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Key Construction Techniques for Transfer Beams of Large-Span and Ultra Large Cross-Section Structures

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Abstract

With the development of China's construction industry, various new construction technologies continue to emerge. Steel reinforced concrete transfer beams are widely used with many advantages. However, large-span and ultra large cross-section steel reinforced concrete transfer beams are an extremely complex system engineering, and the construction difficulty is relatively high. This article combines specific engineering examples to introduce the key construction techniques of large-span and ultra large section steel-concrete transfer beams, providing construction experience for such projects.

Keywords

Extra large cross-section; Conversion beam; Stiffening steel frame beam.

1. INTRODUCTION

Steel reinforced concrete is a type of structure that embeds steel into reinforced concrete. It has the advantages of greater bearing capacity, greater stiffness, and better seismic performance compared to traditional reinforced concrete structures. It can also reduce the cross-section of components, increase usage space, save formwork and support; Compared with steel structures, it has the advantages of good fire resistance, good local and overall stability of the structure, and saving steel. In recent years, with the development of the economy, the number of subway cover projects has gradually increased, leading to more and more steel reinforced concrete transfer beams being applied to large-span subway cover transfer structures. However, due to its different construction techniques from ordinary concrete structures, there are certain construction difficulties. Next, we will discuss the key construction techniques for transfer beams in large-span and ultra large cross-section structures based on engineering examples

2. ENGINEERING BACKGROUND INFORMATION

A certain project is located above the completed Metro Line 1. As Line 1 is an operating line, a structural conversion method is adopted. By setting up frame columns (with drilled cast-in-place piles as the foundation) at the safe construction distance of the subway, and setting up large section conversion beams at the basement floor, the load transmitted by the frame columns above the subway is borne. The connection with the subway is non conformal, reducing the vibration and noise impact of subway operation on the project, Effectively meeting the demand for constructing a central corridor above the subway. The maximum cross-sectional size of the conversion beam is 3500mm × 1800mm, minimum 1200mm × 900mm, concrete strength grade C40, floor thickness 200mm, concrete strength grade C40. At the same time, the excavation of the foundation pit should adopt a segmented and partitioned jumping excavation

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method to analyze the impact of subway deformation and settlement, ensuring the safe operation of the subway.

3. CONVERSION BEAM CONSTRUCTION

Due to the large cross-sectional size of the steel transfer beam structure, it is necessary to develop a reasonable construction sequence and scientifically feasible construction methods to avoid impact disturbance to the subway tunnel caused by the construction of the transfer beam, in order to ensure the smooth completion of the steel transfer beam structure construction.

3.1. Construction process flow

Considering the construction difficulties of steel-concrete conversion beams, literature on the construction methods of steel-concrete conversion beams at home and abroad was consulted. The construction process of steel-concrete conversion beams was formulated, and corresponding construction plans were formulated. The 1:1 steel bar model of the steel-concrete beam node and the 1:1 steel bar model were completed. Afterwards, the concrete mix ratio design and research of steel-concrete conversion beams were carried out to determine the final concrete mix ratio. The construction process of the conversion beam is as follows: setting up steel pipe high support formwork and operating platform - installing beam bottom formwork - pre welding cow leg steel bars - installing box beam horse stool base - installing the first section (lower section) of the inner and outer stirrups of the beam - installing bottom steel bars - installing horse stool support top steel pipe - lifting the box beam - correcting and welding the box beam - reserving steel bars for secondary beams intersecting with the box beam - pouring concrete for the box beam - welding the box beam cover plate - installing the inner part The second section (upper section) of the external reinforcement, as well as the face and waist reinforcement, are welded with tension formwork, installed with beam side formwork, installed with longitudinal reinforcement for the conversion steel column on the steel beam, reserved grouting holes, and poured with concrete for the conversion beam.

3.2. Hoisting of steel beams

The conversion beam in this project is a large-section stiffened steel beam, mainly made of H-shaped steel. During the installation process, temporary connections should be made first, and at the same time, a wind rope should be set up to stabilize it. Then, a total station or level should be used for measurement and correction. After passing the measurement, the welding work between the first section of the transfer beam and the bracket should begin. Weld inspection work carried out after the lifting of the conversion beam is completed. Precautions during the lifting process: Special lifting tools should be used for the lifting of steel beams, with two points tied. During the lifting process, it is necessary to ensure that the steel beams remain horizontal. After the steel beam is placed on the cushion layer, it is temporarily fixed to avoid accidents. The lifting of the steel beam is carried out using a car crane and matched with a manual hoist in place. During installation, temporary connections should also be made first, and deviations should be corrected using a manual hoist.

Node connection, the connection between steel beams and steel columns adopts plate welding, and the web plate adopts welding or bolts. During welding, the distance between columns must be tracked and corrected, especially the shrinkage value of node welding. When docking the beams, use a jack with a top welded channel steel to adjust the two sections of the beams in the docking area, and use a level to horizontally adjust this section of the beams.

3.3. Reinforcement installation

The inner and outer hoops of the steel reinforced concrete conversion beam are 3m high, and it is difficult to bend the hoops into the steel frame during on-site construction, making it

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difficult to install them using conventional hoops. Therefore, the hoop reinforcement of the conversion beam adopts the technology of irregular hoop and straight thread connection of hoop reinforcement, that is, the hoop reinforcement is divided into upper and lower irregular hoops, and the entire hoop reinforcement is formed by welding the two parts or connecting them with straight thread sleeves to avoid the overall bending of the hoop reinforcement. At this point, the installation of steel bars and the lifting of steel ribs can be carried out synchronously. The construction sequence is as follows: layout of hoop reinforcement position - installation of the first section (lower section) of hoop reinforcement - laying of bottom reinforcement - lifting of steel box beams - reserved construction of surface reinforcement and upper column reinforcement - installation of the second section (upper section) of hoop reinforcement (welding and straight thread connection - waist reinforcement construction.

3.4. Installation of beam side formwork

After the installation of the converted steel beam is completed, reinforce the formwork on both sides. The beam section of this project is relatively large. To ensure the quality of concrete pouring, multiple tension screws need to be set up for tensioning. Due to the presence of steel ribs in the transfer beam, reinforcement is carried out by welding the tension screws onto the steel beam. The tension screw is bent into an L-shape and welded to the web plate of the steel frame beam (double-sided welding, welding length>5d), with a longitudinal and transverse spacing of 400mm. The side formwork of the beam is made of 18mm thick plywood, and the back ridge of the beam is made of 50mm $\times$ Fix the 100mm wooden square with M16 split bolts using standard steel pipes. Backridge spacing of 500mm, bolt spacing: horizontal 500mm, vertical 400mm.

3.5. Beam concrete construction

1) Due to the large amount of steel reinforcement in the conversion beam, the amount of concrete pouring is large. Adopting the construction method of pouring beam nodes first, pouring slabs later, and combining layered pouring.

2) The pouring of concrete is carried out symmetrically from the middle to both sides to ensure the stability of the support system. The conversion of beam and slab concrete adopts the principle of "thin layer pouring, gradual progress".

3) In areas with dense steel bars, vibration rods with a diameter of 30mm are used, and the spacing between the insertion points of the vibration rods is $\leqslant$ 300mm. The operation of the vibrating rod should be fast insertion and slow extraction, straight up and straight down, arranged according to the position of the plum blossom point.

4) When pouring and compacting the upper layer of concrete, the depth of insertion into the lower layer of concrete should be $\geqslant$ 50mm. The vibration time at each point should be based on the appearance of mortar on the surface of the concrete and no more bubbles. The vibration sequence of concrete is to start from the bottom layer of the pouring layer and move up layer by layer to ensure the construction quality between the layers of concrete.

4. CONCLUSION

In summary, the functions of modern buildings are becoming increasingly complex. As an important structural part of public buildings, the construction of super large section transfer beams is difficult. Therefore, in order to ensure the construction quality of transfer beams and promote the construction of modern buildings, relevant transfer beam construction personnel should attach great importance to the application of this technology and continuously improve and perfect it.

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