The raft foundation reinforcement construction technology of Hongyun Building B tower

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Abstract: The foundation of Hongyun building B tower is made of raft board foundation which is 3300mm in the thickness include four kinds of reinforcement Φ32, Φ28, Φ12 and12 steel grade two, in respective. It is researched that the raft foundation mass concrete construction technology is expatiated from temperature and cracks of the raft foundation and the temperature control and monitoring of the concrete base slab construction and concrete curing. According to the characteristics with large volume and thickness of the engineering of raft foundation, the construction of the reinforced force was calculated and the quality control measures were used to the reinforcement binding and connection, so it is success that Hongyun Building B tower raft foundation reinforced construction.

1. Project overview

Hongyun Building B tower for raft foundation has four floors underground and thirty floors on the ground. The annex has four underground floors and five floors on the ground. The raft foundation main is made of core tube raft thickness 3300mm, core tube raft thickness 2800mm. The podium is an independent foundation with waterproof plate which is thickness of 650mm to 1200mm and the raft foundation for C40 strength grade of concrete anti permeability level is P10. The thickness of the raft foundation and concrete placement are poured a large amount of concrete belongs to large volume concrete construction technology requirements. Especially the concrete crack can be caused temperature stress in the construction to prevent concrete due to hydration heat temperature difference. Thus preventing crack is the key to control the temperature inside and the surface concrete.

The main specifications of steel slab are Φ 32, Φ 28, Φ 12, Φ 12 four grade steel. The raft core parts of the bottom ribs are provided with three rows of 32@150. The core tube raft bottom ribs are arranged in two rows of 32@150. The raft top ribs are arranged in two rows of 28@150. The pouring a large amount of concrete placement belongs to large volume concrete construction technology requirements.

2. Calculation of reinforcement

2.1. Main parameters

The loads include dead-weight and construction loads. The load of the reinforced frame includes the weight of the upper reinforcement, the construction personnel and the load of the construction equipment. The material of the reinforced frame is determined according to the size of the upper and the lower reinforcing bars and the size of the load. The standard value of the dead load of the upper

steel bar is 1.800 kN/m; Construction equipment load standard is value of 1.500 kN/m; Construction personnel load standard is value of 2.700 kN /m; Cross section resistance moment W= 16.123 cm^3; Elastic modulus of steel beam E=2.05×105 N/mm^2; Cross sectional moment of inertia I= 50.786 cm^3; Height of column h= 3.10 m; Column spacing l= 1.50 m; Steel strength design value f= 206.00 N/mm^2.

2.2. Calculation of support beam

The support beam is calculated according to the strength and deflection of three span continuous beam.The maximum bending moment and deformation of the support beam are calculated on the basis of the foot plate and the live load on the support beam. The calculations are shown in Figure 1 and Figure 2.

1 uniform load value calculation:

Calculated value of static load q1=1.2×1.800+1.2×1.500=3.960 kN/m; Calculated value of live load q2=q2=1.4×2.700=3.780kN/m

Fig. 1 The bracket beam calculation load combination diagram (span maximum bending moment and the maximum deflection)

Fig. 2 The bracket beam calculation load combination diagram (bearing the maximum bending moment)

2 strength calculation:

The maximum bending moment considering bending moment for three span continuous beams under uniform load: $M_{1max}=0.08q_1l^2+0.10q_2l^2$

The maximum bending moment: $M_1=（0.08×3.960+0.10×3.780）×1.5^2=1.563kN.m$

The calculation formula of the maximum bending moment is as follows: $M_{2max}=-0.10q_1l^2-0.117q_2l^2$

Maximum bending moment of support: $M_2=-（0.10×3.960+0.117×3.780）×1.5^2=-1.886kN.m$

The strength of the bearing and the mid span bending moment: $\sigma=1.886×10^6/(16.123×10^3)=116.981N/mm^2$

The calculated strength of support beam is less than 206 N/mm2, which meets the requirements.

3 deflection calculation:

The maximum deflection is considered as the deflection of three span continuous beams under uniform load, the calculation formula is as follows: $v_{max}=（0.677q_1+0.990q_2）l^4/100EI$; Standard value of static load q_1= 1.800+1.500=3.300kN/m; Standard value of live load q_2=2.700kN/m; the maximum deflection of three span continuous beams under uniform load:

$V_{max}=（0.677×3.300+0.990×2.700）×1500^4/（100×2.05×10^5×50.786×10^4）=2.386mm$

The maximum deflection of support beam is less than min (1500/150,10) mm, which can meet the requirements of 2.386mm.

2.3. Calculation of support column

Cross section of support column: A=8.444 cm^2; Radius of gyration: i=2.453 cm; Moment resistance of column: W=16.123 cm^3; The support column is used as the axial compression member to check the

stability: $\sigma = N/\varphi A + M_w/W \leq [f]$. In type: σ- Compressive stress of column; N-Axial pressure design value; φ- Stability coefficient of axial compression member; According to the slenderness ratio $\lambda=h/i$, After looking up the table, φ=0.265; A-Cross section area of vertical bar, A=8.444 cm^2; [f]-Design value of comprehensive strength of vertical pole, [f] ＝206 N/mm^2.

The second step load combination method is used to obtain the maximum support reaction force of the support column to the support beam: $N_{max}=0.617q_1l+0.583q_2l$

Calculated by N=0.617×3.960×1.500+0.583×3.780×1.500=6.971kN

$\sigma=6.971\times1000/(0.265\times8.444\times100)+1.886\times1000/16.123=148.155N/mm^2$

Check the stability of the vertical pole < [f], to meet the requirements.

3. Construction technology of raft foundation reinforcement

3.1. Reinforcement processing

The construction equipment including GJ5-40 type steel bar cutting machine, GJ7-40 type steel bar bending machine, a bar straightening machine, a stirrup bending machine, H2514 tower crane, a FO23B tower crane.

The steel and plate are checked according to the steel standard. The inspection is including the batch furnace tank diameter mark and the quality certificate and quality inspection of the appearance. The drawings and overall layout are familiar. The collocation of steel bar is on the basis of different specifications to the length according first off the long expected, by cutting short material to reduce short head and reduce loss. The fracture may have reinforced U-shaped or bending phenomenon. The length of reinforced bar bending processing must be accurate and allowable deviation of + 10mm. Bar bending according to the drawings have two kinds including 90 and 135 degrees where the steel bending diameter D is not less than the diameter of the steel bar 4 times. Steel shape and plane are without warp-age phenomenon. Steel bending points must not have cracks. For the two grade steel and above the level of steel can't bend over again bent over the two. The deviation of the bending of the steel bar that the total length of 10mm , the bending of the reinforced bar bending point displacement 20mm, bending the reinforcement of the bending height of 5mm, stirrup length 5mm is allowed.

3.2. Steel banding

The steel bar number, diameter, shape, size, and spacing are consistent with the single material card requirements if there is an error corrected immediately and supplement. The lashing wire and lashing tools (steel hooks, small crowbar, lashing frame etc.) prepared are used by 20~22 wire. 22 wires can only be used for pipe diameter below 12mm steel. Non - metallic pads, such as marble, is used for control of concrete protective coatings. The thickness of the cushion block is equal to the thickness of the protective layer. When the cushion block is used in the vertical direction, the plastic cushion block can be used. The reinforcing steel bar is connected with the joint and the position of the joint should be located at the smallest distance. The anchorage length of the tension steel bar is set according to the 03G101 atlas constructions.

The fountain release spacing line is set according to the diagram at the raft bottom bars lashing. The raft for plate thickness is between 3.5 m and 4.2 m in order to ensure the accurate location of the upper rib reinforced. The upper two rows bar diameter is 28 mm. the general reinforcement calculated using the bracket 63 channel spacing of 1.5 reinforced concrete practices attached load attached is not stable. The vertical steel columns are in connection with cast-in-sit raft. Inserted reinforcement, the stirrup ratio of column stirrup is to narrow a column stirrup diameter in order to connect and avoid the column axis. the reinforced columns exposed floor also take part tool type column hoop be folded in a column stirrup diameter. There is the upper column reinforcement lap. When the cross section of the column is changed, the exposed part of the reinforcing steel bar of the lower column must be accurately

contracted prior to the reinforcement of the beam. There is the binding of the column stirrups. There is the binding of the column stirrups. the distance between of the points on the two main diagonal bar is ensure the accuracy of the column reinforcement. the bending hook overlap, staggered in the four corners of the longitudinal reinforcement at stirrup joints. The column reinforcement in the height of the insertion of the raft is carried out the stability with reinforcement method at the four corners of the column with the diameter of the reinforcement of the steel support to do Φ32, as the thickness of the raft in the 2.8 m ~ 3.3 m, the column section of 1.40*1.40m, 1.50*1.50m, etc. The wall reinforcement for the double layered lashing with height of about 4.5 m and hold the iron layer in the two set with a fixed bar and bar spacing. It is supported 12 iron steel production rate with the diameter and length equal to two layers of mesh spacing of about 1m. It is hooked to the wall of reinforced concrete facing inside. The wire must be facing the wall and not allowed towards concrete.

3.3. Construction of steel bar mechanical connection

The raft foundation is reinforcement in parts of the core tube structure. The bottom has three rows of reinforcement diameter 32 steel core tube. The outer bottom reinforcement has two rows of diameter 32 steel. The raft top has two rows of diameter 28 steel. The reinforcement of large diameter and a plurality of joints is adopt reinforced straight thread joint technology in steel joint to ensure the engineering quality and speed up the production schedule. The main parts of the raft foundation have floor frame column and frame beam longitudinal reinforcement. The use of machinery and equipment are including reinforced rib rolling straight thread special machine tools, limit block iron, thread ring gauge, torque wrench and ordinary wrench, grinding wheel cutting machine.

Reinforced connection process: reinforced in place - unscrew the cap - reinforced joint tighten - mark - construction quality inspection. The joint is checked appearance without complete thread exposed and reinforced and the connecting sleeve gap after the completion of the above work for quality inspection. Then tighten the joint inspection quality inspection of torque wrench the degree.

4. Conclusion

The connection quality is assurance through the calculation of the raft reinforced and the reinforcing bar and. Hongyun Building B tower raft foundation reinforced construction is success.

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