Research on Construction Technology of External Hanging Scaffold for Prefabricated Concrete Shear Wall

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Abstract. Combined with an instance of a high-rise residential project in Sino-French Wuhan Ecological Demonstration city, the structural characteristics, construction key technology and disassembly process of the auxiliary external rack of the prefabricated high-rise structure are emphatically analyzed. It is safe and reliable to use the external hanging scaffold structure in the prefabricated high-rise building, which can effectively shorten the construction period and has a beautiful appearance. and also obtains good economic and social benefits, which provides Suggestions and references for the similar prefabricated building construction in the future.

Keywords: Prefabricated building, external hanging scaffold, construction technology

1. Introduction
At present stage, construction land is becoming more and more tense, high-rise residential projects appear constantly, with the gradual improvement of the our country industrialization level, industrial building as the development trend and direction of the construction industry has been recognized by everyone, prefabricated construction as an important form of expression of industrialization construction, increasingly widely used in high-rise residential projects. As a new form of new technology, the external hanging scaffold has the advantages of construction safety, convenient operation and beautiful appearance relative to the traditional building peripheral scaffold protective net. It has become an important part of the prefabricated building system, and its construction technology has a significant impact on the safety of buildings and structures. Combined with the actual situation of Sino-French eco-city, this paper elaborates the construction technology of assembly type external rack in detail.

2. Project summary
The 3-11 floors of this project are prefabricated shear wall structures, so it is difficult to set up conventional cantilevered scaffolds. Therefore, the project plans to adopt external hanging protective scaffolds which are more suitable for prefabricated buildings to protect the adjacent workers. In the overall construction process, two sets of external hangers are used for the turnaround. One set of external hangers is installed on the prefabricated outer wall of the next layer of the working layer to protect the construction personnel on the adjacent side of the working layer. Another set of external
hangers is installed simultaneously during the hoisting of the prefabricated outer wall of the working layer to serve as the protective frame for the construction of the upper layer. The prefabricated outer wall corresponding to the balcony does not carry out the installation of external hangers, and the balcony is directly set up a permanent railing as the construction of the border protection. The layout and turnover diagram of the external rack are as follows:

Figure 1. Turnover of external hanging scaffold  
Figure 2. Vertical transport of external scaffold

3. Craftsmanship of external hanging scaffold

3.1. Craftsmanship of main part
This project is used in the detachable type of external external hanging scaffold, the whole can be divided into three parts: triangular support, step plate, border protection. The internal parts of the three parts are welded into a whole, between the three parts are bolts or U type card anchoring connection method, so that the installation and disassembly is more convenient.

Figure 3. Craft of external hanging scaffold

The tripod support is welded by vertical bar, transverse bar, oblique bar and stiffening bar. The stiffening bar is 6.3# channel steel, and the rest is 10# channel steel.
The pedal frame is composed of longitudinal rods, cross rods and sleeves, all of which are welded by 50×50×3 square tubes, and the upper part of the skeleton is spot welded with 3mm pattern steel plates. The arrangement of the casing and lifting ring should be staggered with the tripod support.
Where the pedal cantilever is large, it is necessary to weld a diagonal brace to connect the tripod stiffening rod and the channel frame.

The elevation protection height is 1800mm, and the skeleton is welded by 40×40×3 square tubes. The longitudinal rod is inserted into the casing and fixed with M10 bolt connection. The enclosure net is made of 25×25×2.5 iron wire square mesh, which is spot welded on the inside of the skeleton, and 200mm skirting board is welded on the outside of the skeleton below.

The external hanging scaffold are painted with blue paint as a whole, and the skirting boards are painted with yellow and black paint. The wall screw is M20, made of 45# steel, and has been quenched and tempered and blackened, equipped with 75×75×10 washers and nuts. The materials are all provided by the manufacturer.

3.2. Quality assurance measures

The quality assurance measures of external hanging scaffold are as follows:

(1) Strictly control the inspection and acceptance of the semi-finished products of the frame body, and all raw materials must have product qualification certificates. Visual inspection is performed when entering the site. Steels with rust, pitting, or deep scratches will not be accepted. The quality of the steel made of the frame body shall comply with the current national standards.

(2) The frame system is strictly prohibited to use welding, so as to avoid burning the main girder section in the process of processing.

(3) In the welding process, if defects such as pores, slag inclusions, and under-welding are found, they should be repaired in time. When entering the site for acceptance, the welds are not allowed to have defects such as cracks, weld bead, burn through, arc craters, and the weld inspection report shall be provided, otherwise the acceptance will not be passed.

(4) Strictly follow the dimensions specified in the construction plan to make the frame, and ensure that the node connection meets the requirements.

(5) The hanging ring of the external hanging scaffold must be welded on the square pipe of the walkway with Grade 1 round steel of Φ12. The round steel must have the factory certificate and inspection report, and be sampled and inspected according to the requirements before it is allowed to be used.

| Serial number | Check content and requirements |
|---------------|--------------------------------|
| 1 Steel structure components | The installation position of the truss meets the requirements |
| | The connection of wall parts, triangular arms and embedded connectors is reliable |
| | Truss, triangular arm and wall parts have no obvious deformation |
| 2 stability | Whether the bolts through the wall are tightened and the gaskets are complete |
| | Whether the bolts, nuts and gaskets are missing |
| | Whether there is a delta-welding phenomenon in the triangular arm |
| | Triangular arm spacing |
| 3 Closed situation | Rack body splitting distance is not more than 20mm |
| | The bottom seal shall not have more than 20mm holes and gaps |

3.3. Load test

"Construction tool type scaffold safety technical code" (JGJ202-2010), scaffold construction load shall not exceed 0.8KN /m², it is strictly prohibited to use the large template root on the hanging frame, so the frame body in the use of the load test before, holding 4 hours after no weld cracking and structural deformation can be used.

Load test procedures are as follows:
(1) Use a tower crane to hoist a piece of pylon to the desired position and reinforce it.
(2) Establish a benchmark on the outside of both ends of the rack, and mark the horizontal position of the rack on the benchmark.
(3) The sandbag is used to load twice, and the total load is 1.5 times of the design load. Add 1/2 total load for the first time, and put the sandbags on the rack evenly. After 2 hours, check the horizontal position of the rack and record the sinking height. For the second loading, as for the first loading, check whether the bolts through the wall and the fixed point are damaged, and record. After 4 hours, the various parts of the hanger, fastening point comprehensive inspection and record, the sinking height of the hanger record, check the various parts, if there is no crack, deformation, no damage to the structural wall, welding part without welding, you can pass the load test. If there are cracks, deformation, etc., the test failed, the rack can not be used.

4. Installation and removal of external hanging scaffold
According to the overall idea of the turnover of the two sets of external pylons, it is planned to install two layers of external pylons in each construction flow section, that is, in each unit. The external pylons of each layer are installed at the designated external pylon installation site, that is, the prefabricated shear wall yard.

4.1. Installation
Each pillar of the first two layers of the installation of the rack, directly into the field of the rack installed on the prefabricated wall, three layers of more than the rack, the need to remove the lower layer of the rack, the overall turnover to the upper.

4.1.1. Triangular support installation. When installing the external rack, the triangle support of the rack corresponding to the prefabricated external wall is installed on the wall, the upper side of the triangle support is installed first with wall bolts, and the lower side bolts are installed after the nut is tightened. The outer side of the wall is equipped with a rubber pad at the laminating support, and the inner side is equipped with a steel pad and the nut is fastened.

4.1.2 Crossing plate installation. The passage plate is hoisted above the triangular support, supported on the support horizontally, and the passage plate is adjusted around to make its position meet the design requirements. The U-type clamp is fastened to the longitudinal rod of the passage plate, and the wire mouth is inserted into the triangular support and fastened with matching nuts.

4.1.3 Protective mesh installation. Lift the mesh vertically above the aisle plate, insert the mesh sleeve on the aisle plate, and insert two bolts from the side to fix it.

4.2. Removal
In the removal of external pylons, special attention should be paid to the removal of light wells. For example, the external pylons at the light wells located between shafts 13-2 and 13-3 and between shafts 13-16 and 13-17 are due to the small space. In the process of removing the outer frame of a slower unit, it may not be possible to avoid the collision between the outer pylon and the structure of another unit. On the basis of wrapping flexible materials such as rubber rings, the height of the tower crane command and the tower crane operator needs to be coordinated. After the swing of the external pylon stops, move the external pylon steadily out of the structure, and then hang it down to avoid the external pylon from colliding with the external wall of another unit during the removal or hanging process.
5. Conclusions
This article takes the high-rise residential project in Wuhan as the engineering background, introduces the characteristics of the external pylons of prefabricated buildings, expounds the key technology of the external pylon structure, and fully embodies the advantages of energy-saving, environmental protection, flexibility, safety and economy of the external pylons. The application of the externally-mounted lifting scaffolding of the prefabricated concrete shear wall not only improves the construction efficiency, shortens the construction period, and reduces the project cost, but also plays an important role in ensuring the quality of the project and preventing the risk of the project, which is in line with the current green construction trend.

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