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Earthwork and the Strategies of Concrete Construction Technology Application in Building Construction

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Abstract: The pouring of mass concrete and earthwork account for a large proportion in building construction, which can play a decisive role in the quality of the building. Therefore, it is necessary to understand the technology of earthwork and concrete engineering in the process of building construction and propose reasonable application strategies.

Keywords: Housing construction; Earthwork; Concrete engineering; Construction technology

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1. Introduction

Earthwork and concrete engineering can have certain impact on the quality and efficiency of housing construction and to a certain extent determine the overall safety of the building. Therefore, it is necessary to conduct in-depth discussions on advanced construction technologies and make reasonable adjustments according to the conditions of construction, with focus on earthwork and concrete engineering of housing construction. In this way, construction technologies can be utilized and the quality, efficiency, and safety of housing construction can be ensured. Therefore, it is of great significance to analyze the application strategy of earthwork and concrete engineering in housing construction.

2. Earthworks of housing buildings

2.1. Preparatory work for earthworks

2.1.1. Measurement and setting out

Firstly, the construction site was surveyed, and the position of each control point in the earthwork is determined. Next, the traverse point and leveling point are remeasured, each point in the design plan has to be consistent with the ones on site. If they are consistent, the next step can be carried out; if there are any inconsistencies, reasonable adjustments should be made accordingly to ensure that the subsequent steps can be carried out smoothly [1].

2.1.2. Construction site treatment

The construction site should be cleaned up before entering the construction stage. The thickness of the cleaning should exceed 0.3 m. No garbage, sundries or other factors that may affect the operation of mechanical equipment should be left in the site. Besides, the area that is cleaned should be larger than the area needed for the construction. The cleaning thickness should be further increased especially in poor geological environments, and a more detailed treatment of roots, sod, and humus should be carried out to avoid the subsequent construction being affected.

2.1.3. Preparation of equipment

There are many types of mechanical equipment involved in earthworks, including excavators, bulldozers, compactors, etc. In order to ensure a smooth construction, a comprehensive inspection of the equipment's performance should be carried out, and any faults should be eliminated. Besides, it is important to make sure that the equipment operates normally, and performance debugging and moderate maintenance should be performed. With the aforementioned steps done, the equipment can then be used in the construction.

2.2. Excavation

The excavation process in housing construction is mainly done with a machine. It is necessary to determine the specific excavation volume according to the design plan and control the excavation area based on relevant requirements. The excavation should be done layer by layer to avoid landslides on the side slope of the foundation pit. When the excavation depth reaches about 20 cm from the designed depth, the operation should be suspended, and control piles should be installed at the corresponding positions, or manual excavation can be performed, so as to improve the accuracy of excavation and prevent over-excavation [2].

2.3. Backfill construction

Bulldozers should be used for backfilling to improve construction efficiency, and supporting compaction equipment should be used simultaneously to carry out compaction treatment in a timely manner to ensure that the backfill position is stable. Because the working space is relatively limited, it is not advisable to use large-scale machinery, so frog-type tamping machines is generally used, and attention should be paid to controlling the thickness of the filling. Generally, the thickness of filling should not exceed 25 cm to avoid affecting the compaction effect.

2.4. Compaction

Common compaction methods include rolling and tamping. In the rolling method, the soil is compacted using a roller. The area of pressure of a sheep foot roller is relatively large, which is suitable for cohesive soil. A flat roller, also known as smooth roller, is an automated roller that is suitable for large-scale rolling. The goal of compaction is to increase the compactness of the soil through the force generated by the free fall of a rammer. This has been established for a long time, and the rams used include wooden rams, stone rams, pneumatic rams, frog rams, etc. It can be applied to cohesive soils and collapsible loess, which is conducive to the improvement of inclined holes in the soil.

2.5. Wellpoint

2.5.1. Light wellpoint

Several small-diameter well point pipes are embedded on the aquifer around the foundation pit, where its upper part is connected to the main pipe, and the main pipe is connected with the pump, so that the groundwater can flow out of the well point pipe and the groundwater level can be lowered to the bottom of the pit. This method is mainly suitable for the soil layers with a permeability coefficient of K = 0.1–50 m/d. The depth of precipitation of single-level light scenic spots can reach 3–6 m, and the precipitation depth of multi-level light scenic spots can reach 6–12 m [3].

2.5.2. Self-jetting wellpoint

If the foundation pit is relatively deep, the self-jetting method of wellpoints should be adopted, and its precipitation depth can reach 8–20 m. The equipment is composed of jet well pipe, water inlet pipe, drain pipe, and high-pressure water pump. The jet well pipe consists of two parts, the inner and outer parts. When the annular space between the parts is sprayed with water by the nozzle, the groundwater can be sucked into the pipe and then pressed out of the ground.

2.5.3. Electroosmotic wellpoint

Electroosmotic wellpoints are mainly suitable for soil layers with a permeability coefficient of below 0.1 m/d. It is difficult for ordinary well points to effectively reduce the groundwater level in this type of soil layer. Therefore, electroosmotic wellpoints are particularly suitable for the drainage of silt layers. In the process of electroosmotic wellpoint, the well point pipe is the negative pole, and the steel pipe or steel bar driven in is the positive pole after it is connected to a direct current supply. The soil particles move from the negative electrode to the positive electrode, and the water moves from the positive electrode to the negative electrode and is discharged. The movement of soil particles is an electrophoretic phenomenon.

2.5.4. Tube well

A tube well is set every 20–50 m along the periphery of the foundation pit, and each tube well corresponds to a water pump, which pumps water outward to lower the groundwater level. This method is mainly suitable for soil layers with large amounts of groundwater and a permeability coefficient of K = 20–200 m/d.

2.5.5. Deep well pumps

If the required precipitation depth exceeds 15 m, and the use of ordinary submersible pumps or centrifugal pumps are insufficient, special deep well pumps can be used.

2.5.6. Soft soil foundation treatment

If the construction site has a soft soil foundation, because the stability and bearing capacity of this part are weak, it is necessary to perform suitable soil treatment method in order to avoid uneven settlement. Common treatments include replacement bedding and chemical reinforcement. Replacement cushions should be applied when the soft soil layer is thin or the groundwater level is low. Chemical reinforcement treatment involves using chemicals to react with the soft soil foundation improve the stability of the foundation. In some cases, loading compaction technology can also be used, that is, to perform compression treatment on soft soil foundations, and to improve the consolidation of soft soil foundations by strengthening overload settlement, so as to improve the stability of the soil.

3. Concrete construction in housing building

3.1. Controlling the quality of concrete raw materials

Cement is the most important raw material in concrete. It is mixed with water to form cement slurry, which can not only wrap the surface of the aggregate, but also fill the gaps between the aggregate and lubricate it before it hardens. Cement also binds the aggregate together during the hardening process. The cement used should be purchased from reliable manufacturers, and low-heat types should be selected. It is also necessary to verify the details and certifications of the cement and check the parameters of the cement material to confirm that it can meet the actual construction needs. High-quality medium-coarse sand and coarse aggregate should be matched with suitable crushed stone. Besides the mud content of fine aggregate should be controlled. Then, a suitable shape and particle size and the strength of coarse aggregate is selected.

Adding an appropriate amount of admixtures can improve the concrete and save water and materials to some extent. Common admixtures include water-reducing agents and air-entraining agents, which can improve the polymerizability and water retention of concrete. The temperature of hydration should be controlled to avoid severe shrinkage and cracks in concrete caused by changes in external temperature [4].

3.2. Controlling the ratio of raw ingredients in the mixture

The ratio of raw ingredients in a mixture can directly affect the quality of concrete, so on the basis of using high quality raw materials, the ratio of the raw materials used should be reasonably controlled based on the needs of the project. The proportion of each raw material is first calculated, and the materials are added according to a specific sequence. The materials are then mixed for a specific period of time. It is important to supervise the entire process of making the mixture. Afterwards, the outbound concrete should be inspected in batches to ensure that all the concrete meets the relevant requirements [5].

3.3. Concrete transportation

To ensure that the concrete used is as "freshly made" as possible, the concrete should be transported to the construction site as soon as possible after quality inspection. Besides, it is also important to ensure the continuity of concrete supply during the pouring process to ensure a smooth construction process. Moreover, the transportation route should be reasonably planned according to various conditions, and the transportation distance and transportation time should be shortened as much as possible to control the slump of the concrete. It is also necessary to use dump trucks as transportation vehicles to make loading and unloading easier.

3.4. Concrete pouring

In terms of concrete pouring, technicians should check the post-pouring belt before pouring to confirm that it complies with relevant regulations. The concrete formwork should be treated to ensure that there is no oil or foreign matter on the surface, so that defects such as pockmarks can be prevented [6].

It is important to pay attention to several aspects during the pouring process. First, the pouring speed should be controlled to avoid the formation of cold joints [7]. Second, the concrete pouring temperature should be controlled to avoid cracks caused by excessive temperature stress. Usually, the lower the pouring temperature, the smaller the temperature difference between the inside and outside of the concrete body during hardening, and the smaller the temperature stress, the less likely cracks will appear. Therefore, generally, the pouring should be performed when the ambient temperature is below 35°C, and the duration of the pouring should be reasonably controlled to improve the pouring efficiency. Third, when performing single-layer pouring, the pouring height should be below 2 m, followed by the pouring of vertical structure parts, in which the height should not exceed 3 m. When pouring beams with integrated columns, walls, and slabs, the beams and slabs should be poured at the same time after 1.5 hours after the pouring of vertical structures is completed, and care should be taken to protect the steel skeleton to avoid its displacement during the pouring process [8]. Fourth, after the pouring is completed, vibration should be carried out remove air bubbles. It is important to check the compactness of the concrete during the process of vibration. Besides, the vibrating rod should not hit the steel bar to prevent the steel bar from shifting. In addition, the principle of fast insertion and slow removal should be followed. The vibration time should be set according to the condition of the concrete surface. The process of vibration is considered complete when there is no slurry, air bubbles, or obvious subsidence on the concrete surface to avoid local voids or segregation [9].

3.5. Concrete maintenance

After the concrete is poured at room temperature, continuous watering and curing should be carried out within 8 hours to ensure that the concrete is kept in a wet state to improve its molding effect. After the formwork is removed, the concrete should be wrapped with plastic sheeting and water retention measures should be applied [10]. The cast-in-place reinforced concrete floor should be watered appropriately. Under normal circumstances, the concrete should be cured for at least 14 days to ensure that it is properly compacted with a smooth surface.

4. Conclusion

There are high requirements for both earthworks and concrete for housing projects in terms of quality, heavy workload, and long construction period, so they should be highly valued, and the construction conditions should be considered in these two processes. Each construction link should be carried out properly to ensure the construction quality, improve the overall quality of housing construction, and drive the development of the construction industry.

Disclosure statement

The author declares no conflict of interest.

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