Research on Roof Waterproofing Construction Technology and Quality Control in Construction Engineering

Jian ZHANG

Anhui Hongtao Construction Group Co., Ltd., Huangshan, Anhui, 245000, China

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Abstract: Roof leakage is a common quality issue that has long plagued construction engineering projects. It not only affects the building's functionality and structural safety but also increases post-construction maintenance costs. This paper takes roof waterproofing construction in construction engineering as the research object. By referring to the Technical Code for Roof Engineering (GB 50345-2012), it systematically analyzes the characteristics and applicable scenarios of roof waterproofing construction technologies, outlines the key processes and technical points of roof waterproofing construction in construction engineering, and proposes multi-dimensional quality control measures. The aim is to provide practical references for addressing roof leakage problems and enhancing the durability of waterproofing projects, thereby contributing to the overall quality improvement of construction engineering.

1. Introduction

During the construction and use of construction engineering projects, the roof, as a crucial enclosing structure at the top of the building, plays a vital role in withstanding external environmental impacts such as rainwater, snow loads, and ultraviolet radiation. Waterproofing performance is the core indicator determining the roof's functionality. In recent years, with the increasing diversification of building forms and the growing complexity of climatic conditions, roof leakage problems have occurred frequently. This not only leads to damage to interior decorations and equipment failures but may also trigger structural safety hazards such as steel bar corrosion and concrete carbonation, seriously affecting the building's service life and occupant comfort. Therefore, in-depth research on roof waterproofing construction technologies and quality control measures in construction engineering can effectively promote the overall improvement of roof waterproofing project quality.

2. Characteristics and Applicable Scenarios of Roof Waterproofing Construction Technologies

2.1 Characteristics of Roof Waterproofing Construction Technologies

The characteristics of roof waterproofing construction technologies revolve around material performance, construction adaptability, and in-service stability, with different technology types exhibiting distinct differences.

Rolled sheet waterproofing technology boasts core advantages in terms of mechanical properties and durability. The materials possess strong tensile and deformation resistance, enabling them to adapt to structural stresses caused by changes in the roof environment. Moreover, standardized processes can be employed during construction to achieve efficient laying. However, this technology has high requirements for the flatness of the base layer, and a flat base surface is essential to ensure proper bonding effects.

Coating waterproofing technology is characterized by its integrity and flexibility. The applied coating can form a seamless waterproof layer, closely conforming to the shape of the base layer. It is particularly well-suited for base layers with complex shapes and offers strong adaptability. The construction tools are simple and easy to operate, eliminating the need for complex cutting

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processes. Nevertheless, this technology is significantly influenced by environmental factors. Temperature and humidity variations directly impact the film-forming quality and drying speed of the coating, necessitating construction under suitable environmental conditions.

Rigid waterproofing technology stands out for its strength and cost-effectiveness. The materials combine structural load-bearing and waterproofing functions, bonding firmly with the base layer. The raw materials are readily available and cost-effective, and the construction process seamlessly integrates with conventional building construction procedures, eliminating the need for specialized professional equipment. However, rigid materials are inherently brittle and have weak deformation resistance. They are prone to cracking due to temperature changes or structural settlements and thus require the auxiliary use of flexible materials.

Composite waterproofing technology is characterized by complementary advantages and high reliability. By combining different types of waterproofing technologies, it integrates the strengths of various techniques to form a multi-layered protective system. Even if a single waterproof layer fails, the overall waterproofing effect can still be maintained. However, the construction process for this technology is more complex, requiring strict control over the compatibility between different materials and the quality of connections between various processes, resulting in a relatively longer construction period.

2.2 Applicable Scenarios of Roof Waterproofing Construction Technologies

The selection of appropriate roof waterproofing construction technologies should be based on a comprehensive assessment of building functional requirements, environmental conditions, and cost budgets.

Rolled sheet waterproofing technology is suitable for roofs with high demands for waterproofing durability and construction efficiency, especially for large-area roofs with regular base layer shapes. In regions with significant temperature variations, its deformation resistance can be fully utilized to meet long-term stable waterproofing needs. It is also applicable to roofs that need to withstand certain external loads.

Coating waterproofing technology is more suitable for roofs with complex base layer shapes and numerous node structures. It can flexibly cover special structural parts through coating application, avoiding weak waterproofing points at nodes. For roofs with small construction areas or those requiring local waterproofing repairs, this technology can simplify the construction process and reduce costs. Additionally, in humid environments, certain types of coating materials can maintain good bonding and waterproofing performance.

Rigid waterproofing technology is applicable to scenarios where there are requirements for the strength of the waterproof layer, limited budgets, and relatively stable roof environments. It can serve as a protective layer for the roof structural layer or waterproof layer. In areas with low leakage risks, it can achieve basic waterproofing functions at an economical cost and is well-suited for projects with close integration with conventional building construction processes.

Composite waterproofing technology is mainly used for roofs with extremely high requirements for waterproofing reliability. In scenarios with stringent waterproofing grades and harsh environmental conditions, the multi-layered protective system can significantly enhance waterproofing safety. It is also applicable to roofs that need to meet multiple functional requirements, ensuring stable overall functionality through technology combinations[1].

3. Key Processes and Technical Points of Roof Waterproofing Construction in Construction Engineering

3.1 Key Processes of Roof Waterproofing Construction in Construction Engineering

Roof waterproofing construction should follow a logical process of "pre-construction preparation - base layer treatment - core waterproofing construction - protective layer construction - acceptance and inspection," with each stage closely linked and indispensable.

The pre-construction preparation stage primarily focuses on materials and construction conditions. It involves conducting quality checks on incoming waterproofing materials to ensure their performance meets design requirements. Simultaneously, the construction area should be cleaned, necessary tools and equipment prepared, and a detailed construction plan formulated to clarify operational standards and personnel assignments for each stage.

Base layer treatment is a fundamental step in waterproofing construction. The roof base layer should be thoroughly cleaned to remove surface debris and contaminants. Any damages or cracks on the base layer should be repaired to achieve a flat, solid, and dry state, creating favorable conditions for the subsequent waterproof layer construction. Inadequate base layer treatment can easily lead to poor bonding between the waterproof layer and the base layer, causing post-construction leakage problems.

Core waterproofing construction is the key stage determining the waterproofing effect. Depending on the selected waterproofing technology type (rolled sheet, coating, rigid, or composite waterproofing), corresponding construction processes should be followed step by step to ensure uniform and complete laying or coating of the waterproof layer. Special attention should be paid to the connection treatment at various parts to avoid issues such as missed laying, missed coating, or loose connections, thereby ensuring the integrity and tightness of the waterproof layer.

Protective layer construction aims to shield the waterproof layer from external damage. It should be carried out promptly after the completion and acceptance of the waterproof layer. Appropriate protective layer materials should be selected based on the roof's usage requirements and laid or poured according to standard processes to ensure firm bonding between the protective layer and the waterproof layer. The protective layer should also possess certain strength and durability to extend the service life of the waterproof layer.

Acceptance and inspection mark the concluding stage of waterproofing construction. A comprehensive inspection of the entire waterproofing project should be conducted, focusing on verifying the integrity of the waterproof layer and the construction quality of the protective layer. Additionally, waterproofing effects should be validated through methods such as closed water tests. Any issues identified should be promptly rectified until the project passes the acceptance, ensuring that the roof waterproofing project meets design and regulatory requirements[2].

3.2 Technical Points of Roof Waterproofing Construction in Construction Engineering

The technical points of roof waterproofing construction should be strictly adhered to throughout the entire construction process, from material control to specific operational details, in accordance with regulatory requirements.

In terms of material control, attention should be paid to the storage and usage management of waterproofing materials to prevent performance degradation due to improper storage. Before use, the appearance and performance indicators of the materials should be rechecked to ensure compliance with construction requirements. Additionally, the compatibility between different materials should be considered to avoid compromising the waterproofing effect due to material incompatibility.

The technical points of base layer treatment lie in accurately controlling the base layer state. Professional methods should be used to determine whether the base layer's dryness and flatness meet standards. For defects such as cracks on the base layer, appropriate repair materials and processes should be employed to ensure seamless integration between the repaired area and the surrounding regions without obvious height differences or gaps. Meanwhile, thorough cleaning of the base layer surface should be carried out to remove substances that may affect bonding, such as oil stains and floating dust.

The technical points of core waterproofing construction vary depending on the technology type, but all require strict adherence to operational norms. For rolled sheet waterproofing, attention should be paid to controlling the laying force and speed to ensure flat laying of the rolled sheets and proper treatment of lap joints according to requirements. For coating waterproofing, the coating thickness and number of applications should be controlled to ensure uniform film formation and avoid issues such as sagging or missed coating. For rigid waterproofing, emphasis should be placed on material proportioning and pouring processes to ensure the density of concrete or mortar. For composite waterproofing, the focus should be on the bonding quality between different waterproof layers to ensure tight connections.

Node treatment is of utmost importance in waterproofing construction. Nodes such as roof internal and external corners, pipe roots, and drainage outlets are prone to becoming leakage potential leakage points. Strengthened treatment measures should be adopted during construction, such as adding additional layers or optimizing sealing methods, to ensure the thickness and tightness of the waterproof layer at node areas. At the same time, attention should be paid to the treatment of the protective layer at nodes to prevent damage due to inadequate protection.

Construction environment control is also a crucial technical point. Close attention should be paid to environmental factors such as temperature, humidity, and wind speed during construction. Construction rhythms and processes should be adjusted according to environmental conditions to avoid conducting waterproofing construction under adverse environments. For example, rainy days, high-temperature, or low-temperature environments may affect the construction quality of the waterproof layer, and construction time should be reasonably planned to ensure construction under suitable environmental conditions[3].

4. Quality Control Measures for Roof Waterproofing Construction in Construction Engi neering

4.1 Pre-event Prevention: Building a Solid Quality foundation

Pre-event prevention is the primary step in quality control for roof waterproofing construction, aiming to avoid quality risks from the source. It mainly focuses on design optimization, material control, and personnel preparation.

In the design phase, the waterproofing grade and technical plan should be clearly defined based on the building's functionality and environmental conditions. Detailed waterproofing treatment measures for roof node structures should be fully considered to prevent inherent defects in subsequent construction due to design oversights. Meanwhile, the design plan should be ensured to be compatible with on-site construction conditions, providing clear guidance for subsequent construction.

Material control should run through the entire process of "material arrival - storage - usage." Upon arrival, the qualification documents of the materials should be checked to verify whether their appearance and performance meet design standards, preventing substandard materials from entering the construction process. During storage, protective measures should be taken according to the material characteristics to avoid performance degradation due to factors such as temperature, humidity, and light. Before use, the material status should be confirmed again, and the compatibility between different materials should be checked to prevent adverse effects on the waterproofing effect due to material incompatibility.

In terms of personnel preparation, a professional construction team with relevant qualifications and experience should be selected. Technical disclosures and training should be organized before construction to clarify construction norms, technical points, and quality standards, ensuring that operators are familiar with the process flow and quality requirements. Additionally, a job responsibility system should be established to clarify the quality control responsibilities of each position, avoiding quality problems caused by non-standard operations or unclear responsibilities.

4.2 In-event Control: Strengthening Construction Process Supervision

In-event control is crucial for ensuring the quality of roof waterproofing construction. It should focus on construction processes, operational norms, and in-process inspections to achieve dynamic supervision throughout the entire construction process.

Process control should adhere to the principle of "only proceeding to the next process after the previous one has passed inspection." Strict control should be exercised over key processes such as base layer treatment, waterproof layer construction, and protective layer construction. Special attention should be paid to verifying whether each process meets technical requirements to avoid quality hazards caused by improper process connections or skipped processes. Meanwhile, attention should be given to the construction details at node areas to ensure compliance with waterproofing norms.

Operational norm control involves real-time supervision of on-site construction behaviors to check whether operators follow the technical plan and regulatory requirements during construction. For example, the lap treatment during rolled sheet laying, thickness control during coating application, material proportioning and pouring processes during rigid waterproofing construction, etc., should be monitored. Non-standard operations should be promptly corrected to ensure that the construction process meets quality standards.

In-process inspection requires establishing a regular inspection mechanism to conduct sampling tests on construction quality at regular intervals. The focus should be on checking the integrity, bonding strength, and tightness of the waterproof layer. Any issues identified should be promptly required to be rectified to prevent the accumulation and expansion of quality problems.

In addition, construction environment monitoring should be strengthened. Construction rhythms should be adjusted according to environmental factors such as temperature, humidity, and wind speed to avoid conducting key process construction under adverse environments. Detailed construction records should be kept, documenting construction parameters, material usage, and quality inspection results to provide a basis for subsequent quality tracing[4].

4.3 Post-event Acceptance: Completing Quality Closed-loop Management

Post-event acceptance is the concluding stage of quality control for roof waterproofing construction. Its core is to validate the project quality through comprehensive inspections, ensuring that the waterproofing project meets design and regulatory requirements. Meanwhile, a post-maintenance mechanism should be established to safeguard the long-term waterproofing effect of the roof.

During the acceptance phase, a comprehensive quality check should be conducted, not only inspecting the appearance quality of the waterproof layer and protective layer but also validating the waterproofing performance through professional testing methods such as closed water tests. Special attention should be paid to checking for potential leakage hazards at node areas and connection regions. For any quality issues identified, a specialized rectification plan should be formulated, and re-inspection should be conducted after rectification until the project fully passes the acceptance.

After acceptance, comprehensive engineering archives should be compiled and archived, including design documents, material qualification certificates, construction records, test reports, etc., to provide complete references for subsequent roof maintenance and quality tracing. Meanwhile, a post-maintenance mechanism should be established to clarify the warranty responsibilities and duration of the roof waterproofing project. A regular inspection plan should be formulated to guide users in conducting daily maintenance, such as cleaning the drainage system and checking the integrity of the waterproof layer, to promptly detect and address minor damages and prevent the expansion of leakage problems, thereby extending the service life of the roof waterproofing project[5].

5. Conclusion

In conclusion, quality control for roof waterproofing construction is not an isolated control measure in a single stage but a whole-lifecycle systematic project spanning "pre-event prevention - in-event control - post-event acceptance." As the construction industry continues to raise quality requirements for engineering projects and with the gradual application of green construction and intelligent monitoring technologies, quality control for roof waterproofing also needs to keep pace with the times. By implementing multi-dimensional quality control measures, the long-term stability of roof waterproofing projects can be truly achieved, laying a solid foundation for the quality improvement and sustainable development of construction engineering.

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