

# **Construction Technology and Quality Control of Mass Concrete in Super High-rise Buildings**

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**Keywords:** Super High-rise Building; Mass Concrete Construction Technology; Quality Control

**Abstract:** Over the past 40 years of reform and opening up, China's economic construction has made great achievements. The improvement of the economic situation has led to the continuous progress and development of society, and the material and spiritual life of the people has been significantly improved. Urban construction has also entered the track of rapid development, and many super high-rise buildings have been built in large and medium-sized cities in China. Super high-rise buildings not only symbolize the comprehensive strength of the country, but also an important symbol of the rapid development of a city. Due to the high technical requirements and quality requirements of large-scale concrete construction and high construction difficulty, the innovative technology and strict control of construction quality have become the focus of engineering and technical personnel.

## **1. Introduction**

The technology and quality control of super high-rise building engineering is the most important task in the field construction. It requires not only the engineers and technicians to have a high professional level, but also the enterprises to have a sound internal management mechanism. Throughout the construction of super high-rise buildings in the current city, the overall engineering quality of super high-rise buildings has been degraded due to poor management, lack of technology, and irregular construction organization, which has brought huge economic losses to enterprises and society.

## **2. Problems in construction**

### **2.1 Management loopholes at the construction site have led to a decline in construction quality**

Super high-rise buildings belong to a city's image project and are the overall trend of future urban development. In recent years, with the continuous improvement and innovation of construction technology, the requirements for the construction technology of large-volume concrete for super high-rise buildings are getting higher and higher. However, in the actual construction process, the construction operation is not standardized, the material quality is unqualified, the overall planning of the building is not well connected, and the behavior of individual construction personnel is not standardized, resulting in a decline in the overall construction quality. In view of this situation, enterprises should further strengthen internal management, strengthen the management of construction site personnel, start from the ideological awareness of personnel, correct the attitude of managers, and consolidate the foundation of field management. In mass concrete construction, managers must conduct scientific and reasonable command and guidance on the construction technology and methods on site to ensure the overall engineering quality of super high-rise buildings [1].

### **2.2 Define the responsibilities of managers at all levels**

Construction enterprises should further establish and improve the post responsibility and authority of managers at all levels, clarify the main responsibilities of construction site managers, establish the

corresponding reward and punishment system, who is responsible for the problems in management. Especially for mass concrete construction, managers at all levels should be fully aware of the importance of quality control in super high-rise buildings. Due to the fact that subcontracting often occurs during construction, the overall project is divided into sub-projects for subcontracting. However, the lack of effective monitoring of enterprise management personnel for each sub-project makes the quality of the project difficult to guarantee, which in turn affects the construction quality of large-faced concrete and makes the overall quality of the construction project not up to standard.

### **2.3 The influence of concrete stability on construction quality**

The most critical link in concrete construction is the pouring and hardening of concrete. Because of the hydration reaction of cementitious materials in concrete, the phenomenon of hydration heat is always accompanied in the construction process. The internal heat of the concrete is completely lost, and the external heat is lost quickly, so that the temperature difference between the inside and the outside of the concrete becomes more and more obvious with the change of construction time. At this time, temperature stress is generated inside the concrete, which deforms the surface of the concrete, and finally the load bearing property, the permeability resistance and the durability of the concrete are affected.

## **3. Rational Selection of Concrete Materials**

When choosing concrete material, if we use cement with higher hydration heat to pour mass concrete, there will be a distinct temperature difference between inside and outside of concrete, and a large temperature difference will lead to cracking of concrete surface. In use, it will bring negative impact on the overall project quality. Therefore, in the selection of concrete materials, cements with relatively low hydration heat must be preferred, such as low-calorie slag Portland cement, fly ash Portland cement, and moderately moderate Portland cement. For the concrete mix, the medium coarse sand is selected, which can greatly reduce the hydration heat of the cement and the shrinkage of the concrete. The choice of coarse aggregate should be as continuous as possible, and the content of soil should not exceed 1%.

In the mixing process of concrete, appropriate proportion of water reducing agent, fly ash and slag powder should be added as admixture to fully improve the performance of concrete. Strictly control the water consumption and cement dosage to delay the solidification time of concrete and further improve the permeability resistance of concrete. Water reducer can effectively reduce the moisture content of concrete mixtures, greatly reduce the hydration calorific value, at any time can effectively compensate the shrinkage of concrete, so that the crack resistance of concrete is significantly enhanced. In addition, when adding fly ash, the dosage should be limited, preferably within 10%, so as to enhance the activity of concrete and optimize the tensile value of mixtures [2].

## **4. Quality Control Strategy of Concrete Construction**

### **4.1 Optimizing mix ratio**

In actual construction, large area cracks often appear on the surface of concrete. Most of the reasons are that when mixing concrete, there is often no reference to the relevant technical specifications and standards, which makes the proportion of concrete imbalance and lack of rationality. As the number of super high-rise buildings in the city increases year by year, the utilization rate of urban land resources has also been significantly improved. Therefore, in the case of ensuring construction quality and safety, the mix ratio of concrete must be strictly controlled.

At present, the concrete used in urban super-tall buildings generally consists of six main components: water, cement, sand, fly ash and admixture. The role of cement is to ensure the stability and fit strength of the overall structure of the concrete. The fly ash is mainly to effectively reduce the hydration heat of the concrete surface, and the effect of the admixture is to ensure the solidification of

the concrete quickly. When proportioning concrete, it is necessary to master the main structure of the building, construction standards and natural conditions in the building area, and further optimize the mix ratio of concrete to meet the specification requirements. For example, in the construction of a 50-storey building project, according to the construction plan and mixing requirements, high-grade cement must be selected. In order to make the overall strength of concrete reach the standard value, improve the quality of concrete structure, so that in the subsequent concrete pouring construction, the corresponding reduction of working strength.

#### **4.2 Temperature adjustment and control inside and outside concrete construction**

Effective control of temperature difference between inside and outside during coagulation construction is an important measure to improve coagulation strength. For large volume coagulation construction, temperature has a great impact on the quality of concrete construction. Usually, the construction temperature control of mass concrete can be divided into the maximum temperature difference between inside and outside, the maximum rate of temperature rise and fall, the highest internal stability, the humidity of the mannequin and the temperature gradient of the section. In the construction specifications, it is explicitly mentioned that the temperature of the concrete mix must be strictly controlled below 25 degrees Celsius. The rate of temperature rise and fall should be controlled within 2 degrees Celsius per hour, and the temperature of the concrete mold should not exceed 50 degrees Celsius [3].

During the temperature control process, the temperature of the concrete must be monitored from time to time, paying attention to the temperature of the concrete entering the mold and the influence of outside air temperature. Most construction companies adopt the following methods for temperature control of concrete. One is to optimize the mix ratio of concrete mix. Minimize the amount of cemented material used to ensure the overall quality of the project. In the process of selecting cement, it is necessary to select a material with low hydration heat instead of cementitious material, or to ensure the solidification speed of concrete by adding slag or admixture. Secondly, appropriate retarder is added to concrete to effectively delay hydration time and reduce the extreme temperature of concrete surface. Thirdly, cold ice and aggregate pre-cooling are used to replace mixing water, and this method is applied to the transportation process of concrete, which plays a very good role in reducing the temperature of concrete pouring body. Fourthly, after the concrete pouring work is completed, the corresponding measures of heat preservation and moisture preservation must be taken to make the temperature difference between inside and outside of concrete reach an optimal value. Fifthly, for large volume concrete with high thickness and height, the way of pre-embedded cooling water pipe is generally adopted, which can also effectively control the temperature difference between inside and outside of concrete to meet the needs of Engineering construction.

#### **4.3 Pouring method of mass concrete**

Mass concrete pouring is different from ordinary pouring. In actual construction, more scientific layered pouring method should be chosen, which is beneficial to the loss of hydration heat of cement. When vibrating the concrete, the layered vibrating method should also be adopted to cover the upper and lower layers of the concrete layer by layer before the initial setting, effectively avoiding the appearance of longitudinal construction joints.

The comprehensive stratification method for concrete pouring is to carry out construction work in stages and without interruption, that is, from the bottom of the construction project. When pouring to a certain distance, the second pouring is carried out, and according to such a construction process, the buildings are sequentially circulated and poured. The layered casting method is applicable to construction projects with less concrete supplied per unit time and construction projects where the thickness of the structure is not large and the area or length is large. The construction principle of the inclined layered pouring method is similar to that of the plane layered pouring method. It starts from the bottom of the building and then moves up slowly. The angle of the inclined plane is determined by the slump of the concrete. The general angle is less than 45 degrees, and the concrete thickness of each floor can not be greater than the effective vibration depth of the vibrating rod, so as to obtain the

best vibration effect. This method of layered placing inclined plane is usually applicable to super high-rise buildings whose length is far greater than the thickness [4].

#### **4.4 Effectively Guarantee the Casting Quality of Concrete**

For the large volume concrete construction of super high-rise buildings, the method of progressive continuous pouring or layered pouring is adopted when pouring. At present, in the actual construction of construction enterprises, construction companies often adopt scientific and reasonable pouring methods according to the internal and external factors of construction engineering and construction requirements, and the ultimate goal is to ensure the overall construction quality.

Some construction companies use the vibrating depth of concrete and the concrete material to determine the final paving thickness when purchasing vibrating equipment. If pumping concrete is used, the paving thickness should be strictly controlled below 600 mm. If non-pumping is adopted, the paving thickness must be controlled below 400 mm to ensure that no air bubbles and cracks appear on the paving surface. When layered continuous pouring is carried out, the construction personnel should ensure the interval time so that when the internal structure of the preceding layer of concrete has not yet fully solidified, the pouring operation of the next layer shall be carried out immediately. To prevent the hardness of the upper layer of concrete from exceeding the standard value, which will affect the overall beauty and quality of the building.

In pouring operation, the construction personnel should pay attention to the initial setting time of concrete. If the interval time of each layer exceeds the initial setting time of the previous layer, the construction joints must be treated in time. Effective control measures should be taken for each pouring layer in continuous pouring. In addition, the treatment of the construction joint can be carried out in the following manner. The floating layer or loose stones containing the floating layer are removed in time to ensure that the surface is clean and the coarse aggregate in the concrete is uniformly exposed. Before pouring the concrete, the surface of the concrete is washed with pressurized water to effectively remove surface impurities.

During the mixing and transportation process, the concrete must meet the requirements of continuous operation to ensure the optimum surface temperature difference. In the summer construction, the concrete mixing station and the mixing field need to spray and cool the fine aggregate and coarse aggregate. If the construction company is equipped with a mixing station, it is necessary to choose the placement position. To shorten the distance from the construction site as far as possible and to effectively control the setting time of concrete is an important prerequisite to ensure the overall quality of concrete. In the application of pumping concrete, the water-cement ratio of concrete is relatively large, and the bleeding often occurs. At this time, the construction personnel should remove the bleeding on the surface in time. If the bleeding situation is not solved in time, it will affect the performance of concrete and the overall quality of buildings.

#### **4.5 Strengthening Construction Site Management**

In the field construction, construction managers at all levels must strictly follow the construction process, and effectively manage the construction process according to industry standards and relevant standards. Construction personnel should pay attention to strengthening their own professional skills and further consolidate their professional knowledge in their spare time to meet the actual needs of construction. In addition, the construction machinery and equipment is the necessary guarantee for the entire construction process. Before the construction, the management personnel and the mechanical operators should conduct fault diagnosis and maintenance on the mechanical equipment every day. Regularly participate in relevant business skills training organized by enterprises, consolidate the foundation of their professional skills, and effectively guide construction operations. In the process of concrete pouring, managers should establish a sense of responsibility and conduct real-time monitoring of each sub-project and sub-project to ensure the construction quality of large-scale concrete in super high-rise buildings.

## 5. Conclusion

In a word, concrete pouring technology has a direct impact on the beauty and overall quality of construction projects. While engineering and technical personnel strive to improve their professional quality and skills, they should also establish a sense of overall situation. Focusing on corporate interests and social interests, we will pay close attention to construction quality and innovative construction methods to contribute to the modern urban construction.

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