Old Building Structure Reinforcement Design and Construction

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ABSTRACT

While making the reinforcement design, the means of surface cast-in-situ and carbon cloth are applied to strengthen the floor plates; the additional beam is applied to reduce the span of floor plates and to transmit the new load of the floor plates; the technology of magnifying cross section is applied to fulfill the request of the load of the frame beam; and the reinforcement technology of wrapping pillar with steel is applied to satisfy the request of the vertical load of the structural column. Meanwhile this paper briefly states the construction points of different reinforcement technology. Through the comprehensive application of reinforcement technology, we will explore a simple and feasible reinforcement method for the transformation of schools’ old buildings in the future.¹

KEYWORDS

The Reinforcement Technology of Magnifying Cross Section; The Reinforcement Technology of Wrapping Pillar With Steel; The Reinforcement Technology By Carbon Cloth; The Reinforcement Technology By Additional Beam; The Points of Construction Technology

INTRODUCTION

With the increasing level of economic development in our country, people's demands for environment and life are also increasing. In line with the people

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centered development thought, the government has also put forward the concept of safe development and green development. Change the past major demolition and construction, reasonable development and make full use of the original structure of resource intensive, the construction of harmonious campus, has very important significance to realize the sustainable development.

GENERAL SITUATION OF ENGINEERING

Our school has a history of sixty years of college level occupation school, Forest Park area is located in the Wuxi city planning, campus buildings building height, architectural appearance, external expansion have been strictly limited. Therefore, in the process of campus reconstruction, in order to meet the overall planning requirements of Wuxi, an original building should be reinforced to meet the new use function. The project belongs to the pilot project, one can make full use of existing teaching resources, reduce the amount of demolition, demolition waste reduction, cost saving; two is the integrated use of a variety of reinforcement techniques, we can explore a new way for the reinforcement of old buildings in the future.

REINFORCEMENT DESIGN

Design Load

Because the function of adjustment, according to the design requirements, will increase the original floor live load from the 2KN/ to 5KN/ square meters.

The original structure of the floor dead load: plate weight: 1.9 KN/ square meters
The surface layer and the foundation: 22+0.03 * 0.05 * 20 = 1.7 KN/ M
Plan: 3.6 x 1.35 = 4.86 KN/ M
Live load: 2 x 1.4 = 2.8 KN/ M
The structure of the floor dead load: plate weight: 1.9 KN/ square meters
The surface layer and the foundation: 20+0.03 * 0.03 * 20 = 1.2 KN/ M
Laminated layer: 0.05 x 25 = 1.25 KN/ M
Plan: 4.35 x 1.2 = 5.22 KN/ M
Live load: 5 x 1.4 = 7 KN/ M

Reinforcement Design Scheme

1) The reinforcement design scheme of floor slab should adopt carbon cloth reinforcement and additional beam reinforcement technology. Because the original floor panel for prefabricated panels, poor integrity and the new load is larger, so the original floor surface to surface layer of cement mortar to eradicate, in the structure on the surface layer of new 50 mm thick concrete composite reinforcement layer, the
laminated layer on one hand can increase the overall stiffness of the floor, on the other hand it can improve the bearing capacity of precast slab. At the same time, the carbon fiber cloth is pasted between the bottom seams of the precast plate to reinforce the steel reinforcement at the bottom of the plate so as to enhance the bearing capacity of the precast plate itself. The span of precast slab is shortened by additional beam, so that the bearing capacity and safety factor of secondary strengthening floor can meet the normal use requirement.

A transverse steel beam A is added to the bottom of the original prefabricated perforated plate, the original plate span is shortened from 4.5m to 2.25m, and the span is calculated to reduce the bending moment that the rear plate can bear.

The original width of 500 mm each plate under load: \((4.86+2.8) \times 0.5 = 3.83\) KN/ M

The span is 4.5 m, and the mid span bending moment is: \(M = 0.125 \times 3.83 \times 4.5 \times 4.5 = 9.67\) KN. M

After adding the steel beam A, each plate bears the load: \((5.22+7.0) \times 0.5 = 6.11\) KN/ M

The span is 2.25 m, and the mid span bending moment is \(m = 0.125 \times 6.11 \times 2.25 \times 2.25 = 3.87\) KN. m<9.67 KN/m

It is proved that adding steel beam A in the plate as the fulcrum is feasible.

Steel A load is not a direct role in the wall between the windows on the lintel, intends to use the new three beams along the longitudinal supporting beam load B as A. The steel beam B uniformly loads the load on both sides of the gable and KJ-1 frame beam.

Because the geological condition of the original building is better, the foundation of the original load-bearing gable is equipped with the ground beam, and the strengthening of the KJ-1 frame beam is only needed without the reinforcement of the load-bearing gable. The layout scheme of A and B beams is shown below.
The calculation diagram of A and B of steel beam is as follows. According to the diagram, the section of steel beam can be calculated.

2) The KJ-1 beam can be strengthened by enlarging section method according to the new concentrated load. Due to limited field conditions, Liang Kuan cannot increase, so only increase the amount of beam reinforcement calculation. According to the KJ-1 beam by trying to add 50 mm thick concrete beams in the upper part, and the layout of new working reinforcement, lower added 100~150 thick concrete, and the layout of new reinforcement arrangement, new force tendon welding with stirrups. The calculation process is omitted.

3) The increase of vertical load is solved by column encased steel reinforcement technology. Is the angle, high strength steel plate perfusion inorganic cementitious material with the original concrete column is reliably connected into a whole, in the new angle section to improve the bearing capacity of the columns at the same time, but also because of confinement effects of new steel plate hoop, the original
concrete columns have three axial stress state is good, and the bearing capacity of columns increased greatly.

**REINFORCEMENT CONSTRUCTION TECHNOLOGY DESIGN**

The order of the first column beam reinforcement plate and general requirements. That is, column reinforced steel construction, Liang Zenggao reinforcement construction, carbon cloth reinforcement construction, additional beam reinforcement construction, floor slab casting.

**Key Points of Construction Technology of Column Encased Steel Reinforcement**

1) The surface plaster concrete column removal and grind, grind small rounded corners, with a wire brush off the floating powder, with a hair dryer blowing.
2) The angle of inner surface rust, and cleaning with xylene, clamping, sectional staggered weld, sealed with epoxy resin mortar will be around steel, leaving holes.
3) Paste the grouting mouth in the lower part, the distance is 2 ~ 3m.
4) Until after the cement grouting nozzle, at the pressure of 0.2 to 0.4Mpa epoxy resin grouting slurry from the nozzle is pressed into the.
5) When the exhaust hole appears slurry, stop pressure, epoxy mortar plugging hole, and then lower pressure to maintain more than 10min stop grouting, after grouting no longer hammering, moving, welding of steel.

6) Special attention should be paid to the welding of steel corbel at the transition between the column and the beam to help the frame beam bear partial shear force.

Key Points of Beam Reinforcement Construction Technology

1) Unloading before reinforcement. To remove all kinds of live loads on the floor, and to chisel out the floor pavement, reduce the dead load, control the construction load, make the old and new structure as common as possible, solve the new part of the stress lag problem.

2) The treatment of the connecting surface. To clear the site of the original defects of compacting concrete, to cut all weathered layer, loose rust and oil carbonization layer, and the surface roughening or a trench. The groove depth should not be less than 6mm, or the 200mm spacing is greater than the stirrup spacing, concrete edges wrapped should be destroyed, and should be removed from the floating debris, dust. The original concrete surface should be washed clean. Before pouring concrete, the surface of the original concrete should keep moisture, dry the remaining water, brush the cement paste or brush the interface treatment agent to deal with.

3) Reinforcement construction. The first set of steel template, in the layout, the original and the new stress bar should be derusted in force, the steel before welding should be taken to support measures, and by the root partition layered section welding, to minimize the influence of welding heat of steel.

4) Concrete construction. Using shotcrete pouring process, after pouring, according to the maintenance requirements for maintenance.

Key Points of Plate Carbon Cloth Reinforcement Construction Technology

1) Cleaning work. Remove the joint between the plaster layer to prefabricated plate, use compressed air to clean the surface dust, remove the surface of the concrete laitance impurities such as concrete grinder, sandpaper and other equipment components of the base of the concrete grinding formation, with acetone will need to paste the place clean.

2) Primer. JGN-P glue a and B group according to the weight of 3:1 said, put in a clean uniform mixing container, with scraper evenly on the precast slab surface net, after the glue after curing the next working procedure.

3) Leveling. The concave part of the concrete surface is filled with repair glue (JGN-C glue mixed with two times powder), and the place with high difference is filled with mending glue, so as to reduce the height difference.

4) Pasting carbon fiber cloth. JGN-C glue a and B group according to 3:1 weight weighed, placed evenly mixed in clean containers, with rubber scraper will be evenly scraping the bottom glue to paste the carbon fiber cloth, then the CFRP has
been cut out according to the design requirements in the design of the site, and then use special roller along the carbon fiber cloth force direction rolling back and forth, out of the bubble. When the finger touches drying, the second carbon fiber cloth can be pasted. The method is the same as the first one. The lap length of carbon fiber cloth is generally 100mm, and the end is fixed with transverse carbon fiber cloth.

5) Two carbon fiber cloth paste finished, to be pressed after drying, and then scrape a layer of JGN-C surface adhesive, rolling back and forth, so that the glue fully penetrated into the carbon fiber cloth.

6) When the surface glue is touched and dried, the surface is made of a cement mortar protective layer.

**Additional Beam Reinforcement Construction Technology Points**

1) According to the design requirements, A and B beam positioning. Clear the plaster layer at the additional beam and polish it.

2) Welding connection preserved steel plate in A, B beam and ring beam and frame beam.

3) According to the design requirements, A, B beam rust, epoxy resin paste to the prefabricated plate, joint welded to the reserved steel plate, pay attention to grasp the size.

**CONCLUSIONS**

This project adopts the reinforcement technology of enlarging section, the technique of steel reinforced by column, the technique of strengthening with carbon cloth and the technique of strengthening with additional beam, etc., and solves the problem of strengthening the building better. As an exploratory strengthening project, the application of various reinforcement techniques provides a good reference for the reinforcement of some old buildings.

**REFERENCES**