Exploration of Waterproof and Anti-seepage Construction Technology in Building Engineering Construction

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Keywords: Building Engineering; Waterproof and Anti-seepage Construction Technology; Base Sheet Membrane; Polyurethane Coating; Prefabricated Component Joints

Abstract: This study examines the waterproofing and anti-seepage construction technologies for four key parts of building engineering: basements, roofs, exterior walls, and bathrooms. It analyzes the operational essentials and applicable scenarios of each technology, and summarizes four application strategies: developing specialized plans according to the specific location, strengthening material acceptance, controlling key nodes, and implementing water ponding tests. The role of the synergy between technology and strategy in preventing engineering leakage is elaborated. The research aims to address the problems of non-standard application of waterproofing technology and frequent potential leakage hazards in building engineering. The results indicate that scientifically selecting waterproofing technologies combined with targeted application strategies can effectively enhance the waterproofing quality of projects, improve the overall level of waterproofing construction in the industry, and promote the development of building engineering towards greater durability and reliability.

1. Introduction

Leakage is one of the common building quality problems which affect not only the function and service life of a structure but it also poses structural safety hazards. At present, the industry has some projects that bad waterproofing technology selection according to site location characteristics issues; poor construction management and control; materials quality management neglect leading to serious problems of frequent leakage phenomenon appeared in basement water seepage, roof leakage, exterior wall infiltration. With the increasing requirements for waterproofing performance, it is an urgent problem to explore relevant waterproofing and anti-seepage technologies which should be suitable for different regions in a systematic way. at the same time, how to ensure the application of these technologies also serves as a key factor. Therefore, conducting the research on waterproof and anti-seepage construction technologies and application strategies for building engineering is of great practical significance in reducing leakage problems and improving building engineering.

2. Building Waterproof and Anti-seepage Construction Technology

2.1 Basement Base Slab Sheet Membrane Waterproofing Construction Technology

Clean surface laitance and debris with a grinding machine after pouring the concrete of the base slab; check flatness of the base course with a 2m straightedge to a maximum deviation of 3mm, and repair cracks in the base course using epoxy resin mortar (not starting subsequent works until they have dried) to prevent voids under the membrane due to unevenment at this time. Employ a base course primer is selected to match the membrane (an example of this may be a polymer-modified asphalt primer), apply evenly using a roller and controlled application to maintain approx thickness of 0.5mm; make sure dry statically for at least 4 hours (using "finger touch method" it should not transfer onto finger otherwise keep waiting) so that primer does NOT negatively impact adhesion in case where it has not been thoroughly dried yet. Membrane Laying Hot-melt Method: unfolded membrane lays flat on the base course, the bottom surface of the membrane heated with a torch

  DOI: 10.25236/icacel.2025.094

until it melts; slowly rolling forward; overlap width > 100mm from both sides (twice in excess), with extra heating to contact area between membranes. Must be pressed using a roller during laying, and household strong voids are avoided. Increase the treatment of nodes: 500mm wide extra membrane at internal and external corners should be pre-laid, which must be beaten firmly, compacted tightly before installing large area membranes; a vertical section is required to extend upwards by 300mm at the interface between base slab and wall slab. The waterproofing membrane for the upper part will need additional overlapping with the waterproofing membrane for side walls in order to form concrete water-stopping structure preventing groundwater from entering into foundation.

2.2 Roof Polyurethane Coating Waterproofing Construction Technology

Perform base treatment: clean up the roof concrete base, no dust and grease stain; in normal temperature and humidity conditions, use moisture content meter to check the base course moisture content 9%; if exceed using breathable film for ventilation drainage; fill up local-wide dry depressions with cement mortar (flatness deviation 3mm), so as to avoid insufficient coating thickness. Before primer: select polyurethane primer material, thoroughly mix in accordance with the ratio, use a brush to evenly paint on the base course at 1.5mm layer thickness; static curing for normally 4-6 hours; after curing, there should be an even film formed on the surface of the base course without any missed place and protruding substrate; Polyurethane dress coating: after the dry cleaning, open coat 0.8mm thick, "first vertical surface, then horizontal surface; high point before low point" to uniform thickness to spray; after the previous layer dries (fully cures for more than 2 hours), apply a second coat of 1.0mm in the opposite direction and pay attention to leveling overlap thickness best; If you want to reach thicker level waterproofing grade and with or increased function such as anti-corrosion inner bench or other up-water level outlet per record must do between two coasts should be absolutely less over thanm Node enhancement: nodes such as roof gutter, eaves, and pipe penetration surface must layout the fabric reinforcement material first and then coating, after laying the cloth to keep flat without wrinkles, the cloth should be completely covered with a paint layer overlapping firmly; only forming a reinforced waterproof layer can effectively avoid leakage.

2.3 Waterproofing Technology for Joints in Exterior Wall Prefabricated Components

Prepare the structure If prefabricated wall panel in and out of factory before forming grooving-Joint parts at joints pre-formed tongue-and-groove joint, floor-to-ceiling with shallow groove 20mm depth; installation between vertical to ensure thickness tightly butt tight Joint grooves are arranged on the upper side for a while; post-construction cleaning debris dust into finely formed at the interface, but comes to blowing out compressed air through Non-ferrous metals does not affect seal effectiveness. Stick water stop tape: choose the 50mm wide, water-expanding waterstop tape and paste it to the external groove of the joint; apply adhesive to the groove surface before pasting; engage in clips manually after sticking to ensure that there are no bubbles or lifting edges between the tape and wall panel, ensuring close contact is achieved by hand pressure; paste continuously, place without breaks, forming behind it the first waterproof barrier [1]. 24h after the tape is applied, starting injecting sealant; select high-elasticity polyurethane, using the ratio provided to mix the main agent and curing agent before inject with a specialized gun from one end of the joint to adjoint side (completed at once); sealant width must reaches 15mm, thickness not less than 10mm; make sure that there are no void or unfilled sections during injection; use spatula post-injection to flatten out its surface flush with wall panel surfaces. Quality Checking: Before sealing the sealant cures, check if the seal is continuous and full without cracking or separation; The water spray test assesses the waterproof performance of joints; observed on the indoor side, whether there is water seepage at different water levels. Reliable waterproof jointing quality.

2.4 Bathroom Polymer Cement-Based Waterproof Coating Construction Technology

Base course Grinding and cleaning of base course: Use angle grinder to grind away the protrusions and sharp debris with allowed height on bathroom floor concrete base course; After

grinding, sweep up dust; If there are pipe penetrations or floor drain gaps on the ground, fill them densely in waterproof mortar, dry it up and then grind level for avoiding leaks from these gaps. Moisten the base course: 1 hour before spraying the waterproof coating, moisten the top with a sprayer to obtain a colored surface without standing water; moistening improves bond adhesion and prevents cracking of coatings due to drying stress on concrete. Layering the waterproof coating: blend the first coat according to ratio, then brush it on to a thickness of 0.5mm along bathroom length; after drying, apply second coat (same mix ratio) along width direction for 0.5mm thickness this cross-direction coverage means no lapses in coverage; this coating must cover all bathroom floors and up walls no less than 1800 mm high, connecting with wall tile waterproof layer [2]. Strengthened node treatment: for floor drains, pipe penetrations and other nodes where the waterproofing is prone to damage when penetrating structures, first brush a layer of waterproof coating on the surrounding wall surface before laying 200mm wide fiberglass mesh as a reinforcement; the mesh should be laid flat and edge-to-edge with no wrinkles; after that, apply another coat of waterproof coating to cover the mesh thoroughly and extend up 100 mm inside the tube at the pipe penetration in order to form a comprehensive strengthened bonding layer that even covers pades all around this position.

3. Application Strategies for Waterproof and Anti-seepage Construction Technology in Building Engineering

3.1 Develop Specialized Waterproofing Plans According to Location

Perform localized water seepage risk analysis: gather geological survey reports and building functional use functions, and carry out a separate seepage risk analysis of the basement, roof, exterior wall and bathroom to identify high-risk areas (above 50%), general-risk areas (30%-50%) or low-risk areas. Identify key technical parameters: Level I waterproofing grade in high-risk regions (two waterproofing barriers), Level II at medium risk (one barrier); determine materials according to location characteristics, preferring cement-based coatings for damp areas, weather-resistant polyurethane coatings for exposed sites. Create specialized plans the plans should identify materials, construction methods, node treatment methods and provide detailed drawings of nodes [3]. Review and confirmation of plans the technical responsible person, together with the supervising engineer should review for rationality as well as paradigm matching in the risk assessment; plans must be approved, and briefed to construction teams before carrying out.

3.2 Strengthen Incoming Inspection of Waterproofing Materials

Inspection preparation stage: (1) Compile a material inspection standard manual that specifies testing indicators for various materials: waterproof membrane thickness deviation $\leqslant$5%, heat resistance no sliding or flowing at 70°C; solid content of waterproof coatings $\geqslant$65% tensile strength $\geqslant$1.8MPa; simultaneously prepare testing tools and contact qualified third-party detection agencies [4]. Appearance check stage: upon receipt of the material to check the appearance batch by batch; waterproof membrane must be free of cracks, holes and edge injury; waterproof coatings can not have stratification and sedimentation phenomenon; Measure the thickness of membrane with a thickness gauge, select 3 rolls at random for each batch, 5 points will be measured per roll, average deviation shall be calculated, If exceed 5% Mark immediately. Performance testing stage: sample materials from each batch according to specifications: 1 group per 1000 rolls for membrane; coating is sampled at 1 group per 50 tons; sent to third-party agencies to test key indicators, such as heat resistance and tensile strength; generally, the testing cycle is 3-5 days [5]. The stage of determining the result: the qualified materials are first stored in warehouse according to the specifications, and meanwhile a material ledger is established; for unqualified materials, an immediate notice is issued for removal, photos should be taken as evidence, contact suppliers for return or replacement; it is strictly forbidden for unqualified materials to enter into construction.

3.3 Enhanced Control of Key Node Waterproofing

Pilot sample stage: prior to construction, select representative nodes for pilot sampleslimit sampling construction strictly according to the plan: pipe penetration nodes need added fiberglass mesh reinforcement, minimum width of 200mm; exterior wall joints must use waterstop tape, with a minimum width of 50mm; organize acceptance after handover of sample completion; review setting and fill additional layers and sealant by the technical responsible person and supervising engineer; pass the acceptance and treat as a practical standard for the settlement as well as organize team observation learning [6]. Standing supervision stage: in node construction, special inspectors for standing supervisors during the node construction process, recording the construction as follows: if additional layers are laid at internal/external corners, and whether or not the overlap width reaches 500mm; during sealant application; checking thickness of sealant to be 10mm continuous full sappers changes immediately stop rectification upon finding that there were operational deviations. Process inspection stage Check quality using specialized tools manually press pipe penetration nodes to check bonding firmness; use sealant detectors to check the density of joint nodes, inspection frequency: sampling 1 out of every 10 nodes, immediately rework if there is a problem [7]. Acceptance confirmation stage: after the construction of all nodes is completed, conduct acceptance; if accepted, fill in the node acceptance record table and sign by the standing supervisor and supervising engineer; nodes that fail to be accepted cannot enter the next link.

3.4 Implement Water Ponding Tests for Waterproofing Engineering

Stage of preparing for the test before conducting the test, clean the surface of waterproofing layer; close drainage outlets; establish water level observation points; have prepared water storage facilities basements and bathrooms, and water spraying equipment for roofs [8]. Water ponding test: water depth should not be less than 20mm, the observation of water level every two hours, and at the same time check the ceiling under the location for any dampness level status; roof is tested with spray pipe set to 2m distance between each other with water pressure setting on a speed of 0.3MPa maintaining a two hours constant spraying while checking each joints and gutter locations if there are pooling or leaking waters. Workability: Leakage handling stage: mark leakage points and analyze the reasons for joint leakagefor those joints leaking, generally due to the lack of sealant in the connection part; remove old sealant then re-fill with new to a thickness no less than 10mmpipe penetration leaking is mostly caused by poor adhesion when bathroom slabs are laid, patch the old coating with reapplicationand add fiberglass mesh reinforcement [9]. Re-inspection confirmation stage: through rectification and then do water ponding or spray test; the basement, bathroom still need 24-hour ponding, roof to do 2 hours spraying until no leakage passes the test record, fill out after completion of tests jointly signed by construction and supervision units as waterproof engineering acceptance basis.

4. Conclusion

The above analysis shows that waterproof and anti-seepage construction technology should be selected according to the characteristics of different building locations and implemented with targeted management strategies. Different locations necessitate focused waterproofing technologies: basement base slabs are applicable with sheet membrane waterproofing, roofs with coating waterproofing and moisture-proof treatments need to implement a combination of structural-waterproofing and material-waterproof, joints in exterior wall prefabricated components should adopt a certain structure-type for organic waterproof coatings; bathrooms must be polymer cement-based waterproof coatings; obtained through strictly following operational procedures. Creating location specific plans allows for technology tailored to need, which promotes material acceptance that controls quality at the source, managing key nodes mitigates leak potential and water ponding tests provide verification regarding waterproof performance. This combination integrates to a complete waterproofing control system, effectively addressing the blind application of technology and unreasonable wide-range underground water level control in traditional

waterproofing constructions, thus improving reliability in engineering waterproofing.

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