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The Technical Application of Industrial Pre-assembled Residential Building Typology

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Abstract Regarding environmental preservation, the high-rise prefabricated home represents the trend of modernization for the national housing sector. Energy conservation strategy should be the ultimate objective of any growing country. The current state of the housing industry Modernization includes industrialized manufacture of residential prefabricated components, prefabricated component installation on the building site, and factory modernization. Advertisements promoting the advantages, acceptability, and quality of prefabricated components and construction on the construction site Management and organization, for example. (The use of prefabricated technology in industrialized residential constructions) primarily entails the manufacture of prefabricated components: enhancements to component construction drawings and structural design of a mould. The installation of prefabricated components mainly includes: confirmation of hoisting process, design of temporary support system and design of temporary supports Plan, construction site layout, type selection of large hoisting equipment, transportation of prefabricated components, etc.

Keywords*: industrialized, residential prefabricated, PC board*

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1. Introduction

The construction industry has evolved from on-site production to factory production, and from manual operation to mechanized operation. The development of mechanized operation, [1] industrialized production, and the use of prefabrication and assembly technology are all considered to be the industry's development trend. Prefabricated assembly style architecture is fast gaining popularity in wealthy nations, and the technology is continually improving. Progression and development [2]. With the growing lack of human resources and the rising cost of living, factory production allows for the efficient use of materials and labor, the acceleration of building progress, and the enhancement of the product quality of construction engineering Quantity and other reasons. [2] Prefabricated components offer the advantages of industrialized production, high quality, and simplicity of process in a short period of time (without formwork erection, reinforcement binding, pouring, curing, and formwork removal), as well as significant reductions in current site construction and wet operation costs, concrete spillage, and noise disturbing residents. [3] It promotes civilized construction and environmental stewardship. These Pre-traditional advantages of component manufacturing will increasingly become apparent. Prefabricated concrete components or pieces are used to assemble and connect the prefabricated concrete structure. For short, the linked structure is referred to as the assembled structure. In the last decade, structures have been fabricated [4].

The structure is gradually heating up in China where construction booms to it optimum heights, and is in architectural design, component production and installation There are obvious improvements and developments in construction and component connection. Already [4], the appearance of new prefabricated residential buildings applied in large-scale engineering Quality, energy-saving effect, comprehensive economic benefit and so on Or better than the performance of cast-in-situ concrete structure, with good development prospect View.

2. Project Overview

Plot B18 / 02 project in Hualongqiao area, Yuzhong District, Chongqing, Buildings 5 and 6 are assembled with integral residential concrete components 134m high, 39 floors, with a building area of 46221.54 m2 The prefabricated component is the external wall bay window (PC board), and the plane and facade shape is complex. PC The installation height of the plate is 19.8 m (6F) to 112.4 m (35F). Most single piece Large weight 5800 kg, minimum weight of single piece 3500 kg; Maximum geometry Size 4860 mm × 3170 mm × 1000 mm, minimum geometry 43950 mm × 3170 mm × 700 mm. It is currently the highest in China Prefabricated (PCboard) oard) prefabricated building shall be applied, which adopts The former domestic application of more mature internal pouring external hanging structure. 2. Main construction points of PC exterior wall panel (see Figure 1). The installation height of the plate is 19.8 m (6F) to 112.4 m (35F). Most single piece Large weight 5800 kg, minimum weight of single piece 3500 kg; Maximum geometry Size 4860 mm × 3170 mm × 1000 mm, minimum geometry 43950 mm × 3170 mm × 700 mm, It is currently the highest in China Prefabricated (PC board) prefabricated building shall be applied, which adopts The former domestic application of more mature internal pouring external hanging structure. 2. Main construction points of PC exterior wall panel (see Figure 1).

(1) Detailed design of drawings: According to the design and construction drawings, the size, shape and nodes of components shall be large carefully analyze the sample and fully understand the design intent and component ownership [5]. The main issues considered in the drawing deepening of prefabricated components are: a. Lifting points for demolding and turnover in component production; [6] b. Determine the lifting point position during component hoisting; c. Determine the position of temporary support embedded parts; d. Formwork connection mode and position of main structure construction; e. Other required reserved hole positions shall be determined. Typical detailed drawing of PC board (see Figure 2).

(2) Temporary support design

(1) Stress analysis of temporary support Temporary supports are used for component installation, fixing and adjustment [7]. Necessary tools. During the design of temporary support, the component installation process shall be considered Analyze the working conditions of the support, calculate the stress of the support, [8] and set The temporary support of the meter shall meet the use function, easy to operate and maintain The certificate will not be damaged within the service life, and has sufficient strength, stiffness and stability. Stress analysis diagram of PC board under temporary support (see Figure 3).

(2) Before the prefabricated components of the exterior wall are anchored and connected with the cast-in-place structure, their the main stress is caused by the self-weight of prefabricated components and temporary support accessories Overturning force and overturning force caused by wind load; [9] Cast in situ structure Horizontal thrust generated. Based on this, the temporary support system of prefabricated components adopts one piece [9] is set on the side of the prefabricated component, which is embedded with.

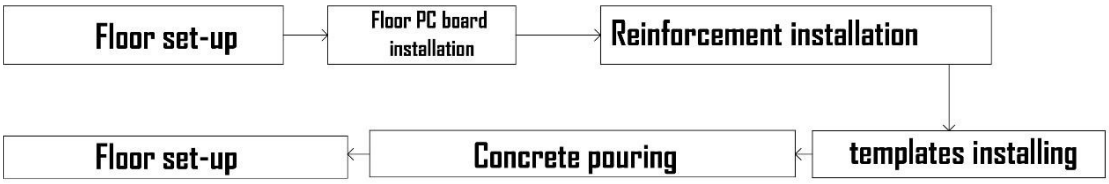

Figure 1. Main construction flow chart of prefabricated buildings

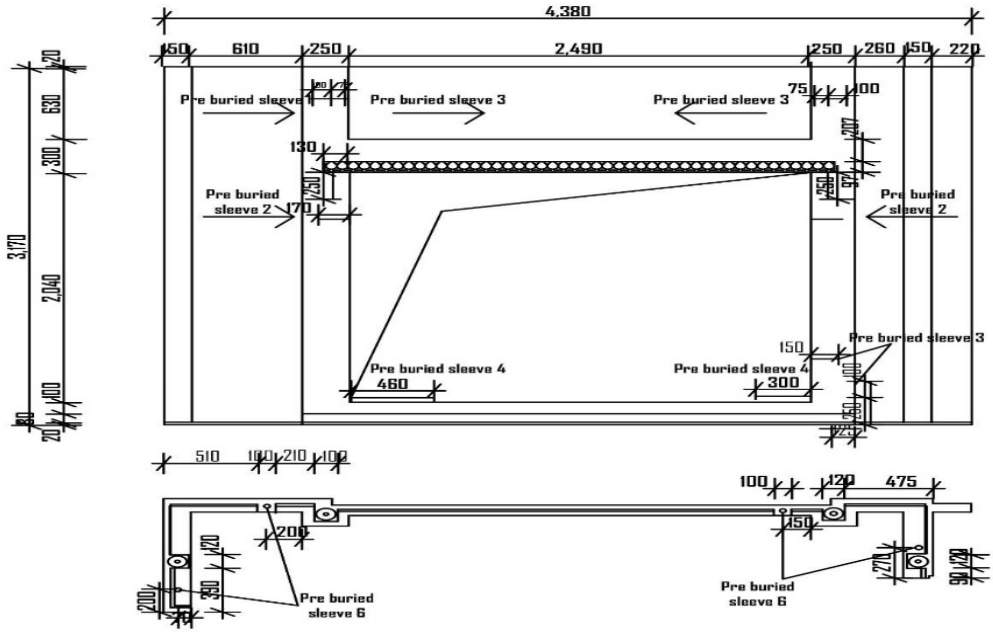

Figure 2. Typical detailed drawing of PC board

The electrode welds were 6 mm in height, and all full welding met the requirements of current national and local quality acceptance specifications: the surfaces of the building blocks were painted with red Dan anti

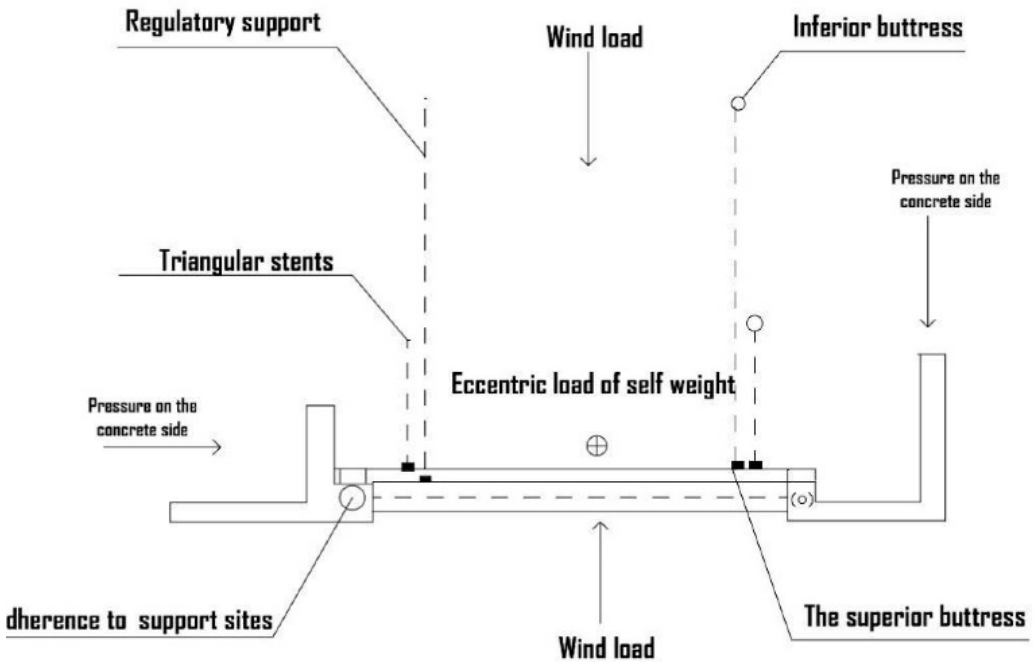

Figure 3. Stress analysis of PC board under temporary support

M16 bolts The connector in the prefabricated member shall be connected and fixed through 2 pieces of 50 mm The top and bottom supports are used to connect the channel steel with the cast-in-situ floor slab Connect to form a triangular stress relationship; The connection between top support and channel steel adopts M16 bolts are used for connection, and M16 bolts are used for connection between bottom support and floor connect. [10] The bottom of the prefabricated component is connected with the cast-in-situ floor slab through 2 (shaped) bottom codes are respectively connected with the joints in prefabricated members with M16 bolts. The barge and cast-in-situ floor slab are connected and fixed. Temporary support system diagram (see Figure 4). All temporary support accessories are made of Q235 steel with steel structure Welding is adopted for the connection of parts. The weld grade is grade II and E43 type is adopted Welding rod, with weld height of 6 mm, fully welded, meeting the current national and international standards Requirements of local quality acceptance Specifications [11]. The surface of components shall be painted with red lead Antirust treatment of 2 ° rust paint.

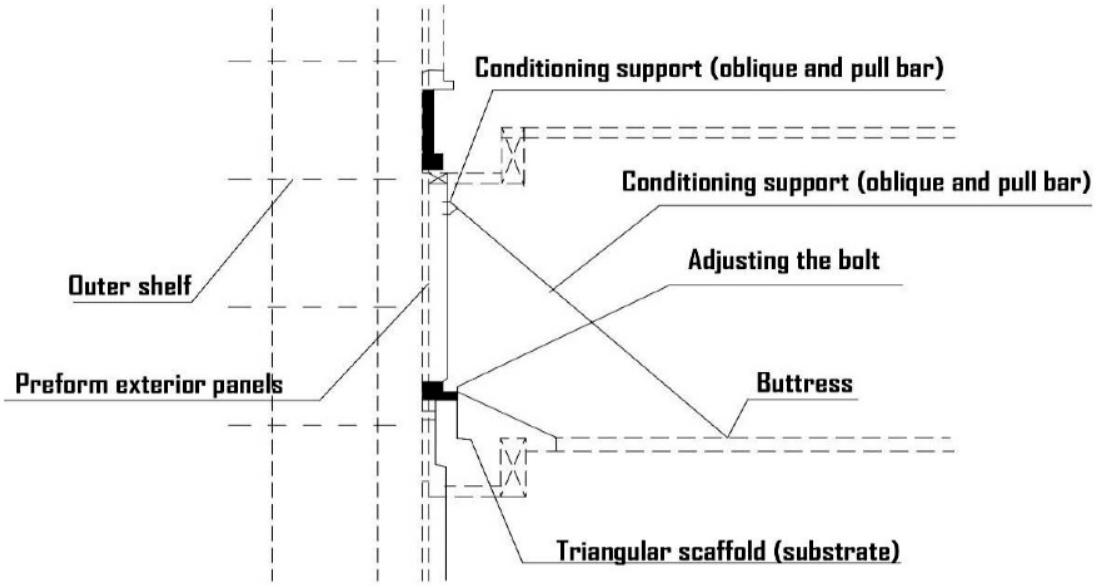

Figure 4. Diagram of the temporary support system

(3) PC board production

(1) Mold making and installation Set shaped steel formwork shall be adopted for formwork, and PC wallboard components shall be determined according to the construction period and PC wallboard components [12]. A total of 9 sets of molds were prepared. Trial assembly shall be carried out after the mould enters the site Quality control of mould size, flatness and convenience of formwork assembly and disassembly The manufacturing point shall be checked and the non-conforming shall be further modified. Until the product quality requirements can be met.

2) Component number for each prefabricated component, it shall be compiled according to the format required by the project. The number is composed of the building number, floor and prefabricated component module.

The number is composed of these three parts, which is easy to clearly and intuitively reflect the prefabricated structure the location of the piece. In addition, the number shall also include the general contractor and the supervisor Signature of unit, production unit and relevant person in charge, project name Production date, etc. For example: t5-6f-pc1-01, where T5 represents the building No., 6F represents the 6th floor, and PC1 represents the component model, 01 represents the batch number of production flow. (4) PC board installation (1) Selection of hoisting machinery The selection of hoisting machinery is determined according to the following conditions: A determined according to the construction schedule; B according to the general building plan, building plan, building height Type of superstructure, basement building structure and setting of hoisting machinery Determination of installation position; C according to the position of lifting machinery, the weight of prefabricated components and the latest Many factors, such as long hoisting and installation distance, determine the safety of hoisting machinery model. Maximum hoisting weight: PC component: G1=5.8 t, slings and slings: G2=0.5 tG=G1+G2=6.3 t Maximum hoisting distance: 43 M. The hoisting equipment of Zoom lion tower crane model tc7035 is selected (see Table 1). Performance parameters of tower crane (tc7035b-16 lifting characteristics) Table 1.

(3) Hoisting site layout

The site area is based on the number of components per floor and the number of on-site reserves the quantity shall be determined to ensure the required for hoisting the site shall be flat without ponding, and the ground shall have a certain bearing capacity Load carrying capacity. C. the components stacked on the site shall be consistent with the main construction roads set a safe distance. For the layout of prefabricated component storage yard, according to the site layout According to the situation and building structure form, one building is set for building 5 and 6 on the site One tc7035 tower crane is installed in each hoisting area. 3) Hoisting process flow (see Figure 5).

4) Component Assembling

The components are stacked vertically to facilitate the mobilization of prefabricated components. For the identification of prefabricated components, each prefabricated component will be numbered independently. [13] In order to minimize the occupied area of the site and eliminate structural damage The components collide with each other during hoisting, and the stacking sequence of components shall be in accordance with the hoisting sequence Arrange and stack in sequence, that is, the components entering the site first, then lifting, and then entering the site Hang first. The stacking sequence of components is: PC8→ PC9→PC7→PC6→PC3→ PC2→ PC1→PC4→PC5.

5) Floor setting out

Plane control: pop up secondary control according to the main control line of the floor Line, pop up the floor component installation line through the primary and secondary control lines. [14] And Pop up the corresponding installation alignment ink line on the manufacturing component (see Figure 6). Elevation control: according to the elevation line of the floor, use a level to level the floor Adjust the top of the regulator to the component installation elevation. Top of level regulator Pay attention to eliminate the accumulated error during installation and achieve accurate positioning (see Figure 7).

6) Installation of PC board temporary support (see Figure 8)

A. Before component hoisting, install back bar and fix and adjust it on the component Upper support of support. The upper support of the brace.

B. Install water stop and horizontal adjusting screw at the base of the component Rod, lower support for fixed adjustment support and triangular bottom code. Horizontal adjustment during screw installation, the elevation shall be controlled with a level according to the floor elevation.

C. After the components are in place, the adjusting support shall be installed first, and then the triangular bottom shall be installed Code. [15]

D. Decoupling.

7) Component lifting in place

Whether the preparations before hoisting are in place is the key to ensure the prefabrication

Table 1. Performance parameters of tower crane

55m arm							
Amplitude M		3.5-20.5	23	25	30	35	40
Lifting capacity	Double rate	8.0					
	Quadruple rate	16.00	14.60	13.30	10.70	8.85	7.49
		43	45	48	50	53	55
Lifting capacity	Double rate	7.61	7.22	6.69	6.38	5.96	5.70
	Quadruple rate	6.83	6.44	5.92	5.60	5.18	4.92

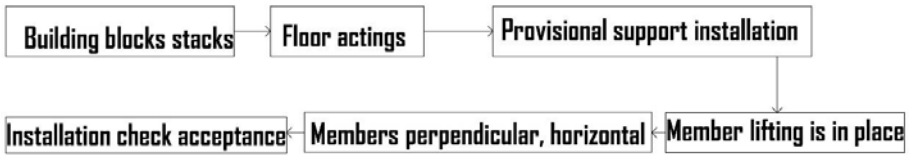

Figure 5. Hoisting process flow charts

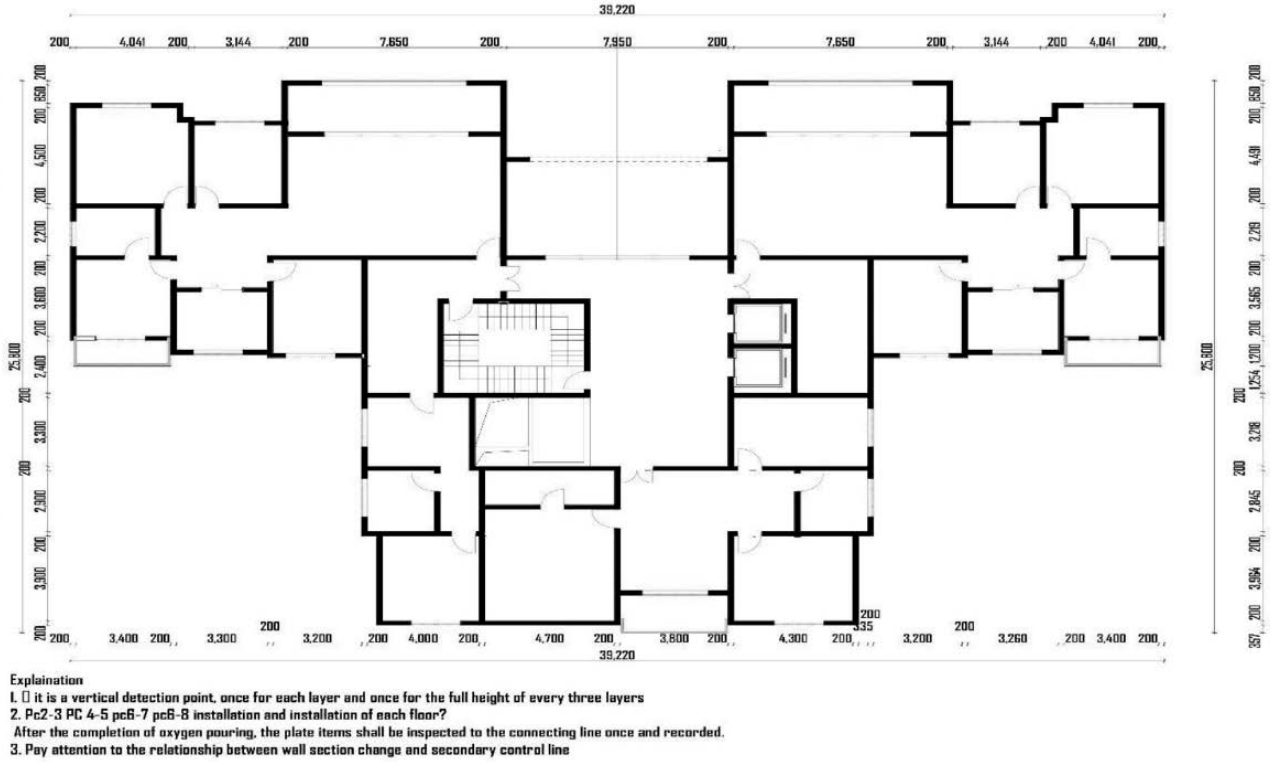

Figure 6. Plane control line diagram pf pc board installation

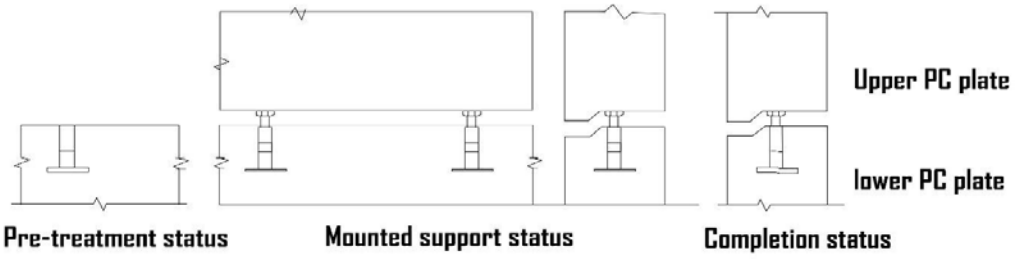

Figure 7. Level regulator

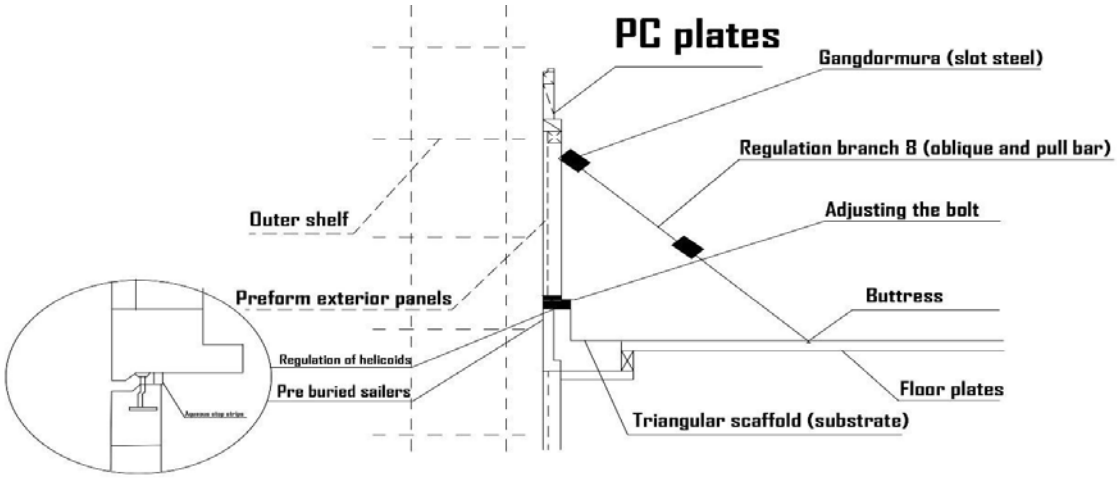

Figure 8. Installation drawing of PC board

As the first step for the smooth installation of components, the following preparations shall be made:

a. Check whether the lifting beam and chain are worn and damaged. If found such potential safety hazards shall be replaced immediately;

b. Check whether communication equipment, tools, installation components and accessories are ready

Complete and intact;

c. Check whether the concrete at the lifting point of prefabricated components is cracked, If the lifting point concrete is found to be broken, corresponding reinforcement measures must be taken As the first step for the smooth installation of components, the following preparations shall be made:

a. Check whether the lifting beam and chain are worn and damaged. If found such potential safety hazards shall be replaced immediately;

b. Check whether communication equipment, tools, installation components and accessories are ready Complete and intact; point concrete is found to be broken, corresponding reinforcement measures must be taken Construction's. Temporary supports for installation shall be set in place. Lifting and positioning steps a. The lifting personnel on the ground hang the lifting beam on the tower with a special lifting chain Hang it on the lifting hook and fasten it on the lifting hook of the prefabricated component with the hook of the lifting chain Nailing's. After the completion of the first step, the hoisting personnel shall the prefabricated component side In a safe position, contact the tower crane operator to lift (off the ground) stably first Tighten the hanging chain, observe whether the connection between the ghost claw and the hanging nail is stable, and the hanging chain is stressed Whether it is uniform; c. Inform the tower crane operator after confirming that the second step is completed and safe The operator slowly lifts the prefabricated components and the tower crane operator during the lifting process The two actions of lifting the operator and rotating the arm shall not be carried out at the same time to ensure safety; d. After the prefabricated components are hoisted to the floor, according to the floor command port Move the prefabricated components slowly to the placement position to approach the placement position when setting, the operator shall straighten and slowly put in place.

8) Component perpendicularity and levelness adjustment After the temporary support is installed, first place the level on the On the prefabricated components, [16] adjust the upper prefabricated components to ensure the upper and lower prefabricated components Leveling of external facade of fabricated components; Then measure with a plumb bob and a level he perpendicularity of prefabricated components can be adjusted by using the adjustable function of inclined support rod adjust the verticality of prefabricated components to meet the requirements of construction deviation. he adjustment of prefabricated components shall ensure that the prefabricated components on the same floor of the facade are watered he width of the horizontal joint is the same, the upper and lower width of the vertical joint of the facade is the same, and the adjacent left align the right exterior elevation component. Tighten the locking of the inclined support after adjustment nut jacking nut of triangular bottom code. Before the concrete pouring of floor structure, the prefabricated components shall be final Check and adjust once. As a result of the impact on prefabricated components during concrete pouring Due to the constant side pressure, the necessary displacement shall be reserved at the upper opening to make it Avoid outward inclination of facade after concrete pouring.

9) Installation inspection and acceptance

The operator shall adjust and correct the levelness and verticality of prefabricated components during straightness, [17] the constructor shall conduct follow-up inspection and confirm that it meets the requirements After, notify the technician of the technical department and the quality officer of the quality department to work with the supervisor manager shall jointly carry out installation acceptance.

3. Quality Acceptance Standard

Refer to code for construction of concrete structures (GB 50666) Code or acceptance of construction quality of concrete structures (GB 50204) And other existing relevant specifications and standards, and formulate the project in combination with the specific reality of the project The acceptance standards for component fabrication and installation shall be submitted to the local government for approval Recognized by the competent construction department as the basis for acceptance. (1) Factory acceptance of prefabricated components shall be inspected and accepted before delivery, mainly for inspection The appearance quality, specification and size of prefabricated components and the requirements for reservation and embedment Whether the quality meets the requirements. The prefabricated components shall be delivered to the products along with the vehicle when entering the site Qualification certificate to prove that the prefabricated components mobilized meet the design drawings Paper, national and local relevant construction acceptance specifications. Installation sheet The supervisor shall conduct re inspection on site. [18]

1) Appearance quality standard

A. whether the component is marked with the production unit, prefabricated component model and manufacturer Production date and quality acceptance mark;

B. There shall be no serious defects in appearance quality;

C. There shall be no exposed reinforcement and honeycomb, pitted surface and that have an impact on the quality Cracks, etc.

2) Specification and dimension standard

A. There shall be no dimensional deviation affecting installation;

B. the size and position of embedded parts and reserved holes shall comply with the design requirements Design gn drawings; Each embedded sleeve needs supporting screws to control the embedded sleeve depth and thread quality inspection

C. whether the lightning protection grounding wire of prefabricated components is set in place.

(2) Installation and acceptance of prefabricated components before the operator adjusts and corrects thinness and verticality of prefabricated components After straightness, the constructor shall conduct follow- up

inspection and confirm that it meets the requirements After, notify the technician of the technical department and the quality officer of the quality department to work with the supervisor The manager shall jointly carry out installation acceptance. Main for acceptance after installation the content is:

1) Check whether the module number of prefabricated components is consistent with the designed elevation The module number is consistent;

2) Check whether all temporary support measures of prefabricated components are in place and whether they are correct Whether it is firm and meets the requirements of detailed drawings;

3) Check whether the horizontal perpendicularity of prefabricated components meets the design requirements requirement. Through the above procedures, the construction party and the supervisor jointly confirm the prefabrication after the component installation has met the design and construction requirements, it shall be accepted.

4. Construction of Relevant Main Structures

(1) External protective scaffold The erection of external scaffold shall not cause any damage to PC components Appearance damage. The external scaffold of the project adopts integral climbing frame. from It is not allowed to make any pre installation on the external wall PC board due to the installation of climbing frame For the purpose of embedding, an attachment frame is set on the floor for the attachment of external climbing frame Fixed with support (see Figure 9).

External wall PC board is a non-stressed structure attached to the main structure the connection is anchored into the main structure through the reserved throwing reinforcement of PC board Middle fixing (see Figure 10). Reinforcement of main vertical structure in connection and Coordination and cooperation shall be paid attention to during binding to avoid the reinforcement and components of the main structure Steel bar collision.

(2) Formwork works: formwork installation, its stability is very important. Due to PC he slab shall be connected with the main vertical structure, so the formwork must be the installation nodes are specially set to ensure that there is no formwork expansion and slurry leakage during concrete pouring. [19] In this project, the sleeve nut of standard 14 is embedded in the PC board, The corresponding split screw fixed template is configured (see Figure 11).

(3) Concrete engineering

In order to minimize the side impact on formwork and PC board during concrete pouring The vertical members of the structure should be poured layer by layer under the pressure. [20] The concrete has been poured Operators shall be arranged for supervision during the process, and problems found shall be handled immediately. (15 Waterproof treatment of PC board connection Waterproof of connection: water stop strip is set inside the cavity of the connection, the outer plug foam rod, and then sealant on the outside side of the foam stick to solve this problem. Eliminate the hidden danger of waterproof [21] (see Figure 12).

5. Conclusion

The project was completed safely, high quality and quickly at the end of September 2013It has become the installation of all components, and its successful implementation is for Chongqing and even the West The application of prefabricated (PC) technology in high-rise residential buildings in southern China provides valuable information [22]. The project practice has accumulated experience and trained for all parties of construction team, and will Promote the development and improvement of PC component supporting market.

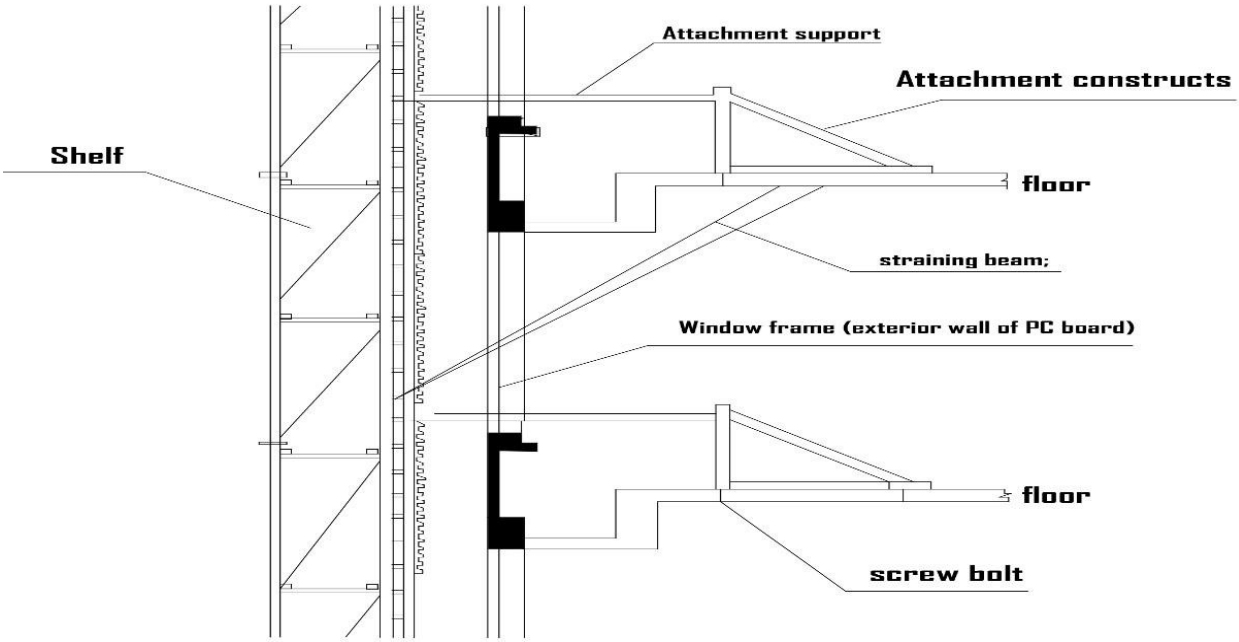

Figure 9. Attachment and installation of climbing frame

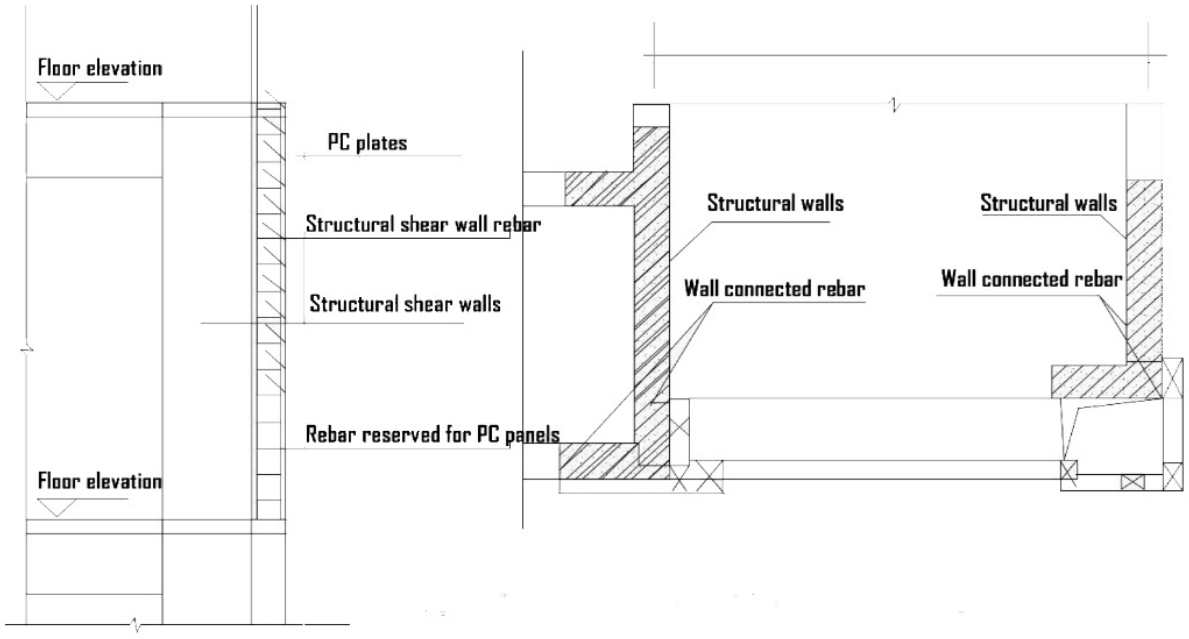

Figure 10. Typical reinforcement installation node

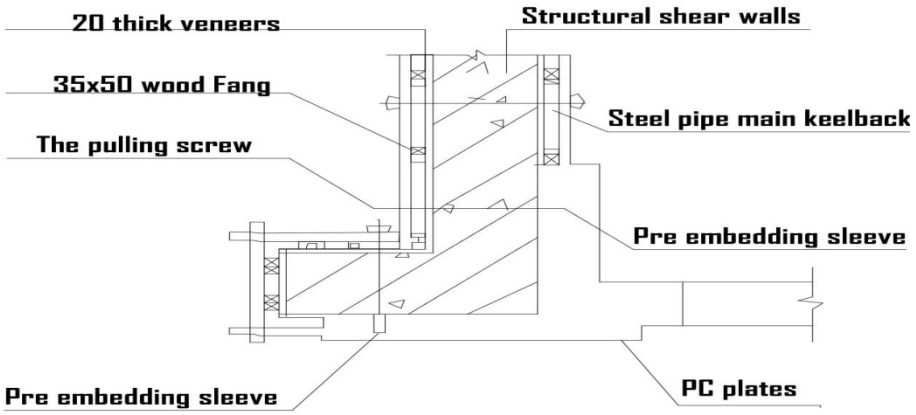

Figure 11. Typical formwork installation

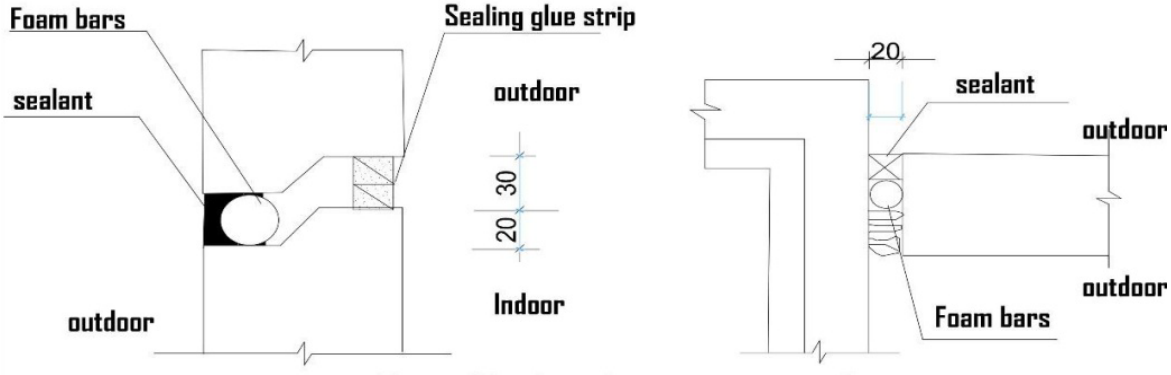

Figure 12. Waterproof of PC board joint

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