of ultra-white). The supporting system of the curtain wall is a fish-belly truss column. The upper and lower ends of the cable fixed ends and the cable adjustment ends are connected through the ear plates welded at the upper end. The cable is mainly divided into two sections, the upper section of the cable is fixed on the steel structure column at one end and fixed on the broken line beam at the lower end of the top glass; the upper end of the lower section of the cable is fixed on the lower end of the top glass. The glass installation order is from bottom to top. After each row of glass is installed, if the deviation is large, the crossbeam needs to be intervened by the cable to reset the crossbeam.

2 KEY TECHNOLOGIES

2.1 Construct BIM Model

Just like Figure 1, construct BIM model according to the drawings, use BIM technology to simulate construction and installation, and install keels and order glass curtain walls in strict accordance with theoretical dimensions by establishing BIM model. Combine Leica 3D scanner to scan the on-site steel structure, build the actual steel frame model, adjust and correct the existing BIM model, and absorb errors.

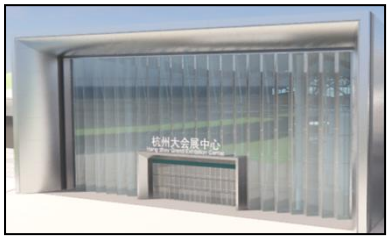

Figure 1 BIM Model

2.2 Measurement and Layout

Construction layout is mainly based on the ±0.000 elevation, building axis and curtain wall design drawings provided on site. All information must be complete. Structural inspection, after the support positioning line is drawn, vertical steel wires and horizontal lines are pulled at the structure as installation control lines. After measuring and laying out the actual exact position of the curtain wall structure, the position of all rods should be checked according to the tie rod support layout diagram. All measurement data must be reviewed. If the allowable error is exceeded, the cause should be found and corrected in time. Measurement and layout can be seen in Figure 2.

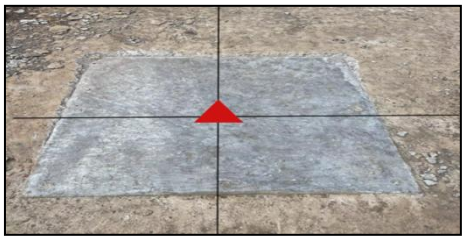

Figure 2 Measurement and layout

2.3 Installation of Fish-Belly Steel Trusses

The whole site adopts hoisting after assembly.In figure 3, the fish-belly trusses are divided into two sections, north and south, for construction. The 24.5m short truss on the upper side of the door head is reserved for final construction. The steel trusses on the north and south sides are constructed first. Two groups of personnel are used, each with a 200T crane + 80T crane + 1 38m aerial platform. After the construction is completed, one group of people is reserved for the construction of the four trusses above the door head. The hoisting position of the 200T crane avoids the central top plate and is selected at the natural ground position. The outriggers are laid with steel plates or sleepers depending on the hoisting situation.

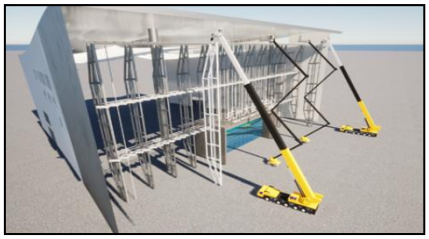

Figure 3 Installation of Fish-Belly Steel Trusses

2.4 Installation of Broken-Line Beams

This project has a total of 5 layers of broken-line beams. The stainless steel cables have only vertical locks. The locks are not connected to the glass, and only the broken-line steel beams of the glass are pulled. The cables are mainly divided into upper and lower sections. One end of the upper glass is fixed to the steel structure column, and the other end is fixed to the beam at the lower end of the top glass. The upper end of the lower cable is fixed to the lower beam of the top glass. Vertically downward, until the upper beam of the last glass ends.
Just like Figure 4, all cables can be installed in place before the glass is installed. The glass installation is divided into 5 areas, and the installation order is from bottom to top. After each row of glass is installed, the arch value of the beam needs to be compared to see if it is consistent with the design result. If the deviation is large, the beam needs to be intervened by the cable to reset the beam.

Figure 4 Installation of Broken Line Beams

2.5 Installation of Vertical Cables

This project is a single-layer cable net structure, with φ22 non-pressed cables used in both the horizontal and vertical directions, and the cable section A=286.37mm2. The top of the curtain wall support system is a fish-belly steel frame column, and the bottom is a box beam structure. The upper and lower cable fixed ends and cable adjustment ends are connected through the ear plates welded at the upper end. The installation sequence of the cable curtain wall cable is:

pre-calculate the deformation value of the beam and calculate the arch value of each cable point → install the beam in place according to the arch value → install the vertical cable → install the glass layer by layer in different areas → check whether the beam is reset.
Installation method of vertical cables: When installing cables, place the cable tray at the vertical position corresponding to each vertical cable, the cable corresponding to the upper steel beam, fix the winch clamp, tie the fixed end of the cable with a wire rope, and use the winch to lift the cable, that is, release it while installing the cable. When the fixed end is raised to about 1.5m away from the ear plate, use two 1.5T guide chains to fix the fixed end to the corresponding ear plate through the pin shaft; similarly, use two 1.5T guide chains to fix the adjustable end to the corresponding ear plate through the pin shaft. Other vertical cables are installed in this way.

2.6 Cable Prestressing

During the prestressing construction process, by monitoring the changes in structural deformation and cable force, the difference between the theoretical calculated value and the measured value can be found, and the calculation model can be corrected in time (if the difference is caused by the error of the calculation model), so as to ensure the correctness of the construction simulation calculation; ensure the safety and quality of the prestressing construction process, and make the final prestressed state consistent with the design requirements.

2.7 Installation of Folded Glass Curtain Wall

(1) The weight of a single piece of folded glass in the East Login Hall is about 1.7 tons, the highest point elevation is about 34m, there are 6 rows of glass on the facade, the height of the glass from the bottom to the top is 6m*5 rows + 5.5m*1 row, and the construction is carried out using 80T crane + ultra-high power electronic suction cup + 38m aerial platform.
(2) Before installation, check whether the size of the glass joint is consistent with the hole position of the joint claw. If it is not within the allowable difference range, it should be adjusted or processed.
(3) When the glass is installed in place, the ultra-high-power electronic suction cup slowly lifts the glass and places it in place on the beam.

2.8 Structural Monitoring

(1) Cable force monitoring. During the construction phase, cable force monitoring can be carried out through oil pressure sensors, dynamic measuring instruments or portable cable force measuring instruments. The cable force monitoring instrument can be selected according to the actual construction conditions. During the use phase, cable force monitoring can be carried out through pressure sensors, dynamic measuring instruments or portable cable force measuring instruments. The cable force monitoring instrument can be selected according to the actual conditions.
(2) Appearance inspection. The contents of the structural appearance inspection include: appearance inspection of cables, nodes, etc. and related surface paint inspections to ensure that various materials are safe and effective, the anti-corrosion meets the design requirements, and the structure is safe and reliable.

3 CONCLUSION

In summary, the functions of modern buildings are becoming increasingly complex. The fish-belly cable-type folded curtain wall is a new curtain wall support structure system with a transparent structure and greatly saves the space used for the support structure. After the construction of the super-high fish-belly cable-type folded curtain wall is completed, it has a good transparent effect, simple and bright, which adds a lot to the overall effect of the login hall and becomes a decorative highlight. It has been recognized by all sectors of society and has promotion value. Through the application of the fish-belly cable-type zigzag curtain wall construction method, good results have been achieved in terms of construction period, quality, safety, environment, etc., creating good economic benefits, social benefits, energy saving and environmental protection benefits, and has broad application prospects.

COMPETING INTERESTS

The authors have no relevant financial or non-financial interests to disclose.

REFERENCES

[1] Cui Hao. Design and construction technology of fish-belly cable point curtain wall. Jiangxi Building Materials, 2016, (19): 91-92.
[2] Chen Longmei. Construction technology of fish-belly cable structure of Gaobao Financial Building. Science and Technology Wind, 2011 (9): 129.
[3] Lu Cuiping. Design of self-balancing point-supported glass curtain wall structure. Engineering Technology, 2016,(3): 41-42.