# Construction Technology and Quality Control of Mass Concrete in Super High-rise Buildings Based on BIM

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**Abstract:** The construction technology of mass concrete requires high requirements, especially in construction to prevent concrete temperature difference caused by hydration heat to produce temperature stress cracks. Therefore, according to the construction characteristics and construction deployment of mass concrete in super high-rise buildings, the author uses BIM technology to analyze the key and difficult points of mass concrete construction in super high-rise buildings. The ideal construction plan and relatively reliable technical measures for large-volume concrete are obtained. The research proves that it is necessary to make sufficient preparations from the material selection and technical measures to ensure the smooth completion of the super-high-rise building mass concrete project.

## 1. Introduction

With the development of urban underground space development and utilization, the design and construction level of foundation pit engineering in China has been greatly improved [1]. The use of commercial concrete, and the addition of suitable admixtures can improve the performance of concrete and improve the anti-doping ability of concrete [2]. On the basis of summarizing and analyzing the early cracks in the comprehensive layered construction of the skirt, the concrete pouring was adopted. At the same time, it is necessary to plan all the accessible roads between the construction site and the concrete mixing stations, and then select the optimal route and the alternate route according to the previous traffic conditions and the distance of the roads of each road [3]. The remarkable characteristics of large volume concrete are large size of length, width and thickness, large area and quantity of concrete pouring, and high requirement of construction continuity [4]. The core tube adopts the dense column steel frame-core tube structure, and the outer floor adopts the composite floor system supported by steel beams. The structure design is light and handy. It is the lowest tube super high-rise building with the least material per unit area in China [5]. If the finite element analysis software is used directly to establish the finite element model, it will be difficult to establish the complex parts and to modify the model parameters many times. Due to the cooperation of the construction parties and commercial concrete companies, the project is progressing smoothly, and the quality of concrete has been evaluated by experts in the province [6].

With the continuous enhancement of China's comprehensive national strength and the improvement of the level of economic development, high-rise or super-high-rise buildings with complex structure and advanced construction technology are constantly emerging in our country, and mass concrete projects are also increasing [7]. With crack-proof concrete waterproofing agent, the weight of mass concrete is 2.3%. The waterproofing agent should not contain chloride salt, which has no effect on the corrosion of steel bars. It can obviously improve the impermeability of hardened concrete. Especially in recent years, with the planning and construction of super high-rise buildings in different regions, the depth of foundation pit, the thickness of foundation floor and the strength grade of concrete have developed rapidly in the direction of deeper, thicker and higher [8]. The theoretical verification of the adiabatic temperature rise and temperature stress of mass concrete was carried out, and a set of construction technical guarantee measures were proposed for the key steps of concrete floor temperature difference control, cold seam prevention and vibration forming [9]. During the concrete pouring, the main gates of the construction site have the only

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effect, that is, they can only enter or leave, avoiding chaos on the site and facilitating management. Because of the excessive number of stones in the thick rock-filled area, it is difficult to construct by rotary drilling. Therefore, the construction method of impact-forming holes is adopted, and the construction time of impact-forming holes is too long. The project department uses 18 sets of punching pile machines to simultaneously construct on the west side, the highest peak. The number of punching pile machines in the field reached 26 units [10]. These difficulties are problems that need to be solved in the pre-processing part of BIM software.

## 2. Methodology

Before pouring concrete, take the initiative to contact the traffic control department, and try to get the assistance of the traffic control department to ensure that the continuous supply of large-volume concrete is not affected by traffic. The most common problem during construction is the cracking of mass concrete. According to the characteristics of mass concrete, it avoids harmful cracks after concrete pouring, mainly considering four aspects: pre-casting preparation, pre-casting crack control calculation, pouring process control and post-construction maintenance. The thickness of the base plate of the super high-rise foundation pit is generally 4~6m, and the partial depth of part of the project has reached 11.8m. It belongs to the typical mass concrete, and the concrete crack control is the top priority of this stage construction. Mass concrete construction should not only meet the requirements of strength and impermeability, but also minimize the hydration heat produced during the hardening process. All construction roads in the site can only travel one way to avoid the interruption of concrete supply caused by the crowding of concrete tankers. If the blockage occurs in the middle of the casting, the pipe should be pulled out after dredging and re-inserted into the concrete (> 1m), then the mud in the pipe should be sucked out by the mud pump, and the concrete should be continued to be poured. Preparations before construction only lasted two months, and the environment in some areas was complex. After repeated reconnaissance by geological exploration units, the design changed a lot.

According to the test of temperature difference, cooling rate and ambient temperature of mass concrete pouring body, the concrete temperature can be controlled at any time so as to take corresponding measures to control the cracks on the surface of concrete when problems occur. The temperature curves of concrete temperature measuring holes in the center and end positions of the foundation floor are shown in Fig. 1 and Fig. 2.

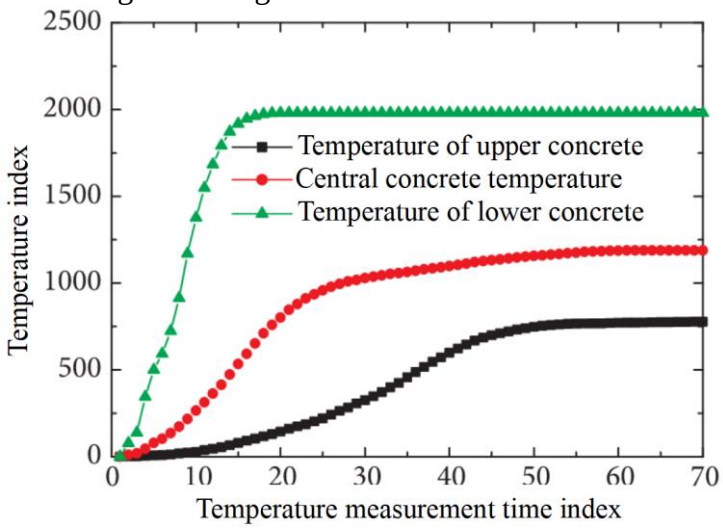


Fig.1. Foundation Floor Center Position

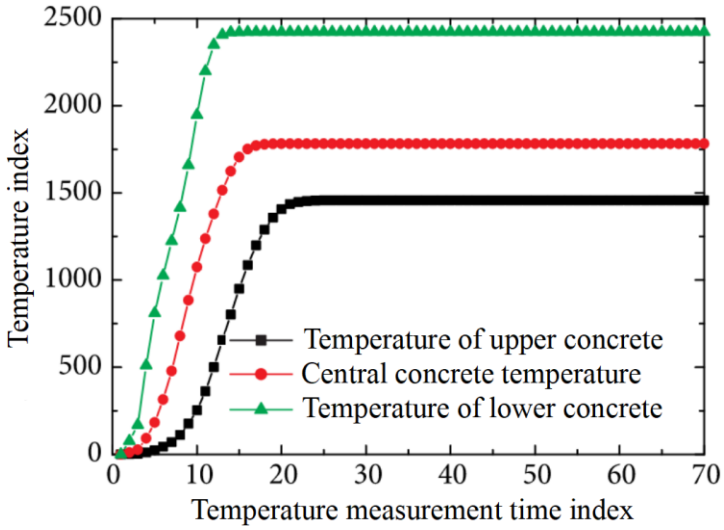


Fig.2. End position of base plate

How to ensure the continuity and stability of the concrete pouring process is the key factor to ensure the smooth completion of the raft pouring. For this reason, the project department carries out unified management, unified coordination and unified deployment on the production, transportation, pouring and other aspects of the raft concrete building to ensure the smooth progress of concrete pouring. Although the size of the anchorage model is symmetrical, 1/4 of the anchorage can improve the speed of modeling and shorten the analysis time. However, considering the unbalanced external forces around the anchorage and other factors, it is necessary to make the model imported into MidasFEA complete. An open space is set up on the site as a concrete tank waiting area for the concrete tank cars entering the site to be queued in order, and the pouring preparation is made to ensure the high-strength uninterrupted pouring of concrete. The main causes of structural cracks are cooling and shrinkage. Studies have shown that if the maximum stress generated by the shrinkage shrinkage exceeds the age of the tensile, the structure will crack. The temperature inside the concrete is related to the thickness of the concrete and the volume of the large volume of concrete. The thicker the concrete, the larger the volume of concrete, the greater the internal temperature.

The research on large-volume concrete for super high-rise buildings was carried out by means of chutes combined with ground pumps and automobile pumps. The specific pouring equipment configuration is shown in Table 1.

Table 1 Pouring equipment configuration

| Name | Specifications | Number |
|---|---|---|
| Chute | 70m | 2 article |
| Concrete pump | HBT70 | 3 stations |
| Conveyor pump pipe | A125 | 1500m |
| Automobile pump | HB37A | 2 stations |

## 3. Result Analysis and Discussion

On the premise of meeting the strength requirements, the mass concrete should adopt the low strength grade, low fineness and small volume concrete. The strength grade should not be lower than 32.5MPa, and reduce the hydration heat of large volume concrete. The principle that the building materials should be taken locally, there is no slag mass concrete in the area, and the sand has only fine sand without medium sand. When the temperature difference between the interior and the surface of the concrete is too large, temperature stress and temperature deformation will occur. The temperature stress is proportional to the temperature difference. The larger the temperature difference, the greater the temperature stress. When optimizing the combination of cementitious

materials, high-quality fly ash is selected. Under the premise of ensuring strength and workability, the amount of fly ash is controlled more than the amount of mineral powder, which fully exerts the function of retaining and reducing the fly ash. According to the geological report, it is not suitable to destroy the existing hardening site, so the construction of rotary digging holes by directly grooving saves the extra time and cost of repairing large-scale mechanical walking roads. Concrete suppliers should work out reasonable concrete production and supply, road transportation, test and inspection schemes to ensure that the quality of concrete on site meets the design and specification requirements and construction needs. Therefore, in order to ensure the construction quality of mass concrete, besides meeting the requirements of strength, rigidity, integrity and impermeability grade, many factors should be considered comprehensively to control the occurrence of cracks in mass concrete.

Because of the large amount of concrete pouring in the base slab, the forced mixer must be used to mix, and the temperature of concrete raw materials must be strictly controlled. Its supply capacity should meet the needs of continuous construction of mass concrete. At the same time, it should also have the function of reducing water, reducing the peak value of hydration heat, compensating the shrinkage of concrete, and improving the crack resistance of concrete. The 60d or 90d strength is used as the concrete mix design and evaluation strength, which can effectively reduce the heat dissipation rate of mass concrete, control and reduce the occurrence and development of harmful cracks. Therefore, there is a high requirement for the organization and coordination of coagulation. In order to prevent the “cold seam” when concrete is poured, the concrete concrete mixing and conveying truck is adopted, the pouring scheme is optimized, the take-over speed is increased, the lifting and picking is combined with the lifting and the uniform organization and coordination, etc., so that the concrete pouring layer is before the initial setting. Combine with tapping. During the filling, when the concrete surface is close to the bottom of the steel cage, the concrete pouring speed should be slowed down, and the pipeline should be kept deeper, so that the conduit bottom and the bottom end of the steel cage are kept at a large distance, so as to reduce the steel cage. The impact. During the concrete pouring construction, a number of measures are planned to ensure the quality of the concrete. The concrete to be poured must adopt the uniform mix ratio, unified construction raw materials, unified dispatching command, and unified inspection test.

## 4. Conclusion

With the increase of the thickness of the base plate of the domestic super high-rise building and the increase of the concrete volume, the concrete grade is increased, and the concrete mix design, pouring method, maintenance method and construction organization arrangement are continuously improved and innovated in many years of construction. This has made the construction technology of deep foundation mass concrete for super high-rise buildings more and more perfect. The BIM model is used to pre-process the finite element model, and then imported into the finite element calculation software for post-processing, which greatly improves the accuracy of the mass concrete construction and the accuracy of the calculation results. Reasonable planning for super-long bulk concrete slab casting ensures that the continuity, integrity and orderly formation of the working face are the key factors for the seamless construction of super-long bulk concrete. At the same time, measures such as optimizing mix proportion design, reasonable organization of traffic inside and outside the site, full vibration, timely covering and maintenance, dynamic temperature detection and so on are also necessary measures to ensure the quality of mass concrete pouring. It effectively controls the generation of concrete cracks. The most appropriate way to maintain mass concrete is thermal insulation and covering method, and try not to use water curing, so as to avoid surface temperature decreasing too fast, so that the temperature difference increases and concrete cracks occur. Practice has proved that in order to ensure the construction quality of mass concrete in super high-rise buildings, it is necessary to meet the requirements of strength, stiffness, integrity and impermeability.

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