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CONSTRUCTION TECHNOLOGY OF LARGE-SPAN CAVITY VENTILATION SHAFT WITH SMALL CLEARANCE ON ROOF

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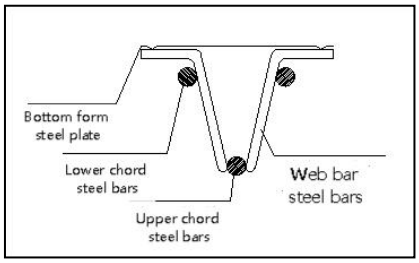
Abstract: The top of the traditional cavity ventilation shaft adopts cast-in-place concrete structure. The formwork system can be removed only after the concrete reaches the strength. If the clearance of the cavity ventilation shaft is only 40cm-70cm, the construction workers cannot carry out construction in the narrow space. Failure to remove the formwork system not only affects the function of the ventilation shaft, but also causes waste of materials. For small-span cavities, the floor decking is constructed and cast in one go. However, in order to solve the fulcrum problem of large-span floor decking, the traditional method is to set concrete structural beams in the cavity as the support of the large-span floor decking. However, this method will affect the ventilation volume of the air shaft due to the horizontal components. In order to ensure that the cavity air shaft does not affect the use function, a construction method of a single floor deck connecting beam for a large-span cavity air shaft with small roof clearance is proposed. The research results show that the construction method of the small clearance and large span cavity wind shaft on the roof can effectively ensure the one-time casting effect of the roof and avoid the risk of roof leakage. This method ensures the use function of the wind shaft and the ventilation volume required by the design; the construction method of the small clearance and large span cavity wind shaft on the roof is convenient for construction, shortens the construction period, reduces costs, is green and sustainable, has reasonable force, is safe and reliable, and can effectively solve the construction difficulties encountered in the small clearance and large span cavity wind shaft; compared with the characteristics of traditional concrete structural beams as large span floor deck support, the cost saving rate of the optimized single floor deck connection beam construction of the small clearance and large span cavity wind shaft on the roof is about 88%, which is worthy of further promotion and application.
Keywords: Single floor deck connection beam; Cavity wind shaft; Floor deck

INTRODUCTION

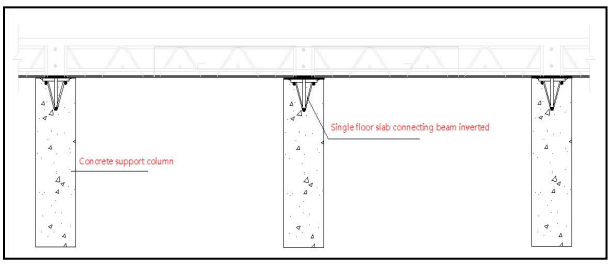
In modern architectural design, the application of large span structures is becoming more and more common, especially when small clearance cavity wind shafts are involved in roofs. In order to solve the construction problem of small clearance cavity air shaft, the floor deck can be cast in one go for small span cavity, but the support point problem of large span floor deck still needs to be overcome. The traditional method is to set concrete beams in the cavity as supports, but this method will affect the ventilation volume of the air shaft [1-3]. For this reason, a single floor deck connecting beam construction method for roof small clearance large span cavity air shaft is proposed, aiming to ensure the ventilation volume and use function of the air shaft and solve the construction problem of roof small clearance large span cavity air shaft.

1 CONSTRUCTION PRINCIPLE OF ROOF SMALL CLEARANCE LARGE SPAN CAVITY AIR SHAFT

As shown in Figure 1, the single floor deck connecting beam construction method for roof small clearance large span cavity air shaft is to use floor deck as the top plate of the air shaft, and the middle support position of the floor deck adopts the vertical component 200mm×200mm concrete column + single floor deck connecting beam inverted. The single floor slab connecting beam has 1 upper chord steel bar and 2 lower chord steel bars, which are connected by web bars and have a bottom formwork steel plate. The use of this single floor slab connecting beam will not affect the ventilation volume of the air shaft; the inverted triangle structure of the single floor slab connecting beam is used to increase the bearing capacity of the connecting beam steel bars to ensure the use function and construction safety of the cavity air shaft.



(a)



(b)

Figure 1 Construction Principle of Large-Span Cavity Air Shaft with Small Clearance on the Roof

2 MAIN PROCESS FLOW

2.1 Drawing Deepening

Before deepening, carefully study the design drawings and related technical requirements to understand the designer's design intent; confirm the key parameters such as the type, material, span, and load of the floor slab; check the main axis position to ensure that the position and size of the floor slab are consistent with the overall structure; design a reasonable connection form according to the different connection parts, refine the connection nodes, and ensure the reliability of the connection and the convenience of construction.

2.2 Concrete Column Construction

(1) Rebar binding: Before tying the reinforcement, the reinforcement should be positioned to ensure the accurate position of the reinforcement. The specifications, quantity and spacing of the reinforcement should be checked according to the drawings, and the reinforcement should be tied according to the design requirements to ensure that the column reinforcement is vertical and the stirrups are straight. After the column reinforcement is tied, the single floor deck reinforcement of the connecting beam is anchored into the column reinforcement (Note: the bottom formwork steel plate of the single floor deck is opened within the column range).
(2) Formwork reinforcement: The column formwork should be installed flat and vertical, the joints should be tight, and no mortar leakage should be allowed. The support of the formwork should be stable, and the support spacing should meet the requirements of the specifications. Back ribs and other reinforcement measures should be used to ensure the overall stability of the formwork.
(3) Concrete pouring: The mix ratio of concrete should be determined according to the design requirements and site conditions to ensure that the slump of the concrete meets the construction requirements. Concrete should be poured from the bottom of the column in layers. The thickness of each layer should not be too large to avoid concrete segregation and ensure dense pouring. After pouring, it should be maintained in time to prevent concrete cracks.

2.3 Construction of ventilation shaft wall

(1) Rebar binding: Process the rebar according to the requirements of the drawings, including cutting, bending, etc., to ensure compliance with the specifications. The rebar should be cleaned and the vertical rebar (vertical rebar) should be tied first, followed by the transverse rebar (horizontal rebar). The vertical rebar should be vertical and the horizontal rebar should be horizontal. Ensure that the rebar mesh is flat and straight. The lap length and anchorage length of the rebar should meet the design specifications.
(2) Angle iron welding: Clean the welding part before welding the angle iron to the shear wall rebar, select the appropriate welding material, select the appropriate welding method according to the specifications and materials of the angle iron and rebar, ensure that the welding current, voltage and other parameters meet the specifications, and the welding sequence should be from the center to both sides to reduce welding deformation and ensure welding quality.
(3) Formwork reinforcement: The formwork should be installed according to the layout position to ensure verticality and flatness. The formwork joints should be tight and no slurry should leak.

2.4 Floor Decking Laying

(1) Floor decking should be laid in the direction and sequence required by the design, starting from one end and gradually laying towards the other end to ensure the continuity and stability of the floor decking.
(2) The connection between floor decking should be tight to avoid gaps. During the laying process, the horizontality and verticality of the floor decking should be checked regularly to ensure that it meets the design requirements. Use pads or adjusters to make fine adjustments to ensure the flatness of the floor decking.
(3) The welding speed and temperature should be strictly controlled at the connection between the floor decking and the single floor decking of the connecting beam and the connection of the shear wall angle steel to avoid overheating and welding defects. After welding, the welding quality should be checked.

2.5 Concrete Pouring

(1) Before pouring, a slump test should be carried out to ensure that the concrete quality meets the requirements. The wall should be poured first, and then the slab. During the pouring process, attention should be paid to the vibration of the concrete to ensure the compactness of the concrete after pouring.
(2) After pouring, it should be covered in time and maintained according to the standards. Avoid working on the concrete before the concrete strength reaches the required level to prevent footprints.

3 QUALITY ASSURANCE MEASURES

3.1 Quality Control Standards

(1) It is strictly forbidden to directly lift the floor decking with wire ropes during loading, unloading and installation. There should be enough fulcrums for transportation and stacking to prevent deformation.
(2) The bent and deformed floor decking should be corrected before laying.
(3) Cutting and hole cutting should be done with a plasma cutter. It is strictly forbidden to cut with oxygen-acetylene flame. The surroundings of large holes should be reinforced.
(4) The floor decking should be installed, straightened, compacted and spot welded according to the drawings.
(5) After the floor decking is laid, straightened and fixed, it should be locked with a locking machine in time to prevent the corrugated board from biting and separating due to the stacking of construction materials and personnel traffic.
(6) After installation, clean up the construction waste in time, and the cut scraps should be collected on the ground and stacked together.

3.2 Quality Assurance Measures

(1) Strengthen technical management and conscientiously implement national regulations, standards, operating procedures and various management systems.
(2) Establish a complete quality management system with the project manager and project leader in charge, and set up capable and experienced professional quality inspectors to conduct quality inspection supervision and technical guidance for each process.
(3) Strictly implement quality target management, closely link quality with job income, and implement the quality target responsibility system. The technical leader is fully responsible for quality, and the quality inspector has the veto power over construction quality, so that quality management is always under control.
(4) The project department should hold a quality meeting for on-site production every day, conduct a comprehensive inspection of the project every week, and carry out three analysis activities, namely: analyze the quality problems, analyze the causes of quality problems, analyze the measures to be taken, and find out the problems and rectify them in time.

4 ANALYSIS OF THE CONSTRUCTION ADVANTAGES OF LARGE-SPAN CAVITY AIR SHAFTS WITH SMALL CLEARANCE ON ROOFS

The construction method of single floor slab connecting beam for large-span cavity air shafts with small clearance on roofs can effectively meet the functional requirements of the air shaft, ensure the structural safety of the roof, and save construction costs to a certain extent. For other roofs with small clearance and large-span cavity air shafts
The characteristics of using traditional concrete structural beams as large-span floor slab supports are:
(1) Easy to construct and shorten construction period: Single floor slab connecting beams are prefabricated floor slabs. Compared with concrete structures, single floor slab connecting beams only need to be installed on site, without the need for formwork erection and concrete pouring. The construction is convenient and greatly shortens the construction period.
(2) Reduce costs and be green and sustainable: Compared with concrete horizontal components, this construction method can reduce construction costs in terms of labor; in terms of materials, it avoids the waste of concrete and formwork materials, thereby protecting the environment and achieving green development.
(3) Reasonable force, safe and reliable: The force of a single floor slab connecting beam as a large-span floor slab support is reasonable, which can effectively ensure safety during construction.
According to cost calculation, the cost of using concrete beams at the support point of the large-span floor slab is 1,770 yuan per unit of material and labor costs, while the cost of using a single floor slab connecting beam is 200 yuan per unit of material and labor costs, which can save 1,570 yuan, and the saving rate is about 88%.

5 ENGINEERING APPLICATION

The second phase of the Huai'an Jianhua Jiulong Peninsula project is located at Jianhua Guanyuan, southwest of the intersection of Cheng'en Avenue and Shanyang Avenue in Huai'an City, Jiangsu Province. The total construction area of the project is 186,051.04 square meters, including 5 high-rise residential buildings, 3 of which are 33 stories high and

97.8 meters high, 2 are 34 stories high and 99.9 meters high, 2 power distribution rooms and garbage rooms, 1 commercial 3-story commercial building and commercial supporting underground garage. The engineering structure is a frame shear structure. The project adopts the construction method of single floor slab connecting beam for small clearance and large span cavity air shaft on the roof, which ensures the use function of the roof air shaft. Under the premise of ensuring quality, the comprehensive benefits have been recognized by relevant units.

6 CONCLUSION

This paper proposes a construction method of single floor slab connecting beam for small clearance and large span cavity air shaft on the roof, and uses theoretical analysis method combined with on-site engineering practice to clarify the construction principle, construction process, operation points, quality assurance measures and method advantages of this method. The main conclusions are as follows:

(1) The construction method of small clearance and large span cavity air shaft on the roof can effectively ensure the one-time casting effect of the roof and avoid the risk of roof leakage. This method ensures the use function of the air shaft and ensures the ventilation volume required by the design.

(2) The construction method of small clearance and large span cavity air shaft on the roof is easy to construct, shortens the construction period, reduces costs, is green and sustainable, has reasonable force, is safe and reliable, and can effectively solve the construction difficulties encountered in small clearance and large span cavity air shaft.

(3) Compared with the characteristics of traditional concrete structural beams as large-span floor deck supports, the cost saving rate of the optimized single floor deck connection beam construction for small roof clearance and large-span cavity air shaft is about 88%, which is worthy of further promotion and application.

COMPETING INTERESTS

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

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