

Research on Construction Technology of Light Cast-in-place Floor Slab of Built-in Special Y-shaped Steel Plates

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Abstract. The existing Cast-in-place reinforced concrete floor slab still has some shortcomings as the cracks caused by shrinkage, temperature difference and settlement of the Cast-in-place concrete are difficult to control, a large amount of on-site wet operation leads to noise and environmental pollution, and the self weight of the Cast-in-place concrete floor slab is big, thereby bringing a lot of adverse influences. This paper innovates on the conventional Cast-in-place reinforced concrete, establishes the construction technology of the light Cast-in-place floor slab of built-in special Y-shaped steel plates, and introduces technology principle, application scope, technological features, technology process and operating points of the technology.

Introduction

The floor slab structure system directly bears all sorts of dead loads and live load acted thereon and transfers the load to vertical bearing structure components as beams and columns. The floor slab shall have sufficient horizontal stiffness and integrity within its own plane and shall be reliably connected with the vertical components, so as to ensure the stability of the vertical components and transfer the horizontal force.

Cao Jiali[1] et al. have analyzed the parameter optimization problem of the single-layer isolated floor slab and proved that the bigger the damping ratio of the main structure, the bigger is the optimized damping ratio and the smaller is the optimized frequency; Yan Hongxia[2] et al. have utilized the finite element software to carry out the numerical simulation of three-dimensional dynamic elastoplastic time intervals on a certain typical “Strong Beam and Weak Pillar” framework, discussed the influence of the Cast-in-place floor slab on the seismic performance of the framework structure and the evaluation of the effective flange of the lower beam end under the action of hogging moment, and recommended adopting the range of 6 times of floor slab width; He Xiping[3] et al. have analyzed the effect of using carbon fiber cloth to reinforce a certain cracked Cast-in-place floor slab and verified the feasibility of using the carbon fiber cloth to reinforce the Cast-in-place floor slab by comparing the result of theoretical calculation with the result of the finite element software. Guo Yiqing[4] et al. have put forward an energy-saving light composite floor slab, tested the bearing capacity thereof, so as to provide evidence for the establishment of related regulations; Zhang Ailin[5] et al. have put forward a novel assembled steel-structure light composite floor slab, namely a novel steel bar truss foamed cement sandwich composite floor slab utilizing novel material foamed cement, so as to make the floor slab components lighter, more effective and better thermal insulating, and the thermal and sound insulation thereof are better than that of the steel bar truss concrete floor slab.

Technology Principle and Application Scope

(1) Technology Principle

The technology principle of the construction technology of the light Cast-in-place floor slab of built-in special Y-shaped steel plates is that according to the design requirements, a light Cast-in-place skeleton, formed by connecting horizontal and longitudinal special Y-shaped steel plates, is arranged in the Cast-in-place reinforced concrete floor slab; after the formwork is set up, the main reinforcement of the floor slab is bound, the bottom parts of the horizontal and longitudinal special Y-shaped steel plates are welded with the distributing bars at the lower layer of the Cast-in-place floor slab; and during the concrete casting, the layered continuous casting is adopted, namely the ordinary concrete at the bottom, the foamed concrete in the light Cast-in-place skeleton and the floor slab concrete at the top are casted continuously in sequence, and the concrete at the upper part shall be completely cast before the initial setting of the concrete at the lower part.

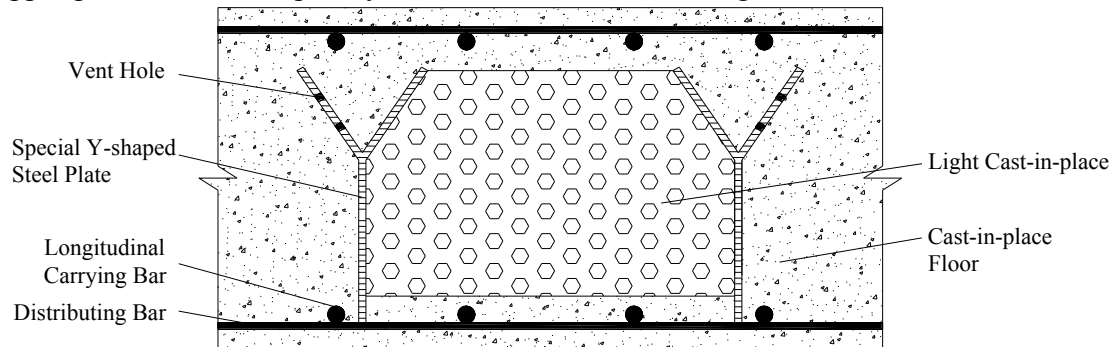


Fig. 1 Structure of the Light Cast-in-place Floor slab of Built-in Special Y-shaped Steel Plates

(2) Application Scope

The technology is applicable to the construction of the Cast-in-place reinforced concrete floor slab adopting the light Cast-in-place floor slab of built-in special Y-shaped steel plates in the technology.

Technological Features

The technology has the following characteristics:

(1) During the construction of the light Cast-in-place floor slab of built-in special Y-shaped steel plates, the layered continuous casting is adopted, namely the ordinary concrete at the bottom, the foamed concrete in the light Cast-in-place skeleton and the floor slab concrete at the top are continuously casted in sequence. The concrete at the upper part is completely casted before the initial setting of the concrete at the lower part, so as to improve the integrity of the light Cast-in-place and the Cast-in-place floor slab.

(2) The light Cast-in-place floor slab of built-in special Y-shaped steel plates consists of multiple light Cast-in-place cores and a Cast-in-place floor slab, and can reduce the floor slab self-weight, has smaller weight, reduces the loads of other structural components (as beam, column and foundation), prolongs the service life of the building and has high thermal insulation performance compared with the conventional technology.

(3) The bottom parts of the longitudinal and horizontal special Y-shaped steel plates are welded with the distributing bars at the lower layer of the Cast-in-place floor slab; as the special Y-shaped steel plates have excellent flexural behavior, the integral seismic resistance is excellent and the structural deformation is small.

Construction Technology Process and Operating Points

(1) Materials

The foamed concrete is formed by adopting the foaming system of the foaming machine to enable the foaming agent to mechanically and sufficiently foam, evenly mixing the foam and the cement paste and form closed foam holes inside the concrete, so as to lighten the concrete, and the dry bulk density of the foamed concrete is 1/5~1/8 of the ordinary one.

(2) Operating Points

1) Formwork Setting-up

The formwork support adopts a steel tube fastener raft support frame, the space between upright tubes is controlled within the range of 1000×1000 mm (can be decreased based on the plate thickness), steel frame tubes of a diameter 48 mm and a wall thickness of 3.5 mm and the 50×100 mm square timbers serve as the keels, 15 mm thick double-sided laminated film plywood with the specification of 1200×2400 mm is combined on site, the space between big keels shall be no greater than 1000 mm, the space between small keels shall be no greater than 250 mm, and all the inside corners of the pillars and the top plate on the small keels are treated with rabbet keels. The contact surfaces of the beams and columns shall be flat and smooth and the sponge tape for sealing shall be glued by snapping the line beforehand, so as to closely contact with the beam and column and avoid mud leakage. The plywood is laid on the rabbet, and the joints of the plywood shall be glued with the sponge tape. In order to ensure the stability of every plywood plate and the accuracy of the arch camber extent, the four corners of the plywood plate are fixed with nails and small keels, and the joint of every two plywood plates is on the same square timber keel.

2) Binding of Reinforcement at the Lower Layer of Cast-in-place Floor Slab

Control lines are snapped from the formwork before binding the floor slab reinforcement so as to enable the reinforcement to be laid according to the lines. Split heads supports need to be added to the two-layer floor slab reinforcement and hogging moment reinforcement, the split heads is formed of three reinforcement bars with a diameter of 12 mm, has 1 M longitudinal interval and horizontal interval, is quincuncial, and has the shape and dimensions same as the raft. In order to effectively prevent the main reinforcement and joists from deviating, positioning stirrup or positioning horizontal bar is added to the upper openings of the column rebar and the joist and is made of third-grade reinforcement with a diameter of 14 mm, so as to prevent the structure stress and verticality from being influenced by reinforcement deviation.

3) Construction of Light Core Skeleton

The special Y-shaped steel plate is prefabricated by welding three square steel plates with the same dimensions in the factory and the same included angles, and the special Y-shaped steel plate is welded with Q235 steel plates of a thickness of 4 mm, a width of 400 mm and a length of 3000 mm.

The longitudinal wing plates of the special Y-shaped steel plate are welded with the distributing bars on the lower layer of the Cast-in-place floor slab.

4) Binding of the Reinforcement on the Upper Layer of the Cast-in-place Floor Slab

The reinforcement on the upper layer of the Cast-in-place floor slab is bound after the installation of the light core skeleton is completed. Protection work shall be carried out during the construction in case that the follow-up procedures damaged the finished products. During the concrete construction, steel setter shall be appointed to look after the reinforcement, so as to ensure that the thickness of the protective layer for the reinforcement of the floor slab meets the requirement, and the reinforcement inserting positions of the wall plates and the columns are correct.

5) Concrete Casting

During the concrete casting, the layered continuous casting is adopted, namely the ordinary concrete at the bottom, the foamed concrete in the light Cast-in-place skeleton and the floor slab concrete at the top are casted continuously in sequence, and the concrete at the upper part shall be completely cast before the initial setting of the concrete at the lower part.

Summary

The following conclusions are reached based on the construction process of the light Cast-in-place floor slab of the built-in special Y-shaped steel plates and the measured parameters thereof:

(1) During the construction of the light Cast-in-place floor slab of built-in special Y-shaped steel plates, the layered continuous casting is adopted, namely the ordinary concrete at the bottom, the foamed concrete in the light Cast-in-place skeleton and the floor slab concrete at the top are continuously casted in sequence. The concrete at the upper part is completely casted before the

initial setting of the concrete at the lower part, so as to improve the integrity of the light Cast-in-place and the Cast-in-place floor slab.

(2) The vent holes reserved in the side wing plates of the special Y-shaped steel plates can reinforce the compactness of the concrete at certain parts of the side wing plates of the Y-shaped steel plates and the casting quality while casting the floor slab concrete.

(3) The bottom parts of the longitudinal and horizontal special Y-shaped steel plates are welded with the distributing bars at the lower layer of the Cast-in-place floor slab; as the special Y-shaped steel plates have excellent flexural behavior, the integral seismic resistance is excellent and the structural deformation is small.

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